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Identification for Need of Demo Project Hungary

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1. Introduction

In the 4BIOMASS project we came to the highly important conclusion several times that biomass can be considered a renewable when it is primarily used on-site and that biomass should be mainly used for heat production to achieve the highest possible level of efficiency. As a consequence the project was approached with the aim of identifying locations with stable and high heat demand all year round and comparing them with places where huge amounts of biomass are constantly available all through the year.

We investigated where large district heating systems are located in Hungary and compared them to data from the forest monitoring network and the map of Hungarian forests assuming that wood waste can be the most reliable source of biomass use. Comparing the two sectors gave us locations where at least a partial switch to biomass should be implemented. The district heating sector was chosen because approximately 650,000 households are heated with district heating in Hungary. Benefits of using biomass in district heat supply include:
- job creation
- reduction of air pollution
- 10-40% cost savings
- value creation in the given town
- independent energy supply, reduced energy dependency,
- calculable heating costs.

In Hungary renewable-based power generation is subsidized on the output side but renewable-based heat production receives no subsidy. As a result heat production projects are generally uneconomical and are not likely to be widely implemented under such conditions. The subsidy system is being reformed right now and although the details are not yet known, the volume of heat produced is expected to be taken primarily into account. Another hindering factor to renewable-based heat production is its unfavourable position in terms of renewable projects. Even though grants are available to both markets the power plant sector can obtain funding from other sources for instance in the framework of the Joint Implementation defined in the Kyoto Protocol.

The widespread emergence of renewable-based producers on the decentralized heat market is prevented by the financial situation of the largest consumers, the residential and communal sectors and their lack of funds to realize renewable projects. The district heating sector, an obvious and concentrated potential market for renewable energies, is practically fighting for survival in several towns even though numerous European examples prove that district heating does have a future. We are convinced that a demo project can set a good example to disseminate such solutions.

The Hungarian heat market is in a poor position with regard to the use of the available volume of renewable energies. Biomass should be the basic renewable source of heat production but the fast growth of multi-subsidized renewable-based power generation did not bring about an increase in the selection of biomass types. Neither the choice of energy crops nor forest wood waste grew substantially, leading to the creation of a higher-priced demand market and further hurting the profitability of renewables on the heat market on the one hand while on the other hand encouraging development-oriented investors to better exploit existing capacities.

In the current energy management structure the use of district heating can be justified by the following:

- These relatively large, calculable systems can provide thermal energy that is generated under regulated, controlled and environment friendly conditions in high-efficiency plants or using renewable energy sources;
- User systems can be operated in a regulated, energy-saving way according to unified principles.

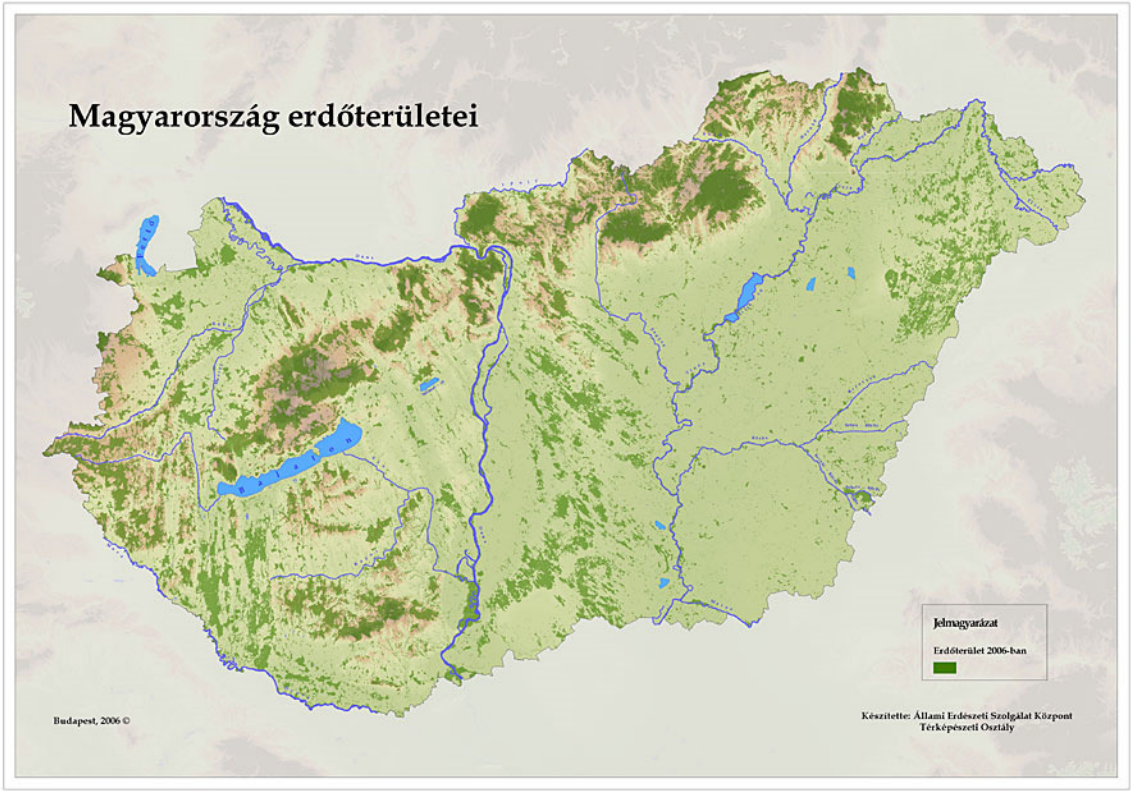
When the Hungarian district heating networks were built in cities the above criteria were not considered critical therefore these coal, fuel oil and heating oil-based networks were advantageous and moreover comfortable in their time. To reduce our dependency on energy imports and carbon-dioxide emissions biomass should be considered as an alternative to be promoted. For this purpose the following options should be studied for the development of a demo project:

1. When biomass-fired boiler(s) (wood chips, pellets, briquettes, mixed waste) are installed in a heating plant their capacity should be determined by taking into account the age, technical conditions and efficiency of existing equipment, the annual district heat demand and the volume of heat purchased through long-term agreements.

2. Certain institutions/facilities can be disconnected from the district heating network by installing biomass-fuelled boilers. The heating system of disconnected institutions can be renovated and equipped with regulation. To reduce energy demand thermal insulation can be installed and doors and windows can be replaced.

3. Calculations should be made to define the amount of fuel needed by the above equipment and the arising residential demands. To ensure that the generated biomass demand is met in the long term at favourable prices forestries, forest owners associations, timber factories should be checked as suppliers. In addition, it should be investigated whether a wood pellet/briquetting plant can be set up and economically operated on the basis of the above.

4. It should be mapped how biomass use will generate job creation with special regard to the labour force needed for the towns, forestries, waste collection and managing energy crops.



1. Figure: Forests in Hungary (Legend: Forest areas in 2006 Prepared by the Cartography Department of the National Forestry Service Centre)

2. Figure: Towns with district heating in Hungary (Legend: Towns and the number of households with district heating; from over 10,000 to no district heating)

Based on these data and the comparison of the two maps we recommend the following cities for consideration as locations for the demo demo project: Miskolc, Ózd, Kazincbarcika, Eger, Salgótarján.

In the next section the district heating network of the town of Ózd will be analyzed in terms of biomass use. First the availability of biomass will be presented as surveyed by Dandroenergia Kft. in 2009 then the potential solutions for biomass firing in the Ózd district heating system will be examined.

2. Analysis of the volume of agricultural lignocellulose and its energy content in the region of Ózd

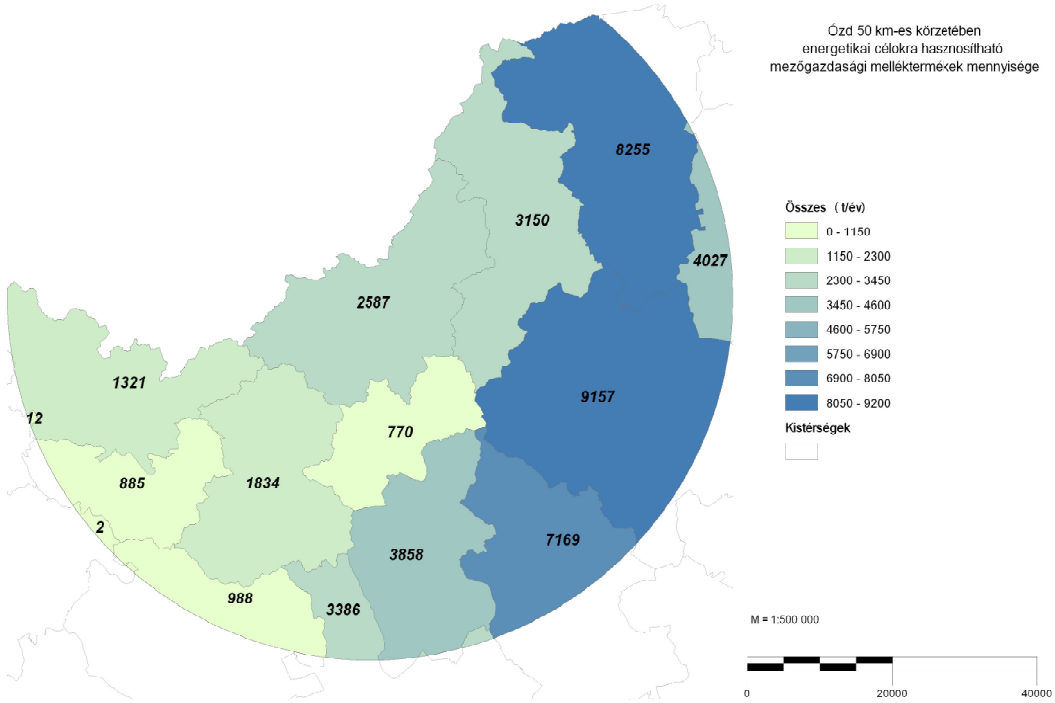
In the region of Ózd 0, 0, 0, 4, 75 (in a region of 10-20-30-40-50 km) TJ are available from cereal straw alone when the full amount available for energy purposes is used. If the energy content of maize stalks, sunflower stalks and rape stalks is also added to cereal straws 15, 52, 103, 228, 638 (in a region of 10-20-30-40-50 km) TJ can be annually supplied.

Animal farming uses a substantial amount of straw in the surveyed region, reaching even 99% of the available cereal straw yet this figure is expected to decline in the future for the above mentioned reasons.

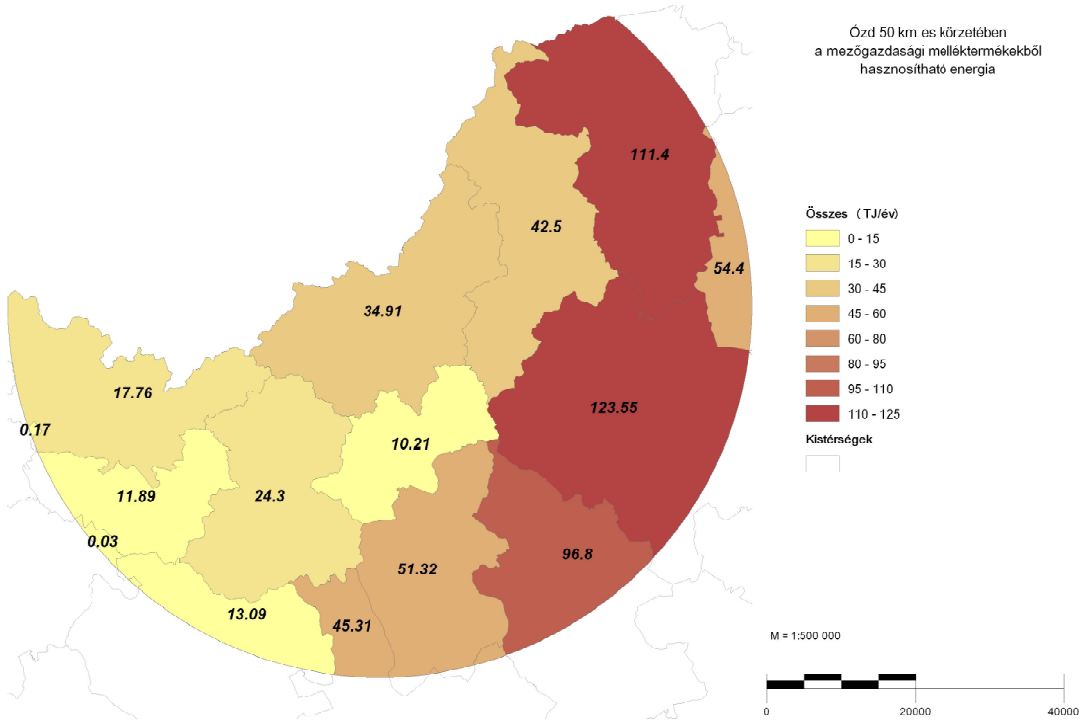
Farmers who are involved in crop farming as well as animal husbandry will probably use a necessary part of the straw to feed the animals and then sell the rest. On the other hand, crop farmers will sell their straw on the future „straw market" thus a considerable share of the straw used in animal husbandry will be available for purchase under the right supplier agreement to the detriment of animal farming.

It should also be noted that the number of animals has significantly declined in the last ten years. This tendency is expected to continue in the future as fewer and fewer animal farmers can meet the European Union's requirements concerning animal husbandry. Decreasing animal stocks will need less straw.

For the supply of raw materials cereal straw or perhaps rape stalks should be the preferred choice as they are available in the required quantities. These raw materials also provide better solutions in terms of burning technology and storage.



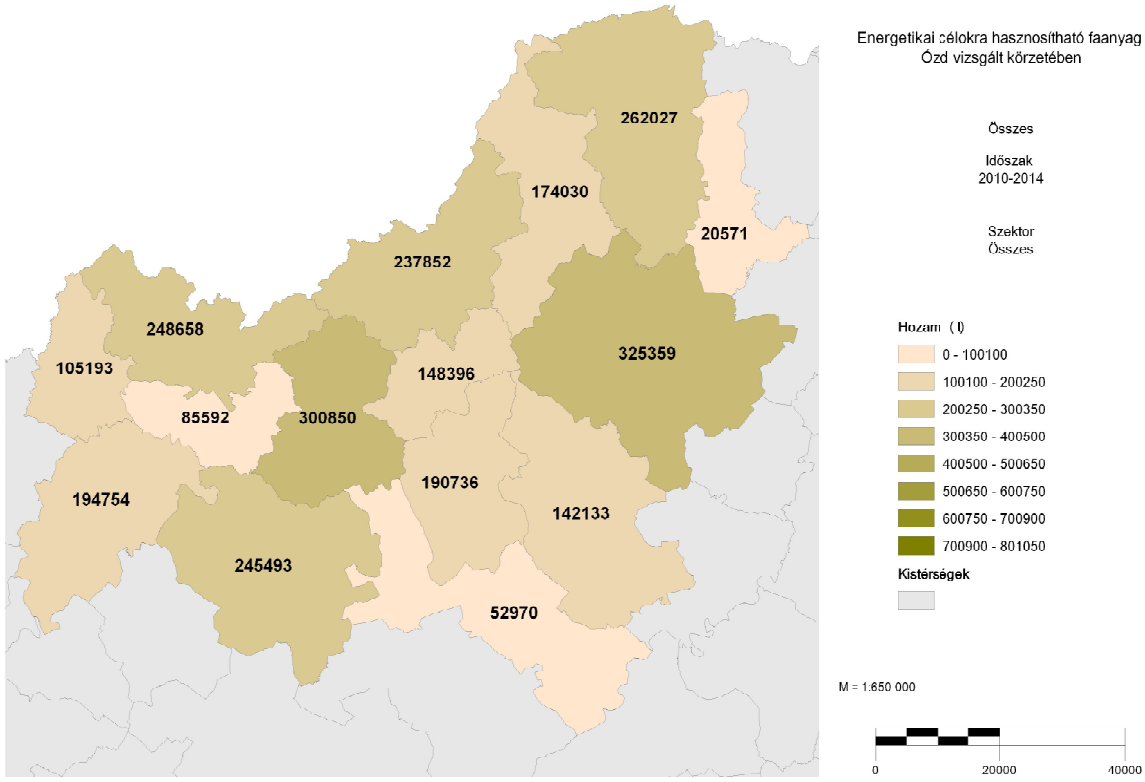
3. Figure: The amount of agricultural by-products available for energy purposes in the 50 km region of Ózd (Legend: Total (t/year); Small regions)



4. Figure: Energy content of agricultural by-products available for energy purposes in the 50 km region of Ózd. (Legend: Total (t/year); Small regions)

3. Potential analysis and prognosis of wood from forestries for energy production in the 50 km region of Ózd

The surveyed 50 km region of Ózd includes several small regions in part or in whole such as the Edelény, Kazincbarcika, Mezőkövesd, Miskolc, Szikszó, Ózd, Bélapátfalva, Eger, Füzesabony, Gyöngyös, Pétervására, Bátonyterenye, Pásztó, Salgótarján and Szécsény regions. The area of each forestry is managed under its own forest management concept and this has an impact on private forests neighbouring the state-owned forest areas. A basic forest management strategy was developed for each unit, based on the conditions and guidelines of sustainable forest management in each case.
In the surveyed area there are different selections of timber produced through forest management which vary in terms of quality and market conditions. Selective and stimulating thinning as well as final cutting are the uses that produce marketable, profitable and economically saleable timber. In the majority of selective and stimulating thinning the produced wood can be used to generate energy. As over 50 % of logged trees can also be used for energy production a significant share of tree uses is suitable for energy purposes where the place of energy generation depends on the demands of the market and the opportunities.
Data show that in the next 20 years the region can annually provide at least 564,000 m3 of wood waste for energy production, equalling approximately 547,000 t (as the share of hard leaves is high) and 6,052 TJ.



5. Figure: Wood for energy production in the surveyed region of Ózd. (Legend: Total; Period; Total Sectors; Yield (t); Small regions)

4. Raw materials from forestry for energy production in the surveyed region of Ózd

Both primary and secondary forest industries generate by-products (slabs, ends, chips, different splinters, sawdust) that are suitable to be used for energy production. By-products from the secondary forest industry usually provide raw materials for the production of further wooden products (or can be re-used together with energy grass by mixing it to the basic material in small quantities, or to make a higher quality product, e.g. pellets from dry, bark-free sawdust), or are used for energy purposes on site.
Wood mills generally only share information about the amount of by-products generated by the mills if they receive a specific business offer. For the surveyed small region there are approximate data available for energy wood waste and by-products (roughly 20-25,000 tons total, about 250-350 TJ). It is clearly seen that there is a considerable amount of wood by-products available in the region which can be used for energy production in large quantities. The reason for the low use of wood waste, however, is that it is used by the mills or sold in other ways.

Available biomass (summary)

1. In the region of Ózd 0, 0, 0, 289, 5527 (in a region of 10-20-30-40-50 km) tons of raw materials are available from cereal straw alone when the full amount available for energy purposes is used. If the energy content of maize stalks, sunflower stalks and rape stalks is also added to cereal straws 1,127; 3,846; 7,640; 16,994; 47,400 (in a region of 10-20-30-40-50 km) tons of raw materials can be annually supplied.

2. In the region of Ózd 0, 0, 0, 4, 75 (in a region of 10-20-30-40-50 km) TJ are available from cereal straw alone when the full amount available for energy purposes is used. If the energy content of maize stalks, sunflower stalks and rape stalks is also added to cereal straws 15, 52, 103, 228, 638 (in a region of 10-20-30-40-50 km) TJ can be annually supplied.

3. In the region of Ózd 0; 0; 212; 7242; 20,528 (in a region of 10-20-30-40-50 km) tons of raw materials are available from grapevines and fruit tree cuttings alone when the full amount available for energy purposes is used.

4. In the region of Ózd 0, 0, 2, 83, 234 (in a region of 10-20-30-40-50 km) TJ are available grapevines and fruit tree cuttings alone when the full amount available for energy purposes is used.

5. In the surveyed region of Ózd in the next 20 years forest management can annually provide at least 564,000 m3 of wood waste for energy production, equalling approximately 547,000 t (as the share of hard leaves is high) and 6,052 TJ.

6. In the region of Ózd 77,249; 262,777; 433,719; 497,823; 546,922 (in a region of 10-20-30-40-50 km) tons of raw materials are available from traditional forest management alone when the amount available for energy purposes is fully used.

7. In the region of Ózd 855; 2,908; 4,799; 5,508; 6,052 (in a region of 10-20-30-40-50 km) TJ are available from traditional forest management alone when the amount available for energy purposes is fully used.

8. Based on this analysis we recommend that in the 50 km region of Ózd 1,011 ha of acacia, 80,149 ha of poplar and 7,555 of willow should be planted. Based on the presented set of criteria over 700 thousand tons or more than 8,800 TJ energy tree crops can be harvested in the 50 km region of Ózd, a considerable volume of biomass that can serve as raw material for crop-based energy production.

9. If the 67 ha of arable land owned by the city of Ózd has an average yield of 8 tons/ha/year for the tree plantation then approximately 535 tons of wood chips can be produced per year, roughly equalling 5,470 GJ in energy content.

10. If in the Ózd small region the potential locations for poplar plantations (5,775 ha) are all considered then, following the above analogy, over 45 thousand tons of poplar chips can be produced annually, roughly equalling 500 TJ in energy content.

11. If the investor decides to plant energy tree crops then in addition to the soil area analysis, habitat exploration, further technology analysis and economic calculations a planting concept and strategy should definitely be developed to ensure the creation and foundation of a modern plantations of energy tree crops.

12. We have exact data from the surveyed small region regarding wood waste suitable for energy production and the location of by-products (approximately 20-25,000 tons total, roughly 250-350 TJ). It can be stated therefore that the small region contains a substantial amount of wood waste that can be used for energy production in large quantities. The reason for the low use of wood waste, however, is that it is used by the mills or sold in other ways.

13. In the 50 km region of Ózd a total of approximately 634,928 tons, 6,924 TJ of solid biomass by-products can be produced for energy purposes. If the potential areas are fully used to plant energy crops another 8,800 TJ from energy tree crops can be used (based on available yield data for energy tree crops).

5. Switch to biomass in district heating in Ózd

First of all, an important factor hindering the wide-spread use of biomass burning: under the heat purchase agreement concluded by Ózdi Erőmű Kft. and the district heating company the heat produced by the gas turbine plant has priority throughout the year over heat produced from other energy sources for 18 years. Such long-term agreements are typical everywhere in Hungary and at their signing were supposed to guarantee the profitability of project. Today, however, they only put an obstacle in the way of switching to alternative energy sources.
The key figures of 2008 in Ózd were the following:

District heating customers (2008)	No.	Heated space lm^3
Households Common rooms	5,537	735,480 62,254
Institutions, companies	176 + 222	365,281
Companies	222	
Total:		**1,163,015**

Heat market data of district heating in Ózd:

Natural gas used	thousand Nm^3	8,308
	GJ	281,130
Heat produced	GJ	213,526
Heat purchased from plant	GJ	121,345
Heat output	GJ	328,714
Total electricity used	MWh	1,288
Cost of natural gas	thousand HUF	805,666
Cost of heat purchased	thousand HUF	280,474
Electricity sold	thousand HUF	152,171
Electricity purchased	thousand HUF	61,585
Resultant energy costs	thousand HUF	995,558

Energy is produced for the district heating network of Ózd at a single facility located at lot number 11127 in the Ózd Industrial Park (Gyár u. 2.), exclusively using natural gas as its energy source. The key attributes of the energy producing equipment are contained in the following table.

Installed energy producing equipment			
Type, no.	**Operational performance [MW]**		**Year of installation**
	thermal	**electric**	
Hot water boiler HLF 10/12 3 boilers	3 x 10	--	1996
Steam boiler HLG 2/12 2 boilers	2 x 2	--	1996
Small-scale blocks with gas motors Ganz Motor SGK 1100 2 blocks	2 x 1,4	2 x 0,875	1996
Hot water container boiler LFT 4001 4 boilers	4 x 4,65	--	1983
Small-scale blocks with gas motors, Jenbacher JMS 616 GS-N.IC 2 blocks	2 x 2,44	2 x 2,43	2005
Total performance:	**56,28**	**6,61**	

The project concept is the following: a biomass-based energy production plant (heating plant or heat and power plant) should be established for the district heating system to

replace the majority of the system's gas consumption. This plant, using fuel produced in the region, could provide the district heating network with cheaper heat.
The attributes and content of the project can be specified in various ways such as:

Development goal	Technical solution
Complex use of the available biomass in the highest possible quantities (generating high value added)	Installing steam or ORC small-scale plant and hot water boiler
Fully replacing natural gas use, only keeping it for peak periods and as reserve	Installing 2 high-capacity hot water boilers that nearly cover the entire demand
Optimal alignment with the planned heat demand of the district heating system to ensure the best use of the high-cost biomass-based heat plant	Installing 1 optimized-performance hot water boiler while continuing to meet heat demand in the peak period by natural gas

In the event the district heating system of Ózd is to remain functional in the long term and there is a realistic chance for expansion then multi-point feed-in should be chosen as in all large district heating networks.
In the event the key objective is to achieve concentrated energy production and the construction of a biomass power plant is a realistic alternative then the existing facility should be upgraded.

All in all, there are numerous arguments for considering a switch to biomass-firing in district heating systems. The dependency on energy imports may decline, and a closer cooperation with forestries can lead to a more easily calculable management for both the district heat supplier and the forestry. Biomass management, energy crops planted as a source of biomass and energy tree crops can also give a boost to regional development, agriculture and the labour market. The same is true for the construction of pellet factories or briquetting plants.
Unfortunately the financial situation of Hungary, the local governments and the district heating companies do not generally permit the financing of such projects despite the fact that these projects would be profitable in the long run and have a positive impact on the environment and the society. The switch to biomass is also prevented by the existing long-term agreements, making the purchase of heat and power generated by fossil-based plants mandatory for years. Another difficulty is the lack of funds available through tenders and the uncertain outcome of bidding.