GA No. 691911

Research Coordination for a Low-Cost Biomethane Production at Small and Medium Scale Applications

Deliverable No. D2.3

Market barriers and risks for the implementation of small to medium scale biomethane production and how to overcome them

Dissemination Level		
PU	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	

Nature		
R	Report	X
O	Website	

Deliverable Details		
Due date:	31.03.2018	
Submission date:	29.03.2018	
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WP no. and title:	WP2 Capacity Building	
WP leader:	DBFZ	
Task no. and title:	Task 2.3 Framework Conditions	
Task leader:	RISE	
Draft/Final:		
Keywords:	Market barriers, Implementation, Market policy, Regulatory policy, R&D financing, Demonstration financing	

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 691911.

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1 Background and introduction

Throughout the course of the Record Biomap project a couple of key areas have stood out as particularly important to overcome market barriers and risks for the implementation of small to medium scale biomethane production systems. These key areas and issues have been raised at project workshops, in conversation with technology developers as well as in discussions with plant owners and project developers. This list makes no claim to be completely exhaustive or correctly prioritized but it is clear that resolution of the issues raised in this report would go a long way to facilitate implementation of small to medium scale biomethane production systems within the EU.

We have divided the areas of importance into three categories, namely:

1. Market policy
2. Regulatory policy
3. R&D financing
4. Demonstration financing

The reason that the list of barriers, risks and means to abate them is not exhaustive is that we have focused on such facilitating measures that are cost neutral to the public purse. As opposed to actions that would require for example new subsidies or additional capital grants, the obstacles identified in this report would “only” require political and bureaucratic will and priority to overcome.

2 Market policy

In most EU countries, no matter where they sit on the scale of comparative energy pricing, vehicle fuel is where the willingness to pay for energy is the highest in terms of cost per unit of energy. For a small to medium scale biomethane project, that in a sense goes against the grain of the scale economy, it is very important to be able to capitalize on the opportunity for margins that is uniquely offered by the vehicle fuel market. Additionally, small to medium scale biomethane production is largely going to be a rural production segment where competition for the renewable drive market from electrical vehicles is significantly lower than in urban centers. Since the diesel drive train (thus also biodiesel) have been discredited of late as well as first generation ethanol, biomethane (both CBG and LBG) fueled NG-vehicles is probably one of the best bets for greening the rural and regional road transportation systems. This is especially true if the biomethane is generated from organic waste streams such as manure, sewage sludge, food processing waste and food waste.

The problem is that policies, both regulatory and economic incentives are missing for biomethane for vehicle fuel application in most countries that we have looked into within the RecordBiomap project. In Rogstrand at al. (2017) it is stated that “it is striking to see for example that all but one of the studied countries have specific policy targets for reducing fossil fuels in the transport sector while less than half of the countries have any kind of framework for using biomethane as a vehicle fuel”.

For small to medium biomethane projects to be feasible at least the following policy concepts should be in place:

- standards for biomethane as both a fuel and for grid injections must be in place
- a significant difference in how fossil fuels (gasoline, diesel and natural gas) are taxed in comparison to biomethane, or other means to compensate for higher production and distribution costs for biomethane in comparison to fossil fuels
- aggressive national targets on replacing fossil fuels for transportation and back-up power for the electrical grid
- guaranteed grid access and reduction or elimination of grid connection costs so that also smaller biomethane producers can participate in the grid gas market
- requirement that all sizable gas stations have at least one renewable alternative on offer

3 Regulatory policy

Economy of scale unfortunately often also apply to regulatory costs and approval processes. This is the one part of the scale economy that the policy makers actually have full control over. Due to the smaller scale the perceived scale of risk (environmental emissions, odor, traffic, hygiene, etc.) is limited and it is therefore a reasonable approach to apply less rigorous regulatory demands on such projects to match the lower risk. This concept allows for progressive fast-tracking of the regulatory processes for small to medium scale biomethane projects.

Based on the above, the fact that less than half of the 15 reviewed EU-countries have a functioning fast track system is a significant barrier to development. Another problem that has been reported is significant regional differences in rules and regulations even within the same country. For small to medium scale biomethane projects to be feasible it is important that fast-track systems are in place and efficiently utilized to ensure that approval processes cost less and takes less time for smaller projects than for larger projects. One concrete example of a progressive fast track system can be found in Sweden. The various scale categories and the resulting regulatory requirements for the Swedish system for environmental approval can be found in table 1 below.

Table 1. Boundaries and classifications with respect to environmental approvals requirements for biomethane projects at various scales in Sweden.

Environmental code – environmental permits	Boundaries and classification	Regulatory review body	Monitoring responsibility
A-class operation Code 90.150	Obligation to seek approval – significant risk of environmental impact Operation for biological treatment of other waste than hazardous waste if the treated amount of waste is greater than 100 000 ton per calendar year.	Environmental court	Regional board or municipality
B-class operation Code 40.10	Obligation to seek approval – significant risk of environmental impact	Environmental review delegation	Regional board or municipality

Code 90.160 Code 90.240	Operation for production of more than 150 000 Nm3 gaseous fuel per calendar year Operation for biological treatment other waste than hazardous waste if the treated amount of waste is greater than 500 ton per calendar year. Operation which in some other way than combustion treats more than 2 500 ton of animal byproducts per calendar year	(Regional board)	
C-class operation Code 40.20 Code 90.170	Obligation to notify – no significant risk of environmental impact Operation for production gaseous fuel per calendar year if it is not obligated to seek approval as a code 40.10-operation Operation for biological treatment of other waste than hazardous waste if the treated amount of waste is less than 500 ton but greater than 10 ton per calendar year.	Municipality	Municipality

Although some of the classification boundaries are a bit ambiguous the Swedish environmental approval system allows for some significant cost and time differentiation associated with the approval process in between large scale projects and small to medium scale projects. It is by no means perfect, but at the very least it manages to break the scale economy of the project costs associated with regulatory approvals and thus reducing the barrier for small to medium scale developments. Similar systems exist in several countries but as stated above, most countries are still lacking in this kind of fast-track system

4 R&D-funding

When canvassing the whole of Europe for developers of innovative biomethane technologies it was surprising to see how few there are out there. We had set the project goal of identifying and describing total of 30 developing technologies that fit the definition of TRL 3-5. In the end we achieved our target but only after expanding the TRL scope to 3-7, and even then, by a very slim margin. When scanning scientific literature and project logs in both the EU and national systems it is striking to see how many review articles and technology aggregation projects there are in comparison to projects where original ideas are developed into prototypes and new products. A surprising ratio of publicly funded project aggregates knowledge and technology information that others have developed, repackages the data for comparison and produce reports based on that. In all fairness Record Biomap is just such a project, and we are

not arguing that this kind of project is not needed, but there seems to be an imbalance that constitutes a barrier.

To reduce capital cost, operational costs, maximizing positive environmental impact and optimizing systems integration the state of the art of biomethane technology has to be moved forward. To do that it is important that there is enough financing available for high risk, original experiments and practical proof of concept projects. Because of the risks involved and the distance to market introduction the funding will primarily have to come from public sources. The 30 developing technologies that we have found is evidence that this progress is happening to some extent but technology developers attests that progress would be faster and more far reaching with access to more funding targeted to original works that physically moves the frontier of technology forward.

To provide a concrete example we entered the following search words: Biogas, and Biomethane, Technology, Energy into the scientific database Science Direct. The search rendered a total of 71 articles, of which approx. 7 articles described work where a novel technology or concept had been physically developed or evaluated. The other approx. 64 articles had no relation to physical development of a novel technology, or just aggregated data from other authors or developers into, for example a comparative format.

This imbalance constitutes a barrier to the development of small to medium scale biomethane technology. It should be noted that we are not necessarily advocating for more public funds going towards biomethane projects but rather a re-prioritization of what is already allotted in favor of original works.

5 Demonstration financing

Some of the reprioritized public R&D funding should be reserved for demonstration financing of completely new products that have never been shown in a production environment in any jurisdiction. The primary reason for this is that the greatest risk in the current innovation system is that an otherwise market ready product does not find its first commercial customer before the investor funding runs out. The perceived risk of being the first to try a new technology or concept, even if the evidence points towards a potentially superior product/process, is often too great to warrant investment on strictly commercial grounds. There is in fact some merit to this perceived risk as new products/processes have a greater prevalence of failure than tried and tested ones, but the fact still remain, this is the one of the most important barriers of getting a completely new product to market.

This is by no means unique to small to medium scale biomethane technologies, but since the scale is limited, so is the risk of involving public funding in financing “first-of-a-kind” installations. As biomethane projects generate very high environmental and social benefits and since the relative scope of required public funding is limited due to scale, targeted governmental investment in demonstration projects specifically for small to medium scale biomethane production could be very efficient public policy.

However, not all technologies are completely new. Many technologies have already been proven in another jurisdiction. In this case you know that the technology works and you know its capacity and output. The risk I lower, but it still has not been proven in a local context in the new jurisdiction and therefore face a barrier to expansion into a new market due to lack of local trust. To enable this kind of “technology transfer”, or “technology introduction” projects, public calls could incorporate specific eligibility criteria that would require an integrated business model where both production and utilization of a product, in this case biomethane, is part of the demonstration project scope. The funding strategy of the call could then be based on a lower grant portion for a moderate reduction of risk and a low interest loan portion to enable the rest of the investment. The key to this is to allow demonstration projects that actually incorporate a net revenue and to have that revenue pay back the low interest public loan over time. For example, a farmer wants to introduce/invest in an upgrading technology that is new to the country or region but proven elsewhere. To help with this, the farmer gets a small grant and a larger low interest loan. This technology would result in vehicle quality biomethane (Bio-CNG). This farmer also uses a tractor on his/her farm (or other facility) which has been so far based on fossil fuels. If the operation costs of the farm are decreased by including in the initial investment a transformation of the tractor to be used now with Bio-CNG, then these savings on operation costs would eventually pay back the public low interest loan on the investment, thus reducing the need for public grant funding to get the demonstration project off the ground.

Another example is when the upgrading to biomethane serves a community and not only an individual. This case would have to have the municipality as a fundamental implementation partner. Then, for example, the community being served may require a shuttle service to the next bigger city, a school route that would switch from fossil fuel to Bio-CNG, or the garbage truck may be switched to run on Bio-CNG. The demonstration financing would include this second part of the project which incorporates the transformation of a bus, a truck, etc. to Bio-CNG. It would then function based on biomethane obtained from the newly demonstrated technology. This vehicle is made a constant user of the biomethane generated, and would have less operating costs than other means of transport working on fossil fuels. What is more, the savings on CO_2 emissions could be marketed and registered within a carbon emissions savings scheme, again generating revenue to pay back a low interst public loan.

In addition, such integral projects that combine several concrete sustainability results, and benefits from the integration of renewable energies, are eligible to participate in crowdfunding schemes and platforms, such as Bettervest or One planet crowd, among others. If the project is solid, well described, and represents a clear win-win situation to the stakeholders involved and sustainability, it is very likely to raise what it requires to be implemented. For example, the EU project CrowdfundRES[1] is meant for the acceleration of RES implementation at an EU level. On their website (see footnote) guidelines for both investors and project developers are presented and are open access to download and use. This is an alternate way to finance or co-finance demonstration projects without governments, the EU or other public funders having to commit additional money.

[1] http://www.crowdfundres.eu/results/