Appendix 8: Draft Roadmap

1. Agenda of the Energy Conservation Seminar on January 31

Energy Efficiency Seminar

Date: 31st January 2023

Venue: National Scientific Research Institute of Renewable Energy Sources

Language: English-Russian simultaneous interpretation

Agenda [Tentative]

Time	Agenda	Speaker	Duration
9:30-10:00	Registration		30 min
10:00-10:05	Opening remark	**Dr. Suguru Miyazaki** Chief Representative, Uzbekistan Office, Japan International Cooperation Agency (JICA)	5 min
10:05-10:10	Opening remark	**Mr. Aziz Alimukhamedov** Director of the National Scientific Research Institute of Renewable Energy Sources	5 min
10:10-10:20	Background and situation of energy efficiency issue	**Mr. Ilkhom Samiyev** Ministry of Energy of the Republic of Uzbekistan	10 min
10:20-10:30	Basic items for energy efficiency program	**Mr. Akifumi Nishihata** Pacific Consultants Co., Ltd. (PCKK)	10 min
Session 1: Activities to be conducted in the energy efficiency program			
10:30-10:45	Energy efficiency improvements in the residential and commercial sector	**Mr. Akifumi Nishihata** Pacific Consultants Co., Ltd. (PCKK)	15 min
10:45-11:00	Energy efficiency improvement in the district heat system and industrial sector	**Mr. Motohiro Washimi** The Energy Conservation Center, Japan (ECCJ)	15 min
11:00-11:10	Expected effects of the energy efficiency program implementation	**Mr. Akira Ishihara** The Energy Conservation Center, Japan (ECCJ)	10 min
11:10-11:40	Q&A and discussion		30 min
11:40-11:55	Coffee break		15 min
Session 2: Strengthening energy management systems			
11:55-12:10	Improving the statistical system of energy supply and demand data at the national level	**Mr. Masayuki Sakai** Asia Engineering Consultant Co., Ltd. (AEC)	15 min
12:10-12:25	Policy promotion of energy management systems and energy conservation standards	**Mr. Akira Ishihara** The Energy Conservation Center, Japan (ECCJ)	15 min
12:25-12:45	Q&A and discussion		20 min
12:45-12:50	Closing Remark	**Mr. Abdullajon Otaboev** Director of the Department of Energy Efficiency Ministry of Energy of the Republic of Uzbekistan	5 min

Energy Efficiency Seminar

Date: 31st January 2023

Venue: National Scientific Research Institute of Renewable Energy Sources

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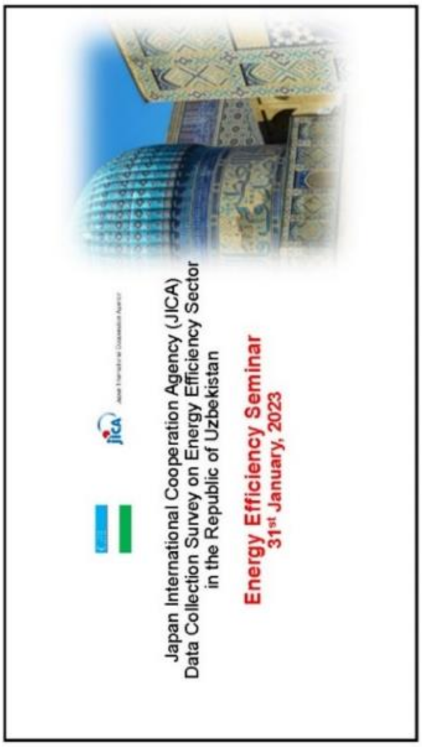
Participants [Tentative]

Entity	Participants [Tentative]
Ministry and Agency	
Ministry of Energy	Abdullajon Otaboev Ilkhom Samiyev Elzod Rahmonov Svetlana Shirshova Abdullayev Adkham
JSC "Hududgazta'minot"	Abdusamad Nabiyevich Onorbayev Hasandjon Maxmudjonovich
Ministry of Economy Development and Poverty Reduction	Alisher A. Alimbaev Shaxzod Islamov
Ministry of Construction	Bakhodir S. Sadikov Rustam Kuchkarov
Ministry of Housing and Communal Services	Aziz Erkaboev Juraev Ravshanbek Mamadjanovich Sherhon Suyarov
Tashkent City	Egamberdiev Sherzod Aleksandr Vasilevich
Ministry of Investment and Foreign Trade	Azamat Shakirov
Uzbek Agency for Technical Regulation	Allaev Botir
State Committee of Statistics	Jurayev Sardor Botirovich
International Organization	
Japan International Cooperation Agency	Suguru Miyazaki Yoshimasa Takemura Hitoshi Seki Abdufarrukh Khabirov Hirotaka Watanabe Yukinori Falah Yanagida
Japan External Trade Organization	Jun Takahashi
World Bank	Tamara Babayan Maksudjon Safarov Bahodir Omonov
European Bank for Reconstruction and Development	Malika Mirsaidova Anvar Nasritdinov
United Nations Development Programme	Sherzod Kattakhodjaev Nodirbek Buriev Bekzat Anarbekov
Asian Development Bank	Adnan Traen Shokhimardon Musaev Katayama Hiroki
French Development Agency	Aurelie Sol Antoine Chevalier
Private Enterprise	
Asakabank	Bobokhon Abdullayev Jakhongir Gadaev
Uzpromstroy Bank	Nizomiddin Rakhmanov
Ventr Vitona	Alexander V. Kotov Dmitriy Kotov

Source: JICA study team

2. Presentation Material of the Energy Conservation Seminar on January 31



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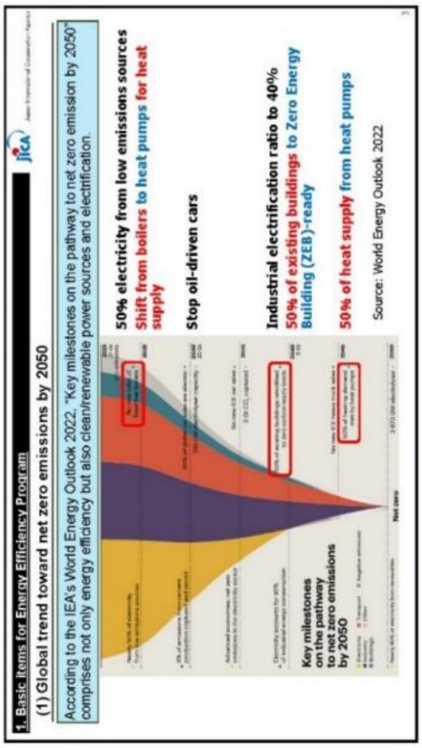

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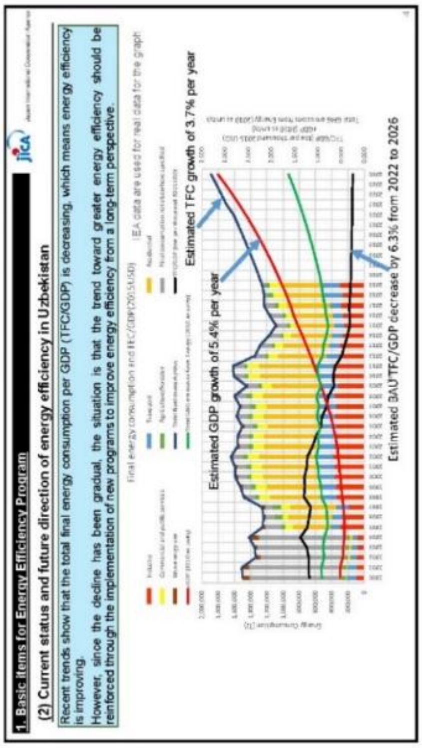


4

1. Basic items for Energy Efficiency Program

(2) Current status and future direction of energy efficiency in Uzbekistan (energy efficiency targets)

The total energy saving potential of the program is equivalent to about 10% of primary energy consumption in Uzbekistan.

Adding efficiency gains in power sector generation, transmission, and distribution, conversion to renewable energy power, and efficiency gains associated with GDP growth, the overall energy efficiency ratio could reach Uzbekistan's energy efficiency target of 20%.

Energy use reduction rate per GDP

target 10%	3%	6% in intensity	RE power generation and future programs (ZEB, EV)
Energy efficiency programs	Loss reduction in power generation, transmission, distribution	Effect of economical growth for energy efficiency	

5

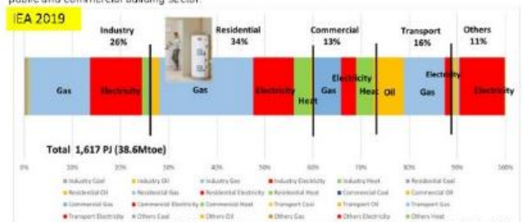
1. Basic items for Energy Efficiency Program

(3) Current status and issues of energy consumption in Uzbekistan (national energy balance analysis)

The efficiency of heat supply and consumption, mainly in the private and industrial sectors, holds an important place in improving energy efficiency in Uzbekistan.

Therefore, this program will focus on the use of heat and the efficiency of natural gas consumption for the use of heat.

- To mainly focus on replacing gas-fired boiler with electric heat pump for heat supply (electrification), identifying and minimizing heat losses, and enhancing insulation performance.
- The project will also focus on the possibility of improving the efficiency of heat supply plants.
- On the other hand, the ongoing efforts to strengthen and improve the efficiency of power sources, as well as the future generation and use of electricity from renewable energy sources, are on the rise. Therefore, the efficiency of electricity use also should be focused.
- Furthermore, from the perspective of improving energy efficiency in each sector, priority measures are proposed for the industrial sector and the public and commercial building sector.



Sectoral Primary Energy Consumption by Energy Type in Uzbekistan

	Sector Total (PJ) (Mtoe)	Total N.G. in sector (PJ) (Mtoe)	N.G Ratio in sector (%)
Industry	416 9.9	372 8.9	89.4%
Residential	546 13.0	486 11.6	89.1%
Commercial	210 5.0	193 4.6	91.7%
Transport	262 6.2	156 3.7	59.5%
Others	183 4.4	140 3.3	76.3%
Total	1,617 38.6	1,347 32.2	83.3%

6

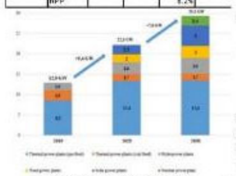
1. Basic items for Energy Efficiency Program

(3) Current status and issues of energy consumption in Uzbekistan (national energy balance analysis)

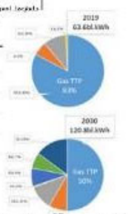
■Power source composition ratio of Uzbekistan's electricity

The MoE Concept Note (2020) indicates that the power supply plan up to 2030 will focus on high-efficiency gas-fired power, RE, and NPP, but the situation where natural gas will continue to be the main power source will continue. In addition to reducing GHG emissions by 35% by 2030 in the 2021 NDC, the development targets for PVPP and WPP are being revised upward.

		2019年	2025年	2030年	
Power Capacity		12.9GW	22.3GW	29.3GW	
Power Capacity Ratio	Gas TTP	65.6%	50.8%	45.7%	* Revised development targets upward
	Coal TTP	19.4%	7.6%	5.8%	
	HPP	13.2%	12.6%	13.6%	
	WPP *		9.0%	10.2%	
	PVPP *		11.2%	17.1%	
	NPP			8.2%	



Growth of Power Capacity in 2019-2030 ,GW



Change of Power Generation in 2019-2030

■Comparison of "heat consumption rate" between Uzbekistan and Japan

	Residential	Industry	Commercial	Country
Uzbekistan	90%	60%	90%	60%
Japan	65%	52%	47%	40%(2010)

・Uzbekistan heat consumption

Because data by use is not available, the following estimates are made based on the IEA's final energy consumption data, with reference to data by use in Japan.

Residential/Commercial : Fuel and heat are total heat consumption, electricity is 15% heat consumption

Industry : 56% of fuel and electricity is heat consumption

・Japanese heat consumption

Residential/Commercial : Handbook of Energy and Economic Statistics 2018 Based on application-specific data such as heating, cooling, hot water supply, kitchen, and power

Industry : Petroleum Consumption Statistics Survey (2017-2020) Based on boiler, cogeneration, heating, raw materials, and other application classifications

7

1. Basic items for Energy Efficiency Program

(3) Current status and issues of energy consumption in Uzbekistan (national energy balance analysis)

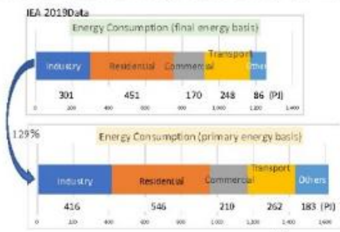
Primary energy conversion of TFC

In order to identify areas where energy conservation should be prioritized and promoted, electricity and heat, which are secondary energy, must be evaluated in terms of primary energy (input fuel). Therefore, energy consumption was recalculated using a primary energy conversion factor of 2.8 times for electricity and 1.15 times for heat.

1. Primary energy conversion of electric energy
   Electricity supplied (4,660ktoe)/input energy (13,034ktoe) = 0.358
   The conversion factor of electricity to primary energy shall be 2.8 (1/0.358).

2. Primary energy conversion of thermal energy
   Heat supply (1,229ktoe)/input energy (1,415ktoe) = 0.869 The conversion factor of heat to primary energy shall be 1.15 (1/0.869). Use the same conversion factor for the heat of the heat supply station

3. Energy consumption was recalculated using the above primary energy conversion factor. The figure on the right shows the conversion results. Since the conversion factor of electricity is large, the ratio of the industrial sector and the agricultural sector, which have a high electricity consumption ratio, will be high.



(PJ)

	Final energy base IEA 2019 Data	Primary energy base	magnification
Industry	301	416	138%
Residential	451	546	121%
Commercial	170	210	124%
Transport	248	262	106%
Others	86	183	213%
Total	1,256	1,617	129%

8

1. Basic Items for Energy Efficiency Program

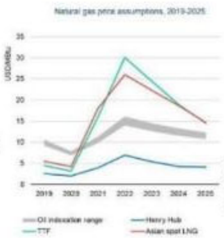
(3) Current status and issues of energy consumption in Uzbekistan (national finance benefit)

Question:

Is it beneficial for gas suppliers to save gas consumption?
Does it end up in decrease of their sales?

Answer:

Exporting more gas!
International gas price is increasing!



Source:
Gas Market Report, Q3-2022,IEA

9

1. Basic Items for Energy Efficiency Program

(4) Program scope and objectives

The program proposes improvements to be implemented as policy primarily for the energy consumption sector in order to improve energy efficiency.

It aims to contribute to the country's economic development and improve the standard of living of its citizens through a multifaceted approach to energy efficiency.

In addition to improving energy efficiency in the energy consumption sector, it is important to simultaneously improve the efficiency of electricity supply (generation, transmission, transformation, and distribution) in the power sector and expand electricity supply from renewable energy sources.

- Although the implementation period is assumed to be 2030, it is desirable to achieve the energy conservation targets as early as possible between 2026 and 2030.
- This is in line with **Presidential Decree No. UP-60** about the strategy of development for new Uzbekistan for 2022 - 2026.

> *take measures for increase till 2026 for 20 percent of energy efficiency of economy and to reducing for 20 percent of amount of emission of harmful gases in the atmosphere by active implementation of technologies of "green economy" to all spheres.*
>
> *programs of expansion and support of use of renewable energy resources, and also increase in energy efficiency of social, commercial and administrative and household buildings and constructions;*

- The program also includes future measures for the long term.
- The use of heat pumps, an important element for increasing the efficiency of heat use in this program, involves electrification in the energy demand sector.
- In this regard, the MOE's "Concept note for ensuring electricity supply in Uzbekistan in 2020-2030" lays out a plan for efficient electricity supply, expansion of electricity supply from renewable energy sources, and efficiency improvements in transmission and distribution of electricity, with a target year of 2030. The completion of this plan is also important for improving consumption efficiency and reducing the use of fossil fuels.

10

1. Basic Items for Energy Efficiency Program

(5) Priority measures

No.	Priority Measures	Implementation Items	Period	Promoters
1.	From gas boiler to heat pump + clean/renewable electricity	➢ Public and commercial facilities are targeted ➢ Transition from supplied heat to electricity by installation of heat pumps	2026	➢ MoE ➢ MoED&PR
2.	Efficient room air conditioning (heating & cooling for all sectors), Efficient refrigerator for residential	➢ Upgrade the energy efficiency class for new purchase of air conditioners and refrigerators ➢ Transition from heat to electricity by utilization of high efficiency air conditioner heating	2024	➢ MoE ➢ MoED&PR ➢ UZstandard
3.	Thermal insulation (window, wall and roof) ZEB and ZEH in the future	➢ Public/ commercial facilities, existing apartment buildings and detached houses are targeted ➢ Windows with double or low-E glass and walls with external insulation or insulation board	2026	➢ MoE ➢ MoC
4.	LED lighting (economically feasible)	➢ Upgrade the energy efficiency class for new purchase of LED illuminations	2024	➢ MoE ➢ UZstandard
5.	Awareness raising (social media and other media)	➢ Residential energy savings are targeted ➢ Effect of energy conservation activities in residential raised by awareness enhancement	2024	➢ MoE ➢ MJKO
6.	Energy management (monitoring) for industry (less cost)	➢ Industrial sector and commercial sector are targeted ➢ Energy efficiency improvement activities are promoted with small or medium investment ➢ Replacement of inefficient boilers to high efficienct ones or heat pumps and replacement of inefficient industrial furnaces	2026	➢ MoE ➢ MoED&PR ➢ SCS
7.	Industry motor from IE1 to IE3, Irrigation water pump	➢ High efficiency motors standardization with obligation ➢ Increasing efficiency and optimal capacity by replacement of deteriorated pumps for irrigation water supply	2026	➢ MoE ➢ MoED&PR ➢ MoWR

11

1. Basic Items for Energy Efficiency Program

(5) Priority measures (heat demand side)

Heat demand side \ Heat supply side		Gas, electricity, district heating
Residential and commercial sector	Housing complex Public facility Commercial building	[#1] From gas boiler to heat pump + clean electricity [#2] Efficient room air conditioning, Efficient refrigerator for residential [#3] Thermal insulation [#5] Awareness raising & Future ZEB
	Detached houses	[#1] From gas boiler to heat pump + clean electricity [#2] Efficient room air conditioning, Efficient refrigerator for residential [#3] Thermal insulation [#5] Awareness raising & Future ZEH
Industrial sector	Low-middle temperature	[#1] From gas boiler to heat pump + clean electricity [#6] Energy management for industry [#5] Awareness raising
	High temperature	[#6] Energy management for industry [#5] Awareness raising

12

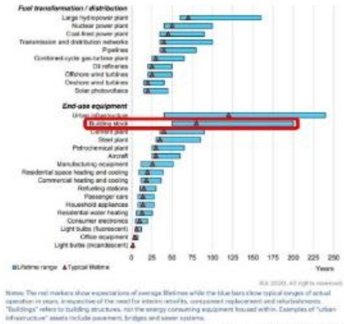
1. Basic items for Energy Efficiency Program

(5) Priority measures (building)

Life time of infrastructure, building, equipment

Buildings' life time is several decades. It will take quite long time to replace them to clean and efficient ones.

⇒ Issue is "stock management"



Source: IEA Energy Technology Perspectives 2020

13

Session 1
Activities to be conducted in the energy efficiency program

14

Japan International Cooperation Agency (JICA)
Data Collection Survey on Energy Efficiency Sector
in the Republic of Uzbekistan

Energy Efficiency Seminar
31st January, 2023

Energy efficiency improvements in the residential and commercial sector

Pacific Consultants Co. Ltd.
Akifumi NISHIAHTA

15

2-1. Energy efficiency improvements in the residential and commercial sector

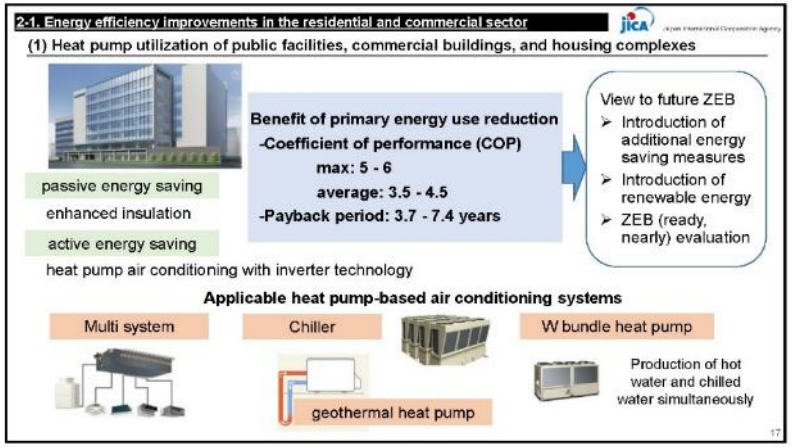
(1) Heat pump utilization of public facilities, commercial buildings, and housing complexes

Promote the introduction of heat pumps, which are highly energy-efficient, in public facilities, commercial buildings, and housing complexes.

- In small buildings, the multi-unit system for buildings is efficient. This method connects floor or grouped air-conditioning terminal equipment to the heat pump, which has a shorter service life than the central system, but requires a smaller investment and is easier to maintain.
- For large building repairs, consider a central system that can use existing building HVAC piping. In large buildings, it is possible to assign a facilities engineer to manage the central system.
- For new construction of large buildings, both the multi-unit system for buildings with small investment scale and the central system with long service life can be applied.
- In the case of large hospitals and hotels, where demand for hot water is high, the application of W-bundle heat pumps, which can supply hot water and cold water for cooling at the same time, is also effective.
- If a new housing complex is planned and public facilities are attached to it, the central method can be applied, with the entire complex as one group. In doing so, care should be taken to avoid long heat transport distances from the standpoint of thermal efficiency.

Energy saving effect: 426 ktoe/y
(changing heat supply source from district heating hot water to individual electric heat pump)

16


2-1. Energy efficiency improvements in the residential and commercial sector
(1) Heat pump utilization of public facilities, commercial buildings, and housing complexes
passive energy saving
enhanced insulation
active energy saving
heat pump air conditioning with inverter technology
Benefit of primary energy use reduction
-Coefficient of performance (COP)
max: 5 - 6
average: 3.5 - 4.5
-Payback period: 3.7 - 7.4 years
View to future ZEB
Introduction of additional energy saving measures
Introduction of renewable energy
ZEB (ready, nearly) evaluation
Applicable heat pump-based air conditioning systems
Multi system
Chiller
W bundle heat pump
geothermal heat pump
Production of hot water and chilled water simultaneously
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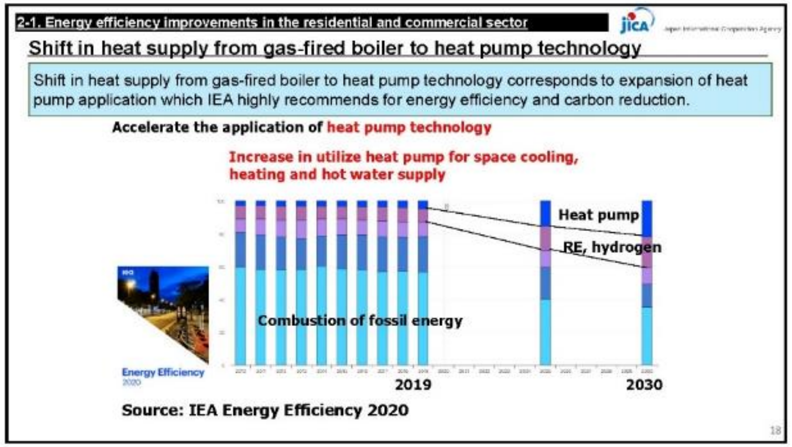
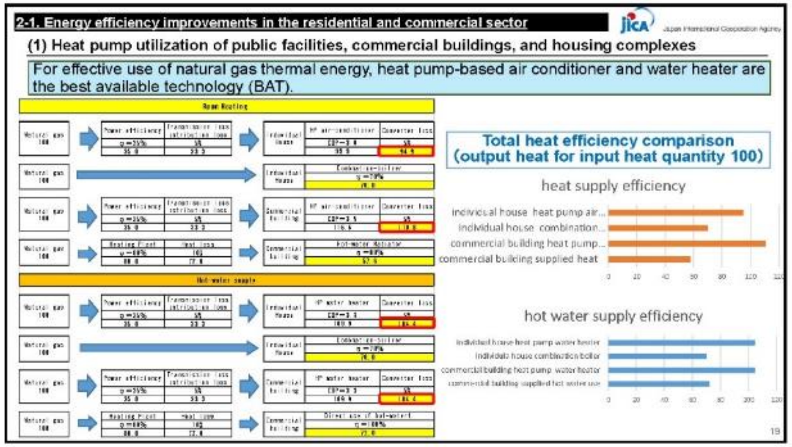
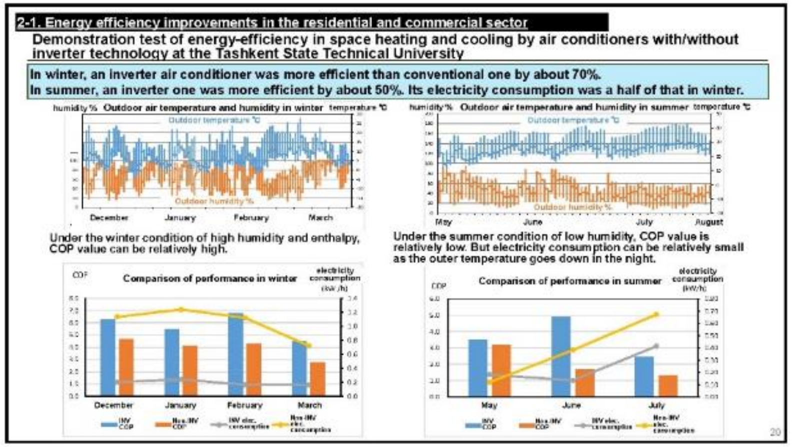
17


2-1. Energy efficiency improvements in the residential and commercial sector
Shift in heat supply from gas-fired boiler to heat pump technology
Shift in heat supply from gas-fired boiler to heat pump technology corresponds to expansion of heat pump application which IEA highly recommends for energy efficiency and carbon reduction.
Accelerate the application of heat pump technology
Increase in utilize heat pump for space cooling, heating and hot water supply
Heat pump
RE, hydrogen
Combustion of fossil energy
Energy Efficiency
2019
2030
Source: IEA Energy Efficiency 2020
18

18


2-1. Energy efficiency improvements in the residential and commercial sector
(1) Heat pump utilization of public facilities, commercial buildings, and housing complexes
For effective use of natural gas thermal energy, heat pump-based air conditioner and water heater are the best available technology (BAT).
Total heat efficiency comparison
(output heat for input heat quantity 100)
heat supply efficiency
individual house heat pump air...
individual house combination...
commercial building heat pump...
commercial building supplied heat
hot water supply efficiency
19

19

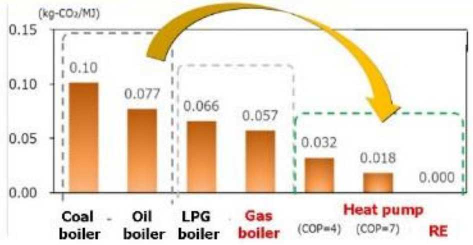

2-1. Energy efficiency improvements in the residential and commercial sector
Demonstration test of energy-efficiency in space heating and cooling by air conditioners with/without inverter technology at the Tashkent State Technical University
In winter, an inverter air conditioner was more efficient than conventional one by about 70%.
In summer, an inverter one was more efficient by about 50%. Its electricity consumption was a half of that in winter.
Outdoor air temperature and humidity in winter
Outdoor air temperature and humidity in summer
December
January
February
March
May
June
July
August
Under the winter condition of high humidity and enthalpy, COP value can be relatively high.
Under the summer condition of low humidity, COP value is relatively low. But electricity consumption can be relatively small as the outer temperature goes down in the night.
Comparison of performance in winter
Comparison of performance in summer
COP
electricity consumption
20

20

2-1. Energy efficiency improvements in the residential and commercial sector

Reduction of CO2 emission by using heat pumps

Using heat pump air conditioning instead of fossil fueled boilers can reduce CO2 emissions.
Besides, its impact can become more prominent by changing power source from current gas fired power generation to future renewable energy sources.



CO2 emissions per 1MJ heat by each heat supply system

Source: Heat Pump & Thermal Storage technology Center of Japan

21

2-1. Energy efficiency improvements in the residential and commercial sector

Policy measures promoting high-efficiency air conditioners and the effects

(1) To facilitate installation of high-efficiency air conditioners in the residential and commercial sectors, to change from conventional air conditioners with energy efficiency rating A or lower to high efficiency inverter-type air conditioners with energy efficiency rating A++ or higher by partially subsidizing (e.g. 30% of the price difference)

- ◆ Energy saving effect (primary energy-based): 44 ktoe/y
- ◆ Payback period (subsidy cost vs energy saving effect per year): 5 years

(for reference) user benefits in the demonstration test condition
10years (expected life cycle) electricity cost saving: 1160 kso'm (3month-use/year)
(note) demonstration test condition: an ideal condition with load just from circumstances
(calculation condition) electricity price: 450 so'm/kWh
electricity consumption: high efficiency (inverter) 0.26 kWh vs low efficiency 0.38 kWh

(2) To recommend using high-efficiency air conditioners in newly built apartment buildings instead of using district heating system

- ◆ Energy saving effect (primary energy-based): 35 ktoe/y

(for reference) user benefits in the demonstration test condition
10years (expected life cycle) electricity cost saving: 1500 kso'm (3month-use/year)
(note) demonstration test condition: an ideal condition with load just from circumstances
(calculation condition) electricity price: 450 so'm/kwh, district hot water price: 110 so'm/kWh
electricity consumption: high efficiency (inverter) 0.2 kWh for thermal load 1.2 kWh
heat energy efficiency for hot water use: 0.8

22

2-1. Energy efficiency improvements in the residential and commercial sector

(2) Improving efficiency of thermal equipment in detached houses

Strengthen support programs to encourage the installation of high-efficiency equipment when upgrading aging boilers existing in the detached houses.

- If there is no gas supply piping in a newly constructed house, heat supply equipment (heating and hot water) using heat pumps is an effective solution.
- On the other hand, for existing gas boilers with hot water tanks that are larger than necessary, it would be effective solution to replace them, as one choice, with more efficient combi boilers to reduce heat dissipation from the too large hot water tanks.

Official promotion on heat source in households

Official guidance to use high efficiency air conditioners for heating in newly constructed apartment buildings with high insulation

Official support for high efficiency boilers or heat pumps when deteriorated boilers and tanks in detached houses

23

2-1. Energy efficiency improvements in the residential and commercial sector

(3) Increase awareness of energy conservation in residential sector

Increasing awareness and understanding of energy conservation in housing complexes and detached houses is quite important as an energy conservation measure in residential sector.

- Countermeasures include optimizing room temperature settings for heating and cooling, using air conditioner, and using hot-water-saving showerheads at bathroom.
- Regarding the use of air conditioner heating functions, society as a whole should reduce the use of natural gas by promoting the use of high-efficiency inverter air conditioners. This is especially effective in residences with enhanced insulation.

Awareness raising for households

Development of knowledge through social media and other media

Diffusion of energy conservation behaviors in households

Room temperature setting for heating and cooling
Shower water saving (saving shower head)
Other conservation practice

Energy efficiency introduction for households

Knowledge about benefits and regulation
high efficiency air conditioners, refrigerators and LED
Heat loss minimization by using thermal insulation
Space heating by using high-efficiency inverter air conditioners

24

2-1. Energy efficiency improvements in the residential and commercial sector

Effect of energy-saving awareness raising and high-efficiency equipment diffusion in residential sector

Awareness raising for households
Effects of 3% of energy saving: 100 ktoe/y
Diffusion of hot water saving shower head
Effects of 35% of shower hot water saving: 197 ktoe/y
High efficiency air conditioners diffusion by energy saving standard and subsidy*
See slide 23
High efficiency boilers or heat pumps diffusion by subsidy* to replace deteriorated boilers and tanks in detached houses
Effects: 50 ktoe/y Payback period (subsidy amount vs effects per year): 6.3 years
High efficiency refrigerators diffusion by standard and subsidy*
Effects: 46 ktoe/y Payback period (subsidy amount vs effects per year): 4.9 years
LED lighting diffusion by regulation
Effects when 50% of lighting replaced: 361 ktoe/y
(*) supposed subsidy: 30% of cost difference between the high efficiency equipment and conventional one

25

2-1. Energy efficiency improvements in the residential and commercial sector

(4) Reinforcement of thermal insulation performance of the buildings and houses

The energy conservation benefits by enhancing thermal insulation performance can be quite obvious.
The scope of application of higher levels of the energy conservation standards, including thermal insulation for new buildings, should be more expanded into not only the use of materials with high thermal insulation properties but also enhancing the use of insulation for all building and house components, windows, walls and roofs.

Public facilities and commercial buildings – modernization and electrification
Heating and cooling systems utilizing heat pumps/ small boiler
separated from the district heat supply system
applied in case of new construction and renovation
Project/ regulation approach

New complex buildings consisting of public/ commercial facilities and housing
compact central heat supply for the complex applicable depending on the size

New apartment buildings
separation from the district heat supply system or
use of current district heat supply system as option

Existing apartment buildings with district heat supply
efficiency improvement of the existing system
Improvement/ support approach

Detached houses
efficiency improvement in its own heating, cooling, hot water supply
Awareness/ support approach

26

2-1. Energy efficiency improvements in the residential and commercial sector

(4) Reinforcement of thermal insulation performance of buildings and houses

Existing buildings should be subject to the same energy conservation standards as new buildings in major repairs. Promote energy-saving measures such as adding wall insulation and improving the thermal insulation performance of windows (upgrading to low-E glass and double-glazing).
Promote energy-saving renovations in public facilities and commercial buildings, and establish a support system for strengthening insulation in housing complexes and detached houses.

- According to the trial calculation concerning measures to strengthen the partial insulation performance of an existing housing complex, the following energy-saving effects can be expected.
- Considering the ease of renovation, it is realistic to prioritize window insulation measures first, and to insulate wall surfaces in conjunction with major repairs.

Classification	Thermal insulation performance enhancement measures	Reduction of thermal transmittance (W/m²K)	Estimation of energy-saving effects
Windows	Change from single glazing to double glazing	6.4 to 3.5	7%
Surface of walls	Reinforcing exterior insulation or attaching urethane boards	2.1 to 0.6	11%.

Total effects of insulation enhancement by enhanced standard and official support for refurbishment (wall, window and roof) at 15% of penetration rate: 402 ktoe/y
Payback period (refurbishment support cost vs effects per year): 5.8 years

27

2-1. Energy efficiency improvements in the residential and commercial sector

(4) Reinforcement of thermal insulation performance of buildings and houses

Estimation of effect of energy saving by heat loss prevention

Assumed conditions U: W/m²K
room temperature 25℃ → 24℃
windows Single-glass → Double-glass
(U value: 6.4 → 3.5)
apartment roof insulation (U value: 2.9 → 0.4)
wall insulation (U value: 2.1 → 0.6)
detached house roof insulation (U value: 3 → 0.4)
wall insulation (U value: 2.2 → 0.5)

Reduction of heat consumption
an apartment house with district heat
→ **reduction rate: around 30%**
a detached house without district heat
→ **reduction rate: around 30%**

Heat loss prevention reinforcement condition for calculation (based on apartment site survey)

double glass (effect weight 9%)
top floor roof insulation material (100mm)
blast or insulation paste (6%)
wall insulation material (30mm)
insulation board paste (15%)
heat insulation for heat supply pipe
change to thin plastic pipe (12%)
(Heat insulation would increase the effect)

Current wall structure

Current heat supply piping (cellar)

28

2-1. Energy efficiency improvements in the residential and commercial sector

(5) Promote Zero Energy Building (ZEB)

ZEB is a global energy and environmental trend, and promotion of its spread should begin.
In order to promote ZEB, it is necessary to develop ZEB evaluation criteria and create a subsidy measure for ZEB promotion especially in public buildings to demonstrate their energy saving impact and encourage their widespread use.

- In order to promote energy conservation and decarbonization in the building sector, ZEB conversion should be promoted.
- Buildings are usually used over 50 years, hence ZEB can create a lot of impact for a long period of time.
- Heat pump installation to public facilities and commercial buildings is one of the components of ZEB.
- ZEB is an important element of the future smart city concept in new buildings, along with the modernization of energy supply.
- Establishing tiered ZEB rating criteria, such as 50% (ZEB ready) and 75% (Nearly ZEB), will also provide guidance for retrofitting existing buildings.
- Possible method includes improving insulation performance of walls, roofs, and windows; installing high-efficiency air conditioning and water heating equipment; using solar and other renewable energy sources; and installing building energy management systems (BEMS).

IEA's forecast in Sustainable Development Scenario

[Future effects] large energy saving in residential and commercial sector: 1105 ktoe/y

29

2-1. Energy efficiency improvements in the residential and commercial sector

(5) Promote Zero Energy Building (ZEB)

ZEB and ZEB family (ZEB ready, Nearly ZEB) is a standard for design and evaluation of buildings according to each energy saving performance.
Standardization and realization support should be implemented in future.

Standardization, realization support, certification of ZEB

Realization of basic energy saving performance

Deepening energy saving performance

Full realization with Introduction of renewable energy

ISO TS23764
"An approach for non-residential zero energy building"
specifies ZEB realization activity in the following stages
- **planning**
- **design**
- **during construction**
- **after completion of building**
- **after operation start**
- **after completion**

Evaluation of energy saving is calculated by primary energy consumption basis of a building.

TS23764 states that the actual levels of ZEB ready and nearly ZEB are determined in the respective country.
The above values 50% and 75% are the set standard in Japan.

30

Japan International Cooperation Agency (JICA)
Data Collection Survey on Energy Efficiency Sector
in the Republic of Uzbekistan

Energy Efficiency Seminar
31st January, 2023

Energy efficiency improvement in the district heat system and industrial sector

The Energy Conservation Center, Japan
Motohiro WASHIMI

31

2-2. Improvement of thermal efficiency in the district heat supply system

area	EE measures	
supply station	Air ratio optimization	Heat supply system design consideration for suitability: large degree-days, short transport distance, low load variation; Air ratio optimization/ small chip investment
	Hot water volume control	Volume control added to temperature change in response to heat demand to reduce loss
	Economizer	recovery of unused heat energy by economizer
Transmission, receiving, consumption	Complete Closed system	Closed system including the use of hot water with associated renewal of heat-receiving units
	Receiving improvement	Piping insulation just around the buildings, heat receiving pipe and unit insulation, bypass valves to control hot water volume at night
	Consumption improvement	High efficiency AC heating as heat supporting, temperature control (valves) in each residence

Measures studied for Tashkent City District Heating Plant

32

2-2. Improvement of thermal efficiency in the district heat supply system

Effect of heat efficiency improvement measures

Energy efficiency of district heat supply can be improved based on official investments.

(Tashkent City District Heat Supply Stations)

- Air ratio optimization : operational with small investment (burner chips)
  - effects 15 ktoe/y
- Volume control added to temperature change in response to heat demand : operational
  - effects 29 ktoe/y
- Recovery of unused heat energy by economizer
  - effects 108 ktoe/y economizer installation cost vs effects per year 0.2

(Transmission, receiving, consumption)

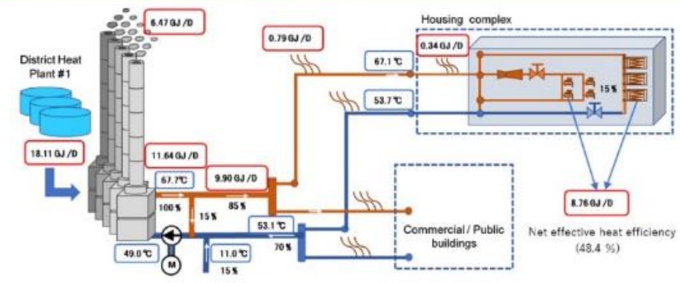
- Closed system including the use of hot water with renewal of heat-receiving units
  - effects 72 ktoe/y refurbishment cost vs effects per year 1.0
- Thermal insulation for piping around the buildings and heat-receiving units, installation of bypass valves to control hot water flow rate, etc.
  - effects 232 ktoe/y installation cost vs effects per year 3.4
  - City piping insulation enhancement maximum potential 280 ktoe/y
- Temperature control for each residence, rooms by introducing control valves
  - effects 193 ktoe/y installation cost vs effects per year 6.0

33

2-2. Improvement of thermal efficiency in the district heat supply system

(1) Current status of thermal efficiency in the district heat supply system

The existing district heat supply system has a fairly low energy efficiency as a whole.
Since the net effective heat value is small due to heat loss, and improvements in heat supply and heat utilization are needed, multiple options for addressing this issue need to be considered.



Example analysis based on on-site temperature measurements

34

2-2. Improvement of thermal efficiency in the district heat supply system

(2) Improvement of thermal efficiency of boilers at district heat supply plants and heat transport piping

At supply-side district heat supply stations, energy conservation measures that can be expected to be effective at low cost should be promoted.

① Heat insulation construction of heat transport main
- Provide heat insulation measures for exposed piping in the culvert section.
- However, heat insulation of underground pipes is a low priority due to the large scale of investment.

② Renewal of combustion burner nozzle chips in boiler and improvement of air ratio
- Air ratio improvements can provide significant energy savings for a small investment.

③ Change to an operation method that adjusts the amount of heat supplied according to the amount of hot water as well as the temperature of the hot water.

④ Exhaust heat recovery and feed water preheating by economizer
- The energy-saving effect of installing economizers is significant. However, it requires modification of funnels including flue sections, which will be a rather large-scale construction work. Therefore, a suitable plan and budgetary measure may be required.

Improvement opportunities in district heating plants

Combustion air supply fan Used for air ratio optimization

Hot water supply equipment to introduce supply volume control

Combustion air supply fan And gas piping (Tashkent City No1 DHP)

Hot water supply pump and motor (Tashkent City No8 DHP)

Hot water supply pump and manual valve for flow control (Tashkent No8 DHP)

35

2-2. Improvement of thermal efficiency in the district heat supply system

(3) Improving efficiency of heat consumption (housing complexes)

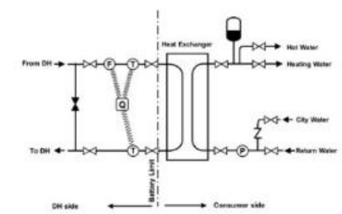
The existing district heat supply system will continue to serve as a lifeline, supplying heat to existing housing complexes, etc.
To improve its energy efficiency, the measures to prevent heat loss should be promoted.

① Automatic data collection from calorimeter
- This is necessary to obtain information to promote energy conservation measures.
- " Visualization" of the effect of heat consumption reductions due to consumer efforts will raise awareness of energy conservation.

② Separation of consumer from supply side (Closed system)
- As a basic measure to improve the efficiency of heat utilization in housing complexes, the heat receiving facilities in housing complexes should be upgraded and promoted to be completely closed.
- For housing complexes that are not converted to closed systems, replace steel pipes without heat insulation with plastic pipes, and implement heat insulation measures for pipes between the heat transport main and the heat-receiving part.

③ Reduction of heat distribution loss
- Install a bypass valve in the heat receiving section to allow adjustment of the hot water supply with keeping the minimum flow.
- Replace old radiation panels with new ones those equipped with temperature control valve to enable households to control room temperature, which will be helpful to prevent heat discharge to outside by opening windows during the middle season (mainly spring).

Separation of consumer from supply side (modification of piping in receiving part)



36

2-2. Improvement of thermal efficiency in the district heat supply system

(4) Separation of public service/commercial buildings, and housing complexes from the district heat supply system

For public service/commercial buildings, and housing complexes, separate them from the district heat supply system and promote the installation of stand-alone heat supply facilities by combining heat pumps for air conditioning (air conditioners, etc.), small boilers for hot water, heat pumps for hot water, etc.

- For new construction of public service/commercial buildings, the use of stand-alone boilers is currently underway, but further energy savings will be achieved through the use of heat pumps (air conditioners, etc.).
- If a new building complex consisting of public service/commercial buildings, and housing complexes is to be constructed, the installation of a heat supply system dedicated to that building complex deserves consideration. Depending on the size of the building complex, it can be part of a smart city.
- In the case of major repairs to existing buildings, promote separation from the district heat supply system in the same manner as for new construction.
- Although new housing complexes are basically separated from the district heat supply system, if smaller housing complexes can be connected to existing district heat supply piping, this can be used from the perspective of lifeline use. However, thorough measures shall be taken to prevent heat loss from heat receiving equipment of district heat supply system.

37

2-3. Energy efficiency improvement in the industrial sector

Energy consuming equipment in industry

Kind of energy	Equipment
Electricity	Pump, fan
	Motor
	Compressor
	Refrigerator
	Illumination
Natural gas	Boiler hot water vapor
	Furnace

Recommendation

- Total reduction by improvement actions facilitated by energy management enhancement
  subsector-wise total potential expectation 10 – 30%
- Replacement of deteriorated water supply pump for irrigation would reduce energy consumption 30% with reviewing the capacity. (2018JICA report).
- Premium IE3/ high IE2 efficiency motor standardization and regulation
- 50% of boilers in industry has insufficient efficiency - replacement or change to heat pump
- Energy saving in industrial furnaces:
  technology: heat recovery (recuperator, regenerative burner), insulation, air ratio, air leakage minimization

38

2-3. Energy efficiency improvement in the industrial sector

Effect of energy efficiency improvement measures in the industrial sector

Energy efficiency in the industry sector can be improved by promoting replacement of low efficient equipment to high efficient equipment by enhancement of energy management, standardization and support such as subsidies for replacement.

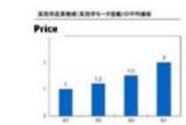
Replacement of deteriorated water supply pump for irrigation
effects 70 ktoe/y replacement cost vs effects per year 9.6
Premium IE3/ high IE2 efficiency motor standardization and regulation
effects 110 ktoe/y motor cost up vs effects per year 5.5
Boilers with insufficient efficiency in industry, replacement or change to heat pump
Heat pumps are mainly feasible as replacement of boilers for hot water.
effects 69 ktoe/y replacement cost vs effects per year 5.1
Energy saving in industrial furnaces using heat recovery technology (recuperator, regenerative burner), insulation, air ratio, air leakage minimization
effects 62 ktoe/y refurbishment cost vs effects per year 6.8

39

2-3. Energy efficiency improvement in the industrial sector

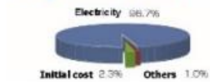
(1) Establishment of efficiency standards for motors

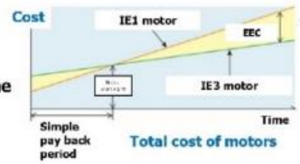
Motors account for much of the electrical consumption in the industrial sector, and defining their energy efficiency and ensuring that newly installed motors are highly efficient is a global trend that can be expected to have a significant energy-saving effect. Except for motors for special applications, the standard shall be premium efficiency (IE3) or variable frequency drive (VFD) and high efficiency (IE2) or better.



Comparison among the prices of different motor classes
Source:JEMA HP

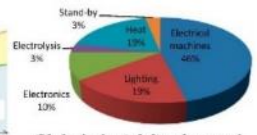
Life cycle cost of motors





Total cost of motors

Ref. Conversion from IE1 to IE3, expected EEC ratio is 2-10%. Financial benefit for end-users is expected to be high.



Global electricity demand by end-use

40

2-3. Energy efficiency improvement in the industrial sector

(2) Renewal of deteriorated boilers

Replace aging and inefficient boilers, as it is estimated that about 50% of all existing boilers in operation in the industrial sector are due for renewal.

- Renewal methods include upgrading to high-efficiency boilers and replacing with heat pumps.
- For upgrading to high-efficiency boilers, the method of installing multiple high-efficiency small boilers and controlling the number of boilers to match the load are particularly effective.
- For replacement with heat pumps, a heat pump is an effective way to supply hot water used in the food, textile, and other industries.

Options for efficient heat supply (vapor, hot water) in industry

Adoption of high efficient boilers

Implementation of multiple high efficiency small once through boiler with optimization control

Application of cogeneration

in case that large heat demand balanced to electricity demand, as in chemical industry

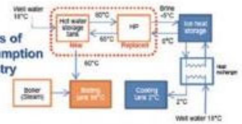
gas turbine + heat recovery boiler

Application of heat pumps

high temperature hot water output

transfer of heat

Applicable to factories of large hot water consumption such as in food industry



41

2-3. Energy efficiency improvement in the industrial sector

(3) Improve thermal efficiency of industrial furnaces

Since the existing industrial furnaces are operating with low thermal efficiency, it is desirable to significantly improve thermal efficiency through methods such as conversion to a regenerative burner system, installation of a recuperator and strengthening of thermal insulation of the external surface and etc..

Since these measures will require a large capital investment, it will require specific projects to be considered by individual establishments and financial support from the government.

Operation Improvement (No/Low Cost Measures)

Easy to be carried out
- Possible at no / low cost
- Possible in short term
- No need high-level decision
- Effect is limited to some extent

Facility Improvement (High Cost Measures)

Large effect can be expected

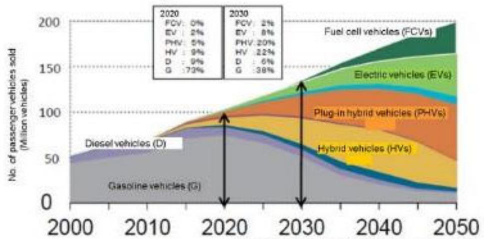
Difficult to be carried out
- Need large investment
- Need long term for installation
- Need high-level decision

42

2-4. Energy efficiency improvements in the transportation sector

The conversion of transportation vehicles to EVs as a program to be implemented in the future is a global trend that needs to be pursued.

Initial goals include (1) installation of recharging stations (assuming 60,000 recharging devices), (2) EV compatibility of production lines at automobile plants, (3) a support system for introduction funds to encourage EV conversion, (4) preparation of power sources that can support EV conversion, and (5) conversion of about 25% of the transportation vehicle stock to EVs.



IEA / ETP (Energy Technology Perspectives) 2012

future effects: large reduction of energy consumption in transportation sector 1647 ktoe/y

43

2-5. Improving energy efficiency in the agricultural sector

The electricity consumption in the agricultural sector is dominated by irrigation pumps.

So far, the planned replacement of aging and inefficient irrigation water pumps and motors is underway in accordance with Presidential Resolution PP3012. Continued efforts to systematically upgrade facilities and reduce water consumption in accordance with Presidential Decree No. 60 are expected to reduce electricity consumption.

At the time of renewal, the amount of water delivered will be reviewed from the standpoint of efficiency, and if the water delivery capacity is excessive, it should also be reduced.

- According to IEA statistical data, the agricultural sector accounts for a large share of electricity use, mainly due to water pumps for irrigation.
- A JICA report (2018) points to the potential for energy savings from updating irrigation water pumps.
- The Irrigation System Administration is responsible for managing a total of 4,997 irrigation pumps (as of 2011) at approximately 1,500 pumping stations.
- A demonstration test comparing the efficiency of a high-efficiency volute pump with an existing double-suction volute pump at the Soilik 1 pumping station near Tashkent verified energy savings of approximately 30% for the high-efficiency volute pump.
- Therefore, if the system is operated for 5 months/year, 8 hours/day, and at an electricity price of 450 so'm/kW, the electricity savings would be 10.8 million som/year. Since PP 6024 (July 10, 2020) targets a 25% reduction in annual electricity use at agricultural pumping stations, the replacement of irrigation water pumps that are aging and have a larger than necessary water delivery capacity should be promoted.

effects: 70 ktoe/y replacement cost vs effects per year 9.6

44

Japan International Cooperation Agency (JICA)
Data Collection Survey on Energy Efficiency Sector
in the Republic of Uzbekistan

Energy Efficiency Seminar
31st January, 2023

Expected effects of the energy efficiency program implementation

The Energy Conservation Center, Japan
Akira ISHIHARA

45

3. Expected effects of program implementation

(1) Components of program

Identify programs to reduce energy consumption intensity per unit of GDP in Uzbekistan.
In the aspect of future superiority, the measures using heat pumps are considered to have priority.

- **Improvement of thermal efficiency of district heat supply system**: Measures that can be implemented on the supply side (district heat supply stations, heat transport piping) and on the demand side (heat receiving facilities).
- **Heat pump installation to public facilities, commercial buildings, and new housing complexes**: Measures to promote the use of heat pumps in large buildings.
- **Reinforcement of building heat insulation performance**: Measures to improve heating and cooling efficiency by reinforcing the insulation performance of building windows, walls, and ceilings. Achieving ZEB (zero energy building) in the future will should be considered.
- **Raising awareness of energy conservation in househoulds**: Measures to improve energy use efficiency through raising the public's awareness of energy conservation.
- **Improving the efficiency of heat use in detached houses**: Measures such as updating aging boiler facilities.
- **Industrial sector energy efficiency improvement**: Measures such as setting efficiency standards for motors, improving pump efficiency, and increasing the efficiency of gas utilization equipment.
- **Policy promotion of energy management**: Measures to establish energy management systems and thereby promote energy conservation.
- **Increasing the efficiency of home appliances and strengthening energy conservation standards**: Measures to promote high-efficiency inverter-type air conditioners, refrigerators, etc. The use of LEDs for lighting equipment should also be promoted.

46

3. Expected effects of program implementation

(2) Relationship with global trends

While taking into account global trends, energy conservation potential (immediate targets and future maximum values) of the high-priority energy conservation programs should be evaluated and these programs should be steadily implemented.

Item	Potential	Estimation factors	Investment Cost (mil-USD)
[No1] From gas boiler to heat pump + clean electricity	1-2% + clean electricity	heat pump system installation in public and commercial buildings: 40% transition from heat supply (future 60%)	1056
[No2] Efficient room air conditioning (heating & cooling for all sectors), Efficient refrigerator for residential	0.5%	air conditioner high efficiency grade up to A++ or A+++ (50% replacement) refrigerator high efficiency grade (50% replacement) air conditioner heating in new apartment houses with high efficiency inverter air conditioners (25% increase of application)	101
[No3] Thermal insulation (window, wall, ceiling)	1-3%	thermal insulation enhancement 15% (future 40%) (public/commercial buildings, apartment house buildings, detached houses: windows and walls)	518
[No4] LED lighting (economically feasible)	0.5%	6% of residential electricity, 12% of commercial electricity replacement 20%, saving ratio 60% (note: LEDs are currently applied in a large extent.)	167

47

3. Expected effects of program implementation

(2) Relationship with global trends

Item	Potential	Estimation factors	Investment Cost (mil-USD)
[No5] Awareness raising (Gov. information)	1%	2% of residential energy	na
[No6] Energy management for industry (system, improvement low cost measures) industrial equipment replace	1.5%	10% of industry electricity (operational improvement and improvement action with investment) 2% of other industry energy Other investment (Boiler/furnace replacement)	643
[No7] Industry motor from IE1 to IE3, Irrigation water pump	0.5-1.5%	motor efficiency regulation as IE3 or IE2 + inverter frequency control: Industry electricity 3% (future 5%) Irrigation water pump replacement: 15% (future 80%)	288
[No8] Heat plant improvement	1%	Tashkent heat plant improvements such as heat loss minimization: implementation rate 30% Other district: similar activities and effects are supposed.	520
future ZEB	future 2.5-5%	max. 40% reduction of commercial energy (ZEB ready, nearly ZEB or ZEB 50%)	1782
future EV + clean electricity	future 2% + clean electricity	25% of transport vehicle stock Energy consumption 50% reduction (fossil fuel electricity)	2610

48

3. Expected effects of program implementation

(3) Contribution to achieving energy conservation targets

The total energy saving potential of the program is equivalent to about 10% of primary energy consumption in Uzbekistan. Adding efficiency gains in power sector generation, transmission, and distribution, conversion to renewable energy power, and efficiency gains associated with GDP growth, the overall energy efficiency ratio could reach Uzbekistan's energy efficiency target of 20%.

- The total expected energy savings from program implementation is 3100 ktoe/y (equivalent to 3794 mil-m3/y of natural gas, or 693 mil-USD/y), for a total investment cost of 3796 mil-USD.
- Adding future programs such as the conversion of transportation vehicles to EVs and buildings to ZEB, the total energy savings would be 5854 ktoe/y and the total investment cost would be 8188 mil-USD.
- Based on MOE's "CONCEPT NOTE FOR ENSURING ELECTRICITY SUPPLY IN UZBEKISTAN IN 2020-2030", the energy savings from improving the efficiency of gas-fired power plants, transmission and distribution systems is equivalent to about 2% of the primary energy consumption in Uzbekistan.
- The incremental 25 b-Wh/y of electricity generated from renewable energy sources in 2030 based on "CONCEPT NOTE" would have the effect of lowering Uzbekistan's natural gas consumption by about 4%.
- Based on IEA data, the energy savings rate (ΔTFC/TFC)/(ΔGDP/GDP) relative to GDP growth in Uzbekistan from 2015 to 2019 is 0.68, indicating that energy efficiency tends to increase with GDP growth. If this trend continues, energy consumption intensity per unit of GDP is assumed to improve by about 6% at an economic growth rate of 5.4%/y from 2022 to 2026.

Energy use reduction

target 10%	3%	6% in intensity	RE power generation future efficiency (ZEB, EV)
Energy efficiency programs	Loss reduction in power generation, transmission, distribution	Effect of economical growth in energy efficient economy	

49

49

3. Expected effects of program implementation

(4) Energy savings potential and cost-effectiveness of each program

Based on the energy-saving potential and cost-effectiveness of each program, programs with high priority should be steadily implemented.

Item	Targeted Energy Consumption Sectors	Energy saving in terms of primary energy (ktoe/y)	Penetration rate assumed for energy savings calculations	Cost-effectiveness ratio estimation	Investment cost (mil-USD)	10-Year Energy Savings Benefit (mil-USD)
Energy management	Industrial sector (and commercial sector)	500	Realization of 10% improvement potential in industrial electricity consumption	4.2 Including investment in improvements	469	1118
Industrial equipment	Motor efficiency standard	110	50%	5.6	138 Production cost	246
	Irrigation water pumps	70	15%	9.6	150	156
	Boilers and heat pumps	69	25%	5.2	80	155
	Industrial furnaces	62	15%	6.8	94	138
High-efficient devices	High-efficient air conditioners and refrigerators, and LED illumination	198	50% replace New purchase + replacement LED 20% replace	6.1	268	441

50

50

3. Expected effects of program implementation

(4) Energy savings potential and cost-effectiveness of each program

Item	Targeted Energy Consumption Sectors	Energy saving in terms of primary energy (ktoe/y)	Penetration rate assumed for energy savings calculations	Cost-effectiveness ratio estimation	Investment cost (mil-USD)	10-Year Energy Savings Benefit (mil-USD)
Building insulation reinforcement (windows and walls)	Public facilities and commercial buildings	71	15%	7.4	116	158
	Existing apartment buildings	307	15%	4.8	328	685
	Detached houses	35	15%	9.4	74	79
Heat consumption and heat supply system improvement	Apartment buildings heat supply	421	30%	4.6	431	937
	Air conditioner heating in new apartment buildings	35	30% new construction ratio 25% application ratio of high-efficient air conditioners	Use of high-efficient air conditioners	na	na
	District heat plant improvement and change to closed system (Tashkent city)	228	30%	0.4	20	502
	the same as above (other cities)	(228)	-	10	500	502

51

51

3. Expected effects of program implementation

(4) Energy savings potential and cost-effectiveness of each program

Item	Targeted Energy Consumption Sectors	Energy saving in terms of primary energy (ktoe/y)	Penetration rate assumed for energy savings calculations	Cost-effectiveness ratio estimation	Investment cost (mil-USD)	10-Year Energy Savings Benefit (mil-USD)
Heat pumps in public and commercial facilities	Public and commercial facilities	426	40%.	7.4	1056	1427
Energy efficiency in residential sector	Heat supply in detached houses	50	25%.	6.4 Additional cost for replacement	72	111
	Residential energy saving	290	50%	Small investment	na	na
Future Policies	Conversion to electric vehicles	1647	25%.	7.1	2610	3678
	Conversion to ZEB	1107	20%.	7.2	1782	2472

[Notes of estimation]

- Benefit of energy savings was calculated based on the reduction in natural gas and international prices (assuming 2000 sum/m3). If the international price of natural gas increases, the cost-effectiveness (investment cost per benefit) will be a small value.
- For measures that involve a change in energy type, such as electrification, it is appropriate to evaluate them by the amount of reduction in natural gas, the main primary energy source.
- Facility costs for electricity supply, heat supply, and gas supply are considered fixed costs. In addition, capital investment is underway for 2030, and it is considered appropriate to evaluate the project based on the assumption of the existence of supply infrastructure.
- Since the benefits of natural gas reductions extend not only to consumer benefits, but also to the effects of reduced government energy subsidies and increased gas export profits, it is considered appropriate to evaluate the overall benefits based on international prices.
- Investment costs include public costs and costs borne by the implementing entity. It does not include investments in the development of electricity supply infrastructure.

52

52

3. Expected effects of program implementation

(5) Cost and benefits estimation methods

Item	Targeted sectors /areas	Energy saving potential occurrence	Energy saving potential estimation method	Cost estimation method
Energy Management	Industrial sector, commercial sector	Energy efficiency improvement activities are promoted with small or medium investment.	Realization of 10% improvement potential in industrial electricity consumption is supposed. For heat, 2%.	Cost for capacity building and cost for investment supposed within three years.
Industrial equipment	Motor efficiency standard	High efficiency motor standardization with obligation.	Energy consumption reduction from IE1 class to IE3 by 7.4%. Motor consumption weight in the whole electricity 75%.	Motor cost difference per kWh.
	Pumps for irrigation water supply	Increasing efficiency and optimal capacity by replacement of deteriorated pumps.	30% consumption reduction for replaced pumps, of which rate is given by previous survey report.	Replacement cost estimated for facility and construction.
	Boilers and heat pumps	Replacement of insufficient efficiency boilers in industry to high efficiency boilers or heat pumps.	Efficiency increase 17%. Possible replacement ratio 50%.	Replacement cost estimated for facility and construction.
	Industrial furnace	Replacement of industrial furnaces.	Increasing of efficiency 30% by replacement to high heat recovery furnace.	Replacement cost estimated for facility and construction.
High efficiency devices	High efficiency air conditioners, refrigerators, LED illumination	Upgrade the energy efficiency class for new purchase. Change to LED.	Efficiency difference between A and A+. 50% of illumination changed to LED.	Cost difference between A and A+ for air conditioners and refrigerators. LED cost for illumination.

53

3. Expected effects of program implementation

(5) Cost and benefits estimation methods

Item	Targeted sectors /areas	Energy saving potential occurrence	Energy saving potential estimation method	Cost estimation method
Building Insulation Reinforcement (wind, wall)	Heat insulation of public and commercial facilities, existing apartment buildings, detached houses	Window: from single to double or low-E glass. Wall: external insulation or insulation board installing	Model calculation of heat loss reduction for reinforced insulation.	Estimated cost of window type changing and wall insulation installing.
Heat consumption/supply system improvement	Apartment buildings heat supply	Loss prevention of heat receiving equipment	Calculation of heat loss reduction.	Cost of system modification.
	Air conditioner heating in new apartment buildings	Transition from heat to electricity by utilization of high efficiency air conditioner heating	Calculation of the benefit of transition.	No additional equipment cost in case of utilizing existing high-efficient air conditioners.
	DHP improvement and change to Closed system (Tashkent city)	DHP improvement and economizers, and closed system and connection piping insulation.	Heat loss reduction calculation.	Cost for equipment and installation of respective items. Operational improvements need no additional cost.
	DHP improvement (other districts)	Assumption of potential similar to Tashkent City DHP. (No site survey conducted.)		Supposed as ordinary investment efficiency.
Public/commercial facilities heat pump	Heat pumps for public and commercial facilities	Transition from supplied heat to electricity by installation of heat pumps	Calculation of the benefit of energy source transition.	Cost for equipment and installation of heat pumps.
Energy efficiency in household sector	Detached houses heat energy supply efficiency	Purchase of efficient boilers in replacing deteriorated ones.	Effect of efficient boilers.	Cost for equipment and installation of efficient boilers.
	Residential energy saving	Effect of energy conservation activities in residential raised by awareness enhancement.	Calculated effect of decreasing room temperature setting and hot water shower use.	No or small improvement cost.

54

Q&A and discussion

55

Session 2
Strengthening energy management systems

56

Japan International Cooperation Agency (JICA)
Data Collection Survey on Energy Efficiency Sector
in the Republic of Uzbekistan

Energy Efficiency Seminar
31st January, 2023

Improve statistical system of energy supply and demand data at the national level

Asia Engineering Consultant Co. Ltd.
Masayuki SAKAI

57

4-1 . Improve statistical systems for energy supply and demand data at the national level

(1) Importance of energy statistics and necessity of its continuous improvement

Energy balance table which contains data on the energy trade, supply and consumption of coal, oil, gas, electricity, heat, combustible renewables and waste, expressed by using the same unit.

Uzbekistan's Energy Balance [Data reference source] IEA 2019

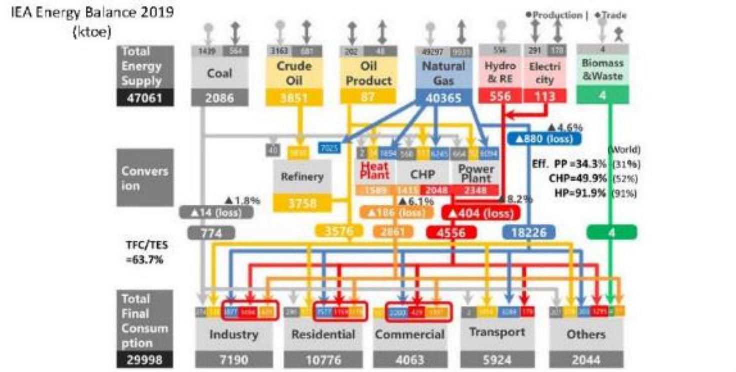
IEA ENERGY BALANCE 2019 UZBEKISTAN ktoe

	41.868TJ=1ktoe 1TJ=0.02388ktoe	Coal	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Wind, solar, etc.	Biofuels and waste	Electricity	Heat	Total
		ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
Total Energy Supply	Production	1,439	3,163		49,297		556		4			54,459
	Imports	564	681	202						291		1,738
	Exports			-48	-9,931					-178		-10,157
	International marine bunkers											
	International aviation bunkers			-136								-136
	Stock changes	82	7	69	999							1,157
	Total energy supply	2,086	3,851	87	40,365		556		4	113		47,061
Conversion	Statistical differences	-19		134	-200					-103	43	-145
	Electricity plants	-684		-92	-6,094		-556			3,203		-4,202
	CHP plants	-568		-117	-6,245					2,259	1,415	-3,258
	Heat plants	-2		-34	-1,694						1,589	-141
	Gas works											
	Oil refineries		-3,830	3,758								-71
	Coal transformation	-40										-40
	Liquefication plants											
	Other transformation											
	Energy industry own use	-6	-5	-156	-7,025					-511		-7,701
	Losses	-14	-17	-5	-880					-404	-186	-1,506
Total Final Consumption	Total final consumption	774		3,576	18,226				4	4,556	2,861	29,998
	Industry	274		116	4,877					1,494	429	7,190
	Transport	2		2,454	3,289					179		5,924
	Residential	290		571	7,577					1,159	1,179	10,776
	Commercial and public services			157	2,280					429	1,197	4,063
	Agriculture / forestry			4	21					1,295	57	1,376
	Fishing				0							0
	Non-specified	207		92	182				4			486
	Non-energy use			182								182

58

4-1 . Improve statistical systems for energy supply and demand data at the national level

Diagrams provide an overview of the main energy flows and how they contribute to the energy balance



59

4-1 . Improve statistical systems for energy supply and demand data at the national level

Energy balance table is created by collecting and aggregating numerous data scattered in various sector

Uzbekistan

Pilot Fuel and Enrgy Balance 2019 (SCS)

PILOT FUEL AND ENERGY BALANCE OF THE REPUBLIC OF UZBEKISTAN 2019

Total Energy Supply

Conversion

Total Final Consumption

Non-Energy Use

60

4-1 . Improve statistical systems for energy supply and demand data at the national level

Collecting energy data is the most important task in energy statistics.

Current status of data collection work by Agency of Statistics (AoS) / State Committee for Statistics (SCS)

Main Items		Location of Data
Primary energy supply, conversion and energy transport	Monthly and annual volume of production, supply, energy industry own use, losses, etc. by energy type	Energy industries
Energy consumption (industrial, transport and large enterprises etc.)	Annual and, or monthly consumption volume by energy type	Enterprises (excluding small businesses), Non-profit organizations, State administrative agencies
Energy consumption (residence)	Annual or monthly sales volume by energy type	Energy industries
	Monthly volume by energy type including conversion from purchase cost etc. Start in 2021.	Household Survey in the Census: Nationwide sampling of 10,000 households

In general, collecting accurate consumption data from energy end-users directly requires the establishment of legal systems, various ideas and efforts for collection, also requires consideration for personal information protection.

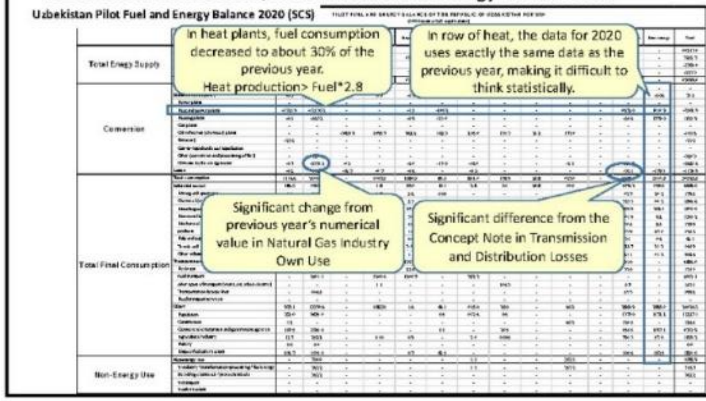
61

61

4-1 . Improve statistical systems for energy supply and demand data at the national level

Issues on the data accuracy in the Pilot Fuel and Energy Balance Table

Uzbekistan Pilot Fuel and Energy Balance 2020 (SCS)



62

62

4-1 . Improve statistical systems for energy supply and demand data at the national level

Current Situation of Responsibilities of Related Ministries and Agencies on Energy Statistics

- AoS is the responsible organization of compilation and dissemination of the official energy statistics in accordance with the Official Statistics Act.
- AoS has been working on the pilot version of energy balance table since 2018 in order to produce energy statistics in line with international methodologies and report it to IEA.
- AoS recognize issues on data accuracy in the energy balance table due to data collection difficulty.
- MoE is the responsible for energy policy making and its implementation and supervision in energy industries.
- To accomplish such tasks, MoE mandates energy industries to report energy information and data. However, It's difficult that MoE obtains detailed consumption data from energy industries and data from end-users directly.
- AoS needs cooperation from various ministries, agencies and research institutions to produce energy statistics. AoS is discussing unification and standardization of statistical production methods with related organizations.

63

63

4-1 . Improve statistical systems for energy supply and demand data at the national level

Improvement on energy statistics, activities and recommendation

- Continuous improvements has been carrying out in accordance with Presidential Resolution 4796 which contains references to international practices by AoS.
- In Japan and many OECD countries, the ministry of energy and related agencies are responsible for producing energy statistics including energy database because they have expertise in energy fields as same as they can easily obtain data in energy industries. They knows best what kind of data is needed to formulate an energy strategy.
- We recommend MoE should be responsible for producing energy statistics including its database in near future.
- Regarding the UIS (Unified Information System) currently under development, we believe that there are issues such as how to accurately input data on terminals, how to find simple input errors, how to balance data continuity and system update and how to link with other database. We would like to point out that the issues needs to be solved in early stage.
- Obtaining the required energy consumption data directly from energy end-users through surveys or something methods is crucial for policy making for energy conservation, but not easy and expensive. We recommend to develop human resources with know-how on how to conduct efficient and economical surveys, or to develop outsourced companies.

64

64

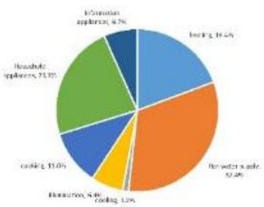
4-1 . Improve statistical systems for energy supply and demand data at the national level

Example of a Study on Residential Sector Final Energy Consumption in Japan

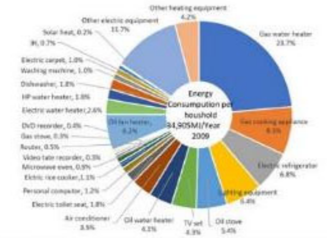
Knowing final energy consumption in as much detail as possible is essential for pursuing energy saving potential and measures.

In Japan, surveys of final energy consumption in various sectors are conducted in a variety of ways, and are used to make energy conservation policies.

Energy Consumption by Use



Energy Consumption by Equipment



Source: Compiled based on the Agency for Natural Resources and Energy's "Actual Energy Consumption in Households" (2009, 10,000 household questionnaire survey)

65

4-1 . Improve statistical systems for energy supply and demand data at the national level

(2) Improvement of demand-side energy measurement accuracy

● **Importance of automated measurement system for energy data**

- In the future, it will become increasingly important to automatically measure and transmit energy data in real time.
- In particular, demand side measurement for energy consumption data requires the installation of a huge amount of meters and the construction of a data transmission system.
- At present, smart meters for electricity and gas have already been installed, and the data is collected by power and gas distribution companies (REN, Khududgaztaminot).

Gas Smart Meter

- Regarding heat, although we are aware of the difficulty of automatic measurement, we believe that it is desirable to realize automatic measurement in the same way as electricity and gas.

● **Necessity of supplementary survey for fields where energy consumption data have not been acquired**

- Residential energy consumption accounts for 1/3 of TFC, so the household consumption survey in the Census has started since 2021.
- In this survey, electricity, gas, heat and other fuels including cotton stalks and livestock waste that are biomass use for energy are target items, but biogas is not appeared.
- It is hoped that reliable survey or ad-hoc research on residential biomass utilization in rural areas will be conducted in the future.

66

4-1 . Improve statistical systems for energy supply and demand data at the national level

Conclusion

Data (statistics) on energy is an indispensable basic infrastructure for energy policy makers to understand policy priorities, evaluate and monitor the implementation of measures, and establish a PDCA cycle. The collection and utilization of accurate data is one of the most important measures to promote energy conservation.
Continuous improvement of the energy statistics system should be encouraged for this purpose.

The importance of metering has been recognized, especially the need to strengthen metering in the heat supply sector (e.g., installation of heat meters and automatic collection of meter reading data).

67

Japan International Cooperation Agency (JICA)
Data Collection Survey on Energy Efficiency Sector
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Energy Efficiency Seminar
31st January, 2023

Policy promotion of energy management systems and energy conservation standards

The Energy Conservation Center, Japan
Akira ISHIHARA

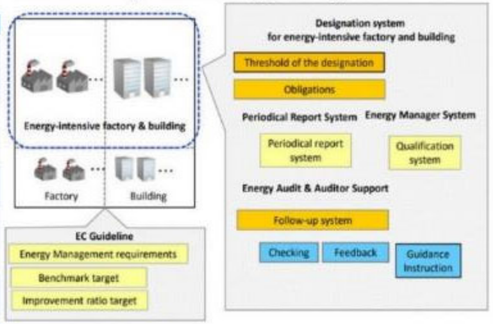
68

Policy promotion of energy management high level structure

Current implementation

Items	Status
Identification of companies/ factories	Yes (PP4779)
Periodical report to government	Yes Monitoring system started
Energy managers	No
Energy audits	Energy audit obligation (PP4779)
Follow up system	No
Benchmark	No

Structure of political energy management



69

Policy promotion of energy management evaluation methodology

Energy management status

Improvement results

Energy management implementation

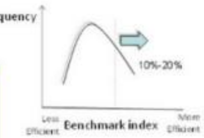
Level of indicators

Guideline for energy management system

Evaluation of companies factories business sites

Instruction, guidance

Benchmark comparison of efficiency among companies/sites of respective subsectors using efficiency index



Classification in Japan

- **Class S** superior in energy conservation efforts
- **Class A** general business operators
- **Class B** energy conservation efforts are not progressing
- **Class C** requiring close monitoring

Benchmark in Japan

Industry	Benchmarked aimed level
Steel manufacturer using blast furnaces	≦0.531kl/t
Ordinary steel manufacturer using electric furnace	≦0.150kl/t
Cement manufacturer	≦3,739MJ/t
Western paper manufacturer	≦6,626MJ/t

⋮

70

Policy promotion of energy management energy management process

Appointment of energy managers and establish management structure as obligation

The energy manager will develop energy conservation plans,
promote energy efficiency conservation activities and
report energy usage to the government.

Strengthening energy managers' capacity, sharing the government's energy policy and guidance.

Energy Audit

Ensuring energy audit obligations in accordance with the Presidential Decree.

Strengthening energy auditors' capacity
by such as training course for energy audits at the Tashkent Polytechnic University.

Appointed energy managers utilizes the audit results.

Improvement of energy efficiency

Identified potentials for energy savings with pay back in about three years should be implemented.

Utilize benchmarks as target energy intensity.

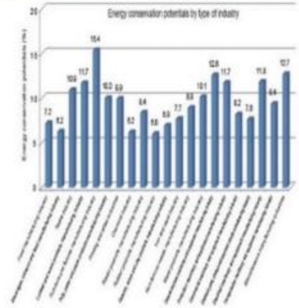
Industrial Fields	Benchmark indicator	Considerations for setting benchmarks
Gas refinery	Specific energy consumption per refining volume	Comparative study of each plant in Uzbekneftegaz
Chemical Fertilizer Plant	Specific energy consumption per product	Comparative Study of Chemical Fertilizer Companies
Vehicle Maintenance Factory	Specific energy consumption per unit of maintenance	Comparative Study of Vehicle Maintenance Companies
Gas transportation system	Specific energy consumption per unit transported	Comparative study of each plant in Uztransgaz

71

Policy promotion of energy management energy audit and improvement potential

Energy improvement potential

around 10%: energy audit results in Japan
(small and medium company, small investment)

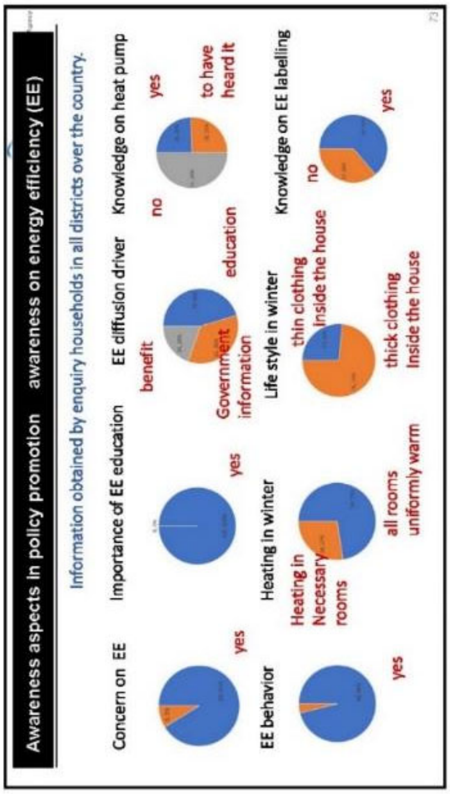


Energy improvement potential

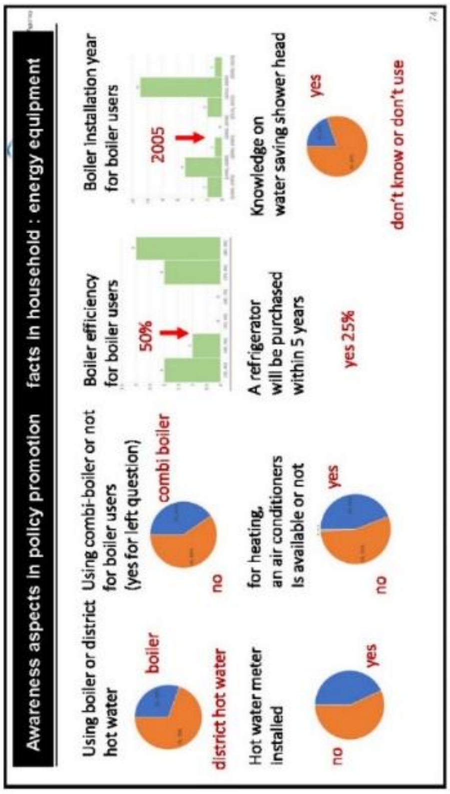
representative industry

industry	Energy improvement potential (energy consumption intensity difference)
Iron and steel industry	supposed 30% consumption intensity estimated 12.9 GJ/ton-product Japan 5.3-9.1 GJ/ton
Non metallic material	supposed 10%-20% consumption intensity estimated 4.2 GJ/ton-product heat input 3. 0 GJ/ton-product representative value (Japan) 3.9 GJ/ton heat input 2.5 GJ/ton-product
Chemistry	potentials in boiler efficiency are found.

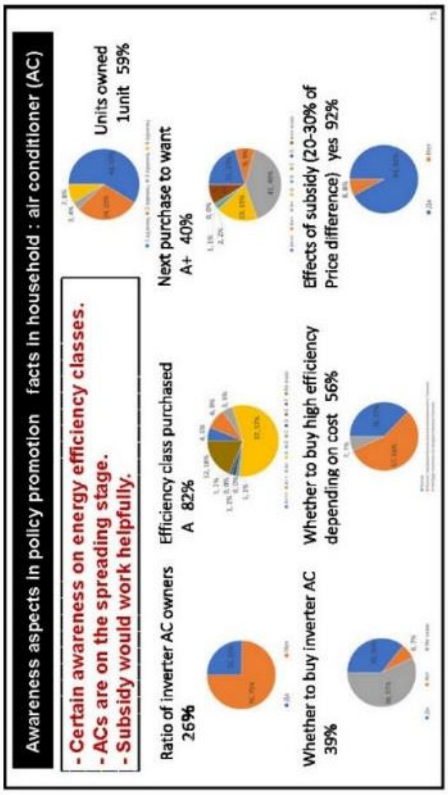
72


Awareness aspects in policy promotion awareness on energy efficiency (EE)
Information obtained by enquiry households in all districts over the country.
Concern on EE
yes
Importance of EE education
yes
EE diffusion driver
benefit
Government information
education
Knowledge on heat pump
no
yes
to have heard it
EE behavior
yes
Heating in winter
Heating in Necessary rooms
all rooms uniformly warm
Life style in winter
thin clothing inside the house
thick clothing inside the house
Knowledge on EE labelling
no
yes

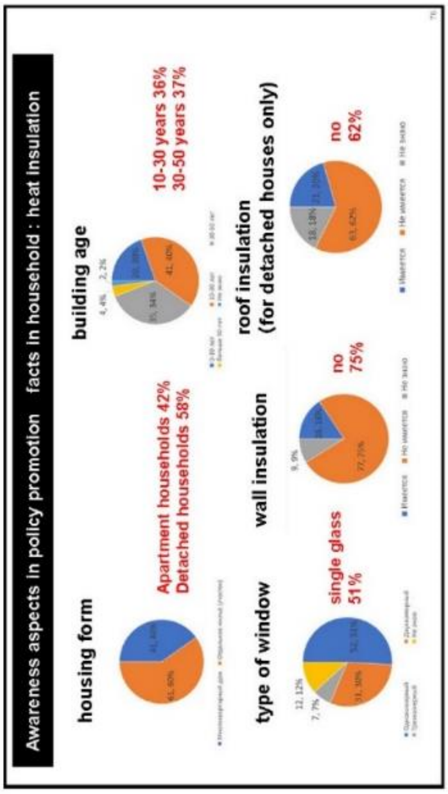
73


Awareness aspects in policy promotion facts in household : energy equipment
Using boiler or district hot water
boiler
district hot water
Using combi-boiler or not for boiler users (yes for left question)
combi boiler
no
Boiler efficiency for boiler users
50%
Boiler installation year for boiler users
2005
Hot water meter installed
no
yes
for heating, an air conditioners Is available or not
no
yes
A refrigerator will be purchased within 5 years
yes 25%
Knowledge on water saving shower head
yes
don't know or don't use

74


Awareness aspects in policy promotion facts in household : air conditioner (AC)
- Certain awareness on energy efficiency classes.
- ACs are on the spreading stage.
- Subsidy would work helpfully.
Units owned 1unit 59%
Ratio of inverter AC owners 26%
Efficiency class purchased A 82%
Next purchase to want A+ 40%
Whether to buy inverter AC 39%
Whether to buy high efficiency depending on cost 56%
Effects of subsidy (20-30% of Price difference) yes 92%

75


Awareness aspects in policy promotion facts in household : heat insulation
housing form
Apartment households 42%
Detached households 58%
building age
10-30 years 36%
30-50 years 37%
type of window
single glass 51%
wall insulation
no 75%
roof insulation (for detached houses only)
no 62%

76

Standard in policy promotion air conditioner standard and labelling

- Energy efficiency standards and labeling for energy-consuming equipment such as air conditioners is effective in increasing consumer awareness. By further promoting the system, the purchase of new high efficiency air conditioners equipped with inverters should be encouraged.
- Inverter air conditioners realize efficient performance for load with variation, not in case of full power operation for all the time.

- Promoting air conditioners' energy efficiency class transition from C (five years ago) to A (current) to A++, A+++ by utilizing the standard and labelling system.
- Now the use of air conditioners is growing, and in ten years new purchases for efficiency will make a significant effect
- Promotion methods;
  Subsidy for A++, A+++ purchase as 20～30% of price difference.
  Raising minimum efficiency allowed above Class D to above class A.
- Strengthening the testing laboratory capability.

Energy efficiency classes for air conditioners

Energy Efficiency Class	SEER	SCOP
A+++	SEER ≥ 8,50	SCOP ≥ 5,10
A++	6,10 ≤ SEER < 8,50	4,60 ≤ SCOP < 5,10
A+	5,60 ≤ SEER < 6,10	4,00 ≤ SCOP < 4,60
A	5,10 ≤ SEER < 5,60	3,40 ≤ SCOP < 4,00
B	4,60 ≤ SEER < 5,10	3,10 ≤ SCOP < 3,40
C	4,10 ≤ SEER < 4,60	2,80 ≤ SCOP < 3,10
D	3,60 ≤ SEER < 4,10	2,50 ≤ SCOP < 2,80
E	3,10 ≤ SEER < 3,60	2,20 ≤ SCOP < 2,50
F	2,60 ≤ SEER < 3,10	1,90 ≤ SCOP < 2,20
G	SEER < 2,60	SCOP < 1,90

77

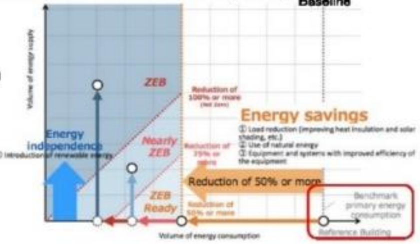
Standard in policy promotion ZEB evaluation

ZEB family Concept

Definition and evaluation methods of ZEBs

The Building Energy Conservation Act specifies how to calculate the baseline to define ZEB Family Concept.

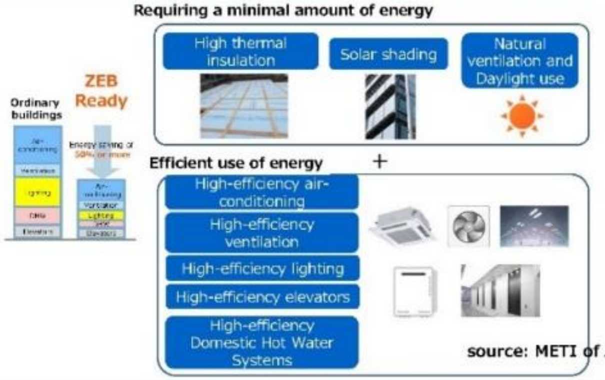
ZEB evaluation



source: METI of Japan

78

Standard in policy promotion ZEB evaluation



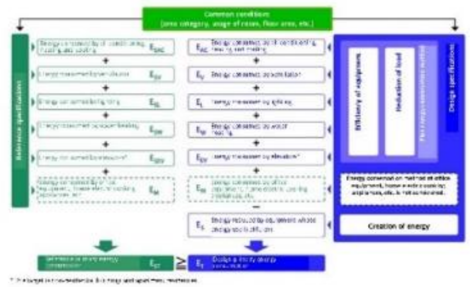
source: METI of Japan

79

Standard in policy promotion ZEB evaluation

Primary Energy Consumption Design Standard

Based on the following calculation methods, the design building primary energy consumption should be less than the standard values. The calculation is performed by the computer simulation program.



source: ECCJ

80

Standard in policy promotion other areas

appliances

Refrigerators standard and labelling

promoting of transition from current main class A to A++, A+++ classes.

equipment

High/premium efficiency motor standard

promoting diffusion by suppliers' obligation for motor efficiency standard IE3+inverter and IE3.

buildings

Heat insulation standard for buildings

strengthening of the current standard to a higher level.

management process

Energy management guideline

ensuring energy management implementation.

81

Q&A and discussion

82

Source: JICA study team

Japan International Cooperation Agency

Japan International Cooperation Agency (JICA)
Data Collection Survey on Energy Efficiency Sector
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Energy Efficiency Seminar

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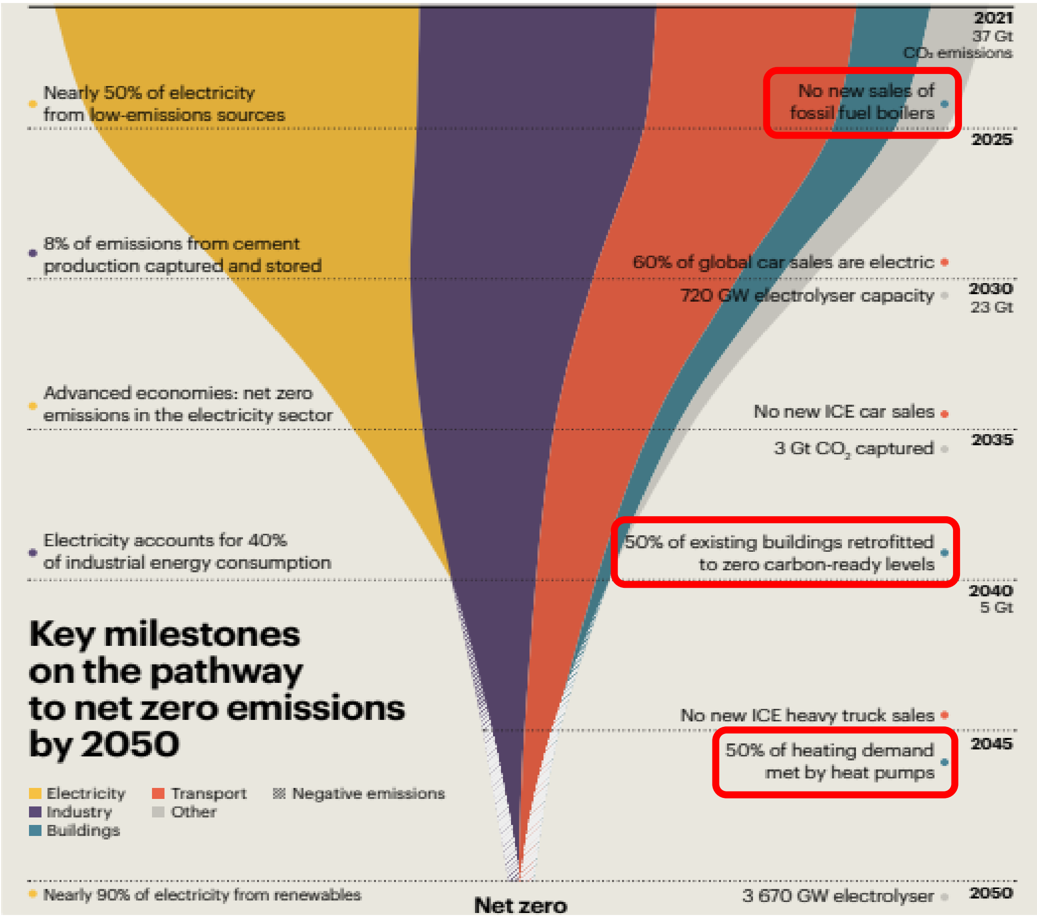
Basic items for energy efficiency program

Pacific Consultants Co. Ltd.
Akifumi NISHIAHTA

Japan International Cooperation Agency

(1) Global trend toward net zero emissions by 2050

According to the IEA's World Energy Outlook 2022, "Key milestones on the pathway to net zero emission by 2050" comprises not only energy efficiency but also clean/renewable power sources and electrification.



50% of electricity from low emissions sources

Shift from boilers to heat pumps for heat supply

Stop oil-driven cars

Industrial electrification ratio to 40%

50% of existing buildings to Zero Energy Building (ZEB)-ready

50% of heat supply from heat pumps

Source: World Energy Outlook 2022

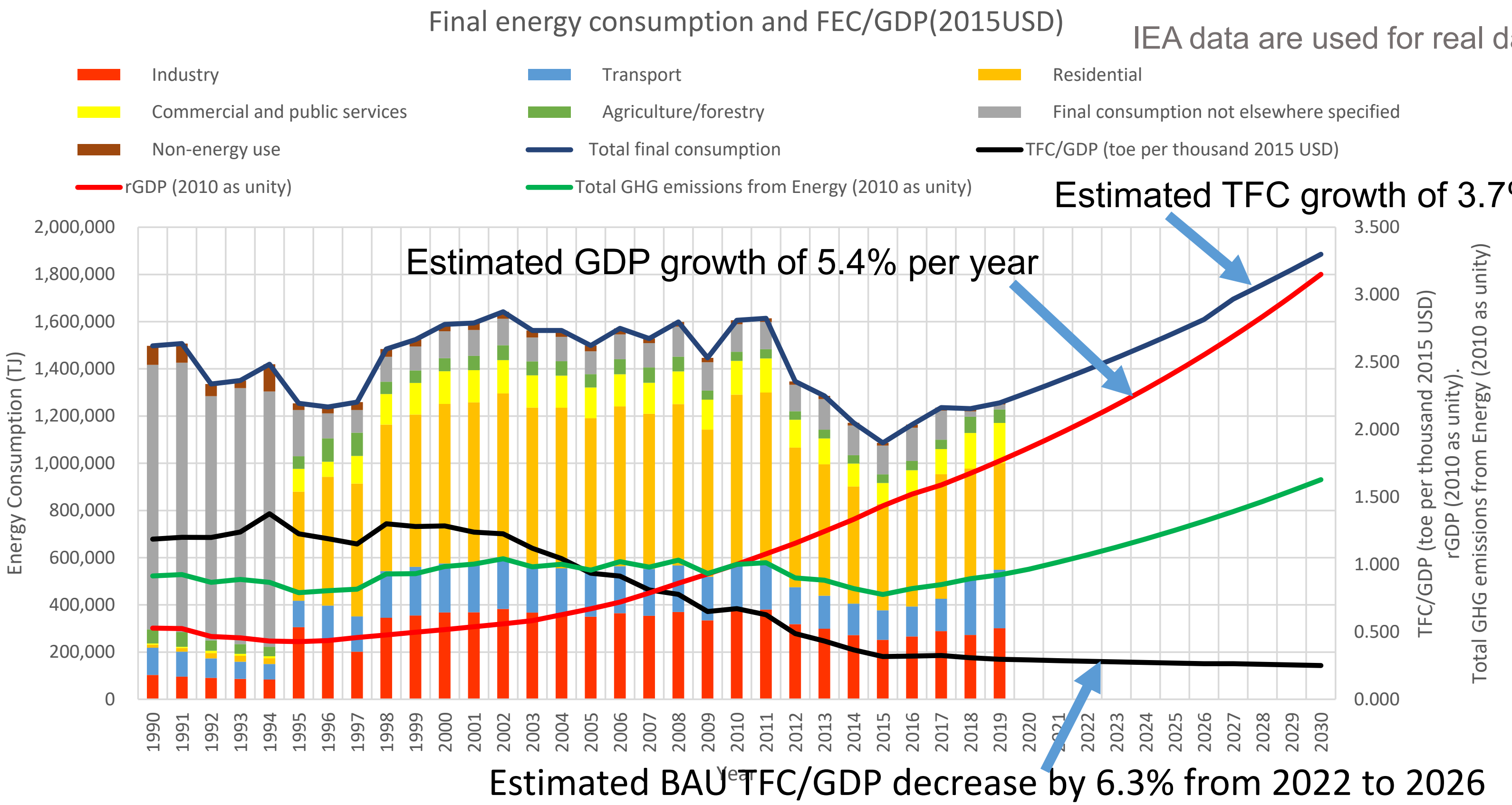
Japan International Cooperation Agency

(2) Current status and future direction of energy efficiency in Uzbekistan

Recent trends show that the total final energy consumption per GDP (TFC/GDP) is decreasing, which means energy efficiency is improving.

However, since the decline has been gradual, the situation is that the trend toward greater energy efficiency should be reinforced through the implementation of new programs to improve energy efficiency from a long-term perspective.

IEA data are used for real data for the graph



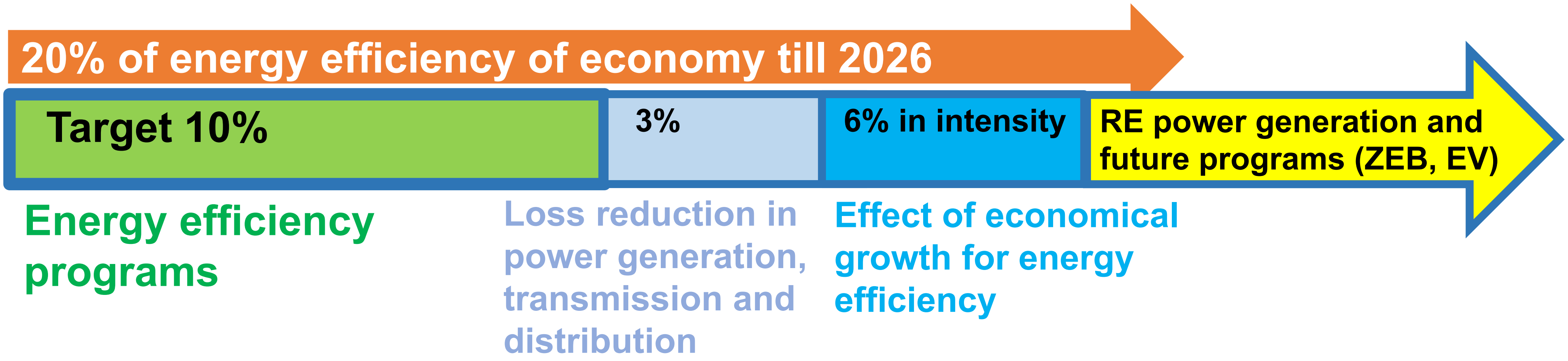
1. Basic items for Energy Efficiency Program

Japan International Cooperation Agency

(2) Current status and future direction of energy efficiency in Uzbekistan (energy efficiency targets)

The total energy saving potential of the program is equivalent to about 10% of primary energy consumption in Uzbekistan.

Adding efficiency gains in power sector generation, transmission, and distribution, conversion to renewable energy power, and efficiency gains associated with GDP growth, the overall energy efficiency ratio could reach Uzbekistan's energy efficiency target of 20%.

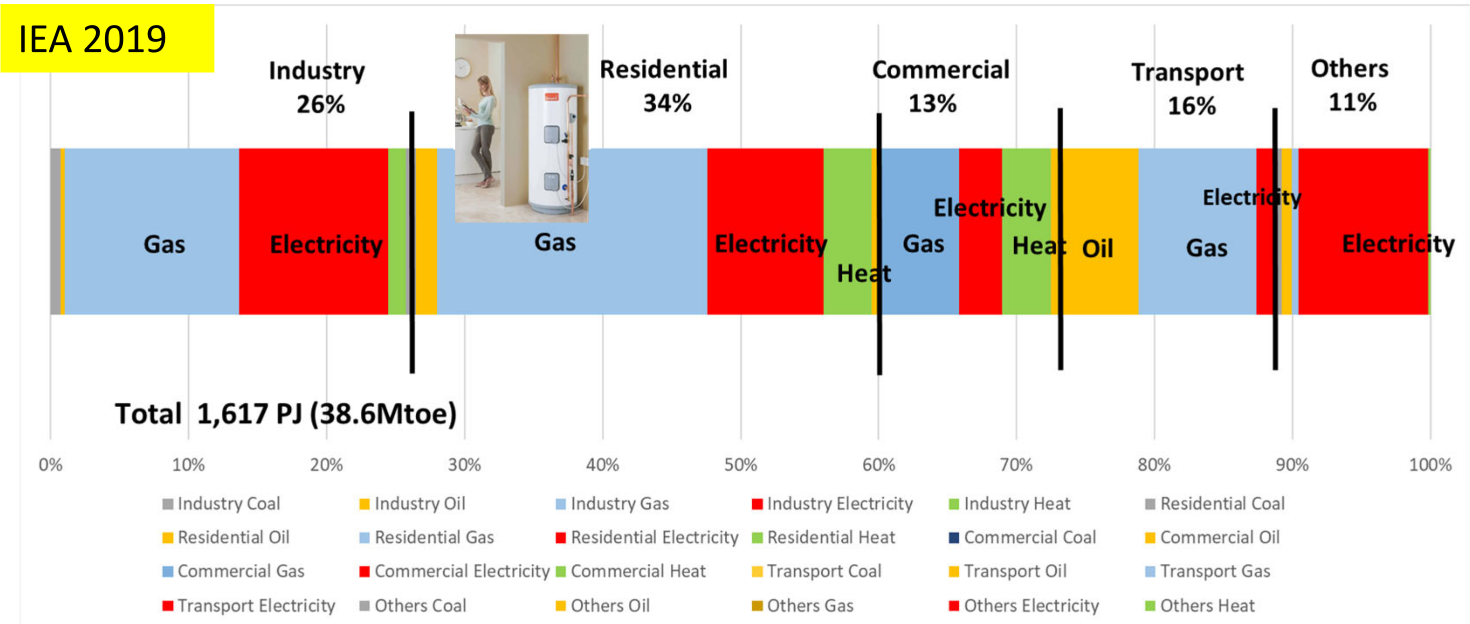


(3) Current status and issues of energy consumption in Uzbekistan (national energy balance analysis)

The efficiency of heat supply and consumption, mainly in the private and industrial sectors, holds an important place in improving energy efficiency in Uzbekistan.

Therefore, this program will focus on the use of heat and the efficiency of natural gas consumption for the use of heat.

- To mainly focus on replacing gas-fired boiler with electric heat pump for heat supply (electrification), identifying and minimizing heat losses, and enhancing insulation performance.
- The project will also focus on the possibility of improving the efficiency of heat supply plants.
- On the other hand, the ongoing efforts to strengthen and improve the efficiency of power sources, as well as the future generation and use of electricity from renewable energy sources, are on the rise. Therefore, the efficiency of electricity use also should be focused.
- Furthermore, from the perspective of improving energy efficiency in each sector, priority measures are proposed for the industrial sector and the public and commercial building sector.



Sectoral Primary Energy Consumption by Energy Type in Uzbekistan

	Sector Total (PJ) (Mtoe)	Total N.G. in sector (PJ) (Mtoe)	N.G.Ratio in sector (%)
Industry	416 9.9	372 8.9	89.4%
Residential	546 13.0	486 11.6	89.1%
Commercial	210 5.0	193 4.6	91.7%
Transport	262 6.2	156 3.7	59.5%
Others	183 4.4	140 3.3	76.3%
Total	1,617 38.6	1,347 32.2	83.3%

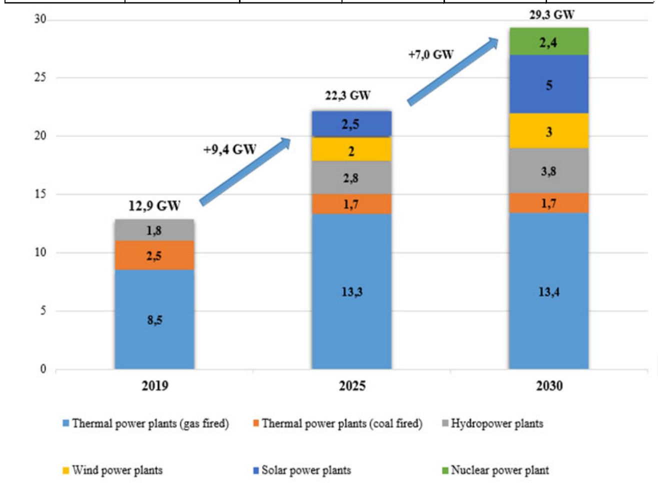
1. Basic items for Energy Efficiency Program

(3) Current status and issues of energy consumption in Uzbekistan (national energy balance analysis)

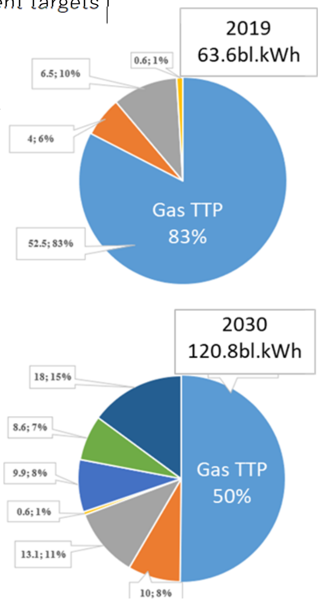
■Power source composition ratio of Uzbekistan's electricity

The MoE Concept Note (2020) indicates that the power supply plan up to 2030 will focus on high-efficiency gas-fired power, RE, and NPP, but the situation where natural gas will continue to be the main power source will continue. In addition to reducing GHG emissions by 35% by 2030 in the 2021 NDC, the development targets for PVPP and WPP are being revised upward.

		2019年	2025年	2030年	
Power Capacity		12.9GW	22.3GW	29.3GW	
Power Capacity Ratio	Gas TTP	65.9%	59.6%	45.7%	
	Coal TTP	19.4%	7.6%	5.8%	
	HPP	13.2%	12.6%	13.0%	＊Revised development targets upward
	WPP＊		9.0%	10.2%	
	PVPP＊		11.2%	17.1%	
	NPP			8.2%	



Growth of Power Capacity in 2019-2030 ,GW



Change of Power Generation in 2019-2030

■Comparison of "heat consumption rate" between Uzbekistan and Japan

	Residential	Industry	Commercial	Country
Uzbekistan	90%	60%	90%	60%
Japan	65%	52%	47%	40%(2010)

・Uzbekistan heat consumption

Because data by use is not available, the following estimates are made based on the IEA's final energy consumption data, with reference to data by use in Japan.

Residential/Commercial : Fuel and heat are total heat consumption, electricity is 15% heat consumption

Industry : 56% of fuel and electricity is heat consumption

・Japanese heat consumption

Residential/Commercial : Handbook of Energy and Economic Statistics 2018 Based on application-specific data such as heating, cooling, hot water supply, kitchen, and power

Industry : Petroleum Consumption Statistics Survey (2017-2020) Based on boiler, cogeneration, heating, raw materials, and other application classifications

(3) Current status and issues of energy consumption in Uzbekistan (national energy balance analysis)

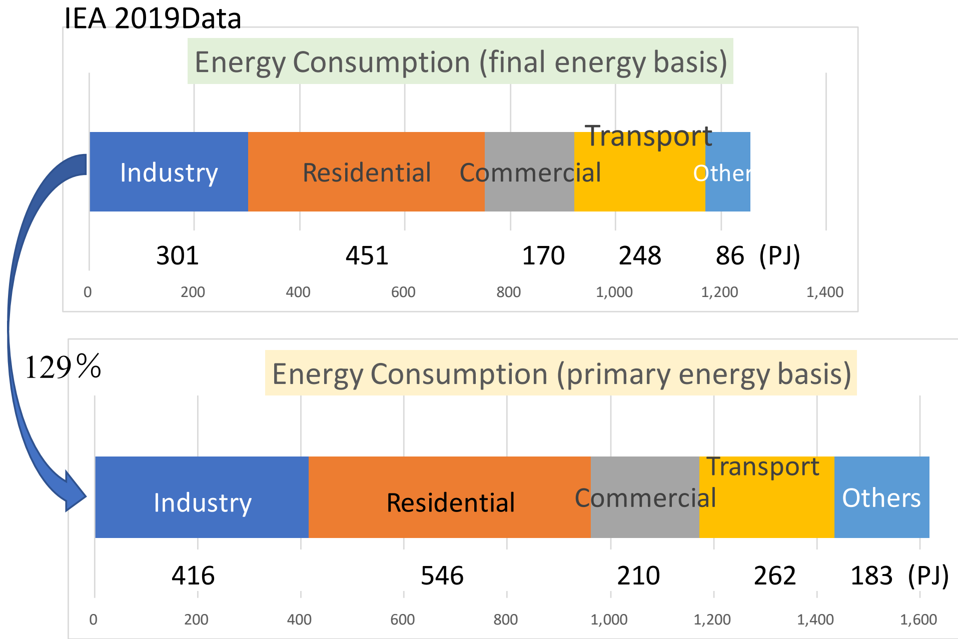
Primary energy conversion of TFC

In order to identify areas where energy conservation should be prioritized and promoted, electricity and heat, which are secondary energy, must be evaluated in terms of primary energy (input fuel). Therefore, energy consumption was recalculated using a primary energy conversion factor of 2.8 times for electricity and 1.15 times for heat.

1. Primary energy conversion of electric energy
   Electricity supplied (4,660ktoe)/input energy (13,034ktoe) = 0.358
   The conversion factor of electricity to primary energy shall be 2.8 (1/0.358).

2. Primary energy conversion of thermal energy
   Heat supply (1,229ktoe)/input energy (1,415ktoe) = 0.869 The conversion factor of heat to primary energy shall be 1.15 (1/0.869).
   Use the same conversion factor for the heat of the heat supply station

3. Energy consumption was recalculated using the above primary energy conversion factor. The figure on the right shows the conversion results. Since the conversion factor of electricity is large, the ratio of the industrial sector and the agricultural sector, which have a high electricity consumption ratio, will be high.



(PJ)

	Final energy base IEA 2019 Data	Primary energy base	magnification
Industry	301	416	138%
Residential	451	546	121%
Commercial	170	210	124%
Transport	248	262	106%
Others	86	183	213%
Total	1,256	1,617	129%

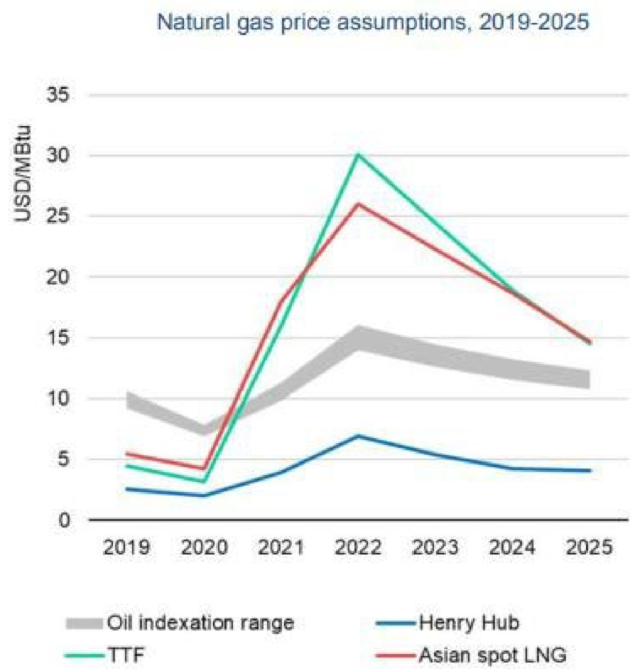
(3) Current status and issues of energy consumption in Uzbekistan (national finance benefit)

Question:

Is it beneficial for gas suppliers to save gas consumption?
Does it end up in decrease of their sales?

Answer:

Exporting more gas!
International gas price is increasing!



Source:
Gas Market Report, Q3-2022,IEA

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(4) Program scope and objectives

The program proposes improvements to be implemented as policy primarily for the energy consumption sector in order to improve energy efficiency.

It aims to contribute to the country's economic development and improve the standard of living of its citizens through a multifaceted approach to energy efficiency.

In addition to improving energy efficiency in the energy consumption sector, it is important to simultaneously improve the efficiency of electricity supply (generation, transmission, transformation, and distribution) in the power sector and expand electricity supply from renewable energy sources.

- Although the implementation period is assumed to be 2030, it is desirable to achieve the energy conservation targets as early as possible between 2026 and 2030.
- This is in line with **Presidential Decree No. UP-60** about the strategy of development for new Uzbekistan for 2022 - 2026.

take measures for increase till 2026 for 20 percent of energy efficiency of economy and to reducing for 20 percent of amount of emission of harmful gases in the atmosphere by active implementation of technologies of "green economy" to all spheres.

programs of expansion and support of use of renewable energy resources, and also increase in energy efficiency of social, commercial and administrative and household buildings and constructions;

- The program also includes future measures for the long term.
- The use of heat pumps, an important element for increasing the efficiency of heat use in this program, involves electrification in the energy demand sector.
- In this regard, the MOE's "Concept note for ensuring electricity supply in Uzbekistan in 2020-2030" lays out a plan for efficient electricity supply, expansion of electricity supply from renewable energy sources, and efficiency improvements in transmission and distribution of electricity, with a target year of 2030. The completion of this plan is also important for improving consumption efficiency and reducing the use of fossil fuels.

1. Basic items for Energy Efficiency Program

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(5) Priority measures

No.	Priority Measures	Implementation Items	Period	Promoters
1.	From gas boiler to heat pump + clean/renewable electricity	➢ Public and commercial facilities are targeted ➢ Transition from supplied heat to electricity by installation of heat pumps	2026	➢ MoE ➢ MoED&PR
2.	Efficient room air conditioning (heating & cooling for all sectors), Efficient refrigerator for residential	➢ Upgrade the energy efficiency class for new purchase of air conditioners and refrigerators ➢ Transition from heat to electricity by utilization of high efficiency air conditioner heating	2024	➢ MoE ➢ MoED&PR ➢ UZstandard
3.	Thermal insulation (window, wall and roof) ZEB and ZEH in the future	➢ Public/ commercial facilities, existing apartment buildings and detached houses are targeted ➢ Windows with double or low-E glass and walls with external insulation or insulation board	2026	➢ MoE ➢ MoC
4.	LED lighting (economically feasible)	➢ Upgrade the energy efficiency class for new purchase of LED illuminations	2024	➢ MoE ➢ UZstandard
5.	Awareness raising (social media and other media)	➢ Residential energy savings are targeted ➢ Effect of energy conservation activities in residential raised by awareness enhancement	2024	➢ MoE ➢ MJKO
6.	Energy management (monitoring) for industry (less cost)	➢ Industrial sector and commercial sector are targeted ➢ Energy efficiency improvement activities are promoted with small or medium investment ➢ Replacement of inefficient boilers to high efficienct ones or heat pumps and replacement of inefficient industrial furnaces	2026	➢ MoE ➢ MoED&PR ➢ SCS
7.	Industry motor from IE1 to IE3, Irrigation water pump	➢ High efficiency motors standardization with obligation ➢ Increasing efficiency and optimal capacity by replacement of deteriorated pumps for irrigation water supply	2026	➢ MoE ➢ MoED&PR ➢ MoWR

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(5) Priority measures (heat demand side)

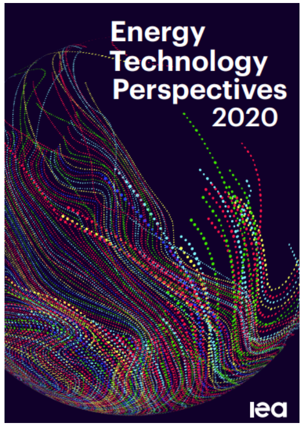
Heat supply side / Heat demand side		Gas, electricity, district heating
Residential and commercial sector	Housing complex Public facility Commercial building	[#1] From gas boiler to heat pump + clean electricity [#2] Efficient room air conditioning, Efficient refrigerator for residential [#3] Thermal insulation [#5] Awareness raising & Future ZEB
	Detached houses	[#1] From gas boiler to heat pump + clean electricity [#2] Efficient room air conditioning, Efficient refrigerator for residential [#3] Thermal insulation [#5] Awareness raising & Future ZEH
Industrial sector	Low-middle temperature	[#1] From gas boiler to heat pump + clean electricity [#6] Energy management for industry [#5] Awareness raising
	High temperature	[#6] Energy management for industry [#5] Awareness raising

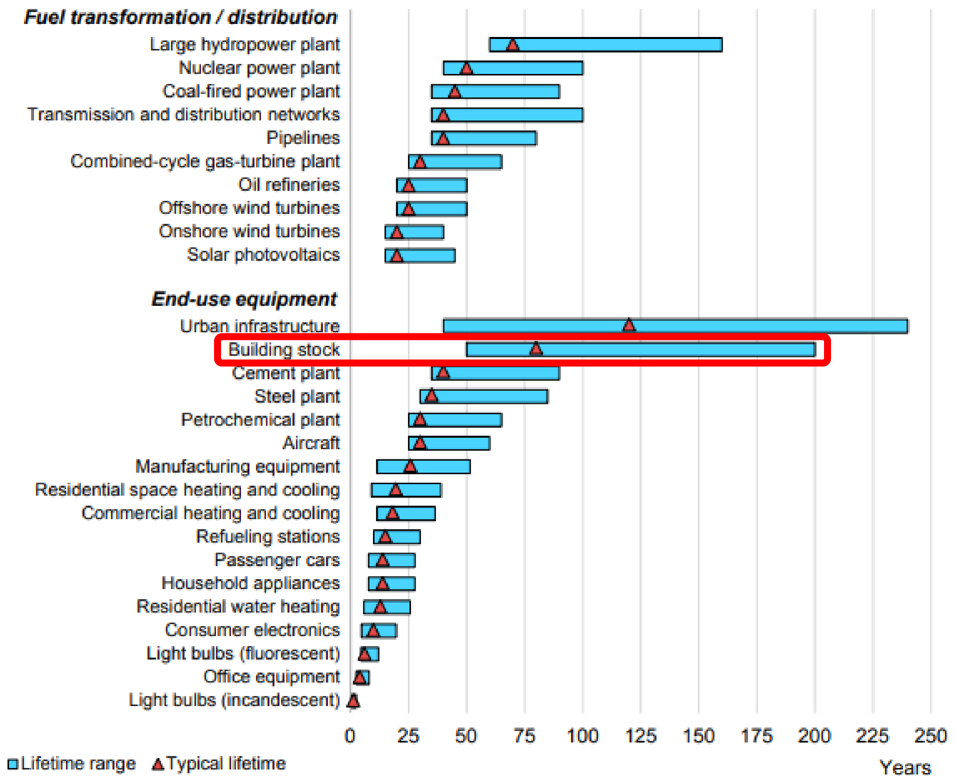
(5) Priority measures (building)

Life time of infrastructure, building, equipment

Buildings' life time is several decades.
It will take quite long time to replace them to clean and efficient ones.

⇒ Issue is "stock management"





Notes: The red markers show expectations of average lifetimes while the blue bars show typical ranges of actual operation in years, irrespective of the need for interim retrofits, component replacement and refurbishments. "Buildings" refers to building structures, not the energy consuming equipment housed within. Examples of "urban infrastructure" assets include pavement, bridges and sewer systems.

Source: IEA Energy Technology Perspectives 2020

Session 1
Activities to be conducted in the energy efficiency program

Japan International Cooperation Agency (JICA)
Data Collection Survey on Energy Efficiency Sector
in the Republic of Uzbekistan

Energy Efficiency Seminar

31st January, 2023

Energy efficiency improvements in the residential and commercial sector

Pacific Consultants Co. Ltd.
Akifumi NISHIAHTA

(1) Heat pump utilization of public facilities, commercial buildings, and housing complexes

Promote the introduction of heat pumps, which are highly energy-efficient, in public facilities, commercial buildings, and housing complexes.

- In small buildings, the multi-unit system for buildings is efficient. This method connects floor or grouped air-conditioning terminal equipment to the heat pump, which has a shorter service life than the central system, but requires a smaller investment and is easier to maintain.
- For large building repairs, consider a central system that can use existing building HVAC piping. In large buildings, it is possible to assign a facilities engineer to manage the central system.
- For new construction of large buildings, both the multi-unit system for buildings with small investment scale and the central system with long service life can be applied.
- In the case of large hospitals and hotels, where demand for hot water is high, the application of W-bundle heat pumps, which can supply hot water and cold water for cooling at the same time, is also effective.
- If a new housing complex is planned and public facilities are attached to it, the central method can be applied, with the entire complex as one group. In doing so, care should be taken to avoid long heat transport distances from the standpoint of thermal efficiency.

Energy saving effect: 426 ktoe/y
(changing heat supply source from district heating hot water to individual electric heat pump)

2-1. Energy efficiency improvements in the residential and commercial sector

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(1) Heat pump utilization of public facilities, commercial buildings, and housing complexes

passive energy saving

enhanced insulation

active energy saving

heat pump air conditioning with inverter technology

Benefit of primary energy use reduction

-Coefficient of performance (COP)

max: 5 - 6

average: 3.5 - 4.5

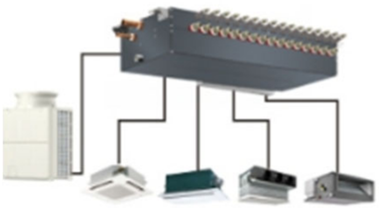
-Payback period: 3.7 - 7.4 years

View to future ZEB

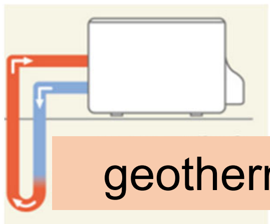
- Introduction of additional energy saving measures
- Introduction of renewable energy
- ZEB (ready, nearly) evaluation

Applicable heat pump-based air conditioning systems

Multi system



Chiller



geothermal heat pump

W bundle heat pump

Production of hot water and chilled water simultaneously

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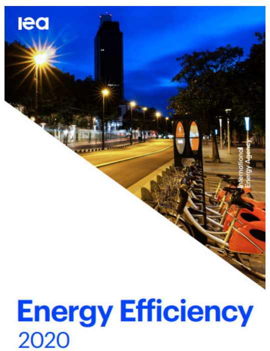
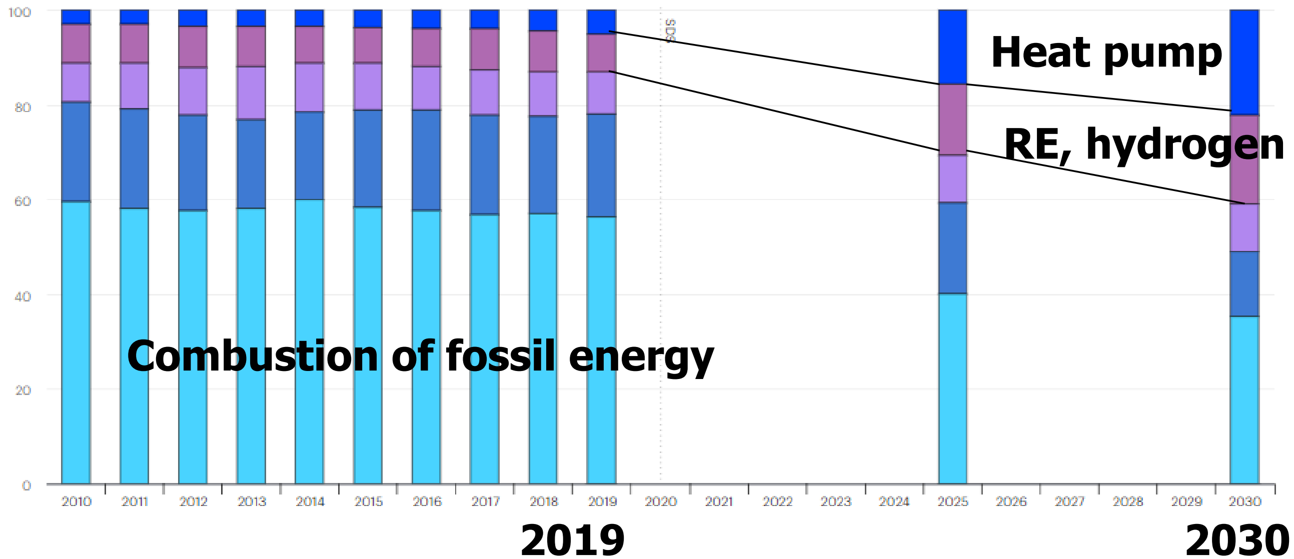
Shift in heat supply from gas-fired boiler to heat pump technology

Shift in heat supply from gas-fired boiler to heat pump technology corresponds to expansion of heat pump application which IEA highly recommends for energy efficiency and carbon reduction.

Accelerate the application of heat pump technology

Increase in utilize heat pump for space cooling, heating and hot water supply





Source: IEA Energy Efficiency 2020

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(1) Heat pump utilization of public facilities, commercial buildings, and housing complexes

For effective use of natural gas thermal energy, heat pump-based air conditioner and water heater are the best available technology (BAT).

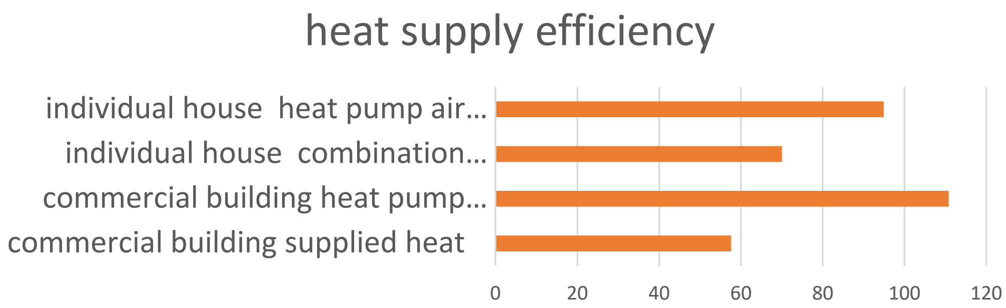
Room Heating

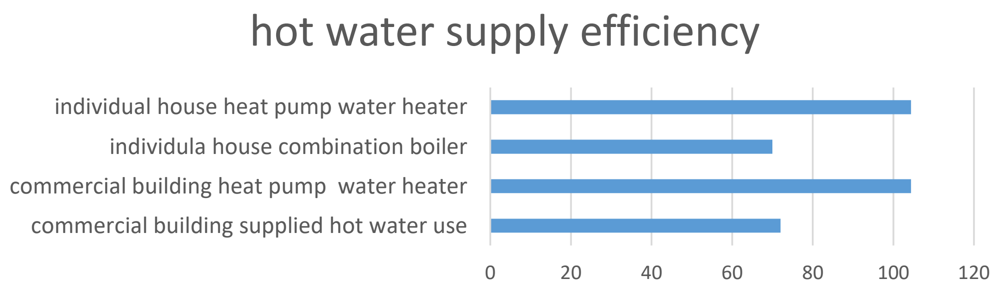
Natural gas 100	Power efficiency	Transmission loss ostribution loss	Induvidual House	HP air-conditioner	Converter loss
	η＝35%	5%		COP＝3. 0	5%
	35. 0	33. 3		99. 9	94. 9
Natural gas 100			Induvidual House	Combnation-boilrer	
				η＝70%	
				70. 0	
Natural gas 100	Power efficiency	Transmission loss ostribution loss	Commercial building	HP air-conditioner	Converter loss
	η＝35%	5%		COP＝3. 5	5%
	35. 0	33. 3		116. 6	110. 8
Natural gas 100	Heating Plant	Heat loss	Commercial building	Hot-water Radiator	
	η＝80%	10%		η＝80%	
	80. 0	72. 0		57. 6	

Hot-water supply

Natural gas 100	Power efficiency	Transmission loss ostribution loss	Induvidual House	HP water heater	Converter loss
	η＝35%	5%		COP＝3. 3	5%
	35. 0	33. 3		109. 9	104. 4
Natural gas 100			Induvidual House	Combnation-boilrer	
				η＝70%	
				70. 0	
Natural gas 100	Power efficiency	Transmission loss ostribution loss	Commercial building	HP water heater	Converter loss
	η＝35%	5%		COP＝3. 3	5%
	35. 0	33. 3		109. 9	104. 4
Natural gas 100	Heating Plant	Heat loss	Commercial building	Direct use of hot-watert	
	η＝80%	10%		η＝100%	
	80. 0	72. 0		72. 0	

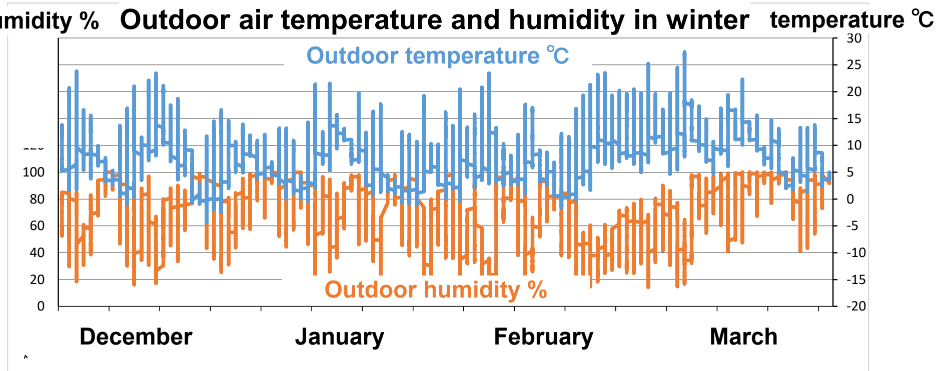
Total heat efficiency comparison
（output heat for input heat quantity 100）

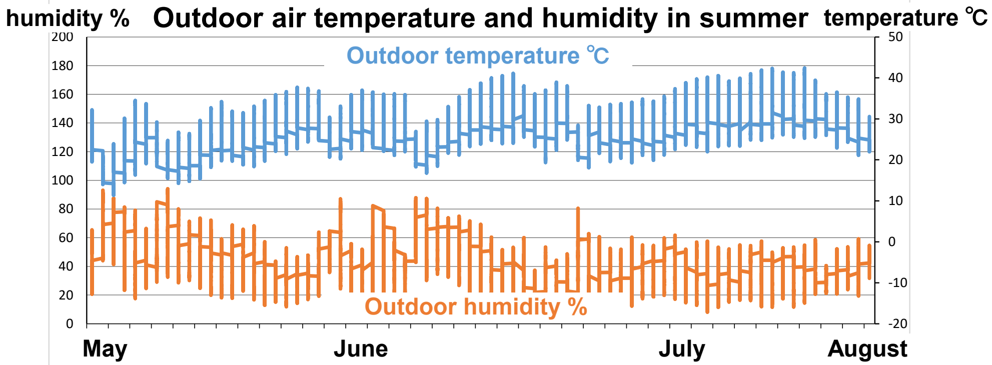




Demonstration test of energy-efficiency in space heating and cooling by air conditioners with/without inverter technology at the Tashkent State Technical University

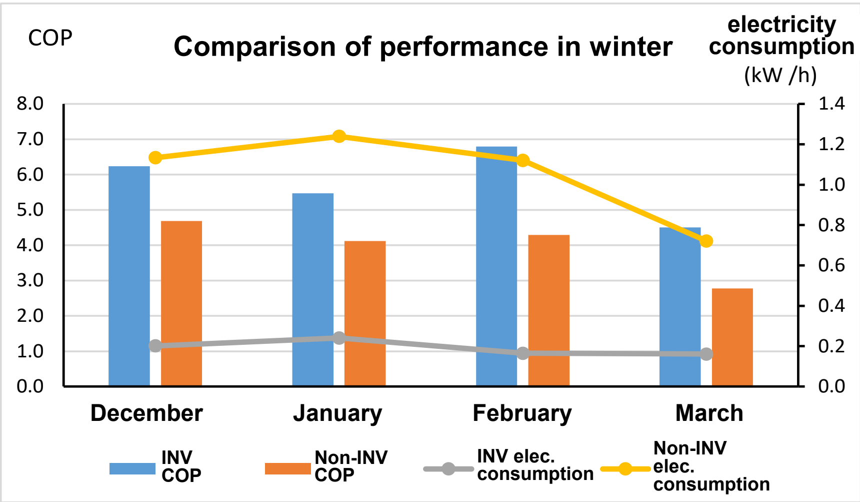
In winter, an inverter air conditioner was more efficient than conventional one by about 70%.
In summer, an inverter one was more efficient by about 50%. Its electricity consumption was a half of that in winter.

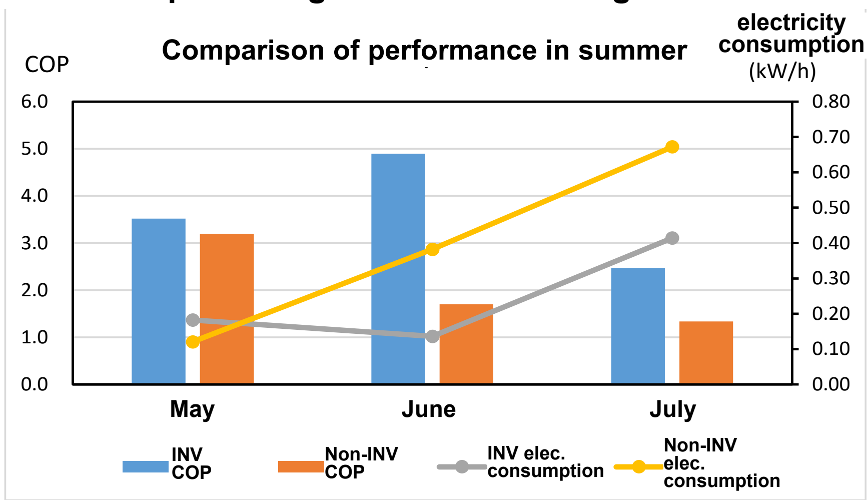




Under the winter condition of high humidity and enthalpy, COP value can be relatively high.

Under the summer condition of low humidity, COP value is relatively low. But electricity consumption can be relatively small as the outer temperature goes down in the night.





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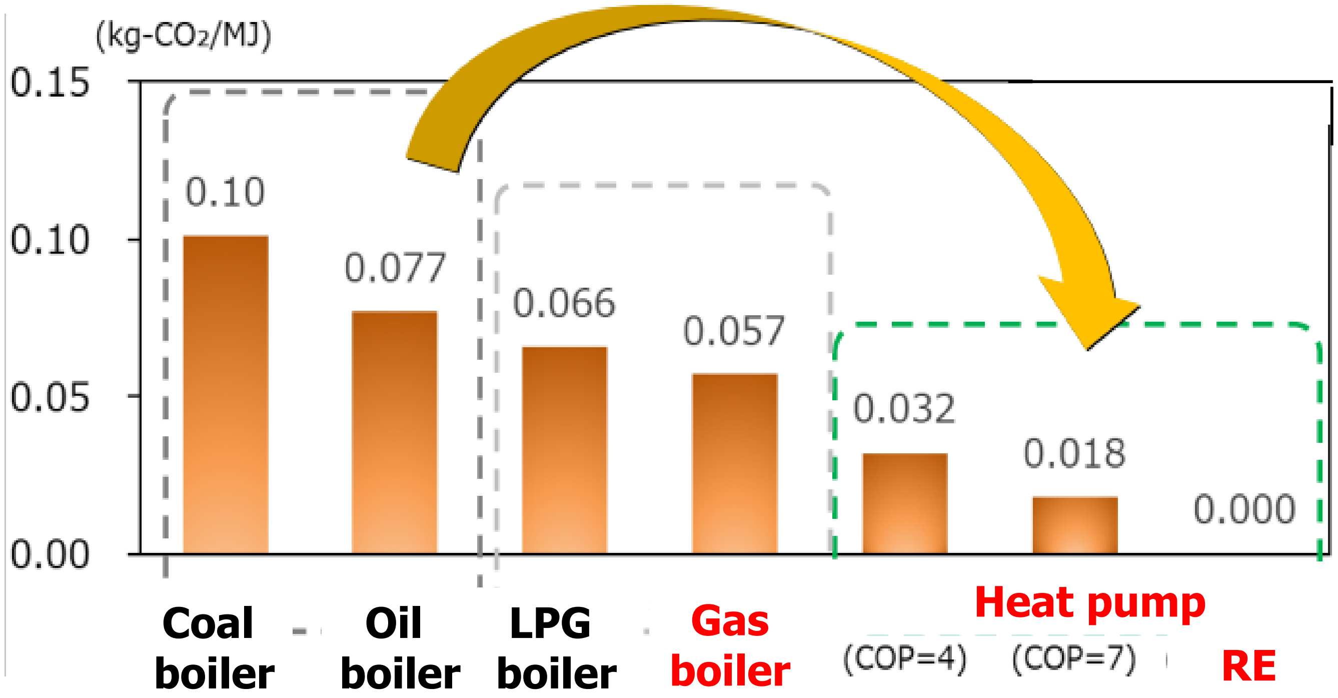
Reduction of CO2 emission by using heat pumps

Using heat pump air conditioning instead of fossil fueled boilers can reduce CO2 emissions.
Besides, its impact can become more prominent by changing power source from current gas fired power generation to future renewable energy sources.



CO2 emissions per 1MJ heat by each heat supply system

Source：Heat Pump & Thermal Storage technology Center of Japan

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Policy measures promoting high-efficiency air conditioners and the effects

(1) To facilitate installation of high-efficiency air conditioners in the residential and commercial sectors, to change from conventional air conditioners with energy efficiency rating A or lower to high efficiency inverter-type air conditioners with energy efficiency rating A++ or higher by partially subsidizing (e.g. 30% of the price difference)

- Energy saving effect (primary energy-based): 44 ktoe/y
- Payback period (subsidy cost vs energy saving effect per year): 5 years

(for reference) user benefits in the demonstration test condition
10years (expected life cycle) electricity cost saving: 1160 kso'm (3month-use/year)
(note) demonstration test condition: an ideal condition with load just from circumstances.
(calculation condition) electricity price: 450 so'm/kWh
electricity consumption: high efficiency (inverter) 0.26 kWh vs low efficiency 0.38 kWh

(2) To recommend using high-efficiency air conditioners in newly built apartment buildings instead of using district heating system

- Energy saving effect (primary energy-based): 35 ktoe/y

(for reference) user benefits in the demonstration test condition
10years (expected life cycle) electricity cost saving: 1500 kso'm (3month-use/year)
(note) demonstration test condition: an ideal condition with load just from circumstances.
(calculation condition) electricity price: 450 so'm/kwh, district hot water price: 110 so'm/kWh
electricity consumption: high efficiency (inverter) 0.2 kWh for thermal load 1.2 kWh
heat energy efficiency for hot water use: 0.8

(2) Improving efficiency of thermal equipment in detached houses

Strengthen support programs to encourage the installation of high-efficiency equipment when upgrading aging boilers existing in the detached houses.

- If there is no gas supply piping in a newly constructed house, heat supply equipment (heating and hot water) using heat pumps is an effective solution.
- On the other hand, for existing gas boilers with hot water tanks that are larger than necessary, it would be effective solution to replace them, as one choice, with more efficient combi boilers to reduce heat dissipation from the too large hot water tanks.

Official promotion on heat source in households

Official guidance to use high efficiency air conditioners for heating in newly constructed apartment buildings with high insulation

Official support for high efficiency boilers or heat pumps when deteriorated boilers and tanks in detached houses

(3) Increase awareness of energy conservation in residential sector

Increasing awareness and understanding of energy conservation in housing complexes and detached houses is quite important as an energy conservation measure in residential sector.

- Countermeasures include optimizing room temperature settings for heating and cooling, using air conditioner, and using hot-water-saving showerheads at bathroom.
- Regarding the use of air conditioner heating functions, society as a whole should reduce the use of natural gas by promoting the use of high-efficiency inverter air conditioners. This is especially effective in residences with enhanced insulation.

Awareness raising for households

Development of knowledge through social media and other media

Diffusion of energy conservation behaviors in households

Room temperature setting for heating and cooling
Shower water saving (saving shower head)
Other conservation practice

Energy efficiency introduction for households

Knowledge about benefits and regulation
high efficiency air conditioners, refrigerators and LED
Heat loss minimization by using thermal insulation
Space heating by using high-efficiency inverter air conditioners

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Effect of energy-saving awareness raising and high-efficiency equipment diffusion in residential sector

Awareness raising for households

Effects of 3% of energy saving: 100 ktoe/y

Diffusion of hot water saving shower head

Effects of 35% of shower hot water saving: 197 ktoe/y

High efficiency air conditioners diffusion by energy saving standard and subsidy*

See slide 23

High efficiency boilers or heat pumps diffusion by subsidy* to replace deteriorated boilers and tanks in detached houses

Effects: 50 ktoe/y Payback period (subsidy amount vs effects per year): 6.3 years

High efficiency refrigerators diffusion by standard and subsidy*

Effects: 46 ktoe/y Payback period (subsidy amount vs effects per year): 4.9 years

LED lighting diffusion by regulation

Effects when 50% of lighting replaced: 361 ktoe/y

(*) supposed subsidy: 30% of cost difference between the high efficiency equipment and conventional one

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(4) Reinforcement of thermal insulation performance of the buildings and houses

The energy conservation benefits by enhancing thermal insulation performance can be quite obvious.

The scope of application of higher levels of the energy conservation standards, including thermal insulation for new buildings, should be more expanded into not only the use of materials with high thermal insulation properties but also enhancing the use of insulation for all building and house components, windows, walls and roofs.

Public facilities and commercial buildings – modernization and electrification
Heating and cooling systems utilizing heat pumps/ small boiler
separated from the district heat supply system
applied in case of new construction and renovation

Project/ regulation approach

New complex buildings consisting of public/ commercial facilities and housing
compact central heat supply for the complex applicable depending on the size

New apartment buildings
separation from the district heat supply system or
use of current district heat supply system as option

Existing apartment buildings with district heat supply
efficiency improvement of the existing system

Improvement/ support approach

Detached houses
efficiency improvement in its own heating, cooling, hot water supply

Awareness/ support approach

(4) Reinforcement of thermal insulation performance of buildings and houses

Existing buildings should be subject to the same energy conservation standards as new buildings in major repairs. Promote energy-saving measures such as adding wall insulation and improving the thermal insulation performance of windows (upgrading to low-E glass and double-glazing).

Promote energy-saving renovations in public facilities and commercial buildings, and establish a support system for strengthening insulation in housing complexes and detached houses.

- According to the trial calculation concerning measures to strengthen the partial insulation performance of an existing housing complex, the following energy-saving effects can be expected.
- Considering the ease of renovation, it is realistic to prioritize window insulation measures first, and to insulate wall surfaces in conjunction with major repairs.

Classification	Thermal insulation performance enhancement measures	Reduction of thermal transmittance (W/m^2K)	Estimation of energy-saving effects
Windows	Change from single glazing to double glazing	6.4 to 3.5	7%
Surface of walls	Reinforcing exterior insulation or attaching urethane boards	2.1 to 0.6	11%.

Total effects of insulation enhancement by enhanced standard and official support for refurbishment (wall, window and roof) at 15% of penetration rate: 402 ktoe/y

Payback period (refurbishment support cost vs effects per year): 5.8 years

(4) Reinforcement of thermal insulation performance of buildings and houses

Estimation of effect of energy saving by heat loss prevention

Assumed conditions U: W/m²K

room temperature 25℃ → 24℃

windows Single-glass → Double-glass (U value : 6.4 → 3.5)

apartment roof insulation (U value : 2.9 → 0.4)

wall insulation (U value : 2.1 → 0.6)

detached house roof insulation (U value : 3 → 0.4)

wall insulation (U value : 2.2 → 0.5)

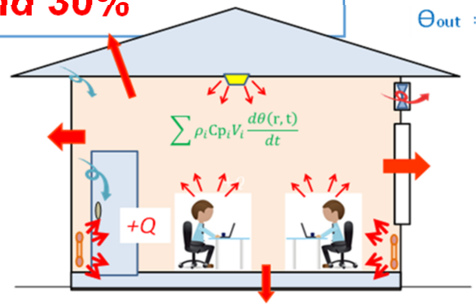
Reduction of heat consumption

an apartment house with district heat

→ reduction rate: around 30%

a detached house without district heat

→ reduction rate: around 30%



Heat loss prevention reinforcement condition for calculation (based on apartment site survey)

double glass (effect weight 9%)

top floor roof insulation material (100mm)

blast or insulation paste (6%)

wall insulation material (30mm)

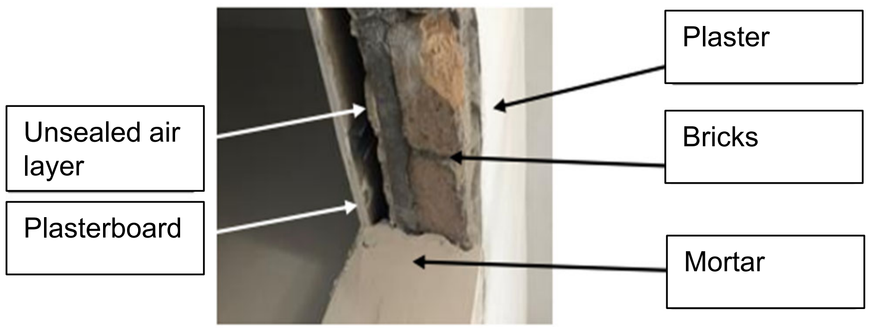
insulation board paste (15%)

heat insulation for heat supply pipe

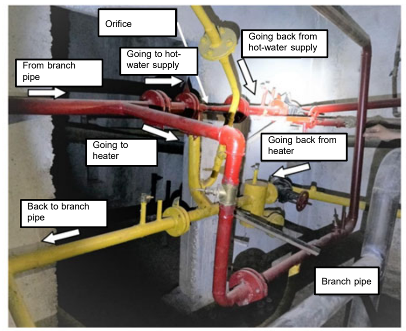
change to thin plastic pipe (12%)

(Heat insulation would increase the effect)

Current wall structure



Current heat supply piping (cellar)



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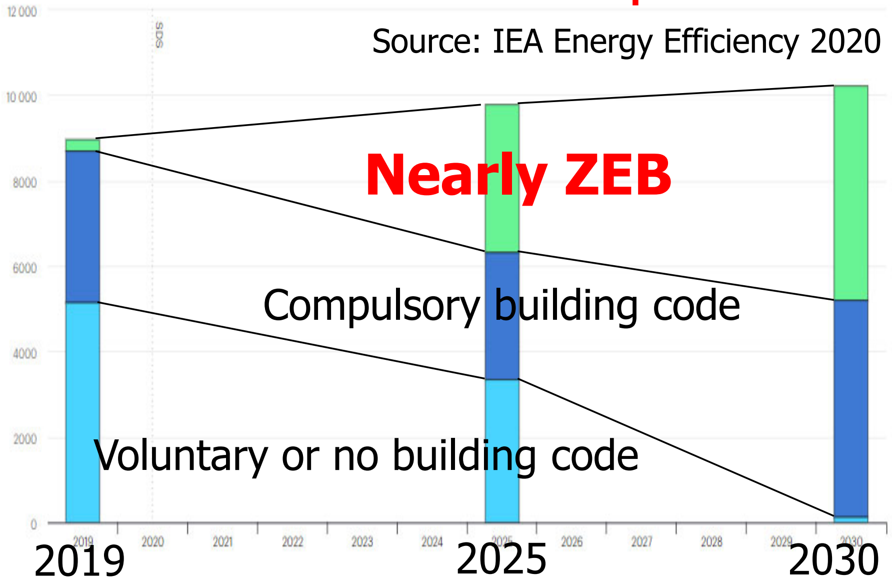
(5) Promote Zero Energy Building (ZEB)

ZEB is a global energy and environmental trend, and promotion of its spread should begin.

In order to promote ZEB, it is necessary to develop ZEB evaluation criteria and create a subsidy measure for ZEB promotion especially in public buildings to demonstrate their energy saving impact and encourage their widespread use.

- In order to promote energy conservation and decarbonization in the building sector, ZEB conversion should be promoted.
- Buildings are usually used over 50 years, hence ZEB can create a lot of impact for a long period of time.
- Heat pump installation to public facilities and commercial buildings is one of the components of ZEB.
- ZEB is an important element of the future smart city concept in new buildings, along with the modernization of energy supply.
- Establishing tiered ZEB rating criteria, such as 50% (ZEB ready) and 75% (Nearly ZEB), will also provide guidance for retrofitting existing buildings.
- Possible method includes improving insulation performance of walls, roofs, and windows; installing high-efficiency air conditioning and water heating equipment; using solar and other renewable energy sources; and installing building energy management systems (BEMS).

IEA's forecast in Sustainable Development Scenario



[Future effects] large energy saving in residential and commercial sector: 1105 ktoe/y

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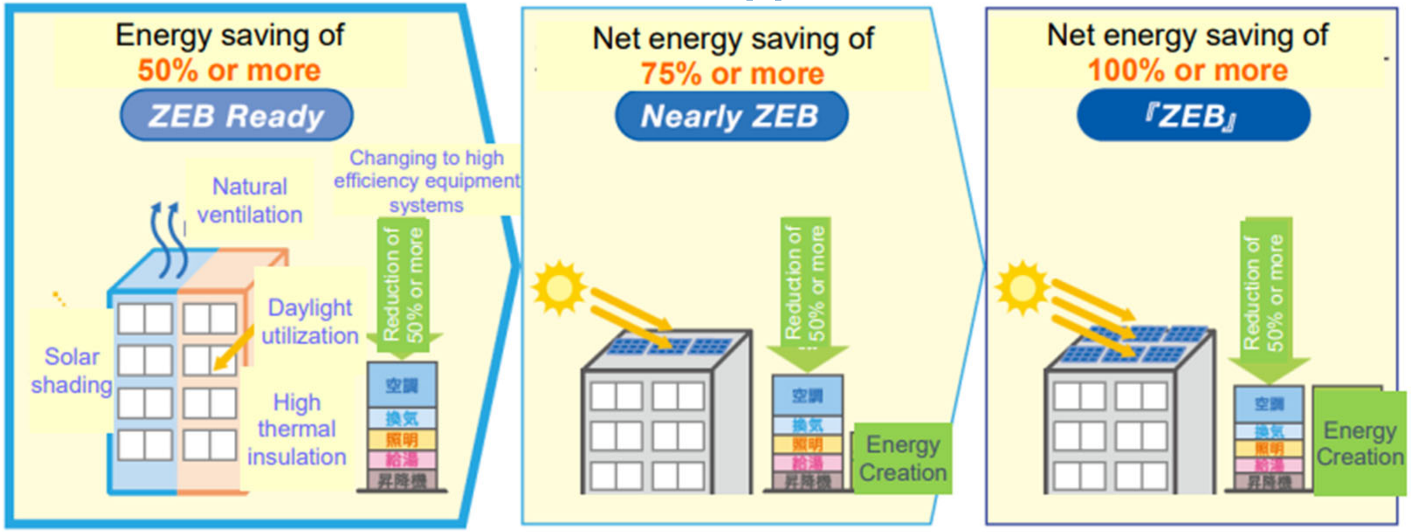
(5) Promote Zero Energy Building (ZEB)

ZEB and ZEB family（ZEB ready, Nearly ZEB）is a standard for design and evaluation of buildings according to each energy saving performance.

Standardization and realization support should be implemented in future.

Standardization, realization support, certification of ZEB



Realization of basic energy saving performance

Deepening energy saving performance

Full realization with Introduction of renewable energy

ISO TS23764
"An approach for non-residential zero energy building"
specifies ZEB realization activity in the following stages
- **planning**
- **design**
- **during construction**
- **after completion of building**
- **after operation start**
- **after completion**

Evaluation of energy saving is calculated by primary energy consumption basis of a building.

TS23764 states that the actual levels of ZEB ready and nearly ZEB are determined in the respective country.
The above values 50% and 75% are the set standard in Japan.

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Japan International Cooperation Agency (JICA)
Data Collection Survey on Energy Efficiency Sector
in the Republic of Uzbekistan

Energy Efficiency Seminar

31st January, 2023

Energy efficiency improvement in the district heat system and industrial sector

The Energy Conservation Center, Japan
Motohiro WASHIMI

2-2. Improvement of thermal efficiency in the district heat supply system

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area	EE measures	
supply station	Air ratio optimization	Air ratio optimization/ small chip investment
	Hot water volume control	Volume control added to temperature change in response to heat demand to reduce loss
	Economizer	recovery of unused heat energy by economizer
Transmission, receiving, consumption	Complete Closed system	Closed system including the use of hot water with associated renewal of heat-receiving units
	Receiving improvement	Piping insulation just around the buildings, heat receiving pipe and unit insulation, bypass valves to control hot water volume at night
	Consumption improvement	High efficiency AC heating as heat supporting, temperature control (valves) in each residence

Heat supply system design consideration for suitability
large degree-days, short transport distance
low load variation

Measures studied for Tashkent City District Heating Plant

Effect of heat efficiency improvement measures

Energy efficiency of district heat supply can be improved based on official investments.

(Tashkent City District Heat Supply Stations)

Air ratio optimization : operational with small investment (burner chips)

effects 15 ktoe/y

Volume control added to temperature change in response to heat demand : operational

effects 29 ktoe/y

Recovery of unused heat energy by economizer

effects 108 ktoe/y economizer installation cost vs effects per year 0.2

(Transmission, receiving, consumption)

Closed system including the use of hot water with renewal of heat-receiving units

effects 72 ktoe/y refurbishment cost vs effects per year 1.0

Thermal insulation for piping around the buildings and heat-receiving units, installation of bypass valves to control hot water flow rate, etc.

effects 232 ktoe/y installation cost vs effects per year 3.4

City piping insulation enhancement maximum potential 280 ktoe/y

Temperature control for each residence, rooms by introducing control valves

effects 193 ktoe/y installation cost vs effects per year 6.0

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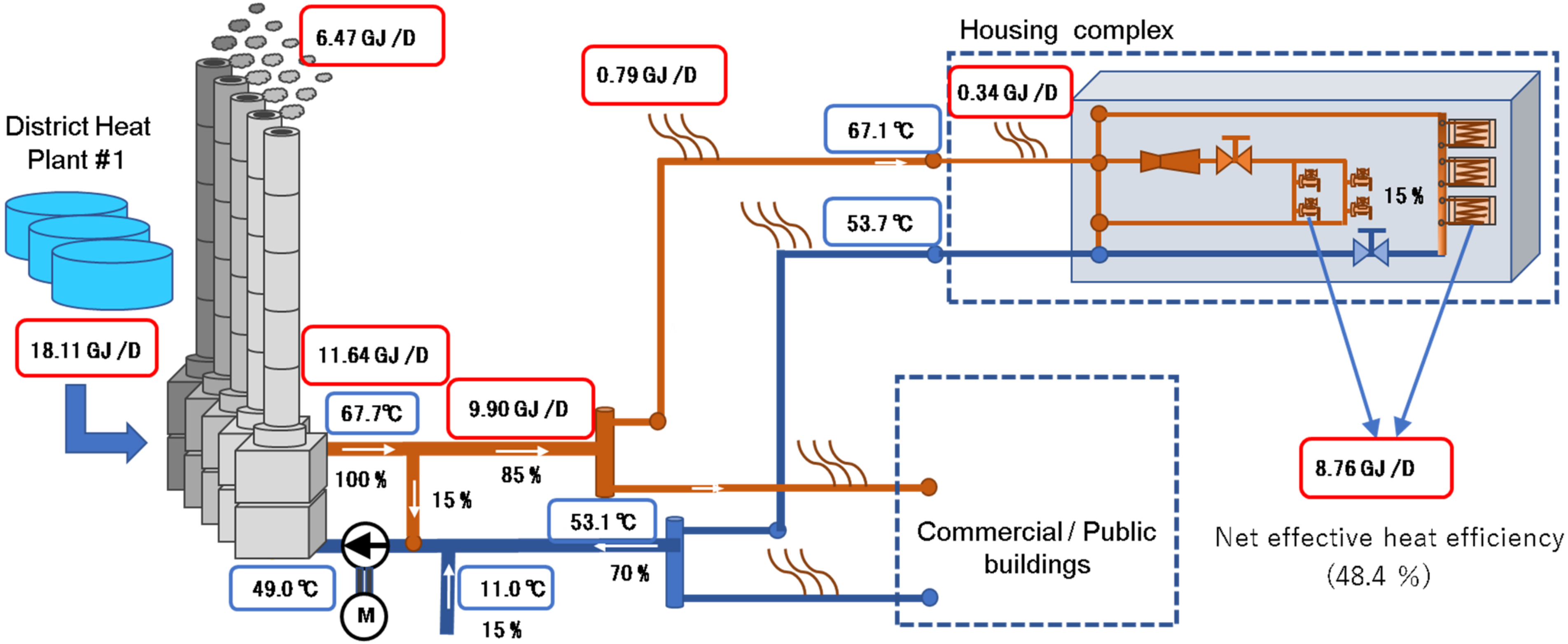
(1) Current status of thermal efficiency in the district heat supply system

The existing district heat supply system has a fairly low energy efficiency as a whole.
Since the net effective heat value is small due to heat loss, and improvements in heat supply and heat utilization are needed, multiple options for addressing this issue need to be considered.



Example analysis based on on-site temperature measurements

(2) Improvement of thermal efficiency of boilers at district heat supply plants and heat transport piping

At supply-side district heat supply stations, energy conservation measures that can be expected to be effective at low cost should be promoted.

① Heat insulation construction of heat transport main
- Provide heat insulation measures for exposed piping in the culvert section.
- However, heat insulation of underground pipes is a low priority due to the large scale of investment.

② Renewal of combustion burner nozzle chips in boiler and improvement of air ratio
- Air ratio improvements can provide significant energy savings for a small investment.

③ Change to an operation method that adjusts the amount of heat supplied according to the amount of hot water as well as the temperature of the hot water.

④ Exhaust heat recovery and feed water preheating by economizer
- The energy-saving effect of installing economizers is significant. However, it requires modification of funnels including flue sections, which will be a rather large-scale construction work. Therefore, a suitable plan and budgetary measure may be required.

Improvement opportunities in district heating plants

Combustion air supply fan
Used for air ratio optimization

Hot water supply equipment
to introduce supply volume control

Combustion air supply fan
And gas piping (Tashkent City No1 DHP)

Hot water supply pump and motor
(Tashkent City No8 DHP)

Hot water supply pump and manual valve
for flow control (Tashkent No8 DHP)

(3) Improving efficiency of heat consumption (housing complexes)

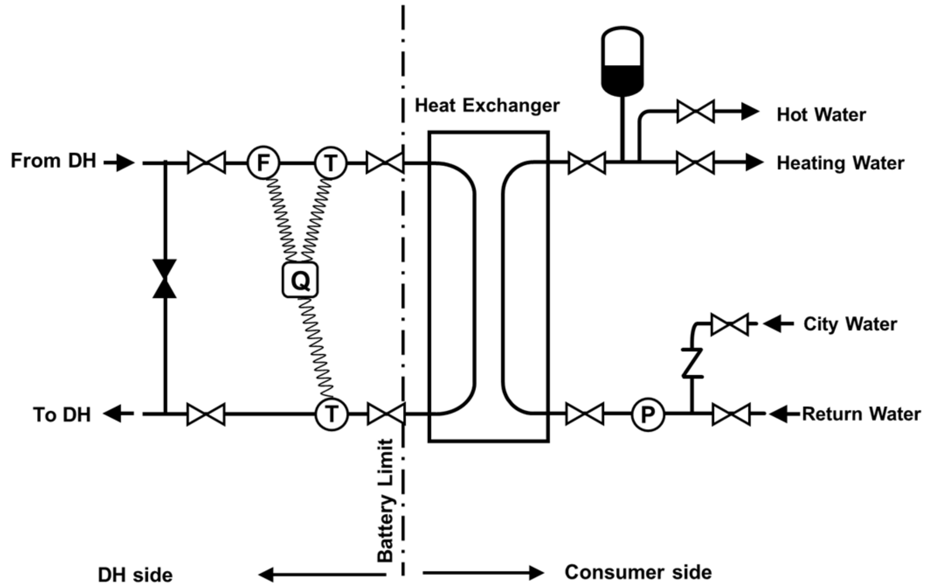
The existing district heat supply system will continue to serve as a lifeline, supplying heat to existing housing complexes, etc. To improve its energy efficiency, the measures to prevent heat loss should be promoted.

① Automatic data collection from calorimeter
- This is necessary to obtain information to promote energy conservation measures.
- " Visualization" of the effect of heat consumption reductions due to consumer efforts will raise awareness of energy conservation.

② Separation of consumer from supply side (Closed system)
- As a basic measure to improve the efficiency of heat utilization in housing complexes, the heat receiving facilities in housing complexes should be upgraded and promoted to be completely closed.
- For housing complexes that are not converted to closed systems, replace steel pipes without heat insulation with plastic pipes, and implement heat insulation measures for pipes between the heat transport main and the heat-receiving part.

③ Reduction of heat distribution loss
- Install a bypass valve in the heat receiving section to allow adjustment of the hot water supply with keeping the minimum flow.
- Replace old radiation panels with new ones those equipped with temperature control valve to enable households to control room temperature, which will be helpful to prevent heat discharge to outside by opening windows during the middle season (mainly spring).

Separation of consumer from supply side (modification of piping in receiving part)



(4) Separation of public service/commercial buildings, and housing complexes from the district heat supply system

For public service/commercial buildings, and housing complexes, separate them from the district heat supply system and promote the installation of stand-alone heat supply facilities by combining heat pumps for air conditioning (air conditioners, etc.), small boilers for hot water, heat pumps for hot water, etc.

- For new construction of public service/commercial buildings, the use of stand-alone boilers is currently underway, but further energy savings will be achieved through the use of heat pumps (air conditioners, etc.).
- If a new building complex consisting of public service/commercial buildings, and housing complexes is to be constructed, the installation of a heat supply system dedicated to that building complex deserves consideration. Depending on the size of the building complex, it can be part of a smart city.
- In the case of major repairs to existing buildings, promote separation from the district heat supply system in the same manner as for new construction.
- Although new housing complexes are basically separated from the district heat supply system, if smaller housing complexes can be connected to existing district heat supply piping, this can be used from the perspective of lifeline use. However, thorough measures shall be taken to prevent heat loss from heat receiving equipment of district heat supply system.

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Energy consuming equipment in industry

Kind of energy	Equipment
Electricity	Pump, fan
	Motor
	Compressor
	Refrigerator
	Illumination
Natural gas	Boiler hot water vapor
	Furnace

Recommendation

Total reduction by improvement actions facilitated by energy management enhancement
subsector-wise total potential expectation 10 – 30%

Replacement of deteriorated water supply pump for irrigation would reduce energy consumption 30% with reviewing the capacity.（2018JICA report）.

Premium IE3/ high IE2 efficiency motor standardization and regulation

50% of boilers in industry has insufficient efficiency - replacement or change to heat pump

Energy saving in industrial furnaces:
technology: heat recovery (recuperator, regenerative burner), insulation, air ratio, air leakage minimization

Effect of energy efficiency improvement measures in the industrial sector

Energy efficiency in the industry sector can be improved by promoting replacement of low efficient equipment to high efficient equipment by enhancement of energy management, standardization and support such as subsidies for replacement.

Replacement of deteriorated water supply pump for irrigation

effects 70 ktoe/y replacement cost vs effects per year 9.6

Premium IE3/ high IE2 efficiency motor standardization and regulation

effects 110 ktoe/y motor cost up vs effects per year 5.5

Boilers with insufficient efficiency in industry, replacement or change to heat pump

Heat pumps are mainly feasible as replacement of boilers for hot water.

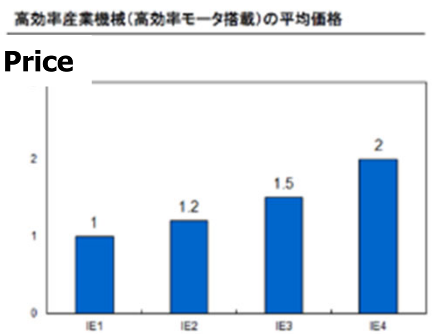
effects 69 ktoe/y replacement cost vs effects per year 5.1

Energy saving in industrial furnaces using heat recovery technology (recuperator, regenerative burner), insulation, air ratio, air leakage minimization

effects 62 ktoe/y refurbishment cost vs effects per year 6.8

(1) Establishment of efficiency standards for motors

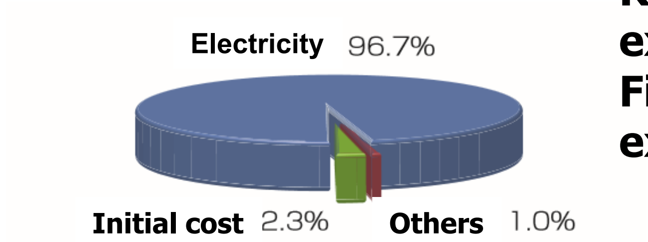
Motors account for much of the electrical consumption in the industrial sector, and defining their energy efficiency and ensuring that newly installed motors are highly efficient is a global trend that can be expected to have a significant energy-saving effect. Except for motors for special applications, the standard shall be premium efficiency (IE3) or variable frequency drive (VFD) and high efficiency (IE2) or better.

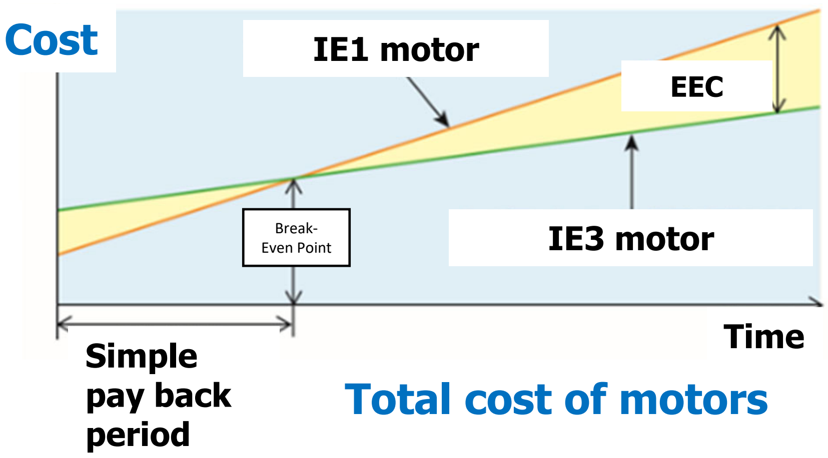


Comparison among the prices of different motor classes

Source：JEMA HP

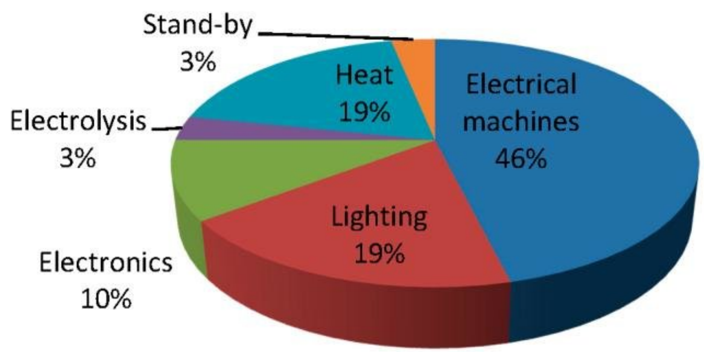
Life cycle cost of motors





Total cost of motors

Ref. Conversion from IE1 to IE3, expected EEC ratio is 2-10%. Financial benefit for end-users is expected to be high.



Global electricity demand by end-use

Source : IEA Energy Efficiency Series 2011, "Energy Efficiency Policy Opportunities for Electric Motor-Driven Systems

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(2) Renewal of deteriorated boilers

Replace aging and inefficient boilers, as it is estimated that about 50% of all existing boilers in operation in the industrial sector are due for renewal.

- Renewal methods include upgrading to high-efficiency boilers and replacing with heat pumps.
- For upgrading to high-efficiency boilers, the method of installing multiple high-efficiency small boilers and controlling the number of boilers to match the load are particularly effective.
- For replacement with heat pumps, a heat pump is an effective way to supply hot water used in the food, textile, and other industries.

Options for efficient heat supply (vapor, hot water) in industry

Adoption of high efficient boilers

Implementation of multiple high efficiency small once through boiler with optimization control

Application of cogeneration

in case that large heat demand balanced to electricity demand, as in chemical industry

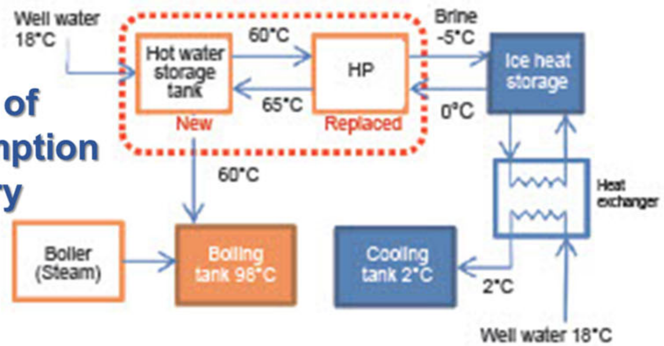
gas turbine + heat recovery boiler

Application of heat pumps

high temperature hot water output

transfer of heat

Applicable to factories of large hot water consumption such as in food industry



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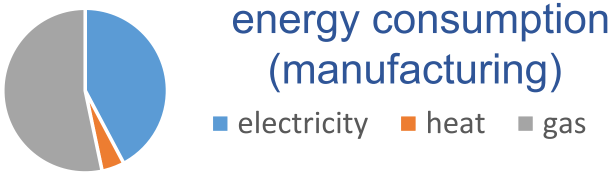
(3) Improve thermal efficiency of industrial furnaces

Since the existing industrial furnaces are operating with low thermal efficiency, it is desirable to significantly improve thermal efficiency through methods such as conversion to a regenerative burner system, installation of a recuperator and strengthening of thermal insulation of the external surface and etc..
Since these measures will require a large capital investment, it will require specific projects to be considered by individual establishments and financial support from the government.



Operation Improvement
(No/Low Cost Measures)

Easy to be carried out
- Possible at no / low cost
- Possible in short term
- No need high-level decision

Effect is limited to some extent

Facility Improvement
(High Cost Measures)

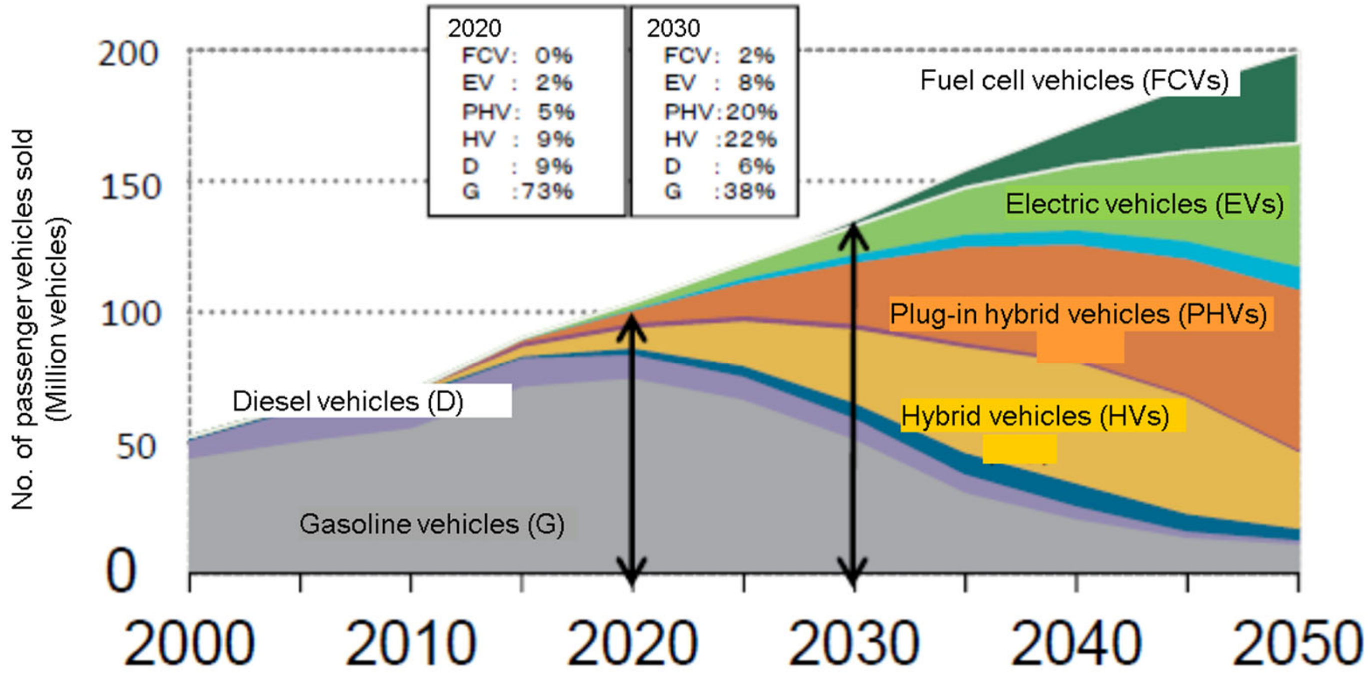
Large effect can be expected

Difficult to be carried out
- Need large investment
- Need long term for installation
- Need high-level decision

2-4. Energy efficiency improvements in the transportation sector

The conversion of transportation vehicles to EVs as a program to be implemented in the future is a global trend that needs to be pursued.

Initial goals include (1) installation of recharging stations (assuming 60,000 recharging devices), (2) EV compatibility of production lines at automobile plants, (3) a support system for introduction funds to encourage EV conversion, (4) preparation of power sources that can support EV conversion, and (5) conversion of about 25% of the transportation vehicle stock to EVs.



IEA / ETP (Energy Technology Perspectives) 2012

future effects: large reduction of energy consumption in transportation sector 1647 ktoe/y

2-5. Improving energy efficiency in the agricultural sector

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The electricity consumption in the agricultural sector is dominated by irrigation pumps.
So far, the planned replacement of aging and inefficient irrigation water pumps and motors is underway in accordance with Presidential Resolution PP3012. Continued efforts to systematically upgrade facilities and reduce water consumption in accordance with Presidential Decree No. 60 are expected to reduce electricity consumption.
At the time of renewal, the amount of water delivered will be reviewed from the standpoint of efficiency, and if the water delivery capacity is excessive, it should also be reduced.

- According to IEA statistical data, the agricultural sector accounts for a large share of electricity use, mainly due to water pumps for irrigation.
- A JICA report (2018) points to the potential for energy savings from updating irrigation water pumps.
- The Irrigation System Administration is responsible for managing a total of 4,997 irrigation pumps (as of 2011) at approximately 1,500 pumping stations.
- A demonstration test comparing the efficiency of a high-efficiency volute pump with an existing double-suction volute pump at the Soilik 1 pumping station near Tashkent verified energy savings of approximately 30% for the high-efficiency volute pump.
- Therefore, if the system is operated for 5 months/year, 8 hours/day, and at an electricity price of 450 so'm/kW, the electricity savings would be 10.8 million som/year. Since PP 6024 (July 10, 2020) targets a 25% reduction in annual electricity use at agricultural pumping stations, the replacement of irrigation water pumps that are aging and have a larger than necessary water delivery capacity should be promoted.

effects: 70 ktoe/y replacement cost vs effects per year 9.6

Japan International Cooperation Agency (JICA)
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Energy Efficiency Seminar

31^{st} January, 2023

Expected effects of the energy efficiency program implementation

The Energy Conservation Center, Japan
Akira ISHIHARA

3. Expected effects of program implementation

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(1) Components of program

Identify programs to reduce energy consumption intensity per unit of GDP in Uzbekistan.
In the aspect of future superiority, the measures using heat pumps are considered to have priority.

- **Improvement of thermal efficiency of district heat supply system**: Measures that can be implemented on the supply side (district heat supply stations, heat transport piping) and on the demand side (heat receiving facilities).
- **Heat pump installation to public facilities, commercial buildings, and new housing complexes**: Measures to promote the use of heat pumps in large buildings.
- **Reinforcement of building heat insulation performance**: Measures to improve heating and cooling efficiency by reinforcing the insulation performance of building windows, walls, and ceilings. Achieving ZEB (zero energy building) in the future will should be considered.
- **Raising awareness of energy conservation in househoulds**: Measures to improve energy use efficiency through raising the public's awareness of energy conservation.
- **Improving the efficiency of heat use in detached houses**: Measures such as updating aging boiler facilities.
- **Industrial sector energy efficiency improvement**: Measures such as setting efficiency standards for motors, improving pump efficiency, and increasing the efficiency of gas utilization equipment.
- **Policy promotion of energy management**: Measures to establish energy management systems and thereby promote energy conservation.
- **Increasing the efficiency of home appliances and strengthening energy conservation standards**: Measures to promote high-efficiency inverter-type air conditioners, refrigerators, etc. The use of LEDs for lighting equipment should also be promoted.

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(2) Relationship with global trends

While taking into account global trends, energy conservation potential (immediate targets and future maximum values) of the high-priority energy conservation programs should be evaluated and these programs should be steadily implemented.

Item	Potential	Estimation factors	Investment Cost (mil-USD)
[No1] From gas boiler to heat pump + clean electricity	1-2% + clean electricity	heat pump system installation in public and commercial buildings: 40% transition from heat supply (future 60%)	1056
[No2] Efficient room air conditioning (heating & cooling for all sectors), Efficient refrigerator for residential	0.5%	air conditioner high efficiency grade up to A++ or A+++ (50% replacement) refrigerator high efficiency grade (50% replacement) air conditioner heating in new apartment houses with high efficiency inverter air conditioners (25% increase of application)	101
[No3] Thermal insulation （window, wall, ceiling）	1-3%	thermal insulation enhancement 15% (future 40%) (public/commercial buildings, apartment house buildings, detached houses; windows and walls)	518
[No4] LED lighting (economically feasible)	0.5%	6% of residential electricity, 12% of commercial electricity replacement 20%, saving ratio 60% (note: LEDs are currently applied in a large extent.)	167

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(2) Relationship with global trends

Item	Potential	Estimation factors	Investment Cost (mil-USD)
[No5] Awareness raising (Gov. information)	1%	2% of residential energy	na
[No6] Energy management for industry (system, improvement low cost measures) industrial equipment replace	1.5%	10% of industry electricity (operational improvement and improvement action with investment) 2% of other industry energy Other investment (Boiler/furnace replacement)	643
[No7] Industry motor from IE1 to IE3, Irrigation water pump	0.5-1.5%	motor efficiency regulation as IE3 or IE2 + inverter frequency control: Industry electricity 3% (future 5%) Irrigation water pump replacement: 15% (future 80%)	288
[No8] Heat plant improvement	1%	Tashkent heat plant improvements such as heat loss minimization: implementation rate 30% Other district: similar activities and effects are supposed.	520
future ZEB	future 2.5-5%	max. 40% reduction of commercial energy (ZEB ready, nearly ZEB or ZEB 50%)	1782
future EV + clean electricity	future 2% + clean electricity	25% of transport vehicle stock Energy consumption 50% reduction (fossil fuel electricity)	2610

(3) Contribution to achieving energy conservation targets

The total energy saving potential of the program is equivalent to about 10% of primary energy consumption in Uzbekistan. Adding efficiency gains in power sector generation, transmission, and distribution, conversion to renewable energy power, and efficiency gains associated with GDP growth, the overall energy efficiency ratio could reach Uzbekistan's energy efficiency target of 20%.

- The total expected energy savings from program implementation is 3100 ktoe/y (equivalent to 3794 mil-m3/y of natural gas, or 693 mil-USD/y), for a total investment cost of 3796 mil-USD.
- Adding future programs such as the conversion of transportation vehicles to EVs and buildings to ZEB, the total energy savings would be 5854 ktoe/y and the total investment cost would be 8188 mil-USD.
- Based on MOE's "CONCEPT NOTE FOR ENSURING ELECTRICITY SUPPLY IN UZBEKISTAN IN 2020-2030", the energy savings from improving the efficiency of gas-fired power plants, transmission and distribution systems is equivalent to about 2% of the primary energy consumption in Uzbekistan.
- The incremental 25 b-Wh/y of electricity generated from renewable energy sources in 2030 based on "CONCEPT NOTE“ would have the effect of lowering Uzbekistan's natural gas consumption by about 4%.
- Based on IEA data, the energy savings rate (ΔTFC/TFC)/(ΔGDP/GDP) relative to GDP growth in Uzbekistan from 2015 to 2019 is 0.68, indicating that energy efficiency tends to increase with GDP growth. If this trend continues, energy consumption intensity per unit of GDP is assumed to improve by about 6% at an economic growth rate of 5.4%/y from 2022 to 2026.

Energy use reduction

target 10%	3%	6% in intensity	RE power generation future efficiency (ZEB, EV)
Energy efficiency programs	Loss reduction in power generation, transmission, distribution	Effect of economical growth in energy efficient economy	

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(4) Energy savings potential and cost-effectiveness of each program

Based on the energy-saving potential and cost-effectiveness of each program, programs with high priority should be steadily implemented.

Item	Targeted Energy Consumption Sectors	Energy saving in terms of primary energy (ktoe/y)	Penetration rate assumed for energy savings calculations	Cost-effectiveness ratio estimation	Investment cost (mil-USD)	10-Year Energy Savings Benefit (mil-USD)
Energy management	**Industrial sector** (and commercial sector)	500	Realization of 10% improvement potential in industrial electricity consumption	4.2 Including investment in improvements	469	1118
Industrial equipment	**Motor efficiency standard**	110	50%	5.6	138 Production cost	246
	Irrigation water pumps	70	15%	9.6	150	156
	Boilers and heat pumps	69	25%	5.2	80	155
	Industrial furnaces	62	15%	6.8	94	138
High-efficient devices	**High-efficient air conditioners and refrigerators, and LED illumination**	198	50% replace New purchase + replacement LED 20% replace	6.1	268	441

3. Expected effects of program implementation

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(4) Energy savings potential and cost-effectiveness of each program

Item	Targeted Energy Consumption Sectors	Energy saving in terms of primary energy (ktoe/y)	Penetration rate assumed for energy savings calculations	Cost-effectiveness ratio estimation	Investment cost (mil-USD)	10-Year Energy Savings Benefit (mil-USD)
Building insulation reinforcement (windows and walls)	**Public facilities and commercial buildings**	71	15%	7.4	116	158
	Existing apartment buildings	307	15%	4.8	328	685
	Detached houses	35	15%	9.4	74	79
Heat consumption and heat supply system improvement	**Apartment buildings heat supply**	421	30%	4.6	431	937
	Air conditioner heating in new apartment buildings	35	30%: new construction ratio 25%: application ratio of high-efficient air conditioners	Use of high-efficient air conditioners	na	na
	District heat plant improvement and change to closed system (Tashkent city)	228	30%	0.4	20	502
	the same as above (other cities)	(228)	-	10	500	502

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(4) Energy savings potential and cost-effectiveness of each program

Item	Targeted Energy Consumption Sectors	Energy saving in terms of primary energy (ktoe/y)	Penetration rate assumed for energy savings calculations	Cost-effectiveness ratio estimation	Investment cost (mil-USD)	10-Year Energy Savings Benefit (mil-USD)
Heat pumps in public and commercial facilities	Public and commercial facilities	426	40%.	7.4	1056	1427
Energy efficiency in residential sector	Heat supply in detached houses	50	25%.	6.4 Additional cost for replacement	72	111
	Residential energy saving	290	50%	Small investment	na	na
Future Policies	Conversion to electric vehicles	1647	25%.	7.1	2610	3678
	Conversion to ZEB	1107	20%.	7.2	1782	2472

[Notes of estimation]

- Benefit of energy savings was calculated based on the reduction in natural gas and international prices (assuming 2000 sum/m3). If the international price of natural gas increases, the cost-effectiveness (investment cost per benefit) will be a small value.
- For measures that involve a change in energy type, such as electrification, it is appropriate to evaluate them by the amount of reduction in natural gas, the main primary energy source.
- Facility costs for electricity supply, heat supply, and gas supply are considered fixed costs. In addition, capital investment is underway for 2030, and it is considered appropriate to evaluate the project based on the assumption of the existence of supply infrastructure.
- Since the benefits of natural gas reductions extend not only to consumer benefits, but also to the effects of reduced government energy subsidies and increased gas export profits, it is considered appropriate to evaluate the overall benefits based on international prices.
- Investment costs include public costs and costs borne by the implementing entity. It does not include investments in the development of electricity supply infrastructure.

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(5) Cost and benefits estimation methods

Item	Targeted sectors /areas	Energy saving potential occurrence	Energy saving potential estimation method	Cost estimation method
Energy Management	Industrial sector, commercial sector	Energy efficiency improvement activities are promoted with small or medium investment.	Realization of 10% improvement potential in industrial electricity consumption is supposed. For heat, 2%.	Cost for capacity building and cost for investment supposed within three years.
Industrial equipment	Motor efficiency standard	High efficiency motor standardization with obligation.	Energy consumption reduction from IE1 class to IE3 by 7.4%. Motor consumption weight in the whole electricity 75%.	Motor cost difference per kWh.
	Pumps for irrigation water supply	Increasing efficiency and optimal capacity by replacement of deteriorated pumps.	30% consumption reduction for replaced pumps, of which rate is given by previous survey report.	Replacement cost estimated for facility and construction.
	Boilers and heat pumps	Replacement of insufficient efficiency boilers in industry to high efficiency boilers or heat pumps.	Efficiency increase 17%. Possible replacement ratio 50%.	Replacement cost estimated for facility and construction.
	Industrial furnace	Replacement of industrial furnaces.	Increasing of efficiency 30% by replacement to high heat recovery furnace.	Replacement cost estimated for facility and construction.
High efficiency devices	High efficiency air conditioners, refrigerators, LED illumination	Upgrade the energy efficiency class for new purchase. Change to LED.	Efficiency difference between A and A+. 50% of illumination changed to LED.	Cost difference between A and A+ for air conditioners and refrigerators. LED cost for illumination.

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(5) Cost and benefits estimation methods

Item	Targeted sectors /areas	Energy saving potential occurrence	Energy saving potential estimation method	Cost estimation method
Building Insulation Reinforcement (wind, wall)	Heat insulation of public and commercial facilities, existing apartment buildings, detached houses	Window: from single to double or low-E glass Wall: external insulation or insulation board installing	Model calculation of heat loss reduction for reinforced insulation.	Estimated cost of window type changing and wall insulation installing.
Heat consumption/supply system improvement	Apartment buildings heat supply	Loss prevention of heat receiving equipment	Calculation of heat loss reduction.	Cost of system modification.
	Air conditioner heating in new apartment buildings	Transition from heat to electricity by utilization of high efficiency air conditioner heating	Calculation of the benefit of transition.	No additional equipment cost in case of utilizing existing high-efficient air conditioners.
	DHP Improvement and change to Closed system (Tashkent city)	DHP improvement and economizers, and closed system and connection piping insulation.	Heat loss reduction calculation.	Cost for equipment and installation of respective items. Operational improvements need no additional cost.
	DHP improvement (other districts)	Assumption of potential similar to Tashkent City DHP. (No site survey conducted.)		Supposed as ordinary investment efficiency.
Public/commercial facilities heat pump	Heat pumps for public and commercial facilities	Transition from supplied heat to electricity by installation of heat pumps	Calculation of the benefit of energy source transition.	Cost for equipment and installation of heat pumps.
Energy efficiency in household sector	Detached houses heat energy supply efficiency	Purchase of efficient boilers in replacing deteriorated ones.	Effect of efficient boilers.	Cost for equipment and installation of efficient boilers.
	Residential energy saving	Effect of energy conservation activities in residential raised by awareness enhancement.	Calculated effect of decreasing room temperature setting and hot water shower use.	No or small improvement cost.

Q&A and discussion

Session 2
Strengthening energy management systems

Japan International Cooperation Agency

Japan International Cooperation Agency (JICA)
Data Collection Survey on Energy Efficiency Sector
in the Republic of Uzbekistan

Energy Efficiency Seminar
31st January, 2023

Improve statistical system of energy supply and demand data at the national level

Asia Engineering Consultant Co. Ltd.
Masayuki SAKAI

(1) Importance of energy statistics and necessity of its continuous improvement

Energy balance table which contains data on the energy trade, supply and consumption of coal, oil, gas, electricity, heat, combustible renewables and waste, expressed by using the same unit.

Uzbekistan's Energy Balance **(Data reference source) IEA 2019**

IEA ENERGY BALANCE 2019 UZBEKISTAN ktoe

	41.868TJ=1ktoe 1TJ=0.02388ktoe	Coal	Crude oil	Oil products	Natural gas	Nuclear	Hydro	Wind, solar, etc.	Biofuels and waste	Electricity	Heat	Total
		ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe	ktoe
Total Enegy Supply	Production	1,439	3,163		49,297		556		4			54,459
	Imports	564	681	202						291		1,738
	Exports			-48	-9,931					-178		-10,157
	International marine bunkers											
	International aviation bunkers			-136								-136
	Stock changes	82	7	69	999							1,157
	Total energy supply	2,086	3,851	87	40,365		556		4	113		47,061
Conversion	Statistical differences	-19		134	-200					-103	43	-145
	Electricity plants	-664		-92	-6,094		-556			3,203		-4,202
	CHP plants	-568		-117	-6,245					2,259	1,415	-3,258
	Heat plants	-2		-34	-1,694						1,589	-141
	Gas works											
	Oil refineries		-3,830	3,758								-71
	Coal transformation	-40										-40
	Liquefication plants											
	Other transformation											
	Energy industry own use	-5	-5	-155	-7,025					-511		-7,701
	Losses	-14	-17	-5	-880					-404	-186	-1,506
Total Final Consumption	Total final consumption	774		3,576	18,226				4	4,556	2,861	29,998
	Industry	274		116	4,877					1,494	429	7,190
	Transport	2		2,454	3,289					179		5,924
	Residential	290		571	7,577					1,159	1,179	10,776
	Commercial and public services			157	2,280					429	1,197	4,063
	Agriculture / forestry			4	21					1,295	57	1,376
	Fishing				0							0
	Non-specified	207		92	182				4			486
	Non-energy use			182								182

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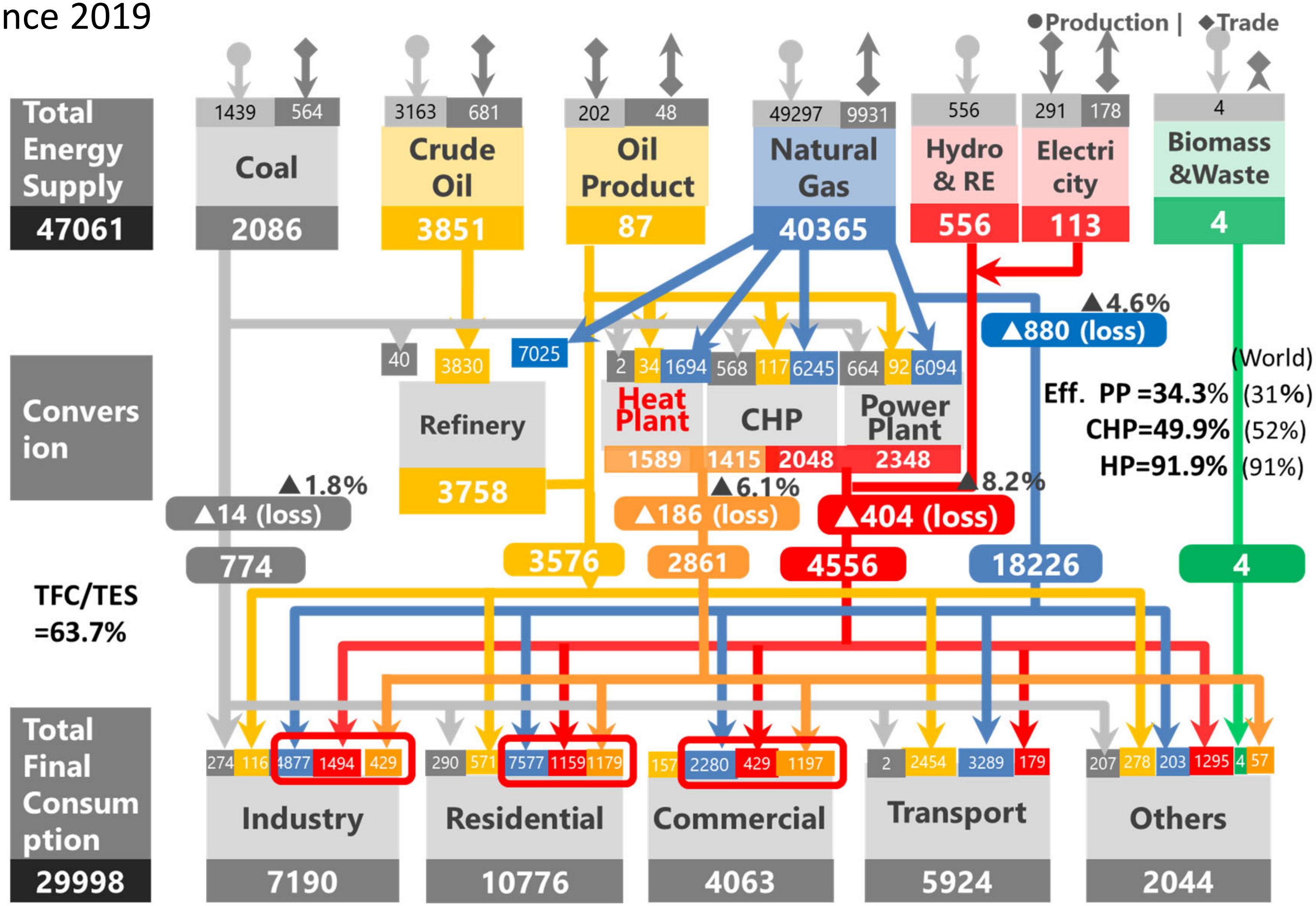
Diagrams provide an overview of the main energy flows and how they contribute to the energy balance

IEA Energy Balance 2019
(ktoe)



4-1 . Improve statistical systems for energy supply and demand data at the national level

Japan International Cooperation Agency

Energy balance table is created by collecting and aggregating numerous data scattered in various sector

Uzbekistan

Pilot Fuel and Enrrgy Balance 2019 (SCS)

PILOT FUEL AND ENERGY BALANCE OF THE REPUBLIC OF UZBEKISTAN 2019

(1000 tons of oil equivalent)

			l gas	Oil, including gas condensate	Motor gasoline	Diesel fuel	Fuel oil	Liquefied petroleum gases	Kerosene	Coke	Other types of petroleum products	Nuclear energy	Electric power	Heat energy	Total
Total Enegy Supply	Production	1154.5	49306.6	3010.9	-	-	-	-	-	-	-	-	557.0	-	54028.9
	Import (+)	574.5	-	666.5	4.2	73.9	125.5	-	-	0.04	227.9	-	290.6	-	1963.2
	Export (-)	-	-9933.2	-	-	-	-	-	-	-	-	-	-177.7	-	-10111.0
	Change in residuals (+, -)	69.2	999.0	6.6	55.0	3.3	3.4	1.5	4.8	-	-	-	-	-	1142.8
	Total primary energy supply (=)	**1798.2**	**40372.3**	**3684.0**	**59.2**	**77.3**	**128.9**	**1.5**	**4.8**	**0.0**	**227.9**	**-**	**669.8**	**-**	**47023.9**
Conversion	Transfers	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Statistical discrepancy	-	-	0	-	-	-	-	-	-	-3.8	-	-2.0	-0.06	-5.9
	Power plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Heat and power plants	-974.7	-12294.7	-	-	-1.5	-207.8	-	-	-	-	-	4736.0	1414.9	-7327.8
	Heating plants	-0.5	-1741.1	-	-	-0.9	-33.5	-	-	-	-	-	-510.9	1779.0	-507.9
	Gas plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Oil refineries (chemical) plants	-	-	-3662.7	1088.4	1071.9	212.9	914.4	171.1	20.0	205.4	-	-	-	21.5
	Transformation of coal (briquette and house furnaces)	-112.9	-	-	-	-	-	-	-	-	-	-	-	-	-112.9
	Gas-to-liquid and coal liquefaction	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Other (conversion and processing of fuel)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Own use by the energy sector	-0.8	-7026.8	-4.7	-	-6.4	-17.0	-16.4	-	-	-2.1	-	-331.8	-	-7406.0
	Losses	-15.9	-880.7	-16.6	-4.7	-0.6	-	-0.5	-	-	-	-	-72.7	-179.3	-1170.9
Total Final Consumption	**Total consumption**	**693.4**	**18628.8**	**-**	**1143.0**	**1139.8**	**83.5**	**899.0**	**176**	**20.1**	**427.4**	**-**	**4658.2**	**3014.5**	**30883.6**
	Industrial sector	**240.5**	**4877.7**	**-**	**1.8**	**55.4**	**14.3**	**2.8**	**3.1**	**20.1**	**14.0**	**-**	**1458.9**	**429.2**	**7117.9**
	Mining and quarrying	0.8	107.6	-	0.03	5.6	0.00	-	-	-	-	-	43.8	24.2	181.9
	Chemical (except petrochemical) industry	-	1897.3	-	0.87	8.3	0.0	1.1	0.50	-	14.0	-	311.6	44.2	2277.9
	Metallurgical industry	10.8	572.5	-	0.3	27.6	4.8	-	0.1	20.1	-	-	674.3	208.1	1518.6
	Non-metallic mineral products	224.2	1163.8	-	0.03	7.6	8.7	-	0.4	-	-	-	86.5	9.8	1500.9
	Mechanical engineering	0.0	48.8	-	0.06	0.8	0.8	0.1	0.1	-	-	-	28.3	8.5	87.4
	Food industry, production of beverages and tobacco products	0.4	351.2	-	0.011	1.0	0.1	0.6	0.46	-	-	-	39.3	67.4	460.4
	Pulp and paper and printing industry	0.1	27.2	-	-	0.0	-	-	0.422	-	-	-	3.9	4.6	36.1
	Textile and leather industry	1.3	254.6	-	-	3.47	0.05	-	-	-	-	-	191.6	21.2	472.2
	Other industries	2.9	454.8	-	0.5	1.1	-	1.0	1.0	-	-	-	79.8	41.2	582.5
	Transport sector	**2.9**	**3289.8**	**-**	**981.8**	**1082.7**	**0.1**	**382.2**	**147.8**	**-**	**-**	**-**	**181.9**	**-**	**6069.2**
	Railways	2.9	-	-	2.0	82.5	0.1	-	1.5	-	-	-	125.5	-	214.6
	road transport	-	2762.1	-	978.7	1000.2	-	382.2	-	-	-	-	-	-	5123.2
	other types of transport (water, air, urban electric)	-	-	-	1.1	-	-	-	146.3	-	-	-	2.7	-	150.1
	Transportation by pipelines	-	527.7	-	-	-	-	-	-	-	-	-	53.7	-	581.4
	Road transport services	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Other	**450.0**	**10061.7**	**-**	**159.40**	**1.6**	**69.1**	**512.6**	**25.0**	**-**	**60.2**	**-**	**3017.4**	**2585.4**	**16942.4**
	Population	318.7	7578.4	-	-	-	0.5	510.2	0.5	-	-	-	1159.0	1178.8	10746.0
	Construction	1.8	-	-	-	-	-	-	-	-	60.2	-	35.7	-	97.7
	Commercial enterprises and government agencies	117.3	2280.2	-	159.30	-	0.1	-	24.5	-	-	-	427.4	1197.1	4205.9
	Agricultural industry	11.7	21.0	-	0.10	0.9	-	2.4	0.005	-	-	-	1294.8	57.0	1387.8
	Fishery	0.0	0.4	-	-	-	-	-	-	-	-	-	-	-	0.4
	Unspecified other sectors	0.5	181.8	-	-	0.7	68.5	-	-	-	-	-	100.6	152.5	504.6
Non-Energy Use	**Non-energy use**	**-**	**399.5**	**-**	**-**	**-**	**-**	**1.3**	**-**	**-**	**353.2**	**-**	**-**	**-**	**754.0**
	in industry / transformation-processing / fuel energy	-	199.8	-	-	-	-	1.3	-	-	353.2	-	-	-	554.3
	including chemicals / petrochemicals	-	199.8	-	-	-	-	-	-	-	-	-	-	-	199.8
	in transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	in other sectors	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Japan International Cooperation Agency

Collecting energy data is the most important task in energy statistics.

Current status of data collection work by Agency of Statistics (AoS) / State Committee for Statistics (SCS)

Main Items		Location of Data
Primary energy supply, conversion and energy transport	Monthly and annual volume of production, supply, energy industry own use, losses, etc. by energy type	Energy industries
Energy consumption (industrial, transport and large enterprises etc.)	Annual and, or monthly consumption volume by energy type	Enterprises (excluding small businesses), Non-profit organizations, State administrative agencies
Energy consumption (residence)	Annual or monthly sales volume by energy type	Energy industries
	Monthly volume by energy type including conversion from purchase cost etc. Start in 2021.	Household Survey in the Census: Nationwide sampling of 10,000 households

In general, collecting accurate consumption data from energy end-users directly requires the establishment of legal systems, various ideas and efforts for collection, also requires consideration for personal information protection.

Japan International Cooperation Agency

Issues on the data accuracy in the Pilot Fuel and Energy Balance Table

Uzbekistan Pilot Fuel and Energy Balance 2020 (SCS)

PILOT FUEL AND ENERGY BALANCE OF THE REPUBLIC OF UZBEKISTAN FOR 2020
(1000 tons of oil equivalent)

In heat plants, fuel consumption decreased to about 30% of the previous year.
Heat production> Fuel*2.8

In row of heat, the data for 2020 uses exactly the same data as the previous year, making it difficult to think statistically.

Significant change from previous year's numerical value in Natural Gas Industry Own Use

Significant difference from the Concept Note in Transmission and Distribution Losses

						Dies							r	Heat energy	Total
Total Enegy Supply														-	44813.4
						42								-	3218.7
														-	-2709.4
						3								-	-223.3
						42								**-**	**45099.4**
Conversion														-	-
	Statistical discrepancy	-0.5			0.0	-0.1								-0.06	70.5
	Power plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Heat and power plants	-1321.9	-12130.2	-	-	-1.5	-140.2	-	-	-	-	-	4676.0	1414.9	-7502.9
	Heating plants	-0.5	-567.8	-	-	-0.9	-23.4	-	-	-	-	-	-50.6	1779.0	1135.9
	Gas plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Oil refineries (chemical) plants	-	-	-3489.9	1095.7	968.6	168.3	816.4	131.3	35.8	172.4	-	-	-	-101.6
	furnaces)	-23.2	-	-	-	-	-	-	-	-	-	-	-	-	-23.2
	Gas-to-liquid and coal liquefaction	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Other (conversion and processing of fuel)	-	-384.3	-	-	-	-	-	-	-	-	-	-	-	-384.3
	Own use by the energy sector	-0.7	-2370.5	-4.5	-	-6.4	-17.0	-16.4	-	-	-2.1	-	-266.2	-	-2683.6
	Losses	-0.8	[illegible]	-16.7	-4.7	-0.6	-	-0.5	-	-	-	-	-32.1	-179.3	-1139.9
Total Final Consumption	**Total consumption**	**1116.6**	**21408**	**-**	**1407.3**	**1384.3**	**84.3**	**801.4**	**175.9**	**35.8**	**427.4**	**-**	**4467.0**	**3014.5**	**34323.5**
	Industrial sector	**186.3**	**4322**		**1.8**	**55.4**	**15.1**	**2.8**	**3.1**	**35.8**	**14.0**		**1572.2**	**429.2**	**6638.0**
	Mining and quarrying	0.1	106		0.03	5.6	0.00	-	-	-			42.7	24.2	179.5
	Chemical (ex					8.3							323.3	44.2	1596.6
	Metallurgica					27.							702.9	208.1	1540.0
	Non-metallic					7.							41.9	9.8	1330.2
	Mechanical					0.							44.5	8.5	129.9
	products					1.							43.9	67.4	425.2
	Pulp and pap					0.							3.1	4.6	62.1
	Textile and l					3.4							88.7	21.2	465.9
	Other industr					1.							81.1	41.2	908.6
	Transport sect					**1327**							**91.0**	**-**	**6186.4**
	Railways					82.5							32.0	-	121.4
	road transport	-	2541.1	-	1244.0	1244.7	-	382.2	-	-	-	-	-	-	5412.1
	other types of transport (water, air, urban electric)	-	-	-	1.1	-	-	-	146.3	-	-	-	5.7	-	153.1
	Transportation by pipelines	-	446.5	-	-	-	-	-	-	-	-	-	53.3	-	499.8
	Road transport services	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Other	**927.1**	**13374.6**	**-**	**158.33**	**1.6**	**69.1**	**415.0**	**25.0**	**-**	**60.2**	**-**	**2803.9**	**2585.4**	**20420.2**
	Population	282.4	9675.4	-	-	-	0.5	412.6	0.5	-	-	-	1337.0	1178.8	12887.1
	Construction	1.8	-	-	-	-	-	-	-	-	60.2	-	124.5	-	186.5
	Commercial enterprises and government agencies	107.5	2395.0	-		-	0.1	-	24.5	-	-	-	450.5	1197.1	4332.9
	Agricultural industry	18.7	258.8	-	0.10	0.9	-	2.4	0.005	-	-	-	791.3	57.0	1129.2
	Fishery	0.0	0.4	-	-	-	-	-	-	-	-	-	-	-	0.4
	Unspecified other sectors	516.7	1045.0	-	-	0.7	68.5	-	-	-	-	-	100.6	152.5	1884.0
Non-Energy Use	**Non-energy use**	**-**	**724.4**	**-**	**-**	**-**	**-**	**1.3**	**-**	**-**	**353.2**	**-**	**-**	**-**	**1078.9**
	in industry / transformation-processing / fuel energy	-	362.2	-	-	-	-	1.3	-	-	353.2	-	-	-	716.7
	including chemicals / petrochemicals	-	362.2	-	-	-	-	-	-	-	-	-	-	-	362.2
	in transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	in other sectors	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Current Situation of Responsibilities of Related Ministries and Agencies on Energy Statistics

- AoS is the responsible organization of compilation and dissemination of the official energy statistics in accordance with the Official Statistics Act.
- AoS has been working on the pilot version of energy balance table since 2018 in order to produce energy statistics in line with international methodologies and report it to IEA.
- AoS recognize issues on data accuracy in the energy balance table due to data collection difficulty.
- MoE is the responsible for energy policy making and its implementation and supervision in energy industries.
- To accomplish such tasks, MoE mandates energy industries to report energy information and data. However, It's difficult that MoE obtains detailed consumption data from energy industries and data from end-users directly.
- AoS needs cooperation from various ministries, agencies and research institutions to produce energy statistics. AoS is discussing unification and standardization of statistical production methods with related organizations.

Improvement on energy statistics, activities and recommendation

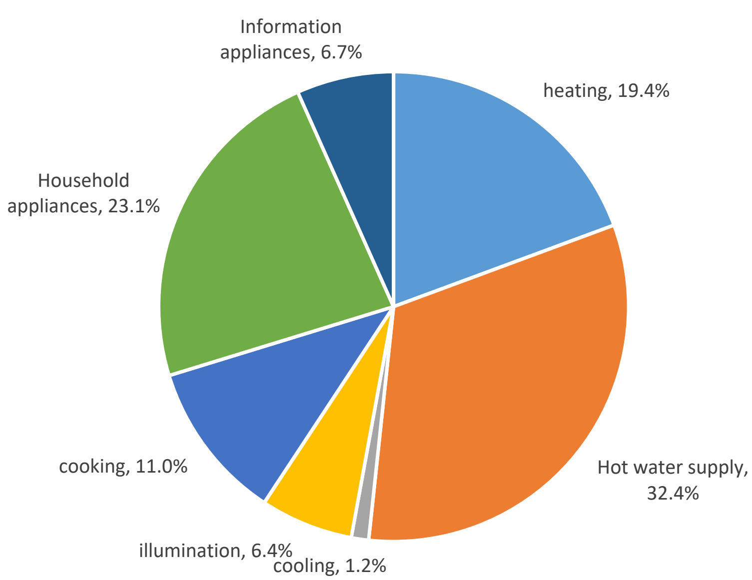
- Continuous improvements has been carrying out in accordance with Presidential Resolution 4796 which contains references to international practices by AoS.
- In Japan and many OECD countries, the ministry of energy and related agencies are responsible for producing energy statistics including energy database because they have expertise in energy fields as same as they can easily obtain data in energy industries. They knows best what kind of data is needed to formulate an energy strategy.
- We recommend MoE should be responsible for producing energy statistics including its database in near future.
- Regarding the UIS (Unified Information System) currently under development, we believe that there are issues such as how to accurately input data on terminals, how to find simple input errors, how to balance data continuity and system update and how to link with other database. We would like to point out that the issues needs to be solved in early stage.
- Obtaining the required energy consumption data directly from energy end-users through surveys or something methods is crucial for policy making for energy conservation, but not easy and expensive. We recommend to develop human resources with know-how on how to conduct efficient and economical surveys, or to develop outsourced companies.

Example of a Study on Residential Sector Final Energy Consumption in Japan

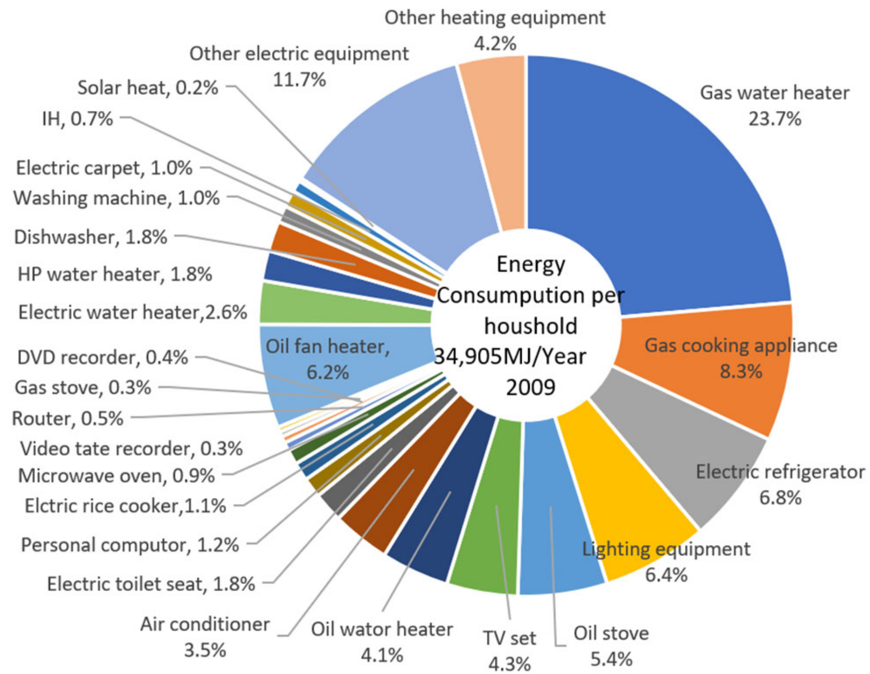
Knowing final energy consumption in as much detail as possible is essential for pursuing energy saving potential and measures.

In Japan, surveys of final energy consumption in various sectors are conducted in a variety of ways, and are used to make energy conservation policies.

Energy Consumption by Use



Energy Consumption by Equipment



Source: Compiled based on the Agency for Natural Resources and Energy's "Actual Energy Consumption in Households" (2009, 10,000 household questionnaire survey)

(2) Improvement of demand-side energy measurement accuracy

● **Importance of automated measurement system for energy data**

Gas Smart Meter

- In the future, it will become increasingly important to automatically measure and transmit energy data in real time.
- In particular, demand side measurement for energy consumption data requires the installation of a huge amount of meters and the construction of a data transmission system.
- At present, smart meters for electricity and gas have already been installed, and the data is collected by power and gas distribution companies (REN, Khududgaztaminot).
- Regarding heat, although we are aware of the difficulty of automatic measurement, we believe that it is desirable to realize automatic measurement in the same way as electricity and gas.

● **Necessity of supplementary survey for fields where energy consumption data have not been acquired**

- Residential energy consumption accounts for 1/3 of TFC, so the household consumption survey in the Census has started since 2021.
- In this survey, electricity, gas, heat and other fuels including cotton stalks and livestock waste that are biomass use for energy are target items, but biogas is not appeared.
- It is hoped that reliable survey or ad-hoc research on residential biomass utilization in rural areas will be conducted in the future.

Japan International Cooperation Agency

Conclusion

Data (statistics) on energy is an indispensable basic infrastructure for energy policy makers to understand policy priorities, evaluate and monitor the implementation of measures, and establish a PDCA cycle. The collection and utilization of accurate data is one of the most important measures to promote energy conservation.

Continuous improvement of the energy statistics system should be encouraged for this purpose.

The importance of metering has been recognized, especially the need to strengthen metering in the heat supply sector (e.g., installation of heat meters and automatic collection of meter reading data).

Japan International Cooperation Agency (JICA)
Data Collection Survey on Energy Efficiency Sector
in the Republic of Uzbekistan

Energy Efficiency Seminar

31st January, 2023

Policy promotion of energy management systems and energy conservation standards

The Energy Conservation Center, Japan
Akira ISHIHARA

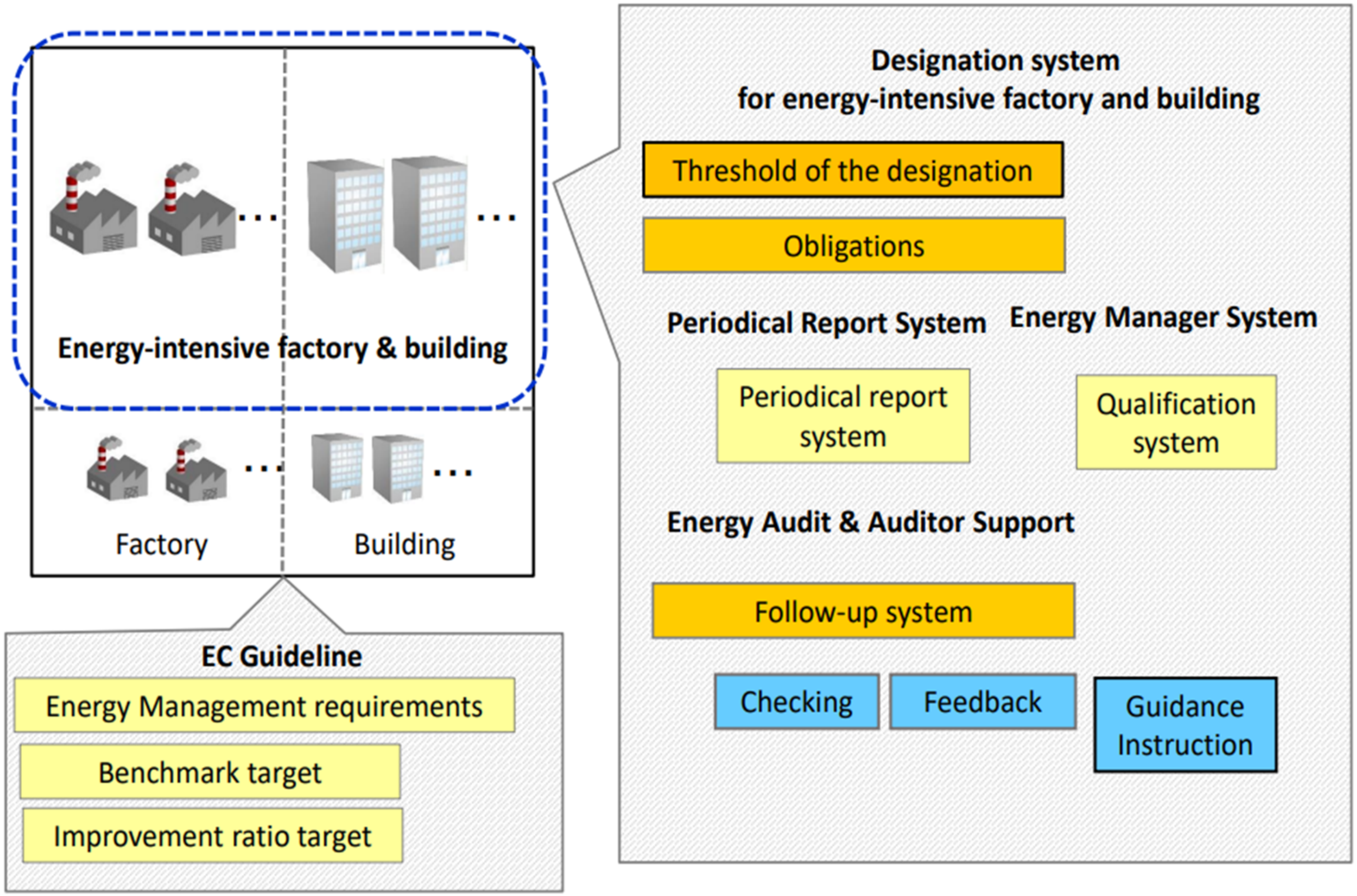
Policy promotion of energy management high level structure

Japan International Cooperation Agency

Current implementation

Items	Status
Identification of companies/ factories	Yes（PP4779）
Periodical report to government	Yes Monitoring system started
Energy managers	No
Energy audits	Energy audit obligation（PP4779）
Follow up system	No
Benchmark	No

Structure of political energy management



Policy promotion of energy management evaluation methodology

Japan International Cooperation Agency

Energy management status

Improvement results

Energy management implementation

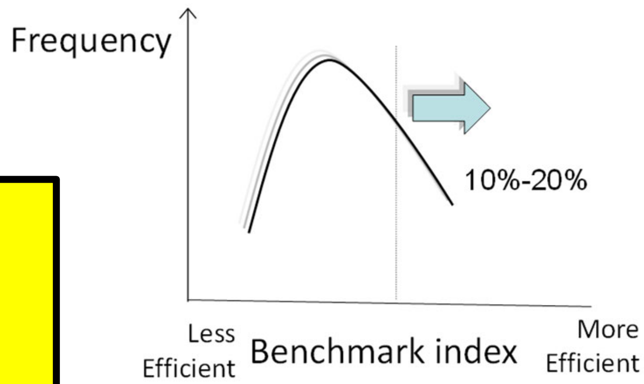
Level of indicators

Guideline for energy management system

Benchmark
comparison of efficiency among companies/sites of respective subsectors using efficiency index

Evaluation of companies factories business sites

Instruction, guidance



Classification in Japan

Class S
superior in energy conservation efforts

Class A
general business operators

Class B
energy conservation efforts are not progressing

Class C
requiring close monitoring

Benchmark in Japan

Industry	Benchmarked aimed level
Steel manufacturer using blast furnaces	≦0.531kl/t
Ordinary steel manufacturer using electric furnace	≦0.150kl/t
Cement manufacturer	≦3,739MJ/t
Western paper manufacturer	≦6,626MJ/t

⋮

Policy promotion of energy management energy management process

Appointment of energy managers and establish management structure as obligation

The energy manager will develop energy conservation plans,
promote energy efficiency conservation activities and
report energy usage to the government.

Strengthening energy managers' capacity, sharing the government's energy policy and guidance.

Energy Audit

Ensuring energy audit obligations in accordance with the Presidential Decree.

Strengthening energy auditors' capacity
by such as training course for energy audits at the Tashkent Polytechnic University.

Appointed energy managers utilizes the audit results.

Improvement of energy efficiency

Identified potentials for energy savings with pay back in about three years should be implemented.

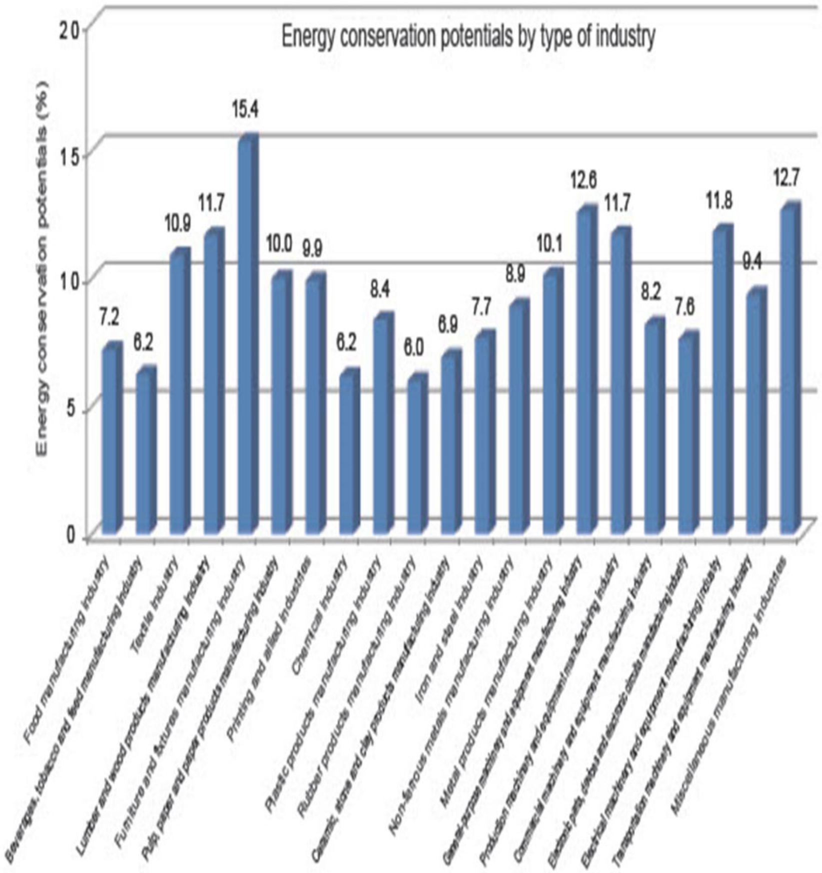
Utilize benchmarks as target energy intensity.

Industrial Fields	Benchmark indicator	Considerations for setting benchmarks
Gas refinery	Specific energy consumption per refining volume	Comparative study of each plant in Uzbekneftegaz
Chemical Fertilizer Plant	Specific energy consumption per product	Comparative Study of Chemical Fertilizer Companies
Vehicle Maintenance Factory	Specific energy consumption per unit of maintenance	Comparative Study of Vehicle Maintenance Companies
Gas transportation system	Specific energy consumption per unit transported	Comparative study of each plant in Uztransgaz

Policy promotion of energy management　energy audit and improvement potential

Energy improvement potential

around 10%: energy audit results in Japan
(small and medium company, small investment)



Energy improvement potential

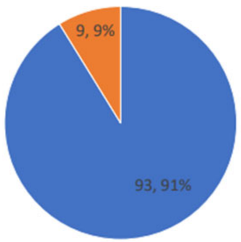
representative industry

industry	Energy improvement potential (energy consumption intensity difference)
Iron and steel industry	supposed 30% consumption intensity estimated 12.9 GJ/ton-product Japan 5.3-9.1 GJ/ton
Non metallic material	supposed 10%-20% consumption intensity estimated 4.2 GJ/ton-product heat input 3. 0 GJ/ton-product representative value (Japan) 3.9 GJ/ton heat input 2.5 GJ/ton-product
Chemistry	potentials in boiler efficiency are found.

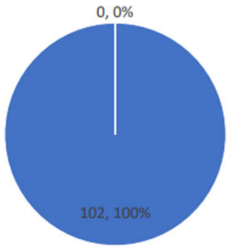
Awareness aspects in policy promotion　awareness on energy efficiency (EE)

Information obtained by enquiry households in all districts over the country.

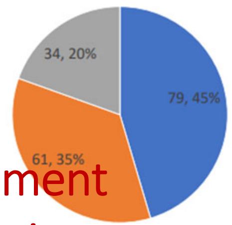
Concern on EE



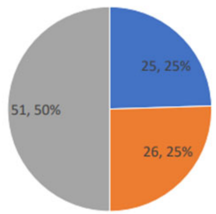
Importance of EE education



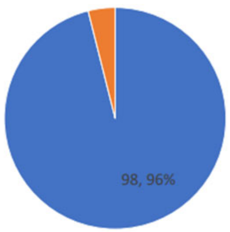
EE diffusion driver



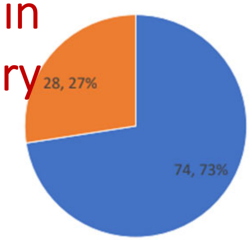
Knowledge on heat pump



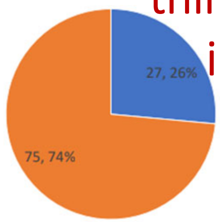
EE behavior



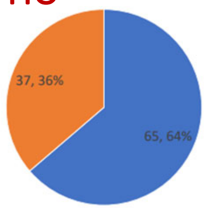
Heating in winter



Life style in winter

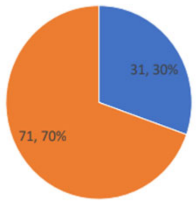


Knowledge on EE labelling



Awareness aspects in policy promotion facts in household : energy equipment

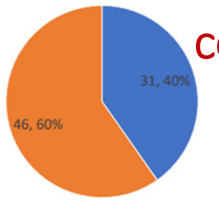
Using boiler or district hot water



boiler

district hot water

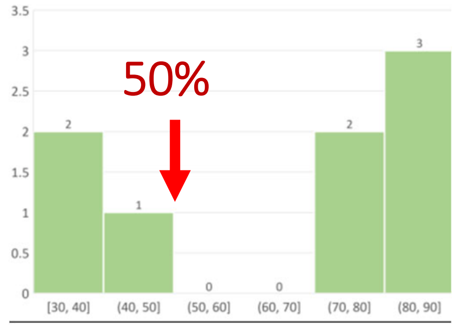
Using combi-boiler or not for boiler users (yes for left question)



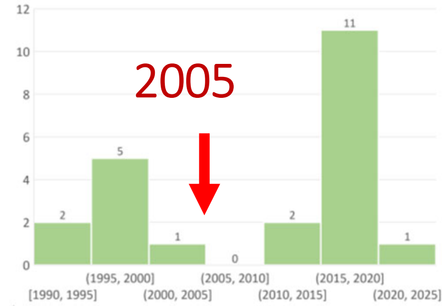
combi boiler

no

Boiler efficiency for boiler users



Boiler installation year for boiler users

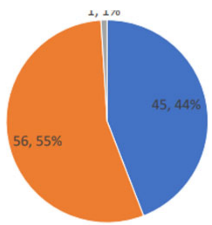


Hot water meter installed

no

yes

for heating, an air conditioners Is available or not



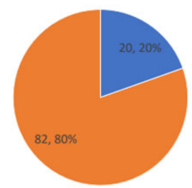
yes

no

A refrigerator will be purchased within 5 years

yes 25%

Knowledge on water saving shower head

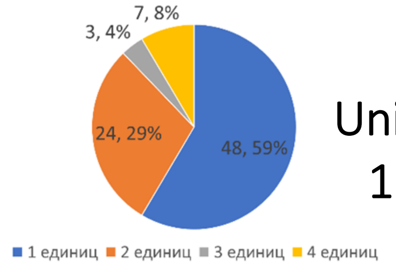


yes

don't know or don't use

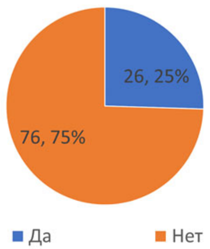
Awareness aspects in policy promotion facts in household : air conditioner (AC)

- **Certain awareness on energy efficiency classes.**
- **ACs are on the spreading stage.**
- **Subsidy would work helpfully.**

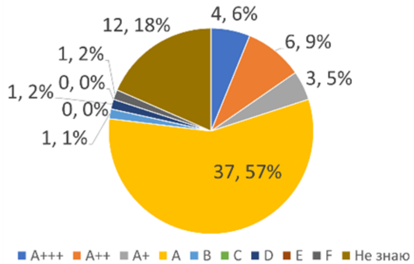


Units owned
1unit 59%

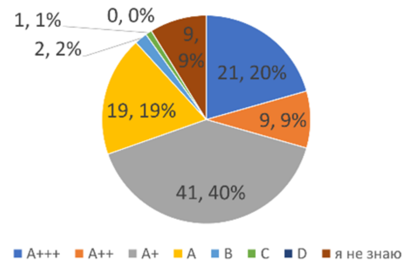
Ratio of inverter AC owners
26**%**



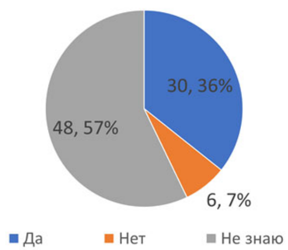
Efficiency class purchased
A 82%



Next purchase to want
A+ 40%

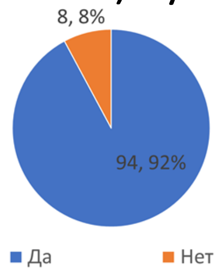


Whether to buy inverter AC
39%



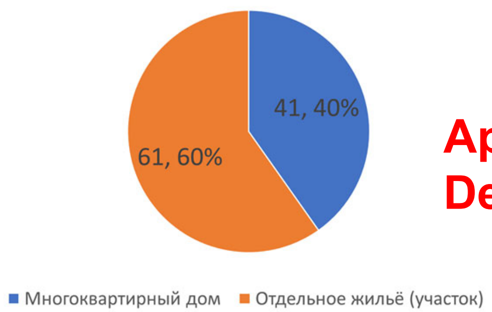
Whether to buy high efficiency depending on cost 56%

Effects of subsidy (20-30% of Price difference) yes 92%



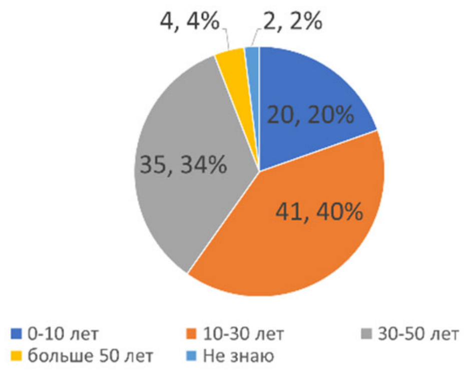
Awareness aspects in policy promotion facts in household : heat insulation

housing form



Apartment households 42%
Detached households 58%

building age

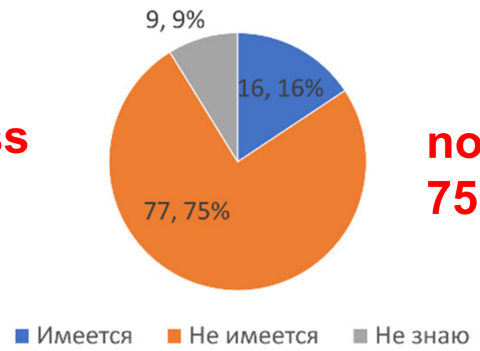


10-30 years 36%
30-50 years 37%

type of window

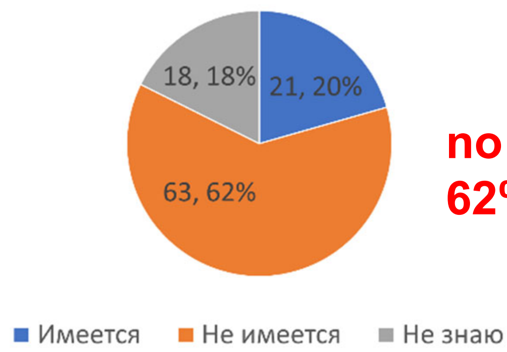
single glass 51%

wall insulation



no 75%

roof insulation (for detached houses only)



no 62%

Standard in policy promotion　air conditioner standard and labelling

Japan International Cooperation Agency

- Energy efficiency standards and labeling for energy-consuming equipment such as air conditioners is effective in increasing consumer awareness. By further promoting the system, the purchase of new high efficiency air conditioners equipped with inverters should be encouraged.
- Inverter air conditioners realize efficient performance for load with variation, not in case of full power operation for all the time.

- Promoting air conditioners' energy efficiency class transition from C (five years ago) to A (current) to A++, A+++ by utilizing the standard and labelling system.
- Now the use of air conditioners is growing, and in ten years new purchases for efficiency will make a significant effect
- Promotion methods;
  Subsidy for A++, A+++ purchase
  as 20～30% of price difference.
  Raising minimum efficiency allowed
  above Class D to above class A.
- Strengthening the testing laboratory capability.

Energy efficiency classes for air conditioners

Energy Efficiency Class	SEER	SCOP
A+++	SEER ≥ 8,50	SCOP ≥ 5,10
A++	6,10 ≤ SEER < 8,50	4,60 ≤ SCOP < 5,10
A+	5,60 ≤ SEER < 6,10	4,00 ≤ SCOP < 4,60
A	5,10 ≤ SEER < 5,60	3,40 ≤ SCOP < 4,00
B	4,60 ≤ SEER < 5,10	3,10 ≤ SCOP < 3,40
C	4,10 ≤ SEER < 4,60	2,80 ≤ SCOP < 3,10
D	3,60 ≤ SEER < 4,10	2,50 ≤ SCOP < 2,80
E	3,10 ≤ SEER < 3,60	2,20 ≤ SCOP < 2,50
F	2,60 ≤ SEER < 3,10	1,90 ≤ SCOP < 2,20
G	SEER < 2,60	SCOP < 1,90

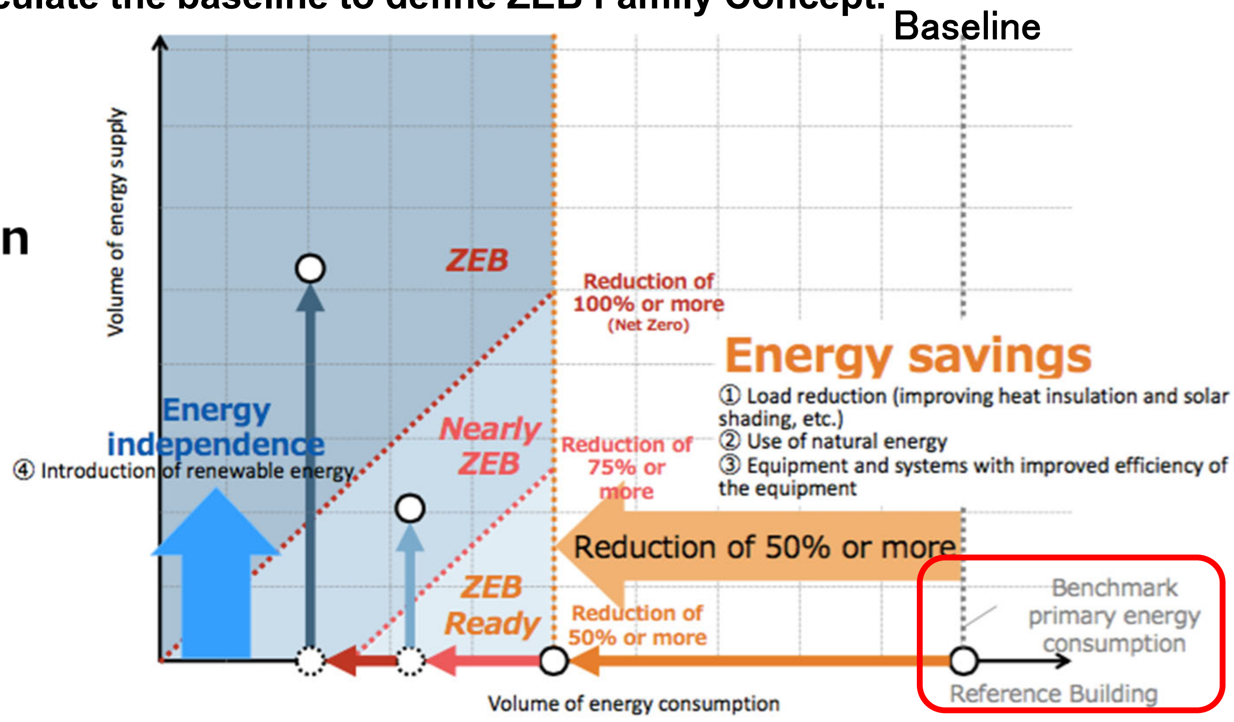
Standard in policy promotion　ZEB evaluation

ZEB family Concept

Definition and evaluation methods of ZEBs

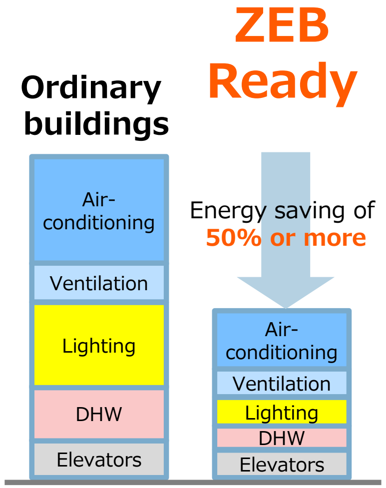
The Building Energy Conservation Act specifies how to calculate the baseline to define ZEB Family Concept.

ZEB evaluation



source: METI of Japan

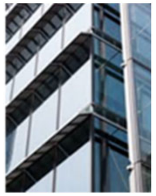
Standard in policy promotion ZEB evaluation



Requiring a minimal amount of energy

High thermal insulation

Solar shading



Natural ventilation and Daylight use

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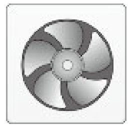
Efficient use of energy

- High-efficiency air-conditioning
- High-efficiency ventilation
- High-efficiency lighting
- High-efficiency elevators
- High-efficiency Domestic Hot Water Systems

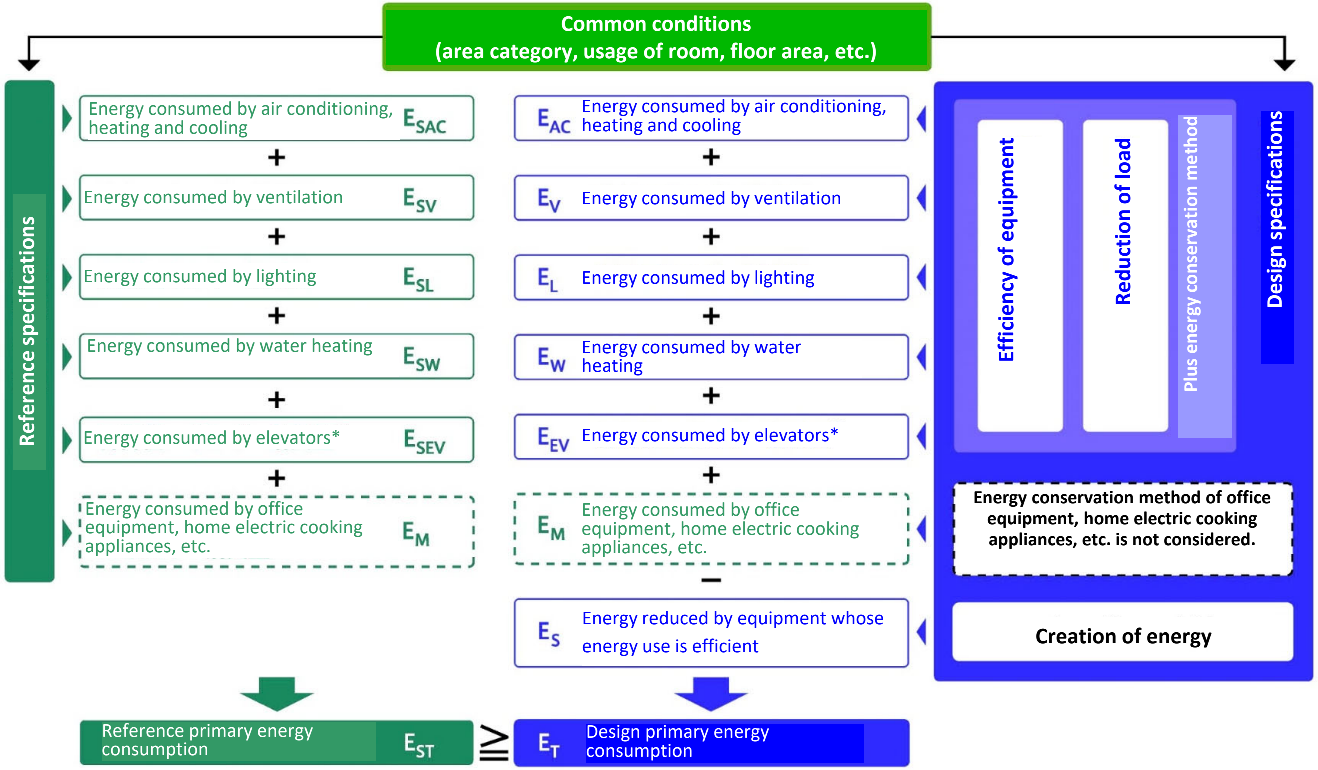


source: METI of Japan

Standard in policy promotion ZEB evaluation

Primary Energy Consumption Design Standard

Based on the following calculation methods, the design building primary energy consumption should be less than the standard values. The calculation is performed by the computer simulation program.



* The target is non-residential buildings and apartment residences.

source: ECCJ

Standard in policy promotion other areas

appliances

Refrigerators standard and labelling

promoting of transition from current main class A to A++, A+++ classes.

equipment

High/premium efficiency motor standard

promoting diffusion by suppliers' obligation for motor efficiency standard IE3+inverter and IE3.

buildings

Heat insulation standard for buildings

strengthening of the current standard to a higher level.

management process

Energy management guideline

ensuring energy management implementation.

Q&A and discussion