



Survey findings

Market conditions for biomass-to-energy
projects in Ukraine

In partnership with:



In partnership with the Finnish Ministry of International Affairs, the Free State of Saxony (Germany), and the Agency for International Business Cooperation within the Dutch Ministry of Economic Affairs.

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Acknowledgements

This report was prepared by a team of IFC staff, including Kristina Turilova, Viera Feckova, Olga Iakymenko, Maria Kuznetsova, Roman Novikov, and Stratos Tavoulareas, as part of the IFC Ukraine Resource Efficiency Program.

The Program is implemented in partnership with the Free State of Saxony (Germany), the Finnish Ministry of Employment and Economy, and the Agency for International Business and Cooperation of the Dutch Ministry of Economic Affairs.

The authors wish to thank GfK Ukraine, a leading market research company in the country, and Tetiana Sytnyk for conducting the survey.

The authors also wish to express deep gratitude to the following companies and experts who provided valuable input in the preparation of this report.

- Bo Eske Nyhus, Senior Investment Manager, NEFCO;
- Georgii Geletukha, Chairman, Bioenergy Association of Ukraine (UABio);
- Mykola Kolomyichenko, President, Ukrainian Pellet Union;
- Petra Schwager, Program Manager, UNIDO.

Background

This report is based on the survey conducted in 2015 by GfK Ukraine. Its objective is to analyze market conditions for biomass-to-energy projects in Ukraine, as well as their types, key drivers, and barriers to implementation. The survey has been conducted among 200+ local stakeholders: pellet producers, agricultural producers (agro-holdings), as well as municipal energy suppliers.

Survey findings

Market conditions for biomass-to-energy
projects in Ukraine

Opening remarks

The agricultural sector receives significant attention from NEFCO for its potential in bioenergy development and the reduction of emissions of climate gases. It produces one of Ukraine's bulk export goods. Many of the agro-businesses are large and financially sound; and unutilized biofuels are available in excess quantities. The major challenge is the lack of experience developing solutions for replacing old boilers and incorporating residual waste from farming activities to achieve cost efficiency and farm-based climate-smart bioenergy systems.

Bo Eske Nyhus,

Senior Investment Manager, NEFCO

The development of bio- and biomass energy is of strategic importance for countries with a strong focus on agriculture, such as Ukraine. According to the World Bank, Ukraine's agriculture sector contributed 11.8 percent value added to the country's GDP in 2014. The country has enormous potential for the use of biomass for energy generation. Lastly, working with international partners and specialized agencies such as UNIDO, Ukraine can achieve impressive targets in terms of renewable energy and resource efficiency.

Petra Schwager,

Program Manager, UNIDO

Preface and about the survey

Biomass globally and in the EU

Globally, by 2050 biomass could provide 3,000 TWh of electricity, or around 7.5% of the world's generation, and could create 1.3 billion tons of CO₂ equivalent emission savings per annum. In addition, biomass could provide 22 exajoules (EJ) of final heat consumption in industry (15% of the total) and 24 EJ in the buildings sector (20% of the total) by said year.

According to an IEA report,¹ biomass heat and electricity can already be competitive with fossil fuels today. Satisfying the demand will require around 5-7 billion dry tons of biomass by 2050 for electricity and heat production. International trade in biomass thus will be vital to match the demand and will require properly functioning value chains.

Potential use of biomass for energy generation is a significant part of the EU 2020 Energy Strategy whereby heat and power production from biomass is expected to reach 1,650 TWh in 2020, making more than doubling from today's level of 800 TWh.²

Biomass in Ukraine

According to an IRENA report,³ Ukraine has the potential to increase renewable energy use tenfold from 87 petajoules (PJ) in 2009 to 870 PJ of the total final renewable energy in 2030. Out of this, 73% is accounted for heat, 20% by electricity generation, and 7 % by transport. Nearly 80% of this total comes from biomass technologies including heating buildings and industrial plants (particularly district heating), power generation, and transport fuels.

Ukraine can contribute to the EU renewable targets, as imports of biomass to Europe will be needed. Even if the "aggressive supply mobilization" scenario in Europe were to fully materialize, annual imports of 150-750 TWh of primary energy would be needed to meet the EU targets. These imports will probably be in the form of pellets for the most part, due to their lower transport costs. The volumes above correspond to between 30 and 150 million tons of pellets, or the output from 50 to 300 large-scale pellet mills.

Given Ukraine's unique climate and natural resources, biomass represents a strong market opportunity for the country from the viewpoints of energy security, energy generation, and integration into the biomass supply chain.

¹ OECD/IEA, 2012 Technology Roadmap: Bioenergy for Heat and Power.

² European Climate Foundation, 2010 Biomass for heat and power: Opportunity and economics.

³ IRENA, 2015 REmap 2030: Renewable Energy Prospects for Ukraine.

What would it take for Ukraine to realize market opportunity?

The Ukrainian biomass-to-energy market is just starting to evolve. This survey has been launched to gauge perceptions and attitudes towards this market opportunity among key local players. These attitudes will shape investment and operational decisions in the short run, but the survey may also reveal how they could change due to a better understanding of opportunities and thus lead to more informed and appropriate decisions in the long run.

The survey has been conducted among 200+ local stakeholders: pellet producers, agricultural producers (agro-holdings), as well as municipal energy providers. The survey was conducted in January-March 2015. It gives insights into wider market players' acumen and will be helpful for policy decision makers to shape potential support responses, for vendors to understand potential market opportunities, and for financial institutions to understand which financial instruments will be best suited. We have supplemented the survey findings with some recommendations from technical and financial experts experienced in developing and financing similar projects in Europe and globally. We hope that this report will provide useful information and support the future development of the Ukrainian biomass market.

Executive summary



The structure of the Ukrainian biomass-to-energy market is taking shape

The **supply side** of the market is represented by the forestry and wood processing companies and crop and animal farms that are sources of biomass. Pellet producers process available waste into pellets. Boilers for burning biomass are available in the market from either local producers or importers.

Biomass-to-energy facilities produce electricity and/or heat for a variety of users (industrial, commercial, and residential). In some cases, users generate electricity and/or heat for their own use. In others, (private or municipal) electricity/heat producers sell to end-users directly or through the power grid. Biomass-to-energy facilities may use biomass only or in combination (co-fired) with other fuels (oil, gas, or coal).

The **demand side** is represented by biomass-to-energy facilities:

- Companies or individual users that burn biomass to produce energy (electricity or heat) for in-house consumption. This segment includes industrial companies, crop and animal farms, individual households, schools, and hospitals which install biomass-burning boilers to receive energy. They may use own-sourced biomass or procure it, particularly from pellet suppliers.
- Private and municipal heat suppliers. The former install biomass boilers and sell heat to customers such as schools, hospitals, and small industrial plants. The latter use biomass boilers together with traditional fuel (mainly, natural gas) boilers to reduce the cost of energy.
- Electricity generators. These companies implement projects with the objective of selling electricity to the national grid. For instance, animal farms process biomass into biogas and sell electricity to the grid.

The Ukrainian biomass-to-energy market is rather fragmented. There is a lack of established links in the market between players, which prevents it from smooth functioning.

The most robust segment of the market is that of municipal heat supply. Heat-supplying companies, both municipal and private, are the most active users of biomass for energy generation:

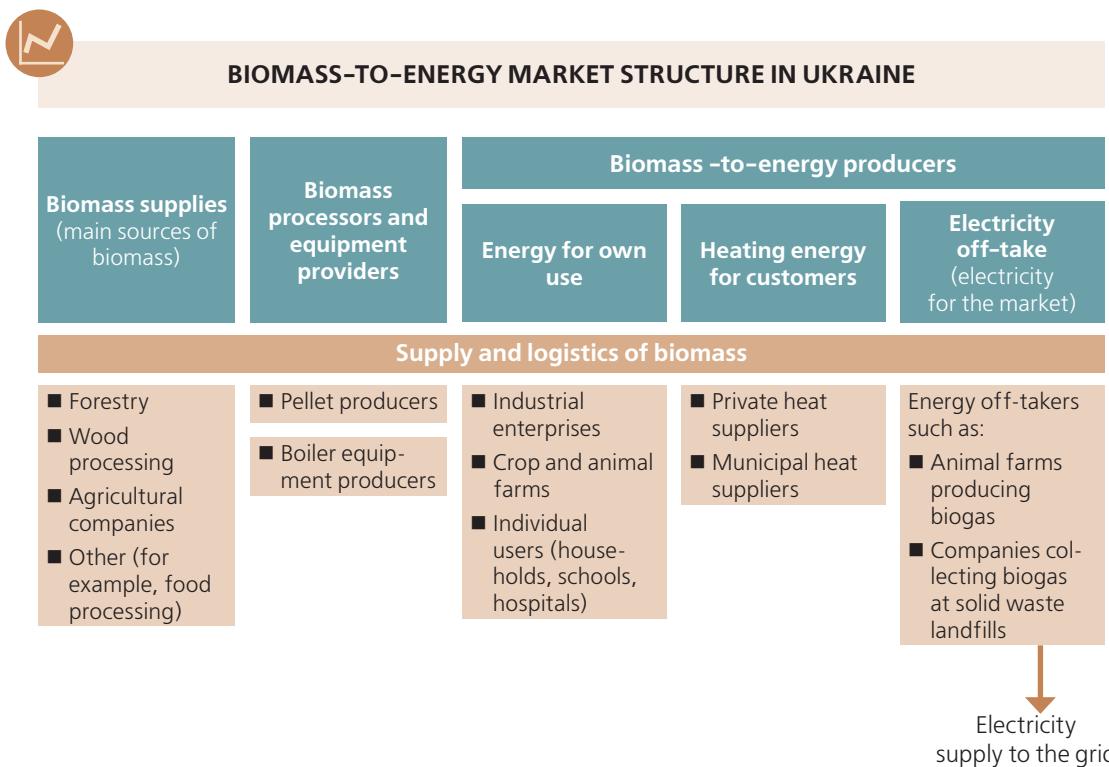
- More than one third (36%) of all the surveyed heat-supplying companies use biomass boilers. Most of them run both gas and biomass boilers. Combined usage of traditional fuel and biomass (co-firing) is very rare among those polled.
- Another 27% of the total number of surveyed heat suppliers have designed a project to install biomass boilers.

Demand for biomass-to-energy initiatives has been growing in Ukraine, being driven by the motivation of cost savings and increased efficiency. In the short term, the share of heat suppliers using biomass boilers could grow up to 63% of all the surveyed players. Despite the expanding share of municipal heat suppliers using biomass boilers in the total number of companies, the share of biomass in the overall volume of fuel consumed by the surveyed entities remains low (14%). The most common fuel is natural gas, with a share of 80% in the total volume of fuel used by municipal heat suppliers.

Competition is intensifying in the heat-supplying segment of the biomass-to-energy market. Nearly a quarter (23%) of the surveyed municipal heat suppliers have reported cases of clients switching off the heat supply after installing their own biomass boilers. Schools, hospitals, and other social institutions are those most frequently named for discontinuing municipal heat supply and installing their own biomass boilers. These entities are also the most common clients for private heat suppliers using biomass.

Private heat suppliers have been **actively entering the biomass-to-energy market**. They install and operate boilers generating heat to be delivered to clients (usually schools, hospitals, and small businesses).

Another important segment of the biomass-to-energy market is industrial enterprises using biomass to produce energy for in-house needs. According to the survey of pellet producers, about 20% of their sales go to industrial enterprises. As a result, industrial enterprises and private heat suppliers are the key domestic customers of pellet producers in Ukraine.



Although agricultural companies have direct access to biomass, they are not its leading users for energy production. In total, 11% of all the surveyed agro-companies use their agricultural waste for burning in their own boilers. About 14% have considered using crop residue in boilers to reduce energy cost; 13% of the big farms have considered installing a biogas plant, but only 2% have designed a project to install a biogas plant.

Agricultural companies are reluctant to sell their agricultural waste to pellet producers. Currently, 14% of the agro-companies reported that they cooperate with pellet producers and only 8% of them plan to start doing so. In the meantime, 7% of the surveyed companies have already started their own pellet production and 18% are going to do so. These companies are motivated to produce pellets to use them for their own energy needs, as opposed to selling them widely to the market.

Electricity generation projects are very rare in Ukraine. The key to the implementation for the implementation of these projects are the large initial investment in equipment, additional investment in the electricity grid, technical risks, significant operation costs, and the instability of green tariff regulation. In addition, co-firing of biomass with other fuels does not qualify for the renewable feed-in tariff.

Financial constraints are the key impediment to further development. They include a high bank loan interest rate, the need for a large initial investment in equipment, and the need for additional investment in logistics and storage capacities for biomass.

Additionally, the shortage of biomass of required quality is considered the main risk when it comes to implementing biomass-to-energy projects. The shortage of biomass and the growing demand for it pushes prices up, which increases the cost of a project and the uncertainty regarding the investment payback period.

The current biomass supply in Ukraine is unbalanced, which may lead to an even greater biomass shortage in the future. Wood, including raw wood, unprocessed wood, and wood pellets, is the main type of biomass currently used in Ukraine. The usage of agricultural waste is limited.

This imbalance creates the risk of unsustainable forest management and regional limits in implementation of biomass-to-energy projects (they are mainly implemented in regions with greater availability of wood).

Adjustment of the supply of biomass to meet the growing demand for it will require:

- Investment in collection and treatment of biomass, its storage, and logistics at all levels of the supply chain, including raw biomass suppliers, and
- Closer links and cooperation between market players, particularly among the agricultural companies and pellet producers.



1 Municipal heat suppliers

The most dynamically developing segment of the market is that of district heat supply.

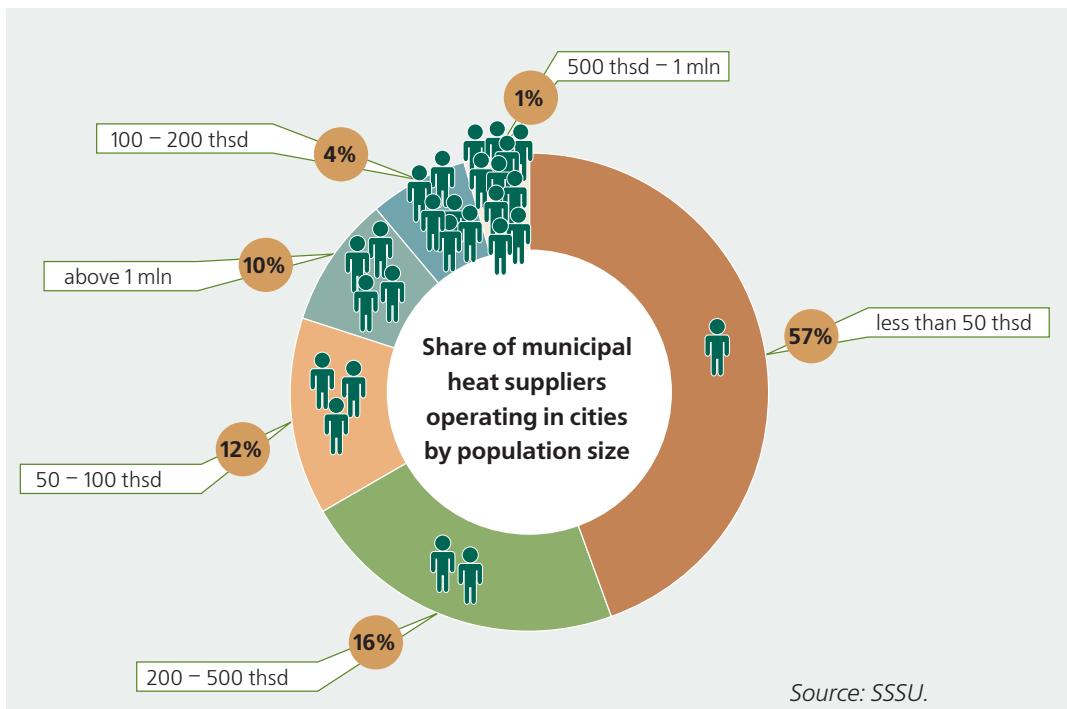
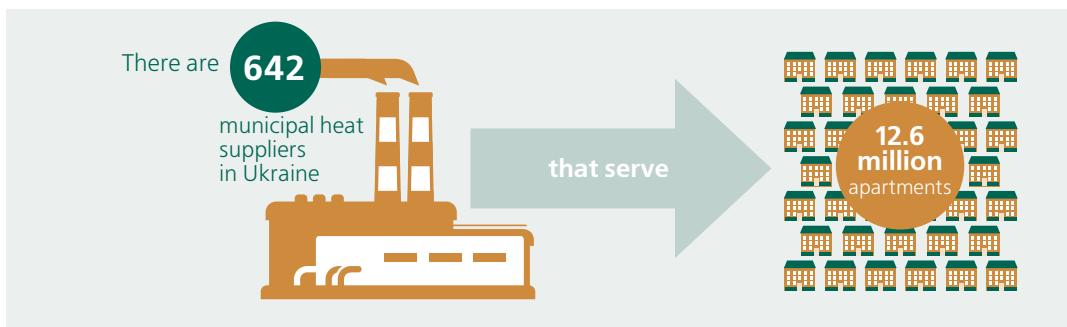
Heat suppliers, both municipal and private, are the most active users of biomass to produce energy:

- More than one third (36%) of all the surveyed heat-supplying companies use biomass boilers. Most of them operate both gas and biomass boilers. Combined usage of traditional fuel and biomass (co-firing) is very rare among those polled.
- Another 27% of the total number of heat suppliers surveyed have designed a project to install biomass boilers.

Despite the expanding share of municipal heat suppliers using biomass boilers **in the total number of companies**, the share of biomass **in the overall volume** of fuel consumed by the surveyed entities remains low (14%). The most common fuel is natural gas, with a share of 80% in the total volume of fuel used by municipal heat suppliers.

Competition is intensifying in the heat supplying segment between municipal and private suppliers. Nearly a quarter (23%) of the surveyed municipal companies have reported cases of clients switching off the heat supply after installing their own biomass boilers. Schools, hospitals, and other social institutions are those most frequently named for discontinuing municipal heat supply and installing their own biomass boilers. These entities are also the most common clients for private heat-supplying companies using biomass.

Private heat suppliers have been **actively entering the biomass-to-energy market**. They install and operate boilers generating heat which is delivered to clients (schools, hospitals, and small commercial companies). Their importance in the biomass-to-energy market is proven by the evidence from the pellet producers survey. According to those polled in that survey, about 20% of their pellet sales go to private heat suppliers.



Biomass utilization and replacement of natural gas in district heating systems (budget-financed consumers and commercial companies) is expected to rise to 3.2 bln m³ annually by 2020 (from 0.14 bln m³ in 2013).

Source: UABio.

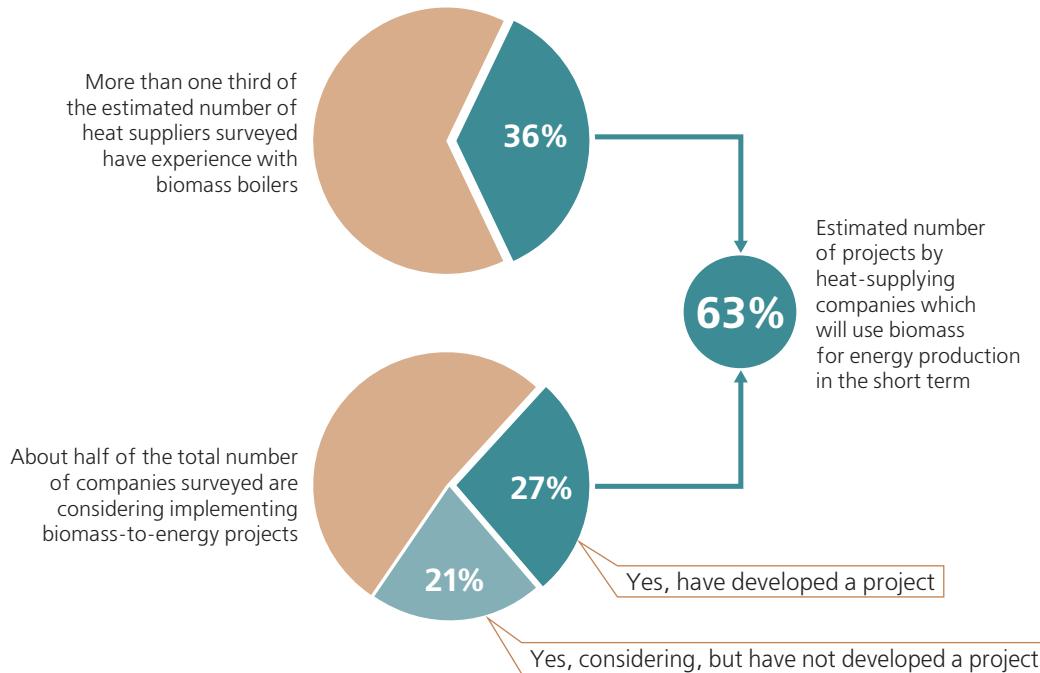
Current and planned usage of biomass by heat-supplying companies

In the short term, the share of heat-supplying companies using biomass boilers could go up to 63% of the total number of entities surveyed. This is estimated as a sum of the shares of those currently using biomass boilers (36%) and those that have a project designed to install them (27%).⁴

Municipal heat supply is the most dynamically developing sector of the biomass-to-energy market in Ukraine



CURRENT AND PLANNED USAGE OF BIOMASS BY HEAT-SUPPLYING COMPANIES



⁴The share of the total number of companies that use biomass is implied here. At the same time, they can use other types of fuels, such as gas, coal etc.



There is a stable trend of public and commercial consumers replacing gas boilers with biomass installations. During the 2014/2015 heating season, about 450 MWh of biomass boilers were installed in the public sector alone.

At present, wood biomass (like wood chips, firewood, and pellets) is the most commonly used type of biomass for heat generation. Nevertheless, a number of schools and other public buildings in rural areas, as well as agro-companies, resort to straw (both as bales and pellets) for the same purpose. In our opinion, looking forward, the number of boilers running on straw and other agro-waste (like maize stalks, maize cobs, and sunflower stalks) will increase considerably while the rise in the number of wood-fired boilers will be comparatively limited.

Another promising option for heat is the use of energy crops (like willow, poplar, and miscanthus). This is due to the structure of available biomass resources in Ukraine, the main constituents of which are agricultural residues and energy crops with a comparatively small volume of wood biomass.

We believe that the development of the market for biomass as a fuel will be accompanied by increasing biomass prices, although this trend is not as pronounced as that of natural gas and other fossil fuels. With the further development of the biofuels market and the entry of a large number of competing suppliers, biomass prices will probably stabilize at a market-driven level.

Georgii Geletukha,
Chairman, UABio

Current usage of biomass as fuel

Natural gas is the main fuel used by municipal heat suppliers; it accounts for 80% of the total volume.

Raw wood, unprocessed wood waste (sawdust, wood chips), and wood pellets are the most commonly used type of biomass to produce energy by municipal heat suppliers. The usage of agricultural waste is quite rare, as only one company mentioned using pellets made from sunflower husk.

The share of biomass in the total volume of fuel used stands at 14%.

Wood is the most commonly used types of biomass.

Raw wood and unprocessed wood waste is used by 32% of the surveyed companies, and its share in the overall volume of fuel used is 9%. Wood pellets are utilized by 21% of the companies and account for a 5% share of the total volume of fuel used. The key reason for choosing this kind of biomass is its accessibility compared to other options. Heat suppliers obtain raw wood, wood waste, and wood pellets either from forestry enterprises or from private companies. Two companies have mentioned having in-house sources of biomass.



CURRENT USAGE OF BIOMASS AS FUEL BY HEAT-SUPPLYING COMPANIES

Types of fuel used

% of the total number of companies surveyed

86

Natural gas

32

Wood or wood waste

21

Wood pellets

18

Coal

5

Peat

2

Pellets from sunflower husk

Types of fuel used

% of the total volume used

9

5

1

Other

Ways of using biomass

% of the total number of companies surveyed

As co-firing

6

For a separate plant

94

Sample: 44 respondents

Sample: 44 respondents

Sample: 16 respondents that use biomass

Respondents were allowed to select multiple answers from the list of choices.

Drivers and barriers for biomass-to-energy projects

The most frequently mentioned drivers that can accelerate implementation of biomass-to-energy projects are as follows:

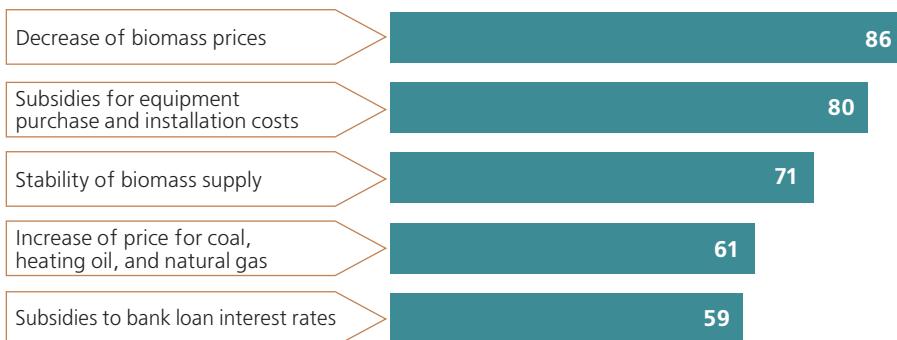
- A decrease in biomass prices (this was mentioned by 86% as compared to 61% who mentioned an increase of prices for coal, heating oil, and natural gas as the driver to implement biomass projects),
- Government subsidies for a share of equipment purchase and installation costs (mentioned by 80% of the respondents),
- Stable biomass supply,
- Subsidies to bank loan interest rates.

A decreasing price of biomass is the key driver for its use.



KEY DRIVERS TO IMPLEMENT BIOMASS-TO-ENERGY PROJECT

% of all the surveyed heat-supplying companies which consider the driver to be important



Respondents were allowed to select multiple answers from the list of choices.

The key barriers are also related either to significant upfront investment or to the lack of stability of biomass supply. The top barriers to the implementation of biomass-to-energy projects by heat-supplying companies are as follows:

- A high loan interest rate,
- Large initial investment,
- A lack of confidence in stability of biomass supply,
- Additional investment required for biomass storage,
- A lack of government support for biomass-to-energy projects.

High loan interest rates and initial investment are perceived as the key barriers for biomass-to-energy projects.



KEY BARRIERS TO IMPLEMENT BIOMASS-TO-ENERGY PROJECTS

% of all the surveyed heat-supplying companies which consider the barrier to be important



Respondents were allowed to select multiple answers from the list of choices.

When comparing technological risks related to producing energy from biomass and traditional fuel, the shortage of biomass of required quality is the key concern of heat-supplying companies. Another important risk associated with usage of biomass is that of unstable energy output (as a result of unstable quality and heat content in the input biomass). About half of the surveyed companies are concerned about the quality of equipment used for biomass burning.



The key barriers to implementing biomass-to-energy projects identified in the survey are for the most part correct. However, this should be supplemented by another important impediment, i.e. the still subsidized price of natural gas for district heating.

The drivers mentioned in the survey are desirable for accelerating biomass-to-energy projects but do not exist now. Among the available drivers we can point to the following: the increasing price of natural gas in the commercial sector and for those that own individual homes, availability of the feed-in tariff for renewable power that can enable introduction of biomass CHP plants, and availability of the stimulus tariff for heat produced "not from natural gas" for public sector consumers. In the near future, we expect that a similar stimulus tariff will be introduced for heat generated "not from natural gas" covering the general public heated through DH systems and also that a simplified procedure will be in place for allocation of land for construction of renewable energy installations.

Georgii Geletukha,
Chairman, UABio

2 Pellet producers



Pellet producers represent the supply side of the biomass market. They process waste into pellets, which are sold to municipal heat suppliers, industrial enterprises, and other customers for production of energy.

The pellet producers are optimistic about their business prospects:

- About one third of those surveyed reported that their output volume increased in 2014 as compared to 2013, while one fourth indicated a decrease in production. The output growth rate is estimated to be over 20% by most of the pellet producers which reported an increase in production.
- Pellet production is mostly a profitable business, as 61% of the pellet producers reported turning a profit in 2014. The share of loss-making pellet producers is 22%, according to the survey.
- Pellet producers are even more optimistic about their business prospects in 2015 as compared to 2014: 44% of them expect their business to expand, as compared to 7% who anticipate a decline.

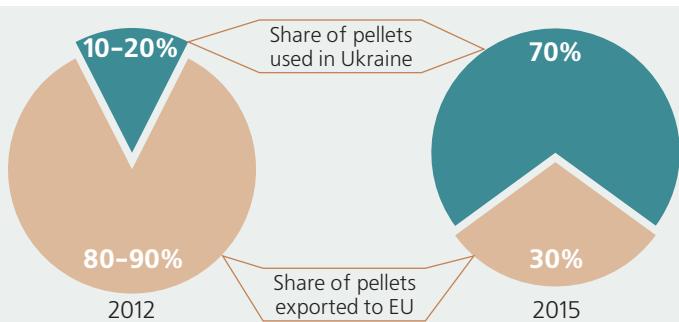
Business prospects in the pellet market are not limited by strong competition. Most of the surveyed producers do not feel any stringency in the market, with only 17% assessing competition as strong. The pellet producers are not restrained by capacity limits and can easily expand production: more than half of the surveyed pellet producers (59%) reported a capacity utilization rate below 90%.

Pellet production in Ukraine

The total production reached about 1,500 kilotonnes (kt) in 2014 and is expected to rise 5 times to 7,500 kt by 2020*



* The Ukrainian Pellet Union.



80-90% of Ukrainian pellets were exported to EU countries till 2012.*

In 2014-2015 the share of pellets used in Ukraine was increasing. It is expected to reach 70% in 2015.

*CRES, 2012.

Production

The most common pellet business in Ukraine is producing wood pellets. All the surveyed pellet producers manufacture wood pellets. Additionally, three companies produce pellets from sunflower husk. Other kinds of pellets produced in Ukraine include cereal straw pellets, corn stalk pellets, and sunflower stalk and head pellets. Each of them was mentioned by one company only. More than half of those surveyed (54%) are focused solely on pellet production. The rest combine it with other activities, the most common of which is wood processing.

The share of pellet producers which increased production exceeded that of those who saw a decline in output.

One fourth reported a decrease in production due to the economic crisis and lower demand.



PELLET PRODUCTION BUSINESS LANDSCAPE

Types of pellets produced,
% of the surveyed pellet producers

Wood pellets, or briquettes	100
Sunflower husk pellets	7
Spiked cereals straw pellets	2
Corn stalks pellets	2
Sunflower stalks and heads pellets	2
Peat pellets	2

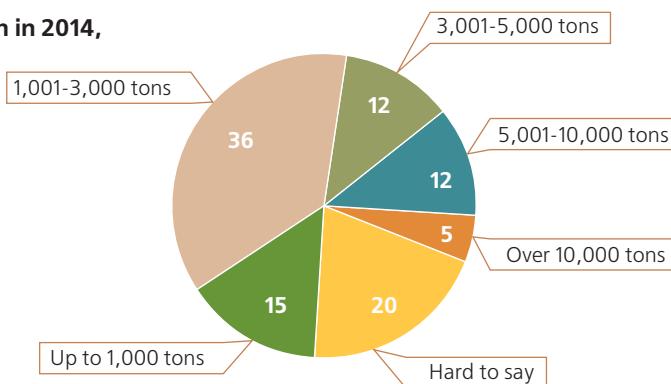
Other activities,

% of the surveyed pellet producers

Do not have other activity types	54
Wood processing	22
Other	10
Production/sales of boilers	7
Production/sales of charcoal	5
Forestry enterprise	2

Respondents were allowed to select multiple answers from the list of choices.

Volume of pellet production in 2014,
% of the surveyed pellet producers



In most of the cases, the annual volume of pellet production per company ranged from 1,000 to 3,000 tons in 2014.

Raw material supply

Wood waste is the main raw material for pellet production, as it is used by 95% of the surveyed pellet producers, with its share reaching 87% in the total volume of raw materials. The use of agricultural waste is rare, with sunflower husk being mentioned most frequently.

Raw materials are mainly supplied by external vendors, 88% of the total being procured from them, while the remaining 12% are obtained from producers' own enterprises. In most of the cases, the pellet producer cooperates with 2 to 5 vendors on a regular basis. Frequent changes of suppliers are usually avoided.

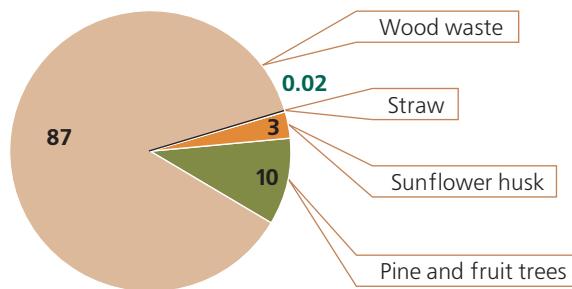
Wood waste is the main raw material for pellet production.

Its share reaches 87% in the total volume.

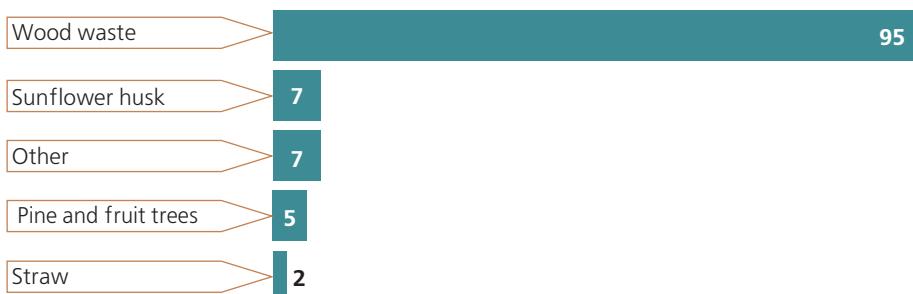


USAGE OF RAW MATERIALS FOR PELLET PRODUCTION

Volume distribution of raw materials, % of the total raw materials used



Types of raw materials, % of the total number of pellet producers surveyed



Respondents were allowed to select multiple answers from the list of choices.

EU pellet market development snapshot

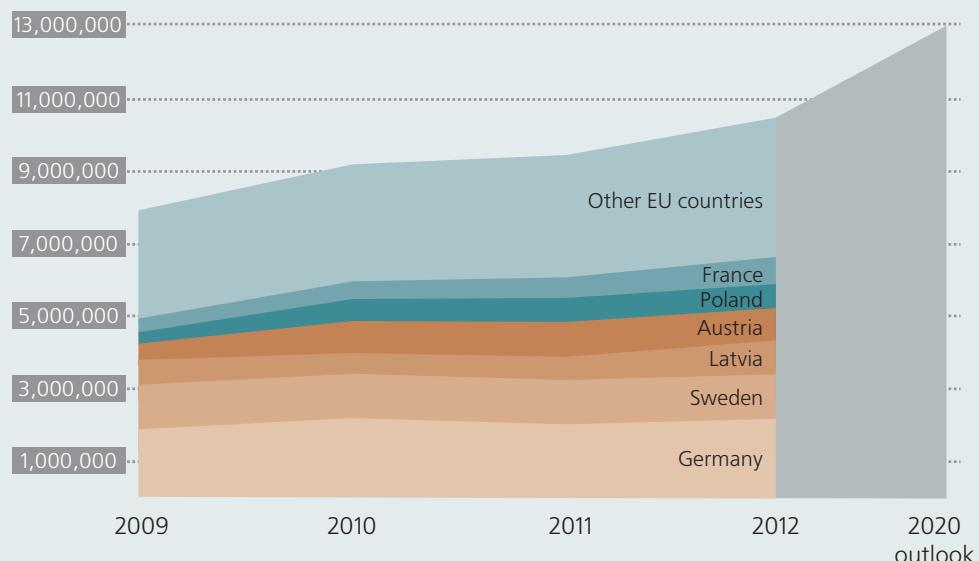
Europe is the biggest producer of wood pellets in the world (50%), with over 12.2 mln tons of them delivered in 2013.

Europe is the biggest consumer of wood pellets in the world (70%), with 18.3 mln tons of pellets utilized in 2013.

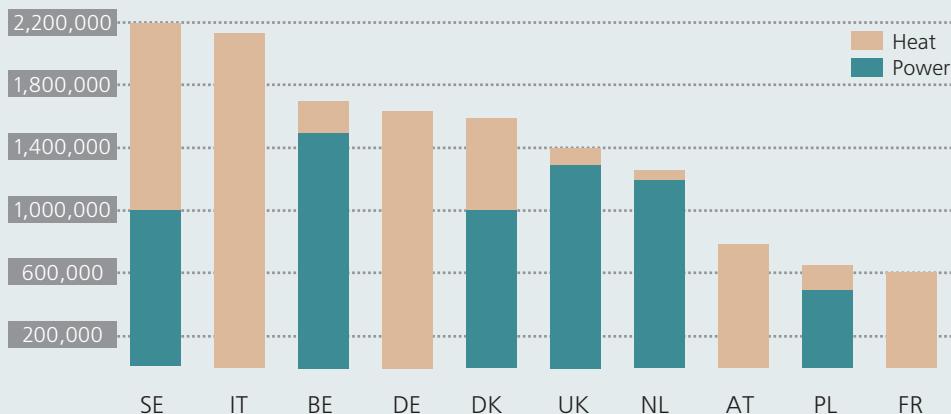
0.28 mln tons of pellets were imported from Ukraine and Belarus in 2013, which accounted for 4.6% of overall EU imports.

The share of extra-EU biomass is projected to increase to 6-7% in 2020 and 12-13% in 2030. The role of traded biomass and especially extra-EU trade is increasingly important.

EU wood pellet production (tons)



Share of EU wood pellet consumption in 2012 (tons)



Source: AEBIOM.

Pellet sales

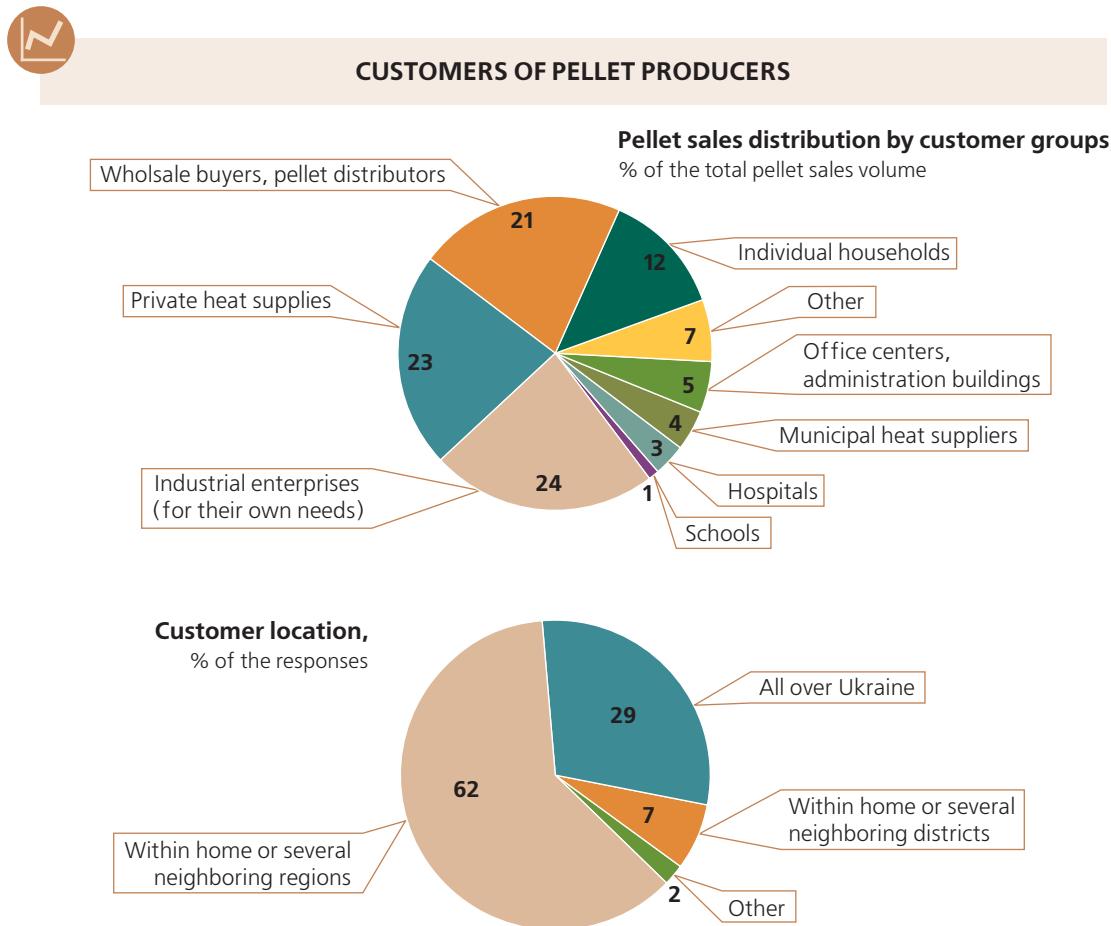
One third of the surveyed producers sell products exclusively on the domestic market, while two thirds combine exports and domestic sales. The export share averages 40% (according to the survey). The key domestic customers for pellet producers are the following:

- industrial enterprises that buy pellets for in-house energy production needs,
- private heat suppliers,
- pellet wholesalers.

More than 60% of the total pellet sales go to the three groups of customers: industry, private heat suppliers, and wholesale buyers. Pellets are also sold to retail customers such as individual households, office centers, hospitals, and schools.

The geography of pellet sales on the domestic market is relatively wide:

- 61% of the surveyed pellet producers sell their pellets within the region (home and neighboring region)
- 29% sell pellets all over Ukraine.



Plans of pellet producers

The pellet producers are optimistic about their future prospects and plan expansion of their business:

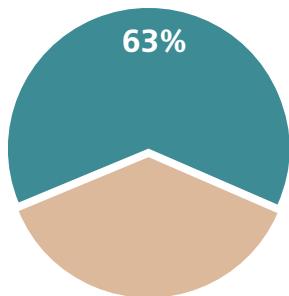
- 63% plan to increase production capacity;
- 20% plan to produce pellets from new types of raw materials (spiked cereals straw and sunflower husk are of the greatest interest);
- 61% plan additional investments in the logistics system (trucks and storages).

Pellet producers are optimistic about their future prospects and plans.

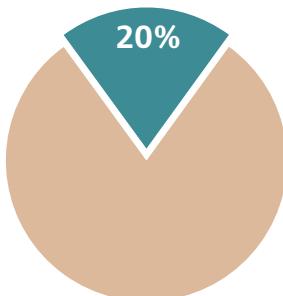


FUTURE PLANS OF PELLET PRODUCERS

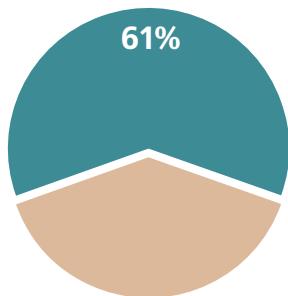
Plan to increase production capacity



Plan to use a new raw material



Plan additional investments in the logistics system



As for the drop in pellet exports, currently the EU, a major market for Ukrainian pellets, has very strict requirements for certification of solid biofuel. Ukrainian companies (with the exception of 3) do not comply with the rules. This is why their products are delivered via intermediaries (Poland, Czech Republic, Slovakia, etc.) that present the Ukrainian pellets as their own produce.

As for the increase in pellet consumption on the domestic market, due to the government's program to promote projects to replace natural gas in heating, there has been a hike in domestic consumption of pellets in 2014-2015. The trade mark-up is the same for both exports and the national market. As of today, the ratio between national consumption and exports is 70 to 30, respectively. It is projected to reach 75 to 25 by year-end 2015.

Mykola Kolomyichenko,
President, Ukrainian Pellet Union

3 Agricultural companies

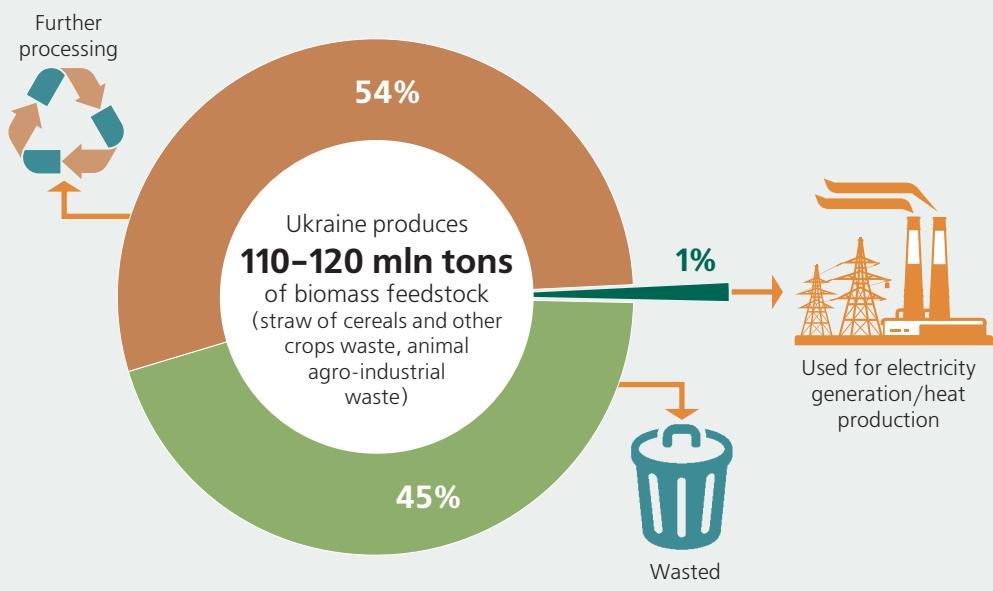


Although agricultural companies have direct access to biomass, they are not its leading users in energy production. In total, 11% of all the surveyed big arable crop and animal farms utilize their own agricultural waste in their boilers. The key impediments to the implementation of biomass-to-energy projects by farms are the large initial investment requirements and the lack of government support.

About 14% of those surveyed are considering using crop residue boilers to reduce energy cost; 13% of the big farms are considering a biogas plant, but only 2% have designed a project to do so.

Given the growing profile of Ukrainian arable crops, the most common agricultural waste from crop growing includes cereal straw, corn stalks, corn silage, sunflower stalks, heads, and husk. Most of this waste is utilized as a fertilizer for forage or bedding for animals.

Meanwhile, when it comes to producing energy for their own needs, agricultural companies use raw wood more intensively than agricultural waste. According to the survey, 30% of all the surveyed farms use raw wood as a fuel for their boilers. Raw wood is the second most common fuel after natural gas.



Use of biomass by agricultural companies

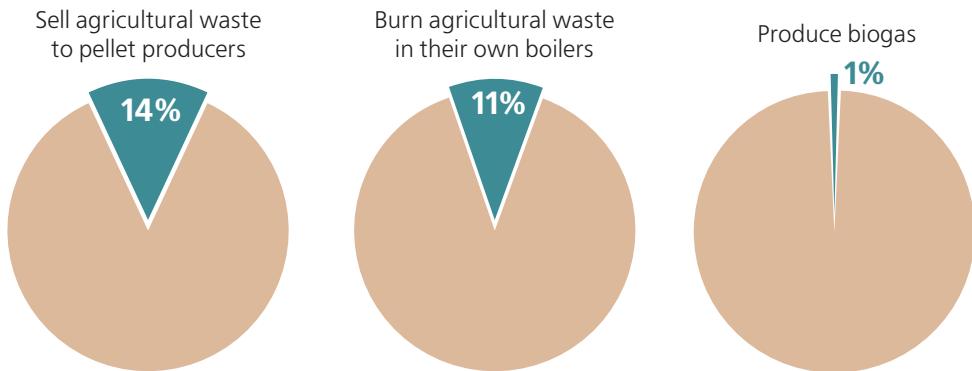
According to the surveyed agricultural companies, there are a small number of farms involved in activities related to the biomass-to-energy market.

- 14% of the surveyed farms sell agricultural waste to pellet producers (in most cases, cereal straw and/or substandard yield are sold to pellet producers),
- 11% of the farms use agricultural waste in their own boilers to produce energy for in-house needs (agricultural waste burnt includes cereals straw, sunflower stalks, and substandard yield), and
- One farm uses substandard yield to produce biogas.

There are a small number of agro-companies involved in activities related to the biomass-to-energy market.



SHARE OF AGRICULTURAL COMPANIES IN THE TOTAL NUMBER OF THOSE USING AGRICULTURAL WASTE FOR BIOMASS-TO-ENERGY PROJECTS



Baling

Baling is important for appropriate storage of waste and makes its transportation easier. It increases the quality of biomass. 80% of the surveyed agricultural companies use balers for cereal straw, and 48% of the total straw is baled on average.

Corn is an important crop for Ukraine, and agricultural companies have started using balers for corn stalks. According to the survey, 8% of the surveyed agricultural companies bale corn stalks, and on average these farms bale 50% of the corn stalks they collect. It is applied on 50% of the collected corn stalks by these farms on average.

Out of 23 agricultural companies that sell their waste to pellet producers, only 4 do so in bales. Other focus on chopped waste.

Awareness of and attitudes towards energy crops

The surveyed agricultural companies are not interested in growing energy crops: 15% report that they have studied the possibility of growing energy crops, but most of them do not plan to enter this business. They cited the following reasons for not entering the energy crop business:

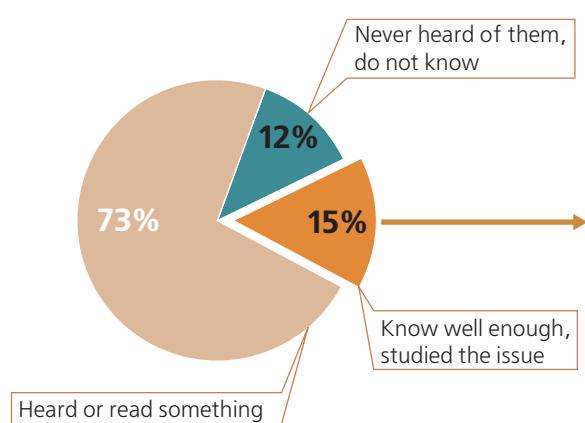
- A lack of government support and subsidies,
- No need for the company to grow energy crops,
- A lack of excess land,
- The complex cultivation technology,
- A lack of market for sales,
- A long wait before the first harvest,
- Low profitability.

Surveyed agricultural companies are not interested in growing energy crops.



ATTITUDE OF AGRICULTURAL COMPANIES TOWARDS ENERGY CROPS

15% are aware of energy crops and studied this issue



Barriers to cultivating energy crops, number of respondents

6	There is no government support, subsidies, privileges
5	There is no need in energy crops
4	A lack of excess land
3	Difficult cultivation technology
2	There is no sales market
2	A long wait until the first harvest
1	It is not profitable

Sample: 101 respondents

Sample: 14 respondents that are aware energy crops

Respondents were allowed to select multiple answers from the list of choices.

Cooperation with pellet producers

Currently, 14% of the big agricultural companies co-operate with pellet producers to supply agricultural waste for pellet production; another 16% of agricultural companies have been contacted by pellet producers and entered into negotiations on waste supply. The talks have been successful and turned into contracts only in one of four cases (4 farms reached an agreement with pellet producers out of 16 negotiators). In almost half of the cases (7 farms out of 16 negotiators), they failed.

Big agricultural companies are more inclined to implement their own biomass-to-energy projects than to sell biomass on the market.

The agricultural companies are very reluctant to cooperate with pellet producers. According to the survey, 14% of them already cooperate with pellet producers and only 8% plan to establish such cooperation.

That said, reasons for the reluctance cited by the surveyed agricultural companies are as follows:

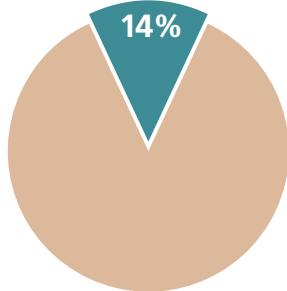
- All the waste is used at the company, no excess waste is left,
- Pellet producers offer low prices,
- Agricultural companies are not able to meet logistics and quality requirements.

On the other hand, those 8% who plan to initiate cooperation with pellet producers are motivated by earning additional revenue and more efficiently utilizing of their waste (including cleaning of fields).

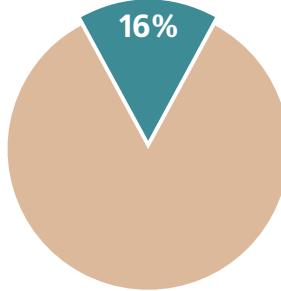


CURRENT AND PLANNED COOPERATION WITH PELLET PRODUCERS

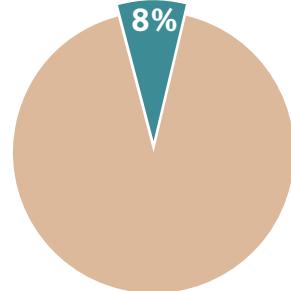
Sell agricultural waste to pellet producers



Have been contacted by pellet producers



Plan to cooperate with pellet producers





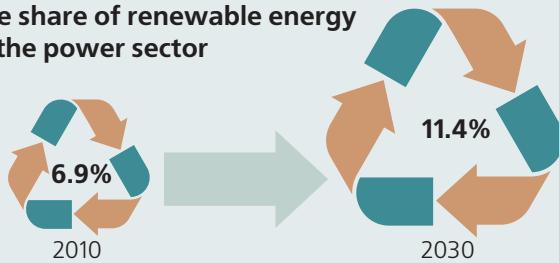
NEFCO supports the report's statement that Ukraine provides a significant undeveloped potential for investments in biomass-to-energy solutions. NEFCO is committed to municipal and private sector investments to develop a bioenergy market. An urgent and growing priority for NEFCO is to address open-field burning in the agricultural sector. Open burning contributes to lower air quality and elevates a regional health risk. The most environmentally friendly alternative to open burning is to collect residual straw and utilize it as a biomass fuel for local heat and electricity demands. NEFCO applies a multi-pronged approach incorporating education, policy support, and financing solutions in order to raise awareness, introduce Nordic technologies for controlled burning, and successfully abate short-lived climate pollutants. An extension of the Ukrainian biomass-to-energy sector would not only have a prominent positive impact on the climate globally and locally, but also strengthen Ukraine's energy security, food security, and exports.

Bo Eske Nyhus,
Senior Investment Manager, NEFCO



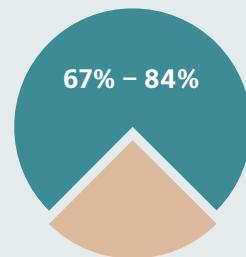
4 Electricity generators

The share of renewable energy in the power sector



The Government expects that electricity generation from biomass, often combined with district heating, will grow by **10% annually**

Biomass continues to dominate the mix, with its share (among renewables) projected to remain between 67% and 84% in the period 2010-2030.



Source: IRENA, REmap 2030: Renewable Energy Prospects for Ukraine.

Biomass could be used to produce electricity, typically in one of the three following ways:

- Biogas produced through a digester and converted to electricity in a gas engine;
- Landfill gas collected in a waste landfill area and converted to electricity in a gas engine;⁵
- Biomass burned or gasified in a power or combined heat-power plant. The plant could be designed to handle only biomass or burn it in combination with some other fuel (e.g. gas, oil, or coal).

Biogas (digester-based) tends to involve smaller systems and be more expensive than the other two options in terms of both initial capital and the cost of the energy produced.

In Ukraine, companies with access to biomass tend to choose the option of electricity, not heat for a number of reasons:

- First, selling electricity at the green tariff is more profitable compared to selling heat.
- Second, places where biogas is collected (such as animal farms or solid waste landfills) are located far from residential areas and the transportation of heat is usually inefficient and expensive. In some cases, co-generation is considered, when electricity is sold to the national grid, with heat being used internally.

For example, an animal farming company was required to invest in a 10 km transmission line to connect a biogas power plant to the grid. Moreover, investment was required to modernize transformers and other equipment owned by the operator. The cost of modernizing the grid was estimated at 10% of the total project investment.

The capacity of projects varies from 1 megawatt (landfill gas collection and processing at solid waste landfills) to 3 megawatts (biogas collection and processing at animal farms). The size of the investment is evaluated at EUR 1.5-2 million. The expected payback period is 5-7 years.

Implementation of biogas projects can be time-consuming. For instance, for one animal farm it took two years from the beginning of project design to commercial start-up. Another animal farm representative mentioned that it had taken one year just to choose the supplier of equipment. In the case of a landfill gas project at a solid waste landfill, it took three years to sign an agreement on the project between municipal authorities and the project developer. It took 3-4 more years to implement the project and start operations.

The necessity to comply with bureaucratic requirements and procedures contributes to longer time periods for project implementation. Project developers have faced difficulties with burdensome procedures in the following areas:

- Customs clearance of imported equipment,
- Negotiations with the local power grid company on connection to the grid,
- Negotiations with the energy market regulator on green tariffs and permits to sell electricity,
- Getting an approval from the occupational safety inspectorate.

⁵ Landfill gas collection projects at solid waste landfills are being implemented in areas around the city of Kyiv, in Bila Tserkva, Mykolayiv, Vinnytsia, Kremenchuk, and Zaporizhzhia.

Biogas-to-energy projects are technically sophisticated, and their implementation is associated with the following technical risks:

- In the case of animal farming, the characteristics of waste for biogas production should be carefully analyzed and monitored, including chemical content (content of nitrogen), humidity levels, and temperature. The features of biomass affect the amount of power generated. Seasonal fluctuations in the quality of biomass lead to seasonality of generation.
- There is a lack of qualified staff who can work with the equipment.
- For solid waste landfill gas projects, the quality of solid waste landfill management is important.

In the past, private investors and/or bank loans were sources of financing for project implementation. One animal farm raised funding from a foreign bank under an export support program for equipment producers. Another animal farm received a loan from Oschadbank. Together with funds from private investors, the bank loan was taken for a greenfield dairy farm project.

For future projects, the lack of external financing is an important impediment, given the significant size of the initial investment. There are the following obstacles to bank financing for electricity generation projects:

- High interest rates offered by Ukrainian banks.
- Reluctance of foreign banks to lend in Ukraine due to the current political and economic environment.
- Refusal of banks to credit electricity generation projects due to the uncertainty in the green tariff legislation (particularly, in terms of local content regulation).

The key motivation for investors to implement biogas projects is to earn revenue from selling electricity to the national grid at the green tariff. Additional motives are related to benefits for the community such as reducing the environmental burden of animal farms or waste landfills, creating new jobs, and covering the company's own energy needs.

The uncertainty with green tariff regulation leads to changes in the expected payback period and profitability of projects for investors. For instance, one of the surveyed animal farm representatives mentioned that when the investment was planned its payback period was expected to be 3 years, assuming that the company would sell electricity at the green tariff. However, it was refused because manure was not legally considered to be waste. As a result, the company is selling electricity at the normal tariff, and the payback period has been revised to 7 years.⁶

Investors demand greater certainty on green tariff legislation and a clear definition of the terms under which the green tariff may be applied.

⁶ At the time when the survey was conducted, selected types of biomass, such as manure, were not eligible for the green tariff. Following new changes introduced to Law No. 2010-d of May 19, 2015 the term "biomass" is aligned with EU Directive 2009/28/EC that both products and waste are considered as biomass for the purpose of qualifying for the feed-in tariff.



GREEN TARIFF RATES FOR BIOMASS/BIOGAS⁷

	Type of alternative energy source	
	electricity generated from biomass	electricity generated from biogas
Retail price*, EUR/kWh		0.05385
Factor in effect from July 01, 2015 till December 31, 2015		2.30
Tariff rate in effect from January 01, 2015 till December 31, 2015		0.1239
Factor in effect from January 01, 2016 till December 31, 2016		2.30
Tariff rate in effect from January 01, 2016 till December 31, 2016		0.1239
Factor in effect from January 01, 2017 till December 31, 2017		2.30
Tariff rate in effect from January 01, 2017 till December 31, 2017		0.1239
Factor in effect from January 01, 2020 till December 31, 2024		2.07
Tariff rate in effect from January 01, 2020 till December 31, 2024	0.1115	0.115
Coefficient from January 01, 2025 till December 31, 2029		1.84
Rate of the tariff from January 01, 2025 till December 31, 2029		0.0991

* The retail electricity price for 2nd class consumers as of January 2009, established in accordance with Resolution of National Energy Regulation Commission No. 1440 of December 23, 2008 converted at the applicable NBU exchange rate in EUR.



With regard to biomass-to-electricity projects, there are two sub-options: (i) combustion (in grate or circulating fluidized bed boilers) and (ii) gasification. Combustion is a conventional option, with equipment being provided by both domestic and foreign suppliers. In addition, its investment needs are moderate, certainly of the order of magnitude to make biomass projects financially viable under the feed-in tariff offered in Ukraine. Usually, the issue is the risk associated with biomass supply (quantity, quality, and price). Biomass gasification is a relatively new option (depending on the supplier, the specific equipment may be well-established or may be new and entail technology-related risks), and it is more expensive (per energy output).

Stratos Tavoulareas,
Senior Energy Advisor, IFC

⁷ Law on Introduction of Changes to Certain Laws of Ukraine with respect to Securing Competitive Conditions for Generation of Electricity from Alternative Energy Sources, No. 2010-d of May 19, 2015.



5 Finance

Financial constraints are the key impediment to future market development. They are the greatest concern for market players in considering biomass-to-energy projects.

The list of the most frequently mentioned financial constraints include:

- A high bank loan interest rate,
- Large initial investment required for equipment,
- Additional investment required for logistics and biomass storage capacity,
- A lack of government support for implementation of biomass-to-energy projects.

Parties that plan to implement biomass-to-energy projects in the future rely more on either government funds (in case of municipally-owned enterprises) or their own company funds. The sector players do not expect to raise a significant amount from bank loans or private investor funding. In the meantime, they anticipate more funding coming from international financial institutions.

Sources of investment

For already implemented biomass-to-energy projects, investment came either from the local or central budget (33% from the local budget and 5% from the central one in the total investment volume) or from companies' own funds (26% of the total investment volume). Three companies used bank loans and three more received private investor funding. As a result, the share of bank loans in all the investment sources was 18% and the share of private investor funds was 16%.

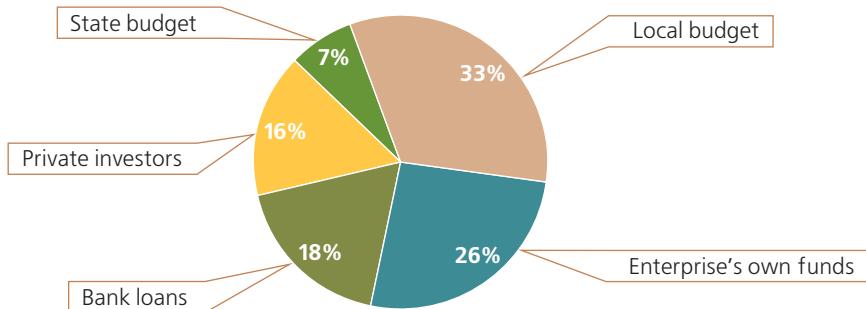
In the future, from the perspective of the implementation of planned biomass-to-energy projects, government budget funds and companies' own funds will remain the most important sources for investment. The companies do not expect to raise a significant amount from bank loans or private investor funding. The share of bank loans is predicted to decline to 3% of total investment sources, and the share of private investor funding is estimated at around 7%. This can be explained by the economic and banking crisis in Ukraine in 2014, which resulted in high interest rates and a lack of lending. The companies expect to compensate for the lack of bank loans and private investor funds by attracting grants from international organizations.



SOURCES OF INVESTMENT FOR ALREADY IMPLEMENTED AND PLANNED PROJECTS

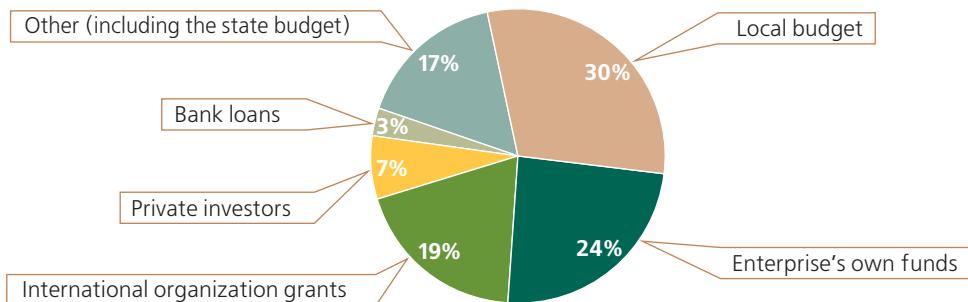
Investment for implemented projects

% of the surveyed companies



Investment for planned projects

% of the surveyed companies



Perception of financial institutions that are ready to give loans to biomass-to-energy projects

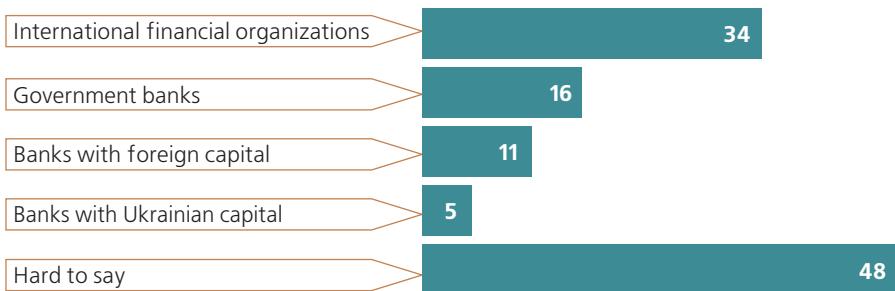
One third of the surveyed heat suppliers (34%) perceive international financial institutions as the key lenders to support biomass-to-energy projects. Next to these are government-owned banks and banks with foreign capital, which are deemed to be ready to finance biomass-to-energy projects.



TYPES OF BANKS THAT ARE READY TO FINANCE BIOMASS-TO-ENERGY PROJECTS

Perceived types of lenders ready to finance projects

% of the surveyed companies



Respondents were allowed to select multiple answers from the list of choices.

Attitude towards attracting private investors for biomass-to-energy projects

The majority of municipal heat suppliers in Ukraine are owned by local governments. Generally, those surveyed are positive about attracting private investor funds. However, one third of the polled companies reported that it was difficult to establish and maintain cooperation with a private investor.

One of the key reasons for such difficulties is a lack of distinct legislation, according to those surveyed. The companies mentioned the lack of a mechanism to attract private investor funding and the lack of their own knowledge on how to negotiate with private investors. About one fourth of the surveyed companies say that investors set excessive requirements that lead to the failure of negotiations. The representatives also mentioned that private investors are reluctant to cooperate with municipal companies.



The polled companies noted high interest rates on loans as one of the key financial barriers to the implementation of projects. Notably, the current market situation suggests that the rate of recovery on biomass projects is pretty high even with the current interest rates. The first thing to look into is a project feasibility study. It is quite possible that a soundly prepared project would be viable and approaching banks would make sense even under the current circumstances.

Roman Novikov,

Program Manager,

Sustainable Energy Finance in Europe and Central Asia, IFC

6 Ukrainian biomass-to-energy legislation



The recently adopted Law of Ukraine No. 2010 resolves all major problems faced by power generating facilities that work on alternative energy sources and attract investments (for both commercial enterprises and private households). This includes (i) aligning the term "biomass" with EU Directive 2009/28/EC so that both products and waste are considered as biomass for the purpose of qualifying for the feed-in tariff; (ii) new green tariff rates, introducing home-unit levels, abolishing peak load factors for solar and hydro generation, tiering solar tariffs based on capacity, and setting a degression schedule; and (iii) no mandatory local content requirement.

In regards to CMU Decrees No. 293 and 453, the proposed amendments have a number of advantages as compared to the current situation, though these regulatory acts might be further improved in the following aspects:

- Removing from CMU Decree No. 293 the clause about the need to calculate the working cost while taking into account a threshold rate of return not higher than 21%.
- Establishing in CMU Decree No. 293 a tariff for heat energy generated for households with use of alternative fuels at the level of 100% of the weighted average tariff for heat energy generated with use of natural gas.



Annexes

Annex 1. Participants in the survey

Total number of companies in the database and in the sample

Sector	Total number in the database*	Number of companies surveyed	% of the total number
Big agricultural companies	2,301	101	4.4%
Municipal heat suppliers (teplokomunenergo)	605	44	7.3%
Pellet producers	476	41	8.6%

Annex 2. Biomass facts and figures

Biomass is a non-fossil biologically renewable matter of organic origin that is capable of biological decomposition, in the form of products, waste and residues of forestry and agriculture (crops and livestock), waste of fisheries and technologically related industries, as well as a component of industrial or municipal waste.⁸ This definition of biomass in Ukrainian legislation was harmonized with that of Europe, i.e. EU Directive 2009/28/EC.

Bioenergy is energy derived from the conversion of biomass where biomass may be used directly as fuel or processed into liquids and gases.

Energy crops are grown specifically to produce some form of energy. Energy may be generated through direct combustion or gasification of the crops to create electricity and heat, or by converting them to liquid fuels such as ethanol for use in vehicles.

⁸ Law on Introduction of Changes to Certain Laws of Ukraine with respect to Securing Competitive Conditions for Generation of Electricity from Alternative Energy Sources, No. 2010-d of May 19, 2015.

RES

The National Renewable Energy Action Plan (NREAP)⁹ sets out the general target for renewable energy sources (RES) by 2020, namely 11% of the gross final energy consumption. Biomass is an important part of this, and, according to the NREAP, its main contribution is planned in the heating/cooling sector: 5,000 ktoe/year in 2020, equal to 85% of the contribution of all the RES. In addition, by 2020 it is planned to install 950 MWe of biomass power equipment and to use 390 ktoe/year of biofuels (bio ethanol and biodiesel) for transport.



NATIONAL INDICATIVE TARGETS FOR RES IN GFEC** UNTIL 2020 AND THE CALCULATED PATH FOR REACHING THEM

Indexes	2009	2014	2015	2016	2017	2018	2019	2020
RES: heat generation, %,	3.4	5.7	6.7	7.7	8.9	10.0	11.2	12.4
- including biomass, ktoe	1,433	2,280	2,700	3,100	3,580	4,050	4,525	5,000 (85%)*
RES: power generation, %,	7.1	7.6	8.3	8.8	9.7	10.4	10.9	11.0
including biomass, MWe:	0	40	250	380	520	650	780	950
solid biomass		28	175	260	360	455	540	660 (12%)*
biogas		12	75	120	160	195	240	290 (5%)*
RES: transport, %,	1.5	4.1	5.0	6.5	7.5	8.2	9.0	10.0
- including biofuels (bioethanol, biodiesel), ktoe	0	110	150	220	265	300	340	390 (77%)*
Total RES share in GFEC, %	3.8	5.9	6.7	7.4	8.3	9.1	10.1	11.0

* The biomass share as estimated by the UABio.

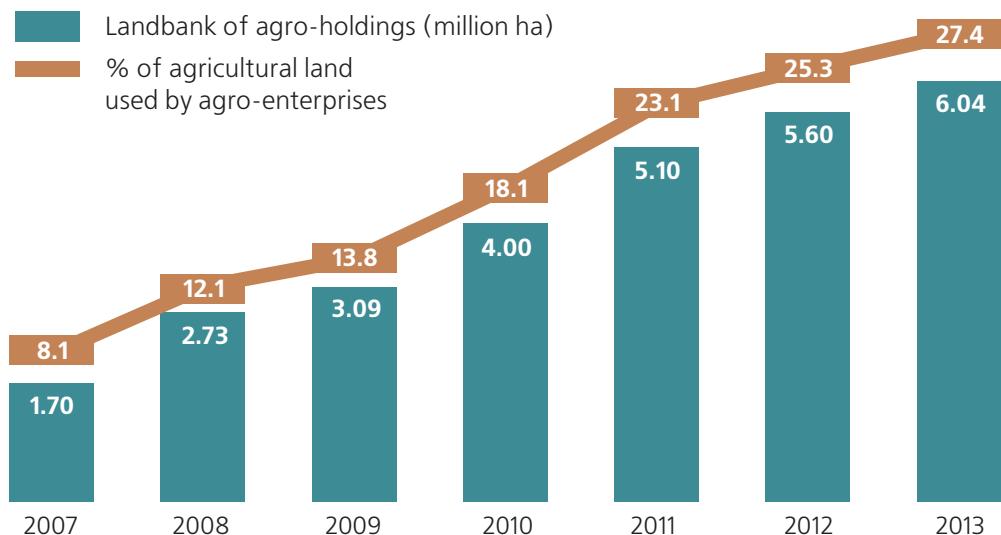
** GFEC – gross final energy consumption.

⁹ Cabinet of Ministers of Ukraine's Regulation No. 902-r (dated October 1, 2014) "National Action Plan on Renewable Energy until 2020."



AGRO-HOLDINGS

Landbank of agro-holdings





KEY CHARACTERISTICS OF SOLID BIOMASS AND BIOFUELS

Types of biomass/ biofuels	Moisture content, %	Density, kg/m ³	Bulk density, kg/m ³	Ash content, %	Lower heating value, MJ/kg
Straw:					
- loose (not baled)					
yellow (fresh)	10-20		40-55 (chaff)	4	13-16
grey (not fresh)				3	
- baled		100-140 (bale density)	~100	3-4	
- pellets	10	1000-1400	550-650	4-5	15-16
Maize stalks	30-35		80-90	5	12-14
Maize cobs	15-20		150-190	5	14-16
Wood:					
- chips	40-50	600-800 (wood density)	250-350	0.6-1.5	8-10
- firewood			300-330		
- felling residues			150		
- sawdust			120-300		
- pellets	10	1000-1400	550-650	0.5-1	17-19
Sunflower husk					
- loose	15		90-100	4-5	16
- pellets	10	1,000-1,400	550-650	4-7	15-17
Peat:					
- milled	50	~1,000 (particle density)	200-300	3-20	8-10
- pellets	12	1000-1400	650-700	3-15	16-20
- briquettes	12	1000-1200	650-700	3-12	17

Source: UABio.

NEFCO

The Nordic Environment Finance Corporation (NEFCO) is an international financial institution established in 1990 by five Nordic countries. NEFCO provides loans and makes capital investments in order to generate positive environmental effects of interest to the Nordic region.

To date, NEFCO has financed a wide range of environmental projects in Central and Eastern European countries, including Ukraine. Its activities are focused on initiatives that achieve cost-effective environmental benefits across the region. NEFCO prioritizes efforts that reduce releases of climate gases, improve the ecological status of the Baltic Sea, or mitigate emissions of toxic pollutants. NEFCO's portfolio comprises over 600 small and medium-sized projects spread across different sectors, and it currently administers funds valued at EUR 501 million.

NEFCO has been financing environmental projects in Ukraine since 2003. In 2009, NEFCO signed a framework agreement with the Ukrainian government, which enabled NEFCO to also finance municipal energy projects in the country. Currently, NEFCO has 156 active projects in Ukraine.

NEFCO is engaging in both direct and indirect investments to strengthen advancement in the bioenergy sector by financing the installation of new boilers, supporting fuel-supply chains in Ukraine, and making modern equipment available to the market. For example, it has provided loan-backed investments in biogas burners at agricultural farms that use the manure from their livestock to produce heat and energy. Moreover, NEFCO has co-financed projects to burn pellets made from the farm's residual straw to heat the facilities and neighboring infrastructure. Given Ukraine's improving green electricity feed-in tariffs and an increasing demand for biofuels, progressive farms are in a position to make additional profits by selling energy and fuels. NEFCO investments in fuel-switch solutions allow the agro-businesses to make large savings and, simultaneously, to contribute to significant reductions of greenhouse gases.

Bo Eske Nyhus,
Senior Investment Manager, NEFCO

UNIDO

The United Nations Industrial Development Organization (UNIDO) is the specialized agency of the United Nations that promotes industrial development for poverty reduction, inclusive globalization, and environmental sustainability. The mandate of UNIDO is to promote and accelerate inclusive and sustainable industrial development (ISID) in developing countries and economies in transition. The concept of ISID is included in the Sustainable Development Goals, namely Goal 9: Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation.

UNIDO and the United Nations Environment Programme (UNEP) have been collaborating under the joint flagship Resource Efficient and Cleaner Production Programme (RECP) since the 1990s, aiming to facilitate the delivery of RECP services to industries by assisting organizations – especially small and medium enterprises, governments, civil society, research institutions, and related stakeholders. In order to respond to the growing demand for RECP at a global level, UNIDO and UNEP established the RECPnet in 2010, which has brought together more than 70 members.

Ukraine has been a member country of UNIDO since 1985. In 1995, UNIDO signed a cooperation agreement with the Ukrainian Government to foster sustainable industrial development in the country. This agreement set the basis for UNIDO's large project portfolio in Ukraine, which covers the promotion of RECP, energy efficiency, renewable energy, and the implementation of energy management standards at the company level.

Developing partnerships and strengthening cooperation with international financial institutions are the core elements of UNIDO's global efforts to increase the up-take of ISID. In 2013, UNIDO finalized its agreement with IFC to jointly promote RECP in Ukraine. Since then, experts from the National RECP Centre, established by UNIDO in 2012, have worked hand in hand with IFC teams to help local industries improve their production efficiency and environmental performance by applying RECP technologies.

Petra Schwager,
Program Manager, UNIDO

In partnership with the Finnish Ministry of International Affairs, the Free State of Saxony (Germany), and the Agency for International Business Cooperation within the Dutch Ministry of Economic Affairs.

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