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Renewable energy on animal farms: support system and practical application

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SUMMARY

Renewable energy applications were examined in animal farms. The investment support system for animal farms – which has renewable elements – has been summarized through analyzing the legislation and future prospects. The most important in this topic is the Animal Farm Modernization Support, which had several application periods during the 2007–2013 CAP budgets. For analyzing practical application of renewable energies interviews and farm visits have been done in Hajdú-Bihar County. The questions covered the general attributes of the farms and the details of the (existing or planned) renewable energy application. In terms of economic analysis saving, the investment return time and the employment effect were examined. The results show wide variety of applied renewable energy application. The investment support plays great role in renewable energy projects by lowering the return time; and through additional points in application assessing, which is an incentive for farmers to include renewable energy element in their modernization projects.

Keywords: renewable energy, animal husbandry, investments, biogas, biomass

ÖSSZEFOGLALÁS

Az állattartó telepeken történő megújuló energia használat került vizsgálatra jelent tanulmányban. Az állattenyésztő telepek számára elérhető beruházási támogatások keretében megújuló energia fejlesztések is támogathatók. A legfontosabb e téren az EMVA által finanszírozott Állattartó Telepek Korszerűsítése (ÁTK) támogatás, melynek több igénylési időszaka is volt a 2007–2013 KAP költségvetési időszakban, némileg változó feltételekkel. A megújuló energia használatának felmérésére telepi interjúk készültek több Hajdú-Bihar megyei állattartó telepen. A kérdések az üzem általános jellemzőit, valamint a (meglévő, vagy tervezett) megújuló energia alkalmazás adataira tértek ki. A felmérés során megújuló energia számos formáját sikerült felvételezni a megkérdezett üzemekben. A válaszok alapján a beruházási támogatások nagy szerepet játszanak, a fejlesztések létrejöttében, mivel csökkentik a megtérülési időt. Továbbá az ÁTK pályázatok pontozási rendszere is ösztönzést jelent, hogy többet ponttal járó megújuló energia fejlesztést tartalmazzon a gazdálkodók pályázata.

Kulcsszavak: megújuló energia, állattenyésztés, beruházás, biogáz, biomassza

INTRODUCTION

The recent measures in the European Union promote the usage of renewable energies and enhancing the energy efficiency. In the 29/2009 EC directive the European community defined targets in this topic for 2020. According to this document energy efficiency shall be 20% higher, greenhouse gas (GHG) emission has to be 20% lower and the share of renewable energy has to be 20% in energy consumption. Regarding renewable energy share, to reach the community target, each member state has its own target value according to their opportunities (EC, 2009). Hungary takes upon to reach 13% renewable energy share in this document which increased to 14.65% in the national renewable energy action plan in 2011 (Hungary, 2010). According to the latest EUROSTAT figures the share of renewable energy was 13.0% of the EU 28 average, and the Hungarian share was 9.1% in 2011 (Eurostat, 2013). There is another trend related to the topic: the introduction of cross compliance regulations in agriculture. As a part of this measure the nitrate directive sets instructions on manure usage and handling, biogas production can offer a solution for this.

On a business level in agriculture other factors influence the usage of renewable energies. The most important among these is cost saving. Basically two causes can lead to cost saving: firstly the reduction on energy expenditures itself, secondly through other

benefits related to renewable energy usage. For instance more effective manure handling, less straw demand.

In this area the investments usually need high amount of capital and its return time usually exceeds five years. The green electricity feed-in the prices per kWh in Germany is significantly higher than in Hungary. This difference is the reason why the biogas and solar energy are much more frequent in Germany compare to Hungary. Since the selling prices are not highly subsidized the credit interests are high in Hungary the investment return time is higher therefore less renewable energy application can be seen in our country. Almost only option to lower the return time of renewable energy application is to get support for the project. In the animal farming sector the main possibility is the Animal Farm Modernization Support (Hungarian acronym is ÁTK) in the 2007–2013 CAP budget period.

Animal farms have opportunities in using renewable energy in several ways. On the one hand there are sectors, where the energy demand is continuously high in electricity (e.g. forage grinders, mixers, milk coolers, air ventilation systems) or in heating (e.g. stables for poultry or piglets) On the other hand in extensive farming the renewable technologies can be used as off-grid solutions, because the other alternative to get an electric power connection could be more expensive. Beside the energy demand in agricultural sector there are several products and side products suitable for energy production. For example different kinds of organic manures and

corn silage could be raw materials for biogas production; plant residues like cereal straw and corn stalk bales could be combusted in boilers. Furthermore solar cells or solar collectors can be mounted on the big roof surfaces of animal farm buildings.

MATERIALS AND METHODS

The examinations in this article have two directions. On the one hand the support possibilities especially ÁTK will be analyzed through the concerning legislation and the future possibilities via the available rural strategies.

The second field of the examination is the interviews made with animal farm managers in Hajdú-Bihar County between May and November 2013. The data were collected through oral interviews and farm visits. The data collection topics consist of the farm identification data, the technical and the socio-economic attributes of the renewable energy application and the future development plans. In this article the names of the farms are not indicated, they are only referred with a number (Farm1, Farm2 etc.). The recent examination can be considered as trial interviews before a wider range of farm interviews. Therefore I asked farms dealing with different animals, have different renewable energy application and these projects are in different status; in order to develop the questions for a later use.

RESULTS

Renewable energy support possibilities for animal farms

Investment support – ÁTK

The most important investment support program for animal farms is the Animal Farm Modernization Support (the ÁTK is long form of the acronym Állattartó Telepek Korszerűsítése). This program is founded by European Agriculture Fund for Rural Development (EAFRD). In its Hungarian support fund the AEFDR have four axes. The ÁTK support is one of the measures in the First Axis, which titled as Competitiveness of Agriculture and Forestry. The goal of this support program is – as its name indicates – to help technological, machinery and infrastructural investments in animal husbandry sector. Among the numerous supportable items some is related to renewable energy production. Since ÁTK is an investment like support it is post financed, which means support is transferred only after realization and financial fulfilment.

The support intensity is normally 40%, which can be increased by 10% if the farm area is NATURA 2000 or Naturally Least Favored Area (Hungarian acronym: KAT), and/or +10% if the applicant is a young farmer (natural person under 40 years).

The support had four application periods in the 2007–2013 CAP budget which are the followings:

- ÁTK I. 23rd April 2007 – 23rd Maj 2007,
- ÁTK II. 13rd August 2007 – 17th September 2007,
- ÁTK III. 16th November 2009 – 15th December 2009,
- ÁTK IV. 1st August 2012 – 31st August 2012.

The basic regulation for the first three application periods was the 27/2007. (IV. 17.) FVM decree (Department of Agriculture and Rural Development)

(FVM, 2007). The basic regulation for the last application period (ÁTK IV.) is the 61/2012. (VI. 29.) VM decree (Department of Rural Development) (VM, 2012a). The final deadline for the winners in ÁTK IV. Completing their projects is 31st December 2014, and the financial settlement has to be finished by 31st January 2015. The last date is also the deadline for paying form EASDF.

Exceptionally in the first application period (ÁTK I.) the intensity was 75% for manure handling, including biogas plants.

These renewable energy possibilities in ÁTK were collected to three points:

1. manure handling with anaerobic fermentation;
2. boilers using renewable energy, solar collectors with connected heating system;
3. water supply system powered by solar cell or wind energy.

The first option “Manure handling with anaerobic fermentation” means biogas plants. It was available in ÁTK I. I. III. To ensure the adequate farm size for biogas plants, the decree contained requirement that the applicant must have at least 200 livestock unit from cattle, and/or pig, and/or poultry during the compulsory five year maintenance period. The intensity was 75% in ÁTK I., because it is a part of manure handling measures.

Livestock units are defined in the Appendix 5. of 50/2008 FVM decree for each species, the mentioned ones have the following livestock unit:

- bull, cow, or other cattles above 2 years – 1.0;
- cattle between 6 months and 2 years – 0.6;
- cattle below 6 months – 0.4;
- sow above 50 kg – 0.5;
- other pig 0.3;
- hen for egg production – 0.014;
- other poultry – 0.03 (FVM, 2008).

The 2nd and the 3rd options were part of infrastructure measures, which means limitation in application budget share. All the infrastructure expenditures can't exceed 30 percent of the overall budget in an application.

In order to select the winners the submitted applications are assessed according to the given assessing charts in the decrees. Additional points could be acquired if the application contained renewable energy. In the first three application periods 2 points from total 110; and in ÁTK IV. 10 points from total 133.

ÁTK 5.

In December 2013 a new support program opened for animal farm (and food industry) technology modernization. This support is often called as ÁTK V; however there are major differences comparing the other ÁTK programs. The program supports only stable and mobile machinery and technology, without buildings, because projects including building cannot be finished until the EARDF final deadline, which is 31st December 2014. Unlike the other ÁTK programs, the submitted projects are not evaluated by point system. If a project meets the minimum requirements, the submission time is essential. This kind of evaluating system is faster due to the EARDF final deadline.

The application period is 16th December 2013 and 31st January 2014, however to the application is closed by 20th December 2013 due to the high number of submitted application. The intensity is between 40% and 60% for

built-in technologies, depending on the applicant. The total support budget is be 35 billion HUF (VM, 2013).

The IH announcement contains the official MVH Machine Catalog (MVH, 2013) categories In ÁTK 5 the following renewable machines or equipments are supportable (IH, 2013):

- 6213 Biomass heat production equipment and its accessories;
- 6217 Machines and equipments of biogas production and utilization;
- 6219 Machines and equipments of other bioenergy production and utilization;
- 6221 Machines and equipments of solar energy production and utilization;
- 6222 Machines and equipments of wind energy production and utilization;
- 6223 Machines and equipments of water energy production and utilization;
- 6224 Machines and equipments of geothermal energy production and utilization.

Other supports, future prospects

National Diversification Program (NDP) was opened in November 2009. The support was available for farmers in any agricultural sectors in settlements affected with the closing of sugar-beet factories. The aim was to help the diversification of the production for farmers, therefore the supportable measures have very wide range. The intensity of the support was 60%.

Among the small-scale infrastructure development measures, renewable energy utilization was supported for hot water production, heating, electricity generating (FVM, 2009).

Regarding future prospects the importance of animal production and environment protection is stated in Darányi Ignác National Rural Strategy, therefore in the next EARDF budget period there will be also supports for renewable energy projects in animal farms (VM, 2012b).

Farm interviews

The questions of the interview can be divided to the following topics:

- identification data (branch, livestock amount);
- technical attributes of renewable energy investment (type, capacity, saved energy, resources used);
- socio-economic attributes of renewable energy investment (finance, support, total cost, savings, return period, additional employment, status of project, estimated time of finish);
- future development plans.

The oral interviews and farm visits were covered eight animal farms in Hajdú-Bihar county. Regarding the branches of the businesses there were six was dairy cattle farms, one beef cattle farm and one pork farm.

The summary of applied renewable energy solutions on interviewed farms are shown in *Table 1*.

Table 1.

Summary of the technological attributes of renewable energy usage on interviewed farms

	Farm1	Farm2	Farm3	Farm4	Farm5	Farm6	Farm7	Farm8
Animal branch	Dairy farm, pork farm	Dairy cattle farm	Dairy cattle farm	Pork farm	Beef cattle farm	Dairy cattle farm	Dairy cattle farm	Dairy cattle farm
Animals	1800 dairy cows, 600 sows	700 dairy cows	580 dairy cows	sows	100 beef cows	620 dairy cows	400 dairy cows	700 dairy cows
Renewable energy type	Biogas plant	Solar collector	–	Big bale boiler	Solar cells	Biomass boiler	Solar collector	Solar collector + small bale boiler
Renewable energy capacity, attributes	Fermenter 2400 m ³ , gas engine 625 kW	11 panels, 22 m ² surface	–	600 kW, puffer tank 50 m ³	48 panels, surface 96 m ² , 12 kWp, 13.2 kWh/yr	–	2 panels, 4 m ² surface	14 panels, 28 m ² surface; 3 boilers 220 kW total capacity
Saved energy	Electricity	Heating water in milking house	–	Heating stables, instead of natural gas	Electricity	Heats general building	Heating water in milking house, instead of natural gas	Hot water in milking house, instead of PB; it heats general buildings
Status of realization	In use	In use	–	In use	Permits ready, in progress	In use	In use	In use
Start of operation	2011	2003	–	2011	2014	1990	2013	2013

Six of the farms use some kind of renewable energy solution. The results show wide range of these application, because there is one biogas plant, two biomass boilers the one is for big bales, the other for small ones, there are three solar collectors.

The Farm1 has a biogas plant and uses slurry from both dairy cattle and pig branches. In the dairy farm 1000 cows placed in stables using slurry technology, therefore the manure from the rest of the cows is not used for the biogas plant. The amount of dairy input is

120 m³ cattle slurry, and 50 m³ pig slurry and silage corn as a supplement. Beside the produced energy the investment was made to use more cost-efficient slurry handling and save straw in cow stables. Residual heat has not yet utilized.

The Farm2 uses a complete solution to lower the water heating cost in milking house. The water heating system firstly uses the waste heat of milk cooling tanks, then it heats the water through solar collectors. If the previous solutions don't heat water enough there is an electric boiler. This complex heating system only generates hot water, it has no connection with the heating system.

The Farm3 made calculation and building plans for a biogas plant with 530 kW gas engine and 1300 m³ fermenter capacity, but the implementation was delayed. The main reason for skipping the project was that the biogas plant also has its demand for silage corn, and the farm does not have additional arable lands for feeding the biogas plant as well.

The Farm4 built a biomass boiler for big bales in 2011, which has 60% less operating cost than the previous natural gas boilers.

The Farm5 plans to install solar panels on the stable roof to generate electricity. The planned capacity of the solar panels is close to the annual consumption.

The Farm6 uses old mixed boilers for heating general buildings.

The Farm7 installed two solar collectors on the roof of the milking house for helping to heat the water and lower the costs.

The Farm8 invested to two different renewable solutions in 2013. Firstly the hot water production in the milking house is provided by solar collectors, and a new propane-butane gas boiler was purchased for supplementary heating. Secondly the heating system in general buildings replaced from PB gas boilers to small bale biomass boilers fed by rape straw and wheat straw.

Summary of socio-economic attributes of renewable energy solutions on interviewed farms is shown in Table 2.

The expected investment return time includes the support (if any), and has lower value than without it. In case of the Farm2 the farm manager couldn't say value for return time, because the combined water heating system with waste heat was part of the building's technology from the beginning.

Only two farms (the Farm1, the Farm5) sell energy in the electricity grid: the biogas plant and the solar cell, it is because other renewable solutions are for heat production, not electricity. In case of the solar cells it is only theoretical and means a two way electricity consumption counter, because the expected electricity production is a bit less than the annual consumption. The capacity was designed for this size for a purpose, because saved electricity has higher price than a sold (if there is a surplus). Therefore the additional investment for bigger output than the consumption has significantly higher return time.

All the examined farmers have experiences at least in one of EARDF projects, mostly ÁTK support.

Three farms submitted application for ÁTK IV in 2012. All of them have some renewable elements in their application for additional points in assessment, and all three farms won. In case of the Farm7 that was the main goal by installing only 2 panels.

The Farm1 employs 6 additional workers for its biogas plant. In case of biomass combustion some additional workers hours were recorded, but the values didn't reach a full worker, therefore these numbers are mainly theoretical.

Six from the eight of the farms have further development plans in renewable energy. The Farm1 plans to increase its biogas plant if all stables will have a slurry technology, and to use biogas (after cleaning) for their gas boilers. They plan also to use the waste heat of the gas engine for some purpose. The Farm2 has an application for biogas plant, but its realization is still in question. The Farm3 plans (beside the biogas plant) to lower the heating and hot water cost of the main building by installing solar collectors. The Farm4 is about to build more stables

Table 2.

Summary of the socio-economic attributes of renewable energy usage on interviewed farms

	Farm1	Farm2	Farm3	Farm4	Farm5	Farm6	Farm7	Farm8
Support fund	ÁTK I. 75%	–	–	ÁTK III. 40%	ÁTK IV. 50%	–	ÁTK IV. 40%	ÁTK IV. 40%
Expected return time (incl. support)	5 years	?	–	2–3 years	6.5 years	–	3 years	3 years, 1 year
Energy selling	Yes	No	–	No	Yes	No	No	No
Additional employment	6 workers	–	–	0.5 worker	–	–	–	0.2 worker
Experience in EARDF programs	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Further renewable plans	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Further renewable plans in detail	Increase biogas plant capacity, biogas for heating gas boilers	Biogas plant?	Solar collectors for office buildings; Biogas plant?	More stables, increase biomass heating capacity	Increase solar cells capacity, biomass heating for general buildings	–	–	Solar cells on stable roof

for their pigs, which buildings also will be heated with big bale boilers. The Farm5 plans to heat the social building and the machine workshop with a small bale biomass boiler, and increase solar cell capacity if electricity consumption grows. The Farm6 and the Farm7 don't have any further plans regarding renewable energies. The Farm8 is planning to mount solar cells on the roof of the newly built stable in 500 kWp magnitude.

CONCLUSION

The examined farms provided useful information regarding the practical application in renewable energy topic.

- The renewable energy investments have high capital demand; their return period usually exceeds five years, even with support, except for replacing natural gas or PB gas boilers. Projects mostly start when support fund, can be added.
- All the examined farmers have experiences at least in one of EARDF projects, mostly ÁTK support.
- ÁTK support application gave opportunities for renewable energy projects in animal farms. Furthermore as a part of a complex farm modernization

project, though additional points, renewable energy solutions gave higher chance of winning the application.

- Only biogas and biomass combustion resulted higher employment in animal farms
- All the farms are aware of the renewable energy options, and most of them have further plans in this topic.
- It is advised to the businesses to seek the best suitable technologies in energy saving by consulting external experts and benchmarking, and to adopt the good practices from other businesses.
- The main motive for farmers using renewable energy is cost saving (and ensuring the winning of an application). For making the right decision it is essential to make exact return calculations, and (if available) to seek additional finance sources from supports.

As a result of this present survey the questionnaire will be modified for the later research, because the technical attributes cannot be properly compared if more farms are interviewed. The questions will focus mainly to the knowledge and attitude of farmers in the renewable energy topic. Technical attributes will be used for calculations in case of defined sample farms.

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