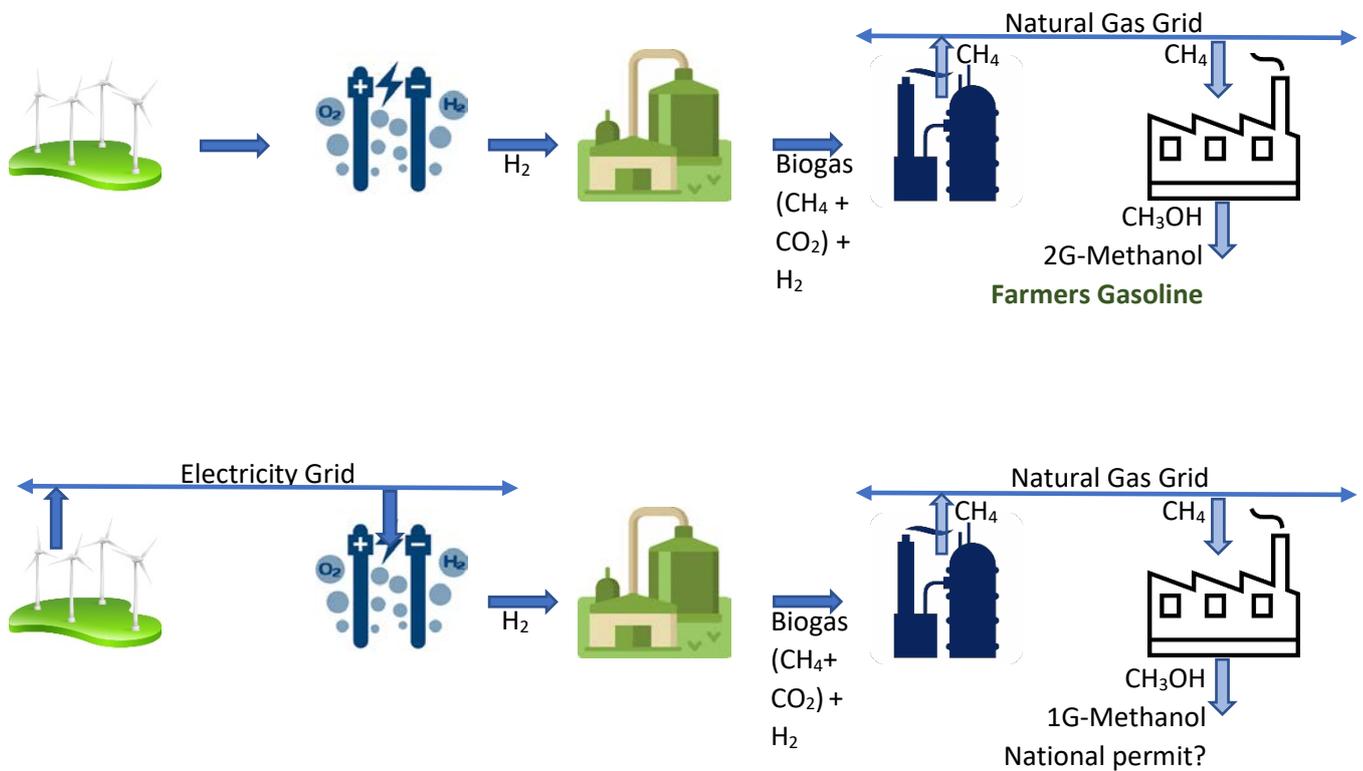


IEA-AMF Annex 56 Methanol as Motor Fuel – Annex 4 Feedstock & Distribution



## Power to Liquid



E-mail from Peter Hawighorst, ISCC System GmbH, 04-10-2016.

*Under ISCC EU and European legislation (FQD) the following pathways will be possible:*

1. *CO<sub>2</sub> from biogas plants processed using electricity from renewable sources*
2. *CO<sub>2</sub> from fossil sources (non-biological origin) processed using electricity from renewable sources*

*The direct supply of renewable electricity (without grid connection) will definitely be possible.*

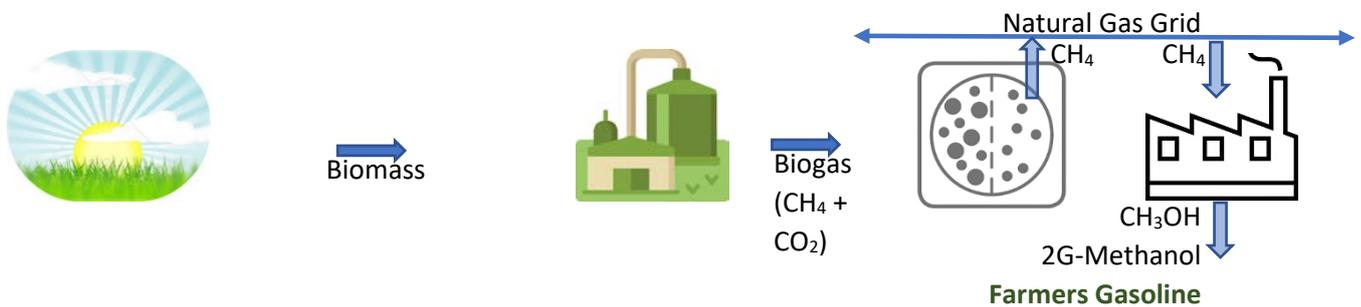
*For the off-taking of electricity from the grid, national obligations will probably be taken into account. As a first step this can be certified under ISCC, if certain requirements will be fulfilled (e.g. double-accounting of the renewable electricity is excluded).*

Rules for transport in the gas and electricity networks, respectively, are significantly different.

Certified biomethane from waste and residues injected into the grid may be withdrawn as a corresponding amount of natural gas anywhere at no cost and the methanol will be recognized as second generation fuel.

Wind power cannot be “moved” in a similar way and the methanol is not recognized as second generation fuel. This is a significant trade barrier preventing use of wind power as “liquid electricity” for transportation.

## Gas to Liquid



Decentral collection of biomass and conversion to biomethane saves transport. Placement of methanol plant can be central and given a profitable capacity of a few thousand tons of methanol per day.

Profitability could be increased by concurrent use of wind power for central electrolysis. This would allow the use of both oxygen and hydrogen from the electrolysis - but it requires regulatory changes.

Danish forests generate little waste, but it does agriculture. Until reasonable rules for using wind power are introduced, we may continue to use the pathway illustrated above.

### Raw material, potential quantities

Methanol is the most basic alcohol and several renewable production pathways exist. Methanol is made from a wide range of feedstocks. In Denmark it is obvious to produce methanol of biogas (biomethane) and methanated wind energy.

"*Biogas in Denmark - Status, Barriers and Perspectives*" prepared by the Danish Energy Agency February 2014 states that the maximum technical biogas potential based on Danish biomass resources can be estimated between 44 and 78 PJ depending on the time perspective and the amount of energy crops. The Biogas Taskforce has for the analysis of the use of biogas in the future energy system used a revised biogas potential of 48.6 PJ<sub>LHV</sub>. Conversion of this biogas gives 37.4 PJ<sub>LHV</sub> methanol + useful heat.

To the above there is an additional potential of methanated wind energy. Statistics Denmark reported a production of 13,000 GWh wind energy in 2014 ~ 47 PJ. Enough for 28 PJ<sub>LHV</sub> methanol (1.4 million tons). The proposed amendment from Parliament to only allow the use of air captured CO<sub>2</sub> in a redrafted Renewable Energy Directive (RED II) is an unnecessary restriction. In the Energy Statistics 2018, the EOF states a Danish consumption of 1.8 million m<sup>3</sup> petrol per year, corresponding to 58 PJ<sub>LHV</sub>.

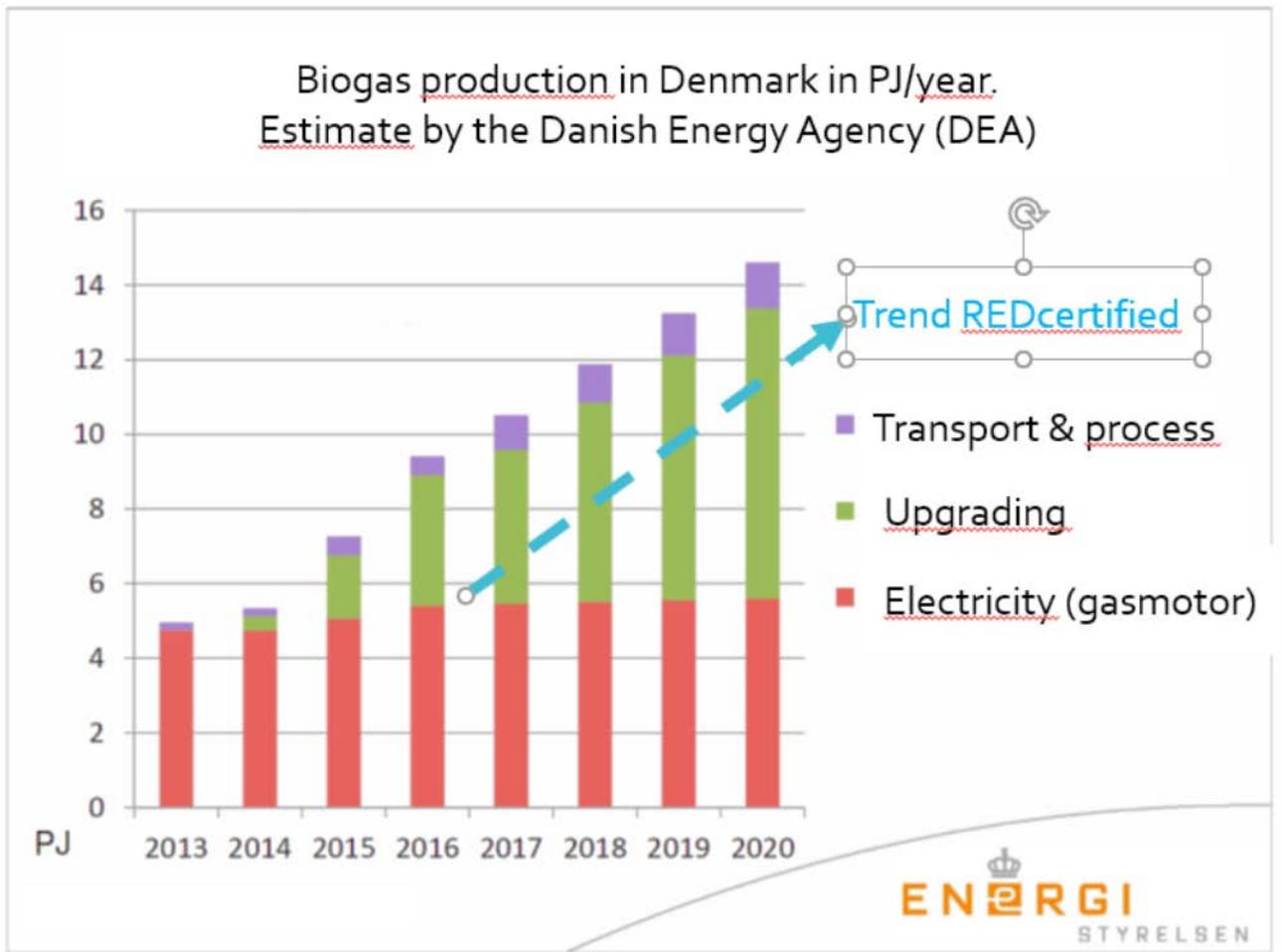


Figure 1 Until 2014, biogas was burned in gas engines for electricity and heat. This use has practically ceased for new plants and the gas is instead upgraded to bio-natural gas that can be injected into the gas grid. Recently, an increasing proportion is being RED-certified and hence suitable for green second-generation biofuel in the form of biomethanol. "Trend RED-certified" is an estimate inserted by DMA.

### Feedstock Distribution

Energinet.dk owns the overall distribution system for both electricity and gas in Denmark. The infrastructure exists, but permits is so far only in place for the use of the gas grid.

Production facilities for methanol abroad can be used, as the EU Commission recognizes the transport of biogas in the European gas network as illustrated below. When the gas is first injected into the gas network, it loses its identity, but an EU-certification system ensures a documentary track.

In Denmark, we know two EU accredited inspection and certification companies, which have obtained their certification system recognized by EU - ISCC System GmbH and REDcert International Pvt Ltd. Both act through cooperating partners - Certification Bodies (CB).

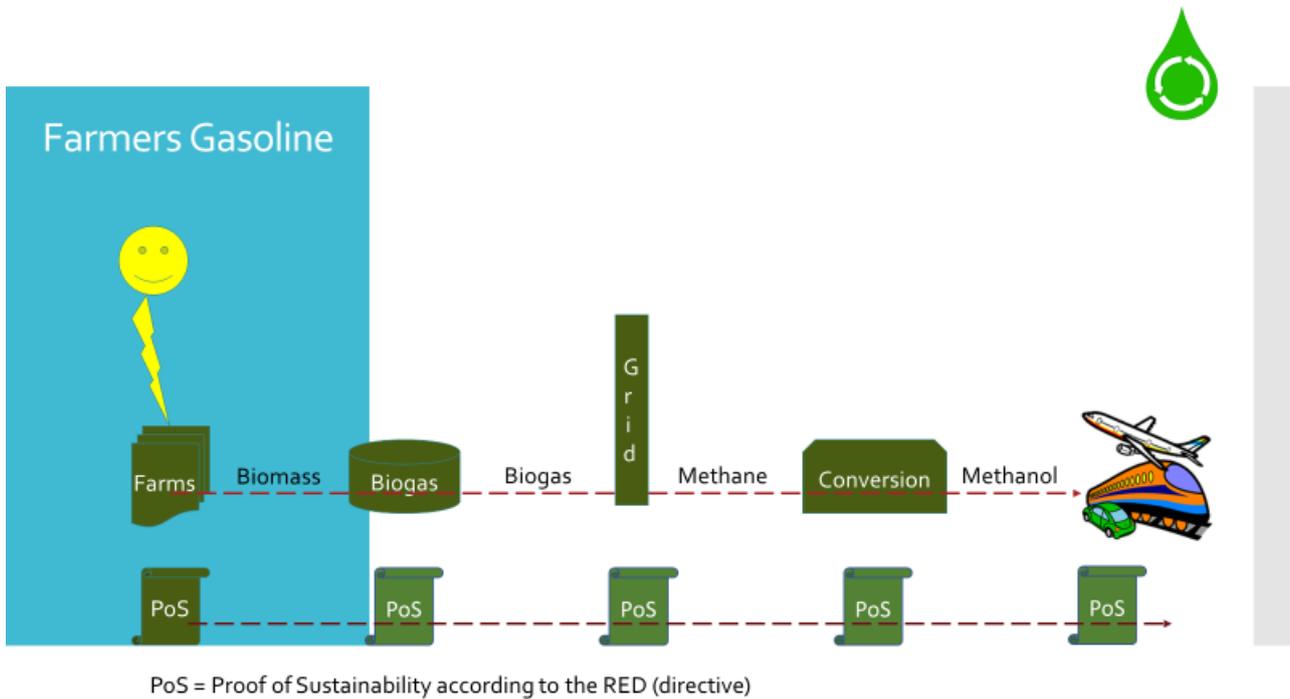


Figure 1. Farmers Gasoline is a trademark used by New Fuel A/S for their ISCC EU certified biomethanol. Biomass from farms is transported by road to biogas installations. The biogas is purified to biomethane and through a short pipeline injected into the gas grid. The European gas network can be regarded as a container capable of receiving gas from many sources and from which gas can be taken in many places for many purposes. When gas is taken by a Conversion Unit and converted to methanol, it is transported by ship, road tanker or rail wagon to a Warehouse and distributed to an end-user.

### Conversion Efficiency

Conversion efficiency is reported for a modern methanol factory <sup>1</sup>.

	<b>MJ<sub>LHV</sub>/t methanol</b>	<b>Consumption MJ<sub>LHV</sub>/t methanol</b>	<b>MJ<sub>LHV</sub> gas / MJ<sub>LHV</sub> methanol</b>
Methanol	19,9		
Natural gas		28,74	
Conversion factor			1,44

The emission savings is found using a tool provided by Biograce <sup>2</sup>. The BioGrace greenhouse gas (GHG) calculation tool has been recognized as a voluntary scheme by the European Commission.

<sup>1</sup> The 2,400 MTPD Methanol Plant at Tjeldbergodden by Anders Gedde-Dahl and Karl Jørgen Kristiansen Statoil a/s, Tjeldbergodden, Norway and Helge Holm-Larsen Haldor Topsøe A/S, Lyngby, Denmark <http://newfuel.dk/ne/CU2%20WMC%201998%20without%20color%20frontpage.pdf>

<sup>2</sup> <http://www.biograce.net/home>

## Product Storage



*Figure 2. One of two Methanol tanks – each 2.500 m<sup>3</sup> - owned by Nordalim A/S, Port of Aarhus. The tanks are ISCC certified as warehouse for biomethanol traded by New Fuel A/S.*

## Distribution of Biomethanol

The conversion of biogas to methanol is in place. The same can be said for storage in Denmark. Some customers have their own storage tanks and docks for receiving methanol by ship. Others must take the methanol by road tanker. This can today be done by receiving methanol from the two tanks belonging to Nordalim A/S, Port of Aarhus - each of 2,500 m<sup>3</sup>. From the APM terminal methanol can be shipped by rail.