

Distributed generation and the role of solar and wind power

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Painel Energia Solar e Eólica no contexto da geração distribuída

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Energy and climate Platform



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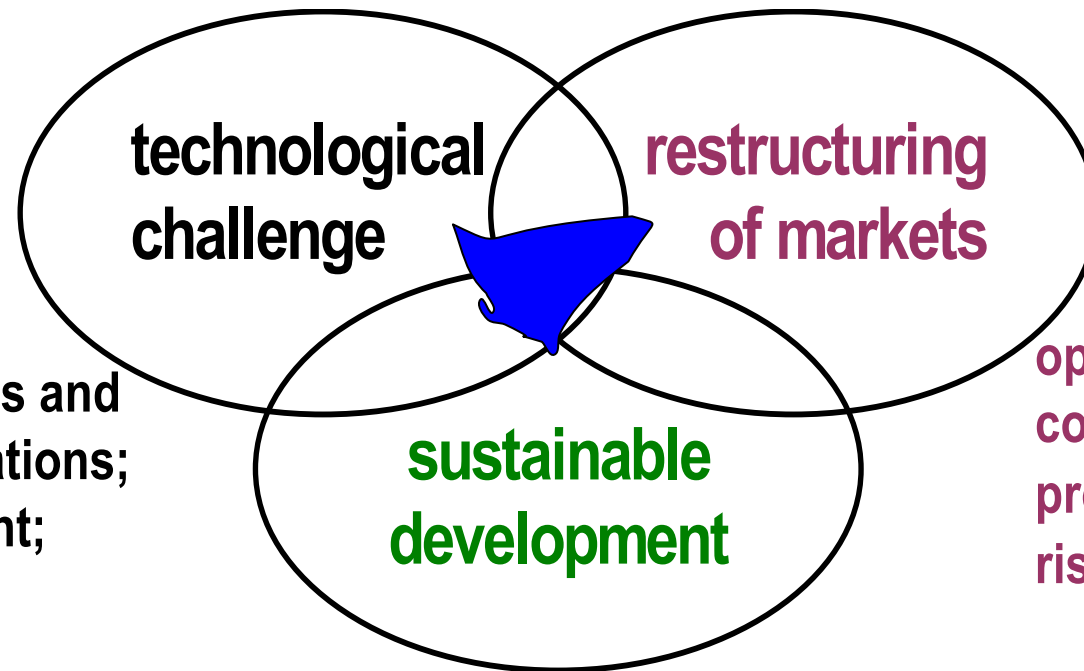


KTH's research, education and interaction with industry and society in the field of energy shall contribute with solutions towards sustainable energy systems to meet climate and socio-economic challenges in the world.

Energy and Climate Studies

Searching for synergies

- resource management
- structural changes in exchange flows between natural and human systems
- infrastructure systems



conversion processes and performance; applications; resource management; improved efficiency

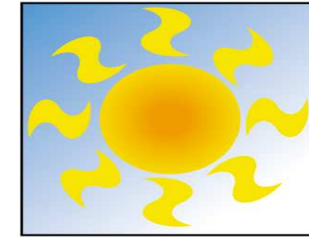
optimize applications in competitive markets; project structure and finance; risk management; institutions

biodiversity; socio-economic development in rural areas; economic robustness of local and global systems; climate change mitigation and adaptation

How to develop and build sustainable energy systems globally?



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We search systems solutions that:

- satisfy criteria of efficiency, reliability and sustainability
- are in line with markets and technology options
- respond to climate change and development agendas
- explore international co-operation, fully incorporating developing countries

Distributed generation and the role of solar and wind power



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- trends in Europe
- the changing landscape of the energy sector
- opportunities and challenges in distributed generation

Strategic issues influencing the global energy agenda



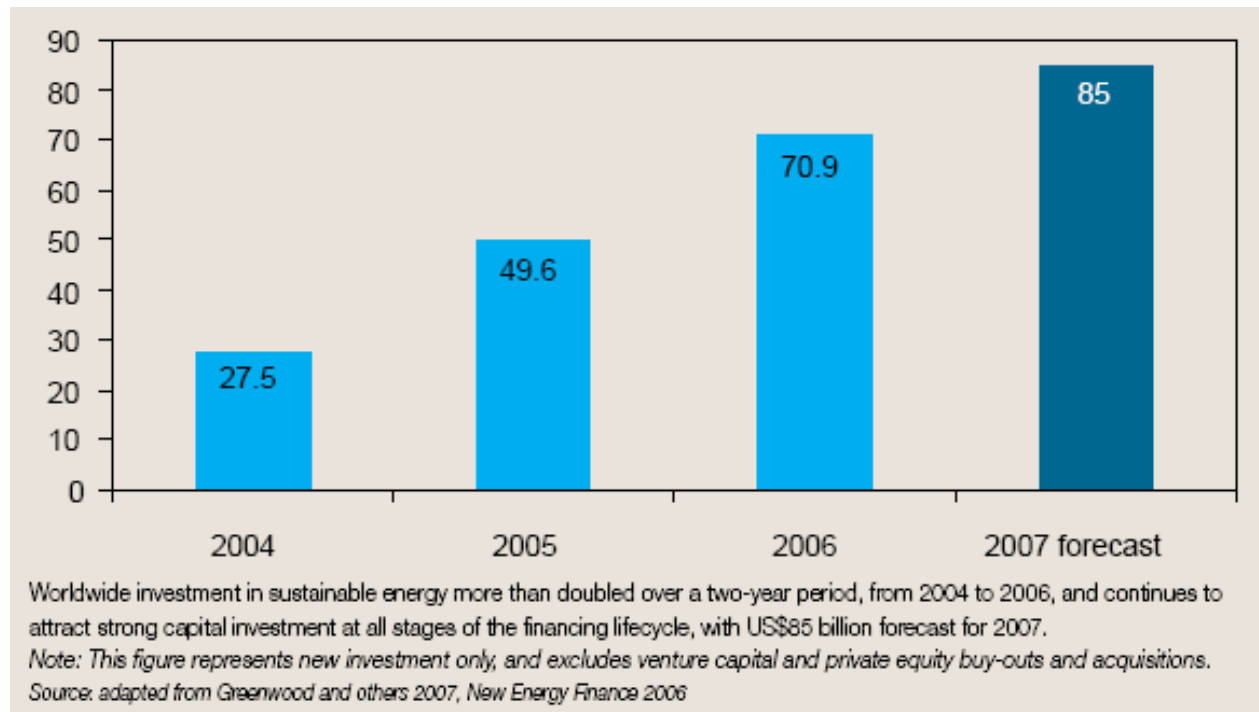
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- security of energy supply
- climate change
- market competition
- investment needs in energy-supply infrastructure
- accessibility of modern energy in developing countries

Global investment in sustainable energy, 2004-2007, US\$



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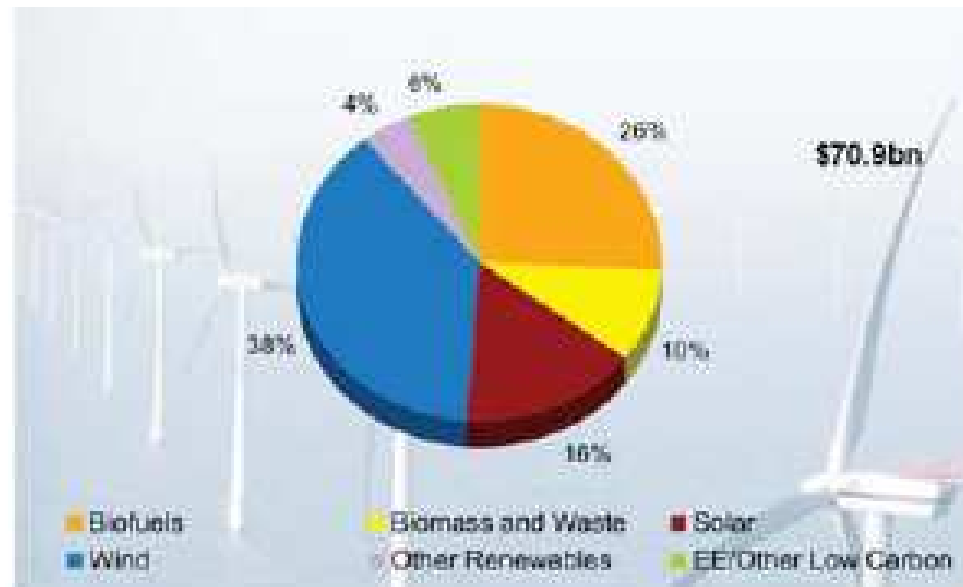
Source: Feature focus, UNEP.

OBS: EU 15 declared subsidies amounted to EUR 29,2 billion in 2001

Global investment in sustainable energy technology 2006, by energy source



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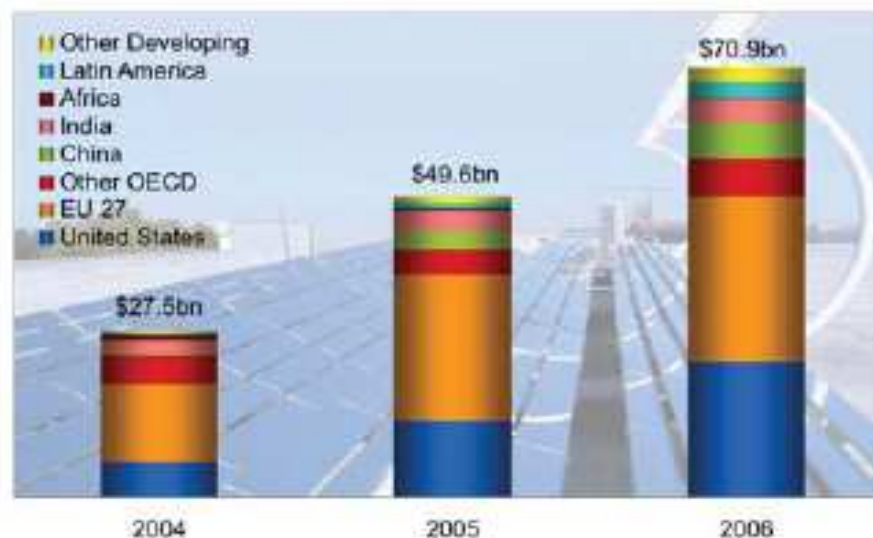
Note: Grossed-up values based on disclosed deals. The figures represent new investment only, and do not include PE buy-outs, acquisitions of projects, nor investor exits made through Public Market /OTC offerings.

Source: SEFI, New Energy Finance

Global investment in sustainable energy technology by region, 2004-2006



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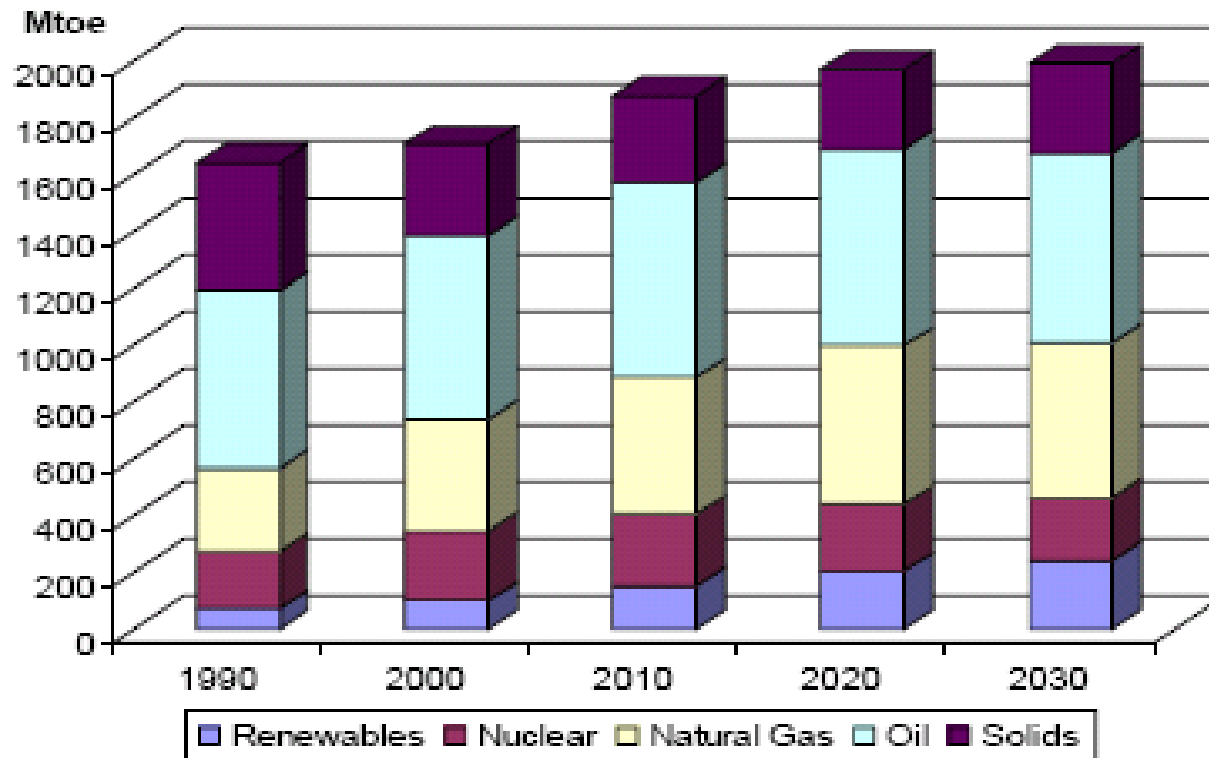
Note: Grossed-up values based on disclosed deals. The figures represent new investment only, and do not include PE buy-outs, acquisitions of projects, nor investor exits made through Public Market /OTC offerings.

Source: SEFI, *New Energy Finance*

Total supply of primary energy EU-27 1990-2030



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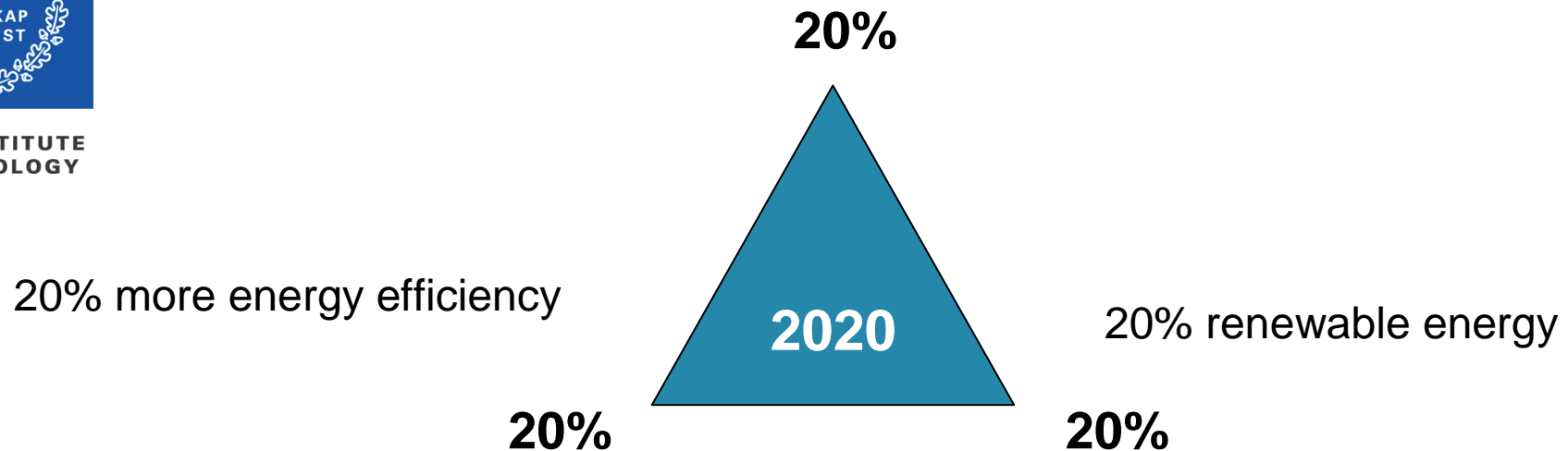
Ambitious goals in the EU define new market conditions



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At least 20% less ghg emissions
30% if a global agreement is reached

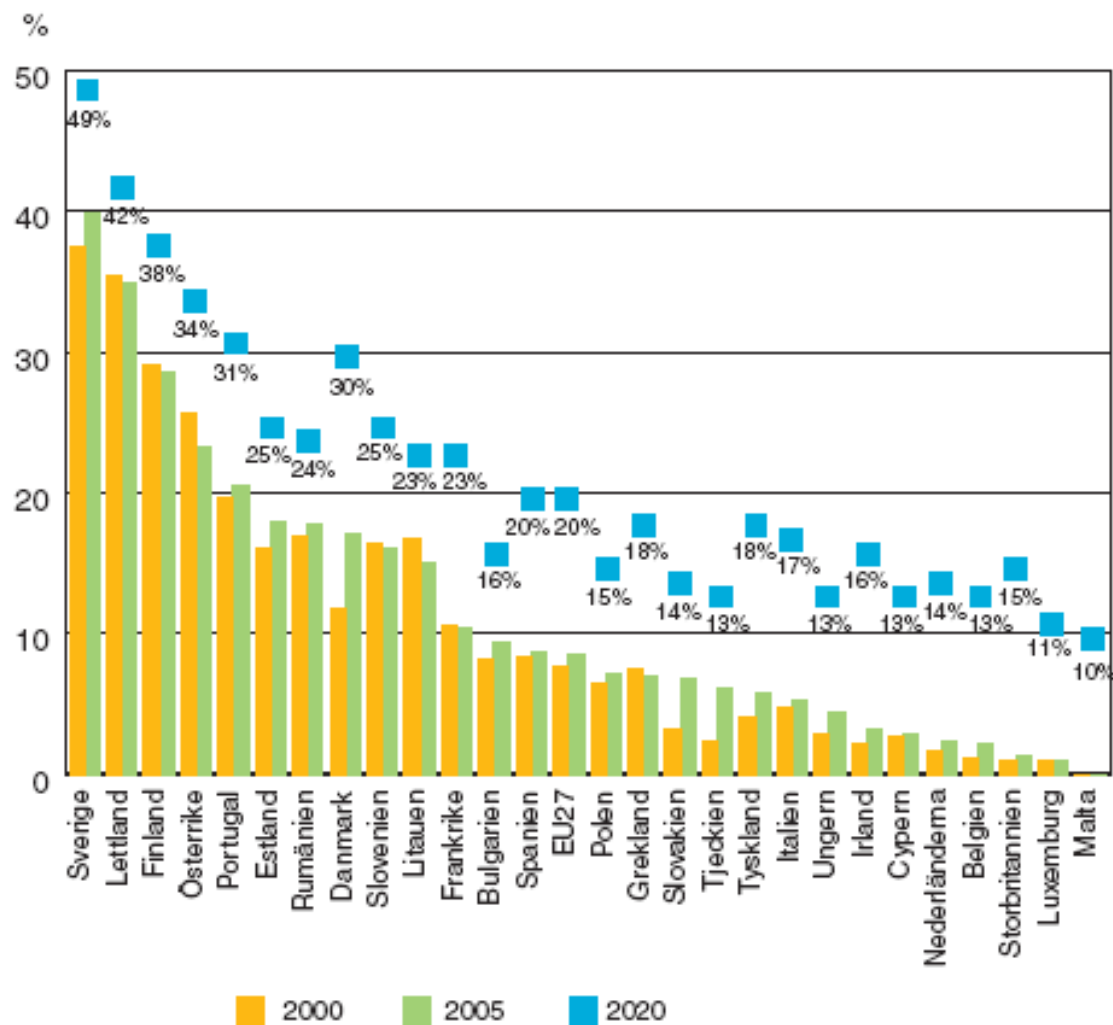
20 20 20 - 2020



Renewables for EU 27, 2000 and 2005, and target for 2020 (commission's suggestion)



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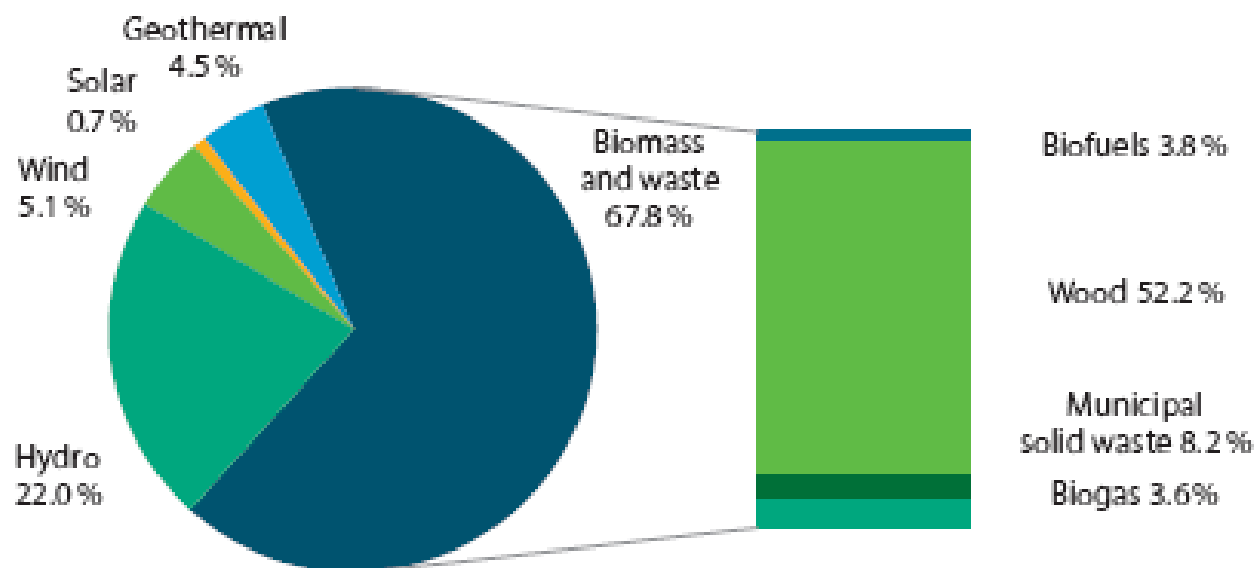


Source: Eurostat, Swedish Energy Agency

Primary energy from RES, EU-27, 2005



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Source: Eurostat

EU-27 renewable final energy consumption 2000-2005 (Mtoe*)

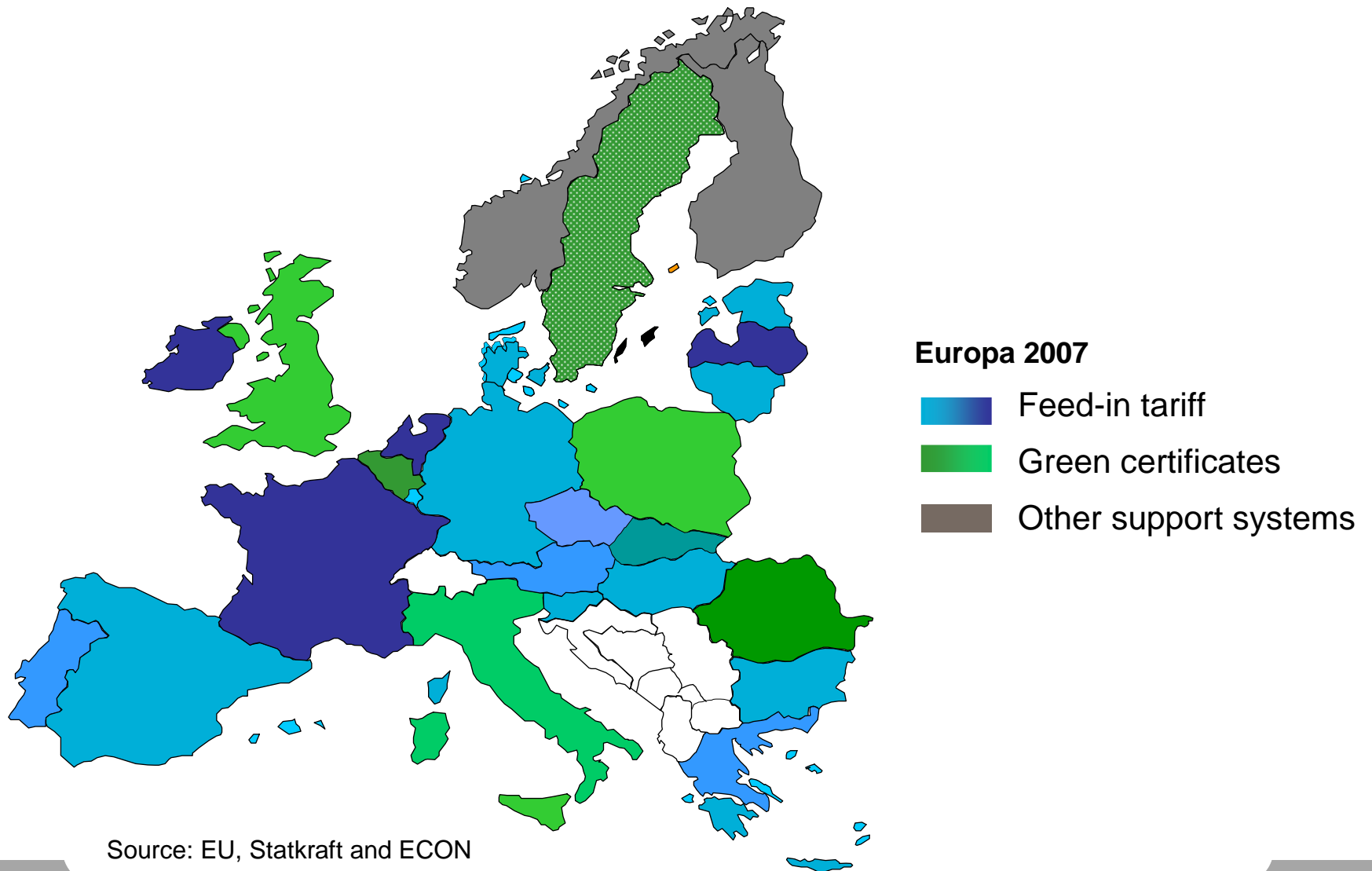
2000	2003	2004	2005	SHARE IN CONSUMPTION (2005)
87.0	93.8	99.4	104.2	8.5 %

Source: Eurostat
*Million tons of oil equivalent

Different support systems are applied in Europe today



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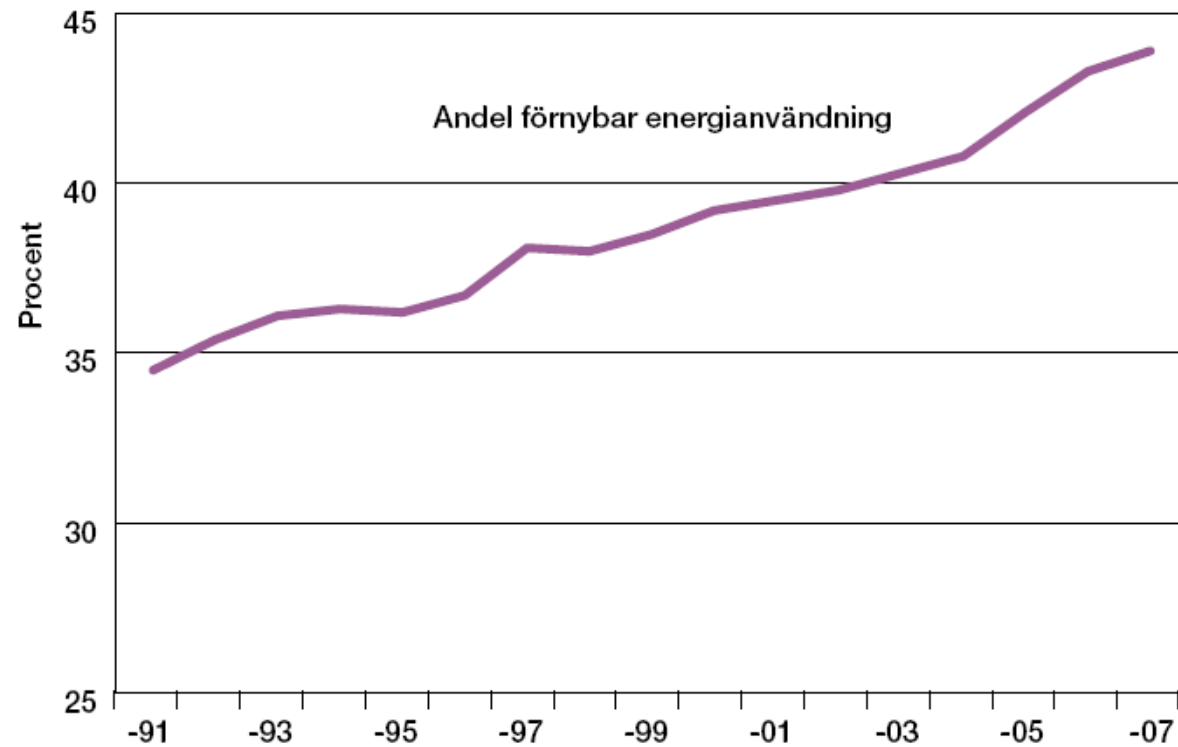


Source: EU, Statkraft and ECON

Share of renewables in Sweden



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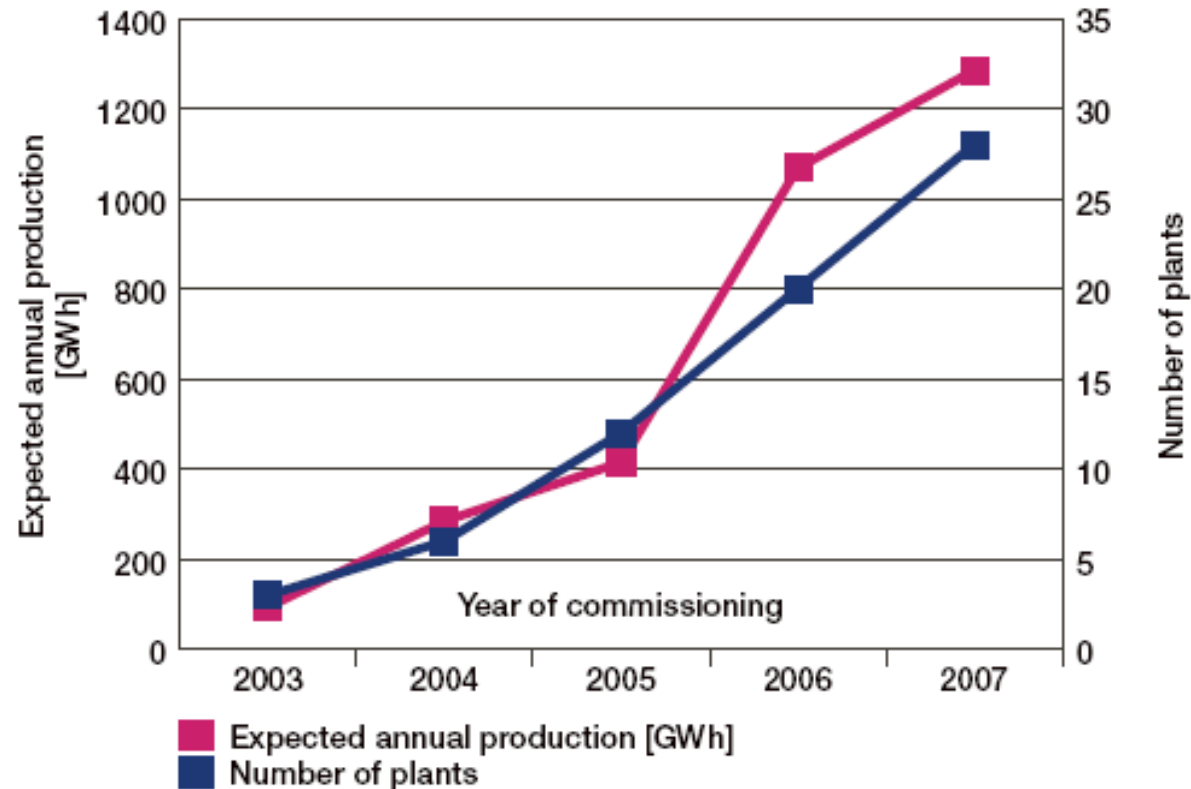


Source: Swedish Energy Agency

Number of new plants in the electricity certificate system and expected annual production



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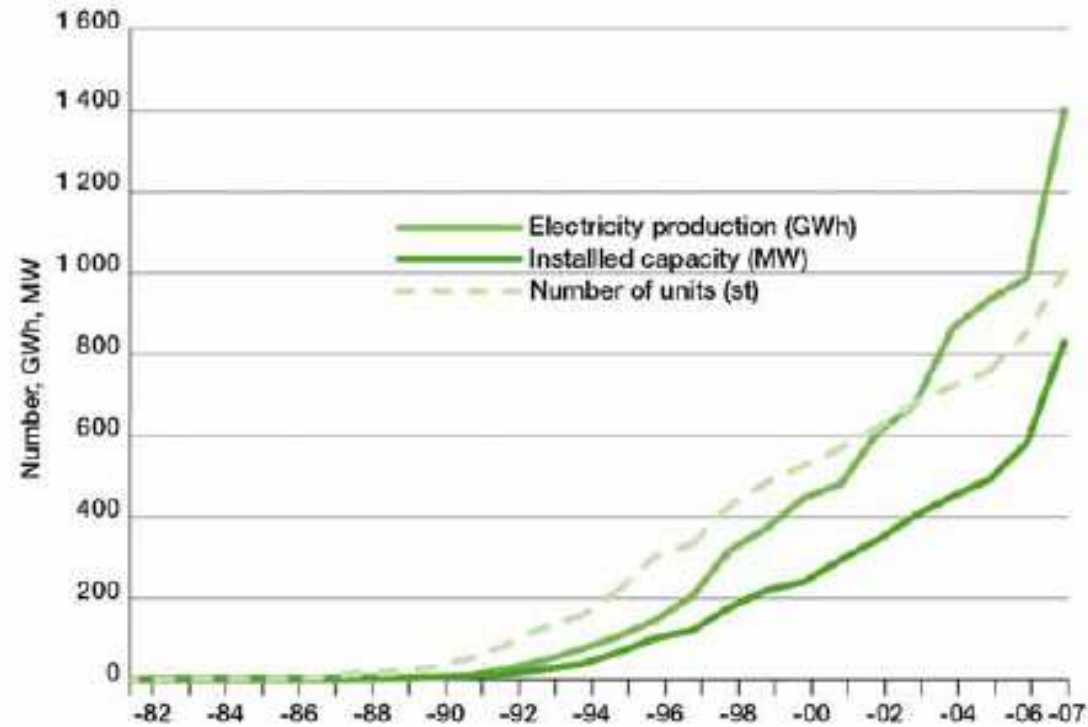


Source: Svenska Kraftnät's Cesar accounting system; Swedish Energy Agency.

Wind power production 1982-2007



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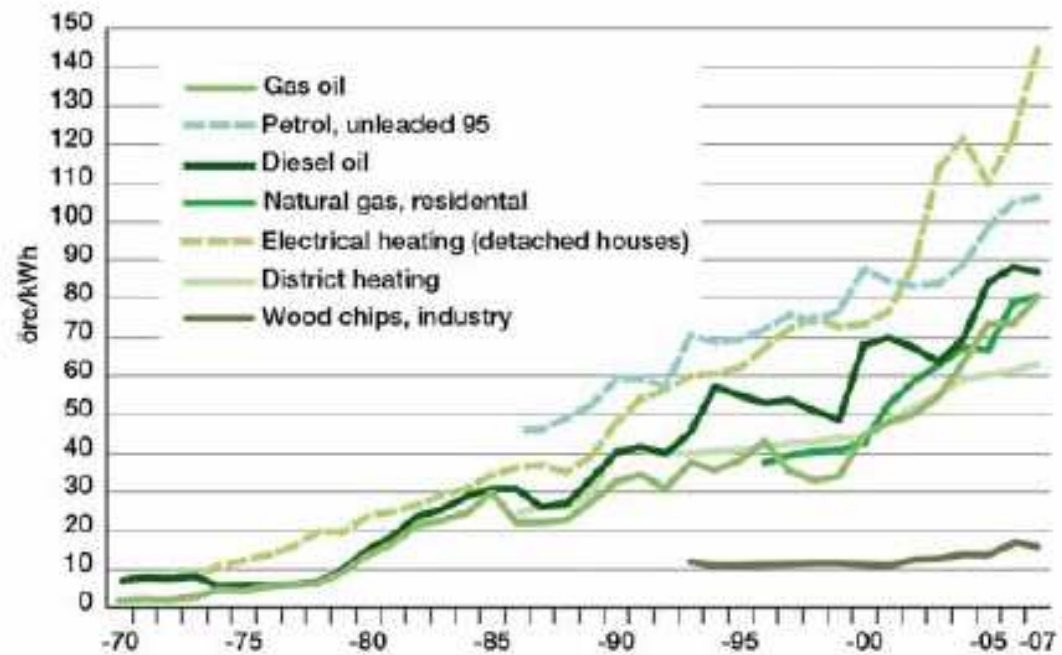
SOURCE: SWEDISH ASSOCIATION OF ELECTRICAL UTILITIES AND THE SWEDISH ENERGY AGENCY'S ANNUAL REPORT ON THE ELECTRICITY CERTIFICATE SYSTEM

Increase of 45% in 2006: from 0.98 to 1.43 TWh

Development of energy prices Sweden 1980-2007



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SOURCE: SWEDISH PETROLEUM INSTITUTE, STATISTICS SWEDEN, SWEDISH ENERGY AGENCY AND EUROSTAT

* Prices include taxes

Real price of electricity (2007 price level) 1980-2007



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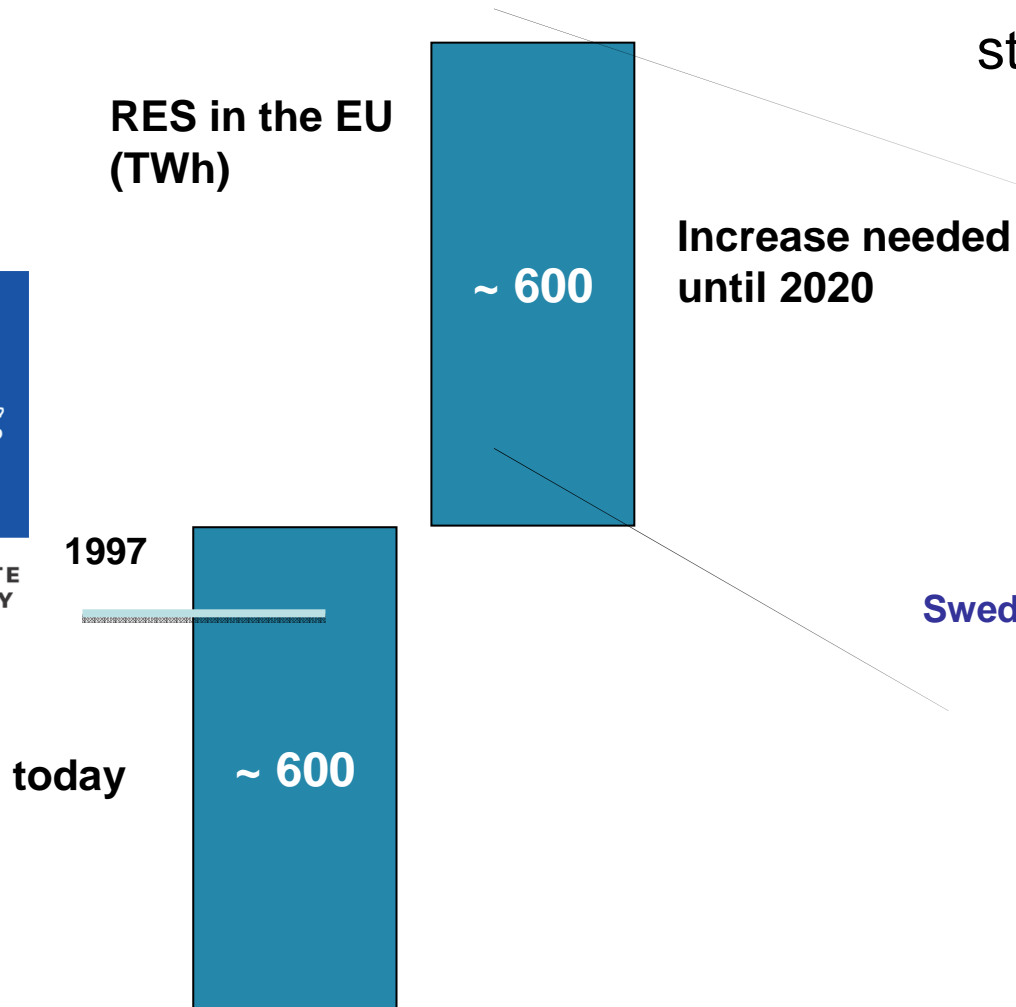
SOURCE: STATISTICS SWEDEN, BANK OF SWEDEN AND NORDPOOL

NOTE: THE PRICE OF ELECTRICITY IS THAT FOR DOMESTIC AND INDUSTRIAL USERS, AND IS WEIGHTED IN PROPORTION TO THE RESPECTIVE SECTORS' PROPORTIONS.

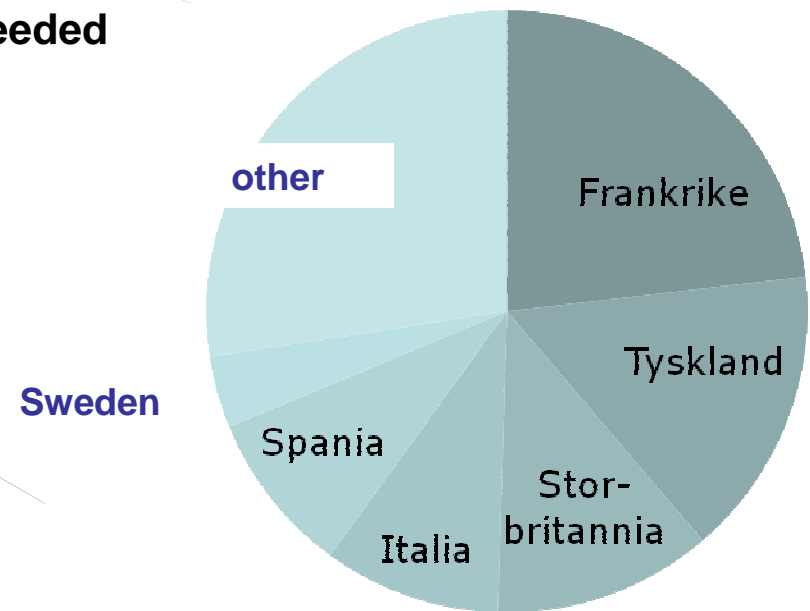
Large investments are needed



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strong leadership of a few countries



Geographic distribution of new generation with renewables (TWh)

Source: OPTRES, EU Commission, Statkraft, ECON

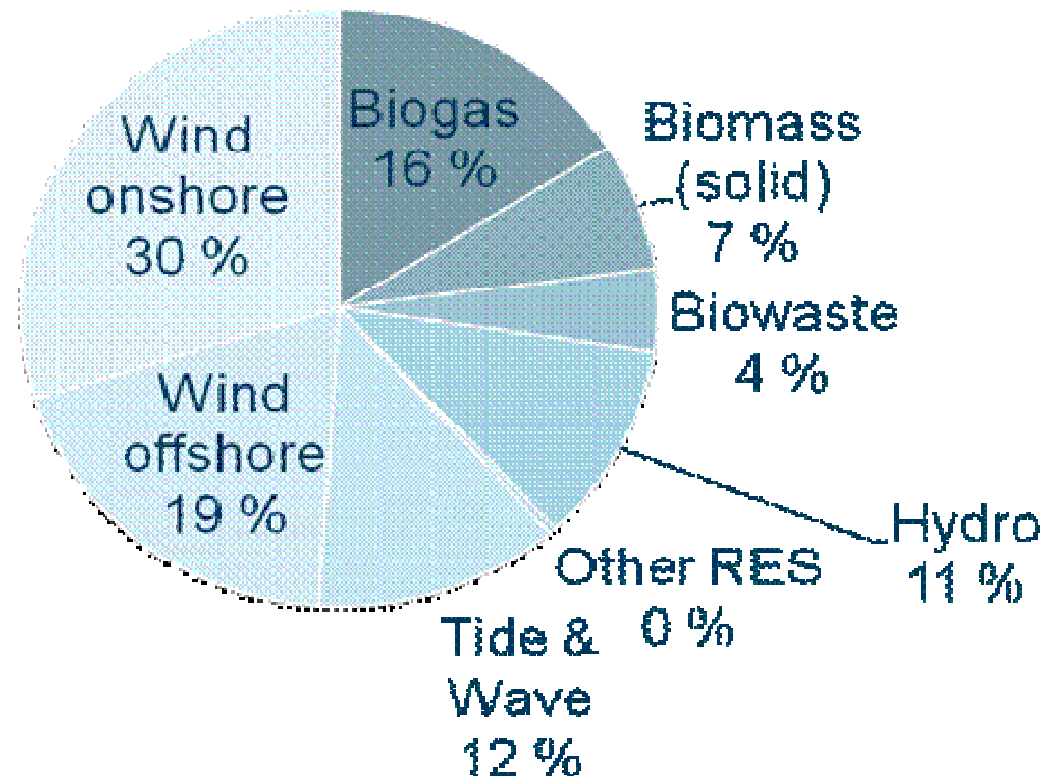
...in various technologies

600 TWh in new generation until 2020



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- **The technical potential in the EU is large but financial support is necessary**
- **Subsidies of the order of € 25-35 billion per year are needed in the coming 12 years**



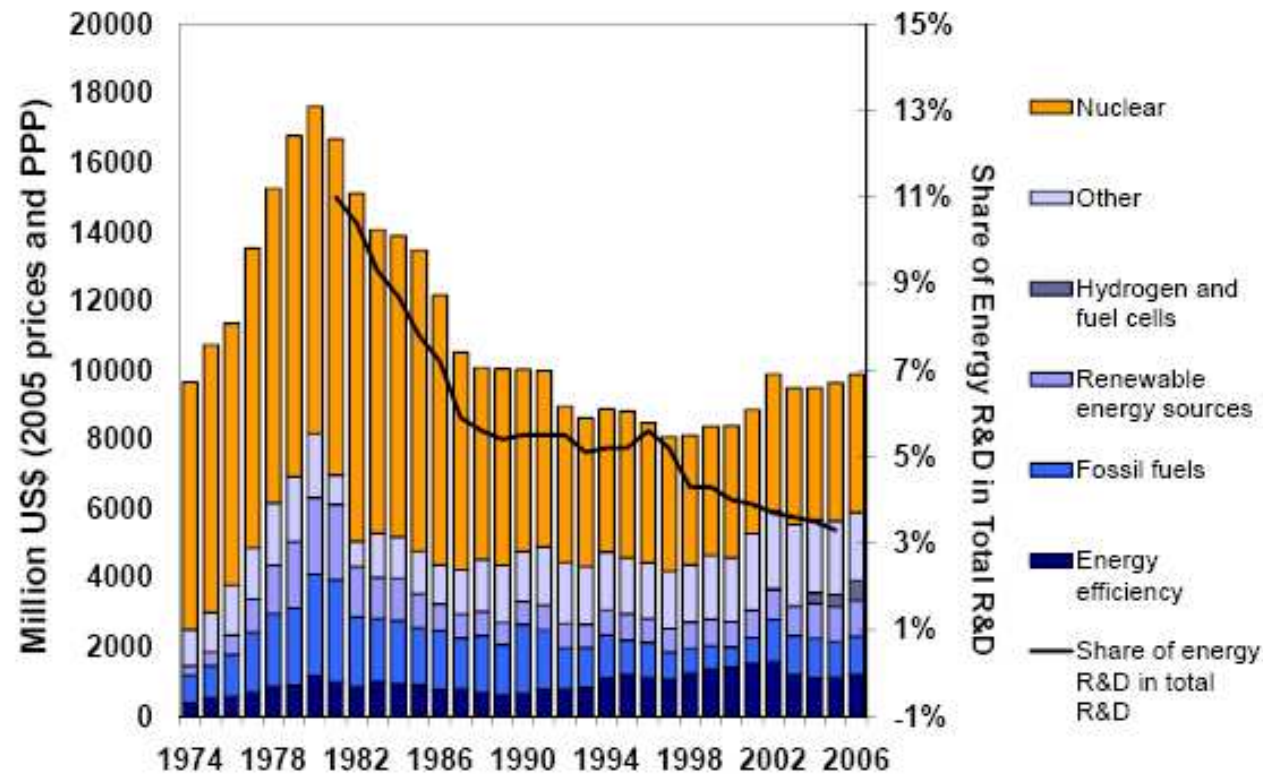
Source: OPTRES, Statkraft, Econ

Public sector energy R&D

IEA countries from 1974 to 2006



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Source: IEA 2008, in support to G8 plan of action

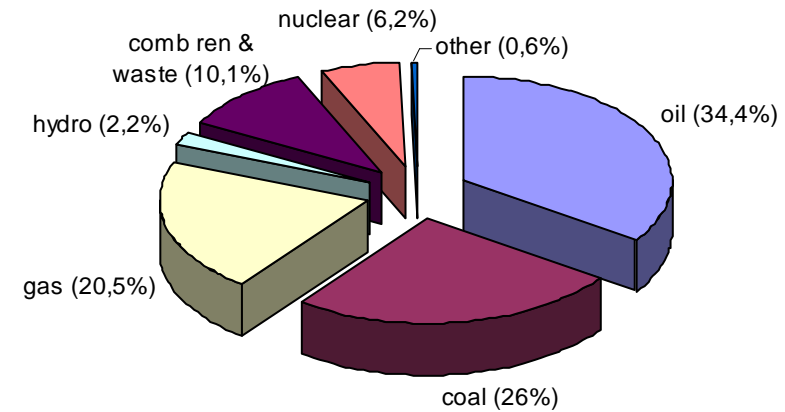
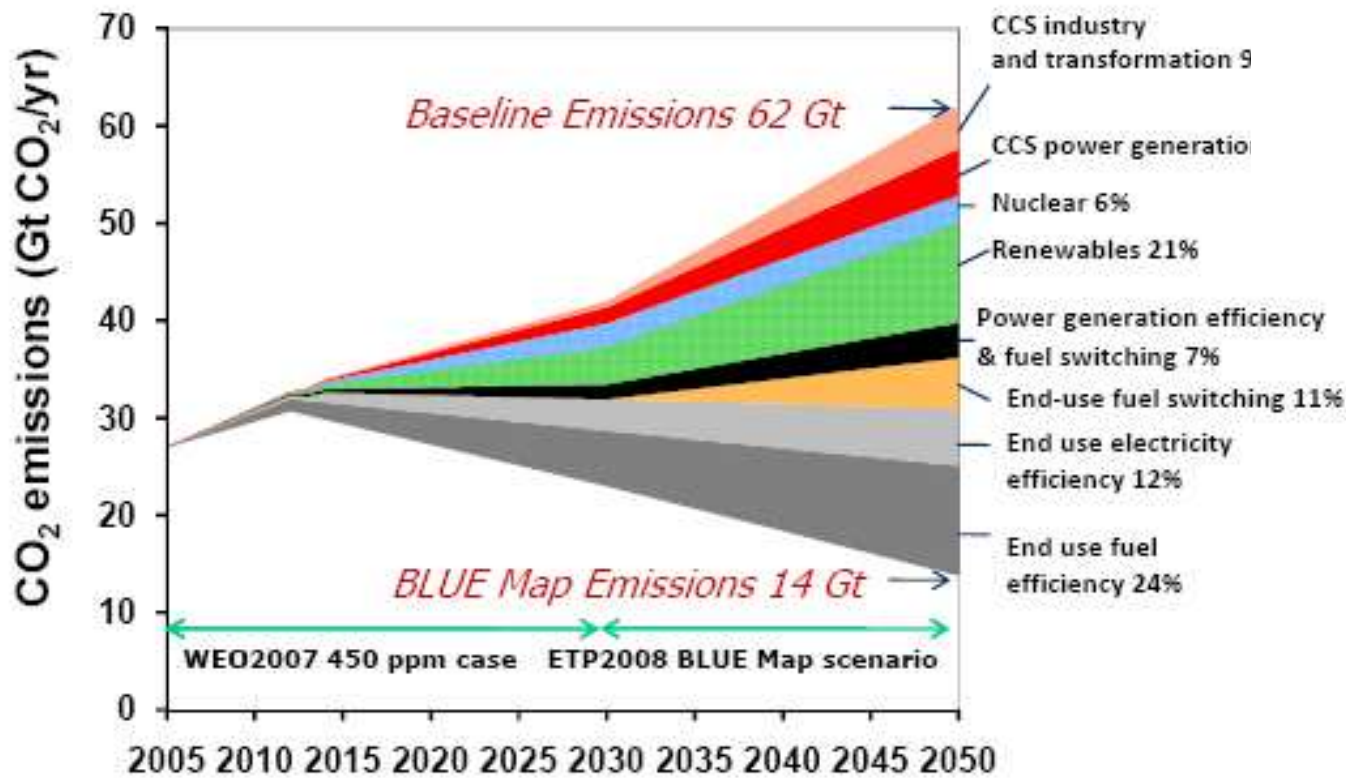
Thus how is progress in EU renewables?



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- Progress in national targets differ strongly
- Not all countries have national measures to complement EU
- Biomass is lagging behind
- Success of wind not outweighing slow growth of biomass elec
- Solar following same pattern of wind (12 years behind)

Cutting energy related CO₂ emissions



Source: IEA 2008, in support to G8 plan of action

Key pillars in sustainable energy systems



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- energy conservation
- sustainable production of energy services
- efficient distribution and use of energy services

Decentralized systems support the use of renewables and help achieve better total efficiency of energy systems

Changing landscape in the energy sector



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- from centralized to decentralized generation/fuel production
- from segmentation of markets to synergy in generation and uses
- from transmission and distribution grids to smart grids
- from utilities to multiple actors in competitive markets
- technological convergence promoted through research
- new cost structures and institutional requirements taking shape

Changing landscape in the energy sector



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Active planning these changes is important to capture the potential of renewable technologies

Renewed interest for distributed generation due to

- technological development
- constraints in development of transmission lines
- consumer demand for reliability
- market liberalization
- climate change concerns



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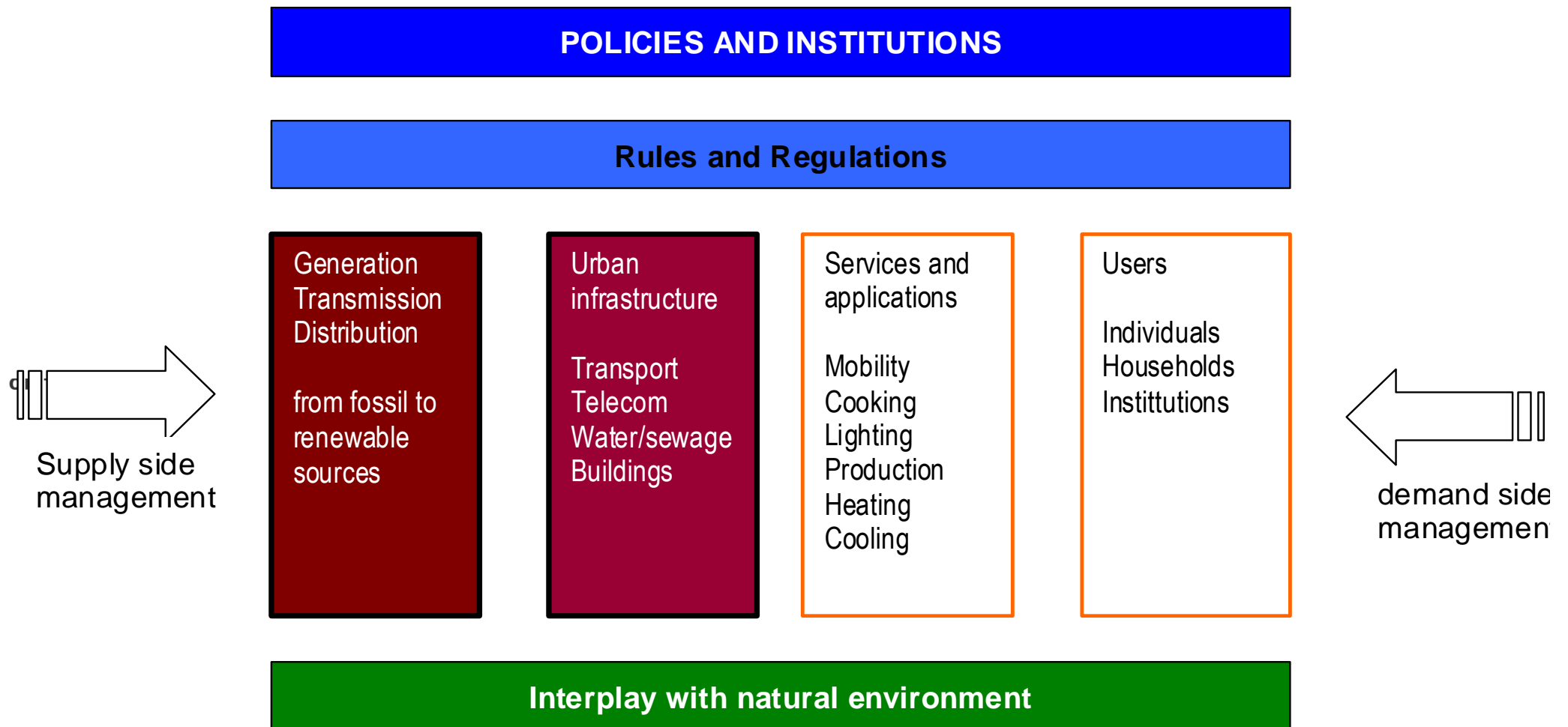
Decentralized systems in urban areas



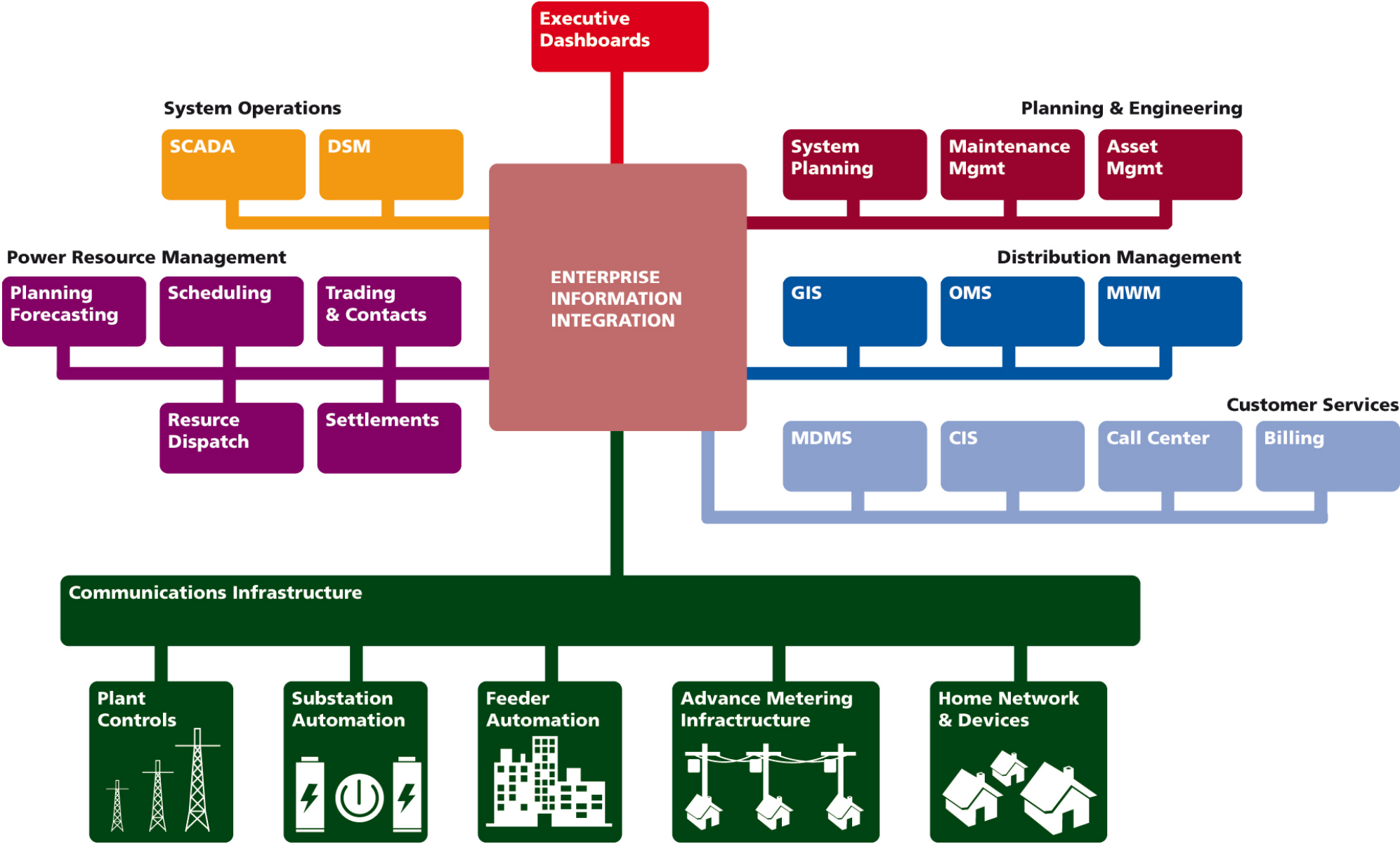
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- multiple systems - networks for electricity, heat, cooling and gas
- compatible systems for multiple uses
- interactive networks
- small-scale electricity generation connected with distribution
- gas networks - natural gas and biogas integration

Energy planning framework in the urban environment



Smart grid key concepts and elements



European Electricity Networks of the Future

key challenges for smart-grids in Europe



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- Strengthening the grid and enhancing its intelligence
- Moving offshore and integrating intermittent generation
- Developing decentralized architectures
- Communications infrastructure and technologies
- Active demand side and broad participation in the grid
- Capturing the benefits of decentralized generation and storage
- Preparing for electric vehicles
- Creating new regulatory and institutional frameworks
- Defining new products and pricing models

How shall policy and research redirect the development of renewables?



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- orchestrate establishment of new networks
- frame technology dissemination in the context of total solutions
- reduce transaction costs for decentralized systems
- institutional and regulation issues need to be improved
- devise new business models (i.e. from supply to service focus)



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Obrigada pela atenção!