



## Analysis of value chains of horse manure to biogas

This project has investigated the preconditions for developing new business models for horse manure and identified how the value chain can be improved through technical, organizational or market improvements. However, horse owners are a fragmented group and differs on aspects such as size, geographical location and type of business which implies a costly and complicated value chain.

Horsekeeping is typically done for training, competition and leisure, which contribute to economic and social values, but the horse manure has to be tended for, which is a significant cost for a stables.

This can be turned into a profit, since research has shown that it is technically feasible to convert horse manure to biogas by means of anaerobic digestion. A major barrier are the logistics cost as well as the lack of business models for biogas production that benefits all actors along the supply chain.

In response, this project has mapped potential supply chains for horse manure to biogas and pointed at important obstacles that must be overcome in order for the collection to be efficient and the business models sustainable.

### The geographical spread is a problem

The results show that there are barriers all along the supply chain that obstructs efficient logistics. Important factors include the geographical spread of many small stables which makes it hard to plan for efficient transportation.

Furthermore, the stable personnel is responsible for container selection as well as transport orders, which makes the logistics costly. Also, horse owners prefer different bedding for their horses as a function of cost and personal preferences which obstructs biogas production.



*Horse manure holds a potential of 600 GWh which could be made use of to produce renewable biogas. This could contribute to replace fossil fuels such as natural gas in the Swedish mix of energy, contribute to lower emissions, reduce leakage of nutrients and improve recycling thinking. (Photo: Pixabay)*

There are also multiple potential segments of end users for horse manure and multiple end users within each segment, which may lead to sub-optimization from a supply chain perspective.

### Locally produced renewable biogas

The potential biogas production has also been mapped from a business model perspective, based on Osterwalder and Pigneur (2010). Given that biomass is produced from a bulk commodity and continuously distributed, several of the parts of the business model are straight-forward.

However, key partners will be of significant importance for the business model to be economically viable in the long run, as there may be a lack of raw material otherwise. Also, the central part of the value proposition is locally produced and renewable biogas.

### Special vehicles for efficient collection

This project suggest that both technical and organizational developments are needed.

From a technical perspective, specialized vehicles for efficient collection may reduce logistics cost. Also, the trade-off between storage efficiency and transport efficiency needs to be addressed by mathematical modelling.

From an organizational perspective, it is important to develop business models with positive revenue streams for all actors in order to avoid sub-optimization. Also, managing vertical and horizontal channels are of similar importance.

### A part of the Swedish energy system

The project has been presented at three industrial conferences, won a price for best poster at an international research conference and been published in the international research journal *Renewable energy*.

In all, it is concluded that the logistical barriers identified may be overcome and that horse manure has a small part to play within the Swedish energy system.

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## Project facts

**Project name:** Analysis of value chains of horse-manure to biogas

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