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Fact Sheet: Biomethane production potential in the EU-27 + EFTA countries, compared with other biofuels

Main data for this Fact Sheet was taken from the NGVA Europe's Position Paper "Biomethane", prepared by Mattias Svensson. All the references used for this paper are indicated at the end of this document.

Note about units:
1 EJ (exaJoule) = 10^{18} Joule; 1 PJ (petaJoule) = 10^{15} Joule; 1 EJ ~ 24 Mtoe

BIOMETHANE PRODUCTION POTENTIAL

Some basic data at world level:

- Current global energy utilization in 2007 amounted to 347 exajoules (EJ, corresponding to 8.286 Mtoe, or 96,4 petawatthours, PWh) (*IEA 2009*).
- Theoretical energy potential of the global annual primary production of biomatter is enormous, 4.500 exajoules (EJ)
- Out of the 2.900EJ theoretically harvestable biomass, approximately a tenth is considered technically available on a sustainable basis, 270EJ (75PWh) (*WEA 2000*)
- Other research indicates an upper limit of 1.135EJ in 2050 for a sustainable global bioenergy production not interfering with the supply of food crops (*Ladanai and Vinterbäck 2009*)

European level

- It is reported that the sustainable primary biomass potential, waste streams included, will increase from 8 EJ (2,2PWh) in 2010 to 12EJ (3,3PWh) in 2030 (*EEA 2006*).
- Higher total estimations are also reported, for example a technical potential of biomass of 17EJ (4,7PWh) for EU-27 (*Ericsson and Nilsson 2009*).
- **A large share of this may come from agriculture, increasing from 2EJ (547TWh) in 2010 to 5,9EJ (1,6PWh) in 2030 (*EEA 2007*).**
- **With a conservative land utilization (5% of the arable land), estimations on the biogas potential of energy crops from anaerobic digestion in EU-27 show yields ranging between 0,9 to 2,7EJ (252–758TWh) with harvest yields of 10–30 tonnes dry solids per hectare (*Holm-Nielsen 2008*).** This value is coherent with the previous estimation of 2 EJ for 2010.
- A coarse estimate for the 500 million inhabitants of EU-27 indicates a biogas potential of 68TWh (0,24EJ) from wastewater sludge. In agriculture, animal manure represents a very large biogas potential. Estimates for EU-27 show a theoretical potential of 205TWh (0,72EJ) (*Holm-*

Nielsen 2008). Summing up, as much as 453TWh (1,6EJ), not including landfills, could come annually from waste streams.
Energy crops could optimistically add to that figure up to 1.500TWh (5,4EJ), depending on share of arable land and crop yields.

- Most European countries have extensive grid coverage, enabling a large share of the biomethane potential of Europe to be realized through injection schemes. A German biomethane injection study (*Thrän et al. 2007*) shows that the biomethane potential of anaerobic digestion and thermal gasification from residual products and a sustainable production of energy crops in the vicinity of the European gas grid (EU-28) may in 2020 be in the range of 2.000–3.500TWh (7–12,4EJ).
  If including the potential of the CIS countries, the potential increase to 4.000–6.000TWh (14,1–21,2EJ), large enough to cover the current EU-28 natural gas utilization.

Additional data from other sources, confirming the estimates

Other studies (Möglichkeiten einer europäischen Biogaseinspeisunfsstrategie. Institut für Energetik und Umwelt, Leipzig, 2007 and Biomethane in the transport sector. An appraisal of the forgotten option. Max Ahman, 2009) estimate for the EU 27 the biomethane potential to be approx. 5,47–8,9EJ (131–214Mtoe) in 2020. The given numbers can be taken as a theoretical maximum reference based on available biomass resources in Europe (energy crops, ligneous waste, wet biomass without urban waste, etc.). Taking into account current infrastructure conditions and different biomethane interests in the various European countries, reaching 10% of the mentioned total biomethane potential is feasible for the EU 27 and EFTA countries in 2020. This potential includes biomethane produced though biological and the thermo chemical conversion process.

This figure of 5,47–8,9EJ in 2020 is quite well aligned with the other previously indicated forecast of 8EJ in 2010 to 12EJ in 2030 (*EEA 2006*).

COMPARISON WITH OTHER BIOFUELS

The production of other (liquid) biofuels is based only in crops, and its land surface efficiency is clearly lower than in the case of biogas. See illustrations below.

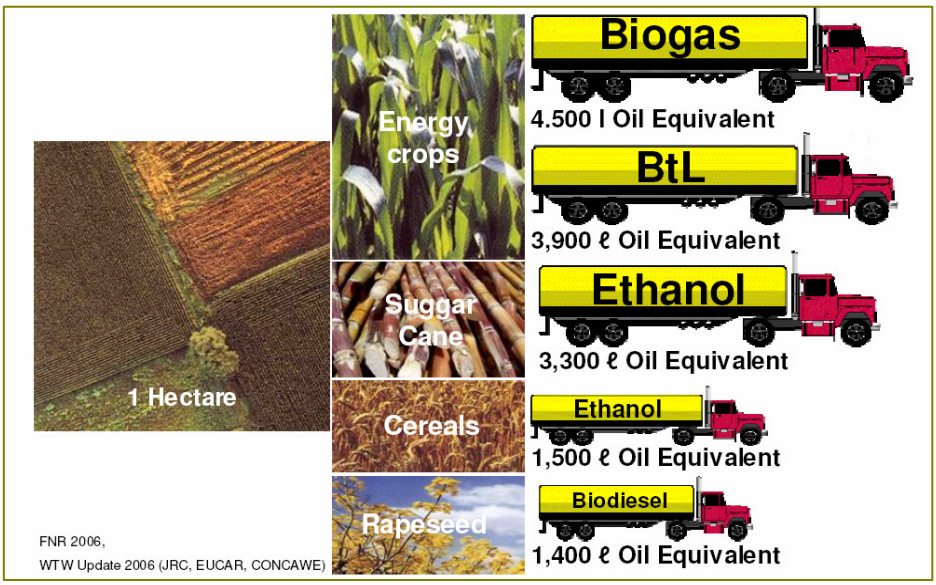
The efficiency of the land devoted to ethanol production, as an average of cereals and sugar cane crops, would be 2.400 litre of oil equivalent per hectare. In the same conditions the biogas production reaches 4.500 litre of oil equivalent, which is roughly double.

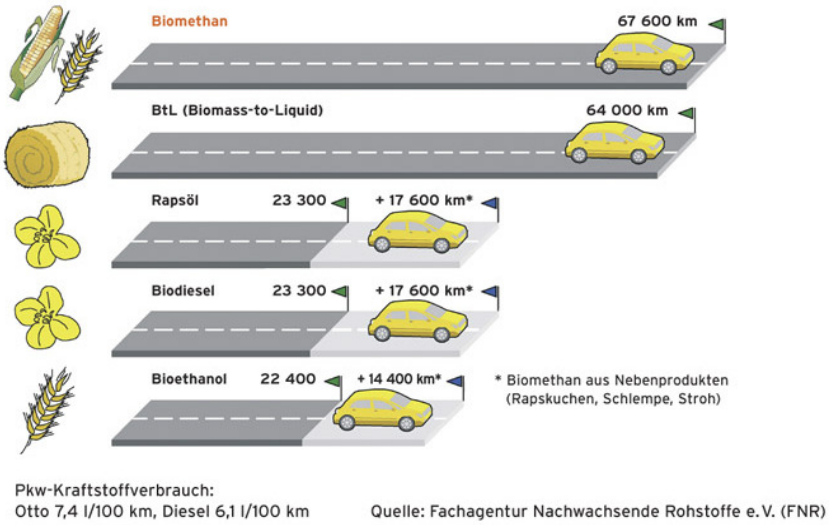
If we apply this 53% land efficiency of bioethanol against biogas production, both coming from crops, the total 1.500 TWh (5,4EJ=130Mtoe) estimated potential for biogas, would be reduced to some 800 TWh (2,9EJ= 70Mtoe) in the case of ethanol.

If we now take the global estimation of 2.750 TWh (9,9EJ=238Mtoe) (as an average between 2.000 and 3.500 TWh), this quantity is made out of 1.500 TWh (5,4 EJ=130Mtoe) coming from crops plus another 1.250TWh (4,5EJ=1.108Mtoe) coming from other sources: sewage, manure, landfills, etc.

If we choose bioethanol instead of biogas we would loose the potential of the waste, sewages, etc (1.250TWh, 4,5EJ=108Mtoe) and we would also reduce the efficiency of the crops by 47%.

In other words we would obtain 800TWh (2,9EJ=70Mtoe) instead of 2.750TWh (9,9EJ=238Mtoe).





CONCLUSIONS

It is clear that among all biofuels, biogas/biomethane **offers the best results in terms of energy production potential and land efficiency**, and it is also the only one able to be efficiently produced from several different sources.

Additionally we have to keep in mind that **biomethane is the only biofuel in which the composition of the renewable fuel is exactly the same than in the gas coming from well**. This characteristic allows biomethane to be mixed with natural gas at any percentage and without any problem for the vehicle engines.

REFERENCES

NGVA Europe's Position Paper "Biomethane", prepared by Mattias Svensson, MSc Chem. Eng., PhD Env. Biotechnology, Research Manager at the Swedish Gas Center, in June 2010. (http://www.ngvaeurope.eu/)

Åhman M (2010). "Biomethane in the transport sector—An appraisal of the forgotten option". Energy Policy 38 (1),208-217 doi:10.1016/j.enpol.2009.09.007

EEA, European Environment Agency (2006). "How much bioenergy can Europe produce without harming the environment?", Report No. 7/2006 (http://www.eea.europa.eu/publications/eea_report_2006_7)

EEA, European Environment Agency (2007). "Estimating the environmentally compatible bioenergy potential from agriculture" Report No. 12/2007 (http://www.eea.europa.eu/publications/technical_report_2007_12/at_download/file)

Ericsson K, Nilsson LJ (2009). "Assessment of the potential biomass supply in Europe using a resource-focused approach". Biomass and Bioenergy 30 (1), 1-15

Holm-Nielsen JB (2008). "Biogas – a promising renewable energy source for Europe", AEBIOM Workshop - European Parliament Brussels, December 11. 2008: The Future of Biogas in Europe: Visions and Targets until 2020, 2008 (http://www.aebiom.org/IMG/pdf/Nielsen_text.pdf)

IEA, International energy Agency (2009). "Key World energy Statistics"

Ladanai S, Vinterbäck J (2009). "Global Potential of Sustainable Biomass for Energy" (http://www.worldbioenergy.org/system/files/file/WBA_PP-1_100122final10.pdf)

Thrän D, Seiffert M, Müller-Langer F, Plättner A, Vogel A (2007) "Möglichkeiten einer europäischen Biogaseinspeisungsstrategie, Teilbericht I, Potenziale" (http://www.gruene-bundestag.de/cms/publikationen/dokbin/166/166883.pdf)

WEA, World energy Assessment (2000). "Energy and the challenge of sustainability" (http://www.undp.org/energy/activities/wea/drafts-frame.html)