Cost minimising Governance systems for the implementation of a high proportion of Renewable Energy- the Danish case

Frede Hvelplund
Aalborg Universitet
Department of Development and Planning

1. Background:
Economic paradigm and cost efficiency

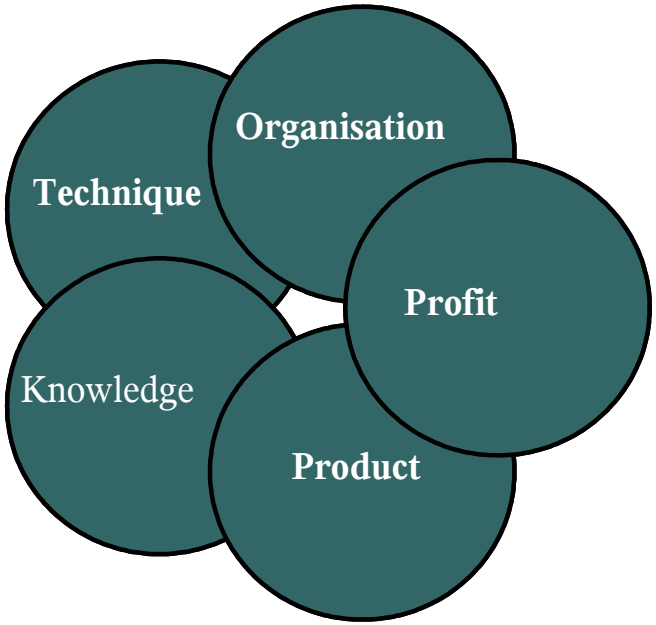
A historical transition

From fossil fuels with renewable energy to renewable energy with fossil fuels.

This requires a new infrastructure, as we are going from stored energy to fluctuating energy.

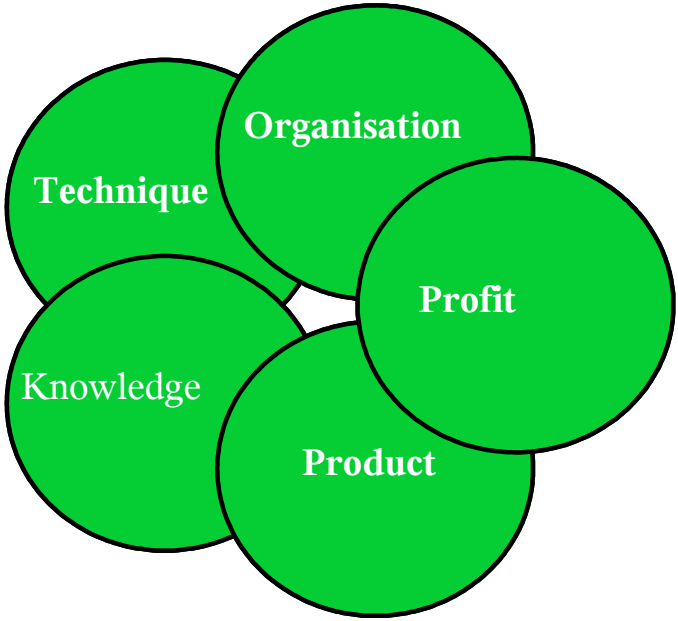
From fossil fuel to Renewable Energy is a fundamental change

Fossil fuel/uranium



Fundamental technological change

Renewable Energy Conservation



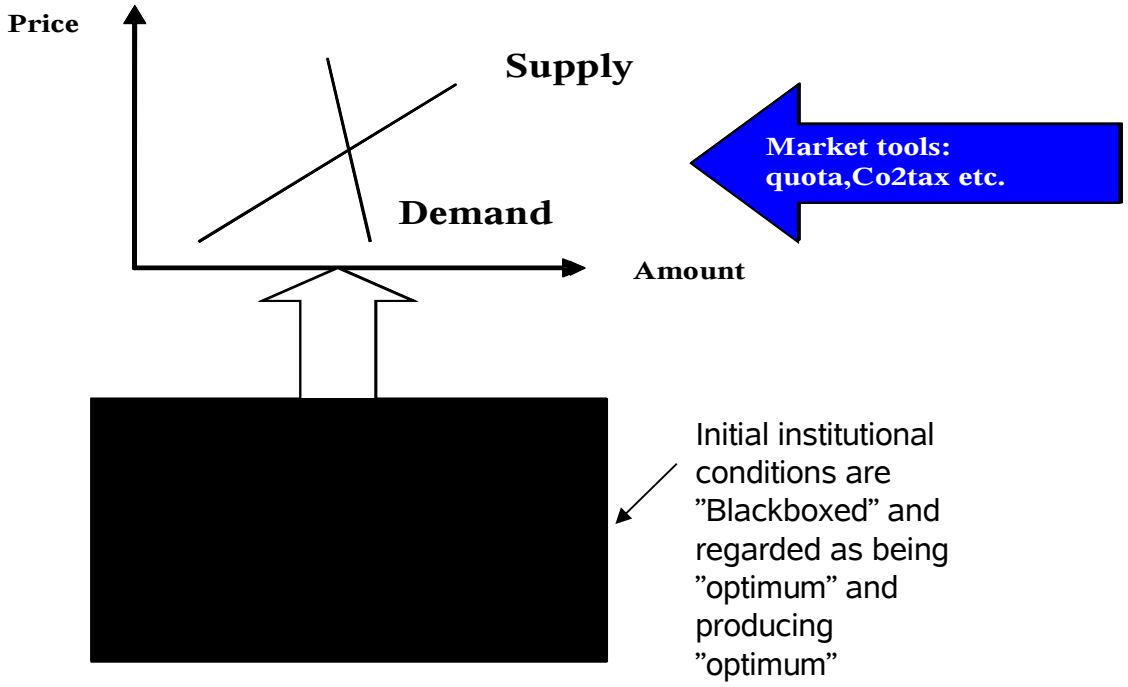
Institutional Economy and cost efficiency

1. Economy is an institutional construction.

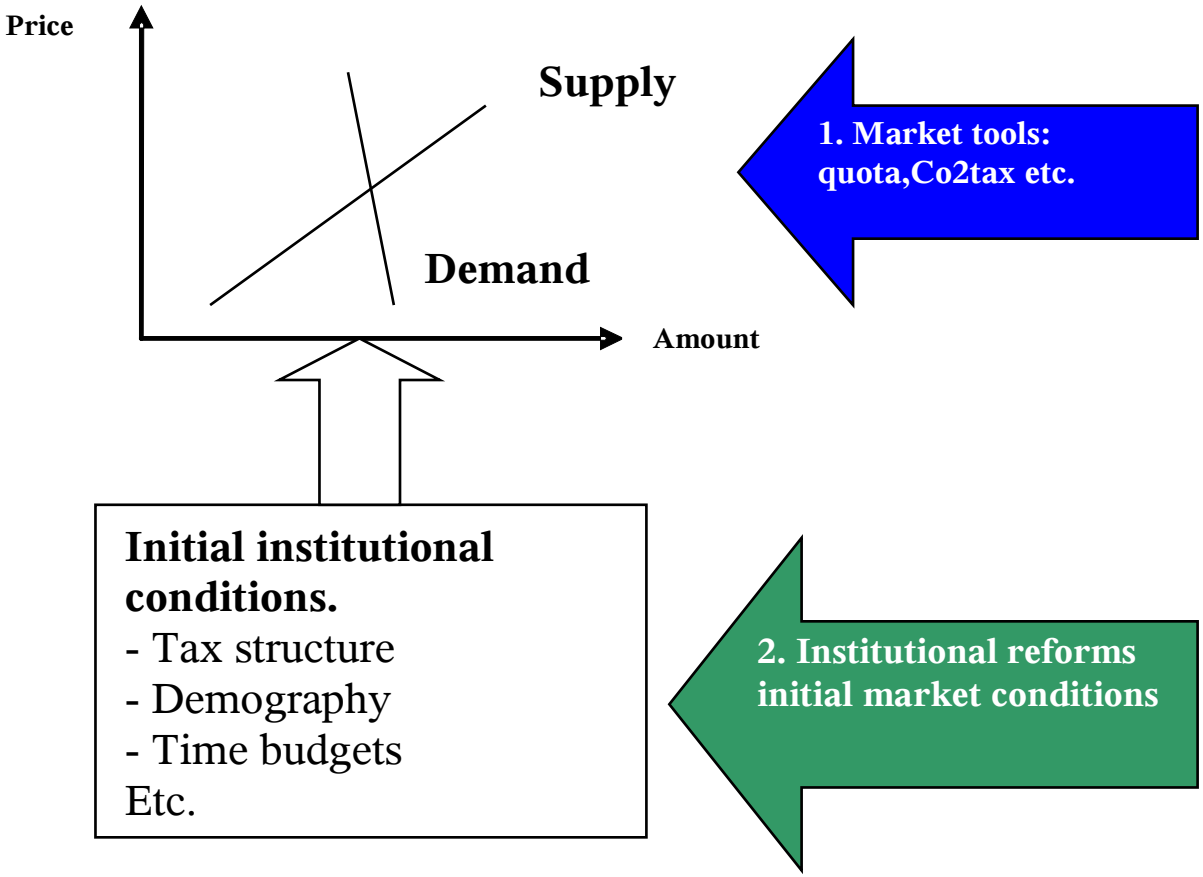
2. We are not in optimum

3. In a situation of change ”cost efficiency” is achieved by changing the ”whole system” incl. the infrastructure.

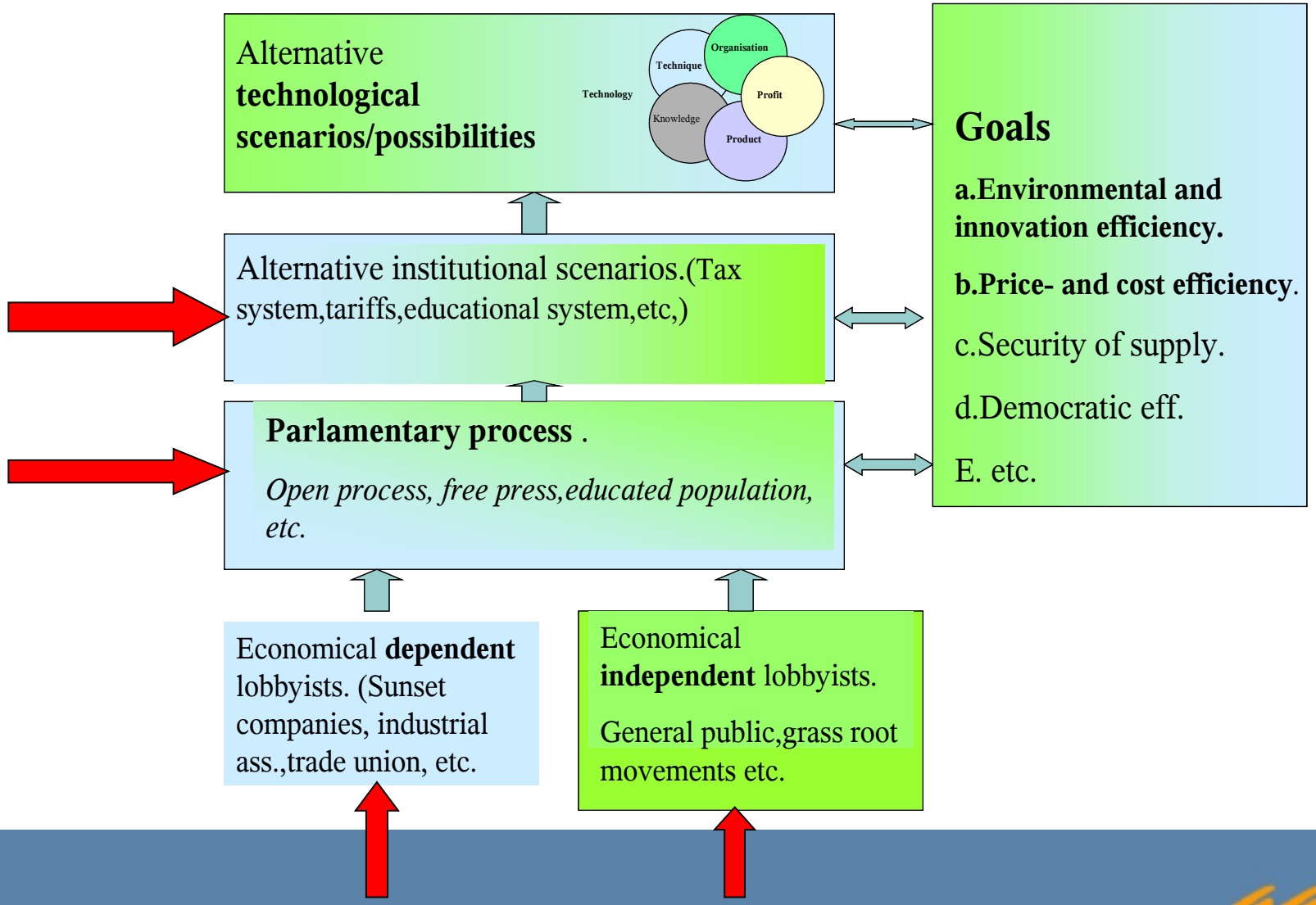
Neoclassical approach- start position in optimum-only market tools



Institutional economy approach (market and institutional policy)



Institutional Economy and Governance

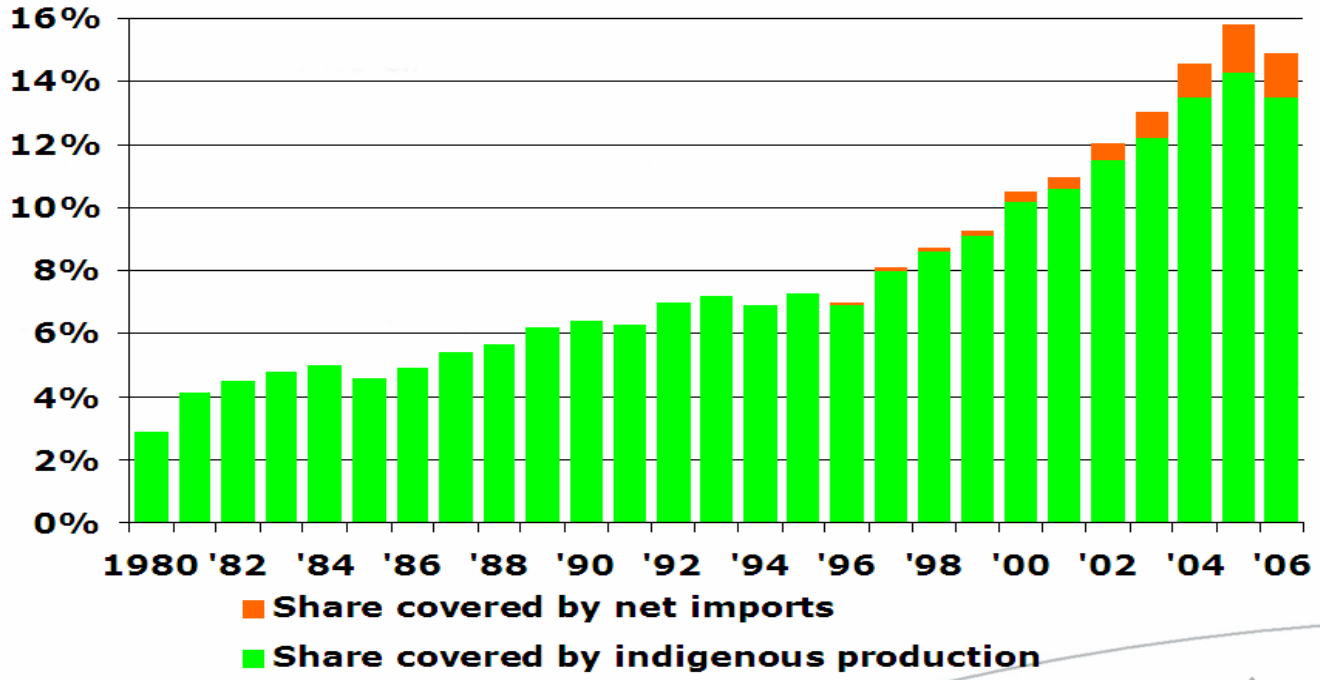


The two areas of Renewable energy Governance system

- A need for a system that furthers the introduction of Renewable Energy technologies (FIT tariffs for instance)
- A need for a governance system that furthers infrastructural system that can incorporate large amounts of fluctuating energy sources.

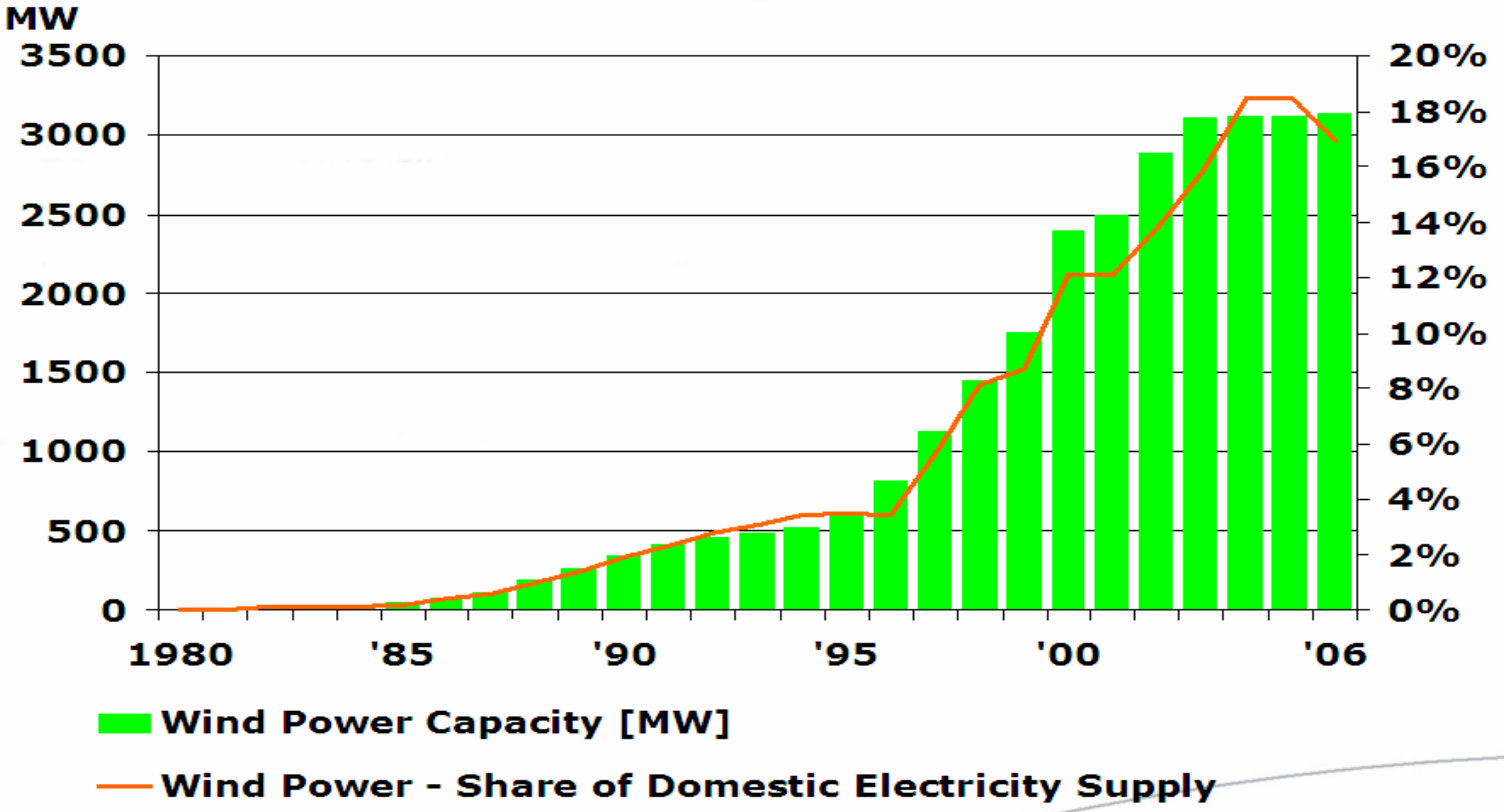
2. Present Danish Energy Situation

Production and Consumption of Renewable Energy – Share of Gross Energy Consumption



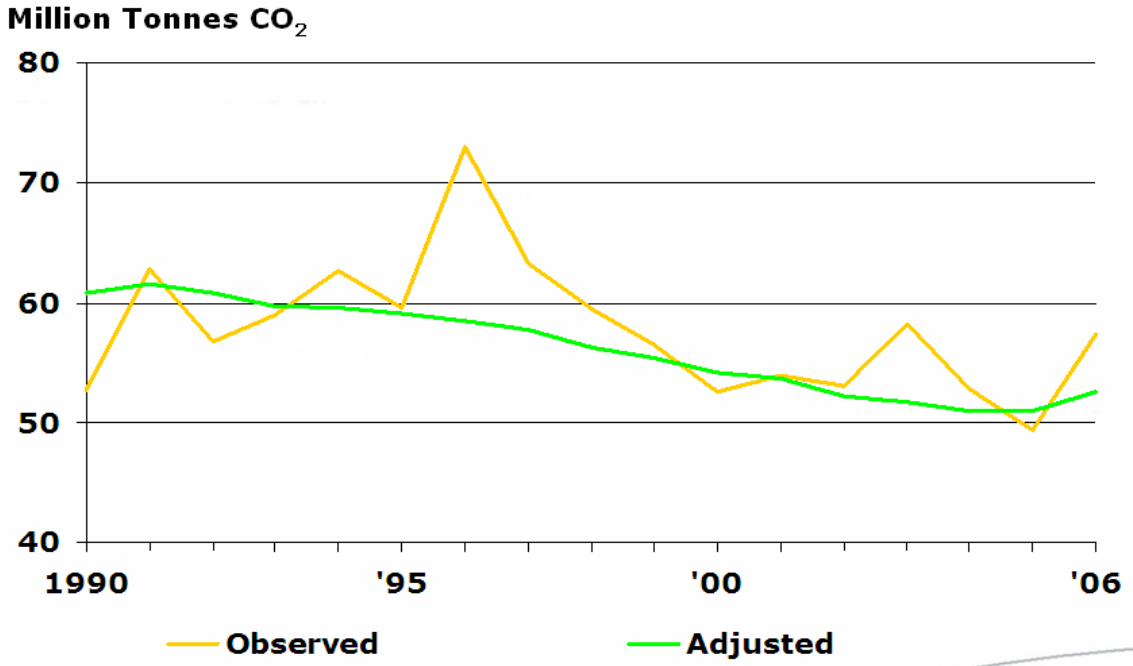
DANISH ENERGY

Wind Power Capacity and Share of Domestic Electricity Supply



DANISH ENERGY AUTHORITY

CO_2 Emissions, Observed and Adjusted



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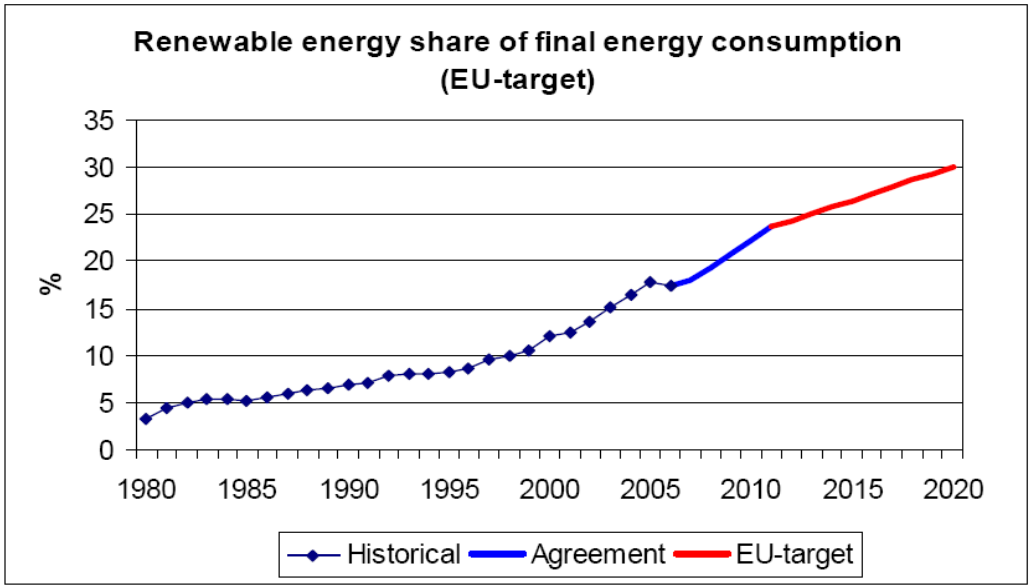
Towards 30% renewable energy



The goal for the renewable energy share of *gross energy consumption* is 20% in 2011. This corresponds to 22.4% renewable energy relative to *final energy consumption*.

2008 Danish energy policy problems

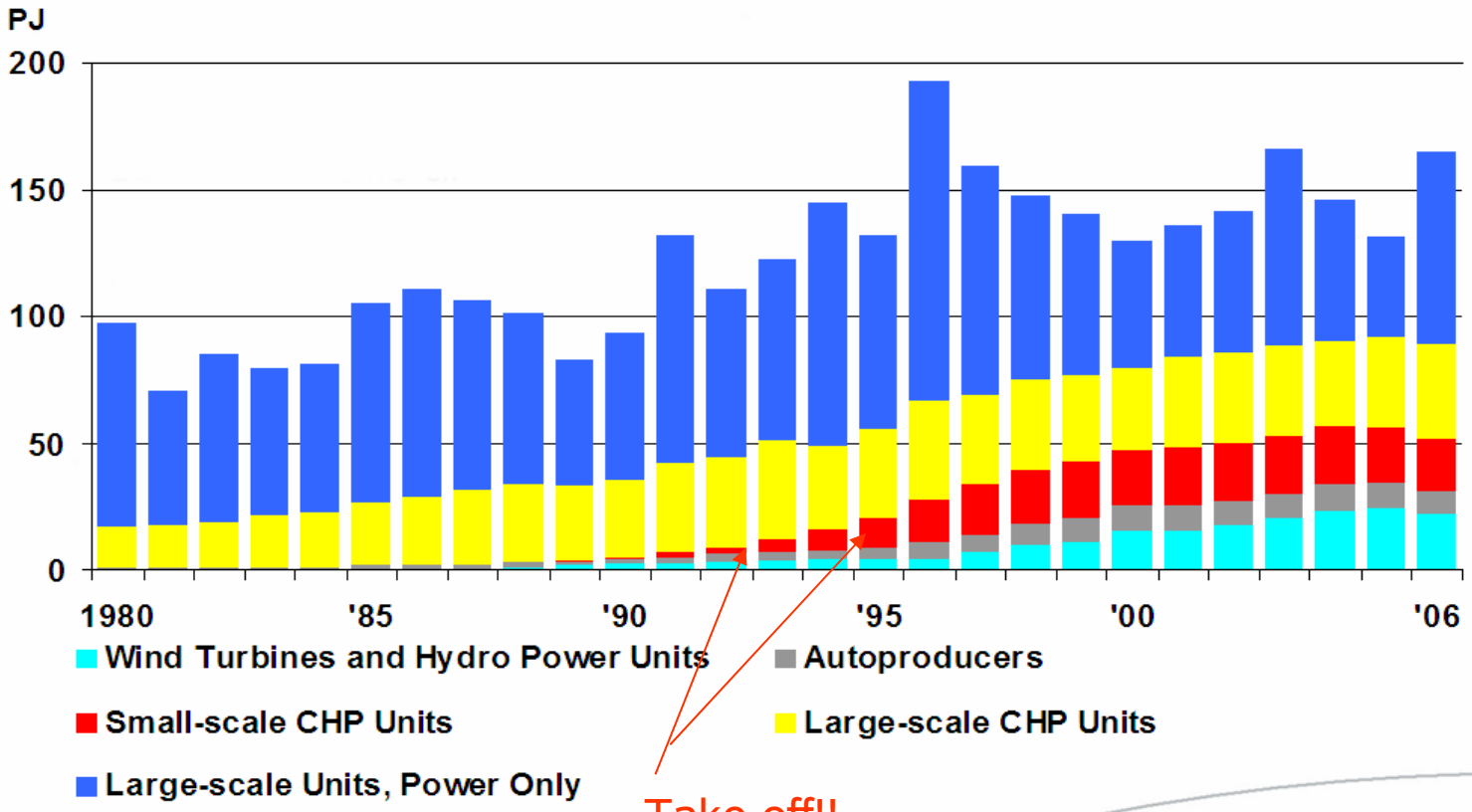
1. Wind power expansion stagnated for 5 years.
2. Danish CO2 emission is increasing since 2006
3. Danish oil and gas reserves running out within 10-30 years
4. We have promised EU 30% RE in 2030

3. The present Danish heat and power system

Institutional reforms and cogeneration in Denmark

year	1987	1988	1989	1990	1991	1992	1993	1994	1995
Standard gas prices	-	+	+	+	+	+	+	+	+
Long run marginal cost pricing	-	+	+	+	+	+	+	+	+
Index loans	-	-	+	+	+	+	+	+	+
Municipal guaranty	-	-	+	+	+	+	+	+	+
Standard grid payment	-	-	-	-	+	+	+	+	+
CO2 subsidy	-	-	-	-	-	-	+	+	+
Etc.						Take off!!!			

Electricity Production by Type of Producer



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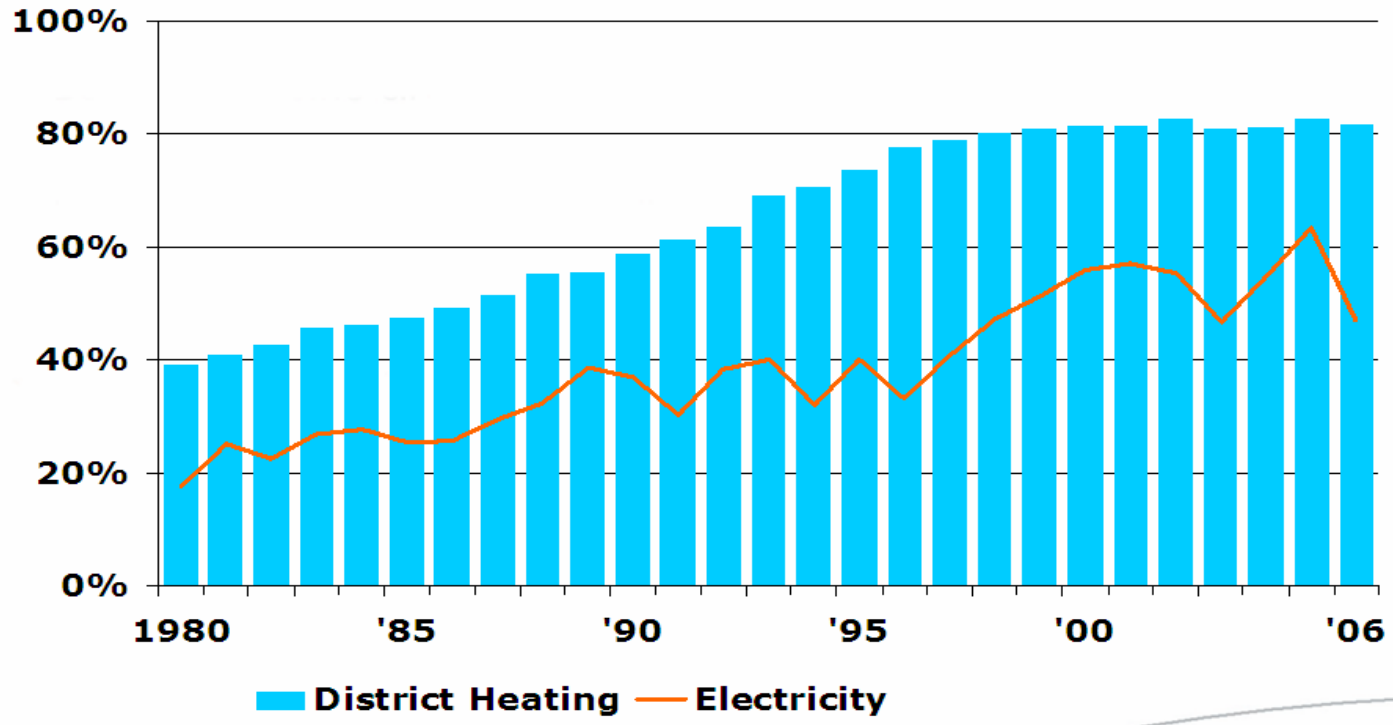
CHP Proportion of Electricity and District Heating Production



DANISH ENERGY AUTHORITY

Conclusion regarding the present Danish energy system

1. Wind power 20% of electricity consumption
   (Increases to about 25% in 2012)
2. Cogeneration 80% of heat consumption
3. Cogeneration 60% of electricity consumption
4. Wind power and decentralised cogeneration around 40% of electricity consumption.

The flexible cogeneration systems is the first step in the creation of a new infrastructure for fluctuating energy sources.

4. Cost efficiency of wind power is a function of its surrounding energy system

The two areas of Renewable energy Governance system

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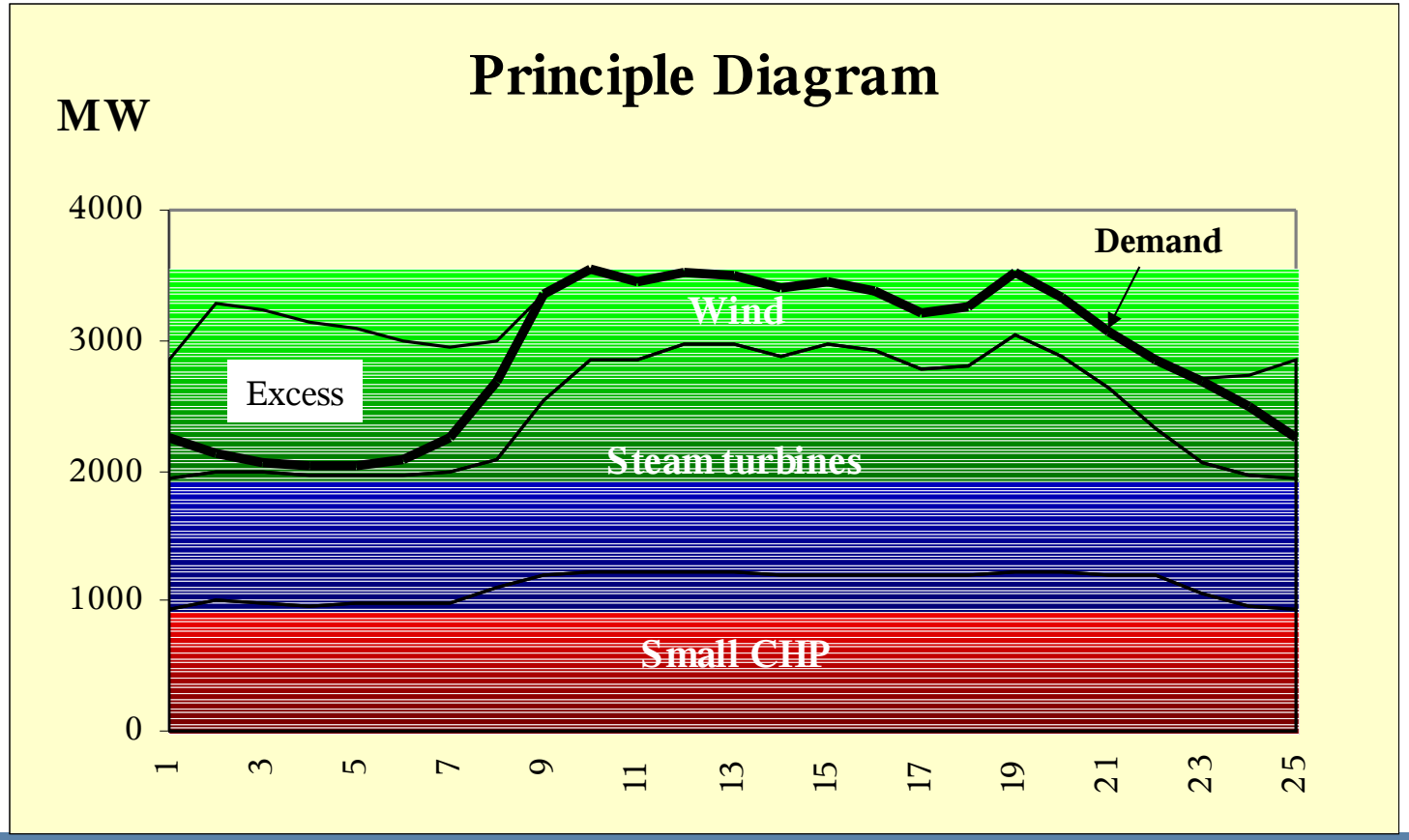
- A need for a system that furthers the introduction of Renewable Energy technologies (FIT tariffs for instance)

Electricity Excess Production



3. The need to solve the Renewable Energy fluctuation ”problem”.

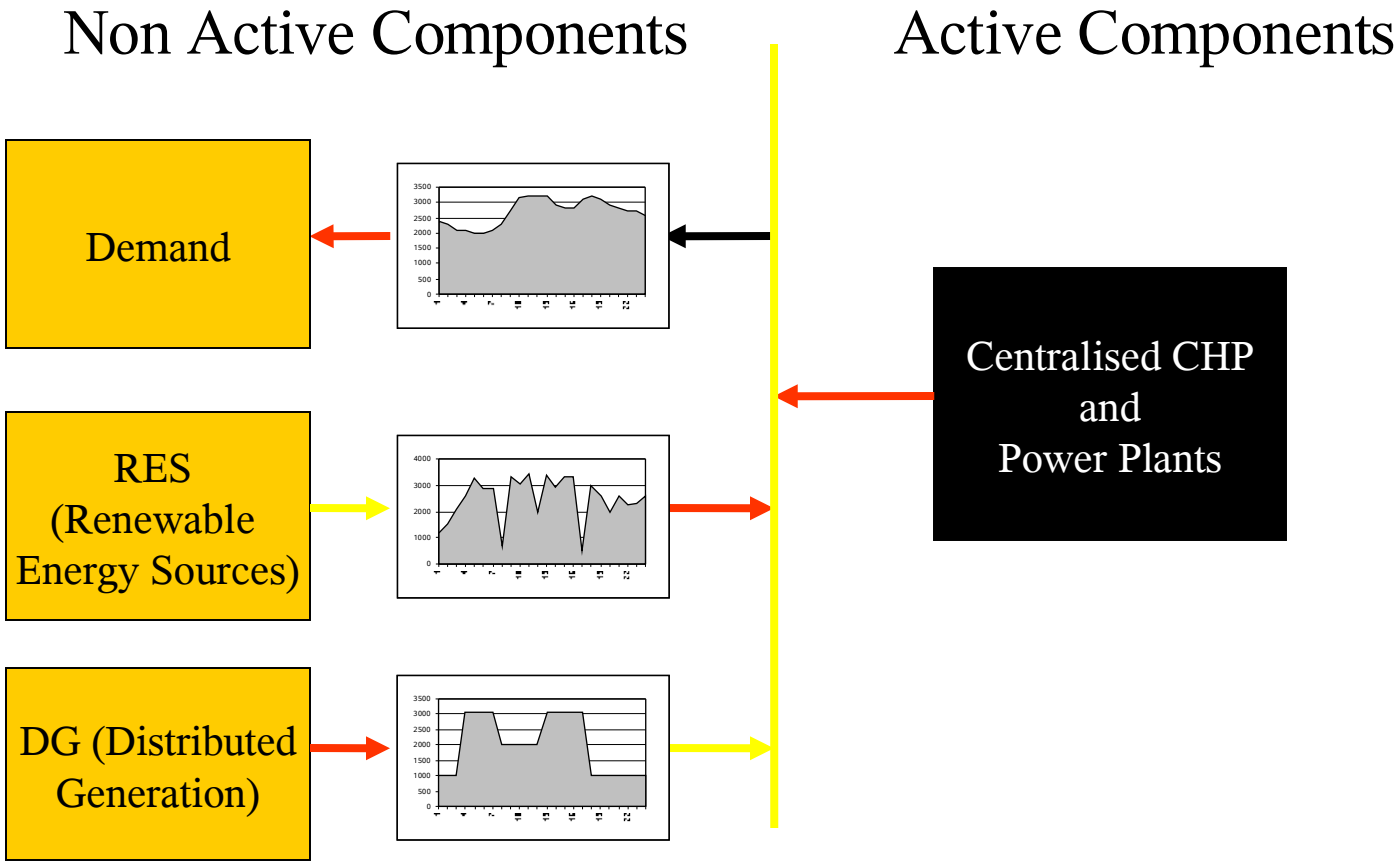
a. Establish local flexible systems

b. Establish counterbalancing regional systems

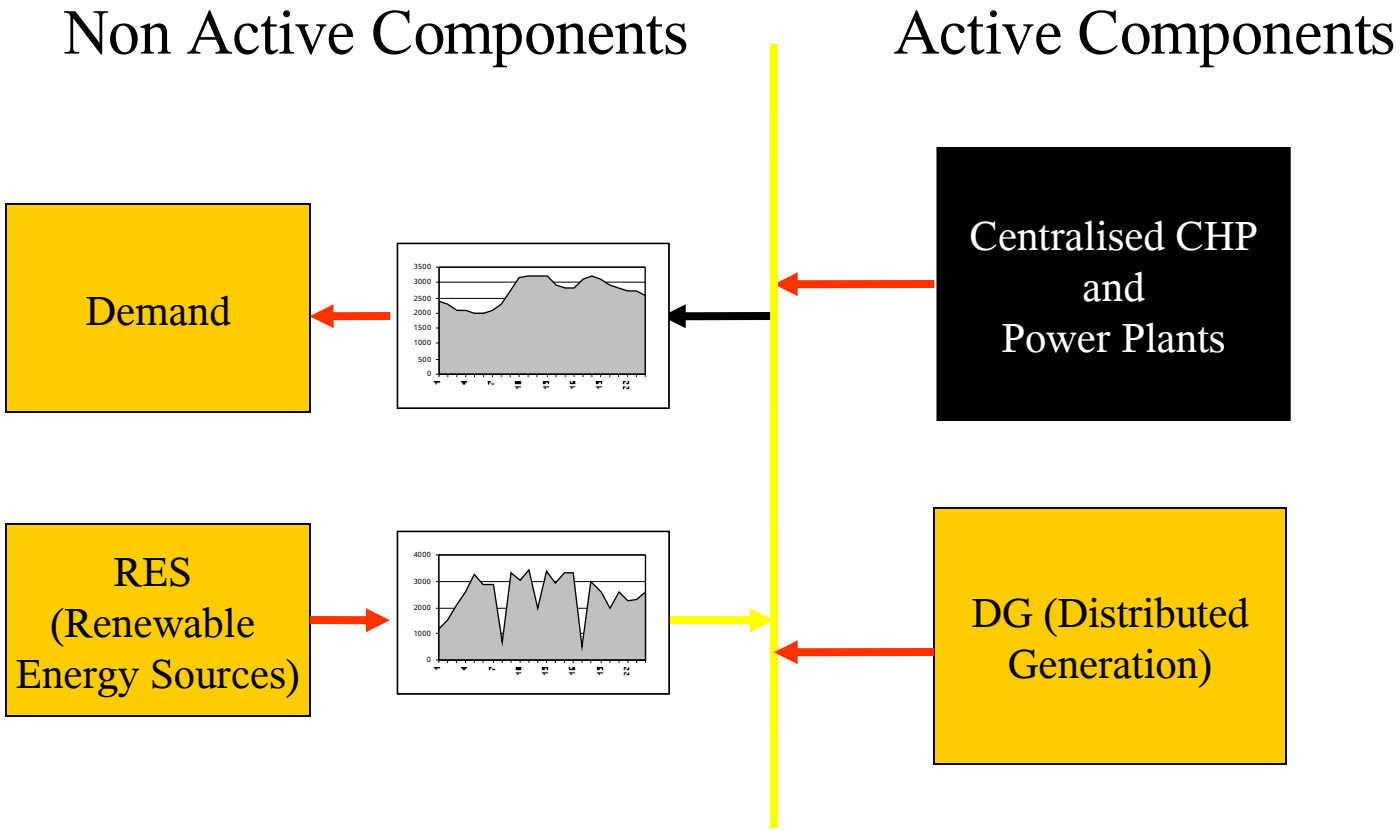
c. Establish storage systems

d. Combination of a,b,c and d.

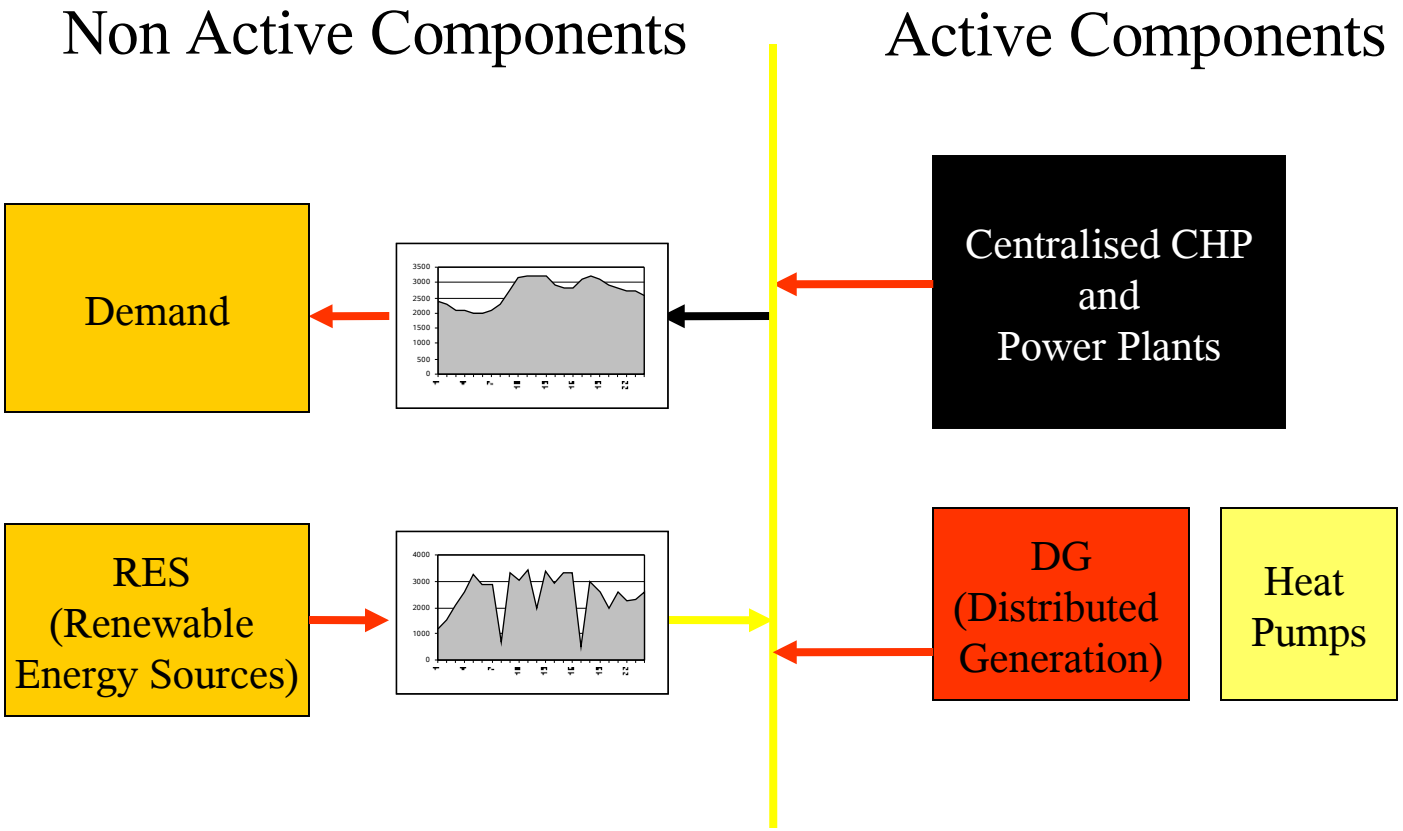
System 1. Electricity Balance and Grid Stability



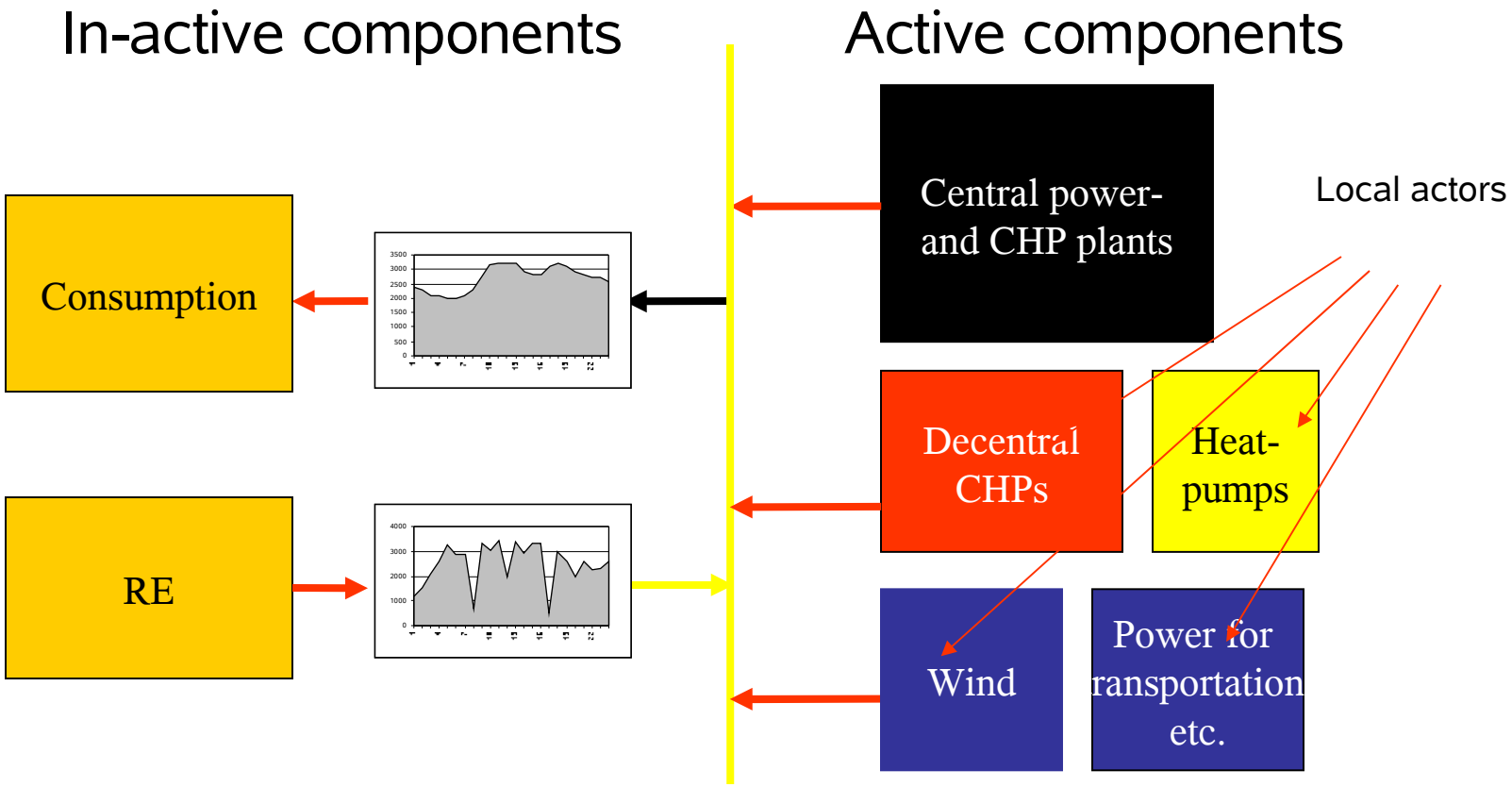
System 2:
Activating DG CHP-units



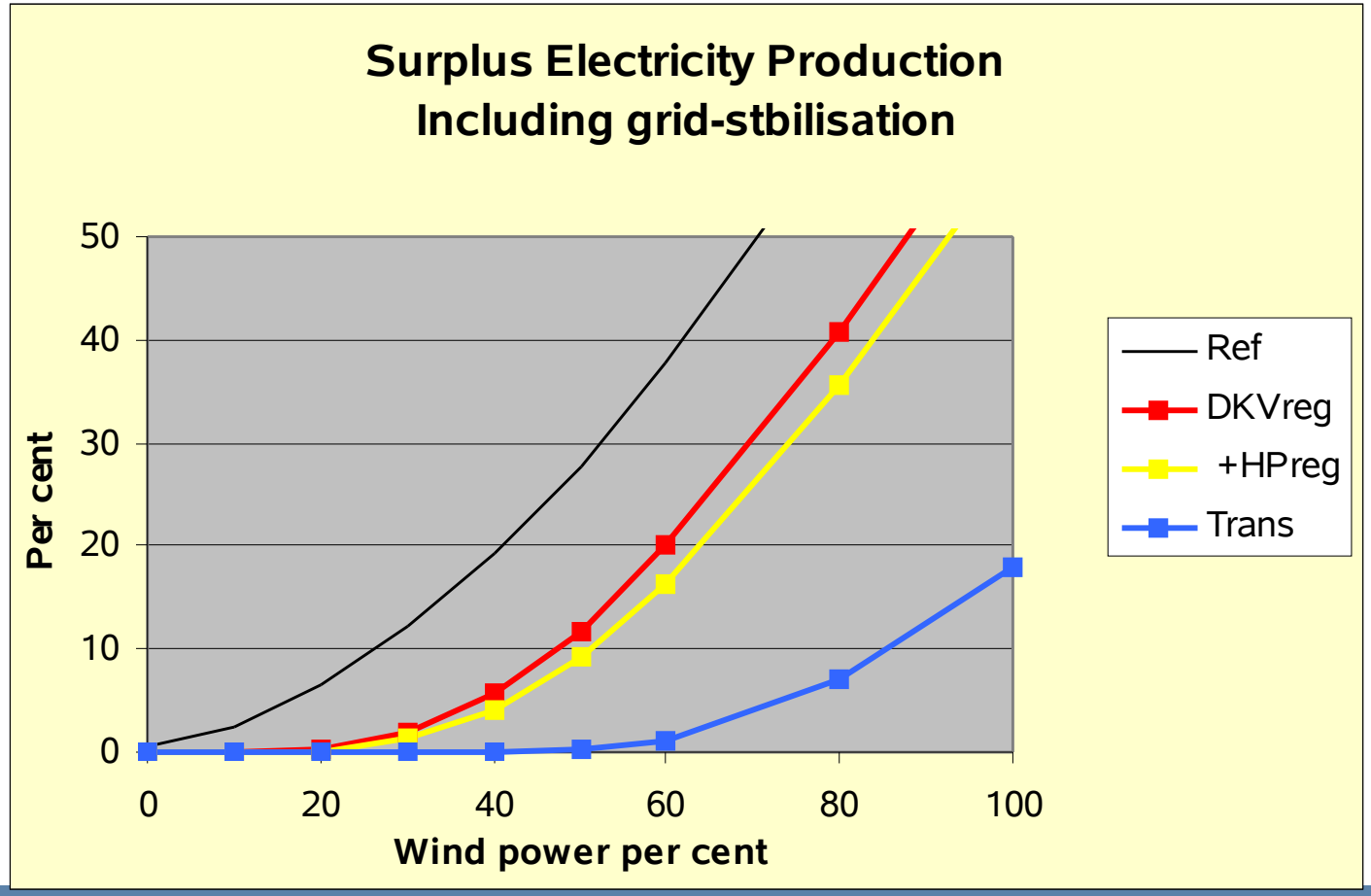
System 3:
CHP-units and Heat Pumps



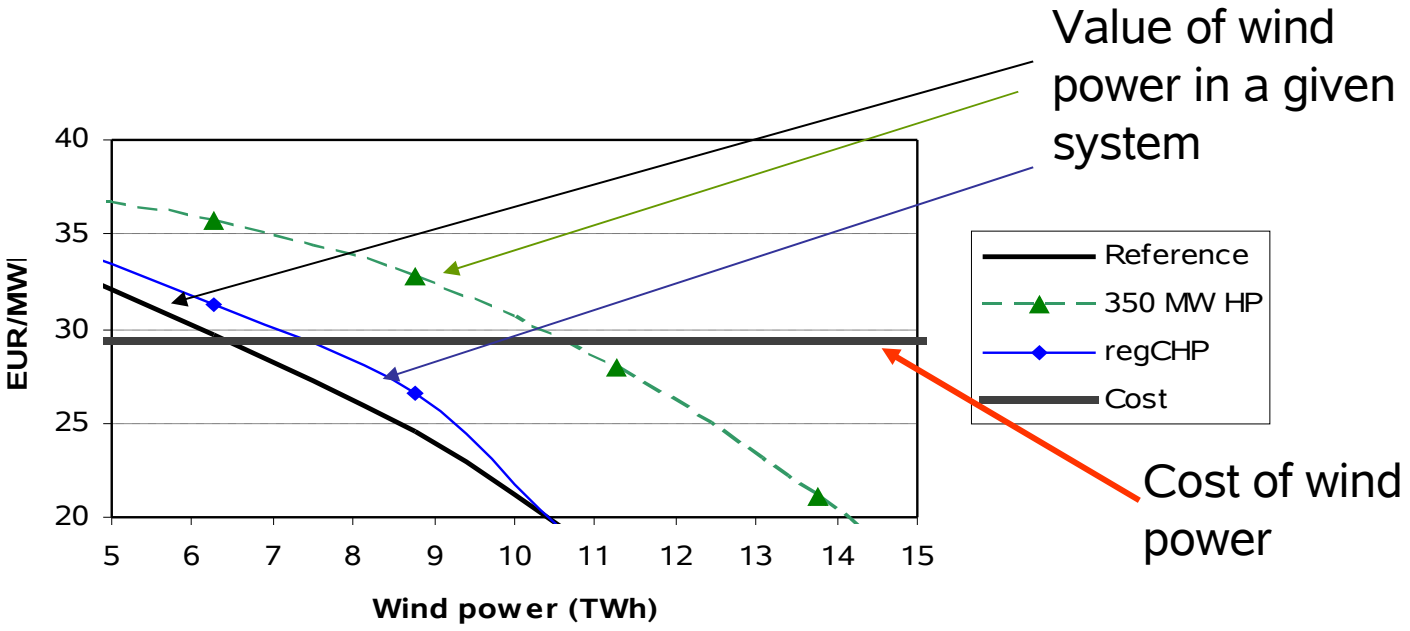
System 4
Activating RE via increased power consumption for heat pumps and transportation.



The amount of wind power without export is a function of surrounding energy system



The value of wind power is a function of the "surrounding" energy system.
(Lund.H and Münster 2004)



Conclusion regarding infrastructure for renewable energy

- We have cogeneration
- We need to establish heat storage, CHP regulation,heat pumps and electrical cars.
- We need a Governance system that supports the further development of the new Renewable energy infrastructure!!

5. Cost effective development and implementation of single Renewable Energy technologies

The two areas of Renewable energy Governance system

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Two renewable energy Governance models competing in the EU

1. The "Political quota-/certificate price market" model, where the amount of RE is decided upon by politicians and the price is determined on the market.

2. The "Political price-/amount market" model, where politicians determine the price of RE and the quantity of RE is determined on the market. This was the former Danish model, and is the present Spanish, German and French model.

Special characteristics of renewable energy

1. Having different natural resource bases from location to location, a factor which makes it necessary to establish a governance system, which furthers an EU-wide "site efficiency”.

2. Being energy automatons: Having a cost structure with a very high percentage of investment-/fixed costs and very low running costs, which implies high investor risks on the market

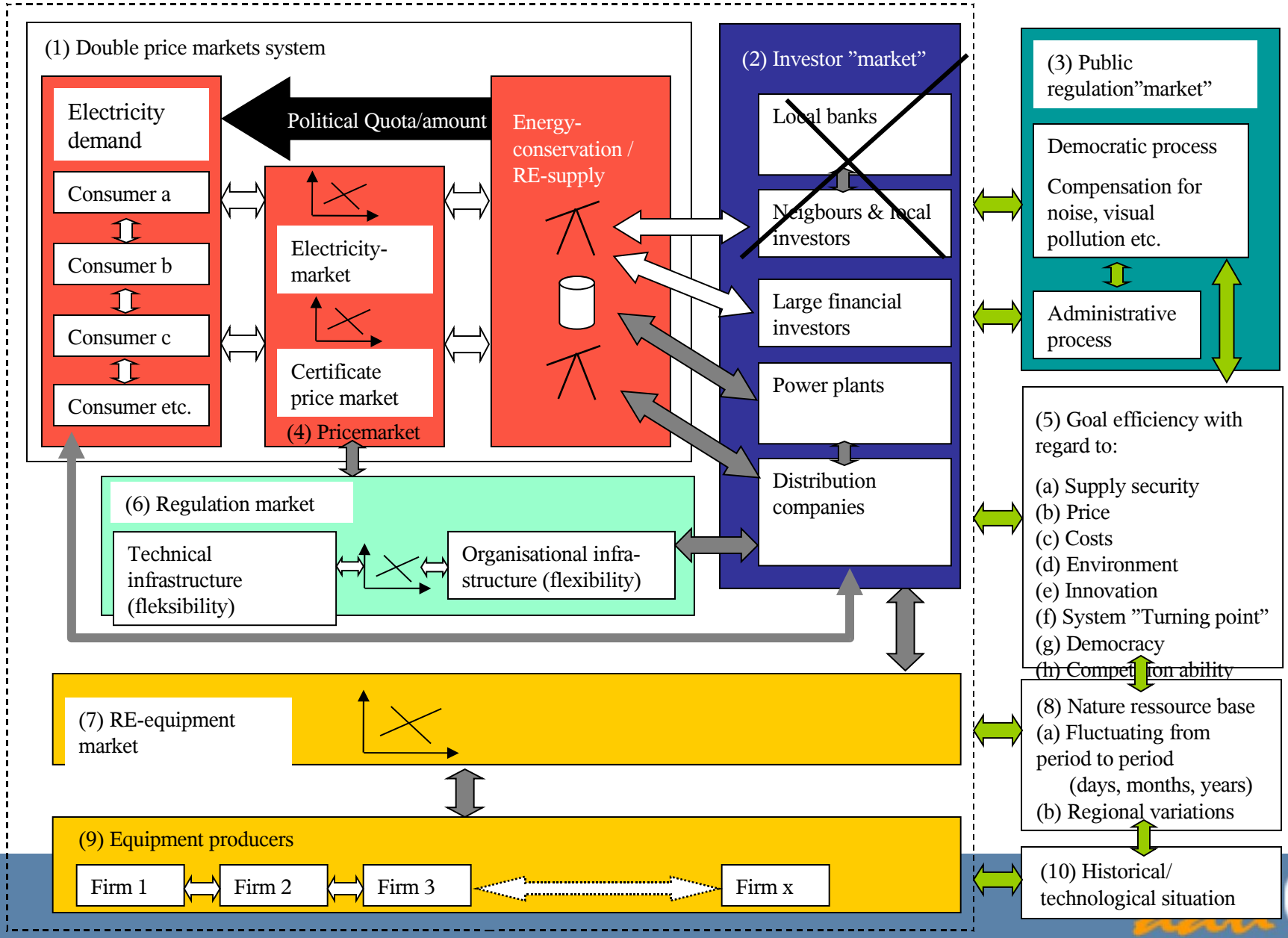
3. Being dispersed around the country, and often in residential areas, which makes it particularly crucial to involve neighbours and people from the region in the design, development and ownership of RE projects.

4. Being newcomer technologies, thus having minor market shares and meeting resistance strategies from established technologies.

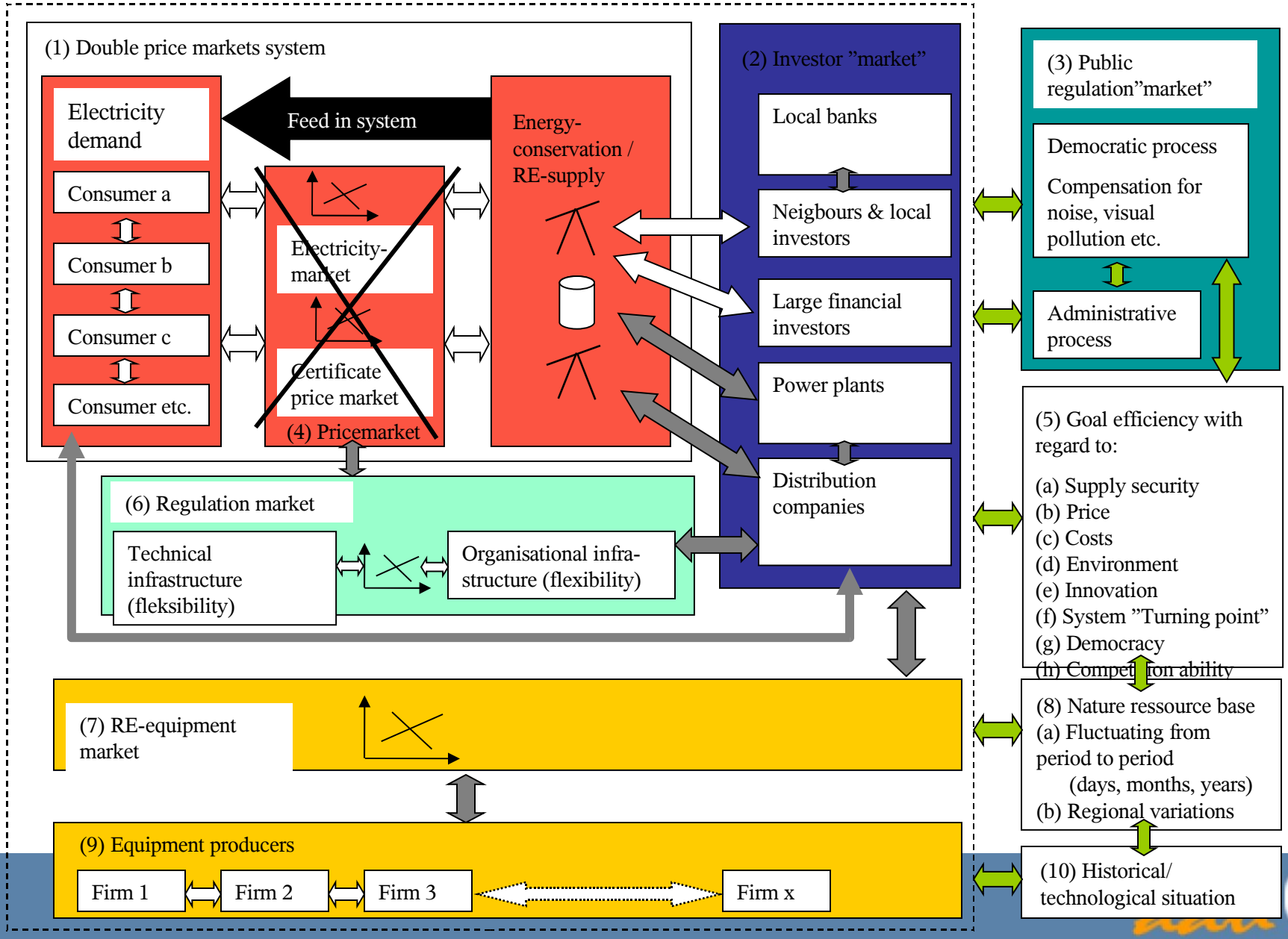
5. Fluctuating energy source: Producing when the sun shines and the wind blows, making it important to have

fluctuations..

Relevant Markets and Renewable Energy



Relevant Markets and Renewable Energy



Some important RE conditions and institutions

1. The regional variation of natural resource base matters for RE Governance systems.

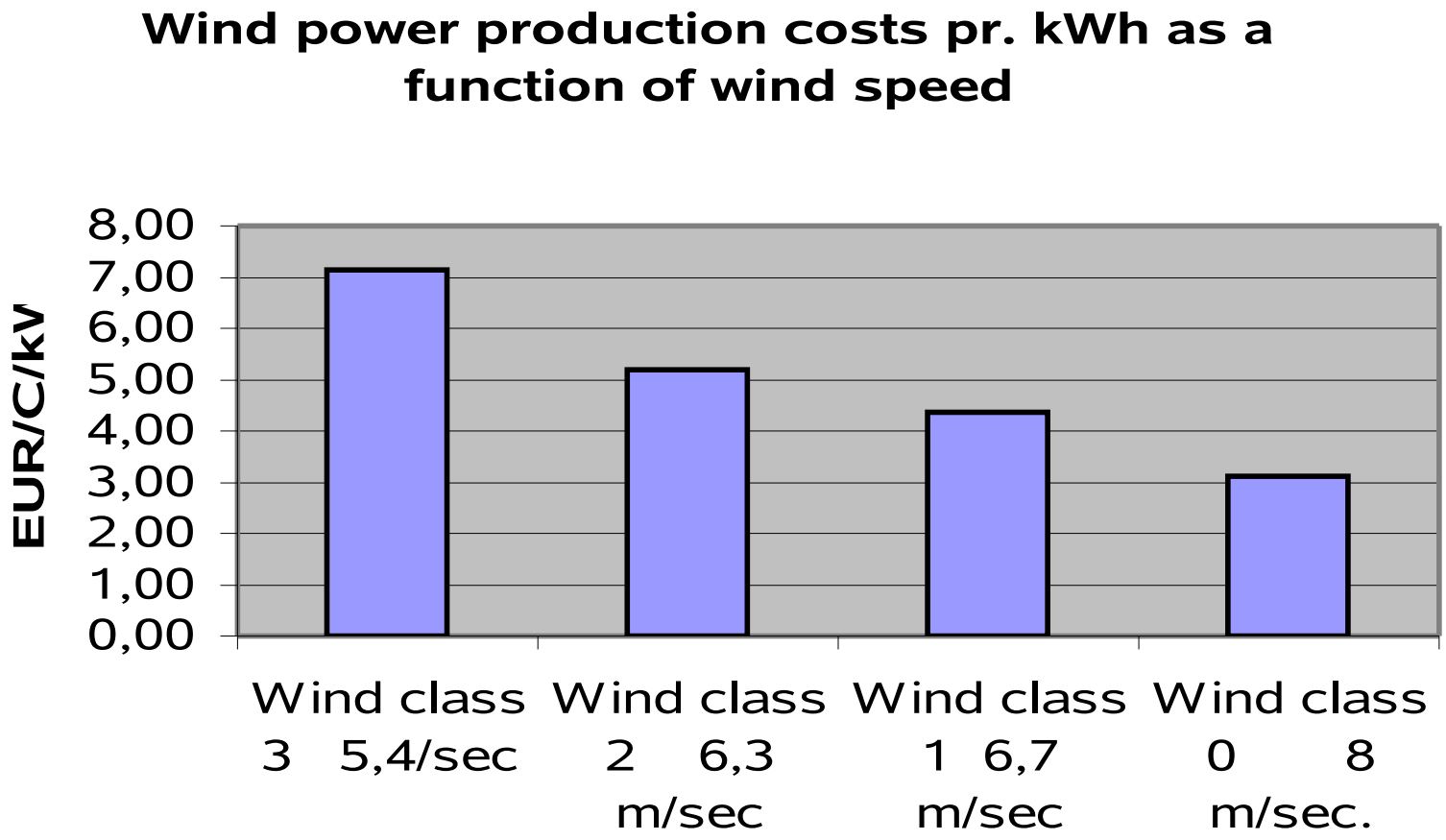
2. The RE equipment market should be included in the context (box 7)

3. The RE “investor supply” and its composition does matter (box 3).

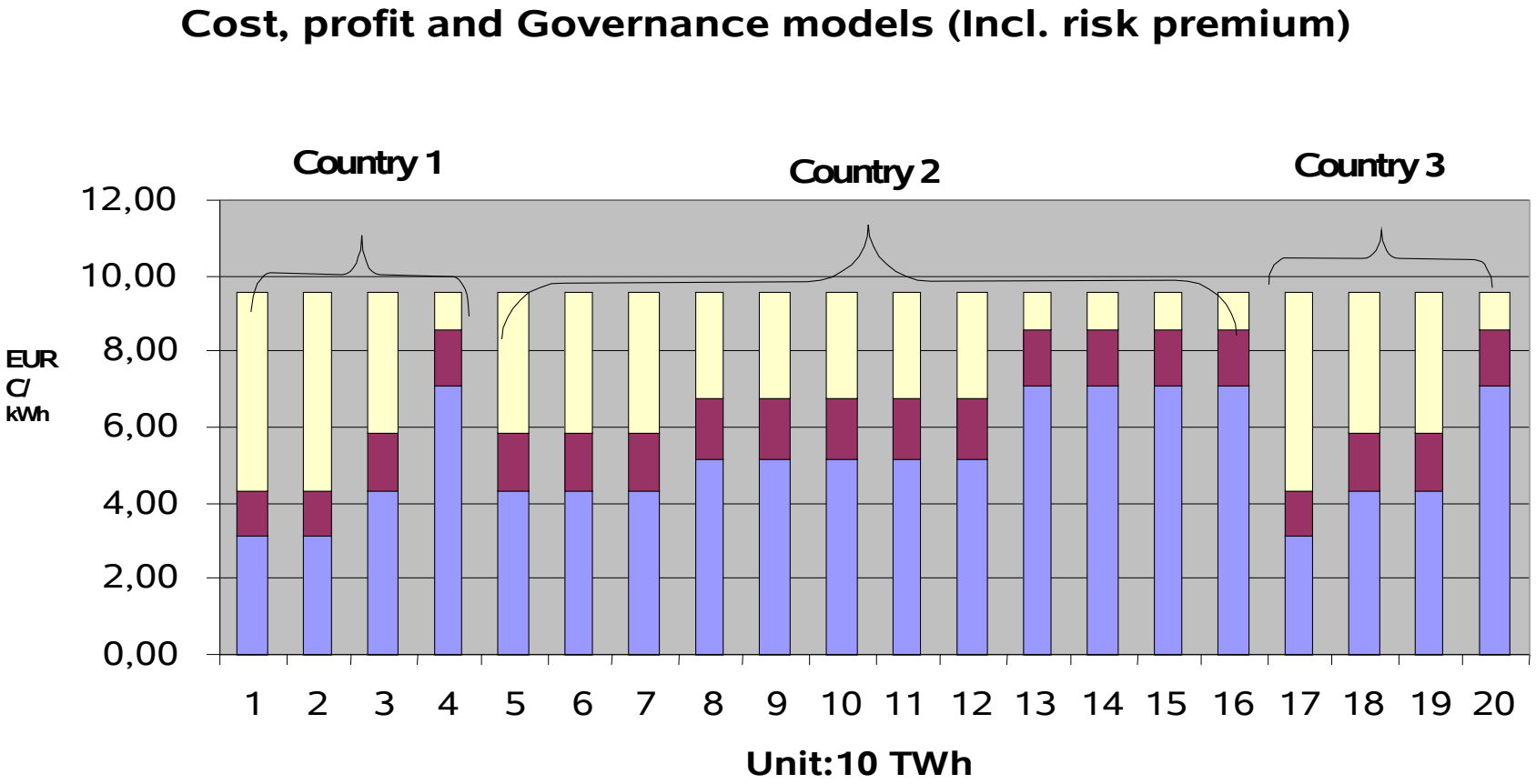
4. The study of market power does matter.

5. The flexibility of the RE infrastructure should be analysed.

Wind-power costs and wind-resource base



Extra costs in a political amount/market price system



Features of the political price amount market model (Feed in model)

1. It supports neighbour and local investors. Possible to get bank loans.
2. It can differentiate the price between new and old technologies as done in the German model. (Wind power, biomass, photovoltaic, etc.)
3. It can differentiate the price between wanted good and less good wind sites. (Avoiding to pay overprice for good wind sites)
4. It can differentiate the price over time for a given plant.
5. It can differentiate the price of old and new plants, establishing an innovation pressure.
6. It keeps the amount market alive, and therefore the competition between wind turbine producers.

All these features can keep the wind power costs and price down, and are not build into the political amount certificate market model.

6. Conclusion

A Renewable energy Governance system must address two areas

- Development of a governance system that furthers infrastructural system that can incorporate large amounts of fluctuating energy sources.
- Development of a system that furthers the development and implemtation of single Renewable Energy technologies (FIT tariffs for instance)

Need for local participation and acceptance especially in later phases of RE developments.

1. The need for public participation in RE development is important in the RE introduction phase.

2. It is <u>however important to underline</u>, that the need for public participation in later phases is increased, due to the fact, that RE technologies are dispersed around an area/country,and that increased market .

3. Consequently it is, concurrently with increased RE market share, increasingly important to <u>establish RE Governance models which can further the acceptance and participation of local people living in the neighbourhood of the RE plants.</u>

Policy 1:
Renewable Energy infrastructure policy

Establish a policy that supports:

- Survival of Danish CHP plants.
- That CHP plants participates in regulation activities at the NORDPOOL market.
- Establishment of needed heat storage capacity.
- Establishment of needed heat pump capacity
- Establishment of a system with ”plug in” electrical cars.
- Include transmission costs in electricity prices.
- Establish ”Energinet” procedures for the establishment of an Renewable Energy infrastructure.
- Etc.etc.

Policy 2
For development and implementation of Renewable Energy technologies

1. Establish a Political Price/market amount regulation (FIT).
2. Establish new ownership models with local and regional ownership of Renewable Energy Technologies.
3. Change rules regarding locations, where it is permitted to build Renewable Energy technologies. (Coastline-close to motorways-etc.)

Will this policy be implemented in Denmark?

1. The official policy is to increase RE from present 15% to 20% in 2012, and wind power from present 20% to 25% in 2012.
2. In 2008 a FIT legislation has been introduced for Biogas electricity.
3. 3.5 Eurocent as fixed extra payment to wind power in 22.000 ”full production” hours has been introduced. So now wind power has acceptable economic conditions in Denmark. But other types of legislation are still needed.
4. A specific policy for local ownership participation is being prepared.
5. CHP plants are there as infrastructure, but a policy for heat pumps is not yet in place.
6. A systematic policy for electrical cars is not yet in place, although there is no tax on electrical cars in Denmark at present.
7. An extensive discussion regarding RE infrastructure policy is being performed in many organisations.