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سَلام عَلى كُم
स्वागत
V e l k o m m e n
Laipni lūdzam
স্বাগতম
مرحبا
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歓迎
வணக்கம்
Sugeng Rawuh
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W ë l l k o m m e n

The future thinks electric

Development of an e-mobility value chain as a fundament for a new energy paradigm

Portorož Business Conference
October 30rd and 31st in Ljubljana

Prof. Dr. Guy Fournier

Agenda

- Drivers of the new paradigm
- Options for our future mobility
- The new mobility value chain
- Impact on the energy needs and infrastructure
- New business opportunities and new business models
- How to enable synergies and economic growth
- Conclusion

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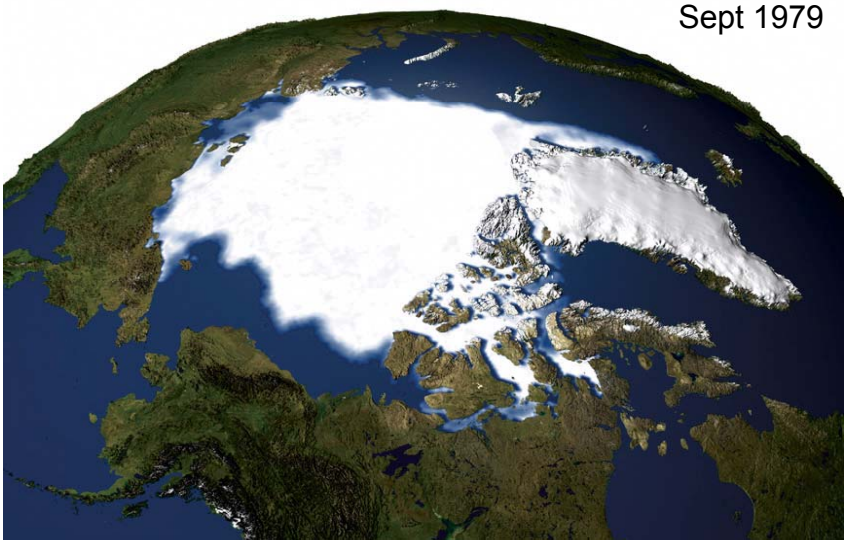
Global warming

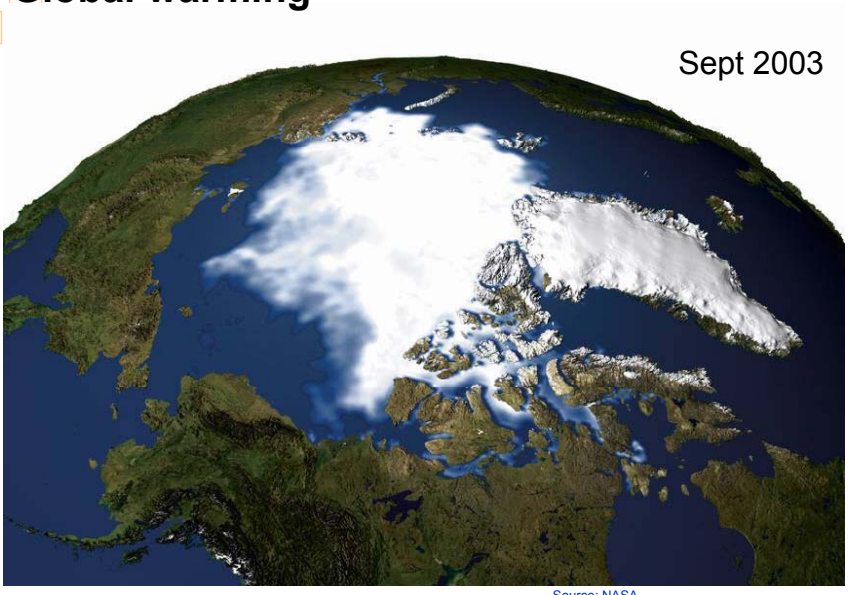
Sept 1979



Source: NASA

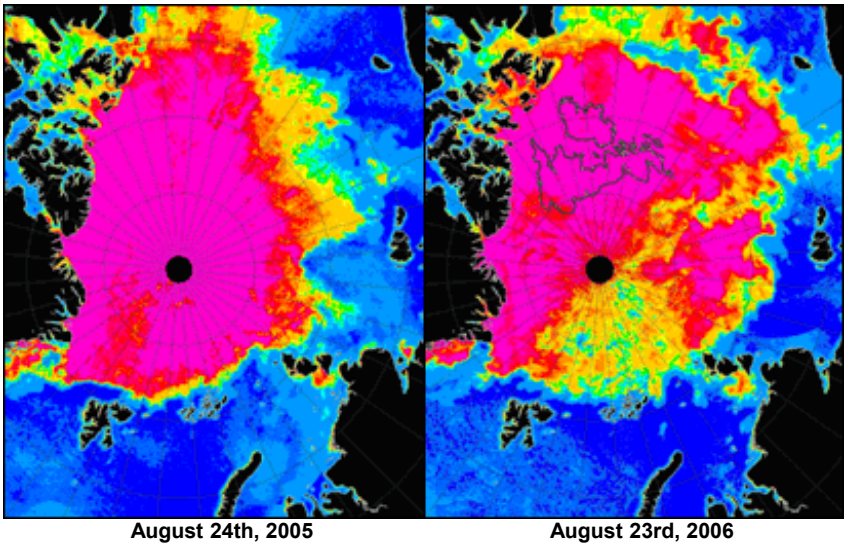
Global warming

Sept 2003



Source: NASA

Global warming



August 24th, 2005 August 23rd, 2006

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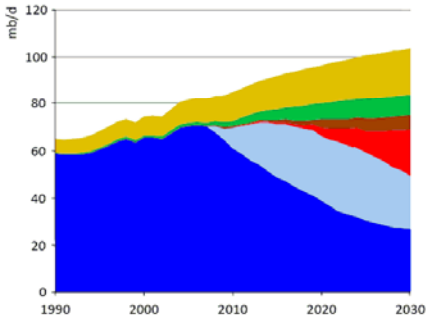
Source: ESA (2006)

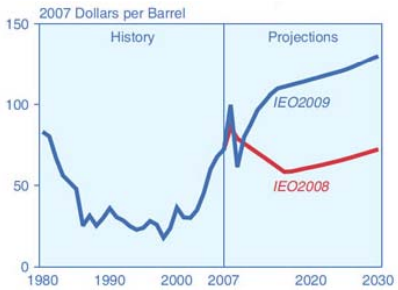
Energy challenge: dependence on oil



- Natural liquid gas
- Non conventional crude oil (incl. Canadian oil sands)
- Crude oil – additional EOR (Enhanced Oil Recovery)
- Crude oil – fields yet to be found
- Crude oil – fields yet to be developed
- Crude oil – currently producing fields

Source: International Energy Agency (2008)

- **World fossil fuel production increased by 2.9% in 2008, reaching the highest level ever recorded**
- **Current price for crude oil: 78 $/barrel (brent, October 2009)**
- **Estimation of EIA: 120-180 $/barrel in 2030**
- **Estimation of IEA: 200 $/barrel in 2030**



Source: Energy Information Administration (2009), p. 2

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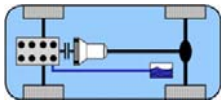
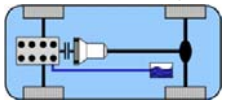
Our future mobility options

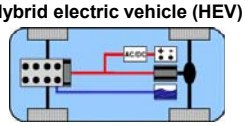
Internal combustion engine (ICE)



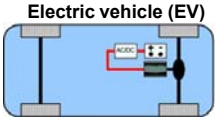
Internal combustion engine (ICE)



Hybrid electric vehicle (HEV)

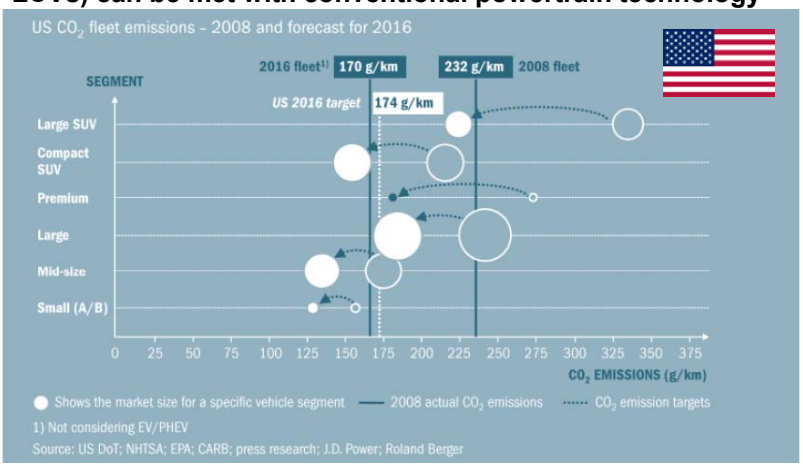


Electric vehicle (EV)



ICE powertrain

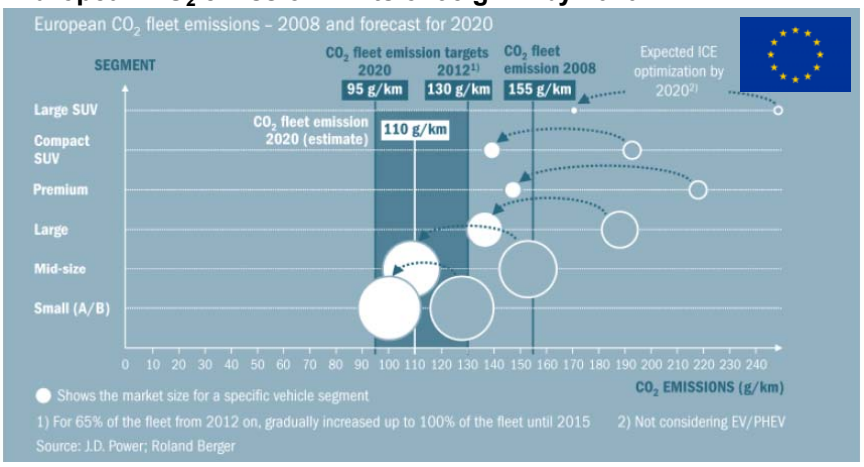
New US CO_2 fleet emission target of 35.5 mpg by 2016 (incl. LCVs) can be met with conventional powertrain technology



Source: Roland Berger 2009, p. 30

ICE powertrain

ICE powertrain optimization is unlikely to be enough to meet European CO_2 emission limits of 95 g/km by 2020



Source: Roland Berger 2009, p. 28

Range with one hectare (10,000 m²) cultivated area

Electric Vehicle

Solar Energy

7 800 000 km**

ICE 2. Gen Biofuel

Biomethane — 67 600 km

BtL (Biomass-to-Liquid) — 64 000 km

ICE 1. Gen Biofuel

Rape Oil — 23 300 km + 17 600 km*

Biodiesel — 23 300 km + 17 600 km*

Bioethanol — 22 400 km + 14 400 km*

Algae Fuel
3. Gen Biofuel

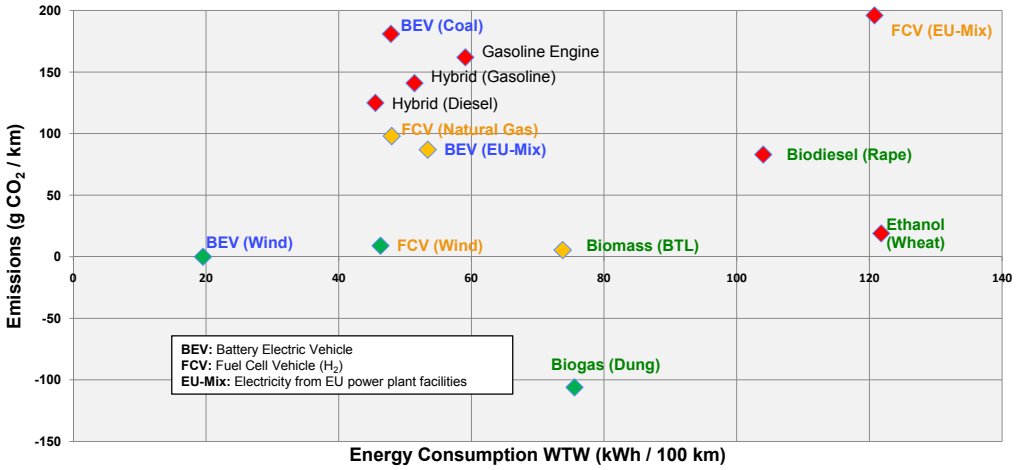
- huge amount of oil
- 100x oil / ha / p.a. than soya bean
- but not until 2020

Car fuel consumption: Petrol 7.4 l/100 km, Diesel 6.1 l/100 km
*** Biomethane of byproducts (colza cake, draff, straw)**
**** 1 280 000 kWh per hectare (Central Germany, 2008), 15 kWh/ 100 km per vehicle**

Source: Fachagentur Nachwachsende Rohstoffe e.V. 2008 ; Fournier 2009

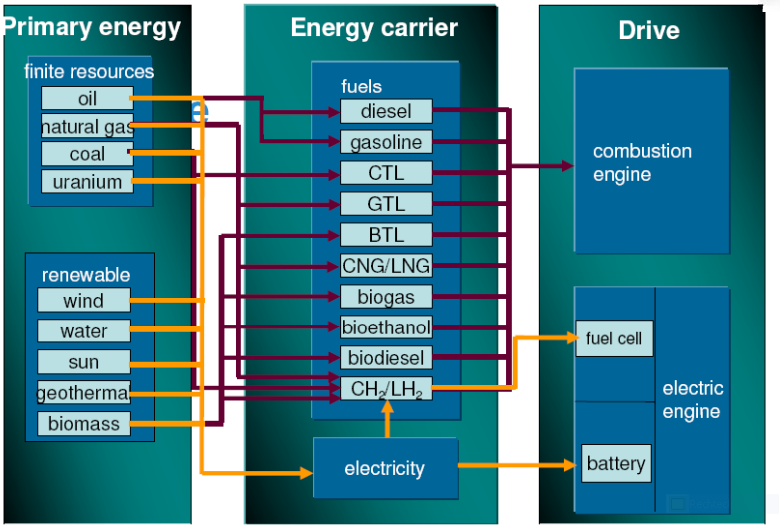
Solar Energy: 330-fold range compared to Rape Oil or Biodiesel, 115-fold to BtL

CO_2 and energy efficiency of power trains (Well-to-Wheel)



Source: based on data from Concawe, Eucar, JCR 2007; Daimler Optiresource tool

Electric Vehicle: flexibility of using primary energy



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Source: Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit (2009)

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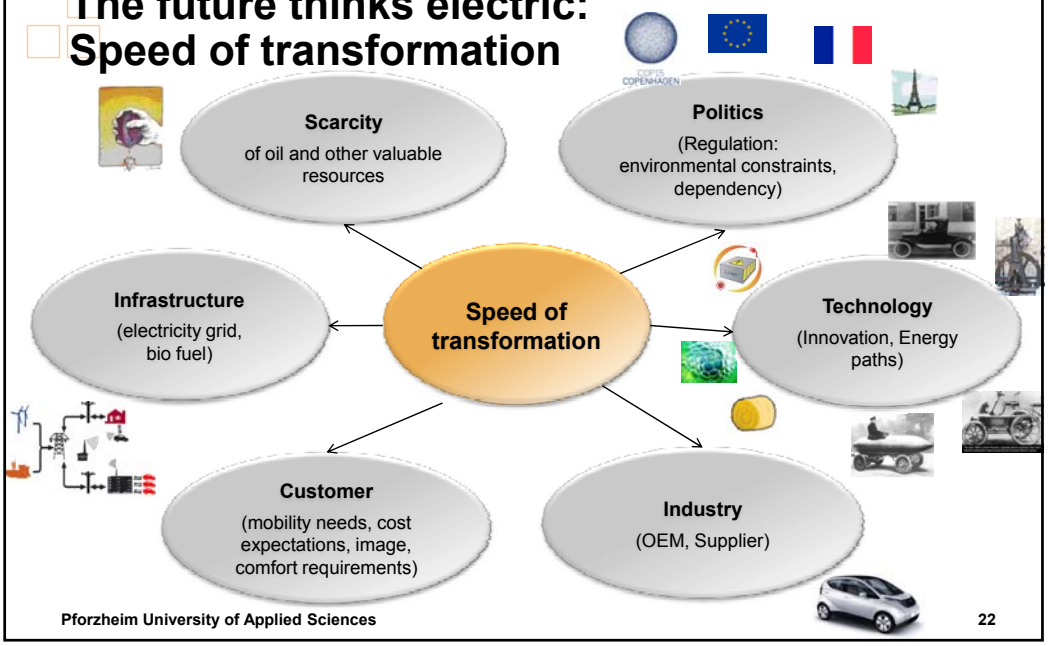
The future thinks electric: Speed of transformation



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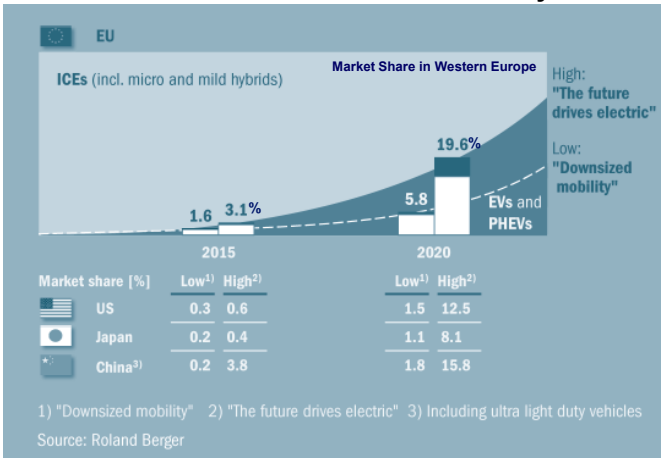
The future thinks electric: speed of transformation
Market share development of EV and PHEV

In 2020, Western Europe may be the lead market with annual sales of more than 3 million EVs and PHEVs – followed by China



- **The main question is therefore not if, but when (near) zero emission vehicles will penetrate the market**
- **2 Scenarios**

Source: Roland Berger 2009, p. 69

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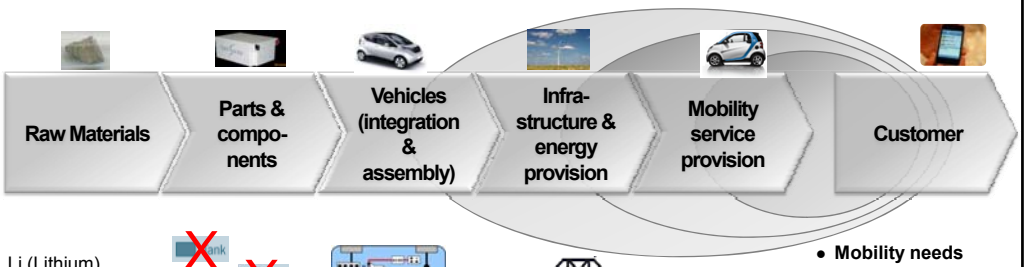
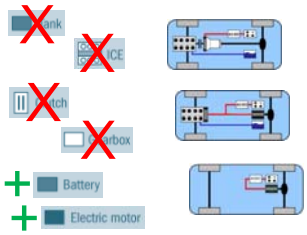
The new mobility value chain



Li (Lithium)
Co (Cobalt)
Nd (Neodymium)
La (Lanthanum)
Cu (Copper)



better place

- Mobility needs
  - Driving range
  - Unrestricted mobility
- Cost expectations
- Comfort requirements
- Image (ecol. awareness)

Source: according to Roland Berger (2009) p. 55, 70

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Additional electric energy requirements (Germany)

- Fleet in Germany: 41.3 mio.
- Average energy consumption per EV in kWh: 15 kWh
- Kilometrage p.a.: 13,000 km
- Power generation 2008: 639.1 TWh

Source: KBA (2009), DIW (2005) , AGEB (2008)

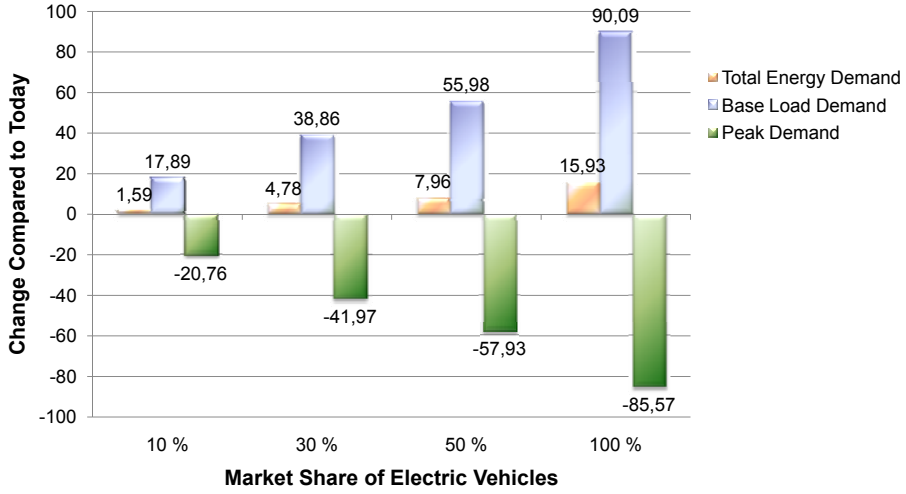
Fleet in Germany (20%) | Average energy consumption per 100 km | Kilome-trage p.a.

41,300,000 x 0,20 x 15 kWh x 13,000 km pa
= 16 TWh p.a.

+ 2.52 % of electricity generation (20 % EV)

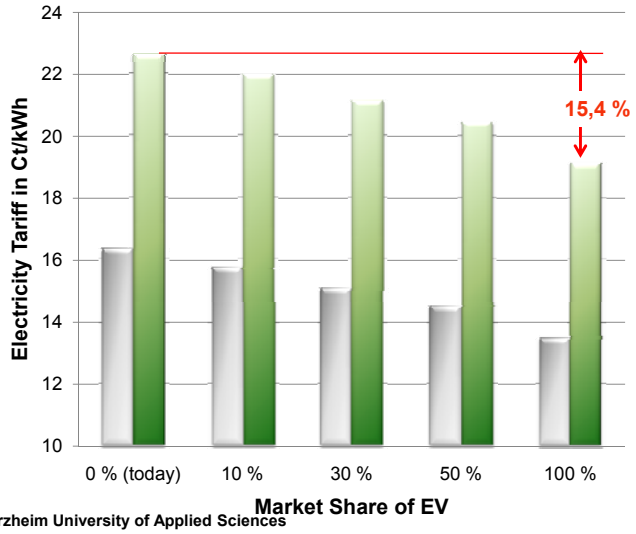
- Impact in Austria (20% electric vehicles in 2030):
  - + 2.6% of electricity generation
  - - 16% CO2 for road traffic
  - Contribution to EU Energy Efficiency targets of Austria: 39%
  - Effect on the national budget: largely neutral
  - Net effect on the economy: + 1.3 bn €

Additional electric energy requirements (Germany)



Source: Brumme 2009, p. 35

Additional electric energy requirements Impacts on electric costs (Germany)

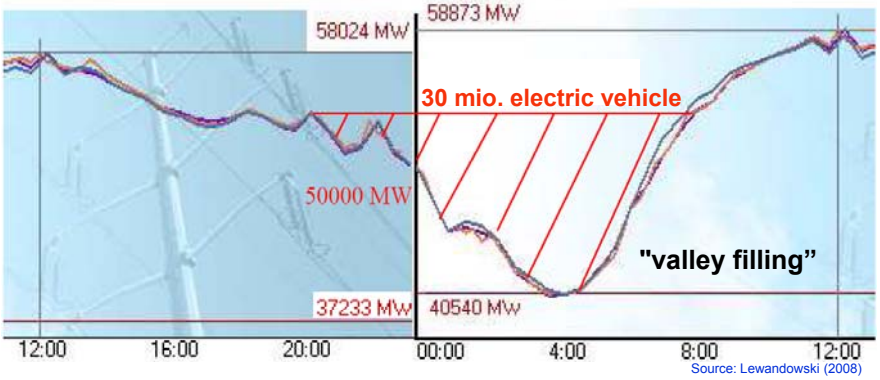


- **Prices could decrease despite energy demand rises!**

Source: Brumme (2009), p. 36

Additional power plants requirements (France)

Capacity and load of power plants, typical September day in France (2008)

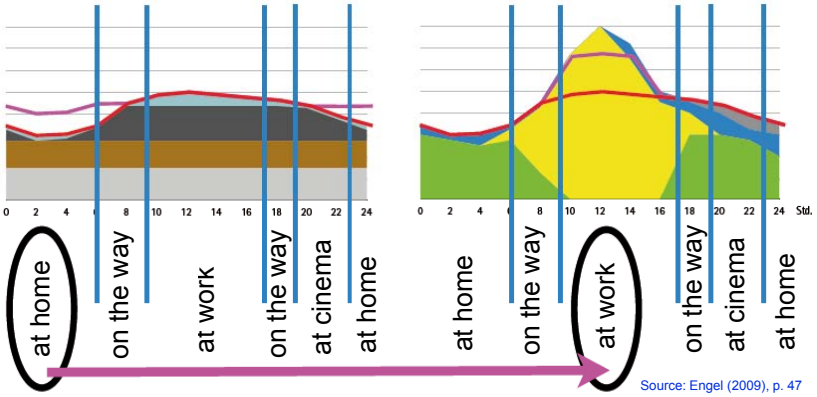


Source: Lewandowski (2008)

- **Utilisation of power fluctuation to charge the car batteries**
- **No need for massive development of power plants**
- **Even with a fast growing electric vehicles market**

Synergies with renewables photovoltaic energy

- **Synergy by:**
  - **"valley filling" (fossil energy)**
  - **"peak shaving" (photovoltaic energy)**



Source: Engel (2009), p. 47

Synergies with renewables, windmills Negative Price in Germany on a windy day Oct. 2009

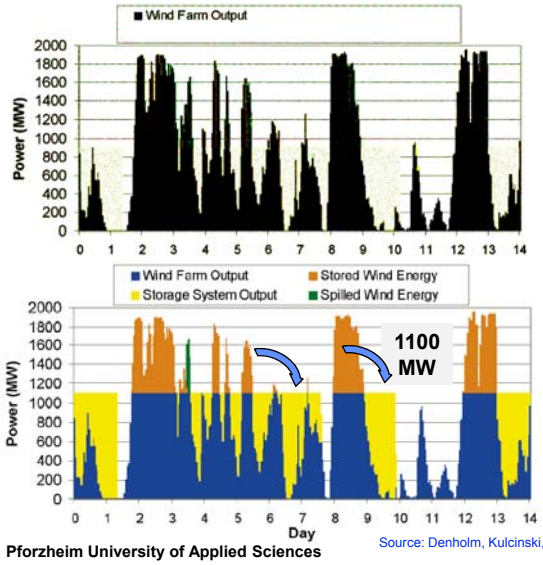
		So, 04.10.
00-01	€/MWh	0,05
	MWh	17.414,0
01-02	€/MWh	-105,76
	MWh	18.042,7
02-03	€/MWh	-500,02
	MWh	17.620,6
03-04	€/MWh	-100,09
	MWh	18.176,4
04-05	€/MWh	-60,09
	MWh	18.176,7
05-06	€/MWh	-25,04
	MWh	18.222,6
06-07	€/MWh	0,00

Approximately 9 Mio. €!

- **Synergy by:**
  - **"valley filling" (windy day in Denmark or Germany)**

http://www.eex.com/de

Synergies with renewables, windmills

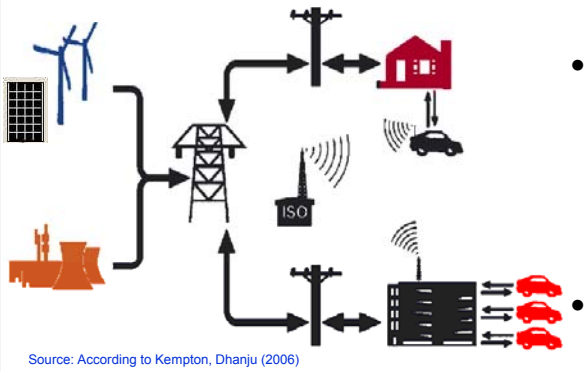


- Synergy by:
  - "valley filling" (Denmark, Germany)
  - "peak shaving"
- V2G Makes renewable systems:
  - economically viable,
  - more efficient,
  - stable and
  - reliable
- Grid integration required to integrate these variable generation sources

Source: Denholm, Kulcinski, Holloway (2005)

Synergies with renewables

Grid integration



Source: According to Kempton, Dhanju (2006)

- Vehicles as smart temporary storage
- Vehicles useful for energy supply:
  - In time of peak load
  - Supply shortfall
  - Administration of frequency and voltage
- Even in rush hour between 16h00 and 19h00 there are at most 8% of motor vehicles on the roads

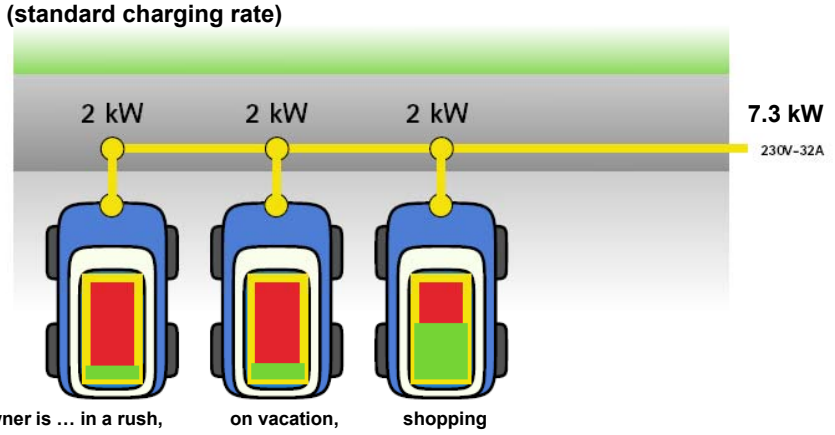
Denmark: CEESA project, EDISON project

- Denmark is seeking ways to supply 100 % renewable energy by 2050

- 3 phases: research, technological development and demonstration.
- Demonstration: Bornholm Island in the Baltic Sea:
  - just 40,000 inhabitants,
  - relies mostly on wind energy
  - with only one sea cable connecting it to the national power grid.
- Allow researchers to study the effects of an increased number of electric vehicles.

Intelligent networks: from dumb to smart energy provision

Static (standard charging rate)

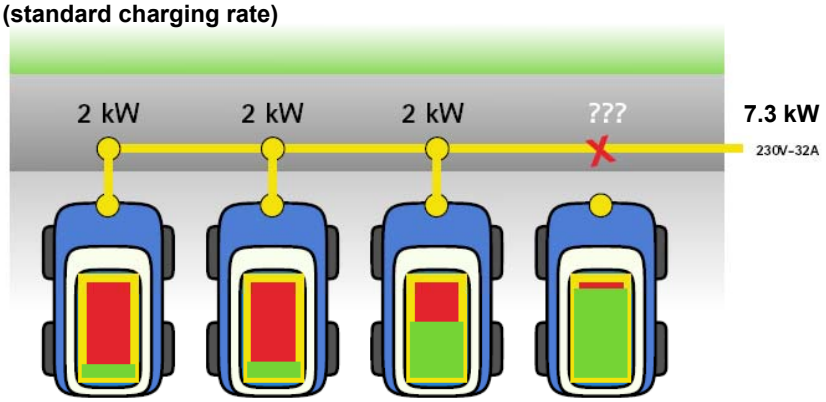


→ Same charging capacity for everyone

Source: Engel (2008), p. 34

Intelligent networks: from dumb to smart energy provision

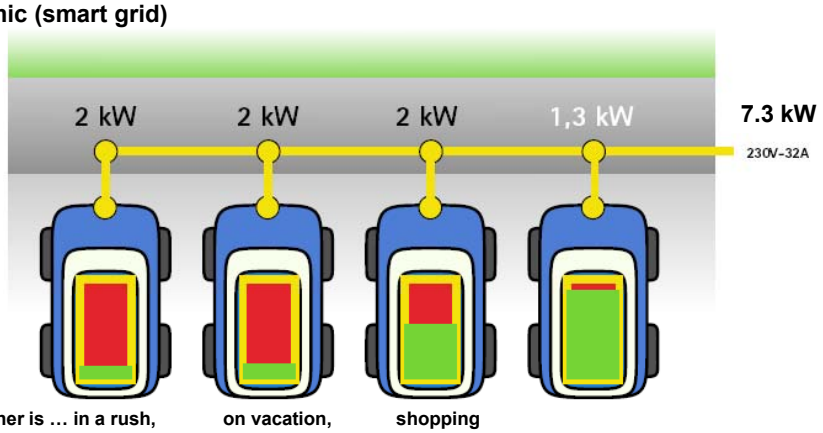
Static (standard charging rate)



Source: Engel (2008), p. 35

Intelligent networks: from dumb to smart energy provision

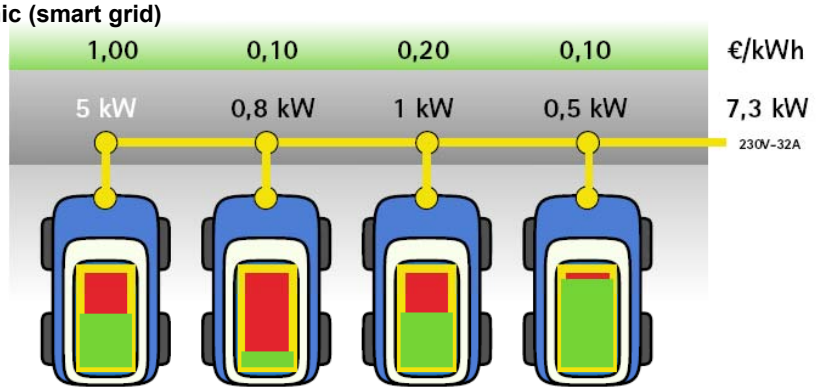
Dynamic (smart grid)



Source: Engel (2008), p. 36

Intelligent networks: from dumb to smart energy provision

Dynamic (smart grid)



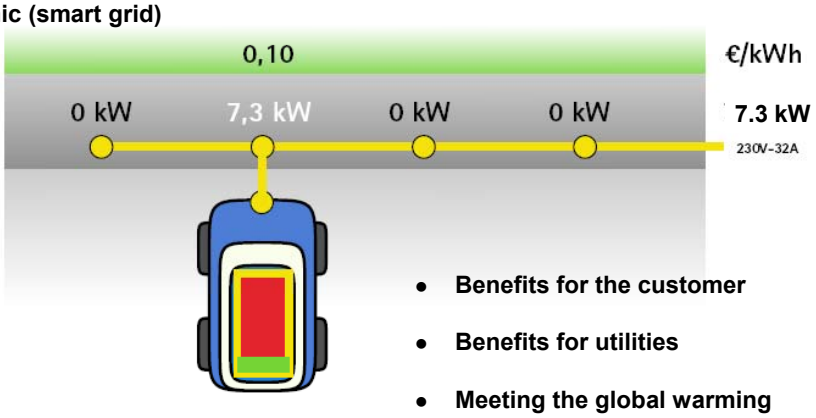
Owner is … in a rush, on vacation, shopping

Source: Engel (2008), p. 37

Dynamic allocation of grid capacity: user-friendly, cost-effective, resource-efficient, …

Intelligent networks: from dumb to smart energy provision

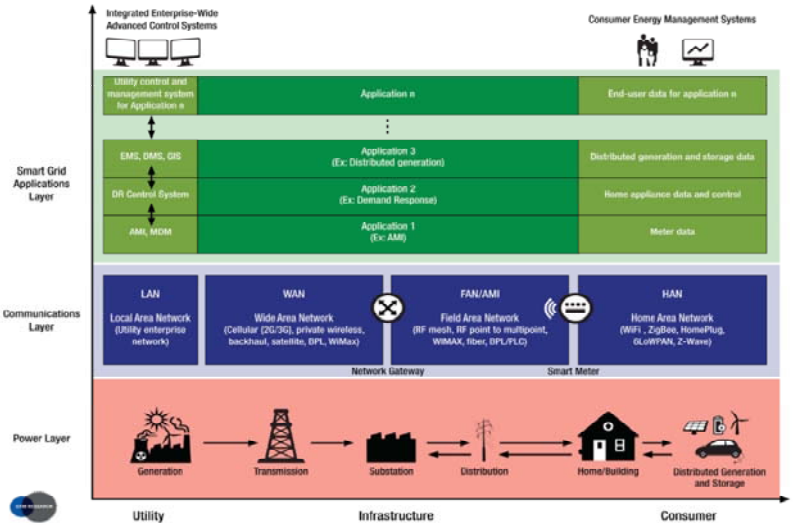
Dynamic (smart grid)



- **Benefits for the customer**
- **Benefits for utilities**
- **Meeting the global warming challenge, reducing the dependency on fossil energy**

Source: Engel (2008), p. 39

Intelligent networks: from dumb to smart energy provision



Source: GTM Research (2009), p.13

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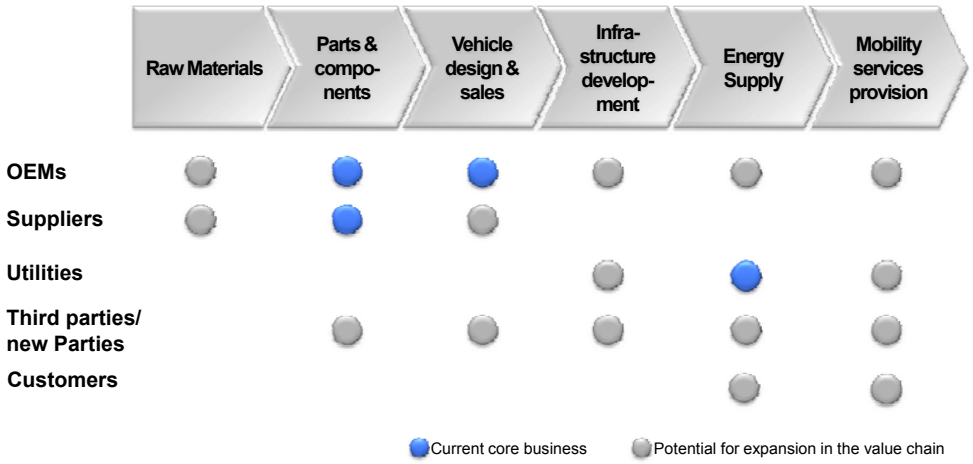
New business models and new business opportunities



Source: according to Roland Berger (2009), p. 80

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How to enable synergies and economic growth

- EU should continue the “carrot and stick” policy to accelerate the transformation process

- New regulation of the energy sector

- Moderation of the different participants of industry
  - Define a master plan of industry or governmental program
  - Take the leadership and define European and worldwide standards

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Conclusion

"The best way to predict the future is to create it“
Peter F. Drucker

Source: Siemens 2009

Thank you for your attention!

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