Energy Scenarios for EU27

34th Euroheat and Power Congress
26 May 2009

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Ea Energy Analyses (www.eaea.dk)

STOA energy scenarios

Scope

- EU-27 technology scenarios for 2030 illustrating barriers, challenges and opportunities
- Publicly available modelling tool (STREAM), including data

Prepared for

- STOA Scientific Technology Options Assessment panel in the European Parliament
- Supervisors: MEPs Jose Hasse Ferreira (Port.) and Anders Wijkmann (Swe.)

…by

- The Danish Board of Technology
- RISØ DTU
- Ea Energy Analyses

Two concrete goals

1. Reduce CO_2 emissions by 50 per cent compared to the 1990-level
2. Reduce oil consumption by 50 per cent compared to the present level

Phase I Phase II

Workshop

MEPs
Stakeholders
Experts
-Energy
-Transport
-Savings

Public model tool
Draft report

Dinner debate

MEPs
Dialogue on
- targets
- measures
- scenarios

Final workshop

- Final scenario report
- Two scenarios
- Model tool+data

Updated tool, data, and scenarios

Website

Dissemination

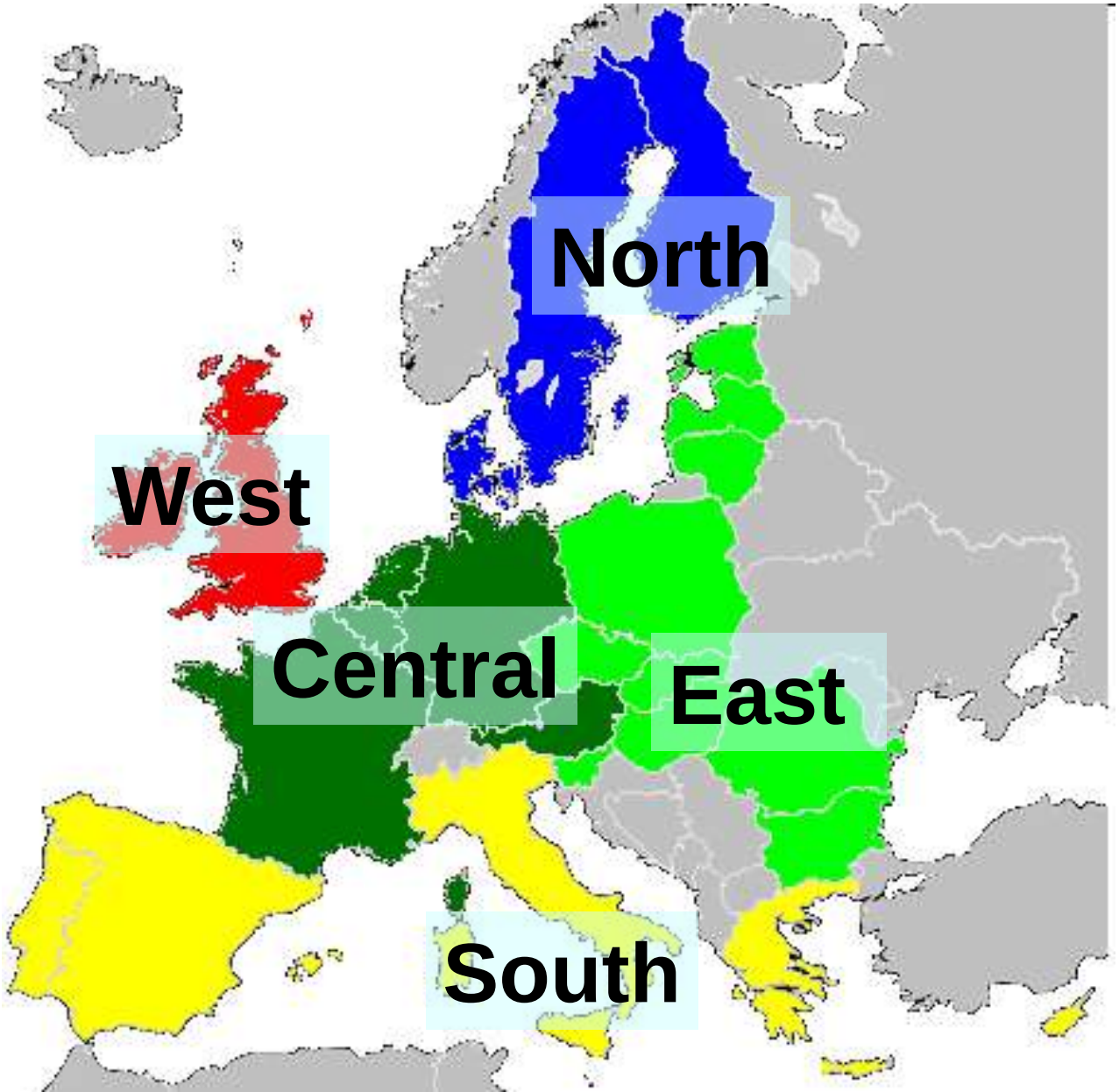
Nov./Dec. 2007

Feb. /March

April/May 2008

Sep./Oct.

We have modelled five regions



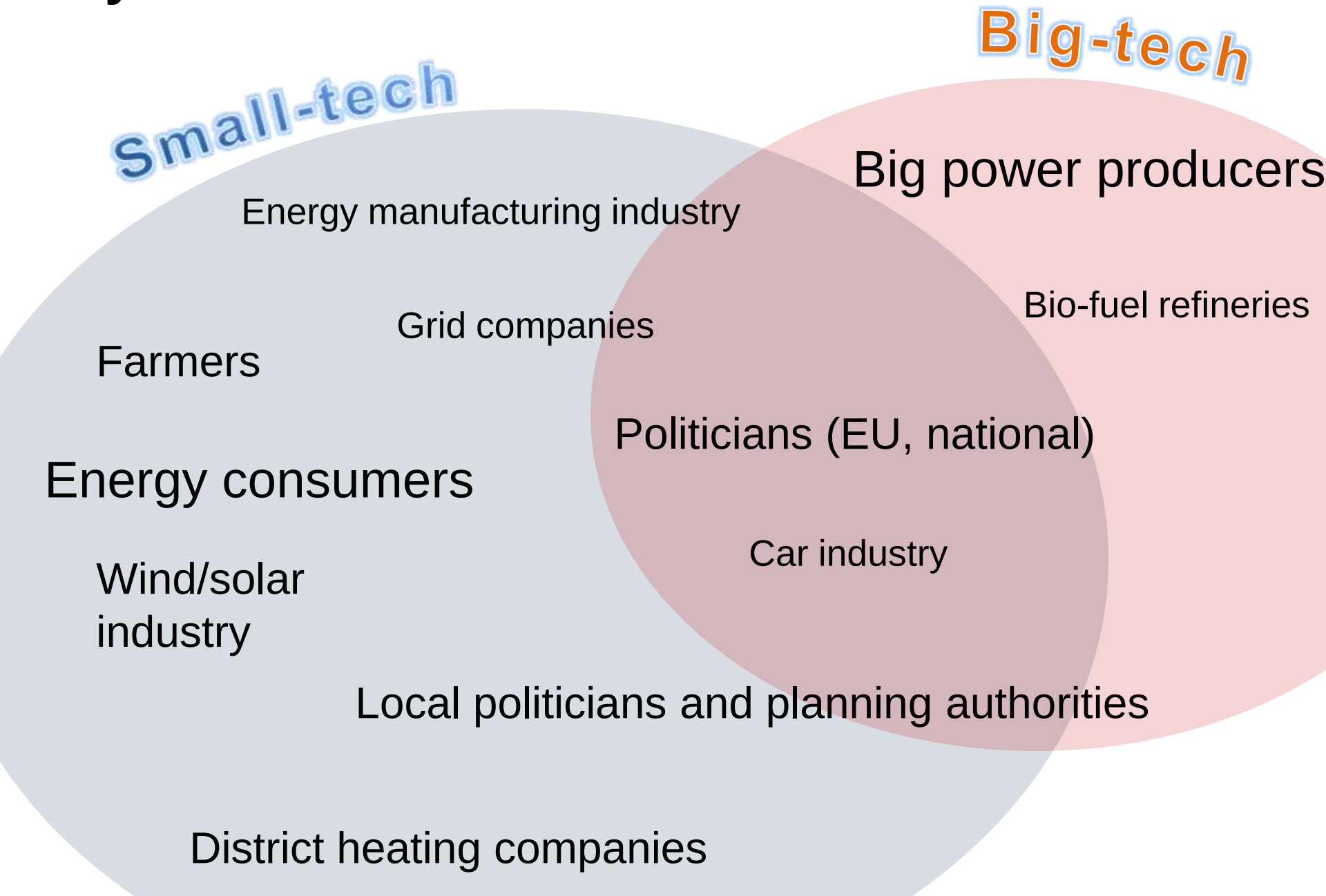
=>
aggregated
to EU level

Two scenarios for 2030

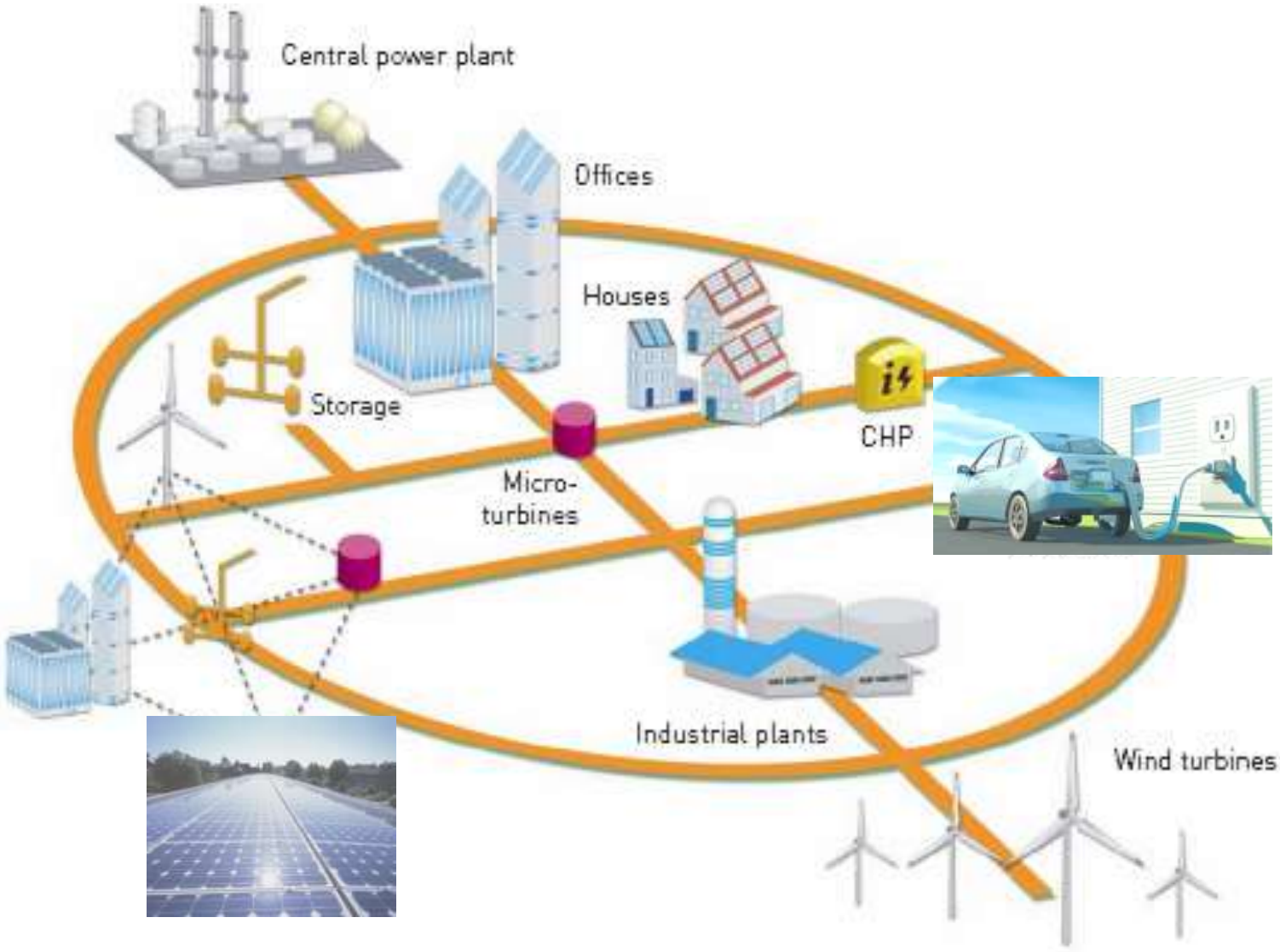
	Small-tech	Big-tech
Energy	• Energy savings • District heating - CHP • Biomass • Solar, wind, wave	• Carbon Capture & Storage • Nuclear power • Biomass
Transport	• Improved fuel economy • Modal-change • Electric vehicles • ICT	• Improved fuel economy • Modal-change • Electric vehicles • Biofuels

…or perhaps a combination

Key decision makers

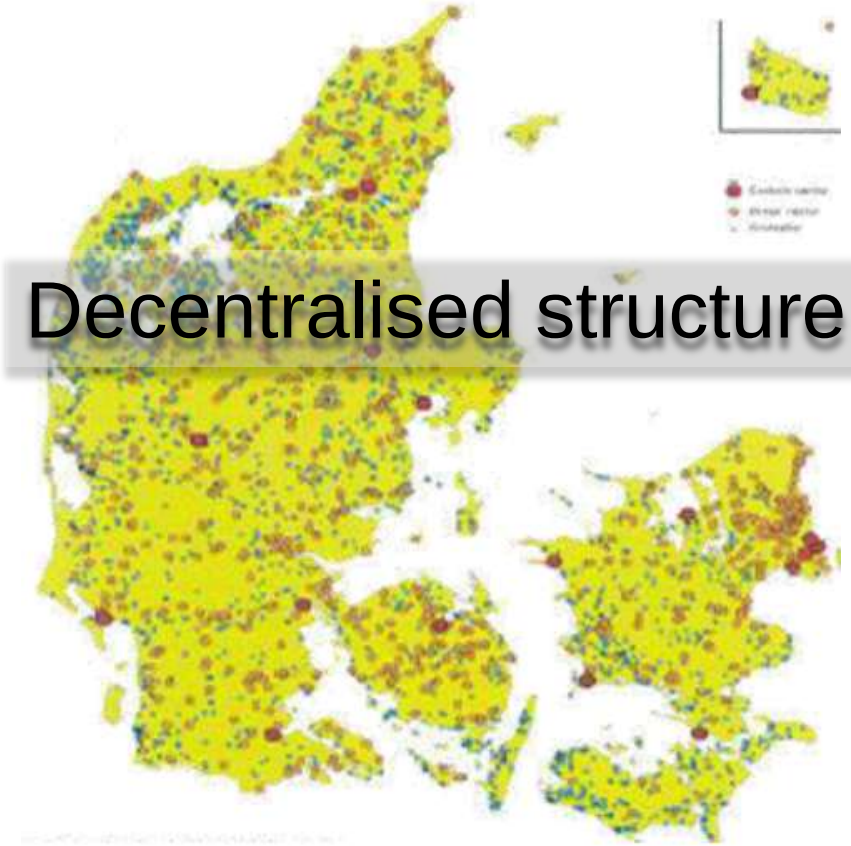


Small-tech calls for smart grids and ICT



Electricity and heat supply

Small-tech



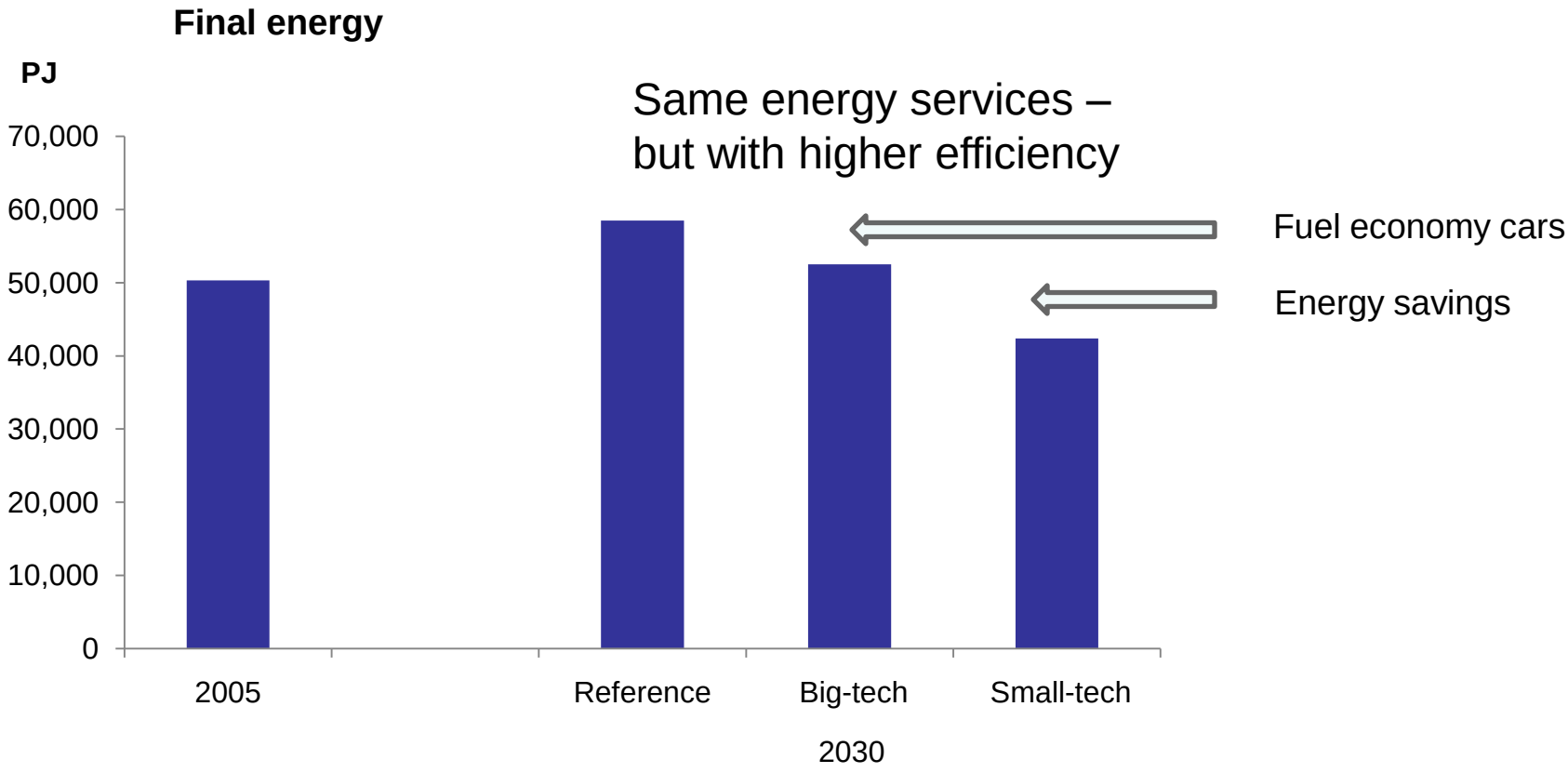
Decentralised structure

Big-tech

Centralised structure

Growth and demand

Approx 2 % GDP growth annually in both scenarios – app. 70 % over 25 years

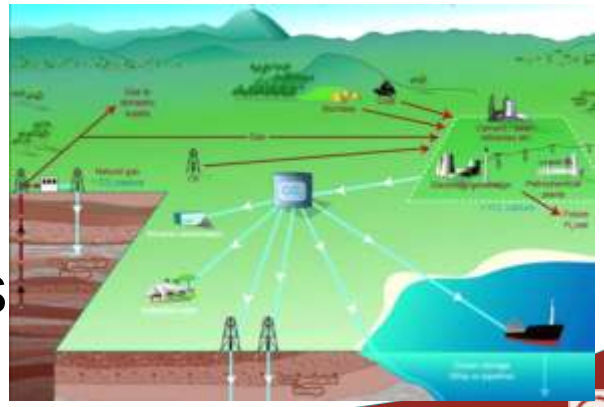


Nuclear power

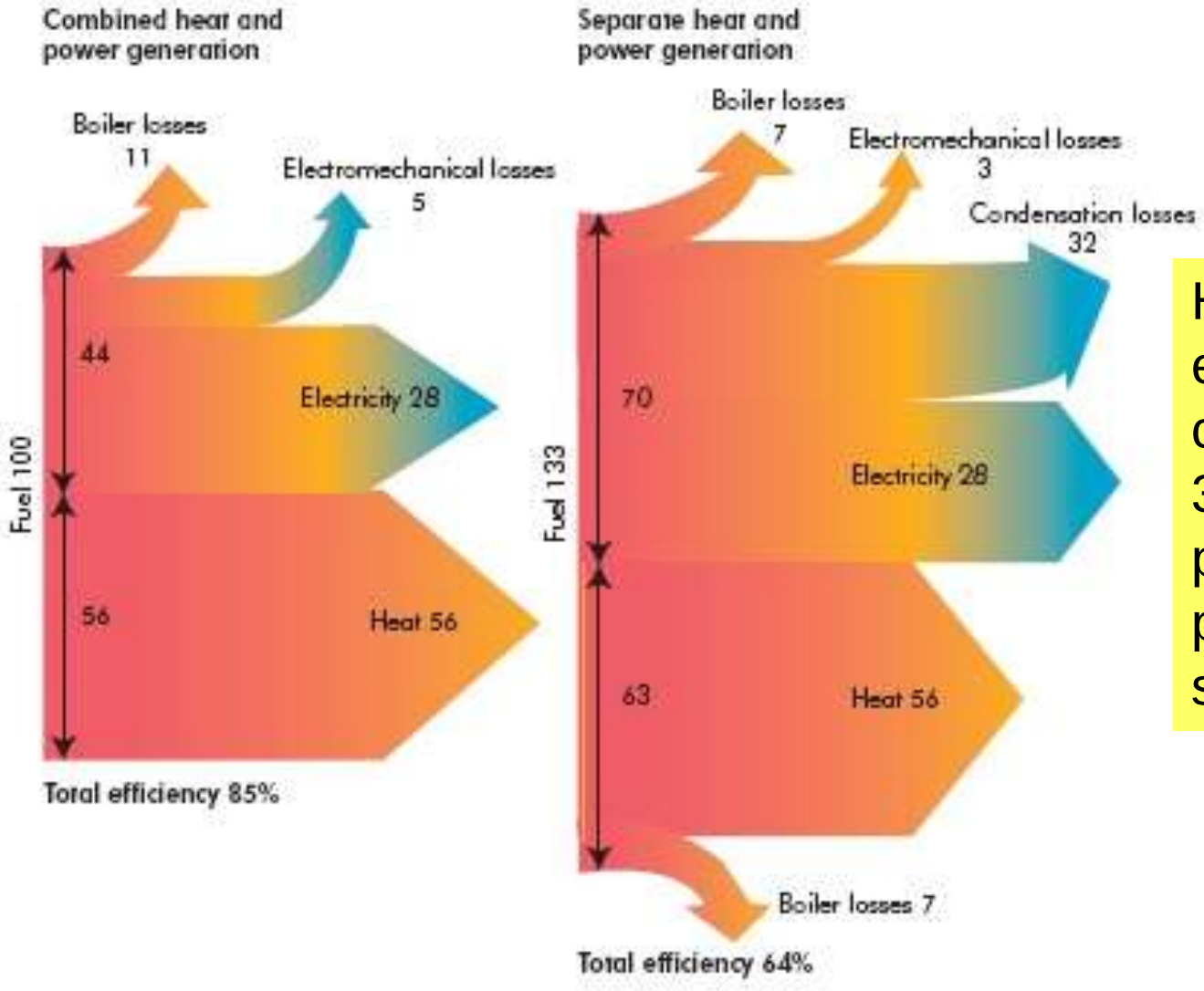
- **Big-tech**
  - **Compared to today, nuclear capacity is increased from approx. 135 GW to 175 GW**
- **Small-tech**
  - **Not a dedicated measure, nuclear not decommissioned beyond what is assumed in the reference projection – 104 GW**
- **SET-plan technology map points at nuclear potential in the range of 127-200 GW in 2030**

Carbon Capture and Storage

- Key measure in Big-tech
  - 145 GW power capacity equipped with CCS
  - all large thermal power plants commissioned beyond 2020 with CCS. Coal power plants commissioned in the period 2010-2020 are prepared for CCS
- SET plan indicates a potential of 90-190 GW of CCS capacity in 2030
- Assuming
  - 90 % cleaning eff.
  - 10 %-point electric efficiency loss

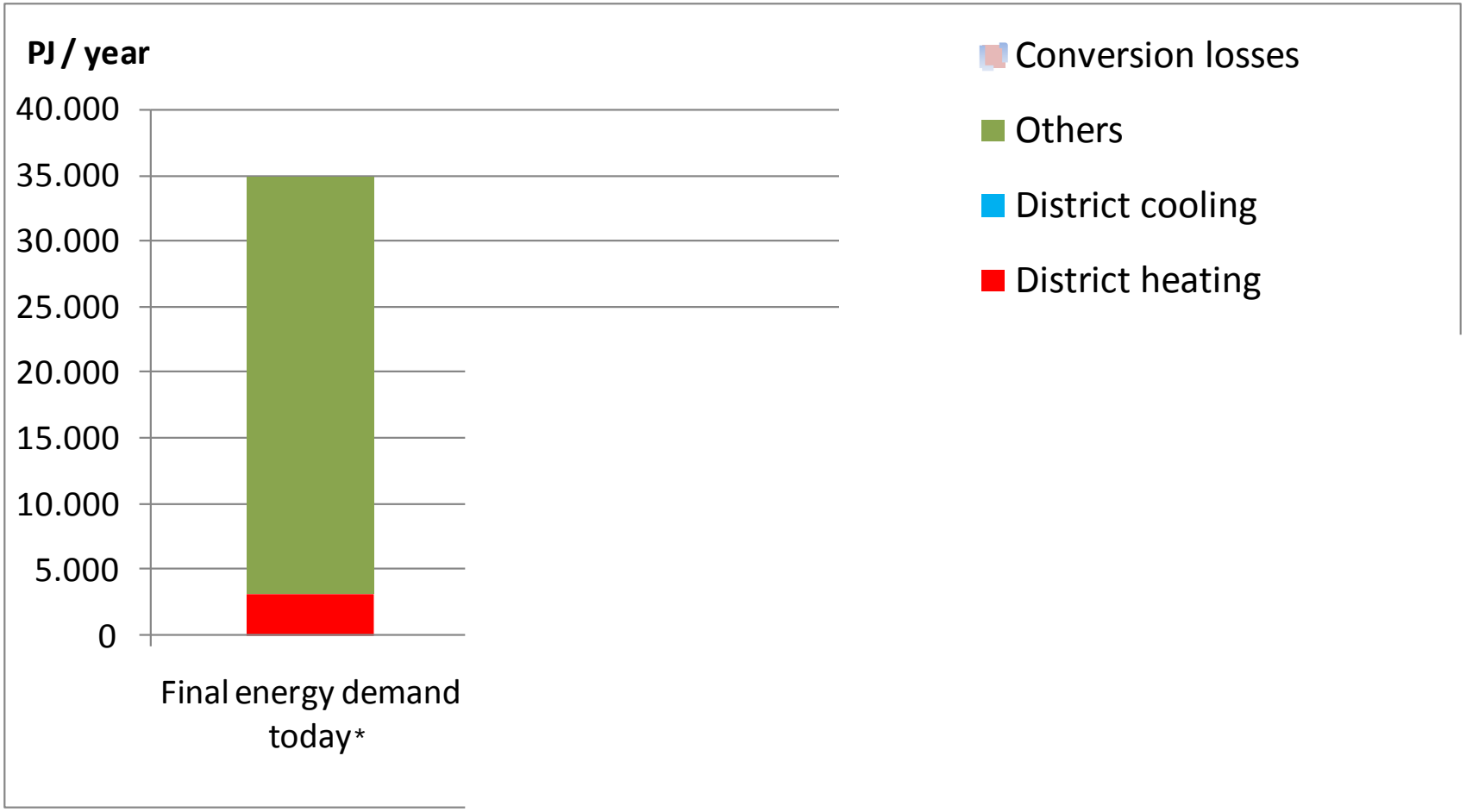


Why combined heat and power production?



Higher fuel efficiency – it costs around 30% more fuel to produce the power and heat separately

Potential for CHP based district heating

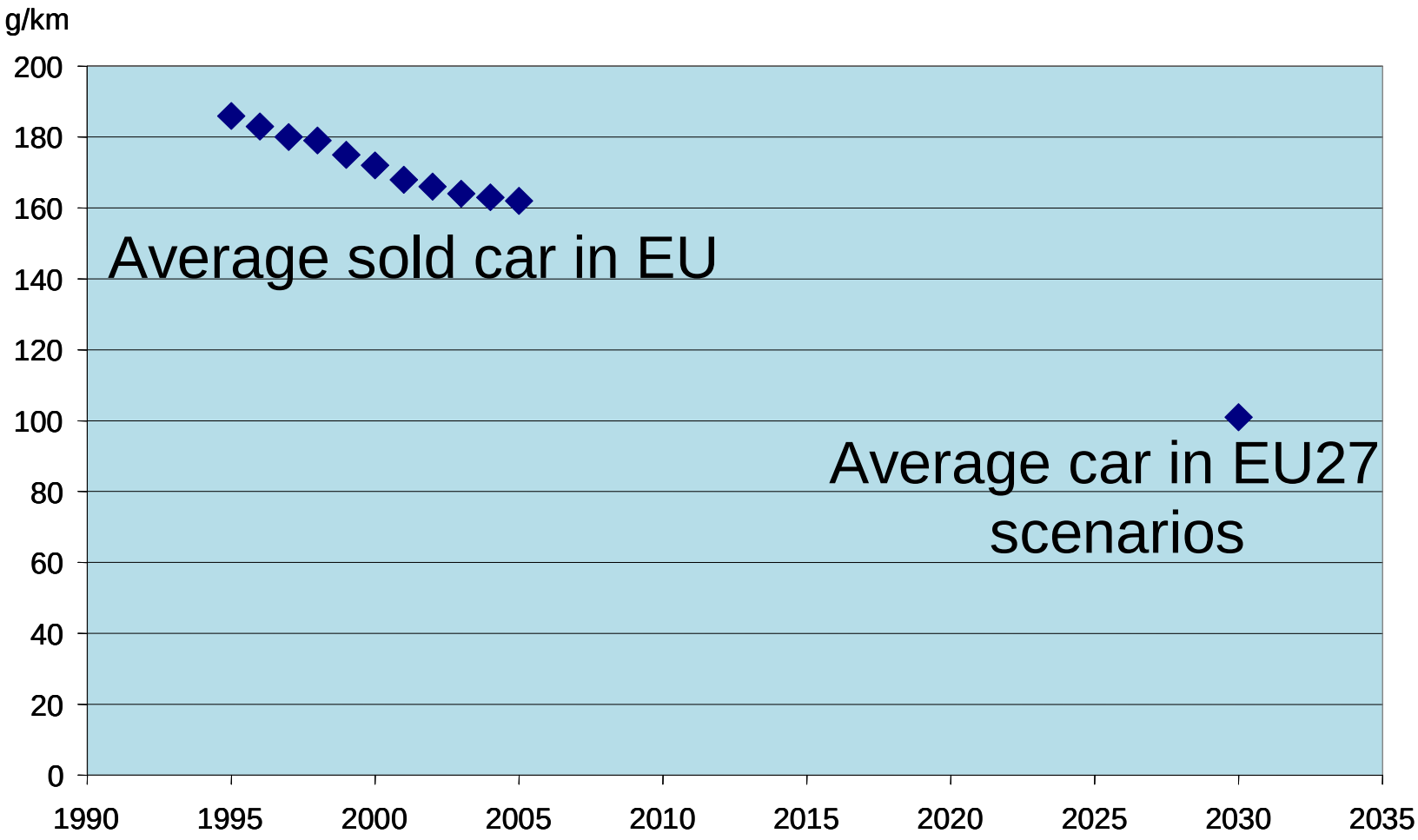


* excl. transport

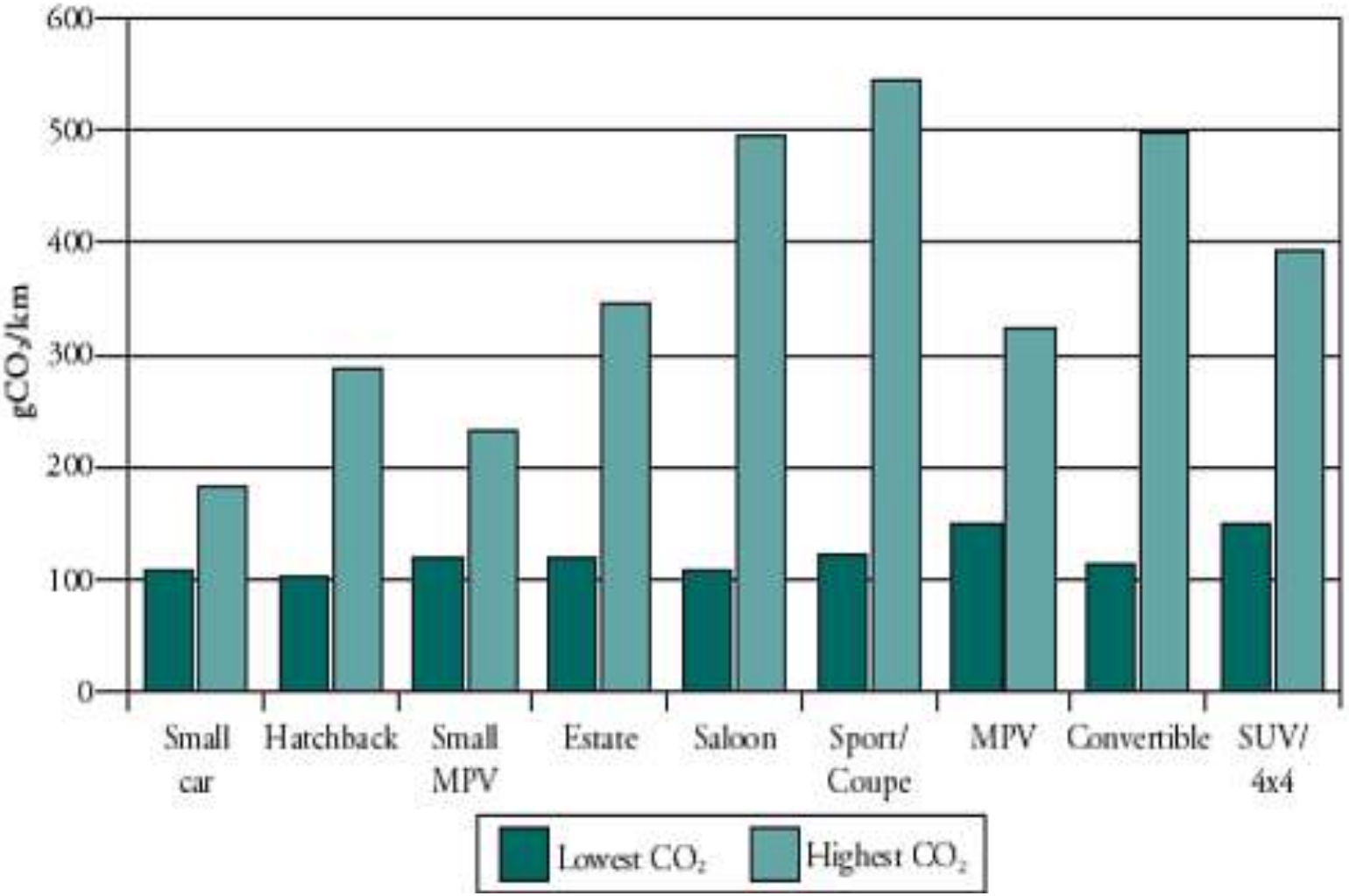
Transport

	2005	2030 Small-tech	2030 Big-tech
Fuel economy	160 g CO_2/km	100 g CO_2/km	100 g CO_2/km
Electric vehicles	0%	15-20%	15-20%
Biofuels	1%	5%	15%
ICT		3 % of transport work shifted	
Modal change		8 % of transport work shifted	8 % of transport work shifted

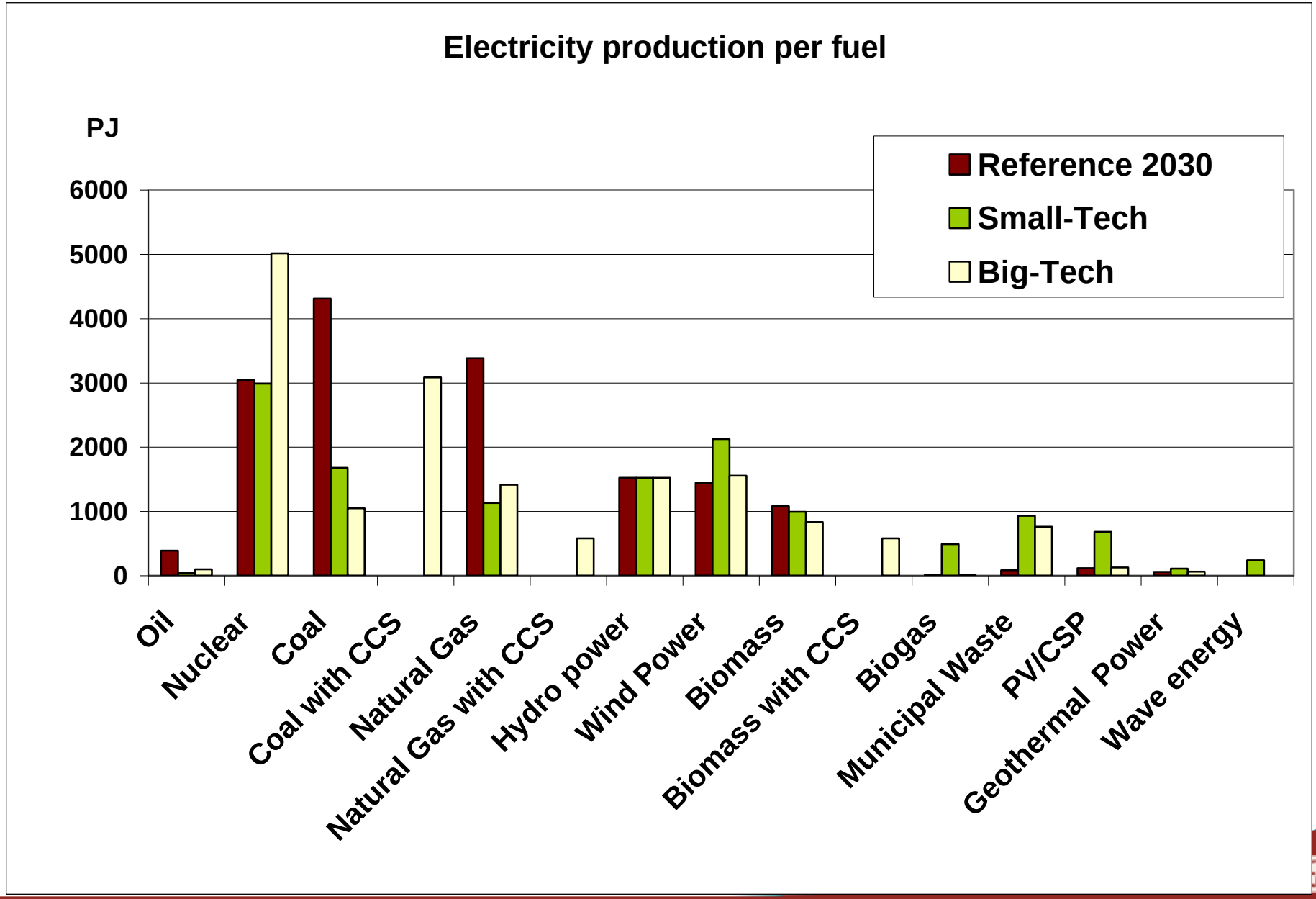
Improvements in fuel economy



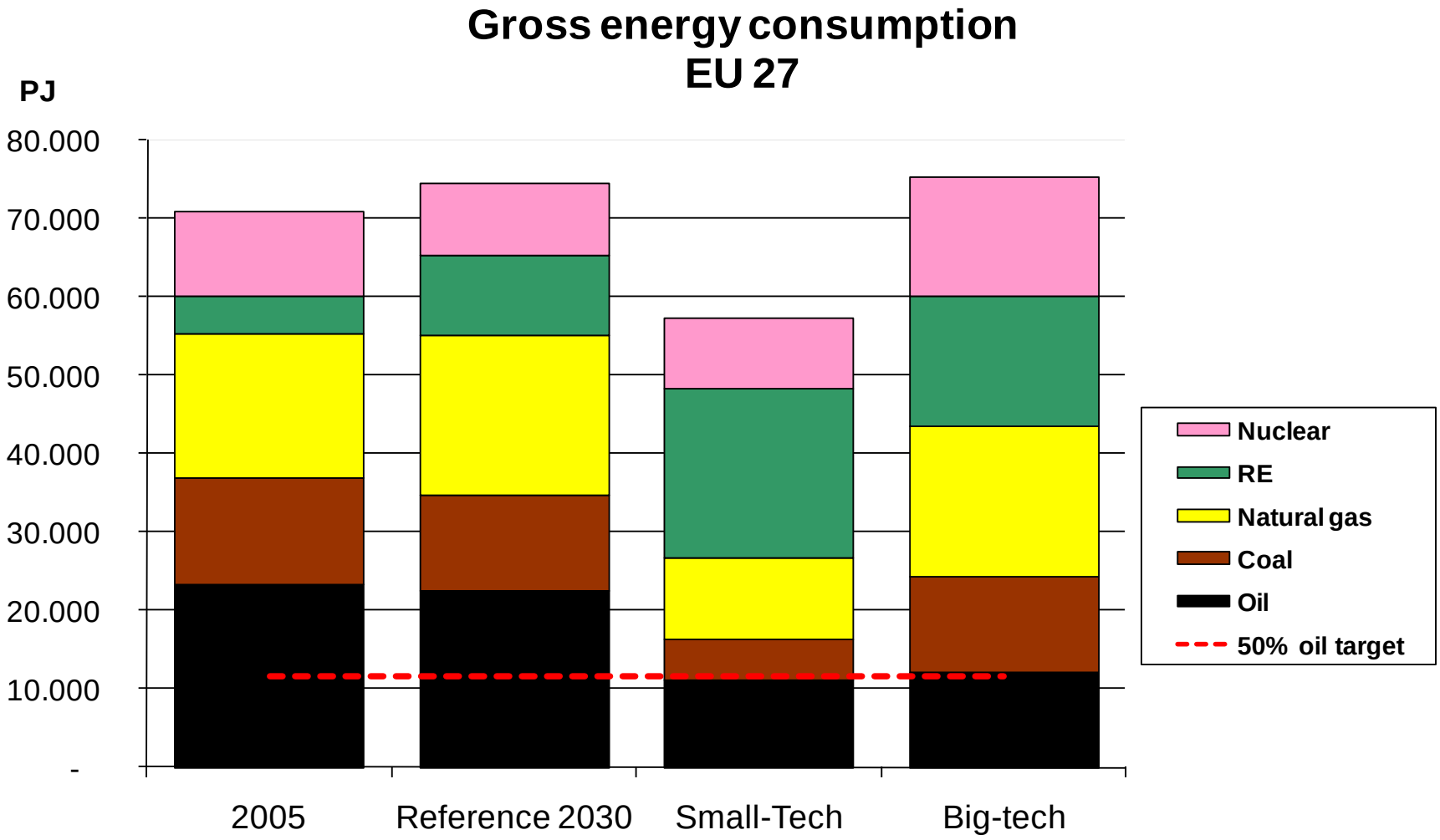
Today's efficiency potential



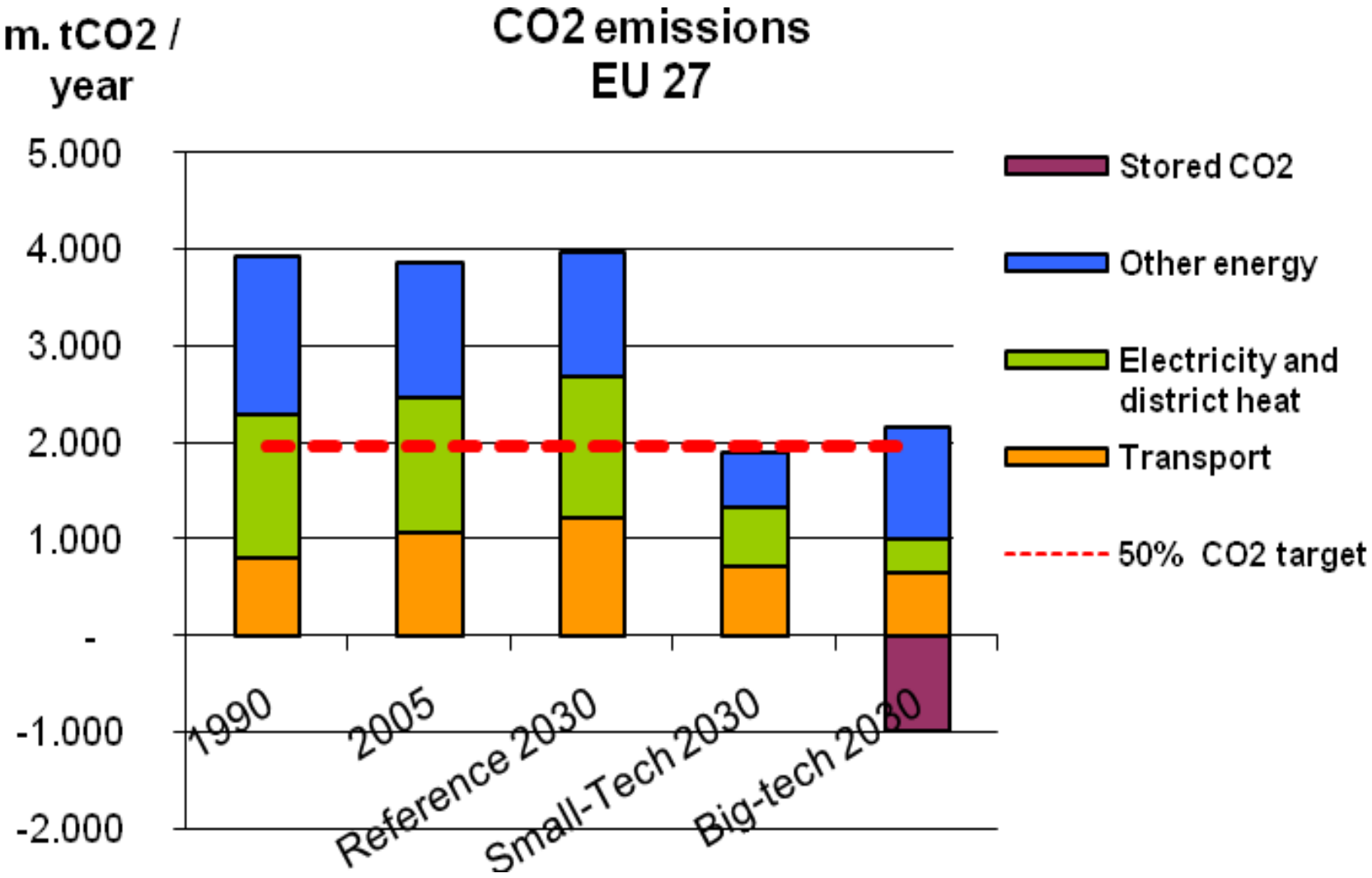
Electricity supply



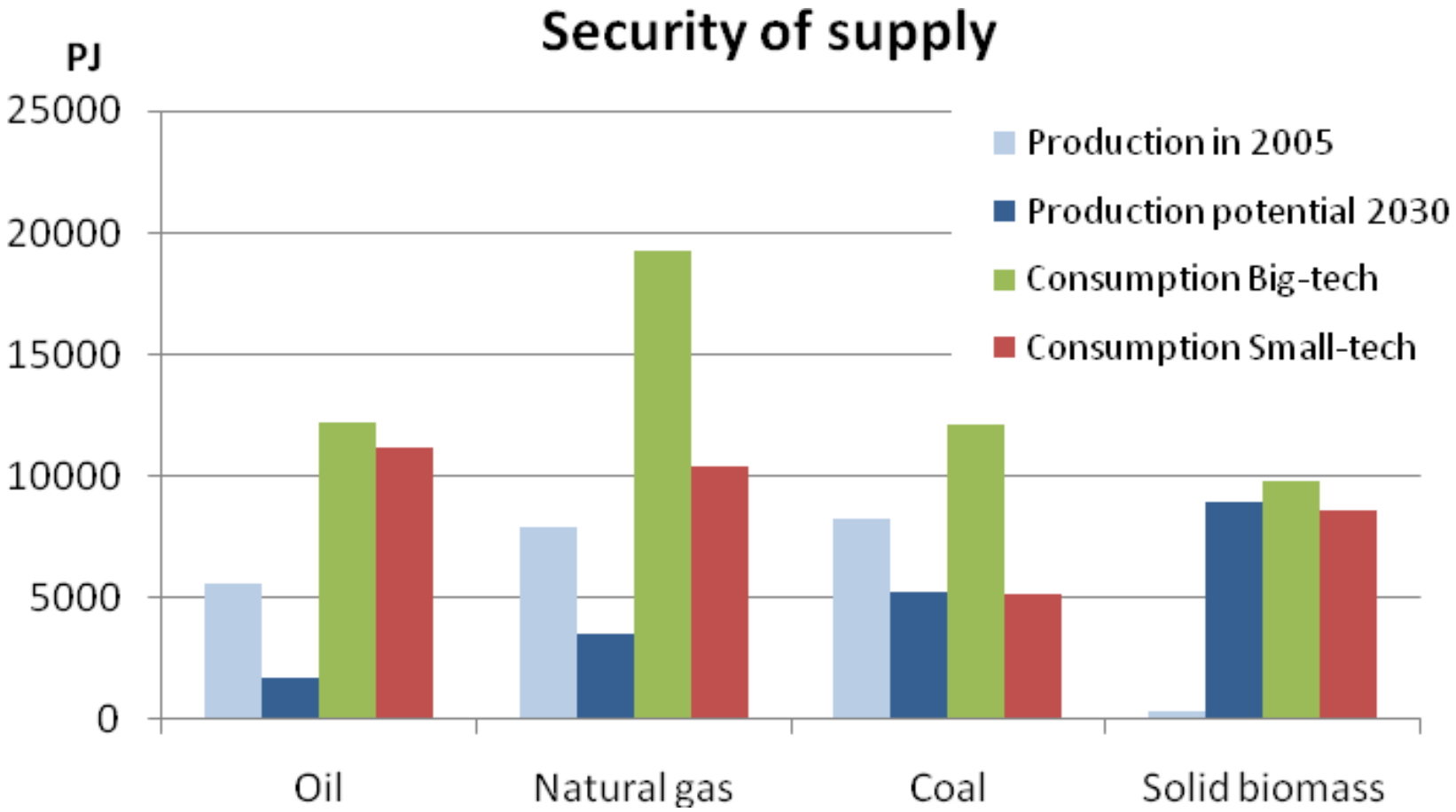
Results


Gross energy consumption
EU 27
PJ
80.000
70.000
60.000
50.000
40.000
30.000
20.000
10.000
-
2005
Reference 2030
Small-Tech
Big-tech
Nuclear
RE
Natural gas
Coal
Oil
50% oil target

Results


m. tCO2 / year
CO2 emissions EU 27
5.000
4.000
3.000
2.000
1.000
-
-1.000
-2.000
1990
2005
Reference 2030
Small-Tech 2030
Big-tech 2030
Stored CO2
Other energy
Electricity and district heat
Transport
50% CO2 target

Results


Security of supply
PJ
25000
20000
15000
10000
5000
0
Production in 2005
Production potential 2030
Consumption Big-tech
Consumption Small-tech
Oil
Natural gas
Coal
Solid biomass

Economic results

- Annuitized value of the entire energy system in the scenario year (2030) i.e.
  - the average annual capital costs
  - costs for fuels, operation and maintenance, CO2-costs
- Not considered
  - Health benefits
  - Cost of modal change and efficiency in transport
  - Transaction costs related to implementation
- Technology and fuel costs may divert from projections

- <u>Therefore: interpret results with caution</u>

Economics

Fuel price projections	Oil (USD/bbl)	Gas ($/MBtu)	Coal ($/ton)
Low **(IEA projection 2007*)**	62	7.3	61
High **(Prices in September 2008)**	115	16	179

CO_2: 45 €/t

Economics

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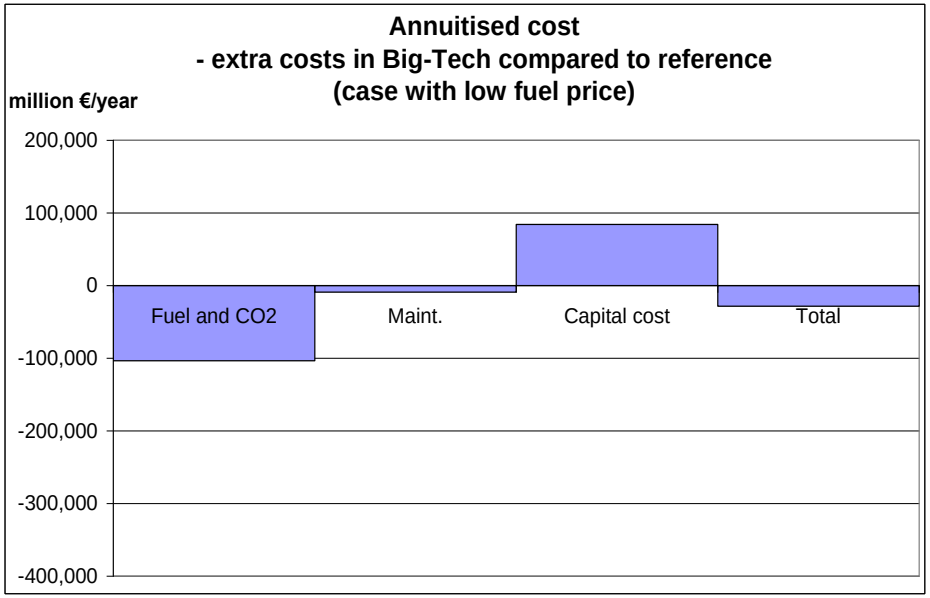
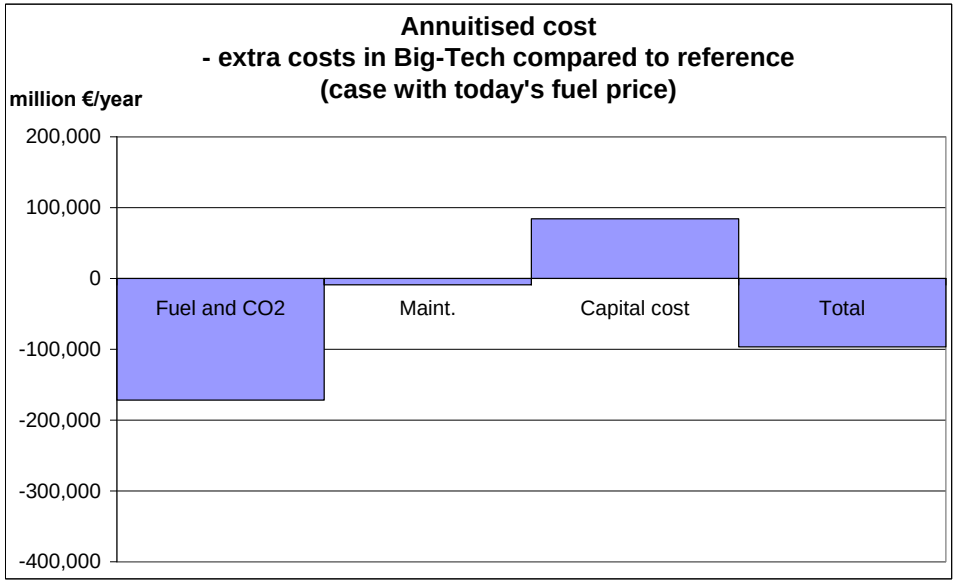
Big-tech





Critical Assumptions

Small-tech scenario	Big-tech scenario
- Energy saving potentials are harvested (many barriers that are not only economic) - Local planning effort to expand district heating and cooling systems (to enjoy benefits of combined heat power) - Significant improvement of the economy of solar power	- That natural gas, coal and uranium are accessible at reasonable prices. - Dependent on the commercialization of carbon capture and storage technology - Public support for more nuclear power
Both - The increased production of biomass for energy conversion. - The fuel economy of new cars is improved considerably. - That electric vehicles or plug-in hybrids are commercialized	

Pro  ons

- **Saving ene** ; energy
- A targeted evelopment of **district** l
- **Strengther electricity infrastruct** e future to allow for a ergy sources.
- The **fuel ef** e improved considerab
- Due to the biofuels **biomass sh** l **heat generatior**
- **Municipal** urce in many European

Energy Perspectives of the Baltic Sea Region

Interim Report

Study on the enhanced regional energy cooperation

Baltic Development Forum

Energianalyse a/s

Sponsored by: norden Nordic Council of Ministers norden Nordic Council Danfoss Fabrikant Mads Clausens Fond

Thank you!

- References:
  - Danish Board of Technology www.tekno.dk
  - Science and Technology Options Assessment www.europarl.europa.eu/stoa/network/default_en.htm
  - Ea Energy Analyses www.eaea.dk

- Contact:
  - Anders Kofoed-Wiuff akw@eaea.dk

Energy Perspectives of the Baltic Sea Region

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Municipalities/ cities

l experience

d district heating

Local Commitment

nning and t policies

Existing buildings

CO2 Neutral Houses

en npaigns

Urban districts

Electric/plug-in hybrid cars/buses

g

EU

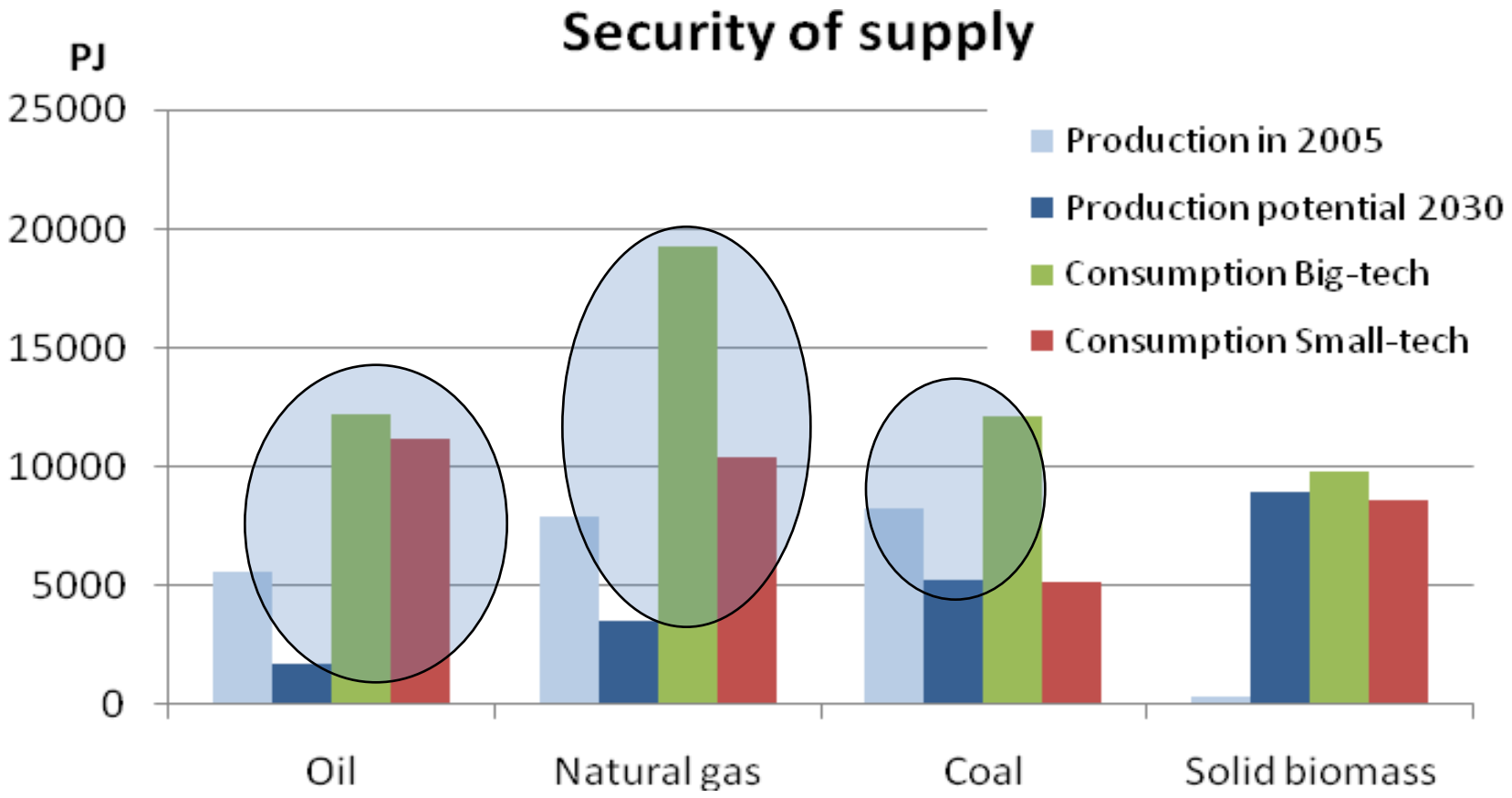
To develop energy efficient vehicles

Global

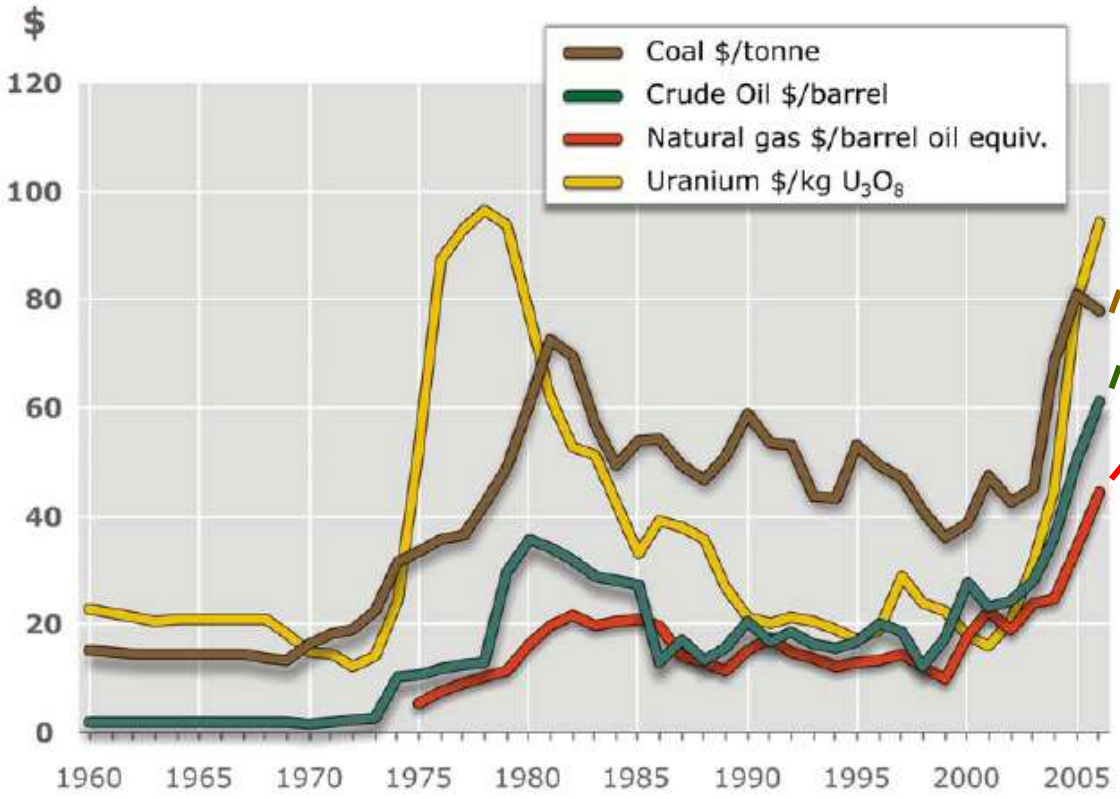
Local

EXTRA SLIDES

Resources and security of supply



Development of nominal fuel prices from 1960 to 2006 (annual averages)



Coal

Oil

Gas

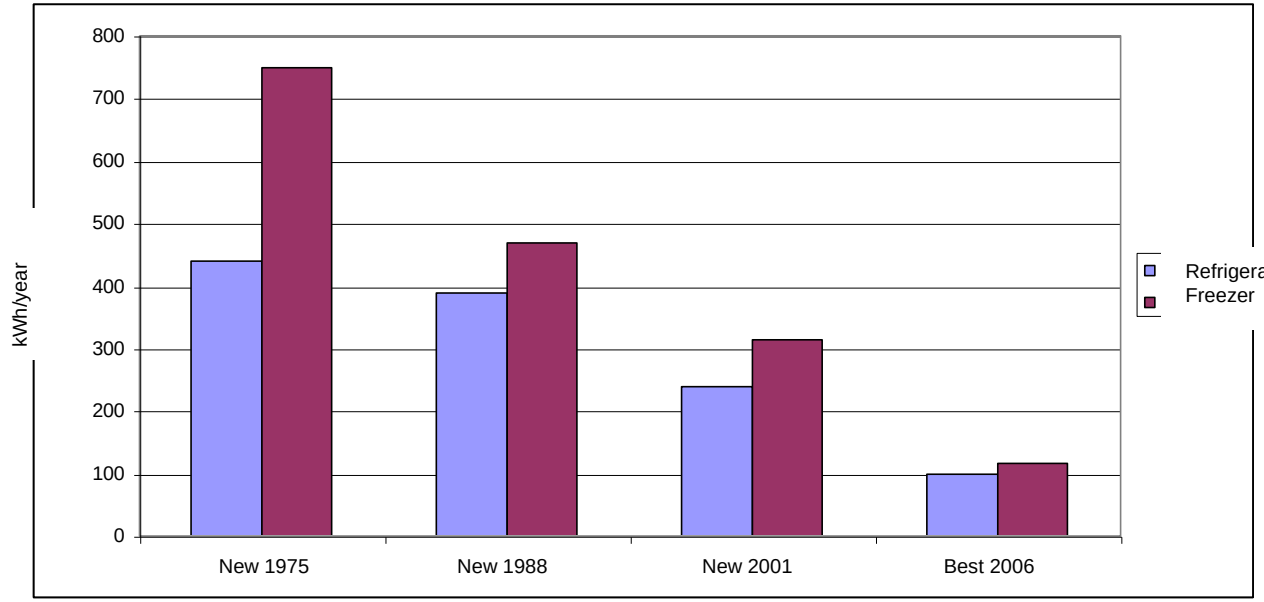
Questions:

- How will fuel prices develop?
- Do the current high prices reflect temporary bottlenecks or long term trends?
- Is it acceptable for the EU to have increasing import dependency of:
  - oil?
  - gas?
  - coal?
  - biomass?

Energy savings - large potentials…

	Saving potential	Description
Heating existing buildings	42 %	Improved insulation etc.
Lighting	65 %	Compact fluorescent lighting
Water heating	65 %	High efficient electric water heater and solar water heater
Major appliances	40-60 %	Increasing appliance efficiency standards at 2-3% per year
Small appliance standby	40 %	Reduce standby power req. of televisions, set-top boxes etc.

Source: McKinsey Eurima



Energy savings in the scenarios

- Efficiency improvements in reference, Big-Tech and in Small-Tech

Percentage saving compared to today's level	Energy form	Energy savings in DG-Tren, reference and Big-Tech	Additional savings in Small-Tech
Tertiary	Electricity	20-30 %	10-20 %
	Heating	20-30 %	6-10 %
Industry	Energy	20-30 %	10-16 %
Residential	Electricity	20-35 %	10-20 %
	Heating	20-40 %	7-15 %

Stays within potentials identified in other studies.

The costs of savings?

- Uncertainty concerning the costs of savings

Prices used in the scenarios:
18-25 €/GJ for electricity savings
10-16 €/GJ for heat savings

Using high fuel prices the investment costs in the energy savings in the Small-Tech scenario could be 5 times higher and still give a net benefit. With the low fuel prices it could be 2.5 times higher.

Saved investments in the power system due to reduction in electricity demand

- The 16% additional electricity savings in Small-tech scenario reduces demand for power capacity

2,500 PJ electricity is saved each year in the Small-Tech scenario replacing around 200 power plants at 600 MW capacity.

Saved investment in the power system due to flexible electricity demand

- 2% of the total electricity demand is assumed to be flexible in the Small-Tech scenario

e.g. 30% of residential electricity used for refrigerators and freezers

and thereby reduces peak load by 50 GW

50 GW cut in peak load saves investments in 80 peak power plants at 600 MW capacity.

Why is it difficult to achieve the savings? What should be done?

EPC (European Policy Centre) – Gain without pain: towards a more rational use of energy:

- New policy measures are needed + active use of existing directives, such as the Eco-Design Directive.
- Third-party financing (such as ESCO's) should be promoted.
- All public sector organizations should have ambitious targets (including the European Institutions).
- Metering and individual pay by the user is important.

What should be done?

E.g. as pointed out in “Capturing the European Energy Productivity Opportunity”, McKinsey&Company, September 2008.

Four key areas to get right:

- Setting energy-efficiency standards for appliances and equipment.
- Upgrading the energy efficiency of new buildings and remodels.
- Raising corporate standards for energy efficiency
- Investing in energy intermediaries (e.g. ESCO’s)

ENERGY EFFICIENCY CREATES SEVEN BASIC CATEGORIES OF BUSINESS OPPORTUNITIES

Building-technology products	Electrical devices	Transportation	Transparency-creating products	Customized solutions	Energy services	Financing of investments
• Space heating • Windows • Insulation • Elevators • Water boilers	• Appliances • CF lamps • Office supplies • White goods • Consumer electronics	• "Eco" cars • Locomotives • Carbon structure • Regenerative braking • Tires	• Advanced metering • Smart grids • Eco Drive program • Navigation devices	• HVAC* systems for buildings • City lighting • Measurement and control systems	• Energy consulting • Demand monitoring and mgmt. • Heat and power from cogeneration	• Earmarked loans • Leasing of equipment







* Heating, ventilation, and air conditioning.

Source: McKinsey Global Institute analysis