2KR Project Implementation Unit
Ministry of Agriculture and Food Industry
Republic of Moldova

The Preparatory Survey on the Project for Effective Use of Biomass Fuel in the Republic of Moldova

Final Report

March 2013

JAPAN INTERNATIONAL COOPERATION AGENCY

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Summary

1 Outline of the Republic of Moldova

(1) Territory and Nature

The Republic of Moldova is located between 48.21° and 45.28°N latitude and between 30.05° and 26.30°E longitude. Its total area is approximately 33,843 km^2 and the country is about 350 km in length from north to south, and approximately 150 km from east to west. Moldova is considered a part of Eastern Europe, bordering Romania to the west and bordering the Ukraine on all other sides.

The topography of Moldova consists primarily of gentle hills and/or slopes (the highest elevation above sea level is 429 m) with elevation gradually decreasing toward the Black Sea. Moldova lies primarily between two major rivers, the Dnester River in the east and the Prut River in the west. Significant flooding of these rivers has been recorded in the past.

Although the country is located in the middle of the Eurasian Continent, there have been some earthquakes with hypocenters along the Carpathian Mountains in neighboring Romania. Six earthquakes of seismic intensity 3 or 4 at Chisinau were observed in a recent 5 year period (2005-2010).

(2) Energy Sector

Moldova has very few domestic energy resources and is largely dependent upon imported energy resources. For each of the last nine years, 80% of Moldova's national energy supply has been derived from imported energy resources. Imported natural gas comprised nearly half of the total energy supply until 2007, but Moldova's dependence on imported gas has eased slightly, with the resource accounting for 42% of the total energy supply in 2009, 43% in 2010 and 41% in 2011.

The largest consumer of energy resources in Moldova is electric-power production, constituting approximately 30-40% of total demand. Direct public consumption is ranked immediately below power production, and most direct public consumption seems to be dedicated to heating.

The Moldovan energy sector faces a number of key challenges including the following:

- Lack of domestic energy resources (e.g. natural gas, oil, coal)
- Total reliance on imported fossil fuels and electricity
- Low energy efficiency and limited use of renewable energy sources
- Over-reliance on imported natural gas
- Non-uniform regional electricity generation capacity (insufficient capacity on the right bank of Dnester River, where electricity generation represents only 30% of total energy consumption)
- Advanced wear and tear on power station equipment, high voltage power lines and distribution networks
- Insufficient investment in the energy sector
- Minimal natural gas supply to rural areas

2 Background of the Project

In January 2006, difficulties in natural gas price discussions with Russia, resulted in the suspension of the natural gas supply to Moldova and Ukraine. This break in natural gas supply literally froze the Moldovan people. In winter, gas consumption in the country is typically eight to nine times higher than in the summer months. The supply disruption placed the Government of Moldova (GoM) and the Moldovan people in extreme distress.

Agriculture is the main industry of many Moldovan rural communities, and local authorities often do not have enough tax revenue for energy procurement. As a result, public facilities such as kindergartens and schools struggle to heat classrooms. In the past, some schools have had to close their doors during the coldest month of the year.

Moldova's most recent national development plan, "Moldova 2020 - National Development Strategy: 7 solutions for economic growth and poverty reduction", set seven national priorities: 1) Education, 2)

Upgraded road infrastructure, 3) Access to finance, 4) Business climate, 5) Energy efficiency, 6) Pension reform, and 7) Justice. The key stated priorities in the energy sector are to increase energy efficiency and to draw a greater share of energy from renewable sources. Key numerical targets for the energy sector set in the plan are included in the table below.

Table 1 Target Indicators of the Energy Sector

Indicators	2015	2020
Energy Security		
Stimulating the use of energy produced from renewable energy sources in the total gross domestic consumption, %	10	20
Ensuring the share of bio-fuels in the total of fuels used, %	4	10
Energy Efficiency		
Reducing greenhouse gas emissions (compared to 1990), %		25

Source: Moldova 2020 - National Development Strategy: 7 solutions for economic growth and poverty reduction, p47, Obtained from "http://gov.md/libview.php?l=en&idc=447&id=4957"

The Ministry of Economy controls the energy sector in Moldova, and has adopted the following two policies: "National Energy Efficiency Programme 2011-2020" and the "Energy Strategy of the Republic of Moldova until 2020". Based on the latter document, the Ministry is promoting the following measures:

- Creating a more efficient, reliable and competitive national energy industry geared towards serving the needs of the customer
- Enhancing security of energy supply
- Promoting energy and economic efficiency
- Liberalizing the energy market and further restructuring the power industry
- Boosting Moldova's role as an important transit country for electricity and gas

The table below details the change in energy supply composition between 2003 and 2011. Among the energy resources listed, firewood, agricultural residuals and wood residuals are considered renewable sources.

Table 2 Change of Energy Supply Composition by Resource

(Unit: 1,000 tons of coal equivalent)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total resources	3,127	3,398	3,520	3,471	3,374	3,444	3,304	3,434	3,494
Coal	290	262	241	231	224	286	234	234	251
Diesel fuel	468	520	531	524	559	596	575	671	713
Residual fuel oil	53	47	40	38	31	39	87	65	49
Motor gasoline	343	367	372	336	344	361	370	336	359
Kerosene	23	1	1	–	–	–	–	–	–
Natural gas	1,445	1,478	1,657	1,657	1,527	1,436	1,322	1,392	1,349
Liquid gas	97	100	97	91	90	100	105	112	125
Electricity	223	414	374	363	364	374	368	382	395
Firewood	95	85	88	102	91	99	96	88	94
Agricultural waste	11	16	16	16	15	21	27	27	30
Wood waste	24	19	17	18	15	17	20	12	8
Other	55	89	86	95	114	115	100	115	121
Renewable energy (%)	4.2%	3.5%	3.4%	3.9%	3.6%	4.0%	4.3%	3.7%	3.8%

Source: The Energy Balance of the Republic of Moldova Statistical Collection 2011, National Bureau of Statistics of the Republic of Moldova

Renewable energy has comprised approximately 3-4% of the national energy supply since 2003, a figure which has not significantly increased or decreased. To accomplish the national renewable energy production targets (10% of total energy consumption by 2015 and 20% by 2020) the energy shifting process must accelerate greatly.

A Grant Assistance for Grass-roots Human Security Project ("Improvement of Heating System for the Kindergarten and School in Hirtopul Mare Village") was implemented by Japan in 2008. Two sets of biomass heating systems were installed and their effectiveness as biomass heating system was confirmed empirically. The GoM issued an official request to the Government of Japan for assistance in expanding and disseminating biomass heating systems in 2009 ("Biomass Heating Systems in Moldovan Rural Communities"), which includes the following three items.

- Installation of Biomass Heating Systems at 100 sites (including boiler, piping system rehabilitation/installation)
- 100 units of balers
- Guidance and technical supports to the national and local authorities and communities for proper facility maintenance

In response to the request, the Japan International Cooperation Agency (hereinafter referred as "JICA") conducted a preliminary study to collect basic information and confirm the request in February 2011. The preliminary study concluded that expansion of the biomass heating system in Moldova had strong potential. Following completion of the consultant tender processes, a preparatory survey was commenced in December 2011 to establish appropriate outline design and initial cost estimation of the Project.

3 Outline and Contents of the Project

The Project aims to accomplish three primary goals through the installation of biomass heating systems at public facilities and the installation of one biomass pellet plant: 1) energy cost reduction, 2) sustainable heating system operation, and 3) improvement of living conditions in the subject Moldovan rural communities. The biomass heating systems will be installed mainly in education facilities including primary schools, and will consist of boilers fueled by biomass pellets.

In addition, through the expanded implementation of biomass heating systems, the Project aims to secure improved education opportunities for infants and children living in rural areas of Moldova and to promote the transition from fossil energy to renewable energy sources. An additional overall goal of the Project is to improve energy self-sufficiency and reduce greenhouse gas emissions in Moldova.

Together with the 2KR Project Implementation Unit (2KR-PIU) under the Ministry of Agriculture and Food Industry (MoAFI), the preparatory survey conducted two on-site surveys in Moldova; from January to March 2011 and from June to August 2011. The survey revealed that straw boilers named in the original request, which burn straw bales for heating had become less popular than pellet boilers by 2011. Based on this finding, the primary equipment of the Project was changed from straw boilers to pellet boilers, and one pellet production plant was added as a project component. After supplementary work in Japan, the survey was completed in March 2012.

To achieve the goals named above, the Project shall include procurement and installation of biomass heating systems at public facilities in Moldovan rural communities (mainly education facilities such as primary schools) and shall provide technical assistance for operation and maintenance. In doing so, the Project will reduce Moldovan dependence upon imported natural gas, and thereby cut energy costs paid by local authorities, which have increased in recent years. The Project will also enable public facilities to operate heating systems continuously, which will reduce the number of emergency school closure dates during the coldest season, thereby improving education opportunities for rural children.

In line with this project concept, the support plan under the Japanese assistance will include: 1) procurement and installation of 25 biomass boilers at public facilities in rural communities in the central region of Moldova (mainly educational facilities such as primary schools) and one pellet production plant in the City of Chisinau, and 2) technical assistance for operation and maintenance of both the biomass pellet boilers and the pellet production plant. The biomass boilers will be fuelled with pellets produced by the pellet production plant using agricultural byproducts and residuals.

Based on the findings of the second site survey in Moldova, and a series of discussions, a total of 25 sites in the Central Region were selected for pellet boiler installation. The 25 sites include the 2KR National Training Center (NTC) in Chisinau where a pellet boiler will be installed for training

purposes.

Table 3 List of the 25 Candidate Sites for Boiler Installation

S/N	Priority Ranking	Code	Rayon	Community	Kinds of Beneficial Facility	Persons of Full day use	No. of Visitors	Proposed Boiler Size (kWh)
1	1	1903	Ialoveni	Răzeni	Lyceum	896		580
2	2	1802	Hînceşti	Lăpuşna	Lyceum	791		580
3	7	2202	Anenii - Noi	Mereni	2 Kindergartens + Primary school	658		348
4	11	3201	Rezina	Ignaţei	Lyceum	490		348
5	12	7203	Nisporeni	Varzaresti	Kindergarten + Lyceum	740		580
6	22	1706	Orhei	Jora de Mijloc	Kindergarten + Gymnasium	447		348
7	23	7702	Straseni	Micauti	Gymnasium + Culture Center	537	150	580
8	24	1712	Orhei	Susleni	Lyceum	326		232
9	27	7703	Straseni	Scoreni	Lyceum	480		580
10	28	1803	Hînceşti	Buţeni	Gymnasium	360		580
11	30	2104	Ungheni	Pîrliţa	Gymnasium	400		348
12	31	1714	Orhei	Furceni	Kindergarten + Gymnasium	342		348
13	38	1705	Orhei	Trebujeni	Gymnasium	223		232
14	39	1702	Orhei	Brăneşti	Kindergarten + Gymnasium	195		232
15	42	8002	Chisinau	Cricova	Kindergarten	485		232
16	45	301	Rezina	Cuizauca	Lyceum	344		407
17	47	6101	Anenii Noi	Maximovca	Kindergarten	230		232
18	51	8004	Chisinau	Bubuieciu	2 Kindergartens	471		232
19	54	7501	Rezina	Mateuti	Kindergarten + Gymnasium	303		348
20	57	6402	Calarasi	Tibirica	Lyceum	452		580
21	60	8003	Chisinau	Tohatin	Kindergarten + Gymnasium	409		348
22	63	7201	Nisporeni	Siscani	Gymnasium	300		348
23	64	1708	Orhei	Chiperceni	Gymnasium	217		232
24	65	1711	Orhei	Piatra	Kindergarten + Gymnasium	325		232
25			Chisinau		2KR National Training Center			116
Total						10,421		

Source: JICA Survey Team

In general, pellet boilers will be installed using a module[1] construction method, involving installation of the boiler components onto a skid and the installation of a housing around the components. The modules shall be assembled in the designated central assembling factory.

The dimensions of the modules after assembly in the central factory will be:

4 m width x 4 m height x 12 m length

It will be possible to transport modules of this size to most of the installation sites using Moldovan official roads, but road width on the routes to some locations is insufficient to transport full-sized modules. Two different assembly methods, including a design for smaller roads, are illustrated in the next page.

[1] The term "module" is used hereafter to refer to a single completed unit comprised of the boiler equipment mounted on a skid and enclosed in a housing.

Module Construction Method (Standard method for this project)

1. Skid & housing will be assembled in the central assembly factory, and components will be assembled into the housing to make a complete "module". Following assembly, an operational test and final check will be performed.
2. Completed modules will be transported to the designated sites.
3. Modules will be installed directly on concrete foundation.

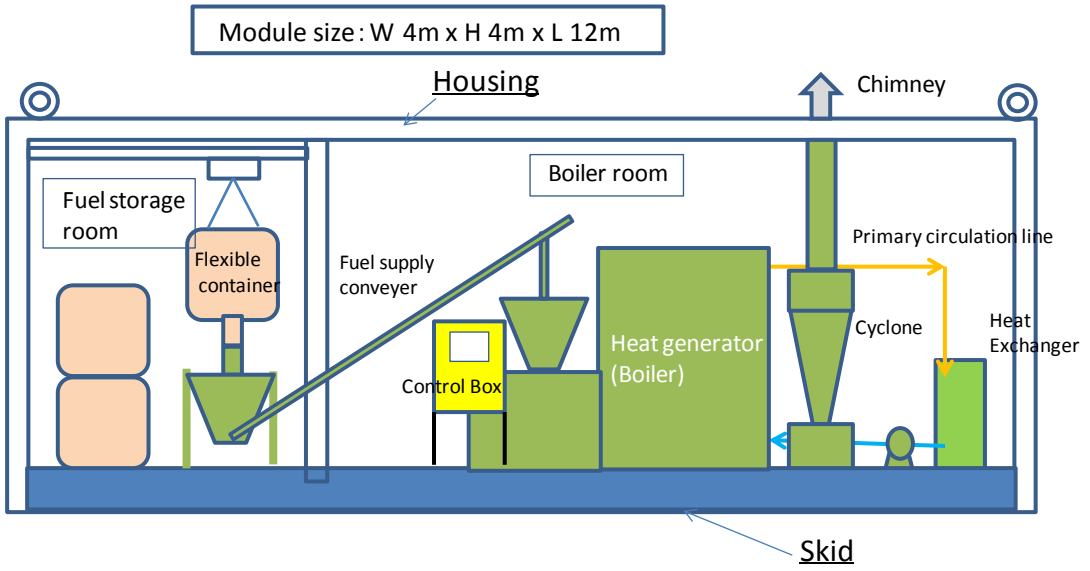


Figure 1 Module Method

Skid Construction Method (For transport over narrow roads)

1. Skids will be assembled in the central factory and the boiler components will be installed onto the skid, creating a "skid unit". Preliminary assembly tests will be performed.
2. Skids will be transported to the installation sites.
3. The unit housing will be assembled on site and the skid unit will be installed into the housing.

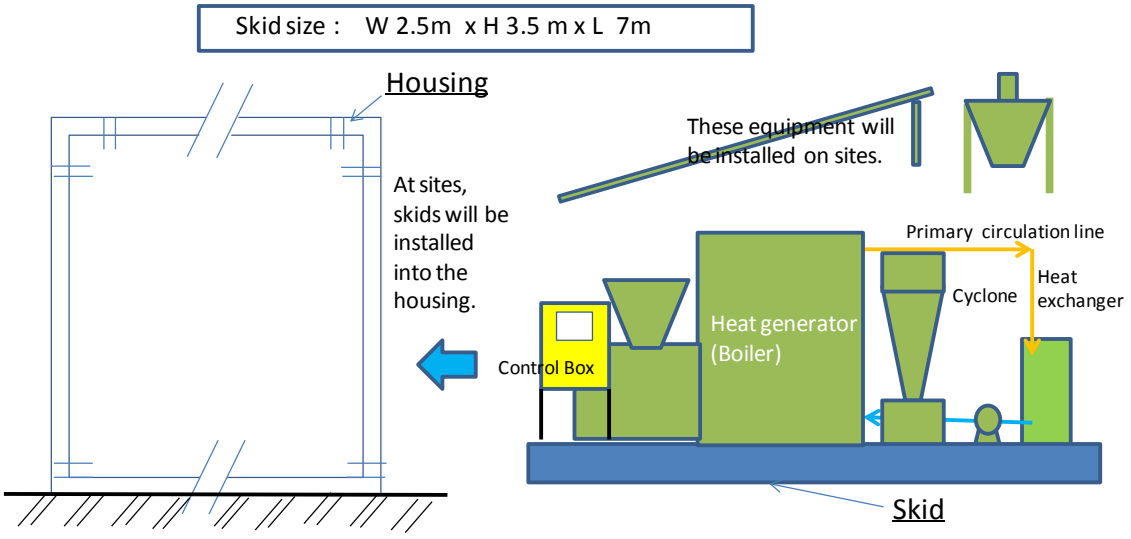


Figure 2 Skid and Housing Method

The principal equipment specifications, quantities and purpose of use are shown as below.

Table 4 Equipment Specifications, Quantities and Purpose of Use

Equipment	Specifications	QTY	Purpose of use
Pellet boiler (116kWh)	Calorie: over 100,000 kcal/hr Dimensions: within 3.0 x 1.7 x 2.1m (L x W x H) Fuel usage: Approx. 30kg/hr Ignition: either gas, oil burner or direct ignition on pellet	1	Educational facilities (kindergartens, primary schools, Gymnasiums and Lyceums)
Pellet boiler (232kWh)	Calorie: over 200,000 kcal/hr Dimensions: within 4.4 x 2.0 x 2.3m (L x W x H) Fuel usage: Approx. 60kg/hr Ignition: either gas, oil burner or direct ignition on pellet	8	Educational facilities (kindergartens, primary schools, Gymnasiums and Lyceums)
Pellet boiler (348 - 407kWh)	Calorie: 300,000 – 350,000 kcal/hr Dimensions: within 4.5 x 2.3 x 2.6m (L x W x H) Fuel usage: Approx. 90kg/hr Ignition: either gas, oil burner or direct ignition on pellet	8	Educational facilities (kindergartens, primary schools, Gymnasiums and Lyceums)
Pellet boiler (407 - 464kWh)	Calorie: 350,000 – 400,000 kcal/hr Dimensions: within 5.0 x 2.4 x 2.8m (L x W x H) Fuel usage: Approx. 120kg/hr Ignition: either gas, oil burner or direct ignition on pellet	1	Educational facilities (kindergartens, primary schools, Gymnasiums and Lyceums)
Pellet boiler (580kWh)	Calorie: over 500,000 kcal/hr Dimensions: within 5.5 x 2.5 x 3.0m (L x W x H) Fuel usage: Approx. 150kg/hr Ignition: either gas, oil burner or direct ignition on pellet	7	Educational facilities (kindergartens, primary schools, Gymnasiums and Lyceums)
Pellet production plant	1. Initial crusher 2. Secondary crusher (mill) 3. Dryer 4. Raw material volumetric feeder 5. Pelletizer (1,000kg/hr capacity) (Flat or ring die type) 6. Chiller 7. Product screener 8. Pellet storage silo 9. Packing machine with flexible container bags 10. Material conveyor between equipment 11. Cyclone dust collector 12. Main power board, control box 13. Other necessary equipment or devices	1	For fuel (pellet) supply to pellet boilers
Test stand	1. Flexible tube 2. Valves 3. Flow meter 4. Calorie meter 5. Circulation pump 6. Filter 7. Cooling tower	1	For pre-installation boiler performance testing (water circulation and water leakage etc.)

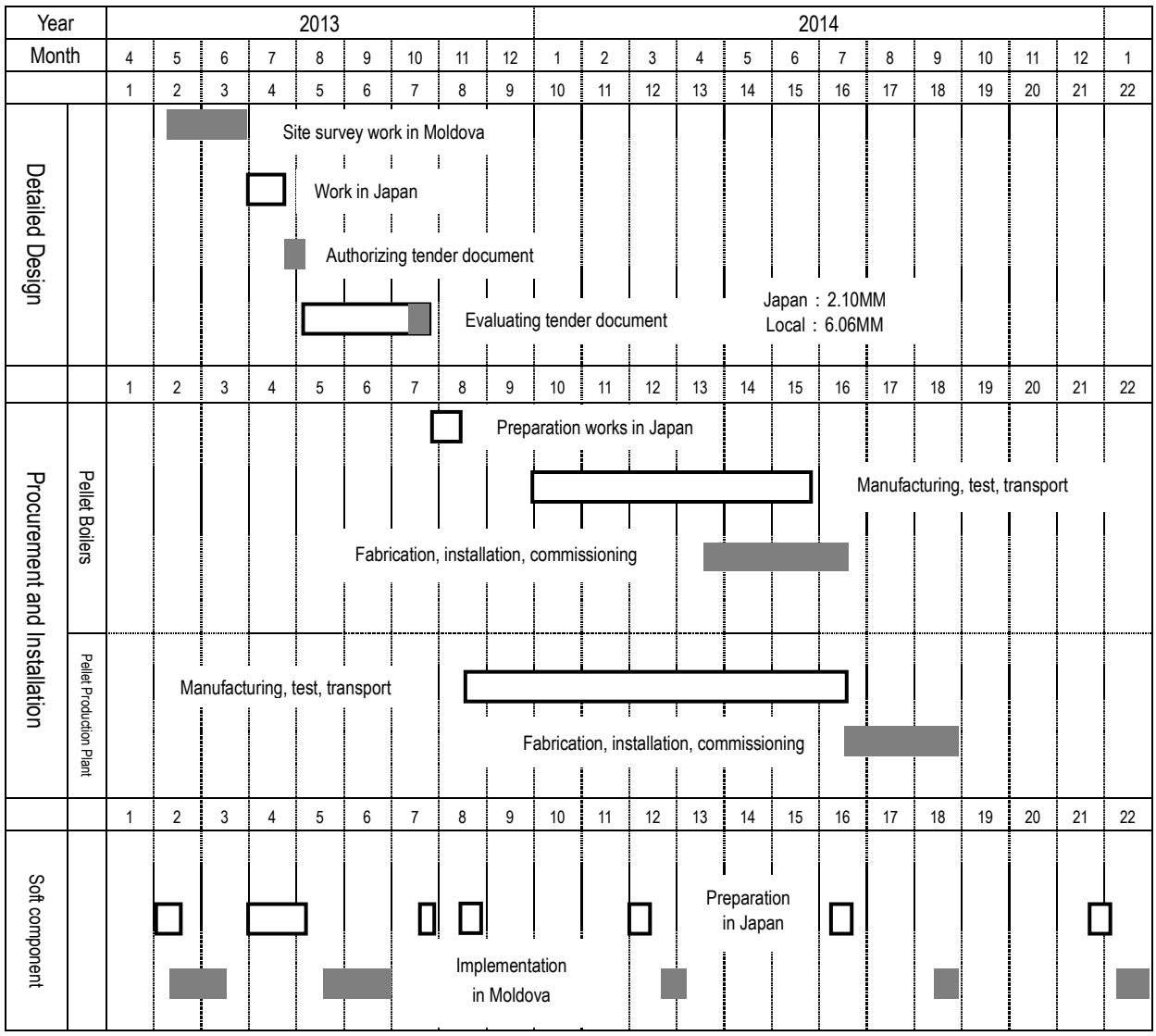
Source: JICA Survey Team

4 Implementation Schedule and Project Cost

The Japanese consultant team shall perform detailed design work (including final confirmation of the undertakings by the Moldovan side) following the Government of Japan's decision on project implementation. A contractor for procurement and installation of the equipment shall be selected through competitive bidding by the Moldovan side. Following the completion of bidding and

contractor selection, equipment procurement shall begin with procurement meetings (preparation, verification of shop drawings under client approval). The table below summarizes the project implementation schedule.

Table 5 Overall Project Implementation Schedule



Source: JICA Survey Team

In accordance with the expected undertakings of the recipient country, the cost breakdowns of the Moldovan side are estimated as follows.

Total Amount:	17,550,000 MDL
1. Boiler installation work:	1,950,000 MDL
2. Workshop structure for pellet production plant:	15,600,000 MDL

5 Project Evaluation

(1) Relevance

This project seeks to act as a model implementation to promote the increased utilization of biomass, a domestic energy source, as fuel. To accomplish this goal, the Project will include demonstration of all procedures from pellet production to the use of biomass as fuel (pellets and unprocessed biomass). An expected secondary effect of the Project is the recognition and promotion in Moldova of Japanese companies and technologies. The following items are considered as a basis for showing the validity

and pertinence of this project;

1. Beneficiary population of the Project will be up to 10,421 people. These are the anticipated direct users of the target public facilities for installation, including schools and kindergartens (this number does not include the 2KR-PIU site beneficiary).
2. The Moldovan national agricultural development plan "National Strategy of Durable Agro-industrial Sector Development, 2008-2015" enumerates the following priority policies;
    1) Sustainable economic growth in rural areas,
    2) Reduction of poverty and inequality; encouraging the participation of citizens in local activities.
    3) Living/Dynamic infrastructure development and improvement.

    In addition, the national development plan "PLAN Government actions for the period 2011-2014" also prioritizes the utilization of biomass.
3. The Project will contribute to improved living and learning environments through the winter season in the target rural areas.
4. Moldovan domestic industries associated with the use of biomass are expected to grow (e.g. biomass fuel production/sales, manufacturing and sales of parts/ equipment, maintenance, and operational management).
5. This project is intended as a model to show the effectiveness of pellet boilers systems and infrastructure, not only through boiler installation but also through demonstrating the necessity of the pellet fuel supply chain. The model will function as an effective model and will encourage the further spread of renewable energy development in Moldova.
6. The Project is expected to use Japanese technologies, and thereby to present an opportunity for small and medium Japanese enterprises (SMEs) to expand business in Moldova.
7. The Project will contribute to reduction of GHG gas emissions.
8. The introduction of funding from the Japanese Grant Aid system ensures that the Project can be carried out without great difficulty.
9. The Project was initiated at the request of the Moldova government to Japanese government, in order to achieve Moldova's middle- and long-term development plan objectives.

Based on these factors, the Project is considered to be both valid and pertinent.

(2) Effectiveness

The following effects of implementing this project are expected:

Quantitative Effects

1) Boiler operator job creation

Compared with existing coal-fired boiler operation at the target sites, pellet boiler operation requires fewer operators, due to the comparative ease of fuel supply work (decreasing from 3 to 2 personnel). However, the introduction the pellet boilers will increase the number of operators at site currently using natural gas-fired boilers, due to the need for fuel supply and ash clearing work (increasing from 0 to 2 personnel). In total, the Project will create 26 new jobs compared to the existing system, and the total number of jobs at the 25 sites will increase from 24 to 50. Additionally, at least 8 new jobs will be created by the installation of the planned pellet production plant.

2) Heating cost reduction

Current fuel sources at the 25 target sites consist of coal (8 sites), natural gas (16 sites), and electricity (1 site). Respective boiler capacities by fuel sources at the 25 sites are 46.1% coal, 48.0% natural gas and 5.9% electricity. Taking the average operating time ratios of the existing boilers (17% of 180 days/year) into account, annual heating costs will be reduced by an estimated 6,753,361 to 5,602,845 MDL, approximately 82.9% of current heating costs.

3) GHG reduction

By replacing the existing fossil fuel boilers (coal, natural gas, electricity) with pellet boilers annual CO_2 emissions will be reduced by an estimated 5,629.2 tons.

Qualitative Effects

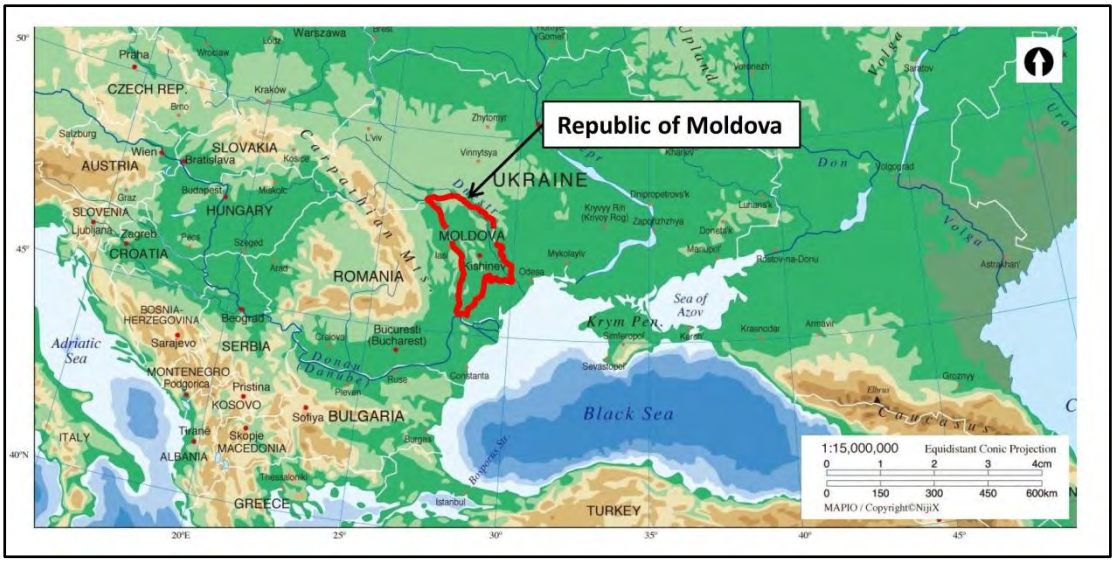
The following qualitative effects are anticipated:

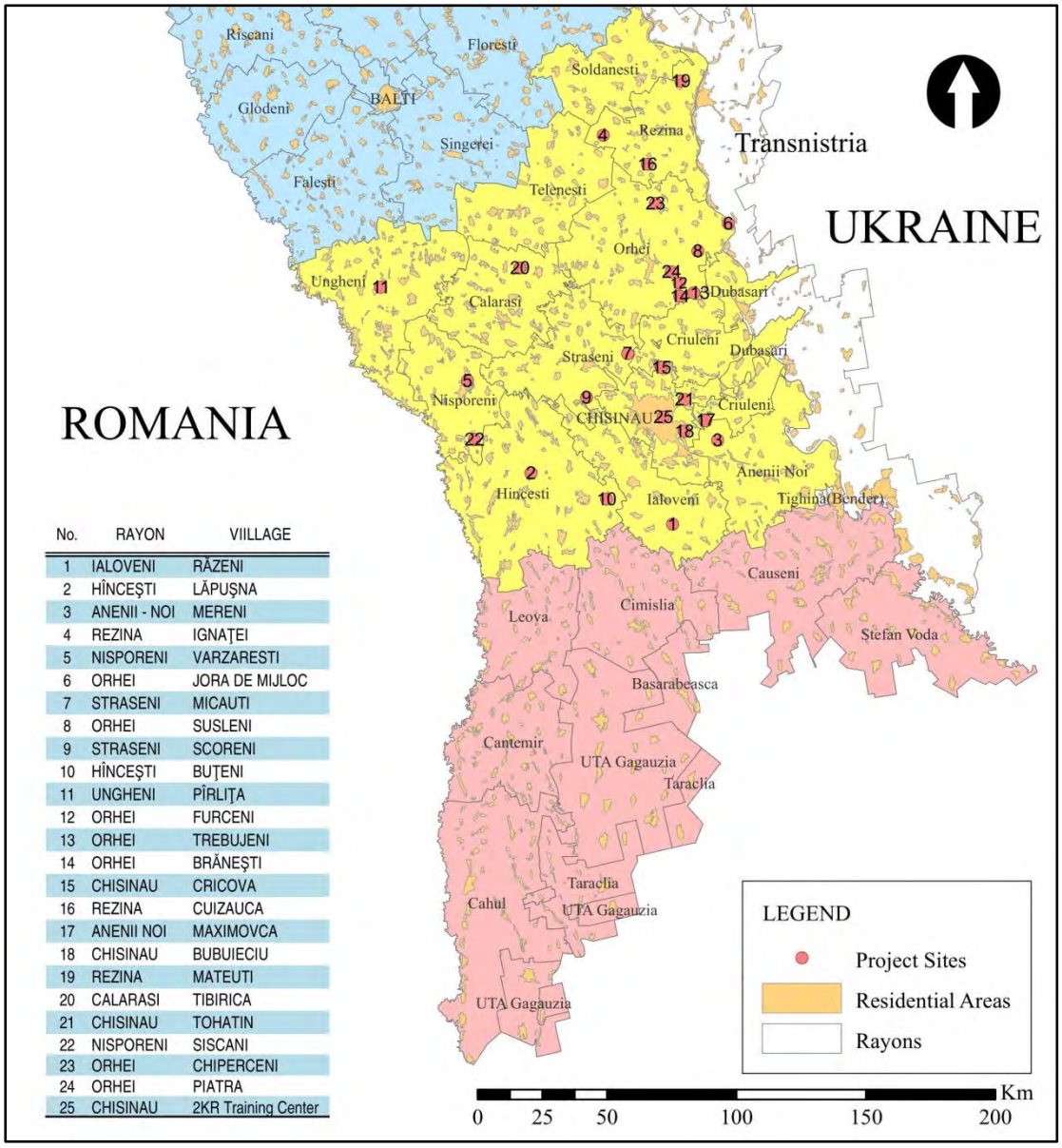
- Heating system installation will improve living and learning environments in target rural communities.
- The Project will contribute to climate change mitigation efforts, national energy strategy objectives and diversification of energy sources.
- Introduction of the planned model pellet supply chain will promote further pellet production and pellet boiler installation.
- The Project will promote biomass utilization in target areas and surrounding countries due in part to energy security concerns. The Project will spur the development of biomass related industries in Moldova.
- Target facilities (schools, kindergartens and other public buildings) will inform and raise awareness among community members, thereby creating an effective system for education and dissemination of information about renewable energy and biomass.

In addition, the Project will support “the promotion of energy efficiency and economical utilization of renewable energy resources”, one of the strategic objectives of the Moldovan "National Energy Strategy to 2020". The Project also contributes to following policy targets declared under the “Law on Renewable Energy”:

- To diversify primary energy sources in the country.
- To achieve a target share of energy supply from renewable energy sources (10% in 2015, 20% in 2020).
- To develop a system for energy resource production, distribution and commercialization, rational energy utilization and fuel source security
- To provide and share information for the development of renewable energy business

Contents





No.	RAYON	VIILLAGE
1	IALOVENI	RĂZENI
2	HÎNCEŞTI	LĂPUŞNA
3	ANENII - NOI	MERENI
4	REZINA	IGNAŢEI
5	NISPORENI	VARZARESTI
6	ORHEI	JORA DE MIJLOC
7	STRASENI	MICAUTI
8	ORHEI	SUSLENI
9	STRASENI	SCORENI
10	HÎNCEŞTI	BUŢENI
11	UNGHENI	PÎRLIŢA
12	ORHEI	FURCENI
13	ORHEI	TREBUJENI
14	ORHEI	BRĂNEŞTI
15	CHISINAU	CRICOVA
16	REZINA	CUIZAUCA
17	ANENII NOI	MAXIMOVCA
18	CHISINAU	BUBUIECIU
19	REZINA	MATEUTI
20	CALARASI	TIBIRICA
21	CHISINAU	TOHATIN
22	NISPORENI	SISCANI
23	ORHEI	CHIPERCENI
24	ORHEI	PIATRA
25	CHISINAU	2KR Training Center

Location Map

List of Tables

List of Figures

Abbreviations

2KR-PIU	2KR Project Implementation Unit, Ministry of Agriculture and Food Industry
BOCM	Bilateral Offset Credit Mechanism
CDM	Clean Development Mechanism
CER	Certified Emission Reductions
CO_2	Carbon Dioxide
COP	Conference of the Parties
DOE	Designated Operational Entity
E/N	Exchange of the Notes
EU	European Union
G/A	Grant Aid Agreement
IFC	International Finance Corporation
IMS	Information Management System
JICA	Japan International Cooperation Agency
JIS	Japan Industrial Standards
JST	JICA Survey Team
MoAFI	Ministry of Agriculture and Food Industry
NOx	Nitrogen Oxide(s)
NTC	National Training Center, 2KR-PIU
ODA	Official Development Assistance
O&M	Operation & Maintenance
SOx	Sulfur Oxide(s)
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
USD	US dollar
TeraJ	Terajoule, 10^{12} J
VAT	Value Added Tax

Exchange Rate: 104.55 JPY/ Euro (Average rate between 1 February and 31 July 2012)
6.68 JPY/MDL (Average rate between 1 February and 31 July 2012)
15.6278 MDL/Euro (Calculated from the above rates)
81.06 JPY/USD (Average rate between 1 February and 31 July 2012)

Chapter 1 Background of the Project

1.1 Background of the Project

(1) Present Conditions of the Sector

The Republic of Moldova is largely dependent upon imported energy resources. Over 80% of Moldova's national energy supply has been derived from imported energy resources for each the last 9 years as shown in the table below.

Table 1.1.1 Energy Balance for the Year 2003-2011

(Unit: TeraJ)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Resources - total	91,649	99,691	103,329	101,861	98,989	101,065	96,946	100,779	102,563
Internal sources	3,633	3,563	3,693	3,853	3,709	4,633	5,160	4,342	4,886
Liquid fuel	88	347	429	296	672	1,098	1,560	1,296	1,288
Natural gas	–	8	8	5	4	5	8	3	2
Solid fuel (mainly coal)	3,311	2,995	2,951	3,276	2,913	3,233	3,395	2,758	3,321
Hydroelectricity	234	213	305	276	120	297	197	285	275
Imported sources	81,920	87,882	91,605	90,448	88,767	88,163	82,712	86,884	90,184
Liquid fuel	24,150	25,569	26,091	25,327	27,041	27,968	27,679	27,947	31,062
Natural gas	44,463	45,408	50,498	50,328	46,523	44,319	40,925	43,295	42,536
Solid fuel (mainly coal)	6,976	4,796	4,326	4,411	4,641	5,218	3,521	4,725	5,265
Electricity	6,331	12,109	10,690	10,382	10,562	10,658	10,587	10,917	11,321
Stocks from the previous year	6,096	8,246	8,031	7,560	6,513	8,269	9,074	9,553	7,493

Source: The Energy Balance of the Republic of Moldova Statistical Collection 2011, National Bureau of Statistics of the Republic of Moldova

Imported natural gas comprised nearly half of the total energy supply until 2007, but Moldova's dependence on imported gas eased slightly, with the resource accounting for 42% of the total energy supply in 2009, 43% in 2010 and 41% in 2011 as illustrated in the chart below.

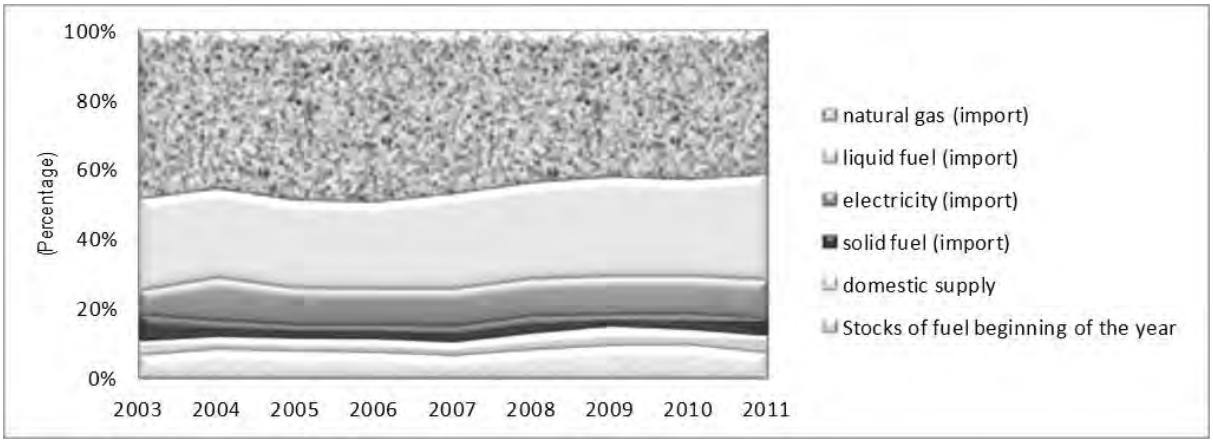


Figure 1.1.1 Share of Energy Supply Sources for Year 2003-2011

Source: The Energy Balance of the Republic of Moldova Statistical Collection 2011, National Bureau of Statistics of the Republic of Moldova

The largest consumer of energy resources in Moldova is electric-power production (referred to as "Transformation in other types of energy" in the table below), which constitutes approximately 30-40% of the total demand. Direct public consumption ("Sold to population" in the table below) is ranked immediately behind power production, and most direct public consumption appears to be dedicated to heating.

Table 1.1.2 Energy Demand for the Year 2003-2011

(Unit: TeraJ)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Distribution – total	91,649	99,691	103,329	101,861	98,989	101,065	96,946	100,779	102,563
Internal consumption*1	82,827	89,792	95,595	95,136	90,645	91,780	86,761	92,544	93,879
Transformation in other types of energy	28,488	32,585	35,287	34,247	32,114	32,017	30,015	30,933	30,014
Production-technological needs	54,339	57,207	60,300	60,884	58,527	59,763	56,746	61,611	63,865
Industry and construction	5,129	5,604	6,944	6,980	6,654	6,157	3,755	4,596	5,064
Agriculture	3,282	3,009	2,613	2,563	2,200	2,175	1,971	2,043	1,935
Transport	11,635	10,686	11,239	11,942	13,705	14,068	12,209	15,130	16,141
Trade and communal facilities	5,714	5,331	5,059	5,163	5,056	5,113	7,276	6,610	6,693
Sold to population	24,093	27,529	29,480	28,967	25,094	26,553	27,680	28,859	29,686
Other*2	4,486	5,048	4,965	5,269	5,818	5,697	3,855	4,373	4,346
Export	528	1,833	152	196	290	211	654	799	599
Stocks of fuel end-year	8,294	8,066	7,582	6,529	8,054	9,074	9,531	7,436	8,085

*1: Calculation formula: internal sources + import – export + changes in stocks
*2: Includes losses during storage and transportation
Source: The Energy Balance of the Republic of Moldova Statistical Collection 2011, National Bureau of Statistics of the Republic of Moldova

(2) Issues of the Sector

The Moldovan energy sector faces a number of key challenges including the following:

- Lack of domestic energy resources (e.g. natural gas, oil, coal)
- Total reliance on imported fossil fuels and electricity
- Low energy efficiency and limited use of renewable energy sources
- Over-reliance on imported natural gas
- Non-uniform regional electricity generation capacity (insufficient capacity on the right bank of Dnester River, where electricity generation represents only 30% of total energy consumption)
- Advanced wear and tear on power station equipment, high voltage power lines and distribution networks
- Insufficient investment in the energy sector
- Minimal natural gas supply to rural areas

Among the issues facing the Moldovan energy sector, the most serious are supply instability and the soaring price of imported natural gas. Currently, 40% of the total energy supply is derived from natural gas, all of which is being imported from Russia via Ukraine. The price of this imported gas has recently risen repeatedly and precipitously as shown in the figure below.

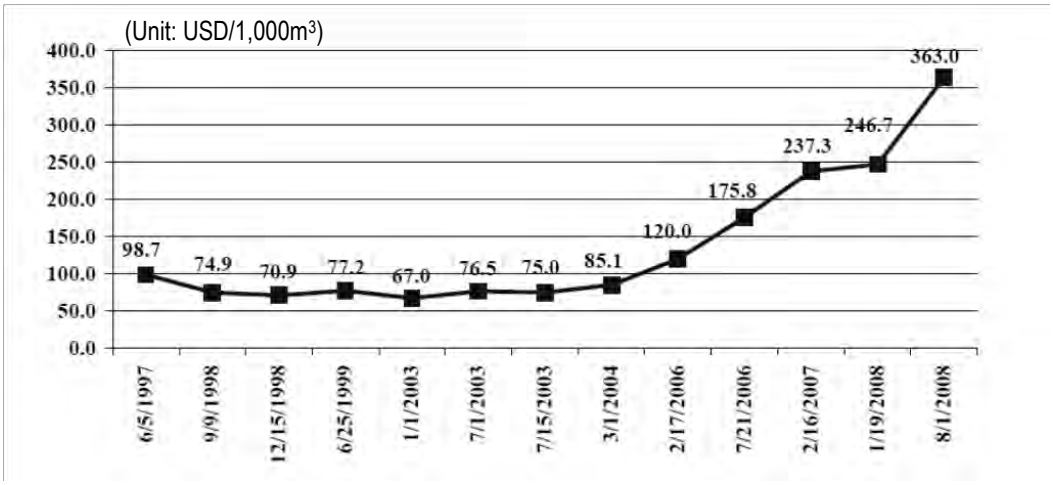


Figure 1.1.2 Natural Gas Price Change after 1997

Source: Republic of Moldova: National Energy Policy Information for Regional Analysis, United Nations Economic Commission for Europe, September, 2009

(3) Development Plans

Moldova's most recent national development plan, "Moldova 2020 - National Development Strategy: 7 solutions for economic growth and poverty reduction", set seven national priorities: 1) Education, 2) Upgraded road infrastructure, 3) Access to finance, 4) Business climate, 5) Energy efficiency, 6) Pension reform, and 7) Justice. The key stated priorities in the energy sector are to increase energy efficiency and to draw a greater share of energy from renewable sources.

The Ministry of Economy controls the energy sector in Moldova, and has adopted the following two policies: "National Energy Efficiency Programme 2011-2020" and the "Energy Strategy of the Republic of Moldova until 2020". Based on the latter document, the Ministry is promoting the following measures:

- Creating a more efficient, reliable and competitive national energy industry geared towards serving the needs of the customer
- Enhancing security of energy supply
- Promoting energy and economic efficiency
- Liberalizing the energy market and further restructuring the power industry
- Boosting Moldova's role as an important transit country for electricity and gas

The document also outlines the following three specific objectives for 2020:

- Improvement of energy supply security through increased capacity for interconnection with Romania and the Ukraine:
  The Joint Operational Programme Romania-Ukraine-Moldova 2007-2013 is currently ongoing, under funding provided by the EU. Under this programme, Romania and Moldova plan to build the Ungheni-Iasi pipeline. An ongoing project to make the Moldovan energy system compatible with the European Network of Transmission System Operators for Electricity is also currently in implementation, and is expected to provide an additional source of energy imports.
- Energy efficiency and renewable energy sources:
  Gradual reconciliation of national legislation with relevant regulations of the EU acquis and increased production of energy from renewable energy sources (6% in 2010 and 20% in 2020)
- Opening-up of the domestic energy sector:
  2009 Law on electricity and 2009 Law on natural gas

(4) Background and Outline of Proposal for Japan's Grant Aid

A Grant Assistance for Grass-roots Human Security Project (Improvement of Heating System for the Kindergarten and School in Hirtopul Mare Village) was implemented by Japan in 2008. Two sets of biomass heating systems were installed in Moldova and empirically tested to prove their effectiveness as biomass heating system. The Government of Moldova (hereinafter referred as "the GoM") issued an official request to the Government of Japan for assistance in expanding and disseminating biomass heating systems in 2009 ("Biomass Heating Systems in Moldovan Rural Communities"), which includes the following three items.

(1) Installation of Biomass Heating Systems at 100 sites (including boiler, piping system rehabilitation/installation)
(2) 100 units of balers
(3) Guidance and technical supports to the national and local authorities and communities for proper facility maintenance

In response to the request, the Japan International Cooperation Agency (hereinafter referred as "JICA") conducted a preliminary study to collect basic information and confirm the request in February 2011. The preliminary study concluded that expansion of the biomass heating system in Moldova had strong potential. Following completion of the consultant tender processes, a preparatory survey was commenced in December 2011 to establish appropriate outline design and initial cost estimation of the Project.

The preparatory survey included two on-site investigations in Moldova; from January to March 2011 and from June to August 2011. The survey revealed that straw boilers named in the original request, which burn straw bales for heating, had become less popular than pellet boilers by 2011. Based on this finding, the primary equipment of the Project was changed from straw boilers to pellet boilers, and one pellet production plant was added as a project component. After supplementary work in Japan, the survey was completed in March 2012.

1.2 Natural Conditions

The Republic of Moldova is located between 48.21° and 45.28°N latitude and between 30.05° and 26.30°E longitude. Its total area is approximately 33,843 km^2 and the country is about 350 km in length from north to south, and approximately 150 km from east to west. Moldova is considered a part of Eastern Europe, bordering Romania to the west and bordering the Ukraine on all other sides.

The topography of Moldova consists primarily of gentle hills and/or slopes (the highest elevation above sea level is 429 m) with elevation gradually decreasing toward the Black Sea. Moldova lies primarily between two major rivers, the Dnester River in the east and the Prut River in the west. Significant flooding of these rivers has been recorded in the past. Recent flood records are as follows;

-June 2010 Prut River (significant damages), Dnester River
-August 2008 Prut River, Dnester River
-August 2005 Prut River (significant damages)

The tables below summarize the following historic data for major Moldovan cities: monthly average temperature, monthly maximum temperature, monthly minimum temperature, monthly average rain fall, monthly average wind velocity, and annual hours of daylight.

Table 1.2.1 Monthly Average Temperature Data in the 3 Regions

Region	North (Briceni)				Central (Chişinău)				South (Cahul)			
Year	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
January	2,5	-2,4	-2,8	-7,4	3,9	-1,5	-0,1	-5,2	3,7	-1,3	-0,1	-4,2
February	-1,2	1,2	-0,2	-2,9	0,5	2,3	1,5	-0,9	1,9	2,7	2,0	0,1
March	6,4	5,0	2,4	3,1	7,1	7,2	3,9	4,0	7,2	8,1	4,8	4,8
April	9,3	9,9	11,1	10,3	10,6	11,0	12,2	11,0	10,9	11,7	11,8	11,6
May	17,5	14,4	15,1	16,2	18,9	15,5	16,6	16,8	18,7	15,8	16,8	17,2
June	20,2	19,0	19,1	19,4	23,2	20,9	21,7	21,0	23,2	20,9	21,6	20,7
July	21,9	19,8	21,4	21,8	25,8	22,2	24,0	23,3	26,0	22,2	24,4	23,2
August	20,8	20,5	19,7	22,4	23,9	23,8	22,3	24,9	23,8	24,2	22,7	24,9
September	14,5	13,6	16,7	13,9	16,7	15,5	18,7	16,1	16,4	16,2	18,4	17,1
October	9,3	10,5	9,2	5,9	11,3	12,4	11,5	7,5	11,9	12,7	12,3	8,6
November	1,1	4,0	5,4	8,2	3,0	5,1	6,5	10,3	3,7	6,0	7,1	11,1
December	-1,7	0,5	-2,1	-4,3	-0,4	1,3	-0,1	-2,1	-0,3	2,6	0,0	-0,7
Annual Mean Temp.	**10,1**	**9,7**	**9,6**	**8,9**	**12,1**	**11,3**	**11,4**	**10,6**	**12,3**	**11,8**	**11,8**	**11,2**

Source: National Bureau of Statistics of the Republic of Moldova

Table 1.2.2 Monthly Maximum Temperature Data in the 3 Regions

Region	North (Briceni)				Central (Chişinău)				South (Cahul)			
Year	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
January	13,1	10,4	6,0	3,6	13,5	9,6	8,7	11,3	15,0	9,5	11,5	15,4
February	8,0	18,2	13,0	6,7	15,8	19,1	13,9	13,3	16,2	19,3	14,9	14,1
March	19,0	17,5	15,3	21,3	20,0	20,5	18,2	20,6	22,0	20,9	19,9	21,1
April	23,4	21,5	24,0	22,7	21,1	21,8	22,9	22,0	23,2	23,9	23,5	22,5
May	32,0	27,5	29,3	26,6	34,2	26,5	28,5	25,9	32,9	27,5	28,6	28,9
June	33,8	30,8	31,4	32,3	35,4	32,1	34,5	34,1	36,6	33,7	34,0	33,8
July	35,6	32,2	33,5	32,5	39,5	33,5	36,3	32,8	39,4	33,5	37,9	32,4
August	34,7	34,0	31,6	35,3	39,1	37,5	33,7	36,6	38,4	37,9	34,4	36,8
September	24,8	30,0	29,2	24,7	27,6	32,6	32,6	26,4	27,8	32,5	32,5	28,1
October	23,0	22,5	25,4	14,1	24,3	23,7	26,0	15,4	24,8	24,6	25,7	16,4
November	9,4	18,4	15,6	20,9	11,0	19,9	18,4	22,8	11,6	22,0	18,6	23.0
December	7,4	15,4	11,6	9.0	9,2	16,2	14,2	13.0	10,0	17,0	16,0	16.0
Annual Max. Temp.	**36,6**	**34,0**	**33,5**	**35,3**	**39,5**	**37,5**	**36,3**	**36,6**	**39,4**	**37,9**	**37,9**	**36,8**

Source: National Bureau of Statistics of the Republic of Moldova

Table 1.2.3 Monthly Minimum Temperature Data in the 3 Regions

Region	North (Briceni)				Central (Chişinău)				South (Cahul)			
Year	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
January	-10,7	-18,6	-14,9	-27,4	-9,1	-15,3	-12,1	-21,8	-8,4	-17.0	-10,6	-21,2
February	-18,1	-12,4	-8,7	-14,9	-16.0	-9,8	-6,6	-11,8	-15,8	-9,7	-5,7	-10,7
March	-2,1	-3,4	-8.0	-10,4	-0,3	-0,7	-6,2	-8,8	-1,8	-0,2	-5,5	-8,7
April	-0,5	0,9	-0,2	1,7	0,6	3,2	1,9	2,9	1,9	3,1	1,2	3,4
May	-2.0	4,5	3,9	7,5	3,3	6,3	7,3	9,3	4,1	6,6	8,2	8,5
June	10,4	1,5	8,4	9.0	14,2	8,8	11,1	12,7	13,4	8,8	11,8	10,6
July	11,4	10,9	10,4	13,3	12,6	13,7	13,9	13,9	12,3	12,7	15.0	14,5
August	9,8	8,9	9,2	7,9	13,5	10,2	13,5	11,8	11,6	10,2	13,1	12,7
September	3,6	4,8	5,5	5,8	8,2	4,8	8,8	7,8	5,9	5,1	7,2	8,4
October	-0,3	0,8	-2,6	-3.0	1,9	2,8	-1,1	-2.0	2,6	3,6	0.0	-2,5
November	-7,9	-5,9	-3,6	-6,3	-4,9	-5,5	-3,3	-0,9	-4,9	-3,8	-5,2	0.0
December	-11,9	-13,3	-19,7	-13,6	-8,8	-11,9	-16,8	-12,1	-9,8	-12,3	-16,7	-10,7
Annual Min. Temp.	**-18,1**	**-18,6**	**-19,7**	**-27,4**	**-16.0**	**-15,3**	**-16,8**	**-21,8**	**-15,8**	**-17.0**	**-16,7**	**-21,2**

Source: National Bureau of Statistics of the Republic of Moldova

Table 1.2.4 Monthly Average Rainfall & Humidity Data in the 3 Regions

Region	North (Briceni)				Central (Chişinău)				South (Cahul)			
Year	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
January	29	27	32	62	44	26	25	86	41	14	32	35
February	41	19	32	40	62	6	26	62	27	2	21	43
March	21	27	40	23	34	36	63	29	44	33	48	29
April	18	127	9	34	37	48	3	45	21	47	18	23
May	62	54	24	109	19	43	33	69	25	49	49	82
June	88	37	95	205	27	63	39	85	37	95	20	121
July	121	212	41	196	4	51	68	67	0	43	34	146
August	91	71	34	38	34	31	33	53	105	20	20	25
September	42	89	4	76	26	75	22	46	39	46	41	31
October	46	46	67	45	71	16	30	69	49	22	35	80
November	38	29	23	56	60	16	9	40	63	13	13	20
December	21	35	44	76	62	55	95	83	66	60	74	64
Annual Rainfall (mm)	**618**	**773**	**445**	**960**	**480**	**466**	**446**	**734**	**517**	**444**	**405**	**699**
Annual Rainy Days	**131**	**146**	**132**	**159**	**114**	**107**	**122**	**134**	**95**	**114**	**101**	**140**
Annual Mean Humidity (%)	**73**	**76**	**71**	**76**	**64**	**70**	**68**	**74**	**67**	**71**	**68**	**73**

Source: National Bureau of Statistics of the Republic of Moldova

Table 1.2.5 Monthly Average Wind Velocity & Duration of Daylight Data in the 3 Regions

Region	North (Briceni)				Central (Chişinău)				South (Cahul)			
Year	2007	2008	2009	2010	2007	2008	2009	2010	2007	2008	2009	2010
January	2,8	3,2	1,8	2,3	2,2	2,2	3,1	3,2	4,1	3,7	3,4	3,9
February	3,0	2,4	1,8	3,2	1,9	2,0	3,3	3,6	4,6	3,7	4,0	4,3
March	3,4	2,8	2,5	2,8	2,1	2,2	3,1	3,6	4,7	4,4	3,9	4,1
April	2,5	2,6	2,7	2,8	1,9	1,9	3,8	3.0	3,4	4,1	3,8	3,6
May	2,3	1,9	2,2	2,4	2,0	2,8	3,0	2,9	4,1	3,2	3,5	3,1
June	1,7	1,7	2,1	2,1	1,8	2,6	3,1	3,2	3,2	2,7	3,1	3,2
July	1,5	2,1	1,9	1,6	1,9	3,4	3,0	2,8	3,7	3,1	3,0	2,6
August	1,2	1,6	1,4	1,7	1,6	2,9	3,4	2,8	3,3	2,9	3,2	2,9
September	1,8	1,7	1,5	2.0	1,8	3,2	2,6	2,7	3,4	3,3	2,9	3,1
October	1,6	1,9	2,1	2,2	1,5	2,9	2,6	3.0	2,8	3,1	3,0	3,6
November	2,6	2,5	2,7	2,6	2,1	3,1	2,8	3,3	3,8	3,3	3,1	3,4
December	2,3	2,8	2,6	2,3	1,8	3,8	2,7	3,1	3,3	4,3	3,2	3,1
Annual Average Wind Speed (m/sec)	**2,2**	**2,3**	**2,1**	**2,3**	**1,9**	**2,8**	**3,2**	**3,1**	**3,7**	**3,5**	**3,8**	**3,4**
Duration of day light (hours)	**1791**	...	...	**1874**	**2320**	**2188**	**2327**	**2226**	**2031**	...	...	**2207**

Source: National Bureau of Statistics of the Republic of Moldova

Although the country is located in the middle of the Eurasian Continent, there have been some earthquakes with hypocenters along the Carpathian Mountains in neighboring Romania. Six earthquakes of seismic intensity 3 or 4 at Chisinau were observed in a recent 5 year period (2005-2010).

Table 1.2.6 Records of Major Earthquakes in Moldova

Date of occurrence	Time of occurrence (Greenwich Mean Time)	Epicenter		Depth of Epicenter (km)	Magnitude (Richter)	Intensity at Chişinău
		Latitude	Longitude			
2005/5/14	1:53	45°60′	26°51′	140	5.3	IV
2005/6/18	15:16	45°68′	26°71′	130	5.4	III-IV
2006/2/16	2:49	45°59′	26°72′	100	4.4	0
2006/3/16	10:40	45°44′	26°63′	100	4.4	III
2007/2/14	6:56	45°38′	26°34′	150	4.2	0
2007/2/15	2:32	45°72′	26°81′	100	4.1	0
2008/3/21	16:18	45°80′	27°17′	30	4.1	0
2008/7/5	8:00	45°29′	30°90′	20	5.5	III-IV
2008/6/9	19:48	45°77′	26°56′	20	4.1	0
2009/4/25	17:18	45°70′	26°66′	100	5.3	III-IV
2009/8/5	7:49	43°85′	28°39′	30	5.0	0
2010/6/8	15:16	45°62′	26°38′	110	4.7	II
2010/9/30	5:31	45°60′	26°35′	140	4.7	II-III

Source: National Bureau of Statistics of the Republic of Moldova

1.3 Environmental and Social Considerations

1.3.1 Screening

This project had been designated as a "Category C" project, meaning it is likely to have minimal or no adverse environmental impact, based on the JICA Guidelines for Environmental and Social Considerations (April 2011).

We conducted a preliminary screening, and re-evaluated the category designation based on our findings. Basic facilities to be installed under this project are the following;

- Biomass pellet boilers and associated equipment/facilities;
- Heat exchangers and hot water pipeline systems
- Pellet production plant

This subject equipment of this project consists of 25 pellet boilers (one of which will be installed as a test plant in Chisinau city) with capacities ranging between 232 and 580 kWh and one pellet production plant with a production capacity of 1,000 kg per hour. The Project will not mandate any involuntary resettlement because all boiler and plant equipment is to be installed in existing public facilities. No social/environmental problems are anticipated.

Stack particulate emissions will be in line with international standards and no additional air pollution is anticipated because each pellet boiler system will be outfitted with a cyclone dust precipitator. Ash from pellet burning can be utilized as a fertilizer. No adverse environmental effects are anticipated.

Based on these findings, we found the original project designation as "Category C" to be appropriate.

1.3.2 Scoping

Findings of the preliminary scoping investigation (conducted in accordance with the JICA Guidelines for Environmental and Social Considerations) are attached as Appendix 6.6. Individual findings which are expected to have some degree of negative (Category A or B) or positive impact (Category E) on social and/or environmental factors are shown below in Table 1.3.1.

Table 1.3.1 Scoping Results

Environmental/ Social Factor	Evaluation	Content and Size of Impact
Air	B	Pellet boiler Emissions of SOx and NOx will be reduced compared with fossil fuel use. Because there are no emission standards for particulate matter in Moldova, EU standards are adopted as a matter of best practices. Particulate emissions from Japanese-manufactured pellet boilers procured

<table>
<tr><th>Environmental/ Social Factor</th><th>Evaluation</th><th>Content and Size of Impact</th></tr>
<tr><td></td><td></td><td>for this project are expected to range between 50 and 150 mg/m^3. These emission levels meet the relevant EU standard. No adverse impact on air quality is anticipated.
<u>Emission standards</u> (Particulate Matter)
(unit: mg/m^3)
<table>
<tr><th>Moldova</th><th>IFC *1</th><th>EU Standards *2</th><th>Japan *3</th></tr>
<tr><td>N/A</td><td>50 or up to 150 if justified by environmental assessment</td><td>150
(at 10 % O_2)</td><td>300</td></tr>
</table>
*1 IFC EHS guidelines Air Emissions and Ambient air quality/ Table 1.1.2 - Small Combustion Facilities Emissions Guidelines (3MWth - 50 MWth)
*2 European Standards EN 303-5
*3 Air Pollution Control Act, implementation restrictions, emission standard for particulate matter (Article 4)</td></tr>
<tr><td>Waste</td><td>E</td><td><u>Pellet boiler</u>
Although combustion reduces the fuel volume by approximately 95%, the residual ash includes nutrients such as potassium, magnesium, phosphorus, calcium. So the ash will be useful as organic fertilizer in the field.</td></tr>
<tr><td>Accidents</td><td>B</td><td><u>Pellet boiler</u>
There is a potential for accidents and injuries, including burns when extracting ash from boilers and unintentional ignition in storages. The occurrence of such accidents can be greatly reduced by the implementation of security systems, safety considerations and operator training programs for industrial accident prevention.</td></tr>
<tr><td></td><td>B</td><td><u>Pellet production plant</u>
There is a potential for accidents and injuries during the operation of pelletizing equipment and other heavy machinery (e.g. forklifts). The occurrence of such accidents can be greatly reduced by the implementation of an industrial safety program including safety education and establishment of an occupational safety manual.</td></tr>
<tr><td>Climate Change</td><td>E</td><td><u>Pellet boiler</u>
The planned boilers use biomass fuel, which is deemed carbon neutral. Accordingly, CO_2 emissions can be expected to be considerably reduced compared to the use of fossil fuels such as natural gas and coal.</td></tr>
<tr><td></td><td>B</td><td><u>Pellet production plant</u>
Electricity consumption during pellet production and the transportation of agricultural residue and pellet are expected to create some CO_2 emissions.</td></tr>
<tr><td>Local economy (employment and livelihood, etc.)</td><td>B</td><td><u>Pellet boiler</u>
The implementation of this project is expected to reduce the number of operators. Existing fossil fuel boilers require three operators per facility on average. The planned pellet boilers require only two operators per facility on average.</td></tr>
<tr><td></td><td>E</td><td><u>Pellet production plant</u>
Implementation of this project is expected to create jobs in the pellet production process and the transportation process for agricultural residues and pellets.</td></tr>
<tr><td>Social institutions such as social capital and local decision-making</td><td>E</td><td><u>Pellet boiler</u>
These boilers contribute to a stable heat supply for educational facilities, and are therefore expected to make a positive impact on communities.</td></tr>
</table>

Environmental/ Social Factor	Evaluation	Content and Size of Impact
institutions	E	Pellet production plant This equipment helps establish a stable fuel supply for the target educational facilities, and is therefore expected to make a positive impact on communities.
Existing social infrastructures and services	E	Pellet boiler These boilers contribute to a stable heat supply for educational facilities, and are therefore expected to make a positive impact on social infrastructures.
	E	Pellet production plant This equipment helps establish a stable fuel supply for the target educational facilities, and is therefore expected to make a positive impact on social infrastructures.
Children's welfare	E	Because this project is targeted mainly at schools and kindergartens, the beneficial impact on children is expected to be quite significant.

Evaluation: A (Significant adverse impact on the environment is expected.), B (Adverse environmental impact is expected, but to a lesser degree than that of A), C (Size of adverse impact on the environment is not obvious.), D (minimal or no adverse environmental impact is expected), E (Implementation of the Project is expected to make a positive impact)

1.3.3 Result of the Study for Environmental and Social Considerations

No expected adverse impacts on environmental and social considerations were identified in the project evaluation. Details are attached in Appendix 6.7.

(1) Pellet Boilers

- Environmental Impact

  SOx and NOx emissions from the biomass boilers will be lower than those of existing fossil fuel boilers. Stack particulate emissions are also expected remain within the levels stipulated in international standards (EU Standards) through the provision of cyclone dust precipitators.

- Social Impact

  No adverse impacts on the social environment from the operation of this facility are anticipated, excluding a reduced need for operators at some sites due to the automated operation of pellet heating systems.

(2) Pellet Production Plant

- Environmental Impact

  No adverse environmental impacts from the operation of this facility are anticipated, excluding minimal CO_2 emissions.

- Social Impact

  No adverse impacts on the social environment from the operation of this facility are anticipated.

1.4 Greenhouse Gas Emission Reduction through the Project

1.4.1 Applicability of Clean Development Mechanism (CDM) to the Project

Japan will not participate in the second commitment period of the Kyoto Protocol after 2013 and is working to establish new mechanisms to complement the current CDM including the Bilateral Offset Credit Mechanism (BOCM).

The Kyoto Mechanisms stipulate that "Public funding for the CDM project activities must not result in the diversion of the Official Development Assistance (ODA)." At the 2001 meeting in Marrakesh, Morocco the Conference of the Parties to the UNFCCC agreed that *"public funding for clean development mechanism projects from parties in Annex 1 is not to result in the diversion of official development assistance and is to be separate from and not counted towards the financial obligations of Parties included in Annex I"*. Under this agreement, the Government of Japan conducted the CDM

project "Zafarana Wind Power Plant Project, Arab Republic of Egypt" and issued an official document confirming that the public funding used for this project did not result in a diversion of Official Development Assistance.

After COP3, there have been worldwide discussions concerning "non-additional Certified Emission Reductions (CERs)" for CDM projects funded by ODA. It is currently a commonly-held opinion internationally that CERs may only be purchased using official funds if those funds are not designated as current ODA.

It is therefore expected that the project may qualify for carbon credit (including CERs) only if one of the two options described below is implemented.

1) The Government of Japan issues an official document stating clearly that public funding used in the project will not result in a diversion of ODA, and the recipient/host country reviews and discusses the applicability thereof.
2) The Government of Japan and the recipient/host country discuss at an official level the purchase of CERs using "additional (non-ODA) official funds".

1.4.2 Estimation of Greenhouse Gas emission Reductions

Switching fuel from fossil fuel (coal and natural gas) to biomass offers reduced of CO_2 emissions. Estimated CO_2 emission reductions of the Project are summarized below. Details are attached in Appendix 6.8.

(1) Project Boundary

The Boundary of the Project is set as the following.

1) Baling of agricultural residuals at production fields
2) Transportation of agricultural residuals from fields to the pellet production plant
3) Pellet production
4) Transportation of pellets from pellet production plant to boilers
5) Boiler operation

(2) Baseline Emissions

Baseline emissions (BE_y) for a given year consist of 1) CO_2 emission from burning of fossil fuels in that year ($BE_{PFi,y}$) and 2) CO_2 emission of existing boilers for power consumption for the year ($BE_{e,y}$). BE_y can be calculated by the following formula.

$$BE_y = BE_{PFi,y} + BE_{e,y}$$

$BE_{PFi,y}$ and $BE_{e,y}$ were calculated to be 8,066.8 tCO_2/y and 104.0 tCO_2/y.

From the above calculations, the baseline emission (BE_y) from 24 boilers was calculated to be 8,170.8 t CO_2/y.

(3) Project Emissions

Biomass fuel is considered carbon neutral under the Kyoto Protocol, so CO_2 emission from biomass burning are considered to be "zero". Therefore CO_2 emitting processes under the Project are limited to the following.

1) Baling process of agricultural residue ($PE_{rol,y}$);
2) Transporting process of agricultural residue from the fields to the pellet production plant ($PE_{F\text{-}P,y}$);
3) Pellet production process ($PE_{pel,y}$);
4) Transportation process of pellets from pellet production plant to boilers ($PE_{P\text{-}B,y}$);
5) Boiler operation process ($PE_{boiler,y}$)

Project emissions (PE_y) are calculated by the following formula.

$$PE_y = PE_{rol,y} + PE_{F-P,y} + PE_{pel,y} + PE_{P-B,y} + PE_{boiler,y}$$

Table 1.4.1 CO_2 Emission Data by Process

Emission process		CO_2 emission	
Baling of agricultural residue at fields	$PE_{rol,y}$	17.9	tCO_2/y
Transportation of baled agricultural residue from fields to pellet production plant	$PE_{F-P,y}$	17.1	tCO_2/y
Pellet production	$PE_{pel,y}$	1,496.8	tCO_2/y
Pellet transportation	$PE_{P-B,y}$	836.9	tCO_2/y
Boiler operation	$PE_{boiler,y}$	172.9	tCO_2/y
Total		2,541.6	tCO_2/y

Source: JICA Survey Team

Project emissions (PE_y) were calculated to be 2,541.6 tCO_2/y.

(4) Estimated CO_2 Emission Reductions

As per the calculations below, project emission reductions (*ERy*) are estimated at 5,629.2 tCO_2/y.

$$\boldsymbol{ER_y = BE_y - PE_y}$$

$$= 8{,}170.8 - 2{,}541.6$$

$$= 5{,}629.2\ tCO_2/y$$

Chapter 2 Contents of the Project

2.1 Basic Concept of the Project

(1) Overall Goal and Project Objectives

The current national development plan, "Moldova 2020 - National Development Strategy: 7 solutions for economic growth and poverty reduction", aims to reduce energy consumption through increased energy efficiency and increased use of renewable energy sources. Key numerical targets set in the plan are included in the table below.

Table 2.1.1 Target Indicators of the Energy Sector

Indicators	2015	2020
Energy Security		
Stimulating the use of energy produced from renewable energy sources in the total gross domestic consumption, %	10	20
Ensuring the share of bio-fuels in the total of fuels used, %	4	10
Energy Efficiency		
Reducing greenhouse gas emissions (compared to 1990), %		25

Source: Moldova 2020 - National Development Strategy: 7 solutions for economic growth and poverty reduction, p47, Obtained from "http://gov.md/libview.php?l=en&idc=447&id=4957"

The table below details changes in energy supply composition between 2003 and 2011. Among the energy resources listed, firewood, agricultural residuals and wood residuals are considered renewable sources.

Table 2.1.2 Change of Energy Supply Composition by Resource

(Unit: 1,000 tons of coal equivalent)

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total resources	3,127	3,398	3,520	3,471	3,374	3,444	3,304	3,434	3,494
Coal	290	262	241	231	224	286	234	234	251
Diesel fuel	468	520	531	524	559	596	575	671	713
Residual fuel oil	53	47	40	38	31	39	87	65	49
Motor gasoline	343	367	372	336	344	361	370	336	359
Kerosene	23	1	1	–	–	–	–	–	–
Natural gas	1,445	1,478	1,657	1,657	1,527	1,436	1,322	1,392	1,349
Liquid gas	97	100	97	91	90	100	105	112	125
Electricity	223	414	374	363	364	374	368	382	395
Firewood	95	85	88	102	91	99	96	88	94
Agricultural waste	11	16	16	16	15	21	27	27	30
Wood waste	24	19	17	18	15	17	20	12	8
Other	55	89	86	95	114	115	100	115	121
Renewable energy (%)	4.2%	3.5%	3.4%	3.9%	3.6%	4.0%	4.3%	3.7%	3.8%

Source: The Energy Balance of the Republic of Moldova Statistical Collection 2011, National Bureau of Statistics of the Republic of Moldova

Renewable energy has comprised approximately 3-4% of the national energy supply since 2003 and that figure has not significantly increased or decreased. To accomplish the national renewable energy production targets (10% of total energy consumption by 2015 and 20% by 2020) the energy shifting process must accelerate greatly.

This project aims to accomplish three primary goals through the installation of biomass heating systems at public facilities and the installation of one biomass pellet plant: 1) energy cost reduction, 2) sustainable heating system operation, and 3) improvement of living conditions in the Moldovan rural communities. The biomass heating systems will be installed mainly in education facilities including primary schools, and will consist of boilers fueled by biomass pellets.

In addition, through expanded installation and implementation of biomass heating systems, the Project aims to secure improved education opportunities for infants and children living in rural areas of Moldova and to promote the transition from fossil energy to renewable energy sources. The Project

also has an overall goal of improving energy self-sufficiency and reducing greenhouse gas emissions in Moldova.

(2) Outline of the Project

To achieve the goals named above, the Project will include procurement and installation of biomass heating systems at public facilities (mainly education facilities such as primary schools) in rural communities in Moldova and will also include provision of technical assistance for operation and maintenance. The Project will reduce Moldovan dependence upon imported natural gas, and thereby cut energy costs paid by local authorities, which have increased in recent years. The Project will also enable public facilities to operate heating systems continuously, which will lead to fewer emergency school closure dates during the coldest season, and ensure improved education opportunities for rural children.

The implementation of the Project support plan under a Japanese assistance will include: 1) procurement and installation of 25 biomass boilers at public facilities in rural communities in the central region of Moldova (mainly educational facilities such as primary schools) and procurement and installation of one pellet production plant in the City of Chisinau, and 2) technical assistance for operation and maintenance of both the biomass pellet boilers and the pellet production plant. The biomass boilers will be fuelled with pellets produced by the pellet production plant from agricultural byproducts and residuals.

2.2 Outline Design of the Japanese Assistance

2.2.1 Design Policy

This Project shall be undertaken using funding from Japan's Grant Aid program, which emphasizes use of major equipment produced by Japanese small- and medium-sized enterprises. As such, the Project qualifies as a "Japan-tied" grant project to Moldova. The following are basic design policies of the Project.

- Key equipment and materials must originate from Japan.
- Both the pellet boilers and the pellet production plant consist of various equipment and mechanical/instrument/electrical materials. All of such equipment and materials must be engineered for quality, cost and delivery.
- Both the pellet boilers and the pellet production plant must be designed with the expertise of knowledgeable manufacturers with sufficient experience in design, manufacture, construction, operation and maintenance of similar boilers and plants and must take into account the specific circumstances of Moldova (e.g. regulations).

(1) Design Criteria

1) Environmental Conditions

A) Atmospheric Temperature

(a) Process design temperature for calculation of heat balance

- Maximum outdoor temperature: 40 °C
- Minimum outdoor temperature: -16 °C
- Indoor temperature: 22 °C (for kindergarten)
  18 °C (for other facilities)

(b) Mechanical design temperature

- Maximum outdoor temperature: 50 °C
- Minimum outdoor temperature: -30 °C

B) Humidity 40-60%

C) Wind Velocity

According to Moldovan meteorological records, average wind speed is not especially high but

sudden gusts of wind in mid-summer and/or mid-winter must be factored into the design of buildings and outdoor structures.

- Wind velocity for mechanical design: 40 m/sec

D) Rainfall

- Maximum hourly rainfall for mechanical design: 50 mm/hr

E) Snowfall

- Maximum hourly snowfall for mechanical design: 30 mm/hr
- Maximum snow accumulation for mechanical design: 1.5 m

F) Earthquake

- Maximum horizontal acceleration for mechanical design: 400 Gal

2) Requirement and/or Regulation for Mechanical Design

A) Equipment/Materials Exported from Japan

- shall be in accordance with Japan Industrial Standards (JIS).

B) Temperature of Hot Water Discharged from Pellet Boilers

- Normal: 80 °C Maximum: 90 °C

C) Painting

(a) Color: Manufacturer's standard color

(b) Painting: Rustproofing: Once

Finishing: Twice

D) Hanging Rig

Four pieces of hanging rig shall be equipped on module and/or skid for pellet boiler under the consideration of weight balance.

3) Requirements and/or Regulation for Electrical and/or Instrument Design

A) Equipment and/or Materials Exported from Japan

- shall be in accordance with Japan Industrial Standards (JIS).

B) Electricity

- Power supply: 380 V, 3-phase, 50 Hz
- Control power: 220 V, Single, 50 Hz

(2) Survey Results of Japanese Manufacturers

Potential suppliers for the Project will be selected from among Japanese manufacturers. The JICA Survey Team (henceforth referred to as JST) conducted a preliminary survey of possible manufacturers in Japan in 2012.

1) Pellet Boiler

To date, four candidate suppliers have been identified. Each of the suppliers has its own line-up machines as listed below.

Table 2.2.1 Pellet Boiler Line-up by Manufacturer

Capacity (1,000kcal/hr)	60	100	150	200	250	300	350	400	450	500	600	800	1000
A Company	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	Yes	Yes	Yes	Yes
B Company	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No
C Company	No	Yes	Yes	Yes	Yes	No	Yes	No	No	Yes	No	No	No
D Company	No	Yes	No	No	No	Yes	No	No	No	Yes	No	No	No

Source: JICA Survey Team

In principle, boiler capacity should be calculated based on the specific conditions of the target buildings/facilities and in accordance with Moldovan laws/regulations. However, designing customized boilers with specific capacities for each site would be cost-prohibitive. Based on consultations with the Ministry of Agriculture and Food Industry (MoAFI), boiler designs with the following five capacities were selected.

	1,000 kcal/hr [2]	or	kWh
1.	100		116
2.	200		232
3.	300		348
4.	350		407
5.	500		584

Details of the candidate companies and their products are described on the following pages.

2) Pellet Production Plant

The key piece of equipment of the pellet production plant is the pelletizer. Generally speaking, there are two types of pelletizer: flat die type and ring die type. In Europe, ring die type pelletizers are common for high volume pellet production systems. In Japan, both types are available from several manufacturers.

Performance differences between the two die types are minimal. In general, the ring die type is more suitable to high capacity (more than 1,500 kg/hr) systems and the flat die type is more suitable for smaller capacity plants.

[2] In Japan, "kcal/hr" is widely used to indicate boiler capacity while "kWh" is commonly adopted in Moldova. Conversion factor: 1.163Wh = 1 kcal/hr

Table 2.2.2 Comparison of the Boilers by Manufacturer

Element		A	B		C	D
Function	Equipment		Smoke tube	Water tube		
Boiled type		Non-pressurized hot water heat generator	<=	<=	<=	<=
Fuel supply	Pellet silo	reverse pyramid	<=		<=	<=
	First step screw feeder	metering screw	None		metering screw	<=
	Rotary valve	Exist	None		None	None
	Anti back-fire	Emergency shut-off damper	Back-fire protection		<=	<=
	Second step screw feeder	Exist	metering screw		None	Exist
	Fuel supply type	Drop down	Underfeed		Drop down	<=
Furnace	Grate	SS circle plate	Cast iron low corn sharp		SS circle plate	Horizontal Cylindrical grate
	Clinker breaker	Rotary breaker	Ring breaker		Pop-up combustion Fluidized combustion	Automatical intermittent movement
Ignition	Mechanism	L-oil pilot burner	Embers		L-oil pilot burner	L-oil pilot burner
	Pilot fuel tank	60 - 80L	No pilot burner necessary		60 - 80L	60 - 80L
Air supply	Furnace interior pressure control	Interior pressure balanced control	<=		<=	<=
	Ventilation fan	Exist	<=		<=	<=
	Exhaust fan	Exist	<=		<=	<=
Furnace	Furnace wall	Fireproof brick	Water jacket		Partial water jacket	Double pipe air cooling
	Ash treatment	Tray manual removal	<=		<=	Automatic exhauster
Heat generating system	Type	Water surface is open to atmosphere	<=	<=	<=	<=
	Heat generator	Vertical plate type	Vertical smoke pipe type	Horizontal water pipe type	Horizontal water pipe type	Vertical smoke pipe type
	Hot gas flow	Up & Down counter flow	<=	Rectangular flow	<=	Up flow
	Water supply	Automatic supply	<=		<=	<=
System control & Aram	Control	Generator water temperature	<=		<=	<=
		Fuel & air supply ON, OFF	<=		<=	<=
	Aram	Low water level alarm	<=		<=	<=
Dust collect	Dust Collector	Cyclone	<=		<=	<=
Primary circulation	Pump	In-line pump	<=		<=	<=
Heat Exchange	Heat Exchanger	Plate type	<=		<=	<=

Note: Symbol <=: same as left

Source: JICA Survey Team

Table 2.2.3 List of Pellet Boiler Manufacturers

Item	Unit	A	B	C	D
Funded Year		1 November 1983	1 September 1981	April 1947*	12 August 1948
Capital	M Yen	10	10	12.16*	8
Number of employees	person	8	10	70*	102
Factory location		Hokkaido	Shizuoka	Niigata*	Kagoshima
Site area	m2	11,154*	3,487	3,901*	14,248
Building area	m2	2,363*	974	1,277*	6,490
Timing of handover		Factory shipment	Factory shipment	Factory shipment	Factory shipment
Condition of payment					
Contract		30%	30%	30%	30%
Middle of handover		40%	40%	40%	40%
Final handover		30%	30%	30%	30%
Engineering Capability					
Design Capability		Planning/Design	Planning/Design	Planning/Design	Planning
Purchasing Capability		Yes	little weak	Yes	Yes
In-house production Cap.		None	In-house production	In-house production	None
Outsourcing production Cap.		Contract to out	Partially	Contract to out	Partially
Elec.& Inst. works		Contract to out	Contract to out	Contract to out	Contract to out
SV Capability		Yes	Yes	Yes	Yes
Manufacturing experience					
Pellet boiler		10	202 (include export)	34	None
Wood chip boiler		22	None	None	Wood chip boiler 3units
Others (Gas, Oil, boiler & Biomass Dryer etc.)		700 (include export)	Oil Boiler 60 - 100units/y	Oil & Gas boiler more than 100/y	Steam Fumigator 71units (include export)
Total Wood Biomass Boilers		32	202	34	3

Source: JICA Survey Team

(3) Potential Local Subcontractors for Construction and/or Installation Works

1) Central Assembling Factory for Pellet Boiler

Boilers components will be imported from Japan, and assembled into prefabricated modules (including housing and skid) at a factory in Chisinau. (Refer to "(4) Basic Design Policy" below for details.) One appropriate candidate factory for assembly with the following capacities has been identified in Chisinau.

Employees:	Present 120 Possible 400
Facilities/Equipment:	Machining (Lathe, Cutting, Plasma Flat Cutting, Sand Blasting), Welding, Painting, etc.
Site Area:	49,686 m^2
Building Footprint:	11,856 m^2
Max. Handling Size:	Experience manufacturing a 5m diameter object, 4 m x 12 m length

2) Transportation of Boilers

Moldovan authorities have granted permission for transport of objects up to 4m width x 4m height x 12m length.

3) Installation Work

Several local contractors have relevant experience with similar projects under the UNDP and Moldova Social Investment Fund.

(4) Basic Design Policy

1) Pellet Boiler

Based on the findings of installation site surveys and domestic research in Japan, the following basic design principles for the boiler were designated.

- Boilers will use pellets produced from agricultural residuals from rural areas of Moldova such as straw, leaves/stalks of sunflower and maize, and orchard and vineyard pruning residuals.
- Pellet boiler combustion efficiency should be no less than 80 %.
- Environmental profiles for gas emissions and waste ash from pellet boilers shall be in accordance with relevant Japanese standards and regulations.
- Pellet boiler operation shall be fully automated including safety devices such as back-fire preventers. Additionally, the equipment shall allow for near continuous operation for a 6-month period (over the winter season) excepting brief shutdowns to perform maintenance.
- All pellet boiler parts including piping, wiring and related peripheral devices shall be mounted on a steel skid and installed in a housing (to be constructed at the central assembling factory in Chisinau) in order to 1) reduce work at installation sites, 2) maintain consistent equipment quality, and 3) minimize total project cost. Materials for housings and skids shall be locally procured.

2) Pellet Production Plant

- The pellet production plant shall produce biomass fuel pellets using agricultural residuals from rural areas of Moldova including straw, leaves/stalks of sunflower and maize, and orchard and vineyard pruning residuals.
- Environmental profiles for gas emissions and waste ash from pellet boilers shall be in accordance with relevant Japanese standards and regulations.
- Pellet plant production capacity shall be at minimum 1,000 kg/hr. This capacity must be demonstrated in practice using at least one of the designated materials.

2.2.2 Basic Plan (Construction Plan / Equipment Plan)

(1) Selection of Sites for Pellet Boiler Installation

In the first phase of the pellet boiler installation site selection process, the JST reviewed a list of 138 candidate villages prepared by the 2KR Project Implementation Unit of the MoAFI (2KR-PIU). Following the completion of the first stage of JST survey work in Moldova (March 2012), the candidate list included 182 public facilities in 119 villages. Among these, public facilities with more than 100 potential beneficiaries (including both pupils and employees) accounted for 118 facilities in 93 villages.

2KR-PIU continued accepting project applications from rural villages during the first survey work period in Moldova. Additional applications after the start of the first survey included a total of 92 public facilities in 88 villages at the end of March 2012. Among these new candidates, 83 public facilities with over 100 beneficiaries in 58 villages remained after a 2KR-PIU pre-screening. A second round of site surveys was performed in June 2012, including the new candidate facilities as well as 22 candidate facilities from the first group of candidates that could not be surveyed at the time of the March 2012 survey. Based on the findings of these screenings and surveys, a final list of 117 candidate facilities for pellet boiler installation was prepared at the end of July 2012. The distribution of villages with candidate facilities by Region and Rayon on the final list is shown below.

Table 2.2.4 Distribution of 117 Candidate Villages by Region and Rayon

North		Center		South	
Rayon	Site No.	Rayon	Site No.	Rayon	Site No.
Briceni	3	Anenii Noi	2	Basarabeasca	2
Donduşeni	2	Călăraşi	4	Cahul	6
Drochia	9	Criuleni	3	Cantemir	6
Edineţ	6	Dubăsari	1	Căuşeni	2
Făleşti	3	Hînceşti	3	Cimişlia	3
Floreşti	3	Ialoveni	4	Leova	2
Glodeni	5	Nisporeni	3	Ştefan Vodă	1
Ocniţa	3	Orhei	8	Taraclia	1
Rîşcani	2	Rezina	4	UTA Găgăuzia	7
Sîngerei	5	Străşeni	3		
Soroca	2	Teleneşti	3		
		Ungheni	2		
		Mun. Chişinău	4		
Sub total	43	Sub total	44	Sub total	30

Source: JICA Survey Team

The JST and MoAFI agreed on March 5, 2012 upon the following basic criteria for selection of candidate villages.

1. Educational facilities were given higher priority than other public facilities. This consideration arose from the fact that facilities such as community centers and clinics nominated by village authorities generally have fewer beneficiaries per site compared to educational facilities.
2. Among educational facilities, higher priority was given to those with more beneficiaries (including both pupils and employees). Educational facilities with fewer than 100 beneficiaries were excluded, in principle. This consideration was based on the quantitative efficiency per boiler procured through the Project.
3. In the event that there were not enough educational facilities with over 100 beneficiaries to consume the full budget of the Project, other public facilities with over 100 beneficiaries were to be considered as candidate sites.

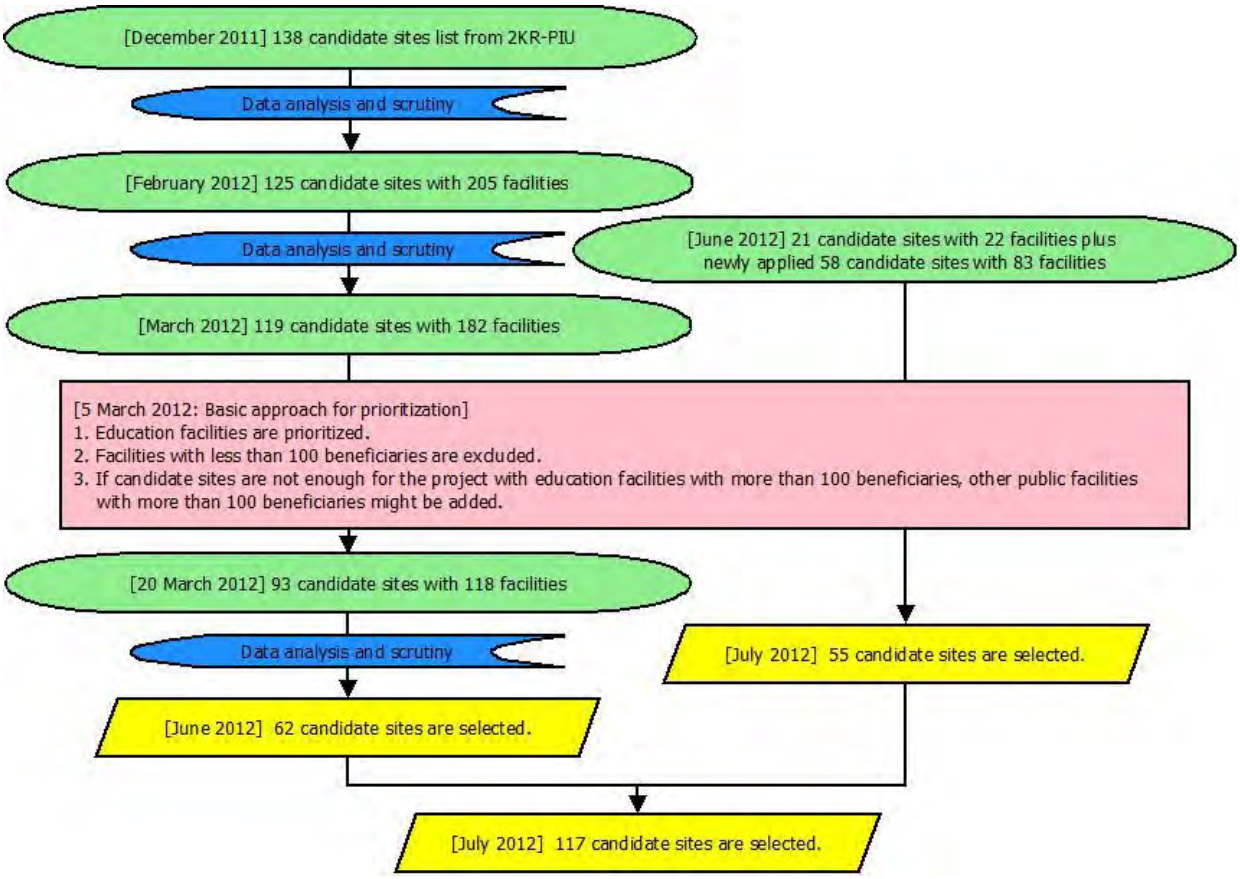
The JST and MoAFI also agreed the principles below.

4. Several facilities may be regarded as a single candidate site if they can reasonably be heated by a single pellet boiler based on their proximity and site survey findings. For

example, a single pellet boiler may be deemed sufficient to provide heating for both a primary school and an adjacent a community center.

5. In cases where applications were received for several facilities in one village, the facility with the most beneficiaries will be considered the top priority candidate site from that village in consultation with the village mayor.

The process flow diagram is indicated below.



Source: JICA Survey Team

Figure 2.2.1 Selection Flow Diagram of 117 Candidate Sites

The 117 candidate sites were scored using the rubric described below. Facility conditions were evaluated based on visual inspection observations from the time of JST and subcontractor site visits.

Table 2.2.5 Evaluation Criteria for Site Prioritization

Criteria	Score
1. Educational Facilities	10
2. Non-educational Facilities	1
3. Number of Beneficiaries	Number of Beneficiaries x 0.01
4. Facility Conditions (3-level evaluation: A, B, C)	
Building -Windows, ceiling, wall (heat retention)	A:3, B:2, C:1
Indoor/outdoor piping, Indoor radiators (heat transfer)	A:5, B:3, C:1

Source: JICA Survey Team

The 117 candidate sites were ranked by priority based on total score as shown in the table below. The JST and 2KR-PIU agreed that a site's six "Facility Conditions" scores for heat retention and heat transfer would be multiplied by a factor of 30% in totaling the candidate site's score.

Table 2.2.6 Result of the 117 Candidate Sites Prioritization

S/N	Code No.	Region (1:North, 2:Central, 3:South)/ Rayon	Village	Building Information			Facility Condition						Agriculture performance	Total Score **
				Facility type *	Persons of Full day use	No. of Visitors	Windows Condition A:3, B:2, C:1	Ceiling Condition A:3, B:2, C:1	Wall Condition A:3, B:2, C:1	Outdoor Piping System	Indoor Piping System	Original Radiator		
				A	B		C	D	E	F	G	H	I	J
1	1903	2 Ialoveni	Răzeni	4	896		3	3	3	3	5	3		24.96
2	1802	2 Hînceşti	Lăpuşna	1	791		3	3	3	5	5	3		24.51
3	802	3 UTA Ggagauzia	Congaz	4	1,060		1	1	1	3	3	3		24.20
4	1301	1 Briceni	Corjeuţi	4	820		3	3	3	3	5	3		24.20
5	1101	1 Glodeni	Ciuciulea	1	830		3	3	3	3	3	3		23.70
6	1003	1 Sîngerei	Sîngerei Noi	4	642		3	3	3	5	5	5		23.62
7	2202	2 Anenii - Noi	Mereni	112	658		3	3	3	3	5	5		23.18
8	304	1 Drochia	Sofia	4	557		3	3	3	5	5	5		22.77
9	805	3 UTA Ggagauzia	Ceadîr - Lunga	3	807		1	1	2	3	5	3		22.57
10	604	1 Floreşti	Ghindeşti	4	520		3	3	3	5	5	5		22.40
11	3201	2 Rezina	Ignaţei	4	490		3	3	3	5	5	5		22.10
12	7203	2 Nisporeni	Varzaresti	14	740		3	2	2	3	2	3		21.90
13	6902	1 Floresti	Frumusica	4	658		3	3	2	3	3	3		21.68
14	2103	2 Ungheni	Costuleni	14	698		3	2	2	3	2.5	3		21.63
15	404	3 Cantemir	Goteşti	4	565		2	3	3	5	3	3		21.35
16	303	1 Drochia	Cotova	4	450		3	3	3	3	5	5		21.10
17	402	3 Cantemir	Pleşeni	3	436		2	3	2	5	5	5		20.96
18	1302	1 Briceni	Larga	4	400	50	2	3	3	5	5	5		20.90
19	1005	1 Sîngerei	Cotiujenii Mici	13	369		3	3	3	5	5	5		20.89
20	6802	1 Falesti	Calinesti	4	530		3	3	3	3	3	3		20.70
21	6301	3 Cantemir	Cociulia	4	587		3	2	2	3	3	3		20.67
22	1706	2 Orhei	Jora de Mijloc	13	447		3	3	3	5	3	3		20.47
23	7702	2 Straseni	Micauti	36	537		2	3	3	3	3	3		20.47
24	1712	2 Orhei	Susleni	4	326		3	3	3	5	5	5		20.46
25	801	3 UTA Ggagauzia	Chirşova	138	618		1	2	2	3	3	3		20.38
26	1501	3 UTA Ggagauzia	Cişmicioi	4	578		2	2	2	3	3	3		20.28
27	7703	2 Straseni	Scoreni	4	480		3	3	3	3	3	3		20.20
28	1803	2 Hînceşti	Buţeni	3	360		3	3	3	5	5	3		20.20
29	306	1 Drochia	Suri	4	465		3	3	3	3	3	3		20.05
30	2104	2 Ungheni	Pîrliţa	3	400		3	3	3	5	3	3		20.00
31	1714	2 Orhei	Furceni	13	342		2	2	2	3	3	3	2	19.92
32	2701	3 UTA Ggagauzia	Cioc - Maidan	14	486		2.5	2.5	2.5	3	3	3		19.81
33	1601	3 Taraclia	Cairaclia	4	307		3	3	3	3	5	5		19.67
34	403	3 Cantemir	Ciobalaccia	4	456		2	3	3	3	3	3		19.66
35	8102	3 UTA Ggagauzia	Besalma	4	570		1	2	2	3	2	3		19.60
36	1108	1 Glodeni	Glodeni	1	292		3	3	3	3	5	5		19.52
37	1110	1 Glodeni	Sturzovca	38	378		3	3	2	5	3	3		19.48
38	1705	2 Orhei	Trebujeni	3	223		3	3	3	5	5	5		19.43
39	1702	2 Orhei	Brăneşti	13	195		3	3	3	3	3	3	2	19.35
40	501	3 Cahul	Burlacu	4	410		2	3	3	3	3	3		19.20
41	2802	3 Căuşeni	Copanca	1	200		3	3	3	5	5	5		19.20
42	8002	2 Chisinau	Cricova	1	485		3	2	2	2	2	3		19.05
43	2602	1 Drochia	Gribova	3	184		3	3	3	5	5	5		19.04
44	1303	1 Briceni	Criva	3	180		3	3	3	5	5	5		19.00

S/N	Code No.	Region (1:North, 2:Central, 3:South)/ Rayon	Village	Building Information			Facility Condition						Agriculture performance	Total Score **
				Facility type *	Persons of Full day use	No. of Visitors	Windows Condition A:3, B:2, C:1	Ceiling Condition A:3, B:2, C:1	Wall Condition A:3, B:2, C:1	Outdoor Piping System	Indoor Piping System	Original Radiator		
				A	B		C	D	E	F	G	H	I	J
45	301	2 Rezina	Cuizauca	4	344		3	3	3	3	3	3		18.84
46	1107	1 Glodeni	Dusmani	139	381	70	1	2	2	2	2	1	2	18.81
47	6101	2 Anenii Noi	Maximovca	1	230		3	1	2	3	3	3	2	18.80
48	7401	1 Ocnita	Sauca	3	191		3	3	1	3	3	3	2	18.71
49	2401	2 Telenesti	Cazanesti	13	328		3	3	3	3	3	3		18.68
50	6302	3 Cantemir	Tartaul	13	473		3	2	2	3	2	1		18.63
51	8004	2 Chisinau	Bubuieciu	11	471		2	2	2	2	2	3		18.61
52	3501	1 Soroca	Căinarii Vechi	1	137		3	3	3	5	5	5		18.57
53	6603	1 Drochia	Popestii de Sus	14	404		3	2	1	3	3	3		18.54
54	7501	2 Rezina	Mateuti	13	303		3	2	2	3	2	3	1	18.53
55	701	3 Leova	Ceadîr	3	216		3	2	3	3	5	5		18.46
56	1009	1 Sîngerei	Ciuciueni	133	216		2	2	2	5	5	5		18.46
57	6402	2 Calarasi	Tibirica	4	452		3	2	2	3	2	1		18.42
58	1206	1 Edineţ	Ruseni	3	180		3	3	3	3	5	5		18.40
59	2901	3 Ştefan Vodă	Feşteliţa	1	179		3	2	2	5	5	5		18.39
60	8003	2 Chisinau	Tohatin	13	409		3	2	2	2	2	3		18.29
61	6601	1 Drochia	Mindic	3	362		3	2	2	3	2	3		18.12
62	6901	1 Floresti	Zaluceni	3	101		2	3	3	3	3	3	2	18.11
63	7201	2 Nisporeni	Siscani	3	300		3	3	3	3	2	3		18.10
64	1708	2 Orhei	Chiperceni	3	217		1	3	3	1	2	3	2	18.07
65	1711	2 Orhei	Piatra	13	325		3	2	2	3	3	3		18.05
66	7202	2 Nisporeni	Calimanesti	129	198		1	2	2	3	2	3	2	17.88
67	6701	2 Dubasari	Oxentea	18	366		2	2	2	3	2	3		17.86
68	6202	3 Basarabesca	Carabetovca	4	290		3	2	2	3	3	3		17.70
69	7801	2 Telenesti	Tintareni	4	371		3	3	2	3	1	1		17.61
70	7101	2 Ialoveni	Hansca	3	200		1	2	2	3	3	1	2	17.60
71	202	2 Criuleni	Măşcăuţi	29	334		1	2	2	3	3	3		17.54
72	8101	3 Gagauzia	Congazcic	13	332		1	2	2	3	3	3		17.52
73	1004	1 Sîngerei	Copăceni	3	180		1	2	3	5	5	3		17.50
74	6602	1 Drochia	Tarigrad	4	259		2	2	2	3	2	2	1	17.49
75	506	3 Cahul	Larga Nouă	13	264		1	3	3	3	3	3		17.44
76	706	3 Leova	Tochile Răducani	3	204		3	3	3	3	3	3		17.44
77	7001	2 Hincesti	Ivanovca	13	223		1	2	2	3	3	3	1	17.43
78	6201	3 Basarabesca	Sadaclia	1	148		3	3	3	3	3	1	1	17.28
79	7701	2 Straseni	Micleuseni	1	162		1	1	1	3	3	3	2	17.22
80	504	3 Cahul	Alexanderfeld	3	209		2	3	3	3	3	3		17.19
81	7402	1 Ocnita	Hadarauti	13	236		3	3	3	2	2	3		17.16
82	7601	1 Singerei	Marinesti	13	265		3	2	2	3	2	3		17.15
83	1202	1 Edinet	Hancauti	3	182		1	2	2	2	2	2	2	17.12
84	6401	2 Calarasi	Dereneu	49	211	50	1	2	2	1	2	2	2	17.11
85	1105	1 Glodeni	Iabloane	33	289		2	2	2	3	3	2		17.09
86	401	3 Cantemir	Vişneovca	3	198		3	3	2	3	3	3		17.08
87	6604	1 Drochia	Moara de Piatra	3	185		2	2	2	3	2	3	1	17.05
88	1405	1 Rîşcani	Hilinţi	13	255		2	2	2	3	3	3		17.05
89	1201	1 Edineţ	Parcova	3	163		3	3	3	3	3	3		17.03

S/N	Code No.	Region (1:North, 2:Central, 3:South)/ Rayon	Village	Building Information			Facility Condition						Agriculture performance	Total Score **
				Facility type *	Persons of Full day use	No. of Visitors	Windows Condition A:3, B:2, C:1	Ceiling Condition A:3, B:2, C:1	Wall Condition A:3, B:2, C:1	Outdoor Piping System	Indoor Piping System	Original Radiator		
				A	B		C	D	E	F	G	H	I	J
90	9002	2 Criuleni	Raculesti	3	219		2	2	3	3	3	3		16.99
91	1204	1 Edineţ	Bleşteni	3	158		3	3	3	3	3	3		16.98
92	1709	2 Orhei	Ivancea	3	147		2	2	2	3	3	3	1	16.97
93	2402	2 Telenesti	Zgardesti	13	142		3	3	3	3	2	1	1	16.92
94	8001	2 Chisinau	Singera	3	344		2	2	2	3	2	0		16.74
95	2503	3 Cimislia	Cimislia	1	187		1	3	3	3	3	3		16.67
96	1205	1 Edinet	Corpaci	3	166		2	2	2	2	1	1	2	16.66
97	906	1 Donduşeni	Scăieni	3	180		2	3	2	3	3	3		16.60
98	2601	1 Drochia	Drochia	3	240		2	2	2	3	2	3		16.60
99	6403	2 Calarasi	Temeleuti	3	177		2	3	3	3	2	3		16.57
100	8201	1 Donduseni	Taul	3	266		1	2	2	3	2	3		16.56
101	2502	3 Cimislia	Satul Nou	1	104		3	3	3	3	3	3		16.44
102	2301	2 Călăraşi	Bravicea	1	160		2	3	2	3	3	3		16.40
103	1203	1 Edinet	Alexandreni	36	159	21	2.5	2.5	2.5	3	2.5	3		16.39
104	3001	1 Ocniţa	Lencăuţi	3	187		1	3	2	3	3	3		16.37
105	1403	1 Rîşcani	Branişte	3	185		2	2	2	3	3	3		16.35
106	2001	1 Falesti	Natalievca	1	120		3	3	2	3	3	3		16.30
107	502	3 Cahul	Ursoara	1	125		3	3	3	5	3	3	-1	16.25
108	201	2 Criuleni	Işnovăţ	3	200		2	3	3	3	3	3	-1	16.10
109	9001	3 Cahul	Doina	3	189		3	2	1	3	2	2		15.79
110	302	2 Rezina	Lipceni	13	178		2	2	2	3	2	2		15.68
111	2801	3 Căuşeni	Hagimus	3	200		1	1	1	3	3	3		15.60
112	7103	2 Ialoveni	Ulmu	1	106		3	2	2	3	2	3		15.56
113	502	3 Cahul	Lebedenco	3	143		1	2	3	5	3	3	-1	15.53
114	7102	2 Ialoveni	Puhoi	1	104		3	2	2	3	2	1		14.94
115	2504	3 Cimislia	Troitcoe	3	182		1	2	2	3	1	1		14.82
116	3401	1 Soroca	Racovat	1	164		0	0	0	3	3	3		14.34
117	6801	1 Falesti	Taxobeni	6	100		3	3	3	3	3	3	2	9.40

*Note1: Facility type: 1: Kindergarten, 2: Primary School, 3: Gymnasium, 4: Lyceum, 5: Other School, 6: Community & Culture Center, Library, Gym, 7: Church, 8: Hospital, Medical Clinic, Rehabilitation Center, 9: Mayor's office (Ex. 112 = two Kindergartens and one Primary School)

**Note 2: Total score (J): If the facility type (A) is educational (1-5), the total score (J) is calculated using the following formula: J = 10 + B*0.01 + (C+D+E+F+G+H)*0.3 + I. If the facility type (A) is non-educational (6-9), the total score (J) is calculated using the following formula: J = 1 + B*0.01 + (C+D+E+F+G+H)*0.3 + I.

Source: JICA Survey Team

Based on the findings of the second site survey in Moldova, and a series of discussions, a total of 25 sites in the Central Region were selected as the sites for pellet boiler installation. The 25 sites include the 2KR National Training Center (NTC) in Chisinau where a pellet boiler will be installed for training purposes. (See the table on the next page.)

Table 2.2.7 List of the 25 Candidate Sites for Boiler Installation

S/N	Priority Ranking	Code	Rayon	Community	Kinds of Beneficial Facility	Persons of Full day use	No. of Visitors	Proposed Boiler Size (kWh)
1	1	1903	Ialoveni	Răzeni	Lyceum	896		580
2	2	1802	Hînceşti	Lăpuşna	Lyceum	791		580
3	7	2202	Anenii - Noi	Mereni	2 Kindergartens + Primary school	658		348
4	11	3201	Rezina	Ignaţei	Lyceum	490		348
5	12	7203	Nisporeni	Varzaresti	Kindergarten + Lyceum	740		580
6	22	1706	Orhei	Jora de Mijloc	Kindergarten + Gymnasium	447		348
7	23	7702	Straseni	Micauti	Gymnasium + Culture Center	537	150	580
8	24	1712	Orhei	Susleni	Lyceum	326		232
9	27	7703	Straseni	Scoreni	Lyceum	480		580
10	28	1803	Hînceşti	Buţeni	Gymnasium	360		580
11	30	2104	Ungheni	Pîrliţa	Gymnasium	400		348
12	31	1714	Orhei	Furceni	Kindergarten + Gymnasium	342		348
13	38	1705	Orhei	Trebujeni	Gymnasium	223		232
14	39	1702	Orhei	Brăneşti	Kindergarten + Gymnasium	195		232
15	42	8002	Chisinau	Cricova	Kindergarten	485		232
16	45	301	Rezina	Cuizauca	Lyceum	344		407
17	47	6101	Anenii Noi	Maximovca	Kindergarten	230		232
18	51	8004	Chisinau	Bubuieciu	2 Kindergartens	471		232
19	54	7501	Rezina	Mateuti	Kindergarten + Gymnasium	303		348
20	57	6402	Calarasi	Tibirica	Lyceum	452		580
21	60	8003	Chisinau	Tohatin	Kindergarten + Gymnasium	409		348
22	63	7201	Nisporeni	Siscani	Gymnasium	300		348
23	64	1708	Orhei	Chiperceni	Gymnasium	217		232
24	65	1711	Orhei	Piatra	Kindergarten + Gymnasium	325		232
25			Chisinau		2KR National Training Center			116
Total						10,421		

Source: JICA Survey Team

Supplemental data of the candidate sites are attached in Appendix 6.4 and Appendix 6.5.

(2) Basic Structure

1) Pellet Boiler

In general, pellet boilers shall be installed using a module-based construction method, involving installation of the boiler components onto a skid and the installation of a housing around the components. These ”modules” shall be assembled in the designated central assembling factory as described in “2.2.1 (4) Basic Design Policy”.

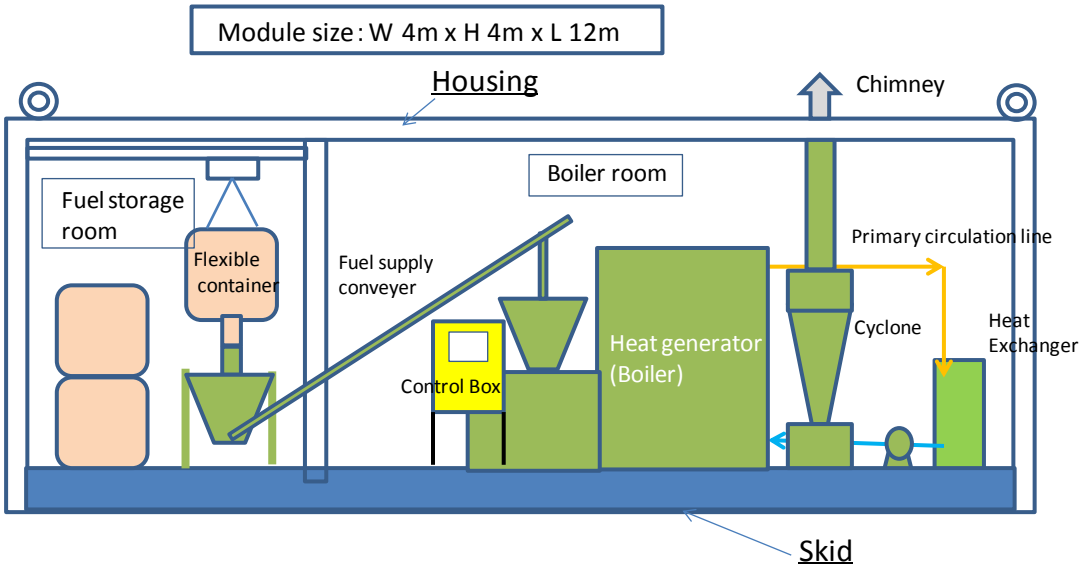
The dimensions of the modules after assembly in the central factory will be:

4 m width x 4 m height x 12 m length

It will be possible to transport modules of this size to most of the installation sites using Moldovan official roads, but road width on the route to some locations is not sufficient to transport full-sized modules. Two different assembly methods, a standard design and a design for smaller roads, are illustrated below.

Module Construction Method (Standard method for this project)

1. Skid & housing will be assembled in the central assembly factory, and components will be assembled into the housing to make a complete "module". Following assembly, an operational test and final check will be performed.
2. Completed modules will be transported to the designated sites.
3. Modules will be installed directly on concrete foundation.

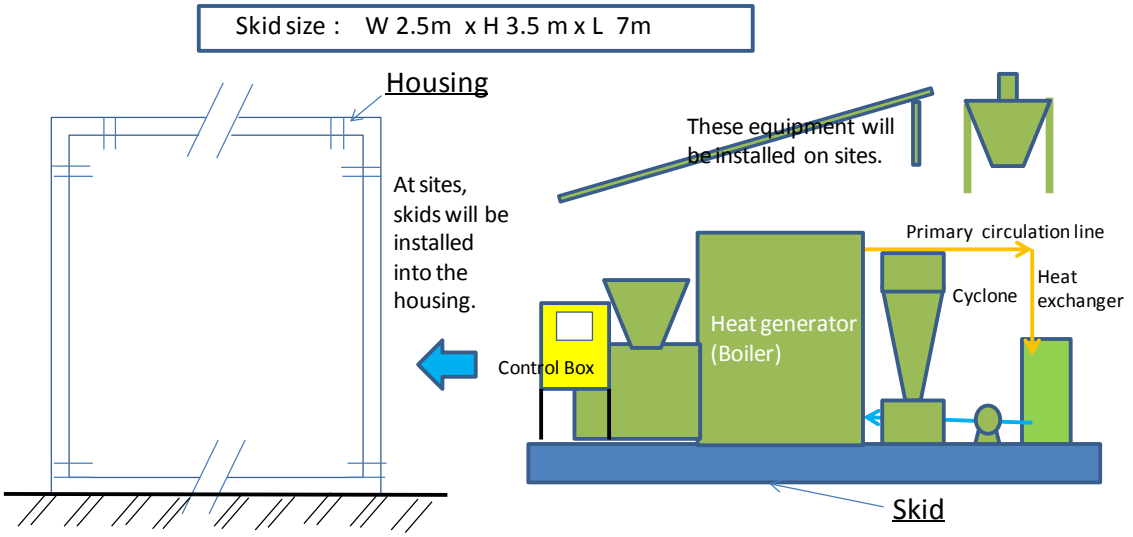


Source: JICA Survey Team

Figure 2.2.2 Module Method

Skid Construction Method (For transport over narrow roads)

1. Skids will be assembled in the central factory and the boiler components will be installed onto the skid, creating a "skid unit". Preliminary assembly tests will be performed.
2. Skids will be transported to the installation sites.
3. The unit housing will be assembled on site and the skid unit will be installed into the housing.



Source: JICA Survey Team

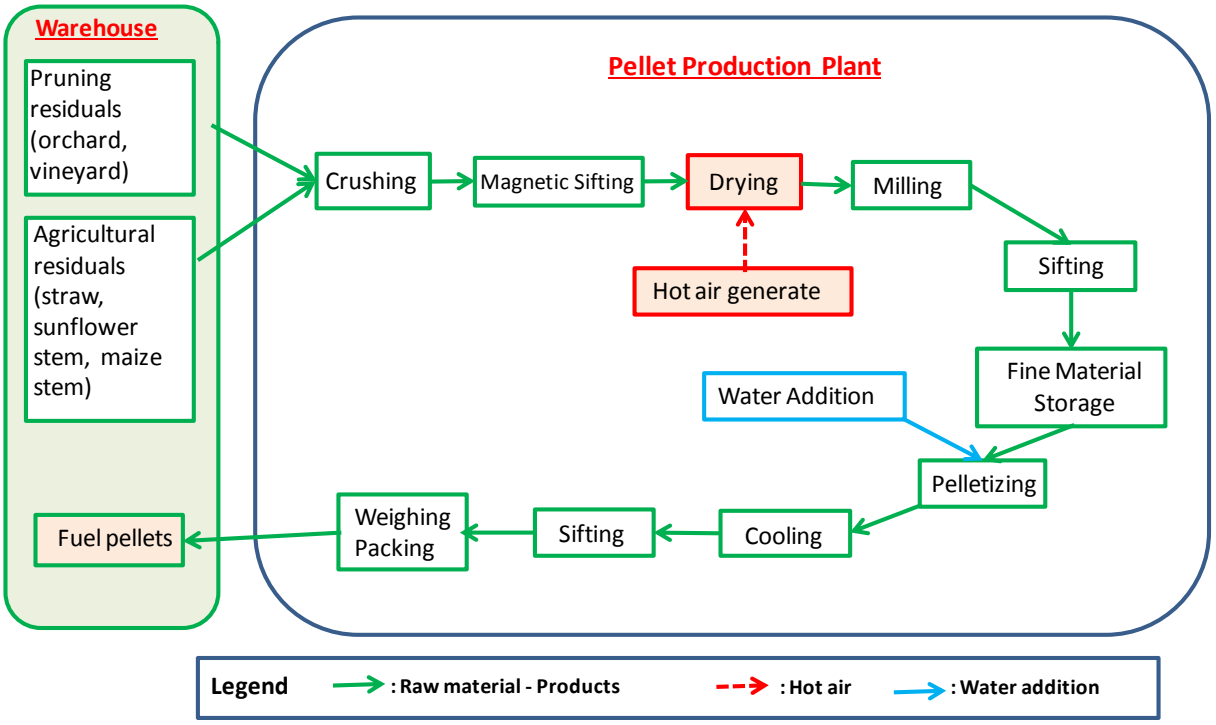
Figure 2.2.3 Skid and Housing Method

2) Pellet Production Plant

The pellet production plant will process biomass to produce biomass fuel pellets. Process inputs will include agricultural residuals from rural areas of Moldova such as straw, leaves/stalks of sunflower and maize, and orchard and vineyard pruning residuals. A simplified flow chart of plant processes is presented below in Figure 2.2.4.

The plant is a complex system with multiple components. Components/materials and key issues of the plant are as follows.

- Different raw materials have differing physical and chemical characteristics, which demand that the plant be equipped to operate flexibly and handle a wide range of inputs.
- Some equipment (including crushers, dryers and milling machines) will be required to handle both hard materials (like pruning twigs) and soft materials (like straw) in the same line.
- Plant operation includes the presence of dried biomass powder and the operation of a firing unit in the same line. Fire protection and safety measures must be carefully considered and given utmost priority.



Source: JICA Survey Team

Figure 2.2.4 Block Diagram for Pellet Production Plant

(3) Installation Sites and Equipment Quantities

1) Pellet Boiler

Pellet boilers shall be installed at 25 sites (24 in rural areas). The number of boilers categorized by capacity is summarized in the next table.

Table 2.2.8 Number of Pellet Boilers to Be Installed

Boiler Capacity			Number of Boilers
1.	100,000 kcal/hr	(116 kWh)	1
2.	200,000 kcal/hr	(232 kWh)	8
3.	300,000 kcal/hr	(348 kWh)	8
4.	350,000 kcal/hr	(407 kWh)	1
5.	500,000 kcal/hr	(584 kWh)	7
			25

Source: JICA Survey Team

2) Pellet Production Plant

One pellet production plant with an output capacity of 1,000 kg/hr shall be installed on the premises of 2KR-PIU in Chisinau.

(4) Basic Equipment Specifications

1) Pellet Boiler

Pellet boilers shall consist of the following primary equipment and/or facilities.

1) Pellet feeder silo: 0.5-1.0 m^3
2) Pellet feeder: Screw conveyor automatic feed control
3) Pellet conversion & water heating unit:
   - Non-pressurized water heating unit with alarm systems, back-fire protection, water temperature controls, water level detector, pellet feeder silo level detector and earthquake sensor.
   - Maximum water temperature: 90 °C; Normal output temperature: 80 °C
   - Heat efficiency shall be at least 80 %. (85% is preferable)
   - Manual ash discharging
   - Minimize the clinker and scale accumulation on the surface of heat tube
4) The boiler shall be equipped with an igniter (gas, oil burner or direct pellet ignition)
5) Boiler exhaust gas shall comply with relevant Japanese standards.
6) Preventative countermeasures including equipment and/or procedures for long term blackout

2) Pellet Production Plant

The pellet production plant shall consist of the following primary equipment and/or facilities.

1) A stockyard for raw input materials such as straw, sunflower, maize and twigs from orchard and vineyards
2) Initial crusher for incoming raw materials
3) Intermediate post-crushing stock silo
4) Hot-air material dryer:
   - The dryer shall be rotary kiln type and be equipped with safety devices which immediately segregate the rotary kiln from hot air generator in the event of power failure or other emergency.
   - The hot air generator shall be able to burn off-spec pellets.
5) Secondary crushing (milling) of dried materials:
   - Milling type is preferable.
6) Fine material stock silo for pelletizer

7) Pelletizer:
   - Production rate is 1,000 kg/hr capacity.
   - Materials shall be agricultural residuals from Moldova including straw, sunflower, maize and twigs from orchards and vineyards.
8) Pellet cooling facility
9) Sifter
10) Pellet filling/packing equipment:
   - For filling 1 m^3 flexible container bags
11) Preventative countermeasures including equipment and/or procedures for long term blackout

(5) Equipment Plan

Primary equipment specifications, quantities and purpose of use are shown as below.

Table 2.2.9 Equipment Specifications, Quantities and Purpose of Use

Equipment	Specifications	QTY	Purpose of use
Pellet boiler (116kWh)	Calorie: over 100,000 kcal/hr Dimensions: within 3.0 x 1.7 x 2.1m (L x W x H) Fuel usage: Approx. 30kg/hr Ignition: either gas, oil burner or direct ignition on pellet	1	Educational facilities (kindergartens, primary schools, Gymnasiums and Lyceums)
Pellet boiler (232kWh)	Calorie: over 200,000 kcal/hr Dimensions: within 4.4 x 2.0 x 2.3m (L x W x H) Fuel usage: Approx. 60kg/hr Ignition: either gas, oil burner or direct ignition on pellet	8	Educational facilities (kindergartens, primary schools, Gymnasiums and Lyceums)
Pellet boiler (348 - 407kWh)	Calorie: 300,000 – 350,000 kcal/hr Dimensions: within 4.5 x 2.3 x 2.6m (L x W x H) Fuel usage: Approx. 90kg/hr Ignition: either gas, oil burner or direct ignition on pellet	8	Educational facilities (kindergartens, primary schools, Gymnasiums and Lyceums)
Pellet boiler (407 - 464kWh)	Calorie: 350,000 – 400,000 kcal/hr Dimensions: within 5.0 x 2.4 x 2.8m (L x W x H) Fuel usage: Approx. 120kg/hr Ignition: either gas, oil burner or direct ignition on pellet	1	Educational facilities (kindergartens, primary schools, Gymnasiums and Lyceums)
Pellet boiler (580kWh)	Calorie: over 500,000 kcal/hr Dimensions: within 5.5 x 2.5 x 3.0m (L x W x H) Fuel usage: Approx. 150kg/hr Ignition: either gas, oil burner or direct ignition on pellet	7	Educational facilities (kindergartens, primary schools, Gymnasiums and Lyceums)
Pellet production plant	1. Initial crusher 2. Secondary crusher (mill) 3. Dryer 4. Raw material volumetric feeder 5. Pelletizer (1,000kg/hr capacity) (Flat or ring die type) 6. Chiller 7. Product screener 8. Pellet storage silo 9. Packing machine with flexible container bags 10. Material conveyor between equipment 11. Cyclone dust collector 12. Main power board, control box 13. Other necessary equipment or devices	1	For fuel (pellet) supply to pellet boilers

Equipment	Specifications	QTY	Purpose of use
Test stand	1. Flexible tube 2. Valves 3. Flow meter 4. Calorie meter 5. Circulation pump 6. Filter 7. Cooling tower	1	For pre-installation boiler performance testing (water circulation and water leakage etc.)

Source: JICA Survey Team

2.2.3 Outline Design Drawing

(1) Pellet Boiler

The following outline design drawings are attached in Appendix 6.1.

- Simplified diagram of Pellet Boiler: JST-FD-005-001
- Conceptual drawing of Test Stand: JST-FD-005-010
- Outline drawing of module and the component lay-out in module:
  JST-LY-005-580-A, JST-LY-005-407.348-B, JST-LY-005-232-C, JST-LY-005-116-TW
- Module structure:
  JST-MD-005-580-A, JST-MD-005-407.348-B, JST-MD-005-232-C, JST-MD-005-116-TW
- Skid and Piping Structures: JST-SK-005-580-A, JST-SK-232-C
- Plot Plans by site: 24 sites (except for 2KR-PIU NTC)

(2) Pellet Production Plant

Provisional sample drawings of the pellet production plant (in Japanese) are attached in Appendix 6.2.

2.2.4 Implementation Plan

2.2.4.1 Implementation Policy

The Project shall be implemented under Japan's Grant Aid program. The following policies must therefore be applied to the implementation.

- After conclusion of the Exchange of Note (E/N) between Moldova and Japan, JICA and 2KR-PIU shall make a Grant Aid Agreement (G/A) for the Project. All project processes such as component confirmation, contractor selection through bidding, equipment procurement and installation, commissioning and reception shall be properly completed in accordance with the timeline specified under the G/A.
- Strong positive relations between 2KR-PIU, the consultant team and the contractors, will drive smooth implementation of the Project.

Following execution of the G/A between 2KR-PIU and JICA, a Japanese consultant team contracted directly with 2KR-PIU shall implement the Project in cooperation with 2KR-PIU. The contractor is to be selected via tender and shall procure and install all relevant equipment and facilities.

The Project is categorized as an "equipment procurement" project. The two major components of the Project are the pellet boilers and the pellet production plant. Some construction works (including preparation of module foundation at installation sites) and provision of buildings for the pellet production plant are to be undertaken by the Moldovan side. Pellet boilers shall be assembled into a single "module" including housing and skid. Module assembly will be performed by a local Moldovan sub-contractor. The pellet boilers shall be required to adhere to all relevant local laws as a heating system. Module fabrication including assembly of pellet boiler components shall be conducted at a factory in Chisinau; assembled modules shall then be transported to the respective installation sites and installed.

The principal roles and responsibilities of the client, consultant and contractor for the Project are

shown as below.

Client

The Ministry of Agriculture and Food Industry (MoAFI) is responsible for the Project on the Moldovan side. The 2KR-PIU under the MoAFI shall be considered the implementation organization. 2KR-PIU will be a primary organization for project implementation and the signatory to agreements on consulting service and equipment procurement under the G/A.

Consultant

Following the signing of the G/A, 2KR-PIU shall execute a consulting service agreement with a Japanese consulting firm (the consultant) recommended by JICA. The consultant shall execute tasks specified in the agreement for the Project. The consultant shall provide the following consulting services to the client.

Design confirmation and bidding arrangement

The consultant will provide technical assistance to the Moldovan side, including final confirmation of facilities and equipment plan (including specifications and quantities of equipment/facilities, beneficiary obligations, etc.) as well as amendments to basic designs, preparation of tender documents, opening of bids and tender evaluation.

Procurement supervision

For the client and beneficiaries, the consultant will supervise procurement services such as Contractor shop inspection, pre-shipment equipment inspection, transportation in Moldova, assembly in Moldova, installation-time test run, initial operational training, etc.

Soft Component

The JICA "Soft Component Guideline (October 2010)" describes following two main purposes of the Soft Component.

1) To help the Project proceed smoothly (including undertakings by Moldova)

2) To secure sustainable positive outcome

Planned services are comprised of operation management and equipment maintenance as follows.

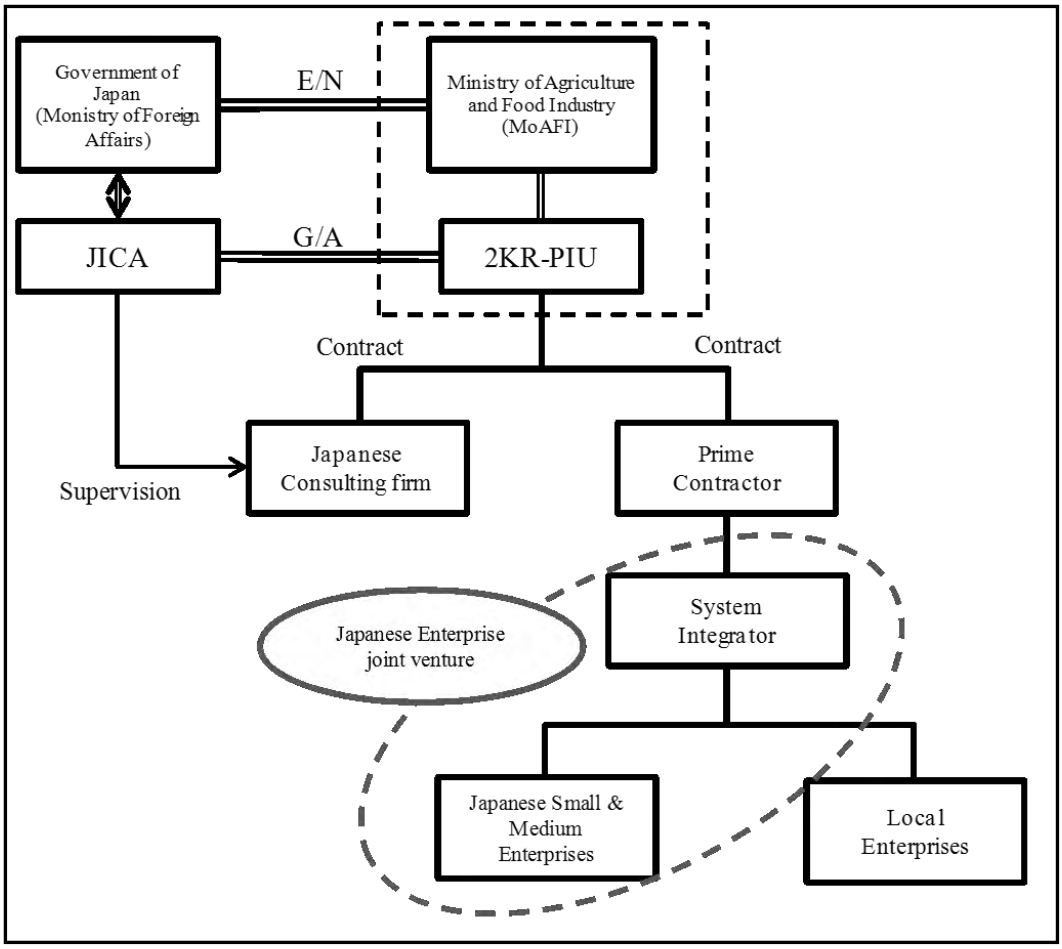
- Establishment of operation management system
- Reinforcement of the operation management system
- Awareness education activity on biomass heating system

Contractor

After conclusion of the G/A, a Japanese contractor, to be selected through a tender organized by the Moldovan side, shall make a contract for equipment procurement with 2KR-PIU. The contractor shall make subcontracts with Moldovan local firms for local procurement (boiler module fabrication/assembly, module transportation and installation, and commissioning). In addition, the consultant and the contactor shall conduct a series of meetings and site inspections to confirm adequate preparations on the part of beneficiary communities. Services to be provided by the contractor are as follows.

- Procurement and transportation of the equipment
- Fabrication, installation, test run and initial operational training for the equipment

Relations of the relevant organizations are summarized in the figure below.



Source: JICA Survey Team

Figure 2.2.5 Implementation Organizations

2.2.4.2 Implementation Conditions

In order to ensure smooth implementation of equipment procurement including transportation, fabrication, installation and commissioning, the client, the consultant and the contractor shall cooperate coordinate closely, and each shall fulfill its respective duties without delay. All parties involved in the Project must give careful consideration to the points below.

(1) Considerations in Equipment Procurement

The Project aims to make use of high-tech tools and equipment from Japan manufactured not only by large enterprises but also by small and medium enterprises. Suitable tools and equipment will be granted to Moldova. The primary subject equipment of the Project consists of multiple pellet boilers and one pellet production plant.

Documents required for the importation of equipment to Moldova from Japan are as follows.

- Boiler specifications and photos
- Translated manufacturers' product specifications (Romanian or Russian preferred, English acceptable)
- Equipment heat efficiency (above 80%) should be indicated. (Written on the specifications shall suffice.)
- The pellet production plant requires the same documents as above.

Submission of documents described above may be made by the consultant directly to 2KR-PIU, who shall submit the documents to the MoAFI and the Ministry of Economy. According to reports from the

Ministry of Economy, approval of these documents will take about one month.

In Moldova, several laws (including those described below) are currently undergoing revisions to better conform to EU standards, and new related legislation including "Law on Introduction of Biomass Energy" is under preparation.

- Law on Energy Efficiency Nr. 142
- Law on Renewable Energy Nr. 160
- National Program of Energy Efficiency 2011-2020, Nr. 833

(2) Considerations during Construction Work

The following items are to be considered during the construction period.

- Procurement schedules for boilers, transportation schedules to installation sites and installation schedules should be confirmed.
- Concrete foundation work by the Moldovan side during the winter season should be avoided to ensure quality. It is recommended that concrete work be started after spring.
- Prior to arrival of the pellet boilers from Japan, local production management and fabrication schedules should be clarified to prevent any issues due to miscommunication.
- Approximately eight or nine housings will be produced per month. Fabrication, installation and commissioning of all twenty-five units is expected to take approximately 3 months. To avoid delays, schedule management and production management should be well-coordinated.

The modules will be fabricated/assembled at a factory in Chisinau. This factory must ensure provision of the following safety measures.

- A factory is likely to have potentially dangerous process equipment, large raw materials and narrow or restricted pathways. Factory workers should exercise due caution.
- Accidental fall are possible when using cranes in a factory. Appropriate preparation before the start of work and the use of due caution at all times are indispensable.
- Protective equipment including goggles, protective gloves and helmets must be used where appropriate.

Modules will be delivered to each installation site following completion of assembly/fabrication at local factories in Moldova. The following provisions must be ensured during delivery and installation work.

- Selection of an appropriate route to avoid collisions between modules and overhead objects in transit (e.g. gas pipelines, phone lines and power cables)
- Tow trucks or similar equipment will be necessary while unloading the modules at sites. Careful consideration must be given to parking for these vehicles due to the large combined weight of the trucks and modules. Appropriate care must be given to overhead obstacles during loading and unloading as well.

Planned work flow for boiler fabrication/installation is described in Appendix 6.3.

Japanese engineers from the pellet production plant manufacturer will be on hand in Moldova during plant installation work. Operators for the pellet production plant should work together with the Japanese engineers to understand the system and ensure proper operation after the completion.

2.2.4.3 Scope of Works

The Government of Japan and the Government of Moldova shall be responsible for procurement and installation component tasks as shown below.

(1) Undertakings to be Borne by the Japanese Side

- Consulting services on design validation, tender document preparation, tender arrangement and procurement supervision
- Procurement of all items from the equipment list manufactured in Japan

- Transportation, fabrication, installation, functional testing and initial operation training for project equipment
- Establishment of the operatiing management system (a "soft component")

(2) Undertakings to be Borne by the Moldovan Side

Pellet boiler at each site

- To build appropriate foundations for the modules (including materials for the construction work)
- To supply electric power and clean water for the module
- To prepare fire protection and fire suppression facilities
- To prepare temporary ash storage
- To prepare facilities for equipment operators (toilet, washing basin, etc.)
- To recruit equipment operators

Pellet production plant

- To prepare a building for the pellet production plant
- To prepare material handling equipment (e.g. forklift)
- To supply electric power and clean water for the pellet production plant
- To prepare fire protection and fire extinguishing facilities
- To prepare facilities for plant operators (toilet, washing basin etc.)
- To recruit plant operators

2.2.4.4 Consultant Supervision

(1) Procurement Planning

Pellet boiler

It is not feasible for a single manufacturer to produce all 25 required boilers, so boilers will be procured by several manufacturers. The following considerations will therefore be necessary to streamline the Project.

- To coordinate plans/schedules between boiler manufacturers in Japan and local production of equipment housing
- To ensure that the most recent transportation information is used, especially marine transportation information
- To confirm transportation routes from Chisinau to each installation site
- To confirm preparations at installation sites (concrete foundation for the module and secondary piping in connected buildings)

Pellet production plant

- To ensure that the most recent transportation information is used, especially marine transportation information
- To confirm preparations at the installation site (a building for the pellet production plant)

(2) Consultant Supervision

Construction work is scheduled to take five months. Work will start with planning/implementation meetings for construction work and will be completed with initial operation training for operators of the installed equipment.

Pellet boiler

One of five sizes of boiler will be procured for each site as appropriate to site conditions. The boilers will be supplied by several different manufacturers. The local subcontractor will need to assemble the various boilers under different conditions unique to each site. Detailed discussions and consideration of the manufacturer's drawings and precise specifications will be necessary to

avoid work delays.

Pellet production plant

The pellet production plant will be installed by engineers from the Japanese plant manufacturer. Primary parts and components will be imported from Japan, but some materials will be procured locally. The Japanese engineers and local sub-contractors will need to coordinate and clarify critical points of concern in pre-work discussions and meetings. These meetings will ensure that both parties can work smoothly and begin immediately from the scheduled start of work.

Table 2.2.10 Work Responsibilities

Contents	Pellet boiler		Pellet production plant	
	Principal work	Initial operation guidance by	Principal work	Technical transfer for
Unpacking / arrangement	Local sub-contractor	Japanese supervisor	Japanese engineer	Local staff
Equipment layout	Local sub-contractor	Japanese supervisor	Japanese engineer	Local staff
Fabrication	Local sub-contractor	Japanese supervisor	Japanese engineer	Local staff
Installation	Local sub-contractor	Japanese supervisor	Japanese engineer	Local staff
Test run	Local sub-contractor	Japanese supervisor	Japanese engineer	Local staff
Initial operation training for operators	Local sub-contractor	Japanese supervisor	Japanese engineer	Local staff

Source: JICA Survey Team

2.2.4.5 Quality Control Plan

The quality control process will commence with the preparation of various drawings (equipment fabrication drawings, detail drawings and shop drawings) which will form the basis of work plan and procedure plan (for fabrication/assembly and installation), and preparation of a site control plan. An inspection of transit damages and quantities of equipment shall be performed after unloading at Chisinau and the findings will be compared with the pre-delivery and pre-shipment inspection results.

(1) Equipment

Pellet boiler

Combustion tests shall be performed at the facilities of respective manufacturers in Japan. Performance testing in Chisinau of all parts and devices shall be performed using a test stand (dummy load) without secondary piping.

Pellet production plant

Each piece of equipment shall be separately subjected to a pre-shipping inspection at the manufacturer's factory in Japan.

(2) Installation

Pellet boiler

The size and routing of piping must be confirmed during the fabrication of both the boilers and the housings. Boilers must be thoroughly examined for water leakage prior to transport to each site. Following the completion of site installation, confirmation of commissioning with the site beneficiaries shall signify overall work completion.

Pellet production plant

Following completion of assembly and installation of the equipment, a test run of pellet production will be performed using local raw materials. Size, moisture content and pelletizing condition of the test run pellets will be measured, and approval of completion will be issued if all parameters meet the specifications.

2.2.4.6 Procurement Plan

A list of the major equipment to be procured as a part the Project is as follows.

Table 2.2.11 Major Equipment to Be Procured by the Project

	Equipment	Procured from	Country of origin	QTY
1	Pellet boiler (116kWh)	Japan	Japan	1
2	Pellet boiler (232kWh)	Japan	Japan	8
3	Pellet boiler (348 - 407kWh)	Japan	Japan	8
4	Pellet boiler (407 - 464kWh)	Japan	Japan	1
5	Pellet boiler (580kWh)	Japan	Japan	7
6	Hoist with electric trolley	Japan	Japan	33
7	Roller conveyor	Japan	Japan	25
8	Pellet production plant	Japan	Japan	1
9	Flexible container bag	Japan	Japan	500
10	Test stand	Moldova	Moldova	1

Source: JICA Survey Team

Items nos. 1 to 9 in the table above will be procured in Japan as will ancillary parts such as primary pipes between the boiler and heat exchanger. The materials for boiler housings will be locally procured in Moldova. Secondary pipes from the heat exchanger to serviced buildings are to be provided by the Moldovan side.

Pellet production plant equipment including cables between units will be procured in Japan, but power cables and the power panel will be procured locally.

2.2.4.7 Operational Guidance Plan

Neither pellet boilers nor pellet production plants are exceedingly rare in Moldova, as the country already has an installed base of pellet boilers imported from other countries (Greece, Poland, Germany, Ukraine, etc.) and secondhand pellet production plants. However, the mechanical systems of the Japanese-manufactured boilers for this project may differ significantly from other countries' products. The Japanese-manufactured boilers have semi-automatic control functions for several processes, from pellet supply to exhaust gas emission. Production capacity at the newly introduced pellet production plant will be approximately the same as the currently active secondhand pellet production plant, but the new plant is larger than the existing secondhand plant due to the provision of semi-automated functions including conveyance between the different processes.

Manuals for basic operation and maintenance will be translated into either Romanian or Russian and initial operational guidance will be provided for equipment operators. Operation of semi-automatic equipment differs from conventional equipment, so the necessary operator training will be provided during the initial operational guidance. The key points of concern during the guidance process are described below.

Pellet boiler

Although the operation is semi-automatic, human supervision is indispensable.

(i) Pellets are automatically supplied from the silo to the boiler, but the pellet must be supplied manually to the silo. The operator will need to refill the silo manually in the event of a low pellet alert.

(ii) Clinker, non-combustible debris produced in furnaces, is removed automatically. Clinker generation rates differ depending on the composition of the raw input materials. Operators should therefore be aware clinker generation rates and may sometimes need to remove the clinker manually.

(iii) Ash must be discharged manually.

(iv) Differences in raw input materials by season and production location may yield pellets with differing characteristics. Mixing pellets should therefore be avoided, and a single kind of

pellet should used whenever possible. Differences in pellet characteristics including calorie content and clinker production will necessitate adjustments to operation parameters.

(v) In the event of a power failure, manual operation will be required to compensate for poor combustion due to the lack of semi-automatic operations and the suspension of the air blower and dust collector equipment.

Pellet production plant

(i) Addition of multiple different raw input materials while the pelletizer is running should be avoided.

(ii) The die must be changed or adjusted depending on the raw input materials.

(iii) Operation of the raw material drying unit will require close attention in the event of a power failure.

(iv) Proper moisture content should be maintained.

It is anticipated that the considerations detailed above have not generally been applicable to existing equipment, and thorough instruction in optimal operating procedures for the new equipment will be required.

Reporting guidance

Following completion of pellet boiler and pellet production plant installation on the designated sites, each site will be required to prepare a report on equipment operation as a part of the project evaluation process. Training for preparation of this report is not included in the operational guidance, but reporting related training will be provided as a part of "soft component".

2.2.4.8 Soft Component (Technical Assistance) Plan

(1) Necessity of Soft Component Plan

In addition to actual operation and maintenance of the installed equipment and plant, a "soft component" plan concentrating on technical assistance is required in order to manage the Project and to ensure appropriate operating conditions and sustainable operation over the long-term for the twenty-five pellet boilers and the pellet production plant. Key tasks of the soft component plan include the following.

(i) Strengthening project management skills to streamline the simultaneous introduction of new equipment in large numbers; Developing the required information management system (IMS) and strengthening operation and maintenance skill to effectively implement and use the IMS.

(ii) Planning/design of pellet supply chain model for further expansion of pellet boiler installation in the future

(iii) Environmental education and information sharing for expansion of pellet boiler

(2) Outline of the Soft Component Plan

1) Purpose

The primary goal of the soft component plan is to achieve the project purpose and thereby to achieve broader overall goals by developing necessary functions to ensure sustainable operation of the granted equipment. (Project purpose and the overall goal of the Project are detailed in "2.1Basic Concept of the Project".)

2) Expected Results

The following three results are expected as outcomes of implementing the soft component plan.

Result 1: Appropriate operation and maintenance (O&M) of the pellet boilers is instituted.

Result 2: Appropriate O&M of the pellet production plant is instituted.

Result 3: The general public is made aware of the benefits of biomass utilization.

(3) Contents

Table 2.2.12 Activities of the Soft Component Plan

Result	Training Activities	Training Targets
Result 1: Appropriate O&M of pellet boilers	○2KR-PIU and JICA experts develop project evaluation and monitoring method ○2KR-PIU, JICA experts and IT system integrator develop information management system (IMS) ○IT system integrator provides program for 2KR-PIU on IMS operation and maintenance skill development ○2KR-PIU and JICA expert develop reporting rule, education program and reporting manual for boiler operation information gathering	●2KR-PIU
	○2KR-PIU and JICA experts implement reporting rule education program for site managers ○2KR-PIU and JICA experts implement reporting rule education program for boiler operators ○2KR-PIU and JICA experts develop reporting rule operation monitoring program	●Mayors, Assistants ●Site Managers, assistants, boiler operators
Result 2: Appropriate O&M of pellet production plant	○2KR-PIU and JICA experts develop reporting rule, education program and reporting manual for pellet production information gathering	●2KR-PIU
	○2KR-PIU and JICA experts plan pellet supply chain ○2KR-PIU and JICA experts develop education program to develop skills to promote the pellet production	●2KR-PIU
	○2KR-PIU and JICA experts implement reporting rule education program for plant manager ○2KR-PIU and JICA experts develop reporting rule operation monitoring program	●2KR-PIU ●Plant manager, assistants, operators
Result 3: Awareness of biomass utilization benefits	○2KR-PIU, JICA experts and IT system integrator plan and develop a project web-site ○IT system integrator provides program for 2KR-PIU on Web-site management skill development, operation manual development	●2KR-PIU
	○2KR-PIU and JICA experts plan and open a Workshop to introduce the Project ○2KR-PIU and JICA experts develop and implement education programs for the beneficiaries ○2KR-PIU and JICA experts develop tools for education programs	●Members of related ministries, universities, other organization and donors ●Pellet boiler installation site users (teachers, student, etc)

Source: JICA Survey Team

(4) Schedule

Three JICA experts with relevant and complementary skills will cooperate to accomplish the three goals of the soft component plan as illustrated in the table below.

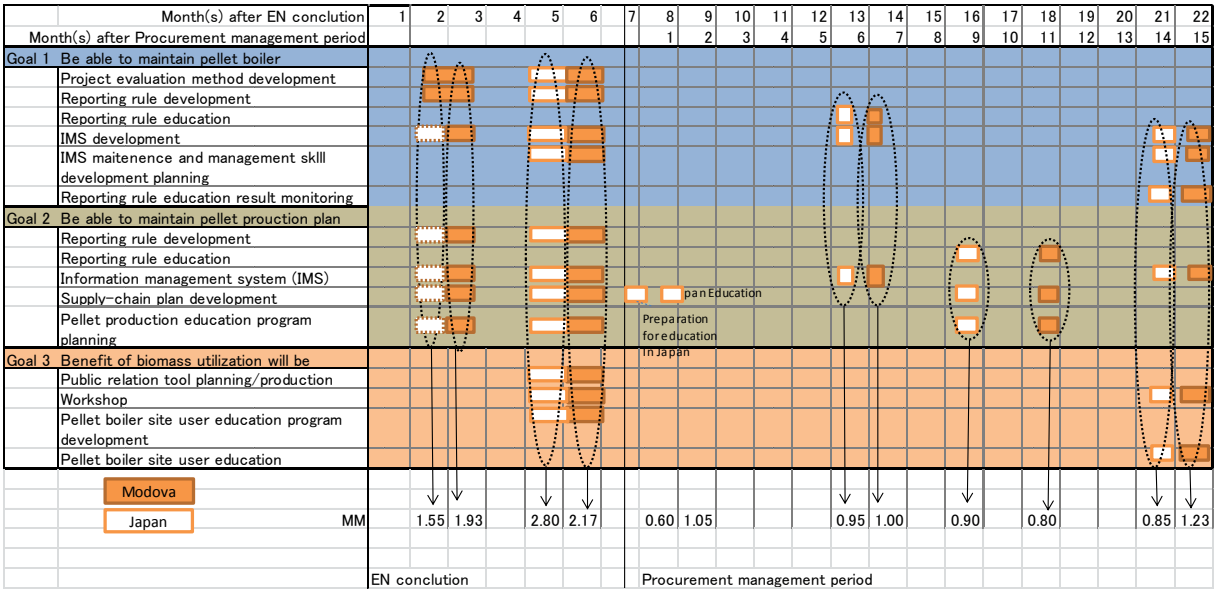
Table 2.2.13 Roles of Experts

		Soft Component Manager	Information Management System (IMS) expert	Facility Expert
Goal 1	Be able to maintain pellet boiler			
	Project evaluation method development	◎		
	Reporting rule development	◎		△ (Technical support)
	Reporting rule education	◎		△ (Technical support)
	IMS development	○	◎	△ (Technical support)
	IMS maitenence and management skIll development planning		◎ (Instructor=Local resource)	
	Reporting rule education result monitoring	◎	△	
Goal 2	Be able to maintain pellet prouction plan			
	Reporting rule development	◎		
	Reporting rule education	◎		○
	Information management system (IMS) development		◎	
	Supply-chain plan development	◎ (Business planning)		◎ (Facility/technology)
	Pellet production education program planning	◎ (Business planning)		◎ (Facility/technology)
Goal 3	Benefit of biomass utilization will be recognized			
	Public relation tool planning/production	◎	△ (Involvement of IMS)	△ (Technical support)
	Workshop	◎	○ (IMS instructor)	
	Pellet boiler site user education program development	◎		△ (Technical support)
	Pellet boiler site user education	◎		

Source: JICA Survey Team

The soft component plan requires timely action and coordination of schedules with the equipment/ plant procurement, installation and start-up processes. The soft component plan is expected to total 22 months from start to finish, beginning at the time of the E/N conclusion.

Table 2.2.14 Soft Component Plan Schedule



Source: JICA Survey Team

2.2.4.9 Implementation Schedule

The Japanese consultant team shall perform detailed design work (including final confirmation of the undertakings by the Moldovan side) following the Government of Japan's decision on project implementation, and a contractor for procurement and installation of the equipment shall be selected by the Moldovan side through competitive bidding. Following the completion of bidding and contractor selection, the process of equipment procurement shall begin with procurement meetings (preparation, verification of shop drawings under client approval).

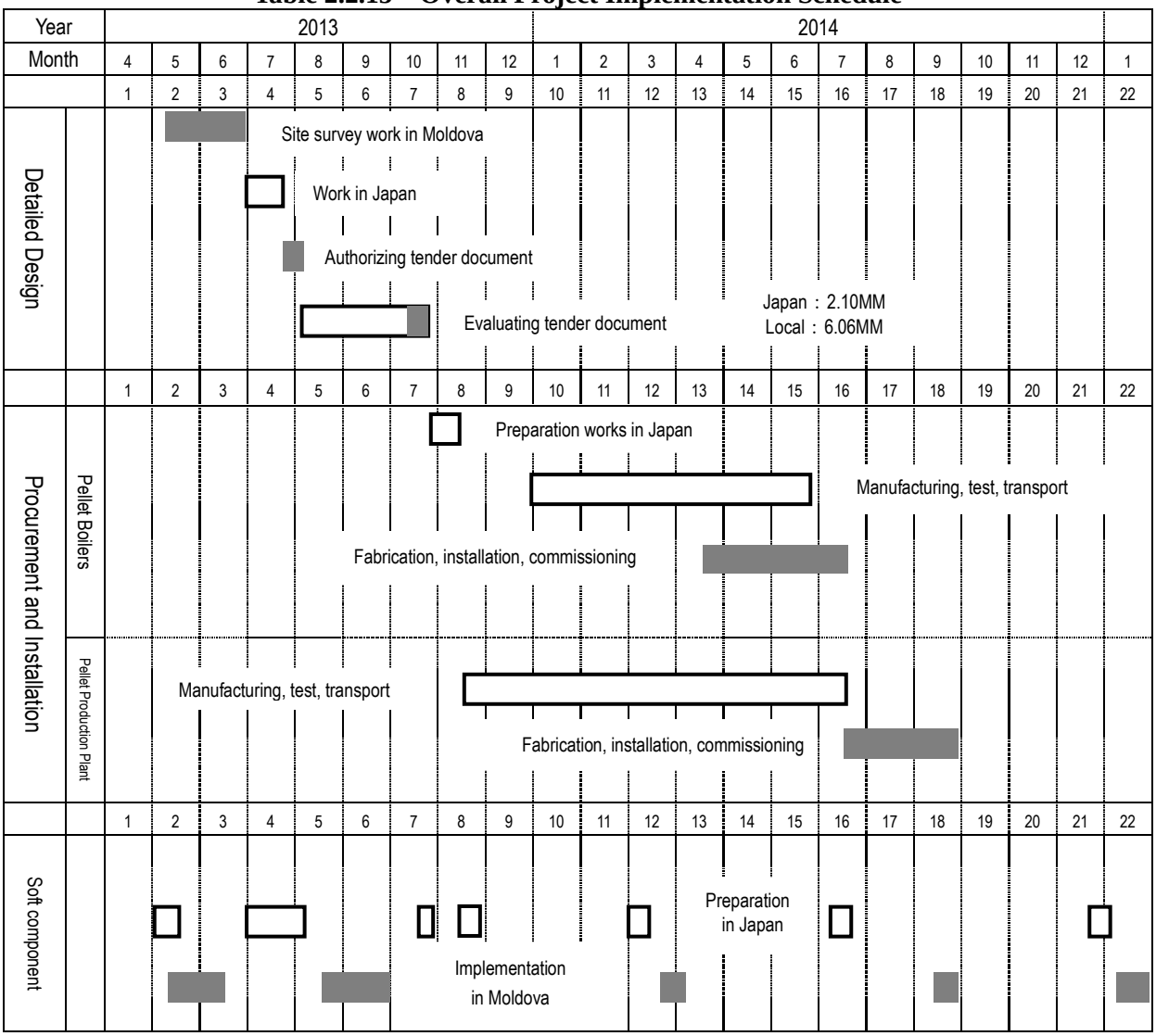
Official approval from the Ministry of Economy of Moldova for importation of equipment manufactured in Japan shall be completed during the course of detailed design work by the consultant. (Refer to "2.2.4.2 Implementation Conditions".) Due to this constraint, the scheduled term of the detailed design work process is somewhat longer than may be typical.

The table below indicates the respective undertakings of Japan and Moldova during the project implementation period.

Undertakings of Japan	Undertakings of Moldova
1. Preparation of import approval application related documentation for equipment from Japan	1. Submission of documentation to relevant agencies
2. Preparation of mechanical and shop drawings	2. Acquire confirmation of local authorities in beneficiary communities to meet relevant obligations
3. Manufacturing, product inspection and transportation of equipment procured in Japan	3. Tax exemption
4. Procurement of additional equipment in Moldova (as necessary)	4. Tax exemption
5. Installation work	5. Tax exemption
6. Inspection of the installation work	6. Confirmation of completion
7. Technical assistance for operation management ("soft component")	7. Recruitment of necessary personnel for equipment operation

The table below summarizes the project implementation schedule including the activities described above.

Table 2.2.15 Overall Project Implementation Schedule



Source: JICA Survey Team

2.3 Obligations of Recipient Country

(1) Pellet Boilers

The equipment imported from Japan shall be assembled onto a skid and installed into a housing at a central assembly factory in Chisinau. After assembly of all necessary equipment, the completed modules (and reduced-width "skid units") shall be transported to each of the 25 sites and installed. Before commencement of the work, the following obligations shall be met by the Moldovan side.

- Provision and preparation of land and buildings for the central assembly factory (further discussions with the Moldovan side are required to establish details)
- Ensuring the following preparations at each boiler installation site
  - Construction of an appropriate foundation for the module
  - Installation of secondary piping (between the module and the connected buildings as well as piping and radiators inside the buildings)
  - Provision of electric power supply
  - Provision of clean water supply
  - Provision of appropriate drainage for the module
  - Provision of a paved access road to the foundation

- Provision of a storage structure for pellets (seven day supply)
- Provision of temporary ash storage structure/facility
- Provision of fire protection and fire extinguishing equipment
- Provision of appropriate material transport carriers (e.g. forklift)
- Preparation of facilities for operators (e.g. toilet, washing basin)
- Provision/Installation of fences
- Recruiting of boiler operators

The elements above shall be thoroughly discussed during the detailed design works.

(2) Pellet Production Plant

Major parts and components of the pellet production plant shall be procured in Japan, and each shall be inspected prior to shipping. All pipes, valves, fittings and wires/cables shall be counted and inspected in accordance with the predetermined specifications before shipping. Some common parts or materials will be procured in Moldova.

The Moldovan side shall be responsible for the following considerations.

- Provision of appropriate land and building for the pellet production plant (Basic design and the necessary data for the equipment layout and loading data shall be supplied by the Japanese manufacturer.)
- Provision of electric power supply
- Provision of clean water supply
- Provision of appropriate drainage
- Provision of a paved access road to the foundation
- Provision of temporary raw material storage
- Provision of fire protection and fire extinguishing equipment
- Provision of appropriate material transport carriers (e.g. forklift)
- Preparation of facilities for operators (e.g. toilet, washing basin)
- Provision/Installation of fences
- Recruiting pellet production plant operators

(3) Soft Component (Technical Assistance) Plan

In order to ensure effective and sustainable use of equipment procured as a part of the Project, 2KR-PIU shall implement the following activities.

- Implementation and revision (as necessary) of the various manuals and regulations prepared during plan implementation
- Securing adequate budget to manage the information management system and its web site properly
- Securing adequate budget for information terminal devices (for heat meter data transmission)
- Securing adequate budget for appropriate regular monitoring of the equipment
- Provision of environmental education concerning biomass energy utilization to the pellet boiler users and beneficiary communities

2.4 Project Operation Plan

(1) Operation, Management and Finance Responsibilities

It is intended that pellet boiler and pellet production plant will be operated and managed under the structure summarized in the table below.

Table 2.4.1 Expected Operation Management Structure

	Pellet boiler	Pellet production plant
O&M responsibility	(24) Rural sites: Mayor Demonstration boiler: 2KR-PIU Director	2KR-PIU
Equipment/plant owner	(24) Rural sites: Pellet boiler installation site manager (e.g. School master) Demonstration boiler: 2KR-PIU Director	2KR-PIU
Operator	(24) Rural sites: Operator(s) to be hired by installation site or local authority Demonstration boiler: NTC staff	Operator to be employed by 2KR-PIU or a sub-contractor selected by 2KR-PIU
O&M expense sharing	(24) Rural sites: Pellet boiler installation site Demonstration boiler: NTC	2KR-PIU

Source: JICA Survey Team

Anticipated allocation of costs for management and operation is shown below.

Pellet boiler

At present, budgets for gymnasiums kindergartens and other education facilities are allocated directly by rayon, which means gymnasiums and kindergartens will bear expenses involved in pellet boiler operation. Associated expenses for other public facilities will be borne by the local authority. In cases where an installed pellet boiler supplies heating to both educational facilities and other public facilities, there shall be a cost sharing rule between the two facilities. Expenses include pellet purchase cost, operator labor cost, electricity, other consumables and maintenance service fees. The chief of the local authority (e.g. Mayor) will be responsible for project management and work related to project evaluation.

2KR-PIU will be responsible for management of one demonstration boiler, to be installed in Chisinau NTC. Labor and other operating costs will be borne by Chisinau NTC.

Pellet production plant

As the project matures, proceeds from pellet sales are expected to cover production plant O&M expenses, but during the start-up period these costs will be borne by 2KR-PIU. 2KR-PIU will manage pellet production, but may entrust O&M functions to other appropriate organizations such as the NTC under the MoAFI. Primary plant expenses are expected to include raw material procurement, operator labor cost, electricity/fuel, consumables and maintenance service fees.

(2) Equipment Maintenance

The expected equipment maintenance structure is summarized in the following table.

Table 2.4.2 Expected Equipment Maintenance Structure

	Pellet boiler	Pellet Production Plant
Original provision of manuals/guidance materials	Equipment supplier JICA Consultant	Equipment supplier
Daily inspections	Operator hired by site owner	Operator hired by 2KR-PIU or organization entrusted by 2KR-PIU
Regular (seasonal) inspections (start and end of heating season)	Local agents of equipment suppliers	Equipment supplier or its agent
Emergency maintenance	Local agents of equipment suppliers	Equipment supplier or its agent

Source: JICA Survey Team

(3) Supply Chain System of the Pellet

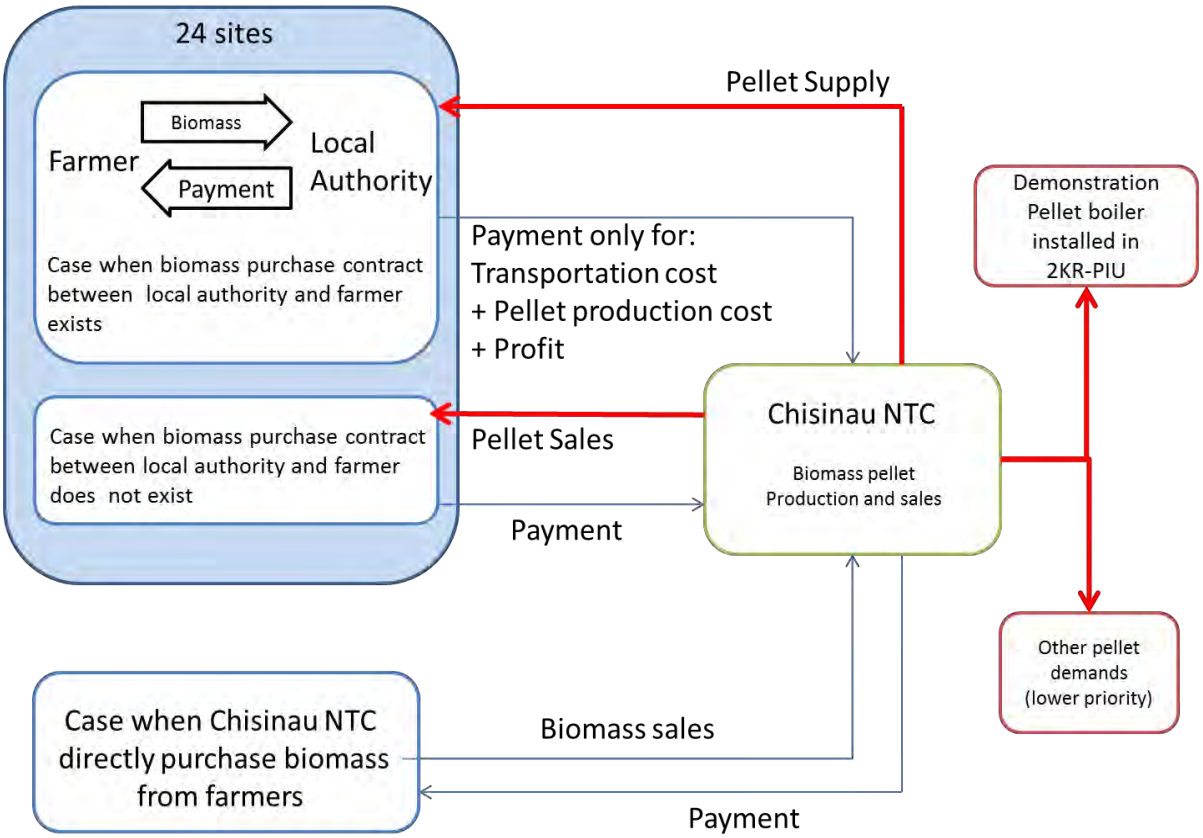
Planning and design of the raw material and processed pellet supply chain system shall be performed as a part of the "soft component" plan. A preliminary conceptual proposal is outlined in the diagram below.

Raw material suppliers will be categorized as either A) suppliers (farmers) living in installation site communities or B) suppliers from outside these communities. In principle, the pellet production plant

will purchase raw materials from both categories of supplier, and contract with local authorities for pellet sales/supply.

Local authorities of the 24 installation site communities may alternately conclude a procurement contract for raw materials directly with suppliers in order to purchase the raw materials and consign them to the pellet production plant for processing. This transaction structure allows local authorities to potentially bypass additional intermediary costs.

The pellet production plant shall, in principle, fulfill pellet demand of the 25 boiler sites (including the demonstration boiler at 2KR-PIU), before selling any additional production to other customers.



Source: JICA Survey Team

Figure 2.4.1 Structure of Pellet Supply Chain System

2.5 Project Cost Estimation

2.5.1 Initial Cost Estimation

In accordance with the expected undertakings of the recipient country specified above, the cost breakdowns of the Moldovan side are estimated based on the conditions below.

- **Moldovan Side Costs**

  17,550,000 MDL (Approx. 117,230,000 JPY)

  I. Boiler installation work

  1,950,000 MDL (Approx. 13,020,000 JPY)

  II. Building for pellet production plant

  15,600,000 MDL (Approx. 104,210,000 JPY)

- **Conditions for Cost Estimation**

I. Time of estimation

August 2012 (on the month of survey completion)

II. Exchange rates

1 USD	=	81.06 JPY
1 Euro	=	104.55 JPY
1 MDL	=	6.68 JPY

III. Construction and procurement period

Detailed design and procurement period are indicated in the Table 2.2.15.

IV. Others

The initial cost is estimated in accordance with the Grant Aid Scheme of the Government of Japan.

2.5.2 Operational and Maintenance Cost

(1) Pellet Boilers

One of five different sizes of boiler (116kWh to 580kWh) will be installed at each site as appropriate for the heat demand conditions of the site. Expenses for labor and operation information reporting (OIR) are expected to be identical for each of the five sizes, but costs associated with pellet supply, electricity, other consumables and maintenance/service will vary depending on the boiler size.

Table 2.5.1 Operation and Maintenance Cost by Boiler Size

Boiler Size	Cost					Total
	Operation ratio	17%				Lei/Year
	Pellet	Electricity	Maintenace	Labor	Reporting	
116 kW	51,237	2,031	12,000	19,750	1,000	86,018
232 kW	102,474	4,061	14,400	19,750	1,000	141,686
348 kW	179,330	7,107	25,200	19,750	1,000	232,387
407 kW	204,949	8,123	28,800	19,750	1,000	262,621
580 kW	256,186	10,153	36,000	19,750	1,000	323,089

Note 1: Calculations are based on estimated maintenance fees for a 116kWh boiler (12,000 MDL) adjusted for boiler size. (e.g. 232kWh/116kWh x 0.6 x 12,000MDL = 14,400 MDL)
Note 2: Data above do not include OIR-related labor costs such as personnel expenses of local authority.
Source: JICA Survey Team

(2) Pellet Production Plant

Pellet plant production capacity as installed will be 1,000 kg/hr, and the plant is expected to operate for 300 days/year, 14 hours/day. Expected annual processed pellet output is 3,780 tons, 90% of input (4,200 ton/year), accounting for evaporation of moisture and residues. The expected operating and management costs for the pellet production plant are 5,482,820 MDL/year.

- Raw material procurement costs:
  1,218,000 MDL/year (raw material purchase: 4,200 ton/year, transportation fee: 50km radius, storage fee)
- Marketing costs involved in product sales:
  472,500 MDL/year (product: 3,780 ton/year, packing, transportation fee: 80km radius)
- Labor costs: 240,000 MDL/year (average 25,000 MDL/year per person x 8 person)
- Electricity: 1,552,320 MDL/year (1.54MDL/kWh x 300kWh x 0.8 x 14hours x 300days)
- Other Consumables:1,500,000 MDL/year (spare parts for shredder, pelletizer, heat furnace)
- Others costs: 500,000 MDL/year (maintenance service fee)

(3) 2KR-PIU

2KR-PIU must provide an appropriate budget for IMS-related costs which are estimated at 18,155 MDL/year. 2KR-PIU must also provide an appropriate budget for biomass boiler education and expansion activity, as necessary. The following cost does not include the labor cost of 2KR-PIU.

- IMS expenses 18,155 MDL/year (system maintenance and consulting fee)
- Other expenses (such as expenses for biomass boiler education and expansion activity)

Chapter 3 Project Evaluation

3.1 Preconditions

(1) Pellet Boiler Module Installation Sites (25 sites including the 2KR-PIU site)

1) Permission to use the land required for the pellet boiler module installation

Each site owner shall provide an appropriate space for setting up the pellet boiler module. Site owners shall also provide space for temporary equipment storage and a meeting area as well as an appropriate break room near the construction site for the workers, for the duration of the installation period.

2) Preparations within the Moldovan side scope of work

Preparatory work to be performed by the Moldovan side under the agreed scope of work shall be completed before the pellet boiler module is transported to each site.

3) Confirmation of wireless communication network at site

The existence of an effective wireless communication network (e.g. 3G network) shall be prepared and verified prior to the start of pellet boiler module installation.

(2) Pellet Production Plant Installation Site

1) Permission to use the land required for the pellet production plant installation

The site owner shall provide an appropriate space for setting up the pellet production plant. The site owner shall also provide land for a temporary office area and equipment storage for the duration of the installation period.

2) Preparations within the Moldovan side scope of work

Preparatory work to be performed by the Moldovan side under the agreed scope of work shall be completed before the pellet production equipment is transported to the installation site.

(3) Common Subjects for Both Boilers and Pellet Production Plant

1) Utilities

Site owners shall provide necessary utilities including electricity and water for the Project, for the duration of the installation period.

2) Operating personnel

Prior to the start of installation work at each site, the respective site owners shall ensure the provision of sufficient numbers of personnel for equipment operation.

3) Approvals

All required applications, permits and other necessary approvals for installation of the facilities, including building certifications, must be approved without delay prior to or during installation.

4) Exemption

Japanese companies participating in the Project shall be exempt from all relevant taxes (e.g. import tax, VAT, levy) for importation from Japan of equipment/materials for the installation and for purchase in Moldova of equipment/materials/services for the installation.

5) Expedience provision

Appropriate efforts shall be made to ensure expedience for project materials and equipment that must be imported from Japan. Appropriate expedience should include timely offloading, and clearance of customs and smooth inland transportation. Appropriate efforts shall also be made to ensure expedience in entering and staying in Moldova (for the duration of each person's role in the Project) for Japanese and other international workers engaging in this project.

6) Ensuring safety and security

Local security circumstances shall be kept stable, and shall not cause any harm or significant risk

of harm to the personnel, construction and installation, and equipment procurement related to the Project.

(4) 2KR-PIU

1) Internet connection

Stable internet connection must be ensured at 2KR-PIU facilities prior to the start of pellet boiler operation.

3.2 Necessary Inputs by Recipient Country

The following responsibilities are entrusted to the Moldovan side, in order to successfully implement the overall project plan:

- The relevant groups (e.g. Communes and/or Rayons) shall secure the necessary budget required for operation and maintenance (including labor costs).
- Relevant supplementary systems for operation and maintenance of the Project shall be established (including 2KR-PIU monitoring activity).
- Continuing awareness/educational activities shall be carried out by the Moldovan side.

3.3 Important Assumptions

The following external contingencies shall also be met:

- A system for parts supply and maintenance of the installed equipment/machinery shall be established by group of manufacturers, exporters/importers and sales/technical agents.
- Observational data shall be collected, retained and managed appropriately and shall be shared with outside agencies/organizations and donors, to encourage the further dissemination of biomass use.

3.4 Project Evaluation

3.4.1 Relevance

This project seeks to act as a model implementation to promote the increased utilization of biomass, a domestic energy source, as fuel. To accomplish this goal, the Project will include demonstration of all procedures from pellet production to the use of biomass as fuel (pellets and unprocessed biomass). An expected secondary effect of the Project is the recognition and promotion in Moldova of Japanese companies and technologies. The following items are considered as a basis for showing the validity and pertinence of this project;

1. Beneficiary population of the Project will be up to 10,421 people. These are the anticipated direct users of the target public facilities for installation, including schools, kindergartens (this number does not include the 2KR-PIU site beneficiary).
2. The Moldovan national agricultural development plan "National Strategy of Durable Agro-industrial Sector Development, 2008-2015" enumerates the following priority policies;
   1) Sustainable economic growth in rural areas,
   2) Reduction of poverty and inequality; encouraging the participation of citizens in local activities.
   3) Living/Dynamic infrastructure development and improvement.

   In addition, "PLAN Government actions for the period 2011-2014" which is the national development plan, is prioritizing the utilization of biomass as well.
3. The Project will contribute to improve living and learning environments through the winter season in the target rural areas.
4. Moldovan domestic industries associated with the use of biomass are expected to grow (e.g. biomass fuel production/sales, manufacturing and sales of parts/ equipment, maintenance, and operational management).

5. This project is intended as a model to show the effectiveness of pellet boilers systems and infrastructure, not only through boiler installation but also through demonstrating the necessity of the pellet fuel supply chain. The model will function as an effective demonstration encouraging the further spread of renewable energy development in Moldova.
6. The Project is expected to use Japanese technologies, and thereby to present an opportunity for small and medium Japanese enterprises (SMEs) to expand business in Moldova.
7. The Project will contribute to reduction of GHG gas emissions.
8. The introduction of funding from the Japanese Grant Aid system ensures that the Project can be carried out without great difficulty.
9. The Project was initiated at the request of the Moldovan government to Japanese government, in order to achieve Moldova's middle- and long-term development plan objectives.

Based on these factors, the Project is considered to be both valid and pertinent.

3.4.2 Effectiveness

The following effects of implementing this project are expected:

(1) Quantitative Effects

1) Boiler operator job creation

Compared with existing coal-fired boiler operation at the target sites, pellet boiler operation requires fewer operators, due to the comparative ease of fuel supply work (from 3 to 2 personnel). However, the introduction the pellet boilers will increase the number of operators at site currently using natural gas-fired boilers, because of the need for fuel supply and ash clearing work (from 0 to 2 personnel). In total, the Project will create 26 new jobs compared to the existing system, and the total number of jobs at the 25 sites will increase from 24 to 50. Additionally, at least 8 new jobs will be created by the installation of the planned pellet production plant.

2) Heating cost reduction

The current fuel sources at the 25 target sites are coal (8 sites), natural gas (16 sites), and electricity (1 site). Respective boiler capacities by fuel sources at the 25 sites are 46.1% coal, 48.0% natural gas and 5.9% electricity. Taking the average operating time ratios of the existing boilers (17% of 180 days/year) into account, annual heating costs will be reduced by an estimated 6,753,361 to 5,602,845 MDL, approximately 82.9% of current heating costs.

3) GHG reduction

By replacing the existing fossil fuel boilers (coal, natural gas, electricity) with pellet boilers annual CO_2 emissions will be reduced by an estimated 5,629.2 tons in total.

(2) Qualitative Effects

Expected qualitative effects are as follows.

- Heating system installation will improve living and learning environments in target rural communities.
- The Project will contribute to climate change mitigation efforts, national energy strategy objectives and diversification of energy sources.
- Introduction of the planned model pellet supply chain will promote further pellet production and pellet boiler installation.
- The Project will promote biomass utilization in target areas and surrounding countries due in part to energy security concerns. The Project will spur the development of biomass related industries in Moldova.
- Target facilities (schools, kindergartens and other public buildings) will inform and raise awareness among community members, thereby creating an effective system for education and dissemination of information about renewable energy and biomass.

In addition, the Project will support “the promotion of energy efficiency and economical utilization of renewable energy resources”, one of the strategic objectives of the Moldovan "National Energy Strategy to 2020". The Project also contributes to following policy targets declared under the “Law on Renewable Energy”:

- To diversify primary energy sources in the country.
- To achieve a target share of energy supply from renewable energy sources (10% in 2015, 20% in 2020).
- To develop a system for energy resource production, distribution and commercialization, rational energy utilization and fuel source security
- To provide and share information for the development of renewable energy business