IEA Bioenergy

European Commission

iea Energy Technology Network

The future of biomethane as transport fuel

David Baxter

European Commission, JRC
&
IEA Bioenergy, Leader of Task 37

Overview of Presentation

- IEA Bioenergy and the Biogas Task
- Political support for biogas in Europe
- Biomethane as a transport fuel
- CEN standards

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www.ieabioenergy.com

IEA Bioenergy comprises 12 Tasks

Task 29: Socio-Economic Drivers in Implementing Bioenergy Projects
Task 32: Biomass Combustion and Co-Firing
Task 33: Thermal Gasification of Biomass
Task 34: Pyrolysis of Biomass
Task 36: Integrating Energy Recovery into Solid Waste Management
Task 37: Energy from Biogas
Task 38: Greenhouse Gas Balances of Biomass and Bioenergy Systems
Task 39: Commercialising Liquid Bio-Fuels from Biomass
Task 40: Sustainable International Bioenergy Trade – Securing Supply and Demand
Task 41: Joint Project with the Advanced Motor Fuels Implementing Agreement
Task 42: Biorefineries: Co-Production of Fuels, Chemical, Power and Materials from Biomass
Task 43: Biomass Feedstocks for Energy Markets

Task 37
Energy from Biogas

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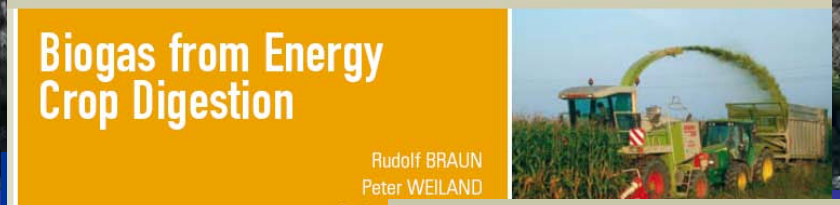
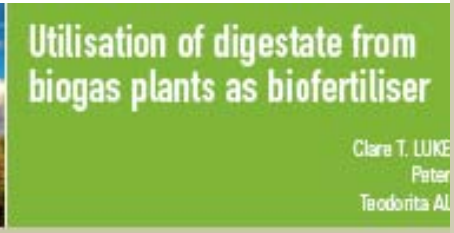
Publications





Web Address: www.iea-biogas.net

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NUTRIENT RECOV
AND
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BIOGAS PIPELINE
POWER PRODUCTION I

IEA Bioenergy Task 37

BIOGAS IN SOCIETY
A Success Story from
IEA BIOENERGY TASK 37
"Energy from Biogas"

PIONEERING BIOGAS FARMING IN CENTRAL FINLAND

FARM SCALE BIOGAS PLANT PRODUCES VEHICLE FUEL, HEAT, ELECTRICITY AND BIO-FERTILIZER

PUBLISHED: FEBRUARY 2012

SUMMARY

Kalmari farm is one of the pioneer farms producing biogas in Finland, and an excellent example of innovative use of biogas technology. The farm is self-sufficient in electricity, heat and vehicle fuel. Excess electricity is sold to the grid, and vehicle fuel sales exceeded 1000 MWh in 2011. The biogas plant digests cow manure and confectionery by-products, and in the future will also digest fat trap waste and liquid biowaste (under the EU animal by-products regulation). Occasionally smaller amounts of energy crops, mainly grass silage, are digested as well. Digestate is used as bio-fertilizer on the farm's own fields. Biogas technology on the Kalmari farm thus efficiently combines energy production, waste treatment and nutrient recycling.

Figure 1.
The patented Metener biogas upgrading technology (Jussi Läntelä, Metener Ltd.)

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IEA Bioenergy – New Biomethane Project

'Biomethane in Heavy Duty Engines' (Task 41)

Phase 1: literature survey
Phase 2: emission and engine performance from state-of-the-art methane fuelled heavy duty engines (either dedicated gas engines or diesel engines fuelled with a combination of methane (in various forms) and diesel) - testing partly on chassis dynamometer under controlled laboratory conditions and partly on the road during real life operation

European Political Support for Biogas

The Renewables Directive: 2009/28/EC (RED)

- **Grid Access:**

Article 16 (7):

Member States shall ensure that charging of transmission and distribution tariffs does not discriminate against gas from renewable sources

The Renewables Directive: 2009/28/EC (RED)

- **Grid Access: Gas**

Article 16 (9):
Where relevant, Member States shall assess the need to extend existing gas network infrastructure to facilitate integration of gas from renewable sources

Article 16 (10):
Where relevant, Member States shall require grid operators to publish technical rules regarding network connection (viz. gas quality, odorisation, pressure) and publish connection tariffs for renewable gas sources

Some GHG Savings in the RED

- Default GHG savings compared with fossil petrol/diesel (Annex V.A)

Biogas from municipal organic waste*	*73%*
Biogas from wet manure*	*81%*
Biogas from dry manure*	*82%*
Rapeseed biodiesel	*38%*
Palm oil biodiesel (process not specified)	*19%*
Palm oil biodiesel (CH_4 capture at mill)	*56%*
Sugar beet ethanol	*52%*
Sugar cane ethanol	*71%*

*(* in the form of compressed biomethane compatible with natural gas)*

What about biomethane from energy crops ?

Biomethane (as compressed natural gas):

from maize: cultivation* = 20 gCO_2eq/MJ
transport = 2 gCO_2eq/MJ
processing** = 11 gCO_2eq/MJ

60% saving !!

Source of data: Renewable Energy Directive 2009 (Annex V.D)
* EU cultivation
** data for dry manure

Future Developments with the RED

- Refinement of Default GHG savings production

Original calculation covered only components of production of biomethane:

cultivation, transport and processing

Future calculation could also include "land use change"

More is now known about CH_4 emissions during production – likely reduced GHG savings

Currently waiting for Commission Communication and Impact Assessment later in 2012

EU White Paper
Roadmap to a Single Transport Area

COM (2011) 144

- focus on "growing out of oil" with new technological solutions (new engines, materials and design; new fuels and propulsion systems), health benefits from clean vehicles (43 + 44)
- strategy for transport in close cooperation with the SET-Plan (Energy) (45)
- standardisation to avoid fragmentation (47)
- elimination of tax distortions (59)

Transition fuels versus ready-made fuels for use far into the future !!!!!!!! Methane

EU Biomethane Production Potential

European Environment Agency (Report No. 7 – 2006)

- 60 Mtoe/y from energy crops by 2030

Leipzig Institute for Energy and Environment (2007)

- 410 Mtoe/y by 2020; half by biogas from animal and municipal wastes and energy crops, half from gasification

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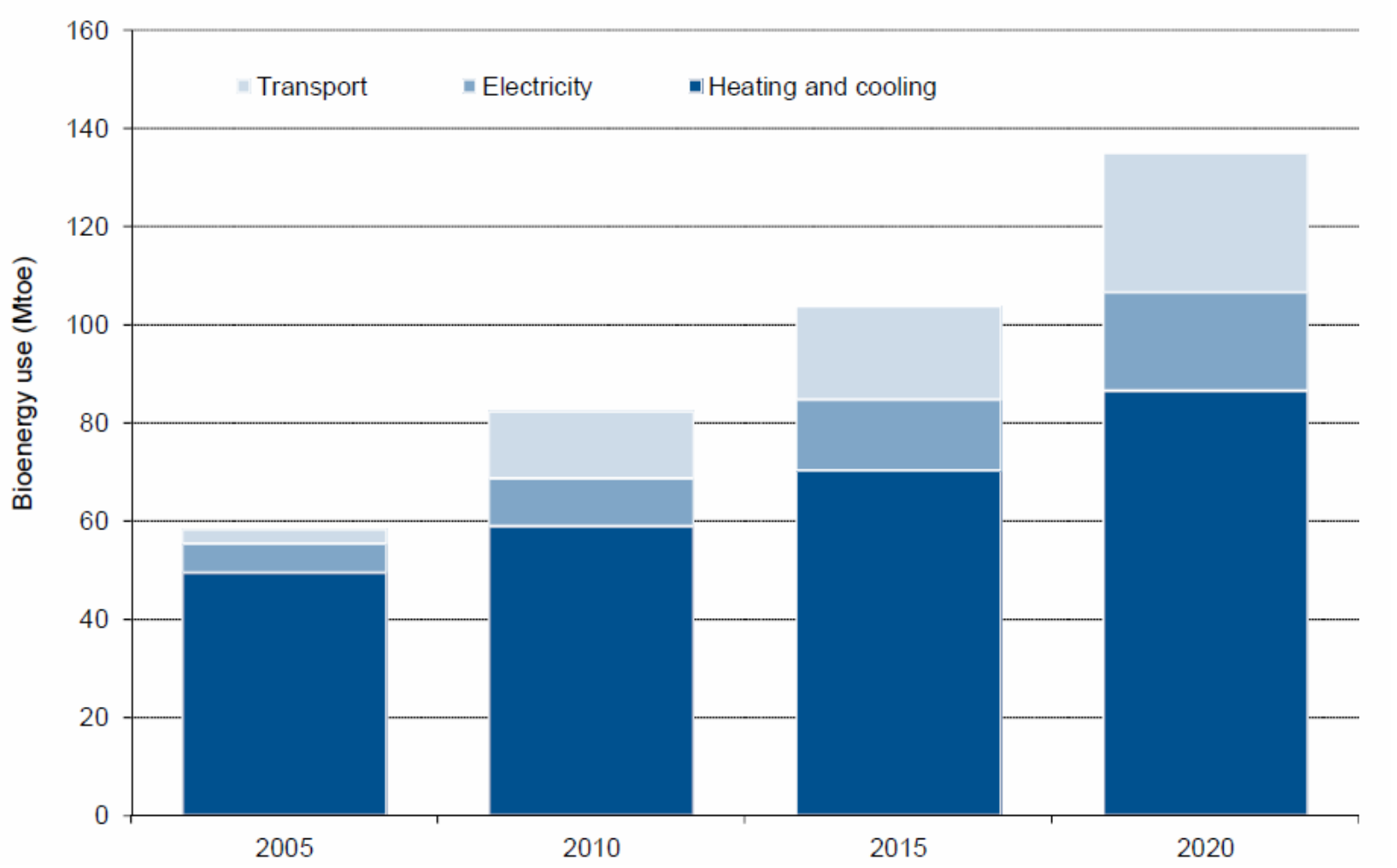
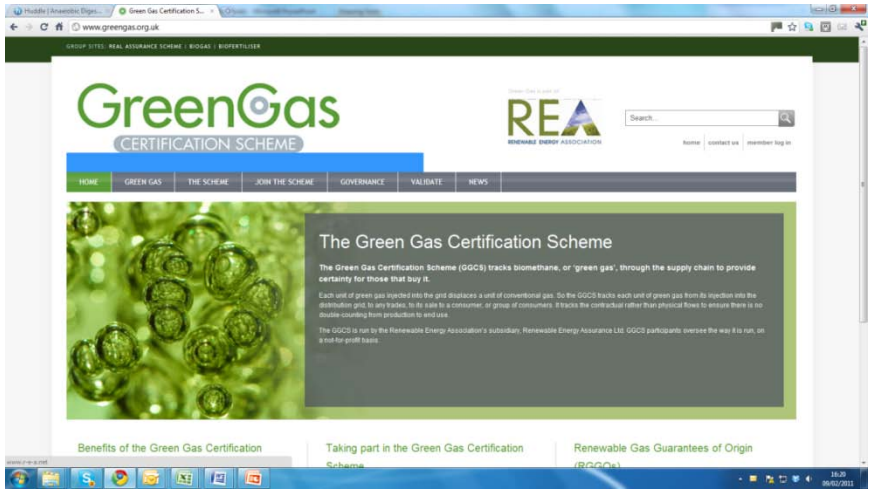
Bioenergy Projections for 2020 (based on NREAPs)



Green Gas Certificate Scheme

- United Kingdom scheme launched 3rd March 2011 by Renewable Energy Assurance Ltd
- Designed to allow 'tracking of biomethane from injection point to customer"
  - Integrity - no 'double counting'
- Allows the gas purchaser to work with the producer to market biomethane to customers



Biomethane as a Transport Fuel

Future Transport Fuels Report (01-2011)

Conclusions:

- NG engine technology already well established
- Emissions with NG/biomethane reach EURO 6
- Emissions: low-NOx, up to 24% lower CO_2 than petrol, particulates close to zero
- Dual-fuel at 75-85% NG with diesel possible – engine can run on 100% diesel (=good transition technology)
- Harmonised standards for gas grid injection and building of extensive refuelling infrastructure highest priority
- Biomethane could be readily available as CNG or LNG
- Double yield / hectare for biomethane versus bioethanol

Methane Vehicles

Worldwide

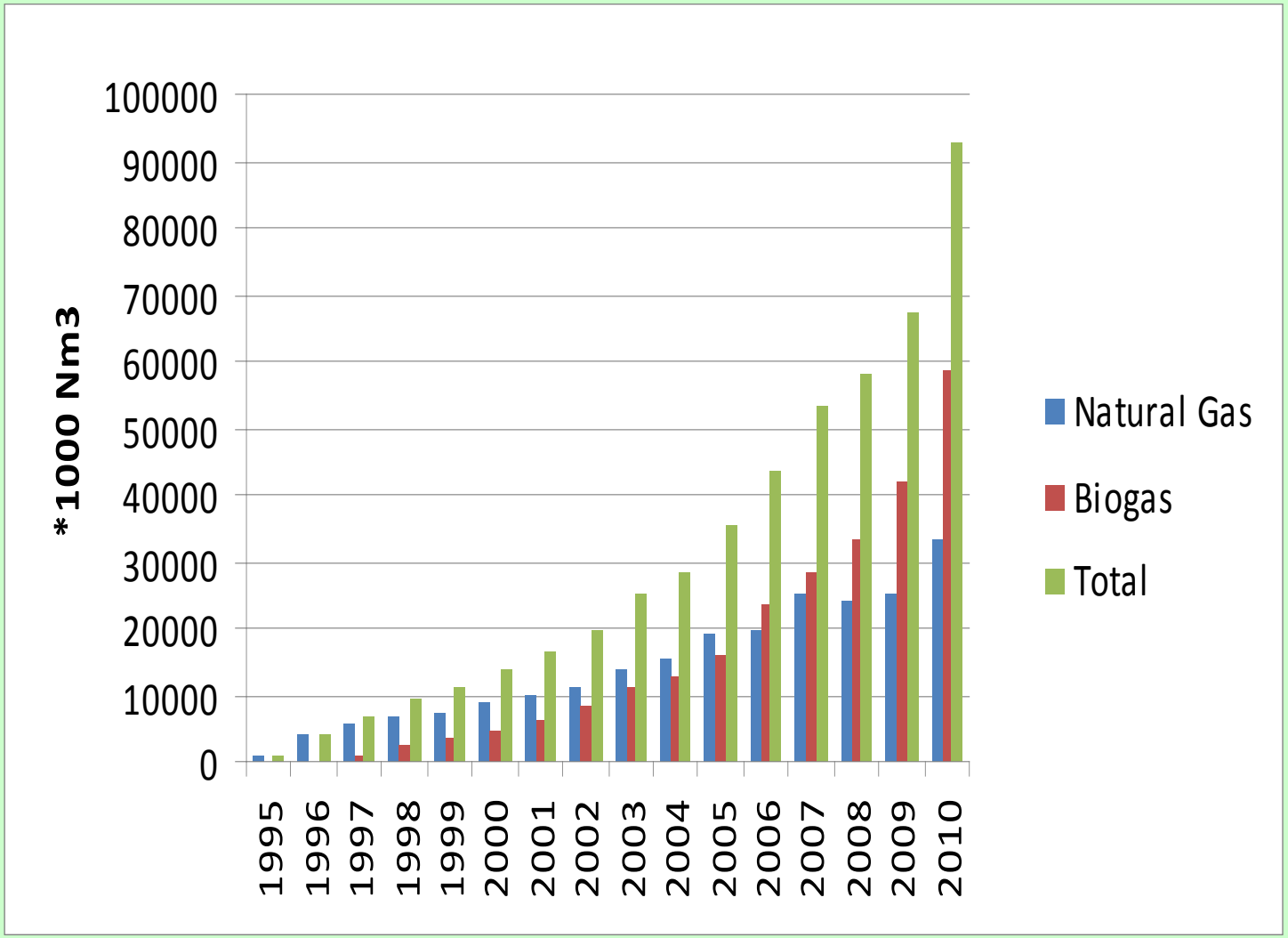
- 70% of road fuel used in Pakistan
- 20-25% in some Latin American countries
- EU only 0.4% (Bulgaria 3%, Italy 1.5%)

- Sweden leads with biomethane use: 61% of >90 MNm^3 (balance natural gas); ~30,000 vehicles

Support Mechanisms

Sweden

- Investmen
- LIP KLIMP
- Support fo
  NG/bi
- Investmen
- Green car
- Discount o
- Free parki



Swedish Fuel Standard for biomethane for Otto engines

- Particles < 1 µm
- Methane 97+/- 2 %
- Water < 32 mg/Nm^3
- CO_2, O_2, N_2 < 5%
- Oxygen < 1 vol %
- Sulphur < 23 mg/Nm^3
- N (except for N_2) expressed as NH_3 <20 mg/Nm^3
- Odourised
- Compressed to 200 bar

For grid injection: Addition of propane (around 7-9 vol%)

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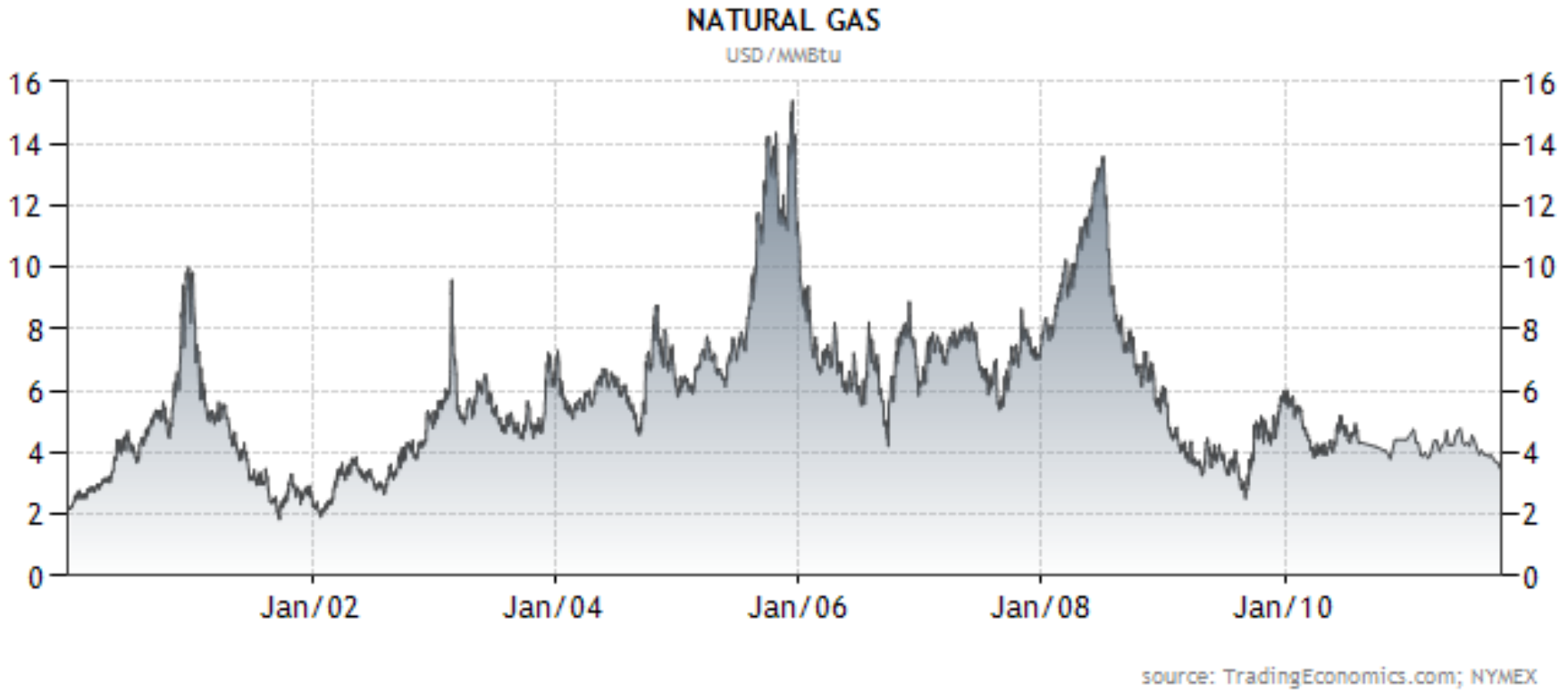
The Price of Natural Gas



CEN
European Standards

Mandate from the European Commission for both gas grid injection and vehicle fuel.

CEN decided to combine the work into one new Technical Committee CEN/TC408

(Originally planned to be carried out in CEN/TC234/WG9 + CEN/TC19)

Chaired by AFNOR, France
Kicked-off in September 2011

CEN/TC408

Working on mandate from the European Commission:

Main Aim:

- accommodate biomethane in grid with acceptable consequences (local and transport grids)
- specification for injection should comply with H-gas standard under preparation (2014)

Gaps in Knowledge:

- system integrity (contaminants – O_2, CO_2, H_2S, ammonia, siloxanes, PAHs, ...)
- health issues (CO, PAHs, pathogens, ……)
- aspects of gas exchangeability

CEN/TC408

Injection of gases from non-conventional sources into natural gas networks

Key Issues:

- integrity of the natural gas system
- combustion properties of the gas
- properties of the gas for consumers that use the gas as a feedstock
- human, animal and plant health of those exposed to gas of flue gas
- need to add propane to achieve calorific value of NG ?

CEN/TC408

Progress

Expert Groups (EG) (started work in 2011)

1. Measurement and tracing of the biogenic content of methane in gas grids
2. Characteristics of biomethane for use as a fuel for vehicle engines
3. Characteristics of biomethane for injection into natural gas grids

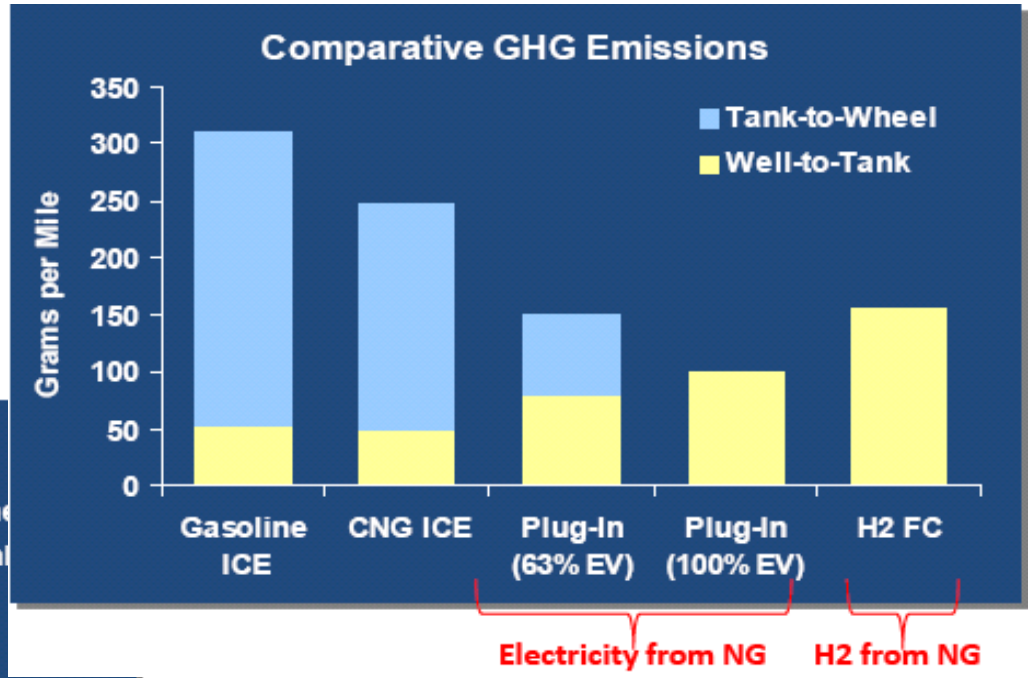
Future Perspectives

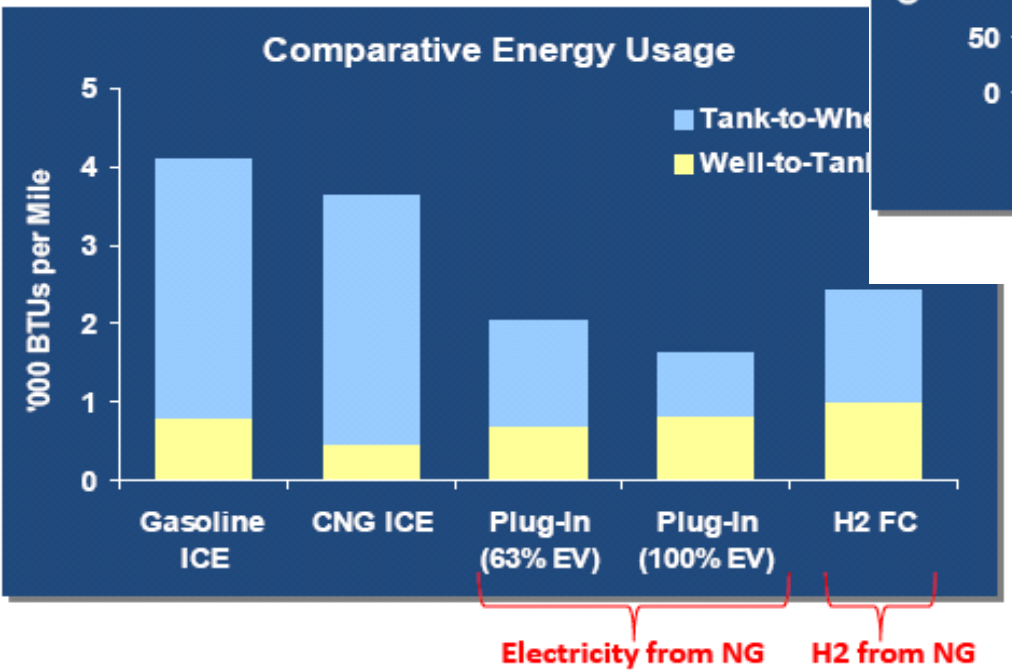
Natural Gas-to-Hydrogen for FCEVs*

Supply Chain Options

- Reform natural gas at large scale and compress/liquefy hydrogen for distribution by truck to stations which store and dispense
- Pipe natural gas to stations and reform, compress, store and dispense hydrogen at station scale
- Reform natural gas at medium/large scale and pipe hydrogen with natural gas to stations and separate/reform, compress, store and dispense at station scale

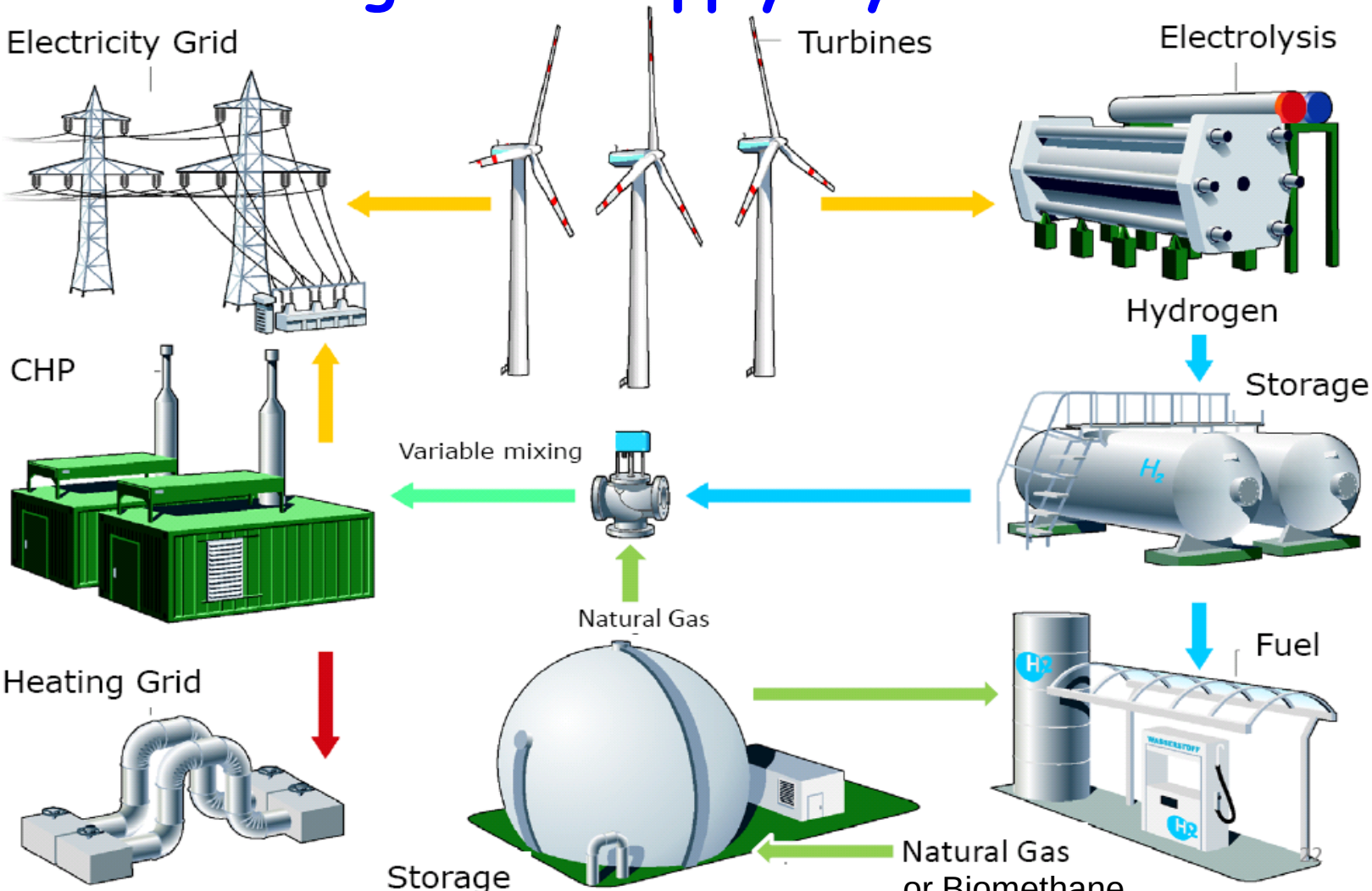
Natural Gas-to-Hydrogen for FCEVs





Source: Burns (2011) US-HTAC

Integrated Supply System



Source: Burns (2011) US-HTAC

Summary

- Biomethane is an ideal substitute for natural gas – mixing over the range 0 to 100% is easily achieved
- Biomethane and natural gas well-proved fuels for internal combustion engines – millions of vehicles in use worldwide – supported by policy makers in EU
- Vehicle emissions lower than liquid fuels – first target for biomethane should be urban transport
- Supply infrastructures lacking in many countries – at least in terms of refuelling stations for public use
- Lack of common standards for biomethane use as vehicle fuel and for natural gas grid injection
- Economic viability strongly influenced by price of natural gas

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Thank you for your attention

http://www.iea-biogas.net/ http://iet.jrc.ec.europa.eu/