bioenergy2020+

Sustainability versus Cost – The Perfect Future Energy Carrier

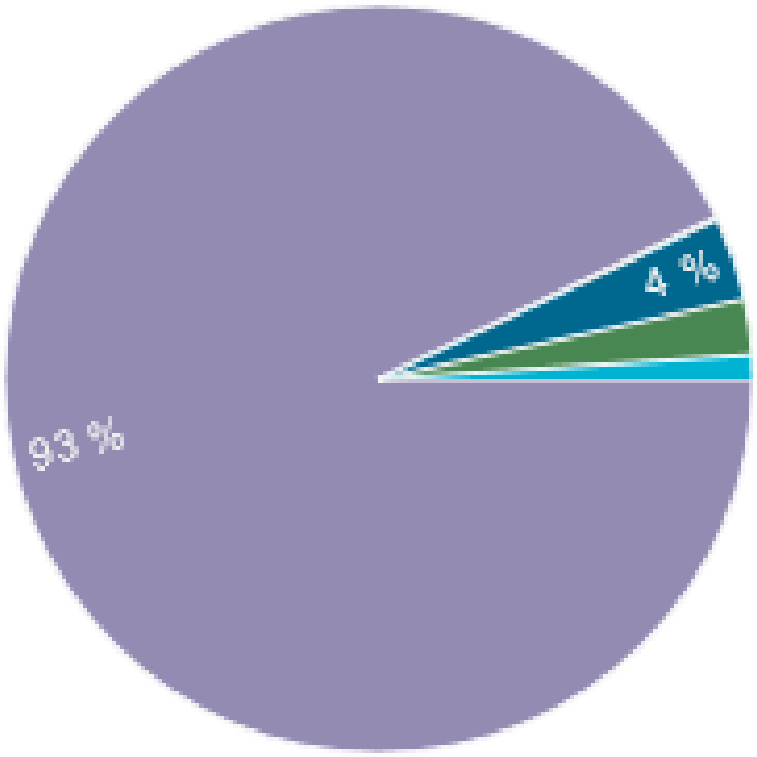
Dina Bacovsky, BIOENERGY 2020+

Eco-Mobility 2025plus

9-10 November 2015

innovations kompetenz

Global final energy demand in the transport sector (2012)



Oil products	2 328 Mtoe
Coal	3 Mtoe
Natural gas	90 Mtoe
Biofuels and waste	60 Mtoe
Electricity	26 Mtoe
Total	**2 507 Mtoe**

http://www.iea.org/Sankey/index.html#?c=World&s=Final%20consumption

Information on Fuels – AMF Fuel Info

ADVANCED MOTOR FUELS
IEA-AMF
AMF
IMPLEMENTING AGREEMENT FOR ADVANCED MOTOR FUELS

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About AMF
Mission and Objectives
Overview of Activities
Contracting Parties
IEA Background

Publications
Annual Reports
Project Reports
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Government Agencies
IEA-related
Industry Associations
Emissions & Fuel Quality

iea Energy Technology Network

Home > FUEL INFORMATION > Fuel Info Home

Introduction

The "AMF Fuel Information System" focuses on the end-use aspects of advanced motor fuels. Performance of cars, effects on emissions and compatibility with infrastructure are included, whereas resources, production and GHG emissions are excluded. When the end-use aspects are evaluated, the complex field of engine/aftertreatment options, uncertainties of measurement methods and incomparability of measurement campaigns has to be taken into account. Priority is given to new studies; however, these represent only minor part of published studies.

The aim of the "AMF Fuel Information System" is to provide easy access to all end-use related aspects of advanced motor fuels.

Available content:

- Diesel and Gasoline
- Fatty Acid Esters
- Paraffins
- Ethanol
- Methanol
- Butanol
- Oxygenates for diesel
- Ethers
- Bio/synthetic gasoline
- Methane
- LPG
- DME
- Oils and fats

http://www.ieahev.org
http://www.ieafuelcell.com

Search

NEWS
AMFI Newsletters
EU Parliament supports advanced biofuels
US: Renewable Fuel Standard volumes released
Methanol and DME plant for Trinidad Tobago
Gevo sells renewable jet fuel to NASA

EVENTS
Future Events
Past Events

PROJECTS
Active Projects (Annexes)
Completed Projects (Annexes)

FUEL INFORMATION
Fuel Info Home
Diesel and gasoline
Fatty Acid Esters (biodiesel)
Bio/synthetic gasoline
Bio/synthetic diesel (paraffins)
Ethanol
Methanol
Butanol
Oxygenates
Methane

http://iea-amf.org/content/fuel_information/fuel_info_home

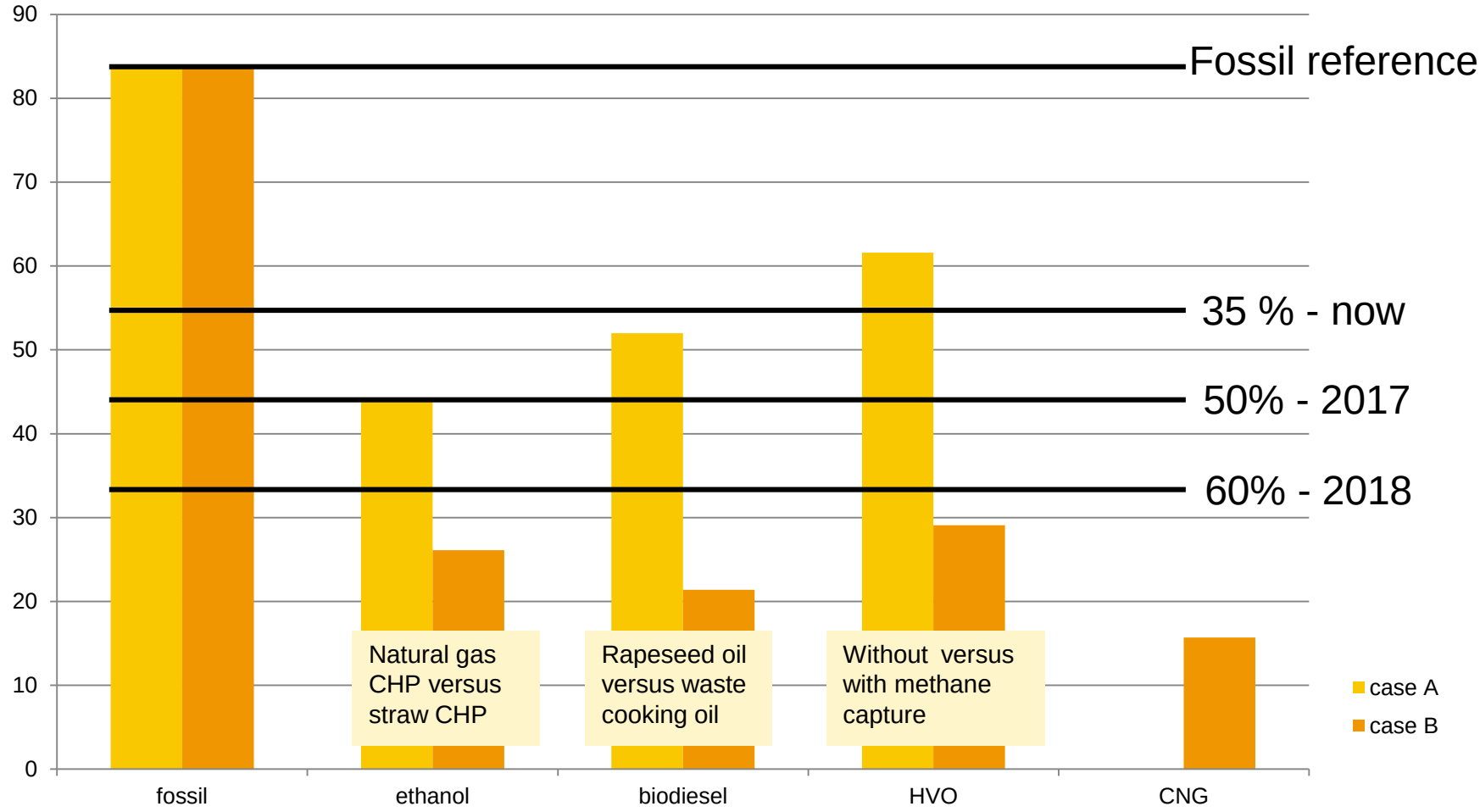
Fuel options by source

- Fuel options
  - **Oil products**
    - Diesel
    - Gasoline
    - Jet fuel
    - Residual oil
  - **Natural gas**
    - LNG, LPG, Synthetic Diesel, Methanol
    - CNG, DME, Hydrogen
    - Electricity
  - **Biofuels**
    - Biodiesel, HVO, FT Diesel
    - Ethanol, Methanol, Butanol
    - Bio-SNG, Bio-DME, Bio-hydrogen
    - Bio-jet
  - **Renewable Electricity**
  - **Renewable Hydrogen**

- Internal Combustion Engines (ICE)
- Aviation
- Electric Vehicles
- Fuel Cell Vehicles

SUSTAINABILITY

GHG emissions – selected values [gCO2eq/MJ]



EU Renewable Energy Directive – Annex V

Variation between different LCA assessments

- Why do different LCA for the same fuel pathways lead to differing results?
  - Data from different time periods used
  - Data from different regions used (technologies, environment,…)
  - Data quality (secondary data, taken from different sources, different boundary conditions,…)
  - Data not representative (does not include start-up/shut-down phases, production problems,…)
  - Differing methodology, e.g. allocation of emissions to by-products

AMF Annex 40: Life Cycle Analysis of Transportation Fuel Pathways
http://iea-amf.org/content/projects/annexes/40

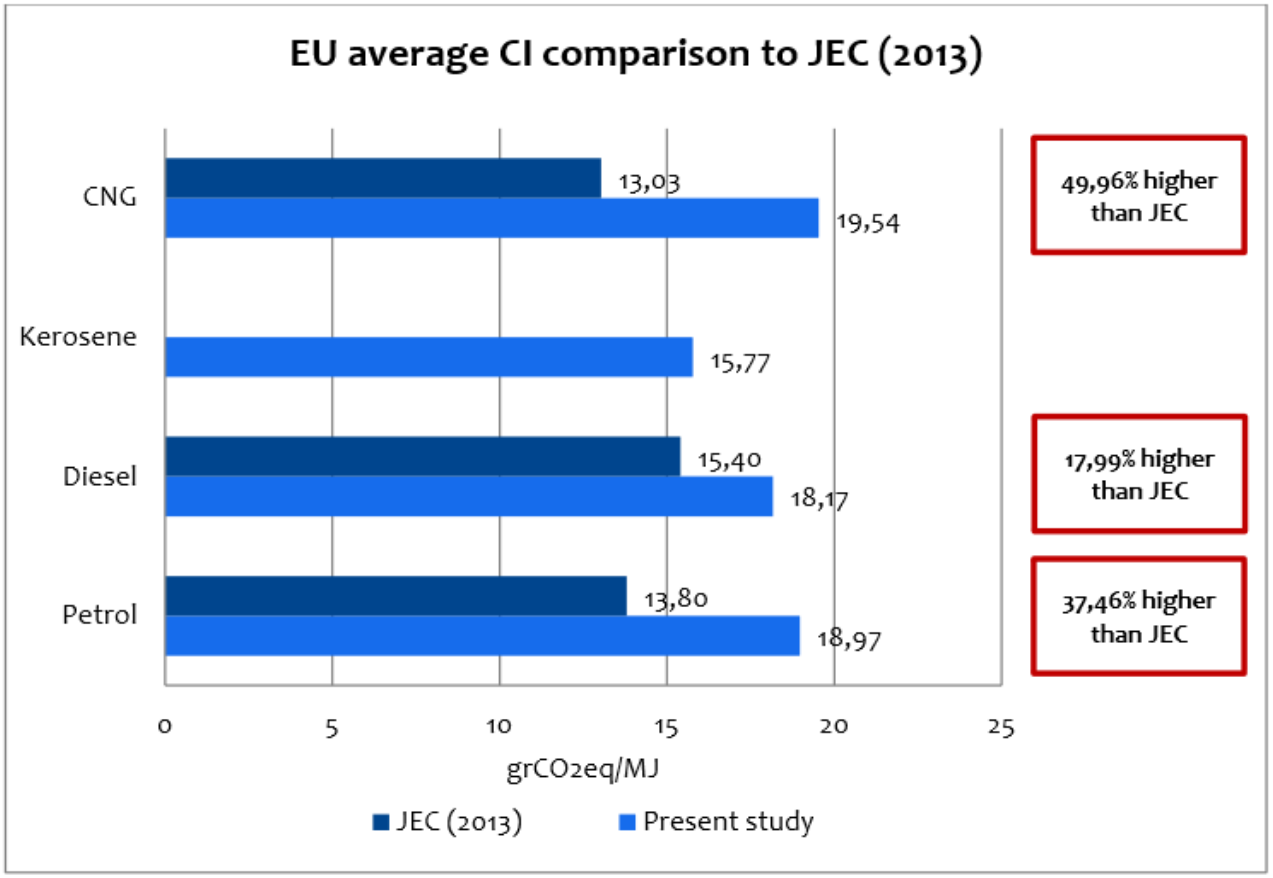
Variation in ethanol GHG emission results

- Nitrogen fertilizer variations
- Emission factor used to determine N2O emissions
- Increased yields and reduced fertilizer requirements for most feedstocks over time
- Variation in yields achieved for the same feedstock in one region to another
- Increasing soil carbon not accounted for
- Ethanol plant technology improvement over time
- Allocation method
- Carbon intensity of the electric power consumed

AMF Annex 40: Life Cycle Analysis of Transportation Fuel Pathways
http://iea-amf.org/content/projects/annexes/40

GHG emissions of fossil fuels

Figure 9-6 Comparison of average CI of oil products and gas streams with JEC values



https://ec.europa.eu/energy/en/studies/study-actual-ghg-data-diesel-petrol-kerosene-and-natural-gas

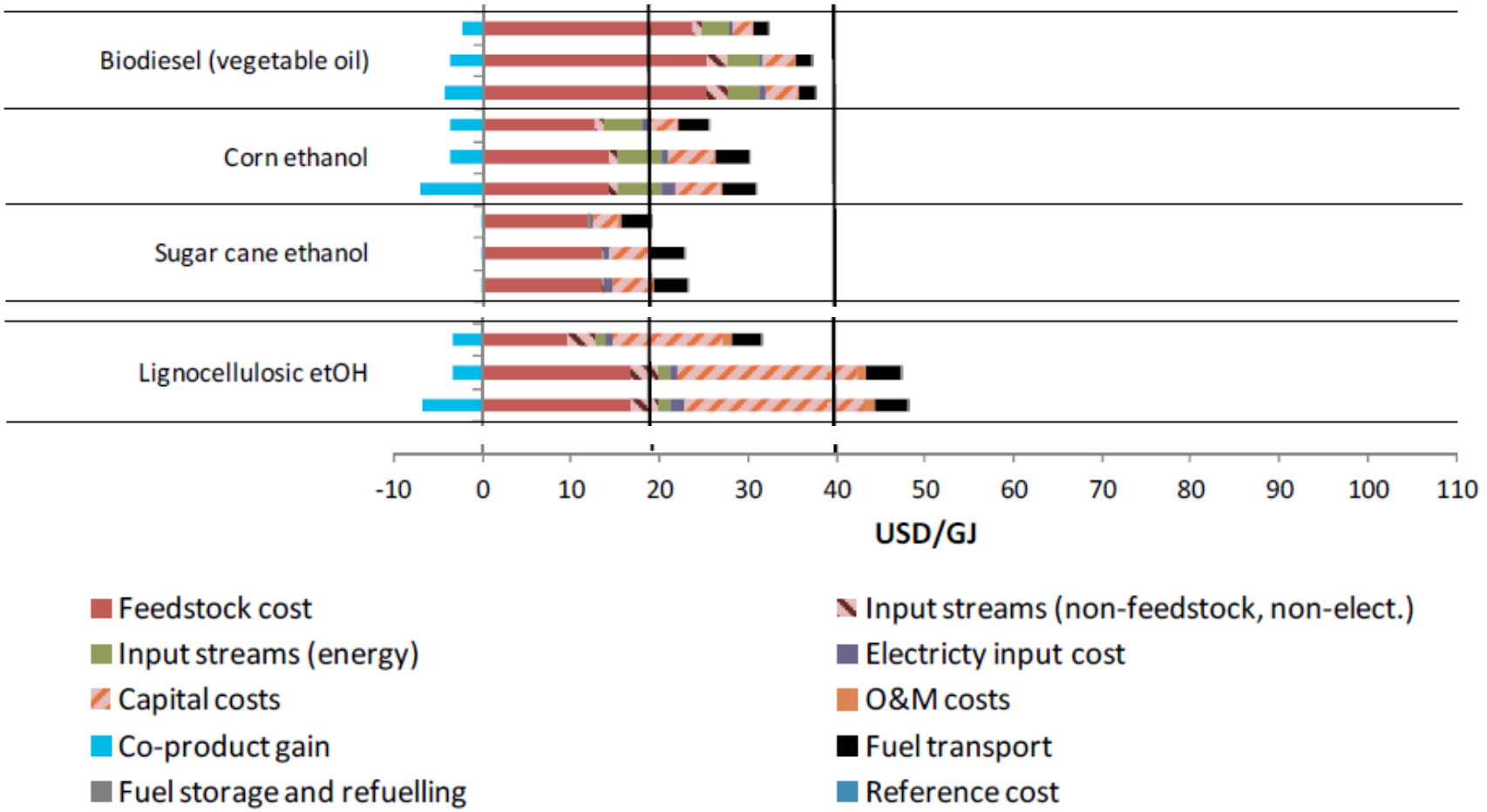
Sustainability Summary for Biofuels

- All biofuels offer GHG emission reductions
- How much depends on
  - Raw material
  - Energy source
  - Conversion efficiency
  - Regional variation
  - Fossil fuel comparator

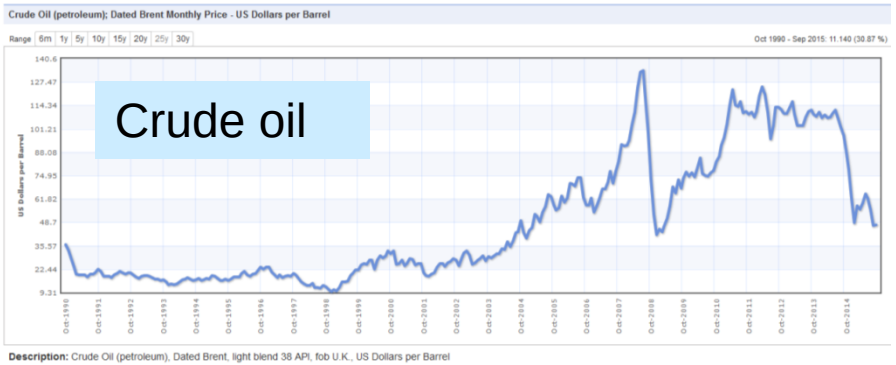
COST

IEA 2013: Production Costs of Alternative Transportation Fuels

http://www.iea.org/publications/freepublications/publication/FeaturedInsights_AlternativeFuel_FINAL.pdf

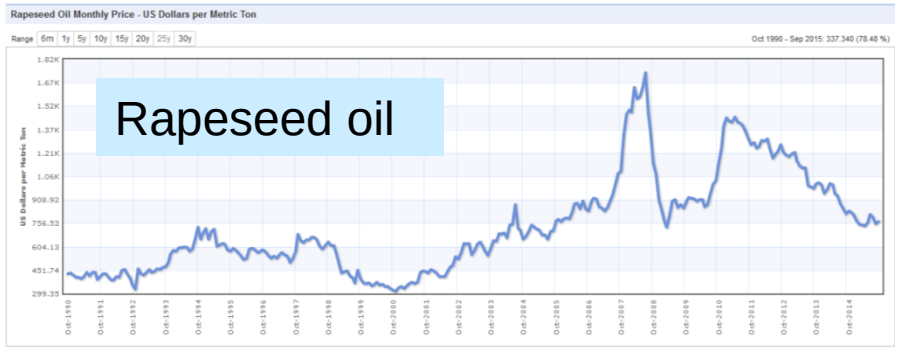


Price development of crude oil and biomass feedstock is interlinked



Description: Crude Oil (petroleum), Dated Brent, light blend 38 API, fob U.K., US Dollars per Barrel

Description: Maize (corn), U.S. No.2 Yellow, FOB Gulf of Mexico, U.S. price, US Dollars per Metric Ton

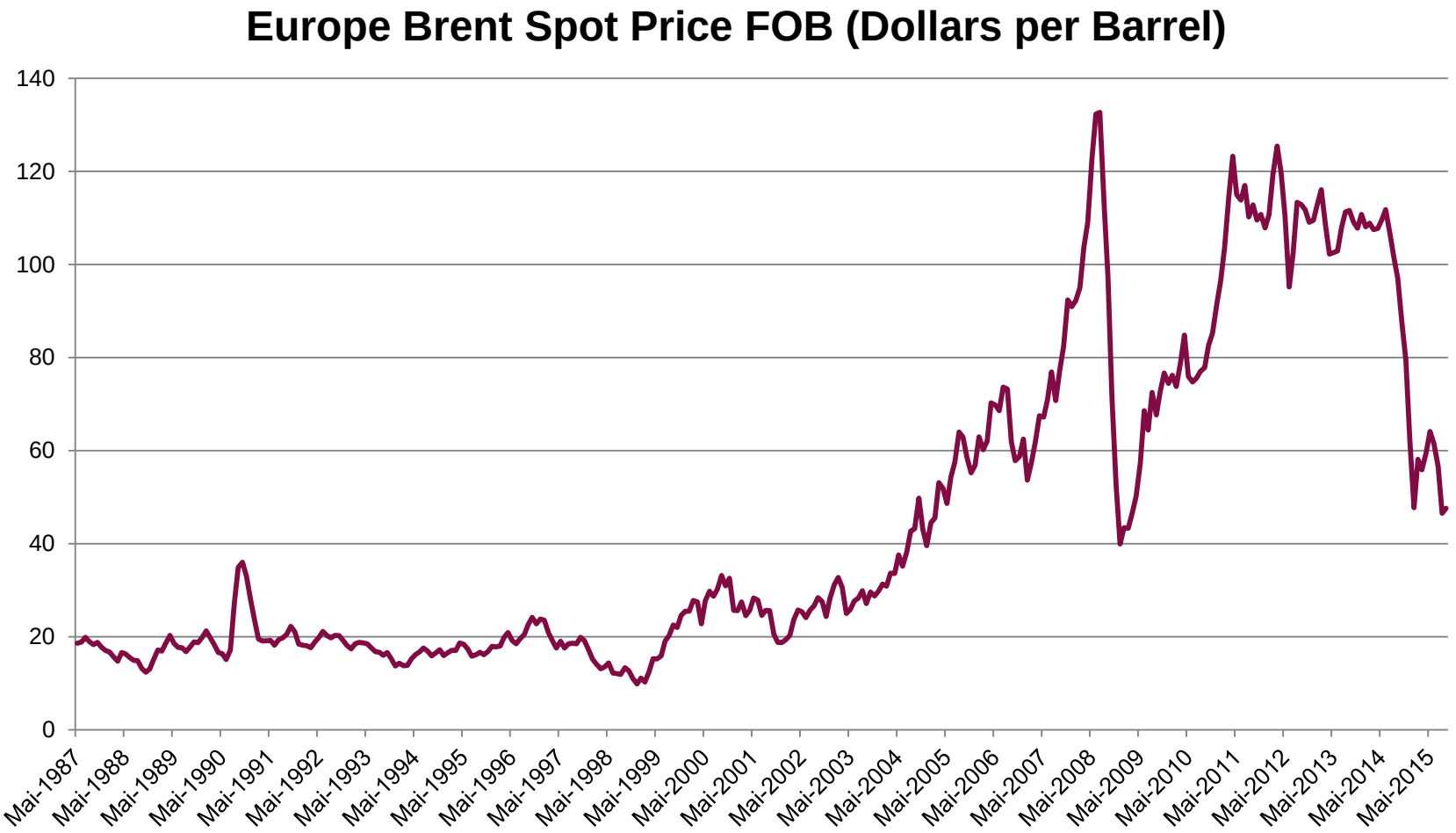


Description: Rapeseed Oil, Crude, fob Rotterdam, US Dollars per Metric Ton

Description: Wheat, No.1 Hard Red Winter, ordinary protein, FOB Gulf of Mexico, US Dollars per Metric Ton

http://www.indexmundi.com/commodities/?commodity=crude-oil-brent&months=300

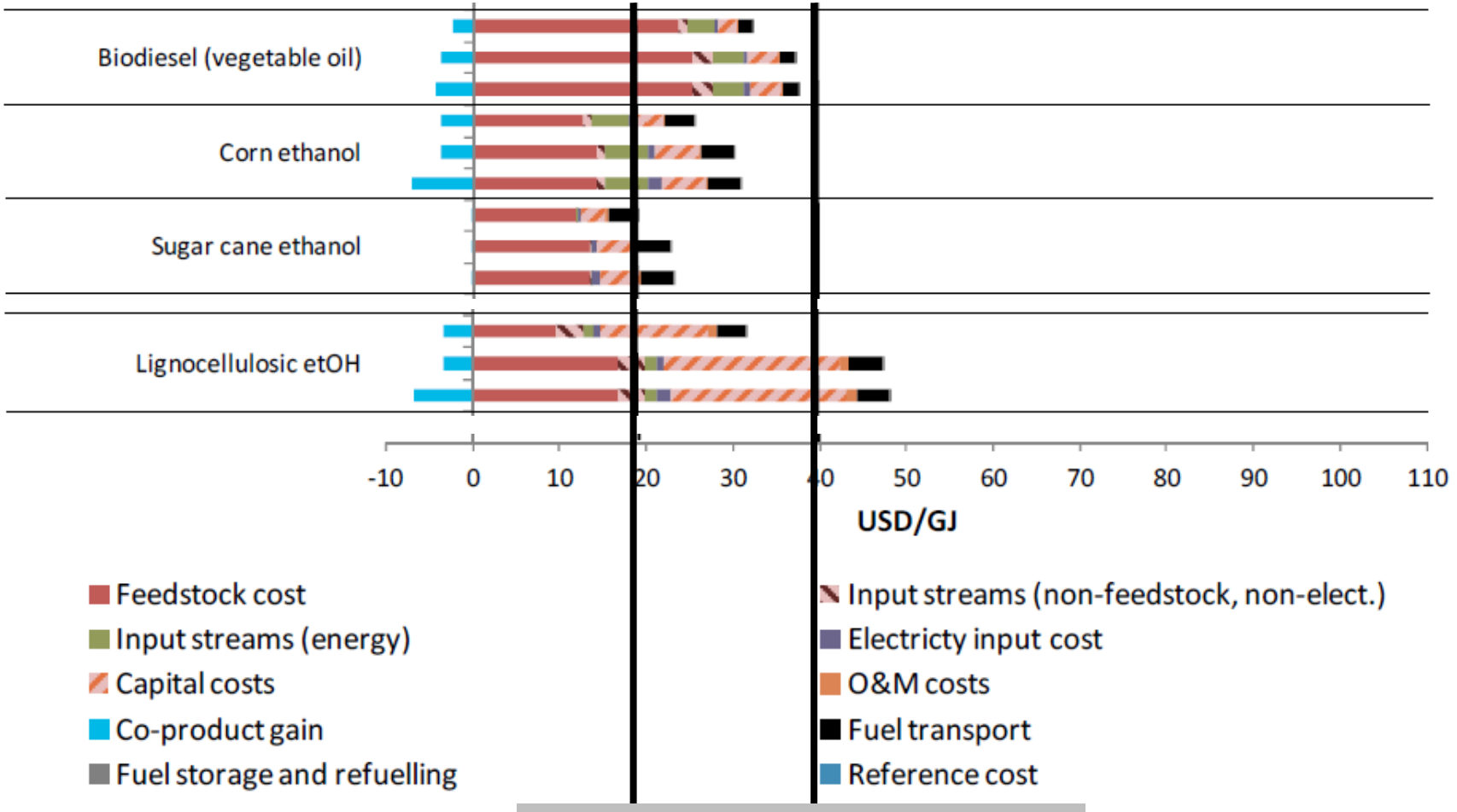
Crude oil price development



US Energy Information Administration:
http://www.eia.gov/petroleum/data.cfm#prices

IEA 2013: Production Costs of Alternative Transportation Fuels

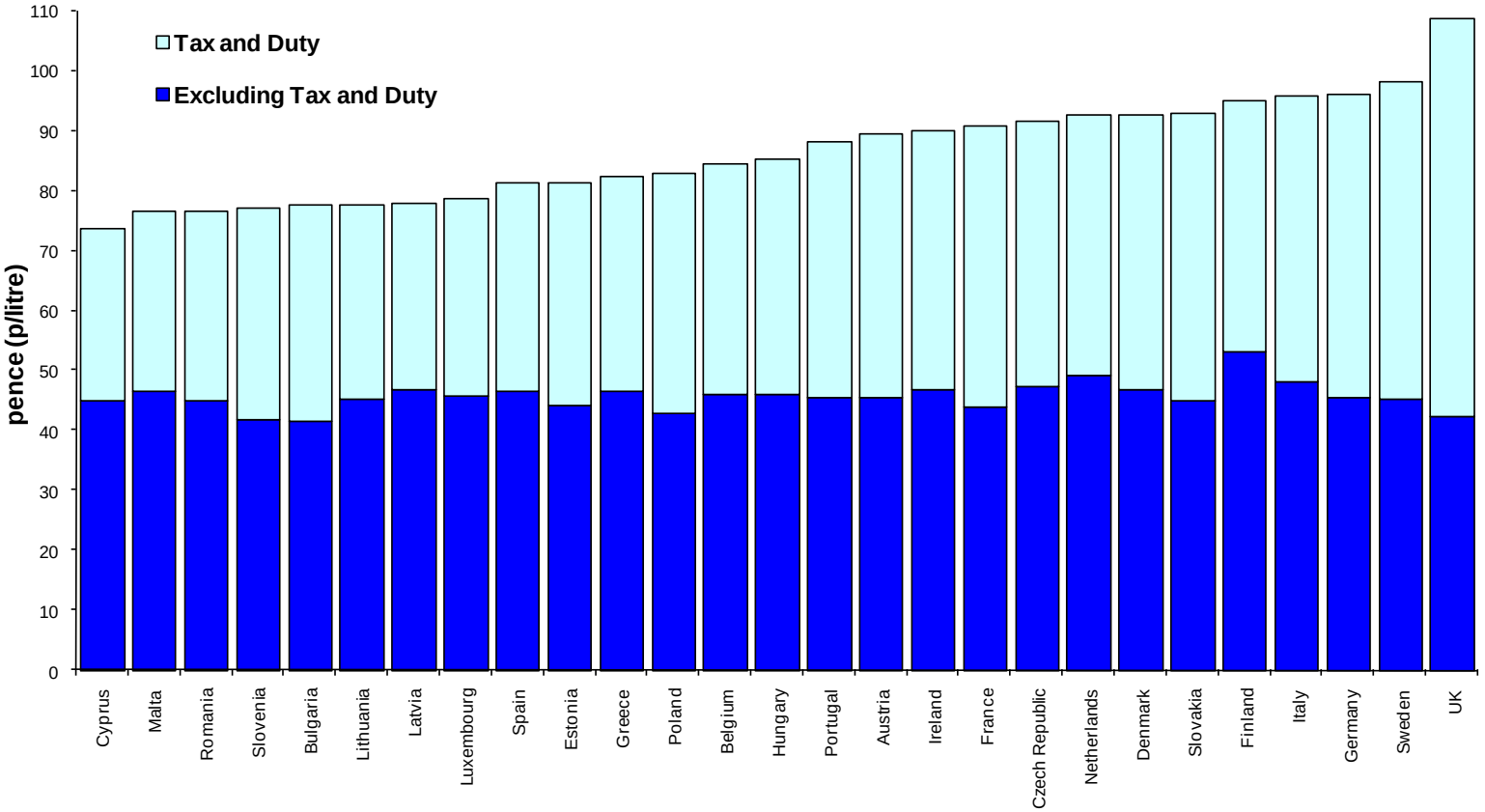
http://www.iea.org/publications/freepublications/publication/FeaturedInsights_AlternativeFuel_FINAL.pdf



Crude oil price of
60 USD/bbl – 150 USD/bbl

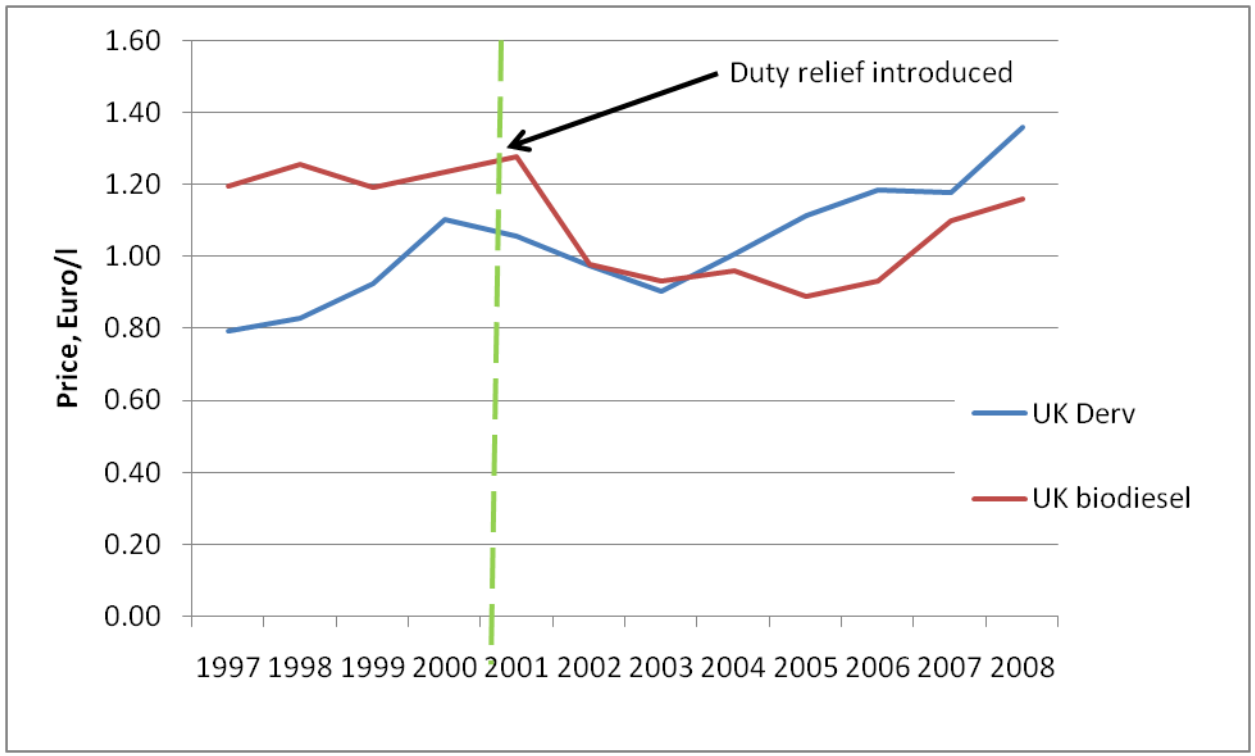
Tax exemptions for biofuels enhance their competitive ability

Diesel pump prices across Europe including duty and VAT



Guy Hitchcock: „The Economics of Biofuel Production and Use“ www.sts-technology.com

Tax exemptions enhance competitive ability of biofuels



Guy Hitchcock: „The Economics of Biofuel Production and Use“ www.sts-technology.com

Cost Summary for Biofuels

- Biofuel production prices depend largely on feedstock prices, which are not independent from crude oil prices;
- Tax exemptions can make up for higher production costs

SUSTAINABILITY VERSUS COST

Advanced Biofuels

For better sustainability and lower costs:
focus on residues and waste streams

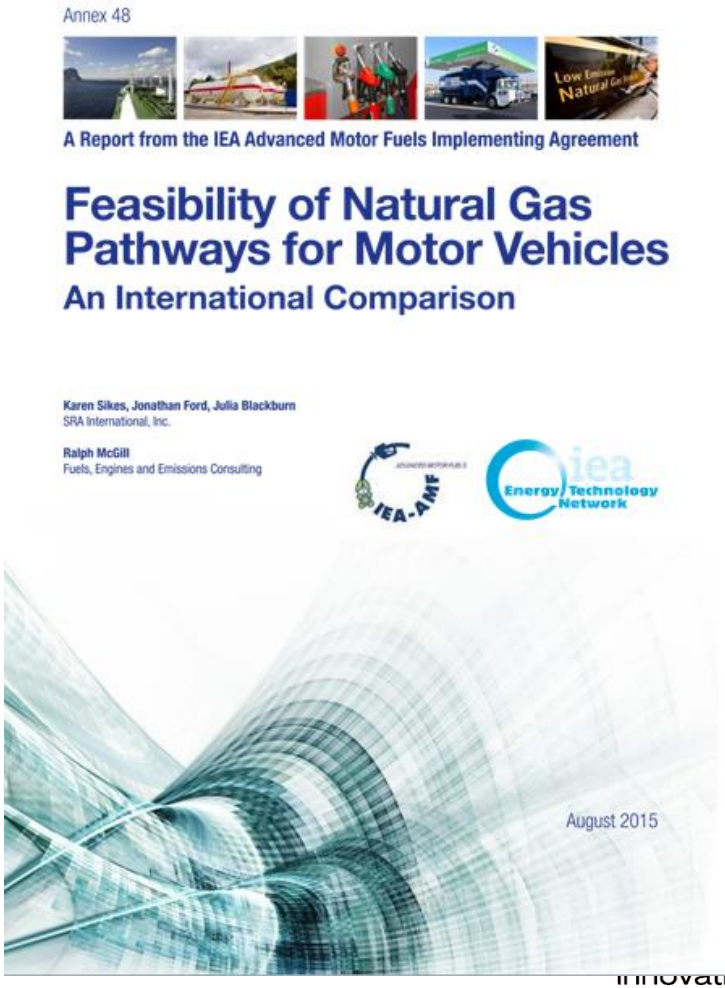
- Waste cooking oil – biodiesel
- Straw – ethanol
- Manure – biogas

However:

- Limited resources available
- Some technologies not yet mature

Investigation of existing alternatives
AMF Annex 48

Analysis of
GHG emissions and
costs of
various alternative fuels
based on natural gas pathways



http://iea-amf.org/content/projects/annexes/48

NG-derived Fuel/Powertrain Combinations Investigated

Light Duty Vehicles	
END USE FUEL	POWERTRAIN
Natural gas (compressed; fossil or biomethane)	ICE
FT Diesel	ICE
Synthetic Gasoline	ICE
Hydrogen (compressed)	Fuel cell
Methanol (M85)	ICE
LPG*	ICE
Electricity	EV, PHEV (40/50km)
Heavy Duty Vehicles	
END USE FUEL	POWERTRAIN
Natural gas (compressed or liquefied; fossil or biomethane)	ICE
FT Diesel	ICE
Synthetic Gasoline	ICE
Methanol (M85)	ICE
LPG*	ICE
Hydrogen (compressed)	Fuel cell
Dimethyl Ether (DME)	ICE

***LPG composition varies by country. The following propane/butane ratio are used in this study: Canada: 95/5, China: 50/50, Denmark: 70/30, Finland: 95/5, Israel: 20/80, and United States: 95/5.**

http://iea-amf.org/content/projects/annexes/48

Winners

Canada	LDV Emissions	LDV Costs	HDV Emissions	HDV Costs
CNG (fossil)				
CNG (AD)				
LNG (fossil)				
LNG (AD)				
LPG				
FT Diesel				
Synthetic Gasoline				
DME				
Methanol (M85)				
Compressed H_2 – Fuel Cell				
Electricity PHEV (40/50 km)				
Electricity EV				

China	LDV Emissions	LDV Costs	HDV Emissions	HDV Costs
CNG (fossil)				
CNG (LFG)				
LNG (fossil)				
LNG (LFG)				
LPG				
FT Diesel				
Synthetic Gasoline				
DME				
Methanol (M85)				
Compressed H_2 – Fuel Cell				
Electricity PHEV (40/50 km)				
Electricity EV				

Clear Winners

Baseline is Superior

Marginal Winners

Not Investigated

http://iea-amf.org/content/projects/annexes/48

Winners

Denmark	LDV Emissions	LDV Costs	HDV Emissions	HDV Costs
CNG (fossil)				
CNG (AD/LFG)				
LNG (fossil)				
LNG (AD/LFG)				
LPG				
FT Diesel				
Synthetic Gasoline				
DME				
Methanol (M85)				
Compressed H_2 – Fuel Cell				
Electricity PHEV (40/50 km)				
Electricity EV				

Finland	LDV Emissions	LDV Costs	HDV Emissions	HDV Costs
CNG (fossil)				
CNG (AD)				
LNG (fossil)				
LNG (AD)				
LPG				
FT Diesel				
Synthetic Gasoline				
DME				
Methanol (M85)				
Compressed H_2 – Fuel Cell				
Electricity PHEV (40/50 km)				
Electricity EV				

Clear Winners

Baseline is Superior

Marginal Winners

Not Investigated

http://iea-amf.org/content/projects/annexes/48

Winners

Israel	LDV Emissions	LDV Costs	HDV Emissions	HDV Costs
CNG (fossil)				
CNG (AD)				
LNG (fossil)				
LNG (AD)				
LPG				
FT Diesel				
Synthetic Gasoline				
DME				
Methanol (M85)				
Compressed H_2 – Fuel Cell				
Electricity PHEV (40/50 km)				
Electricity EV				

United States	LDV Emissions	LDV Costs	HDV Emissions	HDV Costs
CNG (fossil)				
CNG (AD)				
LNG (fossil)				
LNG (AD)				
LPG				
FT Diesel				
Synthetic Gasoline				
DME				
Methanol (M85)				
Compressed H_2 – Fuel Cell				
Electricity PHEV (40/50 km)				
Electricity EV				

Clear Winners

Baseline is Superior

Marginal Winners

Not Investigated

http://iea-amf.org/content/projects/annexes/48

Sustainability versus Cost Summary

Winners on both GHG emissions and costs

- Often draw on wastes and residues as raw materials
- May have limited resource availability
- Some technologies are not yet fully developed
- Winners depend on the regional conditions

Investigate county-specific to obtain meaningful results!

Clean Power for Transport: A European alternative fuels strategy (2013)

comprehensive mix of alternative fuels

EU-wide availability and common technical specifications should be provided for all alternative fuels

Fuel \ Mode / Range		Road-passenger			Road-freight			Air	Rail	Water		
		short	medium	long	short	medium	long			inland	short-sea	maritime
LPG		■	■	■	■	■	■			■	■	
Natural Gas	LNG	■	■	■	■	■	■		■	■	■	■
	CNG	■	■	■	■	■						
Electricity		■			■				■			
Biofuels (liquid)		■	■	■	■	■	■	■	■	■	■	■
Hydrogen		■	■	■	■	■			■	■		

Thank you for your attention!

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www.bioenergy2020.eu

IEA Advanced Motor Fuels:

www.iea-amf.org

IEA Bioenergy Task 39:

www.task39.org

Online database:

http://demoplants.bioenergy2020.eu

Netzwerk Biotreibstoffe:

www.nwbt.at

Task 39
IEA Bioenergy

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