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Brændstoffer og energiforbrug i fremtidens transport

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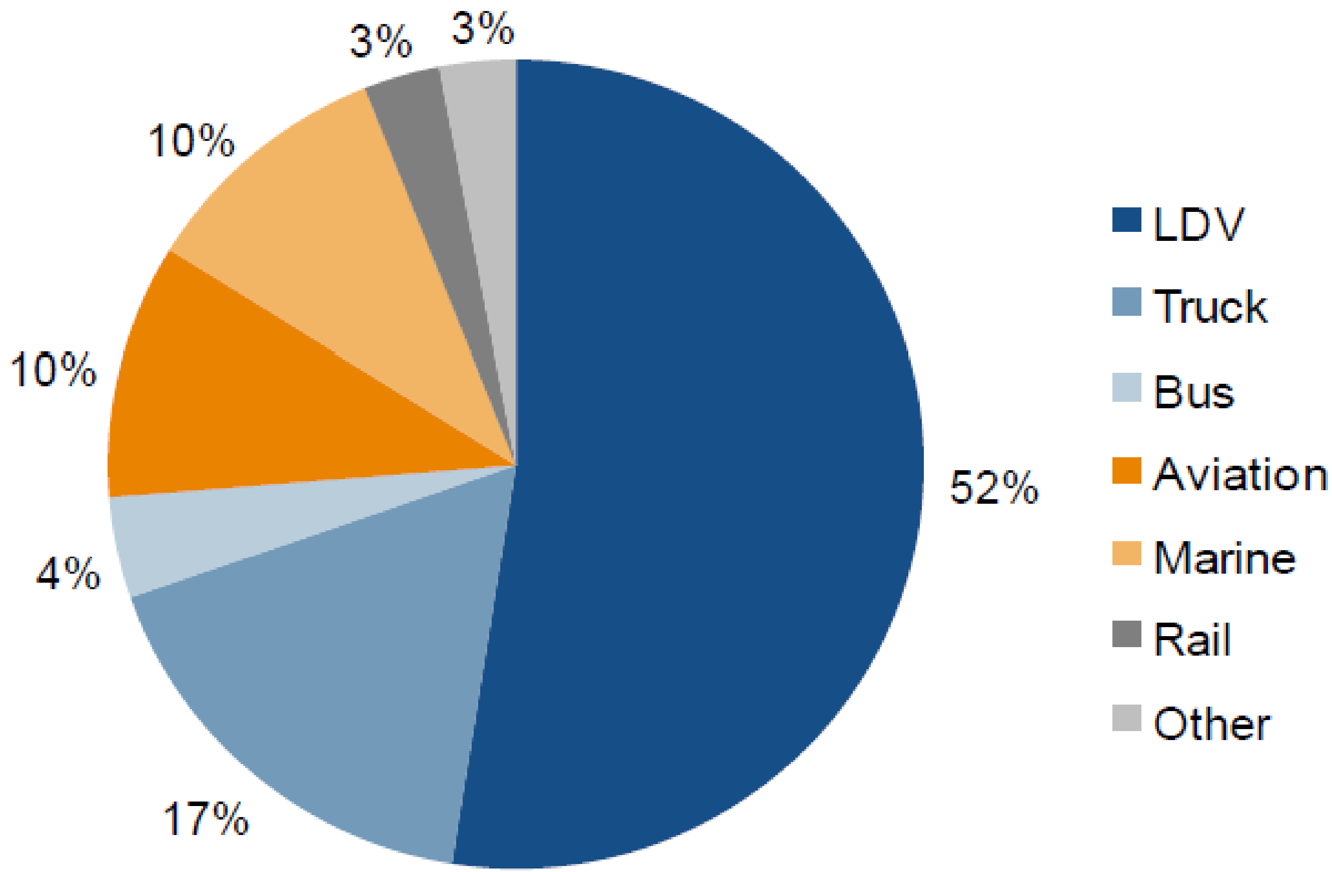
- **Transportformer**
  - Vejtransport
  - Tog
  - Skibe
  - Fly



3%
3%
10%
10%
4%
17%
52%
LDV
Truck
Bus
Aviation
Marine
Rail
Other

- **Fremtidens teknologi til vejtransport**
  - Forbrændingsmotorer
    - Benzin, diesel
    - Naturgas
    - GTL, CTL, BTL
    - Biobrændstoffer
  - Brændselsceller
  - Elektriske biler

Background assumptions for the different IEA transport scenarios.

ETP Transport Scenarios

- Baseline – business as usual through 2050
- ACT – measures costing up to $50/tonne; stabilization of CO_2
  - Efficiency measures dominate
- BLUE – measures costing up to $200-500; reduction of global CO_2 to below 2005 levels with downward trend
  - BLUE Map – mix of biofuels, fuel cell vehicles (FCVs), and electric vehicles (EVs) for cars and light trucks in 2050
  - BLUE Conservative – no FCVs or EVs (only plug-ins)
  - BLUE FCV Success – FCVs dominate by 2050
  - BLUE EV Success – EVs dominate by 2050

Worldwide CO_2 emissions in 2050 according to the various IEA transport scenarios.

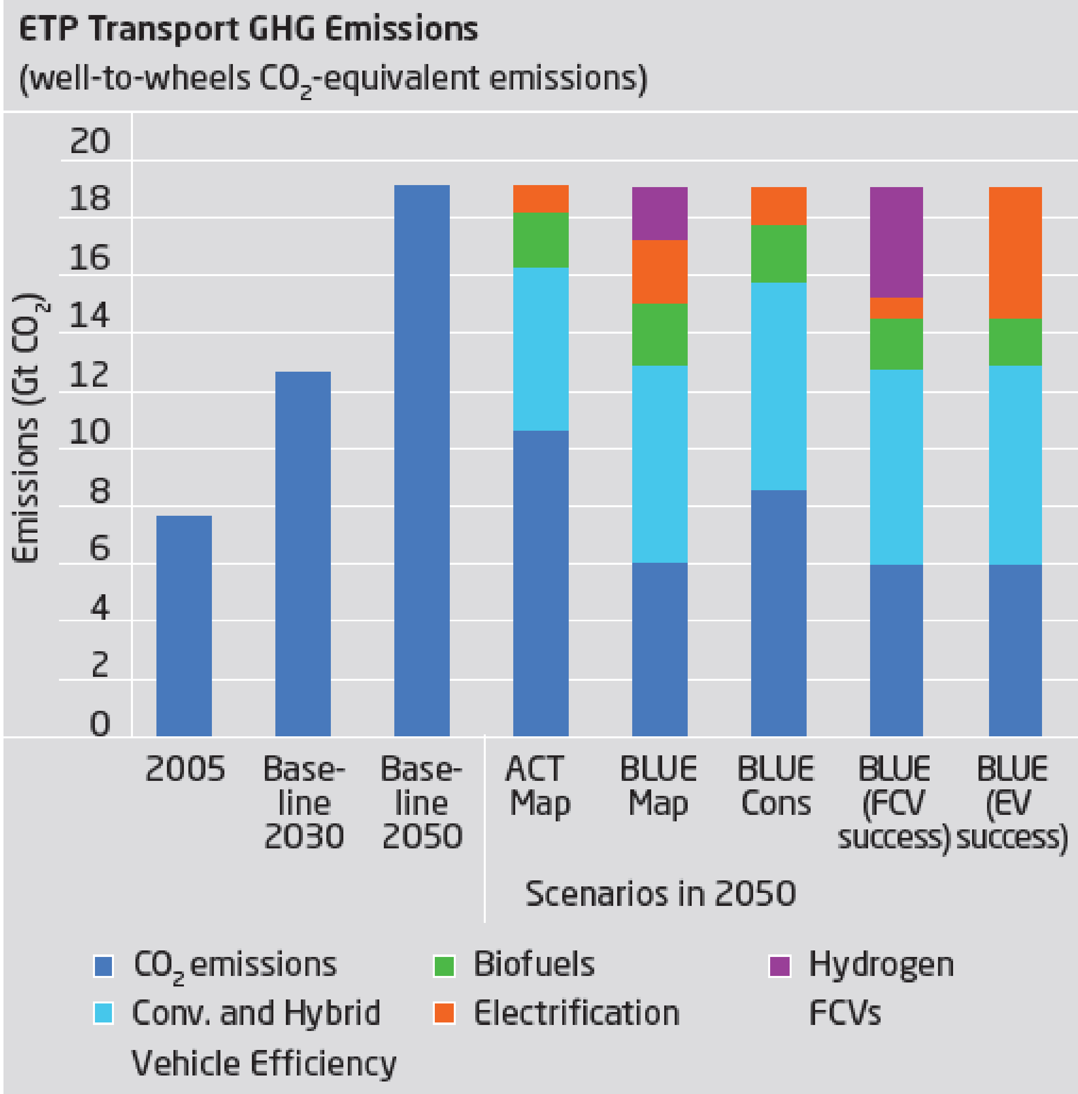


Figure 27

Well-to-wheel (WTW) energy efficiency and associated CO_2 emissions from different fossil and renewable fuels. [49]

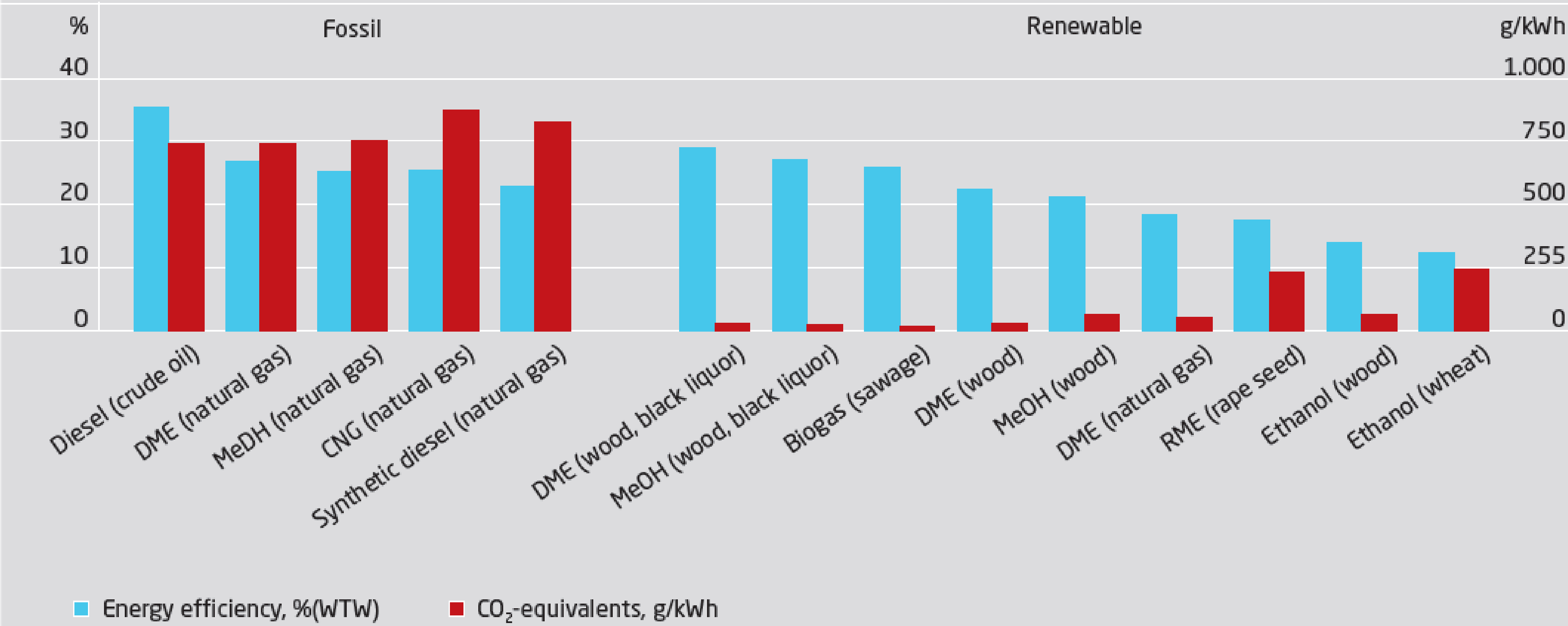


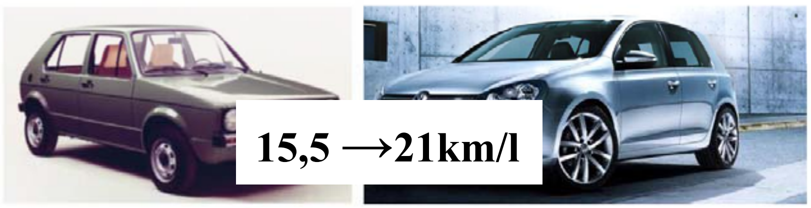
Figure 24

Comparative data for the VW Golf diesel from 1976 and 2011 [45].

	VW Golf VI diesel 2011	VW Golf diesel 1978
Displacement (l)	1.6	1.5
Max output (kW)	77	37
Torque (Nm)	250	84
Max speed (km/h)	190	144
Acceleration 0-100 km/h (s)	11.3	18
Kerb weight	1318	780
Fuel comsumption (EU comb. l/100 km)	3.8	6.4
CO_2 emission (g/km)	99	163
Particulate filter	yes	no

Forbruger behov og prioritering

VW Golf I diesel 1976 | VW Golf VI diesel 2009



15,5 →21km/l

engine displacement (l) 1.5 2.0
power (kW)
torque (Nm)
speed (km/h)
acceleration 0 –
curb weight
fuel consumption
CO_2 emission (g
particulate filter

- <u>Priority:</u>
- ++++Comfort
- ++++"Fun"
- +++++Safety
- ++++Air Pollution
- +Fuel Economy
- +Sustainability

Fuel Cell DTU Ecocar

810 km/l

IC Engine DTU Ecocar

589 km/l

- <u>Priority:</u>

1 person

30 km/hour!

"Smooth Traffic"!

- +++++Sustainability

Everything has to fit together
– different stakeholders have to work together!

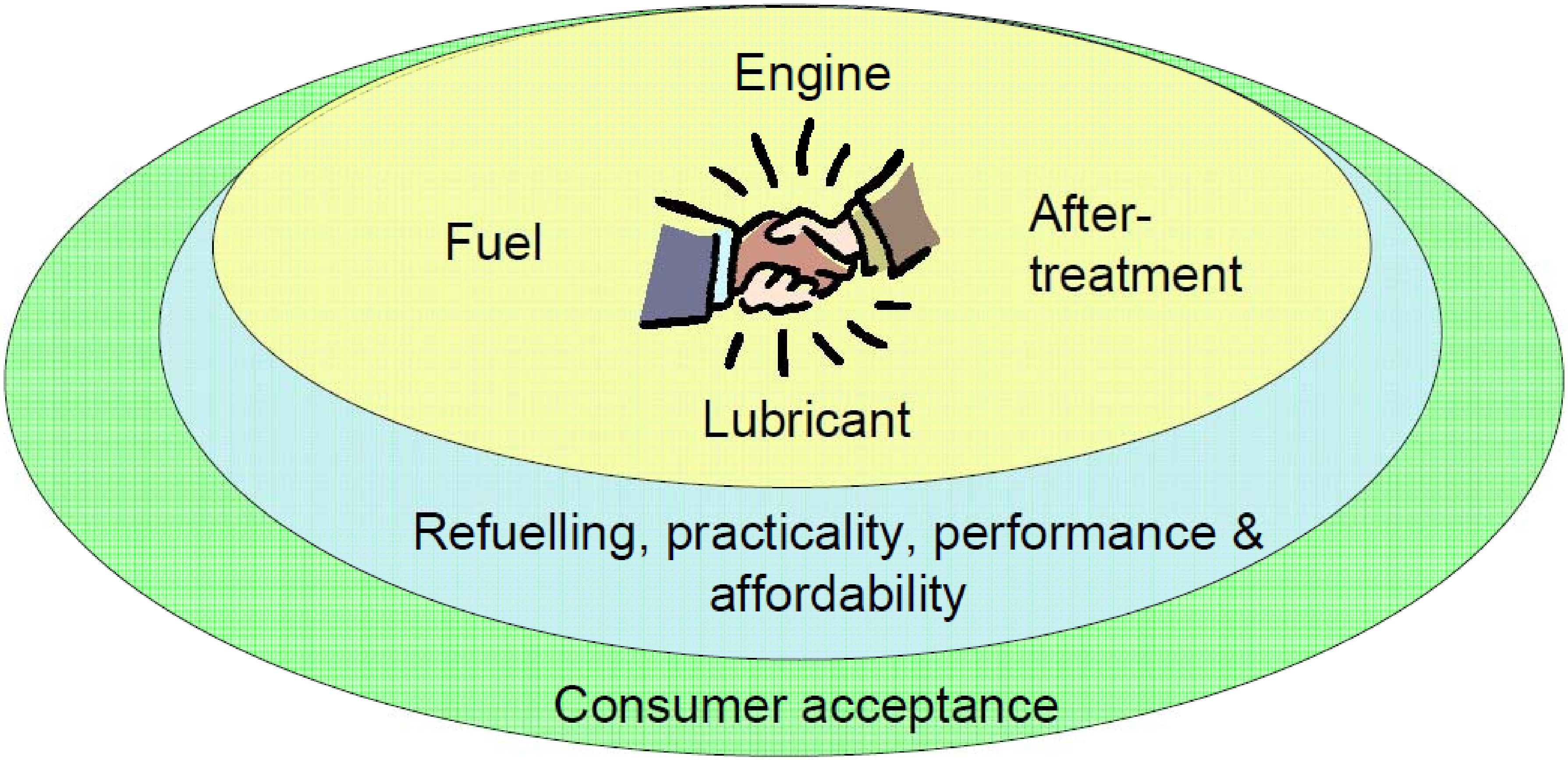


Figure 28

Comparison of fuel economy (km/l petrol equivalent) for vehicles using various technologies, 2009. The performance of European cars appears somewhat higher than their US counterparts due to differences in the test procedures and car models [52].

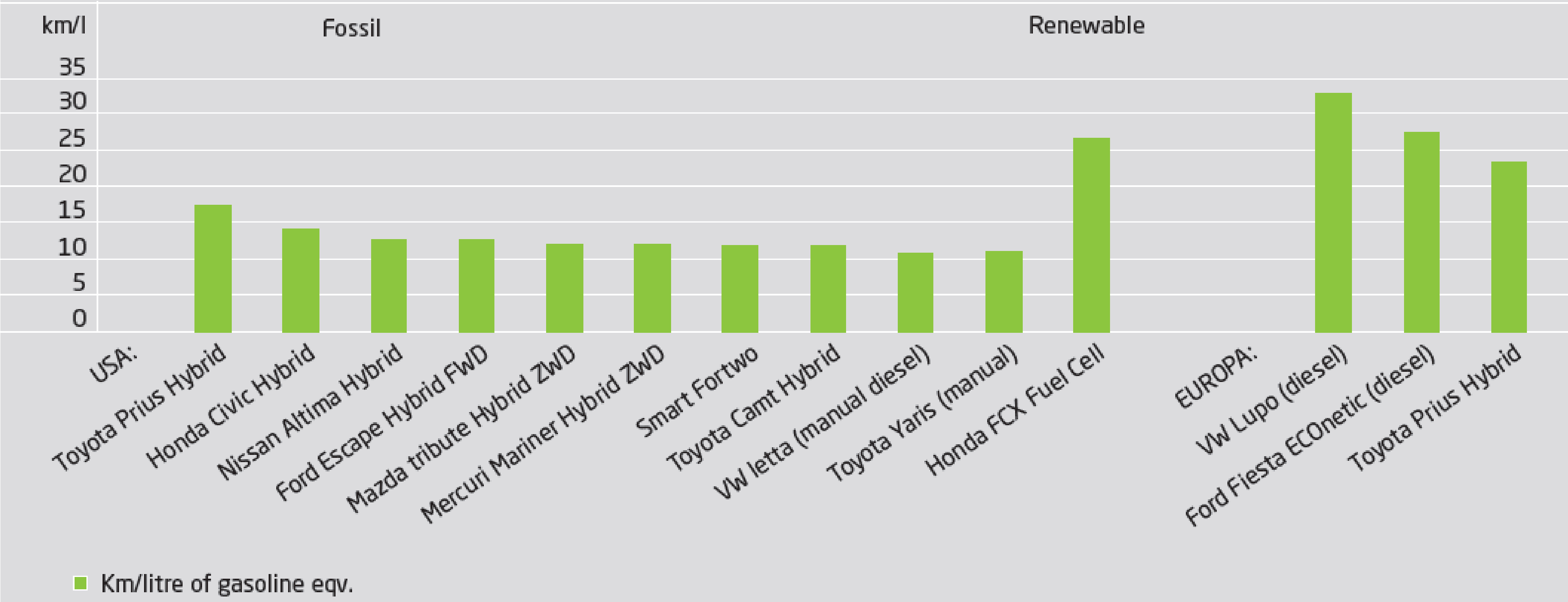
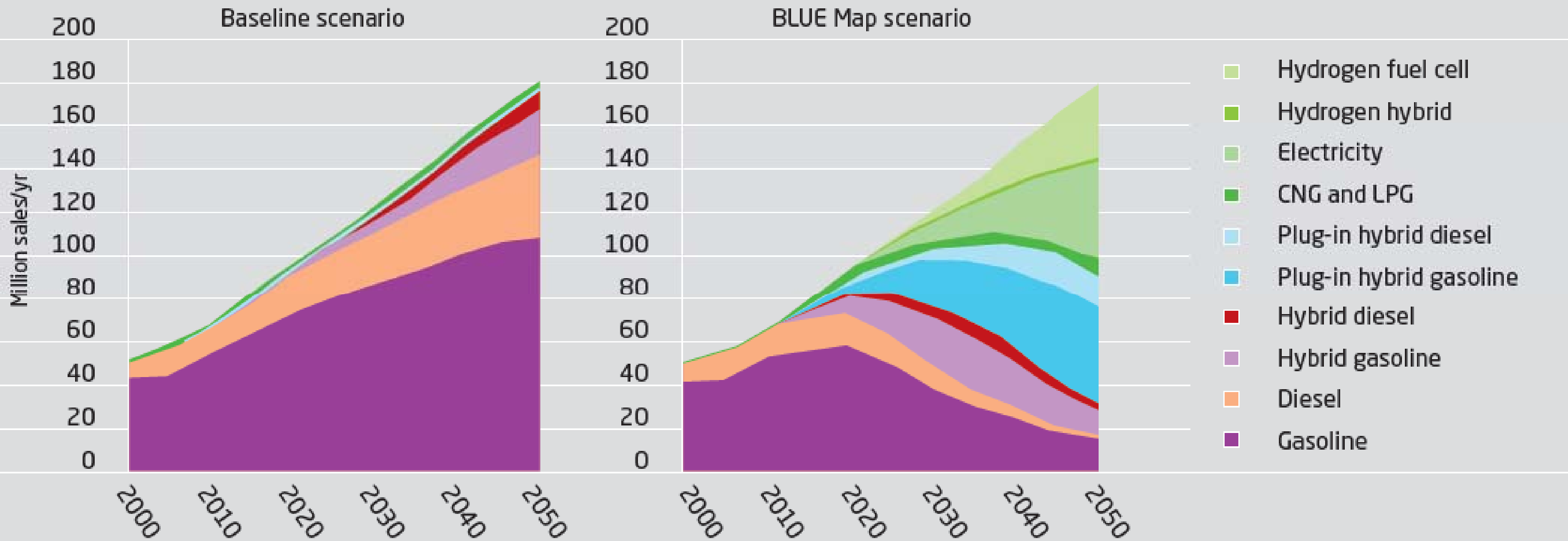


Figure 31

Yearly sales of different vehicle technologies as predicted by the IEA baseline and BLUE Map scenarios.



Energistyrelsen:

Danmark

Energipolitiske milepæle frem mod 2050

- 2020: Halvdelen af det traditionelle elforbrug er dækket af vind
  - VE-andel i transport øges til 10 pct.
  - CO_2-udledning fra ikke kvoteomfattede sektorer reduceres med 20 pct. i forhold til 2005
- 2030: Kul udfases fra de danske kraftværker, oliefyr udfases
- 2035: El- og varmeforsyningen dækkes af vedvarende energi
- 2050: Hele energiforsyningen – el, varme, industri og transport – dækkes af vedvarende energi.

Energistyrelsen:

	Vej		Bane	Luftfart	søfart
	Personbiler/varebiler:	Lastbiler			
Kort sigt	Diesel/biodiesel Benzin/bioethanol El	Diesel/biodiesel CNG (evt. hybrid)	El Diesel/ Biodiesel (Hybrider)	Jetfuel Flydende biobrændstoffer	Diesel Flydende biobrænd-stoffer CNG / LNG
Mellem-langt sigt	Flydende bio-brændstoffer (benzin/diesel) El og brint Biogas Hybridteknologier	Diesel/bio-diesel Biogas/CNG/LNG Brint	El Hybrider (diesel/el/ biodiesel)	Flydende biobrænd-stoffer	Flydende biobrænd-stoffer Biogas
Langt sigt	El og brint Biogas (Biobrændstoffer) (Hybridteknologi)	Flydende bio-brændstoffer - 2.g. El og brint Biogas	El	Flydende biobrænd-stoffer 2.g.	Flydende biobrænd-stoffer 2.g. Biogas

Konventionelle brændstoffer til transport i 2050:

• DK energiaftale 2012:	0%
• World Energy Council forecast:	80%

Danske ambitioner er banebrydende!

Conclusions:

- Motor fuels have been based almost entirely on crude oil for the last century
- During the last couple of decades engines built for traditional fuels have become more advanced and efficient; this has reduced fuel consumption by around 40%
- Natural gas is also becoming an interesting fuel due to its large ressources worldwide
- GTL, CTL and BTL are liquid fuels produced from solid or gaseous sources
  - GTL and CTL are not very CO_2 friendly, but easy to implement
  - Methanol and DME produced from biomass are among the most CO2-reducing fuels
- FCV progress is heavily dependent on an infrastructure
- With an acceptable fast charging infrastructure at least 85% of the one-car families in Denmark could be potential EV customers
- Range improvements resulting from better batteries are expected to create a large increase in the number of EVs in Denmark between 2020 and 2030
- PHEV's will be an important step in the transition to future EV's
- The future transport will be driven by dramatic efficiency improvements in modes of transport based on fossil fuels. At the same time it is necessary to promote research and demonstration of new power train technologies which can be used beyond 2050
- The Danish ambitions for 2050 are exceptional and challenging

Thank you for your attention!