Islamic Republic of Pakistan
National Energy Conservation Center (ENERCON)
Pakistan Engineering Council (PEC)

# Data Collection Survey on Energy Efficiency and Conservation in the Building Sector in the Islamic Republic of Pakistan

# Final Report

**January 2016**

**Japan International Cooperation Agency (JICA)**

**Fukunaga Architects - Engineers**
**Asia Engineering Consultant Co., Ltd.**
**Nippon Koei Co., Ltd.**

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# Summary

# Summary

## 1. Background to the Survey

The Islamic Republic of Pakistan (hereinafter referred to as “Pakistan”) has structural problems in the power sector, e.g. the high power generation cost, pricing below cost, the high ratio of power transmission and distribution losses, inefficient operation and inappropriate governance. Such problems mean a gap between supply and demand and severely hinder daily economic activities.
The Government of Pakistan (hereinafter referred to as “GOP”) works with the World Bank, ADB and JICA in accordance with a policy matrix of ten reform items and three major goals; firstly to reduce subsidies and increase the electricity tariff, secondly to reduce the cost of power generation and thirdly, to promote accountability and transparency. One of the reform issues involves effectively improving the demand side to promote energy conservation and GOP has tried to establish energy conservation with pending bills. Henceforth, various measures will be required to introduce the Energy Conservation Law, although the GOP lacks experience in introducing the Law, which has delayed moves to investigate the introduction.

JICA implements the program loan with the World Bank and ADB to support energy sector reform. As Japan has experience and knowledge of the relevant energy conservation issues, attempts will be made to support GOP by coordinating among donors. Within three years of commencing the program loan, the establishment of a fourth-year action plan between GOP and donors will be considered. One of the candidates is considered to be promoting attempts to establish a power conservation system in the building sector, which is expected to significantly reduce energy consumption. GOP imposed the Building Code of Pakistan - Energy Provision - 2011 (hereinafter referred to as “BCP-EP-2011”) against the building sector on a mandatory basis and has promulgated the same by Statutory Regulation Order (Hereafter S.R.O.) in 2013. As no detailed rules and penalties were defined in the provision, such relevant institution and framework must be provided as soon as possible.

(1) Survey Objectives

By clarifying the current situation and issues of the energy conservation legal framework in the building sector in Pakistan, medium- to long-term initiatives and priority actions to promote energy conservation will be planned. A cooperation program, assisted by Japan, will be suggested via the JICA Survey Team in future

(2) Survey Area

The study area of this project is shown on the location map and encompasses:

1) Islamabad and Rawalpindi
2) Lahore City area: Punjab Province
3) Karachi City area: Sindh Province

## 2.1 Basic Condition of Building Sector in Pakistan

(1) Number of Electrical Contract

The number of electrical contracts concluded is a useful indicator to determine the scale of the building sector. Table 1 shows the number of electrical contracts, categorized into Domestic, Commercial and Industrial, for the last ten years.

Number of domestic contract occupies 83-86% of total of building sector . The Access to electricity of household was 79.5% in 1998 and had been improved to 93.6% in 2012.[1] This is one of the reason why the annual growth ratio of domestic electrical contract is greater than annual population growth which is estimated approximately 2%. However, Based on the estimated population of 190mil, the number of persons per contract is about 9 which is far greater number compared to the number of person per housing unit in 1998 census, which was 6.8. This gap is in line with 9 million housing backlog as descried later. So current number of electrical contract seems to be suppressed number and there will be a potential of further growth depending on the effort of government and private housing development scheme.

Number of commercial contract occupies 12-15% of total of building sector which is in line with urban zoning plan regulated by Building Control Authority. Commercial activities are under mix influence of population and economy, so annual growth rate of 2-4% seems reasonable considering the growth of population and GDP in last decade.

Number of industry contract occupies relatively smaller number. 5-6% of annual growth rate was observed before 2008 and less growth after that. This may be explained by global economic crisis in 2008 and energy crisis happening in Pakistan.

Table 1 Number of electrical contract (thousand)

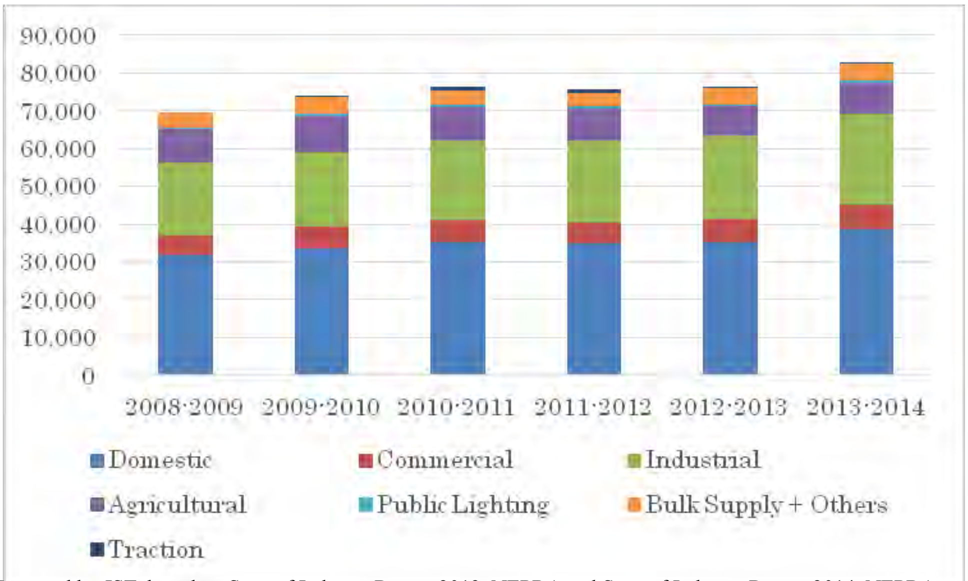
| | 2003-4 | 2004-5 | 2005-6 | 2006-7 | 2007-8 | 2008-9 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Domestic Total | 13,086 | 13,889 | 14,830 | 15,849 | 16,745 | 17,390 | 18,255 | 18,954 | 19,637 | 20,374 | 20,972 |
| Change from Previous year | | 106.1% | 106.8% | 106.9% | 105.7% | 103.9% | 105.0% | 103.8% | 103.6% | 103.7% | 102.9% |
| Percentage in total | 83.73% | 84.17% | 84.49% | 84.84% | 85.12% | 85.28% | 85.52% | 85.68% | 85.81% | 85.99% | 86.05% |
| Commercial Total | 2,313 | 2,379 | 2,477 | 2,577 | 2,662 | 2,729 | 2,807 | 2,874 | 2,939 | 3,003 | 3,073 |
| Change from Previous year | | 102.9% | 104.1% | 104.0% | 103.3% | 102.5% | 102.9% | 102.4% | 102.3% | 102.2% | 102.3% |
| Percentage in total | 14.80% | 14.42% | 14.11% | 13.79% | 13.54% | 13.38% | 13.15% | 12.99% | 12.84% | 12.67% | 12.61% |
| Industrial Total | 230 | 233 | 244 | 255 | 264 | 274 | 284 | 293 | 307 | 317 | 326 |
| Change from Previous year | | 101.3% | 104.6% | 104.5% | 103.4% | 103.8% | 103.8% | 103.3% | 104.5% | 103.4% | 102.7% |
| Percentage in total | 1.47% | 1.41% | 1.39% | 1.37% | 1.34% | 1.34% | 1.33% | 1.33% | 1.34% | 1.34% | 1.34% |
| Grand Total | 15,629 | 16,501 | 17,551 | 18,681 | 19,671 | 20,393, | 21,346 | 22,121 | 22,883 | 23,694 | 24,371 |
| Change from Previous year | | 105.6% | 106.4% | 106.4% | 105.3% | 103.7% | 104.7% | 103.6% | 103.4% | 103.5% | 102.9% |

Source: NEPRA state of industry report 2009,2011 and 2014

[1] World Bank indicator

(2) Electrical consumption

In terms of electricity consumption, 45% is domestic, 25% industry and 7% commercial. Average annual electrical consumption per contract was about 2070KWh in year 2006-8 for both domestic and commercial and have been reduced due to the frequent load shedding.

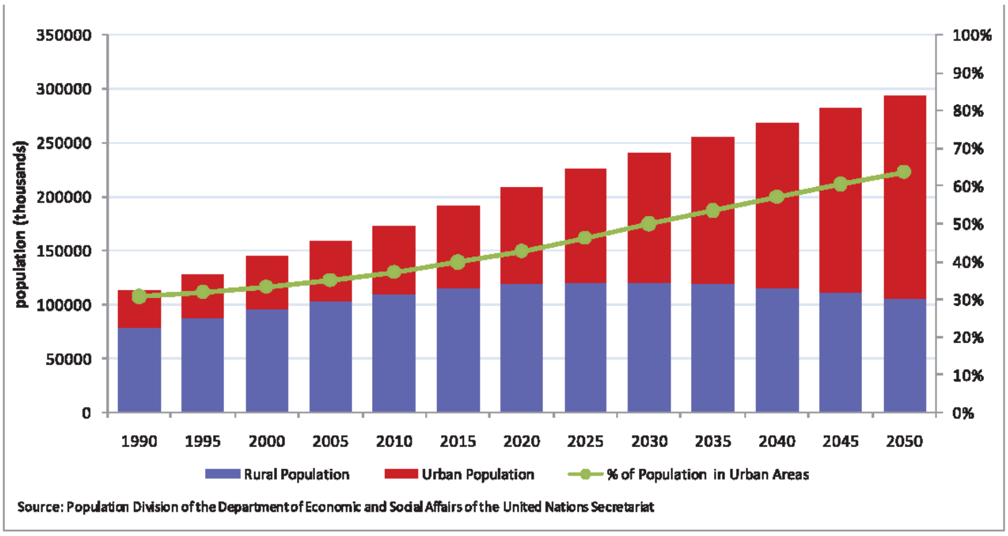



Source: Prepared by JST based on State of Industry Report 2013, NEPRA and State of Industry Report 2014, NEPRA.

Figure 1 Trend of amount of Electricity Consumption in entire Pakistan (Unit: GWh)

(3) Urbanization

Urbanization in Pakistan will continue to increase and the urban population of Pakistan will constitute 50% of the total in a decade. The urbanization trend from 1990 to 2050 is shown in Figure below.




Source: National Report of Pakistan For HABITAT III

Figure 2 Urbanization Trend from 1990 to 2050

(4) Urban Development, Estate Development

Pakistan is currently confronting a severe housing backlog of about nine million units. The government is making plans for the low-income group with support from financial institutions such as the State Bank of Pakistan and House Building Finance Company. The high interest rates mean housing loans are not common in Pakistan.

Meanwhile, the estate development for the middle- to high-income group is strong in major cities, driven by the Defence Housing Authority and private sector developer and builders. Strong demand for residential and commercial development means both land and building prices in major cities are escalating rapidly.

The recent earthquake (2005) focused the attention of regulatory authorities and end users on the seismic quality of buildings. Further, given the recent security issues caused by anti-social forces as well as the high crime rate, security appeals to middle-class buyers and executives. The development model is a “Gated Community”, which offers 24-hour security patrols in the area.

# 3 Legal System regarding EE&C in the Building Sector in Pakistan

## 3.1 Structure of Building Control in Pakistan

Building control authorities are subdivided into several government entities, such as the Federal Government, Provincial Government, Ministry of Defence, etc. Each building authority has been established with its own legislation under the respective government, with its own building regulations. Depending on the construction project location, the applicant shall follow the building regulations and procedures of the respective building control authority.

The Building Code of Pakistan, published in 1986, (BCP-1986) has not been adopted into those building control authorities for the review process. In adopting the national new policy, such as Energy Efficiency and Conservation, revisions to the current regulation shall be accepted by the board of respective building control authorities via recommendation by the relevant government entity. Meanwhile, the newly introduced building code, such as Seismic Provision and Energy provision, has been enforced on professionals under the Pakistan Engineering Council Act 1975. Theoretically, those new building code provisions shall be implemented by the engineers involved. However, there has been no third party review to monitor code compliance to date.

Figure 2.2-1 indicates a diagram of the building sector in Pakistan.

(1) Contents of the Building Code of Pakistan Energy Provision 2011

The Energy Provision 2011 is intended to provide energy-efficiency benchmarks for buildings. MOHW acknowledges that it has the permission of ASHRAE to transcribe and reproduce portions of

ASHRAE standards 90.1-2004. The only exception is Section 4 Building Envelope, which has been developed with the Energy Codes of regional countries and the local environment in mind.

Table below shows comparison of the Building Code of Pakistan Energy Provisions (BCP-EP-2011) with those of India and Japan. In terms of criteria, JST recognized that BCP-EP-2011 lacks any offset mechanism to consider different climatic conditions and building usage and no comprehensive evaluation method with the potential to introduce a certification/rating system. Further JST is concerned that the application format and a guidebook for BCP-EP-2011 to facilitate implementation has not yet been prepared.

Table 2 Comparison of Energy Codes for Buildings in Pakistan, India and Japan

| Item | | Pakistan<br>BCP-EP-2011 | India<br>ECBC | Japan<br>Act of EEC |
|---|---|---|---|---|
| Criteria | The building scale subject to | Total load >100kw<br>Contract demand >125kva<br>Conditioned area >900m²<br>Un-conditioned area >1200m² | Total load ≧100kw or<br>Contract demand >120kva | More than 300 m² (amended in 2010) |
| | Regulated construction works | New building, extension works, rehabilitation of equipment, scale up to or beyond the criteria of the electric contract | Same as shown on the left | New building, extension works, reconstruction works. Where the building has more than 2000 m² of floor space, rehabilitation of equipment is also covered |
| | Voluntary / Mandatory | Mandatory (included voluntary articles)<br>PEC has the power to penalize violators | The provision was introduced on a voluntary basis in 2007 and they planned to impose it on a mandatory basis for all states. As of 2013, only two out of all 35 states had imposed it on a mandatory basis | Notification is mandated (penalty)<br>Periodic reports shall be submitted every three years |
| | Building part or equipment subject to | Envelop (Wall, Roof, Window)<br>Air-conditioner<br>Ventilation<br>Hot water supply<br>Lighting<br>Transformer, Motor | Same as shown on the left | Envelope (Wall, Roof, Window)<br>Air-conditioner<br>Ventilation<br>Hot water supply<br>Lighting |
| | Offset by climate condition | NA | 5 climate zones | 8 climate zones |
| | Offset by other condition | NA | Only day use / 24 hour use | Building usage |
| | Methodology for confirmation to comply with criteria | Confirmation to comply with criteria for all parts and building equipment | Elective<br>1. Confirmation to comply with criteria for all parts and building equipment<br>2. Comprehensive building-wide evaluation | Comprehensive building-wide evaluation |
| Implementation Material | Application Format | NA | Prepared | Prepared |
| | Confirmation on site | Not adopted by DA | No | No |
| | Periodic report after completion | NA | NA | Periodic reports shall be submitted every three years |
| | Guidebook | NA | Prepared | Prepared |
| | Building labeling scheme | NA | LEED India, GRIHA | BELS, CASBEE |

Source: JST

## 3.2 Potential of energy saving in building design

(1) Envelope

After interviewing several stakeholders, JST summarized the current situation of building envelope technologies in Pakistan as follows:

Table 3 Building Envelope Specification in Pakistan

| Components | Majority | Advanced (less than 5%) |
|---|---|---|
| Roof | RC slab and water proofing, covered by topping concrete. No insulation. | Two inches of extruded polystyrene (XPS: U-value 0.035) above the RC slab and water proofing, covered by topping concrete. Then install finish material on the raised frame. |
| Wall | 9 inch brick wall or concrete block. No insulation. | Double brick wall with two-inch insulation in the cavity. |
| Window | Single-glazed aluminum window. Commercial buildings have tinted glass. | Double-glazed aluminum window, for high-end hotels, offices.<br>LOW-E glass must be imported. |

Source: Summarized by JST

The recognition of benefit of insulated envelope is very low in the majority of building sector. Meanwhile, the projects for high-end user are adopting insulated envelope, reason seems to be i) make sense economically, ii) high expectation from client/user, iii) high awareness of general environmental issue.

(2) Services

Air-conditioning and lighting are two major components of building energy consumption. Usage of energy-saving products as well as proper insulation to prevent energy loss are essential.

Focusing on the electricity consumption on buildings, the percentage of electricity of respective building services are estimated as shown below table, taking Pakistan characteristics of, i) Gas is widely used for hot water and cooking plate, ii) there is no mechanical ventilation requirement for habitable space like Japan, iii) Both Air Conditioner and ceiling/ wall mount fan are often installed.

Table 4 Estimated electricity consumption ration in building in Pakistan

| | Air conditioner and ceiling/ wall mount fan | Lighting | Others |
|---|---|---|---|
| Electricity consumption (%) | 50-70% | 15-25% | 15-25% |

Source: Estimated by JST

## 4. Barrier to promote EE&C in the Building Sector

### 4.1 Financial Barrier and awareness of benefit

(1) Construction cost

Based on interviews with builders and manufacturers, the initial cost impact for ensuring building envelopes comply with BCP-EP-2011 requirements will add approximately PKR 150-200/ft$^2$ to the overall building unit cost. If the project is for high-end users, this cost escalation could be accepted with a reasonable benefit. However, if the project is for the low- to low-middle-income group that may not gain benefit of reduced Air-conditioning load and running cost , with a construction unit cost of PKR 1000-1500 /ft$^2$, the cost impact equates to an escalation of about 13-20% and is almost impossible to accept Table below indicates a rough calculation of the cost impact.

Table 5 Cost impact of BCP-EP-2011 standard building envelope

| | Construction Unit cost (PKR/ft$^2$) | Insulated envelope construction unit cost (PKR/ft$^2$) | Additional cost impact |
|---|---|---|---|
| Low-income group building | 1000-1500 | 1150-1700 | 13-20% |
| Middle-income group building | 1500-2500 | 1650-2700 | 8-13% |
| High-income group building | 2500-5000 | 2650-5200 | 4-8% |

Source: Calculated by JST using unit cost provided by various stakeholders.

(2) Lack of awareness of benefit

Investment in the building envelope will have two main benefits. One is the initial cost-saving on air-conditioners by lowering the heat load and the other is cost saving on reduced energy usage.

Insulated envelopes could reduce the heat load by 30-50% compared to non-insulated envelopes, which will significantly reduce the initial cost by lowering air-conditioner capacity. Energy usage for air-conditioners will also be reduced by around 35-45% annually.

When combining the initial cost investment and saving on running costs, the pay-back period can be calculated during the design stage. However, the lack of knowledge and tools mean there is no rational discussion between the design team and client except for high-end projects. Comparing to Japan, construction cost is relatively low and electrical cost is high in Pakistan. Pay-back period for investment for insulated building envelope is estimated less than two years. Furthermore, given the diffusion of back-up generator in high-end user buildings, pay-back period might be much shorter due to the high unit cost supplied by generator.

## 4.2 Barrier on Building Regulation and Building Code of Pakistan

Despite of S.R.O. issuance in 2013, no Development Authority has adopted BCP-EP-2011 to date which caused by a system of local autonomy and structure of building administration. Since the earthquake in 2005, GoP has been active to establish provisions for Building Code of Pakistan such as Seismic provision, Energy Provision and Fire Safety Provision that are intended to be adopted as national standard code. However, those federal government initiated codes are not well adopted by Building Control Authorities due to their autonomy.

Both BCP-SP-2007 and BCP-EP-2011 are developed as PROVISION of BCP-1986 that was establish by MOHW in 1986. JST has been striving to obtain the copy of BCP-1986 to confirm its legislation basis but not successful to date . According to the several stakeholder, BCP-1986 has been developed as guideline and there is no legal basis to enforce code compliance.

## 4.3 Barrier on Implementation Framework

Vetting for BCP-EP-2011 requires a broad range of knowledge for EE&C from architectural to mechanical and electrical technology. JST has collected data of existing building authority inspection organization as indicated in table below.

Table 6 Human resources of Development Authorities

| | CDA | RDA | FDA | MDA | GDA | SBCA |
|---|---|---|---|---|---|---|
| Number of annual applications | 1806 | 700-800 | 800 | 1000 | 15-20 | 4876 |
| Number of Inspectors | 16 | 4 | 13 | 8 | 5 | 90-100 |
| Qualification of inspectors | DAEC | 3DAE | 3DC/A | 3DAE | 3DCE | |
| Number Applications/Staff | 112.9 | 175-200 | 61.5 | 125.0 | 3~4 | 48~54 |

Source: Interview/ questionnaire to respective development authorities
DAEC: Diploma Associate Engineer, Civil /3DAE: 3 year Diploma Associate Engineer
3DC/A: 3 year Diploma in Civil/ Architecture/ 3DCE: 3 year Diploma in Civil Engineering

The above data indicates that one inspector, most of whom have a civil background, must inspect 50 to 100 or more buildings annually. Considering the complexity of the BCP-EP-2011 checks, both the skill level and number of inspectors must be reconsidered for implementation.

Possible barriers are predicted as listed below once BCP-EP-2011 is adopted by building control authorities. The necessary capacity development must be implemented prior to launching the implementation of BCP-EP-2011.

- ✧ Inadequate skill and knowledge of inspectors.
- ✧ Inadequate number of inspectors.
- ✧ Lack of accountability

## 5 Summary of key findings in Pakistan and suggestion

(1) Country characteristics

- ✧ Pakistan is currently facing an electrical crisis due to demand exceeding supply, meaning people suffer from constant load shedding. Summer is a peak period, from 5-11PM, showing that cooling and household consumption are the critical portion. Moreover, a combination of population growth and changed life style is expected to fuel demand from 600,000 new households annually, meaning action in the form of house building is a critical issue.
- ✧ About 45% of the electrical consumption in Pakistan comprises Domestic use (25% Industry, 7% commercial)[2] . Moreover, more than 90% of electricity is consumed by the tariff group of less than 300kwh consumption.[3] It is hard to imagine most households under the 300kwh slot having air-conditioners in their homes at present[4]. However, lifestyle, expectations of the living environment and climatic conditions may change drastically in the next decade. Another reality is that air-conditioners are likely to be installed by building users on completion of building construction. The policy shall take those assumptions into account.
- ✧ Urbanization is expected to be progressed and the population in urban area will be doubled in 2030, tripled in 2050 compared to the urban population in 2010.[5] Ten major cities will cover 58% of urban population in Pakistan in 2030. Meantime, population in rural area will be peak-out in 2025. The building regulation in major cities needs to be designed in consideration of those projections.
- ✧ The diffusion and the awareness of benefit for insulation, insulated window and high efficiency Air-Conditioner are poor in the current building sector. Conversely, the potential of energy saving in this factor is big.

(2) Implementation framework

- ✧ Building regulatory authorities are established as autonomous bodies under the provincial government or other governments ordinance, with their own legislation and building regulations. Currently most building regulations do not reference the Building Code of Pakistan, prepared by federal government, including Energy Provision and Seismic Provision. The adoption of BCP-EP-2011 is also subject to approval by the board of authority.
- ✧ Awareness of enforcement of BCP-EP-2011 remains seemingly insufficient. During the JST

[2] NEPRA state of industry report 2014
[3] Rethinking Electricity Tariffs and Subsidies in Pakistan (World bank 2011)
[4] All air-conditioner holder out of 120 household were contract load of more than 300kWh in JICA survey in 2014. (Expert for Institution-Building and Promotion of Energy Saving)
[5] National Report of Pakistan for HABITAT III

interview, many architects, engineers and builders stated that they were unaware of BCP-EP-2011, hence the need for a further awareness campaign.

✧ BCP-EP-2011 simply shows indicators for respective building portions, such as the U-value for roofs. There is no supporting information such as calculation methodologies, certified material information and approved testing procedure to justify whether or not the proposed design is code-compliant. A clear guideline shall be added as supplemental information to justify the compliance.

✧ No handbook has been produced. Architects, engineers and inspectors from building authorities need detailed information stating how to comply with the code criteria. A uniform calculation method and checklist shall be produced and made accessible online.

✧ The lack of awareness of the benefit of compliance with BCP-EP-2011. The higher construction cost severely hinders building owners, although the impact of the initial cost will be offset by low energy usage for several years. The benefits of code compliance must be also be properly explained and understood by building owners. User-friendly software will help clarify the comparison between initial costs and savings on running costs.

(3) Validity of BCP-EP-2011

✧ Applicable buildings are limited to those on a large scale. (900m² or more of air-conditioned space) This approach is also common overseas. However, as per the NEPRA report, most electrical consumption is seemingly from households. Consideration on residential buildings for possible revision to BCP-EP-2011 is required.

✧ Applicable activities are limited to i) new constructions, ii) Portions of new extensions, iii) New systems, iv) upgrades of electrical contract. It will take years to achieve the actual energy-saving effect in the building sector and some kind of measurement for existing building will have to be developed.

✧ There is no offset in the given indicator for climate zoning and building usage. Since energy requirements differ according to building usage and climate conditions, setting an appropriate indicator to reflect usage and climate zoning would elicit more energy-saving potential.

✧ BCP-EP-2011 indicates the criteria for each of the building portions and equipment for which minimum standards are to be provided. Although this is an effective way to boost minimum standards, it lacks potential to improve energy performance for industry leaders. The introduction of a comprehensive evaluation method, capable of visualizing benchmarks, will be essential for further improvement in the near future. Once the methodology and benchmark have been set, several measures are applicable, i.e. labeling, incentive scheme.

## 6 Action Plan

### 6.1 Action Plan for the medium- to long-term

To promote EE&C of the building sector strategically, we propose to start the activity with limited coverage, where the federal government has power to control building regulations as a leading action. While the first stage action is being implemented, a capacity development framework and monitoring system are being developed, from which other building regulatory authorities can learn. Eventually the coverage of action will be diffused nationwide. The government should also consider an incentive scheme to attract the private sector, which may also have a positive impact on the market. Three action plans are proposed as indicated below. Applying all three at once would strongly catalyze the building sector , but there is also scope to apply them individually as well.

(1) Promotion of adoption of BCP-EP-2011
    (Enforcement for implementation of BCP-EP-2011 at Building Control Authority)
(2) Support for Promotion of Advanced EE&C to the Private Sector (Incentive Scheme)
(3) Leading Action by the Public Sector (Public Building Improvement Scheme)

Countermeasures are to be applied in stages to facilitate adoption by stakeholders. However, the countermeasures must be effectively phased and well-coordinated to maximize the end results. Any new findings or barriers during early stage activities must also be carefully analyzed and reflected in later stage activities. As building regulatory authorities are autonomous body under provincial governments and other governments ordinance, the adoption of BCP-EP-2011 may take longer than expected due to the numerous stakeholders. Meanwhile, a complementary policy could be applied to limited stakeholders with optimized effort.

As a start, we suggest improving the implementation of the current BCP-EP-2011 in Islamabad as a model city which expected to be adopted quickly by federal government power and function.[6] At the same time, complementary policies, such as a certification or labeling system, should be established and included in the model city as an incentive scheme, while keeping in mind the complementary policy to be planned as future mandatory regulation. This explains the evaluation methodology of a single system in-between BCP-EP-2011 and a complimentary system. As a government leading action, we propose that new construction for public works shall be enforced to adopt BCP-EP-2011 standards with its voluntary guidelines or a higher rating. A data collection survey and analysis of existing government-owned public buildings will be carried out at this stage to prepare for the next.

[6] The revision to current building regulation in Islamabad requires approval by board of CDA. CDA is one of ten divisions of Capital Administration and Development Division（CAD） and established under CDA ordinance 1960. According to the ordinance, not less than three members ,including chairman, vice chairman and financial advisor, shall be appointed by federal government.

During the second stage, to promote newly introduced complimentary policy in the first stage, an additional incentive scheme will be applied nationwide to eliminate barriers to high energy-efficiency buildings. This could include tax reductions for energy-efficient material and equipment, low-interest housing loans and other measures, while the leading action will include a project to retrofit existing public buildings to be planned by government, with a target total and completion year. The design development process for retrofitting existing buildings shall include analysis of the existing situation, a study of the proposed design and a comparison between old and new systems with a view of initial cost and running cost. Simultaneously, a pilot project shall be planned and developed aiming for Zero Energy Building with technical support from foreign expert. The design development process for both retrofitting existing buildings and pilot projects could also encompass training for professionals using building evaluation software.

As a third stage, the model city concept can be applied to other major cities, while as indicated in the BCP-EP-2011; the criteria could be amended to suit local characteristics. Construction of the pilot project shall commence at this stage and the processes of design, construction and the end result of the pilot project will be shared with as many stakeholders as possible for future reference.

As stage 4, following three years of implementation at the model city and public works, BCP-EP-2011 will be revised based on new policy learned from early stage activities. By the end of the fifth year, BCP-EP-2011 would hopefully be adopted nationwide as a compulsory minimum standard.

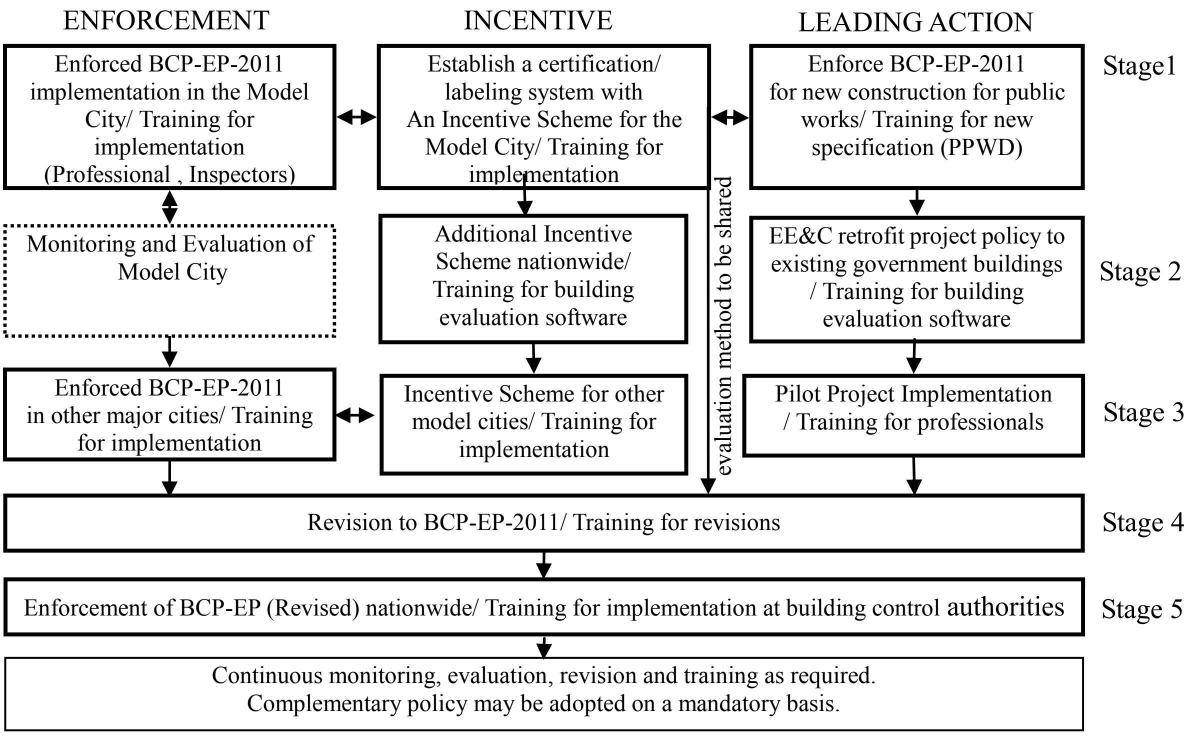
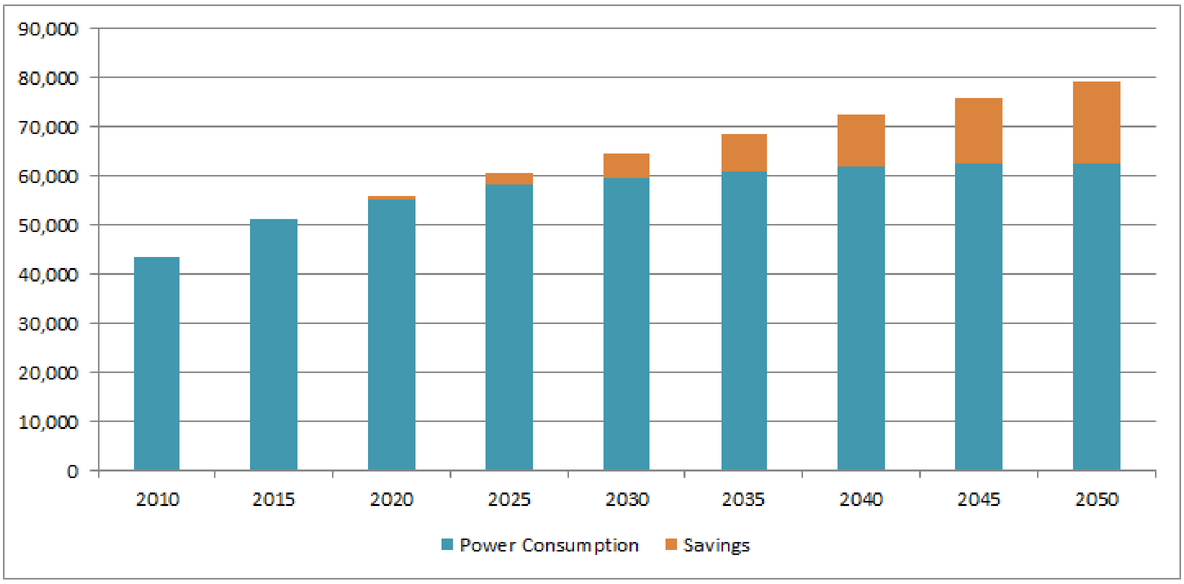



Figure 3 Staged countermeasures

### 6.2 Estimated outcome by Action Plans

Assuming that all action plans are implemented by year 2020, it will improve only one percent of saving in power demand to entire building sector. However, once implementation framework is established, cumulative impact for both new construction and retrofit will be observed.

Power consumption in 2015 as a benchmark, energy efficiency level of entire building sector will be improved to less than 90% in 2035, less than 80% in 2050. Figure 4 indicates reduced power consumption and amount of saving against projected power consumption. Figure Estimated annual reduction of CO2 emission in comparison with projected consumption is shown in Table 7.




Source: Estimated by JST using NEPRA state industry report consumption data

Figure 4 Projected Power Consumption & Savings for Domestic and Commercial usage (GWh)

Table 7 Estimated Power Consumption saving and reduced CO2 emission.

| | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|---|
| Projected Consumption Based on 2006 average consumption /contract (GWh) | 51,268 | 55,832 | 60,395 | 64,421 | 68,447 | 72,474 | 75,963 | 79,184 |
| Reduced Annual Power Consumption (GWh) | 51,268 | 55,198 | 58,288 | 59,568 | 60,848 | 61,726 | 62,389 | 62,542 |
| Annual Savings (GWh) | | 634 | 2,107 | 4,853 | 7,599 | 10,748 | 13,574 | 16,642 |
| Reduction of Annual CO2 emission (million ton-CO2) | | 459 | 1,525 | 3,514 | 5,502 | 7,781 | 9,828 | 12,049 |

Source: Estimated by JST (CO2 emission factor: 0.724t-CO2/KWh)

# FINAL REPORT
for
# DATA COLLECTION SURVEY ON ENERGY EFFICIENCY AND CONSERVATION IN THE BUILDING SECTOR

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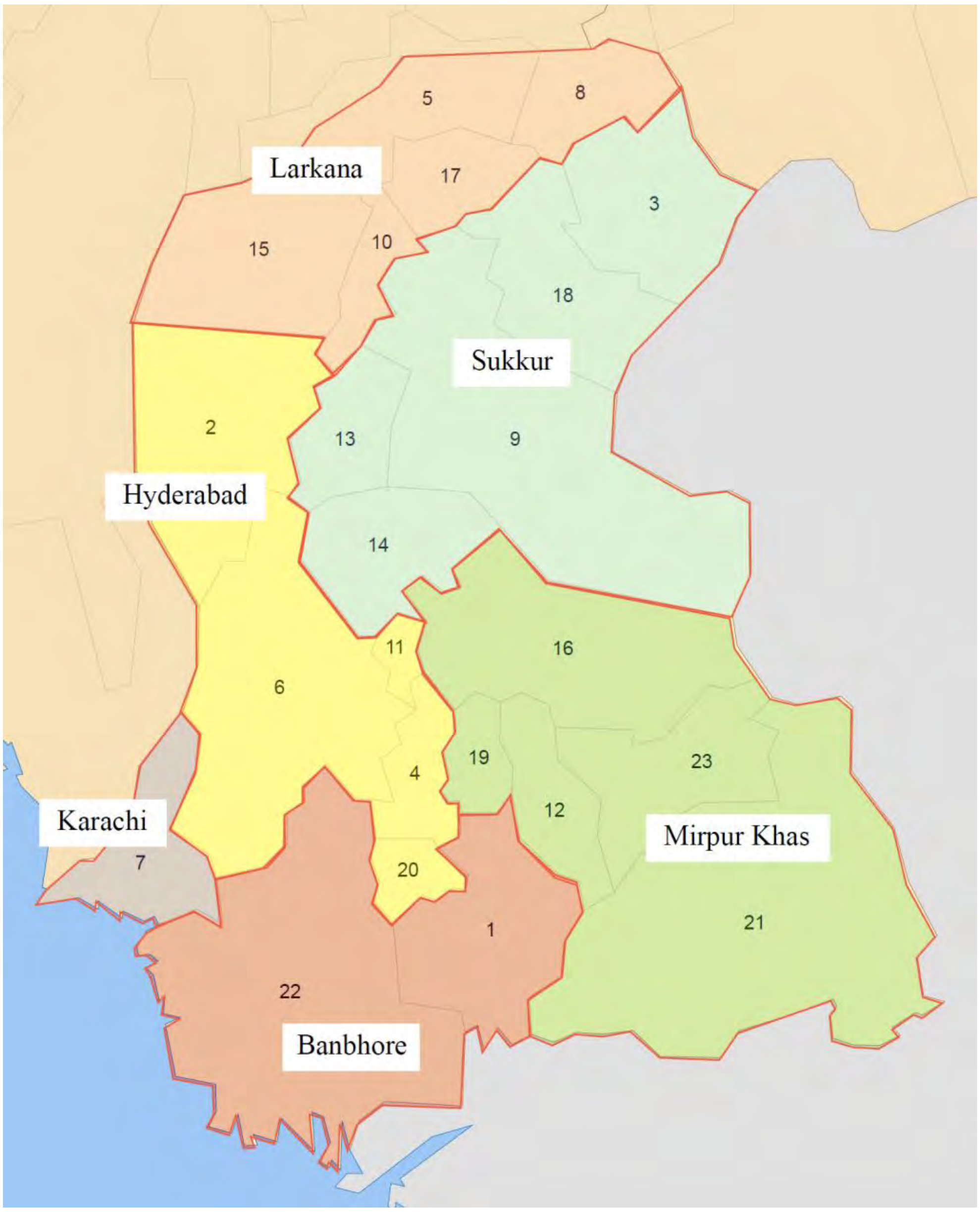
Location Map


Source： Prepared by the Survey Team based on the map published on the website (http://www.freemap.jp/)

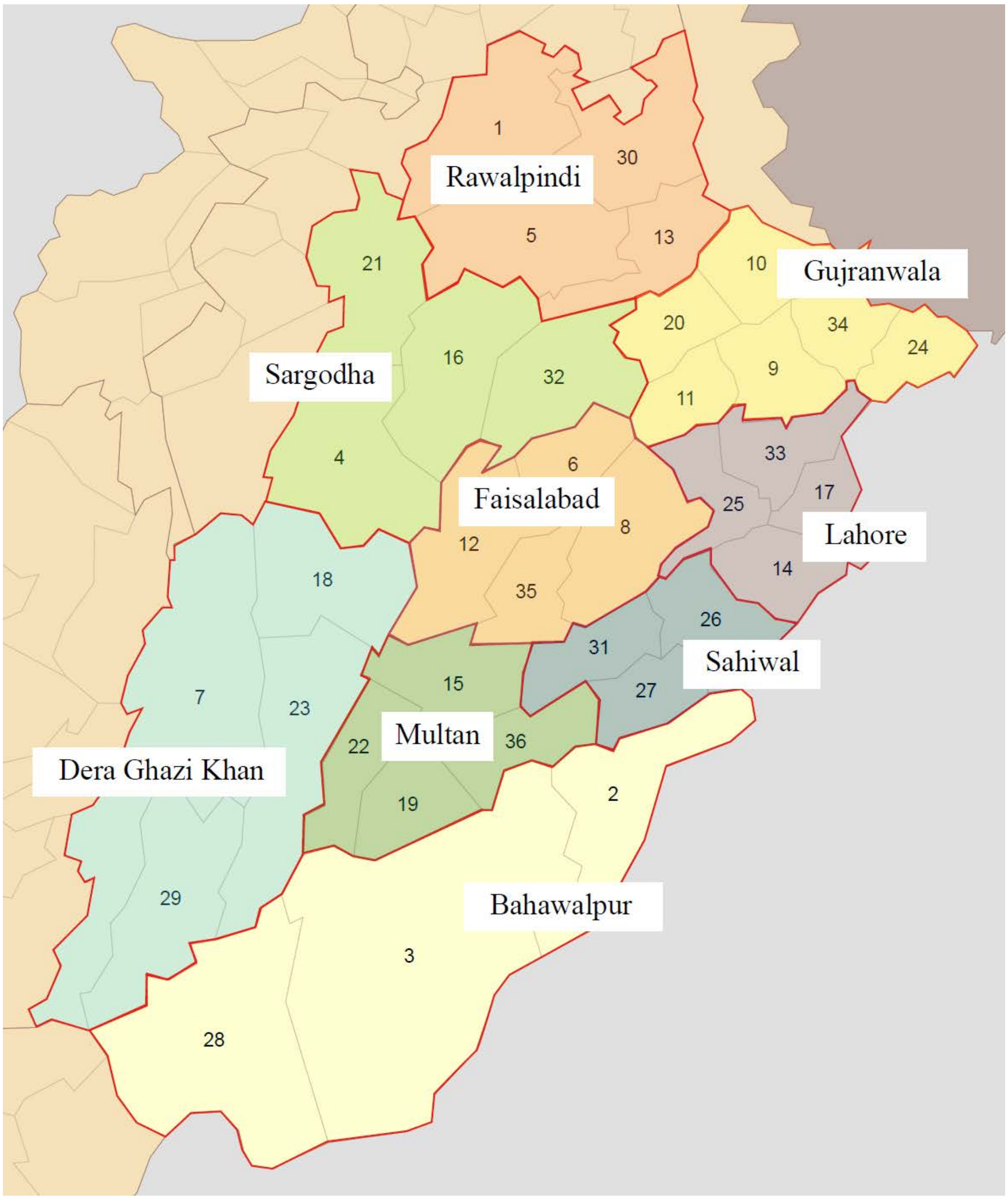
Divisions of Sindh Province




Source: Prepared by the Survey Team based on the map published on the website (https://en.wikipedia.org/wiki/Divisions_of_Pakistan , https://en.wikipedia.org/wiki/List_of_districts_of_Pakistan )

| No. | District | No. | District | No. | District |
|---|---|---|---|---|---|
| 1 | Badin | 9 | Khairpur | 17 | Shikarpur |
| 2 | Dadu | 10 | Larkana | 18 | Sukkur |
| 3 | Ghotki | 11 | Matiari | 19 | Tando Allahyar |
| 4 | Hyderabad | 12 | Mirpurkhas | 20 | Tando Muhammad Khan |
| 5 | Jacobabad | 13 | Naushahro Firoze | 21 | Tharparkar |
| 6 | Jamshoro | 14 | Shaheed Benazirabad | 22 | Thatta |
| 7 | Karachi | 15 | Kambar Shahdadkot | 23 | Umerkot |
| 8 | Kashmore | 16 | Sanghar | | |

Divisions of Punjab Province




Source: Prepared by the Survey Team based on the map published on the website (https://en.wikipedia.org/wiki/Divisions_of_Pakistan , https://en.wikipedia.org/wiki/List_of_districts_of_Pakistan )

| No. | District | No. | District | No. | District |
|---|---|---|---|---|---|
| 1 | Attock | 13 | Jhelum | 25 | Nankana Sahib |
| 2 | Bahawalnagar | 14 | Kasur | 26 | Okara |
| 3 | Bahawalpur | 15 | Khanewal | 27 | Pakpattan |
| 4 | Bhakkar | 16 | Khushab | 28 | Rahim Yar Khan |
| 5 | Chakwal | 17 | Lahore | 29 | Rajanpur |
| 6 | Chiniot | 18 | Layyah | 30 | Rawalpindi |
| 7 | Dera Ghazi Khan | 19 | Lodhran | 31 | Sahiwal |
| 8 | Faisalabad | 20 | Mandi Bahauddin | 32 | Sargodha |
| 9 | Gujranwala | 21 | Mianwali | 33 | Sheikhupura |
| 10 | Gujrat | 22 | Multan | 34 | Sialkot |
| 11 | Hafizabad | 23 | Muzaffargarh | 35 | Toba Tek Singh |
| 12 | Jhang | 24 | Narowal | 36 | Vehari |

**1: High-rise buildings in Islamabad**
High rise buildings are seen along the Jinnah Avenue.

**2: Government Quarter in Islamabad**
Single storey terrace house quarters. 3-4 bedrooms with 60-70m²


**3: Commertial Area in Islamabad**
2-5 storey commertial buildings to designated commertial zone.


**4: Façade of commercial building**
Retail on ground floor with other function in upper floors.

**5: New housing scheme in Rawalpindi**
Typically, 2 storey RC buildings with flat roof

**6: Housing Scheme Model**
Gated Community with individual home, high rise apartment and other commercial amenity. (Baharia Town)

**7: Apartment development in Karachi**
Building volumes are determined by zoning regulation to maximize FAR. (Kings Group)

**8: Crescent-Bay in Karachi**
Mega-scale development at water front in Karachi. (Emaar Giga)

**9: High rise building in Lahore**
Reinforced Concrete structure with curtain wall facade are under construction.

**10: High rise building in Lahore**
Brick wall is major masonry material in Lahore.

**11:3 storey apartment in Karachi**
Windows will be installed after completion of wall plaster and finish.Air-tighness is an issue.

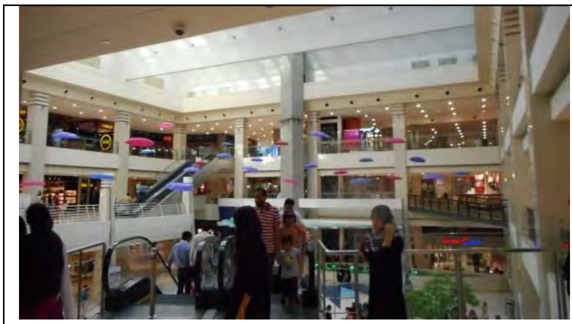
**12: Construction in Karachi**
Concrete block wall is common in Karachi.

**13: Heat insulation on wall**
2 inch insulation (XPS) sandwitched with 4 inch double concrete block wall.

**14: Water Tank on top of roof**
Pumped up from public supply water pipe by each house owners.

**15: Watt hour meter**
Usualy, Consumer can know amount of energy consumption by Watt hour meter

**16: AC condenser at retail buildings**
Majority of AC system is sprit system that installed by tenant owner.



**17: Dolmen Mall in Karachi**

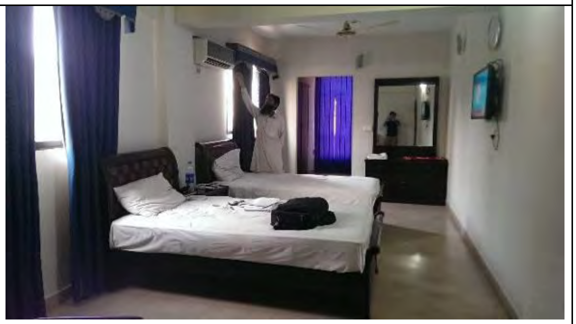
Residential, office, shopping complex in Karachi built by REIT.

**18: Retail shop interior**

Spot light and individual AC are installed.

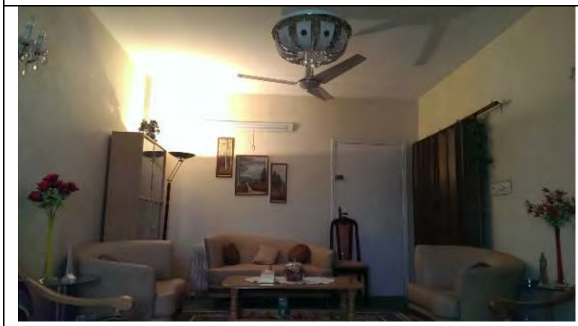
**19: Elementary School**

Ceiling fan and fluorescent lamp lighting are installed.



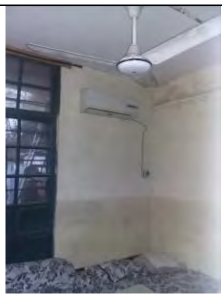
**20: Hotel Guestroom**

Card-key controlled lighting switches are common in high-end hotel.



**21: Living Room in house**

Ceiling fan without AC. Many people chose to install AC at bedroom only.



**22: Bedroom in house**

Both AC and fan are installed. Occupant has choice of two equipment or fan can be operated during load-shedding by using UPS.

**23: Restaurant in Islamabad**

Both AC and ceiling fan are installed. Only fan will be operated during load-sedding using backup generator.

**24: Office with UPS**

During load-shedding, PC and fan are allowed to connect to UPS.

**25: Lighting Fixture Shop-Rawalpindi**
LED Down light occupeis fair amount of space in the shop.

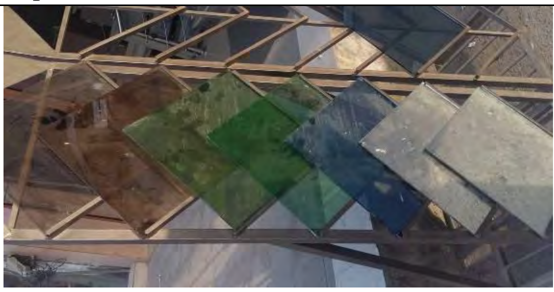
**26: Lighting Fixture Shop-Rawalpindi**
Majority of products are for CFL lamp.

**27: Kitchen appliance shop in Rawalpindi**
It is common to use Gas Cooking Stove for household.

**28: Gas Water Heater**
Gas water heater is common. However, due to the unstable Gas supply, some wealthy people have both Gas and Electric water heater.

**29: Freestanding AC**
Freestanding AC are often seen in commercial facility where large cooling capacity is required.


**30: Wall mount sprit system AC**
Widely diffused in both residential and commercial facilities. High energy efficiency product are seen in the shop but not many.



**31: Glass shop in Rawalpindi**
Single glazing are sold in the retail shop in town for both clear and tinted. Double glazing must be custom made upon purchais order.

**32 Factory of Heat insulation**
Extruded Polystyrene (XPS) are available in Pakistan by local manufacturer.

# Abbreviation

| | | |
|---|---|---|
| ABAD | : | Association of Builders And Developers of Pakistan |
| AC | : | Air Conditioner |
| ACE | : | Awareness Campaign Conservation and Environment |
| ACI | : | American Concrete Institute |
| ADB | : | Asian Development Bank |
| AEDB | : | Alternative Energy Development Board |
| AHAM | : | Association of Home Appliance Manufacturers |
| AISC | : | American Institute of Steel Construction |
| ANSI | : | American National Standards Institute |
| ARCASIA | : | Architects Regional Council Asia |
| ARI | : | American refrigeration Institution |
| ASCE | : | American Society of Civil Engineers |
| ASHRAE | : | American Society of Heating, Refrigerating and Air-Conditioning Engineers |
| BCA | : | Building and Construction Authority |
| BCD | : | Building Control Department |
| BCP-1986 | : | Building Code of Pakistan 1986 |
| BCP-SP-2007 | : | Building Code of Pakistan (Seismic Provision- 2007) |
| BCP-EP-2011 | : | Building Code of Pakistan (Energy Provision - 2011) |
| BECP-1990 | : | Building Energy Code of Pakistan 1990 |
| BEEI, India | : | Bureau of Energy Efficiency, India |
| BEE（評価） | : | Built Environment Efficiency |
| BEE | : | Bureau of Energy Efficiency |
| BEEC | : | Building Energy- Efficiency Code |
| BEI | : | Building Energy Index |
| BELS | : | Building Energy Efficiency Labeling System |
| BEMAJ | : | Building-Energy Manager’s Association of Japan |
| EPCA | : | Energy Policy and Conservation Act |
| BECP | : | Building Energy Codes Program |
| BFC | : | Building Fire Code |
| BIS | : | Bureau of Indian Standards |
| BMMC | : | Building Maintenance & Management Centre |
| BREEAM | : | British Research Establishment Environmental Assessment Method |
| BTO | : | Building Technologies Office |
| CAA | : | Commonwealth Association Of Architects |
| CAMB | : | Centre For Applied & Molecular Biology |
| CASBEE | : | Comprehensive Assessment System for building |
| CCI | : | Council of Common Interests |
| CDA | : | Capital Development Authority |
| CDD | : | Cooling Degree Day |
| CDM | : | Clean Development Mechanism |
| CFL | : | Compact Fluorescent Lamps |
| CIIT | : | COMSATS Institute of Information Technology |
| $CO_2$ | : | Carbon Dioxide |
| COP | : | Coefficient of Performance |
| COP3 | : | The 3rd Session of the Conference of the Parties to the United Nations Framework Convention on Climate Change |
| CPD | : | Continuing Professional Development |
| CSC | : | The Consultants Selection Committee |
| CTTI | : | Construction Technical Training Institution |
| CWHR | : | Council for Work and Housing Research |
| DA | : | Development Authority |
| db | : | Dry Bulb |
| DFID | : | Department for International Development |
| DHA | : | Defence Housing Authority |
| DOE, USA | : | Department of Energy, USA |
| DPC | : | Damp Proofing Course |
| E&C Law, Japan | : | Energy Conservation Law, Japan |
| EC | : | Energy Conservation |
| ECBC, India | : | Energy Conservation Building Code, India |
| ECC | : | Economic Coordination Committee |
| e-CFR | : | Electronic Code of Federal Regulations |
| EDB | : | Engineering Development Board |
| EE | : | Energy Efficiency |

| | | |
|---|---|---|
| EE&C | : | Energy Efficiency and Conservation |
| EE&C Bill | : | Energy Efficiency and Conservation Bill |
| EER | : | energy efficiency ratio |
| EERE | : | Energy Efficiency & Renewable Energy |
| EIA | : | Environment Impact Assessment and Clearance |
| EISA | : | Energy Independence and Security Act |
| EMSD | : | Electrical and Mechanical Services Department |
| ENAEE | : | European Network of Accredited Engineering Education |
| ENCON Fund | : | Thailand Energy Conservation Fund |
| ENERCON | : | National Energy Conservation Center |
| EnMS | : | Energy management Systems |
| EOM | : | Estate Office Management |
| EPA | : | Environmental Protection Agency |
| EP Act | : | Energy Policy act |
| EPC | : | ECBC Program Committee |
| EPCA,U.S.A. | : | Energy Policy and Conservation Act |
| EPE | : | Engineering Practice Examination |
| EPS | : | Expanded Poly-Styrene |
| ESCO | : | Energy Service Company |
| ES&L | : | Energy Standards & Labelling |
| FATA | : | Federally Administered Tribal Areas |
| FAR | : | Floor Area Ratio |
| FBR | : | Federal Board of Revenue |
| FDA | : | Faisalabad Development Authority |
| FEANI | : | European Federation of National Engineering Association |
| FGEHF | : | Federal Government Employees Housing Foundation |
| FPCI | : | Federation of Pakistan Chamber of Commerce and Industry |
| FPSA | : | Fire Protection Association of Pakistan |
| FTA | : | Free Trade Agreement |
| GB | : | Green Building |
| GBC | : | Green Building Council |
| GDA | : | Gujranwala Development Authority |
| GDP | : | Gross Domestic Product |
| GEF | : | Global Environmental Fund |
| GFA | : | Gross Floor Area |
| GIZ | : | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| GNP | : | Gross National Product |
| GOP | : | Government of Pakistan |
| GRIHA | : | Green Rating for Integrated Habitat Assessment |
| GMIS | : | Green Mark Incentive Scheme |
| HBFC | : | House Building Finance Company Limited |
| HDD | : | Heating Degree Days |
| HECP | : | Higher Education Commission Pakistan |
| HFCP | : | Housing Finance Company of Pakistan |
| HP | : | Horse Power |
| HP & EP | : | Housing Physical & Environmental Planning |
| H & PP | : | Housing and Physical Planning Department |
| HSPF | : | Heating Seasonal Performance Factor |
| HUD&PHED | : | Housing, Urban Development and Public Health Engineering department |
| HVAC | : | heating, ventilation, and air conditioning |
| HVACR | : | Heating Ventilation Air Conditioning and Refrigeration |
| IAP | : | Institute of Architects, Pakistan |
| IBEC, Japan | : | Institute for Building Environment and Energy Conservation, Japan |
| ICT | : | Islamabad Capital Territory |
| IEA | : | International Energy Agency |
| IESCO | : | Islamabad Electrical Supply Company |
| IFC | : | International Finance Corporation |
| IMF | : | International Monetary Fund |
| IPLV | : | Integrated Part Load Value |
| IRS | : | Internal Revenue Service |
| IRSA | : | Indus River System Authority |
| IRSZB 2005 | : | Islamabad Residential Sectors Zoning Regulation 2005 |
| ISO | : | International Organization for Standardization |
| JaGBC | : | Japan GreenBuild Council |
| JICA | : | Japan International Cooperation Agency |
| JBEECF | : | Japan Building Equipment and Elevator Centre Foundation |
| JBMA | : | Japan Building Maintenance Association |

| | | |
|---|---|---|
| JLMA | : | Japan Lighting Manufacturers Association |
| JSBC | : | Japan Sustainable Building Consortium |
| JST | : | JICA Survey Team |
| KBCA | : | Karachi Building Control Authority |
| KB&TP2002 | : | Karachi Building and Town Planning Regulations |
| KDA | : | Karachi Development Authority |
| KEMCO | : | Korea Energy Management Corporation |
| KfW | : | Kreditanstalt für Wiederaufbau |
| KIBOR | : | Karachi Interbank Offered Rate |
| KIT | : | Karachi Improvement Trust |
| KMC | : | Karachi Metropolitan Corporation |
| LDA | : | Lahore Development Authority |
| LEED | : | Leadership in Energy and Environmental Design |
| LG&CD | : | Local Government and Community Development Department |
| LPD | : | Lighting Power Density |
| MCB | : | Muslim Commercial Bank |
| MD | : | Managing Director |
| MDA | : | Multan Development Authority |
| MEPS | : | Minimum Energy Performance Standards |
| MHP | : | Mini and micro hydropower |
| MOCC | : | Ministry of Climate Change |
| MOCI | : | Ministry of Commerce and Industry |
| MOEF | : | Ministry of Environment and Forest |
| MOF | : | Ministry of Finance |
| MOHW | : | Ministry of Housing and Works |
| MOP,India | : | Ministry of Power ,India |
| MOPDR | : | Ministry of Planning, Development & Reform |
| MOST | : | Ministry of Science and Technology |
| MOUD, India | : | Ministry of Urban Development, India |
| MOWP | : | Ministry of Water and Power |
| NAECA | : | National Appliance Energy Conservation Act |
| NBC | : | National Building Code |
| NBP | : | National Bank of Pakistan |
| NCCS | : | National Climate Change Secretariat |
| NCL | : | National Construction Limited |
| NEPCA | : | National Energy Conservation and Policy Act |
| NEPRA | : | National Electric Power Regulatory Authority |
| NESPAK | : | National Engineering Services Pakistan |
| NFPA | : | National Fire Protection Agency |
| NGO | : | Non-Governmental Organization |
| NHA | : | National Housing Authority |
| N.I.C | : | National Identity Cards |
| NIE | : | National Institute of Electronics |
| NIO | : | National Institute of Oceanography |
| NIP | : | National Industrial Parks Development & Management Company |
| NOC | : | No Objection Certificate |
| NPCC | : | National Power Construction Company |
| NTDC | : | National Transmission & Despatch Company |
| NUST | : | National University of Science and Technology |
| NWFP | : | North-West Frontier Province |
| Pakistan GBC | : | Pakistan Green Building Council |
| PBRS | : | Pearl Building Rating System |
| PCATP | : | Pakistan Council of Architects and Town Planners |
| PCRET | : | Pakistan Council for Renewable Energy Technologies |
| PCRWR | : | Pakistan Council of Research in Water Resources |
| PCSIR | : | Pakistan Council of Scientific and Industrial Research |
| PCST | : | Pakistan Council for Science and Technology |
| PEC | : | Pakistan Engineering Council |
| PEC-CPCE-1986 | : | Pakistan Engineering Council (Conduct and Practice of Consulting Engineers) Bye-law, 1986 |
| PECT | : | Professional Engineers Consortium for technologies |
| PEFMA | : | Pakistan Electric Fan Manufacturers Association |
| PEMMA | : | Pakistan Motor Manufacturers Association |
| PEPAC | : | Pakistan Environmental Planning Architectural Consultant |
| PETSAC-2014 | : | Pakistan Electric and Telecommunication Safety Code |
| PGBC | : | Pakistan Green Building Council |

| | | |
|---|---|---|
| PGD | : | Post-graduate Diploma |
| PHA | : | Pakistan Housing Authority |
| PHATA | : | Punjab Housing and Town Planning Agency |
| PHED | : | Public Health Engineering Department |
| Ph.D | : | Doctor of Philosophy |
| PIE | : | Punjab Industrial Estate |
| PKR | : | Pakistan Rupee |
| PLV | : | Part Load Value |
| PNAC | : | Pakistan National Accreditation Council |
| PPIB | : | Private Power and Infrastructure Board |
| PPPMCL | : | Pakistan Power Park Management Company Limited |
| PPRA | : | Public Procurement Regulatory Authority |
| PPWD | : | Pakistan Public Works Department |
| PRA | : | Punjab Revenue Authority |
| PURE | : | Productive use of renewable energy |
| PSF | : | Pakistan Science Foundation |
| PSQCA | : | Pakistan Standards and Quality control Authority |
| PTM | : | Pusat Tenaga Malaysia |
| PV | : | Photovoltaic |
| QCC | : | Quality Control Centre |
| RAC-1 | : | Room Air Conditioner |
| RC | : | Reinforced Concrete |
| RDA | : | Rawalpindi Development Authority |
| RE | : | Renewable Energy |
| RE-EE | : | Renewable Energy an Energy Efficiency |
| RIBA | : | Royal Institute of British Architects |
| RIT | : | Rawalpindi Improvement Trust |
| SAARCH | : | SAARC Association of Architects |
| SBCA | : | Sindh Building Control Authority |
| SBP | : | State Bank of Pakistan |
| SCC | : | System Certification Center |
| SBCO | : | Sindh Building Control Ordinance-1979 |
| SDC | : | Standards Development Center |
| SECP | : | Security and Exchange Commission of Pakistan |
| SEER | : | seasonal energy efficiency ratio |
| SHGC | : | Solar Heat Gain Coefficient |
| SIE | : | Sundar Industrial Estate |
| SITE | : | Sindh Industrial Trading Estates |
| SMEs | : | small and medium enterprises |
| SRB | : | Sindh Revenue Board |
| S.R.O. | : | Statutory Regulation Order |
| TEPA | : | Traffic Engineering Planning Agency |
| TERI | : | The Energy and Resources Institute |
| TMA | : | Town Municipal Administration |
| TOR | : | Term of Reference |
| TSC | : | Technical Standard Center |
| UAE | : | United Arab Emirates |
| UBC | : | The Uniform Building Code |
| UIA | : | International Union of Architects |
| ULBs | : | Urban Local Bodies |
| UNDP | : | United Nations Development Programme |
| UNHABITAT | : | United Nations Human Settlements Programme |
| UPC | : | Abu Dhabi Urban Planning Council |
| USA | : | United States of America |
| USAID | : | United States Agency for International Development |
| USD | : | United States Dollars |
| USGBC | : | U.S. Green Building Council |
| VAT | : | Value added Tax |
| WAPDA | : | Water and Power Development Authority |
| WASA | : | Water and Sanction Agency |
| wb | : | Wet Bulb |
| WB | : | World Bank |
| World GBC | : | World Green Building Council |
| XPS | : | Extruded polystyrene |

Units

| | | |
|---|---|---|
| A (Ampere) | : | Unit of current |
| V (Volt) | : | Unit of voltage |
| kV (kilovolt) | : | 1,000 volts |
| kVA | : | Kilo-Volt Amps |
| W (Watt) | : | Unit of active power |
| kW (kilowatt) | : | 1,000 watts |
| MW (Megawatt) | : | 1,000kW |
| GW (Gigawatt) | | 1,000MW |
| Wh (Watt-hour) | : | Unit of energy |
| kWh (kilowatt-hour) | : | 1,000Wh |
| MWh (Megawatt-hour) | : | 1,000kWh |
| GWh (Gigawatt-hour) | | 1,000MWh |
| m (meter) | : | Unit of length in SI |
| ft (feet) | : | Unit of length in Imperial units |
| yd(yard) | : | Unit of length in Imperial units |
| Inch | : | Unit of length in Imperial units |
| cfm (cubic feet per minute) | : | Unit of fluid in Imperial units |
| $m^2$ | : | Square meter |
| $ft^2$ | : | Square feet |
| $yd^2$ | | Square yard |
| ° C | : | Unit of temperature in SI |
| ° F | : | Unit of temperature in Imperial units |
| Btu | : | British thermal Unit |

# Chapter 1 Introduction

# Chapter 1 Introduction

## 1.1 Background to the Survey

The Islamic Republic of Pakistan (hereinafter referred to as "Pakistan") has structural problems in the power sector, e.g. the high power generation cost, pricing below cost, the high ratio of power transmission and distribution losses, inefficient operation and inappropriate governance. Such problems mean a gap between supply and demand and severely hinder daily economic activities.

The Government of Pakistan (hereinafter referred to as "GOP") announced its National Power Policy 2013 in September 2013, in which power sector reform is recognized as one of the key issues. This policy aims to limit current power sector subsidies to 0.3 to 0.4% of GDP. The GOP is also trying to raise the electricity tariff and reduce power sector subsidies by reducing the cost of power generation and innovating governance. Moreover, an Extended Fund Facility will get underway the same year by the IMF, amounting to $ 6.6 billion for 3 years. One of the priority actions in this program involves setting the electricity tariff below the current level and innovating the power sector for the Structural Benchmark.

GOP works with the World Bank, ADB and JICA in accordance with a policy matrix of ten reform items and three major goals; firstly to reduce subsidies and increase the electricity tariff, secondly to reduce the cost of power generation and thirdly, to promote accountability and transparency. One of the reform issues involves effectively improving the demand side to promote energy conservation and GOP has tried to establish energy conservation with pending bills. Henceforth, various measures will be required to introduce the Energy Conservation Law, although the GOP lacks experience in introducing the Law, which has delayed moves to investigate the introduction.

JICA implements the program loan with the World Bank and ADB to support energy sector reform. As Japan has experience and knowledge of the relevant energy conservation issues, attempts will be made to support GOP by coordinating among donors. Within three years of commencing the program loan, the establishment of a fourth-year action plan between GOP and donors will be considered. One of the candidates is considered to be promoting attempts to establish a power conservation system in the building sector, which is expected to significantly reduce energy consumption.

GOP imposed the Building Code of Pakistan - Energy Provision - 2011 (hereinafter referred to as "BCP-EP-2011") against the building sector on a mandatory basis and has promulgated the same by Statutory Regulation Order (Hereafter S.R.O.) in 2013. As no detailed rules and penalties were defined in the provision, such relevant institution and framework must be provided as soon as possible.

### 1.2 Survey Objectives

By clarifying the current situation and issues of the energy conservation legal framework in the building sector in Pakistan, medium- to long-term initiatives, priority actions to promote energy conservation and cooperation program ideas, assisted by Japan, will be proposed.

### 1.3 Survey Area

The study area of this project is shown on the location map and encompasses:

(1) Islamabad and Rawalpindi

(2) Lahore City area: Punjab Province

(3) Karachi City area: Sindh Province

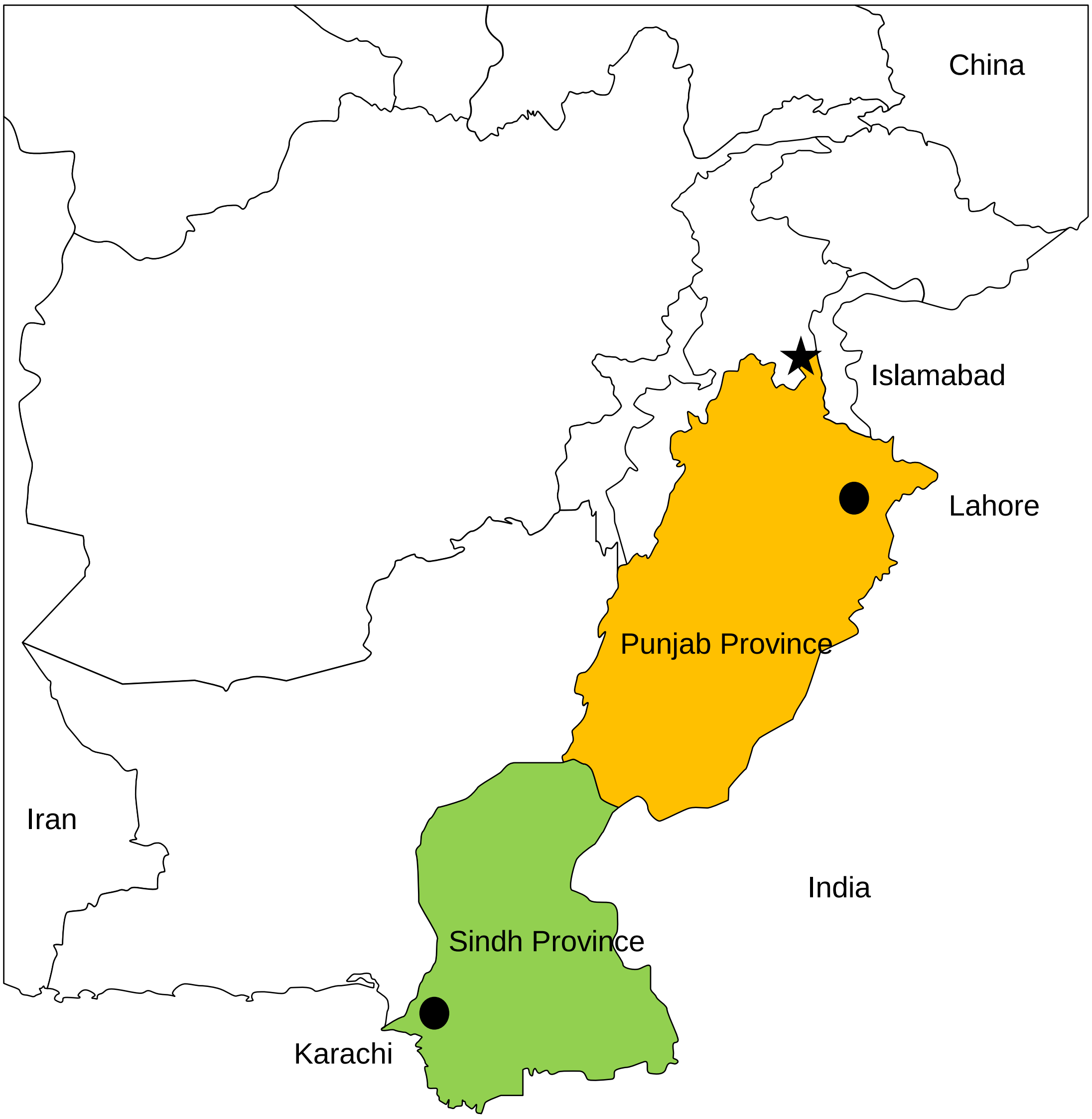
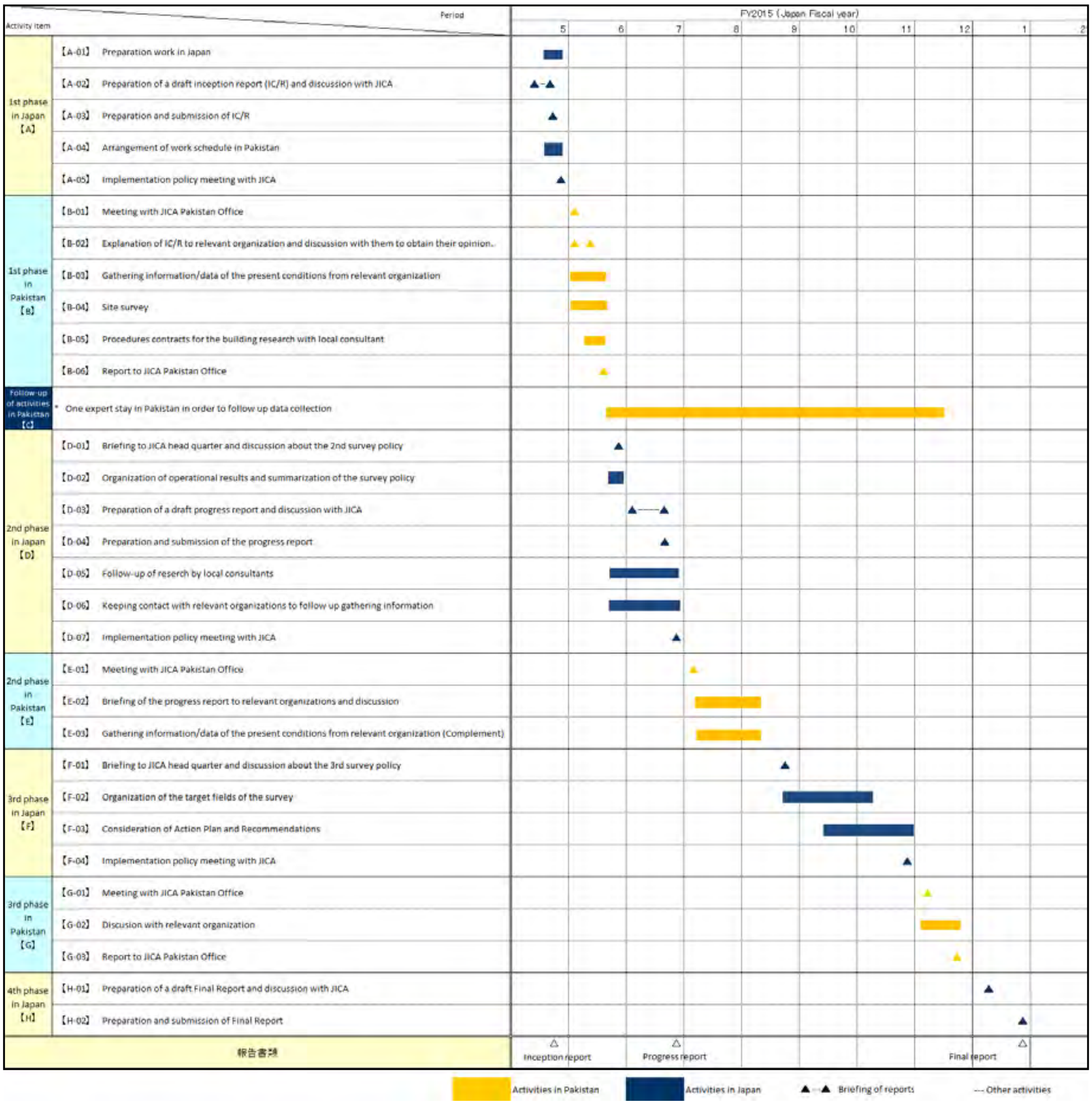



Figure 1.3.1 Location Map

Source : Prepared by the Survey Team based on the map published on the website (http://www.freemap.jp/)

## 1.4 Schedule of the Surveys

The Survey will be carried out from the end of May 2015 to the end of January 2016 (about eight months). The schedule is shown in Figure 1.4-1.




Source: Prepared by the JICA Survey Team

Figure 1.4-1 Implementation Schedule

# Chapter 2 Basic Data and Information of Building Sector in Pakistan

# Chapter 2 Basic Data and Information of Building Sector in Pakistan

## 2.1 Basic Condition of Building Sector in Pakistan

### 2.1.1 Categorization and number of Buildings

(1) Categorization of building

Categorization of building in the three cities of Pakistan, as well as categorization in Japan under the Energy Conservation Act for reference is shown in Table 2.1-1. In Islamabad and Lahore, buildings are categorized into four categories, i.e. residential, commercial, public and industrial. Commercial buildings include shops and offices, further public buildings include hospital, educational and governmental types. In Karachi, buildings are not categorized by building usage, but by scale. The Building Code of Pakistan Energy Provision 2011 (BCP-EP-2011) categorizes by floor area, rather than building usage.

Under the Energy Conservation Act in Japan, buildings are categorized into two categories, i.e. residential, non-residential. Non-residential buildings are further sub-categorized, i.e. into hotels, hospitals, retail shops, offices, educational establishments, restaurants, halls and factories. The character of respective building categorization in Pakistan is shown in Table 2.1-2 and is akin to the Japan experience. Hotels and hospitals provide visitors in the form of hotel guests and hospital inpatients with high-class service, while buildings in these categories generally operate on an ongoing basis, 24/7. Retail shops are also generally open for 15 hours and apart from residential buildings, buildings in the other categories generally operate for around 8 to 10 hours daily.

Table 2.1- 1 Categorization of building

| Categorization of building in Pakistan (Islamabad, Lahore, Karachi) | | | Categorization of building in Japan (Under Energy Conservation Act for reference) |
|---|---|---|---|
| CDA (Islamabad) | LDA (Lahore) | SBCA (Karachi) | |
| 1) Residential<br>2) Commercial<br>a) Shop<br>b) Office3) Public<br>a) Hospital<br>b) Educational<br>c) Governmental<br>4) Industrial | 1) Residential<br>2) Commercial<br>a) Market<br>b) Shop<br>c) Office<br>d) Hotel<br>e) Restaurants<br>3) Public<br>a) Hospital<br>b) Educational<br>c) Governmental<br>d) Hall<br>4) Industrial | 1) Category I<br>a) Bungalow on plot up to 120 $yd^2$. (100.33 $m^2$)<br>b) Any other building on plot up to 120 $Yd^2$. (100.33 $m^2$) with height up to 33 ft. (10 m).<br>2) Category II<br>a) All bungalows.<br>b) Any other building with total floor area up to 20,000 $ft^2$. (1,858.74 $m^2$) and/or height up to 50 ft (15.2m), other than Categories I & IV.<br>3) Category III<br>All buildings with total floor area exceeding 20,000 Sq. ft. (1,858.74 $m^2$) and/or height exceeding 50 ft. (15.2 m), other than Category IV.<br>4) Category IV<br>Public use or Industrial buildings with total floor area exceeding 10,000 $ft^2$ (929.36 $m^2$) or with span exceeding 40 ft. or ground floor height exceeding 15 ft., building for essential facilities and public sale buildings. | 1) Residential building<br>2) Non residential building<br>a) Hotel<br>b) Hospital<br>c) Retail shop<br>d) Office<br>e) Educational<br>f) Restaurant<br>g) Hall<br>h) Factory |

CDA: Capital Development Authority
LDA: Lahore Development Authority
SBCA: Sindh Building Control Authority
Source: Prepared by JICA Survey Team

Table 2.1- 2 Character of respective building categorization in Pakistan (Under categorization in Japan)

| Categorization of building | Character of Category | | | |
|---|---|---|---|---|
| | Main user | Daily operation | Annual working day | Characteristic appliance |
| Hotel | Visitor | 24H | 365 days* | Kitchen facilities* |
| Hospital | Visitor | 24H | 365days* | Medical facilities* |
| Retail shop | Visitor | 10.5H | Approx. 300 days* | |
| Office | Occupant | 8.5H | Approx. 220 days* | |
| Educational | Visitor | 8H | Approx. 220 days* | |
| Restaurant | Visitor | 9H | 360days* | Kitchen facilities |
| Cultural | Visitor | 8H | Approx. 220 days* | |
| Factory | Occupant | 10H | Approx. 220 days* | Factory facilities |
| Residential | Occupant | 24H | 365 days* | |

*: To be confirmed
Source: Prepared by JICA Survey Team based on interview survey in Islamabad, Lahore. After Karachi data will come, the mentioned data will be amended.

(2) Numbers regarding buildings in Pakistan

The number of electrical contracts concluded is a useful indicator to determine the scale of the building sector. Table 2.1-3 shows the number of electrical contracts, categorized into Domestic, Commercial and Industrial, for the last ten years.

The Access to electricity of household was 79.5% in 1998 and had been improved to 93.6% in 2012.[1] This is one of the reason why the annual growth ratio of domestic electrical contract is greater than annual population growth which is estimated approximately 2%. However, Based on the estimated population of 190mil, the number of persons per contract is about 9 which is far greater number compared to the number of person per housing unit in 1998 census, which was 6.8. This gap is in line with 9 million housing backlog as descried later. So current number of electrical contract seems to be suppressed number and there will be a potential of further growth depending on the effort of government and private housing development scheme.

Number of commercial contract occupies 12-15% of total of building sector which is in line with urban zoning plan regulated by Building Control Authority. Commercial activities are under mix influence of population and economy, so annual growth rate of 2-4% seems reasonable considering the growth of population and GDP in last decade.

Number of industry contract occupies relatively smaller number. 5-6% of annual growth rate was observed before 2008 and less growth after that. This may be explained by global economic crisis in 2008 and energy crisis happening in Pakistan.

[1] World Bank indicator

Table 2.1- 3 Number of electrical contract (thousand)

| | 2003-4 | 2004-5 | 2005-6 | 2006-7 | 2007-8 | 2008-9 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Domestic Total | 13,086 | 13,889 | 14,830 | 15,849 | 16,745 | 17,390 | 18,255 | 18,954 | 19,637 | 20,374 | 20,972 |
| Change from Previous year | | 106.1% | 106.8% | 106.9% | 105.7% | 103.9% | 105.0% | 103.8% | 103.6% | 103.7% | 102.9% |
| Percentage in total | 83.73% | 84.17% | 84.49% | 84.84% | 85.12% | 85.28% | 85.52% | 85.68% | 85.81% | 85.99% | 86.05% |
| Commercial Total | 2,313 | 2,379 | 2,477 | 2,577 | 2,662 | 2,729 | 2,807 | 2,874 | 2,939 | 3,003 | 3,073 |
| Change from Previous year | | 102.9% | 104.1% | 104.0% | 103.3% | 102.5% | 102.9% | 102.4% | 102.3% | 102.2% | 102.3% |
| Percentage in total | 14.80% | 14.42% | 14.11% | 13.79% | 13.54% | 13.38% | 13.15% | 12.99% | 12.84% | 12.67% | 12.61% |
| Industrial Total | 230 | 233 | 244 | 255 | 264 | 274 | 284 | 293 | 307 | 317 | 326 |
| Change from Previous year | | 101.3% | 104.6% | 104.5% | 103.4% | 103.8% | 103.8% | 103.3% | 104.5% | 103.4% | 102.7% |
| Percentage in total | 1.47% | 1.41% | 1.39% | 1.37% | 1.34% | 1.34% | 1.33% | 1.33% | 1.34% | 1.34% | 1.34% |
| Grand Total | 15,629 | 16,501 | 17,551 | 18,681 | 19,671 | 20,393, | 21,346 | 22,121 | 22,883 | 23,694 | 24,371 |
| Change from Previous year | | 105.6% | 106.4% | 106.4% | 105.3% | 103.7% | 104.7% | 103.6% | 103.4% | 103.5% | 102.9% |

Source: NEPRA state of industry report 2009,2011 and 2014

Out of commercial activities, majority are offices and retail shops. Following tables are summaries of available data in Pakistan.

Table 2.1- 4 Ratio of registered telephone number

| | Islamabad | Karachi | Rawalpindi | Average |
|---|---|---|---|---|
| Offices | 47.6% | 36.3% | 34.7% | 37.5% |
| Retail Shops | 32.5% | 34.9% | 43.9% | 35.0% |
| Factories/Industries | 15.6% | 25.6% | 18.2% | 24.2% |
| Hotels/ Restaurants | 1.1% | 0.4% | 0.7% | 0.5% |
| Education/ Institutions | 1.5% | 1.4% | 1.3% | 1.4% |
| Hospitals | 1.6% | 1.3% | 1.2% | 1.3% |
| Total | 100.0% | 100.0% | 100.0% | 100.0% |

Source: Summarized by JST based on the information in Yellow Pages of Pakistan 2015

Table 2.1- 5 Number of Hotel in 2015

| City | Number of hotel | City | Number of hotel | City | Number of hotel |
|---|---|---|---|---|---|
| Faisalabad | 2 | Karachi | 63 | Peshawar | 1 |
| Gilgit | 1 | Lodhran | 1 | Quetta | 8 |
| Gwadar | 1 | Multan | 4 | Rawalpindi | 7 |
| Hyderabad | 2 | Murree | 1 | Sialkot | 1 |
| Islamabad | 15 | Muzafferabad | 3 | Swat | 1 |
| Kaghan-Naran | 1 | Nawabshah | 1 | -- | -- |
| Total number of country –wise building of hotel | | | | | 136 |

Guest house-type hotels excluded from above data.

Source: Prepared by JICA Survey Team based on information of registered hotel on Pakistan Hotel Association

Table 2.1- 6 Number of Medical

| Year | Hospitals | Dispensaries | BHUs Sub Health Centers | Maternity& Child Health Centers | Rural Health Centers | TB Centers |
|---|---|---|---|---|---|---|
| 2009 | 968 | 4,813 | 5,345 | 906 | 572 | 293 |
| 2010 | 972 | 4,842 | 5,344 | 909 | 577 | 304 |
| 2011 | 980 | 5,039 | 5,449 | 851 | 579 | 345 |
| 2012 | 1,092 | 5,176 | 5,478 | 628 | 640 | 326 |
| 2013 | 1,113 | 5,413 | 5,571 | 687 | 667 | 329 |
| 2014 (P) | 1,142 | 5,499 | 5,438 | 671 | 669 | 334 |
| Total number of country –wise building of Medical in 2014 | | | | | | 13,735 |

Source: Pakistan Bureau of Statistics

(3) Number of new construction

Interviews with Development Authorities revealed a rough planned number of applications as shown in Table 2.1- 7. "Population per application" indicates growth speed of the respective city. Islamabad, obviously one of the fastest growing city. Meanwhile, hence the building scale in Karachi is relatively bigger, actual construction activity and floor area production could be greater than other cities.

Only the SBCA has gathered seven years of data, including the number of applications, approved plan, completion certificate and demolition, as shown in Table 2.1-8. According to SBCA statistics, over seven years from 2008 to 2014, 1,377 buildings were officially completed out of 28,096 permit application and remaining 18,234 were either completed without permission or not built. 5,737 buildings have been demolished, in whole or in part, by the SBCA due to violation of building regulation.

Above demolition activity by SBCA may have been giving influence to number of electrical contract in K-electric, electricity supply company in Karachi, as shown in Table 2.1-9, which indicates slow growth ratio and even the decline in last few years. Since 2008, total electrical contract number have been increased by 135,115, while 19,611 building application were approved and 5,737 buildings were forced to demolished. Assuming that all approved application were actually built, in average, 2,000 buildings and 19,300 electrical contracts have been increasing annually. (9 electrical contracts per building)

Table 2.1-7 Number of applications for new construction to Development Authorities

| | Islamabad (CDA) | Rawalpindi (RDA) | Faisalabad (FDA) | Multan (MDA) | Karachi (SBCA) |
|---|---|---|---|---|---|
| Number of annual application *1 | 1806 | 700-800 | 800 | 1000 | 4876 |
| Approx. Population in 2010 (million)*2 | 1.0 | 2 | 2.9 | 1.6 | 13.3 |
| Population per application | 553 | 2666 | 3625 | 1600 | 2727 |

Source: *1By Interview to DA *2: National Report of Pakistan for HABITAT III

Table 2.1- 8 Number of construction of buildings in Karachi (Unit: buildings)

| Years | Plan received | Plan Approved | | Demolition |
|---|---|---|---|---|
| | | Proposed Plan | Completion Plan | |
| 2008 | 3,652 | 2,301 | 243 | 468 |
| 2009 | 3,827 | 2,835 | 154 | 1,000 |
| .2010 | 5,100 | 3,917 | 179 | 789 |
| 2011 | 3,777 | 1,434 | 276 | 873 |
| 2012 | 3,144 | 2,344 | 164 | 708 |
| 2013 | 3,720 | 2,254 | 147 | 813 |
| 2014 | 4,876 | 3,149 | 214 | 1,086 |
| Total | 28,096 | 18,234 | 1,377 | 5,737 |

**'Plan received'** indicates an application.
**'Proposed Plan'** indicates an SBCA-approved plan but with no final inspection conducted by the building owner. According to the SBCA, 90% of those buildings have been completed and occupied without a final inspection and occupancy certificate. For the remaining 10%, it is possible that 1) construction remained pending, or 2) was stopped for some reason.
**'Completion Plan'** indicates officially certified buildings.
**'Plan Approved'** indicates the total of "Proposed plans" and "Completion Plans" by the SBCA. This is 70% of the applied plan to the SBCA. The remaining 30% are 1) rejected by the SBCA, 2) withdrawn by the applicant or 3) suspended for some other reason. Some applicants might have decided to go ahead with construction without approval of plans.
**'Demolition'** indicates the number of demolitions carried out by the SBCA demolition department due to failure to comply with the code. Some are entirely demolished, others are partially demolished and this category comprises 30% of all applied plans. Some demolitions may also apply to illegal constructions without an application.

Source: SBCA

Table 2.1-9 Number of electrical contract in K-electric (thousand)

| | 2007-8 | 2008-9 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
|---|---|---|---|---|---|---|---|
| Domestic KEL | 1,518,664 | 1,531,971 | 1,582,426 | 1,632,604 | 1,659,766 | 1,660,768 | 1,650,034 |
| Change from Previous year | 101.6% | 100.9% | 103.3% | 103.2% | 101.7% | 100.1% | 99.4% |
| Commercial KEL | 433,416 | 437,463 | 445,442 | 452,667 | 456,537 | 452,329 | 438,150 |
| Change from Previous year | 102.0% | 100.9% | 101.8% | 101.6% | 100.9% | 99.1% | 96.9% |
| Industrial KEL | 21,453 | 20,751 | 20,703 | 20,595 | 20,537 | 20,462 | 20,464 |
| Change from Previous year | 97.9% | 96.7% | 99.8% | 99.5% | 99.7% | 99.6% | 100.0% |
| Total KEL | 1,973,533 | 1,990,185 | 2,048,571 | 2,105,866 | 2,136,840 | 2,133,559 | 2,108,648 |
| Change from Previous year | 101.6% | 100.8% | 102.9% | 102.8% | 101.5% | 99.8% | 98.8% |

Source: NEPRA state of industry report 2011 and 2014

### 2.1.2 Energy Usage in Buildings

(1) Categorization of energy usage in buildings

The energy usage for 60 building samples in Islamabad/Rawalpindi, Lahore and Karachi are shown in Tables 2.1-10, 2.1-11 and 2.1-12 respectively. Categorization of energy usage in buildings also includes items such as lighting & socket, heat source, heat transfer, hot water supply, motor and others. A high diffusion of air-conditioners is observed, but the continued usage of fans may reflect the high energy consumption of air-conditioners. For large-scale buildings in particular, the use of generators seems common due to load shedding.

Table 2.1-10 Energy usage in buildings in Islamabad/Rawalpindi

| No. | Completion | Usage | | | | Floor area | Energy usage | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | H | O | C | Other | | A | F | V | H | E | G | Other |
| 1 | 2011 | | | ✓ | | 22 | ✓ | ✓ | | | | | |
| 2 | No data | | | ✓ | | 205 | ✓ | ✓ | ✓ | | | | |
| 3 | 70% complete | | | | Hospital | 12,082 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | Medical Equipment |
| 4 | Under const. | ✓ | | ✓ | | 3,695 | | | | ✓ | | | |
| 5 | Under const. | | | ✓ | | 793 | | | | ✓ | | | |
| 6 | 2000 | ✓ | | | | 1,505 | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| 7 | 1985 | | ✓ | ✓ | | 2,657 | ✓ | ✓ | ✓ | | | | GPS |
| 8 | 2015 | | ✓ | | Hospital | 4,000 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 9 | No data | | ✓ | | | 502 | ✓ | ✓ | ✓ | | | ✓ | |
| 10 | 2008 | | | ✓ | | 1,003 | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| 11 | 1984 | | | ✓ | | 465 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 12 | 2011 | | | | Hospital | 12,082 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 13 | No data | | | | Educational | 266 | ✓ | | | | | | |
| 14 | No data | | | | Hotel | 465 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 15 | 2002 | | | | Museum | 1,394 | ✓ | ✓ | | | | | |
| 16 | 2008 | | | | Restaurant | 557 | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| 17 | In 19th century | | | | Religion | 1,100 | | | ✓ | | | | |
| 18 | 2000 | | | | Factory | 279 | ✓ | ✓ | ✓ | | | | |
| 19 | Under const. | ✓ | | | | 120,818 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 20 | 2010 | ✓ | ✓ | | | 335 | | ✓ | ✓ | ✓ | ✓ | ✓ | |

Legend: 'H' stands for Housing, 'O' stands for Office and C stands for Commercial on the column of Usage respectively.
'A' stands for Air-conditioner, 'F' stands for Fan, 'V' stands for Ventilation, 'H' stands for Hot water, 'E' stands for Elevator and 'G' stands for Generator on the column of Energy Type respectively.
Source: Prepared by JICA Survey Team based on field survey.

Table 2.1- 11 Energy usage in buildings in Lahore

| No. | Completion | Usage | | | | Floor area | Energy usage | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | H | O | C | Other | | A | F | V | H | E | G | Other |
| 1 | 2015 | | ✓ | ✓ | | 21,375 | ✓ | ✓ | | ✓ | ✓ | ✓ | |
| 2 | 2015 | | | ✓ | | 1,301 | ✓ | ✓ | | | | | |
| 3 | 1984 | | | | Library | 646 | ✓ | ✓ | ✓ | | | | |
| 4 | 1992 | | | | Religion | 25,095 | ✓ | | | | | ✓ | |
| 5 | 1930 | | | | Educational | 1,858 | ✓ | | | | | ✓ | |
| 6 | No data | | | | Educational | 792 | ✓ | ✓ | ✓ | | ✓ | ✓ | |
| 7 | 2000 | | | | Hotel | 834 | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| 8 | 2002 | | | | Religion | 2,091 | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| 9 | 2010 | | | | Restaurant | 836 | ✓ | ✓ | ✓ | | | ✓ | |
| 10 | 1996 | | | | Restaurant | 1,020 | ✓ | ✓ | | ✓ | | ✓ | |
| 11 | 1998 | | | | Hospital | No data | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 12 | 1970 | | | | Hospital | 4,377 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 13 | 1996 | | | | Hotel | 6,120 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 14 | No data | | | | Hotel | 874 | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| 15 | 2005 | | ✓ | | | 2,825 | ✓ | ✓ | ✓ | | | ✓ | |
| 16 | 2014 | | ✓ | | | 1,450 | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| 17 | 2014 | | | | Factory | 1,115 | | ✓ | | | | | |
| 18 | 2013 | | | | Factory | 1,061 | ✓ | ✓ | ✓ | | | ✓ | |
| 19 | 1978 | ✓ | | | | 1,041 | ✓ | ✓ | ✓ | ✓ | | | |
| 20 | 2015 | ✓ | | | | 464 | ✓ | ✓ | ✓ | ✓ | | | UPS |

Legend: 'H' stands for Housing, 'O' stands for Office and C stands for Commercial on the column of Usage respectively.
'A' stands for Air-conditioner, 'F' stands for Fan, 'V' stands for Ventilation, 'H' stands for Hot water, 'E' stands for Elevator and 'G' stands for Generator on the column of Energy Type respectively.
Source: Prepared by JICA Survey Team based on field survey.

Table 2.1- 12 Energy usage in buildings in Karachi

| No. | Completion | Usage | | | | Floor area | Energy usage | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | H | O | C | Other | | A | F | V | H | E | G | Other |
| 1 | 2006 | | | ✓ | | 22 | ✓ | ✓ | ✓ | ✓ | | | |
| 2 | 1995 | | | ✓ | | 205 | ✓ | ✓ | ✓ | | | ✓ | |
| 3 | 2006 | | | | Education | 12082 | ✓ | ✓ | ✓ | | | ✓ | |
| 4 | 2000 | | | | Education | 3695 | ✓ | | ✓ | | | | |
| 5 | 1981 | | | | Restaurant | 793 | ✓ | ✓ | | ✓ | ✓ | ✓ | |
| 6 | 1992 | | | | Restaurant | 1505 | ✓ | ✓ | | | | ✓ | |
| 7 | 1956 | | | | Hospital | 2657 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 8 | 2005 | | | | Hospital | 4000 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 9 | 1985 | | | | Hotel | 502 | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| 10 | 2012 | | | | Hotel | 1003 | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| 11 | 1980 | | ✓ | | | 465 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 12 | 1980 | | ✓ | | | 12082 | ✓ | ✓ | | | | ✓ | |
| 13 | 1980 | | | | Factory | 266 | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| 14 | 2005 | | | | Factory | 465 | ✓ | ✓ | ✓ | ✓ | | ✓ | |
| 15 | 2015 | ✓ | | | | 1394 | ✓ | ✓ | ✓ | ✓ | | | |
| 16 | 1990 | ✓ | | | | 557 | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| 17 | 1890 | | | | Cultural | 1100 | ✓ | | | | | | |
| 18 | 1950 | | | | Cultural | 279 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| 19 | 1989 | | | | Education | 120818 | ✓ | | ✓ | | | | |
| 20 | 1992 | | | | Hotel | 335 | ✓ | ✓ | ✓ | ✓ | | ✓ | |

Legend: 'H' stands for Housing, 'O' stands for Office and C stands for Commercial on the column of Usage respectively.
'A' stands for Air-conditioner, 'F' stands for Fan, 'V' stands for Ventilation, 'H' stands for Hot water, 'E' stands for Elevator and 'G' stands for Generator on the column of Energy Type respectively.
Source: Prepared by JICA Survey Team based on field survey.

(2) Energy type

The energy types for 60 building samples in Islamabad/Rawalpindi, Lahore and Karachi are shown in Tables 2.1-13, 2.1-14 and 2.1-15. In the field survey result, almost none of the buildings use oil as an energy source, although some use natural gas as an energy source for hot water and generators. In other buildings, hot water is supplied by electrical hot water equipment.

Table 2.1- 13 Energy type in buildings in Islamabad/Rawalpindi

| No. | Completion | Usage | | | | Floor area | Energy type | | | Usage for Fossil |
|---|---|---|---|---|---|---|---|---|---|---|
| | | H | O | C | Other | | E | G | O | |
| 1 | 2011 | | | ✓ | | 22 | ✓ | | | |
| 2 | No data | | | ✓ | | 205 | ✓ | | | |
| 3 | 70% complete | | | | Hospital | 12,082 | ✓ | ✓ | | Hot water, Generator |
| 4 | Under const. | ✓ | | ✓ | | 3,695 | ✓ | ✓ | | Hot water |
| 5 | Under const. | | | ✓ | | 793 | ✓ | ✓ | | Hot water |
| 6 | 2000 | ✓ | | | | 1,505 | ✓ | ✓ | | Hot water, Generator |
| 7 | 1985 | | ✓ | ✓ | | 2,657 | ✓ | | | |
| 8 | 2015 | | ✓ | | Hospital | 4,000 | ✓ | ✓ | | Hot water, Generator |
| 9 | No data | | ✓ | | | 502 | ✓ | ✓ | | Hot water, Generator |
| 10 | 2008 | | | ✓ | | 1,003 | ✓ | ✓ | | Hot water, Generator |
| 11 | 1984 | | | ✓ | | 465 | ✓ | ✓ | | Hot water, Generator |
| 12 | 2011 | | | | Hospital | 12,082 | | | | |
| 13 | No data | | | | Educational | 266 | ✓ | | | |
| 14 | No data | | | | Hotel | 465 | ✓ | ✓ | | Hot water, Generator |
| 15 | 2002 | | | | Museum | 1,394 | ✓ | | | |
| 16 | 2008 | | | | Restaurant | 557 | ✓ | ✓ | | Generator? |
| 17 | In 19th century | | | | Religion | 1,100 | ✓ | | | |
| 18 | 2000 | | | | Factory | 279 | ✓ | | | |
| 19 | Under const. | ✓ | | | | 120,818 | ✓ | ✓ | | Hot water |
| 20 | 2010 | ✓ | ✓ | | | 335 | ✓ | ✓ | | Hot water, Generator |

Legend: 'H' is abbreviation of Housing, 'O' is abbreviation of Office, and C is abbreviation of Commercial on the column of Usage respectively. 'E' is abbreviation of Electric Power, 'G' is abbreviation of Gas, and 'O' is abbreviation of Oil on the column of Energy Type respectively.
Source: Prepared by JICA Survey Team based on field survey.

Table 2.1-14 Energy type in buildings in Lahore

| No. | Completion | Usage | | | | Floor area | Energy type | | | Usage for Fossil |
|---|---|---|---|---|---|---|---|---|---|---|
| | | H | O | C | Other | | E | G | O | |
| 1 | 2015 | | ✓ | ✓ | | 21,375 | ✓ | ✓ | | Generator |
| 2 | 2015 | | | ✓ | | 1,301 | ✓ | | | |
| 3 | 1984 | | | | Library | 646 | ✓ | | | |
| 4 | 1992 | | | | Religion | 25,095 | ✓ | ✓ | | Generator |
| 5 | 1930 | | | | Educational | 1,858 | ✓ | ✓ | | Generator |
| 6 | No data | | | | Educational | 792 | ✓ | ✓ | | Generator |
| 7 | 2000 | | | | Hotel | 834 | ✓ | ✓ | | Hot water, Generator |
| 8 | 2002 | | | | Religion | 2,091 | ✓ | ✓ | | Hot water, Generator |
| 9 | 2010 | | | | Restaurant | 836 | ✓ | ✓ | | Generator |
| 10 | 1996 | | | | Restaurant | 1,020 | ✓ | ✓ | | Hot water, Generator |
| 11 | 1998 | | | | Hospital | No data | ✓ | ✓ | | Hot water, Generator |
| 12 | 1970 | | | | Hospital | 4,377 | ✓ | ✓ | | Hot water, Generator |
| 13 | 1996 | | | | Hotel | 6,120 | ✓ | ✓ | | Generator |
| 14 | No data | | | | Hotel | 874 | ✓ | ✓ | | Hot water, Generator |
| 15 | 2005 | | ✓ | | | 2,825 | ✓ | ✓ | | Hot water, Generator |
| 16 | 2014 | | ✓ | | | 1,450 | ✓ | ✓ | | Hot water, Generator |
| 17 | 2014 | | | | Factory | 1,115 | ✓ | | | |
| 18 | 2013 | | | | Factory | 1,061 | ✓ | ✓ | | Generator |
| 19 | 1978 | ✓ | | | | 1,041 | ✓ | ✓ | | Hot water |
| 20 | 2015 | ✓ | | | | 464 | ✓ | ✓ | | Hot water |

Legend: 'H' is abbreviation of Housing, 'O' is abbreviation of Office, and C is abbreviation of Commercial on the column of Usage respectively.
'E' is abbreviation of Electric Power, 'G' is abbreviation of Gas, and 'O' is abbreviation of Oil on the column of Energy Type respectively.
Source: Prepared by JICA Survey Team based on field survey.

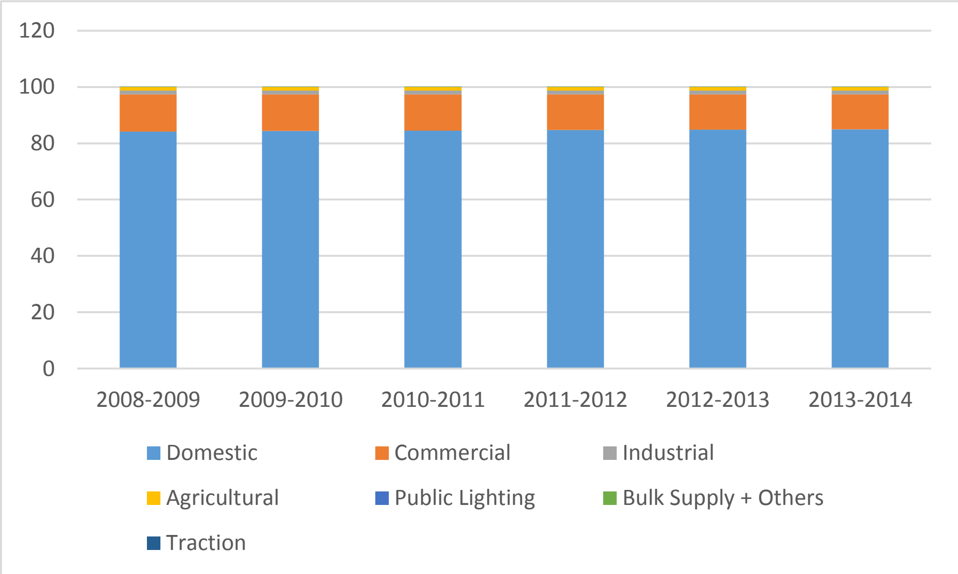
Table 2.1- 15 Energy type in buildings in Karachi

| No. | Completion | Usage | | | | Floor area | Energy type | | | Usage for Fossil |
|---|---|---|---|---|---|---|---|---|---|---|
| | | H | O | C | Other | | E | G | O | |
| 1 | 2006 | | | ✓ | | 22 | ✓ | ✓ | | Hot water |
| 2 | 1995 | | | ✓ | | 205 | ✓ | ✓ | | Generator |
| 3 | 2006 | | | | Education | 12082 | ✓ | ✓ | | Generator |
| 4 | 2000 | | | | Education | 3695 | ✓ | | | |
| 5 | 1981 | | | | Restaurant | 793 | ✓ | ✓ | | Hot water, Generator |
| 6 | 1992 | | | | Restaurant | 1505 | ✓ | ✓ | | Generator |
| 7 | 1956 | | | | Hospital | 2657 | ✓ | ✓ | | Hot water, Generator |
| 8 | 2005 | | | | Hospital | 4000 | ✓ | ✓ | | Hot water, Generator |
| 9 | 1985 | | | | Hotel | 502 | ✓ | ✓ | | Hot water, Generator |
| 10 | 2012 | | | | Hotel | 1003 | ✓ | ✓ | | Hot water, Generator |
| 11 | 1980 | | ✓ | | | 465 | ✓ | ✓ | | Hot water, Generator |
| 12 | 1980 | | ✓ | | | 12082 | ✓ | ✓ | | Generator |
| 13 | 1980 | | | | Factory | 266 | ✓ | ✓ | | Hot water, Generator |
| 14 | 2005 | | | | Factory | 465 | ✓ | ✓ | | Hot water, Generator |
| 15 | 2015 | ✓ | | | | 1394 | ✓ | ✓ | | Hot water |
| 16 | 1990 | ✓ | | | | 557 | ✓ | ✓ | | Hot water |
| 17 | 1890 | | | | Cultural | 1100 | ✓ | | | |
| 18 | 1950 | | | | Cultural | 279 | ✓ | ✓ | | Hot water, Generator |
| 19 | 1989 | | | | Education | 120818 | ✓ | | | |
| 20 | 1992 | | | | Hotel | 335 | ✓ | ✓ | | Hot water, Generator |

Legend: 'H' is abbreviation of Housing, 'O' is abbreviation of Office, and C is abbreviation of Commercial on the column of Usage respectively.
'E' is abbreviation of Electric Power, 'G' is abbreviation of Gas, and 'O' is abbreviation of Oil on the column of Energy Type respectively.
Source: Prepared by JICA Survey Team based on field survey.

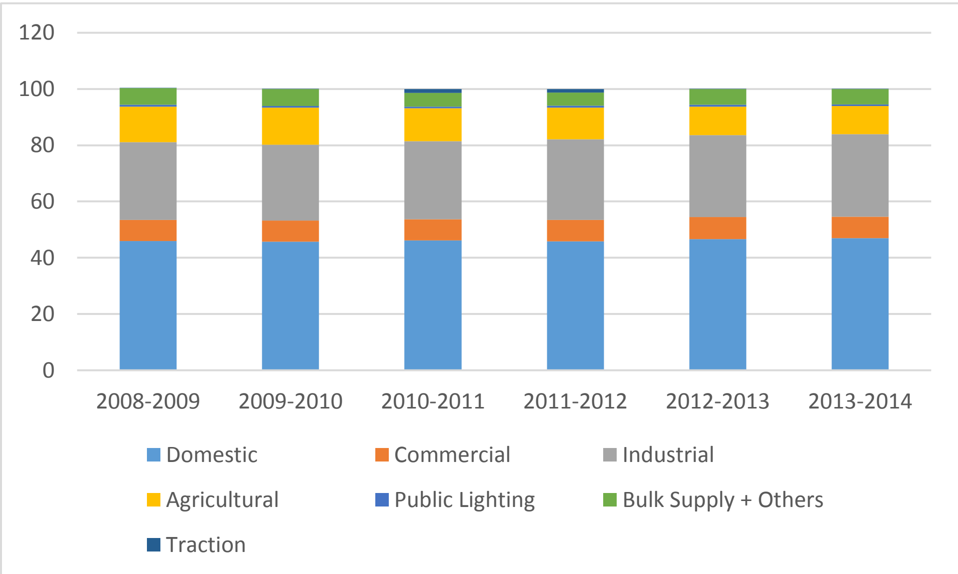
(3) Electrical consumption

According to the 'State of Industry Report 2014', issued by the National Electrical power Regulatory Authority, category-wise Consumers and category-wise Electricity Consumption in Pakistan in percentage form are as shown in Figures 2.1-1 and 2.1-2, including categories of Domestic, Commercial, Industry, Agricultural, Public Lighting and Bulk Supply + Others. Domestic consumers comprise 85%, followed by commercial consumers and collectively, these two categories comprise 95% of all consumers. In terms of electricity consumption, 45% is domestic, 25% industry and 7% commercial.




Source: Prepared by JST based on State of Industry Report 2013, NEPRA and State of Industry Report 2014, NEPRA.

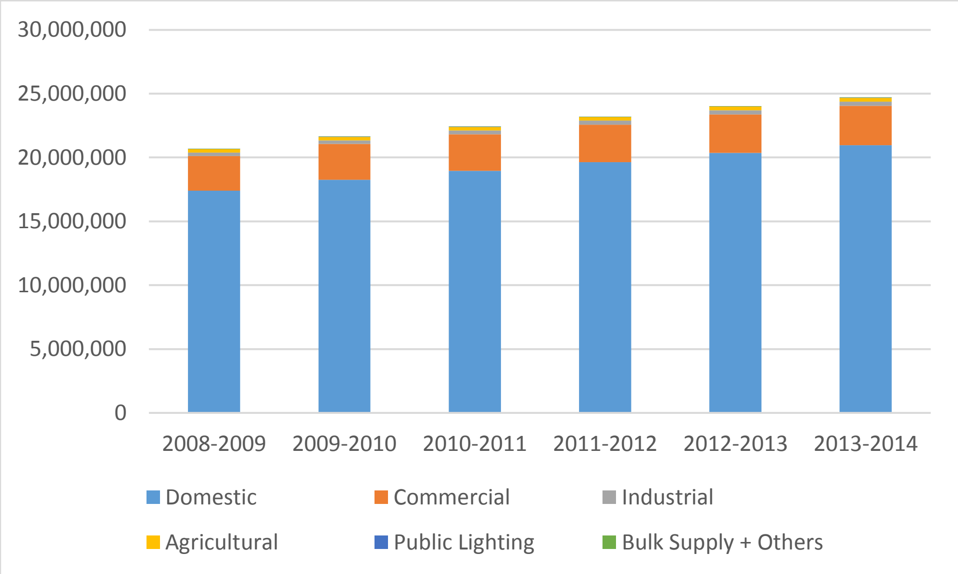
Figure 2.1-1 Category-wise Consumers in entire Pakistan (Unit: %)




Source: Prepared by JST based on State of Industry Report 2013, NEPRA and State of Industry Report 2014, NEPRA.

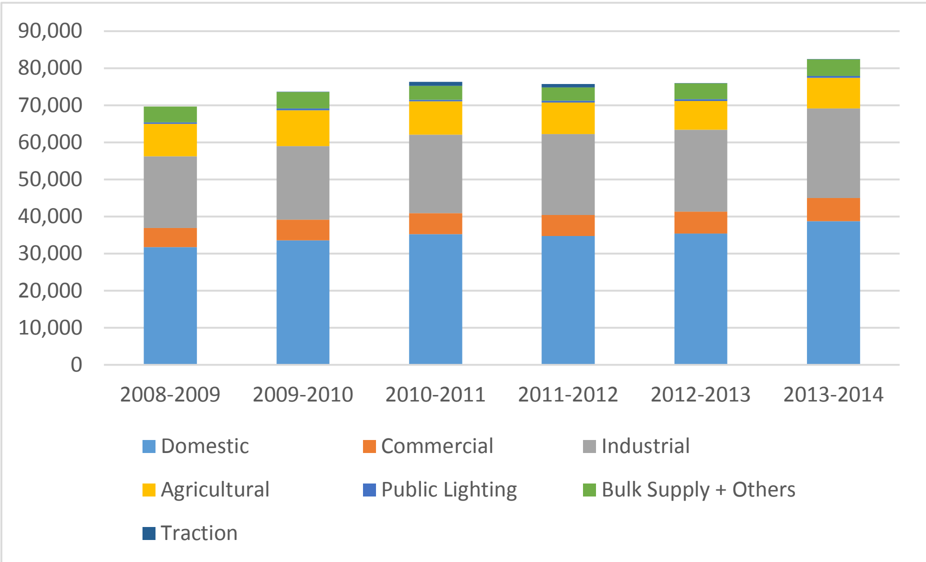
Figure 2.1-2 Category-wise Electricity Consumption in entire Pakistan (Unit: %)

Trends in terms of total consumers and total electricity consumption in Pakistan are shown in Figures 2.1-3 and 2.1-4, with the number of consumers increasing by almost 5,000,000 over the six years from 2009 to 2014, while the electricity consumption rose 1.2 fold during the same period.




Source: Prepared by JST based on State of Industry Report 2013, NEPRA and State of Industry Report 2014, NEPRA.

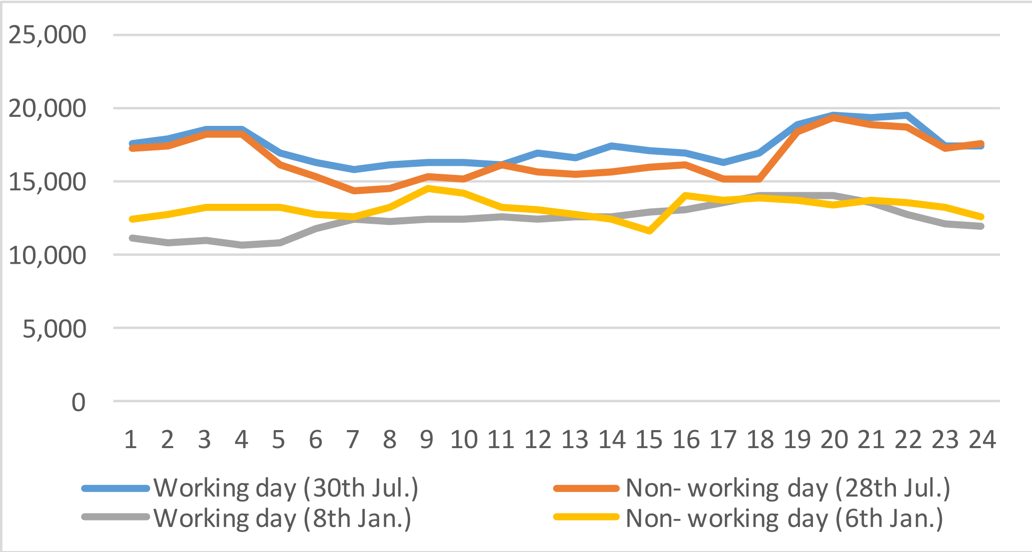
Figure 2.1-3 Trend of number of Consumer in entire Pakistan (Unit: Nos.)




Source: Prepared by JST based on State of Industry Report 2013, NEPRA and State of Industry Report 2014, NEPRA.

Figure 2.1-4 Trend of amount of Electricity Consumption in entire Pakistan (Unit: GWh)

Figure 2.1-5 indicates load curves of typical days in summer and winter. Demand increases in summer; peaking between 5-9 PM, namely not during workplace activities but during those at home. This data shows that most electricity demand seems to come from households. There is no obvious difference between demand curves on working day and demand curves in non-working day.




Source: Prepared by JICA Survey Team based on State of Industry Report 2014, NEPRA.

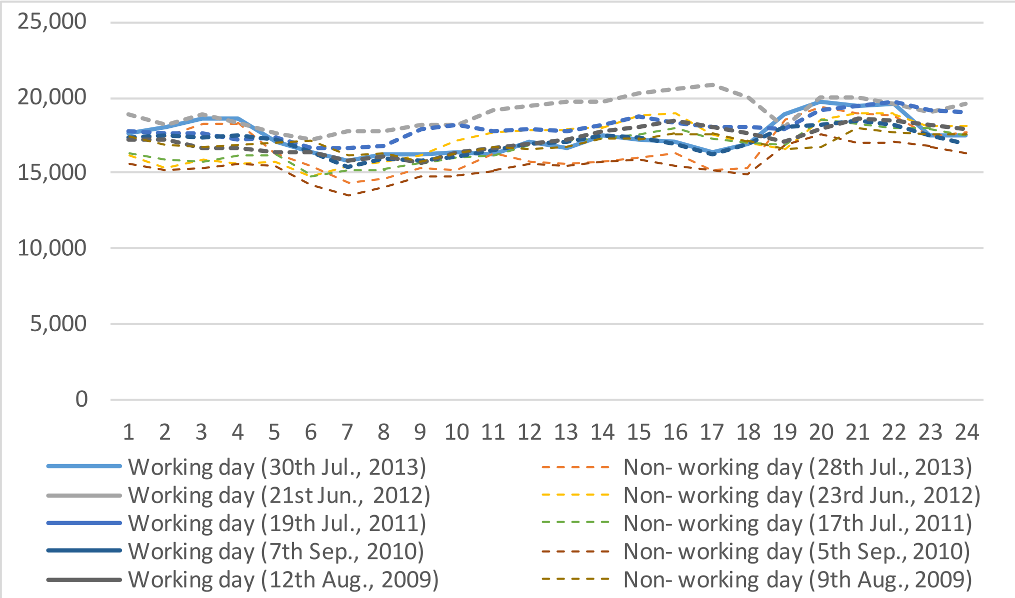
Figure 2.1-5 Demand for a typical day in summer and winter in 2013 in Pakistan (Unit: MW)

According to IESCO, in the IESCO supply area (Islamabad, Rawalpindi, Attok, Jhelum, Chakwal), the following observation was made. In summer season, peak time is from 05:00 to 11:00 p.m. and the difference between summer and winter is due to people using air-conditioners or fans in summer. The consumption of electricity remains high until 03:00 a.m. due to people using air-conditioners and fans while asleep. During winter, the peak time is also from 05:00 to 09:00 p.m. due to use of lighting, whereas in summer, usage among Lifeline Consumers[2] decreases due to more electricity consumption by fan usage. Similarly, in winter, the number of lifeline consumers increases because no heating is required in most of Pakistan. The lifeline consumer only uses one or two bulbs and one fan and natural gas or wood for the kitchen.

According to LESCO, in the LESCO supply area (Lahore, Sheikhupura, Kasur, Okara, Namkana), peak time is observed similar to the IESCO area. LESCO mentioned that the one of the major devices for energy consumption in a household could be a motor used to pump up to a rooftop water tank. Industrial connections consume 40 to 42% of LESCO energy and comprise approximately 2% of its contracts. LESCO receives 40 to 45% of its revenue from the industrial sector.

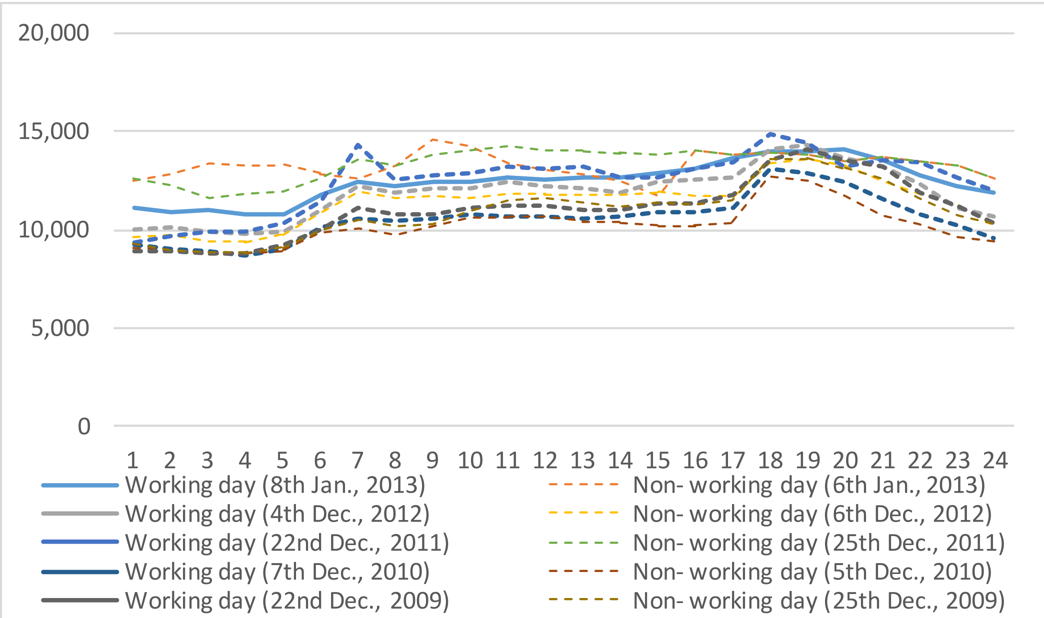
Figures 2.1-6 and 2.1-7 indicate the demand on a typical day in summer and winter over the latest five years respectively. In Pakistan, no obvious difference emerges between working and non-working days.

[2] Definition of Lifeline Consumer by DISCO is the group consumes electricity 50kWh or less per month.




Source: Prepared by JICA Survey Team based on State of Industry Report 2014, NEPRA.

Figure 2.1-6 Demand for a typical day in summer in Pakistan (Unit: MW)




Source: Prepared by JICA Survey Team based on State of Industry Report 2014, NEPRA.

Figure 2.1-7 Demand for a typical day in winter in Pakistan (Unit: MW)

According to LESCO, in the LESCO supply area, people are stealing electricity and/or using it without paying. It went on to state that reported theft cases in the year 2014-2015 comprised approximately 1% of all electricity sold, namely about 1.5 mil units. 90,000 consumers were guilty of using electricity by theft.

(4) Electrical consumption in households

As mentioned above, electrical power consumption in the household sector comprises almost half the entire electric consumption in Pakistan. According to the House Building Finance Company Limited ( here after referred HBFCL), households can be divided into four categories, i.e. low-income, low-middle-income, middle-income and high-income.

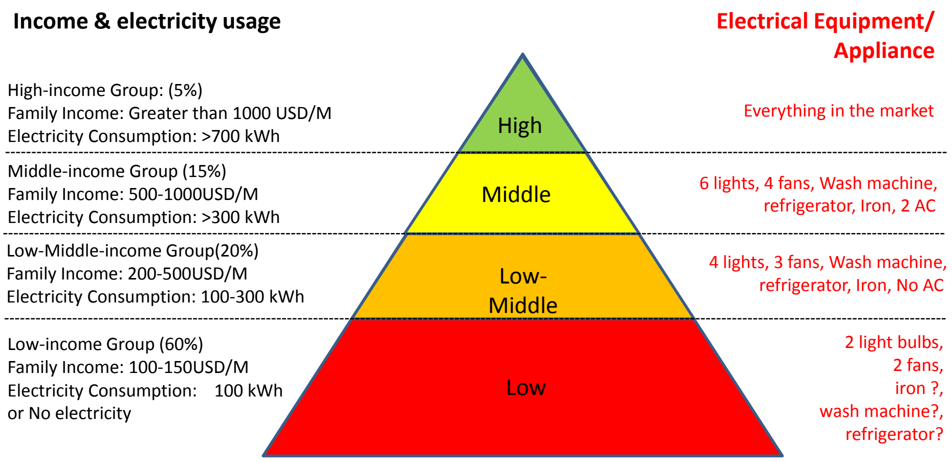
The low-income group comprises almost 60% of all households and their family income is 100 to 150 USD per month. The typical electrical appliances for households in this category are just two lights and two fans, although some households may also have an iron, washing machine and refrigerator. The electrical power consumption in households in this category tends to be 100 kWh or less per month.

The low-middle-income group comprises almost 20% of all households and their family income is 200 to 500 USD per month. Typical electrical appliances for households in this category are four lights, three fans, an iron, washing machine and refrigerator. However, almost no households in this category have an air-conditioner. The electrical power consumption for households in this category tends to be 80 to 150 kWh per month.

The middle-income group comprises almost 15% of all households, with a family income of 500 to 1000 USD per month. Typical electrical appliances for households in this category are six lights, four fans, an iron, washing machine, refrigerator and two air-conditioners. The electrical power consumption for households in this category tends to be 120 to 250 kWh per month.

The high-income group comprises almost 5% of all households and their family income exceeds 1000 USD per month. Typical electrical appliances for households in this category are the same as the middle income group or more. Electrical power consumption for households in this category tends to exceed 250 kWh per month.

The categorization of households by income is illustrated in Figure below.




Source: Prepared by JICA Survey Team based on interview from House Building Finance Company Limited.

Figure 2.1-8 Image of categorization of households by income

### 2.1.3 Socioeconomic Situation index regarding Building Construction

(1) Trend of building construction and relation to the socioeconomic situation

1) Population

According to a census in November 2013, Pakistan has the 6th largest global population. Pakistan comprises four Provinces (Punjab, Sindh, Khyber Pakhtunkhwa and Balochistan) and two Federal Administration Areas (FATA, Islamabad Capital territory). The population in 2005 and from 2010 to 2015 is shown in Table below.

Table 2.1- 16 Population by region in 2005 and from 2010 to 2015

(Unit: Million persons, %)

| Region | 2005 | | 2010 | | 2011 | | 2012 | | 2013 | | 2014 | | 2015 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Punjab Prov. | 85.8 | 55.1 | 94.7 | 54.6 | 96.5 | 54.4 | 98.3 | 54.4 | 100.2 | 54.3 | 102.0 | 54.25 | 103.8 | 54.16 |
| Sindh Prov. | 36.8 | 23.5 | 41.2 | 23.8 | 42.2 | 23.8 | 43.1 | 13.4 | 44.0 | 13.4 | 45.0 | 23.95 | 46.0 | 23.98 |
| Khyber Pakhtunkhwa Prov. | 20.8 | 13.4 | 23.3 | 13.4 | 23.8 | 13.4 | 24.3 | 23.4 | 24.8 | 13.4 | 25.3 | 13.46 | 25.8 | 13.47 |
| Balochistan Prov. | 7.8 | 5.0 | 8.9 | 5.1 | 9.1 | 5.1 | 9.3 | 5.1 | 9.5 | 5.2 | 9.7 | 5.17 | 10.0 | 5.18 |
| FATA | 3.7 | 2.3 | 4.1 | 2.4 | 4.2 | 2.4 | 4.3 | 2.4 | 4.4 | 2.4 | 4.5 | 2.4 | 4.6 | 2.41 |
| Islamabad Capital territory | 1.1 | 0.7 | 1.3 | 0.7 | 1.3 | 0.7 | 1.4 | 0.8 | 1.4 | 0.8 | 1.5 | 0.77 | 1.5 | 0.77 |
| TOTAL | 156.0 | 100.0 | 173.5 | 100.0 | 177.1 | 100.0 | 180.7 | 100.0 | 184.3 | 100.0 | 188.0 | 100.0 | 191.7 | 100.0 |

FATA; Federally Administered Tribal Areas

Source: PAKISTAN ECONOMIC SURVEY 2012-13 version and 2014-15 version, Webpage of Ministry of Finance

2) Housing Backlog

The housing backlog caused by the gap in housing supply and demand was 4.3 million in 1998, but now become 9.0 million. 30-40 % of housing demand is addressed by mainstream developers catering to the high-end market, while the remaining units fall into the low-income category. The current low-income housing deficit within Pakistan is 4.5 million units with an additional 150,000 units per annum.

In 1998, there were 19.3 million households in Pakistan, with an average of 6.8 persons and occupancy at 3.3 persons per room. The overall housing stock comprised 39% shacks (kucha houses mostly without a proper water supply), 40% semi-permanent (semi-pucca houses mostly without planned sanitation or sewerage system) and 21% permanent (pucca) houses.

As against the current incremental demand for housing, estimated at 600,000 units annually, only about 370,000 units are being built annually, mostly in urban areas. The most fundamental challenge of rapid urbanization in Pakistan is the development of katchi abadis[3] due to the lack of affordable housing for the low-income population in major urban areas. About half the urban population lives in slums and Katchi abadis, with inadequate housing and living conditions.

To overcome this problem, the Government of Pakistan has taken initiatives to construct low-cost housing, i.e. the Prime Minister's Program; Apna Ghar Scheme in Punjab; Behan Benazir Basti (Benazir Housing Program) and Shaheed Benazir Bhutto Housing Scheme in Sindh; and similar programs in other parts of the country. The government has also approved National Policy on Katchi Abadi, Urban Renewal and Slum Upgrading.

3) Urbanization

The urban population comprises approximately 40% of the entire population in Pakistan and 75 cities currently have a population of between 0.1 and one million. There are also around 448 smaller towns with a population of less than 100,000. Within the population scenario, the large cities dominate the urban scene.

The population of major cities in Pakistan is shown in Table 2.1-17. Karachi, the largest city in Pakistan and seventh largest city in the world has about 20% of the total urban population, followed by Lahore and Faisalabad with another 15%. Rawalpindi, Multan, Hyderabad, Gujranwala and Peshawar together hold another 12%, while about half the remaining 46% of the urban population lives in relatively small towns and cities. The population in most large cities grew at a rate of over 3% per year, in recent years and this growth rate is forecast to continue for the current decade.

[3] Ramshackle neighbourhoods which can be found in all cities. In such unplanned and unregulated areas, safe drinking water and proper sanitation are rare.

Table 2.1-17 Population of major cities of Pakistan in 1981, 1998 and 2010

(Unit: persons)

| Cities | 1981 | 1998 | 2010 |
|---|---|---|---|
| Karachi | 5,208,132 | 9,339,023 | 13,386,730 |
| Lahore | 2,952,689 | 5,143,495 | 7,214,954 |
| Faisalabad | 1,104,209 | 2,008,861 | 2,912,269 |
| Rawalpindi | 794,834 | 1,409,768 | 2,013,876 |
| Multan | 732,070 | 1,197,384 | 1,610,180 |
| Hyderabad | 751,529 | 1,166,894 | 1,521,231 |
| Gujranwala | 600,993 | 1,132,509 | 1,676,357 |
| Peshawar | 566,248 | 982,816 | 1,386,529 |
| Quetta | 285,719 | 565,137 | 871,643 |
| Islamabad | 204,364 | 529,180 | 972,669 |
| Total | 13,200,787 | 23,475,067 | 33,566,438 |

Source:

4) GDP

The sectoral GDP in Pakistan from 2005/06 to 2014/15 is shown in Table below. The construction sector comprised 2.4% of Pakistan GDP in the last Fiscal Year.

Table 2.1- 18 Sectoral GDP in Pakistan from 2005/06 to 2014/15

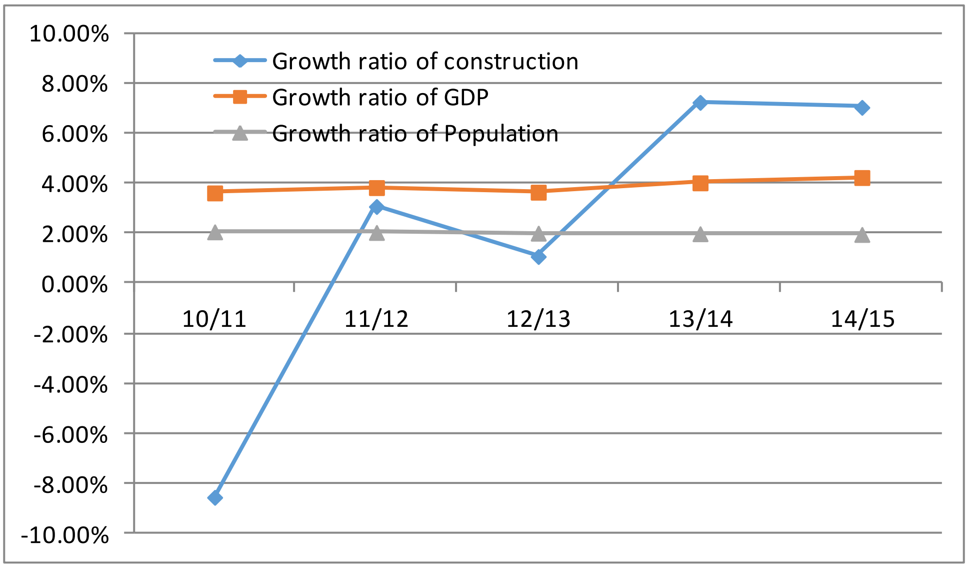
(Unit: PKR in Million)

| Sectors | 2005 / 06 | 2006 / 07 | 2007 / 08 | 2008 / 09 | 2009 / 10 | 2010 / 11 | 2011 / 12 | 2012 / 13 | 2013 / 14 | 2014 / 15 |
|---|---|---|---|---|---|---|---|---|---|---|
| **A Agriculture** | 1,775,346 | 1,836,125 | 1,869,310 | 1,934,691 | 1,939,132 | 1,977,178 | 2,048,794 | 2,103,600 | 2,160,223 | 2,222,337 |
| **B Industrial Sector** | 1,616,157 | 1,741,085 | 1,888,600 | 1,790,263 | 1,851,564 | 1,935,022 | 1,984,316 | 1,996,364 | 2,085,276 | 2,160,685 |
| Mining & Quarrying | 254,345 | 273,032 | 281,635 | 274,710 | 282,269 | 269,798 | 283,727 | 294,727 | 299,588 | 311,095 |
| Manufacturing | 1,065,323 | 1,161,551 | 1,232,430 | 1,180,964 | 1,197,163 | 1,227,091 | 1,252,670 | 1,310,522 | 1,369,003 | 1,412,453 |
| - Large-scale | *903,323* | *989,896* | *1,050,276* | *986,887* | *990,928* | *1,007,331* | *1,018,706* | *1,061,342* | *1,061,342* | 1,129,994 |
| - Small scale | *89,116* | *96,470* | *104,519* | *113,474* | *123,083* | *133,556* | *144,713* | *156,691* | *169,676* | 183,654 |
| - Slaughtering | *72,884* | *75,185* | *77,635* | *80,603* | *83,152* | *86,204* | *89,251* | *92,489* | *95,632* | 98,805 |
| Electricity Generation & Distribution & Gas Distribution | 110,109 | 96,066 | 131,767 | 115,812 | 135,098 | 221,379 | 224,490 | 165,275 | 174,482 | 177,866 |
| Construction | 186,380 | 210,436 | 242,768 | 218,777 | 237,034 | 216,754 | 223,429 | 225,840 | 242,203 | 259,271 |
| **C Services Sector** | 4,324,274 | 4,565,759 | 4,791,238 | 4,855,033 | 5,010,698 | 5,208,136 | 5,437,145 | 5,716,248 | 5,965,957 | 6,261,314 |
| Wholesale & Retail Trade | 1,523,067 | 1,612,086 | 1,703,741 | 1,652,874 | 1,682,465 | 1,718,014 | 1,746,511 | 1,808,124 | 1,880,004 | 1,943,499 |
| Transport, Storage & Communication | 959,499 | 1,025,694 | 1,082,452 | 1,136,990 | 1,170,612 | 1,198,896 | 1,254,126 | 1,304,697 | 1,364,255 | 1,421,737 |
| Finance & Insurance | 282,919 | 308,673 | 328,071 | 296,427 | 286,775 | 274,674 | 279,171 | 302,392 | 315,032 | 334,513 |
| Housing Services | 504,743 | 524,929 | 545,950 | 567,941 | 590,718 | 614,460 | 639,003 | 664,542 | 691,091 | 718,704 |
| General Government Services | 425,218 | 436,848 | 437,742 | 462,193 | 499,038 | 569,191 | 632,130 | 703,717 | 723,823 | 792,180 |
| Other Private Services | 628,828 | 657,529 | 693,282 | 738,608 | 781,089 | 832,901 | 886,204 | 932,776 | 991,752 | 1,050,681 |
| **GDP** | 7,715,777 | 8,142,969 | 8,549,148 | 9,120,336 | 8,801,394 | 9,120,336 | 9,470,255 | 9,816,212 | 10,211,456 | 10,644,336 |

Source: PAKISTAN ECONOMIC SURVEY 2012-13 version and 2014-15 version, Webpage of Ministry of Finance

5) Trend of growth rate

The trend of the growth ratio of construction sector and GDP in Pakistan is shown in Figure 2.1-9. In recent years, the GNP of Pakistan has been growing at approximately 4% annually, while its population of Pakistan has been growing at approximately 2% annually. There is a correlation between the GDP and population growth ratios, but little correlation between the growth ratio of the construction sector and the growth ratio of GDP.




Source: Prepared by JICA Survey Team based on Pakistan Economic Survey 2012-13 version and 2014-15 version, Ministry of Finance

Figure 2.1-9 Trend of Growth ratio of construction sector, GDP and population

(2) Future prediction

1) Population

It is estimated that the population of Pakistan will exceed 240 million in 2030. The actual and forecast population levels in Pakistan from 1998 to 2030 are shown in Table below.

Table 2.1- 19 Actual and forecast Population in Pakistan from 1998 to 2030

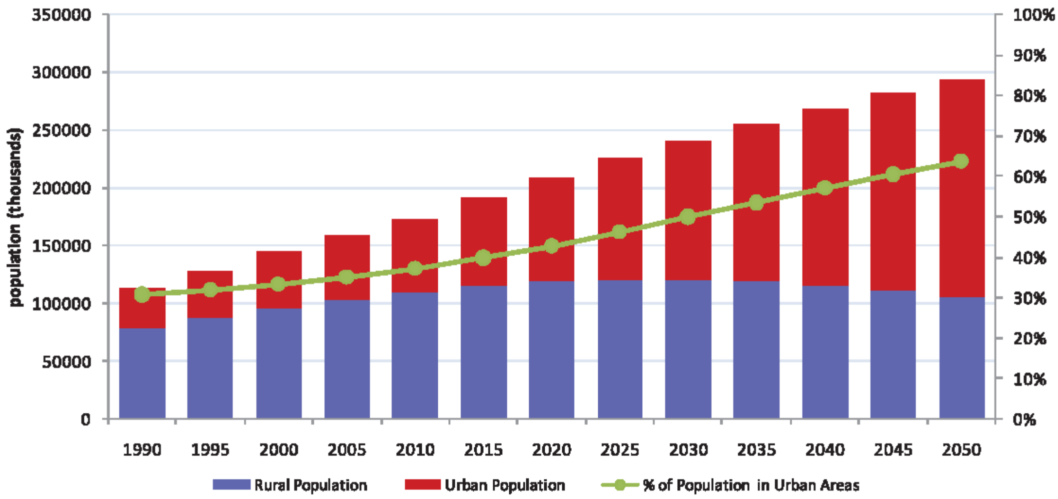
(Unit: Million persons)

| | 1998 | 2000 | 2005 | 2010 | 2011 | 2012 | 2013 | 2015 | 2020 | 2025 | 2030 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MOF source | 132.43 | - | - | - | 177.03 | 180.71 | 184.35 | 191.71 | 210.12 | 227.26 | 242.06 |
| UN source | - | 143.83 | 157.97 | 173.15 | - | - | - | 188.14 | 203.35 | - | - |

Source: Pakistan market and market development, JETRO

2) Urbanization

Urbanization in Pakistan will continue to increase and the urban population of Pakistan will constitute 50% of the total in a decade. The urbanization trend from 1990 to 2050 is shown in Figure below.




Source: National Report of Pakistan For HABITAT III

Figure 2.1-10 Urbanization Trend from 1990 to 2050

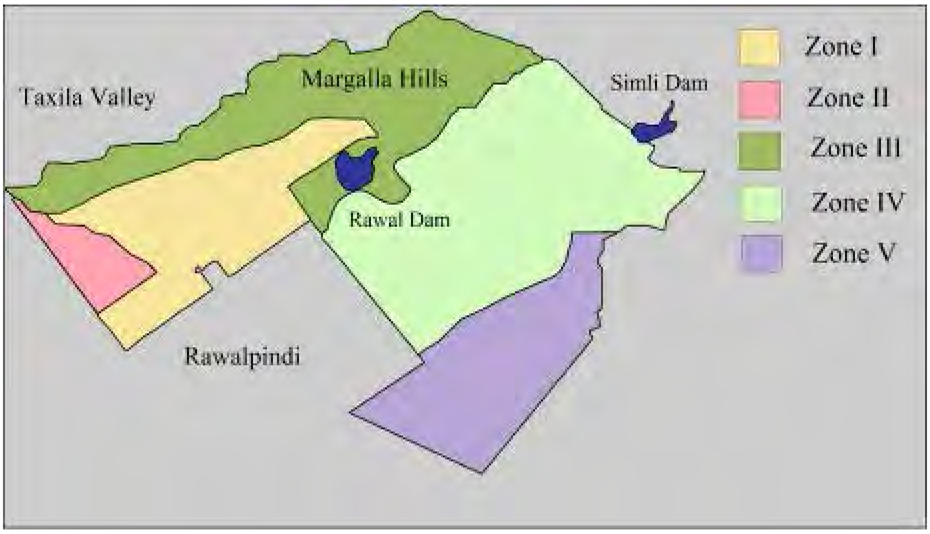
### 2.1.4 Urban Development, Estate Development and Relevant Market

Urban Development is controlled by the relevant Development Authorities. In Islamabad, for example, five zones are designated to control area usage under the Islamabad Capital Territory (ICT) Regulation 1992. Two of the five zones, i.e. -2 and -5, have been earmarked for developing Housing Schemes by the Private Sector i.e. Cooperative Housing Societies/Private Limited Companies. Such private schemes are also allowed under Sector E-11, Islamabad. ICT (Zoning) Regulation 1992 and the Modalities and Procedures framed thereunder to develop private housing schemes empowers CDA to regulate Planning and Development of Private Housing Schemes in Zones -2 and -5 of the ICT.

Table 2.1- 20 Islamabad Zoning and area

| Area | Usage of Land | Square |
|---|---|---|
| Zone I | Developed residential sectors | 222km² |
| Zone II | Under-developed residential sectors | 40 km² |
| Zone III | The Margalla Hills and Margalla Hills National Park. Rawal Lake | 204km² |
| Zone IV | Islamabad Park, and rural areas of the city | 282km² |
| Zone V | Under-developed residential sectors | 158km² |

Source: CDA web site




Source: CDA web site

Figure 2.1-11 Islamabad Zoning

As a reference, the urban planning regulated by CDA and RDA around Zone V is shown in table below. In CDA regulation, residential plot ratio is 86% and remaining 14% is for commercial and public buildings in buildable plot. This ratio is approximately same as the ratio of electrical contract number for domestic and commercial in Pakistan.

Table 2.1-21 Urban planning by CDA and RDA in Zorn V area.

| Land usage | CDA | RDA |
|---|---|---|
| Residential | Not more than 55% (86%) | Not more than 65% (94%) |
| Open/ Green Space/ Park | Not less than 8% | Not less than 7% |
| Roads and Street | Not less than 26% | Not less than 25% |
| Graveyard | Not less than 2% | Not less than 2% |
| Commercial and Parking | Not more than 5% (8%) | Not more than 2% (3%) |
| Public buildings e.g. School, Hospital, Community center | Not less than 4% (6%) | Not less than 2% (3%) |

Source: CDA and RDA. Number in ( ) indicated rate out of buildable site.

(1) Urban Development, Estate Development

As stated in 2.1.3, Pakistan is currently confronting a severe housing backlog of about nine million units. The government is making plans for the low-income group with support from financial institutions such as the State Bank of Pakistan and House Building Finance Company. The high interest rates mean housing loans are not common in Pakistan.

Meanwhile, the estate development for the middle- to high-income group is strong in major cities, driven by the Defence Housing Authority and private sector developer and builders. Strong demand for residential and commercial development means both land and building prices in major cities are escalating rapidly.

The recent earthquake (2005) focused the attention of regulatory authorities and end users on the seismic quality of buildings. Further, given the recent security issues caused by anti-social forces as well as the high crime rate, security appeals to middle-class buyers and executives. The development model is a "Gated Community", which offers 24-hour security patrols in the area.

(2) Defence Housing Authority

The Defence Housing Authority is an upscale real estate and property development organization administered by the Pakistan Army, which develops housing for current and retired military personnel. DHA property is also open to non-army residents and since it combines several aspects such as location, security, living environment and building quality, it has become popular among the public. Property owners are 60% civilian and 40% army (retired) in Islamabad –Rawalpindi.

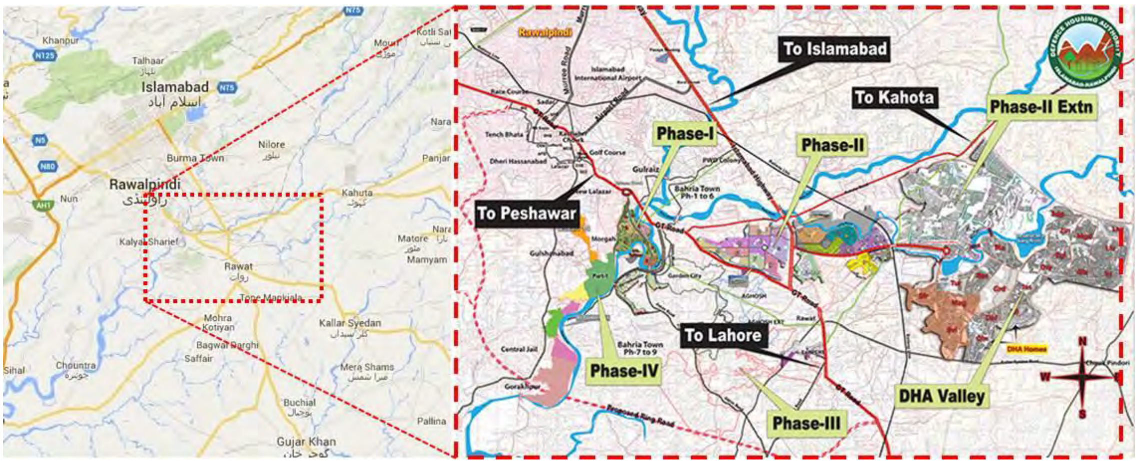
1) DHA Islamabad-Rawalpindi

Most DHA properties are located in southern Islamabad and Rawalpindi. Phases 1 and 2 are almost completed in over 3,000 acres, while phase 2 extension, phase 4 and DHA valley are under development.

Table 2.1-22 DHA Islamabad-Rawalpindi Development

| Name | Facilities | Area (Acre) | Year (Launch/ status) |
|---|---|---|---|
| Phase 1 | 3100 residential Plots, Mosques, Restaurant , Commercial Plaza | 1375 | 1992/ Completed |
| Phase 2 | Shopping complex<br>Educational Facilities<br>Family Club | 1880 | 1994/ (90%) completed |
| Phase 2 Extension | | 6,875 | 2005/ underway |
| Phase 4 | | 2100 | Planning stage |
| DHA Valley | | >7000 | 2008/ underway |

Source: DHA web site




Source: DHA web site

Figure 2.1-12 Map of DHA Islamabad-Rawalpindi development

2) DHA Lahore

Located south of Lahore city, phases 1 to 5 inside the Lahore ring road have been completed and are occupied by buildings. For phases 6 to 9, development has either been completed or remains in progress.


Source: DHA web site

Figure 2.1-13 Map of DHA Lahore development

3) DHA Karachi

Phases 1-8 are located in the south-east of Karachi city, most of which has been developed and built. Currently, the waterfront area is under development, including a large-scale urban development by developer called Crescent Bay. DHA also has been developing an area northeast of Karachi city called DHA city, which will be livable in 2015-16. DHA Karachi currently owns and manages an area of 8,797 acres, serving 81,489 members. [4]

[4] DHA Karachi website


Source: DHA web site

Figure 2.1-14 Map of DHA Karachi development

(3) Industrial Estate Development

Industrial estates are areas zoned and planned for industrial development. The benefit is the fact that they are usually located outside residential areas with convenient transport access, which improves the environment for both residents and industrialists. The boundary of the industrial estate mainly includes factories with office buildings and few accommodation buildings for laborers. Each industrial estate has its own regulatory organization, imposing its own construction and maintenance regulations. Industrial estates usually provide the required infrastructure connections, security and rescue services within the boundary.

The National Industrial Parks Development & Management Company (NIP) has been established as a special initiative of the Ministry of Production, Government of Pakistan to in order to promote nation's industrialization. The Board of Directors includes professionals involved in industrial development. 75% of board members come from the private sector and the remaining 25% are from the public sector.

Table 2.1- 23 Ongoing Industrial Park by NIP in Pakistan

| Name of Estate | Location | Status | Area in acres |
|---|---|---|---|
| Korangi Creek Industrial park | Karachi | Elec. Substation in progress | NA |
| Bin Qasim Industrial Park | Karachi | Infra work in progress | 930 |
| Rachina Industrial Park | Lahore | Construction in progress | 174 |
| Gems & Jewelry Manufacturing Centers | | Pre-construction | 1 |
| Khairpur Special Economic Zone | Khairpur | Pre-construction | 140 |
| Marble city Risalpur | Risalpur | Construction in progress | 185 |

Source: NIP web site

Each province has industrial estates developed by a government organization. The Punjab Industrial Estate (PIE) Development and Management Company was established by the

Government of Punjab.

Table 2.1- 24 Industrial Estates in Punjab Province

| Name of Estate | Established | Area in acres |
|---|---|---|
| Sundar Industrial Estate (SIE) | 2007 | 1,725 |
| Quaid-s- Azam Industrial Estate | 1960 | 565 |
| Multan Industrial Estate | 1960 | 1,410 |
| Bhalwal Industrial Estate | | 441 |
| Rahimyar Khan Industrial Estate | 2012 | 456 |
| Vehari Industrial Estate | 2015 | 277 |

Source: PIE web site

The Sindh Industrial Trading Estate (SITE) was established by the Sindh government in 1947 and privatized. SITE owns ten industrial estates in Sindh province, which covers over 20,000 acres.

Table 2.1- 25 Shindh Industrial Trading Estates (SITE)

| Name of Estate | Established | Area in acres |
|---|---|---|
| SITE Karachi | 1947 | 4,460 |
| SITE Hyderabad | 1950 | 1,268 |
| SITE Tando Adam | 1952 | 150 |
| SITE Kotri | 1962 | 1,875 |
| SITE Sukkur | 1963 | 1,060 |
| SITE Super Highway Phase-I | 1983 | 300 |
| SITE Nooriabad Phase-I | 1983 | 5,342 |
| SITE Super Highway Phase-II | 1992 | 1,000 |
| SITE Nawabshah | 1994 | 240 |
| SITE Nooriabad Phase-II | 2003 | 2,000 |

Source: SITE web site

(4) Market Trends

Together with the fundamental issue of the housing backlog, residential building demand is strong in the country, particularly in major cities and soaring land and apartment prices are driving further investment. Advertisements in newspapers appeal to the middle- to high-income group, offering a high quality of life, security and no load shedding. According to a sales agent of developers/builders in the country, one of the major players seems to be a Pakistani national living outside Pakistan.

The trend in commercial faculties is toward large-scale developments such as residential/office towers with shopping complexes. Dolmen City in Karachi was built as a first project by REIT and has been successful, which may trigger further investment in the market.

Conversely, the market for industrial estates seems highly dependent on location and energy supply issues. The Sundar Industrial Estate in Punjab has strong demand from industrialists and extension is planned. One of the strengths of PIE is that an electrical supply back-up system has been established. SITE in Sindh, however, continues to struggle with prohibitively high energy costs in terms of both electricity and gas.

### 2.1.5 Building Management

(1) Building Management

1) Legal framework for building management
There is no legal system for post completion building maintenance in Pakistan. Building owner do the maintenance or improvement on their own choices. As far as the fire protection is concerned, it is only National Fire Protection Agency (NFPA) that has legal framework in place. New buildings have to follow legal regulations of NFPA and the buildings are also responsible for fire protection systems in the buildings. There is another association namely Fire Protection Association of Pakistan (FPSA) promoting fire protection awareness and advancement in Pakistan.

2) Collective housing
Collective housing buildings can be divided into individual ownership spaces and public spaces. To maintain public spaces of collective housing, each dwelling owner normally pays about 2,000 to 5,000 PKR per year on completion of construction as a means of ensuring maintenance finance in general. After the specified period, each collective housing has its own policy to establish a maintenance framework. However, some collective housing lacks such framework. There are some developer who provides maintenance service to housing owners upon agreement of monthly service fee.

3) Governmental buildings
On federal government buildings, the Pakistan Public Works Department (PPWD) has been maintaining 131 office buildings and 16,000 residential houses/buildings/apartments etc. Regarding the maintenance of buildings, contractors are responsible to maintain buildings within a year of their construction, whereupon the relevant departments then take over maintenance of the buildings are handed over to PPWD, it maintains them indefinitely.
PPWD follows the procedures for designing/constructing the buildings as laid down in PPWD code 1982 (revised). The maintenance policy on federal government buildings is shown in Table below. To maintain the buildings/houses, PPWD has various inquiry offices in major cities to

provide maintenance services. PPWD also has 5,700 staff to maintain buildings. All staff are paid by PPWD.

Table 2.1- 26 Maintenance policy on federal government buildings

| | |
|---|---|
| Usual Maintenance | PWD carries out day-to-day maintenance of the buildings. |
| Special Repair S/R | If anything is completely out of order in the building, it is repaired. |
| A-1 Minor | When new construction is required in existing buildings, the maintenance is carried out.<br>Most government buildings seem to lack sufficient maintenance framework. |

Source: Prepared by JICA Survey Team based on interview from PWD

Apart from PPWD, CDA also maintain large number of government buildings/ houses in Islamabad.

4) Commercial buildings

Commercial buildings usually include a sufficient maintenance framework.Hospitals and hotels generally hire permanent on-site maintenance teams directly. However, many hotels and hospitals struggle to provide adequate maintenance given limited budgets.

5) Building maintenance companies

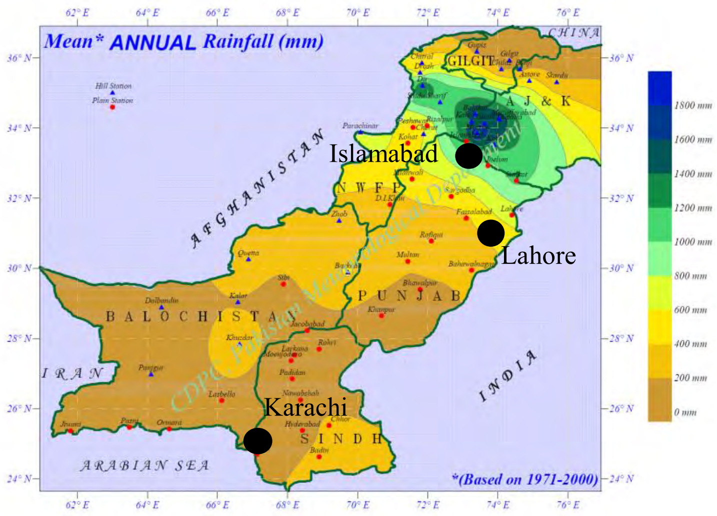
Some building maintenance companies exist in Pakistan and provide periodical facility inspection works for air-conditioners, lighting equipment, generators and elevators for their customers under contract. The scope of work by maintenance companies usually involves maintaining areas of common use within the respective building, while tenant companies are responsible for maintenance work in their leased space. However, despite this principle, maintenance companies can also maintain tenant spaces, if requested by the tenant companies.

### 2.1.6 Climate

Basic information of Climate in Pakistan[5] is reviewed as follows;

(1) Rainfall

In Pakistan, rainfall does not occur year-round, but primarily falls from July to September (with the monsoons) and from December to March (with the Western Disturbances[6]). In the interim, there is some rainfall during thunderstorms.




Source: website of Pakistan Meteorological Department (http://www.pmd.gov.pk/cdpc/)

Figure 2.1-15 Map of Annual rainfall area

Pakistan receives the tail end of the rain-bearing monsoon winds which enter the country after crossing India, in early July and sometimes into early September. Eastern Pakistan receives more rainfall, with the remainder entering southern Punjab and Sindh. The northern hills and mountains record more than 500mm of rainfall, while the volume declines toward the plains to less than 250mm near Sargodha and below 125mm further south. The peak monsoon rainfall was recorded at Muree (813mm) and the lowest at Nok Kundi (2.5mm).

Although the Western Disturbances enter Pakistan from Iran and Afghanistan, where they deposit most of their moisture, the Western highlands receive more rainfall from this weather condition than from elsewhere. These rains begin in December and continue up to March, after which they lose their intensity. Since this period coincides with the winter season, precipitation at higher elevations is often in the form of snow.

(2) Climate Data in Pakistan

The following table reviews the climate data for temperature and rainfall in Islamabad, Lahore and Karachi based on “A Geography of Pakistan: Environment, People and Economy” published by Fazle Karim Khan.

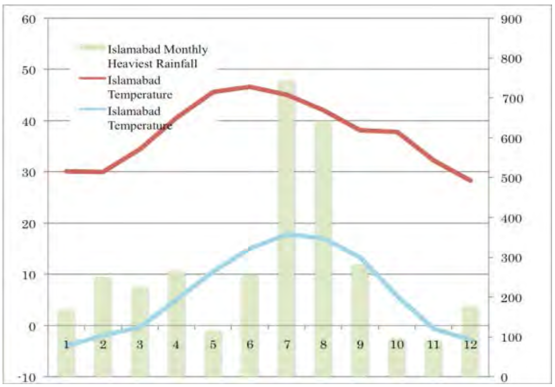
[5] A Geography of Pakistan: Environment, People and Economy – February 6, 1992 by Fazle Karim Khan (Author)

[6] Extra tropical storm in India, Pakistan, Bangladesh and Nepal

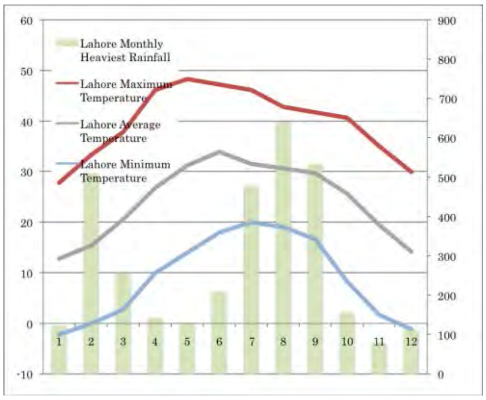
Table 2.1- 27 Climate Data in Pakistan

| Place | | | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. | Annual |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Islamabad | Temperature | Maximum | 30.1 | 30.0 | 34.4 | 40.6 | 45.6 | 46.6 | 45.0 | 42.0 | 38.1 | 37.8 | 32.2 | 28.3 | 47.8 |
| | | Minimum | -3.9 | -2.0 | -0.3 | 5.1 | 10.5 | 15.0 | 17.8 | 17.0 | 13.3 | 5.7 | -0.6 | -2.8 | 0.0 |
| | Monthly Heaviest Rainfall | | 166.9 | 248.8 | 224.0 | 264.9 | 115.3 | 255.0 | 743.3 | 641.4 | 282.0 | 95.8 | -2.8 | 177.9 | 713.0 |
| Lahore | Temperature | Maximum | 27.8 | 33.3 | 37.8 | 46.1 | 48.3 | 47.2 | 46.1 | 42.8 | 41.7 | 40.6 | 35.0 | 30.0 | 48.3 |
| | | Average | 12.8 | 15.4 | 20.5 | 26.8 | 31.2 | 33.9 | 31.5 | 30.7 | 29.7 | 25.6 | 19.5 | 14.2 | 48.3 |
| | | Minimum | -2.2 | 0.0 | 2.8 | 10.0 | 14.0 | 18.0 | 20.0 | 19.0 | 16.7 | 8.3 | 1.7 | -1.1 | -2.2 |
| | Average Rainfall | | 23.0 | 28.6 | 41.2 | 19.7 | 22.4 | 36.3 | 202.1 | 163.9 | 61.1 | 12.4 | 4.2 | 13.9 | 628.8 |
| | Monthly Heaviest Rainfall | | 121.2 | 509.0 | 254.5 | 141.0 | 129.0 | 208.6 | 477.9 | 640.0 | 532.2 | 155.0 | 77.9 | 111.8 | 1232.5 |
| Karachi | Temperature | Maximum | 32.8 | 36.1 | 41.5 | 44.4 | 47,8 | 47.0 | 42.2 | 41.7 | 42.8 | 43.3 | 38.5 | 34.5 | 47.8 |
| | | Average | 18.1 | 20.2 | 24.5 | 28.3 | 30.5 | 31.4 | 30.3 | 28.9 | 28.9 | 27.9 | 23.9 | 19.5 | 26.0 |
| | | Minimum | 0.0 | 3.3 | 7.0 | 12.2 | 17.7 | 22.1 | 22.2 | 20.0 | 18.0 | 10.0 | 6.1 | 1.3 | 63.6 |
| | Average Rainfall | | 6.0 | 9.8 | 11.7 | 4.4 | 0 | 5.5 | 85.5 | 67.4 | 19.9 | 1.0 | 1.8 | 4.4 | 217.3 |
| | Monthly Heaviest Rainfall | | 89.3 | 96.0 | 130.0 | 52.8 | 33.3 | 110.2 | 429.3 | 262.5 | 315.7 | 98.0 | 83.1 | 63.6 | 713.0 |

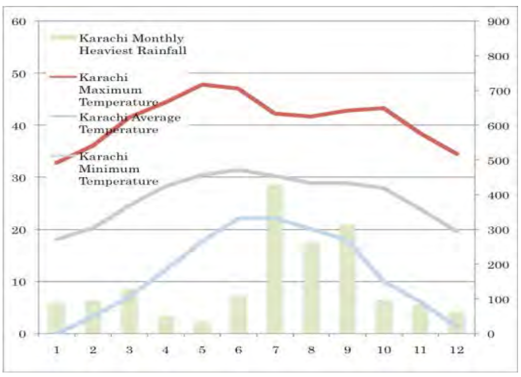
Source: A Geography of Pakistan: Environment, People and Economy



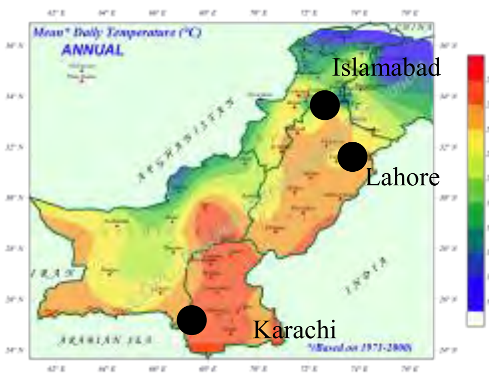

Islamabad Temperature (Max. Min.) & Rainfall




Lahore Temperature (Max. Ave. Min.) & Rainfall




Karachi Temperature (Max. Ave. Min) & Rainfall




Map of Annual daily temperature area

Source: website of Pakistan Meteorological Department (http://www.pmd.gov.pk/cdpc/)

Figure 2.1-16 Temperature and rainfall for major cities

(3) Climatic Regions

A climatic region is characterized by similarities in various climatic elements, like precipitation, temperature, winds, etc. The following are climatic regions from several sources:

1) Climatic Region categorized in "The climate of Pakistan, J.A. Khan, 1993"

According to "The climate of Pakistan, J.A. Khan, 1993", generally based on the location and level of land, the following four regions are categorized as climatic zones in Pakistan.

a) Tropical Coast Lands,
b) Sub Tropical Continental Low Lands
c) Sub Tropical Continental High Lands
d) Very arid plateau Pakistan

2) Climatic Region categorized in "A Geography of Pakistan: Environment, People and Economy, 1992 by Fazle Karim Khan"

Climatic regions are categorized, based on the amount of rainfall and air humidity.

a) Arid areas

Arid or dry conditions prevail over the majority of the country, namely across the whole of Sindh, southern Punjab and southern Balchistan, where annual rainfall is less than 250mm. Farming is done using irrigation.

b) Semi-arid areas

The semi-arid areas in Pakistan are as extensive as the arid areas and cover northern Balochistan, a large part of northern Punjab and a major part of Khyber Pakhtunkhwa. The annual rainfall here ranges from 250 to 750mm.

**c)** Humid areas

Only a small area in northern Punjab, the adjoining parts of Khyber Pakhtunkhwa and a small area around Parachinar experience humid conditions. Here, the rainfall exceeds 750mm, but irrigation is still necessary here, because the rainfall is irregular.

| | |
|---|---|
| a) Arid | 1. with warm summer and mild winter<br>2. with hot summer and mild winter<br>3. with warm summer and cool winter |
| b) Semi- arid | 4. with hot summer and mild winter<br>5. with warm summer and cool winter |
| c) Humid | 6. with hot summer and mild winter<br>7. with warm summer and cool winter<br>8 highland climate |

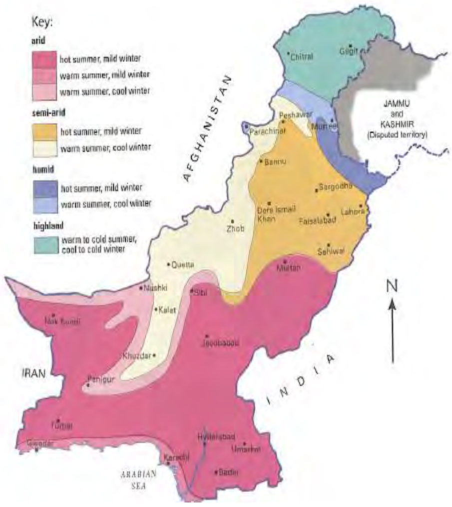



Figure 2.1-17 Climatic Region in "A Geography of Pakistan: environment, People and Economy, 1992

3) Climatic Region categorized in "Building Energy Code of Pakistan 1990"

Building Energy Code of Pakistan, May 1990, specified five climate zones as the design condition to be considered for building envelope. Allowable thermal transmission value, usually it is called U value and also allowable resistance value on each building part is defined by climate zone under BECP 1990.

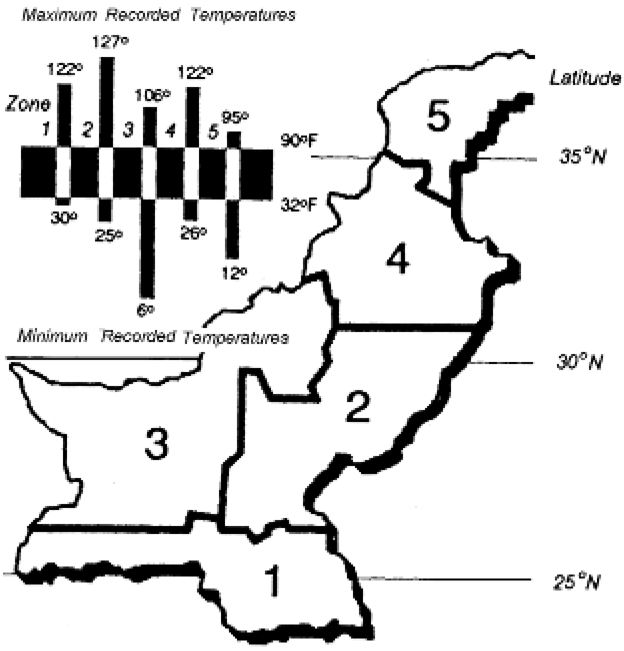


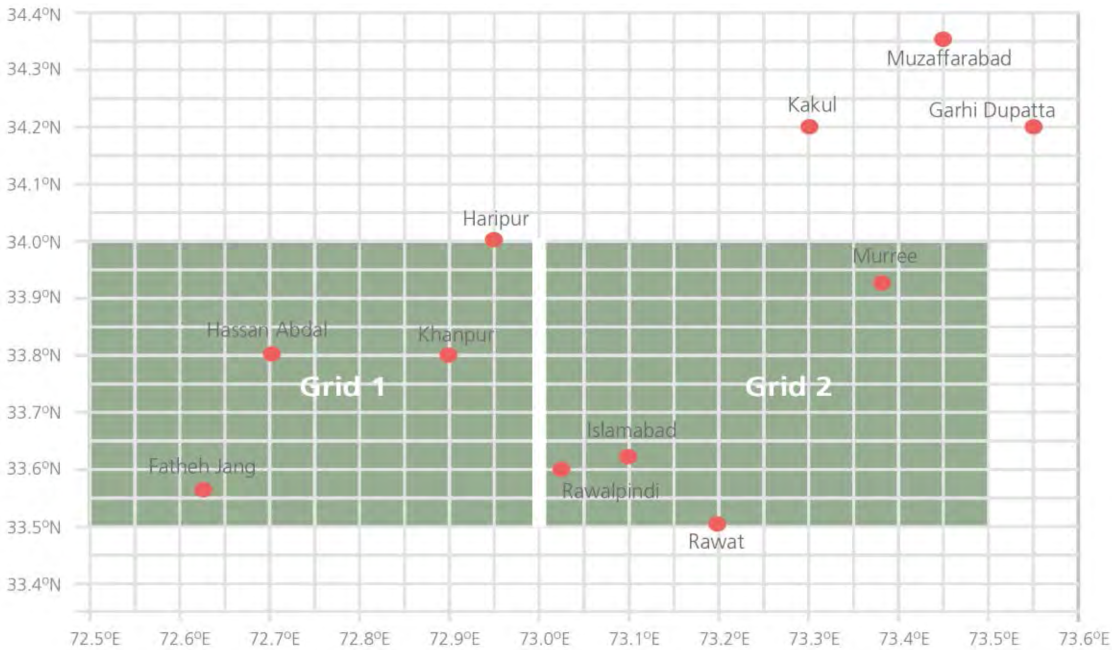

Figure 2.1-18 Climatic Regions in "Building Energy Code of Pakistan 1990"

(4) Appearance of Climate Change in Islamabad

The following is one part of the comprehensive report entitled: Climate Change Vulnerability Assessment of Islamabad which was jointly published by the Capital Administration and Development Division (CADD), Islamabad Capital Territory Administration (ICT), Capital Development Authority (CDA), Pakistan Meteorological Department, Pakistan Space & Upper Atmosphere Research Commission (SUPARCO), Global Change Impact Studies Centre (GCISC), and UN-Habitat in 2014.

1)Methodology

The vulnerability assessment segmented the Islamabad Capital Territory area into two large grids (see Figure below). Grid I corresponds to 33.5–34.0° N 72.5–73.0° E and Grid II corresponds to 33.5–34.0° N 73.0–73.5° E. Islamabad and Rawalpindi are located within Grid II.

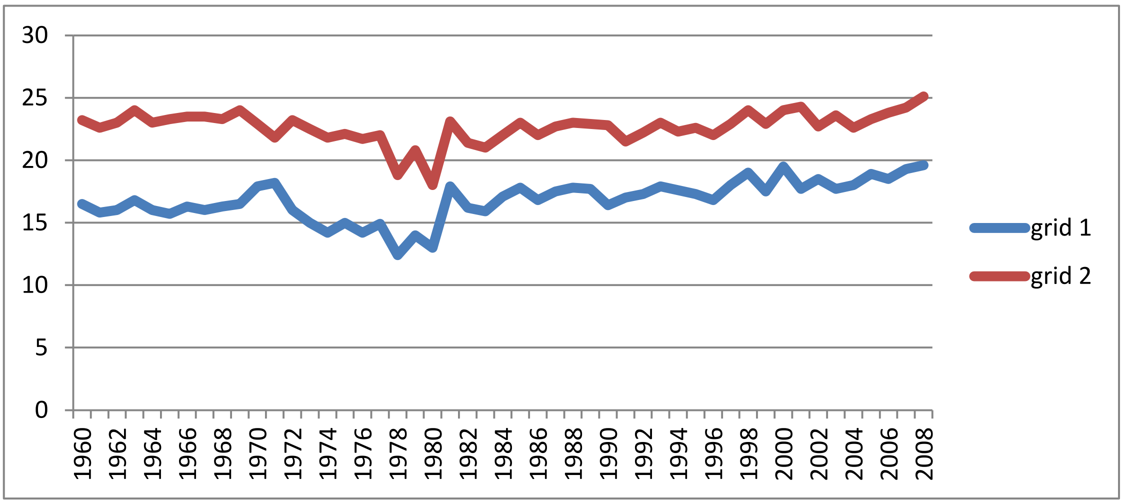



Source: Islamabad- Climate Change Vulnerability Assessment by UN-Habitat 2014

Figure2.1-19. Spatial segmentation of the Islamabad Capital Territory

2) Trends in Temperature

Comparing annual average temperatures over 1961-90 and 1990- 2010, it is clear that the Islamabad Capital Territory has become warmer. This is particularly the case for Grid II.

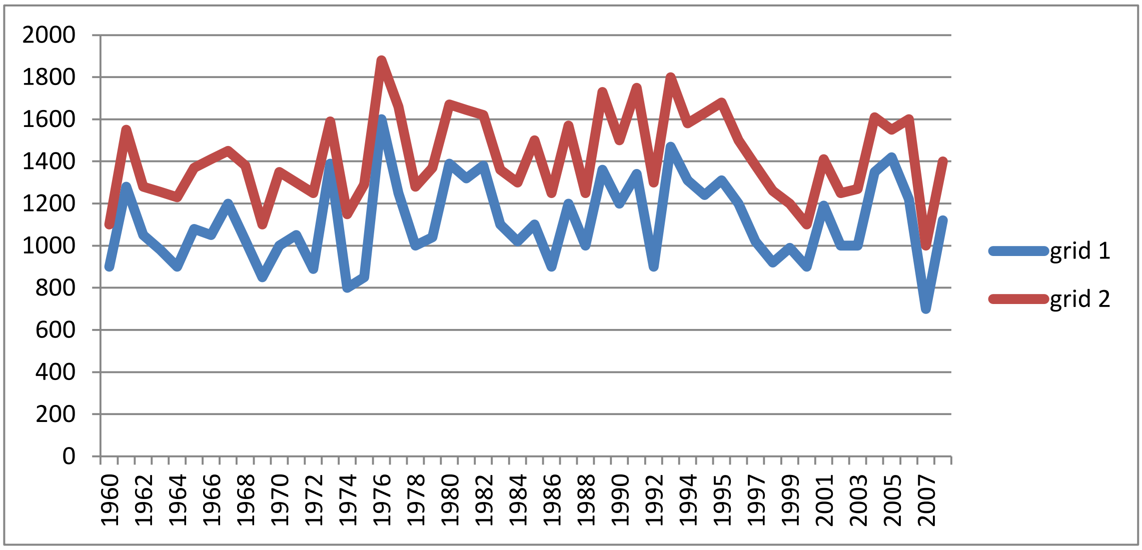



Source: Islamabad- Climate Change Vulnerability Assessment by UN-Habitat 2014

Figure2.1-20 Change in annual average temperature in Islamabad 1961-2010

3) Trends in Precipitation

During the period from1961 to 2010, quantities of rainfall also increased. However, over 1990-2010 the rate of increase in rainfall slowed and in some cases even decreased slightly.




Source: Islamabad- Climate Change Vulnerability Assessment by UN-Habitat 2014

Figure 2.1-21. Average annual precipitation in both grids over 1960-2010

4) Climate Extremes

Islamabad is also exposed to extremes of climate, both in terms of temperature and rainfall. On 23 July, 2001, Islamabad received 620 mm of rainfall in 10 hours - the heaviest rainfall in 24 hours anywhere in Pakistan during the past 100 years. Over 2001-2012, there have been 7 days when over 100 mm of rain fell. Similarly, there have been months of extreme rain fall. The ten months of maximum rainfall over 2001-2012 are shown in table below.

Table 2.1- 28.Days of more than 100 mm of rain 2001-2012

| Date | Rainfall (mm) | Date | Rainfall (mm) |
|---|---|---|---|
| 24 July 2001 | 620 | 6 July 2008 | 128 |
| 18 February 2003 | 105 | 3 September 2012 | 161 |
| 4 September 2003 | 169 | 13 July 2006 | 138 |
| 7 August 2004 | 135 | | |

Source: Islamabad- Climate Change Vulnerability Assessment by UN-Habitat 2014

Table 2.1- 29.The months of maximum rainfall over 2001-2012

| Month | Rainfall (mm) | Month | Rainfall (mm) |
|---|---|---|---|
| July 2001 | 1039 | August 2007 | 380 |
| July 2008 | 531 | August 2002 | 360 |
| August 2006 | 510 | September 2012 | 355 |
| July 2008 | 416 | August 2004 | 313 |
| July 2003 | 407 | July 2007 | 295 |

Source: Islamabad- Climate Change Vulnerability Assessment by UN-Habitat 2014

Along with rainfall, there have been extremes of temperature. Over 1961-1990, the hottest temperature recorded was 46°C in June 2005. Over 1993-2012, there were eleven days when the temperature exceeded 44°C.

Table 2.1-30. Days when the temperature exceeded 44° centigrade in Islamabad

| Date | temperature (°C) | Date | temperature (°C) |
|---|---|---|---|
| 24 June 2005 | 46.6 | 28 June, 2009 | 44.6 |
| 17 June 2007 | 46.1 | 23 June, 2005 | 44.5 |
| 12 May 2001 | 45.7 | 22 June, 2012 | 44.5 |
| 16 June 2007 | 45.3 | 7 May, 2005 | 44.4 |
| 9 June, 2002 | 45.0 | 21 June, 2010 | 44.2 |
| 22 June, 2005 | 45.0 | | |

Source: Islamabad- Climate Change Vulnerability Assessment by UN-Habitat 2014

## 2.2 Legal System regarding EE&C in the Building Sector in Pakistan

### 2.2.1 Structure of Building Control in Pakistan

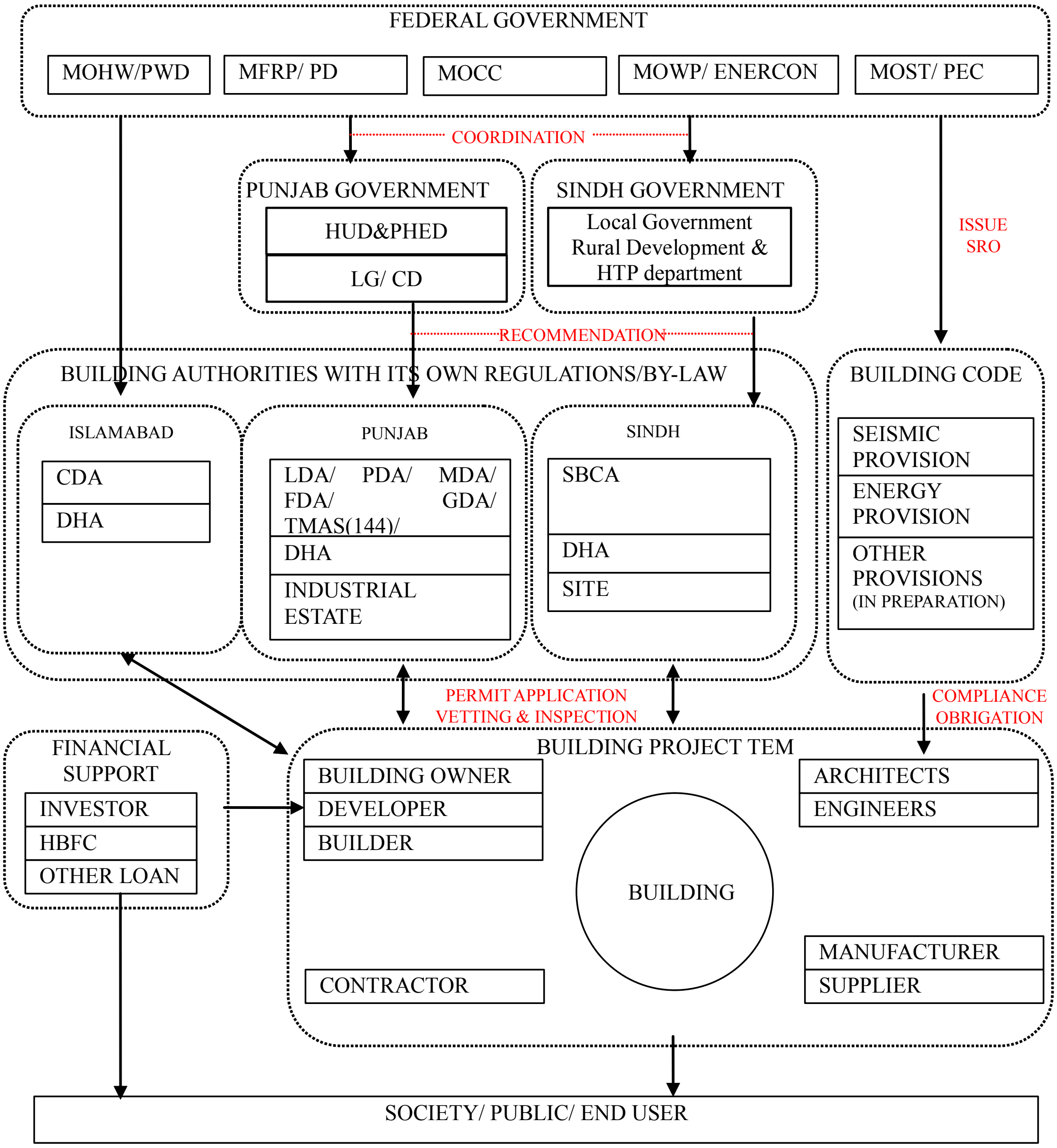
Building control authorities are subdivided into several government entities, such as the Federal Government, Provincial Government, Ministry of Defence, etc. Each building authority has been established with its own legislation under the respective government, with its own building regulations. Depending on the construction project location, the applicant shall follow the building regulations and procedures of the respective building control authority.

Table 2.2-1 Legal Basis and Building Regulations for Building Control Authorities (Islamabad, Punjab, Sindh)

| Name | Legal Basis | Building Regulation |
|---|---|---|
| CDA | The Capital Development Authority Ordinance 1960 | Islamabad Residential Sectors Zoning (Building Control) Regulations -2005 |
| LDA | The Lahore Development Authority Act, 1975 | Lahore Development Authority Building and Zoning Regulations 2014 |
| RDA/ FDA/MDA/GDA | Punjab Development of Cities Act 1976 | Development Authority Building and Zoning Regulations 2007 |
| SBCA | Sindh Building Control Ordinance 1979 | The Karachi Building & Town Planning Regulations, 2002 |
| DHA Islamabad | Defence Housing Authority Islamabad Act, 2013 | Building Bye-Laws DHA Islamabad/ Rawalpindi Revised 2014 |
| DHA Rawalpindi | Defence Housing Authority Rawalpindi Act, 2013 | |
| DHA Lahore | Defence Housing Authority Ordinance 1999<br>Defence Housing Authority Lahore Order, 2002 | DHA Construction & Development Regulations 2014 |
| DHA Karachi | The Pakistan Defence Housing Officer Order, 1980 | Building Control & Town Planning Regulations 2011 |

Source: Summarized by JST using website

The Building Code of Pakistan, published in 1986, (BCP-1986) has not been adopted into those building control authorities for the review process. In adopting the national new policy, such as Energy Efficiency and Conservation, revisions to the current regulation shall be accepted by the board of respective building control authorities via recommendation by the relevant government entity. Meanwhile, the newly introduced building code, such as Seismic Provision and Energy provision, has been enforced on professionals under the Pakistan Engineering Council Act 1975. Theoretically, those new building code provisions shall be implemented by the engineers involved. However, there has been no third party review to monitor code compliance to date.
Figure 2.2-1 indicates a diagram of the building sector in Pakistan.




Source: JST

Figure 2.2-1 Diagram of Building Sector in Pakistan

### 2.2.2 Building Code of Pakistan (Energy Provision)

(1) Background of Building Code of Pakistan (Energy Provision)

A Building Energy Code of Pakistan was issued in May 1990 (hereafter referred as BECP-1990) under MOHW, prepared by ENERCON and notified as an addendum to the Building Code of Pakistan 1986 (BCP-1986) . BECP-1990 specifies minimum performance standards for building walls and openings, heating, ventilation, air-conditioning (HVAC) equipment and lighting. Though mostly based on the American Society of Heating Refrigerating and Air-conditioning Engineers (ASHRAE) standards, effort has been made to ensure its applicability based on Pakistan regional characteristics. In accordance with the BCP-1986, which divides Pakistan into five climatic zones, standards have been provided for each zone.

BECP-1990 was not mandatory and was intended to be promulgated on a mandatory basis after sufficient recognition by the building industry. To ensure general understanding of the code, ENERCON also prepared a Compliance Handbook for use in conjunction with the same.

The idea of revising BECP-1990 was raised during the ACE campaign; Awareness Campaign of Energy Conservation and Environment by MOHW and ENERCON, which was carried out from 2003 to 2010 and extended to 2012. NESPAK was selected to revise BECP-1990, but the deliverables were not submitted on time for some reason and the contract with NESPAK was eventually terminated.

Subsequently, ENERCON decided to engage with PEC so that the Building Energy Code would be adopted in the existing framework of BCP-1986 as a provision. Following the participants' effort, BCP-EP-2011 was notified as an S.R.O. on 28 March, 2013. A Launching Ceremony was held on 13 February, 2014.

According to the latest EE&C Bill, the Federal Government, in consultation with the Authority, may prescribe energy conservation building codes for the efficient use of energy and its conservation in buildings or building complexes and amend energy conservation building codes to suit regional and local climatic conditions. The Authority would be established after enacting the EE & C Bill as ENERCON renewal. Accordingly, ENERCON renewal would have reasonable power to prescribe and amend BCP-EP-2011.

The latest edition of Energy Provision was prepared by PEC through the state-owned consultancy firmed by the Ministry of Water and Power (MOWP) referring to the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE). The latest edition of Seismic provision was prepared by (NESPAK) along with ACI and ASIC. The Building Fire Code is under preparation and will be notified soon. The Building Electrical and Telecommunication Code is also under preparation.[7]

As described above, BCP-EP-2011 has been adopted as a provision to the BCP-1986. The provisions for the BCP-1986 are summarized below.

Table 2.2-2 Building Code of Pakistan and Provisions

| Name of code/ provision | S.R.O. Notification |
|---|---|
| Building Code of Pakistan 1986 | |
| Seismic Provisions- 2007 | Sept 2008 |
| Energy Provision- 2011 | March 2013 |
| Pakistan Electric and Telecommunication Safety Code (PETSAC-2014) (with financial support of USAID-PDP) | Will be notified soon |
| Building Code of Pakistan Fire Safety Provisions | Road map devised for development |

Source: PEC

(2) Contents of the Building Code of Pakistan Energy Provision 2011

The Energy Provision 2011 is intended to provide energy-efficiency benchmarks for buildings. MOHW acknowledges that it has the permission of ASHRAE to transcribe and reproduce portions of ASHRAE standards 90.1-2004. The only exception is Section 4 Building Envelope, which has been developed with the Energy Codes of regional countries and the local environment in mind.

[7] Interview with PEC on 16th June, 2015

Table 2.2-3 Contents of Building Code of Pakistan –Energy Provision

| | |
|---|---|
| CONTENT<br><br>SECTION-1 PURPOSE<br>SECTION-2 SCOPE<br>2.0 Title<br>2.1 Scope<br>2.2 Applicable Building Systems<br>2.3 Exemptions<br>2.4 Limitation<br><br>SECTION-3 ADMINISTRATION & ENFORCEMENT<br>3.0 Administration and Enforcement<br>3.1 Compliance Requirements<br>3.1.1 Mandatory Requirements<br>3.1.2 New Buildings<br>3.1.3 Service Water Heating<br>3.2 Administrative Requirements<br>3.3 Compliance Documents<br>3.4 Supplementary Information<br>SECTION-4 BUILDING ENVELOPE<br>4.1 General<br>4.2 Mandatory Requirement<br>4.2.1 Building Envelope<br>4.3 Compliance Documents<br>SECTION-5 HEATING, VENTILATING AND AIR-CONDITIONING<br>5.1 General<br>5.2 Mandatory Requirements<br>5.2.1 Controls<br>5.2.2 Piping and Ductwork<br>5.2.3 System Balancing<br>5.2.4 Condenser<br>5.3 Recommended Guidelines<br>5.3.1 Minimum Equipment Efficiencies<br>5.3.2 Recommended Requirements<br>5.4 Recommended Voluntary Adoption<br>5.4.1 Natural Ventilation<br>5.4.2 Alternate Energy<br>5.5 Compliance Documentation | SECTION-6 SERVICE WATER HEATING<br>6.1 General<br>6.2 Mandatory Requirements<br>6.2.1 Piping Insulation<br>6.2.2 Equipment Efficiency<br>6.2.3 Swimming Pools<br>6.3 Volunteer Adoption<br>6.4 Compliance Documentation<br>SECTION-7<br>7.1 General<br>7.2 Mandatory Requirements<br>7.2.1 Lighting Control<br>7.2.2 Exit Signs<br>7.2.3Exterior Building Grounds Lighting<br>7.2.4 Landscape Lighting<br>7.3 Interior Lighting Power<br>7.4 Exterior Lighting Power<br>7.5 Recommended Voluntary Adoption<br>7.5.1 Lighting Control<br>7.6 Compliance Documentation<br><br>SECTION-8 ELECTRICAL POWER<br>8.1 General<br>8.2 Mandatory Requirements<br>8.2.1 Transformers<br>8.2.2 Energy-Efficient Motors<br>8.2.3 Power Factor Correction<br>8.2.4 Check-Metering<br>8.2.5 Power Distribution<br>8.3 Compliance Documentation<br>SECTION-9 DEFINITIONS, ABBREVIATIONS & ACRONYMS |

Source: BCP-EP-2011

According to PEC, the implementation of the BCP-EP-2011 is the responsibility of the respective Development Authority (DA), including building controlling authorities at provincial level and district level responsibility (i.e. SBCA, LDA, and RDA). The code compliance for Federal Government buildings must be managed by CDA.

However, as of August 2015, all Development Authorities stated that BCP-EP-2011 had not been adopted for the building permit process yet.

### 2.2.3 EE&C Bill in Pakistan

To provide for establishing institutions and enunciating mechanisms and procedures, to further ensure effective conservation and the efficient use of energy, the GoP is striving to enact the Energy Efficiency and Conservation (EE & C) Bill.As of 2014, the EE&C Bill 2014 had already been approved and submitted to Parliament by the Council of Common Interest (all provincial chief ministers' meeting held on 29 May, 2014) for discussion and final approval. Although the budget session already took place in June 2014, the EE&C Bill 2014 was not enacted.
Now, the GoP is retrying with the EE&C Bill 2015 as an amendment to the EE&C Bill 2014 (aforementioned previous Bill).

An extract of articles regarding the building sector from the EE&C Bill 2015 is shown in Table 2.2-4. According to section three of the EE&C Bill 2015, "buildings sector" means all buildings, including private domestic households, commercial, industrial, public and community buildings. According to section three of the EE&C Bill 2015, after enacting the EE&C Bill 2015 (aforementioned "EE&C Act", after enacting the Bill), the Federal Government shall establish a Board to be known as the Pakistan Energy Efficiency & Conservation Board, which shall comprise relevant ministries and provincial governments, i.e. the Ministry of Water and Power, Ministry of Science and Technology and the Ministry of Housing and Works, Government of Punjab, Government of Sindh, Government of Khyber Pakhtunkhwa, Government of Balochistan. According to section four of the EE&C Bill 2015, The Board shall have the function and power to direct the Authority, any provincial agency or any Government body to prepare, submit, promote or implement projects for energy conservation in a specific sector of the economy or further establish any suitable structure or mechanism to enforce this Act.

The Parliament has referred the EE&C Bill 2015 to the Standing Committee of National Assembly on Water and Power for discussion.

Table 2.2- 4 Extract of articles regarding building sector from EE&C Bill, 2015

| | articles |
|---|---|
| Members of Board (Section 3) | a) Federal Minister for the Division to which <u>subject-matter of this Act stands allocated</u> Chairman<br>b) Federal Secretary of the Division to which <u>subject-matter of this Act stands allocated</u> Vice chairman<br>c) Federal Secretary, Ministry of Finance Member<br>d) Federal Secretary, Ministry of Planning and Development Member<br>e) Federal Secretary of the Division to which subject-matter of petroleum and natural resources stands allocated Member<br>f) Federal Secretary of the Division to which <u>subject-matter of science and technology</u> stands allocated Member<br>g) Federal Secretary of the Division to which subject-matter of industries stands allocated Member<br>h) Federal Secretary of the Division to which <u>subject-matter of housing and works</u> stands allocated Member<br>i) Federal Secretary of the Division to which subject-matter of climate stands allocated Member<br>j) Secretary of the <u>Designated Department, Government of Punjab</u> Member<br>k) Secretary of the <u>Designated Department, Government of Sindh</u> Member<br>l) Secretary of the <u>Designated Department, Government of Khyber Pakhtunkhwa</u> Member<br>m) Secretary of the <u>Designated Department, Government of Balochistan</u> Member<br>n) Chairman, Oil and Gas Regulatory Authority Member<br>o) Chairman, National Electric Power Regulatory Authority Member<br>p) one nominee of Chambers of Commerce and Industry Member<br>q) Managing Director of the Authority Member<br>r) six persons of known integrity and competence from private sector of which three would be full time paid Member |
| Functions and Powers of the Board (Section 4) | (1) The functions of the Board shall be to-<br>(a) be custodian of national policy for energy conservation and ensure proper utilization, planning and management of energy in all sectors of national economy;<br>(b) coordinate, supervise and carry out enforcement of the provisions of this Act;<br>(c) create awareness and disseminate information related to efficient use of energy resources;<br>(d) coordinate integration and inculcation of energy conservation concerns in national development plans and policies;<br>(e) approve energy efficiency standards and ensure their enforcement and compliance;<br>(f) direct the Authority in the conduct of research and development, and preparation and execution of demonstration projects and national programs on energy conservation;<br>(g) recommend to the Federal Government the adoption of measures directly or indirectly conducive to energy conservation;<br>(h) promote investment by the public and private sectors in energy conservation through partnership or otherwise;<br>(i) encourage and facilitate import and local manufacture and indigenous technologies for the promotion of energy conservation through all legal and policy support; and<br>(j) institute national energy conservation and efficiency and management awards for various categories of energy consumers for the promotion and encouragement of energy conservation.<br>(2) <u>The Board may</u>, either itself or upon the request of any person or organization, <u>direct</u> the Authority or any provincial agency or any Government body <u>to prepare, submit, promote or</u> <u>implement projects for energy conservation in a specific sector of economy</u>.<br>(3) <u>The Board, or a Provincial Government</u> with the concurrence of the Board, <u>may establish any suitable structure or mechanism</u> for enforcement of this Act including energy-efficiency standards, labeling, incentives, fines and other related requirements under this Act with effect from the date to be determined by the Board.<br>(4) The Board may approve appropriate strengthening, restructuring, capacity building, terms and conditions of employees and compensation or protection of service benefits for PEECA and its employees, to effectively carry out the functions under the provisions of this Act. |
| Powers and functions of Authority (Section 7) | The powers and functions of the Authority shall be to-<br>a . serve as sole focal Federal authority for initiating, catalyzing carrying out and coordinating the implementation of all energy conservation programs in all sectors of economy;<br>b. administer, implement and enforce the provisions of this Act and the rules and regulations made thereunder; |

c. prepare or update national energy conservation policy for the approval of the Board;

d. prepare draft regulations to be made by the Board pursuant to the provisions of this Act;

e. recommend national energy-efficiency standards to the Board and after approval by the Board ensure implementation of these standards;

f. coordinate energy conservation policies and programs nationally and internationally;

g. establish protocols of coordination between relevant functionaries of the Government and serve as the information house on energy conservation and management;

h. initiate demonstration and research and development programs in support of its functions;

i. establish infrastructure and take appropriate institutional development and capacity building measures for effective implementation of the provisions of this Act;

j. establish systems and procedures for surveys, surveillance, monitoring, inspection and audits to prevent the inefficient use of energy resources and recommend implementation of specific energy conservation measures;

k. establish, maintain and certify one or more laboratories as approved laboratories for conducting tests and analysis to help the Authority in the performance of its functions and to conduct research in various aspects of energy conservation;

l. seek information or data relevant to its functions from any person or organization for quantitative or technological analysis;

m. recommend to the Federal Government or a Provincial Government the adoption of financial and fiscal incentives or schemes for achieving energy conservation objectives;

n. initiate requests for foreign technical and financial assistance for the purposes of this Act, enter into arrangements with foreign agencies and organizations for exchange of information and materials and participate in international meetings and seminars;

o. obtain information or data relevant to the functions of the Authority from any person in such form as the Authority may specify;

p. undertake inquiry or investigation into energy conservation issues, either on its own accord or upon complaint from any person or on the advice of the Board;

q. summon and enforce the attendance of any person or an officer, employee, proprietor, partner, manager, director or chief executive of an entity and require him to supply any information or document needed for the conduct of an inquiry or investigation into any issue being carried out pursuant to the provisions of this Act;

r. direct an initial energy use assessment to be carried out for any upcoming project and submitted to the Authority before commencement thereof;

s. carry out energy audits either by itself or direct any person to receive an energy audit by any accredited or designated energy auditor for any facility, enterprise, factory, building or object for the purpose of identification of energy conservation issues and making recommendations for corrective measures thereof;

t. request for tests and analysis from its own laboratory or from a certified laboratory of an equipment, gadget, accessory or hardware to measure its energy characteristics;

u. prohibit manufacture, sale or import of equipment or appliances which are not energy-efficient and ensure display of such particulars through labels on equipment or appliances as may be necessary;

v. fix and realize fee, rates and charges for rendering any service or providing any facility or information or data audit or assessment or test carried out pursuant to the provisions of this Act and the rules and regulations made thereunder;

w. appoint such technical and legal experts and administrative staff as it considers necessary for the efficient performance of its functions on such terms and conditions as may be prescribed; and

x. perform any other function assigned to it by the Federal Government or the Board including but not limited to-

i. arrange, conduct and monitor the training of relevant professionals for their performance as energy auditors or managers;

ii. facilitate, manage or designate authority for the appropriate registration of energy auditing firms or individuals and professionals;

iii. direct, coordinate, renew and terminate the services of energy auditors, relevant

| | |
|---|---|
| | trainers and energy efficiency inspectors as may be specified by regulations. |
| Powers and functions of the Federal Government to facilitate and enforce efficient use of energy and its conservation (Section 10) | The Federal Government May, in consultation with the Authority:-<br>(a) specify the norms for processes and energy consumption standards for any equipment, appliance which consumes, generates, transmits or supplies energy;<br>(b) specify equipment or appliance or class of equipment or appliances, as the case may be, for the purposes of this Act;<br>(c) prohibit manufacture or sale or purchase or import of equipment or appliance specified under clause (b), unless such equipment or appliance conforms to energy consumption standards:<br>Provided that no notification prohibiting manufacture or sale or purchase or import of equipment or appliance shall be issued within a period of six months from the date of notification issued under clause (a) :<br>Provided further that the Federal Government may, having regard to the market share and the technological development having impact on equipment or appliance, and for reasons to be recorded in writing, extend the said period of six months referred to in the first proviso by a further period not exceeding six months;<br>(d) direct display of such particulars on label on equipment or on appliance specified under clause (b) and in such manner as may be specified by regulations;<br>(e) specify, having regard to the intensity or quantity of energy consumed and the amount of investment required for switching over to energy-efficient equipment and capacity of industry to invest in it and availability of the energy-efficient machinery and equipment required by the industry, any user or class of users of energy in the energy intensive industries and other establishments as a designated consumer for the purposes of this Act;<br>(f) alter the list of energy intensive industries specified by the Authority;<br>(g) establish and prescribe such energy consumption norms and standards for designated consumers as it may consider necessary:<br>Provided that the Federal Government may prescribe different norms and standards for different designated consumers having regard to such factors as may be prescribed;<br>(h) direct, having regard to quantity of energy consumed or the norms and standards of energy consumption specified under clause (a), the energy intensive industries specified to get energy audit conducted by an accredited energy auditor in such manner and intervals of time as may be prescribed by regulations;<br>(i) direct, if considered necessary for efficient use of energy and its conservation, any designated consumer to get energy audit conducted by an accredited energy auditor;<br>(j) specify the matter to be included for the purposes of inspection;<br>(k) direct any designated consumer to furnish to the designated agency, in such form and manner within such period, as may be prescribed, the information with regard to the energy consumed and action taken on the recommendation of the accredited energy auditor;<br>(l) direct any designated consumer to designate or appoint energy manager in charge of activities for efficient use of energy and its conservation and submit a report, in the form and manner as may be prescribed, on the status of energy consumption at the end of every financial year to the designated agency;<br>(m) prescribe minimum qualification for energy auditors and energy managers to be designated or appointed under clause (l);<br>(n) direct every designated consumer to comply with energy consumption norms and standards;<br>(o) direct any designated consumer, who does not fulfill the energy consumption norms and standards prescribed under clause (g), to prepare a scheme for efficient use of energy and its conservation and implement such scheme keeping in view the economic viability of the investment in such form, time and the manner as may be prescribed;<br>(p) prescribe energy conservation building codes for efficient use of energy and its conservation in the building or building complex;<br>(q) amend the energy conservation building codes to suit the regional and local climatic conditions; |

| | |
|---|---|
| | (r) direct every owner or occupier of the building or building complex, being a designated consumer to comply with the provisions of energy conservation building codes for efficient use of energy and its conservation;<br>(s) direct, any designated consumer referred to in clause (r), if considered necessary, for efficient use of energy and its conservation in his building to get energy audit conducted in respect of such building by an accredited energy auditor in such manner and intervals of time as may be specified by regulations;<br>(t) take all measures necessary to create awareness and disseminate information for efficient use of energy and its conservation;<br>(u) arrange and organize training of personnel and specialists in the techniques for efficient use of energy and its conservation.<br>(v) prescribe penalties for the energy inefficient apparatus, appliances, equipment, plant and machinery; and<br>(w) take steps to encourage preferential treatment for use of energy-efficient equipment or appliances:<br>Provided that the powers under clauses (p) to (s) shall be exercised in consultation with the concerned Province. |
| Powers and functions of Provincial Governments to facilitate and enforce efficient use of energy and its conservation (Section 13) | (1) The Provincial Governments may, after approval of proposals to the effect thereof from the Board and in consultation with the Authority, by notification-<br>(a) amend the energy conservation building codes to suit the regional and local climatic conditions and may, by rules made by it, specify and notify energy conservation building codes with respect to use of energy in the buildings;<br>(b) direct every owner or occupier of a building or building complex being a designated consumer to comply with the provisions of the energy conservation building codes;<br>(c) direct, if considered necessary for efficient use of energy and its conservation, any designated consumer referred to in clause (b) to get energy audit conducted by an accredited energy auditor in such manner and at such intervals of time as may be specified by regulations;<br>(d) establish or designate laboratories duly accredited and certified by the Federal Government;<br>(e) collect data and information and maintain database; and<br>(f) direct, any designated consumer to furnish to the designated agency, in such form and manner and within such period as may be specified by rules made by it, information with regard to the energy consumed by such consumer.<br>(2) The Federal Government may establish a fund to be called the Energy Conservation Fund for the purposes of promotion of efficient use of energy and its conservation within its territory.<br>(3) To the Fund shall be credited all grants and loans that may be made by the Provincial Government or the Federal Government or any other organization or individual for the purposes of this Act.<br>(4) The Fund shall be applied for meeting the expenses incurred for implementing the provisions of this Act.<br>(5) The Fund established under sub-section (2) shall be administered by such persons or authority and in such manner as may be specified in the rules made by the Federal Government in respect thereof.<br>(6) The Provincial Government may, by notification in the official Gazette, adopt or make rules for carrying out the provisions of this Act, which shall not be inconsistent with the rules, if any, made by the Federal Government.<br>(7) The Provincial Governments shall nominate a specific department under its control to coordinate with the Authority and facilitate implementation of the provisions of this Act within its jurisdiction. The Authority upon receiving the nomination from Provincial Government, may declare the nominated department as the designated agency. The designated agency may appoint as many inspecting officers as may be necessary for the purpose of ensuring compliance of this Act.<br>(8) Subject to any rules made under this Act, an inspecting officer shall have such powers as vested in him by the Board.<br>(9) The Federal Government or a Provincial Government may, in exercise of their powers and |

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|---|---|
| | performance of their functions under this Act and for efficient use of energy and its conservation, issue such directions in writing to any person, officer, authority or any designated consumer as they deem fit for furthering the purposes of this Act and such person, officer or authority or any designated consumer shall be bound to comply with such directions. |
| Powers of Provincial Government to make rules (Section 14) | (1) The Provincial Government may, by notification in the official Gazette, make rules for carrying out the provisions of this Act and not inconsistent with the rules, if any, made by the Federal Government.<br>(2) In particular, and without prejudice to the generality of the foregoing power, <u>such rules may provide for all or any of the following matters</u>, namely:<br>(a) <u>energy conservation building codes under section 13</u>;<br>(b) the form, manner and period within which information with regard to energy consumption shall be furnished under section 13;<br>(c) the person or any authority who shall administer the Fund and the manner in which the Fund shall be administered under section 13;<br>(d) the matters to be included for the purposes of inspection under section 15;<br>(e) any other matter which is to be, or may be, prescribed, or in respect of which provision is to be made, or may be made, by rules. |

Note: Underline added.

Source: Selected by the JICA Survey Team as per summary from the latest EE&C Bill.

### 2.2.4 National Power Policy

The National Power Policy 2013 was published and uploaded on the website of the Ministry of Water and Power (MOWP) in September 2013. Key points are summarized in Table 2.2-5.
The MOWP is keen to create a culture of conservation and align the ministries involved in the energy sector under The National Power Policy 2013. It shows that MOWP intends to adopt a role of making policy and arrangements against relevant ministries to reduce power consumption in the building sector.

Table 2.2- 5 Key Points of the National Power Policy 2013

| | Policy |
|---|---|
| Vision | Pakistan will develop the most efficient and consumer-centric power generation, transmission, and distribution system that meets the needs of its population and boosts its economy in a sustainable and affordable manner. |
| Challenge | Pakistan's power sector is currently afflicted by a number of inefficiencies that have led to a crisis.<br>1. The supply-demand gap has been continuously growing over the past five years, and such enormous gap has led to load shedding of 12-16 hours across the country.<br>2. Omitted.<br>3. Omitted. |
| Goals | In order to achieve the long-term vision of the power sector and overcome its inefficiencies, the Government of Pakistan (GoP) has set the following nine goals:<br>1. Omitted.<br>2. To create a culture of energy conservation and responsibility.<br>3. Omitted.<br>4. Omitted.<br>5. Omitted.<br>6. Omitted.<br>7. Omitted.<br>8. Omitted.<br>9. To align the ministries involved in the energy sector and improve governance of all related federal and provincial departments as well as regulators.<br>A clear strategy has to be articulated for each of the aforementioned goals in order to actualize the power sector's aspirations. |
| Targets | Supply-Demand Gap: for Goals 1 and 2<br>Decrease supply-demand gap from 4,500-5,000 MW today to zero by 2017.<br>Governance: for Goal 9<br>Decrease decision-making processing time in MOWP and related departments and regulators from long to short duration. |
| Policy Principle | The policy and strategy are formulated based on "efficiency" and "competition". |
| Strategy | There are nine strategies for achieving the nine goals, respectively, as follows:<br>1. <u>Demand Strategy to meet Goal 2</u><br>To create a culture of conservation and responsibility.<br>2. <u>Governance Strategy to meet Goal 9</u><br>To align the ministries involved in the energy sector and improve their governance. |
| Impact | The successful implementation of this policy will lead to enormous improvements within the power sector.<br>- By 2017, the supply-demand gap could be eradicated completely.<br>- After the term of the current government, power surplus can be regionally traded.<br>- After the turn of the decade, Pakistan could be transformed from an energy-strapped importer of power to a regional exporter of power.<br>- The cost of power generation will be reduced to an affordable amount.<br>- Improvements in transmission and distribution efficiency will decrease the burden of power to the end consumer.<br>In summary, prosperity and social development will become a reality in Roshan Pakistan. |

Note: Underline added.

Source: National Power Policy 2013, MOWP

### 2.2.5 Pakistan 2025 (subtitle One Nation- One Vision)

Pakistan 2025 (subtitle One Nation- One Vision) was published and uploaded on the website of the Ministry of Planning, Development & Reform (MOPDR) in May 2014. The key points are summarized in Table 2.2-6. In particular, the issue with urban development is pointed out in the section of Pillar II: Achieving Sustained, Indigenous and Inclusive Growth.

Table 2.2-6 Key Points of Pakistan 2025 (subtitle One Nation- One Vision)

| | Policy |
|---|---|
| Mission | This is defined in terms of the concepts provided by the Father of the Nation at the dawn of independence. |
| Vision | As mentioned, a number of emerging economies (the Asian Tigers) appear to have realized this vision through their experience. The Vision acknowledges this experience in setting out the goal of becoming the next Asian Tiger. |
| Enabling Condition | Crafting the vision will require a number of enabling conditions, namely a Shared National Vision, Political Stability, Peace and Security, Rule of Law and Social Justice. The government is making a strenuous effort to provide the required enabling environment. While these pertain to the third pillar ("Democratic Governance"), they need to be recognized separately because of their character as aspirational goals as well as elements of a national consensus. |
| Pillars | Pillar I: Putting People First - Developing Human and Social Capital<br>Pillar II: Achieving Sustained, Indigenous and Inclusive Growth<br>Pillar III: Democratic Governance, Institutional Reform & Modernization of the Public Sector<br>Pillar IV: Energy, Water & Food Security<br>Pillar V: Private Sector and Entrepreneurship Led Growth<br>Pillar VI: Developing a Competitive Knowledge Economy through Value Addition<br>Pillar VII: Modernizing Transportation Infrastructure & Greater Regional Connectivity |

Source: Pakistan 2025 (subtitle One Nation- One Vision), MOPDR

### 2.2.6 National Housing Policy 2001

The National Housing Policy 2001 was approved by the President and Chief Executive on 22 June, 2001. To prepare the National Housing Policy 2001, the Housing Advisory Board was formed and the board comprised all stakeholders, i.e. builders, constructors, development agencies, bankers, town planners, Provincial Governments, HBFC and State Bank. Half also participated from the private sector.

The background to preparation of National Housing Policy 2001 is because Government of Pakistan did not take appropriate action, despite importance of housing production was recognized through the adoption of "Universal Declaration of Human Rights" in 1948 and "Adequate shelter for all" at the 1996 UN Habitat Conference, 1992 Housing Policy. Key points are summarized in Table 2.2-7. The National Housing Policy 2001 was prepared to provide low-income households with housing. As a countermeasure, incentives regarding the building sector and construction technologies were suggested.

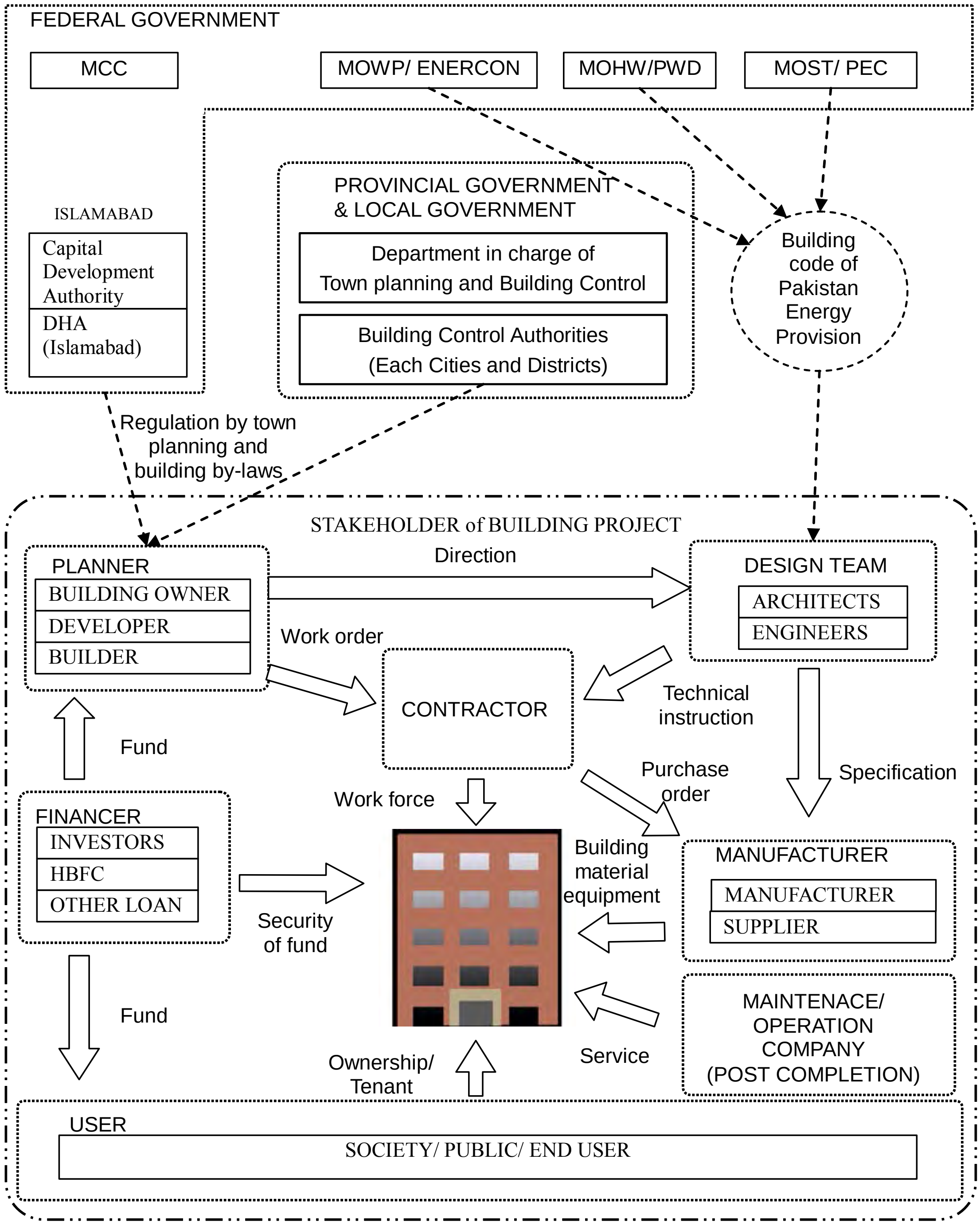
Table 2.2- 7 Key Points of the National Housing Policy 2001

| | Policy |
|---|---|
| Aims and Objectives | a. Housing development through capacity building of formal and informal sector.<br>b. Omitted.<br>c. Omitted.<br>d. Omitted.<br>e. Resource Mobilization through Government initiatives, mortgage loans, refinance facility, savings and loan schemes, induction of insurance, pension and provident funds and introduction of micro finance schemes.<br>f. Provision of incentives through tax rationalization, reduction in property tax and registration, simplification of procedure and enforcement of effective foreclosure Laws.<br>g. Support research and development for economic building material inputs and support modernization of the Construction Technologies.<br>h. Developing indigenous and cost effective approaches particularly for Low-income group.<br>i. Omitted.<br>j. Omitted.<br>k. Introduce a firm and clear-cut institutional and legal framework at all levels of Government with well-defined roles and responsibilities. Removal of shortcomings, gaps and over laps and devise institutional coordination mechanism, transparency and accountability.<br>l. Realizing the importance of role of Private Sector, introduce incentives to encourage their full participation in National Building initiatives.<br>m. Supportive policy for Construction Sector standardizing of contract procedures and enforcement of quality control measures.<br>n. Omitted.<br>o. Omitted.<br>p. Omitted.<br>q. Formulation of system to monitor and evaluate implementation of guidelines provided under Hosing Policy and to ensure coordination with other national level development strategies. |
| Focused item | 1. Lands,<br>2. Housing Finance,<br>3. Construction Services Sector,<br>4. Kachi Abadis, Squatter Settlements & Slum,<br>5. Planning, Zoning and Building Regulations,<br>6. Building Materials, Construction Technology and Research and Development,<br>7. Low-income, Low-Cost and Rural Housing,<br>8. Infrastructure Development,<br>9. Development of Intermediate and Secondary Towns,<br>10. Women in Housing and Community Participation and,<br>11. Institutional and Legal Framework. |

Source: National Housing Policy 2001, MOHW

## 2.3 Stakeholders regarding EE&C in the Building Sector in Pakistan

EE&C policy requires many government department involvement in federal and provincial level. Building sector also requires several stake holders involvement too. Below diagram indicates rough idea of each stakeholders role and function.




Source: Prepared by JST

Figure 2.3-1 Roles and function of stakeholders.

### 2.3.1 Federal Government

Federal governmental organizations involved in the building sector are shown in Figure 2.3-2. In Pakistan, in addition to ENERCON, the Pakistan Engineering Council (PEC) and Pakistan Standard and Quality Control Authority (PSQCA), which are under the umbrella organization of the Ministry of Science and Technology (MOST) and the Ministry of Housing and Works (MOHW), Capital Development Authority (CDA) under Cabinet Secretariat are involved in EE&C of the building sector.

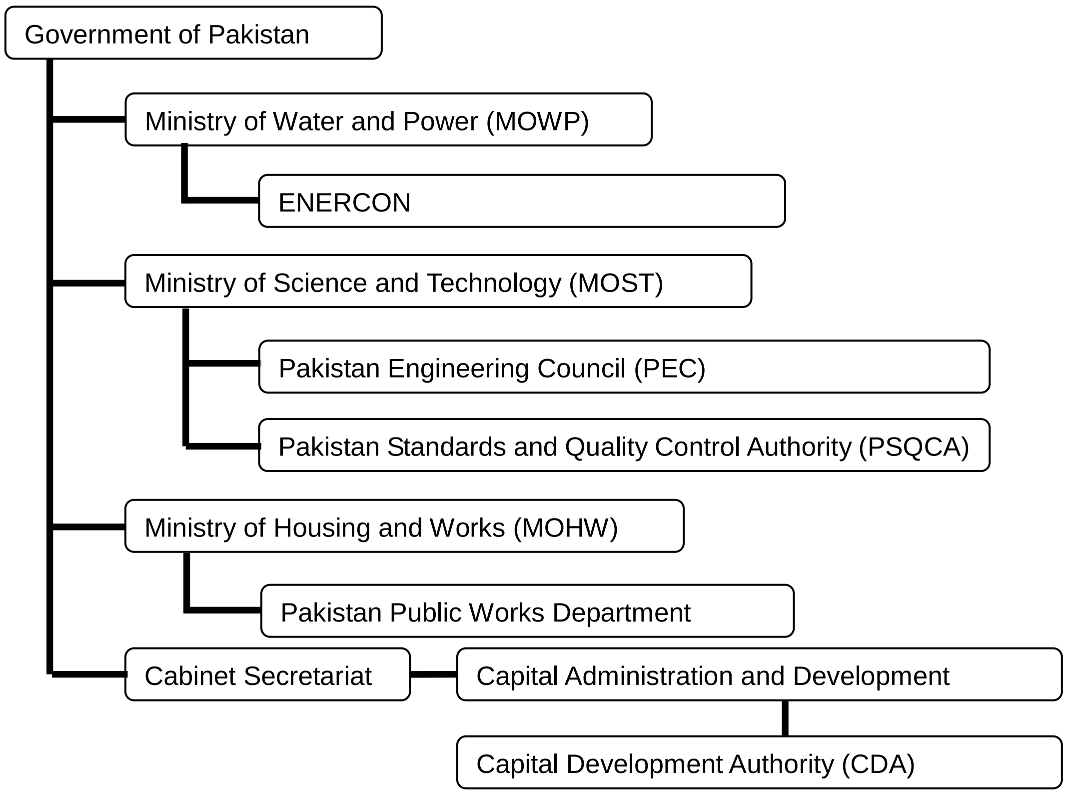



Figure 2.3-2 Federal Governmental Organizations Regarding the Building Sector

(1) Ministry of Water and Power

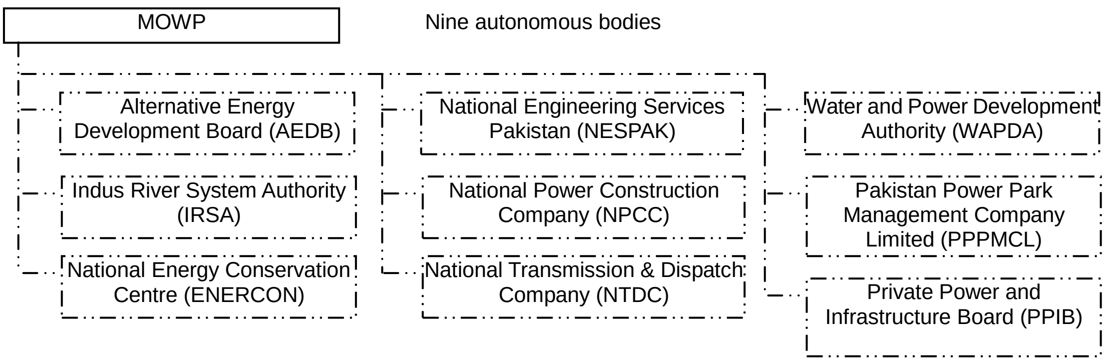
The function of MOWP (as per the Rule of Business, 1973) is shown in Table 2.3-1. MOWP has responsibilities to develop, construct and institute matters regarding power and water. MOWP has nine Autonomous Bodies, i.e. Alternative Energy Development Board (AEDB), Indus River System Authority (IRSA), National Energy Conservation Centre (ENERCON), National Engineering Services Pakistan (NESPAK), National Power Construction Company (NPCC), National Transmission & Dispatch Company (NTDC), Pakistan Power Park Management Company Limited (PPPMCL), Private Power and Infrastructure Board (PPIB) and Water and Power Development Authority (WAPDA). Its organization is shown in Figure 2.3-3.

EE&C for the building sector will require improved public awareness and analysis of energy usage. As EE&C involves several aspects, multiple ministries will be involved to form new policy. ENERCON as a counterpart of this survey, MOWP is expected to establish an initiative to obtain inter-ministry consensus.

Table 2.3- 1 Function of MOWP (as per Rule of Business, 1973)

| | | |
|---|---|---|
| 1. | Matters relating to development of water and power resources of the country. | |
| 2. | Indus Waters Treaty, 1960, and Indus Basin Works. | |
| 3. | (a) | Water and Power Development Authority; |
| | (b) | Matters relating to electric utilities. |
| 4. | Liaison with international engineering organizations in water and power sectors, such as International Commission on Large Dams, International Commission on Irrigation and Drainage and International Commission on Large Power Systems(Cigre). | |
| 5. | Federal agencies and institutions for promotion of special studies in water and power sectors. | |
| 6. | (a) | Electricity; |
| | (b) | Karachi Electric Supply Corporation and Pakistan Electric Agencies Limited. |
| 7. | (a) | Omitted vide SRO 226(I)/2010 (F.No.4-4/2007-Min-I), dated 2.04.2010; |
| | (b) | Institute of Engineers, Pakistan. |
| 8. | National Engineering (Services) Pakistan Limited. | |
| 9. | Administrative control of: | |
| | (i) | Tubewell Construction Company; |
| | (ii) | National Power Construction Company. |
| 10. | Indus River System Authority (IRSA). | |
| 11. | Omitted vide S.R.O. No.195(I)/2002, dated 2.4.2002. | |
| 12. | Private Power and Infrastructure Board. | |
| 13. | Administrative Control of Alternative Energy Development Board. | |
| 14. | Pakistan Trans-border Water Organization. | |

Source: Schedule II of Rule of Business, 1973 (As Amended on 16th August, 2012), Pakistan




Source: Prepared by JICA Survey Team based on website of MOWP

Figure 2.3- 3 Organization of MOWP

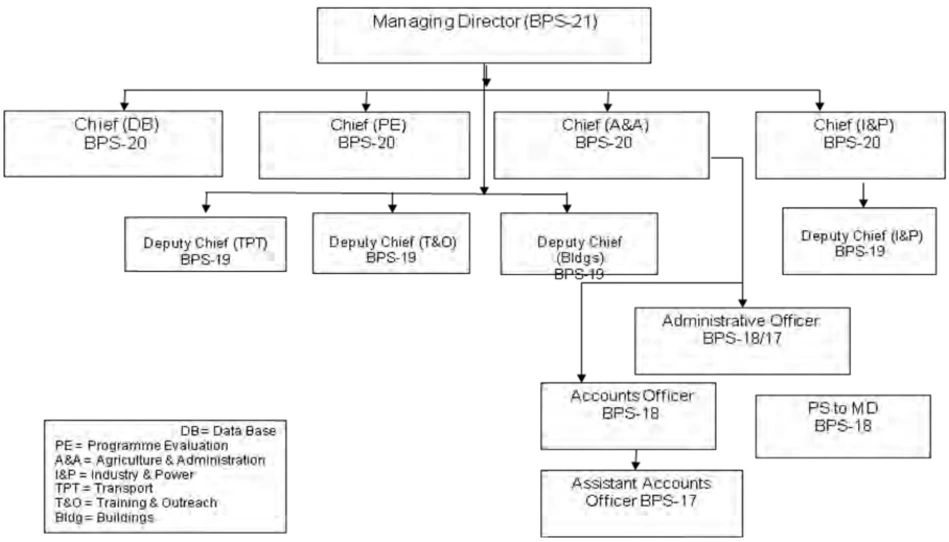
(2) ENERCON

The National Energy Conservation Centre (ENERCON) is an attached Department of the MOWP and serves as a federal focal agency mandated to initiate, catalyze and coordinate all energy conservation activities in all sectors of the economy. According to the ENERCON 2012-2013 YEARBOOK, the primary objective of ENERCON programs is to increase the energy supply to all sectors of Pakistan's economy by reducing energy waste and improving end-use efficiency. The secondary objective is to reduce foreign exchange expenditure on imported crude oil and refined petroleum products by "backing out" oil where possible. The programs implemented by

ENERCON cover all economic sectors and incorporate all the functions necessary to save energy on a national level.

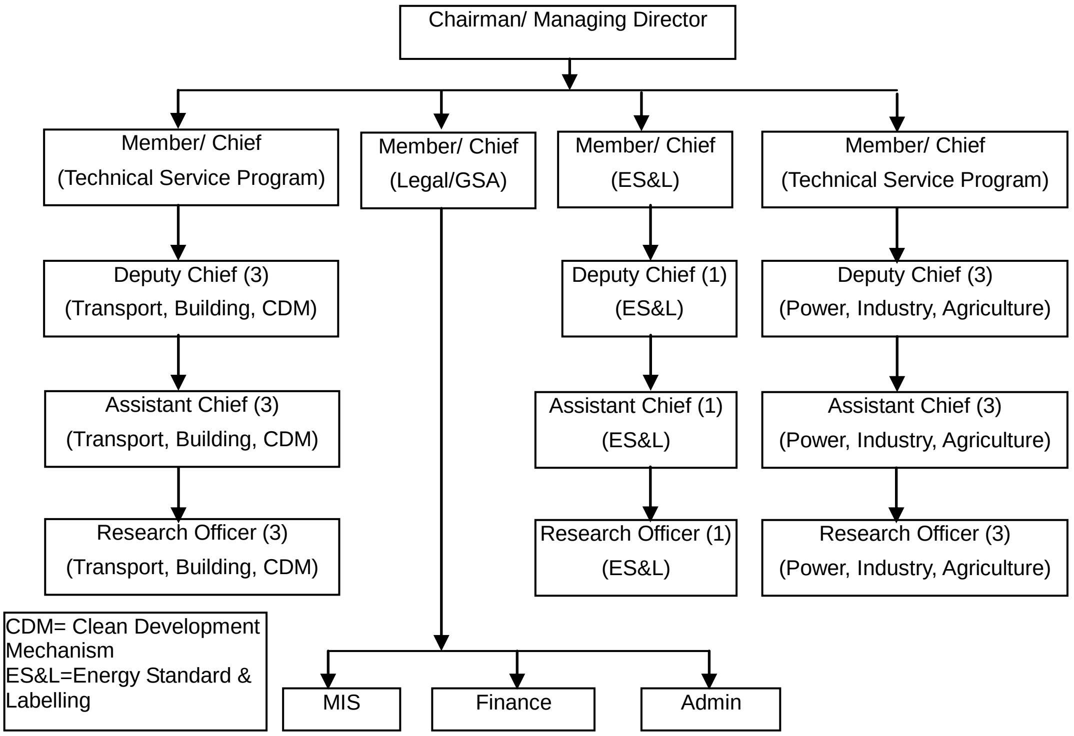
ENERCON has been tasked with wide-ranging responsibilities, including: (i) formulating energy conservation programs in all the main energy-consuming sectors, including agriculture, buildings, industry & power and transport; (ii) planning and initiating energy conservation action nationwide; (iii) outlining policy guidelines to support energy conservation initiatives; (iv) developing a comprehensive database of opportunities for energy conservation; (v) supporting training activities on energy conservation applications; (vi) undertaking field research and pilot demonstration activities on specific energy conservation options and technologies; and (vii) monitoring the implementation of conservation programs by other public and/or private sector entities.

ENERCON will renew after the EE&C Bill is enacted. The organization of existing ENERCON and that of renewal ENERCON are shown in Figures 2.3-4 and 2.3-5 respectively. Now, ENERCON has five wings, i.e. buildings, industry & power, transportation, training & outreach, agriculture & administration and will have seven wings after enactment, i.e. buildings, ES&L, industry, power, Clean Development Mechanism (CDM), transport and agriculture.
The activity record of ENERCON in the building sector is shown in Table 2.3-2. ENERCON had acted to review and upgrade the Building Energy Code and conducted an energy audit of 15 buildings. According to the 2012-2013 YEARBOOK of ENERCON, ENERCON estimated EE&C potential of up to 30% in the building sector.




Source: Information from ENERCON

Figure 2.3- 4 Organizational Chart of Existing ENERCON (as of end of March 2015)




Source: Information from ENERCON

Figure 2.3-5 Organizational Chart of Renewal ENERCON (as of end of November 2014)

Table 2.3-2 Activity Record of ENERCON in the Building Sector

| | |
|---|---|
| Review and up-gradation of Building Energy Code | Developed of Building Energy Code completed.<br>Development & Implementation strategy (SRO) approved. |
| Conduct of Building Energy audits | ENERCON had carried out energy audit on such buildings,<br>ENERCON Building, G-5/2,Islamabad.<br>Hydro Carbon Development Institute of Pakistan, H-9/1, Islamabad.<br>U -Fone Building Gulberg –II Lahore.<br>Telephone House, PTCL ,The Mall Peshawar Cantt.<br>R.C.O.D Complex, G-8/4, Islamabad<br>University of Peshawar, Peshawar<br>Ministry of Environment, Islamabad<br>Prime Minister's Secretariat, Islamabad<br>A-block Pak Secretariat, Islamabad<br>B-block Pak Secretariat, Islamabad<br>C-block Pak Secretariat, Islamabad<br>D-block Pak Secretariat, Islamabad<br>P-block Pak Secretariat, Islamabad<br>R-block Pak Secretariat, Islamabad<br>S-block Pak Secretariat, Islamabad |

Source: summarized by JICA survey team based on YEAR BOOK 2012-2013 of ENERCON

### (3) Ministry of Science and Technology

The function of MOST (as per the Rule of Business, 1973) is shown in Table 2.3-3. MOST is the national focal point and enabling arm of the Government of Pakistan for planning, coordinating and directing efforts; to initiate and launch scientific and technological programs and projects as per the national agenda for sound and a sustainable Science & Technology Research base for socioeconomic development, to achieve a vision for a better Pakistan. The organization of MOST is shown in Figure 2.3-6.

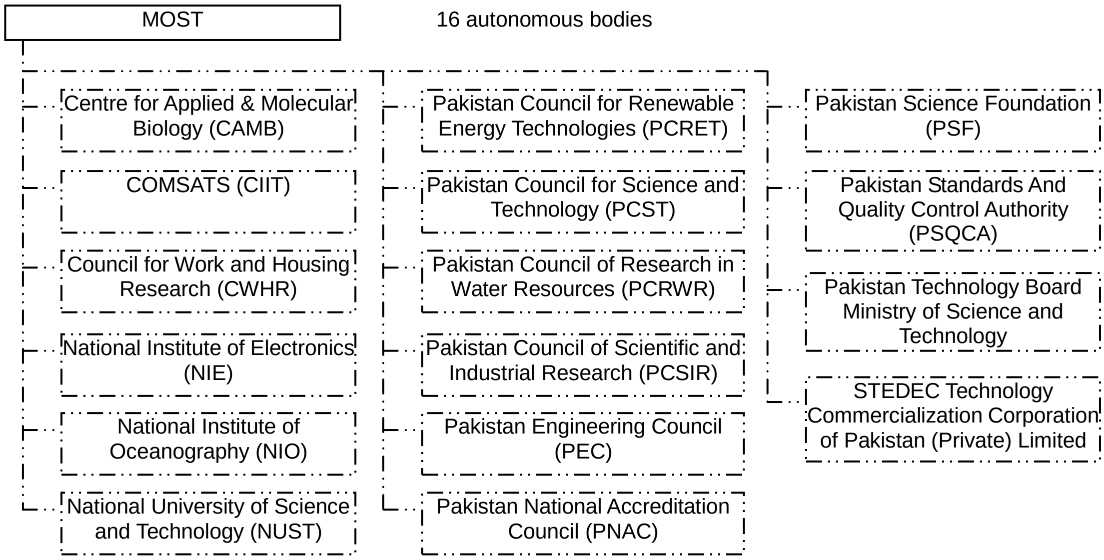
MOST has 16 Autonomous Bodies, i.e. a Centre For Applied & Molecular Biology (CAMB), COMSATS (CIIT), Council for Work and Housing Research (CWHR), National Institute of Electronics (NIE), National Institute of Oceanography (NIO), National University of Science and Technology (NUST), Pakistan Council for Renewable Energy Technologies (PCRET), Pakistan Council for Science and Technology (PCST), Pakistan Council of Research in Water Resources (PCRWR), Pakistan Council of Scientific and Industrial Research (PCSIR), Pakistan Engineering Council (PEC), Pakistan National Accreditation Council (PNAC), Pakistan Science Foundation (PSF), Pakistan Standards and Quality Control Authority (PSQCA), Pakistan Technology Board Ministry of Science and Technology, STEDEC Technology Commercialization Corporation of Pakistan (Private) Limited. EE&C for the building sector requires certification/accreditation of building material and equipment as well as capacity development for engineers. Improvement of the current framework and/or the establishment of a new system will require coordination with MOST.

Table 2.3- 3 Function of MOST (as per Rule of Business, 1973)

1. Establishment of science cities.
2. Establishment of institutes and laboratories for research and development in the scientific and technological fields.
3. Establishment of science universities as specifically assigned by the Federal Government.
4. Planning, coordination, promotion and development of science and technology monitoring and evaluation of research and development works, including scrutiny of development projects and coordination of development programmes in this field.
5. Promotion of applied research and utilization of results of research in the scientific and technological fields carried out at home and abroad.
6. Guidance to the research institutions in the Federation as well as the provinces in the fields of applied scientific and technological research.
7. Coordination of utilization of manpower for scientific and technological research.
8. Promotion and development of industrial technology.
9. Promotion of scientific and technological contacts and liaison nationally and internationally, including dealings and agreements with other countries and international organizations.
10. Initiate promotional measures for establishment of venture capital companies for technological development and growth.
11. Support to NGOs concerned with development of science and technology.
12. Promotion of metrology Standards, Testing and Quality Assurance System.
13. National Commission for Science and Technology.
14. Pakistan Council of Scientific and Industrial Research.
15. Omitted vide Cab: Div: Notification No.4-6/97-Min.I dated 3.3.1998.
16. Pakistan Council of Research in Water Resources.
17. Omitted vide SRO 226(I)/2010 (F.No.4-4/2007-Min-I), dated 02.04.2010.
18. <u>Council for Works and Housing Research.</u>
19. Omitted vide SRO 226(I)/2010 (F.No.4-4/2007-Min-I), dated 02.04.2010.
20. Omitted vide SRO 226(I)/2010 (F.No.4-4/2007-Min-I), dated 02.04.2010.
21. Centre for Applied Molecular Biology.
22. Pakistan Science Foundation.
23. National Institute of Electronics.
24. Pakistan Council of Science and Technology.
25. National Institute of Oceanography.

26. Omitted vide SRO 226(I)/2010 (F.No.4-4/2007-Min-I), dated 02.04.2010.
27. Omitted vide SRO 226(I)/2010 (F.No.4-4/2007-Min-I), dated 02.04.2010.
28. Scientific and Technological Development Corporation.
29. National University of Science and Technology.
30. Pakistan Standards and Quality Control Authority (PSQCA).
31. Prescription of standards and measures for quality control of manufactured goods.
32. Establishment of standards of weights and measures.
33. Development, deployment and demonstration of renewable sources of energy."
34. Pakistan National Accreditation Council (PNAC).
35. Pakistan Council of Renewable Energy Technologies (PCRET).
36. COMSATS Institute of Information Technology.
37. Pakistan Engineering Council (PEC).
38. Omitted vide SRO1088(I)/2011, (4-14/2011-Min-I) dated 09.12.2011.
39. Omitted vide SRO1088(I)/2011, (4-14/2011-Min-I) dated 09.12.2011.

Source: Schedule II of Rule of Business, 1973 (As Amended on 16th August, 2012), Pakistan




Source: Prepared by JICA Survey Team based on website of MOST

Figure 2.3-6 Organization of MOST

(4) Pakistan Engineering Council

The Pakistan Engineering Council (PEC) is a statutory body, constituted under the PEC Act 1976 (V of 1976) amended up to 24 January, 2011, PEC acts to regulate the national engineering profession in order to achieve rapid and sustainable growth in all national, economic and social fields. PEC strive to set and maintain realistic and internationally relevant standards of professional competence and ethics for engineers, license engineers and engineering institutions to competently and professionally promote and uphold such standards. The powers and functions of PEC are shown in Table 2.3-4.

Table 2.3- 4 Power and Functions of PEC (as per PEC Act, 1976)

| |
|---|
| The powers and functions of the Authority shall be -<br>(a) maintenance of a Register of persons qualified to work as registered engineers, professional engineers, consulting engineers, constructors and operators;<br>(b) accreditation of engineering qualifications for the purpose of registration of registered engineers, professional engineers;<br>(c) removal of names from the Register and restoration to the Register of names which have been removed;<br>(d) laying down of standards of conduct for the members;<br>(e) safeguarding the interests of the members;<br>(f) promotion of reforms in the engineering profession;<br>(g) management of the funds and properties of the Council;<br>(h) promotion of engineering education and review of courses of studies in consultation with the Universities;<br>(i) levy and collection of fees from applicants for registration or temporary licenses and members;<br>(j) exercise of such disciplinary powers over the members and servants of the Council as may be prescribed;<br>(k) formation of such committees and subsidiaries as may be prescribed;<br>(l) assistance to the Federal Government as a Think Tank;<br>(m) promotion of engineering profession in totality;<br>(n) encouragement, facilitation and regulation of working of professional engineering bodies for creativity and as custodian of engineering under the umbrella of the Council;<br>(o) ensuring and managing of continued professional development through engineering academies and professional bodies;<br>(p) establishing standards for engineering contracts, cost and services;<br>(q) facilitating engineering sector industries;<br>(r) coordinating between various engineering forums and Federal Government;<br>(s) providing forum for arbitrations, pertaining to disputes in construction and consultancy contracts, and<br>(t) performance of all other functions connected with, or ancillary or incidental to, the aforesaid functions. |

Source: Section 8 of PEC Act, 1976, Pakistan

Its main statutory functions include registration of engineers, consulting engineers, constructors/operators and accreditation of engineering programmes run by universities/institutions, ensuring and managing of continuing professional development, assisting the Federal Government as a think tank, establishing standards for engineering products and services besides safeguarding the interests of its members. PEC facilitate and regulate the work of professional engineering bodies for creativity.

PEC interacts with the Government, both at Federal and Provincial level, by participating in Commissions, Committees and Advisory Bodies. PEC is a fully representative body of the national engineering community. PEC has also been providing support to the Government in conducting technical enquiries and recommending remedial measures on the relevant subjects. Over the years, PEC has spoken for the engineering profession as a whole in the country and acts role of intermediation between Government, industry and education. PEC maintains a very lean secretariat at its Islamabad headquarters and branch offices in all provincial capitals.

PEC prepared the following documents:

- Building Code of Pakistan Seismic Provisions-2007 (For periodic updating)
- Building Code of Pakistan Energy Provision-2011 (Implementation Plan)
- Pakistan Electric and Telecom Safety code (First draft finalized)
- National Fire Safety Code (Under development)

PEC has the power to grant licenses and has established a dedicated 'Registration Department' to handle applications for constructors and consultants and grant licenses on merit and due qualifications in line with due official process.A list of approved and notified documents is available at the PEC website for ready reference, likewise application forms for constructors and consultants. The above registration system is mandatory and participants should renew their licenses every year.

After qualifying from PEC-accredited engineering programs, PEC registers engineering graduates as 'Registered Engineers'. Now after notification of the CPD Bye-laws 2008, continuing professional development activities (short courses, seminars, workshops, writing articles etc.) becomes mandatory for all registered and professional engineers on an annual basis. Every CPD activity has been allocated CPD points as mentioned in CPD Bye-laws 2008.

(5) Pakistan Standards and Quality Control Authority

The Pakistan Standards and Quality Control Authority (PSQCA), under the Ministry of Science and Technology, is the national standardization body. In performing its duties and functions, the PSQCA is governed by the PSQCA Act, 1996. The power and functions of PSQCA are shown in Table 2.3-5.

The components of PSQCA and its organizational chart are shown in Table 2.3-6 and Figure 2.3-7. The PSQCA is headquartered in Karachi. Whereas PSQCA-TSC-Lahore has only material testing facilities, e.g. for tensile strength tests, bending tests, hardness tests and impact tests of steel and other materials, PSQCA-QCC-Lahore also includes some electrical testing facilities for safety standards.

Table 2.3- 5 Power and Functions of PSQCA (as per PSQCA Act, 1996)

The powers and functions of the Authority shall be -

(i) designing, measuring and testing instruments and test procedures :

(ii) inspection and testing of products and services for their quality, specification and characteristics, during use and for import and export purposes;

(iii) to review of matters which may be necessary for quality improvement of products or processes;

(iv) preparation, implementation, coordination or arranging of the training programmers on standardization, quality control testing and weights and measures, for technical staff of the Authority, other organizations and trainees from foreign countries;

(v) setting up, assisting in, establishing and authorizing various inspection and testing centers and agencies at important industrial sites and towns;

(vi) providing for the quality labeling standards which shall specify ingredients, performance, specification, usage, methods and other relevant quality control matters;

(vii) grading the products when requested by manufacturers, or whenever necessary for the purpose of quality improvement;

(viii) setting up the mode of inspection and the manner in which samples may be obtained;

(xi) examination of manufacturing plants for the designated products or processes for approval of marks of the Authority;

(x) to stop manufacture, storage and sale of such products which do not conform to the Pakistan or any other country's standards recognized by the Authority;

(xi) inspection and taking of samples of any material or product for examination as to whether any article or process in relation to which any of Authority mark has been used conforms to the Pakistan standard or a standard of any other country recognized by the Authority or whether any of the Authority mark has been improperly used in relation to any article or process with or without license or certificate;

(xii) specification of the manner and condition subject to which a license or certificate to use any of the Authority marks may be granted or renewed, suspended, cancelled or withdrawn;

(xiii) granting, renewal, suspension, cancellation or withdrawal of a license or certificate for the use of any of the Authority marks;

(xiv) levying of fees, for marking, grant or renewal of any license or certificate in relation to use of any of the Authority marks;

(xv) levying of fees for checking, inspection and testing of products for import, export or local consumption;

(xvi) framing and publishing, amending, revising or withdrawal of the Pakistan Standards in relation to any article, product, process;

(xvii) determination of Pakistan Standards for the measurement of length, weight, volume energy and materials;

(xviii) collection, circulation of statistical and other information relating to standardization, quality control, metrology, applied research;

(xix) establishment, maintenance of libraries, museum, laboratories and accrediting of other laboratories for the purpose of furthering the practices of standardization, metrology and quality control;

(xx) communication with public and Governmental agencies on national and international levels, on matters connected with standardization and other activities of the Authority through circulars, books, public media or through seminars, symposia, workshops and printing and publishing such circulars and books;

(xxi) securing recognition of the Pakistan Standards and confidence in Pakistani products abroad;

(xxii) registration of inspection agencies;

(xxiii) coordination and cooperation with other national, regional and international organizations, associations, societies, institutions or councils, whether incorporate or not, whose objects are wholly or in part similar to those of the Authority; and

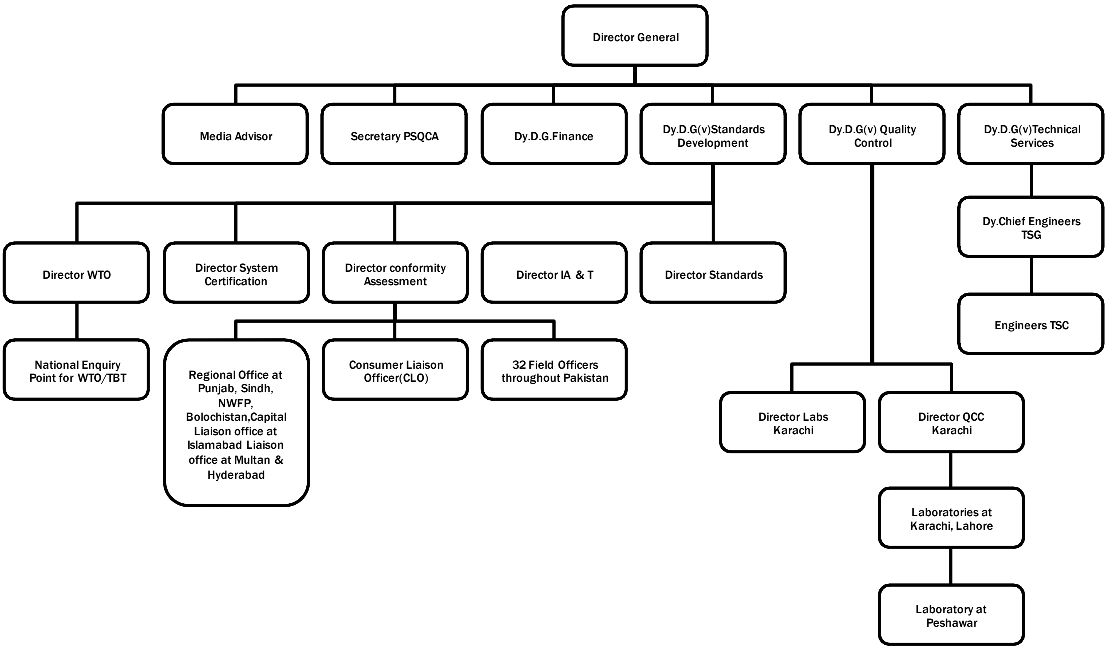
(xxiv) constitution of committees for carrying out the schemes and programmers of the Authority.

Source: Section 9 of PSQCA Act, 1996, Pakistan

Table 2.3-6 Components of PSQCA

| | |
|---|---|
| Standards Development Centre (SDC) | Established in 1951 under the Ministry of Industries (MOST, 1995)<br>Formulation of national standards as per mandate of the PSQCA Act, keeping in view the concept of quality, safety, and health efficiency as basic parameters for sustainable development. |
| Quality Control Centre (QCC) | Established in 1951 under the Ministry of Industries (MOST, 1995)<br>The QCC undertakes testing of industrial raw material and finished products for conformity assessment to establish their quality, with reference to national/international standards. |
| Technical Services Centre (TSC) | Established in 1975 under the Ministry of Industries (MOST, 1995)<br>The TSC is focused on research and development on metal and metallurgical industrial products. |
| System Certification Centre (SCC) | PSQCA, which is responsible to develop and strengthen the quality infrastructure of Pakistan, has established SCC. SCC is an independent operational arm of PSQCA. Main responsibility of SCC is to provide certification and training services to local SMEs in particular and all businesses in general in the areas of management system standards. |

Source: Prepared by the JICA Survey Team




Source: Webpage of PSQCA

Figure 2.3- 7 Organizational Chart of PSQCA

(6) Ministry of Housing and Works

Ministry of Housing and Works (MOHW) is responsible for acquisition and development of sites as well as construction and maintenance of Federal Government buildings. Function of MOHW (as per Rule of Business, 1973) is shown in Table 2.3-7. There is no ministry to deal with construction activity in the private sector in federal government.

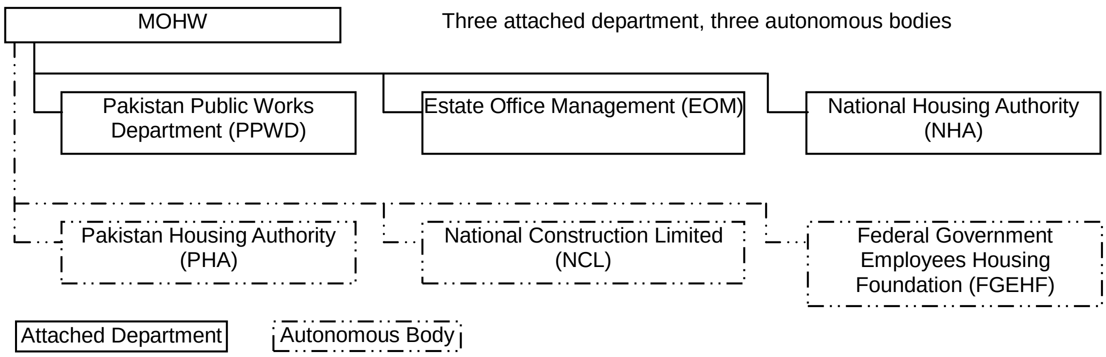
Organization of MOHW is shown in Figure 2.3-8. MOHW has three Attached Departments, i.e. Pakistan Public Works Department (PPWD), Estate Office Management (EO) and National Housing Authority (NHA) and three Autonomous Bodies, i.e. Pakistan Housing Authority (PHA), National Construction Limited (NCL) and Federal Government Employees Housing Foundation (FGEHF).

MOHW was involved in the Building Code of Pakistan, both in Energy Provision and Seismic Provision. In those building codes, a statement of copyright of international standard such as UBC and ASHRAE are indicated under the MOHW name. To promote EE&C in the building sector, improvement of government buildings will require coordination with MOHW.

Table 2.3- 7 Function of MOHW (as per Rule of Business, 1973)

| |
|---|
| 1. Acquisition of Federal Government buildings, except those under the Defence Division. |
| 2. Provision of Government owned office accommodation and residential accommodation, policy for acquisition, requisitioning and hiring of office and residential accommodation for officers and staff of the Federal Government. |
| 3. Fixation and recovery of rent of Government owned, hired and requisitioned buildings. |
| 4. Management of Federal Lodges. |
| 5. Land and buildings belonging to the Federation wherever situated and revenues derived therefrom. |
| 6. Administration of the Federal Government Lands and Buildings (Recovery of Possession) Ordinance, 1965. |
| 7. Matters relating to the Federal Government lands licenses to various Cooperative Housing Societies in Karachi, except those under the Defence Division. |
| 8. Transfer of property, other than agricultural land, registration of deeds and documents. |
| 9. Administrative control of the National Housing Authority. |
| 10. National Housing Policy. |

Source: Schedule II of Rule of Business, 1973 (As Amended on 16th August, 2012), Pakistan




Source: Prepared by JICA Survey Team based on website of HOHW

Figure 2.3-8 Organization of MOHW

(7) Pakistan Public Works Department

The Pakistan Public Works Department (PPWD) is a Federal Department operating under the Ministry of Housing and Works as attached department, headquartered in Islamabad and with sub-offices in all major cities nationwide. PPWD has been in operation since pre-independence days. This organization is the oldest in Pakistan. As per the Rules of Business, 1973, the PPWD is responsible for all federal government buildings and is presently maintaining 131 office buildings and 16,000 residential buildings/houses/apartments etc. PPWD follows procedures for designing/constructing buildings as laid down in the PPWD code 1982 (revised).

In the year 1993-94, a ban was imposed on constructing housing units for federal government employees and it was decided to give them monthly house rent, since which time no further houses have been constructed by the PPWD. The government has established different authorities/departments for housing units e.g. the Pakistan Housing Authority (PHA) and the Federal Government Employees Housing Foundation (FGEHF). Further, from 1994, approval of PC-I against residential accommodation was banned by the Government. A summary of PPWD is shown in Table below.

Table 2.3-8 Summary of PPWD

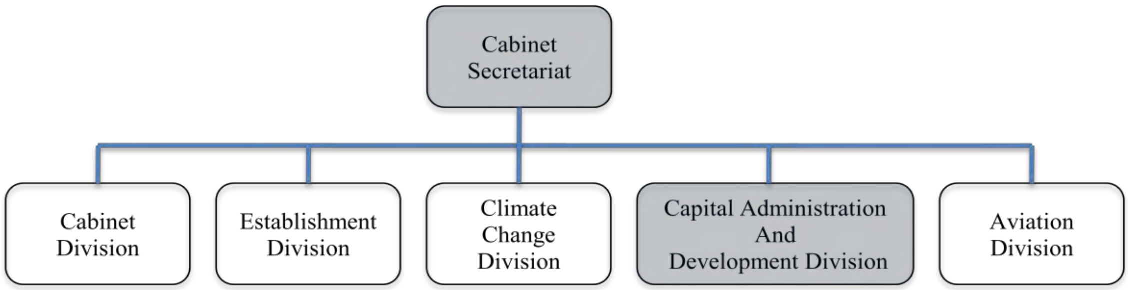
| | Summary |
|---|---|
| Mission (Aim) | To execute office and residential buildings federally funded project except for those of Defence. |
| Vision (Objective) | To execute the offices and residential accommodation for federal Government employee and to overcome the backlog of millions of square foot of office space. |
| Scope | a) Public Sector Development Programme: 36-37 federally funded PSDP project are going to started in the financial year 2015-2016<br>b) Deposit Works: PPWD have 103 buildings under deposit work.<br>c) Maintenance: PPWD carry out maintenance of 131 office buildings and 16,000 residential houses/apartments |
| Function | a) Acquisition and development of Federal Government lands.<br>b) Maintenance of all federally owned Government Building and their furnishing except those financed from Defence budget.<br>c) Construction of federally financed Government Offices and residential accommodation.<br>d) Management of Federal Lodges.<br>e) To act as technical adviser to Federal Government in Engineering matters. |

Source: Prepared by JICA Survey Team based on website of Pakistan Public Works Department and interview from PWD.

(8) Cabinet Secretariat and Capital Administration and Development Division（CAD）

1) Cabinet Secretariat

Capital Administration and Development Division（CAD）is one division of Cabinet Secretariat, and Capital Development Authority (CDA), which regulates building control in Islamabad, is one of ten division of Capital Administration and Development Division（CAD）.




Source: CAD website

Figure 2.3-9 Cabinet Secretariat

2) Capital Administration and Development Division (CAD)

Capital Administration and Development Division has been created in wake of the 18th Constitutional Amendment. The Division is mainly responsible to execute all such functions being previously performed by the abolished Ministries/ Divisions within the jurisdiction of the

Federal Capital Area. As such, functions of the Division are multifarious capturing a range of subjects like health, social welfare, education, rehabilitation of persons with disabilities, population welfare, etc.

Table 2.3-9 Capital Administration and Development Division

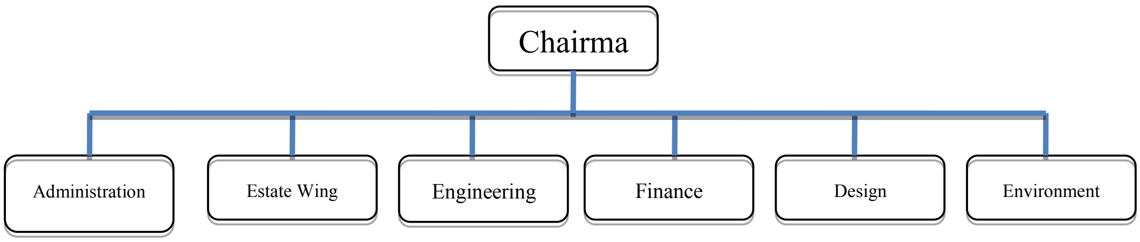
| | |
|---|---|
| Directorate Of Workers Education | Capital Development Authority |
| Department of Tourist Services | Directorate General of Special Education |
| District Population Welfare Office (DPWO) | Federal College of Education |
| Federal Directorate of Eductaion | FG Polytechnic Institute of Women |
| Gun & Country Club | Human Organs Transplant Authority (HOTA) |

Source: Website of Capital Administration and Development Division http://www.mocad.gov.pk/

(9) Capital Development Authority

CDA came into existence on June 14, 1960, initially by an executive order issued on June 24, 1960 known as the Pakistan Capital Regulation, later superseded by the CDA ordinance issued on June 27, 1960.

The objective of the Ordinance initially includes planning and development of Capital (Islamabad) and secondly completing or authorizing the Capital Development Authority (CDA) to perform the functions of a Municipal Committee and ensure the cleanliness, health, education of inhabitants, supply of goods, articles of food and milk and promoting the interests of various sections of the public. CDA comprises the chairman secretariat and six wings as follows:




Source: Website of CDA; http://www.cda.gov.pk/

Figure 2.3-10 Organization of CDA

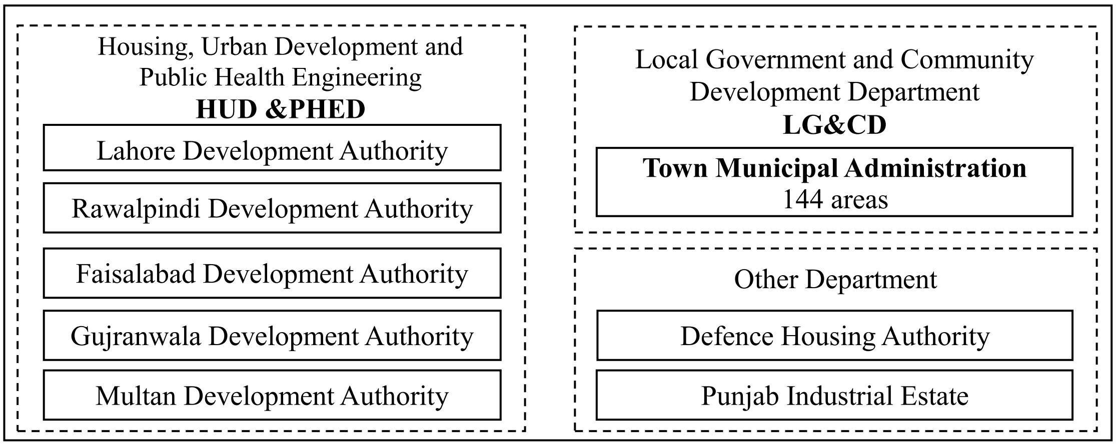
All construction projects in Islamabad have to be approved by the CDA prior to construction. On completion, buildings are then inspected by the CDA to ensure compliance with building regulations.

### 2.3.2 Provincial and Local Government

(1) Building Control in Punjab Province

Within the Punjab province, building regulatory bodies are divided into two major departments, namely HUD & PHED and LG&CD. In principle, HUD & PHED administrate five autonomous regulatory bodies and LG&CD administrate the remaining smaller cities and towns. Exceptions to the above include development areas under the power of other ministries or departments such as the Defence Housing Authority and Punjab Industrial Estate.

**PUNJAB GOVERNMENT**




Source: Created by JST

Figure 2.3-11 Structure of Punjab Province Building Authorities

The following table shows the structure of the Government of Punjab:

Table 2.3- 10 Structure of the Government of Punjab

| **Provincial Department** | | |
|---|---|---|
| Agriculture | Aqua and Religious Affairs | Board of Revenue |
| Chief Minister's Inspection Team | Communication and Works | Cooperatives |
| Energy | Environment Protection | Excise and Taxation |
| Finance | Food | Forest Wildlife and Fisher |
| Health | Higher Education | Home |
| **Housing, Urban Development and Public Health Engineering** | Human Rights and Minorities Affairs | Industries, Commerce and Investment Information and Culture |
| Irrigation | Labor and Human Resource | Law and Parliamentary Affair |
| Literacy and Non Formal Basic Education | Livestock and Dairy Development | **Local Government and Community Development** |
| Management and Professional Development | Mines and Minerals | Planning and Development |
| Population Welfare | Public Prosecution | School Education |
| Transport | Social Welfare and Bait-ul-Maal | Special Education |
| Services and General Administration | Women Development | Youth Affair, Sport, Archeology & Tourism |

Source: Website of the government of the Punjab

1) Housing, Urban Development and Public Health Engineering (HUD & PHED)

a) Role and Function of HUD&PHED

The Housing and Physical Planning Department (H & PP) was created in August 1972. Subsequently, the Improvement Trusts at Faisalabad, Gujranwala, Multan, Rawalpindi, Sargodha and Murree were placed under the administrative control of the Housing & Physical Planning Department during 1973. In 1978, the Public Health Engineering Department (PHED) was placed under the administrative control of H & PP. The Department was renamed the Housing Physical & Environmental Planning (HP & EP) in 1978 and the Environmental Protection Agency (EPA) was created as an attached wing. In 1996, the Environmental Protection Agency was detached from the HP & EP Department and made an independent provincial Department. Finally, the HP & EP was renamed "Housing, Urban Development & Public Health Engineering Department (HUD & PHED)" in 1997.

The following information was reviewed when interviewing the HUD & PHED on 9 June, 2015; HUD & PHED is a purely government department, assigned with administrative control of various organizations of Punjab Province working in major Punjab cities. This organization plays the role of policy-maker and monitors autonomous authorities like the Lahore Development Authority (LDA), Rawalpindi Development Authority (RDA), Faisalabad Development Authority (FDA), Gujranwala Development Authority (GDA), Multan Development Authority (MDA) and the Water & Sanitation Authority (WASA) in Punjab Province. Presently HUD & PHED has administrative control of more than 28 organizations in Punjab. Accordingly, HUD & PHED lacks any power and role to directly regulate any player in the building sector. As there is no Building Code of HUD & PHED, they are not involved in procedures to formulate such building code.

Regarding the Building Code of Pakistan (Energy Provision) for LDA, HUD & PHED stated that LDA is one of the leading regulators, which regulates civic laws to develop the building sector in Lahore for commercial, industrial and residential purposes. LDA has its own building laws/building codes which are being implemented but BCP-EP-2011 has not been adopted. The LDA is an autonomous body, which can create laws whenever required. Accordingly, the LDA should devise an idea for energy provision, whereupon the HUD & PHED will work on it as a government department. The present Organization of HUD & PHED departments are as follows:

Table2.3-11 Department of HUD & PHED

| | |
|---|---|
| Punjab Housing and Town Planning Agency (PHATA) | Public Health Engineering Department (PHED) |
| Lahore Development Authority (LDA) | Rawalpindi Development Authority (RDA) |
| Gujranwala Development Authority (GDA) | Faisalabad Development Authority(FDA) |
| Multan Development Authority (MDA) | Water and Sanitation Agency, Lahore |
| Water and Sanitation Agency, Rawalpindi | Water and Sanitation Agency, Gujranwala |
| Water and Sanitation Agency, Faisalabad | Traffic Engineering and Transport Planning Agency (TEPA), Lahore |
| Parks & Horticulture Authority (PHA), Lahore | Parks & Horticulture Authority (PHA), Faisalabad |
| Parks & Horticulture Authority (PHA), Multan | Improvement Trust (Murree & Sargodha) |

Source; Website of The government of the Punjab; http://punjab.gov.pk/

b) History of HUD & PHED

Table2.3-12 History of HUD & PHED

| | |
|---|---|
| 1972 | The Housing and Physical Planning Department (H & PP) was created. |
| 1973 | The Housing and Physical Planning Department (H & PP) was created Rawalpindi, Sargodha and Murree were placed under H & PP. |
| 1978 | Public Health Engineering Department (PHED) was placed under the administrative control of H & PP. The Department was renamed as Housing Physical & Environmental Planning (HP & EP) Environmental Protection Agency (EPA) was created as its attached wing. |
| 1996 | Environmental Protection Agency was detached from Housing Physical & Environmental Planning Department. |
| 1997 | Housing Physical & Environmental Protection Department was given the name as "Housing, Urban Development & Public Health Engineering Department (HUD & PHED)" |

Source: Website of The government of the Punjab http://punjab.gov.pk/

2) Development Authority

Out of five development authorities, JST reviewed the LDA and RDA in detail.

a) Lahore Development Authority (LDA)

The Lahore Development Authority (LDA) was created under the LDA Act 1975 and duly approved by the Punjab Legislative Assembly, formerly the Lahore Improvement Trust. It includes the following three wings:

Table 2.3-13 Wings of LDA

| Urban Development Wing | Water and Sanction Agency (WASA) | Traffic Engineering Planning Agency |
|---|---|---|
| the planning, designing and development of various projects. | the Planning, Designing, Development, Maintenance, Water Supply, Sewerage and Drainage System in Lahore. | the Planning, Designing and Development of Traffic and Transport System Roads & Project in Lahore. |

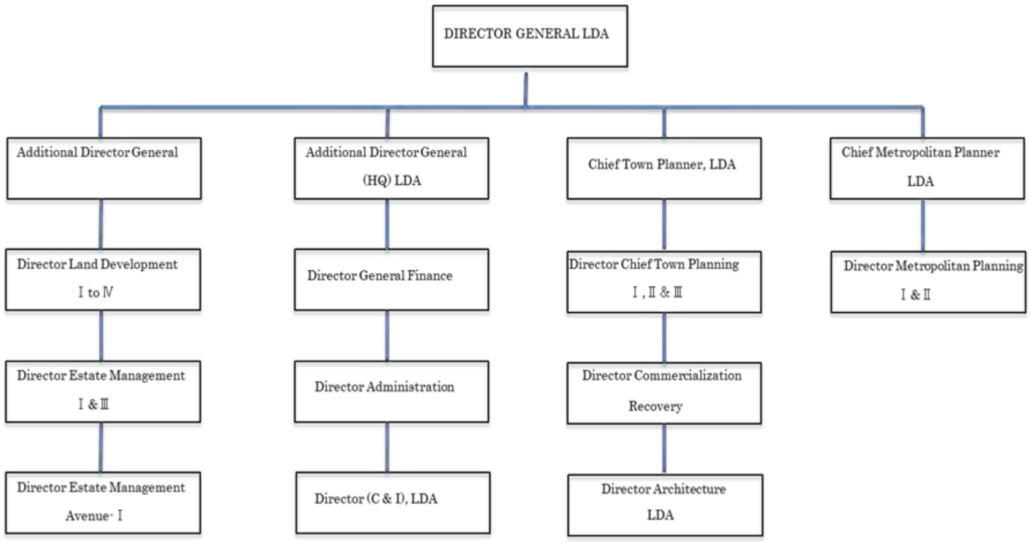
Source: Website of The government of the Punjab: http://punjab.gov.pk/

LDA has established One Window Operation to issue permission to construct residential, commercial and industrial plots. This One Window Operation comprises the following manpower:

Table 2.3-14 Planners of One Window Operation

| Chief Town Planner | Directors (Town Planning) | Deputy Directors (Town Planning) | Assistant Directors (Town Planning) |
|---|---|---|---|
| One person | Three persons | Seven persons | Forty persons |

Source: Meeting Minute with LDA June, 2015




Source: LDA

Figure 2.3-12 Organization of LDA

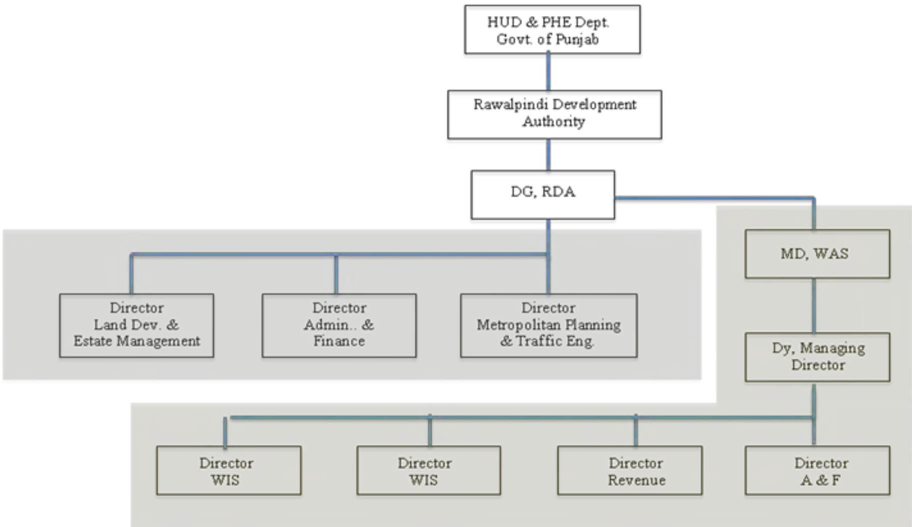
The LDA is primarily intended for housing and creating plots for both public and private sectors to develop housing schemes; second, to develop infrastructure, sewerage, water supply and drainage systems; third relates to TEPA (Transportation Energy Planning Agency).

The LDA has differing wings like the Urban Development Wing, which functions separately under the control of the Chief Engineer to develop roads/bridges and establish or build hospitals and schools etc. The Chief Metropolitan Planner, who is assigned to develop master plans for the whole division and regulate/outline development plans, classification, reclassification and development. The LDA has one Directorate of Architects, which deals in designs for houses/buildings, which the Chief Engineer subsequently executes at ground level, while monitoring mega projects like Metro, Intersection, free traffic signals etc.[8]

b) Rawalpindi Development Authority (RDA)

[8] Interview with LDA on 9 June, 2015

The RDA was established in May 1989 under the Punjab Development of Cities Act, 1976 as an Autonomous Body Replacing the Rawalpindi Improvement Trust (RIT). The RDA started functioning on March 1992. The organizational structure, function and building regulatory framework are as shown below.




Source; Website

Figure 2.3-13 Organization of RDA and HUD & PHE

Table 2.3-15; Function of RDA

| |
|---|
| 1.Plan, Guide, Control and Implementation Short and Long-Term Development Projects including Traffic study, Planning, Design and Preservation of Traffic & Transportation, Corridors, Roads, Bridges, Industry, Education, Health Planning execution.<br>2.Building, Land Use Control and urban development plans.<br>3.Launch Housing schemes and other Projects.<br>4.Approval and Control over Private Housing Schemes and all sort of others development.<br>5.Preservation and Improvement of Environment.<br>6.Land Development and Estate Management.<br>7.Evolve policies and Plans including their implementation.<br>8.Provisions and Maintenance of Water Supply, Sewerage and Drainage Services and Solid Waste.<br>9.Improvement, Beautification, Operation and Maintenance of Parks, Playgrounds, Major Roads Advertisement Hoardings etc.<br>10.Take any steps or adopt any measures for the face lifting and beautification of the area. Acquire property, both movable and immovable.<br>11.Sell, Lease, Exchange or otherwise Dispose of any property vested in it.<br>12. Undertake any works and incur any expenditure.<br>13. Procure machinery, instruments or any other material required by it.<br>14. Enter into contracts.<br>15 Cause Studies, surveys experiments, technical researches or contribute toward the cost of any such studies, surveys<br>16. Issue interim development order<br>17. Seek and obtain advice and assistance for the preparation of any scheme Establish an Agency / Agencies and entrust to it such powers and functions as it may deem fit with the approval of the Government. |

Source; Website of RDA; http://www.rda.gov.pk/

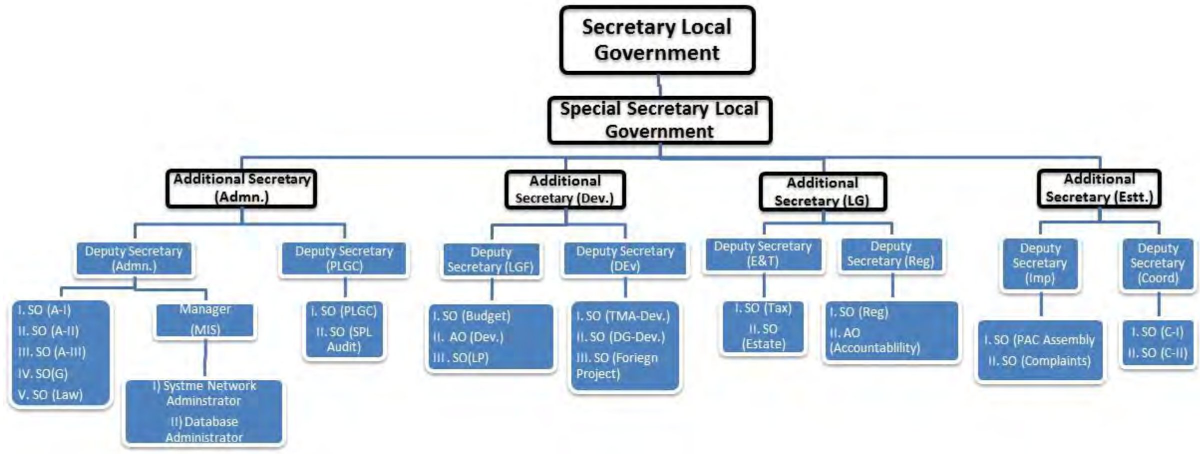
Table2.3-16: The operation regarding Building at RDA

| |
|---|
| 1. Standard Operating Procedure for Approval of Building Plan |
| 2. Procedure For Getting Completion Certificate |
| 3. One Window Procedures |
| 4. Procedure For Enlistment / Renewal of Contractors |
| 5. Procedure For Pre-Qualification of Contractors / Firms |
| 6. Tender Procedure |
| 7. Procedure For Selection of Consultants |
| 8. The Consultants Selection Committee (CSC) |

Source; Website of Rawalpindi Development Authority; http://www.cda.gov.pk/

3) Local Government & Community Development Department (LG&CD)

The major functions of LG&CD include a) to formulate public policy and its promulgation, updating the laws and rules and providing guidelines for the workings of local government, b) to coordinate with federal/provincial government departments and allied agencies, c) to administrate service personnel working in its attached departments, 144 Tehsil Municipal Administrations (TMAs) and 3464 Union Administrations.




Source: LG & CD website

Figure 2.3-14: Local Government Organization

Table 2.3-17 Punjab Division

| | | |
|---|---|---|
| TMA Bahawalpur Division | TMA Dera Ghazi Khan Division | TMA Faisalabad Division |
| TMA Gujranwala Division | TMA Lahore Division | TMA Multan Division |
| TMA Rawalpindi Division | TMA Sargodha Division | TMA Sahiwal Division |

Source: Local Government & Community Development website

Table 2.3-18 TMA Lahore Division

| | | | | |
|---|---|---|---|---|
| **District Lahore 9** | | | | |
| TMO Data Gunj Buksh | TMO Nishtar | TMO Aziz Bhatti | TMO Samanabad | TMO Wahga |
| TMO Ravi | TMO Allama Iqbal | TMO Shalimar | TMO Gulberg | |
| **District Sheikhupura 4** | | | | |
| TMO Sheikhupura | TMO Muridke | TMO Ferozwala | TMO Sharaqpur Sharif | |
| **District Nankana Sahib 4** | | | | |
| TMO Nankana Sahib | TMO Sangla Hill | TMO Safdarabad | TMO Shahkot | |
| **District Kasur 3** | | | | |
| TMO Kasur | TMO Chunian | TMO Pattoki | | |

Source: Local Government & Community Development website: http://lgcd.punjab.gov.pk/tma_lahore

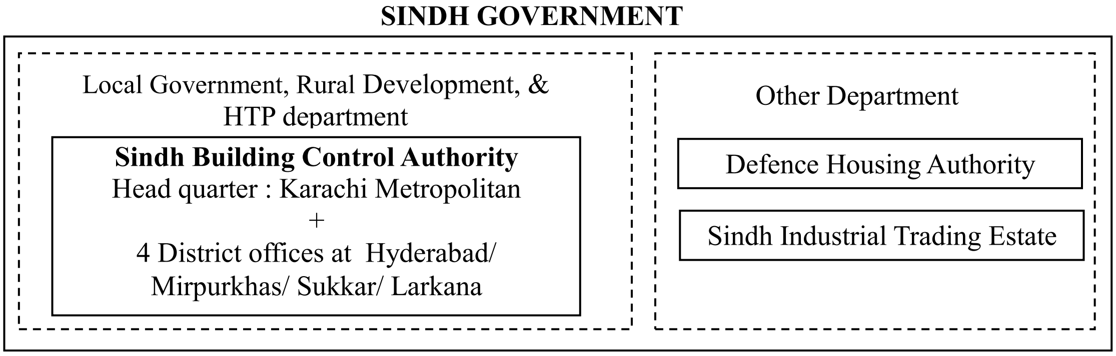
Table 2.3-19 TMA Rawalpindi Division

| | | | | |
|---|---|---|---|---|
| **District Rawalpindi** | | | | |
| Rawal Town | Kalar Saidan Town | Gujar Khan Town | Kahuta Town | Potohar Town |
| Murree Town | Taxila Town | Kotli Sattian Town | | |
| **District Attock** | | | | |
| TMO Attock | TMO Fateh Jhang | TMO Jand | TMO Hassanabdal | TMO Pindi Gheb |
| TMO Hazro | | | | |
| **District Chakwal** | | | | |
| TMO Chakwal | TMO Kalar Kahar | TMO Talagang | TMO Choa Sidan Shah | |
| District Jhelum | | | | |
| TMO Jhelum | TMO Dina | TMO Sohawa | TMO Pind Dadan Khan | |

Source: Local Government & Community Development website: http://lgcd.punjab.gov.pk/tma_lahore

(2) Building Control in Sindh Province

In Sindh Province, the Sindh Building Control Authority is the only building regulatory body for the entire Province, except for the development area under the power of other government entities.




Source: Created by JST
Figure 2.3-15 Structure of Sindh Province Building Authorities

1) History of SBCA

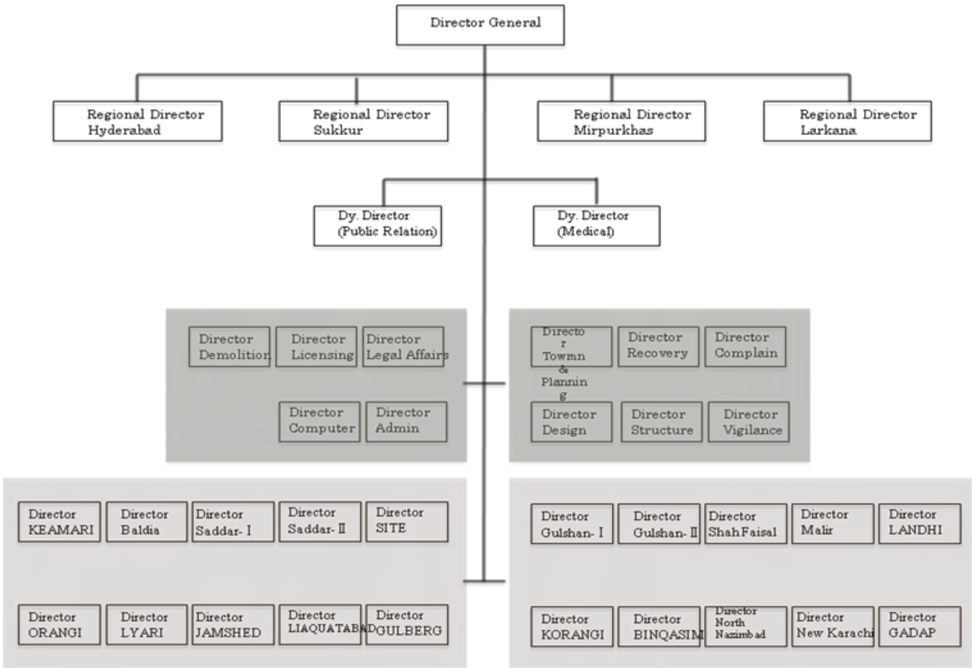
It was announced on 14 February, 2011, that the Government of Sindh had extended the area of the Karachi Building Control Authority (KBCA) to cover the whole of the Province of Sindh with the Headquarters of Karachi. KBCA was renamed the Sindh Building Control Authority (SBCA) as per the Karachi Building and Town Planning Regulations, 2002 (hereinafter referred to as KB&TP 2002). SBCA now has regional offices in the following cities of Sindh Province: Karachi Metropolitan, District Hyderabad, District Mirpurkhas, District Sukkar and District Larkana.

Table 2.3-20 History of SBCA

| | |
|---|---|
| 1950 | Karachi Improvement Trust was created, to approve “Housing Schemes” and to formulate “Town expansion schemes”. |
| 1957 | KDA was established through the merger of KIT, Karachi Joint Water Board, and Rehabilitation Department of the Government of Pakistan.<br>Architect Control Department of KMC was added to oversee the building activity in the entire city. |
| 1962 | The Architect Control Department for the Municipal Areas was transferred to KMC. |
| 1974 | Building Control for some of the KDA Schemes such as North Nazimabad, scheme-2, and F.B. Area was handed over to KMC. |
| 1979 | Karachi Building Control Authority was created under Sindh Building Control Ordinance and both KDA and KMC areas were brought under the jurisdiction of KBCA. |
| 1991 | The KBCA was again bifurcated into two factions i.e. KBCA (KDA) and KBCA (KMC). |
| 1996 | KBCA (KDA) and KBCA (KMC) were re-unified. Director General, KDA was notified as its Chief Executive. KBCA has its jurisdiction over entire Karachi Division excluding Cantonment ITE |
| 2011 | The government notified extension of the jurisdiction of KBCA to the whole of Sindh and renaming KBCA to SBCA |

Source: Website of SBCA

2) Organization Chart of SBCA




Source; Website of SBCA

Figure 2.3-16 The organization of SBCA

3) Function of SBCA

SBCA is a regulatory and supervisory body, the prime function of which is to ensure the approval of building plans, "No-Objection Certificates" (NOCs) and so on. The implementation of approved design/specifications is the sole responsibility of the concerned professionals licensed by SBCA. The function may be summarized as follows:

Table 2.3-21 Function of SBCA

| | |
|---|---|
| 1. | To regulate Town Planning and Building Control in accordance with the Master Plan and Environmental Control (Building & Town Planning) Regulations, given legal cover under SBCA 1979. |
| 2. | Approval of all type of building plans under the jurisdiction of SBCA. |
| 3. | Approval of Structural Designs of the buildings. |
| 4. | Issuance of NOC for sale and advertisements for Public Sale Projects to the Builders and Developers fixing/approving the unit price, time period and construction and development specifications. |
| 5. | To resolve public complaints against builders and developers regarding public sale projects within the purview of the approved plans and specifications. |
| 6. | To take action against builders for violations of approved building plans. |
| 7. | To identify, declare and demolish dangerous buildings in various parts of the city. |
| 8. | To take legal action against builders and developers involved in unauthorized construction and violations of building plan/NOC. |
| 9. | To issue licenses to professionals, builders and developers under the Karachi Building & Town Planning Regulations 2002. (Amended to date). |

Source; Website of SBCA; http://sbca.gos.pk/

(3) Building Control by Defence Housing Authority(DHA)

DHA is primarily a private housing society and set out by-laws and town planning where 60% civilian and 40% army (retired) personnel reside. The DHA develops property by utilizing land purchased from federal/provincial government or the private sectors. After constructing the load and infrastructure, plots are supplied to members who could be individuals or developers/builders. DHA has its own building regulatory authority with bye-laws to control quality. DHA urban planning also accommodates amenities such as educational, commercial and religious facilities in response to the demand from the increased population in the area. DHA has been established in major cities in Pakistan such as Islamabad, Rawalpindi, Lahore, Gujranwala and Karachi as an independent organization.

Table 2.3-22 Objectives of DHA

| | |
|---|---|
| 1. | Develop urban communities. |
| 2. | Provide modern living standards. |
| 3. | Offer sustainable infrastructures. |
| 4. | Generate environment friendly developments. |
| 5. | Facilitate People with essential civic facilities i.e. Health, Education & Entertainment. |
| 6. | Build our socio cultural fiber by reconnecting communities. |
| 7. | Promote religious harmony by defining communal worship centers. |
| 8. | Encourage educational pursuits by designing modern centers of education. |

Source: Website DHA Lahore

DHA identifies zoning for building usage. i) Residential, ii) Commercial, ii) Special build area. Each zoning has regulation of FAR (Floor Area Ratio) and setback regulations to control the living environment. Each DHA also has its own bylaw that regulates building. The DHA inspection division is in charge of monitoring construction activity and at least three stages of approval have to be obtained: i) Planning approval, ii) Foundation stage, iii) Completion stage.

DHA Karachi drafted the PLANNING GUIDELINE, which regulates a sustainable façade for commercial areas, including the usage of insulation as well as double-glazed windows. However, this is subject to internal discussion. The DHA also has its own program for capacity development and workshops such as (Energy-Saving, Water-Saving, Re-use of water, Solar energy and Solar Gyzer)

DHA has a division maintaining buildings/residential houses in the DHA developed area, for which they charge PKR 1500/- per month per household to maintain security, collect garbage, clean roads and offer plumbing services etc.

(4) Building Control in Industrial Estate

Each Industrial Estate, i.e. PIE in Punjab and SITE in Sindh, has its own building control authority with its own regulation. The objectives are to control buildings, roads and relevant infrastructure within the boundary. Industrialists have to submit drawings for review and on approval, construction can commence. During construction, inspectors perform periodic monitoring and a completion certificate is issued following final inspection approval.

### 2.3.3 Developers and Construction Companies

(1) Association of Builders And Developers of Pakistan (ABAD)

ABAD is a national level organization representing builders and developers in Pakistan, registered under the Companies Ordinance, 1984 with the registration number of Karachi No. 4967 of 1977-78, licensed under the Trade Organizations Ordinance 2007-2013 and affiliated with the Federation of the Pakistan Chamber of Commerce and Industry (FPCI). It was formed in 1972, aiming and striving to unify and streamline the construction activities of the private sector.

The aims and objectives of ABAD include the following[9]:

- ✧ Unifying the collective aims and objectives of builders and developers
- ✧ Promoting the housing industry in Pakistan
- ✧ Assisting the government in formulating its housing policies and plans.
- ✧ Dealing with problems faced by its members when executing their projects

As an organization representing the country's builders and developers, ABAD has made a valuable contribution in formulating National Housing Policy and Sindh Building Control Ordinance. It has also played a leading role in securing housing loans as well as allocation to HBFC in the Federal Budget. Exploring the prospects for large-scale projects in the public sector, ABAD secures and execute the projects via a consortium of ABAD members. ABAD includes more than 1,000 leading construction companies and developers.

(2) Real Estate Developers and Builders

One of the particular trends in the real estate market in Pakistan is the Gated Community Style, developments of which are often some distance from the city center for a certain level of security. Within the community, as well as residential buildings, other amenities such as shopping, educational and religious facilities are also constructed to round off the community. Meanwhile,

[9] Website of ABAD of Pakistan

in the city center, high-rise apartments are also booming, with both land and construction costs soaring. Capital gains from the sale of used apartments are also attracting investors.

1) Bahria Town

a) Introduction and projects in Pakistan

Bahria Town is one of the leading developer that provides large-scale development of housing and commercial facilities. Bahria Town has establishments in Islamabad (Phases 2 to 7 and enclave), Rawalpindi (Phases 1 and 8), Lahore, Murree and Karachi. Bahria Town is a mega-gated community, worth $6 billion only in twin cities Islamabad and Rawalpindi, where the original community has nine phases and the capacity of a planned residential city for 1 million people.

Established in 1996, Bahria Town has developed master-plan communities with complete infrastructures, including grid stations, hospitals, schools, recreational facilities, security, civic amenities, utilities, emergency services and futuristic lifestyles in gated communities. Bahria Town has a Building Control Department (BCD), which supervises/monitors buildings/houses and ensures houses are constructed in accordance with the approved plans. BCD finally issues the completion certificate, unless the client fails to follow the approved plan.

Table2.3- 23 Division of Bahria Town

| | | |
|---|---|---|
| Bahria Town Real Estate | Bahria Town Land Holding | Bahria Town Leisure & Recreation |
| Bahria Town Education | Bahria Town Health Care | Bahria Town Trust |
| Bahria Town Retail | Bahria Town Services | Bahria Town Industries |
| Bahria Town Media | | |

Source; Bahria Town website: http://bahriatown.com/

Table 2.3-24 Projects by Bahria Town

| Islamabad/ Rawalpindi | Lahore | Karachi |
|---|---|---|
| - The Sanctuary<br>- Bahria Garden City Zone 5<br>- Bahria Greens<br>- Bahria Enclave Apartments<br>- Enclave Islamabad<br>- Bahria Town Rawalpindi<br>- Safari Villas<br>- Bahria/ Safari Homes<br>- Awami Villas<br>- Bahria Heights<br>- Executive Lodges<br>- Overseas Enclave<br>- Safari Apartments<br>- Safari Valley<br>- Rafi Block<br>- Safari Mall<br>- River View Commercial<br>- Civic Center | - Bahria Civic Center<br>- Sector A, B, C, D, E and F<br>- Canal View Residency<br>- Executive Lodges<br>- Overseas Enclave<br>- Safari Villas<br>- Umer Usman & Ali Blocks<br>- Bahria Orchard<br>- Awami Villas<br>- Bahria Nasheman<br>- Education & Medical City<br>- Park Lane Tower<br>- Mall of Lahore<br>- Green valley<br>- Bahria Homes | - Bahria Homes Karachi<br>- Bahria Apartments<br>- Bahria Town Karachi<br>- Hoshang Pearl Karachi<br>- Opal 225 Karachi<br>- University in BT Karachi<br>- Bahria Town ICON<br>- Bahria Town Tower |

Source: Bahria Town Website

b) Target Market and Purchasing Procedure

According to an interview with a sale agent at the Customer Center at Rawalpindi, the standard purchasing process and the majority of sales prices are described as below.

Sales Price

| | | |
|---|---|---|
| i. | High-end: | PKR 40 million for 500-600 $yd^2$ (418-500 $m^2$); |
| ii. | Mid-range: | PKR 7to8 mil for 200 $yd^2$ (167 $m^2$); |
| iii. | Low-cost product: | PKR 0.5 mil for 75 $yd^2$ (62.7 $m^2$). |

Standard Purchasing Procedure

i. 25% down payment by buyer after signing contract.
ii. Building Contractor starts construction.
iii. Buyer to pay off remainder via quarterly installments, divided over the agreed payment period, which is normally 1-2 years. There is a package in Karachi which allows a four-year payment period.
iv. On completion of payment, building to be handed over to the buyer.

According to an interview with the architect at the Customer Center at Rawalpindi, 4,570 houses have been built in Bahria Town Rawalpindi over the last decade, which represents a current average of 80 houses completed per month. The construction of a total of 8,400 houses has been permitted. This total includes 4,570 completed houses, so about 4,000 houses are listed as having approved designs but remain unbuilt to date.

c) Measure to Load shedding and EE&C Policy

Bahria town is proud of no electrical load shedding by back-up generator. However, the electricity unit cost exceeds that of grid power. Bahria Town is the only private housing society in Pakistan to have obtained a license from the National Electric Power Regulation Authority (hereafter referred as NEPRA), to distribute electricity to its residents.

As far as EE&C concerned, it is purely dependent on the client. There are a few clients who are willing to invest the initial cost for EE&C in the building design. As a percentage, 2 to 3% of clients are keen to consider EE&C, although architects normally refrain from proposing EE&C to clients.

Table 2.3- 25 List of license issued companies

| Name of Company | Number of Consumers | Date of license issued | Date of license would valid |
|---|---|---|---|
| Distribution Company Working in Public Sector | | | |
| Peshawar Electric Supply Company limited | 2,867,778 | 30 Apr., 2002 | 29 Apr. 2022 |
| Tribal Area Electric Supply Company limited | 441,480 | 12 Aug., 2013 | 11 Aug., 2033 |
| Islamabad Electric Supply Company limited | 2,379,302 | 2 Nov., 2001 | 1 Nov., 2021 |
| Gujranwala Electric Supply Company limited | 2,824,053 | 23 Apr., 2002 | 22 Apr. 2022 |
| Lahore Electric Supply Company limited | 3,712,586 | 1 Apr., 2002 | 31 Mar. 2022 |
| Faisalabad Electric Supply Company limited | 3,288,930 | 2 Mar. 2002 | 1 Mar. 2022 |
| Multan Electric Supply Company limited | 4,860,296 | 25 Apr., 2002 | 24 Apr., 2002 |
| Hyderabad Electric Supply Company limited | 952,263 | 23 Apr., 2002 | 22 Apr. 2022 |
| Sukkur Electric Supply Company limited | 712,196 | 18 Aug., 2011 | 17 Aug., 2031 |
| Quetta Electric Supply Company limited | 548,980 | 30 Apr., 2002 | 29 Apr., 2002 |
| Distribution Company Working in Private Sector | | | |
| K-Electric Limited | 2,111,336 | 21 Jul., 2003 | 20 Jul., 2023 |
| **Bahria town (Pvt.) Limited** | **15,636** | **24 Nov., 2010** | **23 Nov., 2030** |
| Distribution License Granted to Small Power Producers | | | |
| Monnnoo Energy Limited | 2 | 20 Oct., 2006 | 7 Dec., 2016 |
| Sapphire Power Generation Limited | 8 | 20 Oct., 2006 | 26 Aug., 2016 |
| Sitara Energy Limited | 16 | 20 Oct., 2006 | 1 Jan., 2017 |
| Gulistan Power Generation Limited | 4 | 20 Oct., 2006 | 15 Nov., 2016 |
| Mahmood Textile Mills Limited | 1 | 14 Nov., 2006 | 21 Oct., 2016 |
| Kohinoor Mills Limited | 1 | 14 Nov., 2006 | 7 Dec., 2016 |
| Quetta Textile Mills Limited | 3 | 14 Nov., 2006 | 31 Jan., 2017 |
| Ibrahim Fibers (Pvt.) Limited | 3 | 22 Jul., 2008 | 30 Dec., 2021 |
| Crescent Powertec Limited | 3 | 18 Dec., 2008 | 21 Oct., 2016 |
| Distribution License Granted to Captive Power Producers | | | |
| Engro Chemical Pakistan Limited | Self-Consumption | 22 Jul., 2007 | 21 Jul., 2007 |

Source: State of Industry Report 2014, NEPRA.

d) Maintenance Policy

Bahria Town has its own staff to maintain houses in the Bahria Town projects. Residents of Bahria Town have to pay a monthly fee of PKR3000/- (which may differ, depending upon the size of the house.) The service maintenance fee levied covers road cleaning, solving electrical or gas problems and other issues with facilities.

2) EMAAR GIGA

a) Introduction and projects in Pakistan

EMAAR is a real estate development company located in the United Arab Emirates (UAE), which operates internationally, providing property development and management services. With six business segments and 60 active companies, EMAAR has a collective presence in 36 markets across the Middle East, North Africa, Pan-Asia, Europe and North America. EMAAR Properties is one of the largest real estate developers in the UAE and is known for various large-scale projects, such as developing Burj Khalifa, the tallest building in the world. Two large-scale projects are underway in Pakistan using land supplied by DHA. This land was awarded to EMAAR after it proposed a development plan to the DHA.

Canyon views in DHA Islamabad

Canyon views come from two types of village, called Mirador Villages and Alma Townhome Villages. The product includes high-end individual residential building with two stories, four to five bedrooms and total floor area of 3,500 to 6,300 $ft^2$.

Crescent Bay in DHA Karachi

Crescent Bay is a 75-acre (300,000 $m^2$) development featuring high- and mid-rise towers for residential and commercial use, a shopping center and a five-star beachfront hotel in Karachi, Pakistan, which was launched on May 31, 2006 as part of a $2.4 billion USD investment in Pakistan by EMAAR properties. The towers will contain approximately 4,000 residential apartments. As of 2015, six buildings are under construction.

Crescent Bay 1 will feature a hotel at the northernmost tip of the property, fronted by a long stretch of public beach.
Crescent Bay 2 will be the most urban of the districts, with a Waterfront Retail Arcade running along the beach. Most of the residential towers are found in this neighborhood, interspersed by parks, play areas and sports facilities.
Crescent Bay 3 is one of the residential neighborhoods, with controlled vehicle access, a waterfront promenade and residential towers.

b) Target Market and Purchasing Procedure

EMAAR has not yet officially disclosed the sale price, but the target market observation is as follows:

High-end apartments in the Clifton and DHA areas of Karachi cost about PKR17 to 20 mil, which only around 1 to 1.5% of the population can afford. In general, high-end residential buildings cost around PKR 6,000 to 7,000/$ft^2$. (including air-conditioning, kitchen equipment and all built-in cabinet/equipment.) Office buildings cost PKR4,500 to 5,500/$ft^2$.

EMAAR customers are mid- to high-income citizens, expatriates of Pakistani and foreigners, with apartments comprising a mixture of 1BR/2BR/3BR/4BR. Depending on demand, the ratio of apartment sizes also varies. In Clifton and DHA areas, penthouse apartments are considered the highest luxury grade because of the ocean view.

The standard payment term is an installment payment of three years, while for individual residential projects, some clients get funding from banks.

c)Measure to Load shedding and EE&C Policy

EMAAR has been trying to establish power generation by themselves, but has been unsuccessful due to rejection by NEPRA. However, on the understanding that government policy for power generation is changing, EMAAR will continue to study power generation/co-generation for their development area.

EMAAR indicated that there are many energy-efficient building materials/equipment available in neighboring countries, although the custom duty and transportation cost would currently make such products economically unfeasible. EMAAR suggested that if the Government of Pakistan were serious about promoting EE&C of the building sector, some incentive schemes for good building materials would provide strong market impetus. UAE has such incentive scheme.
EMAAR also stated that trade-off ideas, such as the bonus Floor Area Ratio, will help incentivize developers, although no such trade-off system exists in Pakistan. Despite the lack of incentives there, the EMAAR project is using Low-E double-glazing windows with an insulated external envelope, because of their client expectations as the standard specification. Their project also includes solar panels.

d) Maintenance Policy

EMAAR also provides a facility management service for residents, which costs PKR5,000-20,000/month depending on the scope of work. The minimum service includes general maintenance for public areas such as elevators, if required by the customer, EMAAR can also help maintain private areas as well. EMAAR is keen to control the design environment, which is why AC is included in the building scope to avoid chaotic installation of condensers in external walls. To replace those AC after handover, the EMAAR facility management service will control the design, which reduces the building-wide energy load by choosing energy-efficient products.

3) Kings Group

a) Introduction and Project in Pakistan

The Kings Group has been in business as a builder in Karachi since 1970 and engages in buying land, constructing buildings and then selling them. Builders purchase building materials by themselves and engage contractors, who do the building. They also hire architects and engineers for their projects.

Most of their products are located in the city of Karachi and depending on the value of land, are categorized into three grades. The following are their products on sale and under construction:

Table 2.3-26 Projects by Kings Group in Karachi

| Project Name | Number of Story | Number of unit | Number of rooms | Floor area ($ft^2$) | Sales price (PKR) | Sales unit cost ($PKR/ft^2$) | Completion |
|---|---|---|---|---|---|---|---|
| Presidency | 15 | 400 | 5 | NA | 7,800,000 | NA | NA |
| | | | 6 | NA | 9,300,000 | NA | NA |
| Classic | 5 | 96 | 5 | NA | 5,500,000 | NA | NA |
| Cottage | 4 | NA | 5 | 1300 | 6,500,000 | 5,000 | 2015 |
| Luxury Homes | 2 | 302 | 5 | 1080 | 7,000,000 | 6,481 | NA |
| | 2 | | 7 | 1350 | 8,800,000 | 6,519 | NA |
| Palm Residency | 11 | NA | 5 | 1950 | 8,500,000 | 4,359 | 2015 |
| Residency | NA | 240 | | NA | 5,700,000 | NA | 2007 |
| Towers | NA | NA | 3 | 1650 | 9,300,000 | 5,636 | 2017 |

Source: Sale brochure by Kings Group

b) Target Market and Purchasing Procedure

Target buyers are in the mid- to mid-high income group and 22 to 25% of buyers seem to be expatriates working outside Pakistan. Their purposes are i) financial stock, ii) saving for funeral and marriage for family, iii) future apartments for personal use.

The local market mainly comprises i) investors, ii) end users owning businesses in Pakistan or iii) groups of people who earn PKR 200,000/month or more. Kings stated that current apartment sales price tend to be PKR 5 to 10 million, with luxury products up to a maximum of 20 million in the Karachi area. However, in the Clifton area, high-end products are in the price range of PKR 40-50 million, driven by foreign base developers such as EMAAR Giga.

Most Kings Group products have sale prices of PKR 4.5 to 7.5 million, targeting the PKR 150,000 to 200,000 family income group, thought to comprise 20 to 30% of the Karachi population. As a standard product specification, kitchens and air-conditioners are excluded from sales products, since the buyer provides them on handover.

Temporary sales offices with a showroom are built next to the construction site and construction starts in phases, depending on the number of sales contracts/reservations. The standard payment scheme is a three-year installment payment, equivalent to the construction period. Figure 2.3-17 shows a sample installment payment schedule, anticipating a 50% bank loan and a 50% three-year installment payment. If the buyer can pay 100% upfront, a 10% discount applies.

**5 Rooms Apartments**

| MODE OF PAYMENT | AMOUNT |
|---|---|
| BOOKING | 70,000 |
| CONFIRMATION (WITHIN 60 DAYS FROM BOOKING) | 70,000 |
| ALLOCATION (WITHIN 90 DAYS FROM BOOKING) | 70,000 |
| START OF WORK (WITHIN 120 DAYS FROM BOOKING) | 70,000 |
| MONTHLY INSTALLMENTS @ 36 X 20,000 (START FROM VERY NEXT MONTH FROM THE DATE OF BOOKING) | 720,000 |
| HALF YEARLY INSTALLMENTS @ 06 X 80,000 | 480,000 |
| ON GROUND FOUNDATION | 70,000 |
| ON PLINTH | 70,000 |
| ON EVERY SLAB CAST @ 6 X 50,000 | 300,000 |
| ON BLOCK MASONRY | 80,000 |
| ON PLASTER | 80,000 |
| ON PLUMEBRING | 80,000 |
| ON ELECTRIFICATION | 80,000 |
| ON FINISHING | 80,000 |
| ON POSSESSION | 80,000 |
| CASH PAYABLE | 2,400,000/- |

**EXPECTED LOAN**
**RS.2,400,000/-**

EXTRA CHARGES:
1. ALLOTED PARKING .... RS.300,000/=
2. WEST OPEN .............. RS.150,000/=
3. CORNER ..................... RS.250,000/=
4. ROAD FACING ........... RS.200,000/=

**Important Note:**

1) 10% Discount on full cash payment at the time of booking.
2) All the installments must be paid on or before 10th of every month.
3) All extra charges will be payable within 180 days from the date of booking.
4) Documentation charges for Lease, Electrical Transformer, Connection charges, of Gas, Electricity, Water& Sewerage etc., will be charged extra and shall be payable by the allotee on demand as these charges are not included in the above mentioned cost.
5) The allocation on unit shall remain provisional until the company receives full & final payment.
6) All discounts are subject to regular payments as per payment schedule.

Source: Kings Group

Figure 2.3-17 A Sample Payment Schedule.

c)Measure to Load shedding and EE&C Policy

For most Kings projects, the customer expects a reasonable sales price rather than highly energy-efficient performance. The current standard specification is a single-glazed window with non-insulated walls & roof.

For multi-story apartments, customers generally prefer first-floor apartments, due to the risk of electricity problems stopping elevator operation. However, in the Clifton area, where no electricity concerns apply, higher level apartments are popular because of the good view.

Kings Group stated that they are keen to reflect consumer demand in their products. If the EE&C effort benefits consumers, they will seriously consider it.

d) Maintenance Policy

Following the building handover, Kings Group will conclude a maintenance contract with the customer. The maintenance fee depends on the service provided, but on average, PKR 3,500/month is the standard service, which includes periodic maintenance of external walls and repainting. Kings understands that keeping buildings in good shape will add value to the product for sale and most owners understand and appreciate their maintenance policy.

### 2.3.4 Manufacturers regarding Building Facilities

In Pakistan, the standard specification and bills of quantities are prepared by Architects, Engineers and Quantity Surveyors before the construction phase, so that the building owner can prevent procurement from substandard manufacturers.

(1) Air-Conditioner

Central air-conditioning systems are only used in the following buildings in Karachi, i.e. five-star hotels, shopping malls and a few commercial office buildings. Other buildings use individual air-conditioning on an as-required basis and an central air-conditioning system with electricity heat source is adopted in almost all buildings, despite the increased operation cost. There is a company named KAAF Engineering that installs air-conditioning chillers imported from overseas, i.e. Japan, China and Korea.

1) Pakistan HVACR Society

The Pakistan HVACR Society was established in 1993 to promote art & science of HVACR in Pakistan. The Society is the sole representative body for HVACR and has acted to promote the cause of HVACR among professions and industry in Pakistan as well as being an affiliate society to ASHRAE, USA. Right from its inception, the society has made all-out efforts to disseminate knowledge and share experience.

2) Main manufacturers of split-type air-conditioners

The main manufacturers of split-type air-conditioners are shown in Table 2.3-27.

Daikin has not acted actively in Pakistan, because they wish to provide adequate maintenance for customers from the safety perspective. However, Acson, a Malaysian company involved in technical cooperation with Daikin, has exported its products to Pakistan. Haier and Orient account for the majority of the air-conditioner market in Pakistan.

Table 2.3- 27 Main Manufacturers for Split-Type Air-conditioner

| Name of manufacturer | Country |
|---|---|
| Mitsubishi | Japan |
| Panasonic | Japan |
| Sharp | Japan |
| General | Japan |
| PEL | Domestic |
| Dawlance | Domestic |
| Orient | Domestic |
| Waves | Domestic |
| Acson | Malaysia (Technical support by Daikin) |
| Singer | USA |
| Kenwood | Italy |
| Haier | Domestic (China fund) |
| GREE | China |
| Samsung | Korea |
| LG | Korea |
| Sabro | Pakistan |

Source: Summarize the information from website both website
http://paperpk.com/shop/tag/ac-price-pakistan/page/3/ and
http://www.whatprice.com.pk/index.php/home-electrical/air-conditioning, interview from HVACR

3) Main manufacturers for heat sources of central air-conditioning

The main manufacturers of central air-conditioner system heat sources are shown in Table below. There are categories and cost per refrigeration capacity of ACs in Pakistan.

1st Category: USA, European, Japan, Installation cost will take 5,500USD/tonne.
2nd Category: Korea, UAE, Malaysia, installation cost will take 4,500USD/tonne.
3rd Category: Pakistan, China, Installation cost will take 3,500USD/tonne.

Table 2.3- 28 Main Manufacturers for heat source of central Air-conditioner system

| Type | Name of manufacturer | Country |
|---|---|---|
| Gas absorption | Kawasaki | Japan |
| | Ebara | Japan |
| | Hitachi | Japan |
| | Mitsubishi | Japan |
| | Sanyo | Japan |
| | Trane | USA |
| | York | USA |
| | Career | USA |
| | L.S (brand by LG group) | Korea |
| | Century | Korea |
| | Samjung (brand by Sumsun group) | Korea |

Source: Prepared by JICA Survey Team based on interview from HVACR

## (2) Lighting equipment

Energy-saver fluorescent lamps, LED lights and inverter ballasts are adopted in Pakistan. To date no automatic light control with sensor has been widely introduced in Pakistan.

1) Association regarding lighting

No association for lighting exists in Pakistan. In Japan however, the Japan Lighting Manufacturers Association (JLMA) exists. To promote environment countermeasures, including energy- and resource-saving and product safety improvement, the JLMA prepares appropriate labeling rules and materials regarding performance and safety. JLMA participates in the standardization activities of standards, etc. for lighting-related products and contributes to the planning, establishment and revision of standards, etc.

2) Main manufacturers for lighting

The main manufacturers for lighting are shown in Table 2.3-29.

According to Tobishima Corporation, Japanese construction company, Philips account for the majority of the lighting equipment market in Pakistan. Now, although LED has started to penetrate in Pakistan, almost all LED appliances come from Thailand or China.

Table 2.3- 29 Main Manufacturers for Lighting

| Type | Name of manufacturer | Country |
|---|---|---|
| Tubular Fluorescent Lamps | Toshiba | Japan, including made in Thailand |
| | Philips | Netherlands, including made in Malaysia |
| | OSRAM | German, including made in Indonesia |
| | Unique | China |
| Compact Fluorescent Lamps | Philips | Netherlands |
| | Osaka | Pakistan |
| | Orient | China |

Source: Prepared by JICA Survey Team based on interview from Tobishima Corporation, Japanese construction company

## (3) General Purpose Motors

General purpose low-capacity motors are produced in Pakistan and utilized in tube-wells.

1) Pakistan Motor Manufacturers Association (PEMMA)

PEMMA includes 135 members of electric fan-producing companies, of which approx. 350 actively produce motors.

2) Main manufacturers for general purpose motors

The main manufacturers for general purpose motors are shown in Table below.

Chinese motors are imported without duty by FTA.

Table 2.3- 30 Main Manufacturers for General Purpose Motors

| Name of manufacturer | Country |
|---|---|
| Allied Group | Domestic |
| Anwar Metal Industries | Domestic |
| Asli Punjab Pumps | Domestic |
| Diamond Electric Motors and Pumps | Domestic |
| Eastern Engineering | Domestic |
| Faisal Motor Pump | Domestic |
| Flow Pak Pump Industries | Domestic |
| Golden Pumps | Domestic |
| Haji Mushtaq Sons | Domestic |
| HMA Pumps | Domestic |
| K.A. Pumps Company | Domestic |
| Nobel Pumps | Domestic |
| OK Electrical Industries | Domestic |
| Shahzad Pumps and Electric Works Industry | Domestic |
| Soherwardi Engineering Pakistan | Domestic |
| Water World | Domestic |

Source: Summarized the report data of "DATA COLLECTION & ESTIMATION OF APPLIANCE POPULATION" by JICA Survey Team

(4) Lift

Office and shopping malls generally provide lift equipment.

1) Associations regarding lifts

There is no association regarding lifts in Pakistan. In Japan, the Japan Building Equipment and Elevator Centre Foundation (JBEECF) exists and has acted to give lectures on lift maintenance and certification of lift inspections.

2) Main lift manufacturers

The main lift manufacturers are shown in Table below.

Table 2.3- 31 Main Manufacturers for Lift

| Name of manufacturer | Country |
|---|---|
| Mitsubishi | Japan |
| ORONA | Spanish |
| BSB elevator | Turkey |
| Symax | China |
| Hyundai | South Korea |

Source: Summarized building resource book 2013-2014 by JICA Survey Team

(5) Electric Fans

The electric fan is a major industry sector in Pakistan and production is dominated by Gujrat and

Gujranwala as two key market players, with almost 98% of the market. There is also some production in Lahore and Karachi. This industry is primarily for small- and medium-sized enterprises (SMEs).

1) Pakistan Electric Fan Manufacturers Association (PEFMA)
PEFMA has 167 electric fan-producing member companies, of which 150 actively produce fans in various types and designs in line with PSQCA standards.

2) Main fan manufacturers
The main fan manufacturers are shown in Table 2.3-32.
The ceiling fans are manufactured in Pakistan. According to a GIZ study report in 2010, the actual motor input power is 90 to 100 W for 1,200 and 1,400mm diameter types. Accordingly, there is a need to develop highly efficient motor and inverter control for ceiling fans.

Table 2.3- 32 Main Fan Manufacturers

| Name of manufacturer | Country |
|---|---|
| Super Asia Group of Industries | Domestic |
| G.F.C Fans | Domestic |
| Pak Fan | Domestic |
| Yunas Fans | Domestic |
| Royal Fans | Domestic |
| Metro Fans | Domestic |
| Perwas Fans | Domestic |
| Pak Punjab Fans | Domestic |
| Champion Fans | Domestic |
| Beeta Industry | Domestic |
| Amin Fans | Domestic |
| Al-Khair Fans | Domestic |
| NGS Fans | Domestic |
| Zam Zam Fans | Domestic |
| Lahore Fans | Domestic |
| Starco Fans | Domestic |

Source: Fan Industry of Pakistan, Trade Development Authority of Pakistan

(6) Insulation of building envelope

To reduce the air-conditioning load, some companies tried to produce insulation material of the building envelope.

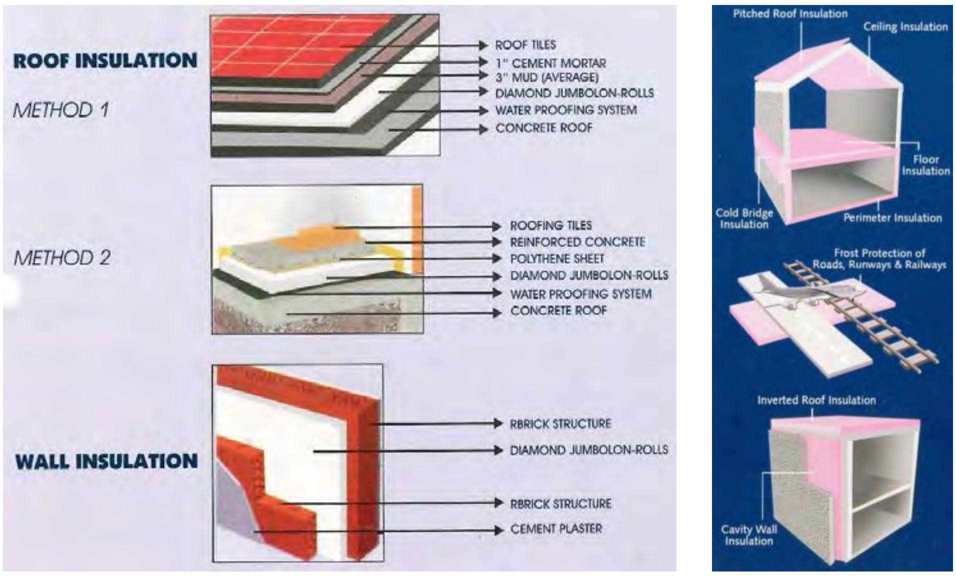
1) Diamond Jamblon
Diamond Jambolon, established a decade ago, has been producing both standard insulation e.g. EPS and XPS. EPS insulation requires 4 inches while XPS insulation requires two-inches to satisfy an equivalent heat transmission performance. The benefit of XPS is its extended service life, due to the waterproofing nature. The performance of EPS, conversely, tends to decline if

water goes inside. XPS is twice the price of EPS for the same thickness, but recent trends have shown both architects and contractors preferring XPS.

Diamond Jambolon are the only manufacturer of XPS in Pakistan and sell approximately 24,000 panels per month. Assuming a size of 3ft×6ft(0.91m×1.83m) panels 50mm thick, this means approximately 60 tons per month equivalent sales by weight.

Every small house owner in Pakistan is keen to have at least one air-conditioner. Those with houses covering 2200 Sq. ft. in Pakistan are part of the middle class and have ACs in their homes, but such ACs exert additional load on the electricity grid. The cost of insulation they are producing is PKR90/ft$^2$, while adding a second layer of bricks (PKR50-60/ ft$^2$) will involve a total additional cost of PKR150/ft$^2$ in new construction. Another technique involves plastering directly on the insulation without brickwork, which costs PKR120/ft$^2$.

According to Diamond Jamblon, for residential buildings in the city area of Lahore, which included the involvement of registered architects, the percentage of insulation used on the roof is around 10%. Of the insulated residential building above, 10% of the project may involve insulation of both roof and wall. (1% in total). For commercial and similar buildings designed by architects and in city areas, including Government Buildings, Hospitals and Universities etc., the percentage of only roof insulation users is less than 5%. (0.5% for roof and wall)
The insulation material used by Diamond Jamblon is shown in Figure below.




Source: Pamphlet of Diamond Jamblon company.

Figure 2.3-18 Insulation material of Diamond Jamblon

(7) Window

To reduce the air-conditioning load, some companies tried to produce windows with low thermal conductivity values, such as double-glazing.

1) Ghani Glass Manufacturers (as glass maker)
Ghani Glass features four modern glass plants in Pakistan producing float and container glass, with an annual capacity of approximately 300,000 tonne. Ghani Glass sells an average of approximately 10,350,000 m² of glass panels each year, which means approximately 150,000 tonne as an annual equivalent of sales by weight. The market shares achieved by the company in Pakistan include 73% for float glass, 90% for pharmaceutical glass containers and 76% for Food & Beverage glass containers. 80 dealers are established in Pakistan.

According to Ghani Glass, projects using double-glazing are limited to mega projects i.e. 5 to 10 million USD or more and are designed by foreign architects. Double-glazing is used for less than 2% of new construction in Pakistan and the cost of the window glass is less than 2% of the total amount of the building. As well as the glass cost, the window frame cost is also a barrier. To accommodate double glass, an aluminum window profile has to be specially made. Given the very low market share of double-glazing, the window frame cost for double-glazing is also excessive.

2) ALUMEX-Pakistan Cables (as window flame maker)
ALUMEX, as an aluminum profile manufacturer, has been involved in i) Windows and Doors, ii) building façades and iii) other aluminum products in the building sector. ALUMEX holds a 15 to 18% market share in Pakistan. Its policy is to guarantee quality, which means its price is 10% higher than most other window frames in Pakistan. According to ALUMEX, the number of domestic window manufacturers is growing and the foreign manufacturer's market share has declined to 10% or less nowadays.

The concept of the glass façade was introduced from UAE-based developers around a decade ago and buildings with glass façades are becoming very popular in Pakistan. Such buildings are either corporate office buildings or commercial buildings targeting high-end users and the clients for such buildings are well aware that energy efficiency of buildings is important. Almost all glass façades are double-glazed.

Most builders/developers are still striving to minimize their construction cost investment. However, due to the high market competition, some developers invest more in high quality at a high price. In terms of construction unit cost, PKR 4,000-5,000/ft² or more is considered a high-end product.

The business structure for aluminum window systems in Pakistan comprises three parties as described below; Firstly, Aluminum Profile Manufacturers, which produce extruded profiles. Secondly, Glass Manufacturers/processers, which produce glass slabs and process tempering and/or double-glazing. Thirdly, Fabricators, which design window systems, study performance, provide the required accessories and construct items on site. They are a single point of contact from the architect/client for window design. Major Fabricators include Queen Service, ALFA engineer and HITEC Engineer.

### 2.3.5 Building Operation and Maintenance Companies

(1) Association regarding Building Operation and Maintenance Companies

No association regarding Building Operation and Maintenance Companies exists in Pakistan.

In Japan, the Japan Building Maintenance Association (JBMA) was established approx. 40 years ago. JBMA is an institution of companies registered under the Building Sanitation Law and designated by the Minister of Health, Labour and Welfare, Japan (MOHLW, Japan) for various types of business to enhance the industry.

(2) Leading Building Operation and Maintenance Companies

There is IMS as leading company of the field of building operation and maintenance in Pakistan. IMS has 30 years experience both of engineering and operation field in Pakistan and their offices are in other countries also, e.g. UAE, Bangladesh, Sri Lanka etc. They have more than 50 clients, more than 15 clients, more than 100 clients in Islamabad, in Lahore, in Karachi respectively. Types of their clients are large scale hotel, large scale hospital, large scale public building, large scale shopping mall.

There are 4 other competitors apart from IMS, but these companies do not provide many services as IMS provides. Name of competitors are Khan Control System, Haseen Habib etc. Other maintenance companies can provide merely minimum services like housekeeping.

IMS have total staff of 400 employees out of which 300 have been working in Pakistan others in UAE. As technical background of staff/qualification, 40% and 30% of IMS staff is Certified engineers and Technical diploma holders respectively, remaining is just office staff. Every engineer who is appointed in IMS has to get factory training certificate as well as BMS training that are conducted in house. Hierarchy is as follows:

a) Project Manager (Regular employee of IMS) , b) Team Leaders (Regular employee of IMS)

c) Technical workers (Regular employee of IMS), d) Unskilled labour (hired on contractual basis)

For reference, in Japan, as a family company of developers, building operation and maintenance companies exist and serve against many buildings constructed by such developers.

### 2.3.6 Organization with Relevant Knowledge and Experience

(1) Institute of Architects Pakistan (IAP)

1) History of IAP

The Institute of Architects, Pakistan (hereinafter referred to as IAP) was established in 1957 by a small group of architects who had been trained in the west and either worked for the government or were in practice. IAP was formally registered in 1968 under the Societies Act and subsequently registered in 1968 under the Companies Ordinance, with the Securities and Exchange Commission of Pakistan (hereinafter referred to as SECP) and the following objectives:

Table 2.3- 33 The Objectives of IAP

| |
|---|
| To organize the profession of architecture and to look after professional interests as well as those of the public in general concerned with the building profession in Pakistan. |
| To promote the courses of Architecture, and to assist the schools of architecture in Pakistan. |
| To enforce a code of ethics and discipline among practicing architects and for this purpose to promote the passing of a statutory Registration Act for architects in Pakistan. |
| To conduct the researches and to organize seminars, conferences and exhibitions for promoting the cause of the architectural profession. |

Source: Website of Institute of Architects Pakistan

2) IAP activity

There are currently over 1,000 fellow and associate members on the IAP register, as well as over 300 candidates and student members of International Affiliations. IAP has been a member of the following international organizations: International Union of Architects (UIA), Commonwealth Association of Architects (CAA), Architects Regional Council Asia (ARCASIA) and the SAARC Association of Architects (SAARCH). The IAP currently has four chapters nationwide: Karachi Chapter, Lahore Chapter, Rawalpindi-Islamabad Chapter and the Peshawar Chapter, which covers NWFP.[10]

3) Interview with IAP

IAP is aware that one major barrier to improve EE&C is education. There is a gap between policy and actual reality. One of the major problems is the shortage of teachers for architectural courses in university. Although there were 5 to 7 architectural courses in university five years ago, there

[10] Website of Institute of Architects Pakistan; http://www.iap.com.pk/

are now 22 such courses and the total is set to increase to 30 courses in the near future. Architectural courses are becoming very popular for students due to high demand and salary in neighboring countries. Architectural teachers are now overseeing those architectural courses and the shortage of skilled teachers is proving problematic. Teacher training is one of the highest national priorities. The IAP has been striving to fill the aforementioned gaps.

(2) Pakistan Green Building Council (Pakistan GBC)

1) Activities of the Pakistan GBC

The Pakistan Green Building Council (hereinafter referred to as Pakistan GBC) is a nonprofit organization committed to a prosperous and sustainable national future through cost-, energy-, water- and natural resource-efficient green buildings and communities. The Pakistan GBC comes directly under the umbrella of the World Green Building Council (hereinafter referred to as World GBC), which is a union of 98 national Green Building Councils worldwide. Currently the Pakista GBC is a prospective member of the World GBC and the only national organization advocating, promoting and developing Pakistan-specific green guidelines and certifying sustainable building practices and products.

Under the mandate of the World GBC, the Pakistan GBC covers all aspects that affect the environment such as subsoil water levels, water consumption and usage, climate change, deforestation, carbon footprints, air quality, transportation, agriculture, industry, renewable and alternative energy/fuel, energy/fuel consumption and usage, design of buildings, living patterns, green product / building certification systems and environmental education at a grassroots level.[11]

2) Objectives of Pakistan GBC

The objectives of Pakistan GBC are as follows:

Table 2.3- 34 The Objectives of GBC

| |
|---|
| 1.Raise public awareness in regards to the creation of a sustainable environment. |
| 2.Assist in the elaboration and presentation of such technologies and practices for consumers and industry professionals in Sustainable design and construction. |
| 3.Educate industry professionals in Sustainable design and construction practices. |
| 4.Exert impact on the elaboration and implementation of any sustainable technologies. |
| 5.Render assistance to the government and other institutions toward creating legislation compatible with the international standards. |
| 6. Contribute toward the establishment in Pakistan of a standard for certification of Green Buildings and Communities. |
| 7.The Pakistan GBC will be the national reference organization in regard to sustainable development. |

Source: Website of Pakistan Green Building Council; http://pakistangbc.org

3) Organization of Pakistan GBC
The CEO informed that they started work in 2012 with three people. Since Pakistan GBC is a new organization, they have volunteers among their registered members who give at least four hours weekly to work and promote green buildings in Pakistan. By the end of this year, they will have all LEED certified staff in PGBC. People obtain online certification from LEED and currently about 15 LEED registered personnel are in Pakistan.

4) LEED registration
To obtain a LEED certificate, the following stages are required:

i. Registration of project (consent of the owner to register with GBC)
ii. Design Stage (green building specifications)
iii. Construction Stage (inspection performed)

The main motivation for clients deciding to obtain LEED certificates are a) benefit in terms of saving up to 40% on running costs and b) international recognition.

5) Pakistan GBC Guideline
Pakistan GBC has not yet framed its own guidelines in Pakistan, so the following LEED applied so far. Pakistan GBC approached USA GBC for guidelines in Pakistan, USA GBC offered to develop Pakistan guidelines at a certain cost, but Pakistan GBC decided not to ask USA when its board members met and is planning to develop its own guideline.

6) Market of Green Building in Pakistan
The green building concept was introduced in 1993 in Pakistan. In the first project, in 2009, there was only one green building in Pakistan. The second project was registered in 2011 and to date, there have been 25 registered green buildings in Pakistan. GBC has set up a roadmap, which targets 100 projects by 2016 and 250 projects by 2017. Until Pakistan GBC establish its own guideline, the US LEED certification is the basic criteria.

Due to the high initial cost, most people are reluctant to apply for green building certification. PGBC has been promoting the idea and benefit of green buildings, which may save up to 40% on electricity bills, but most people remain unconvinced. Roughly 70% of people fail to see the benefit of green building. Awareness and education is essential.

There are several technical issues in Pakistan. To ensure design envelope performance, window frames must be installed without any gap between the frame and wall. Moreover, although sliding windows are popular in Pakistan, the air-tight performance needs to be improved.

[11] Website of Pakistan Green Building Council; http://pakistangbc.org

### 2.3.7 Financial Institution

(1) State Bank of Pakistan

The GoP encourages the construction of houses, but no incentives are available. Presently, a backlog exceeding 600,000 of a 9 million housing increment has to be cut back to 300,000 houses and work is underway. GoP has asked the State Bank of Pakistan (hereinafter referred to as SBP) to prepare some incentive schemes, work on which is underway. Now, the SBP is asking the banks to provide loans to people for 10 years to purchase solar energy. The SBP is also trying to find the way to provide affordable housing loans to the people of Pakistan, who are suffering from a decline in income.

SBP started working with GIZ in early 2015 for Green Banking and is now creating awareness while operating banks in Pakistan. SBP itself is learning about the best international practices. The International Finance Corporation has now been established, in which a number of Asian Countries are participating, and it will become increasing useful as more countries participate in this common cause. Although commercial banks in Pakistan have started Green Banking, they are relatively unfamiliar with the concept, hence the need to raise awareness of the same. The SBP had a seminar/conference, in which the WB, IFC, banks, government utility companies and GIZ participated very actively to understand this issue.[12]

The banks have long been disbursing housing loans to Pakistan citizens. During the period 1992 to 94, commercial loans were given to the people of Pakistan with a 23% markup for consumers, since 40% was not entirely affordable for citizens. Subsequently, during the period 2000 to 04, markup rates came down and up to the level of 7%. Some banks, like Al-Falah Bank and Union Bank, started providing loans to people to buy houses, construct houses or buy building plots etc. However, housing loans in Pakistan have been rare recently, for the following reasons:[13]

i. The salary of government employees is very low, so they cannot afford repayments.
ii. Borrowers do not fulfill the criteria of banks to obtain housing loans. As a general rule, the State Bank of Pakistan, as regulator, has established a principle whereby the income of the borrower should be more than 1.5x the loan amount as a security/guarantee to the bank and only then can the borrower obtain a house loan from any bank in Pakistan. For instance, if anyone wishes to obtain a loan of Rs.1 million, he/she must deposit Rs.3 million as a security/guarantee with the bank.
iii. The tough criteria of the banks means most government employees are ineligible.
iv. Huge interest rate.

[12] Interview with SBP on 12 June, 2015
[13] Interview with Muslim Commercial Bank (MCB) on 8 June, 2015

(2) House Building Finance Company Limited

The Housing Building Finance Company Limited (hereinafter referred to as HBFC) was established in 1952 as a Government statutory institution and incorporated in 2006 under the Companies Ordinance, 1984. GoP and the SBP jointly hold capital in HBFC with shares of 62.50 and 37.50%, respectively
HBFC is focused on financial support for people in the low- and middle-income socioeconomic sector. Since 1952, its accumulated value has encompassed 54 billion PKR and 470,000 homes and currently financed 13 billion PKR with 54,000 account holders.[14] The Company operates throughout Pakistan, including Azad Kashmir and Northern areas.

The unit cost of constructing low-income houses is about 1,000-1,500PKR/ft². In terms of total cost, houses with 50-100 yd² floor area cost 450,000 to 1,300,000 PKR. Account holders borrow 300,000 to 700,000 PKR from HBFC for a maximum of 20 years.

Table 2.3-35 Finance Limit and Tenure of Repayment

| Production | Finance Limit | Tenure of Repayment |
|---|---|---|
| For Home Renovation | Up to PKR.2,500,000 | 2-10 years |
| For Home Construction | Up to PKR10,000,000 | 3-20 years |
| For Home Purchase | Up to PKR10,000,000 | 3-20 years |

Source: HBFCL website; http://www.hbfcl.com/

Depending on the location, HBFC can lend 50 to 70% of the construction cost to the account holder. Criteria is that 1) land is mortgaged, 2) borrower shall have a certain income. The interest rate depends on the Karachi Interbank Offered Rate (hereinafter referred to as KIBOR). The HBFC interest rate is currently 10 to 11% (KIBOR rate (6-7%) + 3.25%).

Table 2.3-36 Profit Rate

| Income Type | Profit Rates (One year fixed installment plan to be re-priced annually) |
|---|---|
| For Salaried Persons | Last Available 1 Year KIBOR Offer Rate + 3.25 % |
| For Business Persons | Last Available 1 Year KIBOR Offer Rate + 3.50 % |

Source: HBFC website; http://www.hbfcl.com/

[14] Interview with HBFC Karachi 31st August, 2015

### 2.3.8 Taxation Authorities

According to the Federal Board of Revenue (hereafter referred to as 'FBR'), it is GoP policy to support the building sector in Pakistan. GoP has exempted renewable energy solar panels from customs duty and service tax. Bricks and crashed stones are also exempt from tax on goods and service to support the low-income house supply. Taxation in Pakistan is a complex system, exceeding 70 taxes, administered by at least 37 agencies of the GoP.

(1) Federal Board of Revenue (FBR)

The FBR is a semi-autonomous supreme federal agency of Pakistan under the FBR Act 2007, which handles income tax and tax on goods. The tax collected by FBR directly to the Ministry of Finance (hereinafter referred to as 'MOF') and is deposited either in the National Bank of Pakistan (hereinafter referred to as 'NBP'), the SBP or in the Government Treasury under heads of Government. First of all, the MOF distributes this amount among the provinces and any left-over is allocated for the Ministries/Divisions/Departments in the annual Budget.

Since the GoP is working under an IMF Structural Adjustment Loan, the FBR cannot exempt tax. However, tax credits can be given to those who pay all their tax for example. If a tax incentive scheme is to be proposed, April is the optimal time, because it is usually when the government prepares the budget. (Pakistan fiscal year: from July 1 to 30 June) If any tax exemption regarding EE&C is required, any government department like the MOWP can initiate such proposal while preparing and sending a summary to the Economic Coordination Committee (hereinafter referred to as 'ECC'), whereupon this Committee can consider whether or not to grant the exemption.

(2) Provincial Board of Revenue

Provincial Boards of Revenue, such as the Punjab Revenue Authority (hereinafter referred to as PRA) and Sindh Revenue Board (hereinafter referred to as SRB), deal with sales tax on services and goods in the province. Value Added Tax (hereinafter referred to as 'VAT') in Punjab, for example, is charged on all supply or sale or the rendition stage of goods and services in commercial chains of production, distribution and consumption. There are several forms of VAT worldwide but that based on a tax invoice-related credit mechanism is considered ideal because of its inbuilt automatic system of converting multi-stage tax assessments into a simple stage levy. Tax rates vary periodically, some increasing and others falling. Presently the highest tax rate is 19.5%, only for telecommunication services and the lowest/general tax rate is 16%. PRA stated that tax exemptions/incentives can only be granted if the Federal Government decides to perform a certain program.

(3) Property Tax

The Provincial Excise and Taxation Department handles property tax under the provincial property tax Act. For Islamabad, CDA is the taxation authority. Property tax is levied on the annual value of buildings and land declared as Rating Areas by the provincial government, which may let out the property on a year to year basis. If the property is self-occupied, there will be less tax on it. If the property is rented out to a tenant, it will be high. Rates are multiplied by Covered Area[15] to calculate the property tax. Since rates are given for the plot as per yard$^2$ and given for the building as per feet$^2$, in urban area where FAR is more than 100%, more than 95% of property tax value are generated by buildings.

Table 2.3-37 Annual Property Tax Rate in CDA

| Rating Area and categories | Plot Area (PKR/ yd$^2$) | Covered area (PKR/ ft$^2$) |
|---|---|---|
| (A) Residential : | | |
| 1. E-Series | 6.00 | 6.00 |
| 2. F-Series | 4.50 | 5.25 |
| 3. G-Series | | |
| a) Plot area upto 356 yd$^2$ | 2.50 | 3.20 |
| b) Plot area more than 356 yd$^2$ | 3.75 | 4.80 |
| 4. I-Series | | |
| a) Plot area upto 356 yd$^2$ | 2.00 | 3.00 |
| b) Plot area more than 356 yd$^2$ | 3.00 | 4.50 |
| (B) Commercial | | |
| 1. Blue Area | | |
| a) Ground floor, shops etc | 6.00 | 9.00 |
| b) Mazanine 1st floor and above | 4.00 | 6.00 |
| 2. Markaz E&F Series | | |
| a) Ground Floor, shops etc. | 5.25 | 8.25 |
| b) 1st Floor and above | 3.50 | 5.50 |
| 3. Markaz G&I Series, I&T Centre/Class-III Shopping Centers. | 3.50 | 5.50 |
| 4. Fruit and vegetable market | 3.00 | 5.00 |
| 5. Industrial Institutions | 1.50 | 3.00<br>2.25 |
| 6. Petrol pump | 30.00 | Shed Area |
| Calculation formula<br>i) (Total Land Area of a Property) x (Per Yd$^2$ Rent Prescribed in the Valuation Table) = **X**<br>ii) (Total Covered Area of a Property) x (Per Ft$^2$ Rent Prescribed in the Valuation Table) = **Y**<br>iii) (**X** + **Y**) = Property Tax Amount | | |

Source: CDA

[15] Covered Area: anything which has roof is called covered area. If there is a double story building, the covered area will also be doubled

Table 2.3-38 Annual Property Tax Rate in Punjab Province

(A) RESIDENTIAL

| CATEGORY | RENTED | | | | SELF-OCCUPIED | | | |
|---|---|---|---|---|---|---|---|---|
| | RATE OF LAND $yd^2$ (IN PKR) | | RATE OF COVERED AREA IN $ft^2$ (IN PKR) | | RATE OF LAND $yd^2$ (IN PKR) | | RATE OF COVERED AREA IN $ft^2$ (IN PKR) | |
| | Up to 500 | Exceeding 500 | Up to 3,000 | Exceeding 3,000 | Up to 500 | Exceeding 500 | Up to 3,000 | Exceeding 3,000 |
| **A** | 23 | 18.4 | 23 | 18.4 | 4.6 | 3.68 | 4.6 | 3.68 |
| **B** | 17 | 13.6 | 17 | 13.6 | 3.4 | 2.72 | 3.4 | 2.72 |
| **C** | 14 | 11.2 | 14 | 11.2 | 2.8 | 2.24 | 2.8 | 2.24 |
| **D** | 11 | 8.8 | 11 | 8.8 | 2.2 | 1.76 | 2.2 | 1.76 |
| **E** | 8.2 | 6.56 | 8.2 | 6.56 | 1.64 | 1.31 | 1.64 | 1.31 |
| **F** | 6.5 | 5.2 | 6.5 | 5.2 | 1.3 | 1.04 | 1.3 | 1.04 |
| **G** | 4 | 3.2 | 4 | 3.2 | 0.8 | 0.64 | 0.8 | 0.64 |

(B) COMMERCIAL

| CATEGORY | | RENTED | | | | SELF-OCCUPIED | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | RATE OF LAND $yd^2$ (IN PKR) | | RATE OF COVERED AREA IN $ft^2$ (IN PKR) | | RATE OF LAND $yd^2$ (IN PKR) | | RATE OF COVERED AREA IN $ft^2$ (IN PKR) | |
| | | Up to 500 | Exceeding 500 | Up to 3,000 | Exceeding 3,000 | Up to 500 | Exceeding 500 | Up to 3,000 | Exceeding 3,000 |
| **A** | Main | 120 | 96 | 120 | 96 | 24 | 19.20 | 24 | 19.20 |
| | Off | 96 | 76.80 | 96 | 76.80 | 19.20 | 15.36 | 19.20 | 15.36 |
| **B** | Main | 80 | 64 | 80 | 64 | 16 | 12.80 | 16 | 12.80 |
| | Off | 64 | 51.20 | 64 | 51.20 | 12.80 | 10.24 | 12.80 | 10.24 |
| **C** | Main | 56 | 44.80 | 56 | 44.80 | 11.20 | 8.96 | 11.20 | 8.96 |
| | Off | 44.80 | 35.80 | 44.80 | 35.80 | 8.96 | 7.17 | 8.96 | 7.17 |
| **D** | Main | 40 | 32 | 40 | 32 | 8 | 6.40 | 8 | 6.40 |
| | Off | 32 | 25.60 | 32 | 25.60 | 6.40 | 5.12 | 6.40 | 5.12 |
| **E** | Main | 30 | 24 | 30 | 24 | 6.00 | 4.80 | 6.00 | 4.80 |
| | Off | 24 | 19.20 | 24 | 19.20 | 4.80 | 3.84 | 4.80 | 3.84 |
| **F** | Main | 20 | 16 | 20 | 16 | 4.00 | 3.20 | 4.00 | 3.20 |
| | Off | 16 | 12.80 | 16 | 12.80 | 3.20 | 2.56 | 3.20 | 2.56 |
| **G** | Main | 15 | 12 | 15 | 12 | 3.00 | 2.40 | 3.00 | 2.40 |
| | Off | 12 | 9.60 | 12 | 9.60 | 2.40 | 1.92 | 2.40 | 1.92 |

Calculation formula
i) (Total Land Area of a Property) x (Per $Yd^2$ Rent Prescribed in the Valuation Table) = **X**
ii) (Total Covered Area of a Property) x (Per $Ft^2$ Rent Prescribed in the Valuation Table) = **Y**
iii) (**X** + **Y**) x 12 = Gross Annual Rental Value (GARV)
iv) GARV – 10% of GARV = Annual Rental Value (or annual value)
v) Annual Rental Value x 0.05=Property Tax Amount

Source: Punjab Excise & Taxation Department

A total number of Taxpayers in Islamabad is 50,000 out of which 35,000 residential taxpayers and rest of 15,000 commercial taxpayers[16]. Commercial taxpayers include buildings, shopping malls, educational institutions, hospitals and Industries etc. However, the plot without building, government properties, religious building, donated facilities are exempted from property tax. CDA has incentive and dis-incentive scheme for payment. The tax payers who pays before 30th September are entitled to a discount or rebate of 5%, while late payment are charged for 1.5% surcharge per month.

[16] Interview to Revenue Dept CDA.

Table 2.3-39 Conditions for the tax exemption/ reduction in CDA

| Category | Exemption |
|---|---|
| 1. Residential houses, flats or apartments owned and self-occupied by persons, their family members including parents. | 50% |
| 2. One residential house, flat or apartment belonging to a widow if she owns no other built up property anywhere in Pakistan. | 100% upto plot area 240 Yd². |
| 3. Places set apart for public worship and actually so used and used for no other purpose. | 100% |
| 4. Hospitals, dispensaries, clinics, educational or training institutions and libraries located on the plot allotted for specified purposes and run wholly from charitable contributions and donations. | 100% |
| 5. Residential house, flat or apartment owned and occupied by a retired Government employee whether in his own name or in the name of or jointly with his wife or dependent minor children. This exemption shall be available if it is his/her or their only property in Pakistan and he/she or they are themselves living in the house or, as the case may be, flat or apartment. This exemption shall also be available in case of death of the retired employee to the surviving spouse and minor children of the deceased employee. | 75% |
| 6. Buildings and lands owned by the Federal or provincial governments, but excluding public and private corporations. | 100% |
| 7. Buildings and land vesting in the Capital Development Authority. This however does not include lands leased out to private individuals and corporations, companies and firms or to any group of individuals. | 100% |

Source: CDA

### 2.3.9 Other Donor Activities

Several international donors are striving to tackle energy efficiency issues in Pakistan. Table below indicates an overview of activities.

Table 2.3-40 International Donor Activities

| Donor | Activities | Status |
|---|---|---|
| UNDP | Barrier Removal to Energy Efficiency Standard and Labeling.<br>Minimum Energy Performance Standards (MEPS) and Labeling system have been developed, approved/ adopted and notified for Fans, CFLs, Motors. | Phase1 completed. (2010-2014) |
| ADB | Energy-Efficiency Investment Program-Tranche 1<br>Tranche 1 includes the National Compact Fluorescent Lamp Project. | Completed. 2009-2013 |
| | Sustainable Energy Sector Reform Program – Subprogram 1<br>The program to help Government with the short-term stabilization measures and start the long-term restructuring for sustainable power sector. | Active. |
| WB | Dasu Hydropower Stage I Project<br>Facilitate the expansion of electricity supply of hydropower in Pakistan. The Project will also improve access to socioeconomic services for local communities in the project area and build the Water and Power Development Authority's (WAPDA's) capacity to prepare future hydropower projects. | Active. (2014- ) |

| | | |
|---|---|---|
| GIZ | Renewable energies and energy efficiency<br>Promotion-mechanism and strategies for investments in renewable energies and energy efficiency are utilizes by small and medium sizes industries and end users. | Active.<br>(2014-2016) |
| KfW | Renewable energies<br>KfW co-funded both of Pakistan's main hydropower projects have been completed in Tarbela and Ghazi Barotha. Together with European partners, KfW is currently involved in the construction of another two hydropower plants. | Active. |
| UNIDO | Solarization of FBR building<br>This project will energize five buildings of FBR with 590 KW solar system which will cover 22% of required electricity demand of those buildings. | Under planning |
| | Preparation of software for EE&C in building<br>The project is to prepare energy compliance software using US base existing software. | Under planning |
| UNHABITAT | Improvement of Thermal performance of RC slab roofs<br>A Project to demonstrate and test measures to improve the thermal performance of housing, specifically to improve Reinforced Cement Concrete (RC) flat roofing. | Completed 2010 |
| | Improvement of Thermal performance of RC slab roofs（PH2）<br>Using the best five options from the last project,2010, further testing to be carried out in other climatic region in Pakistan. Wall insulation as well as double glazed windows might be included in addition. | Under planning |
| USAID | Power Distribution Program (PDP)<br>Improve the commercial performance of the participating DISCOs through technology upgrades and improvements in processes, procedures, and practices as well as training and capacity building. | Completed.<br>2010-2015 |

Source: website of respective donors/ Interview to donor

(1) Interview with GIZ[17]

GIZ has been active in Pakistan with its Renewable Energy and Energy Efficiency (RE-EE) program since 2005, working on behalf the German Federal Ministry for Economic Cooperation and Development. The program, together with its partners aims to:

- ✧ Support federal and provincial government departments on issues pertaining to energy policies and the development of market-based instruments for investment in RE-EE applications. Gender and climate change mitigation aspects are considered within.
- ✧ Prove technical assistance and support in developing the institutional and technical capacities of partner institutions at federal and provincial levels.
- ✧ Provide technical assistance and support to public and private sector partners to develop and

[17] Interview held on 20th August,2015

increase RE applications, namely solar (photovoltaic (PV) and thermal), mini and micro hydropower (hereinafter referred to as MHP) and biomass/biogas.

- ✧ Promote the productive use of renewable energy (hereinafter referred to as PURE), as a downstream activity of MHP development assistance, ensuring equal opportunities for both men and women.
- ✧ Introduce and promote Energy Management Systems (hereinafter referred to as EMS) in four industrial sectors, namely textile, steel re-rolling, edible oil and steel foundries.
- ✧ Provide technical assistance in developing Energy Service Companies (hereinafter referred to as ESCOs) to provide reliable consulting services on EMS application on a commercial basis to different industrial sectors.

1) Green Building scheme and another incentive
GIZ is currently focusing on working with the Punjab Energy Efficiency and Conservation Department (hereinafter referred to as 'PEECD') and developing the concept of the Green Building with them.
IFC is also working with and wishing to support a labeling system for fans and boilers in Punjab.

2) Capacity building of architects and engineer
GIZ has been working on the project to construct WAPDA building in Lahore as a pilot project. GIZ is also working to develop the capacity of Architects and Engineers while involving Academia and other stakeholders in Punjab. The guidelines will be created on a voluntary basis, targeting future mandatory regulation.

(2) Interview with KfW[18]

KfW is currently working on/planning three projects in the field of energy efficiency of the building sector.

1) Improvement of WAPDA Buildings
KfW has been approached by WAPDA to retrofit, with RE&EE policy, the WAPDA building in Lahore, which is an existing office building accommodating 2000 officers, located in the center of Lahore. Once the WAPDA retrofit is completed in Lahore, they may continue the project to retrofit WAPDA buildings in other cities.

2) Showcase Building Projects
As part of support on climate change issue, KfW has granted EUR 6 million to WAPDA to establish the Pakistan Glacier Monitoring Network. This Project includes constructing two new buildings in Lahore and Skardu to receive signals from glacier monitoring equipment. Those

[18] Interview held on 11th September, 2015

buildings will be designed as "Showcase" of EE&C technologies. GIZ is working on the project in Lahore.

3) Improvement of government buildings

KfW is planning to access a Green Climate Fund to improve the energy efficiency of existing government buildings with utilizing Green Climate Fund (hereinafter referred to as 'GCF').. KfW has requested that the Ministry of Climate Change (hereinafter referred to as 'MOCC') collect information on current energy use for the target government building, after analyzing the current situation, improvement measures and construction to be performed. KfW is interested in working with major international donors, including JICA.

(3) Interview with UNIDO[19]

The project UNIDO is currently working on/planning two projects in the field of energy of the building sector.

1) Solarization of FRB Buildings

UNIDO has developed the project of renewable energy/solarization of five buildings of FBR in Islamabad on the initiative of MOCC. Feasibility study of the project was conducted with collaboration of Alternate Energy Development Board (hereinafter referred to as 'AEDB'). Selected five buildings of FBR will be demonstration in Islamabad. This project has not yet been approved by UNIDO Head Office but under consideration to be finalized soon.

This project will energize five buildings of FBR with 590 KW solar system which will cover 22% of required electricity demand of those buildings. For this project, 1.36 million USD from Global Environmental Fund (hereinafter referred to as 'GEF') and 1.4 million USD from FBR, Islamabad would be funded.

2) Preparation of software for EE&C in building

UNIDO has the plan to prepare software for EE&C in building. The software under consideration are US base ENERGY PLUS and eQUEST energy compliance software but that has not been finalized yet. This software has to be licensed.

(4) Interview with UN-HABITAT[20]

1) Improvement of Thermal performance of RC slab roofs （2010）

UN-Habitat designed a project of roof insulation on higher scales to be executed in all four

[19] Interview held on 15th December, 2015
[20] Interview held on 9th December, 2015

provinces of Pakistan on 2010, but initially it was done on small scale only in Islamabad due to limited funds available. In this project, roof insulation in the existing government residential accommodations occupied by low paid employees of Federal government in Sector G-6 in Islamabad was retrofitted. Roof insulation was retrofitted while testing 19 different products including indigenes materials for testing and found best five options.
After completion of this project, some people started adopting roof insulation in the neighborhood and by those who had been made aware of the results during the implementation. Part of the study objective was to actually campaign to change mind of the people towards energy efficient buildings/houses. In low income government quarters, most of people do not have AC, however selected roof insulation improved the living environment even with fans.

2) Improvement of Thermal performance of RC slab roofs (Phase 2)
UN-Habitat is planning project to carry out similar method as 2010 project in other four provinces where represents particular climate character in Pakistan. Due to knowledge that was obtained from the last project,2010, the best five options will be selected, further testing for wall insulation as well as double glazed windows might be included in addition.

## 2.4 Building Construction

### 2.4.1 Procedure

(1) Decision-making procedure
The construction project begins the client devising a general idea, whereupon dialog with the architect commences to assess the project feasibility from both technical and financial perspectives. Once the client and architect agree on the consultancy service contract with the engineering team, the design team has to come up with the concept design. During the concept stage, general planning, regulatory compliance and a preliminary estimate are discussed with the client. During this stage, the general specification and target budget are also agreed and it represents the first and best opportunity to discuss the EE&C criteria for the project.

Upon approval of the concept design, the design team performs a detailed design to ensure an accurate construction estimate. The design team then completes a Design Development Package together with detailed bidding specification. During this stage, the design team prepares an expected construction estimate based on recent project data. This is the second opportunity to discuss EE&C criteria with the client.

After approval of the design development package by the client, the drawing packages are to be distributed to candidate contractors for estimates. For builders' projects, they may obtain only the labor force estimate from the contractor and control material purchases by themselves. If the construction estimates obtained exceed the budget, the client and design team must devise cost-saving ideas. This stage is crucial to determine whether or not EE&C criteria can survive. Prior to building construction, design drawings must be submitted to the respective building control authority for approval.

During construction, the contractor, architect, engineer and client engage in periodical site meetings, like every 2-4 weeks, to discuss construction progress, design changes, material confirmation and cost control. The building authority also dispatch inspector to confirm if building is as per approved drawing. This stage is the last opportunity of decision making process whether EE&C material and equipment are actually purchased and installed on site.

Upon completion, an application for final inspection to be submitted to the building control authority with the latest drawing in case of any changes. Upon approval of final inspection, an occupancy permit will be issued.

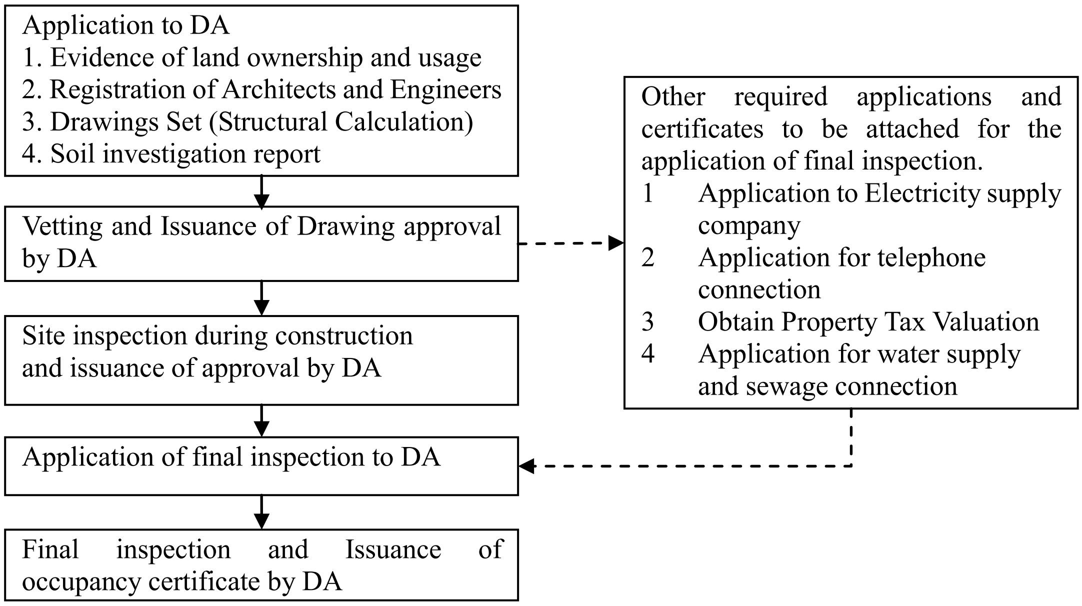
| | Stage | Client | Architects/ Engineers | Contractor | Building Authority |
|---|---|---|---|---|---|
| 1 | Concept Design | Concept Design Approval | Concept Desgin<br>Building Regulation | | |
| 2 | Design Development | Detailed Design Approval<br>Specification Approval<br>Rough Estimate Approval<br>Building Permit Application | Detail Design<br>Propose Building Specification<br>Provide Rough Estimate<br>Building Permit Application | | Plan Approval |
| 3 | Bidding for selection of Contractor | Cost Approval<br>Contract | Evaluation of estimate<br>Cost Control | Estimate<br>Contract | |
| 4 | Construction | Participation of site meeting<br>Approval of design and material | Site Supervision<br>Approval of material<br>Cost Control | Carry out construction<br>Confirmation of specification<br>Material Purchase | Site Inspection |
| 5 | Completion/ Handover | Final Inspection | Final Ispection | Rectificatioin if any | Final Inspection |

Source: Created by JST

Figure 2.4.1 General Procedure of Building Construction

(2) Permit application procedure

Buildings have to submit several applications for building control, such as connecting to public infrastructure and taxation registration. To apply for and request connection to the relevant authority, a certificate of drawing approval issued by DA is also usually required. To apply the final inspection to DA, a certificate obtained from an infrastructure authority as well as valuation from the taxation department must be attached.




Source: Created by JST from CDA regulation

Figure 2.4-2 Flow of Building application to Development Authority

### 2.4.2 Building Specification

(1) Architectural Specification

1) Structure

The methodology of the structure is mainly Reinforced Concrete (RC), while factory structures are made of steel. The general methodology of the construction is an RC framework, with walls made of either bricks or concrete blocks. The Universal Building Code is one of the major structural codes to which structural engineers and building authorities refer. The Building Code of Pakistan Seismic Provision(BCP-SP-2007) indicates Pakistan’s regional characteristics and seismic zoning information.

2) Wall

Concrete blocks or bricks are widely diffused in the market. In Karachi, concrete blocks are the most economical material while bricks are more popular in Islamabad and Lahore. This depends on the location and number of concrete block manufacturers.

Table 2.4-1 Construction Method of Wall in the Area

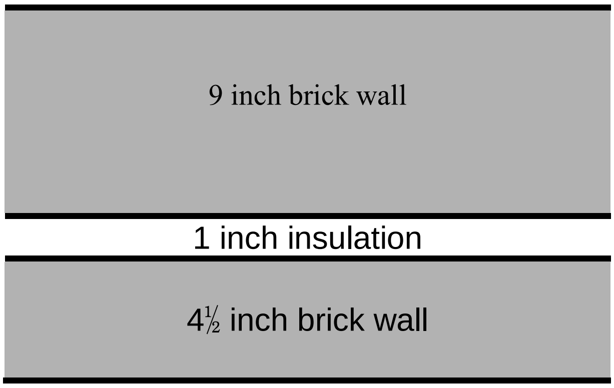
| | |
|---|---|
| Islamabad, Lahore | The wall is mainly made of bricks（W228, D114 and H75） |
| Karachi | The wall is mainly made of concrete blocks (W400, D200,150,100 and H200) |

Source: Summarized by JST from several stakeholder input

Table2.4-2 External wall specification

| | |
|---|---|
| Wall A<br>(Non insulated) | -9 inch thick brick wall<br>-150-200mm thick concrete block wall |
| Wall B<br>(Insulated) | -9-inch external brick wall +1-2 inch insulation + 4½-inch brick wall<br>-100-150 concrete block wall +1-2 inch insulation +100 concrete block |

Source: Summarized by JST from several stakeholder input




Source: Summarized by JST from several stakeholder input

Figure 2.4-3 Insulated brick wall section

According to the BCP-EP-2011 standard, only a 9-inch brick or concrete block wall would not meet the performance requirement. However, the construction site featured a non-insulated brick wall and awareness and enforcement of the code of compliance may be problematic. Standard insulated wall is the double wall with sandwiched insulation in between. Additional cost for insulation and internal wall as well as reduced internal usable floor area seems to be a major barrier for insulated wall.

3) Roof

In rural areas and traditional buildings, timber beams with bricks are often used. In this method, materials are re-usable when people decide to demolish their houses. Most buildings in urban areas are constructed with reinforced concrete slabs. To consider thermal insulation, several methods are widely used.

Table 2.4-3 Construction Method of Roof (Performance A<B<C<D)

| | |
|---|---|
| Roof A | No insulation material |
| Roof B | On top of the waterproofing, provide 3-4 inches of mud with finish material. (Mud seems a cheaper solution compared to insulation material) |
| Roof C | On top of the waterproofing, lean concrete on Styrofoam.<br>Finishing material , stone or tile, may be applied. |
| Roof D | On top of Roof C above, provide finish material on the raised deck. An air gap in between the concrete and finish material provides a further insulation effect. |

Source: Summarized by JST from several stakeholder input

4) Thermal Insulation Material

Several years ago, the only insulation material was expanded polystyrene (EPS). Since then, extruded polystyrene (XPS) has been introduced and is currently available on the market. EPS is economical but weak against water and thermal performance declines over time. XPS is expensive on the market but its thermal performance is considered permanent.

Table 2.4-4 Material of Thermal Insulation

| A) The price of EPS | B) The price of XPS |
|---|---|
| ①thickness=50mm PKR15/ft² | ①thickness=50mm PKR90/ ft² |
| ②thickness=25mm PKR8/ ft² | ②thickness=25mm PKR50/ ft² |

Source: Summarized by JST from several stakeholder input

5) Window

Majority of window frame material is aluminum frame. Aluminum window frames are installed after applying plaster to the brick or concrete block wall opening, although air-tightness may be problematic with this installation method. To improve air tightness, caulking can be applied around the aluminum frame.[21] The window frame manufacturers indicates air tightness performance in their product specification. However, in Pakistan, window manufacturer do not provide such information or certification. Air-tightness and water proofing performance is depending on the skill of contractor on site. The window frame profile is different in the one for single glazing and the one for double glazing. The cost for the frame for double glazing has been more expensive due to the low demand.

6) Glass

Double-glazing is found in high-end hotels and office buildings, otherwise single-glazing is generally used. The tinted glass is used against sunshine mainly in commercial buildings. According to the glass criteria in BCP-EP-2011, single-glazing or tinted-glazing would not meet the performance requirement. Double glazing window seems to be the most reasonable choice to comply BCP-EP-2011 criteria. The cost for the window is combination of window frame and glass specification. Below is the summary of cost information for window. It is common to use tempered glass for commercial or multi-story buildings.

Table 2.4-5 Summary of window cost

| Spec | Aluminum Frame | Glass | Window as a hole |
|---|---|---|---|
| Single Glazing | Rs 440-450/ ft² | Clear: Rs 70/ ft² | 510-520/ ft² |
| | | Tinted: Rs 150-170 | 600-630/ ft² |
| Double Glazing | Rs 500-600/ ft² | Double: Rs 240/ ft²<br>Tempering: Rs 100/ ft² | 840-940/ ft² |

Source: Summarized by JST from several stakeholder input

[21] Interview with TOBISHIMA CORP on 8 June, 2015

(2) Specifications of the Building by Developers

In addition to the BCP-1986 and other regulation applied by regional development authorities, developers like Bahria Town and EMAAR also have their own standards. Given the lack of disaster prevention regulations, mechanical engineers use the standards of MFA of the USA.

Built-for-sale house packages are not common for individual housing in Pakistan. Since standard payment scheme is 1-2 year installment payment, the most of construction starts after the buyers reservation and the buyer has opportunity to reflect their requirement into the building specification. However, the standard design criteria do not currently take account of BCP-EP-2011 or other EE&C standards (no awareness of BCP-EP-2011). A few clients are willing to invest in the initial cost of EE&C for the building design. As a percentage, 2 to 3% of clients are keen to consider EE&C, so architects normally do not propose EE&C to clients.[22]

### 2.4.3 Building Service Specification

(1) Air-conditioner

Central type air-conditioners are installed in high-end hotels, shopping malls and a few large-scale office buildings. Otherwise individual-type air-conditioners are installed in the majority of buildings. In case of central air-condition system, the capacity is decided heat load, and electrical type is selected in Karachi area, gas absorption type is selected in Islamabad area and Lahore area. In case of split type AC, the recommended capacity is indicated by room size. Capacity of sprit type AC by room size is shown in Table below.

Table 2.4-6 Capacity of sprit type AC by room size

| Capacity | Room size |
|---|---|
| 12,000 Btu/h(1 ton) | 125 $ft^2$ to 150 $ft^2$ (11.63 $m^2$ to 13.95 $m^2$) |
| 18,000 Btu/h (1.5 ton) | 140$ft^2$ to 225$ft^2$ (13.02 $m^2$ to 20.93 $m^2$) |
| 24,000 Btu/h(2 ton) | 210 $ft^2$ to 300 $ft^2$ (19.53 $m^3$ to 27.90 $m^2$) |

Source: website of Dawlance (Domestic manufacturer)

(2) Lighting Equipment

Recently CFL and LED lights have increasingly penetrated the market. Automatic lights/sensors are not common in Pakistan.[23]

(3) Ventilation

Ventilation is mechanically installed in high-rise buildings, while natural ventilation is more

[22] Interview with Bahria Town on 9 June, 2015
[23] Same as above

common in residential buildings. Ventilation with heat exchangers is not common in Pakistan.[24]

(4) Hot water Supply

Hot water is usually supplied by gas water heaters.[25] In recent condominium buildings, the use of instantaneous gas water heaters has become popular.

(5) General Purpose Motors

Domestic product motor with low energy efficiency is generally installed as a transportation power source for drinking water, hot water, warm water and chilling water.

(6) Lift

Conventional lifts are generally adopted.

(7) Electric fan

According to a GIZ study report in 2010, the actual motor input power is 90 to 100 W for the 1200- and 1400 mm types, hence the need to develop a highly efficient motor and inverter control for ceiling fans.

### 2.4.4 Capacity of Architects and Engineers

There are two major regulatory bodies, which recognize and protect the building sector profession. The Pakistan Engineering Council (PEC) regulates engineers and the Pakistan Council of Architects and Town Planners (PCATP) regulates architects and town planners in the country. To regulate professionals, those organizations set requirements to be registered, which include a combination of qualifications from accredited institutions, a period of professional experience, credit point of Continued Professional Development and examination.

According to interviews with local architects, engineers and international developers and contractors, the skill level of architects/engineers in major cities suffices to ensure excellent professionals can participate in development projects overseas. However, due to the recent increment of universities for architecture courses, a shortage of qualified professors and a resulting decline in the quality of students is an issue in Pakistan.

(1) Registration requirement by PEC

To practice engineering in Pakistan, consulting firms and/or individuals must register under the Pakistan Engineering Council (Conduct and Practice of Consulting Engineers) Bye-law, 1986

[24] Interview with ABAD on 11 June, 2015
[25] Same as above

(PEC-CPCE-1986) as Consulting Engineers. The requirements are described below. The PEC issues a Certificate of Registration for Consulting Engineers, which has to be renewed annually.

Table 2.4- 7 Requirement for Consulting Engineer

| Requirement | Title in PEC registration | Education | Experience |
|---|---|---|---|
| A | Professional Engineer | Master Degree | 5 years |
| B | Professional Engineer | Graduation | 10 years |

Source: PEC

The requirement imposed to be a Professional Engineer involves passing the Engineering Practice Examination (EPE) after 5 years of experience as a Registered Engineer. A Registered Engineer must earn sufficient Continued Professional Development (CPD) credit points to maintain their registration.

Table 2.4- 8 Categories of CPD

| Category | Applicable CPD Program | Duration (Hrs) | Credit Point |
|---|---|---|---|
| Formal Education | 1. Post-graduate Diploma (PGD) | | 2-4 |
| | 2. Award of Post-graduate Degree in Engineering and related subjects | | 4-6 |
| | 3.Award of Doctorate (Ph.D.) in Engineering | | 12 |
| Work-based Activities | Work Experience (Engineering related work including relevant aspects of Management) | 400 | 1 |
| Developmental Activities | 1. Membership of a recognized professional Association/ body | | 1-2 |
| | 2. Participation in Training & Development Programmes | | 1 |
| | 3. Participation in Conference | 2 | 0.5 |
| | 4. Participation in Seminar | 2 | 0.5 |
| | 5. Participation in Lectures | 2 | 0.5 |
| | 6. Participation in Workshop | day | 1 |
| | 7. Refresher Course/Short Course | day | 1 |
| Individual Activities | 1. Invited Lecturer | | 1.5 |
| | 2. Symposium Panelist | | 0.5 |
| | 3. Writing and publishing a Research Article in Journals /Technical Report | | 1.5-3 |
| | 4. Writing Conference Paper | | 0.5-1.5 |
| | 5. Authoring a Book | | 5 |
| | 6. Part of activities such as emergency/ recognized social work | | 1 |
| | 7. Participation in statutory, technical or non-technical committees | | 1 |
| | 8. Managing Technical event | | 1-2 |

Source: PEC

As a certified qualification to be a Registered Engineer, Engineering Programs of various Universities/Institutions inside Pakistan are accredited by the PEC.

Table 2.4- 9 Schedule A (Pakistan)

| | Location | No. Of Univ./ Institute | No. Of Program |
|---|---|---|---|
| 1 | Islamabad | 21 | 43 |
| 2 | Punjab | 44 | 121 |
| 3 | KPK | 17 | 52 |
| 4 | Sindh | 23 | 91 |
| 5 | Balochistan | 2 | 13 |
| 6 | AJ&K | 1 | 5 |
| | Total | 107 | 325 |

Source: PEC

Table 2.4- 10 Schedule B (Outside of Pakistan)

| | | |
|---|---|---|
| 111 | Engineering Council UK | "Chartered Engineer" shall be eligible to be registered as "Professional Engineer" in the relevant discipline provided he/she possesses four years of engineering qualification and satisfies the PEC Regulations for Engineering Education. |
| 181 | UK Universities / Institutions. | Engineering Qualifications accredited by Engineering Council UK from the year 1993 and subsequent updated qualifications satisfying one of the following criteria:-<br>a. Four years of Bachelor of Engineering.<br>b. Three years of Bachelor of Engineering with Master of Engineering (M.Eng/M.S/M.Sc.)<br>c. Four years of Master of Engineering (M.Eng/M.S/M.Sc.). |
| 182 | European Universities / Institutions | Four years accredited engineering qualification, as per updated Index published by the European Federation of National Engineering Association (FEANI) Paris, France, after 1991 or European Network of Accredited Engineering Education (ENAEE). |
| 198 | European University of Lefke, Turkish Republic of Northern Cyprus | B.Sc. Computer Engineering (From Intake of Batch 2007 up to 2009)<br>B.Sc. Electrical and Electronics Engineering (From Intake of Batch 2007 up to 2008) |
| 199 | Washington Accord | Accredited Engineering Degree programmes recognized by Washington Accord of International Engineering Alliance (IEA) as per updated list published by the respective Signatories. |

Source: PEC

As of June 2014, there were 170,992 engineers registered under the PEC.

Table 2.4- 11 Number of Registered Engineers under PEC

| Discipline | FEDERAL | PUNJAB | AJK | SINDH | KPK | GILGIT BALTISTAN | BALOCHISTAN | FOREIGN NATIONALS | TOTAL |
|---|---|---|---|---|---|---|---|---|---|
| **CIVIL** | 1791 | 12777 | 435 | 13453 | 5586 | 85 | 1253 | 39 | **35419** |
| **ELECTRICAL** | 3336 | 19755 | 1064 | 10485 | 6013 | 47 | 729 | 11 | **41440** |
| **MECHANICAL** | 1339 | 10996 | 303 | 11360 | 2600 | 18 | 448 | 12 | **27076** |
| **CHEMICAL** | 338 | 7984 | 37 | 2697 | 628 | 1 | 95 | 2 | **11764** |
| **ELECTRONICS** | 960 | 4225 | 107 | 11901 | 1853 | 34 | 574 | 7 | **19661** |
| **METALLURGY** | 142 | 1849 | 6 | 1160 | 84 | 2 | 33 | 2 | **3278** |
| **AGRICULTURE** | 111 | 1791 | 10 | 1131 | 446 | 2 | 246 | | **3737** |
| **AERONAUTICAL** | 224 | 827 | 9 | 350 | 268 | 2 | 13 | | **1693** |
| **MINING** | 46 | 646 | 12 | 345 | 313 | 2 | 94 | | **1458** |
| **PETROGAS** | 99 | 523 | 1 | 774 | 134 | | 142 | | **1673** |
| **TELE COMM** | 573 | 2407 | 25 | 1293 | 615 | 9 | 107 | 5 | **5034** |
| **MECHATRONICS** | 156 | 1099 | 10 | 27 | 100 | 3 | | 1 | **1396** |
| **INDUSTRIAL** | 32 | 714 | 9 | 1368 | 90 | 4 | 12 | 2 | **2231** |
| **NUCLEAR** | 4 | 1 | | | 0 | | | | **5** |
| **TEXTILE** | 22 | 1008 | 10 | 602 | 74 | 2 | 41 | | **1759** |
| **BIOMEDICAL** | 9 | 14 | | 814 | 1 | | | | **838** |
| **ENGINEERING SCIENCES** | 20 | 48 | | 11 | 16 | | 2 | | **97** |
| **ARCH ENGG** | 13 | 323 | 4 | 3 | 1 | | 1 | | **345** |
| **COMPUTER** | 800 | 2931 | 165 | 5410 | 1384 | 7 | 252 | 3 | **10952** |
| **GEOLOGY** | 6 | 110 | 3 | 3 | 32 | | 7 | | **161** |
| **TRANSPORT** | 3 | 98 | 1 | | 0 | | | | **102** |
| **POLY** | 1 | 90 | 2 | 149 | 6 | | 1 | | **249** |
| **ENVIRONMENT** | 7 | 132 | | 174 | 9 | | | | **322** |
| **URBAN** | 1 | 3 | | 179 | 0 | | | | **183** |
| **AUTOMOTIVE** | | 2 | | 116 | 1 | | | | **119** |
| **TOTAL** | **10033** | **70353** | **2213** | **63787** | **20254** | **218** | **4050** | **84** | **170,992** |

Source: PEC

(2) Registration Requirement by PCATP

Apart from the registration system for Consulting Engineers under the PEC, for Architects and Town Planners, registration under the Pakistan Council of Architects and Town Planners (PCATP) is required to carry out professional service in Pakistan. The requirements for Registered Architects or Town Planners by the PCATP is to hold a five-year Bachelor of Architecture/Town planner from accredited Institutions in schedule 1 & 2 in PCATP ordinance 1983.

PCATP is currently engaged in revising the Ordinance regarding registration requirements. The proposed requirements it wishes to add to the examination process after at least two years of experience with minimum CPD course attendance. A CPD (Continued Professional Development) course will be established with reference to RIBA (Royal Institute of British Architects). PCATP aims to revise its ordinance by 2016. PCATP and HECP (Higher Education Commission Pakistan) have exchanged an MOU regarding financial support for the new CPD establishment.

PCATP is the national regulatory body, in the country, to accredit professional degree programs in Architecture and Town Planning under above Ordinance. The accredited degree is one of the essential requirements for all graduates to acquire a license for professional practice in Architecture and Town Planning. The accrediting process is intended to verify that each accredited program substantially meets those standards that collectively comprise an appropriate education for an Architect or Town Planner.

Table 2.4- 12 Number of registered Architects and Town Planner as of 2014

| | Registered | Paid up annual fee | Removed*1 | Deceased |
|---|---|---|---|---|
| Architect | 4586 | 2435 | 2039 | 112 |
| Town Planner | 939 | 363 | 557 | 19 |

*1: Architects who do not hold registration, are 1) no longer in the profession, 2) working under registered architects or 3) working illegally using registered architects' name.
Source: PCATP annual report 2014

Table 2.4- 13 Number of accredited Institution of Architects and Town Planner as of 2014

| | Architects | Town Planner |
|---|---|---|
| Schedule 1 (Pakistan) | 18 | 3 |
| Schedule 2 (Outside Pakistan) | 60 | 21 |

Source: PCATP annual report 2014 and website

### 2.4.5 Potential of energy saving in building design

There are two major components for EE&C for building design. One involves designing a building envelope to minimize energy loss, the other is to optimize the required services to minimize energy usage. The International Energy Agency (IEA) stated that the suitability of EE&C technologies was contingent on the type of economy, climate and whether the materials were being used for new buildings or retrofits. Recommended technology in "Hot Climate in Developing Economy" is shown below.

Table 2.4- 14 Recommended Technology in Hot Climate in Developing Economy

| Technology | |
|---|---|
| ***Insulation, air sealing and double-glazed low-e windows for all building*** | |
| New Construction | Retrofit |
| 1. Exterior shading and architectural features<br>2. Low-SHGC windows<br>3. Reflective roofs and wall coatings<br>4. Optimized natural/mechanical ventilation | 1. Exterior shading<br>2. Reflective coatings (roof and wall)<br>3. Low-cost window films<br>4. Natural ventilation |

Source: IEA

(1) Envelope

After interviewing several stakeholders, JST summarized the current situation of building envelope technologies in Pakistan as follows:

Table 2.4- 15 Building Envelope Specification in Pakistan

| Components | Majority | Advanced (less than 5%) |
|---|---|---|
| Roof | RC slab and water proofing, covered by topping concrete. No insulation. | Two inches of extruded polystyrene (XPS: U-value 0.035) above the RC slab and water proofing, covered by topping concrete. Then install finish material on the raised frame. |
| Wall | 9 inch brick wall or concrete block. No insulation. | Double brick wall with two-inch insulation in the cavity. |
| Window | Single-glazed aluminum window. Commercial buildings have tinted glass. | Double-glazed aluminum window, for high-end hotels, offices.<br>LOW-E glass must be imported. |

Source: Summarized by JST

The recognition of benefit of insulated envelope is very low in the majority of building sector. Meanwhile, the projects for high-end user are adopting insulated envelope, reason seems to be i) make sense economically, ii) high expectation from client/user, iii) high awareness of general environmental issue.

(2) Services

Air-conditioning and lighting are two major components of building energy consumption. Usage of energy-saving products as well as proper insulation to prevent energy loss are essential.

The Institute for Building Environment and Energy Conservation (IBEC) in Japan has introduced Model Building for respective building typology which has been used to establish benchmarks for the Japanese Energy Code. The energy consumption ratio by building services are indicated in Table below. This is based on the climatic zoning of Naha in Japan, which is the southern end of zoning. Heating Degree Day (18°C) is 125, Cooling Degree Day (24°C) is 515.

Table 2.4- 16 Energy Consumption Ratio per Building Type in Naha, Japan

| Building type | Air condition | Ventilation | Lighting | Hot water | Elevator | Other |
|---|---|---|---|---|---|---|
| Office (5000m²) | 54% | 4% | 22% | 1% | 1% | 18% |
| Hotel (5000m²) | 61% | 6% | 15% | 13% | 1% | 4% |
| Hospital (5000m²) | 43% | 12% | 21% | 15% | 2% | 7% |
| Retail (5000m²) | 46% | 2% | 17% | 1% | 1% | 33% |
| School (5000m²) | 50% | 9% | 17% | 7% | 0% | 17% |
| Restaurant (1500m²) | 30% | 12% | 15% | 29% | 0% | 14% |

Source: IBEC

Focusing on the electricity consumption on buildings, the percentage of electricity of respective building services are estimated as shown below table, taking Pakistan characteristics of, i) Gas is widely used for hot water and cooking plate, ii) there is no mechanical ventilation requirement for habitable space like Japan, iii) Both Air Conditioner and ceiling/ wall mount fan are often installed.

Table 2.4-17 Estimated electricity consumption ration in building in Pakistan

| | Air conditioner and ceiling/ wall mount fan | Lighting | Others |
|---|---|---|---|
| Electricity consumption (%) | 50-70% | 15-25% | 15-25% |

Source: Estimated by JST

(3) Electricity Cost

The electrical tariff structure at the Islamabad Electrical Supply Company (IESCO) in Pakistan is shown below.

Table 2.4- 18 Tariff Structure at IESCO (SRO No. 985(i)/ 2014

| A-1 GENERAL SUPPLY TARIFF - RESIDENTIAL | | | | |
|---|---|---|---|---|
| Sr. No. | TARIFF CATEGORY / PARTICULARS | FIXED CHARGES Rs/kW/M | VARIABLE CHARGES Rs/kWh | |
| a) | For Sanctioned load up to 5 kW | | | |
| i | Up to 50 Units | - | | 2 |
| | For Consumption exceeding 50 Units | | | |
| ii | 1- 100 Units | - | | 5.79 |
| iii | 101- 200 Units | - | | 8.11 |
| iv | 201- 300 Units | - | | 12.09 |
| v | 301- 700 Units | - | | 15 |
| vi | Above 700 Units | - | | 17.5 |
| b) | For Sanctioned load exceeding 5 kW | - | | |
| | | | Peak | Off-Peak |
| | Time Of Use | - | 17.5 | 11.5 |
| As per the Authority's decision residential consumers will be given the benefits of only one previous slab. | | | | |
| Under tariff A-1, there shall be minimum monthly customer charge at the following rates even if no energy is consumed. | | | | |
| a) Single Phase Connections: | | 75 | | |
| b) Three Phase Connections: | | 350 | | |
| A-2 GENERAL SUPPLY TARIFF - COMMERCIAL | | | | |
| a) | For Sanctioned load up to 5 kW | | | 17.5 |
| b) | For Sanctioned load exceeding 5 kW | 400 | | 15 |
| | | | Peak | Off-Peak |
| c) | Time Of Use | 400 | 17.5 | 11.5 |
| Under tariff A-2, there shall be minimum monthly charges at the following rates even if no energy is consumed. | | | | |
| a) Single Phase Connections: | | 175 | | |
| b) Three Phase Connections: | | 350 | | |

| B - INDUSTRIAL | | | | |
|---|---|---|---|---|
| B1 | Up To 25 kW (at 400/230 Volts) | - | | 14.5 |
| B2(a) | Exceeding 25-500 kW (at 400 Volts) | 400 | | 14 |
| | Time Of Use | | Peak | Off-Peak |
| B1(b) | Up to 25 kW | - | 17.5 | 11.5 |
| B2(b) | 25-500 kW (at 400 Volts) | 400 | 17.5 | 11.3 |
| B3 | For All Loads up to 5000 kW (at 11,33 kV) | 380 | 17.5 | 11.2 |
| B4 | For All Loads (at 66,132 kV & above) | 360 | 17.5 | 11.1 |
| For B1 consumers there shall be a fixed minimum charge of Rs. 350 per month. | | | | |
| For B2 consumers there shall be a fixed minimum charge of Rs. 2,000 per month. | | | | |
| For B3 consumers there shall be a fixed minimum charge of Rs. 50,000 per month. | | | | |
| For B4 consumers there shall be a fixed minimum charge of Rs. 500,000 per month. | | | | |

Source: IESCO website

Table 2.4- 19 Peak time in IESCO Tariff Structure

| Season/Months | Peak Time ( 4 hours/ day) | Off-Peak |
|---|---|---|
| December to February | 5PM to 9PM | Remaining 20 hours |
| March to May | 6PM to 10PM | Remaining 20 hours |
| June to August | 7PM to 11 PM | Remaining 20 hours |
| September to November | 6PM to 10 PM | Remaining 20 hours |

Source: loadshedding.pk

(4) Potential savings by using an insulated envelope and energy-efficient equipment,

1) Lightings

Table 2.4- 20 Light Bulb Comparison

| | Incandescent Lamp | CFL | LED |
|---|---|---|---|
| Energy Consumption | 60W | 15W | 6-8W |
| Energy Efficiency | 1 | 0.25 | 0.12-0.13 |
| Price Factor | 1 | 8 | 96 |
| Lifespan | 1,000 hours | 10,000 hours | 50,000 hours |

Source: JST

<u>Simulation for cost performance</u>

Precondition

Time: 50,000 Hours (Approx. 25 years, based on an average 6 hours/day usage)

Electrical Cost: 15PKR/kwh

Lighting Bulb: 60W incandescent lamp or equivalent luminance

Calculation (Total cost of bulb cost and electricity cost)

Cost for bulb: Unit Cost x Number required for 50,000 hours

Cost for electricity: Energy consumption (W) x 50,000 hour x unit cost

Table 2.4- 21 Simulation for Cost Performance between Light Bulbs

| | Cost for bulb | Cost for electricity | Total cost per light |
|---|---|---|---|
| Incandescent bulb | 25 x 50 = 1,250PKR | 3,000 x15 = 5,000PKR | 46,250PKR |
| CFL | 200 x 5=1,000PKR | 750 x 15= 11,250 PKR | 12,250PKR |
| LED | 2,400 x 1=2,400PKR | 375 x 15= 5,625 PKR | 8,025 PKR |

Source: JST by market research

In 25 years span, CFL will save 74%, LED will save 83% in comparison to the total cost of incandescent bulb. The pay-back period to change from incandescent, CFL will be 2 months only and LED will be 18 month.

2) Building Envelope

Initial investment for the insulated building envelope are mainly determined by combination of three components that are roof insulation, wall insulation and window. Accurate estimate will requires detail information by each project, such as sizes and location of windows, usage of building, operation hour, location and sounded building information etc. Below table indicates general idea of cost impact of insulated envelope.

Table2.4-22 Cost impact of BCP-EP-2011 standard building envelope

| | | | |
|---|---|---|---|
| Calculation Base: 3 storey building<br>Floor Area total 10,800 ft$^2$ ( 60ft x 60ft x 3 story)<br>Area of Roof 3,600 ft$^2$<br>Area of Wall 7,920 ft$^2$ (Wall 60ft x 11ft x3 storey x4 surface)<br>Assume 2,000 ft$^2$ for windows ( 25% of wall) | | | |
| | Non consideration base | EE&C per BCP-EP-2011 | Additional Cost |
| Window (2000 ft$^2$) | Single Glazed Window<br>Unit Cost: Rs 500/ ft$^2$<br>Subtotal: Rs 1,000,000 | Double Glazed Window<br>Unit Cost: Rs 850/ ft$^2$<br>Subtotal: Rs 1,700,000 | Rs 700,000<br>(Unit Cost +Rs 65/ ft$^2$) |
| Roof Insulation (3600 ft$^2$) | No Insulation | 2 inch insulation<br>Unit Cost: Rs 90/ ft$^2$<br>Subtotal: Rs 324,000 | Rs 324,000<br>(Unit Cost +Rs 30/ ft$^2$) |
| Wall Insulation (5920 ft$^2$) | No Insulation | 2 inch insulation + 4 inch internal wall<br>Unit Cost: Rs 150/ ft$^2$<br>Subtotal: Rs 888,000 | Rs 888,000<br>(Unit Cost +Rs82/ ft$^2$) |
| Overall Building cost (Assume Rs 3,000/ ft$^2$) | Unit Cost 3,000 / ft$^2$<br>Total Cost: 32,400,000 | Unit Cost 3,177/ ft$^2$<br>Total Cost: 34,312,000 | Rs 1,912,000<br>(Unit Cost +Rs177/ ft$^2$)<br>(5.9% up) |

Source: Calculated by JST using unit cost provided by various stakeholders.

Additional cost for insulated building envelope is roughly estimated as PKR150-200/ft² as unit cost for entire construction floor area. However, initial cost saving will be expected by reduced Air conditioner capacity. Payback period will be calculated by total initial cost impact, addition by insulation and saving by AC, and reduced running cost. For the building using Air conditioner, total initial cost could be reduced under PKR 100/ft² and payback period could be within two years, subject to building usage and operation hours.

## 2.5 Research on building specification

### 2.5.1 Objective of research

The objective of the research on building specification (hereinafter referred to as 'the research') is to collect the basic data regarding buildings envelop, facilities and operation in Pakistan in order to determine general building specification.

### 2.5.2 Methodology

The research was carried out on following building categorization, area, method and item. The selection of building was intended to be at random in terms of scale, age and grade in order to avoid possible bias.

(1) Number and categorization of buildings : 60 buildings, (Includes multiple usage building)

- Residential: 7 samples
- Hotel: 9 samples
- Office: 9 samples
- Education: 6 samples
- Hospital: 6 samples
- Factory: 6 samples
- Retail: 9 samples
- Restaurant: 6 samples
- Cultural, Gathering Place: 7 samples

(2) Research area

- Islamabad Metropolitan Area includes Rawalpindi, Islamabad
- Lahore, province of Punjab
- Karachi, province of Sindh

(3) Research method

- Interview by face to face
- Walk through on site

(4) Research item

- Architectural components (exterior wall, roof, window/ glass)
- Electrical equipment (lighting fixtures, lighting control, generator, elevator, etc.)
- Mechanical equipment (plumbing and sanitation equipment, gas equipment, air conditioning equipment, ventilation equipment, etc.)
- Operation/ Maintenance method

### 2.5.3 Survey Result

(1) Ratio of building with basement

1) Analysis by location area-wise

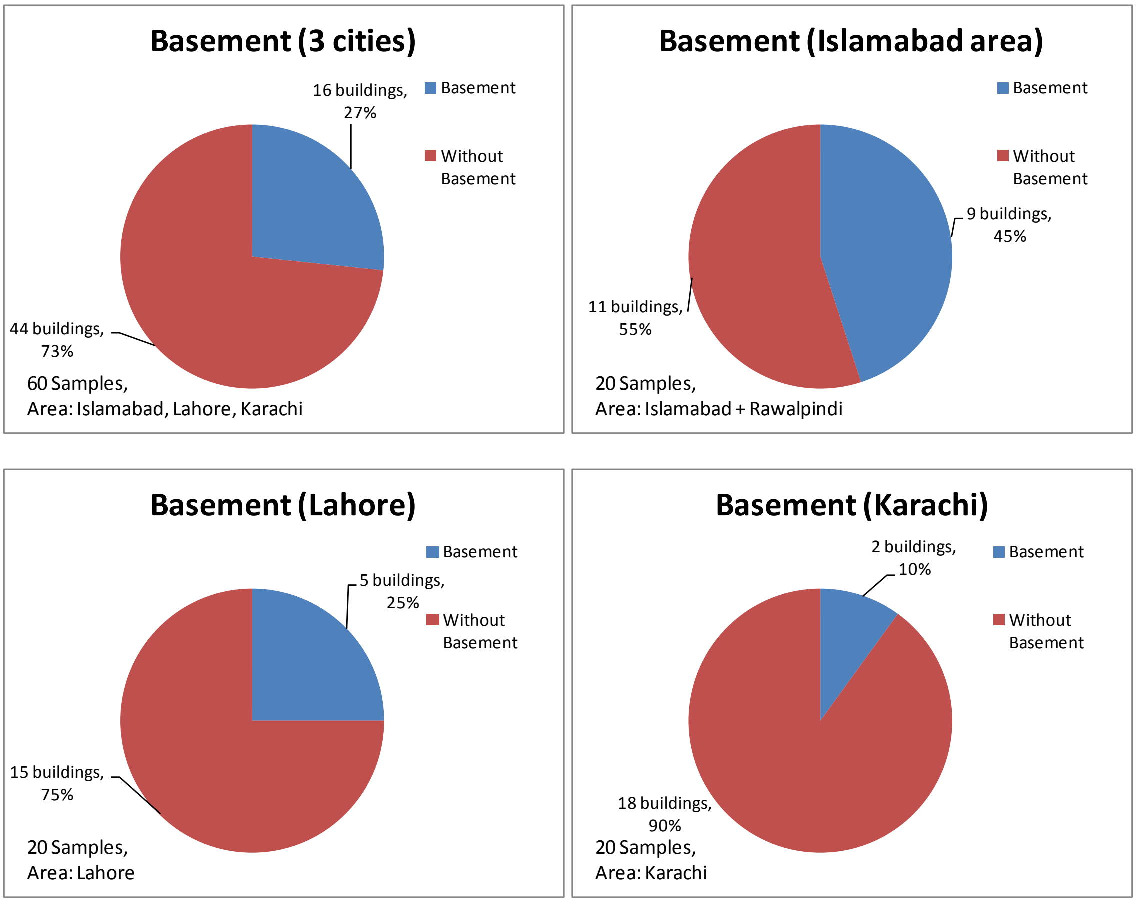
As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of building with basement in three cities is shown in Figure 2.5-1.

a) 3 cities: The ratio of building with basement is 27% in 3 cities.

b) Islamabad area: The ratio of building with basement is 45% in Islamabad. It is higher ratio than other 2 areas. Builder select to construct building with basement in Islamabad in many cases, due to severe height restriction despite that land price is high.

c) Lahore area: The ratio of building with basement is 25% in Lahore area.

d) Karachi area: The ratio of building with basement is 10% in Karachi area.




Source: Prepared by the JICA Survey Team.

Figure 2.5-1 Ratio of building with basement in three cities (Islamabad, Lahore, Karachi)

(2) Ratio of high rise building

1) Analysis by location area-wise

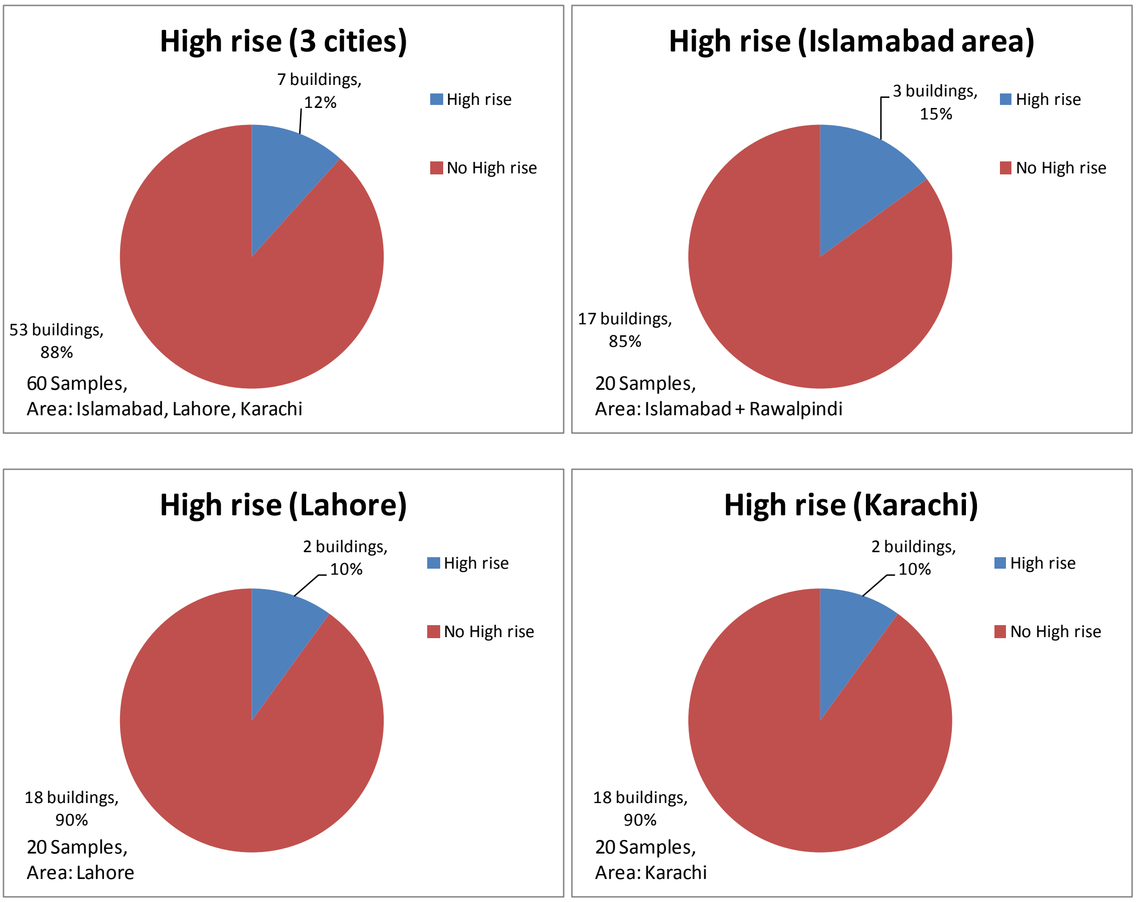
As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of high rise building in three cities is shown in Figure 2.5-2. Generally, the building that has 4 story or more is categorized as high rise building in Pakistan.

a) 3 cities: The ratio of high rise building is 12% in 3 cities. There is no obvious difference among 3 cities.

b) Islamabad area: The ratio of high rise building is 15% in Islamabad.

c) Lahore area: The ratio of high rise building is 10% in Lahore area.

d) Karachi area: The ratio of high rise building is 10% in Karachi area.




Source: Prepared by the JICA Survey Team.

Figure 2.5-2 Ratio of High-rise buildings in three cities (Islamabad, Lahore, Karachi)

(3) Operation hours

1) Analysis by building category-wise: Operation time in retail is shown in Figure 2.5-3.

a) Retail: Peak time of this category seems from 9:00 to 18:00.

b) Office: Office seems almost 8.5 hours operation in Pakistan. Peak time of this category seems from 9:00 to 18:00.

c) Education: Education seems almost 8.0 hours operation in Pakistan. Peak time of this category seems from 9:00 to 14:00.


The graphs in case of hotel, hospital and residential are omitted, because the graph of those categories is simple flat shape due to 24 hours operation in Pakistan also.

Source: Prepared by the JICA Survey Team.

Figure 2.5-3 Operation time by category wise

d) Restaurant: Restaurant seems almost 9.0 hours operation in Pakistan. 24 hours operation restaurant is rare case, because they are in high class hotel and provide 24 hours room service. Restaurant operation graph has 2 peaks, because some of restaurants take break time between lunch time operation and dinner time operation.

e) Cultural: Cultural seems almost 8.0 hours operation in Pakistan. Peak time of this category seems from 9:00 to 16:00.

f) Factory: Factory seems almost 10.0 hours operation in Pakistan. Peak time of this category seems from 8:00 to 18:00.

g) Hotel/ Hospital: 24 hours operation as general Pakistan. Graph is omitted.

(4) Ratio of material on external wall of building envelope

1) Analysis by location area-wise

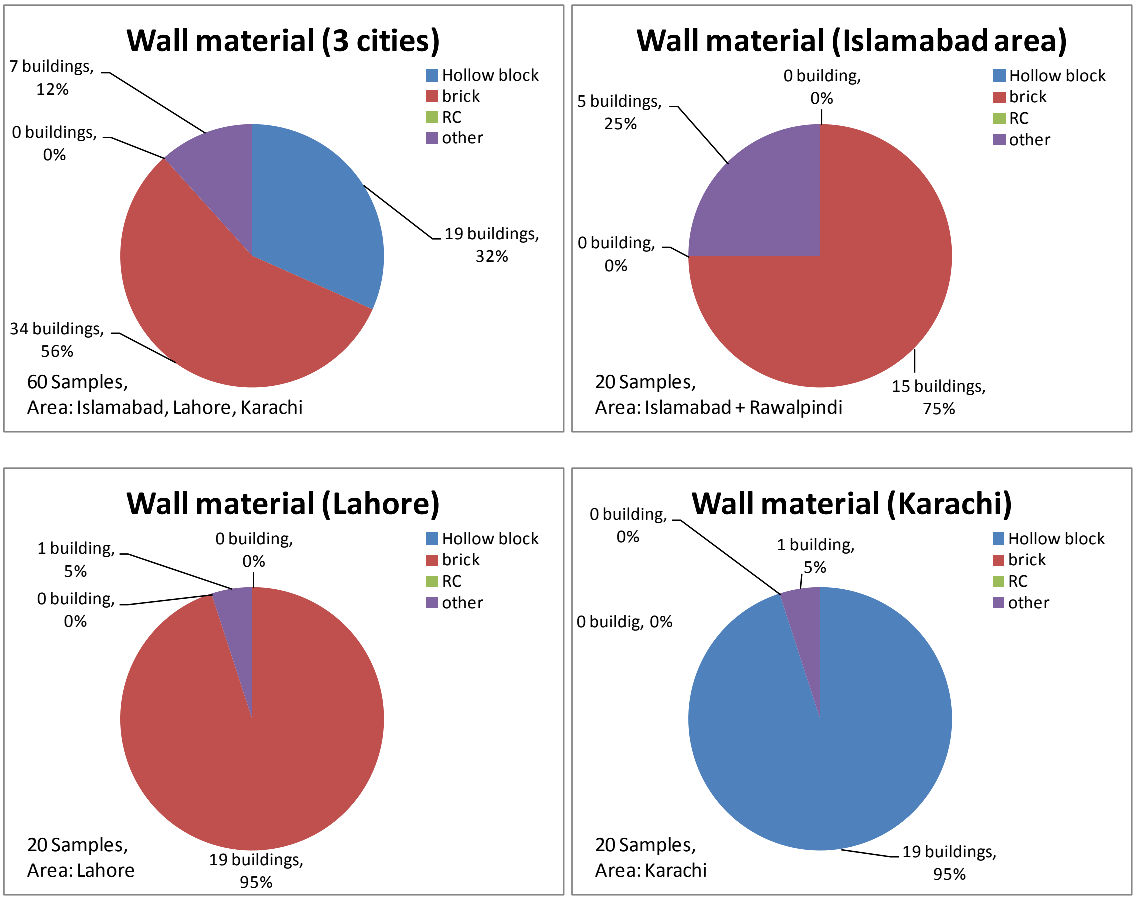
As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of material on external wall of building envelope in three cities is shown in Figure 2.5-4.

a) 3 cities: Material on external wall of building envelope accounts for 32% in concrete block, 56% in brick and 12% by other respectively in 3 cities. Those wall materials are built against Reinforced Concrete structure which is for floor slab, column and beam.

b) Islamabad area: Material on external wall of building envelope accounts for 75% by brick and 25% by others in Islamabad area. No hollow block counts in the research in Islamabad, so hollow block building seems rare case in Islamabad area. The reason is that purchase of brick is easier than hollow block from economical and transportation aspect, because Lahore is main producing area.

c) Lahore area: Material on external wall of building envelope accounts for 95% by brick and 5% by others in Lahore area. No hollow block counts in the research in Lahore. Situation and reason is same as Islamabad buildings.

d) Karachi area: Material on external wall of building envelope accounts for 95% by hollow block and 5% by others in Karachi area. No brick counts in the research in Karachi, so brick building seems rare case in Karachi area. The reason seems to be lack of material for brick and economical advantage to concrete block due to the location of Karachi port.




Source: Prepared by the JICA Survey Team.

Figure 2.5-4 Ratio of wall material in three cities (Islamabad, Lahore, Karachi)

(5) Ratio of adoption of heat insulation on external wall of building envelope

1) Analysis by location area-wise

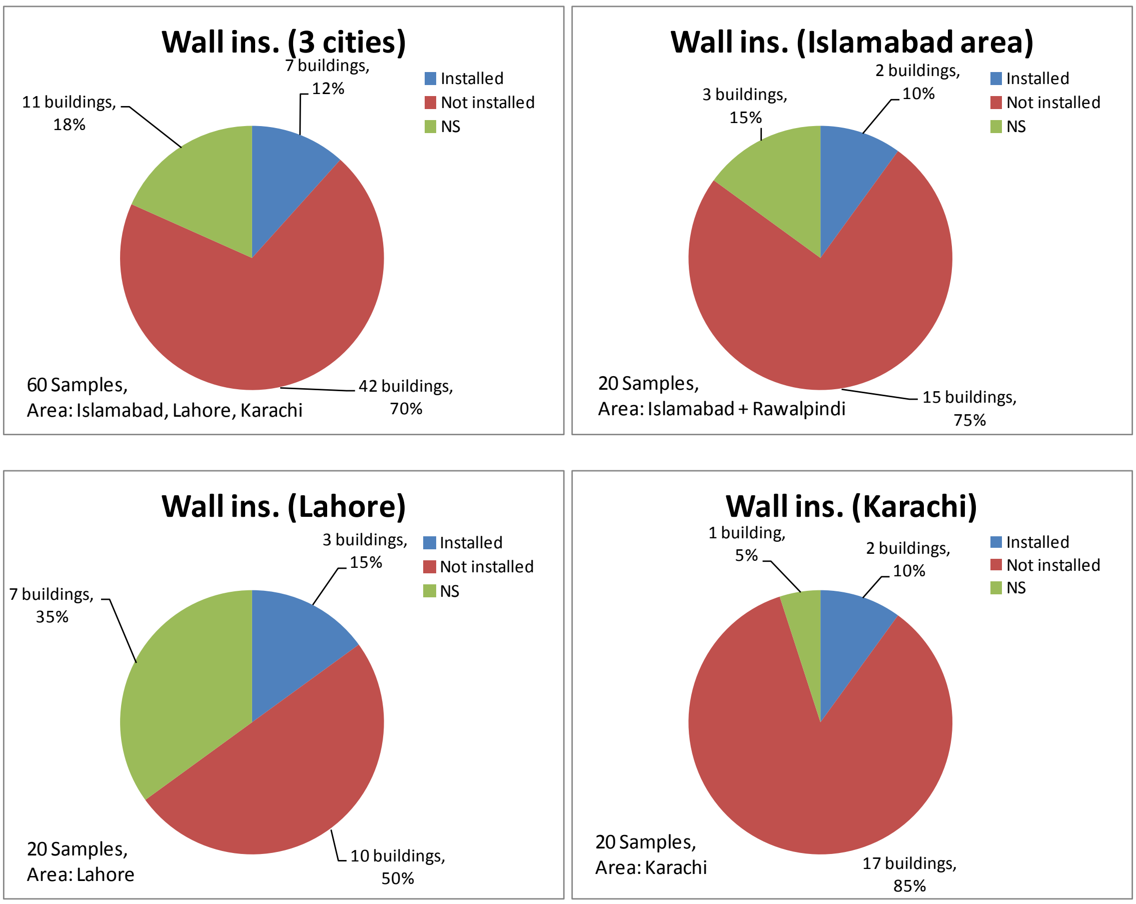
As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of adoption of heat insulation on external wall of building envelope in three cities is shown in Figure 2.5-5.

a) 3 cities: Adoption of heat insulation on external wall of building envelope accounts for 12%, non insulated building is 70%, building that the owner replied ‘not sure’ is 18% in 3 cities. But, reply of ‘not sure’ means uninterested for this matters, it seems almost never insulation on such buildings. Anyway, approximately 10 % of building in urban area seems having insulation.

b) Islamabad area: Adoption of heat insulation on external wall of building envelope accounts for 10%, non insulated building is 75%, building that the owner replied ‘not sure’ is 15% in Islamabad area.

c) Lahore area: Adoption of heat insulation on external wall of building envelope accounts for 15%, non insulated building is 50%, building that the owner replied ‘not sure’ is 35% in Lahore area. Reply of uninterested for this matters is higher ratio of than another 2 cities.

d) Karachi area: Adoption of heat insulation on external wall of building envelope accounts for 10%, non insulated building is 50%, building that the owner replied ‘not sure’ is 35% in Karachi area.




NS: Not Sure
Source: Prepared by the JICA Survey Team.

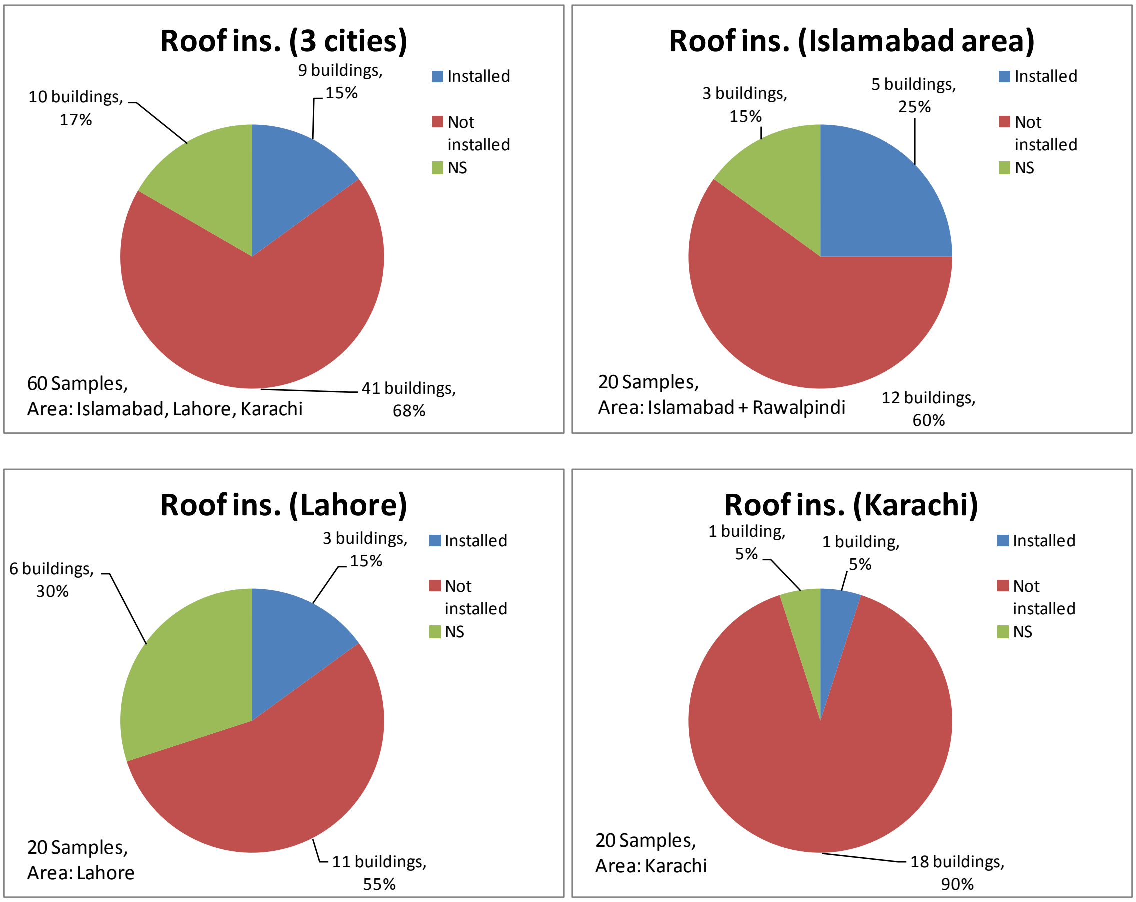
Figure 2.5-5 Heat insulation on wall in three cities (Islamabad, Lahore, Karachi)

(6) Ratio of adoption of heat insulation on roof of building envelope

1) Analysis by location area-wise

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of adoption of heat insulation on roof of building envelope in three cities is shown in Figure 2.5-6.

a) 3 cities: Adoption of heat insulation on roof of building envelope accounts for 15%, non insulated building is 68%, building that the owner replied 'not sure' is 17% in 3 cities. But, reply of 'not sure' means uninterested for this matters, it seems almost never insulation on such buildings. Anyway, approximately 15 % of building in urban area seems having insulation.




NS: Not Sure

Source: Prepared by the JICA Survey Team.

Figure 2.5-6 Heat insulation on roof in three cities (Islamabad, Lahore, Karachi)

b) Islamabad area: Adoption of heat insulation on roof of building envelope accounts for 25%, non insulated building is 60%, building that the owner replied 'not sure' is 15% in Islamabad area.

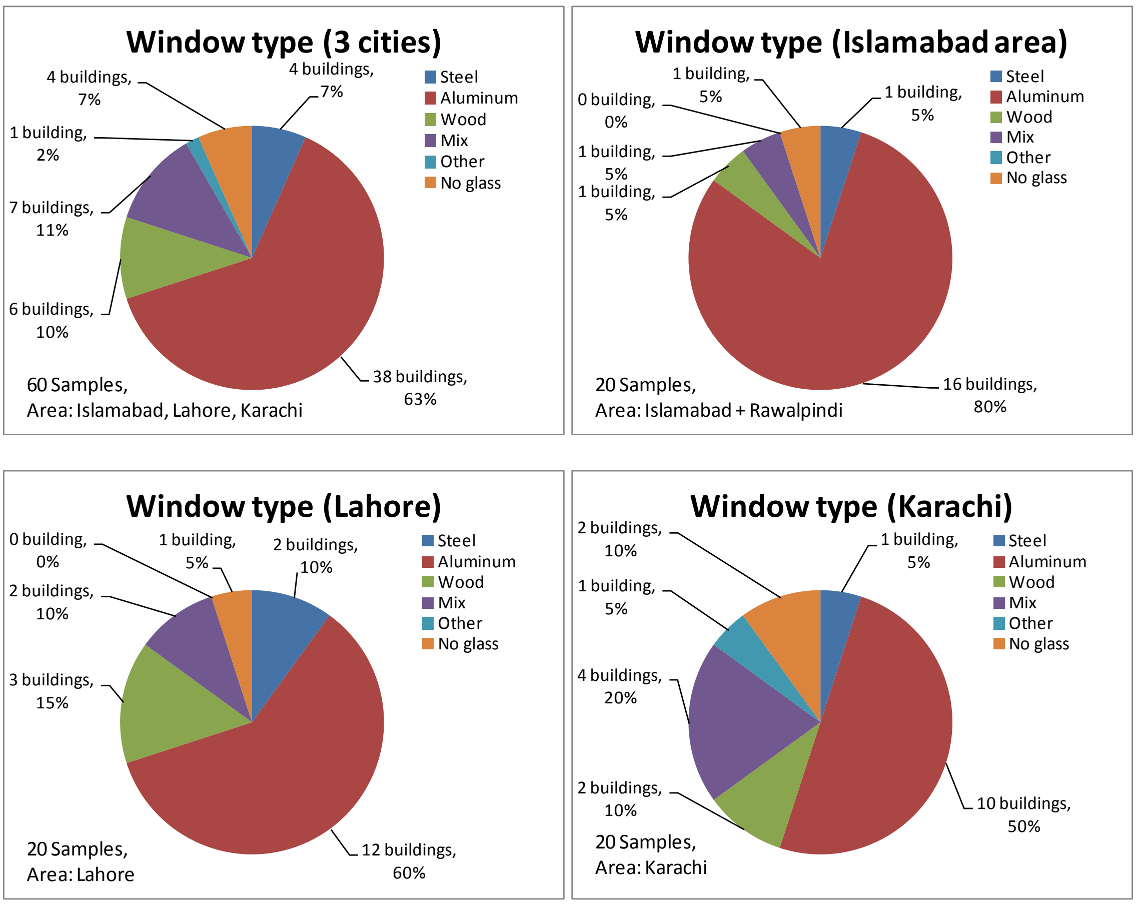
c) Lahore area: Adoption of heat insulation on roof of building envelope accounts for 15%, non insulated building is 55%, building that the owner replied 'not sure' is 30% in Lahore area. Reply of uninterested for this matters is higher ratio of than another 2 cities.

d) Karachi area: Adoption of heat insulation on roof of building envelope accounts for 5%, non insulated building is 90%, building that the owner replied 'not sure' is 5% in Karachi area.

(7) Ratio of material of window frame

1) Analysis by location area-wise

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of material of window frame in three cities is shown in Figure 2.5-7.




Mix: Combination of more than 2 types of window frame
Source: Prepared by the JICA Survey Team.

Figure 2.5-7 Material of window frame in three cities (Islamabad, Lahore, Karachi)

a) 3 cities: Material of window frame accounts for 7% by steel, 63% by aluminum, 10% by wood and 7% by no glass which is mainly in factory, in 3 cities. More than half of window frame is made by aluminum.

b) Islamabad area: Material of window frame accounts for 5% by steel, 80% by aluminum and 5% by wood in Islamabad area.

c) Lahore area: Material of window frame accounts for 10% by steel, 60% by aluminum and 15% by wood in Lahore area.

d) Karachi area: Material of window frame accounts for 5% by steel, 50% by aluminum and 10% by wood in Karachi area.

(8) Ratio of type of window glass

1) Analysis by location area-wise

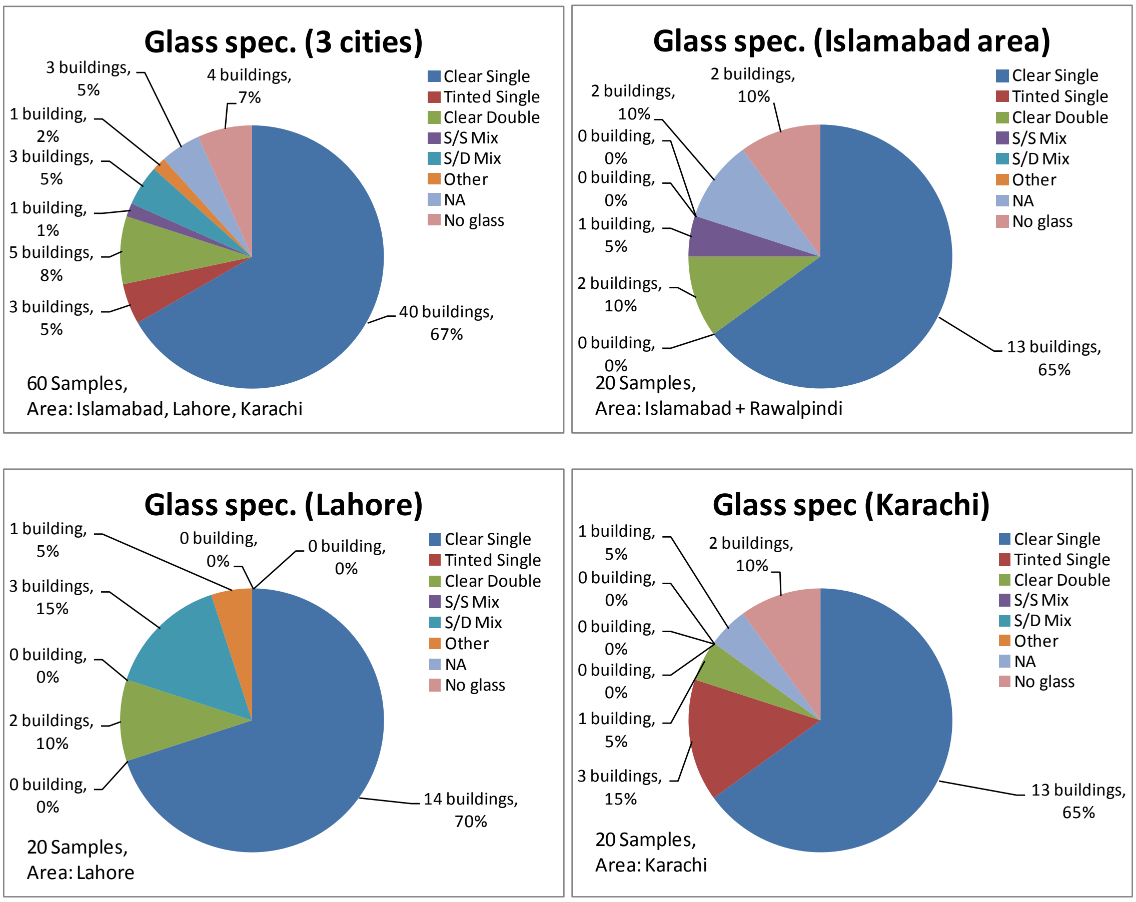
As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of type of window glass in three cities is shown in Figure 2.5-8.

a) 3 cities: Types of window glass account for 67% by clear single, 5% tinted single and 8% clear double in 3 cities. More than half of glass type is clear single. Double glazing window, which is the only BCP-EP-2011 compliance specification among the selection is 6% only.

b) Islamabad area: Types of window glass account for 65% by clear single and 10% by clear double in Islamabad area.

c) Lahore area: Types of window glass account for 70% by clear single and 10% by clear double in Lahore area.

d) Karachi area: Types of window glass account for 65% by clear single 5% by clear single in Karachi area.




S/S Mix: Combination both of Clear Single and Tinted Single, S/D Mix: Combination both of Clear Single and Clear Double, NA: Not Available

Source: Prepared by the JICA Survey Team.

Figure 2.5-8 Type of window glass in three cities (Islamabad, Lahore, Karachi)

(9) Ratio of type of external shade on window

1) Analysis by location area-wise

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of type of external shade on window in three cities is shown in Figure 2.5-9.

a) 3 cities: Types of external shade on window account for 45% by no shade, 25% by cantilever, 17% by louver and 7% by canopy n in 3 cities. There is no external shade on window at almost half of buildings.

b) Islamabad area: Types of external shade on window account for 65% by no shade, 30% by louver and 5% by canopy in Islamabad area.

c) Lahore area: Types of external shade account for 40% by no shade, 20% by louver , 20% by cantilever and 5% by canopy in Lahore area.

d) Karachi area: Types of external shade on window account for 55% by cantilever 30% by no shade and 10% by canopy in Karachi area. Cantilever seems popular in Karachi to create shade.


NA: Not Available, Mix: Combination of more than 2 types of external shade.
Source: Prepared by the JICA Survey Team.

Figure 2.5-9 Type of external shade on window in three cities (Islamabad, Lahore, Karachi)

(10) Ratio of type of internal shade on window

1) Analysis by location area-wise

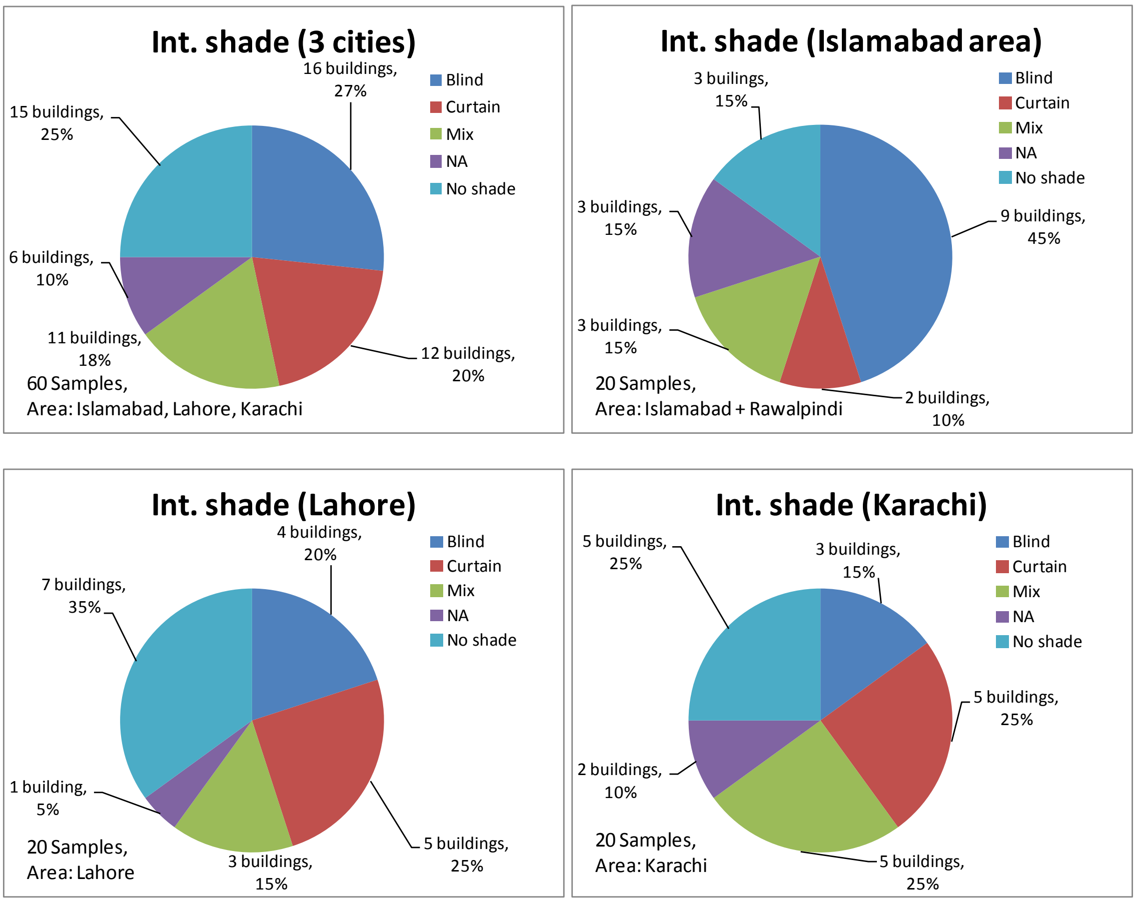
As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of type of inter shade on window in three cities is shown in Figure 2.5-10.

a) 3 cities: Types of external shade on window account for 27%, 20% and 25% by blind, curtain and no shade respectively in 3 cities. There is any internal shade on window at almost half of building.

b) Islamabad area: Types of internal shade on window account for 45%, 15% and 10% by blind, curtain and no shade respectively in Islamabad area.

c) Lahore area: Types of internal shade account on window for 20%, 25% and 30% by blind, curtain and no shade respectively in Lahore area. Buildings in Lahore are high ratio of no internal shade on window in different from the other area.

d) Karachi area: Types of internal shade on window account for 15%, 25% and 25% by blind, curtain and no shade in Karachi area.




NA: Not Available, Mix: Combination of more than 2 types of internal shade.
Source: Prepared by the JICA Survey Team.

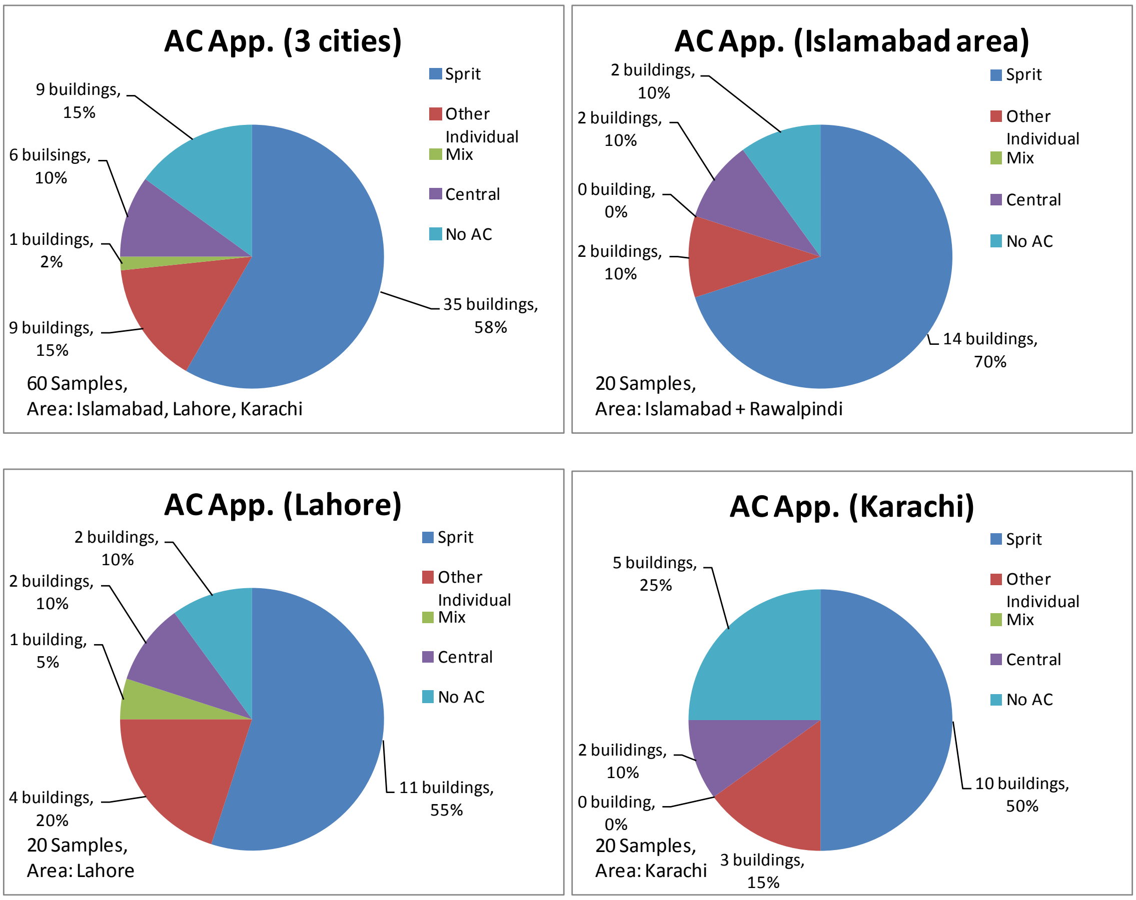
Figure 2.5-10 Type of internal shade on window in three cities (Islamabad, Lahore, Karachi)

(11) Ratio of type of AC appliance

1) Analysis by location area-wise

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of type of AC appliance in three cities is shown in Figure 2.5-11.

a) 3 cities: Types of AC appliance account for 58% by split type, 15% by other individual type, 10% by central and 15% by no AC in 3 cities. Almost of buildings have already AC appliance and its main type is sprit type. It shows importance of introduction of MEPS for room AC (sprit type) in immediate.




Mix: Combination of more than 2 types of AC.

Source: Prepared by the JICA Survey Team.

Figure 2.5-11 Type of AC appliance in three cities (Islamabad, Lahore, Karachi)

b) Islamabad area: Types of AC appliance account for 70% by split type, 10% by other individual type, 10% by central and 10% by no AC in Islamabad area.

c) Lahore area: Types of AC appliance account for 55% by split type, 20% by other individual type, 10% by central and 10% by no AC in Lahore area.

d) Karachi area: Types of AC appliance account for 50% by split type, 15% by other individual type, 10% by central and 25% by no AC in Karachi area. Despite it is hottest area among 3 cities, there is highest ratio of no AC building among 3 cities.

2) Analysis by building category-wise

Category-wise ratio of type of AC appliance is shown in Figure 2.5-12.

a) Hotel: Types of AC appliance account for 78% by split type, 22% by central. All hotels are equipped with AC and Large scale high-end hotels tend to have central system.

b) Hospital: Types of AC appliance account for 33% by split type, 17% by other individual, 33% by central, 11% no AC. There are few hospital that operates with fan only.

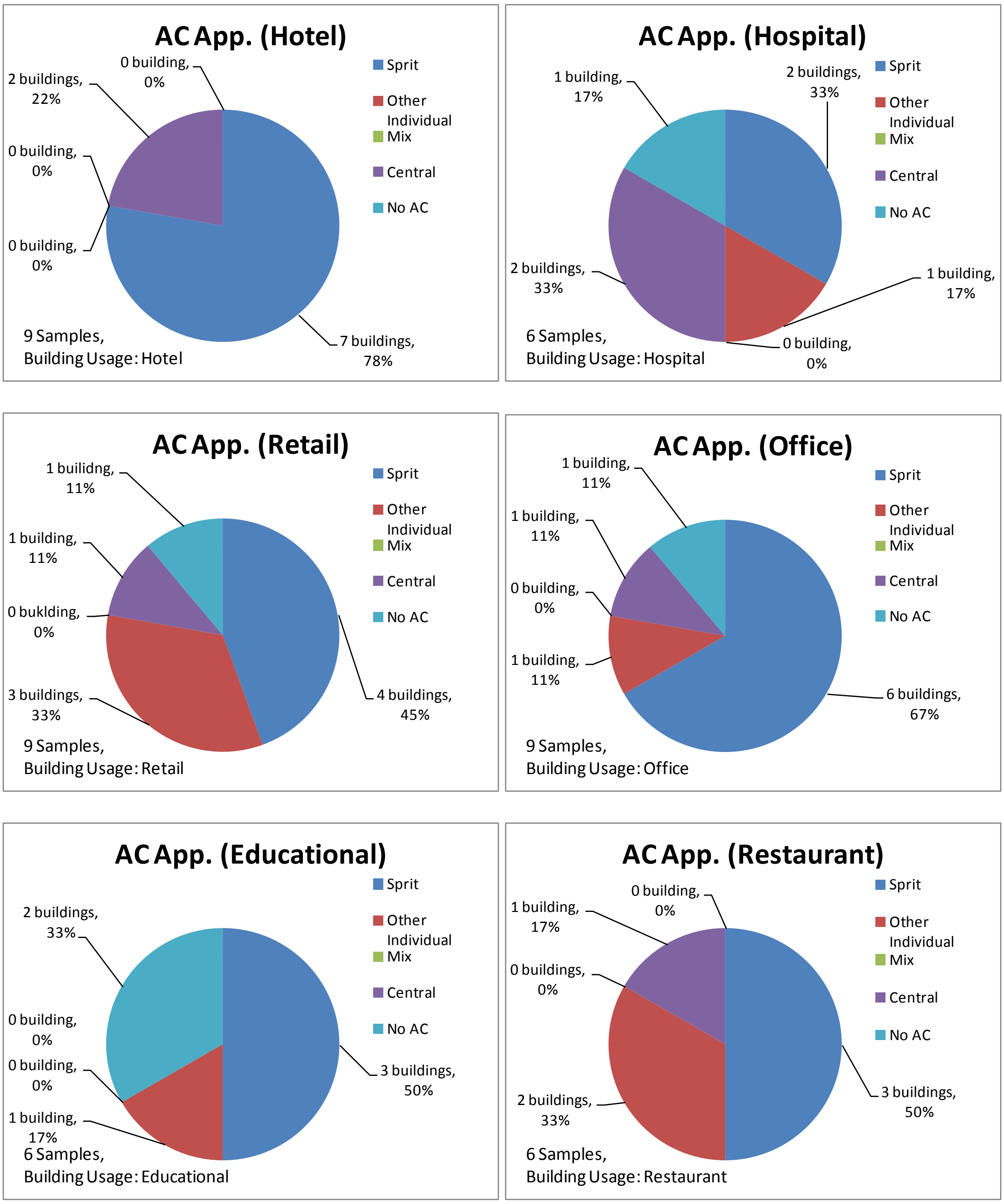
c) Retail: Types of AC appliance account for 45% by split type, 33% by other individual, 11% by central, 11% no AC. In case of large space, multiple sprit systems or package type are often chosen.

d) Office: Types of AC appliance account for 67% by split type, 11% by other individual, 11% by central, 11% no AC. Sprit system has been predominantly chosen as most economical option.

e) Education: Types of AC appliance account for 50% by split type, 17% by other individual, 33% no AC. As survey included elementary/ primary education, many facility do not have AC in the classroom.

f) Restaurant: Types of AC appliance account for 50% by split type, 33% by other individual, 17% by central. All restaurants are equipped with AC. In case of large space, multiple sprit systems or package type are often chosen.

g) Cultural: Types of AC appliance account for 43% by split type, 14% by other individual, 43% no AC. Many facilities do not have AC.



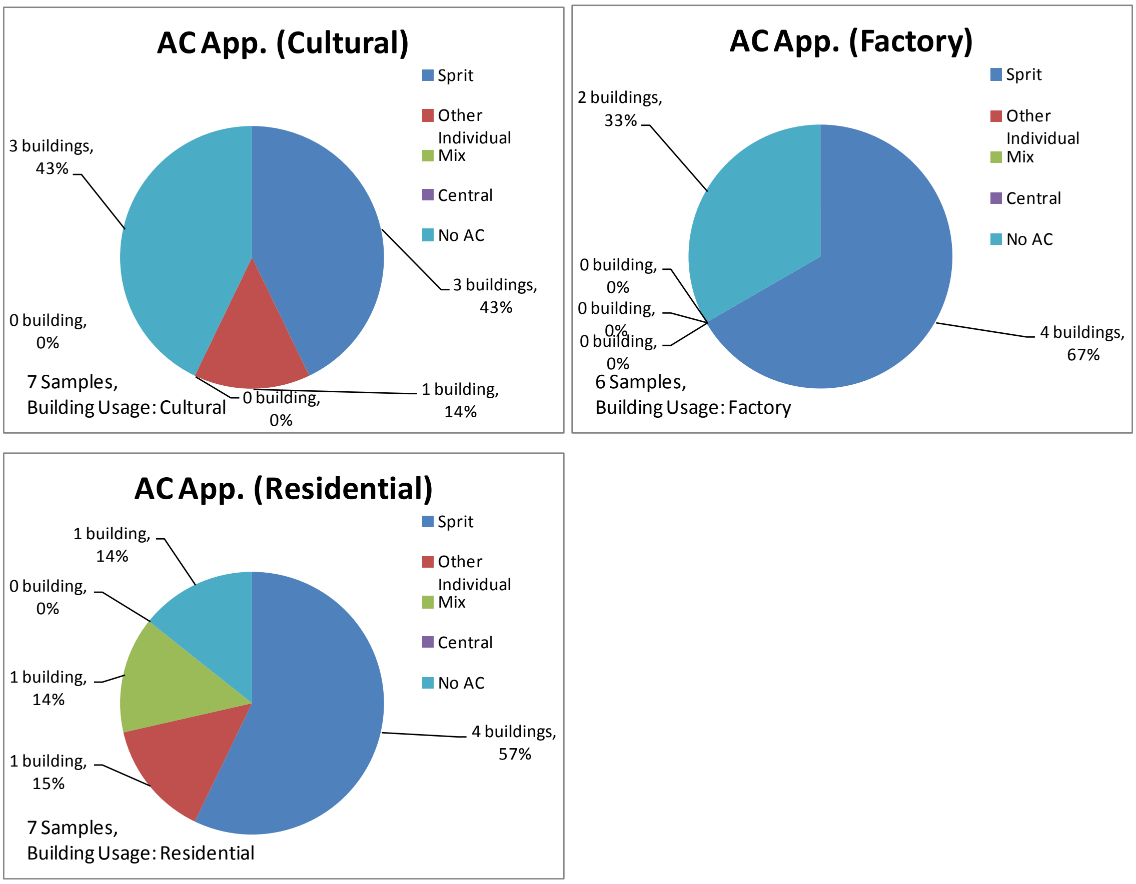

Mix: Combination of more than 2 types of AC.

Source: Prepared by the JICA Survey Team.

Figure 2.5-12 Ratio of type of AC appliance by category-wise

h) Factory: Types of AC appliance account for 67% by split type, 33% no AC. High rate of no AC is observed.

i) Residential: Types of AC appliance account for 57% by split type, 15% by other individual, 14% of mix use, 14% no AC.




Mix: Combination of more than 2 types of AC.

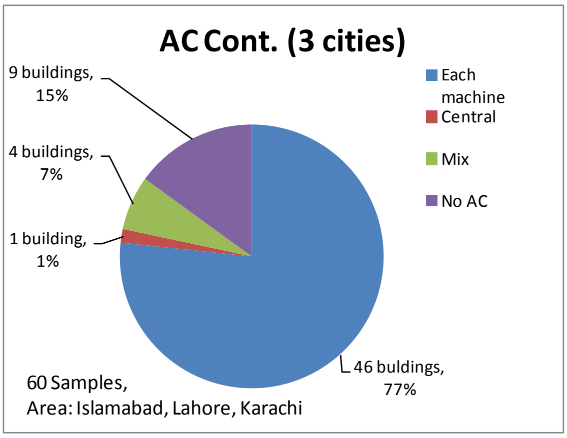
Source: Prepared by the JICA Survey Team.

Figure 2.5-12 Ratio of type of AC appliance by category-wise (continued)

(12) Ratio of type of AC control policy

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of type of AC control policy in three cities is shown in Figure 2.5-13. Types of AC control account for 77% by each machine, 1% central control, 7% mix and 15% no AC in three cities.

As mentioned the ratio of type of AC appliance, split type AC is mainly adopted in Pakistan, therefore type of AC control also is still at each machine control in each room in general. It means room occupant can operate on/off, set room temperature and decide operation time for AC. It is very important to improve awareness with improvement of performance of AC, in order to promote EE&C for AC.




Source: Prepared by the JICA Survey Team.

Figure 2.5-13 Ratio of AC control policy in three cities (Islamabad, Lahore, Karachi)

(13) Ratio of type of lighting appliance

1) Analysis by location area-wise

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of type of lighting appliance in three cities is shown in Figure 2.5-14.

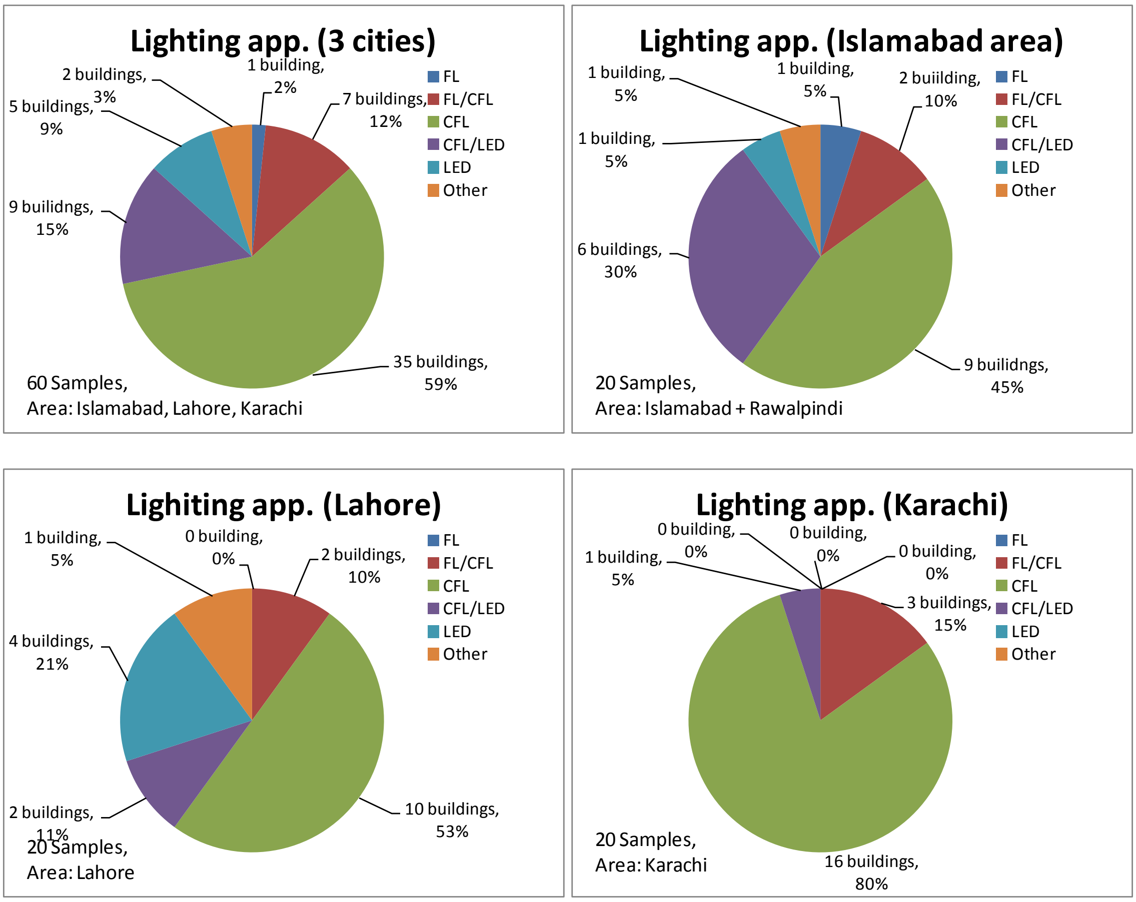
a) 3 cities: Types of lighting appliance account for 12% by combination both of Fluorescent Lamp (LF)/Compact Fluorescent Lamp (CFL), 59% by CFL, 15% by combination both of CFL/Light Emitted Diode (LED) and 9% by LED in 3 cities. Almost of buildings have already been introduced CFL as energy saving lamp and LED also. It shows the energy efficiency in lighting of building moved already.

b) Islamabad area: Types of light appliance account for 10% by combination both of Fluorescent Lamp (LF)/Compact Fluorescent Lamp (CFL), 45% by CFL, 30% by combination both of CFL/LED and 5% by LED in Islamabad area. Ratio of combination both of CFL/LED is higher than other 2 area.

c) Lahore area: Types of lighting appliance account for 10% by combination both of Fluorescent Lamp (LF)/Compact Fluorescent Lamp (CFL), 53% by CFL, 11% by combination both of CFL/LED and 21% by LED in Lahore area. Ratio of CFL/LED is higher than other 2 area.

d) Karachi area: Types of lighting appliance account for 15% by combination both of Fluorescent Lamp (LF)/Compact Fluorescent Lamp (CFL), 80% by CFL and 5% by combination both of

CFL/LED in Karachi area. Ratio of introduction of LED is obviously lower than other 2 area.




FL: Fluorescent Lamp, CFL: Compact Fluorescent Lamp, LED: Light Emitting Diode, FL/CFL: Combination both of FL and CFL in the room, CFL/LED: Combination both of CFL and LED in the room.
Source: Prepared by the JICA Survey Team.

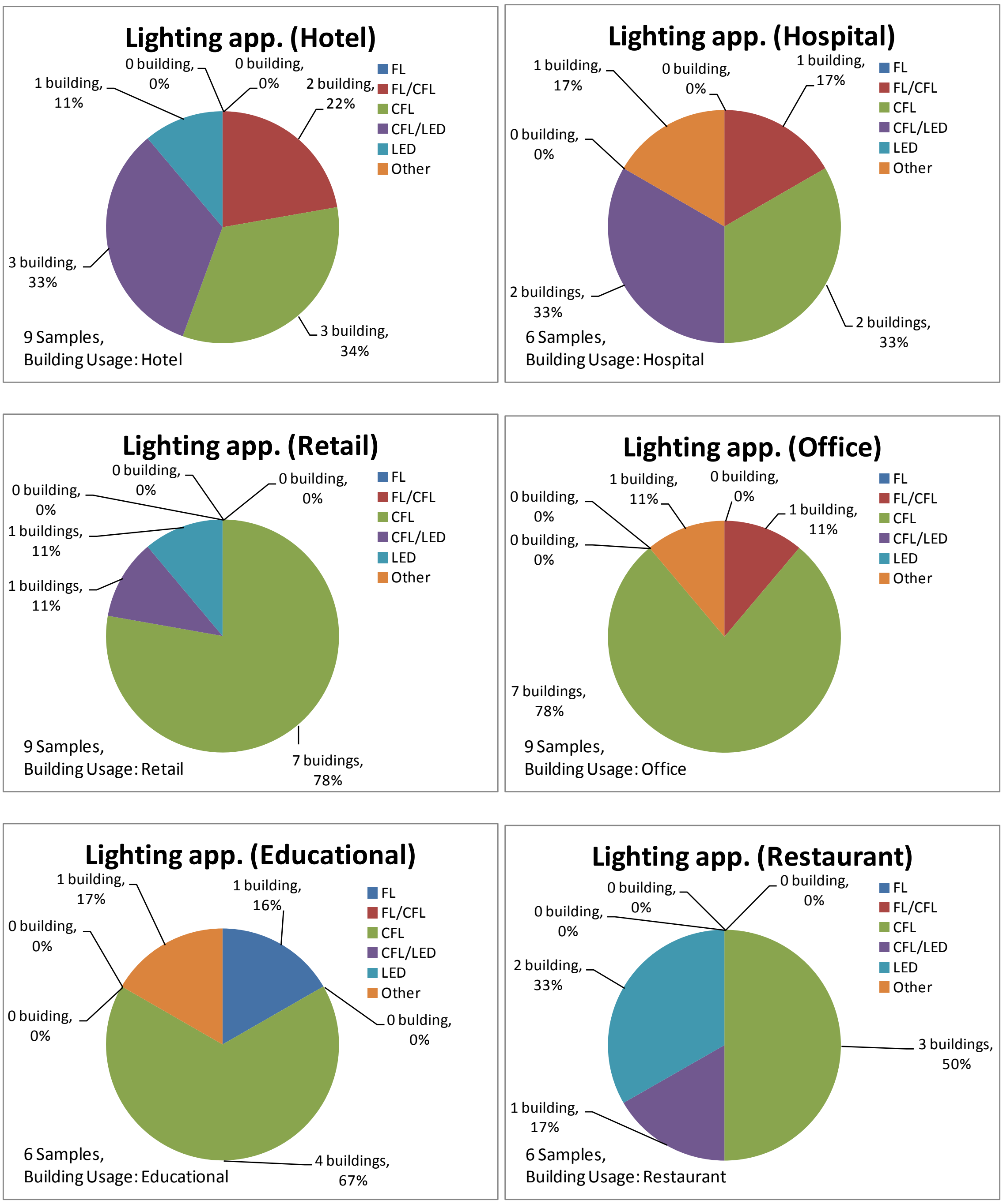
Figure 2.5-14 Ratio of type of Lighting appliance in three cities (Islamabad, Lahore, Karachi)

2) Analysis by building category-wise

Category-wise ratio of type of lighting appliance is shown in Figure 2.5-15.

a) Hotel: Types of lighting appliance account for 22% by combination of LF/ CFL, 34% by CFL, 33% by combination both of CFL/ LED and 11% by LED. Adoption rate of CFL is high and LED also widely used.

b) Hospital: Types of lighting appliance account for 17% by combination of LF/ CFL, 33% by CFL, 33% by combination both of CFL/ LED.




FL: Fluorescent Lamp, CFL: Compact Fluorescent Lamp, LED: Light Emitting Diode, FL/CFL: Combination both of FL and CFL in the room, CFL/LED: Combination both of CFL and LED in the room.
Source: Prepared by the JICA Survey Team.

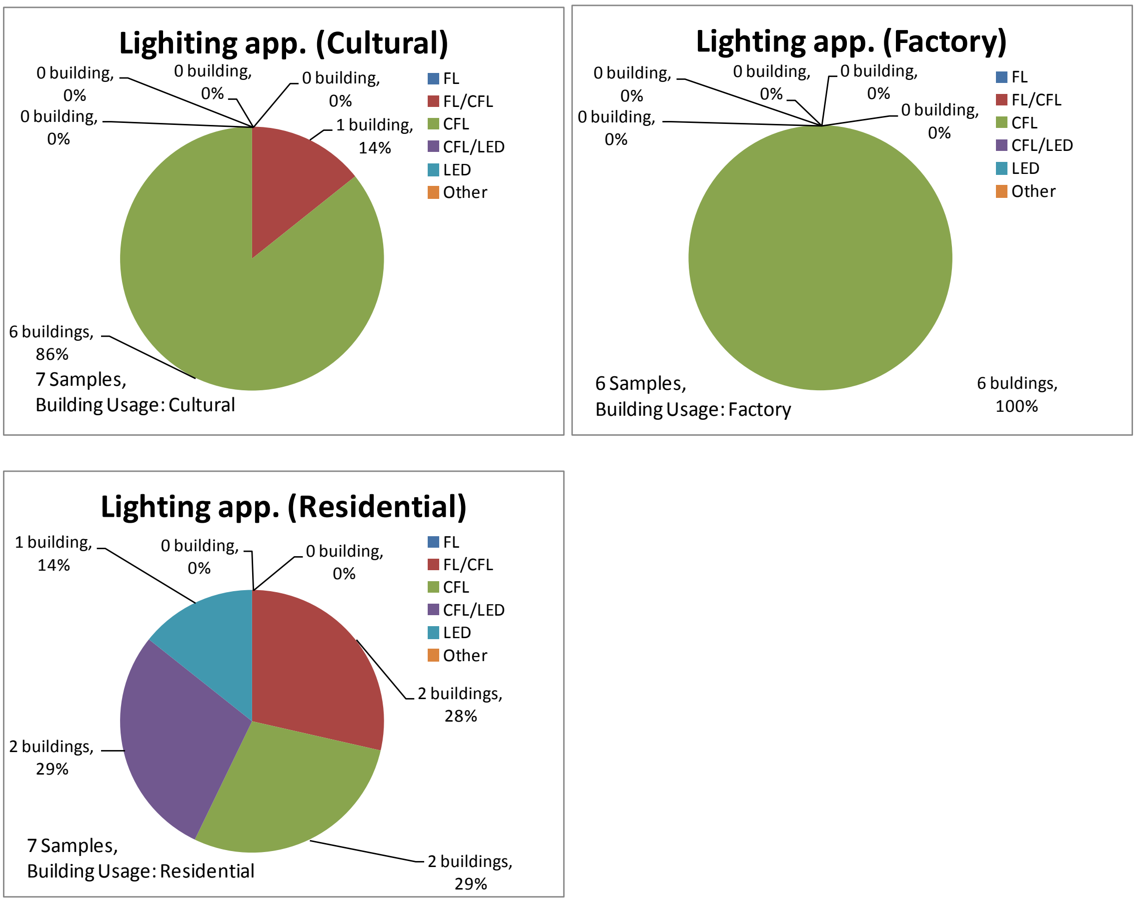
Figure 2.5-15 Ratio of type of Lighting appliance by category-wise

c) Retail: Types of lighting appliance account for 78% by CFL, 11% by combination both of CFL/ LED and 11% by LED.

d) Office: Types of lighting appliance account for 11% by combination of LF/ CFL, 78% by CFL and 11% by Other.

e) Education: Types of lighting appliance account for 16% by LF, 67% by CFL and 67% by Other.

f) Restaurant: Types of lighting appliance account for 50% by CFL, 17% by combination both of CFL/ LED and 33% by LED.




FL: Fluorescent Lamp, CFL: Compact Fluorescent Lamp, LED: Light Emitting Diode, FL/CFL: Combination both of FL and CFL in the room, CFL/LED: Combination both of CFL and LED in the room.
Source: Prepared by the JICA Survey Team.

Figure 2.5-15 Ratio of type of Lighting appliance by category-wise (continued)

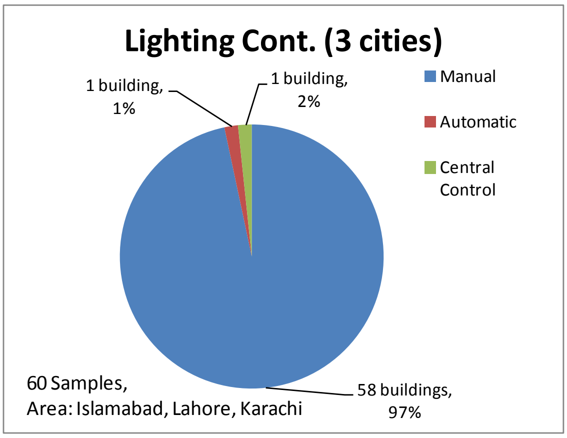
g) Cultural: Types of lighting appliance account for 14% by combination of LF/ CFL, 86% by CFL.

h) Factory: Types of lighting appliance account for 100% by CFL.

i) Residential: Types of lighting appliance account for 28% by combination of LF/ CFL, 29% by CFL, 29% by combination both of CFL/ LED and 14% by LED.

(14) Ratio of type of lighting control policy

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of type of lighting control policy in three cities is shown in Figure 2.5-16. Almost 100 % of types of lighting control is manual type.




Source: Prepared by the JICA Survey Team.

Figure 2.5-16 Ratio of lighting control policy in three cities (Islamabad, Lahore, Karachi)

(15) Ratio of type of hot water appliance

1) Analysis by location area-wise

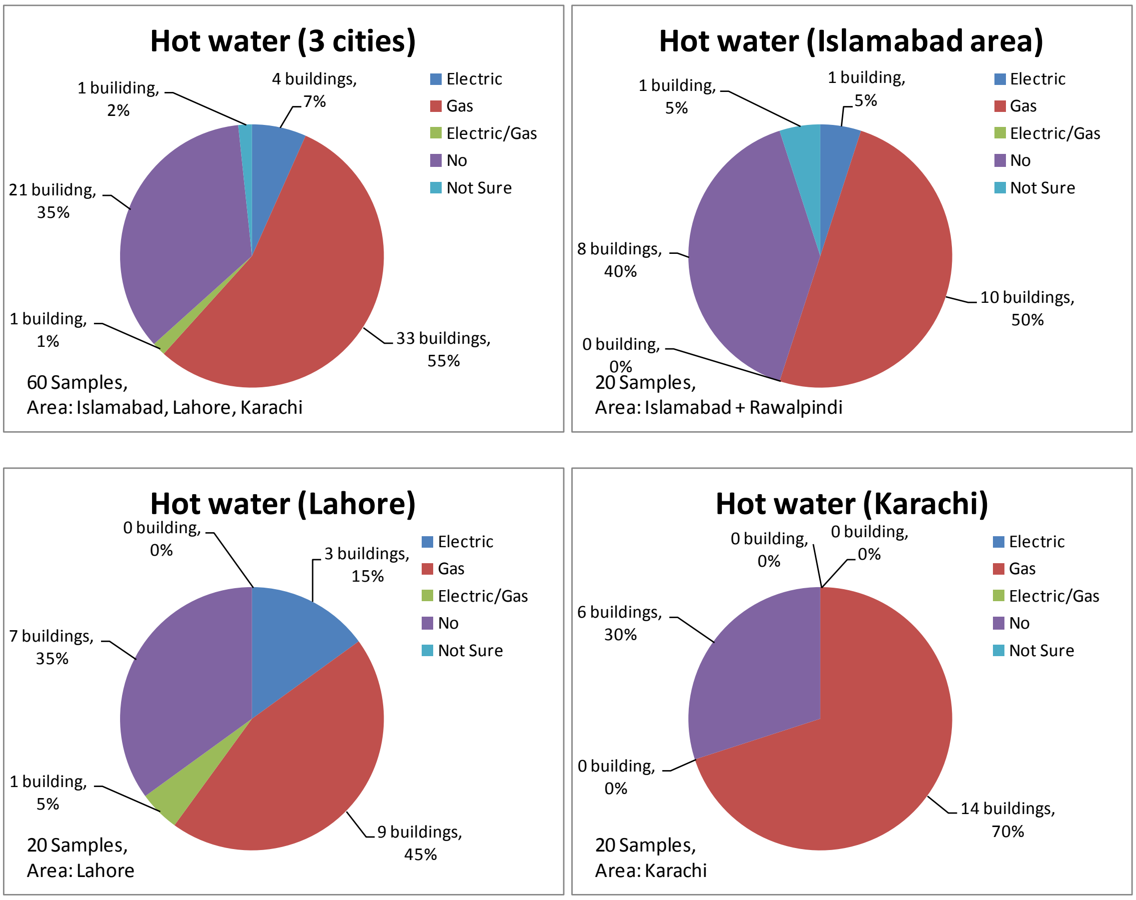
As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of type of hot water appliance in three cities is shown in Figure 2.5-17.

a) 3 cities: Types of hot water appliance account for 7% by electric type, 55% gas type, 1% both of electric type/gas type and 35% by no hot water in 3 cities. Almost 60% of buildings have hot water appliance, and gas type is mainly adopted. Ratio of electric type hot water appliance accounts for merely 1ess than 10%, so action of improvement for hot water appliance would reflect low effect in power sector.

b) Islamabad area: Types of hot water appliance account for 5%, 10% and 40% by electric type, gas type and no hot water respectively in Islamabad area.

c) Lahore area: Types of hot water appliance account for 15% by electric type, 45% gas type, 5% both of electric type/gas type and 33% by no hot water respectively in Lahore area.

d) Karachi area: Types of hot water appliance account for 70% by gas type and 30% no hot water in Karachi area. Electrical type of hot water appliance is adopted very few in Karachi.




Mix: both of electric type/gas type

Source: Prepared by the JICA Survey Team.

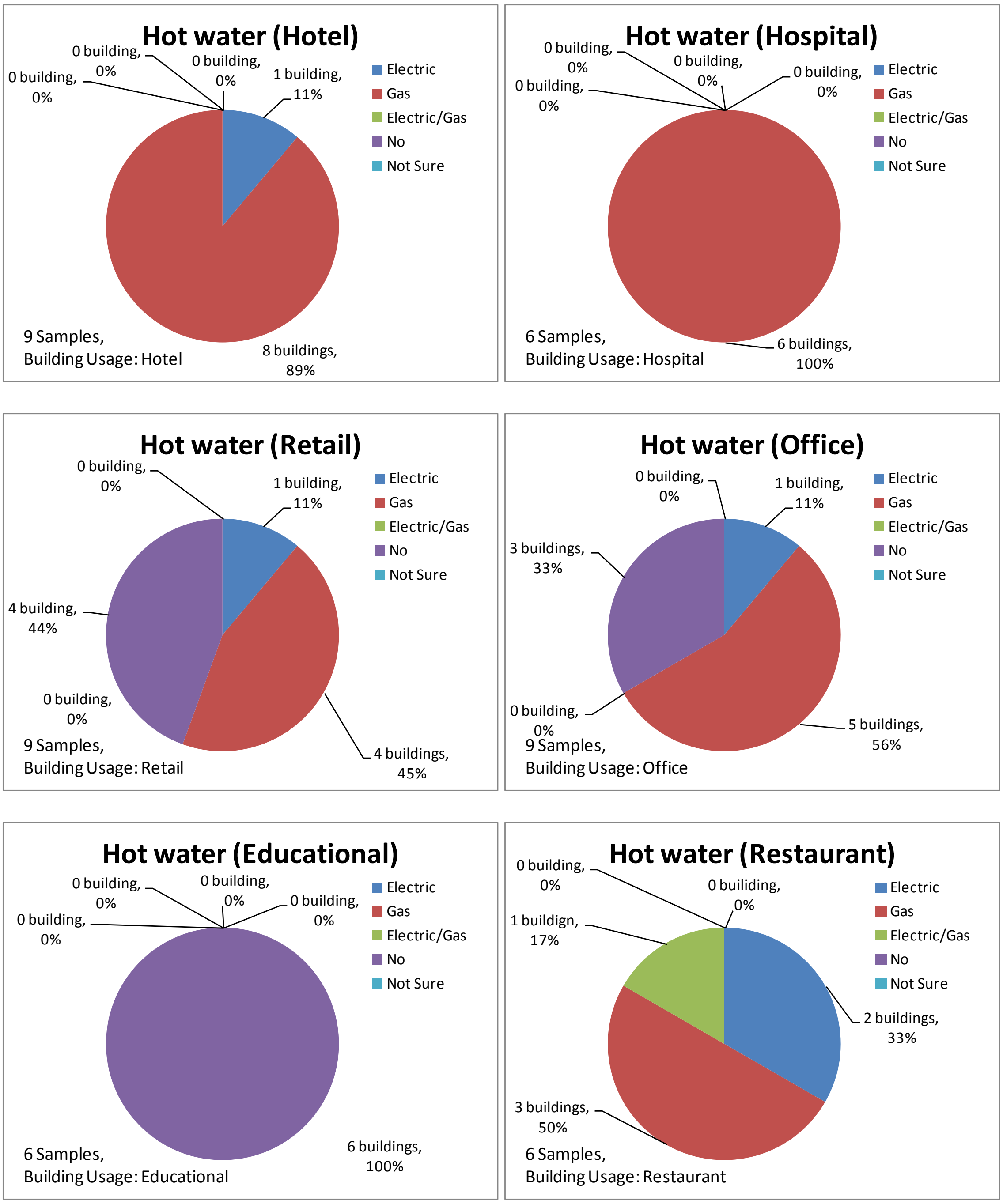
Figure 2.5-17 Ratio of type of hot water appliance in three cities (Islamabad, Lahore, Karachi)

2) Analysis by building category-wise

Category-wise ratio of type of hot water appliance is shown in Figure 2.5-18.

a) Hotel: All of hotels have hot water appliances and types of hot water appliance account for 11% and 89% by electric type and gas type respectively in hotel category.

b) Hospital: All of hospitals have hot water appliance, and all of hot water appliance in hospital category is gas type.




Mix: both of electric type/gas type

Source: Prepared by the JICA Survey Team.

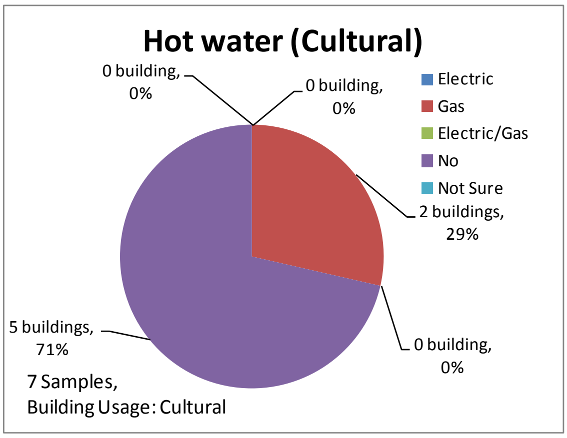
Figure 2.5-18 Ratio of type of hot water appliance by category-wise

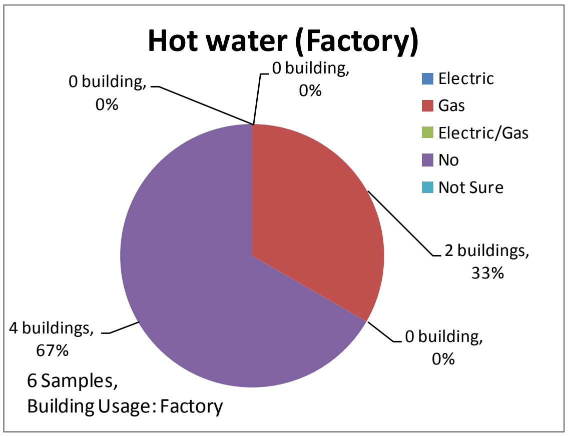
c) Retail: Types of hot water appliance account for 11% by electric type, 44% by gas type and 44% by no hot water in retail category. Almost half of retail has no hot water appliance.

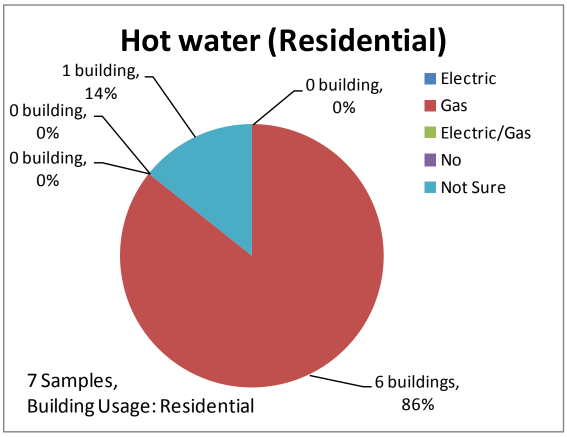
d) Office: Types of hot water appliance account for 11% by electric type, 56% by gas type and 33% by no hot water respectively in office category. Almost one third of office has no hot water appliance.

e) Education: All of education have no hot water appliance, this category do not consume hot water.

f) Restaurant: Types of hot water appliance account for 33% by electric type, 50% by gas type and 17% both of electric type/gas type in restaurant category. All of restaurants have hot water appliance, and almost half of hot water appliance in restaurant category is electric type.




Mix: both of electric type/gas type

Source: Prepared by the JICA Survey Team.

Figure 2.5-18 Ratio of type of hot water appliance by category-wise (continued)

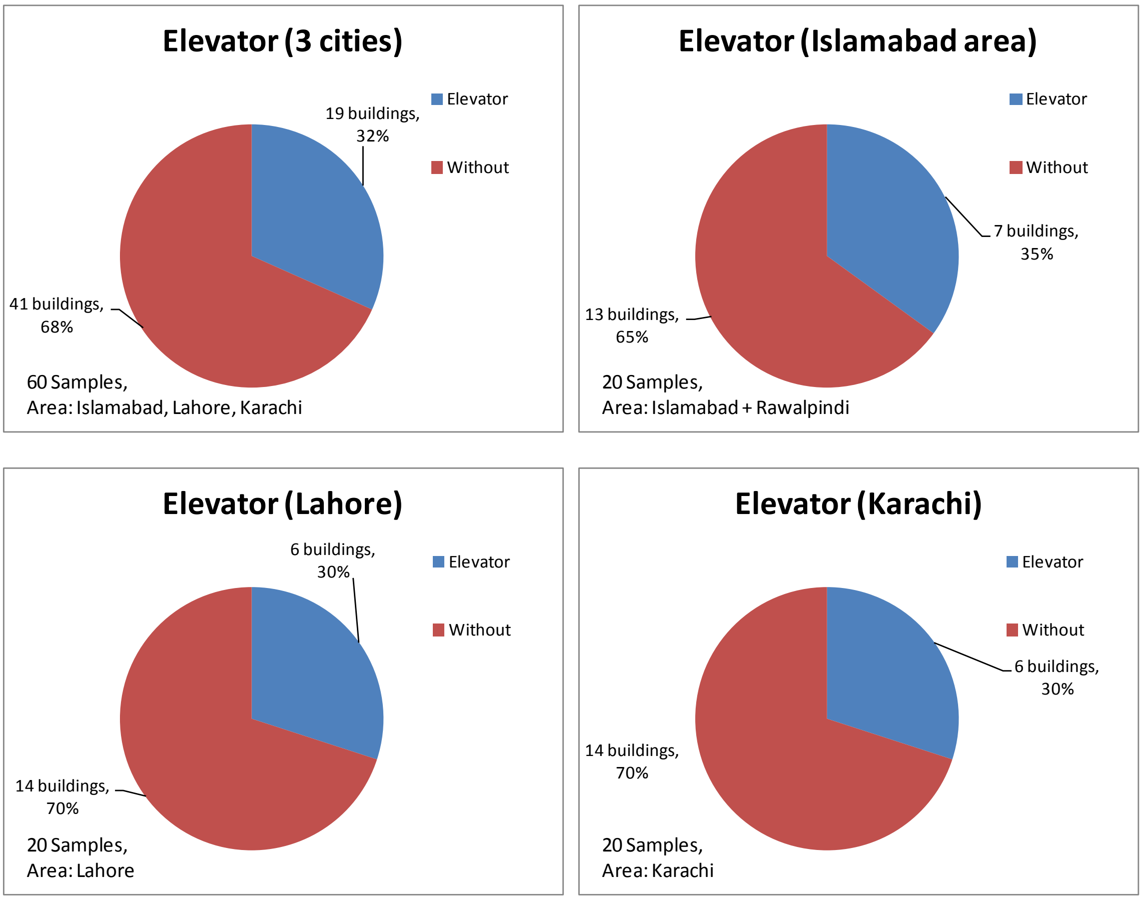
g) Cultural: Types of hot water appliance account for 33% by gas type and 67% by no hot water respectively in cultural category. Almost two third of cultural has no hot water appliance.

h) Factory: Types of hot water appliance account for 33% by gas type and 67% by no hot water respectively in factory category. Almost two third of factory has no hot water appliance.

i) Residential: Types of hot water appliance account for 86% by gas type and 14% ‘not sure’ respectively in residential category.

(16) Ratio of introduction of elevator

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of introduction of elevator appliance in hotel is shown in Figure 2.5-19.

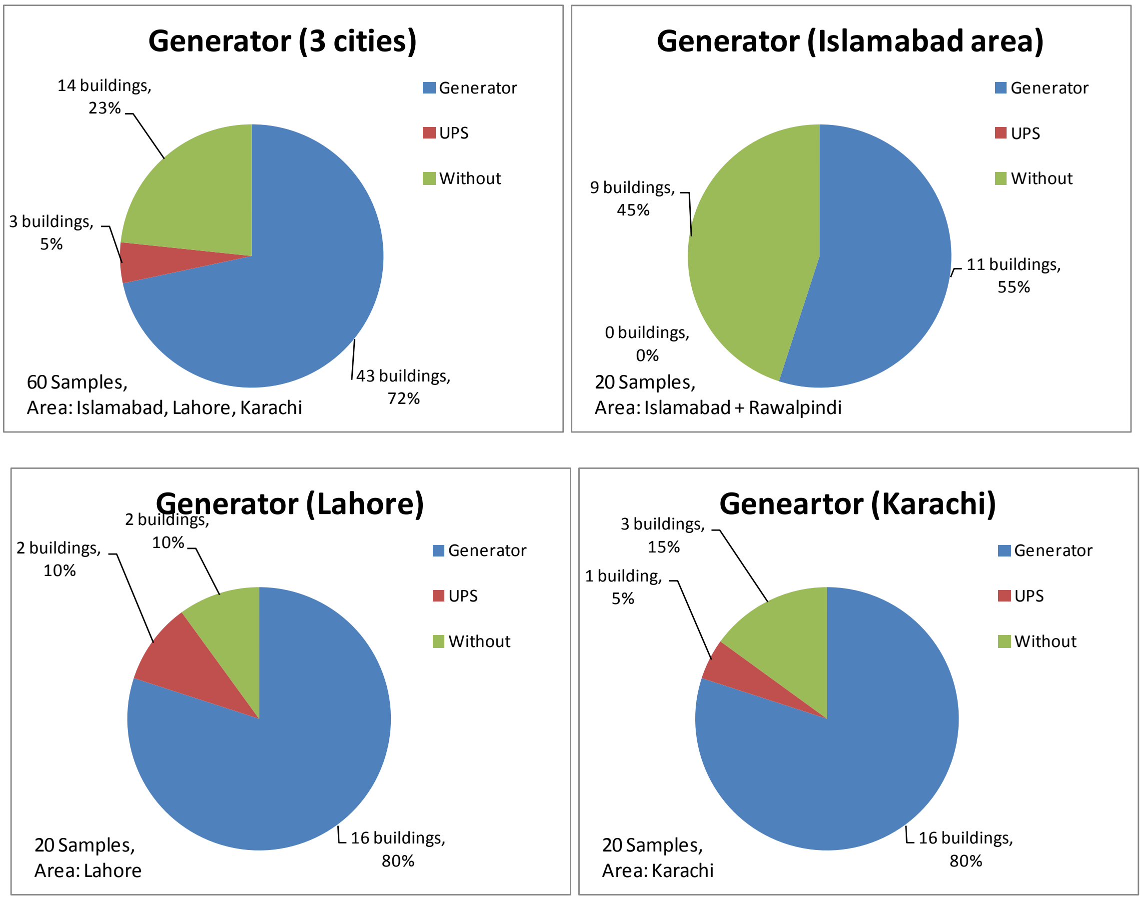



Source: Prepared by the JICA Survey Team.

Figure 2.5-19 Ratio of introduction of elevator appliance

(17) Ratio of emergency generator

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, the ratio of introduction of elevator appliance in hotel is shown in Figure 2.5-20.




Source: Prepared by the JICA Survey Team.

Figure 2.5-20 Ratio of introduction of emergency generator

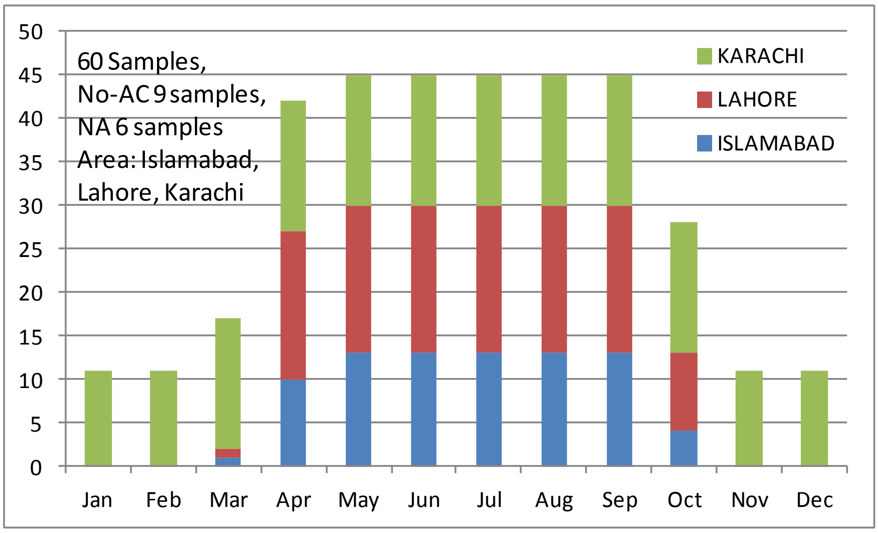
(18) Operation season of AC and fan

1) Air conditioning season for cooling

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, number of building in cooling AC operation by month is shown in Figure 2.5-21. Within 60 buildings, 9 buildings do not have AC appliance, manager of 6 buildings reply not sure (NS) on the question. Therefore number of effective answers are 45 buildings against this question.

Figure 2.5-21 indicates the buildings in Karachi area operate AC appliance for cooling in whole year, and the buildings in three cities operate AC appliance for cooling 6 month from April to

September.

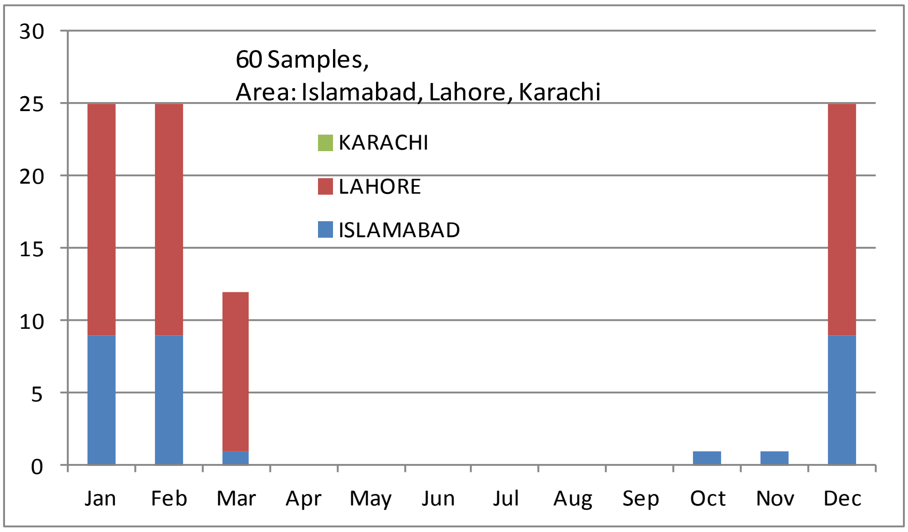



Source: Prepared by the JICA Survey Team.

Figure 2.5-21 Number of building in cooling AC operation by month

2) Air conditioning season for heating

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, number of building in heating AC operation by month is shown in Figure 2.5-22. All of buildings in Karachi do not operate AC appliance for heating, or do not have heating appliance. Buildings in Islamabad and Lahore area operate heating AC appliance for 3 month from December to February. In addition, almost half of buildings in Lahore operate AC appliance for heating in March also.

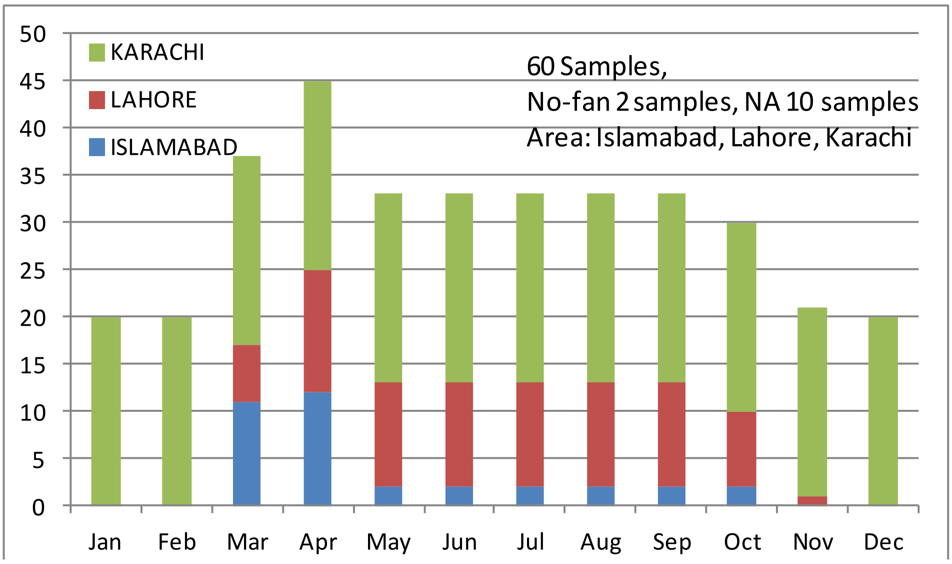



Source: Prepared by the JICA Survey Team.

Figure 2.5-22 Number of building in heating AC operation by month

3) Fan operation season

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, number of building using fan by month is shown in Figure 2.5-23. Within 60 buildings, 2 buildings do not have fan appliance, manager of 10 buildings reply not sure (NS) on the question. Therefore number of effective answer is 48 buildings against this question. Figure 2.5-23 indicates the buildings in Karachi area operate fan appliance for cooling in whole year, and the buildings in three cities operate fan for cooling 8 month from March to October. In Pakistan, in case that capacity of AC appliance is insufficient, room occupant use both of AC appliance and fan appliance in order to complement cooling capacity. In this survey, some of buildings in Islamabad operate fan from March to April mainly, then they stop fan operation from after May.

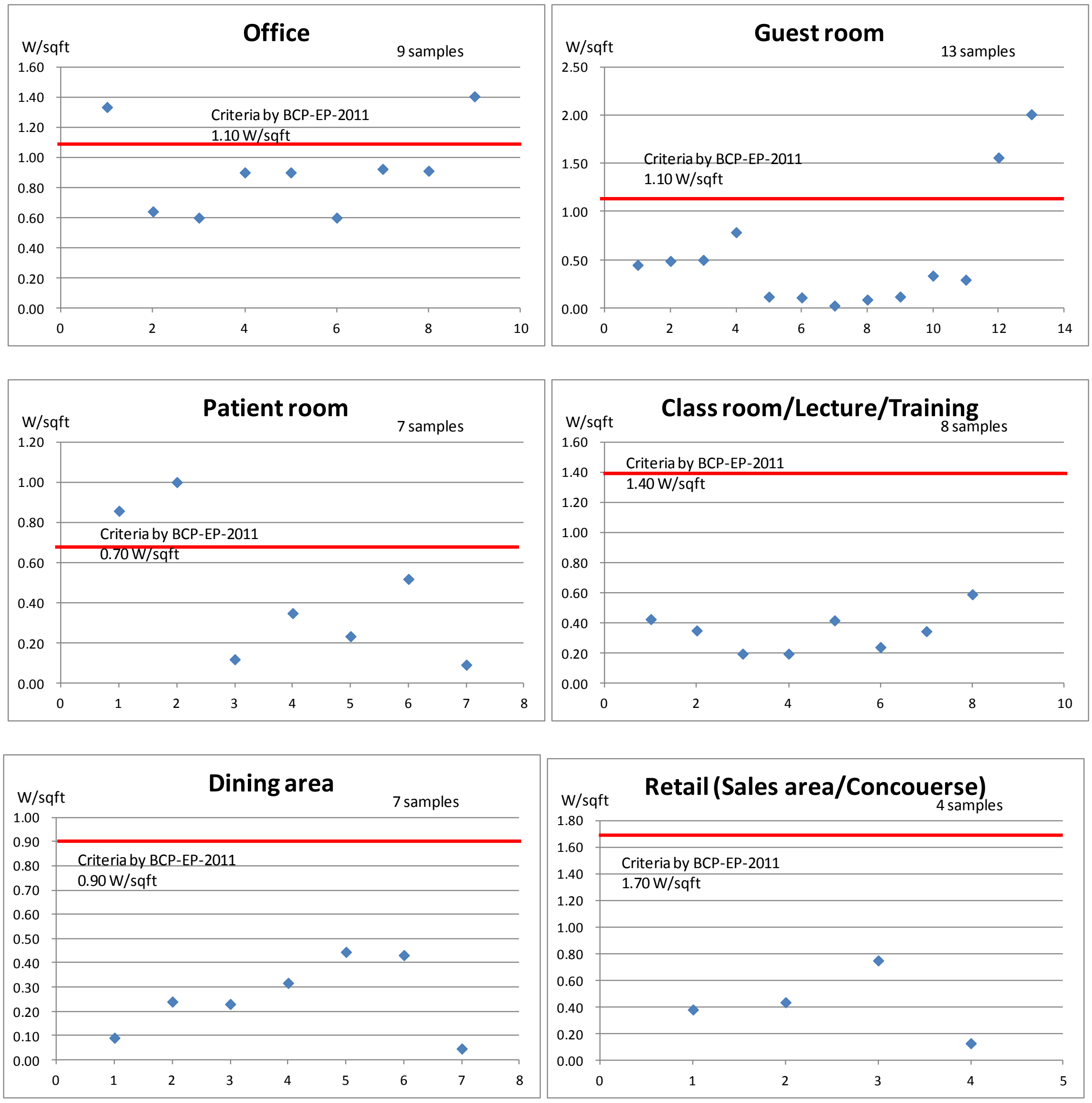



Source: Prepared by the JICA Survey Team.

Figure 2.5-23 Number of building in fan operation by month

(19) Current situation of compliance with BCP-EP-2011 on lighting power density

As the result of the research against 60 buildings that is located in Islamabad, Lahore and Karachi area, current situation of compliance with BCP-EP-2011 on lighting power density by area category wise is shown in Figure 2.5-24. In the figure, value in vertical axis means lighting power density in W/ft$^2$, it indicates efficiency of lighting as lower value is better.




Source: Prepared by the JICA Survey Team.
Criteria of BCP-EP-2011 on lighting density are shown as red line in each figure. In case that the point is plotted upper side from red line, it indicates the lighting in the room do not achieve criteria of BCP-EP-2011. But, In case that the point is plotted lower side from red line, it indicates the lighting in the room keep compliance with criteria of BCP-EP-2011. Horizontal stand for sample No.

Figure 2.5-24 Current situation of compliance with BCP-EP-2011 on lighting power density

1) Office room: Obtained 9 samples through the research and 7 samples are in compliance with BCP-EP-2011. It shows that CFL has already been adopted in many office rooms, therefore lighting in office is effective.

2) Guest room (Hotel): Obtained 13 samples through the research and 11 samples are in compliance with BCP-EP-2011. It shows that CFL and LED have already been introduced in many guest rooms, therefore lighting in guest room is effective.

3) Patient room (Hospital): Obtained 7 samples through the research and 5 samples are in compliance with BCP-EP-2011. It shows that CFL and LED have already been introduced in many patient rooms, therefore lighting in ward room is effective.

4) Class room/Lecture/Training (Education): Obtained 8 samples through the research and all of samples are in compliance with BCP-EP-2011. It shows that CFL has already been introduced in many class rooms, therefore lighting in class room is effective. Most of result was about 30% of BCP-EP-2011 criteria. This may be luminance may be insufficient as classroom.

5) Dining: Obtained 7 samples through the research and all of samples are in compliance with BCP-EP-2011. It shows that CFL and LED have already been introduced in many dining rooms, therefore lighting in dining room is effective. Or, number of lighting fixture may be minimized as operational policy.

6) Retail (Sales area/Concourse): Obtained 7 samples through the research and all of samples are in compliance with BCP-EP-2011. It shows that CFL and LED have already been introduced in many retail area, therefore lighting in retail area is effective.

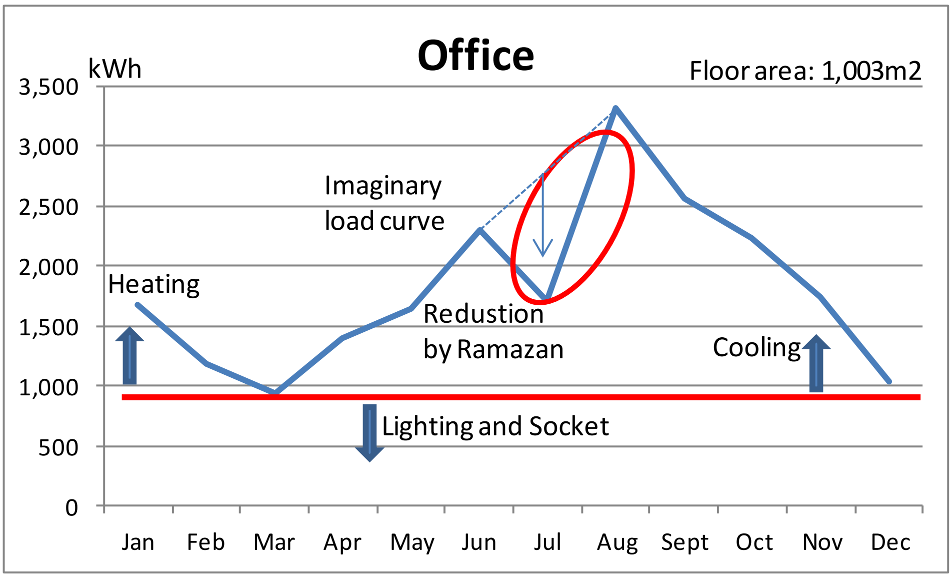
(20) Annual power consumption curve

1) Office

Annual power consumption curve on one of the office is shown in Figure 2.5-25. There is obviously drop of power consumption in July, the reason seems to be the affect of Ramazan. As imaginary power consumption without affect of Ramazan, the average value between Jane and August is shown in dashed line. Bottom of curve appears on December and March.

Bottom of amount of monthly consumption is assumed no AC load in the month. Therefore the bottom value indicates amount of power consumption by lighting and socket. Upper side from bottom value indicates amount of consumption by AC. The amount of upper side value from bottom value in summer season and in winter season indicates amount of power consumption for cooling and for heating respectively.

Under mentioned condition and assumption, power consumption by energy usage wise is estimated. Ratio of electric power consumption by energy usage wise on office is shown in Table 2.5-1. Both cases of actual consumption and assumed consumption, without Ramazan, are analyzed. In Office, ratio of cooling, heating and lighting/socket accounts for almost 45%, 5% and 55% respectively. Specific energy consumption, Annual consumption per square meter, is calculated as approximately 22 kWh/$m^2$.




Source: Prepared by the JICA Survey Team.

Figure 2.5-25 Annual electric power consumption curve on office

Table2.5-1 Ratio of electric power consumption by energy usage wise on office

| | | | | | | | | Floor area ($m^2$) | 1,003 |
|---|---|---|---|---|---|---|---|---|---|
| | Cooling (kWh) | %age | Heating (kWh) | %age | Lighting and Socket (kWh) | %age | Total (kWh) | Specific energy consumption (kWh/$m^2$) | |
| Actual | 9,440 | 43.5% | 977 | 4.5% | 11,304 | 52.0% | 21,721 | 21.7 | |
| Without Ramazan drop | 10,542 | 46.2% | 977 | 4.3% | 11,304 | 49.5% | 22,823 | 22.8 | |

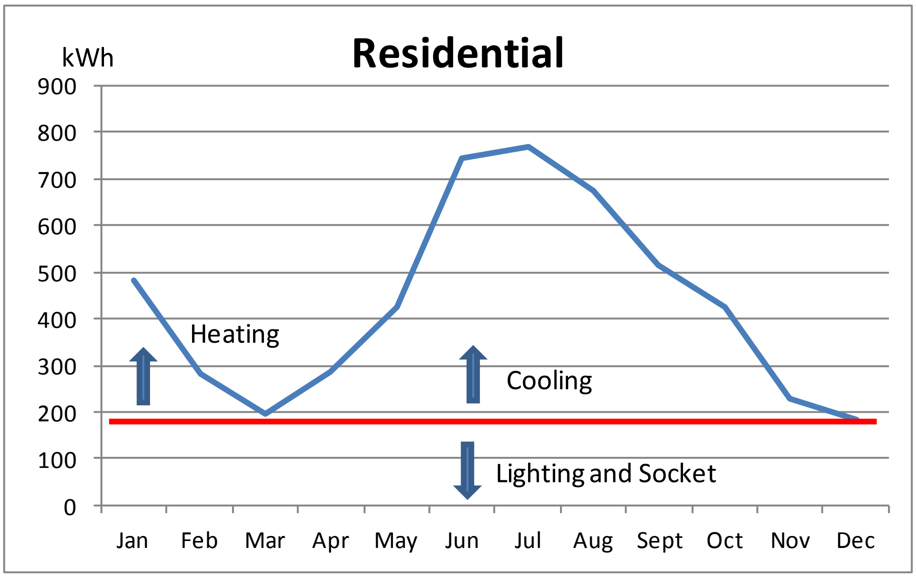
Source: Prepared by the JICA Survey Team

2) Residential

Annual power consumption curve on residential is shown in Figure 2.5-26. Bottom of curve appears on December and March. Peak of curve appears on June and July, which is almost 4 times of bottom value.

Ratio of electric power consumption by energy usage wise on residential is shown in Table 2.5-2.

In residential, ratio of cooling, heating and lighting/socket accounts for almost 50%, 10% and 40% respectively.




Source: Prepared by the JICA Survey Team.

Figure 2.5-26 Annual electric power consumption curve on residential

Table2.5-2 Ratio of electric power consumption by energy usage wise on office

| | | | | | | | Floor area ($m^2$) | 150 |
|---|---|---|---|---|---|---|---|---|
| | Cooling (kWh) | %age | Heating (kWh) | %age | Lighting and Socket (kWh) | %age | Total (kWh) | Specific energy consumption ($kWh/m^2$) |
| Actual | 2,615 | 50.2% | 411 | 7.9% | 2,188 | 41.9% | 5,210 | 34.7 |

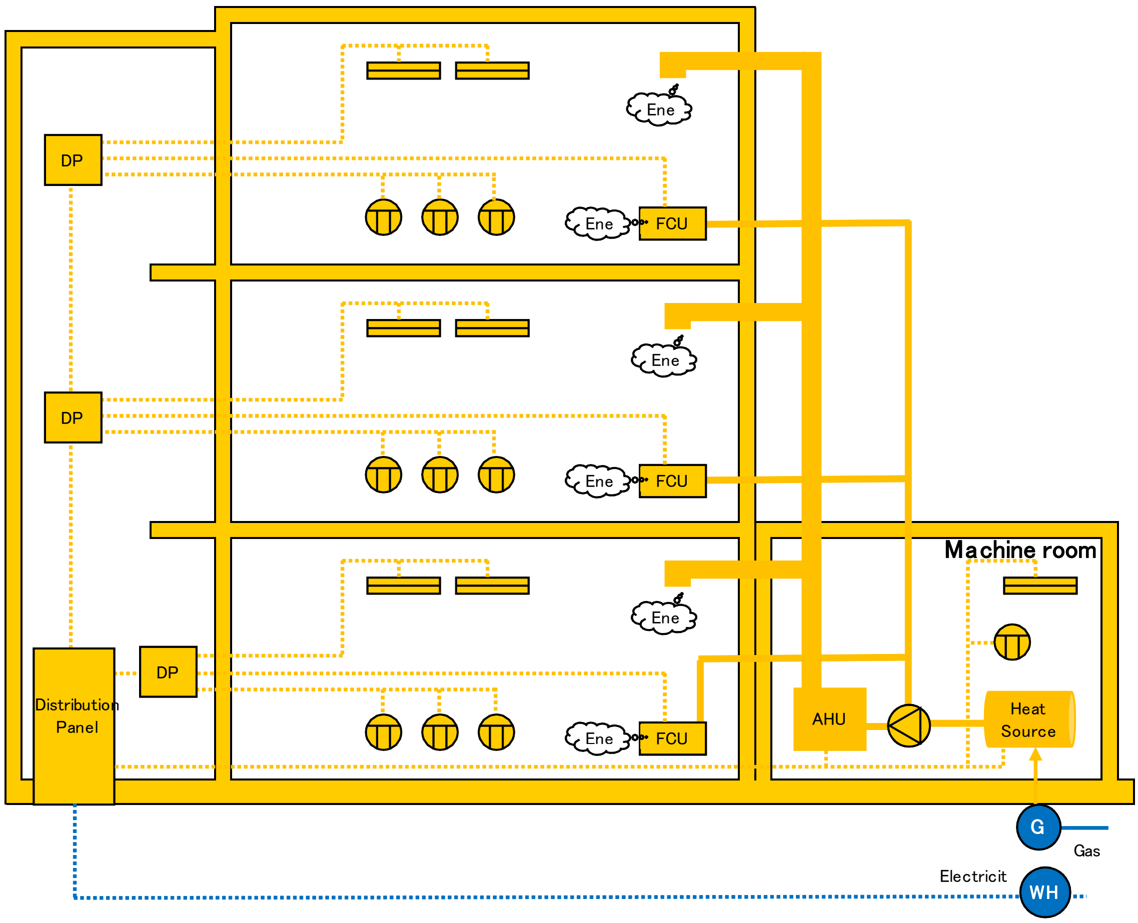
Source: Prepared by the JICA Survey Team

(21) Ownership and responsibility in the building sector

1) Case that owner occupies and/or utilizes whole building for own use

Most of hotel including guest house, hospital exempted for small scale, large scale education and cultural have own buildings to utilize for own business. The image of case that owner occupies and/or utilizes whole building for own use is shown in Figure 2.5-27.

In this case, owner has responsibility on both phase of new construction and rehabilitation in introduction of replace of every appliance, i.e. building envelope, lighting, air conditioning.




| Symbol | Item | Symbol | Item |
|---|---|---|---|
| AC | Package type（e.g. EHP, GHP） | WH | Watt Hour meter（primary） |
| AC-R | Heat source of central air conditioning system（e.g. Electric chiller, absorption chiller） | Ene | Energy by Air Conditioning（Cooling, Heating） |
| | Pump（e.g. Cold and hot water pump） | | Electrical wire |
| AHU | Air Handling Unit on central air condition system | | Coolant pipe（Package type） |
| FCU | Fan Coil Unit on central air condition system | | Duct |
| | Lighting Facilities | | Cold and hot water pipe（Central type） |
| | Socket | | The material/appliance that energy supplier has responsibility |
| WH | Power Distribution Panel（with watt hour meter） | | The material/appliance that buiilder/owner has responsibility |
| DP | Power Distribution Panel（without watt hour meter） | | The material/appliance that tenant has responsibility |

Source: Prepared by the JICA Survey Team.

Figure 2.5-27 Image of case that owner occupies and/or utilizes whole building for own use

2) Tenant building

Most of restaurant, office and retail operate their business with rent-a-space on tenant building. The image of the case that tenant user occupies and/or utilizes building in part for their use is shown in Figure 2.5-28.

In this case, owner has responsibility on both new construction and rehabilitation in introduction or replace of building envelope, external space and internal public space. For tenant space, some owners provide just as skeleton without lighting and/or air conditioning, some owners provide lighting and/or air conditioning as well, it is case by case. Tenant provides other appliances for their business as socket load, i.e. refrigerator, computer, printer and facsimile. In any case, in some tenant building case, owner may not burden responsibility of compliance with BCP-EP-2011 in tenant space.

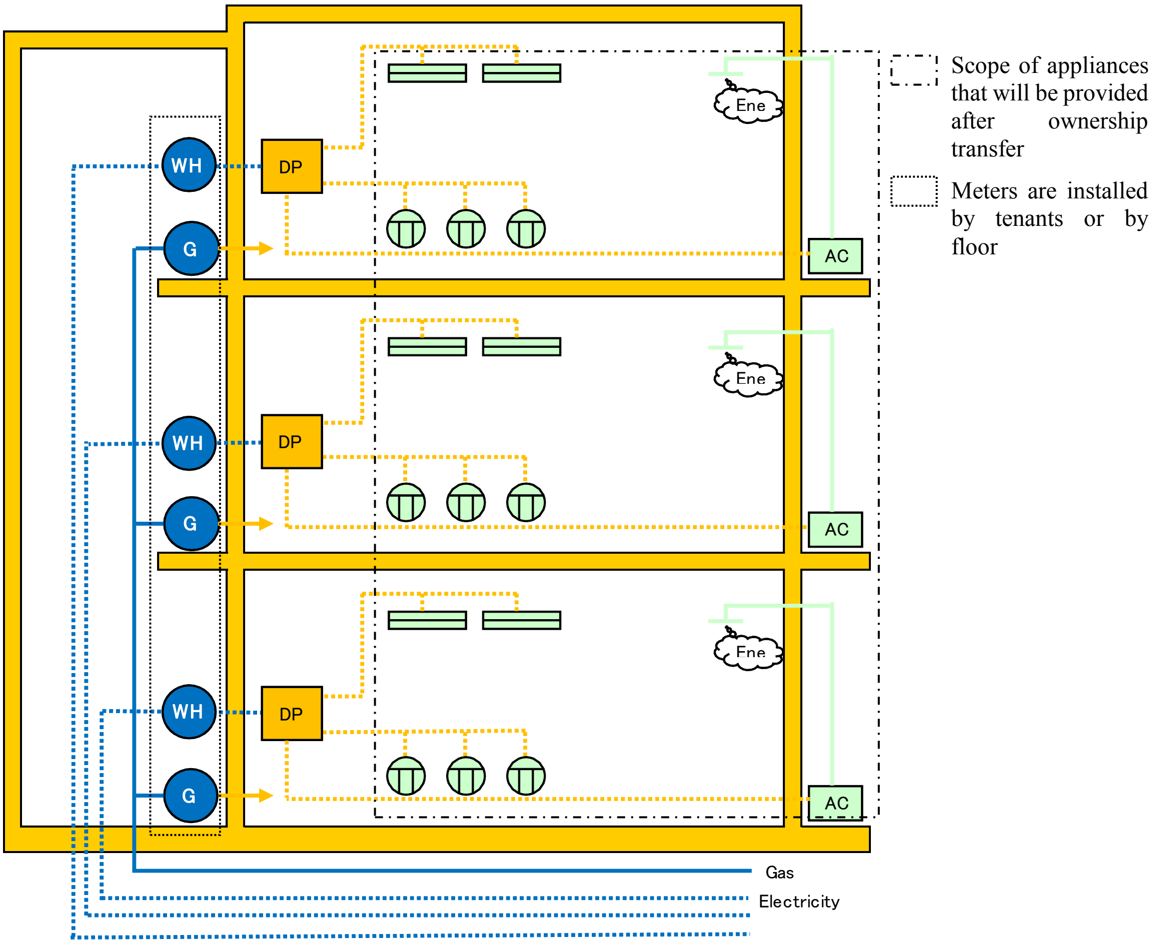
Most of tenant building has energy measurement meters that power distribution company and gas distribution company installed by each tenant area respectively. It means that each tenant apply energy supply agreement with power distribution company and gas distribution company. the tenant can know their own energy consumption, further obtain fruits if they make effort on EE&C action. So tenant can burden responsibility to carry out operation in EE&C and purchase EE&C appliance. However, some large scale building, e.g. U fone building, have only one energy measurement meters and tenant does not have access to see their energy usage.

3) Detached housing

The image of case of detached housing is shown in Figure 2.5-29. It can be seen as small scale of "Case that building owner occupies and/or utilizes whole building for own use". Most of detached housing do not have floor area that is specified in BCP-EP-2011, and do not have responsibility to be in compliance with BCP-EP-2011.

4) Collective housing

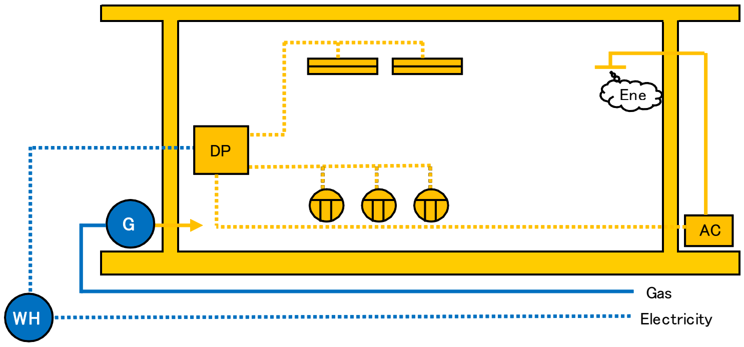
The image of case of detached housing is shown in Figure 2.5-30.In many case, collective housing builder sells to individual person or private organization after completion of building construction. If total floor area exceeds the 900m² which is specified in BCP-EP-2011, it should be complied with BCP-EP-2011. Any fixed services are installed by builders in general, however except for high-end projects, AC is to be purchased and installed by occupants. Although AC requirement is not mandatory in current BCP-EP-2011, in order to improve EE&C, responsibility demarcation between builder and owner/ occupants is important.




| Symbol | Item | Symbol | Item |
|---|---|---|---|
| AC | Package type（e.g. EHP, GHP） | WH | Watt Hour meter（primary） |
| AC-R | Heat source of central air conditioning system（e.g. Electric chiller, absorption chiller） | Ene | Energy by Air Conditioning（Cooling, Heating） |
| | Pump（e.g. Cold and hot water pump） | | Electrical wire |
| AHU | Air Handling Unit on central air condition system | | Coolant pipe（Package type） |
| FCU | Fan Coil Unit on central air condition system | | Duct |
| | Lighting Facilities | | Cold and hot water pipe（Central type） |
| | Socket | | The material/appliance that energy supplier has responsibility |
| WH | Power Distribution Panel（with watt hour meter） | | The material/appliance that buiilder/owner has responsibility |
| DP | Power Distribution Panel（without watt hour meter） | | The material/appliance that tenant has responsibility |

Source: Prepared by the JICA Survey Team.

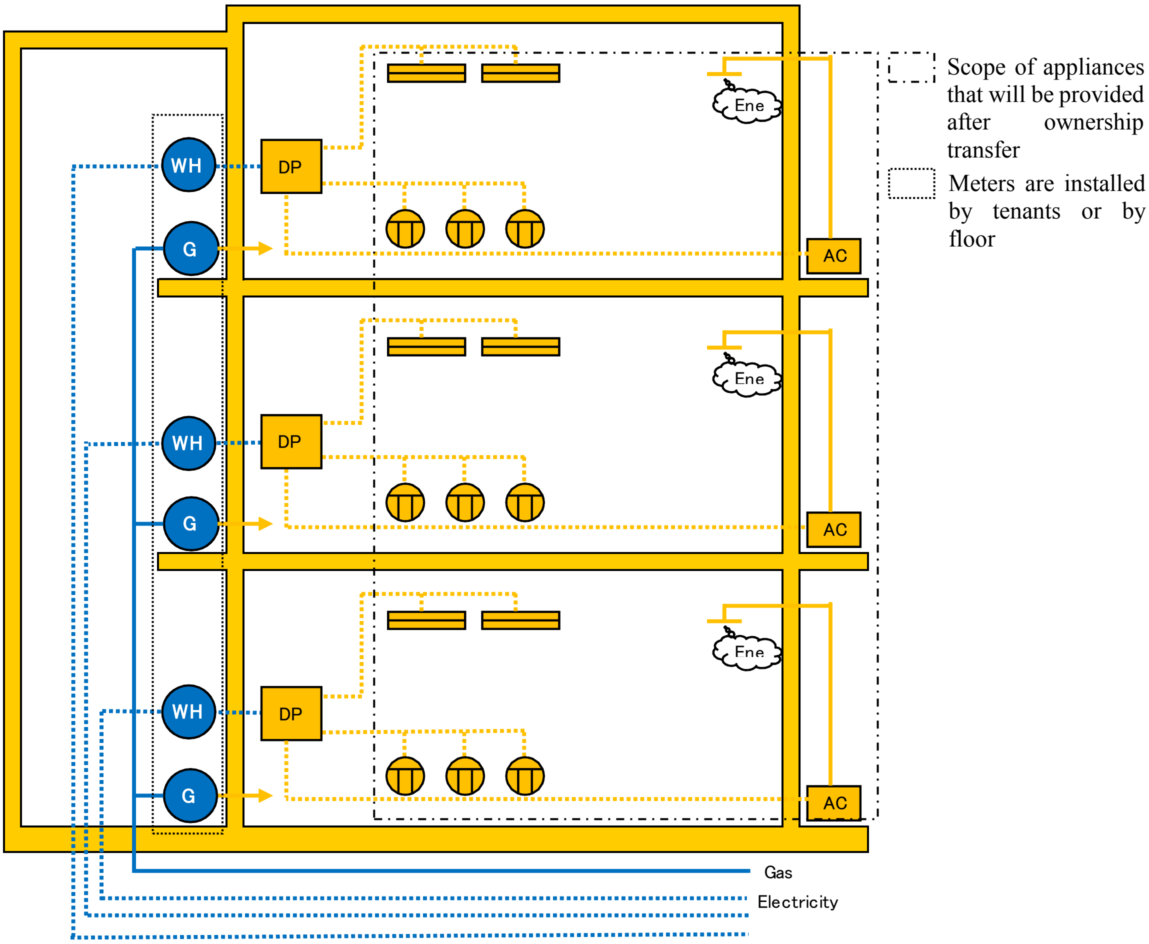
Figure 2.5-28 Image of case that tenant user occupies and/or utilizes building in part for their use




| Symbol | Item | Symbol | Item |
|---|---|---|---|
| AC | Package type（e.g. EHP, GHP） | WH | Watt Hour meter（primary） |
| AC-R | Heat source of central air conditioning system（e.g. Electric chiller, absorption chiller） | Ene | Energy by Air Conditioning（Cooling, Heating) |
| | Pump（e.g. Cold and hot water pump） | | Electrical wire |
| AHU | Air Handling Unit on central air condition system | | Coolant pipe（Package type） |
| FCU | Fan Coil Unit on central air condition system | | Duct |
| | Lighting Facilities | | Cold and hot water pipe（Central type） |
| | Socket | | The material/appliance that energy supplier has responsibility |
| WH | Power Distribution Panel（with watt hour meter） | | The material/appliance that buiilder/owner has responsibility |
| DP | Power Distribution Panel（without watt hour meter） | | The material/appliance that tenant has responsibility |

Source: Prepared by the JICA Survey Team.

Figure 2.5-29 Image of case of detached housing




| Symbol | Item | Symbol | Item |
|---|---|---|---|
| AC | Package type (e.g. EHP, GHP) | WH | Watt Hour meter (primary) |
| AC-R | Heat source of central air conditioning system (e.g. Electric chiller, absorption chiller) | Ene | Energy by Air Conditioning (Cooling, Heating) |
| | Pump (e.g. Cold and hot water pump) | | Electrical wire |
| AHU | Air Handling Unit on central air condition system | | Coolant pipe (Package type) |
| FCU | Fan Coil Unit on central air condition system | | Duct |
| | Lighting Facilities | | Cold and hot water pipe (Central type) |
| | Socket | | The material/appliance that energy supplier has responsibility |
| WH | Power Distribution Panel (with watt hour meter) | | The material/appliance that buiilder/owner has responsibility |
| DP | Power Distribution Panel (without watt hour meter) | | The material/appliance that tenant has responsibility |

Source: Prepared by the JICA Survey Team.

Figure 2.5-30 Image of case of collective housing

## 2.6 Model of existing buildings in Pakistan

Despite of the fact that most of the power consumption of buildings are by Air conditioner, JST recognized that the application of insulation to building envelope is very rare and the awareness of benefit of insulation is also poor in Pakistan. In order to visualize the benefit of EE&C effort, a study of comparison of power consumption between Non-insulated building envelope and high thermal performance material and equipment as per BCP-EP-2011 are shown as following methodology.

### 2.6.1 Methodology

(1) Policy

As per following reason, power consumption by air conditioner for model of building should be set based on building usage, character and location.

1) Location

Climate conditions are different among Islamabad, Lahore and Karachi. Also the buildings in this 3 cities are constructed by different material for building envelope. Therefore, building envelope, air conditioning operation period and outdoor air condition should be individually set by location.

2) Building usage

Operation time of building is different by building usage. Air conditioning load is different depending on the building scale, shape and size of glass area.

3) Scope of services

Only air conditioning consumption for building is analyzed in this study. In building sector, lighting and air conditioning is main load and power consumption by air conditioner is 50% or more in most of the buildings. Because gas hot water supply is majority in Pakistan, electric hot water supply can be ignored. Specific appliance, e.g. medical appliance and kitchen, is not available to introduce EE&C appliance without detailed consideration in each site. Socket load, e.g. office appliance and home appliance should be dealt with ES&L scheme, hence actual socket load cannot be controlled in design and construction phase.

(2) Methodology

1) Building model setting

8 building models, called Hotel, Hospital, Retail, Residential, Education, Restaurant and Cultural, are set applying different floor area, number of story, area of window and operation hours in order to compare the influence of each factor.

2) Formula of air conditioning load

Formula of air conditioning load follows “Design Standard for Building facilities, Ministry of Land, Infrastructure, Transport and Tourism, Japan”

Load for air conditioning is shown in Table 2.6-1.

Table 2.6-1 Load for air conditioning

| | | Cooling | Heating |
|---|---|---|---|
| Structure | | ✓ | ✓ |
| Glass | | ✓ | ✓ |
| Heat generator in room | Lighting | ✓ | - |
| | Human | ✓ | - |
| | Other | ✓ | - |
| Infiltration | | ✓* | ✓* |

Legend: ‘✓’ means ‘to be considered’, ‘✓*’ means ‘if necessary, to be considered’
Source: Design Standard for Building facilities, Ministry of Land, Infrastructure, Transport and Tourism, Japan

a) Air conditioning load from structure (roof, wall) in cooling

Air conditioning load from structure (roof, wall) in cooling is calculated by following formula.

qk1= A x K x (to - ti)

A: Area of Structure
K: U value of Structure
to: Outdoor temperature in design
ti: Indoor temperature in design

b) Air conditioning load from window in cooling

Air conditioning load from window in cooling is calculated by following formula.

qg= qg1+qg2

qg1=A x K x (to - ti)

A: Area of glass
K: U value of glass
to: Outdoor temperature in design
ti: Indoor temperature in design

qg2=A x Ig x SC

A: Area of glass
Ig: Solar heat gain coefficient
SC: Shade coefficient

c) Air conditioning load from lighting in cooling

Air conditioning load from lighting in cooling is calculated by following formula.

$L = A \times W$

- A: Total Floor Area
- W: Lighting load per unit floor area

d) Air conditioning load from human in cooling

Air conditioning load from human in cooling is calculated by following formula.

$= A \times W$

- A: Number of person in the room
- W: Heat generation per one person

e) Air conditioning load from structure (roof, wall) in heating

Air conditioning load from structure (roof, wall) in heating is calculated by following formula.

$qk1 = A \times K \times (ti - to)$

- A: Area of Structure
- K: U value of Structure
- to: Outdoor temperature in design
- ti: Indoor temperature in design

f) Air conditioning load from window in heating

Air conditioning load from window in heating is calculated following formula.

$qg1 = A \times K \times (ti - to)$

- A: Area of glass
- K: U value of glass
- to: Outdoor temperature in design
- ti: Indoor temperature in design

3) Calculation of current air conditioning load in existing building

Current air conditioning load in existing building is calculated under outdoor air temperature condition of Islamabad, Lahore and Karachi, with mentioned assumption of existing building. Outdoor air temperature condition of Islamabad, Lahore and Karachi is shown in Table 2.6-2. Current performance on roof, wall, glass and AC appliance is shown in Table 2.6-3. Detailed method is described in following a) to d).

Table2.6-2 Outdoor air temperature condition at Islamabad, Lahore and Karachi (Unit: ° C)

| | Jan. | Feb. | Mar. | Apr. | May | Jun. | Jul. | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Islamabad | 10.1 | 12.1 | 16.9 | 22.6 | 27.5 | 31.2 | 29.7 | 28.5 | 27.0 | 22.4 | 16.5 | 11.6 |
| Lahore | 12.8 | 15.4 | 20.5 | 26.8 | 31.2 | 33.9 | 31.5 | 30.7 | 29.7 | 25.6 | 19.5 | 14.2 |
| Karachi | 18.1 | 20.2 | 24.5 | 28.3 | 30.5 | 31.4 | 30.3 | 28.9 | 28.9 | 27.9 | 23.9 | 19.5 |

Source: Website of metrological department of Norway, http://www.yr.no/place/Pakistan/Sindh/Karachi/statistics.html

Table2.6-3 Current performance on roof, wall, glass and AC appliance (Unit: inside table)

| | Roof | Wall | Glass (U value) | Glass (SC) | AC performance |
|---|---|---|---|---|---|
| Islamabad | 2.42 W/m²/K | 2.68 W/m²/K | 5.55W/m²/K | 0.725 | 8.53 in EER (2.5 in COP) |
| Lahore | 2.42 W/m²/K | 2.68 W/m²/K | 5.55W/m²/K | 0.725 | 8.53 in EER (2.5 in COP) |
| Karachi | 2.42 W/m²/K | 3.20 W/m²/K | 5.55W/m²/K | 0.725 | 8.53 in EER (2.5 in COP) |

Source: Prepared by JICA survey Team based on BPC-EP-2011

a) U value on roof

Concrete slab is generally adopted as roof material in Pakistan. In case under condition of 254 mm (10 inch) of concrete thickness, U value on roof is set as 2.42 W/m²/° C.

Calculation of U value on roof is shown in Table 2.6-4.

Table 2.6-4 Calculation of U value on roof (Unit: inside table)

| | Thickness(mm) | Resistance per thickness(m x ° C/W) | R value(m² x ° C/W) |
|---|---|---|---|
| | A | B | C=A x B |
| Outside air film | | | 0.044000 |
| Bitumen layer | | | 0.021000 |
| Screed | 51.0 | 0.56 | 0.028560 |
| Concrete section | 254.0 | 0.56 | 0.142240 |
| Cement Plaster | 12.7 | 1.39 | 0.017653 |
| Inside air firm | | | 0.160000 |
| Total | | | 0.413453 |
| U value = 1/ (total of R value)= 1/ 0. 413453= | | | 2.42 (W /m² / ° C) |

Resistance per thickness of Screed, Concrete section and Cement Plaster is referred from Compliance handbook of BEC-1990, R value of outside air film, inside air firm also.

Source: Prepared by JICA survey Team

b) U value on wall

Brick is generally adopted as wall material in Islamabad and Lahore. In case under condition of 228.6 mm (9 inch) of block thickness, U value on roof in Islamabad and Lahore is set as 2.68 W/m²/° C. Calculation of U value on wall in Islamabad and Lahore is shown in Table 2.6-5.

Table 2.6-5 Calculation of U value on wall in Islamabad and Lahore (Unit: inside table)

| | Thickness (mm) | Resistance per thickness (m x ° C/W) | R value (m² x ° C/W) |
|---|---|---|---|
| | A | B | C=A x B |
| Outside air film | | | 0.044000 |
| Cement Plaster | 12.5 | 1.39 | 0.017375 |
| Brick | 228.6 | 0.76 | 0.173736 |
| Cement Plaster | 12.5 | 1.39 | 0.017375 |
| Inside air firm | | | 0.120000 |
| Total | | | 0.372486 |
| U value = 1/ (total of R value)= 1/ 0. 372486= | | | 2.68 (W /m² / ° C) |

Resistance per thickness of Screed, Concrete section and Cement Plaster is referred from Compliance handbook of BEC-1990, R value of outside air film, inside air firm also.

Source: Prepared by JICA survey Team

Further, in Karachi, concrete block is generally adopted as wall material. In case under condition of 203.2 mm (8 inch) of concrete block thickness, U value on roof in Karachi is set as 3.20 W/m$^2$/° C. Calculation of U value on wall in Karachi is shown in Table 2.6-6.

Table 2.6-6 Calculation of U value on wall in Karachi (Unit: inside table)

| | Thickness (mm) | Resistance per thickness (m x ° C/W) | R value (m$^2$ x ° C /W) |
|---|---|---|---|
| | A | B | C=A x B |
| Outside air film | | | 0.044000 |
| Cement Plaster | 12.5 | 1.39 | 0.017375 |
| Concrete section | 203.2 | 0.56 | 0.113792 |
| Cement Plaster | 12.5 | 1.39 | 0.017375 |
| Inside air firm | | | 0.120000 |
| Total | | | 0.312542 |
| U value = 1/ (total of R value)= 1/ 0. 312542= | | | 3.20 (W /m$^2$ / ° C) |

Resistance per thickness of Screed, Concrete section and Cement Plaster is referred from Compliance handbook of BEC-1990, R value of outside air film, inside air firm also.
Source: Prepared by JICA survey Team

c) U value and Shade Coefficient on window

Single glaze is adopted on most of buildings, ratio of introduction of blind is still remaining approximately 50%. So as shade coefficient and U value on window, average between figure on column of “with blind” and figure on column of “without blind” is set. In case under condition of 8 mm of glass thickness, U value on window is set as 5.55 W/m$^2$/° C (average of 6.2 and 4.9), shade coefficient is set as 0.725 (average of 0.93 and 0.52) as well. Shade coefficient and U value by type-wise of glass is shown in Table 2.6-7.

Further way of improvement of glass is both of replacement from single glaze to double glaze with same thickness and enforcement of installation of blind. Therefore in case under condition of double glaze of 8 mm of glass thickness, U value on window is set as 2.9 W/m$^2$/° C, shade coefficient is set as 0.50 as well.

If external glass area accounts for 40% or more, U value needs to be 2.5 W/m$^2$/K or less and shading coefficient to be 0.35 or less as per BCP-EP-2011 requirement. So, Low-e double glazing with light colored blind are set for calculation, in which U value on window is set as 2.5 W/m$^2$/° C, shade coefficient is set as 0.35.

Table 2.6-7 Shading coefficient and U value by type-wise of glass

| Type of glass | | Shading Coefficient | | | U value ($W/m^2/K$) | |
|---|---|---|---|---|---|---|
| | | Without blind | Light colored blind | Natural tinted blind | Without blind | With blind |
| Double glaze | Clear 6mm(o) + Low-e 6mm(i) | ***0.60*** | ***0.46*** | ***0.49*** | ***2.6*** | ***2.2*** |
| | Low-e 6mm(o) + Clear 6mm(i) | ***0.51*** | ***0.34*** | ***0.39*** | ***2.6*** | ***2.2*** |
| | Clear 3mm + Clear 3mm | 0.89 | ***0.54*** | ***0.63*** | ***3.5*** | ***3.0*** |
| | Clear 5mm + Clear 5mm | 0.85 | ***0.52*** | ***0.60*** | ***3.5*** | ***3.0*** |
| | Clear 6mm + Clear 6mm | 0.83 | ***0.52*** | ***0.59*** | ***3.4*** | ***3.0*** |
| | Clear 8mm + Clear 8mm | 0.79 | ***0.50*** | ***0.57*** | ***3.4*** | ***2.9*** |
| | HA 3mm + Clear 3mm | ***0.81*** | ***0.48*** | ***0.56*** | ***3.5*** | ***3.0*** |
| | HA 5mm + Clear 5mm | ***0.72*** | ***0.45*** | ***0.51*** | ***3.5*** | ***3.0*** |
| | HA 6mm + Clear 6mm | ***0.69*** | ***0.43*** | ***0.49*** | ***3.4*** | ***3.0*** |
| Single glaze | HA 8mm + Clear 8mm | 0.62 | ***0.39*** | ***0.44*** | 3.4 | 2.9 |
| | Clear 3mm | 1.00 | ***0.54*** | ***0.66*** | 6.5 | 5.1 |
| | Clear 5mm | 0.97 | ***0.54*** | ***0.63*** | 6.4 | 5.0 |
| | Clear 6mm | 0.96 | ***0.53*** | ***0.63*** | 6.3 | 5.0 |
| | Clear 8mm | 0.93 | ***0.52*** | ***0.62*** | 6.2 | 4.9 |
| | Clear 10mm | 0.90 | ***0.50*** | ***0.60*** | 6.0 | 4.8 |
| | Clear 12mm | 0.89 | ***0.50*** | ***0.59*** | 5.9 | 4.8 |
| | HA 3mm | 0.93 | ***0.52*** | ***0.61*** | 6.5 | 5.1 |
| | HA 5mm | 0.86 | ***0.49*** | ***0.56*** | 6.4 | 5.0 |
| | HA 6mm | 0.83 | ***0.48*** | ***0.55*** | 6.3 | 5.0 |
| | HA 8mm | 0.77 | ***0.46*** | ***0.52*** | 6.2 | 4.9 |
| | HA 10mm | 0.72 | ***0.43*** | ***0.48*** | 6.0 | 4.8 |
| | HA 12mm | ***0.68*** | ***0.41*** | ***0.45*** | 5.9 | 4.8 |

Comment and shape for highlighting is added.
HA stand for "Heat Absorbing", (o) stand for "outside", (i) stand for "inside"
Italic character with bold font indicates the glass specification keep compliance with BCP-EP-2011.
Source: Design Standard for Building facilities, Ministry of Land, Infrastructure, Transport and Tourism, Japan

d) AC performance

Most of adopted AC is split type air conditioner with 1.5 ton (18,000 Btu/h) of capacity. Under condition of 1.5 ton (18,000 Btu/h) of capacity, COP is set as 2.5 in COP (8.53 in EER).

4) Calculation of EE&C potential

EE&C potential should be calculated under assumption that performance of roof, wall, window and air conditioning appliance would improve as per criteria of BCP-EP-2011.
Improved performance on roof, wall, glass and AC appliance is shown in Table2.6-8.

Table2.6-8 Improved performance on roof, wall, glass and AC appliance (Unit: inside table)

<table>
<tr><th></th><th>Roof</th><th>Wall</th><th>Glass (U value)</th><th>Glass (SC)</th><th>AC performance</th></tr>
<tr><td rowspan="3">Performance value</td><td rowspan="3">0.44 W/m<sup>2</sup>/K</td><td rowspan="3">0.53 W/m<sup>2</sup>/K</td><td>2.9 W/m<sup>2</sup>/K</td><td>0.50</td><td rowspan="3">9.7 in EER (2.84 in COP)</td></tr>
<tr><td colspan="2">Glass area 40% or more</td></tr>
<tr><td>2.5W/m<sup>2</sup>/K</td><td>0.35</td></tr>
</table>

Source: Prepared by JICA survey Team based on BPC-EP-2011

Seven estimated power consumption by air conditioner will be calculated in comparison with Non-insulated building as shown in Table below.

Table 2.6-9 Methodology of comparison for power consumption by air conditioner.

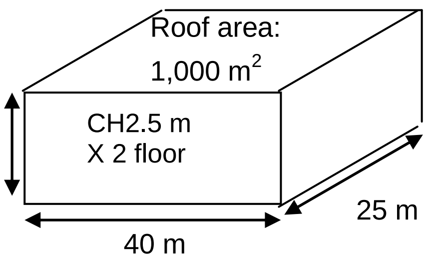
| | | |
|---|---|---|
| 1 | Comparison Base | Non-insulated building with specification as per Table 2.6-3 |
| 2 | Without roof exposure | Calculated based on no roof exposure to external air, such as bottom two floor of commercial facility in multi-story building. Specification is same as above. |
| 3 | Insulated Roof | Calculated based on the insulation applied for roof only as per BCP-EP-2011 criteria. |
| 4 | Insulated Wall | Calculated based on the insulation applied for wall only as per BCP-EP-2011 criteria. |
| 5 | Improved Window | Calculated based on the improved glass criteria as per BCP-EP-2011. |
| 6 | Full insulated envelope | Calculated based on the insulation applied for roof and wall, improved glass as per BCP-EP-2011 criteria. (3+4+5 above) |
| 7 | Improved Air conditioner | Calculated based on the improved air conditioner criteria as per BCP-EP-2011. Building envelope is remain non insulated. |
| 8 | Full compliance | Calculated based on the insulation applied for roof and wall, improved glass and air conditioner as per BCP-EP-2011 criteria. (6+7 above) |

Source: Prepared by JICA survey Team

### 2.6.2 Model building setting

(1) Hotel

Image of model of hotel category is shown in Figure 2.6-1.



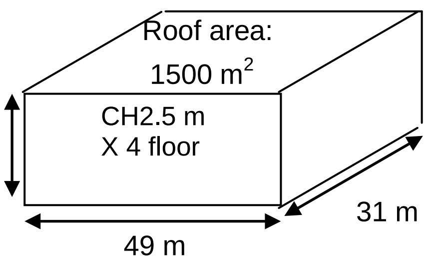

Total floor area: 2,000 $m^2$
Number of storey: 2 stories
Ratio of window: 20%
Total area of Wall: 520 $m^2$
Total area of Window: 130 $m^2$
In door temperature in cooling season: 26 ° C
In door temperature in heating season: 20 °C
Annual operation days: 365 days
Daily operation time: 24 Hours

Source: Prepared by the JICA Survey Team.

Figure 2.6-1 Image of model of hotel categories

(2) Hospital

Image of model of hospital category is shown in Figure 2.6-2.



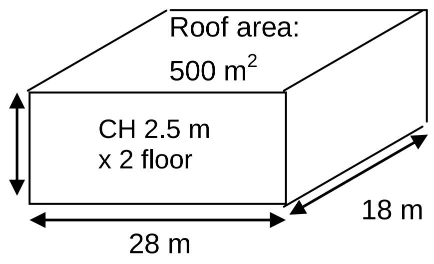

Total floor area: 6,000 $m^2$
Number of storey: 4 stories
Ratio of window square: 20%
Total area of Wall: approx. 1,270$m^2$
Total area of Window: approx. 320 $m^2$
In door temperature in cooling season: 26 °C
In door temperature in heating season: 20 °C
Annual operation days: 365 days
Daily operation time: 24 Hours

Source: Prepared by the JICA Survey Team.

Figure 2.6-2 Image of model of hospital category

(3) Retail

Image of model of retail category is shown in Figure 2.6-3.



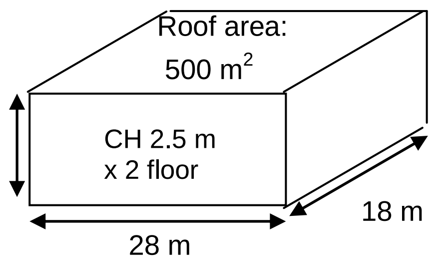

Total floor area: 1,000 $m^2$
Number of storey: 2 stories
Ratio of window square: 20%
Total area of Wall: approx. 370$m^2$
Total area of Window: approx. 90 $m^2$
In door temperature in cooling season: 26 °C
In door temperature in heating season: 20 °C
Annual operation days: 353 days
Daily operation time: 10.5 hours

Source: Prepared by the JICA Survey Team.

Figure 2.6-3 Image of model of retail category

(4) Office

Image of model of office category is shown in Figure 2.6-4.



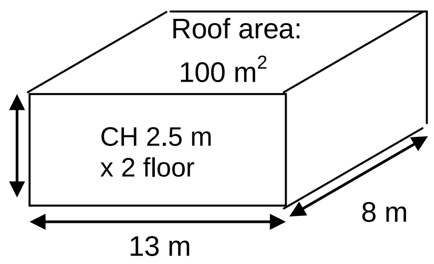

Total floor area: 1,000 $m^2$
Number of storey: 2 stories
Ratio of window square: 50%
Total area of Wall: approx. 230 $m^2$
Total area of Window: approx. 230 $m^2$
In door temperature in cooling season: 26 °C
In door temperature in heating season: 20 °C
Annual operation days: 228 days
Daily operation time: 8.0 hours

Source: Prepared by the JICA Survey Team.

Figure 2.6-4 Image of model of office category

(5) Residential

Image of model of residential category is shown in Figure 2.6-5.



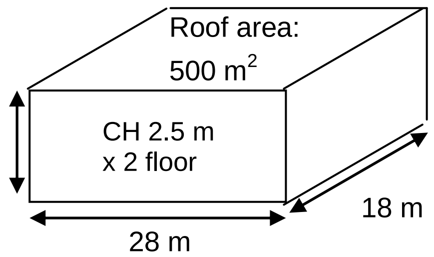

Total floor area: 200 $m^2$
Number of storey: 2 stories
Ratio of window square: 20%
Total area of Wall: approx. 160$m^2$
Total area of Window: approx. 40 $m^2$
In door temperature in cooling season: 26 °C
In door temperature in heating season: 20 °C
Annual operation days: 365 days
Daily operation time: 12 hours

Source: Prepared by the JICA Survey Team.

Figure 2.6-5 Image of model of residential category

(6) Education

Image of model of educational category is shown in Figure 2.6-6.



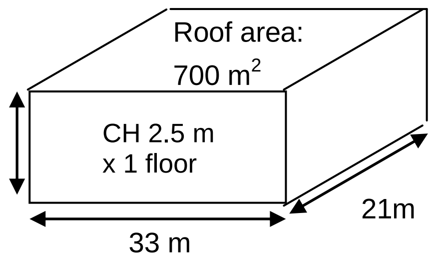

Total floor area: 1,000 $m^2$
Number of storey: 2 stories
Ratio of window square: 20%
Total area of Wall: approx. 370$m^2$
Total area of Window: approx. 90 $m^2$
In door temperature in cooling season: 26 °C
In door temperature in heating season: 20 °C
Annual operation days: 228 days
Daily operation time: 8.0 hours

Source: Prepared by the JICA Survey Team.

Figure 2.6-6 Image of model of educational category

(7) Restaurant

Image of model of restaurant category is shown in Figure 2.6-7.



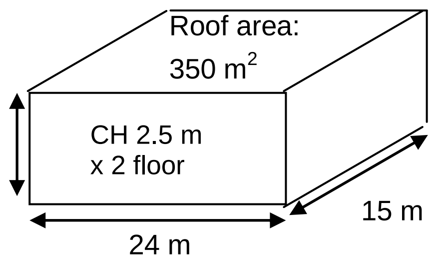

Total floor area: 700 $m^2$
Number of storey: 1 stories
Ratio of window square: 35%
Total area of Wall: approx. 177$m^2$
Total area of Window: approx. 95 $m^2$
In door temperature in cooling season: 26 °C
In door temperature in heating season: 20 °C
Annual operation days: 353 days
Daily operation time: 8.0 hours

Source: Prepared by the JICA Survey Team.

Figure 2.6-7 Image of model of restaurant category

(8) Cultural

Image of model of cultural category is shown in Figure 2.6-8.




Total floor area: 700 $m^2$
Number of storey: 2 stories
Ratio of window square: 20%
Total area of Wall: approx. 310$m^2$
Total area of Window: approx. 80 $m^2$
In door temperature in cooling season: 26 °C
In door temperature in heating season: 20 °C
Annual operation days: 353 days
Daily operation time: 8.0 hours

Source: Prepared by the JICA Survey Team.

Figure 2.6-8 Image of model of cultural category

### 2.6.3 Estimation of annual power consumption and EE&C potential

(1) Hotel

Estimation of annual power consumption and EE&C potential on hotel in Islamabad, Lahore and Karachi is shown in Table 2.6-10, -11, -12 respectively.

Table2.6-10 Estimation of annual power consumption and EE&C potential on hotel in Islamabad

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 296,710 kWh | 85,822 kWh | 382,532 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 118,684 kWh | 34,329 kWh | 153,013 kWh | |
| Case study | 1. Comparison Base (No insulation) | 118,684 kWh | 34,329 kWh | 153,013 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 108,817 kWh | 16,010 kWh | 124,828 kWh | -18.4% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 110,611 kWh | 19,341 kWh | 129,952 kWh | -15.1% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 114,126 kWh | 25,866 kWh | 139,992 kWh | -8.5% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 100,523 kWh | 31,721 kWh | 132,244 kWh | -13.6% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 87,892 kWh | 8,271 kWh | 96,162 kWh | -37.2% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 104,398 kWh | 30,197 kWh | 134,595 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 77,312 kWh | 7,275 kWh | 84,587 kWh | -44.7% |

Source: Prepared by JICA survey Team

Table2.6-11 Estimation of annual power consumption and EE&C potential on hotel in Lahore

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 342,936 kWh | 57,882 kWh | 400,818 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 137,174 kWh | 23,153 kWh | 160,327 kWh | |
| Case study | 1. Comparison Base (No insulation) | 137,174 kWh | 23,153 kWh | 160,327 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 117,441 kWh | 10,798 kWh | 128,239 kWh | -20.0% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 121,029 kWh | 13,045 kWh | 134,073 kWh | -16.4% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 128,058 kWh | 17,445 kWh | 145,503 kWh | -9.2% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 117,608 kWh | 21,394 kWh | 139,003 kWh | -13.3% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 92,347 kWh | 5,578 kWh | 97,925 kWh | -38.9% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 120,663 kWh | 20,366 kWh | 141,029 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 81,231 kWh | 4,907 kWh | 86,137 kWh | -46.3% |

Source: Prepared by JICA survey Team

Table2.6-12 Estimation of annual power consumption and EE&C potential on hotel in Karachi

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 335,784 kWh | 8,581 kWh | 344,365 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 134,314 kWh | 3,432 kWh | 137,746 kWh | |
| Case study | 1. Comparison Base (No insulation) | 134,314 kWh | 3,432 kWh | 137,746 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 117,131 kWh | 1,704 kWh | 118,835 kWh | -13.7% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 120,255 kWh | 2,018 kWh | 122,274 kWh | -11.2% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 124,456 kWh | 2,441 kWh | 126,897 kWh | -7.9% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 115,111 kWh | 3,186 kWh | 118,297 kWh | -14.1% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 91,195 kWh | 780 kWh | 91,975 kWh | -33.2% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 118,147 kWh | 3,019 kWh | 121,166 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 80,218 kWh | 686 kWh | 80,904 kWh | -41.3% |

Source: Prepared by JICA survey Team

(2) Hospital

Estimation of annual power consumption and EE&C potential on hospital in Islamabad, Lahore and Karachi is shown in Table 2.6-13, -14, -15 respectively.

Table2.6-13 Estimation of annual power consumption and EE&C potential on hospital in Islamabad

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 766,952 kWh | 166,738 kWh | 933,690 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 306,781 kWh | 66,695 kWh | 373,476 kWh | |
| Case study | 1. Comparison Base (No insulation) | 306,781 kWh | 66,695 kWh | 373,476 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 291,981 kWh | 39,217 kWh | 331,198 kWh | -11.3% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 294,672 kWh | 44,213 kWh | 338,885 kWh | -9.3% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 295,615 kWh | 45,966 kWh | 341,581 kWh | -8.5% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 262,295 kWh | 60,308 kWh | 322,602 kWh | -13.6% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 239,020 kWh | 17,096 kWh | 256,117 kWh | -31.4% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 269,854 kWh | 58,667 kWh | 328,521 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 210,250 kWh | 15,038 kWh | 225,288 kWh | -39.7% |

Source: Prepared by JICA survey Team

Table2.6-14 Estimation of annual power consumption and EE&C potential on hospital in Lahore

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 856,760 kWh | 112,455 kWh | 969,215 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 342,704 kWh | 44,982 kWh | 387,686 kWh | |
| Case study | 1. Comparison Base (No insulation) | 342,704 kWh | 44,982 kWh | 387,686 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 313,104 kWh | 26,450 kWh | 339,554 kWh | -12.4% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 318,486 kWh | 29,820 kWh | 348,305 kWh | -10.2% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 320,373 kWh | 31,001 kWh | 351,375 kWh | -9.4% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 294,778 kWh | 40,674 kWh | 335,452 kWh | -13.5% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 248,229 kWh | 11,530 kWh | 259,759 kWh | -33.0% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 301,453 kWh | 39,568 kWh | 341,021 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 218,350 kWh | 10,143 kWh | 228,492 kWh | -41.1% |

Source: Prepared by JICA survey Team

Table2.6-15 Estimation of annual power consumption and EE&C potential on hospital in Karachi

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 845,298 kWh | 16,915 kWh | 862,214 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 338,119 kWh | 6,766 kWh | 344,885 kWh | |
| Case study | 1. Comparison Base (No insulation) | 338,119 kWh | 6,766 kWh | 344,885 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 312,346 kWh | 4,173 kWh | 316,519 kWh | -8.2% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 317,032 kWh | 4,645 kWh | 321,677 kWh | -6.7% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 313,973 kWh | 4,337 kWh | 318,310 kWh | -7.7% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 291,082 kWh | 6,163 kWh | 297,246 kWh | -13.8% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 245,848 kWh | 1,613 kWh | 247,461 kWh | -28.2% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 297,420 kWh | 5,952 kWh | 303,372 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 216,256 kWh | 1,419 kWh | 217,675 kWh | -36.9% |

Source: Prepared by JICA survey Team

(3) Retail

Estimation of annual power consumption and EE&C potential on retail in Islamabad, Lahore and Karachi is shown in Table 2.6-16, -17, -18 respectively.

Table2.6-15 Estimation of annual power consumption and EE&C potential on retail in Islamabad

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 76,501 kWh | 21,656 kWh | 98,157 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 30,600 kWh | 8,662 kWh | 39,263 kWh | |
| Case study | 1. Comparison Base (No insulation) | 30,600 kWh | 8,662 kWh | 39,263 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 28,513 kWh | 4,788 kWh | 33,301 kWh | -15.2% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 28,892 kWh | 5,493 kWh | 34,385 kWh | -12.4% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 29,237 kWh | 6,131 kWh | 35,368 kWh | -9.9% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 25,166 kWh | 7,882 kWh | 33,049 kWh | -15.8% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 22,094 kWh | 2,182 kWh | 24,276 kWh | -38.2% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 26,917 kWh | 7,620 kWh | 34,537 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 19,435 kWh | 1,919 kWh | 21,354 kWh | -45.6% |

Source: Prepared by JICA survey Team

Table2.6-16 Estimation of annual power consumption and EE&C potential on retail in Lahore

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 88,172 kWh | 14,608 kWh | 102,779 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 35,269 kWh | 5,843 kWh | 41,112 kWh | |
| Case study | 1. Comparison Base (No insulation) | 35,269 kWh | 5,843 kWh | 41,112 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 31,093 kWh | 3,230 kWh | 34,323 kWh | -16.5% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 31,852 kWh | 3,705 kWh | 35,558 kWh | -13.5% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 32,541 kWh | 4,136 kWh | 36,677 kWh | -10.8% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 29,414 kWh | 5,317 kWh | 34,731 kWh | -15.5% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 23,270 kWh | 1,472 kWh | 24,741 kWh | -39.8% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 31,023 kWh | 5,140 kWh | 36,163 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 20,469 kWh | 1,295 kWh | 21,763 kWh | -47.1% |

Source: Prepared by JICA survey Team

Table2.6-17 Estimation of annual power consumption and EE&C potential on retail in Karachi

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 86,591 kWh | 2,190 kWh | 88,781 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 34,636 kWh | 876 kWh | 35,512 kWh | |
| Case study | 1. Comparison Base (No insulation) | 34,636 kWh | 876 kWh | 35,512 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 31,001 kWh | 510 kWh | 31,511 kWh | -11.3% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 31,662 kWh | 577 kWh | 32,238 kWh | -9.2% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 31,686 kWh | 579 kWh | 32,266 kWh | -9.1% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 28,890 kWh | 802 kWh | 29,693 kWh | -16.4% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 22,966 kWh | 206 kWh | 23,172 kWh | -34.7% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 30,467 kWh | 771 kWh | 31,238 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 20,201 kWh | 181 kWh | 20,383 kWh | -42.6% |

Source: Prepared by JICA survey Team

(4) Office

Estimation of annual power consumption and EE&C potential on office in Islamabad, Lahore and Karachi is shown in Table 2.6-19, -20, -21 respectively.

Table2.6-19 Estimation of annual power consumption and EE&C potential on office in Islamabad

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 69,582 kWh | 12,046 kWh | 81,627 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 27,833 kWh | 4,818 kWh | 32,651 kWh | |
| Case study | 1. Comparions Base (No insulation) | 27,833 kWh | 4,818 kWh | 32,651 kWh | Basis case |
| | 2. Without roof exposure(No insulation) | 26,673 kWh | 2,938 kWh | 29,611 kWh | -9.3% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 26,883 kWh | 3,280 kWh | 30,164 kWh | -7.6% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 27,359 kWh | 4,051 kWh | 31,410 kWh | -3.8% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 16,808 kWh | 3,729 kWh | 20,537 kWh | -37.1% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 15,385 kWh | 1,424 kWh | 16,809 kWh | -48.5% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 24,482 kWh | 4,238 kWh | 28,721 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 13,533 kWh | 1,252 kWh | 14,785 kWh | -54.7% |

Source: Prepared by JICA survey Team

Table2.6-20 Estimation of annual power consumption and EE&C potential on office in Lahore

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 77,015 kWh | 8,113 kWh | 85,128 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 30,806 kWh | 3,245 kWh | 34,051 kWh | |
| Case study | 1. Comparion Base (No insulation) | 30,806 kWh | 3,245 kWh | 34,051 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 28,486 kWh | 1,979 kWh | 30,465 kWh | -10.5% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 28,908 kWh | 2,209 kWh | 31,117 kWh | -8.6% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 29,859 kWh | 2,728 kWh | 32,587 kWh | -4.3% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 19,109 kWh | 2,512 kWh | 21,621 kWh | -36.5% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 16,264 kWh | 959 kWh | 17,222 kWh | -49.4% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 27,098 kWh | 2,855 kWh | 29,952 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 14,306 kWh | 843 kWh | 15,149 kWh | -55.5% |

Source: Prepared by JICA survey Team

Table2.6-21 Estimation of annual power consumption and EE&C potential on office in Karachi

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 75,593 kWh | 1,257 kWh | 76,851 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 30,237 kWh | 503 kWh | 30,740 kWh | |
| Case study | 1. Comparison Base (No insulation) | 30,237 kWh | 503 kWh | 30,740 kWh | Basis case |
| | 2. Without Roof exposure (No insulation) | 28,217 kWh | 314 kWh | 28,531 kWh | -7.2% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 28,584 kWh | 348 kWh | 28,933 kWh | -5.9% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 29,213 kWh | 407 kWh | 29,620 kWh | -3.6% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 18,714 kWh | 394 kWh | 19,108 kWh | -37.8% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 16,037 kWh | 143 kWh | 16,180 kWh | -47.4% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 26,598 kWh | 442 kWh | 27,040 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 14,106 kWh | 126 kWh | 14,232 kWh | -53.7% |

Source: Prepared by JICA survey Team

(5) Residential

Estimation of annual power consumption and EE&C potential on residential in Islamabad, Lahore and Karachi is shown in Table 2.6-22, -23, -24 respectively.

Table2.6-22 Estimation of annual power consumption and EE&C potential on residential in Islamabad

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 31,760 kWh | 8,618 kWh | 40,379 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 12,704 kWh | 3,447 kWh | 16,151 kWh | |
| Case study | 1. Comparison Base (No insulation) | 12,704 kWh | 3,447 kWh | 16,151 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 12,211 kWh | 2,531 kWh | 14,742 kWh | -8.7% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 12,300 kWh | 2,698 kWh | 14,998 kWh | -7.1% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 11,983 kWh | 2,109 kWh | 14,093 kWh | -12.7% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 9,832 kWh | 3,035 kWh | 12,868 kWh | -20.3% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 8,708 kWh | 948 kWh | 9,656 kWh | -40.2% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 11,175 kWh | 3,032 kWh | 14,207 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 7,660 kWh | 834 kWh | 8,493 kWh | -47.4% |

Source: Prepared by JICA survey Team

Table2.6-23 Estimation of annual power consumption and EE&C potential on residential in Lahore

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 36,402 kWh | 5,813 kWh | 42,215 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 14,561 kWh | 2,325 kWh | 16,886 kWh | |
| Case study | 1. Comparison Base (No insulation) | 14,561 kWh | 2,325 kWh | 16,886 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 13,574 kWh | 1,707 kWh | 15,282 kWh | -9.5% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 13,754 kWh | 1,820 kWh | 15,573 kWh | -7.8% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 13,119 kWh | 1,423 kWh | 14,542 kWh | -13.9% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 11,467 kWh | 2,047 kWh | 13,514 kWh | -20.0% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 9,219 kWh | 639 kWh | 9,858 kWh | -41.6% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 12,808 kWh | 2,045 kWh | 14,853 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 8,109 kWh | 562 kWh | 8,671 kWh | -48.6% |

Source: Prepared by JICA survey Team

Table2.6-24 Estimation of annual power consumption and EE&C residential on office in Karachi

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 35,961 kWh | 890 kWh | 36,850 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 14,384 kWh | 356 kWh | 14,740 kWh | |
| Case study | 1. Comparison Base (No insulation) | 14,384 kWh | 356 kWh | 14,740 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 13,525 kWh | 269 kWh | 13,795 kWh | -6.4% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 13,681 kWh | 285 kWh | 13,967 kWh | -5.2% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 12,826 kWh | 199 kWh | 13,025 kWh | -11.6% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 11,348 kWh | 317 kWh | 11,665 kWh | -20.9% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 9,087 kWh | 89 kWh | 9,176 kWh | -37.7% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 12,653 kWh | 313 kWh | 12,966 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 7,993 kWh | 79 kWh | 8,071 kWh | -45.2% |

Source: Prepared by JICA survey Team

(6) Education

Estimation of annual power consumption and EE&C potential on education in Islamabad, Lahore and Karachi is shown in Table 2.6-25, -26, -27 respectively.

Table2.6-25 Estimation of annual power consumption and EE&C potential on education in Islamabad

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 38,610 kWh | 10,509 kWh | 49,119 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 15,444 kWh | 4,203 kWh | 19,647 kWh | |
| Case study | 1. Comparison Base (No insulation) | 15,444 kWh | 4,203 kWh | 19,647 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 14,284 kWh | 2,324 kWh | 16,608 kWh | -15.5% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 14,495 kWh | 2,665 kWh | 17,160 kWh | -12.7% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 14,686 kWh | 2,975 kWh | 17,661 kWh | -10.1% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 12,726 kWh | 3,825 kWh | 16,551 kWh | -15.8% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 11,019 kWh | 1,059 kWh | 12,078 kWh | -38.5% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 13,585 kWh | 3,697 kWh | 17,283 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 9,692 kWh | 931 kWh | 10,624 kWh | -45.9% |

Source: Prepared by JICA survey Team

Table2.6-26 Estimation of annual power consumption and EE&C potential on education in Lahore

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 45,095 kWh | 7,078 kWh | 52,173 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 18,038 kWh | 2,831 kWh | 20,869 kWh | |
| Case study | 1. Comparison Base (No insulation) | 18,038 kWh | 2,831 kWh | 20,869 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 15,718 kWh | 1,565 kWh | 17,283 kWh | -17.2% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 16,140 kWh | 1,795 kWh | 17,935 kWh | -14.1% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 16,522 kWh | 2,004 kWh | 18,526 kWh | -11.2% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 15,086 kWh | 2,576 kWh | 17,662 kWh | -15.4% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 11,672 kWh | 713 kWh | 12,385 kWh | -40.7% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 15,867 kWh | 2,490 kWh | 18,357 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 10,267 kWh | 627 kWh | 10,894 kWh | -47.8% |

Source: Prepared by JICA survey Team

Table2.6-27 Estimation of annual power consumption and EE&C education on office in Karachi

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 44,218 kWh | 1,131 kWh | 45,349 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 17,687 kWh | 452 kWh | 18,139 kWh | |
| Case study | 1. Comparison Base (No insulation) | 17,687 kWh | 452 kWh | 18,139 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 15,667 kWh | 263 kWh | 15,930 kWh | -12.2% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 16,034 kWh | 298 kWh | 16,332 kWh | -10.0% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 16,048 kWh | 299 kWh | 16,347 kWh | -9.9% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 14,796 kWh | 414 kWh | 15,210 kWh | -16.1% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 11,503 kWh | 106 kWh | 11,610 kWh | -36.0% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 15,558 kWh | 398 kWh | 15,956 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 10,119 kWh | 94 kWh | 10,212 kWh | -43.7% |

Source: Prepared by JICA survey Team

(7) Restaurant

Estimation of annual power consumption and EE&C potential on restaurant in Islamabad, Lahore and Karachi is shown in Table 2.6-28, -29, -30 respectively.

Table2.6-28 Estimation of annual power consumption and EE&C potential on restaurant in Islamabad

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 53,755 kWh | 16,440 kWh | 70,196 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 21,502 kWh | 6,576 kWh | 28,078 kWh | |
| Case study | 1. Comparison Base (No insulation) | 21,502 kWh | 6,576 kWh | 28,078 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 19,275 kWh | 2,444 kWh | 21,719 kWh | -22.6% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 19,680 kWh | 3,195 kWh | 22,875 kWh | -18.5% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 21,003 kWh | 5,649 kWh | 26,652 kWh | -5.1% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 17,215 kWh | 5,961 kWh | 23,176 kWh | -17.5% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 14,894 kWh | 1,653 kWh | 16,547 kWh | -41.1% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 18,914 kWh | 5,785 kWh | 24,699 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 13,101 kWh | 1,454 kWh | 14,555 kWh | -48.2% |

Source: Prepared by JICA survey Team

Table2.6-29 Estimation of annual power consumption and EE&C potential on restaurant in Lahore

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 62,615 kWh | 11,090 kWh | 73,705 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 25,046 kWh | 4,436 kWh | 29,482 kWh | |
| Case study | 1. Comparison Base (No insulation) | 25,046 kWh | 4,436 kWh | 29,482 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 20,592 kWh | 1,649 kWh | 22,241 kWh | -24.6% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 21,402 kWh | 2,155 kWh | 23,557 kWh | -20.1% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 24,047 kWh | 3,811 kWh | 27,858 kWh | -5.5% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 20,428 kWh | 4,021 kWh | 24,449 kWh | -17.1% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 15,785 kWh | 1,115 kWh | 16,900 kWh | -42.7% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 22,031 kWh | 3,902 kWh | 25,933 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 13,885 kWh | 981 kWh | 14,866 kWh | -49.6% |

Source: Prepared by JICA survey Team

Table2.6-30 Estimation of annual power consumption and EE&C on restaurant in Karachi

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 60,851 kWh | 1,606 kWh | 62,457 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 24,340 kWh | 642 kWh | 24,983 kWh | |
| Case study | 1. Comparison Base (No insulation) | 24,340 kWh | 642 kWh | 24,983 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 20,462 kWh | 252 kWh | 20,714 kWh | -17.1% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 21,167 kWh | 323 kWh | 21,490 kWh | -14.0% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 23,260 kWh | 534 kWh | 23,794 kWh | -4.8% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 19,808 kWh | 584 kWh | 20,392 kWh | -18.4% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 15,554 kWh | 156 kWh | 15,711 kWh | -37.1% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 21,410 kWh | 565 kWh | 21,975 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 13,682 kWh | 137 kWh | 13,819 kWh | -44.7% |

Source: Prepared by JICA survey Team

(8) Cultural

Estimation of annual power consumption and EE&C potential on cultural in Islamabad, Lahore and Karachi is shown in Table 2.6-31, -32, -33 respectively.

Table2.6-31 Estimation of annual power consumption and EE&C potential on cultural in Islamabad

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 45,842 kWh | 13,101 kWh | 58,944 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 18,337 kWh | 5,240 kWh | 23,577 kWh | |
| Case study | 1. Comparison Base (No insulation) | 18,337 kWh | 5,240 kWh | 23,577 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 17,224 kWh | 3,174 kWh | 20,398 kWh | -13.5% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 17,426 kWh | 3,550 kWh | 20,976 kWh | -11.0% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 17,467 kWh | 3,627 kWh | 21,095 kWh | -10.5% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 14,807 kWh | 4,621 kWh | 19,428 kWh | -17.6% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 13,027 kWh | 1,317 kWh | 14,344 kWh | -39.2% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 16,130 kWh | 4,610 kWh | 20,739 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 11,459 kWh | 1,159 kWh | 12,617 kWh | -46.5% |

Source: Prepared by JICA survey Team

Table2.6-32 Estimation of annual power consumption and EE&C potential on cultural in Lahore

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 59,146 kWh | 9,711 kWh | 68,856 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 23,658 kWh | 3,884 kWh | 27,543 kWh | |
| Case study | 1. Comparison Base (No insulation) | 23,658 kWh | 3,884 kWh | 27,543 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 21,153 kWh | 2,316 kWh | 23,469 kWh | -14.8% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 21,609 kWh | 2,601 kWh | 24,210 kWh | -12.1% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 21,702 kWh | 2,660 kWh | 24,362 kWh | -11.5% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 19,460 kWh | 3,507 kWh | 22,967 kWh | -16.6% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 15,454 kWh | 1,000 kWh | 16,453 kWh | -40.3% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 20,811 kWh | 3,417 kWh | 24,227 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 13,593 kWh | 879 kWh | 14,473 kWh | -47.5% |

Source: Prepared by JICA survey Team

Table2.6-33 Estimation of annual power consumption and EE&C on cultural in Karachi

| | | In summer | In winter | Total | Ratio of reduction |
|---|---|---|---|---|---|
| Annual AC Load (in kilo Watt hour) | | 51,707 kWh | 1,301 kWh | 53,008 kWh | |
| Annual Power consumption on AC (in kilo Watt hour) | | 20,683 kWh | 520 kWh | 21,203 kWh | |
| Case study | 1. Comparison Base (No insulation) | 20,683 kWh | 520 kWh | 21,203 kWh | Basis case |
| | 2. Without roof exposure (No insulation) | 18,744 kWh | 325 kWh | 19,069 kWh | -10.1% |
| | 3. Insulatiion Roof (Comp. with BCP-EP-2011) | 19,096 kWh | 361 kWh | 19,457 kWh | -8.2% |
| | 4. Insulatiion Wall (Comp. with BCP-EP-2011) | 18,802 kWh | 331 kWh | 19,133 kWh | -9.8% |
| | 5. Improvement of window (Comp. with BCP-EP-2011) | 17,020 kWh | 473 kWh | 17,493 kWh | -17.5% |
| | 6. Insulatiion R,W,Win (Comp. with BCP-EP-2011) | 13,553 kWh | 124 kWh | 13,677 kWh | -35.5% |
| | 7. Exchange of AC (Comp. with BCP-EP-2011) | 18,193 kWh | 458 kWh | 18,651 kWh | -12.0% |
| | 8. Full compliance with BCP-EP-2011 | 11,922 kWh | 109 kWh | 12,031 kWh | -43.3% |

Source: Prepared by JICA survey Team

### 2.6.4 Analysis of model building estimation

Summary of building conditions for each model building are shown in Table 2.6-34 and comparison of power consumption between Non- insulated base and full improved option, improved roof, wall, window and air conditioner, are shown in Table 2.6-35.

Table 2.6-34 Summary of building conditions for model buildings

| | Floor Area ($m^2$) | Number of storey | window ratio | Wall Area ($m^2$) | Window Area ($m^2$) | Roof Area ($m^2$) | Roof/ Floor Ratio | Envelope Surface Area ($m^2$) | Surface / Floor Ratio | Annual Operation day (day) | Operation hour/day (hour) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Hotel | 2000 | 2 | 20% | 520 | 130 | 1000 | 0.5 | 1650 | 0.83 | 365 | 24 |
| Hospital | 6000 | 4 | 20% | 1270 | 320 | 1500 | 0.25 | 3090 | 0.52 | 365 | 24 |
| Retail | 1000 | 2 | 20% | 370 | 90 | 500 | 0.5 | 960 | 0.96 | 353 | 10.5 |
| Office | 1000 | 2 | 50% | 230 | 230 | 500 | 0.5 | 960 | 0.96 | 228 | 8 |
| Residential | 200 | 2 | 20% | 160 | 40 | 100 | 0.5 | 300 | 1.50 | 365 | 12 |
| Education | 1000 | 2 | 20% | 370 | 90 | 500 | 0.5 | 960 | 0.96 | 228 | 8 |
| Restaurant | 700 | 1 | 35% | 177 | 95 | 700 | 1 | 972 | 1.39 | 353 | 8 |
| Cultural | 700 | 2 | 20% | 310 | 80 | 350 | 0.5 | 740 | 1.06 | 353 | 8 |

Source: Prepared by JICA survey Team

Table 2.6-35 Comparison of Power consumption (Islamabad)

| | Comparison Base (No insulation) | | Improved option (BCP-EP-2011 criteria to roof, wall, window and air conditioner) | | Reduction Ratio |
|---|---|---|---|---|---|
| | Annual Total Power consumption (kWh) | Consumption / floor (kWh/$m^2$) | Annual Total Power Consumption (kWh) | Consumption / floor (kWh/$m^2$) | |
| Hotel | 153,013 | 76.5 | 84,587 | 42.3 | -44.7% |
| Hospital | 373,476 | 62.2 | 225,288 | 37.5 | -39.7% |
| Retail | 39,263 | 39.3 | 21,354 | 21.4 | -45.6% |
| Office | 32,651 | 32.7 | 14,785 | 14.8 | -54.7% |
| Residential | 16,151 | 80.8 | 8,498 | 42.5 | -47.4% |
| Education | 19,647 | 19.6 | 10,624 | 10.6 | -45.9% |
| Restaurant | 28,078 | 40.1 | 14,555 | 20.8 | -48.2% |
| Cultural | 23,577 | 33.7 | 12,617 | 18.0 | -46.5% |

Source: Prepared by JICA survey Team

Compare to non-insulated building, BCP-EP-2011 compliance option could save 40-55% power consumption for air conditioner. Furthermore, building conditions such as shape, floor area, number of storey, window area, operation day and hours are applied to each model building with consideration of effective combination in order to compare the influence to the power consumption for respective factor. Following notes are key findings from this analysis.

- ✧ Both Hotel and Hospital have large power consumption per floor area value due to the 24H operation without any closure. The difference of condition of this two model are Building floor area and shape only. As a result, power consumption for Hotel is 23% greater in no insulation base which is occurred by the difference of envelope surface area. In improved option, this difference is reduced to 13%. As a nature of building design, hotel building will have more envelope surface are due to the guestroom requirement, while hospital has many space that does not require natural light.

- ✧ In Retail and Education models, building conditions are exactly same except for its operation days and hours. While Education model has two closed day weekly with 8 hours per day operation, Retail model has one closed day monthly with 10.5 hours per day operation. This makes Retail model consumption as twice of consumption of Education model.

- ✧ In Office and Education model, all building conditions except for window ratio is the same. Window ratio is 50% in Office and 20% in Education. As a result, power consumption of Office model is 66% greater than Education model. The improved option shows this gap reduced to 40%. However, this results indicates that air conditioner load increased significantly by large glass surface.

- ✧ Residential power consumption per floor area indicates the biggest value, despite of a half of operation hours compare to Hotel and Hospital model. It is noteworthy that envelope surface area ratio increased in smaller scale building which has negative impact to air conditioner load

- ✧ In Restaurant and Cultural model, total floor area and operation hours are same but different number of storey and window size. The power consumption in Restaurant model is 22% greater than Cultural model. The single story building has more envelope surface compare to multi-story building and therefore air condition load increases. Conversely, the insulation on roof will improve thermal performance significantly. The cost for roof insulation is cheaper than improvement of other factor and it is relatively easy to apply to existing buildings.

- ✧ The power consumption comparison between 3 cities resulted that Lahore is the most power consuming climate. Islamabad as a base, consumption in Lahore is 3-6% more and the same in Karachi is 8-10% less in no insulation base. In improvement option, consumption in Lahore is 1-2% more and the same in Karachi is 4-6%.

# Chapter 3 Building Regulation in Pakistan

# Chapter 3 Building Regulation in Pakistan

## 3.1 Building Code of Pakistan Energy provision 2011

### 3.1.1 Scope of Building

The Building Code of Pakistan (Energy Provision - 2011) (hereinafter referred to as BCP-EP-2011) specifies the scope defined from the aspect of building scale and building construction type, applicable systems, exemption condition and order of priority in case of conflict with any other provisions.

(1) Scope defined from the aspect of building scale
According to section 2.1 of BCP-EP-2011, the scope of building scale is buildings and building cluster with:

1) A total connected load of 100kW or more,
2) A contract demand of 125 kVA or more,
3) A conditioned area of 900 $m^2$ or more,
4) Unconditioned buildings with covered areas of 1,200$m^2$ or more.

(2) Scope defined from the aspect of building construction type
According to section 2.1 of BCP-EP-2011, the scope of the building construction period is based on the design and construction of:

1) New buildings and their systems,
2) New portions of existing buildings and their systems, if the conditioned area or connected load exceeds the details prescribed above,
3) New systems and equipment in existing buildings and
4) Increase in the electricity load beyond the limit mentioned above.

(3) Applicable systems
According to section 2.2 of BCP-EP-2011, the scope of building parts and facilities is:

1) Building envelopes,
2) Building mechanical systems and equipment, including heating, ventilation and air-conditioning (HVAC),
3) Service water heating,
4) Lighting and
5) Electrical power and motors.

(4) Exemptions

According to section 2.3 of BCP-EP-2011, the following buildings are exempt from the scope of buildings:

1) Buildings that do not use either electricity or fossil fuel,
2) Government-notified historically significant and heritage buildings,
3) Equipment and portions of building systems that use energy only for manufacturing processes.

(5) The order of priority in case of conflict with any other provisions

According to section 2.4 of BCP-EP-2011, in case of any conflict, the relevant Provisions of Safety, Health, or Environmental Codes shall prevail.

### 3.1.2 Target Building Parts and Facilities

Target building parts and facilities of BCP-EP-2011 are such four categorized facilities, Building envelopes, Building mechanical systems and equipment, including heating, ventilation and air-conditioning (HVAC), Lighting and Electrical power and motors as mentioned in section 2.2 of BCP-EP-2011. The criteria of building parts and facilities are defined in sections 4 to 8 respectively.

(1) Building envelope

According to section 4 of BCP-EP-2011, the building envelope shall be designed conforming to criteria in three categorized aspects, i.e. external walls and roofs, glass and framing system, air leaks and infiltration.

All building envelope criteria are mandatory.

1) External walls and roofs

Criteria of the overall U value of external walls and roofs are shown in Table 3.1-1. External walls and roofs shall not exceed the limits specified in Table 3.1-1.

Table 3.1- 1 Criteria of Overall U Value [1]of External Walls and Roofs (Unit: inside table)

| | |
|---|---|
| Wall | U: 0.57 W/m$^2$/K (0.100 Btu/h/ft$^2$/F) |
| Roof | U: 0.44 W/m$^2$/K (0.078 Btu/h/ft$^2$/F) |

Source: Building Code of Pakistan (Energy Provision - 2011)

[1] The U value is an indicator of heat conductivity and shows the amount of heat lost in watts (W) per square meter of material (for example wall, roof, floor etc.) when the temperature (k) outside is at least one degree lower. The lower the U-value, the more effective the material is as a heat insulator.

JST finds some issues on this provision. Initially, it is not user-friendly, because the provision merely shows criteria without the certified material type, thickness and calculation method. Secondly, the provision indicates the unification value for the whole of Pakistan, whereas elsewhere, several benchmarks are given based on the climatic character and building usage. The same applies to criteria for Glass and Framing Systems below.

2) Glass and framing system

Criteria for the U value and shading coefficient of external glass are shown in Table 3.1-2. External glass shall not exceed the limits specified in Table 3.1-2.

Table 3.1- 2 Criteria of U Value and Shading Coefficient of External Glass (Unit: inside table)

| | |
|---|---|
| In case that external glass area accounts for 40% or less of the external wall area | U: 3.5 $W/m^2/K$ (0.44 $Btu/h/ft^2/F$)<br>Shading coefficient: 0.76 |
| In case the external glass area accounts for 40% or more of the external wall area | U: 2.5 $W/m^2/K$ (0.37 $Btu/h/ft^2/F$)<br>Shading coefficient: 0.35 |

Source: Building Code of Pakistan (Energy Provision - 2011)

3) Air leak and infiltration

Criteria for the allowable air leak volume are shown in Table 3.1-3. Installed doors and windows shall not exceed the limits specified in Table 3.1-3.

The building envelope shall be durably sealed, caulked, gasketed, or weather-stripped to minimize air leakages whenever likely to occur.

Vestibules, lounges and entrances shall be provided to minimize infiltration through revolving, sliding and swinging doors.

Table 3.1- 3 Criteria of Allowable Air Leak Volume (Unit: inside table)

| | |
|---|---|
| On revolving, sliding, swinging entrance and exit doors | 5.0 $L/sec/m^2$ (1.0 $cfm/ft^2$) |
| On windows, doors | 2.0 $L/sec/m^2$ (0.4 $cfm/ft^2$) |

Source: Building Code of Pakistan (Energy Provision - 2011)

(2) Heating, Ventilation and Air-conditioning

According to section 5 of BCP-EP-2011, appliances and systems for such facilities, i.e. heating, ventilation and air-conditioning shall be designed to conform to requirements and criteria.

Most of the requirements and criteria for heating, ventilation and air-conditioning are mandatory, but some are voluntary.

1) Common requirements (mandatory)

Common requirements for cooling and heating systems (mandatory) are shown in Table 3.1-4.

Table 3.1- 4 Common Requirements for Cooling and Heating Systems (mandatory)

| | |
|---|---|
| Introduction of schedule control (5.2.1.1) | All mechanical cooling and heating systems shall be controlled by a building management system or a time clock that;<br>a) Can start and stop the system under different schedules for three different day types per week.<br>b) Is capable of retaining programming and time setting during a loss of power for a period of at least 10 hours, and<br>c) Includes an accessible manual override that allows temporary operation of the system for up to 2 hours. |
| Introduction of temperature control (5.2.1.2 and 5.2.1.3) | All heating and cooling equipment shall be temperature controlled.<br>Temperature to be maintained as follows;<br>Summer season: not less than 25 degree C<br>Winter season: not more than 22 degree C<br>In the both case of unit system and separate system, temperature control shall provide dead band. |
| Introduction of mechanical ventilation to reduce air condition load (5.2.1.4) | Each mechanical ventilation system shall be equipped with a readily accessible switch or other means for shut off or for volume reduction or shut of when full ventilation is not required.<br>Automatic or gravity dumpers that close when the system is not operating shall be provided for outdoor air intake and exhausts. Automatic or manual dampers installed for the purpose of shutting off ventilation systems shall be designed with tight shutoff characteristics to minimize air leakage. |
| In case that cooling tower installed (5.2.1.6) | All cooling towers and closed circuit fluid coolers shall have preferably variable drives either two speed motors / pony motors, controlling the fans. |
| Piping and ductwork (5.2.2) | Piping and ductwork shall be insulated in accordance with Table 3.1-5 and 3.1-6 respectively. |
| Air system balancing (5.2.3.2) | Air systems shall be balanced in a manner to first minimize throttling losses. Then, for fans with fan system power greater than 1.0 hp (0.75kW), fan speed shall be adjusted to meet design flow conditions. |
| Hydronic system balancing (5.2.3.3) | Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses; then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. |

Source: Building Code of Pakistan (Energy Provision - 2011)

Table 3.1- 5 Minimum Pipe Insulation Thickness (mandatory)

| Fluid design operation temp. Range (degree F) | Insulation conductivity | | Nominal Pipe or Tube size (Inch) | | | | |
|---|---|---|---|---|---|---|---|
| | Conductivity Btu. Inch (h ft2 degree F) | Mean rating temp (Degree F) | <1 | 1 to 1-1/2 | 1-1/2 to 4 | 4 to 8 | Above 8 |
| Heating Systems (Steam, Steam condensate, and Hot water) | | | | | | | |
| > 350 | 0.32 - 0.34 | 250 | 2.5 | 3.0 | 3.0 | 4.0 | 4.0 |
| 251 - 350 | 0.29 - 0.32 | 200 | 1.5 | 2.5 | 3.0 | 3.0 | 3.0 |
| 201 - 250 | 0.27 - 0.30 | 150 | 1.5 | 1.5 | 2.0 | 2.0 | 2.0 |
| 141 - 200 | 0.25 - 0.29 | 125 | 1.0 | 1.0 | 1.0 | 1.5 | 1.5 |
| 105 - 140 | 0.22 - 0.28 | 100 | 0.5 | 0.5 | 1.0 | 1.0 | 1.0 |
| Domestic and Service Hot Water System | | | | | | | |
| 105+ | 0.22 - 0.28 | 100 | 0.5 | 0.5 | 1.0 | 1.0 | 1.0 |
| Cooling systems (Chilled water, brine, and refrigerant) | | | | | | | |
| 40 – 46 | 0.22 - 0.28 | 100 | 0.5 | 0.5 | 1.0 | 1.0 | 1.0 |
| <40 | 0.22 - 0.28 | 100 | 0.5 | 1.0 | 1.0 | 1.0 | 1.5 |

Source: Building Code of Pakistan (Energy Provision - 2011)

Table 3.1- 6 Minimum Duct Insulation R-value (mandatory)

| Duct Location | Supply duct | Return duct |
|---|---|---|
| Exterior | R-6 | R-3.5 |
| Ventilated attic | R-6 | R-3.5 |
| Un-vented attic above insulated ceiling | R-8 | R-3.5 |
| Un-vented attic with roof insulation | R-3.5 | None |
| Un-conditioned space | R-3.5 | None |
| Indirectly conditioned space | None | None |
| Buried | R-3.5 | None |

Source: Building Code of Pakistan (Energy Provision - 2011)

2) Air-conditioners (Recommended Guidelines)

Equipment for air-conditioning shall meet or exceed the minimum energy efficiencies specified in section 5.3.1 of BCP-EP-2011.

Minimum energy efficiencies for air-conditioners and condensing units are shown in Table 3.1-7.

Minimum Energy Efficiencies for Electrically Operated Unitary and Applied Heat Pumps are shown in Table 3.1-8.

Minimum Energy Efficiencies for water chilling packages are shown in Table 3.1-9.

Minimum Energy Efficiencies for Room Air-Conditioners in Table 3.1-10.

Unlike the provision of an envelope, air-conditioning appliances are defined by specifying a standard and the test procedure is also clearly clarified with a reference from the Air-condition and Refrigeration Institute (ARI). However, these are still recommended guidelines and not yet mandatory.

Table 3.1- 7 Minimum Energy Efficiencies for Air-conditioners and Condensing Units (Recommended Guidelines)

| Equipment type | Size Category | Heating Section type | Sub-Category or Rating Condition | Minimum Efficiency | Test Procedure |
|---|---|---|---|---|---|
| Through-the-Wall, Air Cooled | < 30,000 Btu/h | All | Split systems And Single package | 12.0 SEER | ARI 210/240 |
| Small-duct High-Velocity, Air Cooled | < 65,000 Btu/h | All | Split systems | 10.0 SEER | Ditto |
| Air-conditioners, Air Cooled | < 65,000 Btu/h | All | Split systems And Single package | 12.0 SEER | Ditto |
| | More than 65,000 Btu/h to 135,000 Btu/h | Electric resistance | Ditto | 10.3 EER | ARI 340/360 |
| | | All other | Ditto | 10.1 EER | Ditto |
| | More than 135,000 Btu/h to 240,000 Btu/h | Electric resistance | Ditto | 9.7 EER | Ditto |
| | | All other | Ditto | 9.5 EER | Ditto |
| | More than 240,000 Btu/h to 760,000 Btu/h | Electric resistance | Ditto | 9.5 EER 9.7 IPLV | Ditto |
| | | All other | Ditto | 9.3 EER 9.5 IPLV | Ditto |
| | More than 760,000 Btu/h | Electric resistance | Ditto | 9.2 EER 9.4 IPLV | Ditto |
| | | All other | Ditto | 9.0 EER 9.2 IPLV | Ditto |
| Air-conditioners, Water and Evaporatively Cooled | < 65,000 Btu/h | All | Split systems And Single package | 12.1 EER | ARI 210/240 |
| | More than 65,000 Btu/h to 135,000 Btu/h | Electric resistance | Ditto | 11.5 EER | ARI 340/360 |
| | | All other | Ditto | 11.3 EER | Ditto |
| | More than 135,000 Btu/h to 240,000 Btu/h | Electric resistance | Ditto | 11.0 EER | Ditto |
| | | All other | Ditto | 10.8 EER | Ditto |
| | More than 240,000 Btu/h | Electric resistance | Ditto | 11.0 EER 10.3 IPLV | Ditto |
| | | All other | Ditto | 10.8 EER 10.1 IPLV | Ditto |
| Condensing Units, Air Cooled | More than 135,000 Btu/h | - | - | 10.1 EER 11.2 IPLV | ARI 365 |
| Condensing Units, Water and Evaporatively Cooled | More than 135,000 Btu/h | - | - | 13.1 EER 13.1 IPLV | ARI 365 |

PLVs and part load rating conditions are only applicable to equipment with capacity modulation.
ASHRAE 90.1-2004 contains a complete specification of the references test procedure, including the references year version of the test procedure.
Single-phase, air-cooled air-conditioners < 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.
Source: Building Code of Pakistan (Energy Provision - 2011)

Table 3.1- 8 Minimum Energy Efficiencies for Electrically Operated Unitary and Applied Heat Pumps (Recommended Guidelines)

| Equipment type | Size Category | Heating Section type | Sub-Category or Rating Condition | Minimum Efficiency | Test Procedure |
|---|---|---|---|---|---|
| Through-the-Wall, Air Cooled, Cooling mode | < 30,000 Btu/h | All | Split systems And Single package | 12.0 SEER | - |
| Small-duct High-Velocity, Air Cooled, Cooling mode | < 65,000 Btu/h | All | Split systems | 10.0 SEER | - |
| Air Cooled (Cooling mode) | < 65,000 Btu/h | All | Split systems And Single package | 12.0 SEER | ARI 210/240 |
| | More than 65,000 Btu/h to 135,000 Btu/h | Electric resistance | Ditto | 10.1 EER | ARI 340/360 |
| | | All other | Ditto | 9.9 EER | Ditto |
| | More than 135,000 Btu/h to 240,000 Btu/h | Electric resistance | Ditto | 9.3 EER | Ditto |
| | | All other | Ditto | 9.1 EER | Ditto |
| | More than 240,000 Btu/h | Electric resistance | Ditto | 9.0 EER 9.2 IPLV | Ditto |
| | | All other | Ditto | 8.8 EER 9.0 IPLV | Ditto |
| Water source (Cooling mode) | < 17,000 Btu/h | All | 86 Deg. F Entering Water | 11.2 EER | ISO 13256-1 |
| | More than 17,000 Btu/h to 65,000 Btu/h | All | 86 Deg. F Entering Water | 12.0 EER | Ditto |
| | More than 65,000 Btu/h to 135,000 Btu/h | All | 86 Deg. F Entering Water | 12.0 EER | Ditto |
| Through-the-Wall, Air Cooled, Heating mode | < 30,000 Btu/h | - | Split systems And Single package | 7.4 HSPF | - |
| Small-duct High-Velocity, Air Cooled, Healing mode | < 65,000 Btu/h | - | Split systems | 6.8 HSPF | ARI 210/240 |
| Air Cooled (Heating mode) | < 65,000 Btu/h | - | Split systems And Single package | 7.4 HSPF | ARI 210/240 |
| | More than 65,000 Btu/h to 135,000 Btu/h | - | 47 Deg. F db / 43 Deg. F wb Outdoor air | 3.2 COP | ARI 340/360 |
| | | - | 17 Deg. F db / 15 Deg. F wb Outdoor air | 2.2 COP | Ditto |
| | More than 135,000 Btu/h | - | 47 Deg. F db / 43 Deg. F wb Outdoor air | 3.1 COP | Ditto |
| | | - | 17 Deg. F db / 15 Deg. F wb Outdoor air | 2.0 COP | Ditto |
| Water source (Heating mode) | More than 135,000 Btu/h | - | 68 Deg. F Entering Water | 4.2 COP | ISO 13256-1 |

PLVs and part load rating conditions are only applicable to equipment with capacity modulation.
ASHRAE 90.1-2004 contains a complete specification of the references test procedure, including the references year version of the test procedure.
Single-phase, air-cooled heat pumps < 65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.
Source: Building Code of Pakistan (Energy Provision - 2011)

Table 3.1- 9 Minimum Energy Efficiencies for Water Chilling Package (Recommended Guidelines)

| Equipment type | Size Category | Minimum Efficiency | Test Procedure |
|---|---|---|---|
| Air Cooled | All Capacities | 2.80 COP / 3.05 IPLV | ARI 550/590 |
| Water cooled, Electrically Operated, Reciprocating | All Capacities | 2.80 COP / 3.05 IPLV | ARI 550/590 |
| Water cooled, Electrically Operated, Rotary Screw and Scroll | < 150 RT | 4.45 COP / 5.20 IPLV | ARI 550/590 |
| | More than 150RT to 300 RT | 4.90 COP / 5.60 IPLV | Ditto |
| | More than 300RT | 5.50 COP / 6.15 IPLV | Ditto |
| Water cooled, Electrically Operated, Centrifugal | < 150 RT | 5.00 COP / 5.25 IPLV | ARI 550/590 |
| | More than 150RT to 300 RT | 5.55 COP / 5.90 IPLV | Ditto |
| | More than 300RT | 6.10 COP / 6.40 IPLV | Ditto |
| Water cooled, Absorption, Single Effect | All Capacities | 0.7 COP | ARI 550/590 |
| Water cooled, Absorption, Double Effect, Indirect-Fired | All Capacities | 1.00 COP / 1.05 IPLV | Ditto |
| Water cooled, Absorption, Double Effect, Direct-Fired | All Capacities | 1.00 COP / 1.00 IPLV | Ditto |

The chiller equipment requirements do not apply for chillers used in low-temperature applications where the design leaving fluid temperature is < 40 F degree.
ASHRAE 90.1-2004 contains a complete specification of the references test procedure, including the references year version of the test procedure.
Source: Building Code of Pakistan (Energy Provision - 2011)

Table 3.1- 10 Minimum Energy Efficiencies for Room Air-conditioner (Recommended Guidelines)

| Equipment type | Size Category | Minimum Efficiency | Test Procedure |
|---|---|---|---|
| With Louvered Sides | < 6,000 Btu/h | 9.7 EER | ANSV, AHAM, RAC-1 |
| | More than 6,000 Btu/h to 8,000 Btu/h | 9.7 EER | |
| | More than 8,000 Btu/h to 14,000 Btu/h | 9.8 EER | |
| | More than 14,000 Btu/h to 20,000 Btu/h | 9.7 EER | |
| | More than 20,000 Btu/h | 8.5 EER | |
| Without Louvered Sides | < 8,000 Btu/h | 9.0 EER | |
| | More than 8,000 Btu/h to 20,000 Btu/h | 8.5 EER | |
| | More than 20,000 Btu/h | 8.5 EER | |
| Heat pump type with Louvered Sides | < 20,000 Btu/h | 9.0 EER | |
| | More than 20,000 Btu/h | 8.5 EER | |
| Heat pump type without Louvered Sides | < 14,000 Btu/h | 8.5 EER | |
| | More than 14,000 Btu/h | 8.0 EER | |

ASHRAE 90.1-2004 contains a complete specification of the references test procedure, including the references year version of the test procedure.
Replacement units must be factory labeled as follows: “MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALE IN NEW CONSTRUCTION PROJECTS”, replacement efficiencies apply only to units with existing sleeves less than 16 in. high and less than 42 in. wide.
Cap means the rated cooling capacity of the project in Btu/h. If the unit’s capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit’s capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.
Source: Building Code of Pakistan (Energy Provision - 2011)

(3) Lighting

According to section 7 of BCP-EP-2011, lighting systems shall be designed to conform to the relevant requirements and criteria. Most requirements and criteria for lighting are mandatory, but some sections are merely voluntary.

1) Common requirement (mandatory)

Common requirements and criteria for lighting systems (mandatory) are shown in Table 3.1-11.

2) Interior Lighting Power (mandatory)

Interior Lighting Power Densities which involve controlling the lighting power allowance by wattage per square footage are specified as mandatory. Either a) the Building Area Method shown in Table 3.1-12 or b) Space by Space Method, must be chosen for compliance.

3) Exterior Lighting Power (mandatory)

Exterior Lighting Power Densities by area type (mandatory) are shown in Table 3.1-13.
Beside the interior lighting power allowance by building type, BCP-EP-2011 has lighting power criteria by space usage.

Table 3.1- 11 Common Requirements and Criteria for Lighting Systems (mandatory)

| | |
|---|---|
| Introduction of interior lighting control (7.2.1.1) | Each space enclosed by ceiling – height partitions shall have at least one control device to independently control the general lighting within the space. The device can be a switch which is activated either manually or automatically by sensing an occupant sensor. Each control device regardless of type shall have the following functions;<br>a) control a maximum of 250 $m^2$ (2,500$ft^2$) for space less than or equal to 1,000 $m^2$ (10,000$ft^2$) and maximum of 1,000 $m^2$ (10,000$ft^2$) for a space greater than 1,000 $m^2$ (10,000$ft^2$).<br>b) be capable of overriding the required shut off control for no more than two hours.<br>c) be readily accessible and located so that occupant can see the control. |
| Introduction of exterior lighting control (7.2.1.2) | Lighting for all exterior applications, so that is not exempted in section 7.3 of BCP-EP-2011, shall be controlled by photo sensor or astronomical time switch. Such system is capable of automatically turning off the exterior lighting when day light is available or the lighting is not required. |
| Introduction of other kind of lighting control (7.2.1.3) | The following specialty lighting spaces shall be equipped with a control device that separates lighting control from that of general lighting. ;<br>a) Display / Accent Lighting: Display / Accent lighting greater than 300 $m^2$ (3,000$ft^2$) shall have separate control device.<br>b) Case Lighting: lighting in cases used for display purposes greater than 30 $m^2$ (300$ft^2$) area shall be equipped with a separate control device.<br>c) Hotel and Motel Guest Room Lighting: Hotel and motel guest rooms shall have a master control device at the main room entry the controls all permanently installed luminaries and switched receptacles.<br>d) Task Lighting: Supplemental task lighting including permanently installed under shelf or under cabinet lighting shall have control device integral to the luminaries or be controlled by a wall mounted control device provided the control device complies with section 7.2.1.1 of BCP-EP-2011.<br>e) Non – Visual Lighting: Lighting for non – visual applications such as plant growth and food warming shall be equipped with space control device. |
| Criteria for exit sign (7.2.2) | Internally – illuminated exit signs shall not exceed 5 W per face. |
| Criteria for exterior building grounds lighting (7.2.3) | All exterior building grounds luminaries that operate at greater than 100 W shall contain lamps having a minimum efficacy of 60 lm / W unless the luminaries is controlled by a motion sensor. |
| Criteria for Landscape lighting (7.2.4) | Lighting for landscaping shall have a minimum efficacy of 60 lm / W and shall be controlled. |
| Criteria for interior lighting (7.3.1) | Determination of interior lighting power allowance by building type shall be calculated Table 3.1-12 according to Table 7.3.1 of BCP-EP-2011. Beside interior lighting power allowance by building type, BCP-EP-2011 has lighting power criteria by space usage, but it includes inconsistency. |
| Criteria for exterior lighting (7.4) | Determination of exterior lighting power allowance by area type shall be calculated Table 3.1-13 according to Table 7.4 of BCP-EP-2011. |

Source: Building Code of Pakistan (Energy Provision - 2011)

Table 3.1- 12 Interior Lighting Power Densities by Building Type (mandatory)

| Space type | LPD ($W/ft^2$) | Space type | LPD ($W/ft^2$) | Space type | LPD ($W/ft^2$) |
|---|---|---|---|---|---|
| Automotive Facilities | 0.9 | Multifamily | 0.7 | Hotel | 1.0 |
| Convention Centre | 1.2 | Museum | 1.1 | Library | 1.3 |
| Court House | 1.2 | Office | 1.0 | Post Office | 1.1 |
| Dining: Bar Lounge / Leisure | 1.3 | Parking Garage | 0.3 | Motel | 1.0 |
| Dining: Cafeteria / Fast Food | 1.4 | Penitentiary | 1.0 | Retail | 1.5 |
| Dining: Family | 1.6 | Performing Arts Theatre | 1.6 | Sports Area | 1.1 |
| Dormitory | 1.0 | Police / Fire Station | 1.0 | Town Hall | 1.1 |
| Exercise Centre | 1.0 | Manufacturing Facility | 1.3 | Transportation | 1.0 |
| Gymnasium | 1.1 | Religious Building | 1.3 | Warehouse | 0.8 |
| Healthcare-clinic | 1.0 | Motion Picture Theatre | 1.2 | Workshop | 1.4 |
| Hospital/Health care | 1.2 | School/University | 1.2 | | |

Source: Building Code of Pakistan (Energy Provision - 2011)

Table 3.1- 13 Exterior Lighting Power Densities by Area Type (mandatory)

| Area type | LPD |
|---|---|
| Building Entrance (with canopy) | 1.3 $W/ft^2$ (13 $W/m^2$) of canopy area |
| Building Entrance (without canopy) | 30 W/lin ft (90 W/lin m) of door width |
| Building exit | 20 W/lin ft (60 W/lin m) of door width |
| Building facades | 0.2 $W/ft^2$ (2 $W/m^2$) of each illuminated wall or surface |
| Uncovered parking area | 0.15 $W/ft^2$ (1.5 $W/m^2$) |
| Walkways less than 10 ft wide | 1.0 W/ lin ft (3 W/ lin m) |
| Walkways 10 ft wide or greater | 0.2 W/ lin ft (0.63 W/ lin m) |

Source: Building Code of Pakistan (Energy Provision - 2011)

(4) Electrical power and motors

According to section 8 of BCP-EP-2011, electrical power and motors shall be designed to conform to requirements and criteria.

All requirements and criteria for electrical power and motors are mandatory.

1) Transformer (mandatory)

The maximum allowable power losses of transformer (mandatory) are shown in Table 3.1-14.

The minimum acceptable motor efficiencies (mandatory) are shown in Table 3.1-15.

JST finds this provision problematic. The Minimum Energy Performance Standard in Pakistan (MEPS) does not meet BCP-EP-2011 standards. Even a three-star-rated motor, namely categorized in the most efficient group, does not meet the criteria of BCP-EP-2011. For example, in BCP-EP-2011, although the minimum acceptable motor efficiency for 1.1 kW of a two-pole motor capacity is defined at 82.2%, in MEPS, efficiency for a 1.1 kW two-pole motor with a three-star rating is 78.6%. So, even if construction companies purchase a three-star-rated motor, they cannot comply with BCP-EP-2011.

Table 3.1- 14 Maximum Allowable Power Losses of Transformer (mandatory)

| Transformer Capacity (kVA) | Maximum allowable losses at full load in % rating |
|---|---|
| 100 | 2.5 |
| 160 | 2.3 |
| 250 | 2.1 |
| 400 | 1.5 |
| 630 | 1.4 |
| 800 | 1.4 |
| 1,000 | 1.2 |

Source: Building Code of Pakistan (Energy Provision - 2011)

Table 3.1- 15 Minimum Acceptable Motor Efficiencies (mandatory)

| Motor Capacity (kVA) | Efficiency (%) | |
|---|---|---|
| | 2 pole | 4 pole |
| 1.1 (1.5HP) | 82.2 | 83.8 |
| 1.5 (2HP) | 84.1 | 85 |
| 2.2 (3HP) | 85.6 | 86.4 |
| 3.0 (4HP) | 86.7 | 87.4 |
| 4.0 (5.5HP) | 87.6 | 88.3 |
| 5.5 (7.5HP) | 88.5 | 89.2 |
| 7.5 (10HP) | 89.5 | 90.1 |
| 11.0 (15HP) | 90.6 | 91 |
| 15.0 (20HP) | 91.3 | 91.8 |
| 18.5 (25HP) | 91.8 | 92.2 |
| 22.0 (30HP) | 92.2 | 92.6 |
| 30.0 (40HP) | 92.9 | 93.2 |
| 37.0 (50HP) | 93.3 | 93.6 |
| 45.0 (60HP) | 93.7 | 93.9 |
| 55.0 (75HP) | 94 | 94.2 |
| 75.0 (100HP) | 94.6 | 94.7 |

Source: Building Code of Pakistan (Energy Provision - 2011)

### 3.1.3 Penalty

No penalty prescription is included in BCP-EP-2011.

According to S.R.O. 249 (I)/2013, constructions and retrofitting of buildings or building clusters breaching BCP-EP-2011 shall be deemed violations of Professional Engineering Work as specified under clause (xxv) 2 of the Pakistan Engineering Council Act, 1975 (PEC Act). PEC Act includes a prescription for penalties and procedures at section 27, but no indication of any violation of Professional Engineering Work.

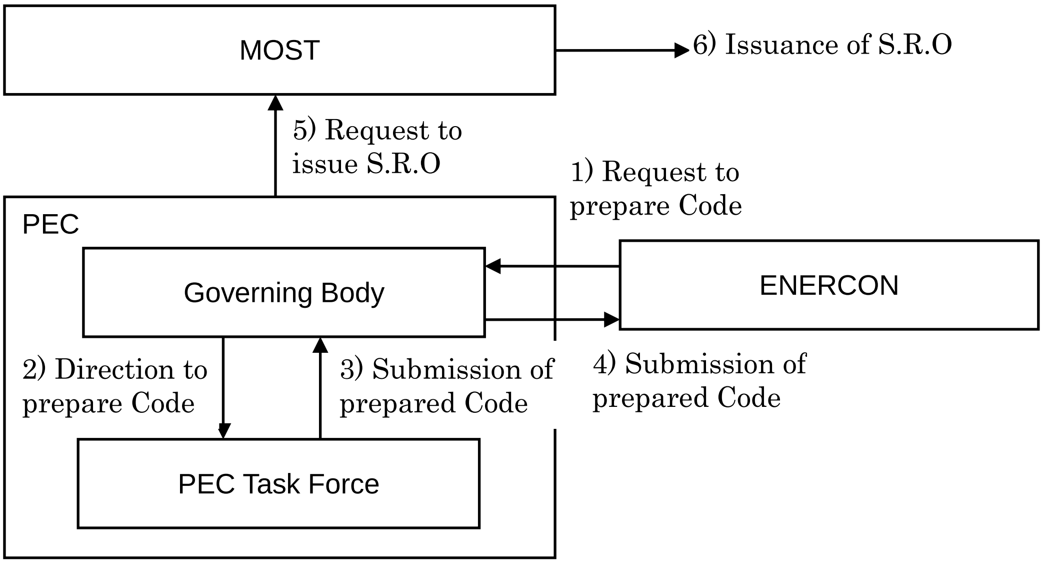
In summary, the applicable penalties for respective stakeholders are described below:

a) Consulting Engineer: Registration may be suspended or removed under PEC byelaw (Conduct and Practice of Consulting Engineers) 1986 / 8 Registration and Penalty (3).
b) Construction Company: Same as above under PEC byelaw (Construction and Operation of Engineering Works) 1987.
c) Building owners, as decision-makers, do not have any risks.
d) Architects: If an architects firm is registered as a Consulting Engineer under the PEC byelaw, they are subject to compliance with BCP-EP-2011. However, if the architect is registered only under PCATP, he/she need not comply with BCP-EP-2011.

### 3.1.4 Procedure of Criteria Decision and Amendment

According to S.R.O. 249 (I)/2013, the provision of the Building Code shall be revised by the Pakistan Engineering Council initially after one year of implementation and thereafter every three years. To date, no amendment has been implemented beyond the period after one year of launch date of BCP-EP-2011. According to preface BCP-EP-2011, as the methodology of amendment, BCP-EP-2011 shall be kept updated by the Standing Committee working under the aegis of PEC and this Committee shall interact with representatives of industry, engineering professionals and other stakeholders through an open code development process before any change is suggested. However, a detailed protocol for the amendment has yet to be defined.

The procedure for preparing BCP-EP-2011 is shown in Figure 3.1-1. GOP has mandated ENERCON to act as the national coordinator for energy conservation measures and policy. In this regard, ENERCON approached PEC to review and finalize BCP-EP-2011. PEC, as the statutory body to develop and implement BCP-EP-2011, constituted a task force for said development. The members of PEC Task Force assigned to prepare BCP-EP-2011 are shown in Table 3.1-16. The Task Force comprised 23 members, including participants from PEC, ENERCON, MOHW, CDA, academic, PCATP, Disco and private companies.




Source: Prepared by JICA Survey Team based on interview from ENERCON and PEC

Figure 3.1- 1 The Procedure of Preparation of BCP-EP-2011

Table 3.1- 16 Member of PEC Task Force to Prepare BCP-EP-2011

| |
|---|
| 1. Engr. Syed Imtiaz Hussain Gilani, Vice Chancellor, University of Engineering and Technology, Peshawar Convener |
| 2. Mr. Faridullah Khan, Managing Director, ENERCON, Islamabad |
| 3. Prof. Engr, Dr. Muzzaffar Mahmood, Pro Vice Chancellor, NED University of Engineering and Technology, Karachi |
| 4. Prof. Engr. Dr. Sarosh H. Lodi, Dean, Faculty of Civil Engineering and Architecture, NED University of Engineering and Technology, Karachi |
| 5. Engr. Muhammad Khalid, Director General, EM & C PEPCO, Lahore |
| 6. Ar. Shama Usman, Chairperson, Pakistan Council for Architects and Town Planners (PCATP), Islamabad |
| 7. Engr. Farhan A. Mehboob, Ex-President, ASHRAE Pakistan Chapter, Karachi |
| 8. Engr. Dr. Javed Yunus Uppal, Chief Executive, EPDC, Lahore |
| 9. Mr. Muhammad Irfan, Deputy Director General, Ministry of Housing and Works, Islamabad |
| 10. Engr. Tafseer Ahmad Khan, Director, PSQCA, Karachi |
| 11. Engr. Faiz M. Bhutta, M/s Isfar Construction (Pvt) Ltd., Lahore |
| 12. Engr. Khurram Khaliq Khan, PEC Task Leader, Fire Safety Provisions, Rawalpindi |
| 13. Engr. Farida Javed, Consultant (Ex-principal) Polytechnic Institute for Women, Islamabad |
| 14. Engr. Abrar Hussain Shah, Director General (E&M), Capital Development Authority (CDA), Islamabad |
| 15. Engr. Nasir J.R. Shaeikh, Advocate, Supreme Court of Pakistan |
| 16. Engr. Dr. Muhammad Irfan Mufti, Mechanical Engineering Department, University of Engineering & Technology, Peshawar |
| 17. Engr. Muhammad Zaman, Consultant/ Ex-Director General CDA, Islamabad |
| 18. Dr. Muhammad Sultan Khan, Associate Professor, Ghulam Ishaq Khan Institution of Engineering Sciences & Technology (GIKI), Topi |
| 19. Engr. M. Norman Ali, Ministry of Housing and Works, Islamabad |
| 20. Engr. Akram Rashid, Assistant Professor, Air University, Islamabad |
| 21. Engr. Z.M. Peracha, Registrar, Pakistan Engineering Council |
| 22. Engr. Dr. Ashfaq Ahmed Sheikh, Additional Registrar, Pakistan Engineering Council |
| 23. Engr. Muhammad Abrar Malik, Assistant Chief, ENERCON, Islamabad |

Source: Building Code of Pakistan (Energy Provision - 2011)

### 3.1.5 Stakeholders and Demarcation of Responsibility

Details of stakeholders and demarcation of responsibility by items are shown in Table 3.1-17.

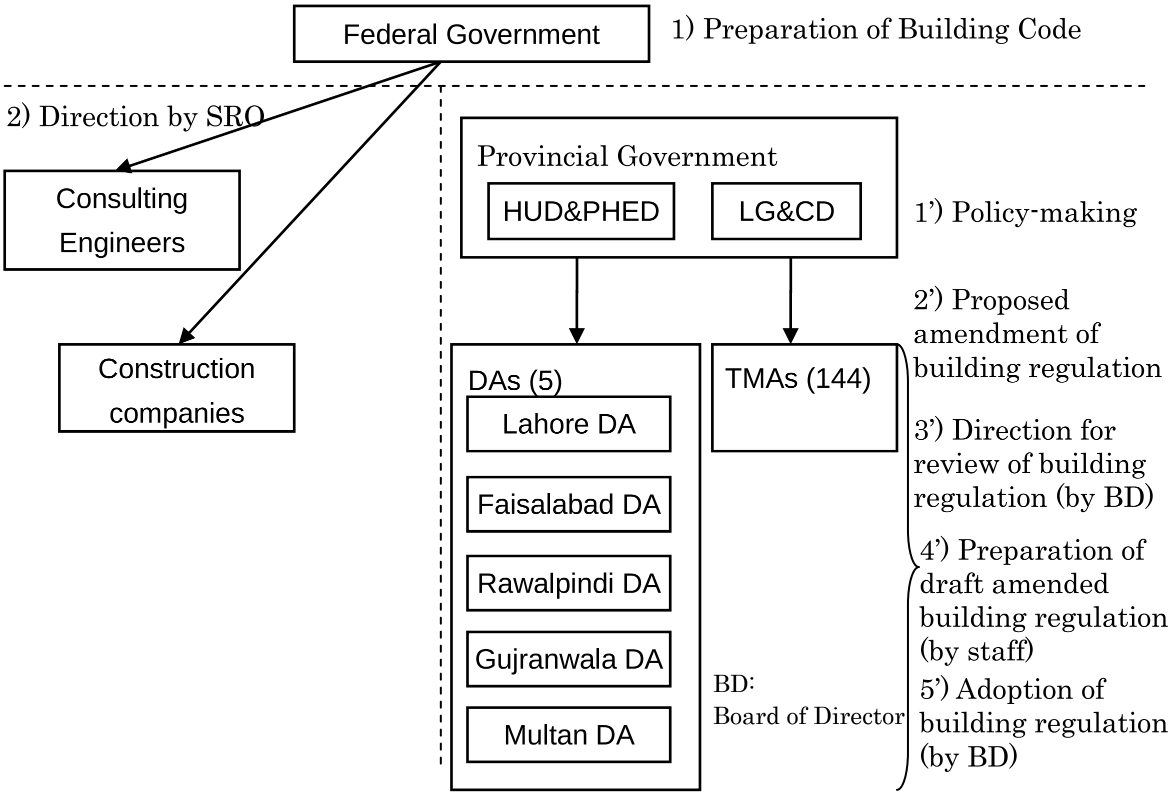
Table 3.1- 17 Stakeholders and Demarcation of Responsibility by Item

| | Player / Tasks | ENERCON | PEC | PSQCA | HUD &PHED | LG & CD | DA | TMA | Academic field | Designers | Constructors | Manufacturers |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Federal | Suggestion to amend BCP-EP-2011 | X | - | - | - | - | - | - | - | - | - | - |
| | Policy making for amendment of BCP-EP-2011 | X | - | - | - | - | - | - | - | - | - | - |
| | Preparation (aegis) of amendment | - | X | - | - | - | - | - | - | - | - | - |
| | Formulation of Task Force | x | X | x | - | - | x | - | x | x | x | x |
| | Approval as Pakistan Standard | - | - | X | - | - | - | - | - | - | - | - |
| | Approval of amendment | X*1 | - | - | - | - | - | - | - | - | - | - |
| | Issuance of amendment | - | X*2 | - | - | - | - | - | - | - | - | - |
| Province & Local Gov. | Policy making for adoption of BCP-EP-2011 | - | - | - | X | X | - | - | - | - | - | - |
| | Preparation of draft amended building regulation | - | - | - | - | - | X | X | - | - | - | - |
| | Direction for review of building regulation | - | - | - | - | - | X | X | - | - | - | - |
| | Adoption of building regulation | - | - | - | - | - | X | X | - | - | - | - |

*1 Board of ENERCON, *2 MOST

X: main player (chairperson), x: participant

Source: Prepared by JICA Survey Team (Confirmed by ENERCON, PEC, HUD&PHED and DA at the joint meeting)




Source: Prepared by JICA Survey Team with assumption based on interview from relevant organization

Figure 3.1- 2 The Procedure of adoption of BCP-EP-2011 in Punjab Province

## 3.2 Building Regulation and Implementation Framework

### 3.2.1 Capital Area (City of Islamabad)

As for the power and role of CDA in the building sector, CDA is to have two roles in building works; one of which involvement in public works of the metropolitan government and the other, a regulator against both private- and public-sector works. Every participant in CDA building works must be registered on a specified CDA list, which is a separate system from the registration of the Pakistan Engineering Council (PEC).

The primary regulation in CDA is the Islamabad Residential Sectors Zoning Regulation 2005 (IRSZB 2005), which regulates construction activity in Islamabad. IRSZB 2005 refers to the Pakistan Building Code, to safeguard against earthquakes and hazards. As a referenced code, the Building Code of Pakistan Seismic Provision 2007 and Islamabad Fire Prevention and Life Safety Regulations 2010 have been adopted for vetting drawings. Structural designs and drawings are in line with standards using the latest software and techniques; Checking and ensuring construction work on all commercial and high-rise projects to ensure the safety of the public and on-site workers using construction management techniques. Monitoring Building Control violations with site checking by field staff; checking the soundness and stability of all existing buildings on completion and ensuring awareness on the part of the general public toward safe construction. However, BCP-EP-2011 had not been adopted as of 2015.

Table 3.2-1 Contents of Islamabad Residential Sectors Zoning Regulation 2005

| | |
|---|---|
| Chapter-1<br>Preliminary | 1. Short Title Extent and Commencement<br>2. Definitions |
| Chapter-2<br>Building and Uses | 1. Authorized Building and Uses<br>2. Permission for Construction of Building<br>3. Sub-division and Amalgamation of Plots/ Buildings<br>4. F.A.R. Ground Coverage, Size, Height, Number of Storeys, Stair Tower, Type and Nature Development<br>5. Demolition of Attached Buildings on Adjacent Plot<br>6. Basement, Vaults, Cellars, etc.<br>7. Accessibility to service<br>8. Permission for Occupation of Buildings<br>9. Distance between Building on a plot<br>10. Servant Rooms/ Servant Quarters<br>11. Structure on roofs<br>12. Setbacks (Compulsory Open Space)<br>13. Maximum Height of Ramps<br>14. Height of Mumty/ Stair Tower<br>15. Ownership and Use of Roof Top<br>16. Irregular Plot<br>17. Ban on Non-Conforming Uses |
| Chapter-3<br>Building Regulatory Procedures | 1. Responsibility of the Owner/Allottee<br>2. Documents at Site<br>3. Employment of Licensed Architect and Eng.<br>4. Submission of Drawings and Certificates<br>5. Documents of Title<br>6. Drawings and Documents<br>7. Period of Approval<br>8. Evidence of Permission<br>9. Cancellation of Permission<br>10. Work Carried out without Permission<br>11. Fees<br>12. Notices, Inspections & Certificates during Construction |
| Chapter-4<br>Miscellaneous | Notes:<br>4.1.17 &18: Safety against Earthquakes, Safety against Hazards (Refer to PAKISTAN BUILDING CODE) |
| Chapter-5<br>General Instruction | 1. Possession of Site<br>2. Appointment of Architects and Structure Engineers<br>3. Approval of Plan<br>4. Water of Connection<br>5. Plinth Level / Building Verification<br>6. Completion Certificate/ Permission to occupy<br>7. General Instructions/ Guidance |
| Chapter-6<br>Schedules | 1. Schedule-1 Zoning and building requirement for Residential, Houses, Flats/ Apartments Plots, other than in diplomatic enclave.<br>2. Schedule-2 Minimum Space Standards/ Size (For rooms)<br>3. Schedule-3 Roof Projections in Terraced Houses<br>4. Schedule-4 Roof Projections in Setbacks<br>5. Annexure-A (Rates of Scrutiny fee for approval of plans and issuance of completion certificate)<br>6. Annexure-B (Fines and Charges ) (For penalty) |

Source: Islamabad Residential Sectors Zoning (Building Control) Regulation 2005

Table 3.2-2 Procedure of building approval in CDA

| | | Required Documentation/ Action by Builder/ Architects/ Engineers | CDA action/ check list |
|---|---|---|---|
| 1 | Plan Approval | 1. Form A1, A2<br>2. Building plans (Architectural & Structural)<br>3. Estate Management forwarding letter<br>4. Copy of N.I.Card of Allottee or Transferee or Attorney as the case may be duly attested.<br>5. Allotment letter or Transfer Letter duly attested.<br>6. Possession Certificate.<br>7. Copy of sub-division of plot, if applicable duly attested.<br>8. Indemnity Bound from the Allottee duly attested<br>9. Soundness and stability certificate by the Engineer.<br>10. Calculation Book. | Document review as per building regulations. |
| 2 | Construction Stage | Site Inspection report by Architects/ Resident Engineer :<br>On completion of foundations of basement and ground floor level (at plinth level / DPC level) of building / each building floor level and the compound wall (Form-D) | Site Inspection:<br>Plot line, Plinth level, Plot size and the building line. |
| 3 | Completion Certificate | 1. Form B1, B2<br>2.Completion plan as per actual construction at site.<br>3. Estate Management dues clearance.<br>4. Copy of N.I.C of Allottee or Transferee or Attorney as the case may be.<br>5. Dues clearance from Revenue Directorate.<br>6. CDA Completion Scrutiny Fee as per rates of approval of building plans.<br>7. Proof of payment of Withholding Tax for non-residential plots. | Site Inspection Check list<br>1. Building Verification Certificates.<br>2. Maximum plinth level from front road (average) level.<br>3. Height of ramp<br>4. Drainage grating level<br>5. Swage connection<br>6. Storm water connection<br>7. Mandatory setbacks<br>8. Total covered area<br>9. Emergency Exit<br>10. Firefighting arrangement<br>11. Additional water tank |

Source: Islamabad Residential Sectors Zoning (Building Control) Regulation 2005

### 3.2.2 Punjab Province (Lahore)

Five Development Authorities in the Punjab Province use the same format of regulations called Building and Zoning Regulations. While RDA, MDA, FDA and GDA have been using the 2007 version to date, LDA has started using the 2014 version. The LDA has been leading DA in Punjab Province to adopt revisions reflecting changes in the urban development environment. Other Development Authorities are engaged in adopting a revised version of the Building and Zoning Regulation. In this regulation, requirements depend on whether buildings are residential, commercial or industrial. Furthermore, multi-storey and public assembly buildings are subject to further conditions for approval.

Table 3.2-3 Contents of LDA Building and Zoning Regulation 2014

| | |
|---|---|
| Chapter 1<br>Definition | 1. Definition<br>2. Commercial Zone<br>3. Industrial Zone |
| Chapter 2.<br>Requirements;<br>Residential | 1. Established Built up Area<br>2. Approved Schemes<br>3. Predominantly Open Area<br>4. Professional Activities Allowed in a Residential Units |
| Chapter 3<br>Requirements;<br>Commercial | 1. Plots of 6 Canals and above located on Roads with 80ft Minimum soft Right of Way<br>2. Central Business District<br>3. Main Civic and Commercial Center<br>4. Neighborhood Commercial Area<br>5. Other Commercial Area<br>6. To the Converted Plot under Commercial Rules<br>7. Predominantly Open Area<br>8. Regulation for Bus Stands and Filing Station<br>9. Regulation for<br>10. Areas Subjected to Special Control |
| Chapter 4<br>Requirements; industrial | 1. Industrial Estates and Industrial Areas in Approved Schemes<br>2. Industrial Zones in Established Built-up Areas<br>3. Industrial Zones in Predominantly Open Area<br>4. General Conditions |
| Chapter 5<br>Parking Requirements | 1. General<br>2. Parking Space Standards<br>3. Parking Spaces Specifications |
| Chapter 6<br>Space and Safety<br>requirements | 1. External Building Requirement<br>2. Internal Building Requirement<br>3. Internal Lighting and Ventilation Specification<br>4. Fire Resistance and Fire Pre<br>5. Emergency Exit Specification<br>6. Utility Service Specification |
| Chapter 7<br>Structural Design of<br>Multi-Storey[2] | 1. Design<br>2. Sites<br>3. Foundations<br>4. Stair Case and Lifts<br>5.Deign Requirements for BTS/ Towers/ Antennas |
| Chapter 8<br>Builder's Obligation | 1. Obligations of Builder at Construction<br>2. Obligations of Development Authority<br>3.Dangerous Buildings |
| Chapter 9<br>Role and<br>Responsibilities | 1. General<br>2. Builder-Responsibilities<br>3. Consultant –Qualification and Responsibilities<br>4. Resident Engineer –Qualification and Responsibilities<br>5. Contractor-Qualification and Responsibilities<br>6. Development Authority-Responsibilities<br>7. General Obligations/ Responsibilities |
| Chapter 10 | 1. General<br>2. Application or Building Works<br>3. Submission of Plans and Documents<br>4. Sanctions/ Rejection of Building Plans<br>5. Plan Scrutiny Committee<br>6. High Level Design Committee (HLDC) /or Any Other Committee<br>7. Validity of Sanctioned Plan<br>8. Inspection of Building<br>9. Completion Certificate<br>10. Fees and `Penalties |

Source; LDA Building and Zoning Regulation 2014

Table 3.2-4 indicates major revisions in the 2014 version of Building Zoning and Regulations in Lahore. Height and FAR limitations are revised to accommodate a larger volume of apartments and

[2] Building having more than three stories or more than 38ft (11.58m), excluding basement.

commercial buildings, which seems to reflect the high demand for large-scale new development in urban areas. Parking requirements are also revised or added to handle the increased number of vehicles in the city. As an energy-efficiency requirement, building envelope insulation is added. Furthermore, to meet commercial building requirements, the use of LED lights and solar panels is also enforced. However requirements are not as specific as BCP-EP-2011 to justify compliance. Also, the required drawing list has not been revised, despite the need to verify lighting fixtures.

Table 3.2-4 Major revisions on LDA Building and Zoning Regulation 2014

| | |
|---|---|
| 2.1.2 | Height limitation revised |
| 2.2.3 | Apartment Building height limitation revised (from 45 to 80ft) |
| 2.2.3<br>FAR<br>Revision | Plot size less than 5 Marla (125$m^2$) 1:1.8 →1:2.4<br>Plot size 5 to10Marla (125to250$m^2$): 1:1.6→lo2.3<br>Plot size 10Marla to1Kanal (250to500$m^2$): 1:1.5→lo2.8<br>Plot size1Kanal to30 Marla (500to750$m^2$): 1:1.4→lo2.6<br>Plot size 30Marla to2Kanal (750to1000$m^2$): 1:1.4→.42.4<br>Plot size 2Kanal and above (≧1000$m^2$): 1:1.3 .1:2.2 |
| 2.2.3 | Minimum Car Parking number requirement added |
| 2.6 | Additional Requirement for residential building<br>7. In residential building insulation of outer walls, roofs and windows shall be provided for energy efficiency.<br>8. Walls facing sun shall be insulated in residential buildings. |
| 3.4.3<br>FAR<br>Revision | Plot size less than 3 Marla (75$m^2$) 1:1.6 1:2.3<br>Plot size 3 to10Marla (75to250$m^2$): 1:2.3ize<br>Plot size 10 Marla and above (≧250$m^2$): 1:4 |
| | FAR for Plot of 6 kanal and above for specific area added<br>(FAR 1:8/ 1:12/1:16) |
| 3.6.4 | Additional Requirements for commercial building<br>J. For energy efficiency, all new commercial building shall provide LED light for lighting.<br>K. In all new commercial building shall provide solar energy system at least for corridor lights.<br>q. In residential building insulation of outer walls, roofs and windows shall be provided for energy efficiency.<br>N.O. Determination of electricity/ gas connection , property tax certification added.<br>P. Under ground or overhead water tank to be provided.<br>r. In multi storey buildings, the outer window shall be double glazed/ heat resistant and tinted in order to control air leakage.<br>s. Walls facing sun shall be insulated in residential buildings.<br>t. The roofs and sun facing buildings sides shall be insulated.<br>v. The lighting system to comply with BCP-EP-2011 |
| 5.2.1 | Apartment car parking requirement revision.<br>1 per 1200$ft^2$ requirement revision<br>For cinema: 1/ 5seats→3/ 1000$ft^2$ |
| 6.6.1 | Ground water tank became mandatory |
| 6.6.6 | Roof Water Harvesting requirement added.<br>a) All buildings to be constructed in future in Lahore should have provision of roof top |
| 8.1.17/<br>8.2.3 | Requirement of building maintenance added |
| 10.3.2 | Evacuation Plan for drawing requirement added. |
| 10.8.1 | Revised number of site visit by DA during construction |
| | Non-compoundable violation revised |

Source; LDA Building and Zoning Regulation 2014
Underline indicates new regulations regarding EE&C.

Table 3.2- 5 Procedure of building permit approval in LDA

| | | Required Documentation/ Action by Builder/ Architects/ Engineers | LDA action/ check list |
|---|---|---|---|
| 1 | Plan Approval | 1. Form BR-1, BR-2<br>2. Building plans (signed and stamped by registered architect)<br>- Site Plan<br>- Plans (with ventilation detail )<br>- Sections/ Elevations(Plinth height)<br>- Drainage Plan<br>- **Evacuation Plan *1**<br>3. Structure Stability Certificate<br>4. Structure Design Drawings<br>- Design Criteria/ Technical Specification<br>- Design computations<br>- Design Drawing<br>- Soil Investigation Report<br>5. Excavation plan & design of pile<br>6. Certificate from fighting dept.<br>7. Certificate of Architect, Resident Engineer and structural engineer.<br>8. Details of Building Material<br>9. NOC from EPA (Environmental Protection Act)<br>10. NOC from Traffic Engineering Agency | 1. Document review as per building regulations.<br>2. Structural Drawing by Vetting Structural Engineer for Multi-storey and Buildings of public assembly |
| 2 | Construction Stage | For Multi-storey[3] and Buildings of public assembly, the builder, the architect, the resident engineer and the structural engineer shall jointly submit certificate as specified at the following stages<br>1. When construction up to plinth level is completed.<br>2. When construction up to 38ft (11.58m) level is completed.<br>3. Upon completion of the building. | DA may inspect such premises, without giving previous notice, through its authorized official/ officer, at any time-<br>**Minimum visits by DA staff are prescribed. *1**<br>On receipt of application from the builder along with the required certificate, a committee consist of Director town planning and Deputy Director town planning shall visit site and verify the construction done as per sanctioned plans. |
| 3 | Completion Certificate | Upon completion, builder shall notice in writing to DA. (For Multi-storey and public assembly building, with form of BR-9 and BR-15) | 1. DA to carry out final inspection to verify the construction done as per sanctioned plans.<br>2. Issue Completion Certificate upon approval. |

Source; LDA Building and Zoning Regulation 2014
*1: Revision made in 2014 version

[3] Building having more than three stories or more than 38ft (11.58m), excluding basement.

### 3.2.3 Sindh Province (Karachi)

SBCO (Sindh Building Control Ordinance-1979,) authorized the SBCA to make rules & regulations for buildings whenever required. The SBCA has its own set of building regulations known as KB&TP Regulations and defines four categories of buildings, for which owners shall engage respective professionals to prepare Architectural/Town Planning/Engineering Design and Drawings, including specifications and supervise their respective works on site.

Table 3.2-6 Category of Development of Works in KB&TP

| | |
|---|---|
| Category-I | a) Bungalow on plot up to 120yd²(100.33 m²)<br>b) Any other building on plot up to 120 yd². (100.33m²) with height up to 33 ft. (10 m). |
| Category-II | a) All bungalows.<br>b) Any other building with total floor area up to 20,000 ft² (1858.74 m²) and/or height up to 50 ft. (15.2m), other than Category I & IV. |
| Category-III | All buildings with total floor area greater than 20,000 ft² (1858.74 m²) and/or height greater than 50 ft. (15.2 m), other than Category IV. |
| Category-IV | Public use buildings or Industrial buildings with total floor area more than 10,000 ft² (929.36 m²) or with span more than 40 ft. or ground floor height more than 15 ft., building for essential facilities and public sale buildings. |
| Category-V | Town Planning works and Land development for area 2.5 acres (1 hectare) and greater. |

Source: Karachi Building & Town planning Regulation 2002

As per KB&TP Regulations, the owner shall submit the necessary documents to the authority. As per Table 3.2-7, the procedure for approval of building construction has been respectively defined for each of the categories as mentioned:

Table 3.2-7 Type of Categories of Approval

| N | Category | Plan signed by professional | Approval granted |
|---|---|---|---|
| 1. | I | Building Designer Or Architect or Professional Engineer (Civil) or Structural Engineer | (One Stage)<br>Final approval |
| 2. | II | Architect and Structural Engineer | (One Stage) final approval |
| 3. | III | Architect and Structural Engineer | (Two Stage) Architecture approval submission of structural design/drawing for record (and vetting) |
| 4. | IV | The submission of the plumbing and electrical drawings regarding public buildings by relevant professionals to concerned Architects | (Two stage) Architectural Approval structural design and drawing duly vetted by Proof Engineer, Plumbing and electrical drawings duly signed by relevant professional. |

Resource: The Karachi Building & Town Planning Regulations, 2002

Table 3.2-8 Content of Karachi Building and Town Planning Regulations 2002

| | |
|---|---|
| Chapter 1<br>Jurisdiction | Chapter 2<br>Definition |
| Chapter 3<br>Permits and Procedures | Chapter 4<br>Licensing/ Enlistment of Professional |
| Chapter 5<br>Public Sale Project | Chapter-6<br>Violations of Land Development |
| Chapter-7<br>Dangerous Buildings | Chapter-8<br>Safety and Security Measures |
| Chapter-9<br>Space Requirements in and about Buildings | Chapter-10<br>Lighting and Ventilation |
| Chapter-11<br>Building Structure Design and Construction Requirements | Chapter-12<br>Water Supply, Drainage & Sanitation |
| Chapter-13<br>Fire Resistance & Fire Precautions | Chapter-14<br>Fire Resistive Structural Requirements |
| Chapter-15<br>Preservation of Heritage Buildings | Chapter-16<br>Widening of Roads |
| Chapter-17<br>Standards for Land Development | Chapter-18<br>Subdivision and Amalgamation of Land and Change of Land use |
| Chapter-19<br>General Standard; Land Use Classification | Chapter-20<br>General Standard; Bulk & Spatial |
| Chapter-21<br>General Standards; Highways, Major Roads, Boulevards | Chapter-22<br>General Standard; Industrial Development |
| Chapter-23<br>General Standards; Coastline Recreation Development | Chapter-24<br>Parking Requirements |
| Chapter-25<br>Zoning Regulations/ Area Standard | |

Source; Karachi Building and Town Planning Regulations 2002

Table 3.2- 9 Procedure of building permit approval in SBCA

| | | Required Documentation/ Action by Building Owner/ Architects/ Engineers | SBCA action/ check list |
|---|---|---|---|
| 1 | Plan Approval | 1. A letter from concerned authority confirming the title/land use physically fresh demarcated/dimensions of the plot along with the existence of any road widening/cut line reservation<br>2. Building Plan duly signed and stamped by the relevant professionals with required detail information prescribed in the regulation.<br>- Plan<br>- Section<br>- Elevation<br>-<br><u>For Category III & IV</u><br>- Structural Working Drawing<br>- Structural Calculation<br>- Soil Investigation Report<br>- Plumbing working drawing<br>- Electrical working drawing | 1. Pass orders granting permission to carry out such building works within 60 calendar days.<br>2. For structural drawing set, vetting by the Proof Engineer to be carried out. |

| | | | |
|---|---|---|---|
| 2 | Construction Stage | 1. Plinth Verification:<br>Except Category I under these Regulations, upon completion of plinth and in the case of basements, upon the completion of foundations and shall give notice to the Authority on prescribed form (ZP-4), and shall not proceed further with the work for a period of 15 days from the date of receipt | The Authority may inspect the premises without giving prior notice:<br>-At any time, before the approval of an application received under these Regulations;<br>- any time during the progress of the building works;<br>-Plinth Verification: verify building lines on site.<br><br>-Officer of Vigilance Department confirm whether the approved specifications are being followed. |
| | | 2. Floor Certificate:<br>For Category III & IV, the owner and Professionals shall submit to the Authority floor certificate (Form ZP-5) casting of slab of each floor, certifying all building line and structural members on the said floor. | |
| 3 | Completion Certificate | Upon completion submit documents<br>1. Notice of completion/ occupancy on the prescribed form (ZP-7) duly signed by the relevant Professional together with certificate<br>2. A Completion Plan showing the building exactly as completed. | Upon receipt of notice from owner, carry out final inspection and issue the completion/ occupancy certificate. |

Source; Karachi Building and Town Planning Regulations 2002

### 3.2.4 Defence Housing Authority

DHA has different regulations from Building Regulations by the Development Authority in respective provincial governments. As each DHA in the respective provinces is established based on its own ordinance or act, the implementation and building regulations differ from each other.

The contents resemble the building regulation provided by Development Authorities, which regulates general building volumes, building services, structure and safety against emergencies.

Table 3.2-10 DHA Islamabad Building Control Regulation, 2000 (Revised 2014)

| Chapter – I | Chapter – II | Chapter – III | Chapter – IV | Chapter – V | Chapter – VI |
|---|---|---|---|---|---|
| Preliminary | General Regulations | Space Requirement for Building | Health and Safety Guidelines | Administrative Aspects | Construction By-Laws |

(Source: DHA Islamabad Building Control Regulation, 2000 (Revised 2014))

Table 3.2-11 DHA Lahore Construction & Development Regulations-2014

| Part-1 | Part- II | Part- III | Part-IV |
|---|---|---|---|
| Definitions | Town Planning & Development | Installation/Erection Sky Board/ Antenna/ Communication Tower/ Neon Sign Boards | Miscellaneous |

Source: DHA Construction & Development Regulations-2014

Table 3.3-12 Building Control & Town Planning Regulations 2011 DHA Karachi

| Chapter – I | Chapter – II | Chapter – III | Chapter – IV | Chapter – V |
|---|---|---|---|---|
| General & Definitions | Submission of Building/Completion Plans for Approval/Sanction | Space Requirements of Buildings | Parking Requirements | Drainage and Sanitation |
| Chapter – VI | Chapter – VII | Chapter – VIII | Chapter – IX | Chapter – X |
| Lighting and Ventilation | Safety & Security Measures during Construction | Building Design and Construction Requirements | Fire Resistance and Fire Precautions | Violation of Regulations |
| Chapter – XI | Chapter – XII | Chapter – XIII | | |
| Change of Land Use | Dangerous Buildings | Public Sale Projects | | |

Source: Building Control & Town Planning Regulations 2011 DHA Karachi

The area of DHA development has been popular among citizens because of it strict quality control. One of the methods used is a checklist from the beginning of construction to completion.

Table 3.2-13 Inspection Chart by DHA Islamabad

| **Town planning Section** | Date | Svy | C/Svy | Offr I/C | Owner |
|---|---|---|---|---|---|
| 1. Demarcation Check Boundary Wall.<br>a Initial Demarcation<br>b After leaning<br>c At DPC level | | | | | |

| **Building Control Section** | Date | Supervisor | Offr I/C | Owner |
|---|---|---|---|---|
| 2. In case basement is to be construct then;<br>A On ground demarcation of area to be dug in.<br>B Foundation layout.<br>C Before pouring concrete<br>D Roof level before pouring roof | | | | |
| 3 a Ground Floor at DPC level<br>B On raising one foot above DPC level | | | | |
| 4 On attaining roof height of ground floor before pouring roof | | | | |
| 5 On raising first floor structure one foot above floor | | | | |
| 6 On attaining roof height of first floor before pouring | | | | |
| 7 On attaining roof height of water tank and munty (if applicable) | | | | |
| 8 Layout of sewerage system before installing sewerage pipe | | | | |
| 9 On completion of septic tank prior to putting the cover. | | | | |
| 10 On making ramp according to the approved plan | | | | |
| 11 Inspection of earth pit of electrical system before connecting to main supply | | | | |
| **Service Connection** | | | | |
| 1 Temporary water connection approved on | | | | |
| 2 Sewer connection opened on | | | | |
| 3 Water connection opened on | | | | |
| Completion | | | | |
| 1 Building completed on | | | | |
| 2 Completion certificate issued on | | | | |
| NOTE:<br>1 Abiding by-laws of DHA Islamabad during construction is the responsibility of member<br>2 Getting inspection at each stage of construction is responsibility of member<br>3 Safe custody of this card is responsibility of the member. In case of loss, duplication card will be issued on payment of rs 500<br>4 The card should be available at site for inspection of DHA's staff<br>5 Member will submit this card duly completed along with completion drawing within 15 days on completion. | | | | |

Source: DHA Islamabad

### 3.2.5 Comparison of Building Regulations

(1) Regulation Comparison

Following tables shows general regulation comparison among the building authorities in Islamabad, Punjab and Sindh. As a reference, Guideline from Baharia Town are also indicated as a one of the example from private sector guideline.

Table 3.2-14 Comparison among the regulations/ bylaws form respective building authorities (Building Control and Structure)

| Respective Government | | Fed | Punjab Gov. | | Sindh Gov. | Defense Ministry | | | Private |
|---|---|---|---|---|---|---|---|---|---|
| Development Authority/ Building Regulatory Body | | CDA | LDA | Other 4DA | SBCA | DHA Islamabad | DHA Lahore | DHA Karachi | Baharia Islamabad |
| Building Control | Submission, Permits and Procedures | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Inspection | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Completion Certificate | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Licensing/ Enlistment of Professionals | ○ | ○ | ○ | ○ | × | × | × | × |
| | Roles, Responsibility and Obligation | ○ | ○ | ○ | ○ | ○ | × | ○ | × |
| | Violation of Regulation Penalty | ○ | ○ | ○ | ○ | × | ○ | ○ | × |
| | Public Sales Projects | × | × | × | ○ | × | × | ○ | × |
| | Dangerous Building | × | × | ○ | ○ | × | × | ○ | ○ |
| Structure | Building Structure Design and Construction Requirements | ○ | ○ | ○ | ○ | × | × | ○ | ○ |
| | Ground Test Soil Test Bearing Capacity | ○ | ○ | ○ | ○ | ○ | × | × | ○ |
| | Wind Load Seismic Load | × | ○ | ○ | ○ | × | × | × | × |
| | Test of Material | × | ○ | ○ | ○ | × | × | × | ○ |
| | Ready Mixed Concrete | × | × | ○ | ○ | × | × | × | ○ |

(Source: Regulation/ bylaws form respective building authorities)

Table 3.2-15 Comparison among the regulations/ bylaws form respective building authorities
(Mechanical &Electrical and Fire Protection)

| Respective Government | | Fed | Punjab Gov | Sindh Gov | Def. Min. | DHA | | | Pvt. |
|---|---|---|---|---|---|---|---|---|---|
| Development Authority/ Building Regulatory Body | | CDA | LDA | Other 4DA | SBCA | DHA Islamabad | DHA Lahore | DHA Karachi | Baharia Islama-bad |
| Mechanical & Electrical | Stair Case and Lift | × | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Design Requirement for BTS/ Towers/ Antennas | × | ○ | ○ | × | × | ○ | × | × |
| | Water Supply, Drainage & Sanitation Water Connection | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Electricity, Lighting and Ventilation | × | ○ | ○ | ○ | ○ | × | ○ | ○ |
| | Generator | × | ○ | × | × | × | ○ | × | × |
| Fire Protection | Fire Protection | × | ○ | ○ | ○ | × | ○ | ○ | ○ |
| | Firewall | × | × | × | ○ | × | × | × | ○ |
| | Emergency Exit Specifications Fire Resistant Door | × | ○ | ○ | ○ | × | × | ○ | ○ |
| | Fire Resistive Structural Requirement | × | × | × | ○ | × | × | × | × |

Table 3.2-16 Comparison among the regulations/ bylaws form respective building authorities
(Space Requirement)

| Respective Government | | Fed | Punjab Gov | Sindh Gov | Def. Min. | Defense Ministry | | | Pvt. |
|---|---|---|---|---|---|---|---|---|---|
| Development Authority/ Building Regulatory Body | | CDA | LDA | Other 4DA | SBCA | DHA Islama -bad | DHA Lahore | DHA Karachi | Baharia Islamab ad |
| Space Requirement | Limit of Building Height Resident | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Limit of Building Height Commercial | – ※1 | ○ | ○ | ○ | ○ | ○ | ○ | |
| | Limit of Building Height Industrial | – ※1 | ○ | ○ | ○ | × | × | × | × |
| | Footprint (Building coverage) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |
| | Floor Area Ratio (Volume) | ○ | ○ | ○ | ○ | ○ | ○ | ○ | – |
| | Parking Requirements | ○ | ○ | ○ | ○ | ○ | ○ | ○ | ○ |
| | Parking Space Specification | ○ | ○ | ○ | ○ | × | × | ○ | ○ |
| | High Level Design Committee | × | ○ | ○ | × | × | × | × | × |
| | High Density Development Board | × | ○ | × | ○ | × | × | × | × |
| | Preservation of Heritage Building | × | × | × | ○ | × | × | × | × |

※1: Apply residential sector height limitation depends on land usage.
(Source: Regulation/ bylaws form respective building authorities)

(2) Comparison for Space Requirement and Parking Requirement

Following tables shows comparison among the building authorities in Islamabad, Punjab and Sindh regarding space requirement and parking requirement.

Table 3.2-17 CDA Space requirement

Residential

| | Plot size (ft²) | Frontage (ft) | Min. Set-back Front (ft) | Min. Set-back side (ft) | Min. Set-back side (ft) | Min. Set-back rear (ft) | Max storey | Max Height (ft) | Max Unit | Min Car Area (ft²) | Max Coverage | Max FAR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Terraced/ Attached Type A | Up to 150 | 20 to 29 | 5 | - | - | 5 | 2 | 30 | 1 | 100 | Construction may cover a block leaving compulsory setback. | |
| | 151 to 200 | 25 to 30 | 6 | - | - | 6 | 2 | 30 | 1 | 180 | | |
| | 201 to 320 | 30 to 39 | 10 | - | - | 8 | 2 | 30 | 1 | 180 | | |
| | 300 to 450 | 40 to 49 | 10 | - | - | 10 | 2 | 30 | 1 | 200 | | |
| Semi-Detached Type B | 300 to 625 | 40 to 49 | 10 | - | 5 | 10 | 2 | 30 | 1 | 200 | | |
| Detached Type C | 400 to 1000 | 50 to 59 | 15 | 5 | 5 | 10 | 2 | 30 | 2 | 200 ft² | Construction may cover a block leaving compulsory setback. | |
| | 530 to1335 | 60 to 69 | 15 | 10 | 5 | 10 | 2 | 30 | 2 | | | |
| Detached Type D | 700 to 1670 | 70 to 79 | 20 | 10 | 10 | 10 | 2 | 30 | 2 | 400 ft² | | |
| | 885 to 2670 | 80 to 89 | 25 | 10 | 10 | 10 | 2 | 30 | 2 | | | |
| | 800 to 2900 | 90 to 99 | 30 | 10 | 10 | 10 | 2 | 30 | 2 | | | |
| | 1770 to 2720 | 100 | 40 | 15 | 15 | 10 | 2 | 30 | 2 | | | |

Apartment

| | Type | Plot size(Acre.) | MaxCoverage | Max FAR | Max storey | Max Height(ft) |
|---|---|---|---|---|---|---|
| Flat/ Apartment | Type-A | Up to 200 | 35% | 1:2.8 | 8 | 92 |
| | Type-B | More than 200 | 30% | 1:3.6 | 12 | 135 |

Source: CDA

Table 3.2-18 LDA Space requirement and Parking requirement

Resident building

| Plot size | Max. of storey | Max Ground Coverage | Max Height | Max FAR | Min Parking Provision |
|---|---|---|---|---|---|
| Less than5Marlas | 3 | 80% | 38 ft | 1:2.4 | Not Mandatory |
| 5 to 10Marlas | 3 | 75% | 38 ft | 1:2.3 | 1 Car |
| 10 Marlas to 1Kanal | 4 | 70% | 45 ft | 1:2.8 | 1 Car per Storey |
| 1Kanal to 30 Marlas | 4 | 65% | 45 ft | 1:2.6 | 1 Car per Storey |
| 30 Marlas to 2Kanal | 4 | 60% | 45 ft | 1:2.4 | 2 Car per Storey |
| Over 2Kanal | 4 | 55% | 45 ft | 1:2.2 | 2 Car per Storey |

Apartment

| Site | Max Ground Coverage | FAR |
|---|---|---|
| Approved Apartment Site | 55% | 1:5 |
| Residential Plots | 55% | 1: 4 |
| Building Height =(R.O.Wx1.5)+setback (R.O.W the width of right way) | | |

Building Height &Ground Coverage and Floor Area Ratio

| Plot size | Max. Building | Max Ground Coverage | Max Ground Coverage | FAR |
|---|---|---|---|---|
| Less than 3 Marlas | 25ft (7.62m) or 2 floor | 7/8th of Plot Area | 3/4th of Plot Area | 1:2.5 |
| 3 to 10Marlas | 40 ft (12.19m) or 3 floor | 7/8th of Plot Area | 3/4th of Plot Area | 1:3 |
| Over7. 10Marlas | 60 ft (18.29m) or 5 floor | 7/8th of Plot Area | 3/4th of Plot Area | 1:4.5 |

Main Civic and Commercial Centers Building Height F.A.R and Ground Coverage

| Height | FAR | Ground Coverage |
|---|---|---|
| Up to 200ft (60.97m) | 1:8 | 65% |
| 201ft (61.28m) to 400ft (121.95m) | 1:12 | 65% |
| Above 400ft (121.95m) | 1:16 | 65% |

Industrial Estates and Industrial Area

| Plot size | Height and storey | Max FAR | Max Ground Coverage |
|---|---|---|---|
| Less than 10 Marlas | 65ft (19.81m) or 6 storey | 1:2 | 65% |
| 10 Marlas to 1Kanal | 65ft (19.81m) or 6 storey | 1:2 | 60% |
| 1Kanal to 2Kanals | 65ft (19.81m) or 6 storey | 1:2 | 55% |
| 2Kanals to 4Kanals | 65ft (19.81m) or 6 storey | 1:2 | 55% |
| 4Kanals to 1 acre | 65ft (19.81m) or 6 storey | 1:2 | 55% |
| 1 acre to 5 acre | 65ft (19.81m) or 6 storey | 1:2 | 55% |
| Over 2Kanal | 65ft (19.81m) or 6 storey | 1:2 | 55% |

Parking Requirement

| | |
|---|---|
| Hotel | 1 car per 6 rooms<br>1 car per 800 ft² (75 m²)shopping area<br>1 car per 1000 ft² (92.95 m²)office area<br>1 car per 500 ft² (46.47 m²) restaurant, café, banquet hall |
| Restaurant, Club, Café | 1 car per 500 ft² (46.47 m²) |
| Marriage Hall, Banquet Hall | 1 car per 500 ft² (46.47 m²) |
| Cinema, Theatre, Concert Hall | 3 car per 1000 ft² (92.95 m²) |
| Cultural Institution, Post Office, Police Station | 1 car per 2000 ft² (185.90 m²) |
| Industrial Building, Warehouse, Godwns | Admin. Office 1 car per 500 ft² (46.47 m²)<br>Other 1 car per 2000 ft² (185.90 m²) |
| School, College, Education Institutions | 1 car per 2000 ft² (185.90 m²) |

（1Marlas＝250ft²=23.23m²／1Kanal=20Marlas=5000ft²=464.52m²／1 acre=43560ft²=4046.86m²）

Source: Regulation/ bylaws form respective building authorities

Table 3.-2-19 RDA and other Das Space requirement and Parking requirement

Resident building & Apartment

| Plot size | Max Ground Coverage | Max Height | Max FAR | Min Parking Provision |
|---|---|---|---|---|
| Less than5Marlas | 85% | Normal case Height: not exceed 38ft (11.58 m)<br>Allowed case not exceed 45ft (13.72 m)<br>1 storey is over 9ft.-6inches ( 2.9m)<br>Not exceed 1.5 times of the width of setback | 1:2 | 1 car per 1200 ft² (111.52m2) |
| 5 to 10Marlas | 80% | | 1:1.6 | |
| 10 Marlas to 1Kanal | 70% | | 1:1.5 | |
| 1Kanal to 30 Marlas | 65% | | 1:1.4 | |
| 30 Marlas to 2Kanal | 60% | | 1:1.3 | |
| Over 2Kanal | 55% | | 1:2.5 | |

Main Civic and Commercial Centers： Building Height F.A.R and Ground Coverage

| Height | FAR | Ground Coverage |
|---|---|---|
| Up to 200ft (60.97m) | 1:8 | 65% |
| 201ft (61.28m) to 400ft (121.95m) | 1:12 | 65% |
| Above 400ft (121.95m) | 1:16 | 65% |

Industrial Estates and Industrial Area

| Plot size | Height and storey | Max FAR | Max Ground Coverage |
|---|---|---|---|
| Less than 10 Marlas | 65ft (19.81m) or 6 storey | 1:2 | 65% |
| 10 Marlas to 1Kanal | 65ft (19.81m) or 6 storey | 1:2 | 60% |
| 1Kanal to 2Kanals | 65ft (19.81m) or 6 storey | 1:2 | 55% |
| 2Kanals to 4Kanals | 65ft (19.81m) or 6 storey | 1:2 | 55% |
| 4Kanals to 1 acre | 65ft (19.81m) or 6 storey | 1:2 | 55% |
| 1 acre to 5 acre | 65ft (19.81m) or 6 storey | 1:2 | 55% |
| Over 2Kanal | 65ft (19.81m) or 6 storey | 1:2 | 55% |

Parking Requirement

| | |
|---|---|
| Hotel | 1 car per 6 rooms<br>1 car per 800 ft² (75m2) shopping area<br>1 car per 1000 ft² (92.95m2) office area<br>1 car per 500 ft² (46.47m2 restaurant, café, banquet hall |
| Restaurant, Club, Café | 1 car per 500 ft² (46.47m2) |
| Marriage Hall, Banquet Hall | 1 car per 500 ft² (46.47m2) |
| Cinema, Theatre, Concert Hall | 1 car per 5 seats |
| Cultural Institution, Post Office, Police Station | 1 car per 2000 ft² (185.90m2) |
| Industrial Building, Warehouse, Godwns | Admin. Office 1 car per 500 ft² (46.47m2)<br>Other 1 car per 2000 ft² (185.90m2) |
| School, College, Education Institutions | 1 car per 2000 ft² (185.90m2) |

（1Marlas＝250ft²=23.23m²／1Kanal=20Marlas=5000ft²=464.52m²／1 acre=43560ft²=4046.86m²）

（Source: Regulation/ bylaws form respective building authorities）

Table 3.2-20 DHA Islamabad Space requirement

Resident Building

| Plot size (yd²) | Allowable Covered Area | Max Height |
|---|---|---|
| Up to200 | 85% | 37 ft<br><br>1ft will be allowed in the payment of Rs.15000- after approval |
| 201 to 249 | 75% | |
| 250 to 399 | 70% | |
| 400 to 600 | 65% | |
| 601 to 800 | 65% | |
| 701 and above | 55% | |

Commercial Building

| Plot size (yd²) | Allowable Covered Area | Floors & Height |
|---|---|---|
| Up to100 | 100% | Main Commercials<br>B+G+5<br>Height 77 ft<br><br>Sectors Commercials<br>B+G+3<br>Height 55 ft |
| 101 to 250 | 100% | |
| 251 to 400 | 90% | |
| 401 to 600 | GF=85% Above GF=75% | |
| 601 to 999 | GF=80% Above GF=70% | |
| 601 to 999 | GF=75% Above GF=65% | |
| 701 and above | 55% | |

（Source: Regulation/ bylaws form respective building authorities）

Table 3.2-21 DHA Lahore Space requirement

| Resident Building | Commercial Building |
|---|---|
| Basement 100% of plot<br>Ground Floor 100% of plot<br>(with the zone of dead wall and leaving 5 feet)<br>First Floor 75% of plot<br>First Floor & Onward 100% of plot | Allowable Covered Area<br>Basement 100% of plot<br>Ground Floor 100% of plot<br>Mezzanine Floor 70% of plot<br>First Floor & Onward 100% of plot<br>Height Less than 17 feet |

（Source: Regulation/ bylaws form respective building authorities）

Table 3.2-22 DHA Karachi Space requirement

Resident Building

| Plot size(yd²) | No. of Floor | Allowable Covered Area | Max Height | Parking Requirement |
|---|---|---|---|---|
| Up to 200 | B+G+1 | 90% | 38 ft | 1 car per 1000 ft² |
| 201 to 400 | B+G+1 | 75% | | |
| 401 to 700 | B+G+1 | 60% | | |
| 701 and above | B+G+1 | 50% | | |

Commercial Buildings Standard

| Plot size (yd²) | FP | FAR | Floors | Height | Parking Requirement |
|---|---|---|---|---|---|
| 81 to 250 | 100% | - | B+G+4 | 4th floor<br>68ft 6inch | 1 car per 800 ft²<br>Shopping area, Business office, Hotels, Restaurants, Conference Room, |
| 251 to 400 | 90% | - | B+G+4 | | |
| 401 to 600 | GF=85%<br>Above GF=75% | 1:5 | As per FAR | 4th floor<br>68ft 6inch<br>B+G+4<br>5th floor<br>78ft 6inch<br>B+G+5 | |
| 601 to 999 | GF=80%<br>Above GF=70% | 1:5 | | | |
| 1000 to 1999 | GF=75%<br>Above GF=65% | 1:5.5 | | | |
| above 2000 | GF=70%<br>Above GF=65% | 1:5.5 | | | |

Health and Education, Amenity Building

| Type of Plot | Plot size | FP | FAR | Floors | Height | Parking Requirement |
|---|---|---|---|---|---|---|
| Educational | All sizes | 40% | 1:0.8 | B+G+1 | 58 feet 6 inches | Educational Institution 1 car per 4000 ft² |
| Hospital | Less than 1000 | 50% | 1:1 | B+G+1 | | |
| | 1000 & above | 60% | 1:1.2 | B+G+1 | | |
| Sports, Entertainment | All sizes | 50% | - | B+G+2 | - | |

Parking Requirements

| | |
|---|---|
| Business office, Hotel, Restaurants, Conference Room, Indoor Recreational Area, Retail Outlet | 1 car per 800 ft² (74.32m2) |
| Apartment, Resident, Residential-cum-Commercial | 1 car per 1000 ft² (92.90m2) |
| Education Institutions | 1 car per 4000 ft² (371.62m2) |
| Hospital | 1 car per 1500 ft² (139.35m2) |
| 4 parking spaces for handicapped person per 100 parking spaces | |

Source: Regulation/ bylaws form respective building authorities

## 3.3 Legal system in Japan and nearby countries

### 3.3.1 Energy Efficiency and Conservation in the building sector in Japan

(1) History of Building Code (Energy Provision) in Japan

The legal structure and background to the legislation on Building Code (Energy Provision) in Japan differ from those in Pakistan and India. To review the Building Code concerning Energy Conservation, reference should be made to the Act on the Rational Use of Energy instead of the Building Code in Japan. As reviewed in the following table, the Act on the Rational Use of Energy was established in 1979, triggered by the Oil Crisis.

Table 3.3- 1 History of Act on the Rational Use of Energy in Japan

| | |
|---|---|
| 1951 | Heat Management Law was established. |
| 1960 | Domestic energy policies were converted from coal to oil. |
| 1972 | Japan Heat Energy Technical Association was established. |
| 1973 | First oil crisis |
| 1978 | Second oil crisis<br>The Energy Conservation Center was established. |
| 1979 | Second oil crisis. The Act on the Rational Use of Energy was enforced including guideline for buildings. |
| 1988 | The first meeting of IPCC (Geneva) was held. |
| 1992 | The Earth Summit was held (Rio De Janeiro). |
| 1993 | Energy Recycle Law/ Basic Environment Law |
| 1995 | Power Liberalization |
| 1997 | The Kyoto Protocol was executed at the Parties to the U.N. Framework Convention on Climate Change (COP3). |
| 1998 | Outline for Promotion Effects to prevent Global Warming was established. |
| 1999 | The Act on the Rational Use of Energy was revised.<br>The Top Runner approach was adopted. |
| 2001 | Document regarding the future energy conservation was established.<br>CASBEE was introduced |
| 2002 | Energy conservation of the “Outline for Promotion Effects to prevent Global Warming” became one of the main countermeasures of global warming.<br>Ratification of the Kyoto Protocol was approved.<br>The Act on the Rational Use of Energy was revised. Countermeasures concerning office buildings, etc. were strengthened. |
| 2003 | Obligation of building owner to submit Energy Conservation Measures for specified buildings on non-residential large scale with total floor area of at least 2,000m² |
| 2005 | The Act on the Rational Use of Energy was revised |
| 2006 | Obligation of building owners to submit Energy Conservation Measures for specified buildings on residential large scale with total floor area of at least 2,000m² |
| 2008 | The Act on the Rational Use of Energy was revised |
| 2009 | Introduction of Top Runner Approach for Housing providers (annual supply of at least 150 units) to submit plans and periodical report on energy consumption |
| 2010 | Obligation of building owners to submit Energy Conservation Measures for specified buildings on small and midsize structures with total floor area of at least 300m² |
| 2013 | Introduction of the valuation standards by Envelop Performance and Primary Energy Consumption |
| 2014 | BELS was introduced |

Source: JICA Thematic Guidelines on Energy Conservation February 2005/ Energy Conservation Law in Japan IEEJ February 2009/ Policy for Building Energy Conservation, MLIT 2015

1) History

The Act on the Rational Use of Energy was established in 1979, triggered by the Oil Crisis, aiming to reduce the energy consumption in the industrial sector in Japan as follows.

a) 1973 - 1978

Immediately after the first 'oil crisis' in 1973, business management and operation were reviewed and improved with investment for highly profitable energy conservation, which involved the entire industrial sector, for reducing energy consumption as the first step of the countermeasures for energy conservation.

b) 1979 - 1990

The Act on the Rational Use of Energy was enacted and financial support system was established. Thus, the improvement of facilities and installation of additional equipment in facilities (adoption of highly efficient equipment for energy conservation) for improvement of energy consumption efficiency were positively implemented as the second step for energy conservation countermeasures in the industry that consumes large amounts of energy. The third steps followed, improving production process for its cost reduction and productivity enhancement, including improvement of energy use efficiency.

c) After 1990

Since improvement of facilities for energy conservation in the industrial sector had mostly been achieved, the weight of energy conservation shifted from the industrial sector to the household and transportation sectors. Additionally, global warming became a new important issue with the challenge of reducing CO2 emissions. As a result, the development of technologies, and utilization of facilities and products for energy conservation that is effective for reducing CO2 emissions have been promoted.

Regarding 'Residential Buildings and Structures', the following were legislated as the original Act on the Rational Use of Energy (1979)[4];

- ✧ Energy conservation guidelines
- ✧ Implementation of an instruction and advisory system by Central Government

The provisions of 'Residential Buildings and Structures' were revised for improvement as follows[5]:

- ✧ Obligation of building owner to submit Energy Conservation Measures for specified buildings on a large non-residential scale with a total floor area of at least 2,000m² (2003)
- ✧ Obligation of building owners to submit Energy Conservation Measures for specified buildings on a large residential scale with a total floor area of at least 2,000m² (2006)

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[4] Energy Conservation Law in Japan, IEEJ 2009 Policy for Building Energy Conservation, MILT 2015

[5] Energy Conservation Law in Japan, IEEJ 2009 Policy for Building Energy Conservation, MILT 2015

✧ Introduction of a Top Runner Approach for Housing providers (annual supply of at least 150 units) to submit plans and a periodical report on energy consumption (2009)
✧ Obligation of building owners to submit Energy Conservation Measures for specified buildings on small and mid-sized structures with total floor area of at least 300m² (2010)
✧ Introduction of evaluation standards by Envelope Performance and Primary Energy Consumption (2013)

(2) Act on the Rational Use of Energy in Japan

The Act on the Rational Use of Energy is the basis of all energy conservation policies in Japan, including 1. Manufacturing plants & Business Establishments, 2. Transportation, 3. Residential Buildings and Structures and 4. Machinery and Equipment as detailed in the following table. The Building Code (Energy Provision) in Japan is legislated in 'Residential Buildings and Structures' as detailed in the following table:

Table 3.3- 2 Act on the Rational Use of Energy in Japan

| Type | Obligation | |
|---|---|---|
| 1.Manufacturing Plants & Business Establishments | **Specified Business operators**<br>Energy consumption of 1,500kl(equivalent crude oil) per year | Obligation to appoint Energy Managers<br>Obligation to periodically report on energy consumption status<br>Obligation to submit medium and long term plans |
| 2.Transportation | **Specified carriers**<br>200 trucks or 300 railway cars for railroads, etc. | Obligation to submit medium and long term plans<br>Obligation to periodically report on energy consumption status |
| | **Specified consigners**<br>Annual transport volume of at least 30 million ton-km | Obligation to submit term plans<br>Obligation to periodically report on energy consumption status |
| 3.Residential Buildings and Structures | **Specified buildings** on non-residential large scale with total floor area of at least 2,000m² | For Owners of buildings;<br>Obligation to submit energy conservation measures<br>Local governments are to give instruction and advice on needed |
| | **Specified buildings** on small and midsize structures with total floor area of at least 300m² | Obligation relating to the submission of notifications pertaining energy measures implemented by construction clients in relation to large scale modifications and obligations relating to reporting the status of overall maintenance. |
| | **Housing providers**<br>Annual supply of at least 150 units | Obligation to submit plans<br>Obligation to periodically report on energy consumption of energy related to consigned transportation |
| 4.Machinery and equipment | **Top runner Standard**<br>23units | Standards for energy conservation of passenger cars, air conditioners, television sets, etc.<br>To exceed the performance of most superior products that have been commercialized at the present time is required of each type of unit. |

Source: Energy Conservation Policies of Japan issued by Agency of Natural Resource and Energy, November 2011

(3) CASBEE and BELS

1) CASBEE

CASBEE (Comprehensive Assessment System for Built Environment Efficiency) is a method for evaluating and rating the environmental performance of buildings. It is a comprehensive assessment of the quality of a building, evaluating features such as interior comfort and scenic aesthetics, in consideration of environmental practices, which include using materials and equipment that save energy or reduce environmental burdens. The CASBEE assessment is ranked in five grades: Excellent (S), Very Good (A), Good (B+), Fairly Poor (B-) and Poor (C).CASBEE was developed by a research committee established in 2001 as part of a joint industrial/government/academic project supported by MLIT. The first assessment tool, CASBEE for Office, was completed in 2002, followed by CASBEE for New Construction in July 2003, CASBEE for Existing Building in July 2004 and CASBEE for Renovation in July 2005.[6]

There are numerous sustainable rating systems for buildings and groups of buildings that have been developed worldwide. The rating tools like the Comprehensive Assessment System for Building Environmental Efficiency (CASBEE), Leadership in Energy and Environmental Design (LEED), British Research Establishment Environmental Assessment Method (BREEAM), Green Building (GB) Tool have its own methodology and evaluation criteria.

Table 3.3- 3 Primary Issues of Concern Identified in Each Building Assessment Tool

| Tool | Country | Year | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BREEAM | UK | 1990 | ○ | | ○ | ○ | ○ | ○ | ○ | | | | | | | | |
| GBTool | International | 1998 | ○ | ○ | ○ | ○ | ○ | | | ○ | ○ | | | | ○ | | ○ |
| LEED | US | 1998 | ○ | ○ | ○ | ○ | ○ | | | | | ○ | | | | | |
| CASBEE | Japan | 2004 | ○ | ○ | ○ | ○ | ○ | | | | | ○ | | ○ | | | |
| HQE | France | 1996 | ○ | ○ | ○ | ○ | ○ | | ○ | | | ○ | ○ | | ○ | | |

Notes: 1.Site/ 2.Indoor/ Environment/ 3.Energy/ 4.Material Resources/ 5.Water/ 6. Transport/ 7. Health/ 8. Social/ 9. Economy/ 10. Comfort/ 11. Management/ 12. Services/ 13. Long term performance/ 14. Design aesthetics/ 15. Functionality.

Source: Sustainable Housing Practices In Malaysian Housing Development written by Abu Hassan, Abu Bakar and Khor Soo Cheen and Rahmawaty

2) BELS

The Ministry of Land, Infrastructure, Transport and Tourism in Japan established evaluation guidelines for the BELS (Building Energy-efficiency Labeling System) for non-residential buildings (2013); aiming to help further improve energy conservation performance for non-residential buildings and provide appropriate information to the real estate market, etc. BELS is a system to evaluate and indicate energy conservation performance and other related matters of non-residential buildings based on these guidelines and an evaluation method that complies with the revised energy conservation standards (fully enforced on April 1, 2014). Evaluation and indication based on BELS shall be conducted by a registered housing performance evaluation institution member of the Housing Performance Evaluation and Indication Society, a designated confirmation and inspection body or a registered building investigation body that has completed filing as an institution to implement BELS operations.[7]

[6] CASBEE for Building Technical Manual (2014 Edition) published by IBEC
[7] Building Energy-efficiency Labeling System (BELS) Assessment issued by Global Logistic Properties

(4) Achievements in energy-efficiency policies in Japan

Criteria have been periodically revised and the current criteria performance for residential buildings indicate energy consumption of about 40% compared to 1980 standards, as shown in Figure 3.3-1 and Table 3.3-4. The code compliance ratio for non-residential building improved after notification of the mandatory requirement for buildings exceeding 2000m² in 2003, as shown in Figure 3.3-2. The code compliance ratio for residential buildings improved after applying the incentive skim in 2008, as shown in Figure 3.3-3.

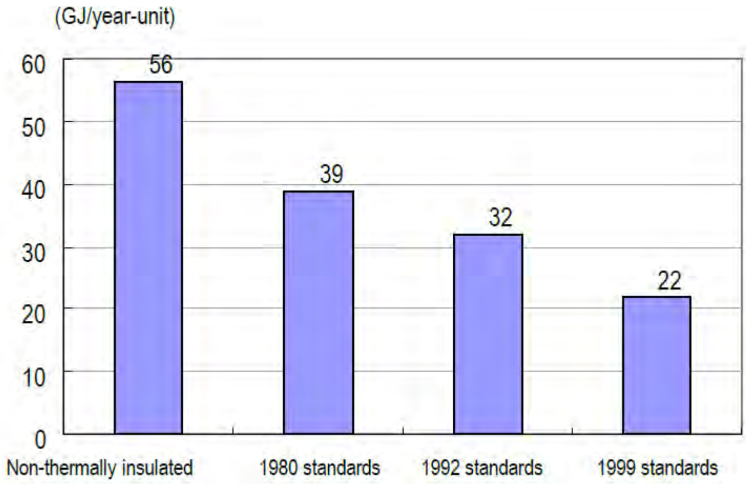
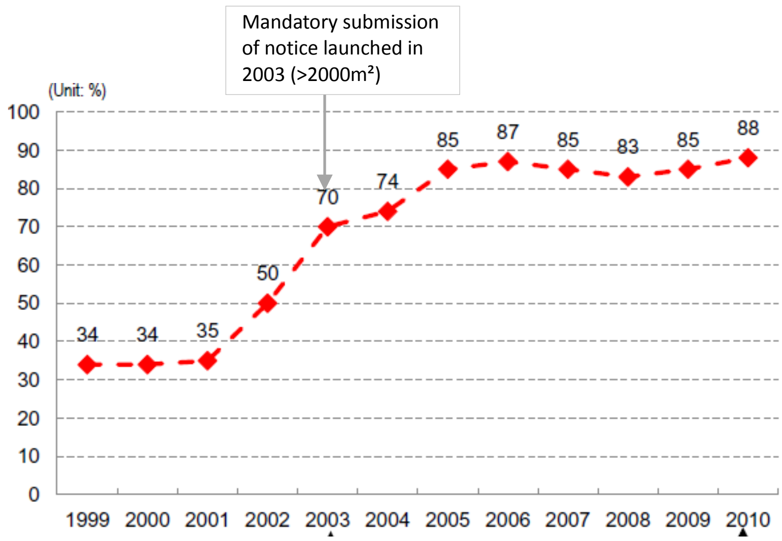



Figure 3.3-1 Provisional Calculation for Annual Energy Consumption (Residential)
Source: Agency of Natural Resources and Energy,
Energy Conservation and Renewable Energy Department, Japan

Table 3.3-4 Comparison of Thermal Insulation Specification by Standards (Residential)

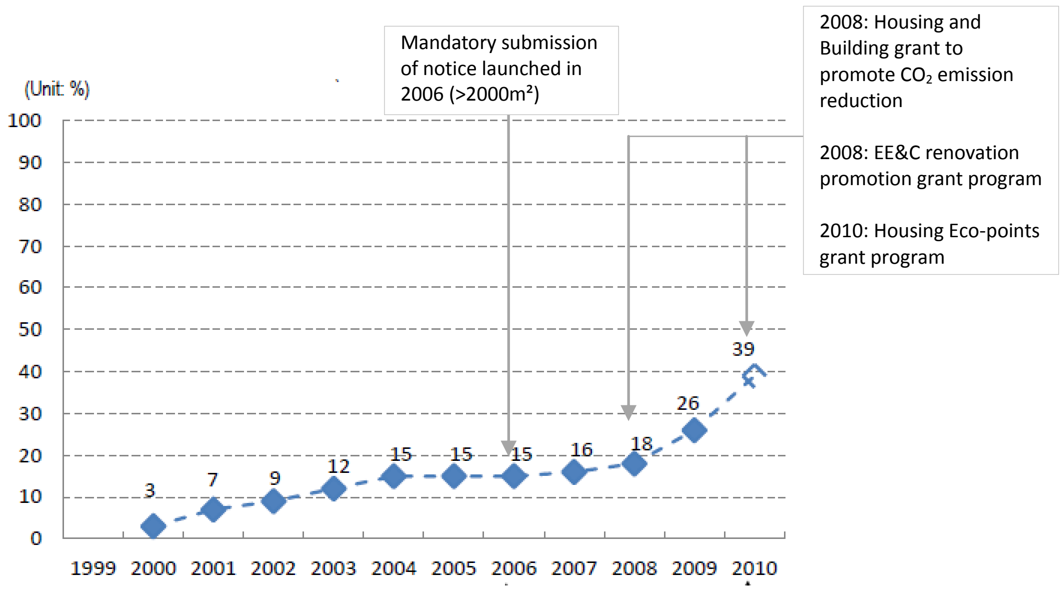
| Item | | Pre-1980 | 1980 standards | 1992 standards | 1999 standards (current) |
|---|---|---|---|---|---|
| Performance standards | Heat loss coefficient (Q-value) | | < 5.2 W/(m²k) | < 4.2 W/(m²k) | < 2.7W/(m²k) |
| Specification standards | Thermal insulation material (External wall) | None | Glass Wool 30mm | Glass Wool 55mm | Glass Wool 100mm |
| | Thermal insulation material (Roof) | None | Glass Wool 40mm | Glass Wool 85mm | Glass Wool 180mm |
| | Opening (window) | Aluminum frame + single pane | Aluminum frame + single pane | Aluminum frame + single pane | Double or single frame + multi-layered glass |
| Annual heating and cooling costs | | 133,000 JPY/ year | 92,000 JPY/ year | 75,000 JPY/ year | 52,000 JPY/ year |
| Annual heating and cooling energy consumption | | 56 GJ | 39 GJ | 32 GJ | 22GJ |

Source: Agency of Natural Resources and Energy,
Energy Conservation and Renewable Energy Department, Japan




Source: Agency of Natural Resources and Energy,
Energy Conservation and Renewable Energy Department, Japan

Figure 3.3-2 Transition of Compliance Rate for
Newly Constructed Non-residential Building Structures (1999 standard)




Source: Agency of Natural Resources and Energy,
Energy Conservation and Renewable Energy Department, Japan

Figure 3.3-3 Transition of Compliance Rate for
Newly Constructed Residential Buildings (1999 standard)

### 3.3.2 Energy Efficiency and Conservation in the building sector in India

The following includes summarized information from 'Developing an Energy Conservation Building Code Implementation Strategy in India'[8].

(1) Implementation of Indian Energy Conservation

1) Energy Conservation Act, 2001
The Government of India enacted the Energy Conservation Act (EC Act) on 1 March, 2002. Under the Act, the Ministry of Power (MOP) of the Government of India established the Bureau of Energy Efficiency (BEE) in March 2002. The EC Act directs BEE to spearhead improvements in energy efficiency through various regulatory and promotional measures and implements the provisions of the act.

2) Energy Conservation Building Code
The EC Act empowers the Central Government to prescribe an Energy Conservation Building Code (ECBC) in the country. BEE, with technical assistance from USAID, supported the Energy Conservation and Commercialization Project (ECO-II Project), a Committee of Experts finalized ECBC in consultation with various stakeholders. In May 2007, MOP formally launched ECBC for its implementation in commercial buildings on a voluntary basis. ECBC sets minimum energy performance standards for commercial buildings with an electrical connected load of 500 kW or more or a contract demand of 600 kVA or more. (Subsequently revised to an electrical connected load of 100kW or more or a contract demand of 120 kVA or more[9])

The Code focuses on building envelopes, mechanical systems and equipment including heating, ventilating and air-conditioning (HVAC) systems, interior and exterior lighting systems, service hot water systems, electrical power and motors and takes into account the five climate zones present in India. A Trade-Off Option allows designers greater flexibility while designing the building envelope.

3) BEE and ECO-III Partnership
Since 2007, BEE has been actively involved in promoting ECBC awareness through nationwide workshops and capacity-building programs for stakeholders. The ECBC Program Committee (EPC) constituted by BEE in 2008, addresses all issues related to ECBC. BEE, on the recommendation of the EPC and with support from the USAID ECO-III Project, brought out a revised version of ECBC in May 2008 to make the document consistent across various sections and rectify typographical errors. In addition, the first national level initiative to collect and analyze standardized building

[8] Written by Satish Kumar and Ravi Kapoor, International Resources Group
[9] Building Energy Efficiency in India, Pacific Northwest, March 2014

energy use data (currently for 760 commercial buildings) has been carried out by BEE in partnership with the USAID ECO-III Project.

4) Institutional Set up for Code Implementation

Implementation of ECBC involves various stakeholders at national as well as state level. Responsibility for implementing codes pertaining to buildings lies with the State-level Urban Local Bodies (ULBs). In India, Standards and Codes are developed at the Central Government level. Subsequently the Central Government advises all State Governments and stakeholders on their voluntary or mandatory adoption at State level. This is also applicable for the implementation of ECBC. The Ministry of Urban Development (MOUD) addresses various urban sector issues through policy guidelines, legislative guidance and sector-specific programs. The town and Country Planning Organization is a technical advisory and consultancy organization of the MOUD on matters concerning urban and regional planning and development strategies, research, monitoring and appraisal of Central Government schemes and development policies. This organization provides technical and policy inputs to the concerned state-level Urban Development.

(2) Other Building Codes and Rating Programs

Apart from ECBC, a few other building codes and building rating systems are currently in use in India, which have been developed by different organizations to promote energy efficiency and environmentally sustainable building systems.

1) National Building Code (NBC)

In 2005, the Bureau of Indian Standards (BIS) developed the National Building Code of India as a comprehensive Building Code, providing guidelines for all building construction activities nationwide. NBC serves only as a Model Code and not a mandatory Code for adoption by all organizations and agencies involved in building construction work. It covers limited guidelines on energy conservation in building systems.

2) Environment Clearance of Large Construction Projects

Since 2007, the Ministry of Environment and Forest (MOEF) undertakes the Environment Impact Assessment and Clearance (EIA) for large buildings and construction projects. Builders and developers must obtain an EIA clearance before construction.

3) Leadership in Energy and Environmental Design (LEED-India[10])

Similar to the LEED rating system, developed by the U.S. Green Building Council (USGBC), LEED-India promotes a whole-building approach to sustainability by addressing performance in the

[10] http://www.igbc.in

following five areas: (1) sustainable site development, (2) water savings, (3) energy efficiency, (4) material selection and (5) indoor environmental quality.

4) Green Rating for Integrated Habitat Assessment

Having recognized that the LEED rating system largely focuses on air-conditioned buildings, while most Indian buildings are not air-conditioned, The Energy and Resources Institute (TERI), developed Green Rating for Integrated Habitat Assessment (GRIHA) [11] — a rating system for new commercial, institutional and residential buildings.

5) Comparison of ECBC and other codes

The following table reviews differences among ECBC, Environmental Clearance, LEED-India and GRIHA:

Table 3.3-5 Comparison of ECBC and Other Codes

| Program | Organization | Framework | Building Type | Key Building Characteristics | Scope |
|---|---|---|---|---|---|
| ECBC | Ministry of Power/BEE | Voluntary | Commercial | Connected load 100 kW≧Contract Demand≧120kVA | Energy Efficiency |
| Environmental Clearance | Ministry of Environment And Forest | Mandatory | Commercial | Built up Area; 20,000-150,000m² | Environmental Impact |
| LEED-India | CII-IGBC | Voluntary | Commercial Institutional Residential | | Sustainable Design/green building |
| GRIHA | Ministry of New and Renewable Energy | Voluntary | Commercial Institutional Residential | | Sustainable Design/green building |

Source: Developing an Energy Conservation Building Code Implementation Strategy in India written by Satish Kumar and Ravi Kapoor, International Resources Group

(3) ECBC User Guide

The ECBC User Guide was produced to assist the Government of India in implementing ECBC, which was launched by the Ministry of Power in May 2007. It is hoped that this document will help create awareness and enhance understanding of the ECBC. The ECO-III Project has developed Tip Sheets and Design Guides previously to help the ECBC implementation efforts.

(4) Comparison between Pakistan, India and Japan

Table below shows comparison of the Building Code of Pakistan Energy Provisions (BCP-EP-2011) with those of India and Japan. In terms of criteria, JST recognized that BCP-EP-2011 lacks any offset mechanism to consider different climatic conditions and building usage and no comprehensive evaluation method with the potential to introduce a certification/rating system. Further JST is

[11] http://www.grihaindia.org/

concerned that the application format and a guidebook for BCP-EP-2011 to facilitate implementation has not yet been prepared.

Table 3.3- 6 Comparison of Energy Codes for Buildings in Pakistan, India and Japan

| Item | | Pakistan<br>BCP-EP-2011 | India<br>ECBC | Japan<br>Act of EEC |
|---|---|---|---|---|
| Criteria | The building scale subject to | Total load >100kw<br>Contract demand >125kva<br>Conditioned area >900m²<br>Un-conditioned area >1200m² | Total load ≧100kw or Contract demand >120kva | More than 300 m² (amended in 2010) |
| | Regulated construction works | New building, extension works, rehabilitation of equipment, scale up to or beyond the criteria of the electric contract | Same as shown on the left | New building, extension works, reconstruction works. Where the building has more than 2000 m² of floor space, rehabilitation of equipment is also covered |
| | Voluntary / Mandatory | Mandatory (included voluntary articles)<br>PEC has the power to penalize violators | The provision was introduced on a voluntary basis in 2007 and they planned to impose it on a mandatory basis for all states. As of 2013, only two out of all 35 states had imposed it on a mandatory basis | Notification is mandated (penalty)<br>Periodic reports shall be submitted every three years |
| | Building part or equipment subject to | Envelop (Wall, Roof, Window)<br>Air-conditioner<br>Ventilation<br>Hot water supply<br>Lighting<br>Transformer, Motor | Same as shown on the left | Envelope (Wall, Roof, Window)<br>Air-conditioner<br>Ventilation<br>Hot water supply<br>Lighting |
| | Offset by climate condition | NA | 5 climate zones | 8 climate zones |
| | Offset by other condition | NA | Only day use / 24 hour use | Building usage |
| | Methodology for confirmation to comply with criteria | Confirmation to comply with criteria for all parts and building equipment | Elective<br>1. Confirmation to comply with criteria for all parts and building equipment<br>2. Comprehensive building-wide evaluation | Comprehensive building-wide evaluation |
| Implementation Material | Application Format | NA | Prepared | Prepared |
| | Confirmation on site | Not adopted by DA | No | No |
| | Periodic report after completion | NA | NA | Periodic reports shall be submitted every three years |
| | Guidebook | NA | Prepared | Prepared |
| | Building labeling scheme | NA | LEED India, GRIHA | BELS, CASBEE |

Source: JST

### 3.3.3 Energy Efficiency and Conservation in the building sector in the U.S.A.

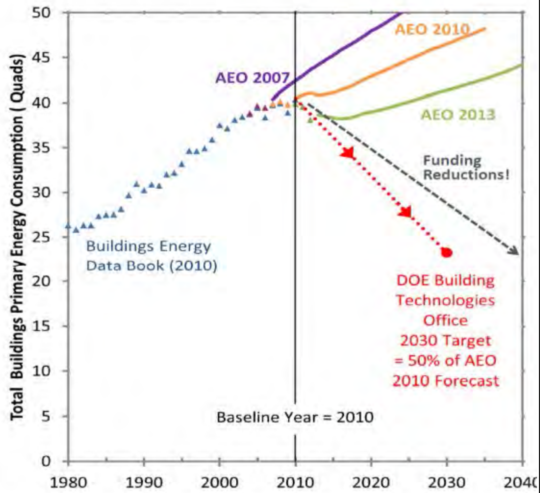
The 'Office of Energy Efficiency & Renewable Energy (EERE)[12] is one of the ten Program Offices of the U.S. Department of Energy (DOE). 'EERE' offers guidance and technical resources to stakeholders involved in Building Energy Conservation, i.e. policy-makers, compliance verification professionals, architects, engineers, contractors and other stakeholders who depend on Building Energy Codes. The following reference is made to the website of 'Office of Energy Efficiency & Renewable Energy' of the 'U.S. Department of Energy':

Table 3.3-7 Statement of Office of Energy Efficiency & Renewable Energy of DOE

*'The U.S. Department of Energy (DOE) is required by law to establish mandatory energy efficiency requirements for new federal commercial and residential buildings and to develop energy efficiency standards for manufactured homes.'*

*'Federal law also requires that DOE publish determinations as to whether new editions of ASHRAE Standard 90.1 and the International Energy Conservation Code will improve energy efficiency. In response, DOE, through the Building Energy Codes Program (BECP) undertakes rulemaking processes to facilitate full disclosure of DOE's analyses and development methodologies, to solicit public input, and to publish final rules. DOE's rulemaking process involves.'*

*'The Building Technologies Office (BTO) supports greater adoption of residential and commercial building energy codes through collaborative efforts with local governments and industry groups, and by providing key tools and assistance for code development, adoption, and implementation. Through advancing building codes, we aim to improve building energy efficiency by 50% in 2030, compared to the energy consumption projected by the 2010 Annual Energy Outlook, and to help states achieve 90% compliance with their energy codes.'*




Source: DOE

(1) History of Energy Conservation in the U.S.A.

The U.S. Building Energy Code was issued as a 'Building Energy Codes Program (BECP)' by the U.S. DOE in 1992. The following table shows the history of the implementation of U.S. Energy Conservation, including Building Energy Conservation.

Table 3.3-8 History of the Implementation of Energy Conservation in USA

| | |
|---|---|
| 1975 | Energy Policy and Conservation Act (EPCA)<br>Call for establishment of energy conservation program and efficiency target |
| 1978 | National Energy Conservation and Policy Act (NEPCA) |

[12] http://www.energy.gov/eere/buildings/building-energy-codes-program

| | |
|---|---|
| | Authorizes DOE to set mandatory standards for thirteen household products |
| 1987 | National Appliance Energy Conservation Act (NAECA)<br>Establishes national standards for home appliances, and schedules regular update through 2012 |
| 1992 | Energy Policy act (1)(EP Act 92)<br>Expands standards to include additional commercial and residential appliances<br>The BECP (the Building Energy Codes Program) was founded in 1992 in response to the Energy Policy Act of 1992 (EP Act 92).[13] |
| 2005 | Energy Policy act (2)(EP Act 05)<br>Updates testing procedures for appliances |
| 2007 | Energy Independence and Security Act (EISA 2007)<br>Expands standard to include additional appliances and updates some existing standard |

Source: Energy Efficiency Policy in the United States: Overview of Trends at Different Levels of Government written

The Energy Policy and Conservation Act of 1975 (EPCA) was enacted on 22 December, 1975 in response to the 1973 oil shock by creating a comprehensive approach to federal energy policy. The National Energy Conservation Policy Act of 1978 is a United States statute; enacted as part of the National Energy Act. Energy Demand Management programs had been legislated earlier in California and Wisconsin as early as 1975.

The National Appliance Energy Conservation Act of 1987 is a United Sates Act of Congress that regulates the energy consumption of specific household appliances. However, Minimum Energy Efficiency Standards were first established by the United State Congress in Part B of Title III of the Energy Policy and Conservation Act (EPCA) and then amended by the National Appliance Energy Conservation Act of 1987, the Energy Policy Act of 1992 and the Energy Policy Act of 2005. All these laws and regulations aim to establish mandatory standards that deal with the energy efficiency of certain household appliances. These standards were stipulated to ensure manufacturers were building products offering optimal energy-efficiency levels that were also technically feasible and economically justified.

The National Appliance Energy Conservation Act of 1987 amended the Energy Policy and Conservation Act and was introduced and supported by democratic Senator Bennett Johnston, Jr. from Louisiana in January 1987. The new amendments to the act established minimum efficiency standards for many household appliances, including the following items:[14]

Table 3.3-9 Items of The National Appliance Energy Conservation Act of 1987

| | | | |
|---|---|---|---|
| Refrigerator | Refrigerator-Freezers | Freezers | Room Air Conditioner |
| Fluorescent Lamp Ballasts | Pool Heaters | Clothes Dryers | Clothes Washers |
| Dishwashers | Water Heaters | Incandescent Reflector Lamps | |
| Television Sets (withdrawn in 1995) | | Kitchen Ranges and Ovens | |

Source: Homepage of Energy. Gov.: http://energy.gov/

[13] EP Act 92 mandated that DOE participate in the model national codes development process and help states adopt and implement more efficient energy codes.

[14] Source; Energy Efficiency Policy in the United States: Overview of Trends at Different Levels of Government written by Ms. Elizabeth Doris and Ms. Jaquelin Cochran and Mr. Martin Vorum

Congress set the initial efficiency standards at the start of the act, followed by a schedule for the U.S. Department of Energy to review them. The act also put into place laws prohibiting manufacturers from making any representations about the energy efficiency of any product on this list without first being subject to federal testing procedures and disclosing the results of such tests.[15]

(2) Department of Energy (DOE) and Energy Star

The U.S. Department of Energy (DOE) is authorized by the Energy Policy and Conservation Act of 1975 (as amended) to enforce compliance with energy and water conservation standards established for certain consumer products and commercial and industrial equipment.

To ensure the current standards for covered appliances and equipment are implemented, the DOE has published certification, compliance and enforcement regulations for these products and equipment in the Code of Federal Regulations linking to the Electronic Code of Federal Regulations (e-CFR). These regulations describe how manufacturers must establish certified ratings based on conducting DOE test procedures on a sample of units of a given basic model and subsequently apply DOE's statistical sampling plans. The regulations also describe how manufacturers must submit certification reports to DOE and maintain records underlying the certification. Finally, the regulations describe processes for DOE-initiated testing and enforcing compliance with the certification provisions and energy and water conservation standards.

(3) Implementation of Building Code in Federal and Local Government

Building efficiency policies historically map to different jurisdictions in the United States in the table mentioned below. The Federal Government sets out nationwide appliance standards, which are uniformly provided for manufacturers, thus easing the burden of providing different equipment for each state market.[16]

Table 3.3-10 Map of Building Code Policies to Jurisdiction

| | **Federal** | **State** | **Local** |
|---|---|---|---|
| **Barrier Reduction** | | | |
| Building Code Design | No | Most | Some |
| Building Code Enforcement | No | Some | All |
| Appliance Standard | Yes | Some | None |
| Labeling | Yes | None | None |
| Public Leadership | Yes | Most | Most |
| **Technology Accessibility** | | | |
| Incentives (Multiple kinds) | Yes | Some | Some |
| Research and Development | Yes | Some | None |

Source: Energy Efficiency Policy in the United States: Overview of Trends at Different Levels of Government written by Ms. Eliza Doris and Ms. Jaquelin Cochran and Mr. Martin Vorum

[15] Source; Website of Energy Gov.; http://energy.gov/

[16] Website of Energy Gov.

Codes help occupants save energy and money over a building's lifetime by regulating aspects of the building envelope and Lighting and Heating, Ventilation and Air-Conditioner (HVAC). Building codes are an essential part of the government effort to transform the long-term market for energy efficiency. Building codes fall primarily within state and local jurisdiction and consequently vary widely across the United States to meet the needs and climates of different regions. The federal government has primary jurisdiction standards. Sixteen states have also adapted standards for residential and commercial appliances not covered by federal legislation.

The U.S. federal government does not have direct jurisdiction over building codes. Local governments have jurisdiction over building codes in four regards:

- ✧ Establishing codes, unless pre-empted by state codes
- ✧ Enforcing codes
- ✧ Leading by example
- ✧ Promoting high-efficiency certification of public and private buildings, typically through the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program.

In states without mandatory building codes, the local governments can establish codes.

(4) Energy Star and Labeling System

The ENERGY STAR is a joint program of the Environmental Protection Agency (EPA) and the Department of Energy (DOE), which aims to help consumers, businesses and the industry save money and protect the environment by adopting energy-efficient products and practices. The ENERGY STAR label identifies top-performing, cost-effective products, homes and buildings. Since its inception, ENERGY STAR has achieved impressive results; in 2010 Americans saved enough energy to avoid greenhouse gas emissions equivalent to those from 33 million cars, while saving nearly $18 billion on utility bills.[17]

The labeling system is only imposed on a federal level. Mandatory comparative labeling was legislated in the Energy Policy and Conservation Act of 1975 and National Conservation Policy Act of 1979 and launched in 1980. Endorsement labels are used in the United States to identify very efficient products of a given class. Under the ENERGY STAR title, endorsement labeling is a voluntary program jointly implemented by the U.S. Environmental Protection Agency (EPA) and DOE. Initiated in 1992, the program now covers 50 product categories and is a well-recognized label.

(5) Incentive Scheme

1) Federal Tax Credit for Energy Efficiency

<u>Tax Credits for Home Builders</u>

[17] Energy Efficiency Policy in the United States: Overview of Trends at Different Levels of Government written by Ms. Elizabeth Doris and Ms. Jaquelin Cochran and Mr. Martin Vorum

The Internal Revenue Service (IRS) has provided the following guidance regarding tax credits to construct new energy-efficient homes available under the Energy Policy Act of 2005:

- ✧ IRS Notice 2008-35 provides guidance for credit for building energy-efficient homes other than manufactured homes.
- ✧ IRS Notice 2008-36 provides guidance for credit for building energy-efficient manufactured homes.

Tax Credits for Manufacturers

The Tax Relief and Job Creation Act of 2010 modifies and extends the energy-efficient appliance credit for certain dishwashers, clothes washers and refrigerators manufactured after December 31, 2010.

Tax Deductions for Commercial Buildings

The commercial building deduction appears in the new section 179D, which was enacted in the Energy Policy Act of 2005. The provision allows deductions for taxpayers who own, or are lessees of, a commercial building and install property as part of the commercial building's interior lighting systems, heating, cooling, ventilation and hot water systems, or building envelope.

### 3.3.4 Energy Efficiency and Conservation policy in other countries

(1) Analysis of Achievements

At the economy-wide level, energy intensity measures (expressed as the amount of energy used to produce a dollar of GDP) are often the most widely applied metric to assess energy usage trends over time and across countries. Most countries set their target relative to either energy intensity or aggregate energy consumption. However, due to the several aspects such as price-driven and income driven changes in demand and the type of major industries in countries, this indicator does not purely represents the level of energy efficiency .

Despite the limitations of these metrics, worldwide energy-intensity levels have improved substantially.

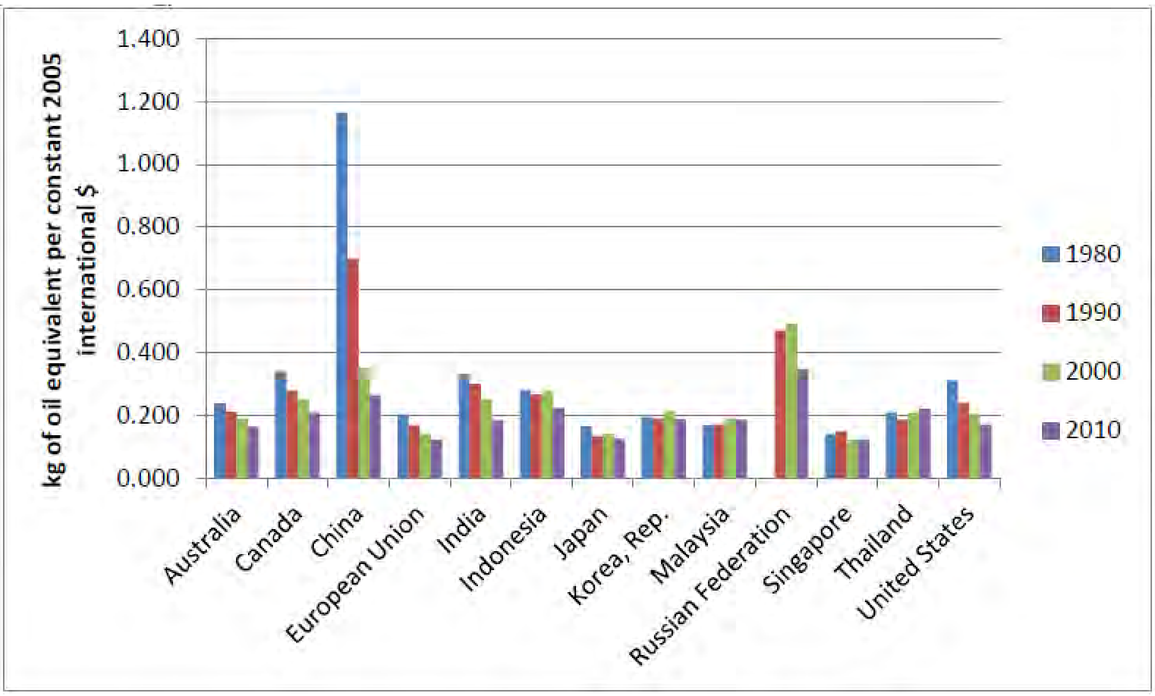



Figure3.3-4-Energy intensities in selected countries, 1980-2010
Source: Pacific Energy Summit 2013

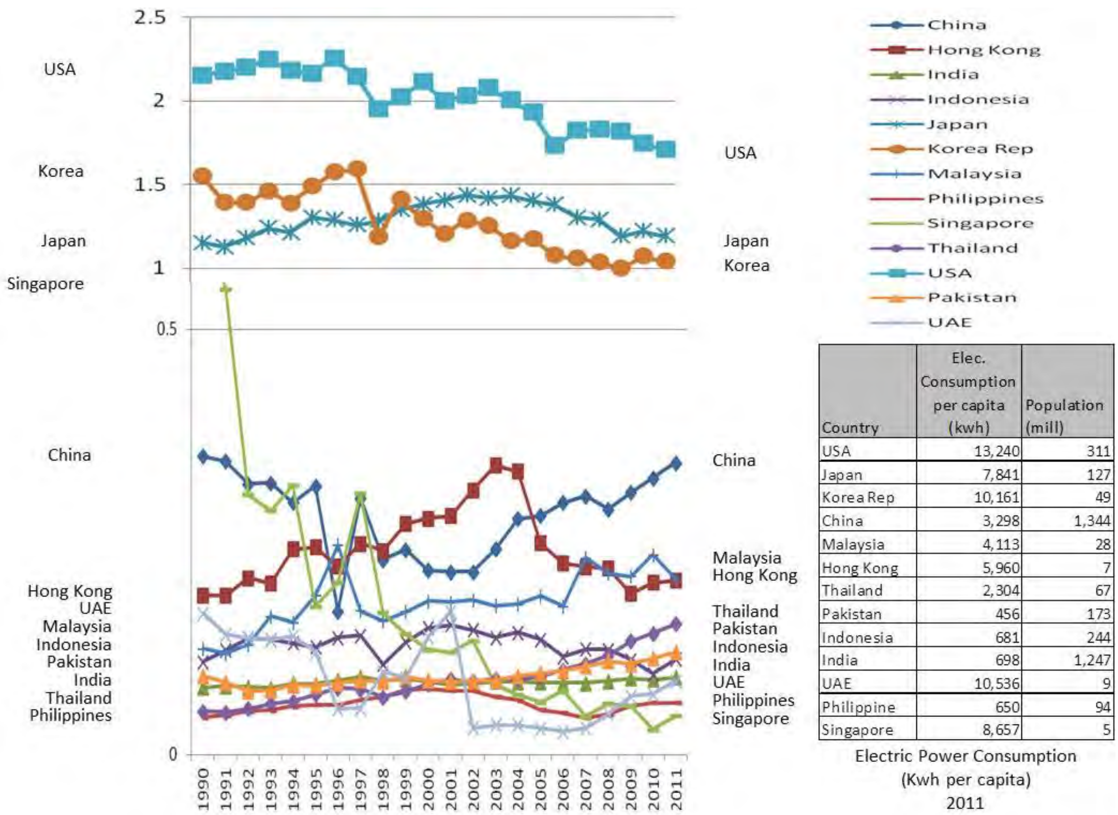
Table 3.3-11- Findings from Figure 3.3-4

| |
|---|
| ✧ Two broad patterns can be discerned: richer countries tend to have lower energy-intensity levels, and energy-intensity levels have fallen across the last three decades in most countries in the sample.<br>✧ As major natural resource producers, Canada and Australia are at higher absolute levels than the European Union (EU).<br>✧ The levels of the United States lie somewhere between Australia and Canada.<br>✧ Japan has the lowest intensity ratios among the OECD group, although given low or negligible economic growth rates over the past two decades, its rate of energy intensity improvement since the 1990s is marginal.<br>✧ The picture for developing Asia is more mixed. Rapidly industrializing countries such as Thailand, Malaysia, and South Korea show no trends of improvement.<br>✧ By contrast, the larger developing countries with lower per capita incomes, such as India and China, show dramatic improvements in energy intensity, reflecting both their rapid rates of economic growth and the very low levels of energy efficiency from which these countries began their impressive economic growth trajectories in the 1980s and 1990s.<br>✧ Most dramatic has been the nearly fivefold decline in energy intensity in China between 1980 and 2010, although China still remains one of the most energy-intensive major economies.<br>✧ While energy intensity tends to be higher in developing countries than in the OECD economies, there has been rapid convergence over the past three decades. According to the IEA, the ratio between the highest and lowest values has declined from a factor of nine in the 1980s to just below five in 2012. |

Source: Pacific Energy Summit 2013

Figure 3.3-5 indicates the amount of $CO_2$ emissions from residential and commercial and public services (metric tons per capita) for the last two decades. Trends of energy usage are visualized and the findings are listed as below:

- ✧ High electricity consumption countries show more $CO_2$ emissions in general. However countries like the UAE and Singapore, despite having a high electric consumption per capita, limit $CO_2$ emissions, which may reflect the low-efficiency level of power generation due to the smaller population and high-efficiency level in demand side.
- ✧ A continuous decline over the last two decades has been observed in the USA, Korea and Singapore, while in Japan, Hong Kong, Indonesia and the Philippines, a decline has been observed in the last 8-10 years following a decade of growth.
- ✧ Continuous growth for the last two decades has been observed in Malaysia and Thailand, in line with the observation of energy intensity in Figure 3.3-4. In China, the last decade of growth generated the same $CO_2$ emissions as twenty years ago.
- ✧ A remarkable decline has been observed in Singapore. The number has been reduced by 93% in two decades.
- ✧ Pakistan's $CO_2$ emission level is relatively low among those countries. However, continuous growth has been observed over the last two decades.




| Country | Elec. Consumption per capita (kwh) | Population (mill) |
|---|---|---|
| USA | 13,240 | 311 |
| Japan | 7,841 | 127 |
| Korea Rep | 10,161 | 49 |
| China | 3,298 | 1,344 |
| Malaysia | 4,113 | 28 |
| Hong Kong | 5,960 | 7 |
| Thailand | 2,304 | 67 |
| Pakistan | 456 | 173 |
| Indonesia | 681 | 244 |
| India | 698 | 1,247 |
| UAE | 10,536 | 9 |
| Philippine | 650 | 94 |
| Singapore | 8,657 | 5 |

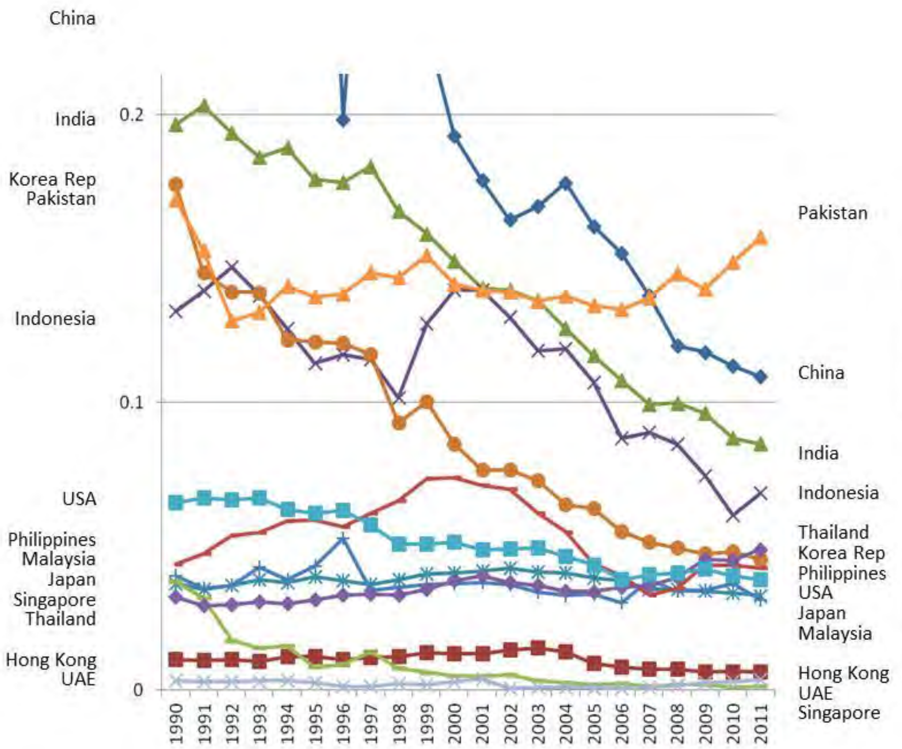
Electric Power Consumption
(Kwh per capita)
2011

Source: Calculated by JST using World Bank Indicator

Figure3.3-5-CO2 emission from residential and commercial and public services (metric ton per capita)

Figure 3.3-6 indicates the $CO_2$ emissions from residential, commercial and public services (kg per 2005 US$ of GDP) over the last two decades.

- ✧ 6 of 13 countries are within 0.03-0.05kg per GDP, which includes the USA and Japan.
- ✧ Remarkable declines have been observed in China, India, Indonesia and Korea. While Korea has reached under 0.05kg per GDP, the remaining three countries still have relatively high $CO_2$ emissions.
- ✧ Except for the USA, Japan and Korea, the general tendency is that the greater the national GDP, the higher the $CO_2$ emissions per GDP.
- ✧ In Hong Kong, the UAE and Singapore, the $CO_2$ emission level per GDP has been very low, like 0.001-0.003 kg per GDP which is less than 10% of majorities.
- ✧ Pakistan is a country showing growth after 2005 with the highest $CO_2$ emission level among the countries shown below. This may reflect negative impact caused by chronic load-shedding worsen after 2005.




| | 2011 |
|---|---|
| Country | bill |
| Pakistan | 213 |
| China | 7,492 |
| India | 1,835 |
| Indonesia | 892 |
| Thailand | 345 |
| Korea Rep | 1,202 |
| Philippine | 224 |
| USA | 15,517 |
| Japan | 5,905 |
| Malaysia | 289 |
| Hong Kong | 248 |
| UAE | 347 |
| Singapore | 275 |

GDP
(Billion current US$)

Source: Calculated by JST using World Bank Indicator
Figure3.3-6-CO2 emission from residential and commercial and public services
(kg per 2005 US $ of GDP)

(2) Policy of Building Energy Efficiency in Asia- Pacific

Table 3.3-12 shows policy tools and leading programs in Asian-Pacific countries. As a major benchmark for EE&C promotion, actions are categorized into five:

i) Minimum Performance Standard.
ii) Labeling of Energy Performance
iii) Financial Incentives
iv) Industry-Capacity Development
v) Education and Awareness Raising

Table 3.3-13 shows a matrix of the above actions carried out in each country.

Table 3.3-12: Policy tool kit for market transformation: lessons learned and Asian examples

| POLICY TYPE | DESCRIPTION | CHARACTERISTICS OF EFFECTIVE PROGRAM | LEADING EXAMPLE IN ASIA |
|---|---|---|---|
| Minimum Energy Performance Standards<br>-Appliances/ Equipment<br>-Buildings | -Shift the distribution of energy-efficient models sold in the market upward by removing most inefficient offerings.<br>-Foundation of most energy efficiency programs world-wide.<br>-Well documented track record globally | -Mandatory<br>-Financially feasible for majority of market and harmonized with international standards.<br>-Industry involved in development.<br>-Legal framework, compliance infrastructure, skilled staff.<br>-Testing procedures and protocols for appliances and equipment.<br>-Provide regulatory certainly and drive innovation through regular standards revision.<br>-Industry awareness-raising.<br>-Government procurement/ tenancy<br>-Complemented by R&D | **Appliance/ Equipment**<br>Japan: Unique Top Runner program widely recognized as innovative and effective.<br>South Korea: Aggressive and comprehensive implementation with corresponding results.<br><br>**Buildings**<br>Singapore, Japan, Taiwan, South Korea all have comprehensive building standards, established compliance and required implementation skills. |
| Labeling of energy performance<br>-Appliances/ Equipment<br>-Buildings | -Enables consumers to include energy efficiency in buying decisions.<br>-Stimulates producers to differentiate their product offering by achieving higher ratings.<br>-Proven complement to minimum energy standards for appliances and equipment.<br>-Emerging trend for buildings- scope often extends beyond energy performance (e.g. green building) | -Mandatory once program established.<br>-Clarity of labeling.<br>-Industry involved in development.<br>-Legal framework, compliance infrastructure, skilled staff.<br>-Testing procedures and protocols for appliances and equipment.<br>-Industry and consumer awareness-raising.<br>-Government procurement/ tenancy<br>-Financial incentives or financing. | **Appliance**<br>South Korea: aggressive and comprehensive implementation, also high-efficiency equipment certification program.<br>Thailand: Unique utility-led appliance labeling program.<br>**Buildings**<br>South Korea: label for superior energy performance for new and existing residential buildings.<br>Singapore: label for achievement of superior energy performance and meeting IAQ requirements for new building.<br>Japan and Hong Kong have labeling systems which include energy performance along with other measure. |
| Financial Incentives | -Financially valuable incentives stimulate investment in energy performance beyond minimum required standards.<br>-Signal the market of future regulatory intent.<br>-May also be used to stimulate demand for energy-efficient consumer products. | -Incentives based on performance, rather than cost or price.<br>-Designed to complement energy standards, labeling programs, etc.<br>-Valued by target sector.<br>-Program accompanied by promotion/ awareness raising.<br>-Costs minimized by setting high goals and modest incentives: 25%-50 of incremental market price.<br>-Simple to understand and administer. | South Korea: incentives linked to building certification level for new and existing buildings and certification of high efficiency equipment.<br>Singapore: incentives linked to green building certification levels and for upgrading of equipment.<br>Japan: support for housing efficiency upgrades.<br>Taiwan: rebates for installation of solar hot |

| | | | |
|---|---|---|---|
| | | -Accurate reporting and tracking of program results.<br>-Compliance recognized with labels or ratings. | water systems.<br>Thailand: unique ENCON fund derived from petrol tax and used to further energy efficiency objectives. |

| POLICY TYPE | DESCRIPTION | LEADING EXAMPLE IN ASIA |
|---|---|---|
| Industry-Capacity Building | Designated Center of Excellence charged with information distribution, technical guidance and research in support of policy development. | South Korea (KEMCO), Hong Kong (EMSD), Singapore (NCCS) and Malaysia (PTM) |
| | Public or public/ private projects to raise industry awareness of improved or new technologies or to demonstrate design compliance with new standards | Malaysia: Securities Commission Building, LEO and ZEO public demonstration buildings.<br>China: MOST public demonstration building, (LEED gold) and pilot cities for energy management programs.<br>Singapore: National Library public building (Green Mark Platinum)<br>India: Cll-Godrej Green Building Center public/ private partnership.<br>Hong Kong: EMSD government building. |
| | Energy performance benchmarking to allow building owners to evaluate performance levels and a vital input to policy making and tracking. | Hong Kong and Singapore have energy benchmarking initiatives which aid both building owners and policy makers. |
| | Skills enhancement such as industry training programs | Singapore: Energy Training Program for Energy Efficient Building Management.<br>Japan: voluntary training of construction techniques linked to newest building standards.<br>Hong Kong: provision of technical and financial analysis to increase industry awareness and understanding. |
| | Building Audit program | Hong Kong: Extensive auditing of government buildings with the findings being used to develop guidelines and recommendations for the private sector.<br>South Korea, Singapore, Thailand, energy audits target building segments. |
| | Government Modeling | Singapore, Taiwan- Mandatory green building certification for government-funded new construction.<br>South Korea: mandatory energy savings plans with semi-annual reporting.<br>Hong Kong: mandatory energy audits for government buildings<br>Philippines: energy reduction targets and ratings |
| Education and Awareness-Raising | Public advertising to establish link between the users' behavior, energy savings and the environment. | Most economies have some form of public awareness campaigns; the most well-known is probably Japan's "Cool Biz" campaign. |
| | Education of children, media, politicians; via school curriculum, exhibitions, seminars, forums, conferences, etc. | Many economies have some form of education outreach targeted to government officials school age children, and/or specific industry segments. |

Source: Building Energy Efficiency, An Asia Business Council Book, 2007

Table 3.3-13-Comparison of Energy Efficiency policy in Asia- Pacific countries as of 2007

| | CHINA | HONG KONG | INDIA | INDONESIA | JAPAN | MALAYSIA | PHILIPPINES | SINGAPORE | KOREA REP. | TAIWAN | THAILAND |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Minimum Energy Performance Standards** | | | | | | | | | | | |
| Appliance/ Equipment | ● | - | ○ | ● | ● | ● | ● | ● | ● | ● | ● |
| Buildings | ● | ● | ● | ○ | ○ | ○ | ● | ● | ● | ● | ● |
| **Labeling of Energy Performance** | | | | | | | | | | | |
| Appliances/ Equipment | ● | ○ | ○ | ○ | ○ | ○ | ● | ○ | ● | ○ | ● |
| Buildings | ○ | ○ | ○ | - | ○ | - | ? | ○ | ○ | ○ | ? |
| Green Building Rating & Certification | ○ | ○ | ○ | - | ○ | - | Ⓟ | ○ | ○ | ○ | - |
| **Financial Incentives** | | | | | | | | | | | |
| To Stimulate Performance/ Supply | Ⓟ | - | - | ? | ✓ | ✓ | ? | ✓ | ✓ | ? | ✓ |
| To Stimulate Demand | Ⓟ | ✓ | - | ? | ✓ | ✓ | ? | - | ✓ | ✓ | ? |
| **Industry- Capacity Building** | | | | | | | | | | | |
| Centers of Excellence | ✓ | ✓ | ✓ | ? | ?(✓) | ✓ | - | ✓ | ✓ | ? | ✓ |
| Energy performance Benchmarking | - | ✓ | - | v | ?(✓) | ✓ | - | ✓ | ? | ✓ | ? |
| Skills Enhancement | ✓ | ? | ✓ | ? | ✓ | ✓ | ✓ | ✓ | ? | ? | ✓ |
| Sponsored R&D | ? | ? | - | ? | ?(✓) | ? | ? | ✓ | ? | ? | v |
| Building Audit Program | ? | - | ✓ | - | ✓ | ✓ | - | ✓ | ✓ | ✓ | ✓ |
| **Labeling-by-example Program** | | | | | | | | | | | |
| Government Modeling | ✓ | ✓ | ✓ | - | ✓ | ? | ✓ | ✓ | ✓ | ✓ | ? |
| Demonstration Buildings | ✓ | ✓ | ✓ | ? | ✓ | ✓ | - | ✓ | ? | ✓ | ✓ |
| **Consumer Awareness-Raising** | | | | | | | | | | | |
| Public Advertising | ? | ✓ | ✓ | ? | ✓ | ? | ✓ | ✓ | ? | ✓ | ✓ |
| School Education Program | ? | ✓ | ? | ? | ✓ | ✓ | ✓ | ✓ | ? | ? | ? |
| **Policy Implementation** | | | | | | | | | | | |
| Enforcement Infrastructure | Ⓟ | ✓ | - | - | ✓ | - | - | ✓ | ✓ | ✓ | - |

●Mandatory ○Voluntary ✓Have program Ⓟ Planned ? Unknown - Non/ Limited
( ) filled by JST
Source: Building Energy Efficiency, An Asia Business Council Book, 2007

(3) Good Practice in Neighboring Countries

1) Singapore

As indicated earlier, Singapore has reduced $CO_2$ emissions dramatically since 1990 to date. As of 2011, the $CO_2$ emission of from residential, commercial and public services are one of the best in Asian countries within a tropical climate. Its policies and measures are widely referred to by neighboring countries as benchmarks.

a) Building an Energy-Efficiency Code (Enforcement)

An exemplary set of mandatory and voluntary building energy-efficiency and green building programs are available in Singapore, most of which are coordinated via the Building Energy Efficiency Master Plan formulated by the Building and Construction Authority (BCA). Singapore was the one of the first countries in the region to develop and implement an energy code, which has been mandatory from the outset. An extensive compliance guideline has also been available since the early 1980s. The history of BEEC is shown below.

Table 3.3-14 History of Building Energy Code in Singapore

| | |
|---|---|
| 1979<br>First Edition | First version referring ASHRAE 1975 Scope of standard includes;<br>(1) the building envelope; (2) air conditioning; (3) lighting; (4) electrical systems; and (5) service water heating |
| 1989<br>Revision | The standard contained requirements for roof and wall insulation, air leakage, location of entry doors, zoning for temperature control, sufficient electric power metering, switching off air conditioning automatically in hotel guest rooms when unoccupied, and data-logging facilities for collecting data for energy audits. |
| 1999 | three codes of practice for buildings were updated:<br>(1) Code of Practice for Energy-Efficiency Standard for Building Services and Equipment; (2) Code of Practice for Mechanical Ventilation and Air conditioning in Buildings; and (3) Code of Practice for Artificial Lighting in Buildings.<br><br>Included a new system analysis tradeoff compliance option in addition to the prescriptive compliance that had been in effect since 1979. This new method uses a software-based set of tools developed and made available by the National University of Singapore (NUS). It can be used by engineers, architects and building services professionals to demonstrate compliance with prescriptive and energy performance standards relating to air-conditioned buildings. |

Source: Building Energy Efficiency, An Asia Business Council Book, 2007

b) Incentives

Green Mark Incentive Scheme (GMIS)

BCA launched the Green Mark Scheme in 2005, to promote environmental awareness in construction and real estate sectors.

There are three levels of financial incentives (gold, gold plus and platinum), corresponding to increasing levels of green technologies and energy savings obtained. For energy performance, the gold level requires energy efficiency at a level required by the building standard. The gold plus level requires energy performance 25% better than standard, while the platinum level requires energy performance 30% better than standard. The incentives range from USD 2-6 / per square meter of gross floor area for new buildings; retrofitting of existing buildings is eligible for about 40% of the incentive for new buildings per square meter.

c) Public Leading Action

To provide landlord government agencies with a rough indication of how they fare in comparison with other buildings of equivalent type in terms of energy performance, the BCA is planning to band all public sector buildings by type based on energy performance into three groups, i.e. the top 25%, middle 50% and bottom 25%. An initial banding of all large public office buildings was completed by 2007.

2) UAE (The Emirates of Abu Dhabi)

a) Estidama

The Abu Dhabi Urban Planning Council (UPC) is recognized internationally for large-scale sustainable urban planning and rapid growth. The Abu Dhabi 2030 urban master plan addresses sustainability as a core principle. Estidama, which is the Arabic word for sustainability, is an initiative developed and promoted by the UPC.

b) Pearl Rating System

The Pearl Building Rating System (PBRS) aims to promote the development of sustainable buildings and improve quality of life. Achieving a sustainable building is contingent on integrating the four pillars of Estidama together with a collaborative and inter-disciplinary approach to building development known as the Integrated Development Process. The PBRS encourages water, energy and waste minimization, local material use and aims to improve supply chains for sustainable and recycled materials and products.

An Executive Council Order of May 2010 states that all new buildings must meet the 1 Pearl requirements starting in September 2010, whilst all government-funded buildings must achieve a minimum of two Pearls. Following this mandate, significant efforts have been made to align the PBRS with the Abu Dhabi Development and Building Codes. The PBRS is applicable to all building typologies, their sites and associated facilities, including hospitals, warehouses, industrial buildings, laboratories and hotels. In essence, any building constructed for permanent use and air-conditioned must meet the PBRS requirements.

The Pearl Rating System is organized into seven categories that are fundamental to more sustainable development and form the heart of the Pearl Rating System:

Table 3.3- 15 Seven Categories in Pearl Rating System

| | |
|---|---|
| Integrated Development Process: | Encouraging cross-disciplinary teamwork to deliver environmental and quality management throughout the life of the project. |
| Natural Systems: | Conserving, preserving and restoring the region's critical natural environments and habitats. |
| Livable Buildings | Improving the quality and connectivity of outdoor and indoor spaces. |
| Precious Water | Reducing water demand and encouraging efficient distribution and alternative water sources. |
| Resourceful Energy | Targeting energy conservation through passive design measures, reduced demand, energy efficiency and renewable sources. |
| Stewarding Materials | Ensuring consideration of the 'whole-of-life.' cycle when selecting and specifying materials. |
| Innovating Practice | Encouraging innovation in building design and construction to facilitate market and industry transformation. |

Source: Pearl Building Rating System: Design & Construction, Version 1.0, April 2010

Table 3.3-16: Pearl Building Rating Levels

| Requirements | Pearl Rating Achieved |
|---|---|
| All mandatory credits | 1 Pearl |
| All mandatory credits + 60 credit points | 2 Pearl |
| All mandatory credits + 85 credit points | 3 Pearl |
| All mandatory credits + 115 credit points | 4 Pearl |
| All mandatory credits + 140 credit points | 5 Pearl |

Source: Pearl Building Rating System: Design & Construction, Version 1.0, April 2010

The number of credit points available in a given section determines the weighting of that section. Different building uses may have a different number of credit points for a particular component.

Table 3.3-17: Maximum Credit Points Available for each Section

| Credit Section | | Maximum Credit Points |
|---|---|---|
| IDP | Integrated Development Process | 13 |
| NS | Natural Systems | 12 |
| LB | Livable Buildings | 37 |
| PW | Precious Water | 43 |
| RE | Resourceful Energy | 44 |
| SM | Stewarding Materials | 28 |
| IP | Innovating Practice | 3 |
| **TOTAL** | | 177 |

Source: Pearl Building Rating System: Design & Construction, Version 1.0, April 2010

* LB: Maximum of 36 credit points available for Offices and 30 credit points for Retail.

PW: Maximum of 45 credit points available for Schools.

Total: Excludes Innovating Practice credit points which are offered as bonus credits

c) The Pearl Rating Stages

The Pearl Rating System recognizes the reality of ownership and responsibility transitions as a project evolves from design team to construction team and facility management team. Accordingly, three rating stages have been established: Design, Construction and Operational.

i) Pearl Design Rating

The Design Rating rewards measures adopted during the design development of a project that meet the intent and requirements of each credit. The Design Rating recognizes the additional marketing value and branding a Pearl Rating will afford development in the early sale or lease phase. A Pearl Design Rating is only valid until construction is complete and requires that all collateral, branding and communication materials identify the project as a Pearl Design Rated project.

ii) Pearl Construction Rating

The Construction Rating ensures that the commitments made for the Design Rating have been achieved. The Construction Rating requires that all collateral, branding and communication materials identify the project as a Pearl Construction Rated project. This document, the Pearl Building Rating System, addresses both the Pearl Design Rating and the Pearl Construction Rating.

iii) Pearl Operational Rating

The operational rating assesses the built-in features and operational performance of an existing building and ensures it is operating sustainably. The operational rating can only be achieved a minimum of two years after construction completion and when the building has reached a minimum occupancy of 80%.

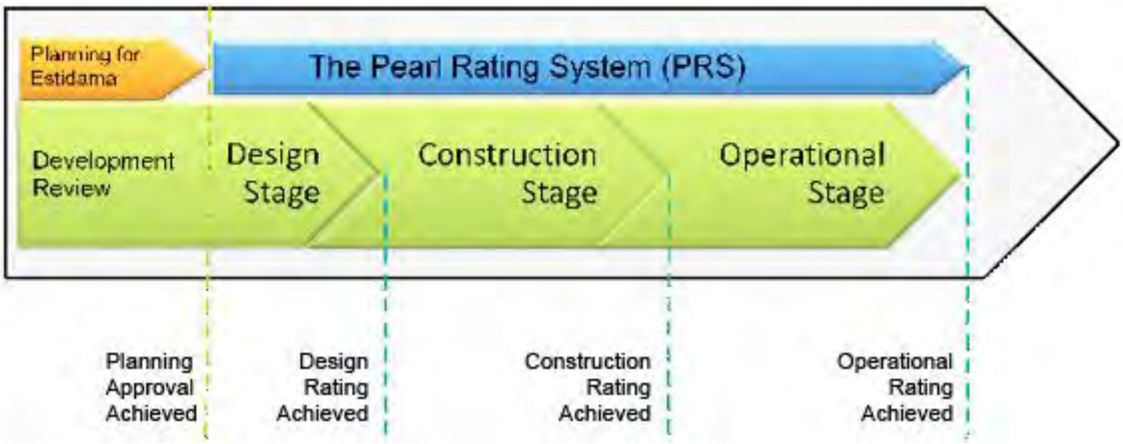



Figure 3.3- 7 The Pearl Rating Stages
Source: UPC

d) Achievement

The Estidama Pearl Rating System has been in force and proven a successful sustainability program for the Emirates, with all new villas, buildings and community developments required to meet minimum quality and sustainability standards. By 2013, the UPC Estidama team had awarded Design Ratings to more than 187 projects, representing approximately 4.4 million square meters of gross floor area (GFA).[18]

(4) Examples of pilot project

Following table indicates some examples of pilot projects carried out in hot and arid regions that shows type of activity and outcomes.

Table 3.3-18 Examples of Pilot Projects

**Pilot Project in Algeria**

The main purpose of this project is to build a pilot residential 80 m² rural house suitable for replication within the framework of Algeria's rural housing program (450.000 rural houses) from 2005-2009 and beyond in the rural areas all over the country in order to keep rural populations in place and to encourage their return from urban areas.

**Basic measures with high / moderate cost efficiency:**

- ✧ optimal orientation
- ✧ thermal insulation of the envelope
- ✧ use of earth stabilized bricks (adobe)
- ✧ double glazed windows
- ✧ use of natural light
- ✧ summer shading
- ✧ natural ventilation in summer
- ✧ solar thermal with gas back-up boiler for domestic hot water

**Additional measures**

- solar thermal system supports also heating

**Main results of the Pilot Project**

The Pilot Project allows reducing the energy consumption by 56%, compared to a conventional building.

**Pilot Project in Egypt**

Refurbishment including solar cooling of the South Sinai Governorate Project, an administrative building with 567 m² floor space and training facilities as well as accommodation for students in Sharm el Sheikh.

The main components of the system are 82 m2 evacuated tube collectors with operation temperatures below 100°C and the 3 ROTARTICA single effect absorption chillers each of maximum 8kW maximum cooling capacity with a maximum total of 24 KW.

**Basic measures with high / moderate cost efficiency:**

- ✧ Special Daikin thermal insulation with reflective coating on the roof
- ✧ 24 sealed windows to prevent air leakage
- ✧ 20 additional shading devices

[18] Country-level snap shot: Global Sustainable Cities Network

- ✧ 60 energy efficient light bulbs
- ✧ Occupancy sensor for lighting control in two corridors
- ✧ Demonstration measure: solar cooling system
- ✧ 3 lithium-bromide Rotartica absorption chillers with total refrigeration capacity of 24 kW
- ✧ 82m² evacuated tube collectors to supply 85°C hot water to the chiller

**Main results of the Pilot Project**

The energy consumption of the existing building is reduced by almost 47% through the implemented refurbishment measures

**Pilot Project in Lebanon**

Renovation of the Centre Hospitalier du Nord, a one block hospital building built in 1986, with 110 capacity, 6000 m2 floor space, located in Zgharta - North Lebanon.

**Profitability**

With the MED-ENEC pilot project, annual energy cost savings of almost 40,000 € could be realized. As only relatively low investments were required, the payback period remained very short with only 1-2 years. The measures can therefore be implemented in any other comparable building without subsidies or substantial investments.

- ✧ Air conditioning efficiency improvement through maintenance
- ✧ Energy efficient lighting
- ✧ Peak shaving through demand side management
- ✧ Improvement of boiler and generator efficiency
- ✧ Thermal insulation of the roof

**Main results of the Pilot Project**

Focusing on extremely cost effective measures, almost 20% of the energy costs of around 270.000 €/year could be saved with relatively low investments.

**Pilot Project in Morocco**

Typical residential villa with 180 m² floor space in the Rabat-Casablanca agglomeration. The villa is a demonstration building on the campus of the National School of Architects in Rabat.

**Main technical features of the Pilot Project**

Passive measures with high/moderate cost-efficiency:

- ✧ insulation of building
- ✧ overhang shading elements
- ✧ use of internal mass for heat/cold buffering
- ✧ natural night ventilation
- ✧ Active measures
- ✧ solar water heating
- ✧ electrical air / water heat pump for space heating and cooling

**Main results of the Pilot Project**

Compared to a conventional building energy savings of 74% are achieved in the Pilot Project with a payback period of approx. 10 years.

Source: MED-ENEC website

## 3.4 Barrier to promote EE&C in the Building Sector

### 3.4.1 Financial Barrier and awareness of benefit

(1) Construction cost

The nature of construction projects mean all parties involved are always subject to cost-cutting pressures. From the client perspective and from the financial calculation, the available investment is usually fixed when the project starts. When the proposed estimate exceeds the budget, floor plans and floor area are likely to be higher priority compared to other factors like finishes and thermal performance. Unfortunately, the priority of EE&C building material and/or equipment has been very low to date.

When clients decide to build houses by themselves by ordering materials & workers, the first few months are predictable because of the general materials such as cement, gravel, steel and bricks. On completion of the building structure, when the finish material, including windows, are to be ordered, the client often realizes that the required materials exceed his/her budget, which could be due to unexpected incidents during construction for structures, together with general inflation. Again, luxury finishes and thermal performance have to be compromised.

Based on interviews with builders and manufacturers, the initial cost impact for ensuring building envelopes comply with BCP-EP-2011 requirements will add approximately Rs 150-200/ft$^2$ to the overall building unit cost. If the project is for high-end users, this cost escalation could be accepted with a reasonable benefit. However, if the project is for the low- to low-middle-income group that may not gain benefit of reduced Air-conditioning load and running cost , with a construction unit cost of PKR 1000-1500 /ft$^2$, the cost impact equates to an escalation of about 13-20% and is almost impossible to accept Table 3.4-1 indicates a rough calculation of the cost impact.

Table3.4-1 Cost impact of BCP-EP-2011 standard building envelope

| | Construction Unit cost (PKR/ft$^2$) | Insulated envelope construction unit cost (PKR/ft$^2$) | Additional cost impact |
|---|---|---|---|
| Low-income group building | 1000-1500 | 1150-1700 | 13-20% |
| Middle-income group building | 1500-2500 | 1650-2700 | 8-13% |
| High-income group building | 2500-5000 | 2650-5200 | 4-8% |

Source: Calculated by JST using unit cost provided by various stakeholders.

According to manufacturers of insulation, window frames and glass, fewer than 3% of projects apply insulation and/or double glazed windows in Pakistan. The weak demand in the current market means a high unit cost for those advanced building materials. If there is more demand, the unit price could be lowered via economies of scale. Moreover, the manufacturer also stated that other neighboring countries, such as the UAE, have a government policy of preferential treatment for such building materials to promote energy efficiency.

(2) Lack of awareness of benefit

Investment in the building envelope will have two main benefits. One is the initial cost-saving on air-conditioners by lowering the heat load and the other is cost saving on reduced energy usage.

Insulated envelopes could reduce the heat load by 30-50% compared to non-insulated envelopes, which will significantly reduce the initial cost by lowering air-conditioner capacity. Energy usage for air-conditioners will also be reduced by around 35-45% annually.

When combining the initial cost investment and saving on running costs, the pay-back period can be calculated during the design stage. However, the lack of knowledge and tools mean there is no rational discussion between the design team and client except for high-end projects. Comparing to Japan, construction cost is relatively low and electrical cost is high in Pakistan. Pay-back period for investment for insulated building envelope is estimated less than two years. Furthermore, given the diffusion of back-up generator in high-end user buildings, pay-back period might be much shorter due to the high unit cost supplied by generator.

From a builders' perspective, remaining competitive in the market means focusing on optimal balance between product quality and sales price. Although builders are keen to meet consumers' demands, based on current market trends, consumers are concerned about load-shedding more than energy saving.

### 3.4.2 Barrier on Building Regulation and Building Code of Pakistan

Despite of S.R.O. issuance in 2013, no Development Authority has adopted BCP-EP-2011 to date which caused by a system of local autonomy and structure of building administration. Since the earthquake in 2005, GoP has been active to establish provisions for Building Code of Pakistan such as Seismic provision, Energy Provision and Fire Safety Provision that are intended to be adopted as national standard code. However, those federal government initiated codes are not well adopted by Building Control Authorities due to their autonomy.

Both BCP-SP-2007 and BCP-EP-2011 are developed as PROVISION of BCP-1986 that was establish by MOHW in 1986. JST has been striving to obtain the copy of BCP-1986 to confirm its legislation basis but not successful to date . According to the several stakeholder, BCP-1986 has been developed as guideline and there is no legal basis to enforce code compliance.

(1) Structure of Building Regulation and Code

The 'BCP-EP-2011' as a provision of BCP-1986, was enacted in response to the national goal to minimize energy consumption and improve energy efficiency. According to the article of BCP-EP-2011, 'Section 3 ADMINISTRATION AND ENFORCEMENT', the following are stated:

- ✧ 'Administrative requirements to permit requirements, having jurisdiction, energy standards, interpretations, claims of exemptions and rights of appeal are specified by the authority having jurisdiction.' (3.2 Administrative Requirements)
- ✧ 'The authority having jurisdiction may require supplementary information necessary to verify compliance with these provisions, such as calculations, worksheets, compliance forms, manufacturer's literature, or other data.' (3.4 Supplementary Information)

The first one above, i.e. 3.2 Administrative Requirements, describes practical and principal policy at national level to leave the fundamental competence of regulatory frameworks with each Development Authority in the regions. Moreover, through the second one above, i.e. 3.4 Supplementary Information, administrative measures by each Development Authority in regions are crucial to provide the necessary information, including both technical data and manuals to identify and verify compliance with BCP-EP-2011, including those to be issued in the near future by each Development Authority in regions.

As reviewed by stakeholders of Building Energy Conservation in Pakistan earlier, JST has not found any Development Authority, and other building regulatory authority such as DHA and Industrial Estate, with a clear implementation method or any supplementary information for BCP-EP-2011 to date.

To be adopted into existing building regulatory authorities, a consensus shall be required from respective government bodies, provincial ministries and the board of building regulatory authorities. Considering the number of subdivided authorized entities, adoption process and required supplementary information, etc., the promotion of BCP-EP-2011 requires enormous effort and action, which seems one of the major barriers.

(2) BCP-SP-2011

Pursuing any useful good practice in order to enforce the compliance to BCP-EP-2011 in the administration by Development Authorities and other regulatory body, the reference was made to Building Code of Pakistan -Seismic Provisions - 2007 (BCP- SP- 2007). This is because, BCP- SP-2007 is issued as provision to BCP-1986 earlier than BCP-EP -2011 and already executed for several years. Planning the further and detailed survey at the next phase, JST briefly reviewed the BCP- SP-2007 as follows;

1) Introduction of 'Building Code of Pakistan – Seismic Provisions – 2007'

Declaring 'This Code is dedicated to the memory of thousands of children, women and men lost in the earthquake of October 2005' at the first page [19], BCP- SP- 2007 is issued by S.R.O.970/(1)2008[20] detailed as below.

- ✧ The provisions of the Building Code of Pakistan (Seismic Provisions-2007) shall apply for engineering design of buildings, like structures and related components.
- ✧ Construction of buildings in violation of the Building Code shall be considered as violation of professional engineering work as specified under clause (XXV) of section 2 of the Act. (Same as BCP-EP-2011)
- ✧ The provisions of the Building Code shall be revised by the Pakistan Engineering Council after every five years or earlier if so required by circumstances.

In the SOURCE DOCUMENT in BCP-SP-2007, it states that MOHW accepts that ICC, ACI, AISC and ASCE have ownership and copyrights of all transcribed and reproduced portions from their respective documents used in the Seismic Provisions (2007). The source documents are summarized as below. This shows that the BCP-SP-2007 has been designed based on an international structural code as a base, with regional seismic information then added.

Table 3.4-2-Source Document for BCP-SP-2007

| Chapter | Description | Source Document |
|---|---|---|
| 1 | Scope | |
| 2 | Seismic Hazard | |
| 3 | Site considerations | |
| 4 | Soils and Foundation | UBC 1997 |
| 5 | Structural Design Requirement | UBC 1997 |
| 6 | Structural test and inspections | UBC 1997 |
| 7 | Structural Concrete | ACI 2005 |
| 8 | Structural Steel | ANSI/ AISC 341-05 |
| 9 | Masonry | UBC 1997<br>IAEE |
| 10 | Architectural Elements | ASCE 1993/2005<br>ANSI/ASCE |
| 11 | Mechanical and Electrical System | ASCE 1993/2005 |

Source: Building Code of Pakistan Seismic provision

[19] The first page of BCP- SP- 2007

[20] S.R.O.970/ (I)/2008 for "Application for Building Code of Pakistan" dated September 10, 2008

2) Practice of Building Code of Pakistan – Seismic Provisions – 2007

From interviews with several building regulatory authorities and confirmation of its latest building regulation, JST summarized the referenced structural design code in several building authorities as shown in table 3.4-3. Of nine regulatory authorities, only CDA stated that they are refereeing BCP-SP-2007 for structural vetting. Of the private sector, Baharia Town refers to BCP-SP-2007 in its Standard Operating Procedures 2013-2014.

Table 3.4-3-Adoption of BCP-SP-2007

| Respective Government | Federal | Punjab Gov | | Sindh Gov | Defense Ministry | Private |
|---|---|---|---|---|---|---|
| Development Authority/ Building Regulatory Body | CDA | LDA | Other 4DA | SBCA | DHA Karachi | Baharia Islamabad |
| Latest Version/( latest revision of regulation) | 2005 | 2014 | 2007 | 2002 (2014) | 2011 | 2014 |
| Adoption BCP-SP-2007 | Yes | No | No | No | No | Yes |
| Referred Structural design code | BCP-SP -2007 | UBC1997/ IBC2006 | UBC1997/ IBC2006 | UBC/ US,BR code | - | BCP-SP -2007 |

Source: Regulation/ bylaws form respective building authorities

BCP-SP-2007 has been designed using UBC for most structural requirements, so the majority of structural design in Pakistan refers to UBC. However, this result indicates that the Building Code of Pakistan lacks sufficient recognition among subdivided building regulatory authorities.

### 3.4.3 Barrier on Implementation Framework

Vetting for BCP-EP-2011 requires a broad range of knowledge for EE&C from architectural to mechanical and electrical technology. JST has collected data of existing building authority inspection organization as indicated in table 3.4-4.

Table 3.4-4 Human resources of Development Authorities

| | CDA | RDA | FDA | MDA | GDA | SBCA |
|---|---|---|---|---|---|---|
| Number of annual applications | 1806 | 700-800 | 800 | 1000 | 15-20 | 4876 |
| Number of Inspectors | 16 | 4 | 13 | 8 | 5 | 90-100 |
| Qualification of inspectors | DAEC | 3DAE | 3DC/A | 3DAE | 3DCE | |
| Number Applications/Staff | 112.9 | 175-200 | 61.5 | 125.0 | 3~4 | 48~54 |
| Approx. population of coverage in 2010 (million) | 1.0 | 2.0 | 2.9 | 1.6 | 1.7 | 13.4 |

Source: Interview/ questionnaire to respective development authorities
DAEC: Diploma Associate Engineer, Civil/ 3DAE: 3 year Diploma Associate Engineer
3DC/A: 3 year Diploma in Civil/ Architecture/ 3DCE: 3 year Diploma in Civil Engineering

The above data indicates that one inspector, most of whom have a civil background, must inspect 50 to 100 or more buildings annually. Considering the complexity of the BCP-EP-2011 checks, both the skill level and number of inspectors must be reconsidered for implementation.

Furthermore, interviews with architects, engineers and developers revealed the following comments regarding the current implementation of building regulation by Development Authorities:

- Site inspection by DA only involves checking the building floor area, heights and setbacks. Detailed inspections, such as rebar for structures, are hardly carried out. The liability depends on the name of architects and engineers on the drawing.
- DA officers are keen on documentation only, site inspections are not strict.
- Lack of accountability. So many obvious illegal buildings are left unchanged.
- Some building owners force illegal constructions, which cause reputable architects/engineers to suffer. Some architects or engineer have to refuse to sign their drawings or write to development authorities claiming that illegal construction is not under their control.
- There is a serious problem of name-rending of registered architect/engineer, which results in sub-standard buildings.

From the information above, possible barriers are predicted as listed below once BCP-EP-2011 is adopted by building control authorities. The necessary capacity development must be implemented prior to launching the implementation of BCP-EP-2011.

- Inadequate skill and knowledge of inspectors.
- Inadequate number of inspectors.
- Lack of accountability

# Chapter 4 Action Plan and Suggestion

# Chapter 4 Action Plan and Suggestion

## 4.1 Action Plan for the medium- to long-term

Given that BCP-EP-2011 has been officially notified since 2013, the highest priority is to improve the implementation framework and raise awareness among building owners, capacity development for architects, engineers, contractors and permit authority. To develop stakeholders' skill, there is a need to create a guidebook and establish an educational framework. It is also vital to establish a system to collect data for building construction and energy usage together to analyze the achievement of the EE&C effort and study further improvement.

Once the implementation of BCP-EP-2011 has been adopted into the process of building construction stakeholders, EE&C shall be further improved by remedying BCP-EP-2011 and/or another system to encourage building owners to construct or retrofit existing buildings with those featuring higher energy performance. Several technologies and systems have been invented and tested worldwide. A suitable approach is to be applied, taking regional characteristics, current capability of construction industries and projected building sector growth into consideration.

To promote EE&C of the building sector strategically, we propose to start the activity with limited coverage, where the federal government has power to control building regulations as a leading action. While the first stage action is being implemented, a capacity development framework and monitoring system are being developed, from which other building regulatory authorities can learn. Eventually the coverage of action will be diffused nationwide. The government should also consider an incentive scheme to attract the private sector, which may also have a positive impact on the market.

Three action plans are proposed as indicated below. Applying all three at once would strongly catalyze the building sector , but there is also scope to apply them individually as well.

(1) Promotion of adoption of BCP-EP-2011
(Enforcement for implementation of BCP-EP-2011 at Building Control Authority)
(2) Support for Promotion of Advanced EE&C to the Private Sector (Incentive Scheme)
(3) Leading Action by the Public Sector (Public Building Improvement Scheme)

Table 4.1-1: Schedule for Action Plan

| Item | 1st year | 2nd | 3rd | 4th | 5th |
|---|---|---|---|---|---|
| **Legislations** | | | | | |
| Enactment of EE&C Act 2015 ☆ | | | | | |
| Enforcement of Islamabad as model city (Mandatory BCP-EP-2011 + Incentive Scheme) | ☆ | | | | |
| Enforcement of EE&C on Public Building Construction | ☆ | | | | |
| Government order of Incentive Scheme (Nationwide) | | ☆ | | | |
| Government order of Existing Public Building EE&C Retrofits & Pilot Project | | ☆ | | | |
| Government order of Model City in other major cities | | | ☆ | | |
| Revision to BCP-EP-2011 | | | | ☆ | |
| Target of Enforcement of BCP-EP-2011 nationwide | | | | | ☆ |
| **Promotion of adoption of BCP-EP-2011 (Enforcement for implementation of BCP-EP-2011)** | | | | | |
| Enforcement for Implementation of BCP-EP-2011 on Model City (Islamabad) | ▬ | | | | |
| Enforcement for Implementation of BCP-EP-2011 in other major cities (nationwide) | | | ▬ | - - - | - - - |
| Revision to BCP-EP-2011 | | | | ▬ | |
| **Support for Promotion of Advanced EE&C to Private Sector (Incentive Scheme)** | | | | | |
| Establishment of Visible Evaluation System (Certification/ Rating Scheme) | ▬ | | | | |
| Incentive for Model City with Utilizing Evaluation System | ▬ | | | | |
| Incentive for construction nationwide with Utilizing Evaluation System | ▬ | ▬ | | | |
| Incentive for Architects side with Utilizing Evaluation System | ▬ | | | | |
| **Leading Action by Public Sector (Public Building Improvement Scheme)** | | | | | |
| Action to New Construction Building | ▬ | | | | |
| Action to Existing Building | ▬ | ▬ | | | |
| Action to Pilot Project for Advanced EE&C Building | | ▬ | - - - | - - - | |

Source: JST

Countermeasures are to be applied in stages to facilitate adoption by stakeholders. However, the countermeasures must be effectively phased and well-coordinated to maximize the end results. Any new findings or barriers during early stage activities must also be carefully analyzed and reflected in later stage activities. As building regulatory authorities are autonomous body under provincial governments and other governments ordinance, the adoption of BCP-EP-2011 may take longer than expected due to the numerous stakeholders. Meanwhile, a complementary policy could be applied to limited stakeholders with optimized effort.

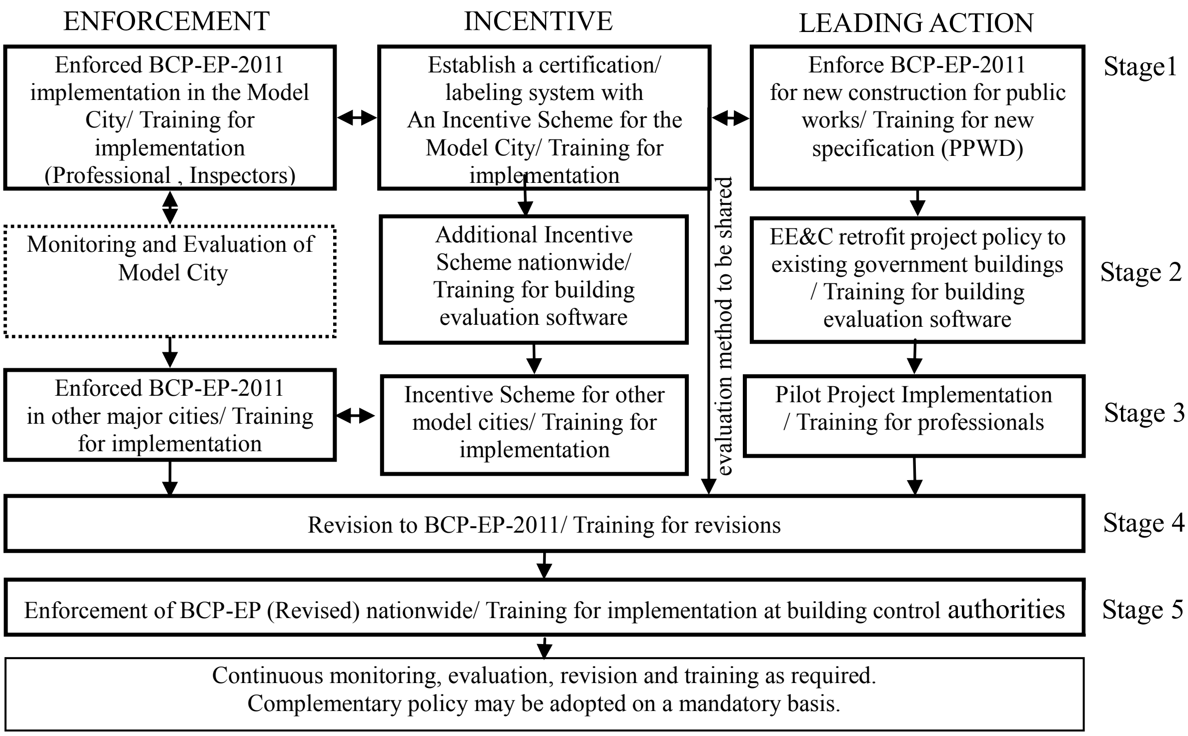
As a start, we suggest improving the implementation of the current BCP-EP-2011 in Islamabad as a model city which expected to be adopted quickly by federal government power and function[1]. At the same time, complementary policies, such as a certification or labeling system, should be established and included in the model city as an incentive scheme, while keeping in mind the complementary policy to be planned as future mandatory regulation. This explains the evaluation methodology of a single system in-between BCP-EP-2011 and a complimentary system. As a government leading action, we propose that new construction for public works shall be enforced to adopt BCP-EP-2011 standards with its voluntary guidelines or a higher rating. A data collection survey and analysis of existing government-owned public buildings will be carried out at this stage to prepare for the next.

[1] The revision to current building regulation in Islamabad requires approval by board of CDA. CDA is one of ten divisions of Capital Administration and Development Division（CAD） and established under CDA ordinance 1960. According to the ordinance, not less than three members ,including chairman, vice chairman and financial advisor, shall be appointed by federal government.

During the second stage, to promote newly introduced complimentary policy in the first stage, an additional incentive scheme will be applied nationwide to eliminate barriers to high energy-efficiency buildings. This could include tax reductions for energy-efficient material and equipment, low-interest housing loans and other measures, while the leading action will include a project to retrofit existing public buildings to be planned by government, with a target total and completion year. The design development process for retrofitting existing buildings shall include analysis of the existing situation, a study of the proposed design and a comparison between old and new systems with a view of initial cost and running cost. Simultaneously, a pilot project shall be planned and developed aiming for Zero Energy Building with technical support from foreign expert. The design development process for both retrofitting existing buildings and pilot projects could also encompass training for professionals using building evaluation software.

As a third stage, the model city concept can be applied to other major cities, while as indicated in the BCP-EP-2011; the criteria could be amended to suit local characteristics. Construction of the pilot project shall commence at this stage and the processes of design, construction and the end result of the pilot project will be shared with as many stakeholders as possible for future reference.

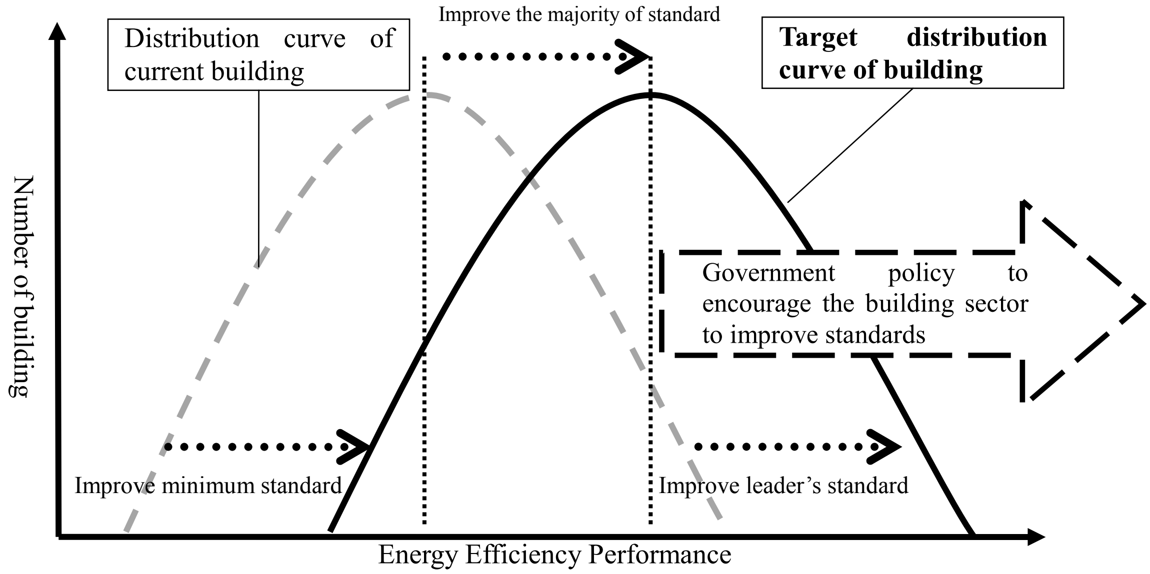
As stage 4, following three years of implementation at the model city and public works, BCP-EP-2011 will be revised based on new policy learned from early stage activities. By the end of the fifth year, BCP-EP-2011 would hopefully be adopted nationwide as a compulsory minimum standard.




Source: JST

Figure 4.1-1 Staged countermeasures

Figure 4.1-2 indicates a diagram to visualize the countermeasures required to improve Energy Efficiency Performance in the big picture. As well as improving the minimum standard, it is essential to improve standards among industry leaders. The greater the volume of high-performance equipment and materials used in the market, the more the price tends to decline, whereupon the majority will recognize the value & benefit of adopting the same in their project.




Source: JST

Figure 4.1-2 Diagram of Standard Improvement

## 4.2 Challenge on EE&C promotion and suggestion

### 4.2.1 Analysis of current situation of EE&C building sector in Pakistan

Table 4.2-1 indicates the current situation of the EE& C building sector in Pakistan in comparison with ten critical steps and with 24 actions suggested by the IEA as part of Modernizing the Building Energy Code - Policy Pathway - 2013. Bold text indicates achievements and the activities underway in Pakistan. Planning phase was confirmed as complete following the BCP-EP-2011 notification in 2013 and the current priority is clearly directed toward implementation phase actions.

Table 4.2-1 EE&C Building Sector status in comparison with IEA Critical Steps

| Four Phases | 10 critical steps | 24 actions | Status in Pakistan (JST understanding) |
|---|---|---|---|
| Plan | 1. Define and adopt the objectives, scope and norm | 1-1: Define and adopt regulatory framework<br>1-2: Define and adopt the necessary norms | **1-1: BCP-EP-2011 under PEC ACT.** EE&C Bill is in progress<br>**1-2: BCP-EP-2011 notified as bye-law in 2013.** EE&C Bill is in progress |
| | 2. Define modalities to support implementation and enforcement | 2-1: Define clear governance structure and institutional arrangements<br>2-2: Define funding mechanisms to secure financial resources<br>2-3: Decide on compliance and evaluation methodologies and indicators<br>2-4: Involve stakeholders and market-actors | **2-1: DA is expected as regulatory authority**.<br>No DA have adopted BCP-EP-2011 yet.<br>2-2: Not enough funds available.<br>**2-3: Indicators are stated in BCP-EP-2011.**<br>No detailed methodologies indicated.<br>**2-4: 23 organizations/ individuals are listed as Task force member** |
| | 3. Set a supportive policy context | 3-1:Consider complementary policies | 3-1: No complementary policies has been established. |
| Implement | 4. Organize awareness campaigns | 4-1: Organize awareness campaigns directed at industry<br>4-2: Organize awareness campaigns directed at buildings' occupiers | **4-1: In process of awareness campaigns.**<br>**4-2: In process of awareness campaigns.** |
| | 5. Develop training materials and provide training | 5-1: Develop long-term training strategy<br>5-2: Review existing construction profession capacities<br>5-3: Develop training material and compliance software<br>5-4: Deliver training on compliance software | **5-1: CPD course for BCP-EP-2011 established.**<br>5-2: Only market leaders are capable.<br>5-3: No handbook and software<br>5-4: No training system established yet. |
| | 6. Develop necessary tools for compliance- checking and tracking | 6-1: Check compliance at the design stage<br>6-2: Check compliance at the construction stage<br>6-3: Check compliance prior to occupancy of the building<br>6-4: Check compliance when the building is occupied<br>6-5: Enforce building energy code<br>6-6:Track compliance at local level | 6-1: No evidence<br>6-2: No evidence<br>6-3: No evidence<br>6-4: BCP-EP-2011 does not enforce compliance for post completion.<br>6-5: No penalty to building owner.<br>6-6: No evidence has been observed. |
| Monitor | 7. Analyze compliance trends at local level | 7-1: Analyze compliance trends at local level | 7-1: No framework for analysis |
| | 8. Communicate compliance results and enforcement actions openly | 8-1: Communicate compliance trends openly<br>8-2: Encourage public debate on compliance trends | 8-1: No framework for data collection.<br>8-2: No framework so far. |
| Evaluate | 9. Generate different metrics and evaluate implementation gaps at national level | 9-1: Calculate evaluation metrics for each building type | 9-1: No framework so far. |
| | 10. Update building energy codes regularly based on lessons learned from the evaluation | 10-1:Use evaluation results for next code's revision | 10-1: No framework so far. |

Source: IEA Modernizing Building Energy Code -Policy Pathway- 2013. & JST understanding by survey

The IEA is striving to encourage governments to establish energy-efficient building policy for several countries. Table 4.2-2 indicates selected key findings from IEA proposals, which JST deems adequate to consider for the Pakistan situation.

The lifespan of buildings far exceeds that of equipment and it is far costlier to upgrade an existing building envelope compared to a new construction, so the building envelope criteria shall not be compromised. Furthermore, the introduction of a single system to evaluate overall energy performance is crucial. A simple and user-friendly calculation method & software will facilitate implementation by all stakeholders and help spawn further performance refinements.

Table 4.2-2: Selected suggestion by IEA:

- ✧ An important first step in improving the global building stock is to establish and enforce stringent building codes that include minimum energy performance for new and refurbished buildings. With buildings in some countries lasting well over 100 years and expensive to retrofit, urgent action is needed to ensure that high-performance building envelopes rapidly gain market share and quickly become the standard for all new construction globally.
- ✧ The most advanced building energy codes focus on overall energy performance and regard the building as one single system. Such codes reduce lock-in effects, accelerate deployment of efficient technologies, provide more freedom to architects and developers, and facilitate compliance-checking.
- ✧ Market barriers in the buildings sector are complex and can be difficult to overcome, so successful implementation of public policy will be essential to achieving high levels of market diffusion. There is a need for integrated and comprehensive policies to help overcome a range of barriers, such as higher initial costs, lack of consumer awareness of technologies and their potential, split incentives and the fact that the true costs of CO2 emissions are not reflected in market prices.
- ✧ In a vast majority of developing countries, there is little or no information and statistics that describe the buildings stock or its energy consumption (SE4ALL, 2013). Without minimum information to establish and understand the baseline, it is hard for policy makers and building stakeholders to initiate the work to promote energy efficiency and to include buildings in a climate mitigation strategy.
- ✧ Energy trends in the buildings sector can vary significantly from country to country depending on a number of factors ranging from climate, population, income, economic development and household sizes. Immediate priorities and future goals will need to reflect a country's energy supply and consumer profile.

Source: IEA (Selected by JST)

### 4.2.2 Summary of key findings in Pakistan and suggestion

(1) Country characteristics

- ✧ Pakistan is currently facing an electrical crisis due to demand exceeding supply, meaning people suffer from constant load shedding. Summer is a peak period, from 5-11PM, showing that cooling and household consumption are the critical portion. Moreover, a combination of population growth and changed life style is expected to fuel demand from 600,000 new households annually, meaning action in the form of house building is a critical issue.
- ✧ About 45% of the electrical consumption in Pakistan comprises Domestic use (25% Industry, 7% commercial)[2] . Moreover, more than 90% of electricity is consumed by the tariff group of less than 300kwh consumption.[3] It is hard to imagine most households under the 300kwh slot having air-conditioners in their homes at present.[4] However, lifestyle, expectations of the living environment and climatic conditions may change drastically in the next decade. Another reality is that air-conditioners are likely to be installed by building users on completion of building construction. The policy shall take those assumptions into account.
- ✧ The climate is divided into 4-5 climate zones. Since the peak period happens in summer, effective criteria against the heat gain through the building envelope shall be applied. HDD[5] and CDD in major cities are as indicated below. In addition to HDD and CDD, wind and humidity during the peak period/time must also be taken into account, since they impact on the comfort level of the room environment.

Table 4.2-3 HDD and CDD in major cities (C°・day)

| | Islamabad Airport (2014July-2015Jun) | Lahore Airport (2014July-2015Jun) | Karachi Airport (2014July-2015Jun) |
|---|---|---|---|
| HDD(18C°) | 763 | 593 | 102 |
| CDD(24C°) | 925 | 1394 | 1585 |

Source: www.degreeday.net

- ✧ Most energy-efficient materials and equipment comprise imported product and most domestic products remain in development, with performance still insufficient. An issue observed in

[2] NEPRA state of industry report 2014
[3] Rethinking Electricity Tariffs and Subsidies in Pakistan (World bank 2011)
[4] All air-conditioner holder out of 120 household were contract load of more than 300kWh in JICA survey in 2014. (Expert for Institution-Building and Promotion of Energy Saving)
[5] Heating degree day (HDD) is a measurement designed to reflect the demand for energy needed to heat a building. It is derived from measurements of outside air temperature. The heating requirements for a given structure at a specific location are considered to be directly proportional to the number of HDD at that location. A similar measurement, cooling degree day (CDD), reflects the amount of energy used to cool a home or business.

BCP-EP-2011 was that due to the reference of ASHARE standards, newly established MEPS standards in Pakistan do not comply with BCP-EP-2011 standards in motor criteria. Coordination between the various applicable standards/organizations will be required.

- ✧ The estimated population growth rate is 2% annually, leading to a population of 242 million in 2030.[6] The expected annual GDP growth is also 4-6% from 2015 to 2017. [7] As well as growth in the residential sector, the industry and commercial sector shall be considered for further development and energy usage.

  Urbanization is expected to be progressed and the population in urban area will be doubled in 2030, tripled in 2050 compared to the urban population in 2010.[8] Ten major cities will cover 58% of urban population in Pakistan in 2030. Meantime, population in rural area will be peak-out in 2025. The building regulation in major cities needs to be designed in consideration of those projections.

  The diffusion of CFL and other energy saving lighting fixture has been observed in the major cities and BCP-EP-2011 lighting compliance Light Power Density requirement may have been complied in buildings in urban area. However, control system and motion sensors are not common yet.

- ✧ The diffusion and the awareness of benefit for insulation, insulated window and high efficiency Air-Conditioner are poor in the current building sector. Conversely, the potential of energy saving in this factor is big.

(2) Implementation framework

- ✧ Building regulatory authorities are established as autonomous bodies under the provincial government or other governments ordinance, with their own legislation and building regulations. Currently most building regulations do not reference the Building Code of Pakistan, prepared by federal government, including Energy Provision and Seismic Provision. The adoption of BCP-EP-2011 is also subject to approval by the board of authority.

  Discipline in terms of compliance with building regulations seems inadequate in Pakistan for several reasons. As well as an enforcement policy, an incentive scheme is also considered to promote EE&C.

- ✧ Awareness of enforcement of BCP-EP-2011 remains seemingly insufficient. During the JST

[6] Pakistan market and market development, JETRO
[7] World bank Global Economic Prospects
[8] National Report of Pakistan for HABITAT III

interview, many architects, engineers and builders stated that they were unaware of BCP-EP-2011, hence the need for a further awareness campaign.

- BCP-EP-2011 simply shows indicators for respective building portions, such as the U-value for roofs. There is no supporting information such as calculation methodologies, certified material information and approved testing procedure to justify whether or not the proposed design is code-compliant. A clear guideline shall be added as supplemental information to justify the compliance.

- No handbook has been produced. Architects, engineers and inspectors from building authorities need detailed information stating how to comply with the code criteria. A uniform calculation method and checklist shall be produced and made accessible online.

- No Development Authorities and other building regulatory authorities have adopted BCP-EP-2011 for their review process as of 2015. The required skills and workload shall be carefully studied and developed to facilitate implementation.

- No penalty seems to have been applied to date to architects, engineers and builders for any violations of BCP-EP-2011. The only possible penalty is removal or suspension for PEC registration as per the PEC ACT. Meanwhile, PCATP, as a regulatory authority for architects, lacks any power to handle violations of BCP-EP-2011, nor is there any legal framework penalizing building owners for non code compliance. It is difficult for architects, engineers and contractors to convince their client who has full financial power without a legal framework. A clear penalty policy to be incorporated into regulations by the building authority or by other means.

- The lack of awareness of the benefit of compliance with BCP-EP-2011. The higher construction cost severely hinders building owners, although the impact of the initial cost will be offset by low energy usage for several years. The benefits of code compliance must be also be properly explained and understood by building owners. User-friendly software will help clarify the comparison between initial costs and savings on running costs.

- There is no framework of data administration for monitoring and evaluation for the building sector. As indicated in IEA critical steps, the energy efficiency framework needs to be monitored and evaluated for continuous revision. Technology is also rapidly improving and it is crucial to establish a monitoring and evaluation framework to optimize the entire system in the optimal manner.

(3) Validity of BCP-EP-2011

- ✧ Applicable buildings are limited to those on a large scale. (900m² or more of air-conditioned space) This approach is also common overseas. However, as per the NEPRA report, most electrical consumption is seemingly from households. Consideration on residential buildings for possible revision to BCP-EP-2011 is required.
- ✧ Applicable activities are limited to i) new constructions, ii) Portions of new extensions, iii) New systems, iv) upgrades of electrical contract. It will take years to achieve the actual energy-saving effect in the building sector and some kind of measurement for existing building will have to be developed.
- ✧ There is no offset in the given indicator for climate zoning and building usage. Since energy requirements differ according to building usage and climate conditions, setting an appropriate indicator to reflect usage and climate zoning would elicit more energy-saving potential.
- ✧ For the envelope performance standard, there is no indication as to how the performance is certified for respective materials. Certified performance information and/or certified testing organizations are to be indicated.
- ✧ BCP-EP-2011 indicates the criteria for each of the building portions and equipment for which minimum standards are to be provided. Although this is an effective way to boost minimum standards, it lacks potential to improve energy performance for industry leaders. The introduction of a comprehensive evaluation method, capable of visualizing benchmarks, will be essential for further improvement in the near future. Once the methodology and benchmark have been set, several measures are applicable, i.e. labeling, incentive scheme.
- ✧ Other than insulation for piping/ducts, equipment energy-efficiency standards for heating and cooling are stated as a "Recommended Guideline". Considering Pakistan's growth in the near future, some kind of enforcement system for equipment efficiency needs to be considered.
- ✧ There is a reality of a lifespan for building. Current existing buildings may remain in place for the next half-century or more. A scheme to improve existing building performance may want to be considered to accelerate energy efficiency in the building sector.
- ✧ If simplified guideline/ regulation are useful for rural area buildings, low-cost buildings and small scale buildings, following list of measures with its priorities are recommended.

Table 4.2-4 List of Prioritized measures

| Priority | Item | Criteria |
|---|---|---|
| 1 | Roof Insulation | U Value as per BCP-EP-2011 |
| 2 | A: Insulated window (1South ,2 West, 3East)*1<br>B: External shading. | U Value as per BCP-EP-2011 |
| 3 | Insulated Wall (1South ,2 West, 3East) *1 | U Value as per BCP-EP-2011 |
| 4 | Lighting Fixture | LPD as per BCP-EP-2011 |

*1: Number indicates the priority in consideration of orientation
Source: JST

## 4.3 Proposed support for EE&C on the Building Sector from Japan

### 4.3.1 Promotion of adoption of BCP-EP-2011

(1) Model City

The purpose is to enhance nationwide awareness of EE&C by implementing BCP-EP-2011 in the selected model city as a government initiative. Islamabad is the optimal selection for the first model city, given its legal relationship with federal government[9] and the CDA capability, which has been used to handle a number of complex building projects. In the mid-term plan, other major cities are also planned for the model city. The promotion to provincial government will also take place at the same time.

(2) Capacity Development

To pave the way for the smooth implementation of BCP-EP-2011, public awareness and technical training for professionals are both required. As well as the relevant documentation, such as a handbook, seminars and workshops are to be given for both the public and professionals.

For the building regulatory authorities, the creation of an EE&C division is recommended as the knowledge required for BCP-EP-2011 differs from the current building regulation. Templates of the application form, checklist and required drawing as well as the methodology of site inspection and issuance of certificates are to be established.

(3) Framework Development

The organization and system must be sufficiently sustainable through continuous skill development and flexible enough to adopt revisions to the code in future. It is also vital to establish a system to collect respective data from the relevant authorities for ongoing analysis and study.

[9] CDA is one of ten divisions of Capital Administration and Development Division（CAD）and is established under CDA ordinance 1960. According to the ordinance, not less than three members ,including chairman, vice chairman and financial advisor, shall be appointed by federal government.

Table 4.3- 1 Overview of Improvement of Implementation of Minimum Requirement

<table>
<tr><td>Project name</td><td>Promotion of adoption of BCP-EP-2011<br>(Phase 1 – Model city Development)</td></tr>
<tr><td>Counterpart</td><td>ENERCON</td></tr>
<tr><td>Target organization</td><td>MOWP, MOST/PEC, MOHW, Respective Development Authority</td></tr>
<tr><td>Purpose</td><td>Enhance the code compliance number in the building sector</td></tr>
<tr><td>Expected Output</td><td>- Implementation of BCP-EP-2011 adopted by the DA<br>- Handbook, manual for BCP-EP-2011 published<br>- Seminars for professionals/ Building Authorities carried out<br>- Framework for sustainable capacity development and monitoring/ evaluation</td></tr>
<tr><td>Required fund</td><td>300(thousand USD)</td></tr>
<tr><td>Period</td><td>1 year</td></tr>
<tr><td colspan="2"><u>A) Required action for Model City (by the Pakistan government)</u><br>✧ Approval for BCP-EP-2011 adoption by the respective DA board<br>✧ SRO to revise DA building regulations and other measures</td></tr>
<tr><td colspan="2"><u>B) Awareness campaign for building owners and users</u><br>✧ Creation of campaign material indicating benefits and techniques of EE&C and the risk of non-compliance.<br>✧ Seminar/advertisements for public awareness</td></tr>
<tr><td colspan="2"><u>C) Capacity development for architects, engineers and contractors</u><br>✧ Creation of a supplementary handbook for BCP-EP-2011, which indicates the basic concept of each EE&C effort, a detailed compliance method, sample specification and certified performance information for material/equipment.<br>Seminar/workshop for professionals</td></tr>
<tr><td colspan="2"><u>D) Inclusion of BCP-EP-2011 into the procedure of building development approval.</u><br>✧ Establish a vetting division in the DA or a system to outsource.<br>✧ Creation of an application format, template for required drawings.<br>✧ Establishment of methodology of the approval process. (drawing review, mid- inspection, final inspection and required documentation).<br>✧ A system for Certificate with BCP-EP-2011 compliance and methodology against non-compliant buildings.</td></tr>
<tr><td colspan="2"><u>E) Framework to develop sustainable capacity</u><br>✧ A system for periodical seminars/lectures for the relevant stakeholders<br>✧ Curriculum development for educational institution for the long-term plan</td></tr>
<tr><td colspan="2"><u>F) Framework for EE&C monitoring and evaluation</u><br>✧ A system to gather building data such as the number of approved plans, issuance of occupancy certificates, floor space and building usage from the respective development authorities.<br>✧ A system to gather energy usage data from the relevant energy distribution authorities.<br>✧ Methodology to evaluate and analyze the above data and provide the same to the public.</td></tr>
</table>

Source: JST

(4) Revision to BCP-EP-2011

Targeting the third year from the model city implementation of BCP-EP-2011, revision to be applied. Gathered data and feedback from stakeholders to implement BCP-EP-2011 in model cities to be analyzed to improve BCP-EP-2011. The objective will be to reconsider applicable building types and construction activity to accelerate EE&C achievements as well as reconsidering the evaluation methodology, coverage of regulations to building services etc. A comprehensive evaluation system shall be introduced in this revision with user-friendly software or web program. A clear benchmark will also be given, with flexibility for architects and engineers. This will also facilitate a rating system for the proposed building, which will be linked to a labeling system.

Table 4.3- 2 Overview of Revision of BCP-EP-2011

| | |
|---|---|
| Project name | Promotion of adoption of BCP-EP-2011<br>(Phase 2-Revision of BCP-EP-2011) |
| Counterpart | ENERCON, PEC |
| Target organization | MOWP, MOST, MOHW, PCATP |
| Purpose | Improve EE&C level in the building sector |
| Expected Output | - Revised BCP-EP approved by task force member<br>- Improved criteria, applicable building coverage<br>- Visible evaluation method with software |
| Required fund | 305(thousand USD) |
| Period | One year (Third year from model city implementation) |
| A) Analysis of Implementation of BCP-EP-2011 in model cities<br>✧ Data collection of model city implementation and market trends<br>✧ Feedback from Building owners, architects, engineers and regulatory authorities.<br>✧ Formulation and operation of a task force<br>✧ Analysis of possible effect and barrier for the revision | |
| B) Revision to applicable building type, scale and construction activity<br>✧ Data collection of building energy consumption (size, usage, operation hours)<br>✧ Analysis of current energy usage on respective building types and scale.<br>✧ Consideration of applicability of residential building typology. | |
| C) Revision of standards<br>✧ Revision to current performance figure, taking climate zoning and building usage into consideration<br>✧ Introduction of other technologies and methods for EE&C for buildings, such as reflective external material, sun shades and control system for building services<br>✧ Establishment of a performance certification method. (i.e. U-value for glass and insulation) | |
| D) Revision and/or addition of penalty for non-compliance<br>✧ Introduction of a penalty imposed on building owners.<br>✧ Revision of the penalty imposed on architects, engineers and contractors. | |
| E) Introduction of a Comprehensive Evaluation Method with user friendly software.<br>✧ Establish a Comprehensive Evaluation Method so that a clear benchmark is given to the respective building for compliance. Benchmarks shall be established based on the building usage and climatic character.<br>✧ Creation of user friendly software or web program | |
| F) Seminars to professionals<br>✧ Seminars to architects, engineers and building regulatory authorities for revisions.<br>✧ Workshop for evaluation software | |

Source: JST

### 4.3.2 Support for Promotion of Advanced EE&C to Private Sector (Incentive Scheme)

Promotion of adoption of BCP-EP-2011 will establish minimum standards for the EE&C building sector. Further EE&C could be achieved by introducing an incentive scheme with rating system which offers promotion of a higher-standard EE&C performance for buildings. The purpose of this project is to aim wide spread of EE&C technology to building sector by creating more demand to advanced building material and equipment by incentive scheme.

(1) Visible evaluation system with labeling system
In order to set clear target for incentive scheme, the EE&C effort to be certified by labeling system with visible evaluation system. Building envelope criteria, building services criteria to be evaluated with clear indicator in comparison with BCP-EP-2011 requirement benchmark. The more advanced EE&C effort applied, the building to be certified as higher label.

(2) Introduction of software and WEB program
Evaluation software will provide opportunities for design, analysis and comparison of several options for both new buildings and retrofits of existing buildings. Building owner will be able to make rational decision by visualizing initial cost investment and benefit of reduction of running cost. Software shall be accessible by professionals via website either by download or WEB program and will require periodical updates. The framework of skill development, manual, handbooks to be developed as well.

(3)Introduction of Incentive Schemes
Incentive scheme is to attract stakeholders by providing benefit for their activities. This could be many ways such as removal of existing barrier, provision of preferential treatment, certification for positive reputation and so on. If model city concept is to be applied, some incentive scheme within model city to be included. The possible idea could be a trade-off of provision to some bonus to existing building regulation such as FAR, height limitation and set-back regulation. As land price is rapidly escalating, developer will see the benefit of gaining more floor space by applying higher EE&C standard.

Another possibility is to provide preferential treatment on property tax, such as reduction of rate for several years, which will attract building owners to invest initial cost on EE&C. In Islamabad, the property tax collection rate is about 70-80% and the tax rate has not been revised for more than ten years[10] . Current property tax rate in Islamabad is 60% or less of the rate in Punjab depends on the area and seems not reflecting current market value of properties. The simultaneous implementation

[10] Interview with CDA revenue department.

of both property tax rate revision and preferential treatment may drive effective incentive scheme for EE&C building without compromising the tax revenue.

The biggest barrier for EE&C will be the amount of initial investment for most of building owner including. An incentive scheme of financial support shall be considered involving State Bank, HBFC and other international donor funds. Apart from financial support to building owners, some kind of incentive to manufacturer or supplier to be considered as well. To remove current barrier, such as high production/import cost, tax reduction on custom duty and sale tax for EE&C product to be considered similar to the treatment applied to solar panel product in Pakistan. Another approach is to provide award to the excellent EE&C project. This will attract architects as well as building owners for gaining positive reputation for their presence. The award will also promote awareness to the public.

Table 4.3- 3 Overview of Support for Promotion of Advanced EE&C to Private Sector

| | |
|---|---|
| Project name | Support for Promotion of Advanced EE&C to Private Sector |
| Counterpart | ENERCON |
| Target organization | MOWP, MOST/PEC, FBR, DA, HBFC, SB |
| Purpose | Widespread of advanced EE&C into building sector |
| Expected Output | -Establish evaluation method and software<br>-Establish certification/labeling system<br>-Incentive Scheme adopted by respective organization |
| Required fund | 150(thousand USD) |
| Period | 2 years |
| A) Establishment of Visible Evaluation System<br>✧ Establish a comprehensive evaluation method in line with BCP-EP-2011 and set labeling system.<br>✧ Establish an organization with evaluation methodology (i.e. Organization, Human Resources, inspection method and certification)<br>✧ Framework for capacity development. (i.e. continuous skill development, registered evaluator) | |
| B) Introduction of software and WEB program<br>✧ Create user-friendly software so that the owner and designer can evaluate new buildings during the design process as well as existing buildings for retrofits.<br>✧ Framework of periodical software revision in line with future code revisions.<br>✧ Create a manual for software users.<br>✧ Establishment of a training system for lecturers and programmers.<br>✧ Establishment of periodical seminars for relevant professionals. | |
| C) Incentive for Model City Utilizing the Eco-building recognition<br>✧ Consideration of trade-off with building regulations (DA and other authorities)<br>✧ Consideration of a tax-reduction scheme with property tax (DA and other authorities) | |
| D) Incentive for nationwide construction Utilizing an Evaluation System<br>✧ Low-interest bank loans for high EE&C performance building. (Banks/HBFC)<br>✧ Consideration of a tax reduction scheme regarding construction material/ equipment (FBR) | |
| E) Incentive on the architects' side Utilizing an Evaluation System<br>✧ Consideration of the Excellent Design Award<br>✧ Introduction of EE&C expert certification | |

Source: JST

### 4.3.3 Leading Action by the Public Sector (Public Building Improvement Scheme)

The purpose of this project is to boost the expansion of EE&C buildings by leading government action. Once the government is committed to a certain standard for EE&C on all public building projects, stakeholders, including architects, engineers, contractors and suppliers of material and equipment must follow the required specification. This will increase the market share and also benefit the private sector.

(1) New Construction Building
New construction projects shall meet the minimum BCP-EP-2011 requirement with higher standards such as voluntary guidelines, since the intention is to show government commitment of EE&C to private sector. Analysis of cost impact and expected energy-saving to be presented for inter-ministry consensus.
Once the policy is approved, standard building specification to be amended for tender documents. Capacity development for professionals at the Public Works Department to be implemented.

(2) EE&C Retrofit of existing public buildings
First of all, the data for existing federal government public buildings, such as envelope and service specification, energy consumption, operation hours and maintenance policy, to be collected for analysis. The methodology of the EE&C retrofit, required budget and expected energy saving to be studied for the phased retrofit project. The plan indicates a target number of buildings with the completion year to be presented for inter-ministry consensus.

A standard technical specification for an EE&C retrofit project is also to be created for the purpose and training for applicable professionals will be implemented. The maintenance concept of government buildings will also be re-studied for sustainable EE&C, which may require developing capacity for maintenance personnel.

Table 4.3- 4 Overview of Leading Action by Public Sector

| | |
|---|---|
| Project name | Leading Action by Public Sector |
| Counterpart | ENERCON |
| Target organization | MOHW/PWD, MOWP, MOST/PEC, PPRA, MFRP/PD |
| Purpose | Boosting penetration of EE&C buildings by government initiative |
| Expected Output | - Enforced EE&C standard for new public building construction<br>- Committed plan to retrofit existing public buildings<br>- Seminars for professionals/ PWD engineers carried out |
| Required fund | 175(thousand USD) |
| Period | 2 years |
| A) Action for New Construction Building<br>✧ Determining plan for new construction building<br>✧ Estimation of construction cost and EE&C effect<br>✧ Amendment of public building standard specification<br>✧ Consensus formulation of policy, planning and budget (Inter-Ministry) | |
| B) Action for Existing Buildings<br>✧ Data collection of building envelope and equipment specifications with current energy usage<br>✧ Analysis of retrofit method, construction cost and EE&C effect<br>✧ Consensus formulation of policy, planning and budget (Inter-Ministry) | |
| C) Capacity development for Professionals/ PWD engineers<br>✧ Amendment of public building new construction/ retrofit standard specification<br>✧ Consideration of maintenance plan (short term, mid/long term)<br>✧ Seminar/workshop for professionals | |

Source: JST

(3) Pilot Project

The major objective of the pilot project, Zero Energy Building is to introduce leading EE&C technology with technical support by experts to promote EE&C awareness as well as capacity development for professionals in Pakistan.

All processes of preliminary design and concept development will be corroborated by local engineers and foreign experts.

During construction, selected professionals to carry out site supervision with technical assistance by experts. The entire process and end result will be recorded as material for a further awareness campaign. The achievement of a pilot project will be used for following building projects as good practice.

Table 4.3- 5 Overview of Pilot Project Implementation stage

<table>
<tr><td>Project name</td><td>Construction of Pilot Project</td></tr>
<tr><td>Counterpart</td><td>ENERCON</td></tr>
<tr><td>Target organization</td><td>MOHW/PWD, MOWP, MOST/PEC, PPRA, MFRP/PD</td></tr>
<tr><td>Purpose</td><td>Promote leading EE&C buildings concept</td></tr>
<tr><td>Expected Output</td><td>- Introduction of advanced technology<br>- Capacity Development of professionals<br>- Pilot Project implementation</td></tr>
<tr><td>Required fund</td><td>9,070(thousand USD) (TBD subject to building size)</td></tr>
<tr><td>Period</td><td>3 years (TBD subject to building size)</td></tr>
<tr><td colspan="2"><u>A) Action to Pilot Project for Advanced EE&C Building</u><br>✧ Formulation and operation of Task Force (Inter-Ministry)<br>✧ Consideration of implementation policy<br>✧ Concept Design of Advanced EE&C Building</td></tr>
<tr><td colspan="2"><u>B) Design Development</u><br>✧ Detailed Design Development<br>✧ Preparation of bidding documents</td></tr>
<tr><td colspan="2"><u>C) Bidding</u><br>✧ Notification of tenders<br>✧ Tender evaluation<br>✧ Award to contractor</td></tr>
<tr><td colspan="2"><u>D) Construction Supervision</u><br>✧ Construction supervision<br>✧ Training to professionals</td></tr>
<tr><td colspan="2"><u>E) Analysis of achievement</u><br>✧ Data collection and analysis<br>✧ Seminar to professionals for achievements<br>✧ Accessible project data from web site</td></tr>
</table>

Source: JST

### 4.3.4 Estimated outcome by Action Plans

(1) Preconditions

- ✧ Estimate is made for the power contract for Domestic and Commercial only which is about 52%[11] of entire power consumption in Pakistan. (Excludes Power consumption by Industry, Agricultural, Public Lighting and Bulk Supply)
- ✧ EE&C estimate includes built-in services for building such as Air-conditioner, fans and lighting and excludes mobile appliances.
- ✧ Building stock will be increased in similar volume as population growth. Total building stock will be increased by 155%[12] in 2050 compare to the building stock in 2015.

Table 4.3-6 Projected Population

| Year | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| Projected Population (Million) | 173 | 191 | 208 | 225 | 240 | 255 | 270 | 283 | 295 |
| 5 year growth | | 10.4% | 8.9% | 8.2% | 6.7% | 6.3% | 5.9% | 4.8% | 4.2% |

Source: National Report of Pakistan for Habitat III

- ✧ Average annual electrical consumption per contract was about 2070KWh in year 2006-8 for both domestic and commercial and have been reduced due to the frequent load shedding. Comparison base is using electrical consumption per contract as 2070KWh which will increase reflecting population growth.

Table 4.3-7 Average Annual Power consumption per contract 2004-2014

| Year | 2003-4 | 2004-5 | 2005-6 | 2006-7 | 2007-8 | 2008-9 | 2009-10 | 2010-11 | 2011-12 | 2012-13 | 2013-14 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Domestic Consumption/ contract (KWh/year) | 1,972 | 1,984 | 2,075 | 2,076 | 1,985 | 1,825 | 1,842 | 1,859 | 1,770 | 1,738 | 1,707 |
| Change from Previous year | | 100.6% | 104.6% | 100.1% | 95.6% | 92.0% | 100.9% | 100.9% | 95.3% | 98.2% | 98.3% |
| Commercial Consumption / contract (KWh/year) | 1,595 | 1,715 | 1,909 | 2,048 | 2,069 | 1,909 | 1,979 | 1,992 | 1,936 | 1,978 | 2,050 |
| Change from Previous year | | 107.5% | 111.3% | 107.3% | 101.0% | 92.2% | 103.7% | 100.7% | 97.2% | 102.2% | 103.6% |

Source: NEPRA state of industry report 2009, 11 and 14

[11] NEPRA state of industry report 2009, 11 and 14

[12] Used population projection rate in National Report of Pakistan for Habitat III

Table 4.3-8 Projected Power Consumption (GWh/year)

| Year | 2010 | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|---|---|
| Total Consumption from Domestic and Commercial | 43,600 | 51,268 | 55,832 | 60,395 | 64,421 | 68,447 | 72,474 | 75,963 | 79,184 |

Source: Calculated by JST using NEPRA state industry report consumption data & HABITAT III population growth data.

- ✧ 2% of Existing building stock in 2015 will be retrofitted or re-build annually. 70% of existing building stock will be re-build or retrofitted by 2050.[14]
- ✧ Incentive scheme will be carried out in stages, (assumed that scheme 1: Priority tax reduction in 2016, scheme 2: FAR trade-off and custom duty reduction in 2020, scheme 3: financial support program in 2025 ) and improve EE&C in both new construction and retrofit project.
- ✧ BCP-EP-2011 compliance and incentive scheme 1 effect will save 30% of current energy usage. [16] Coverage will be 10% of all new building construction.[17]
- ✧ First revision to BCP-EP-2011 and incentive scheme 2, scheduled by 2020, will save 40% of current energy usage[18] and will cover 25% of all new construction.[19]
- ✧ Second revision to BCP-EP-2011 and incentive scheme 3, scheduled by 2025, will save 45% of current energy usage[20] and will cover 40% of all new construction.[21]
- ✧ Enforcement of BCP-EP-2011 and incentive scheme will drive positive influence to building sector by i) cost down of materials by increased demand, ii) raised awareness to consumer.
- ✧ Out of 2% of annual retrofit and re-building of existing building stock, about half of building will save 20% of energy consumption[22] by 2020. (10% in total) Positive influence described above will increase saving as well as coverage in following years.

(2) Summary of preconditions and estimated outcome

Table 4.3-9 indicates summary of preconditions and estimated outcome. Outcomes are calculated separately in Additional Building Stock and Retrofit, re-building for existing buildings. For the respective period, "(D) Total Saving" is calculated by " (A) Assumed Saving per Building" multiplied by "(B) Assumed Coverage".

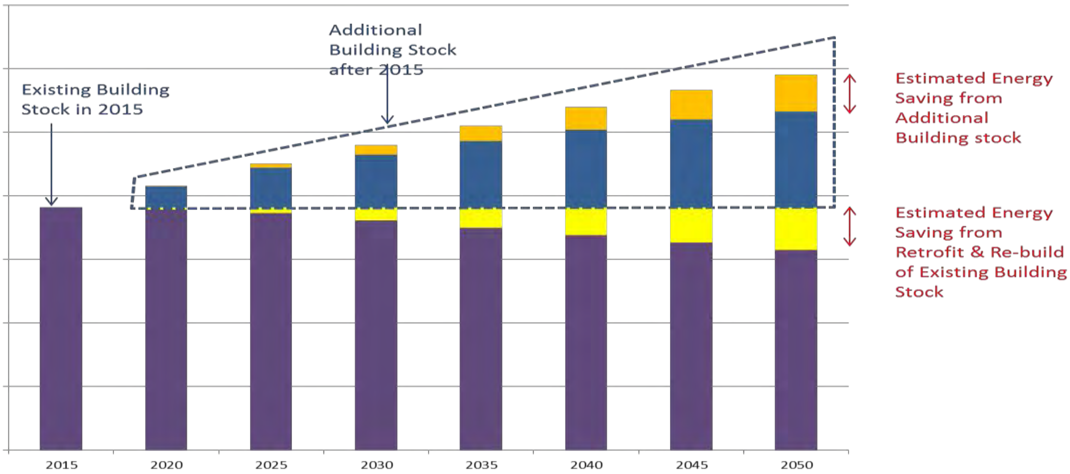
[14] Assumed that retrofitting will be carried out for some amount in addition to re-building due to building life span. According to Ministry of Land, Infrastructure, Transport and Tourism in Japan, Average life span of building is 26 years in Japan, 44 years in USA and 75 years in UK.
[16] Assumed that 25% saving from AC, 5% saving from lighting out of building consumes 60% by AC, 25% by lighting and 15% by others.
[17] From interview to DA, about 4% of buildings are 1000m² or more out of building application. This is assumed as 10% of new construction in floor area.
[18] Assumed that AC criteria, which is currently recommended guideline, will be mandatory.
[19] Assumed that applicable building floor area for BCP-EP-2011 will be reduced.
[20] Assumed that insulated envelope criteria and AC criteria will be revised.
[21] Assumed that applicable building floor area for BCP-EP-2011 will be further reduced.
[22] Assumed that 15% saving from insulation on building envelope, 5% saving from lighting.

Table4.3-9 Summary of Preconditions for estimated outcome

| Additional Building Stock | | | | | |
|---|---|---|---|---|---|
| Period | Action Plan | Estimated energy saving per building (A) | Estimated coverage for new construction (B1) | Estimated energy Saving per additional building stock (C1) = (A) x(B1) | Total energy Saving by additional stock(D1) |
| 2016-2020 | -BCP-EP-2011 enforcement in major cities<br>-Incentive Scheme 1 | 30% | 10% | 3.0% | 3.0% |
| 2021-2025 | -Revision 1 to BCP-EP-2011<br>-Incentive Scheme 2 | 40% | 25% | 10.0% | 17.5% |
| | -Positive influence to building sector (in average) | 10% | 75% | 7.5% | |
| 2026- | -Revision 2 to BCP-EP-2011<br>-Incentive Scheme 3 | 45% | 40% | 18.0% | 30.0% |
| | -Positive influence to building sector (in average) | 20% | 60% | 12.0% | |
| Retrofit and Re-build for existing building stock (for population 191 million in 2015) | | | | | |
| Period | Action Plan | Estimated energy saving per building (A) | Estimated coverage to existing building stock (B2) | Estimated energy Saving per year (C2) = (A) x(B2) | Total Energy Saving in 5 years (D2) (C2) x5 |
| 2016-2020 | -Incentive Measure to Existing Building 1(retrofit)<br>-Re-build per new construction regulation | 20% | 1.0% | 0.2% | 1.0% |
| 2021-2025 | -Incentive Measure to Existing Building 2(retrofit)<br>-Re-build per new construction regulation | 30% | 1.0% | 0.3% | 1.5% |
| 2026- | -Incentive Measures 3 Positive influence to building sector | 40% | 1.5% | 0.6% | 3.0% |

(A) Rate for Energy saving compared to the building do not comply BCP-EP-2011 as majority of Pakistan(No insulation on envelope, General use AC, No energy saver lamp) in both new construction and retrofit.
(B1) Rate for construction floor area comply with criteria of (A) out of all new construction in Pakistan.
(B2) Annual Rate for retrofit/ re-building floor area comply with criteria of (A) out of existing building stock in Pakistan as of 2015.
(C1) Rate of energy saving in new construction in specified coverage in (B1). Calculated by (A) x (B1)
(C2) Annual Rate of energy saving out of existing building stock in Pakistan as of 2015.
(D1) Rate of energy saving in all new construction for additional stock for respective five year period.
(D2) Rate of energy saving in existing building stock in Pakistan as of 2015 for respective five year period.

Source: JST




Source: JST

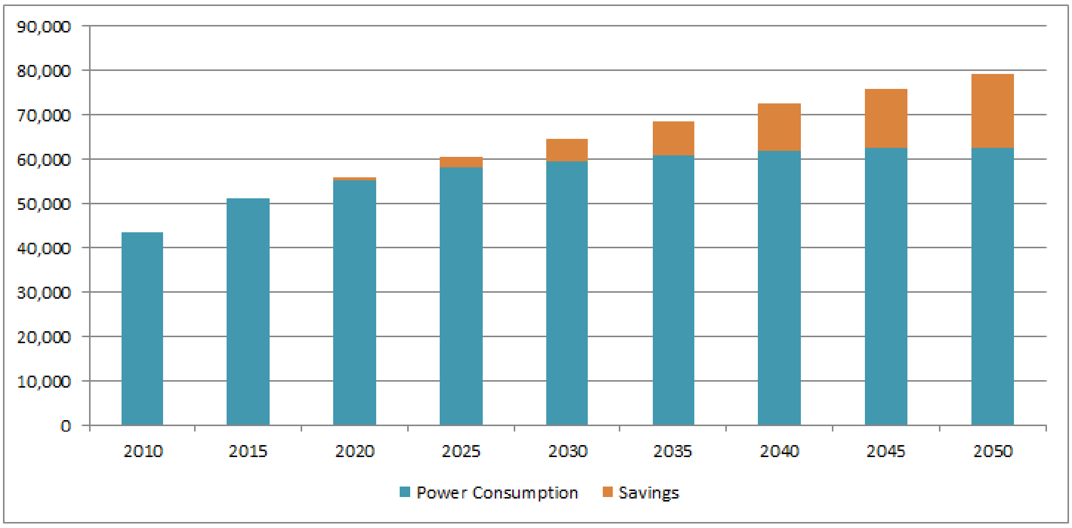
Figure 4.3-1 Diagram of Energy Saving in Additional and Existing Building Stock

(3) Estimated Outcome

1) Estimate for power consumption

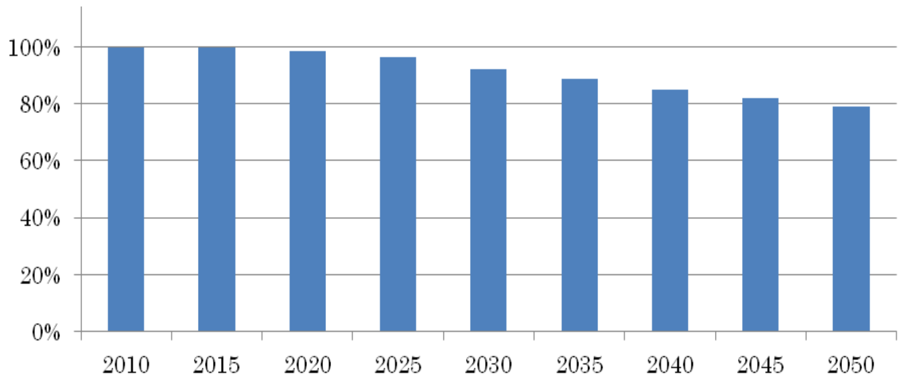
Initial effort, by year 2020, improves only one percent of saving in power consumption to entire building sector. However, once implementation framework is established, cumulative impact for both new construction and retrofit will be observed.

Power consumption in 2015 as a benchmark, energy efficiency level of entire building sector will be improved to less than 90% in 2035, less than 80% in 2050. Figure 4.3-2 indicates reduced power consumption and amount of saving against projected power consumption descried in Table 4.3-8. Figure 4.3-3 indicates the energy efficiency level of building sector in percentage in comparison with the efficiency level in 2015 as 100%. Estimated annual reduction of CO2 emission in comparison with projected consumption is shown in Table 4.3-10.




Source: Estimated by JST using NEPRA state industry report consumption data

Figure 4.3-2 Projected Power Consumption & Savings for Domestic and Commercial usage (GWh)




Source: Estimated by JST

Figure 4.3-3 Projected Building Sector Energy Efficiency Level(Compare to 2015 as 100%)

Table 4.3-10 Estimated Power Consumption saving and reduced CO2 emission.

| Year | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|---|
| Projected Consumption Based on 2006 average consumption /contract (GWh) | 51,268 | 55,832 | 60,395 | 64,421 | 68,447 | 72,474 | 75,963 | 79,184 |
| Reduced Annual Power Consumption (GWh) | 51,268 | 55,198 | 58,288 | 59,568 | 60,848 | 61,726 | 62,389 | 62,542 |
| Annual Savings (GWh) | | 634 | 2,107 | 4,853 | 7,599 | 10,748 | 13,574 | 16,642 |
| Reduction of Annual CO2 emission (million ton-CO2) | | 459 | 1,525 | 3,514 | 5,502 | 7,781 | 9,828 | 12,049 |

Source: Estimated by JST (CO2 emission factor: 0.724t-CO2/KWh)

2) Estimate for power demand

According to the NEPRA state industry report 2014, as a major reason of load shedding, there was deficit in power supply about 4,406MW caused by 20,576MW of demand during peak hours against 16,170MW of generation capability in 2014 . Although peak hour timing is normally from 5PM to 11 PM, the hourly load figures in summer remained about 17,500-18,500MW for the time period of 1AM to 4 AM, which is about 7,500 MW higher than the hourly load figure in the same time period in winter.[23]

The gap of 7,500MW between summer and winter can be considered as the power demand by air conditioner. Therefore, assumed demand by air conditioner in peak hour is 9,000MW which is about 45% of total power demand.

As summarized in Chapter 2.6, the estimated saving by BCP-EP-2011 compliance compared to non-insulated building with general usage air conditioner is about 50% in demand.[24] If all existing

[23] NEPRA state industry report 2014

[24] Analysis on BCP-EP-2011 compliant building power demand resulted 40-55% saving compared to non insulated buildings. (See chapter 2.6)

buildings were BCP-EP-2011 compliance as of current, the demand could be reduced to 4500MW which is about same amount of the deficit in 2014. Table 4.3-11 indicated estimated outcome by improved buildings according to the scenario as shown in Table 4.3-9.

Table 4.3-11 Estimated power demand by AC and savings by improvement per BCP-EP-2011

| Year | 2015 | 2020 | 2025 | 2030 | 2035 | 2040 | 2045 | 2050 |
|---|---|---|---|---|---|---|---|---|
| Estimated demand by AC（MW）<br>(without improvement) | 9,000 | 9,801 | 10,602 | 11,309 | 12,016 | 12,723 | 13,335 | 13,901 |
| Saving by new construction(MW) | | 401 | 801 | 1,154 | 1,508 | 1,861 | 2,168 | 2,450 |
| Saving by retrofit/ re-building<br>from existing building stock(MW) | | 225 | 450 | 788 | 1,125 | 1,463 | 1,800 | 2,138 |
| Estimated improved demand by AC(MW) | | 9,176 | 9,351 | 9,367 | 9,383 | 9,399 | 9,368 | 9,313 |
| Saving rate by improvement | | 6.4% | 11.8% | 17.2% | 21.9% | 26.1% | 29.8% | 33.0% |

Source: Estimated by JST

(4) Cost effectiveness for Each Action Plans

The action of " Enforcement" can be cost effective, hence it requires just preparation of document and training for inspector at the building control authority. The potential of energy saving from this action is high, however there is a risk that regulation is applied only on the application form and not actually enforced on the ground.

The " Leading Action" by government project does not have greater scale of impact but it can be very stable action because it just require government decision and fund. This kind of commitment may drive positive influence to building sector.

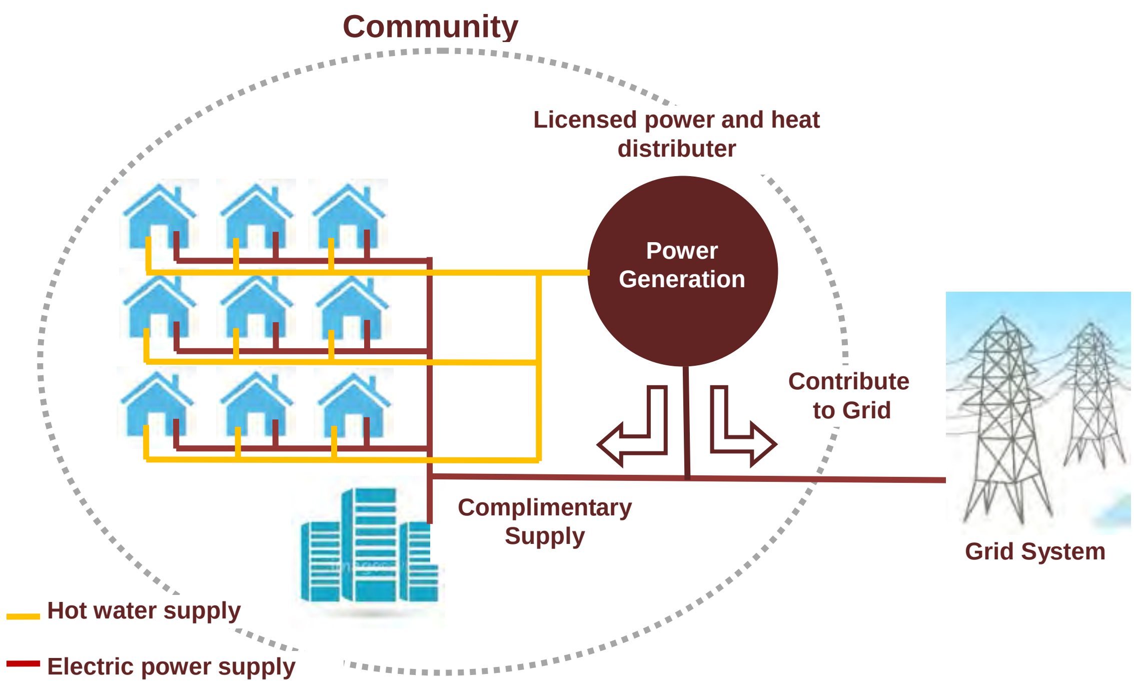
As far as the action of "Incentive" goes, if incentive scheme are intended for financial support, the amount of fund will be large. The potential of financial support incentive could be significant by driving big movement to the building sector through the action, however there is a chance that funds are consumed by selected stakeholders without creating positive movement. Incentive scheme like Bonus FAR trade-off or simultaneous implementation of priority tax rate revision and preferential treatment could be most cost effective action hence it does not require any additional fund for the action.

## 4.4 Other Suggestions

(1) Optimized Decentralized Generation

In the current Pakistan's situation, such as shortage of power supply from grid and trend of creation of gated community in suburbs, the idea of Decentralized Generation might have great potential to establish stable and ecologically friendly electrical system. In contrast to the current conventional power stations and its grid system, Decentralized Generation is the production of electricity at/ or near the point of use, irrespective of size, fuel or technology. The benefits of decentralized generation are to reduce capital investment, lower the cost of electricity, reduce pollution, reduce production of greenhouse gas, and decrease vulnerability of the of the electric system to extreme weather and disaster.

Renewable energy source and co-generation system could be incorporated into the Decentralized Generation system and the surplus electric generation could be contributed to the grid system to fulfill the gap in other area if technically applicable. In order to promote the idea of decentralized generation, liberalization of retail electricity sales and other removal of existing regulation in terms of electricity supply would have to be promoted by government.




Source: JST (except for Pictogram)

Figure 4.4-1 Diagram of Decentralized Generation

(2) Comprehensive evaluation and improvement on key government buildings

When retrofit construction work is carried out, apart from major purpose of retrofit, it is economical to include other required improvement, if beneficial, for structural, mechanical and electrical at the same time to minimize building closure period loss and construction cost in the mid-long term perspective.

Furthermore, as a reinforcement against natural/ human disaster, some key government facility must be remain operational to manage the required immediate action in the crisis. In addition to the EE&C improvement descried in the proposed action plan, comprehensive evaluation and retrofitting for improvement of building stability is highly recommended. Proposed items are shown in Table 4.4-1.

Table 4.4-1 Proposed Improvement of key government building stability

| Item | Evaluation | Improvement |
|---|---|---|
| Structure | -Seismic capacity | -Seismic Strengthening |
| Fire Protection | -Escape Stair/ Ladder, Fire Alarms, Fire extinguisher | -Incorporate into latest fire code.<br>-Establish periodical maintenance |
| Electricity | -Improve Energy Efficiency<br>-Analysis of minimum required load for emergency operation. | -Incorporate Net Zero Energy Building standards.<br>-Formulation of Optimized system both zero energy and emergency generator in emergency case (disconnection with grid). |
| Sanitation | -Review existing sanitation capability. | -Improvement of supply water capacity.<br>-Improvement of waste water treatment (on site mini plant) |
| Telecommunication | -Evaluation of vulnerability | -Installation of stable communication method. |

Source: JST