AALBORG UNIVERSITY

Energy efficiency
- a shortcut to sustainable energy

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"Light Bulb Standards Fought By House Republicans"

EE + RE = SE

Energy Efficiency
+
Renewable Energy
=
Sustainable Energy System

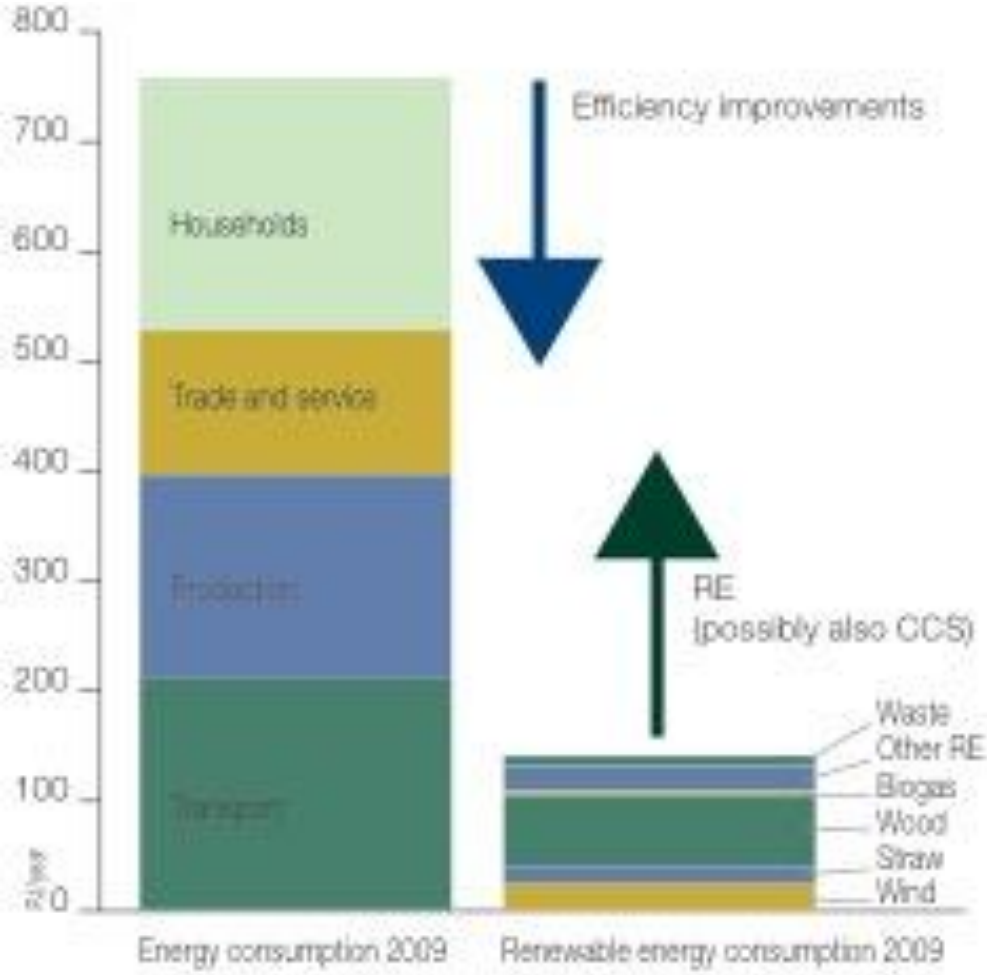


Figure 2.1. Energy consumption and renewable energy 2009. Source: Danish Energy Agency

Climate Objectives of EU

20 – 20 – 20 by 2020

Ambitious objectives sat up by the EU

- European Union commits to *cut greenhouse gas emissions* by at least 20% (compared to 1990)
- 20% of the European energy consumption shall come from *renewable energy* (Denmark 30% since 17% to-day is based on renewable energy to-day)
- *reduce 20%* of EU's total primary energy consumption (not binding and mandatory for the member states)

Proposed Energy Efficiency Directive

Only half of the 20% reduction target will be met with current plans
Review in 2013, if not substantial progress then BINDING targets from 2014

Status:

- Legal obligation to establish *energy saving schemes* in all member states (MS)
- *Energy companies obliged to save 1.5 %* of their yearly energy sales, by volume through the implementation of energy efficiency measures such as improving the heating system, installing double glazed windows, etc.
- *Public sector to lead by example* (The public sector will be required to renovate 3% of their building stock; Local energy efficiency plans; purchase products, services and buildings with high energy performance, etc.)
- *Buildings* – huge potential, challenge: existing buildings, etc.
- *Industry* have to make energy audits, eco-design, and voluntary agreements

Combining EE Strategies - how DK kept energy consumption stable

Energy savings in consumption

- Savings of electricity and heating in households and industry
- Energy efficient products (clean tech)

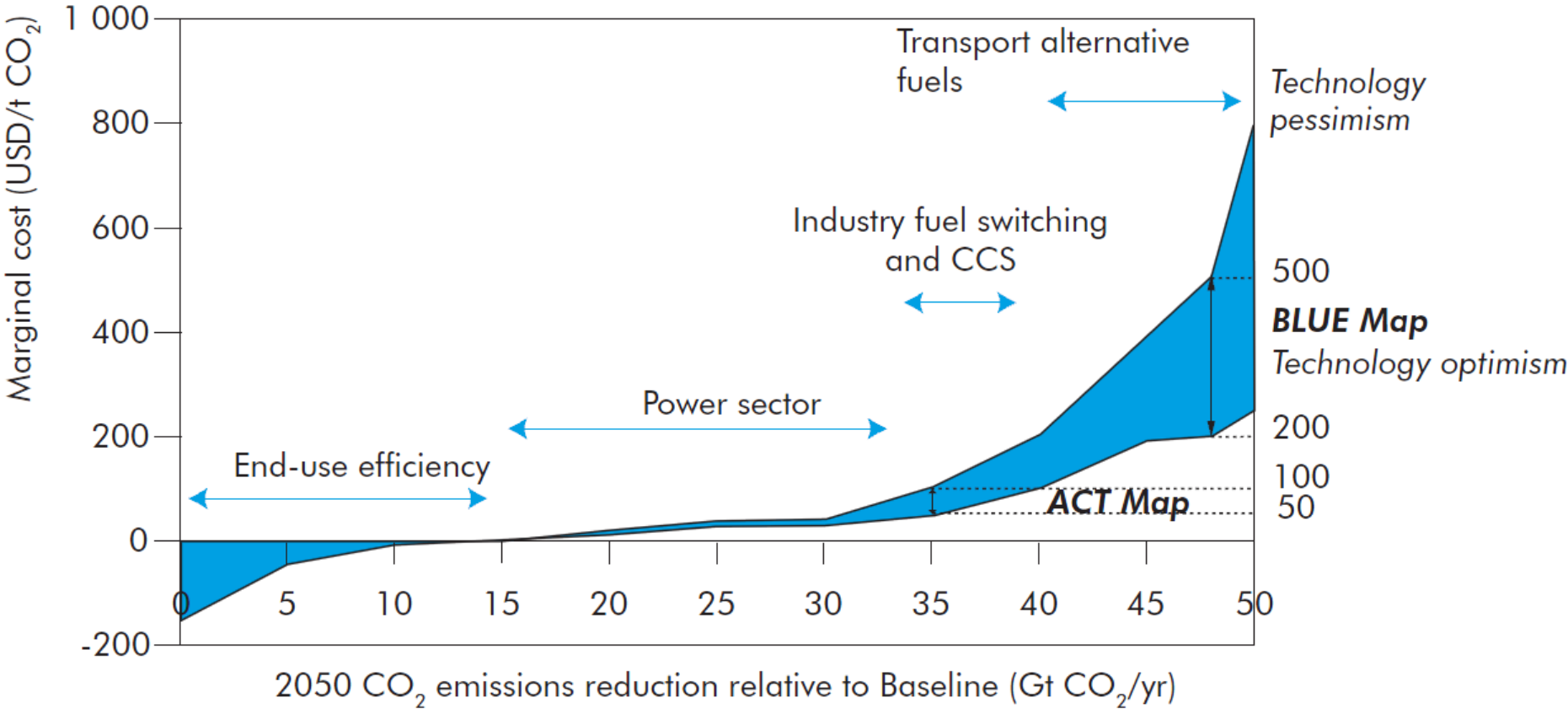
Efficiency in distribution

- Combined heat and power, low temperature district heating, heat pumps, storage, etc.

Renewable Energy Sources

- Distributed and integrated system

Energy Efficiency – the cheap solution



Source: IEA Energy Technology Perspective 2009

Energy efficiency as a business case

A business case – clean tech:
Clean, Clever and Competitive

- Technical Traffic Solutions (TTS) A/S
- Grundfos circulator pump

Green Light, TTS A/S

Traffic signals using LED technology

Environmental benefits

- 2.100 kWh/year (old: 6.500 kWh/year)
- Lifespan: more than 10 years (old: 1 year)
- Less waste – recyclable materials
- If all traffic signals in the EU were replaced: 25% of the yearly energy consumption in Denmark

Other benefits

- Improved traffic safety (more clear signal)
- Design
- No maintenance and cleaning needed

Alpha Pro, Grundfos

A-marked circulator pump

Environmental benefits

- Improved energy efficiency – uses 80% less electricity than the old one
- Pumps consume 20% of world electricity consumption, and 15% of electricity consumption in an average European household

Other benefits

- Saves money in the long run
- Technology, with many spin-offs
- Easy to install

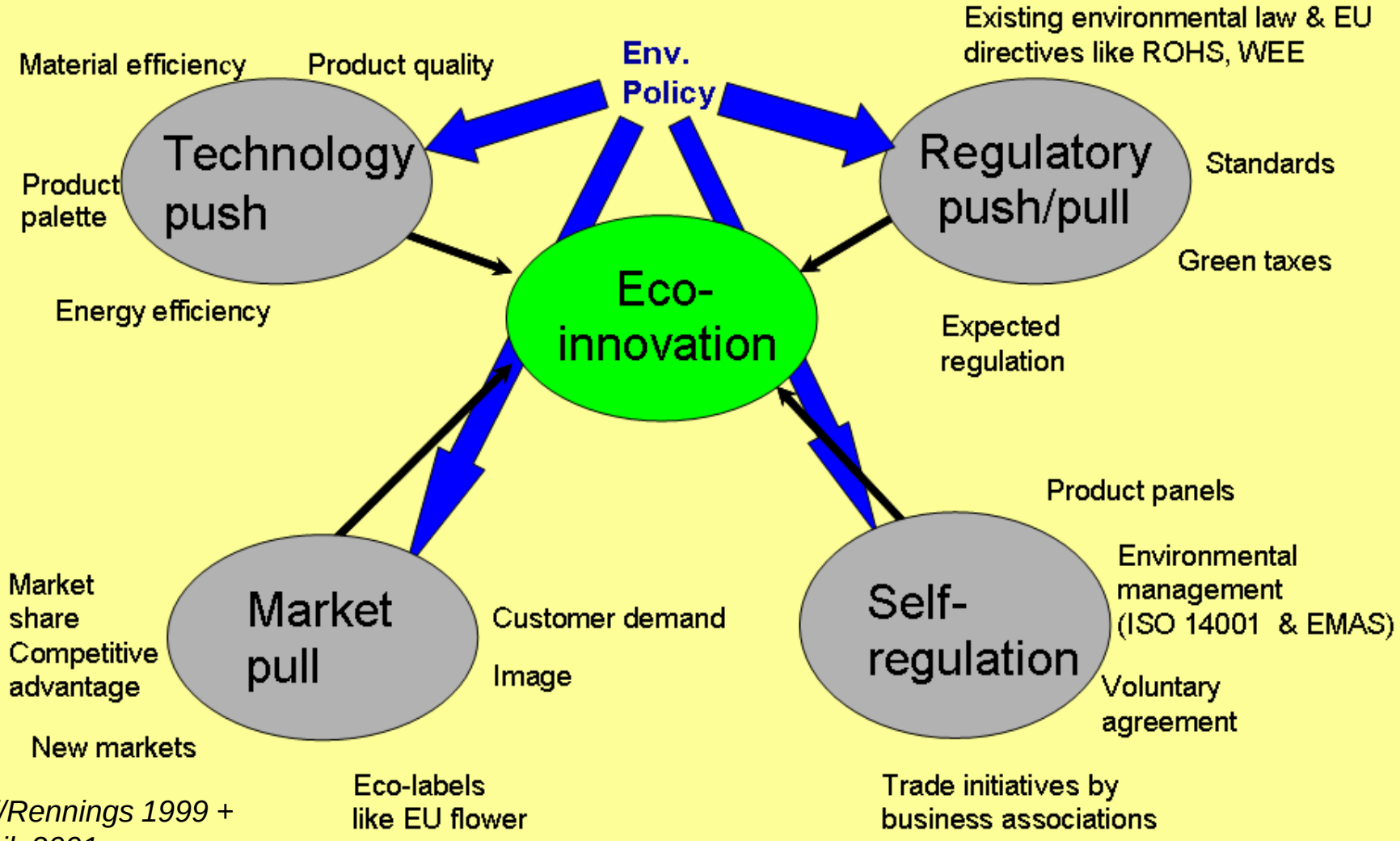
Resource efficiency of pumps

Materials	UPE (Kg)	Alpha Pro (Kg)	Difference (Kg)
Cast iron	1,40	0,79	- 0,61
Sheet metal	3,70	0,32	- *3,38*
Copper	1,20	0,10	- *1,10*
Perma magnet	0	0,12	+0,12
Aluminium	0,95	0,22	- *0,73*
Plast	0,21	0,20	- 0,01
Silicone foundry mass	0,26	0,25	- 0,01
Overall weight kg	7,72	2,00	- 5,72

Recycling profile:

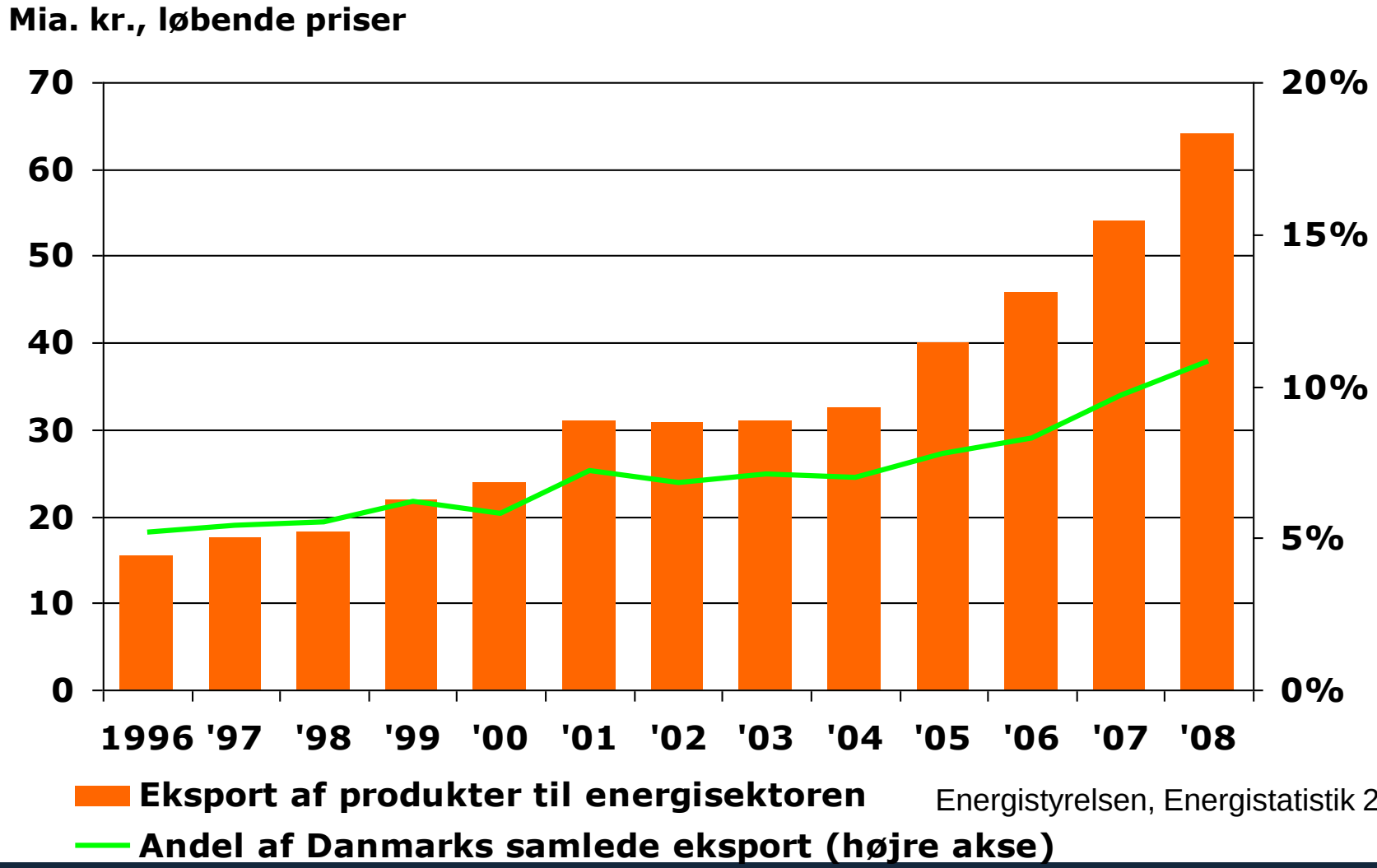
- Reuse/Recovering 94%
- Incineration 4,7%
- Disposal/landfill 1,2 %

Drivers for Clean tech.



Cleff/Rennings 1999 + Rubrik 2001

Exports of Energy Technology and Equipment



Energistyrelsen, Energistatistik 2008

Ford T – 100 years of "fuel efficiency"

US standards on fuel efficiency

1908: 13–21 miles per gallon – Ford T

2012: 15 (city) - 27 (highway) mpg – Ford Taurus 2012 3,5L V6

Fuel efficiency standards in US - upcoming

2016: 35.5 mpg

2025: 54.5 mpg (Federal – announced today)

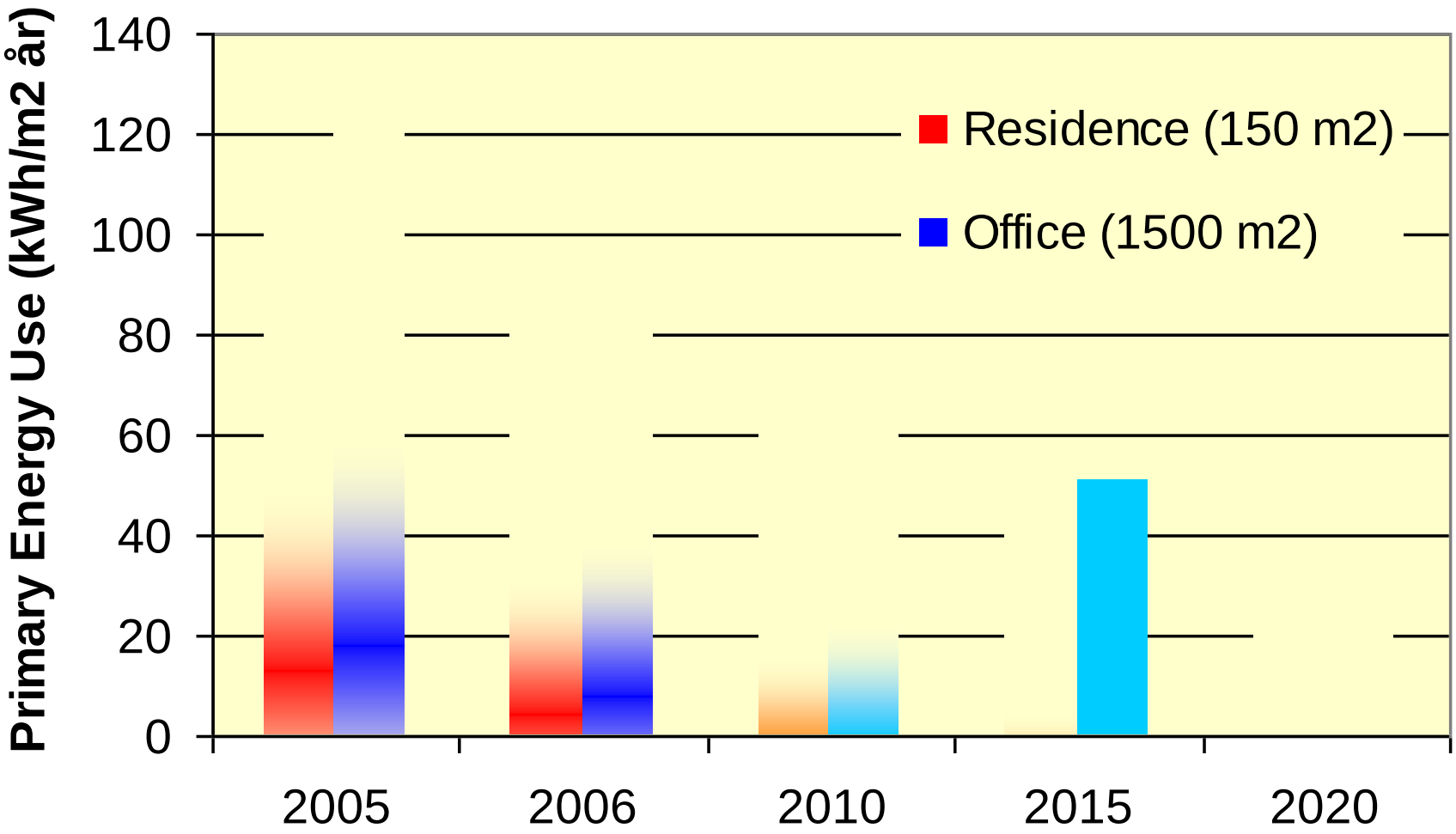
Rebound effects

- Driving more mileages + having more cars pr family

New transport means

Comfort houses in Vejle

Development in Maximum Energy Use in New Buildings in Denmark



Measures to promote energy efficiency

Danish governments have established

- High taxes on energy and on Co2 emissions
- Co-generation of heat and power
- Voluntary agreements on energy savings with industry
- Public awareness campaigns on energy use
- Stringent building codes (insulation, double glazing, etc.)
- Green public procurement (public set an example)

EU has established

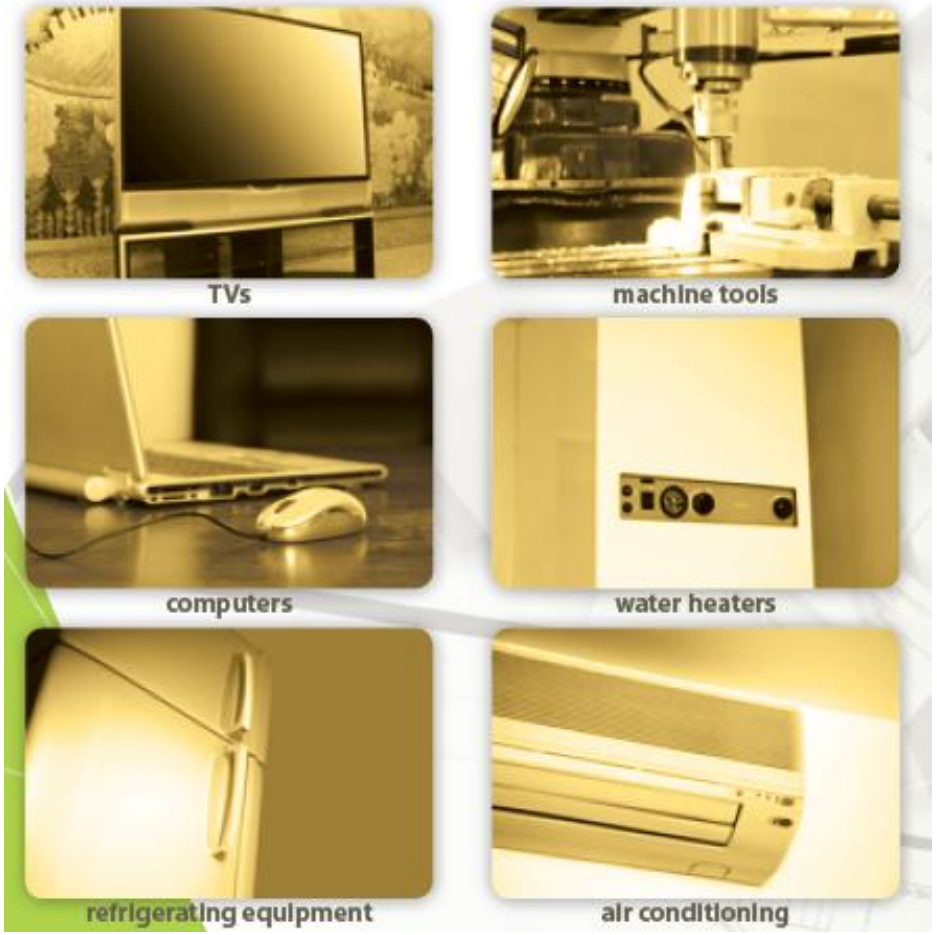
- Mandatory energy labelling
- Directive on Energy-related Products (ErP) setting minimum energy performance standards

EU directive on Energy-related Products

MEPS - Minimum energy performance standards to

Energy-using Products since 2005 such as:
Computers, refrigerators, boilers, washing machines, light bulbs, AC /air conditioner, etc.

Energy-related Products since 2009 such as:
Windows, insulation materials, bathroom devices, etc.



ErP – estimated energy savings

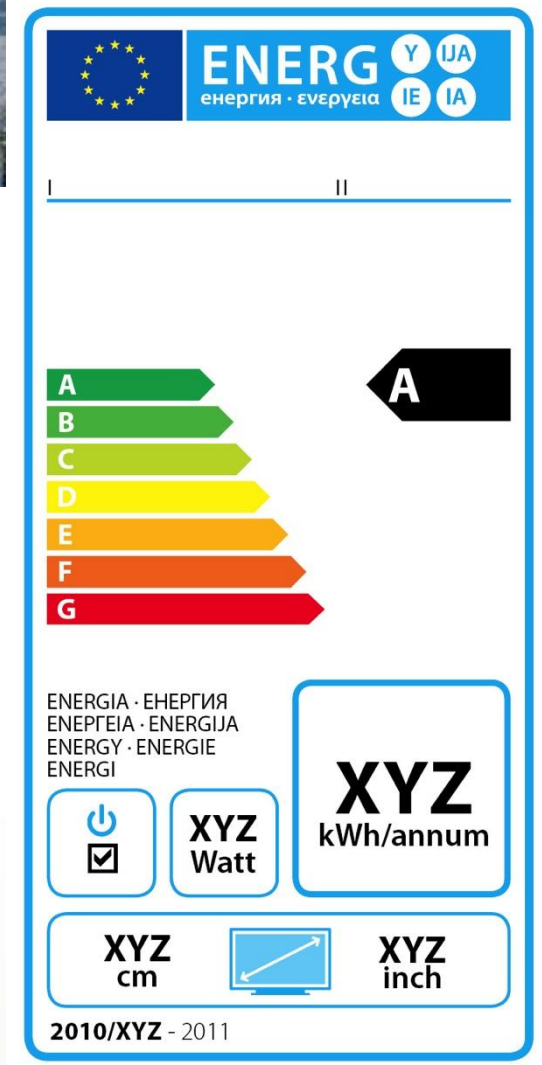
Ecodesign Measure	Adoption	Estimated savings (annual by 2020)
Standby	December 2008	35 TWh
Simple set top boxes	February 2009	6 TWh
Street & Office Lighting	March 2009	38 TWh
Domestic Lighting	March 2009	37 TWh
External power supplies	April 2009	9 TWh
Electric motors	July 2009	140 TWh
Circulators	July 2009	27 TWh
Domestic refrigeration	July 2009	6 TWh
Televisions	July 2009	43 TWh
Total		**341 TWh**

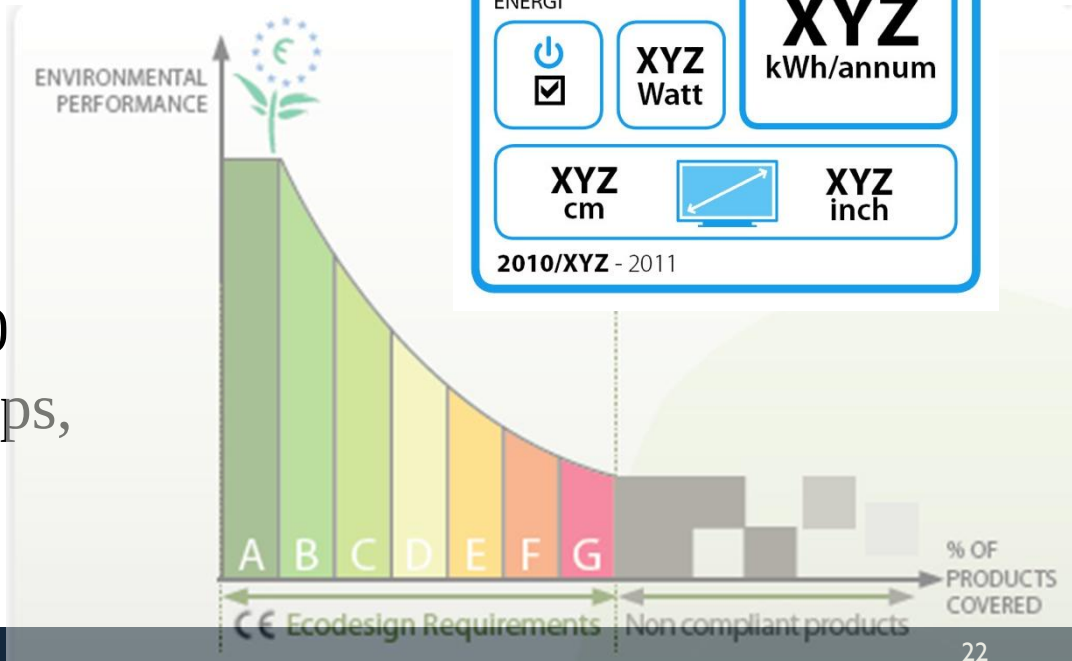
Energy savings equivalent to 12% reduction of EU's electricity consumption in 2007

Energy-labelling

Energy labelling has been efficient in order to change consumer preferences:
If you buy a more efficient product, you save money for the rest of the product life time.

Has been mandatory for ”white goods” and is May 2010 expanded to more product groups, e.g. TV





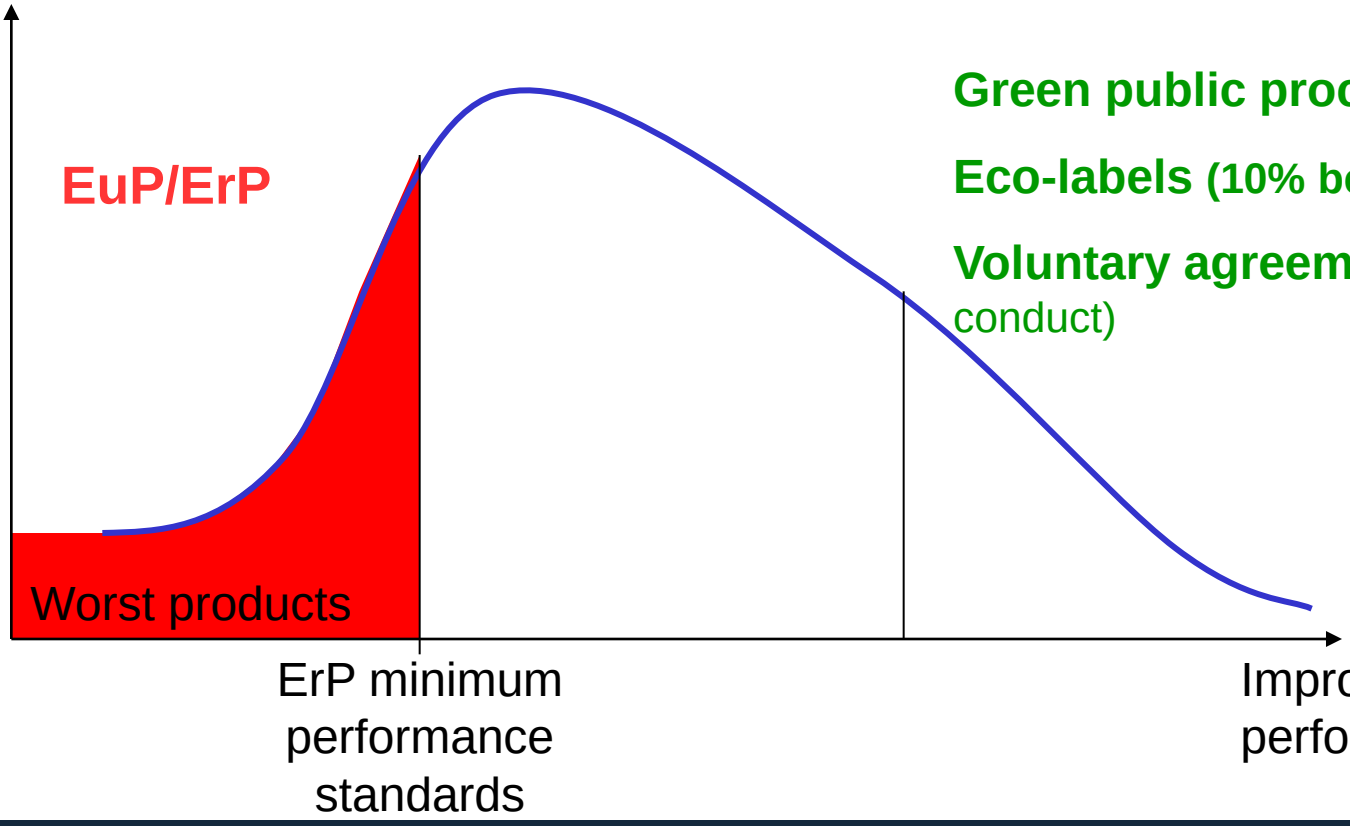
Combining policy instruments

Research and Development

Energy labelling (all products)

Taxes

Products on the market

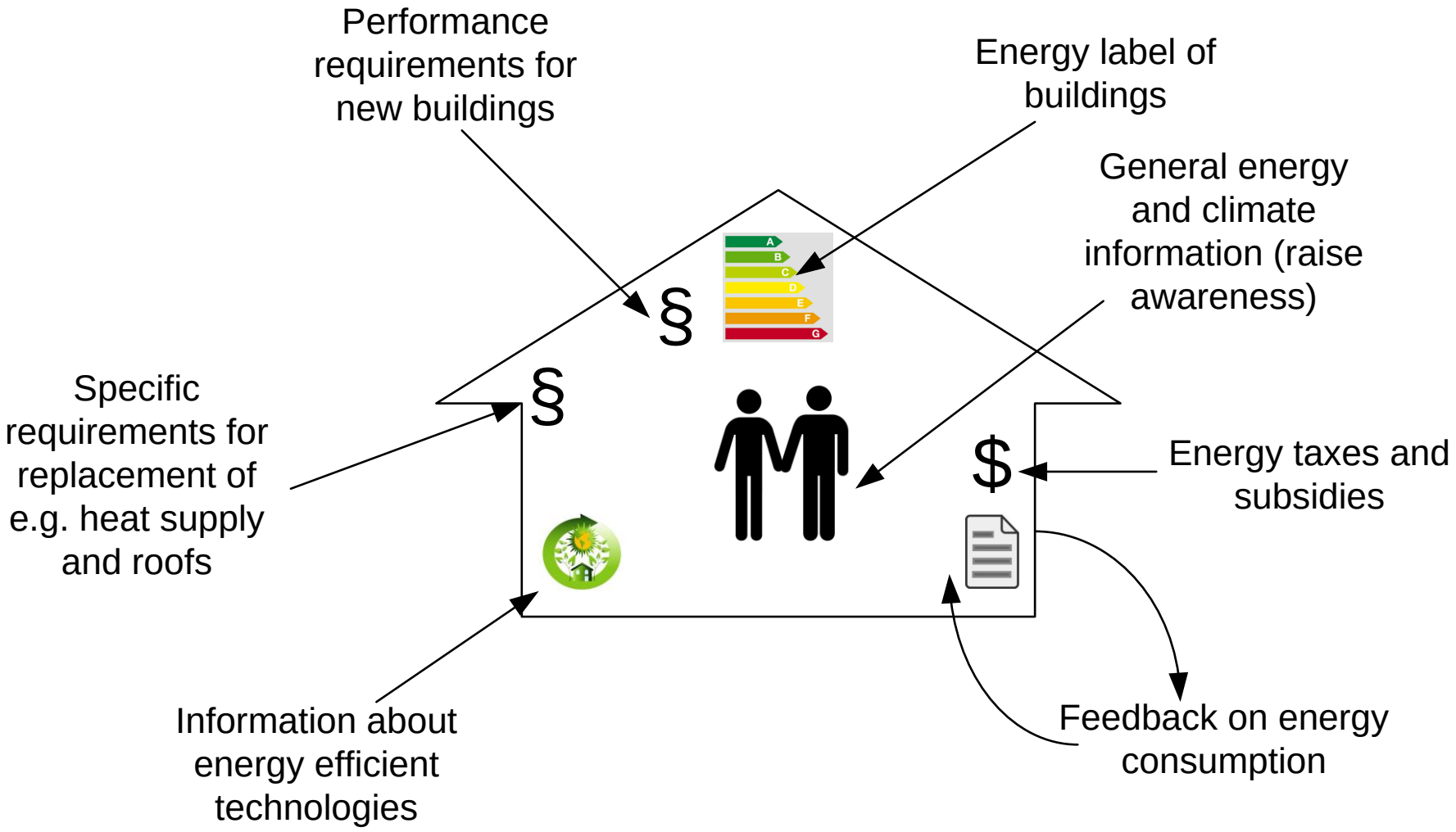


Green public procurement

Eco-labels (10% best)

Voluntary agreements (Code of conduct)

Policy mixes (combine $, § + info)



Benefits of Sustainable Energy (EE + RE)

1) Profit – Enterprises and Society

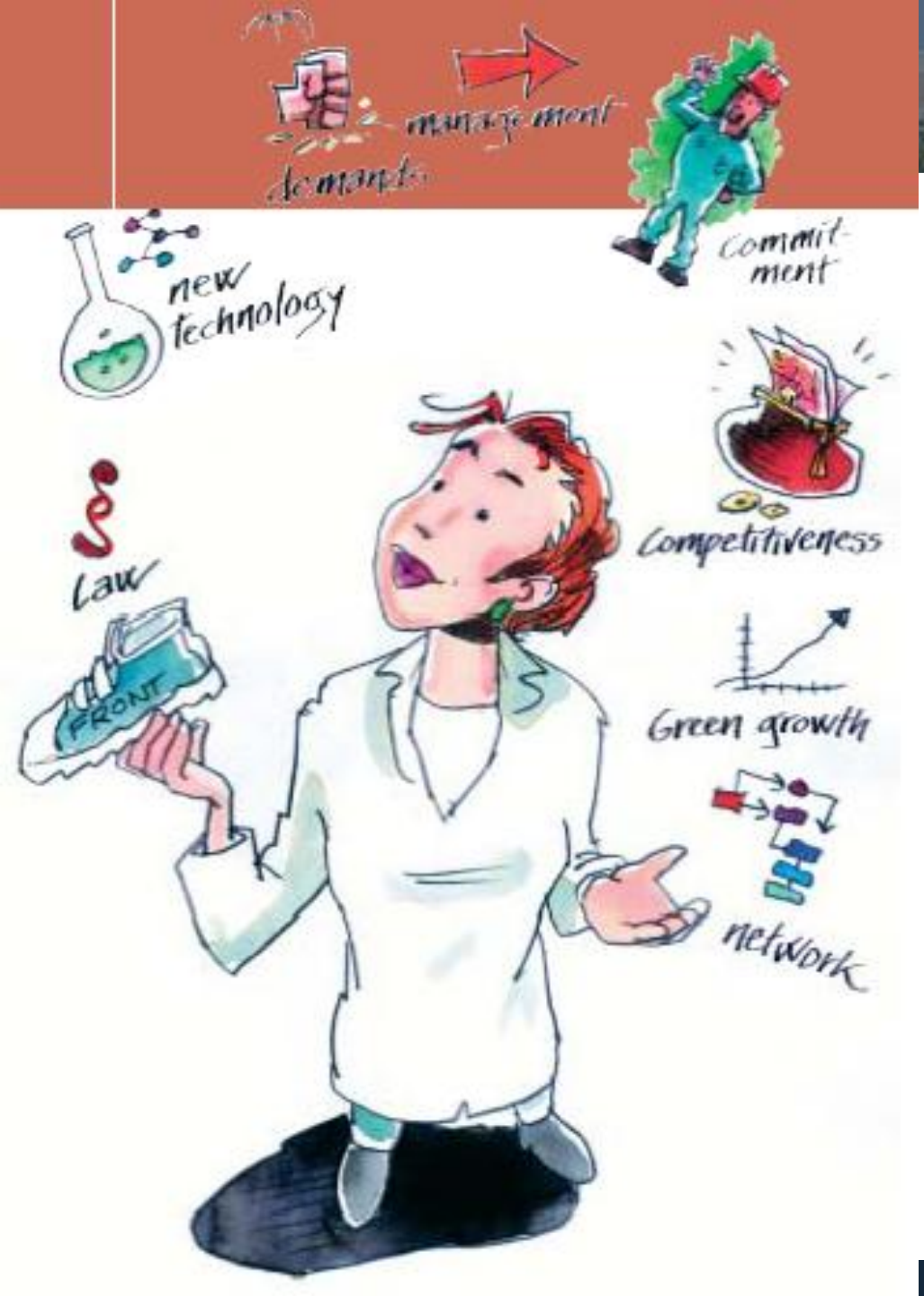
- Security of supply / independent of fossil fuels from unstable societies
- Competitive advantage for industry (from EE + RE technologies)
- Reduced externalities

2) Planet – Environment

- Climate mitigation – reducing the threat of climate change
- Reduction of greenhouse gas emissions
- Pollution prevention

3) People - Citizens

- Employment – creation of new jobs
- Health
- Higher investment but lower running costs



Thank you
for your attention

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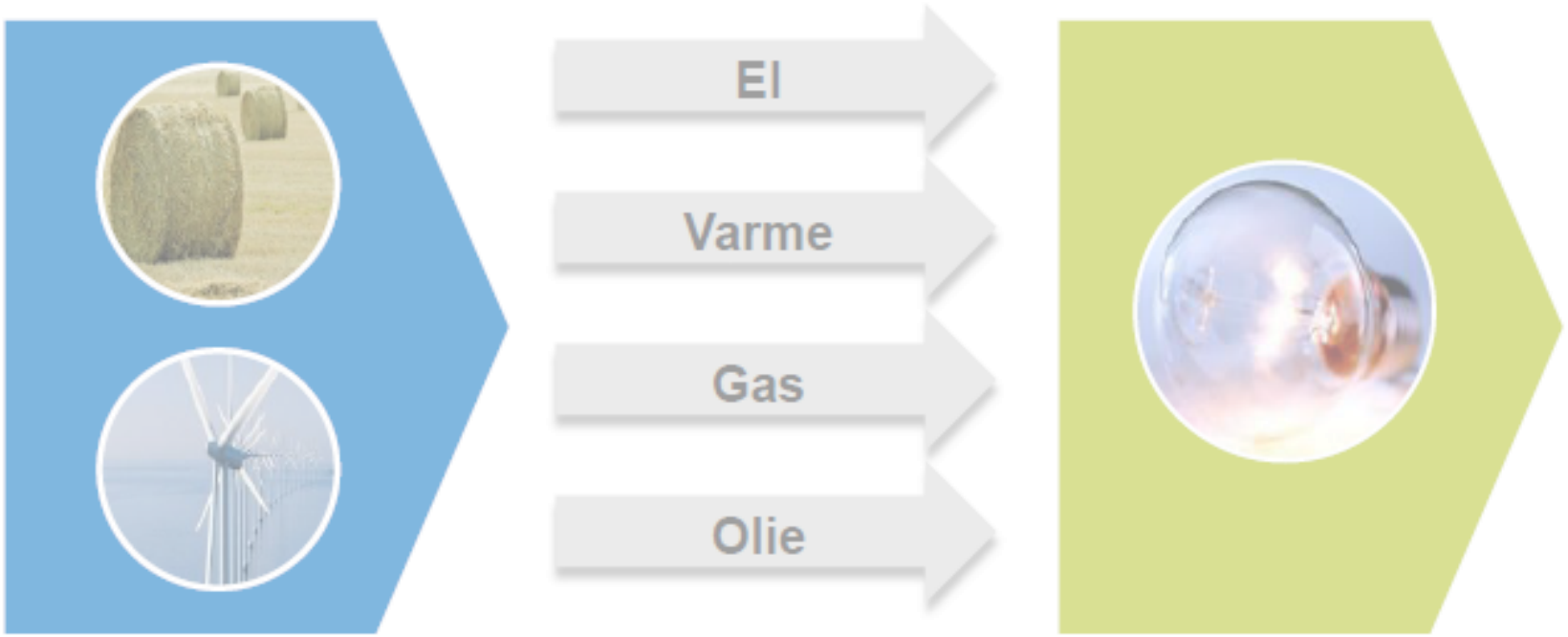
The Energy System – Industrial Society

Production

Distribution

Consumption



Energy System of the Internet Society

1) Demand side becomes production - prosumers

- Energy+ houses (passive houses)
- Electric vehicles (use and deliver electricity)
- Energy efficient products and technologies

2) Renewable energy sources

- Sun, wind, wave, tidal, biogas, biomass, etc. (several thousands)
- CHP – combined heat and power (several hundreds) on RE
- Waste incineration (to power and heat/cooling)

3) From Distribution to Smart Grids

- An ”Intelligent” System – adjust energy use to energy production
- Dynamic prices – depending on peak hours, etc.
- The to-way energy system of the “internet age”