100% Renewable Energy in 2050 - the Danish case

SMART *ENERGY SYSTEM* POLICIES

Presentation 25 February at the International Conference REvision2014:Global Energy Turnarounds and Japan´s Path..”

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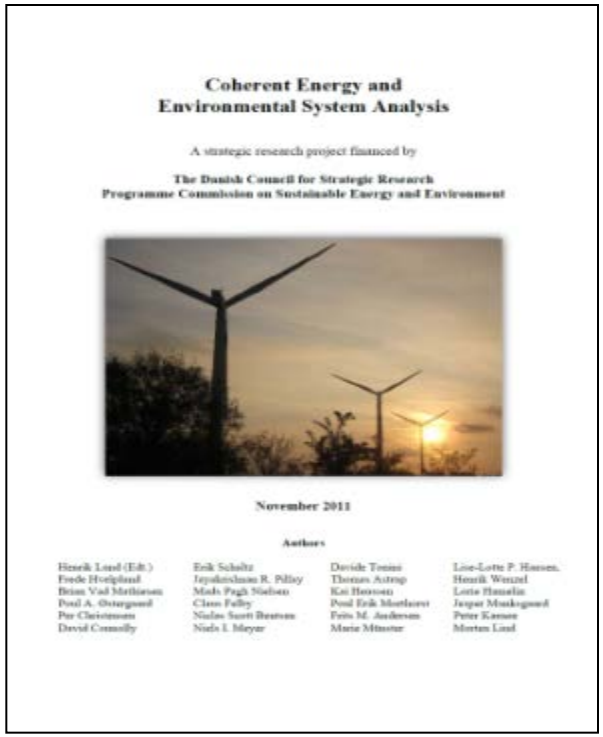
1. The 100% RE project- CEESA project

www.ceesa.plan.aau.dk



Coherent Energy and Environmental System Analysis

A strategic research project financed by

The Danish Council for Strategic Research
Programme Commission on Sustainable Energy and Environment

November 2011

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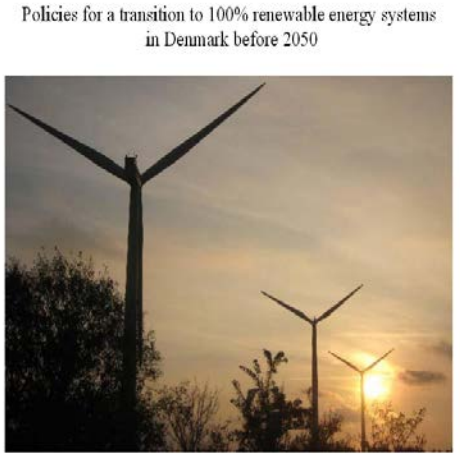


Policies for a transition to 100% renewable energy systems in Denmark before 2050

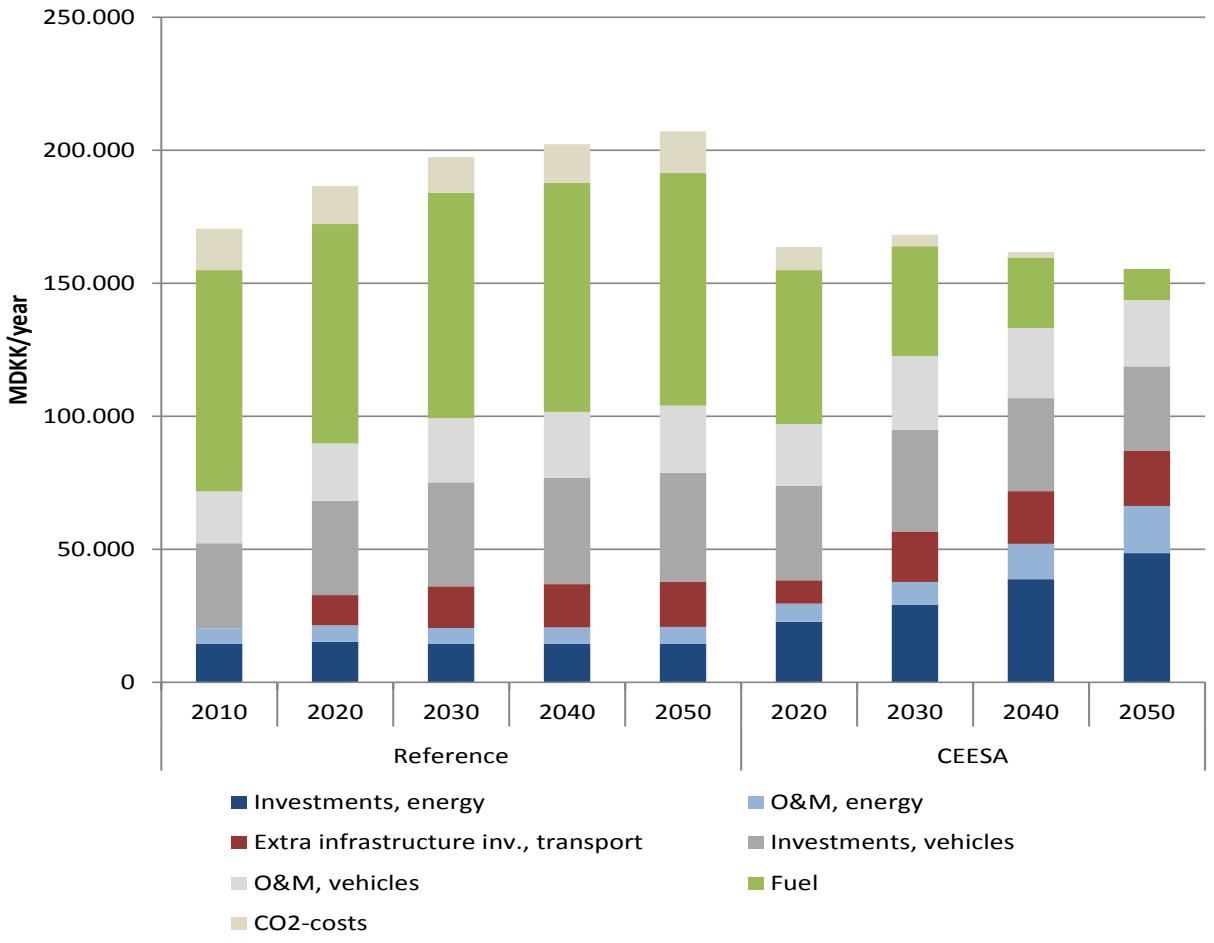
Coherent Energy and Environmental System Analysis

Background Report Part 4

September 2012

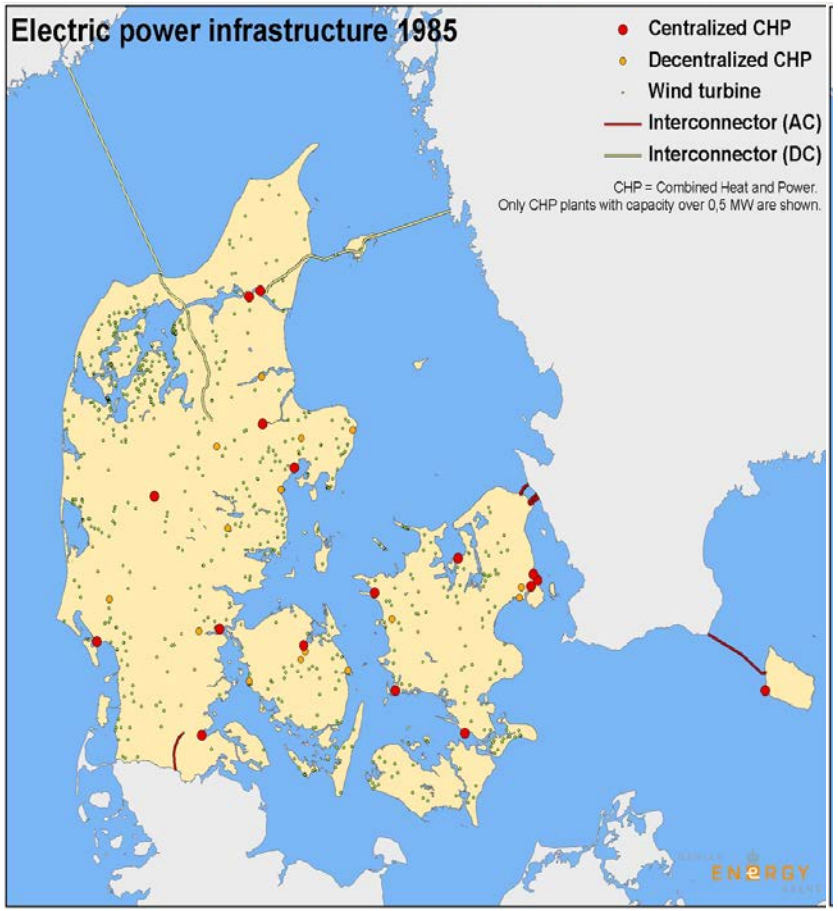
A strategic research project financed by

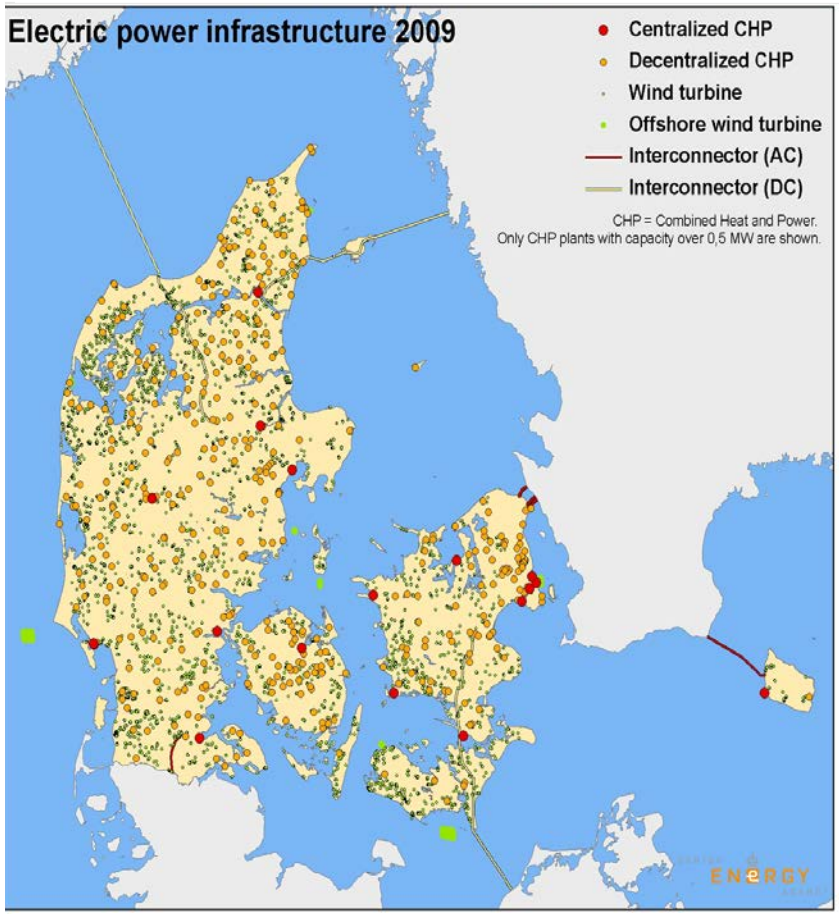
Socio-economic costs in the CEESA project



2. Danish Energy Policy

Transition from a hierarchical centralised to a semi-decentralised energy system – Status

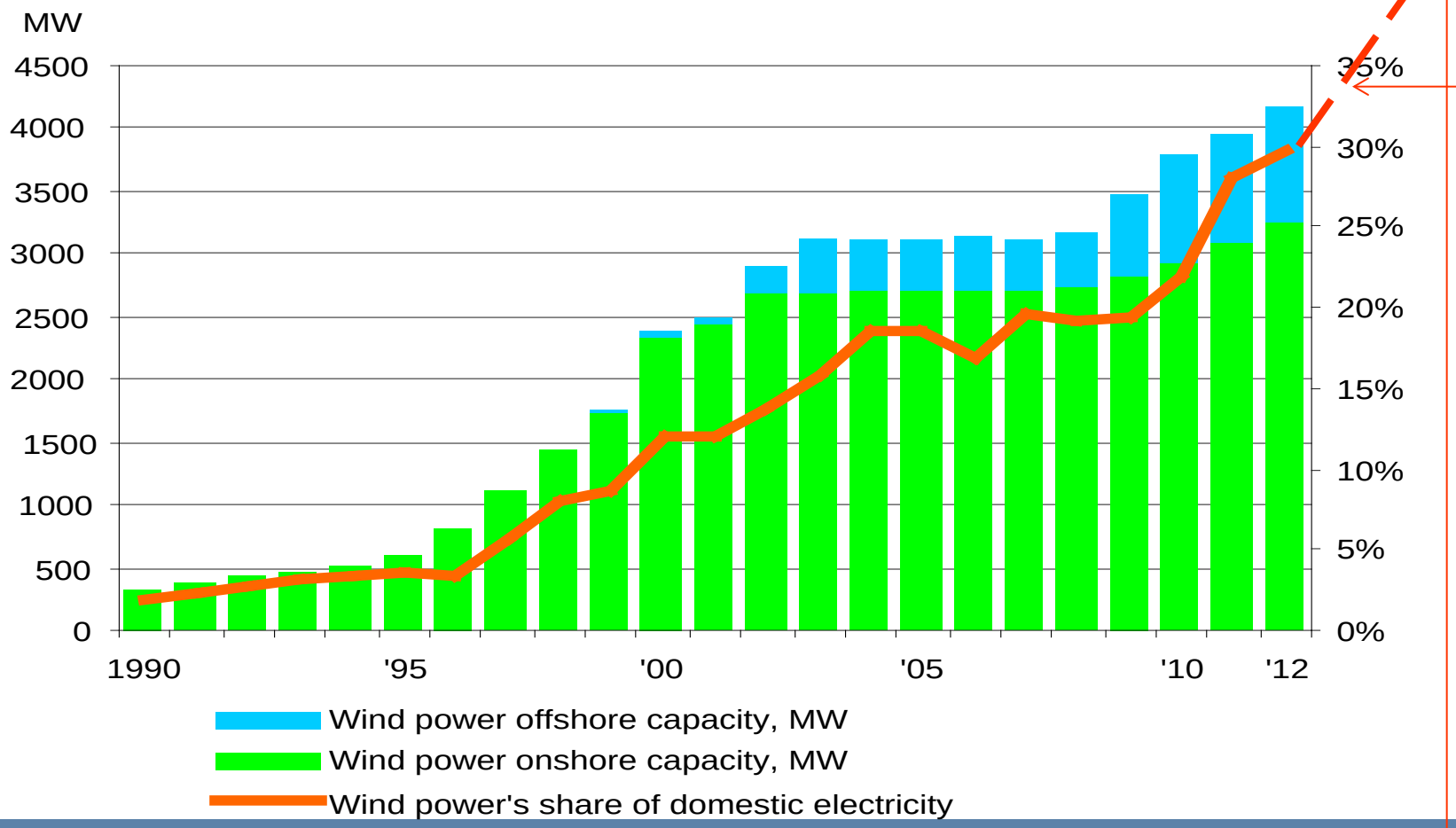




Institutional reforms and decentralized cogeneration in Denmark

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!!!			

Wind power capacity and wind power's share of domestic electricity supply (ens.dk)



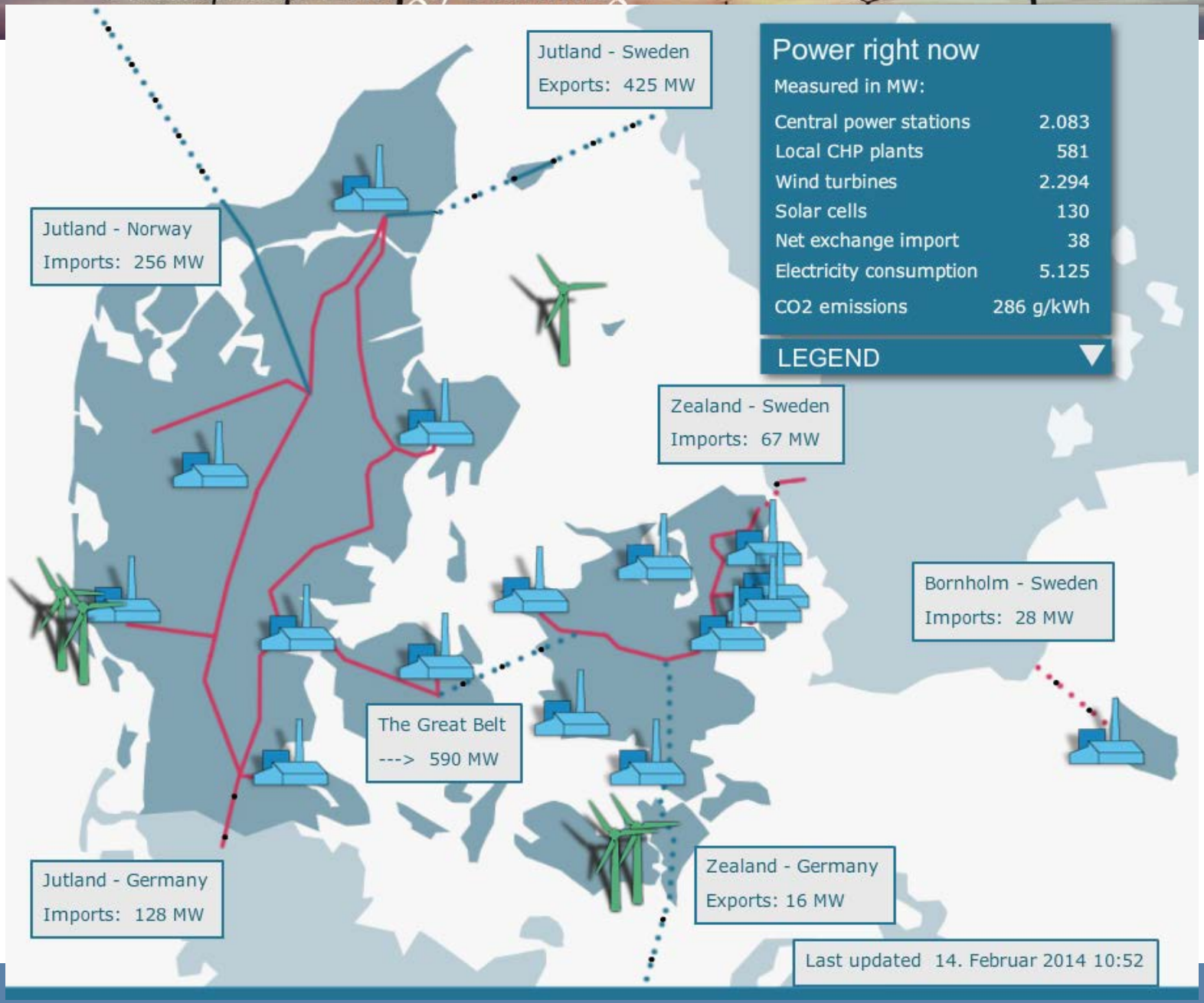
2020

50%

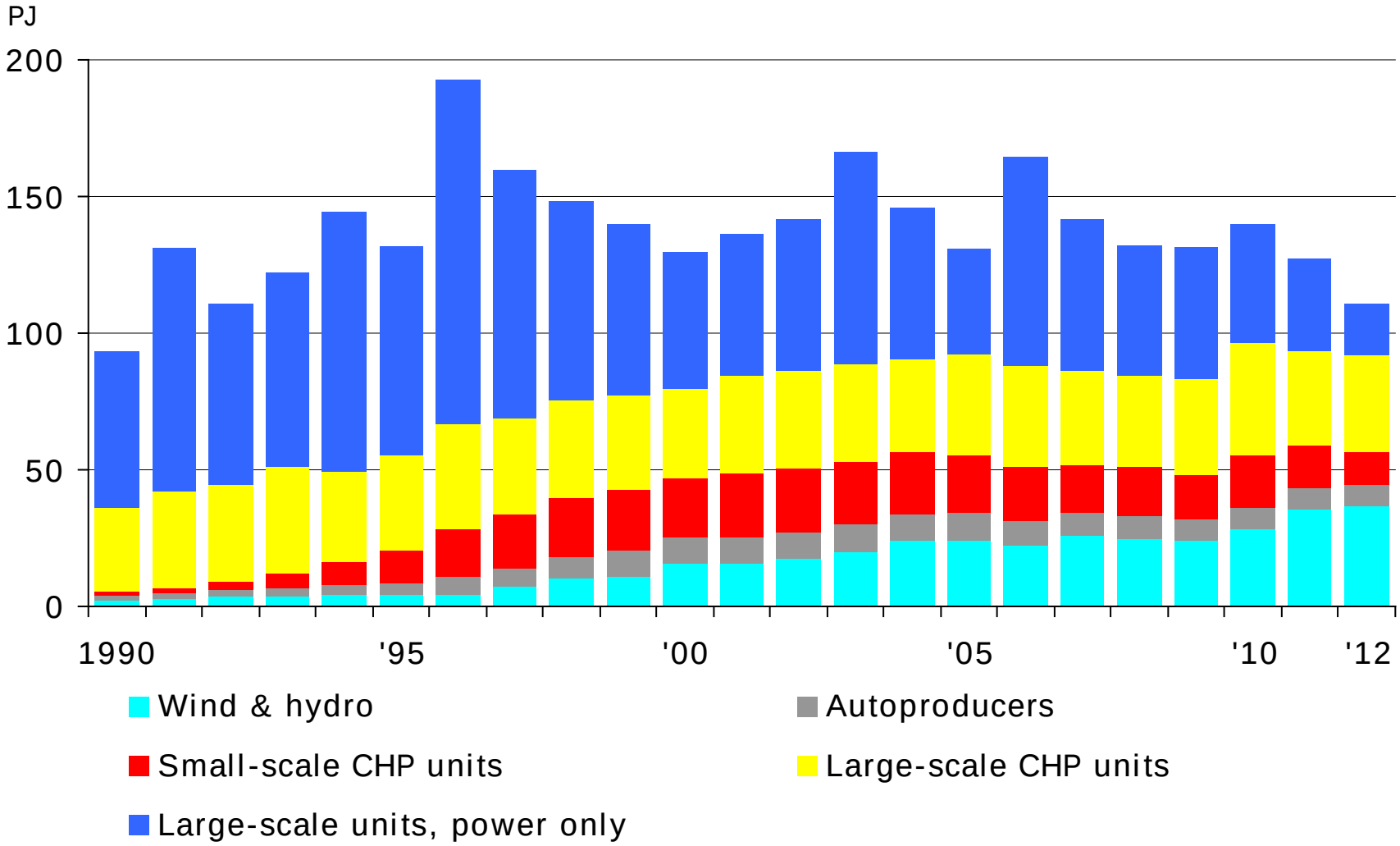
85% of members of parliament behind this goal.)

2013

33%


Jutland - Sweden
Exports: 425 MW
Power right now
Measured in MW:
Central power stations 2.083
Local CHP plants 581
Wind turbines 2.294
Solar cells 130
Net exchange import 38
Electricity consumption 5.125
CO2 emissions 286 g/kWh
LEGEND
Jutland - Norway
Imports: 256 MW
Zealand - Sweden
Imports: 67 MW
Bornholm - Sweden
Imports: 28 MW
The Great Belt
---> 590 MW
Jutland - Germany
Imports: 128 MW
Zealand - Germany
Exports: 16 MW
Last updated 14. Februar 2014 10:52

Electricity production by type of producer



Industrial Electricity prices in Eurpope, first half 2013.

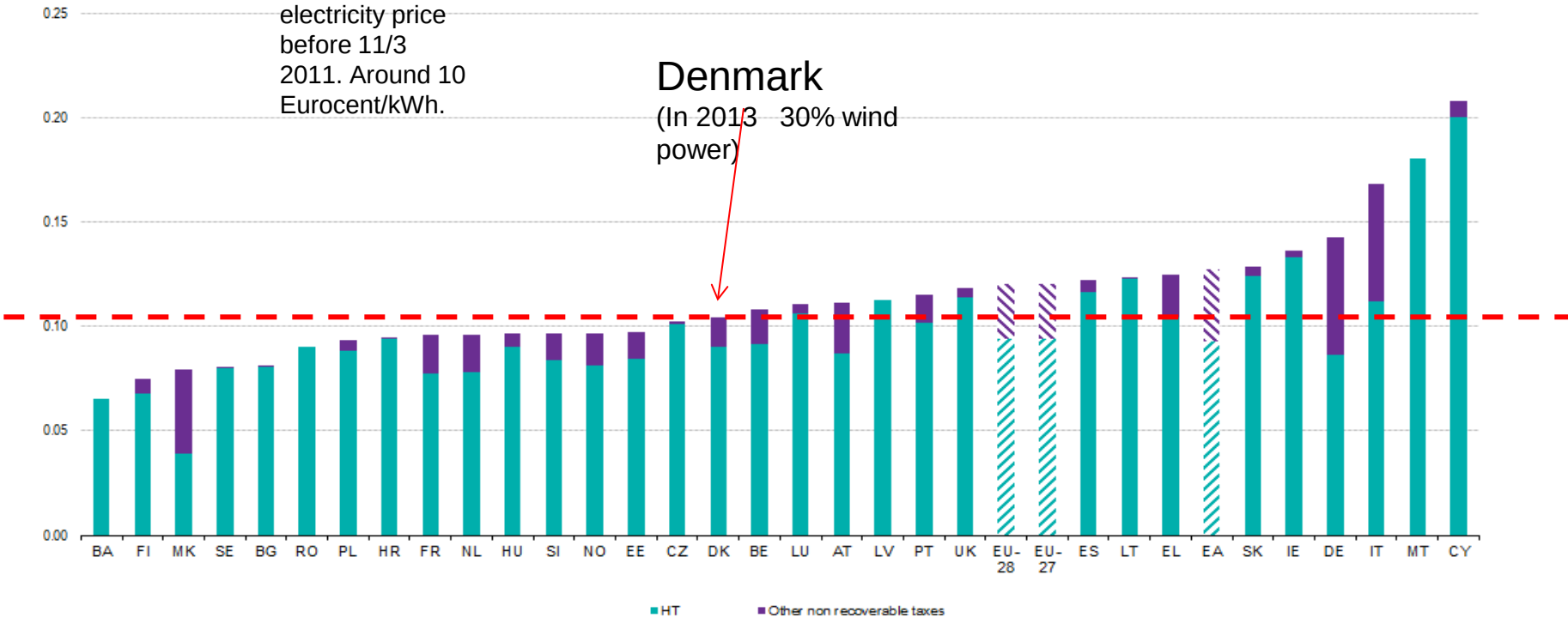
http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/Energy_price_statistics

Prices excluding VAT for consumers between 500 MWh/year and 2000 MWh/year.

Eurocent per kWh

Japan industrial electricity price before 11/3 2011. Around 10 Eurocent/kWh.

Denmark
(In 2013 30% wind power)



New Government September 2011

- 100% RES by 2050
- 100% RES for electricity and heating by 2035
- No coal on power plants and no oil for heating households by 2030
- 50% wind in electricity supply by 2020
- 40% CO2 reduction by 2020 compared to 1990

3. The smart energy system

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.

Smart Energy Systems=

1.Electricity Smart Grids are defined as electricity infrastructures that can intelligently integrate the actions of all users connected to it .

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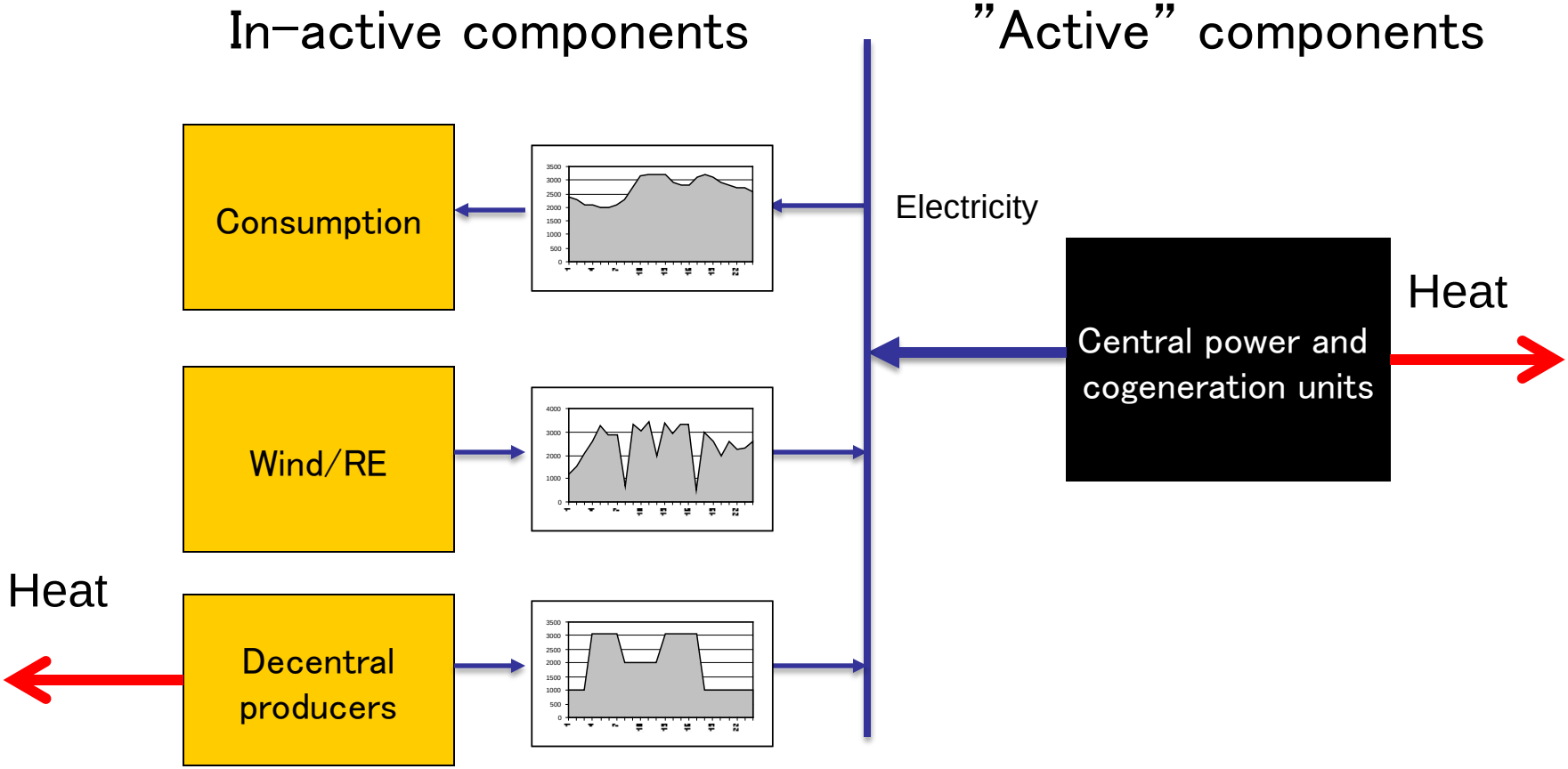
2.District Heating and Cooling Smart Grids is a network of pipes connecting the buildings in a neighbourhood, town centre or whole city, so that they can be served from a centralised plant as well as from a number of distributed heat and/or cooling producing units including individual contributions from the connected buildings.

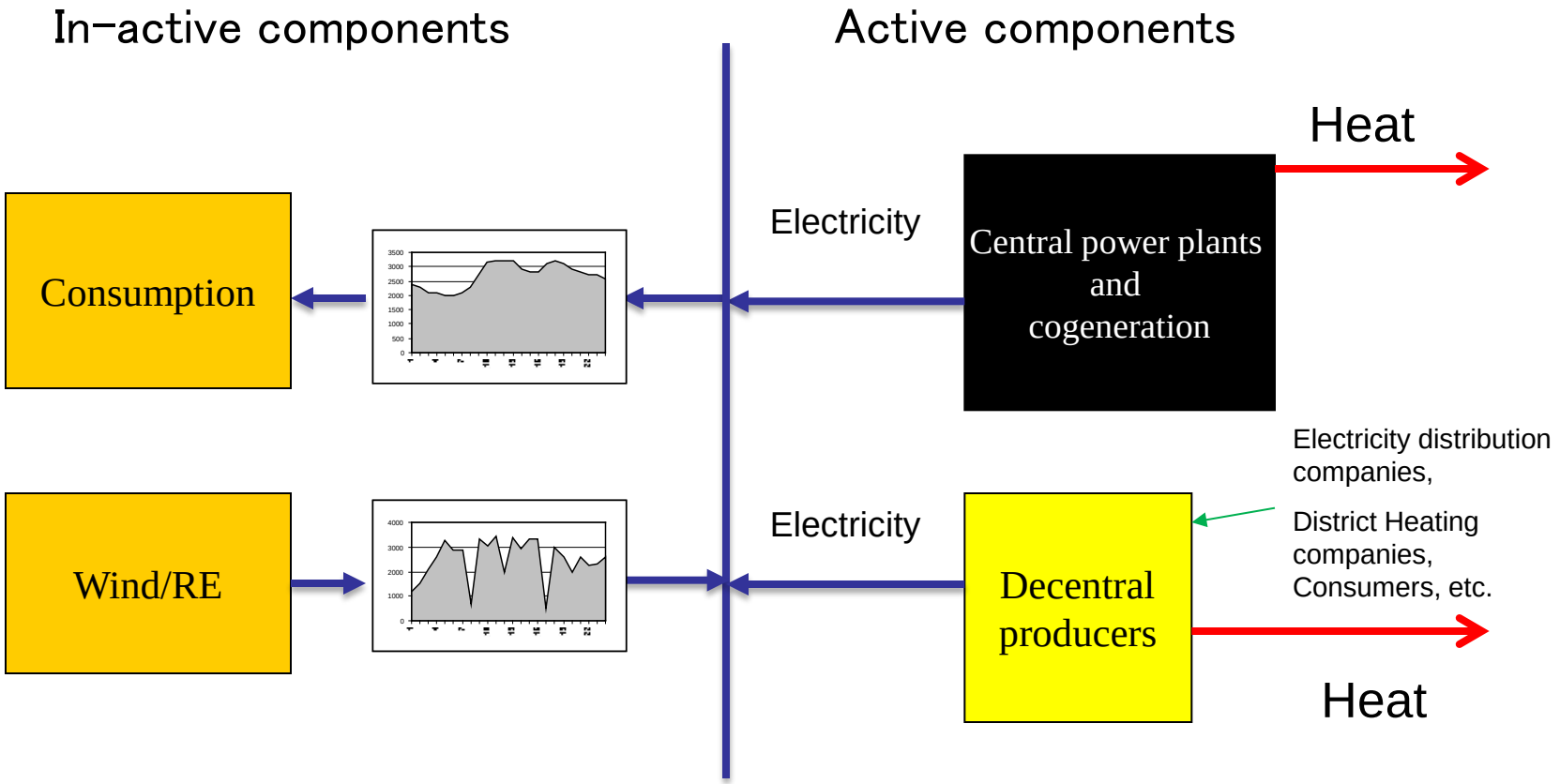
+

3.Gas Smart Grids are defined as gas infrastructures that can intelligent integrate the actions of all users connected to it - supplies, consumers and those that do both - in order to efficiently deliver sustainable, economic and secure gas supplies and storage.

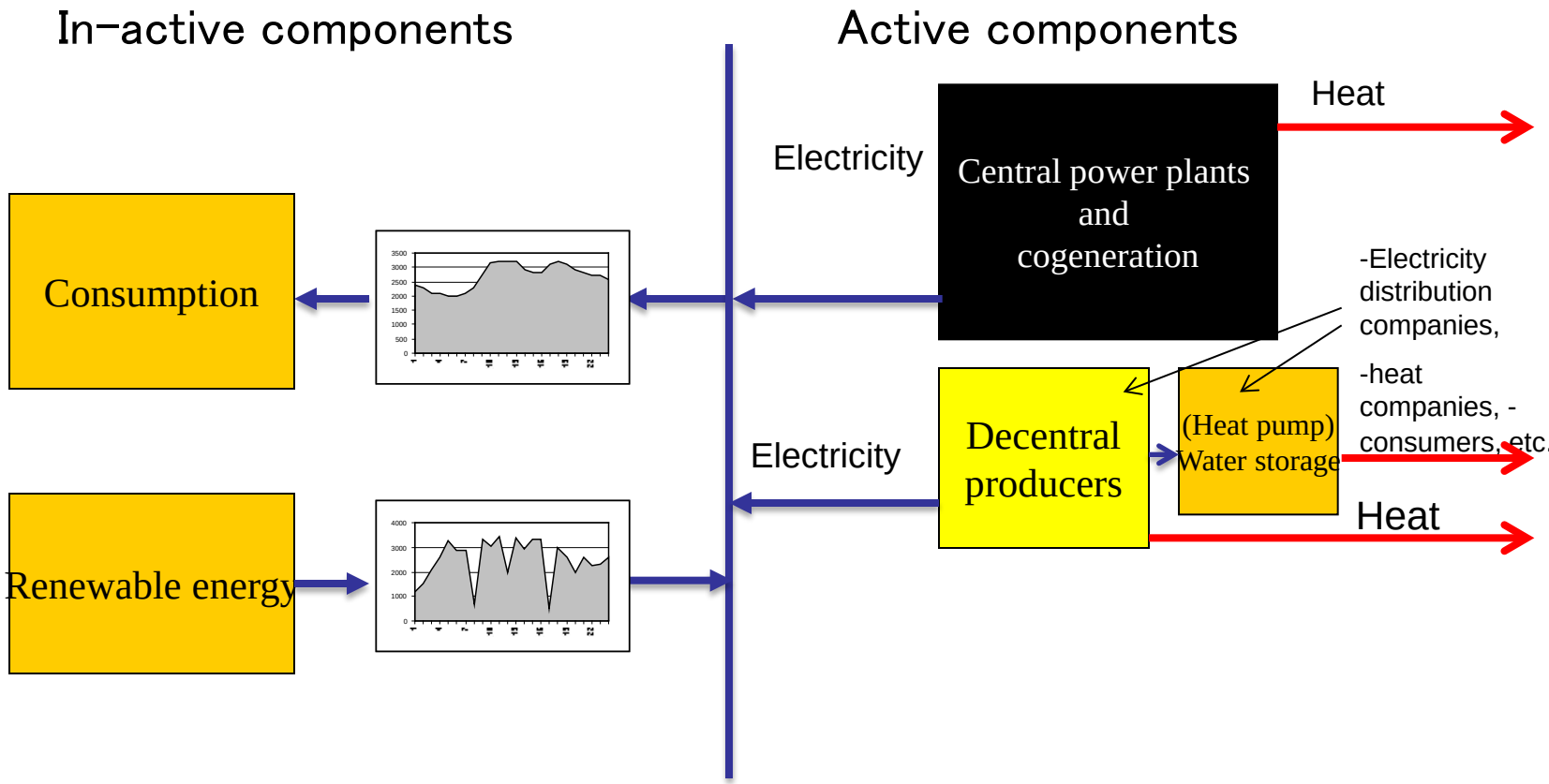
Balance electrical system and grid stability
(Wind power 2-6% of electricity cons. System in Denmark untill around 1996)



System 2 (2000- wind power 15%-19%)
Activating RE via flexible decentral combined heat and power units

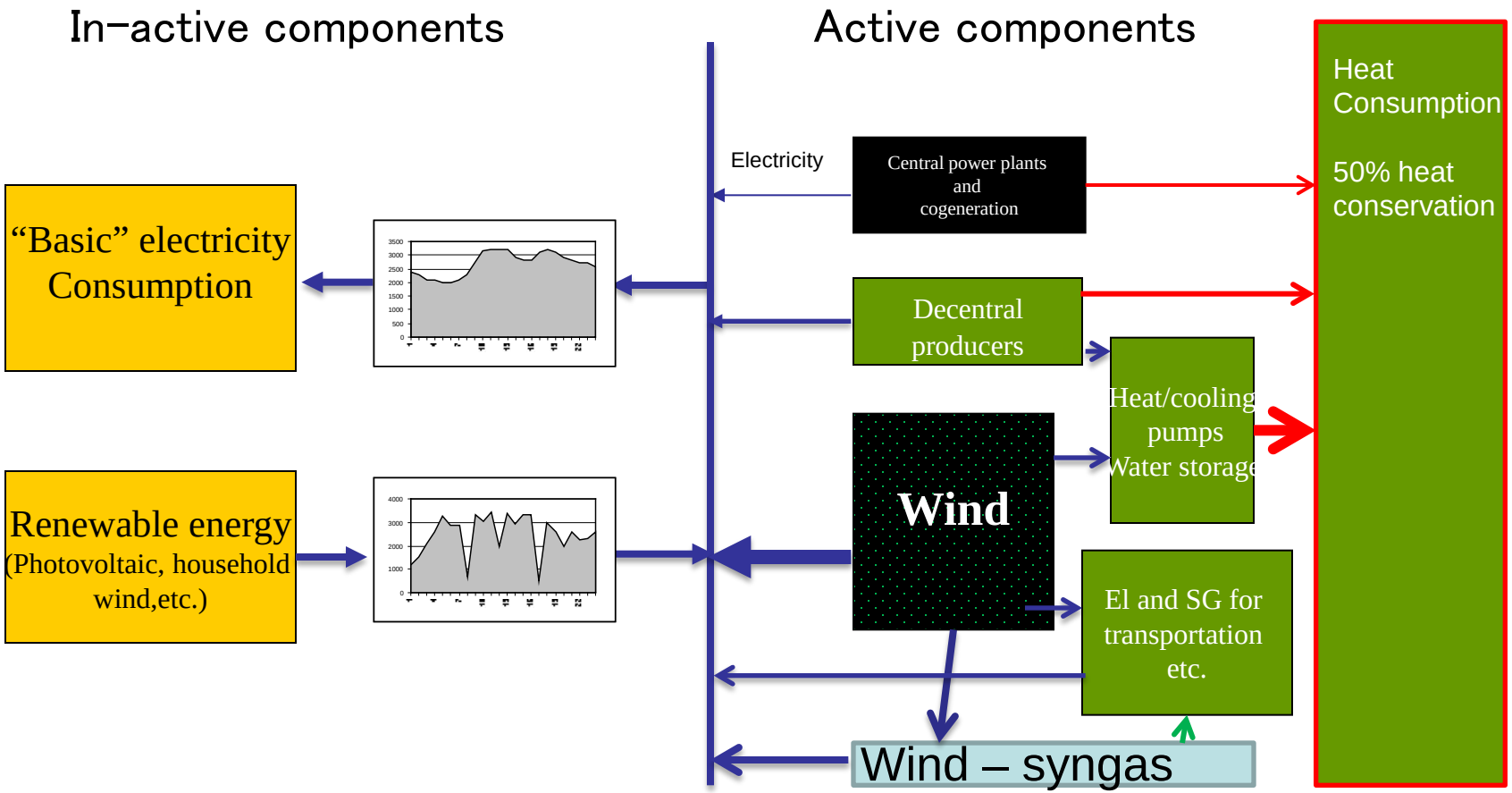


System 3 (2012- wind power 25%-30%)
Activating RE via increased electricity consumption
(heat pumps and water storage)



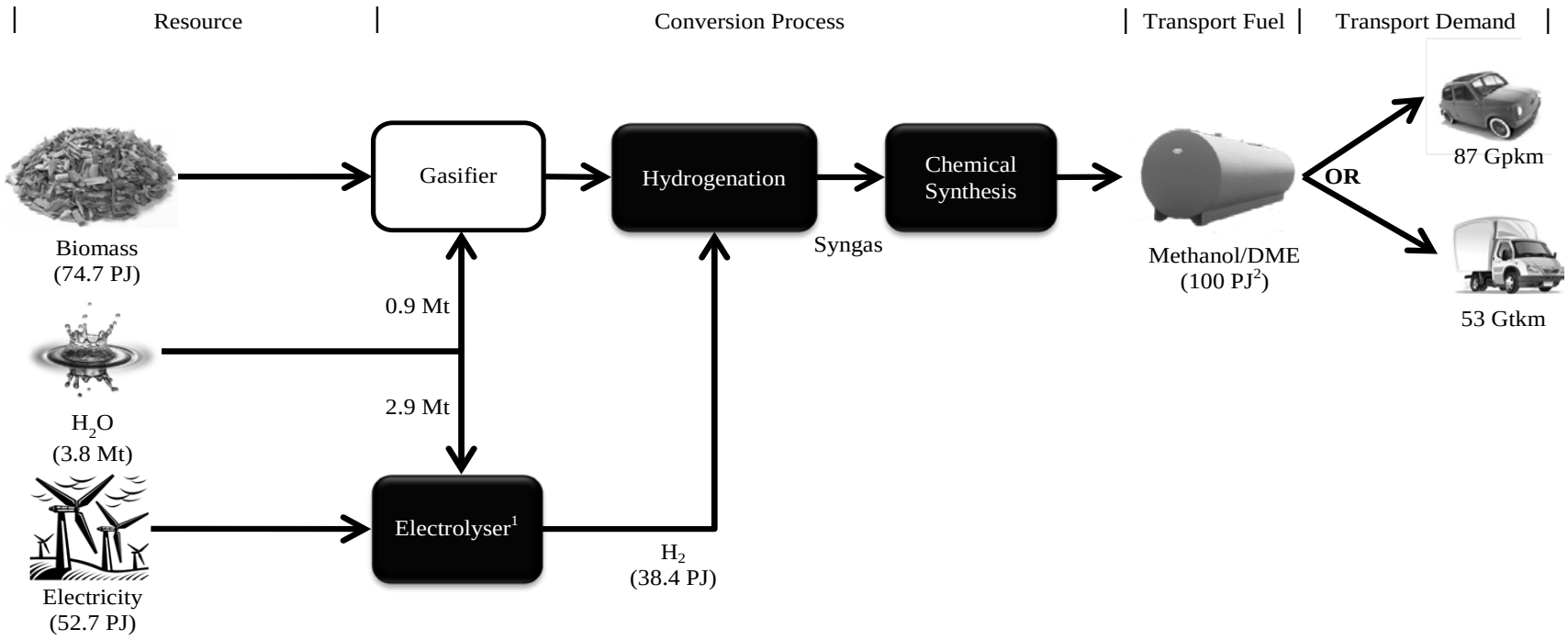
Smart Energysystem (2015- 2050 wind power 50%-100%)

Activating RE via increased electricity consumption for heat pumps and transportation, electricity and heat conservation.



RE and transportation:
Syngas or the Hydrogenation of gasified biomass

(ex. long term solution supplement for electric cars and heat and electricity integration, etc.)



4. Policies for smart energy systems

I. An incentive system for Renewable Energy technologies.

II. A policy for the development and implementation of an intermittency infrastructure.

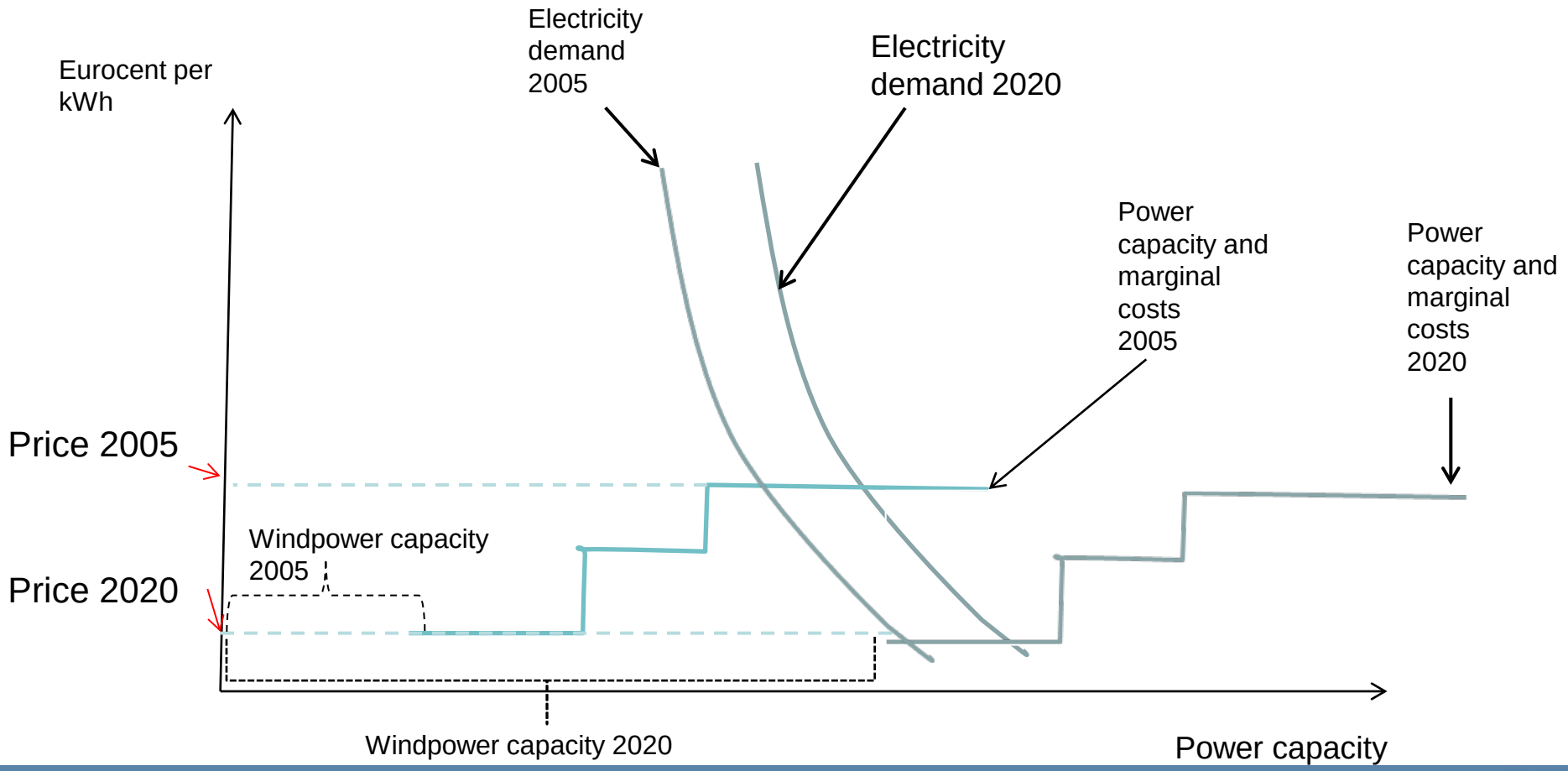
I. Incentive system for Renewable Energy Technologies.

For development and implementation of Renewable Energy technologies

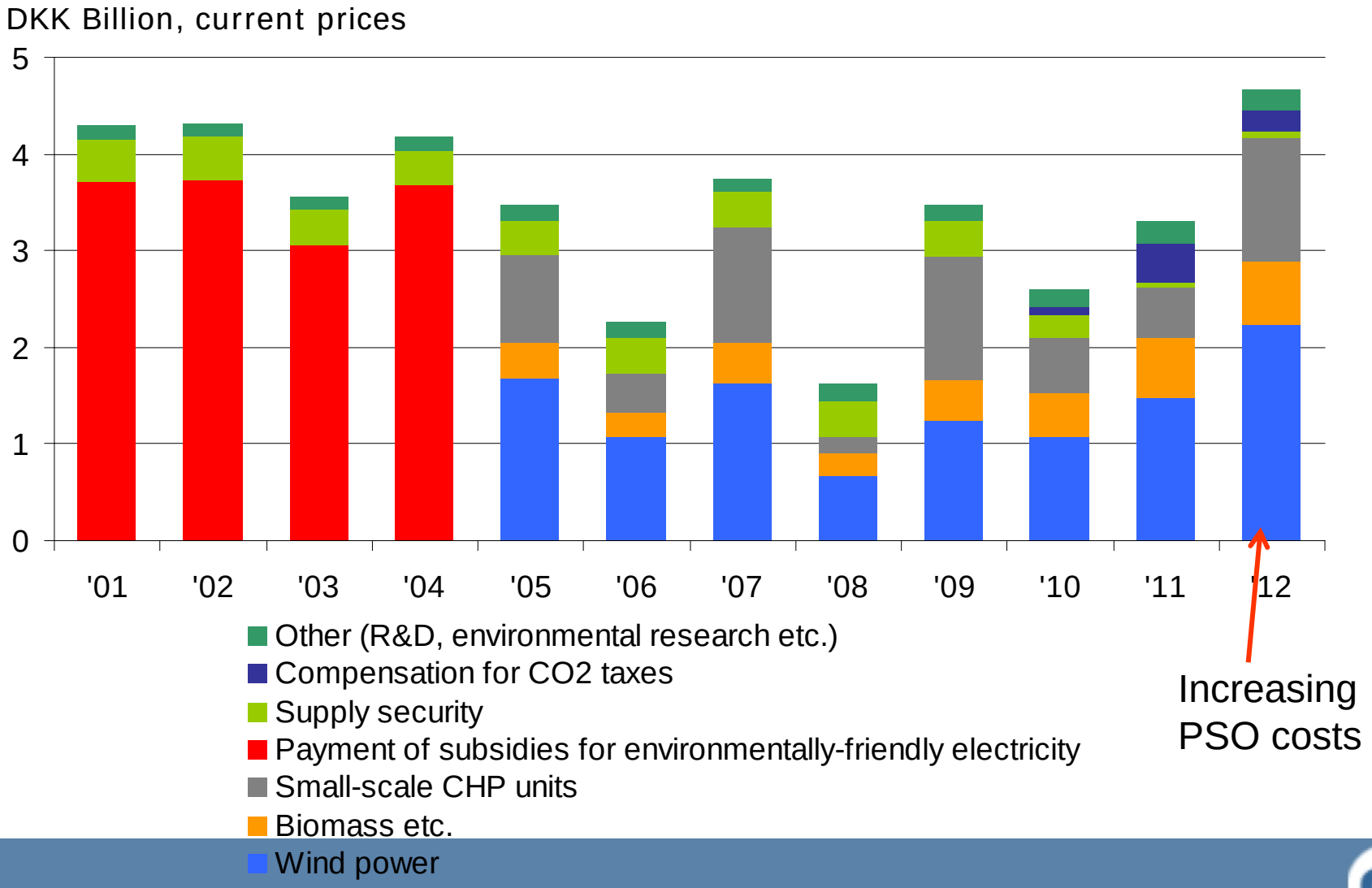
1. Establish a functioning FIT incentive system. (including access, rules for grid payment, etc.()

2. Establish new ownership models with local and regional ownership of Renewable Energy Technologies.

The merit order effect or the economic suicide of wind power on the present power market.



Expenses for public service obligations (PSO) in the electricity area



II. A policy for the development of an intermittency infrastructure.

(some ex. from the Danish case)

Policies for the integration of heat and electricity markets

A first step in The Danish case

1. Reduce electricity tax from 120,5 Euro to 45 Euro per MWh (Note that this is the same as for oil and gas, and higher than on biomass) On following conditions:

2. Obligation to by wind power shares in new wind power capacity equivalent to the annual use of electricity for heat.

3. Obligation to keep a cogeneration capacity alive equivalent to the annual max. use of electricity. (This reduces the need to import electricity in periods of no wind, and thus saves investments in transmission grid systems!!)

4. Obligation to establish a heat pump and hot water storage system at a specified size.

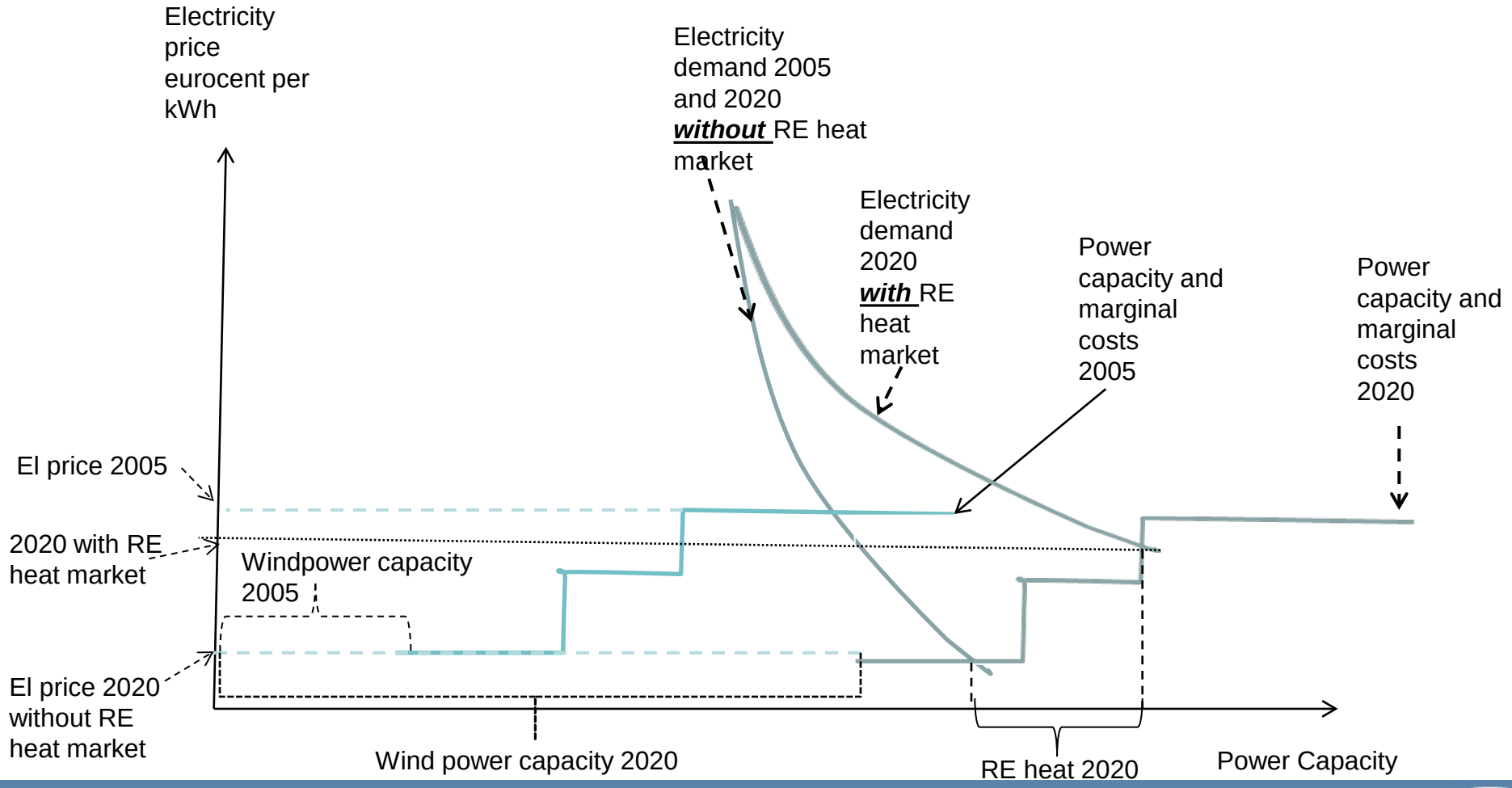
These requirements should make sure:

a. That the lowered tax is not furthering the use of fossil fuel based electricity heating.

b. That the transaction costs linked to the establishment of a flexibility infrastructure is kept low.

c. That a learning proces between owners of wind turbines and owners of flexibility infrastructure should be established.

Integrating electricity and RE heat markets and RE price increase



Intermittency infrastructure policies

1. Secure the survival of Danish CHP plants.
2. Establishment of needed heat storage capacity.
3. Establishment of needed heat pump capacity
4. Establishment of a system with ”plug in” electrical cars.
5. Include transmission costs in electricity prices.
6. Establish ”Energinet” (Danish TSO) procedures for the establishment of an Renewable Energy Intermittency Infrastructure.
7. Establish a policy for the development and implementation of syngas systems.
8. After 1+2+3+4+5+6+7 establish the needed ”international” power transmission systems. (Subsidiarity principle at the RE integration area).
9. And most importantly establish wind turbine ownership to organizations that establishes the needed intermittency infrastructure.

Thank you!