WCRE

Energy for the Future...


Biomass

Wind Power and CHP

for Energy efficiency and balancing of fluctuating power

Preben Maegaard,

Director, Nordic Folkecenter for Renewable Energy

President Emeritus, World Wind Energy Association

Chairman, WCRE, World Council for Renewable Energy,

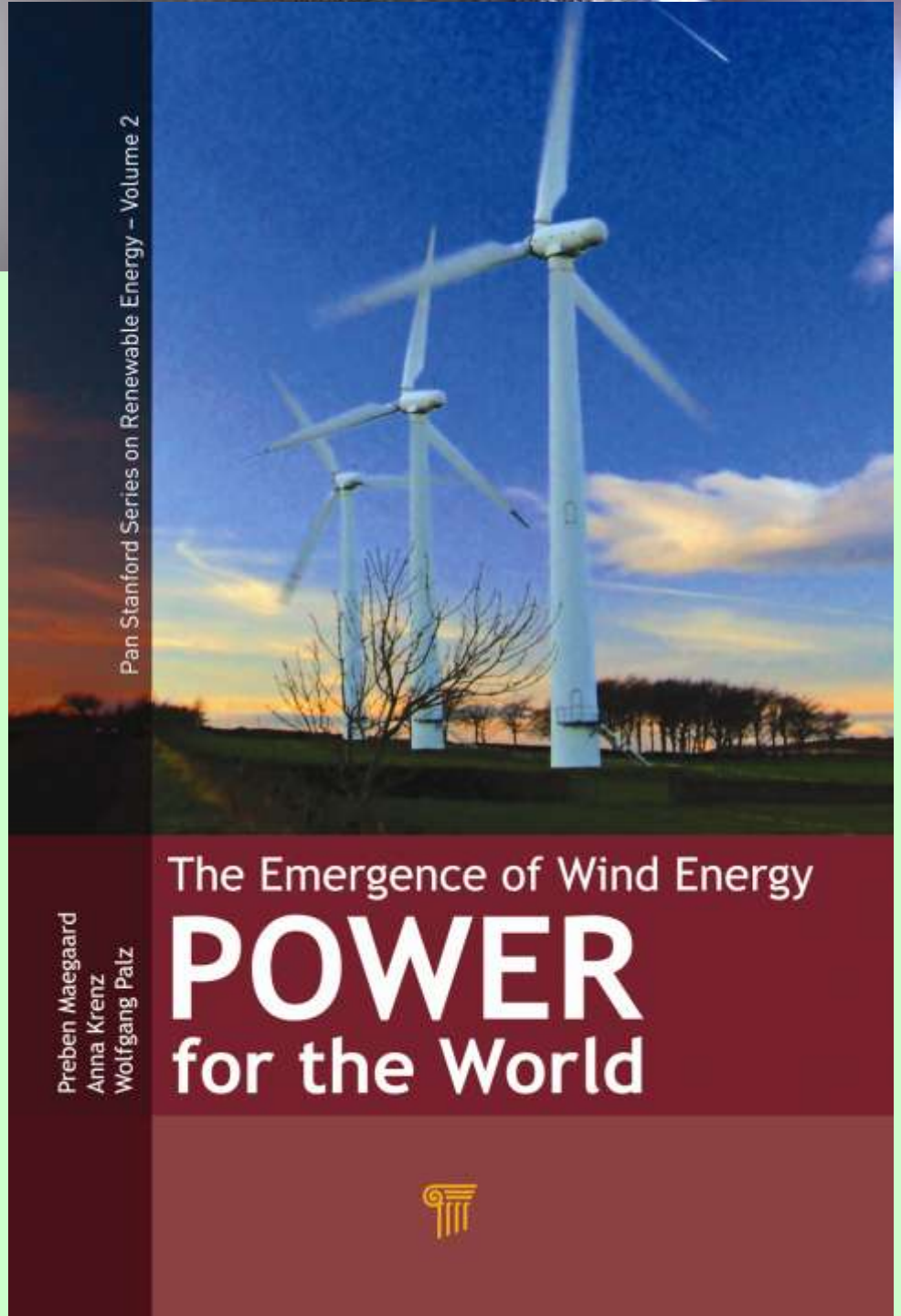
Asian Institute of Technology, Feb. 2., 2013

Folkecenter since1974
had a crucial role:

- To inform
- To inspire
- To involve
- To demonstrate
- To test
- To transfer new technology

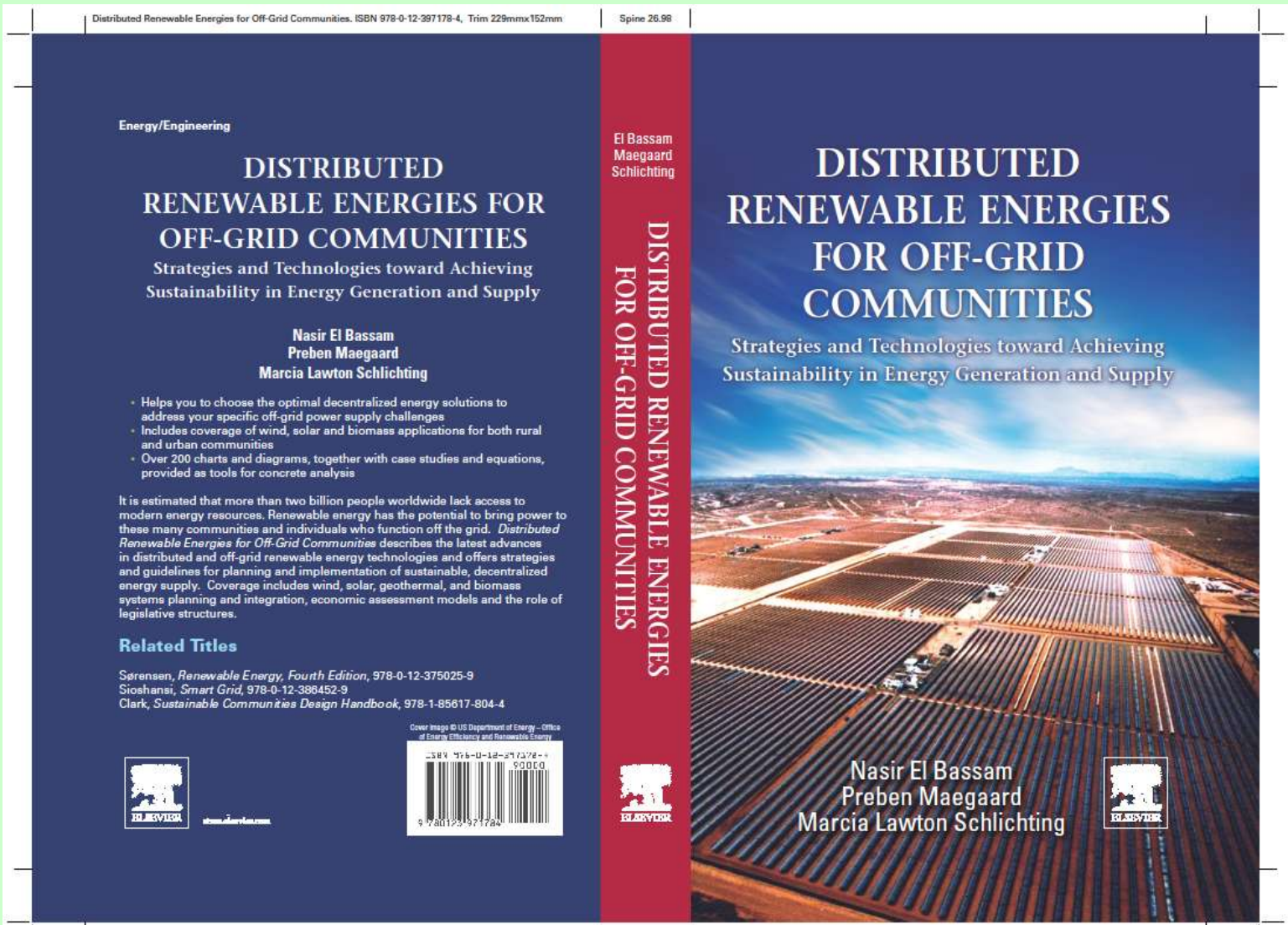
PV at the Folkecenter

WCRE


Pan Stanford Series on Renewable Energy – Volume 2
Preben Maegaard
Anna Krenz
Wolfgang Palz
The Emergence of Wind Energy
POWER
for the World

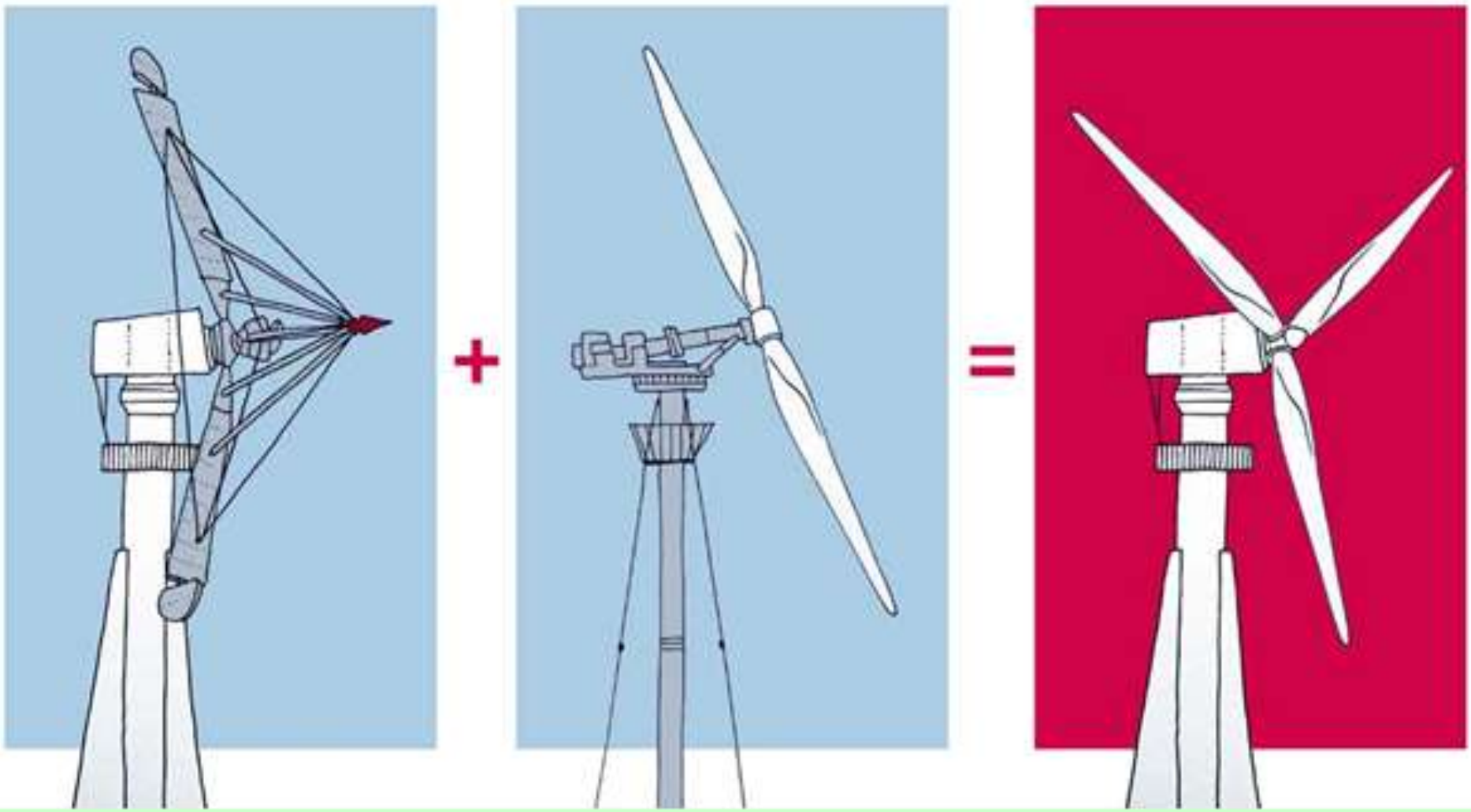
WCRE

• New Book

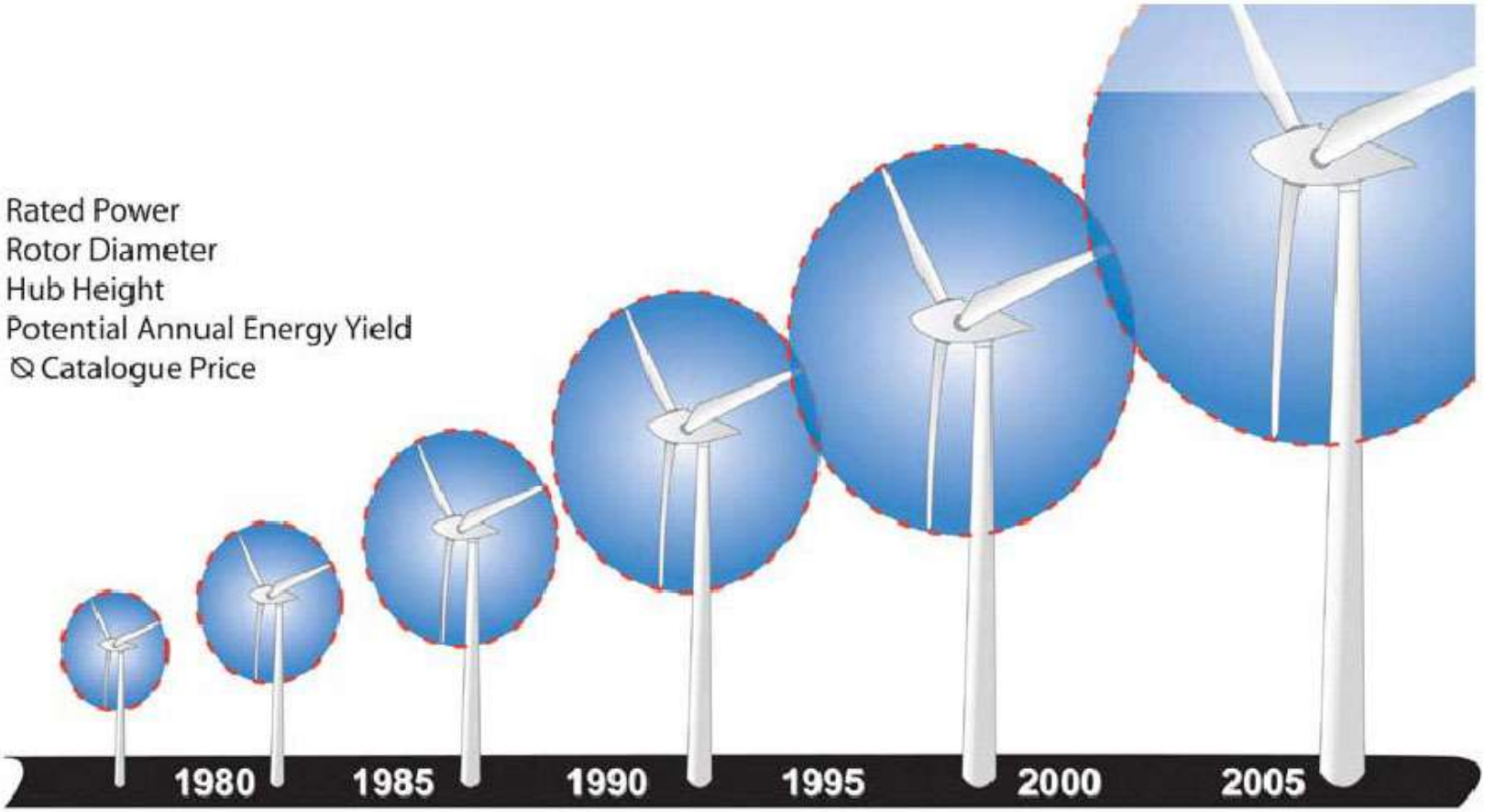


New Book in 2013:
The Emergence of Modern Wind Power

WCRE



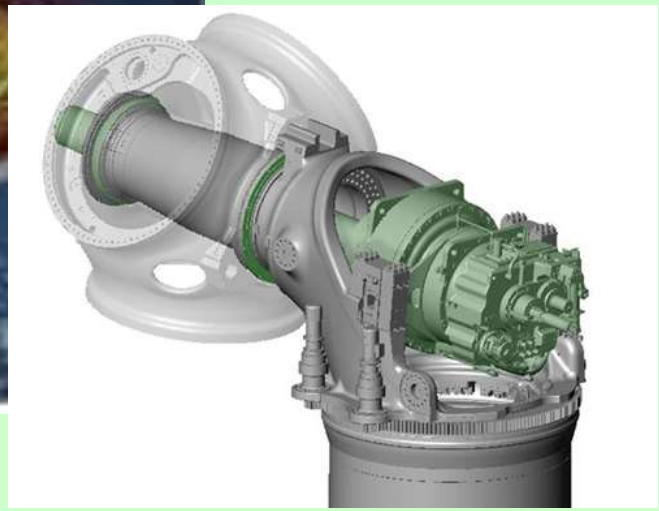
Development of Wind Energy Technology



	1980	1985	1990	1995	2000	2005
R-Power :	30 kW	80 kW	250 kW	600 kW	1.500 kW	5.000 kW (Offshore)
Rotor :	15 m	20 m	30 m	46 m	70 m	115 m
Hub Height:	30 m	40 m	50 m	78 m	100 m	90 m
Yield/a :	35.000 kWh	95.000 kWh	400.000 kWh	1.250.000 kWh	3.500.000 kWh	ca. 17.000.000 kWh

One 2 MW windmill: 8 mio. kWh/y

Alsthom/Ecotenica 5 MW



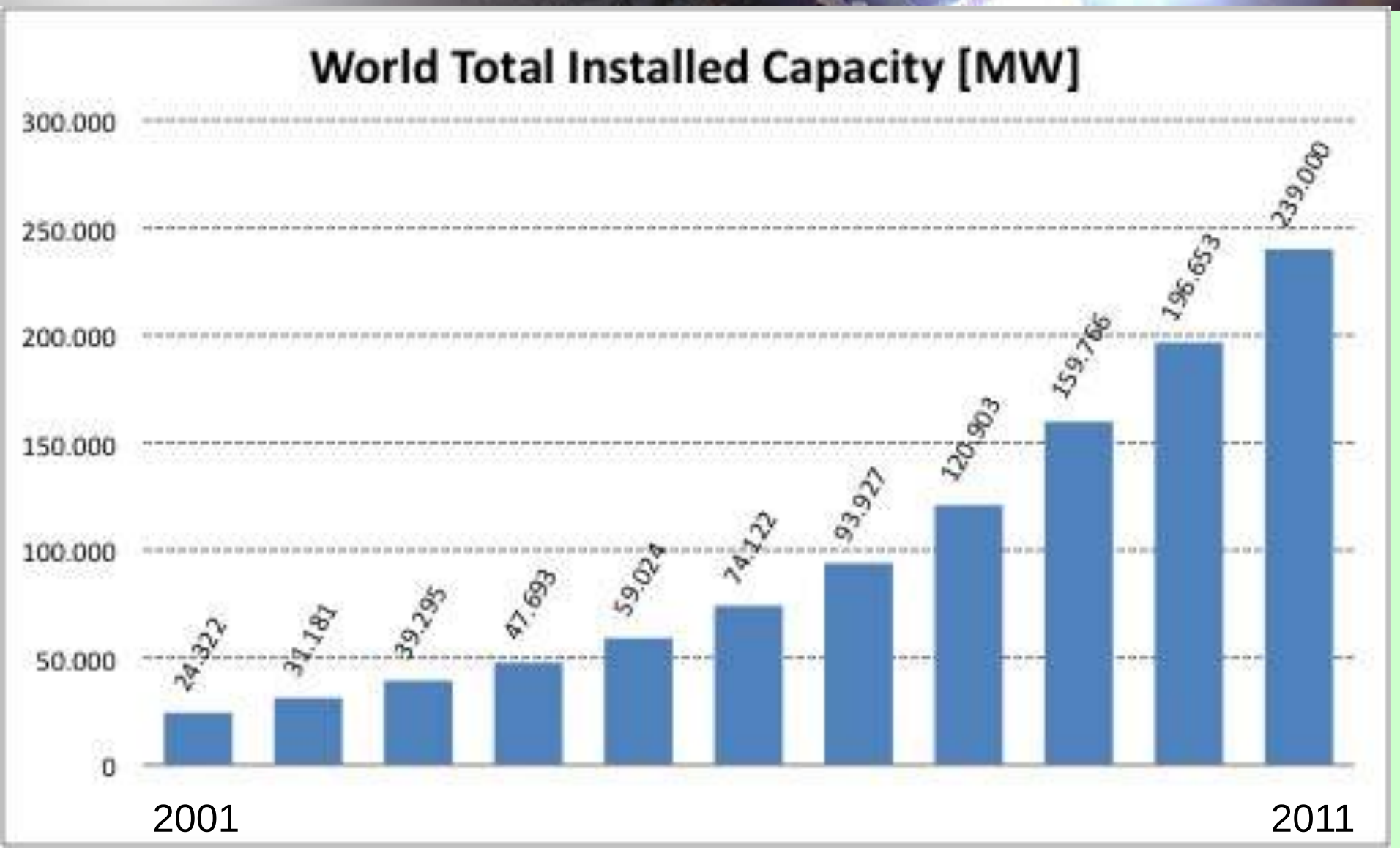
Local Production, Sri Lanka, 2013

Wind Power by Country, ultimo 2011

Country	Total Capacity end of 2011 [MW]	Added Capacity 2011 [MW]	Total Capacity end 2010 [MW]	Added Capacity 2010 [MW]	Total Capacity end 2009 [MW]
China *	62.733	18.000	44.733	18.928	25.810
USA	46.919	6.810	40.180	5.600	35.159
Germany	29.075	2.007	27.215	1.551	25.777
Spain	21.673	1.050	20.676	1.515	18.865
India *	15.800	2.700	13.065	1.258	11.807
Italy *	6.747	950	5.797	950	4.850
France	6.640	980	5.660	1.086	4.574
United Kingdom	6.018	730	5.203	962	4.245
Canada	5.265	1.267	4.008	690	3.319
Portugal *	4.290	588	3.702	345	3.357
Denmark	3.927	180	3.803	309	3.460
Sweden	2.816	746	2.052	603	1.450
Japan	2.501	167	2.334	251	2.083
Rest of the World*	24.200	6.000	18.201	3.191	15.010
Total*	238.604	42.175	196.629	37.642	159.766

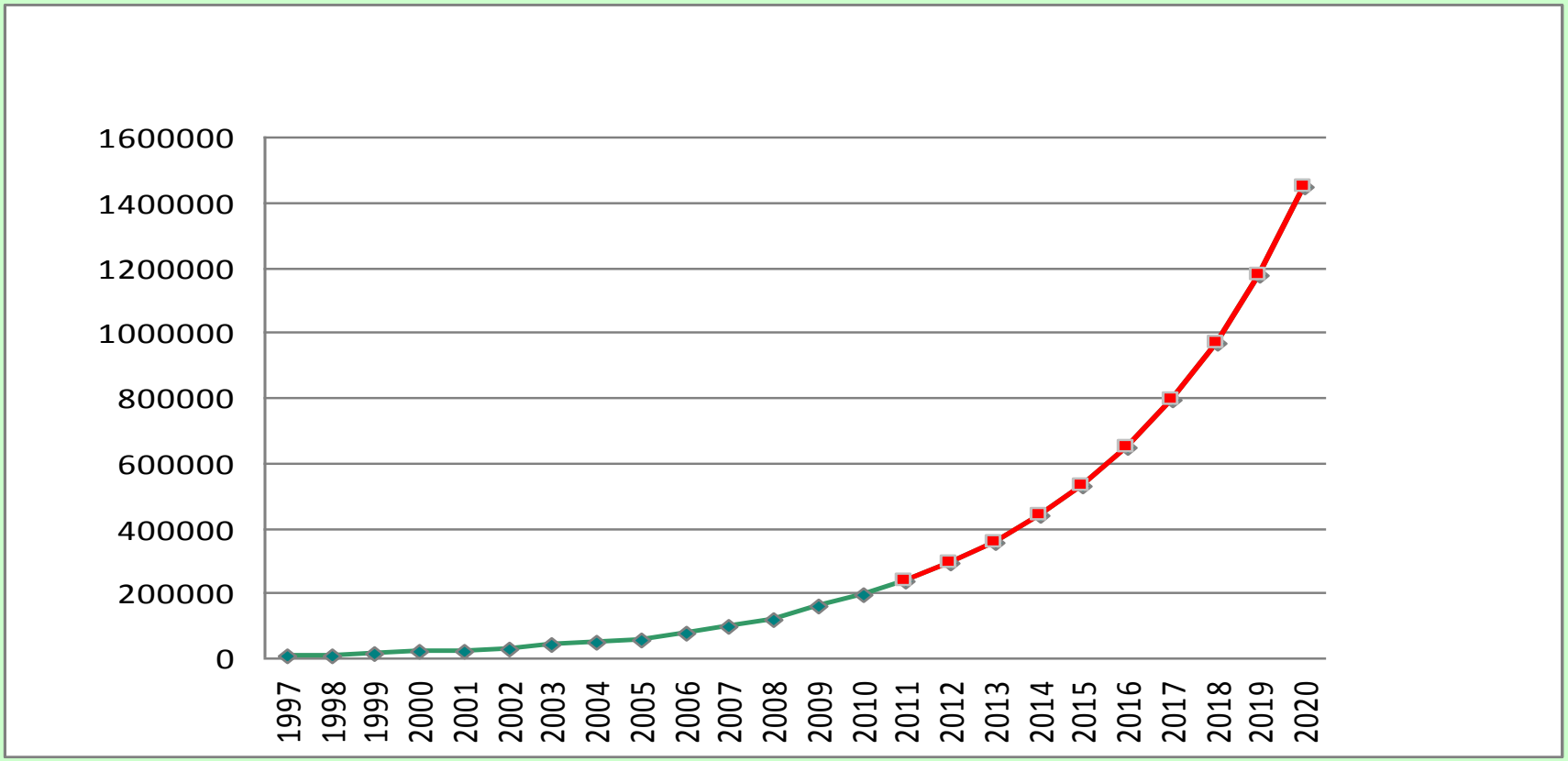
*- Preliminary Data

Wind Power, World Total 2001 til 2011



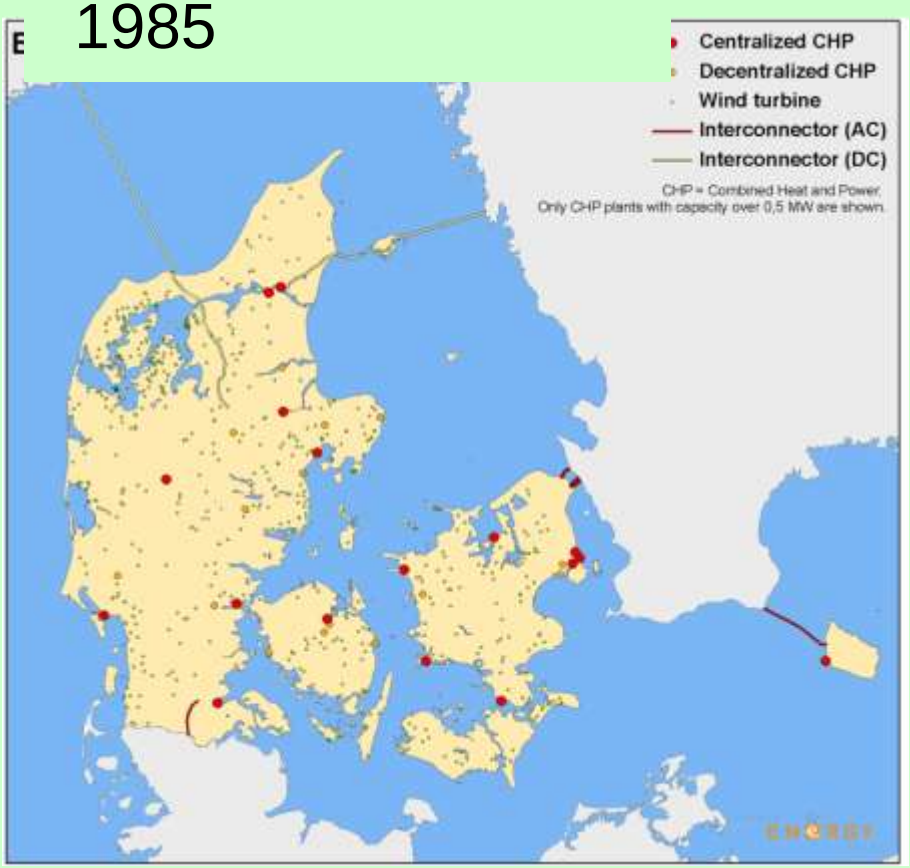
WCRE

Total Installed Wind Capacity 1997 – 2010 [MW] and Forecast of Wind Energy Installation Worldwide up to 2020

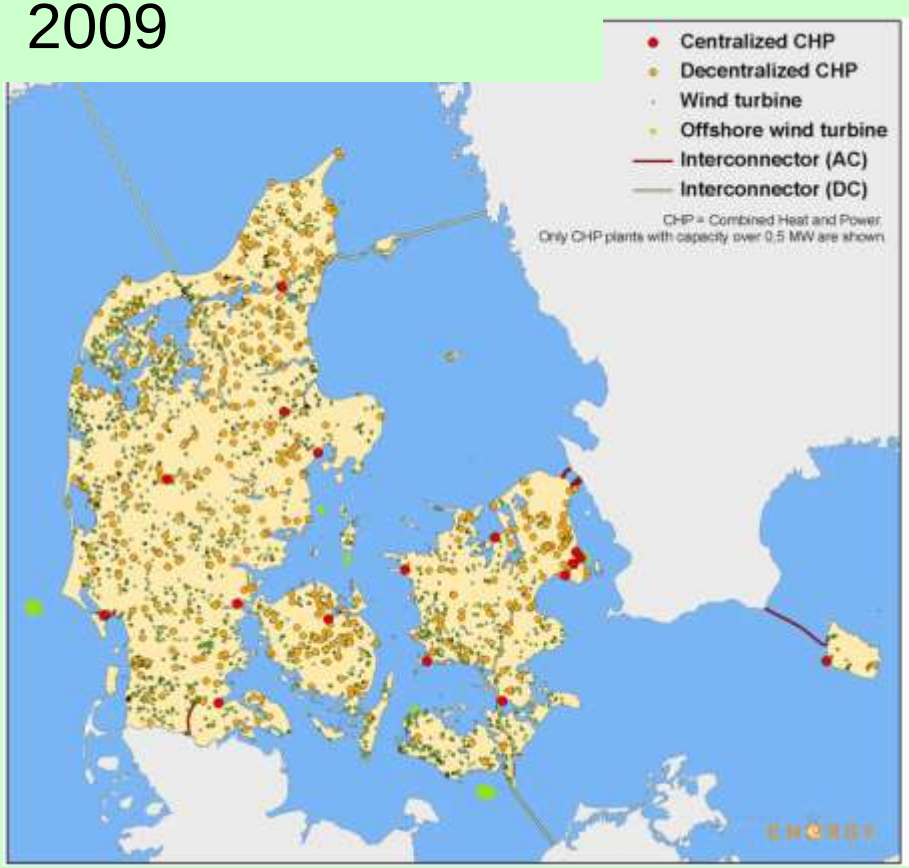


Denmark's Energy Infrastructure 1985 and 2009

1985

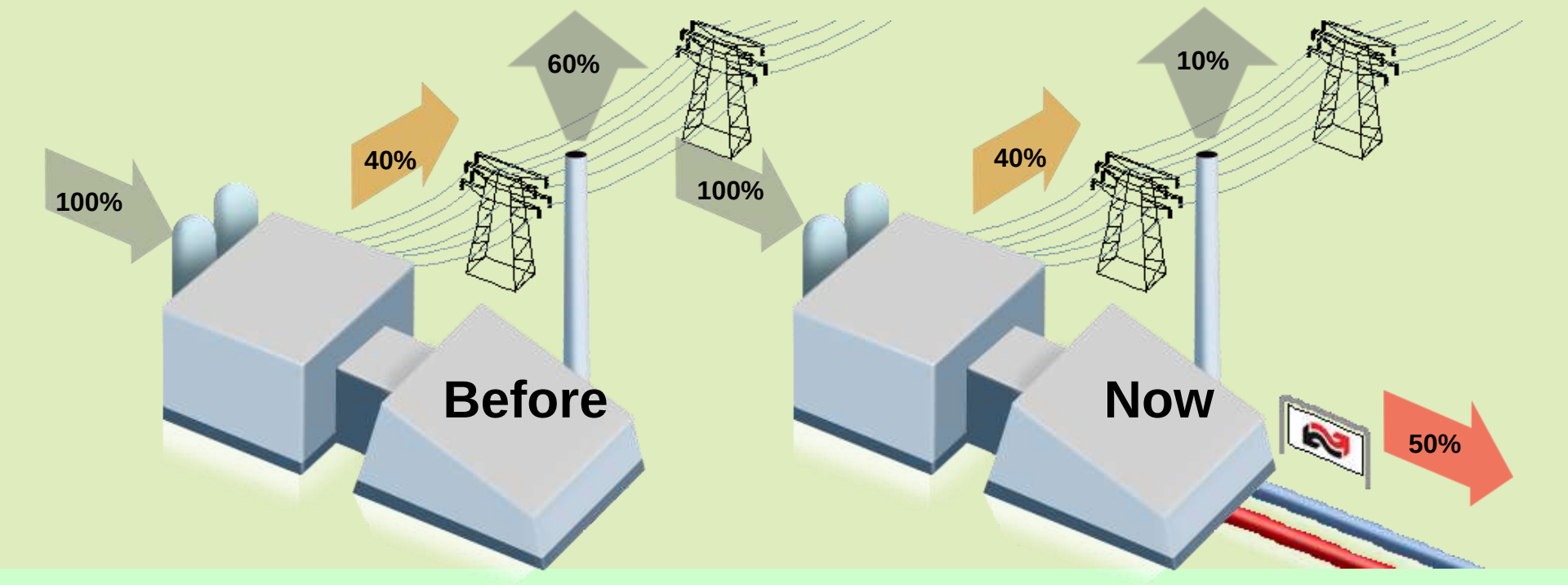


2009



CHP: Two Times more efficient!

District Heating and CHP is the single most important improvement of energy efficiency

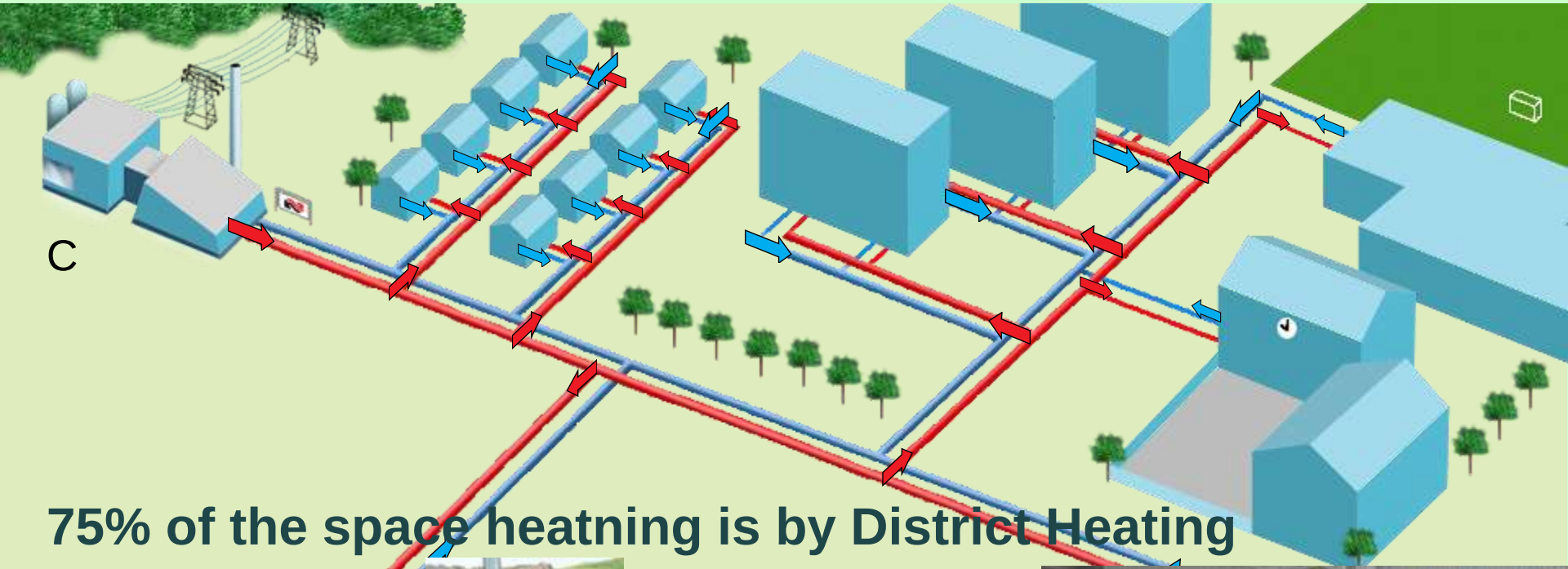


Conventional Power Plant

Combined Heating/Cooling & Power

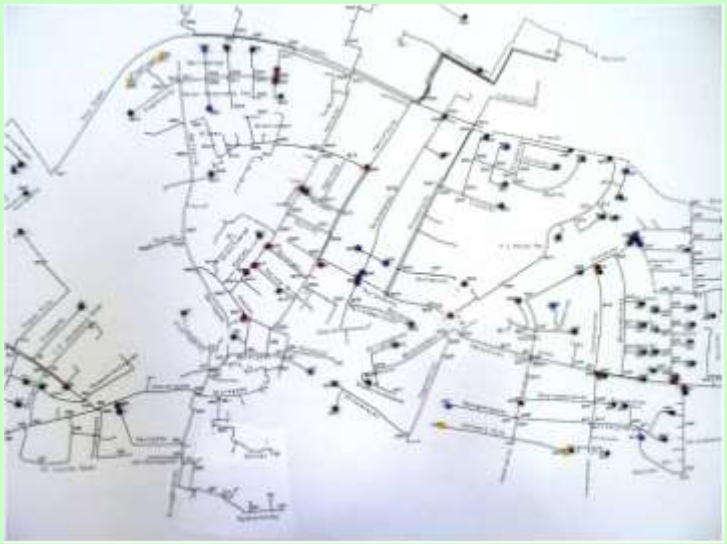
When the Cooling Towers are the Radiators in People,s Houses

60.000 km pipelines for heating and cooling in Denmark



75% of the space heatning is by District Heating

Thyra supplies10.000 households with heat and some power

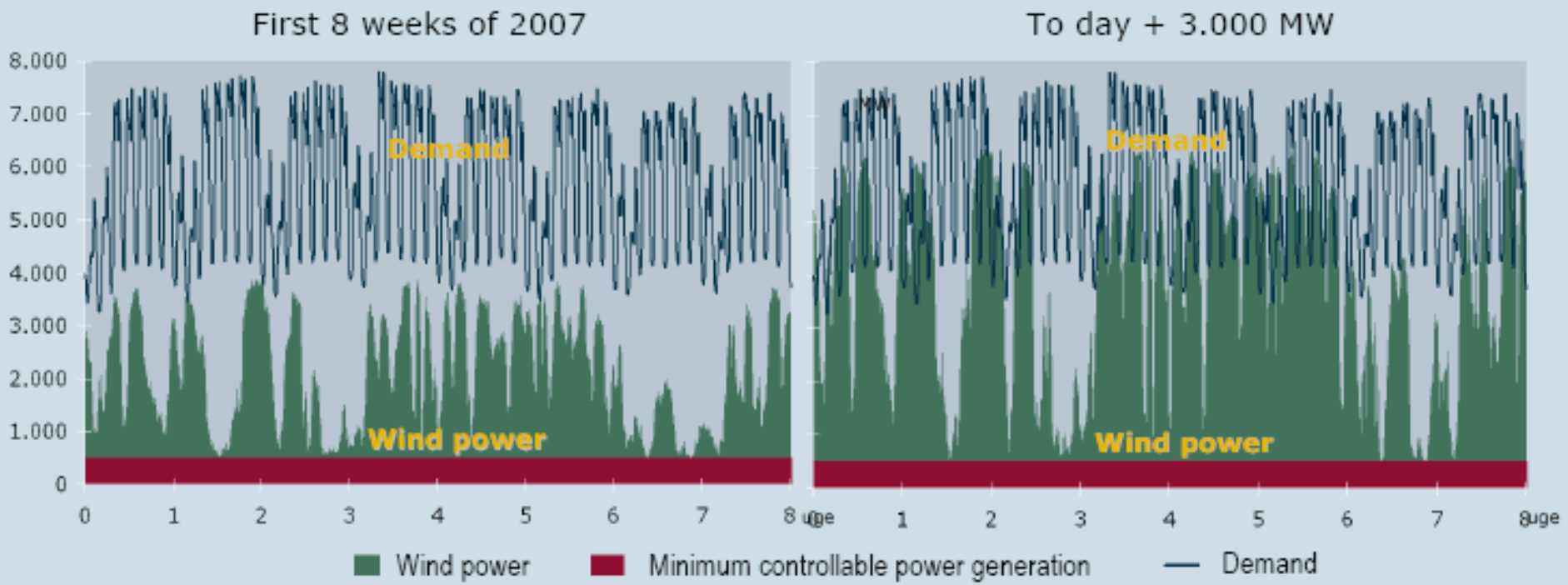


Consumption of power is predictable –

Wind- and solar power fluctuates

Power Demand and Wind Power Denmark, 2007 and 2015

Integration of additional 3,000 MW Wind power?



Denmark must utilize **domestic resources** and **trade with neighbors.**

Security of supply must bee maintained and the value of Wind power should be maximized ecological and economical

WCRE

Denmark, Sep 7, 15.00, 2011

New Government:
50% from the Wind by 2020

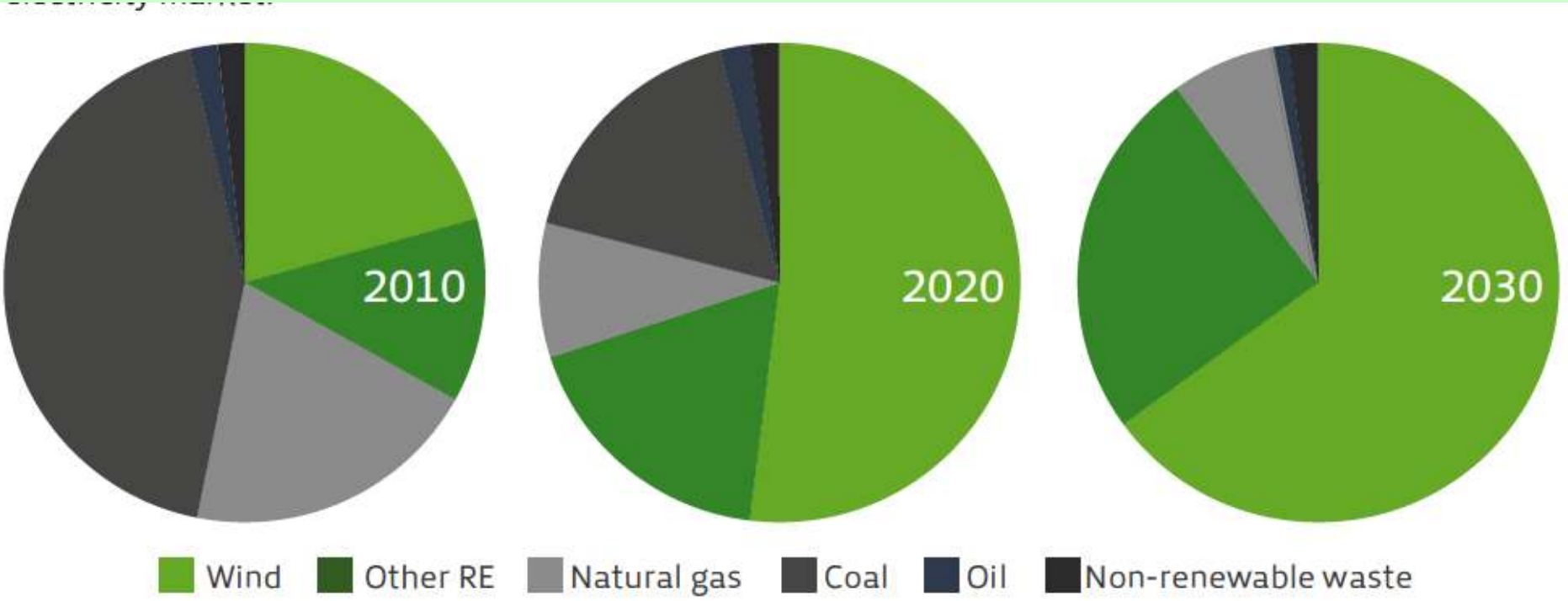


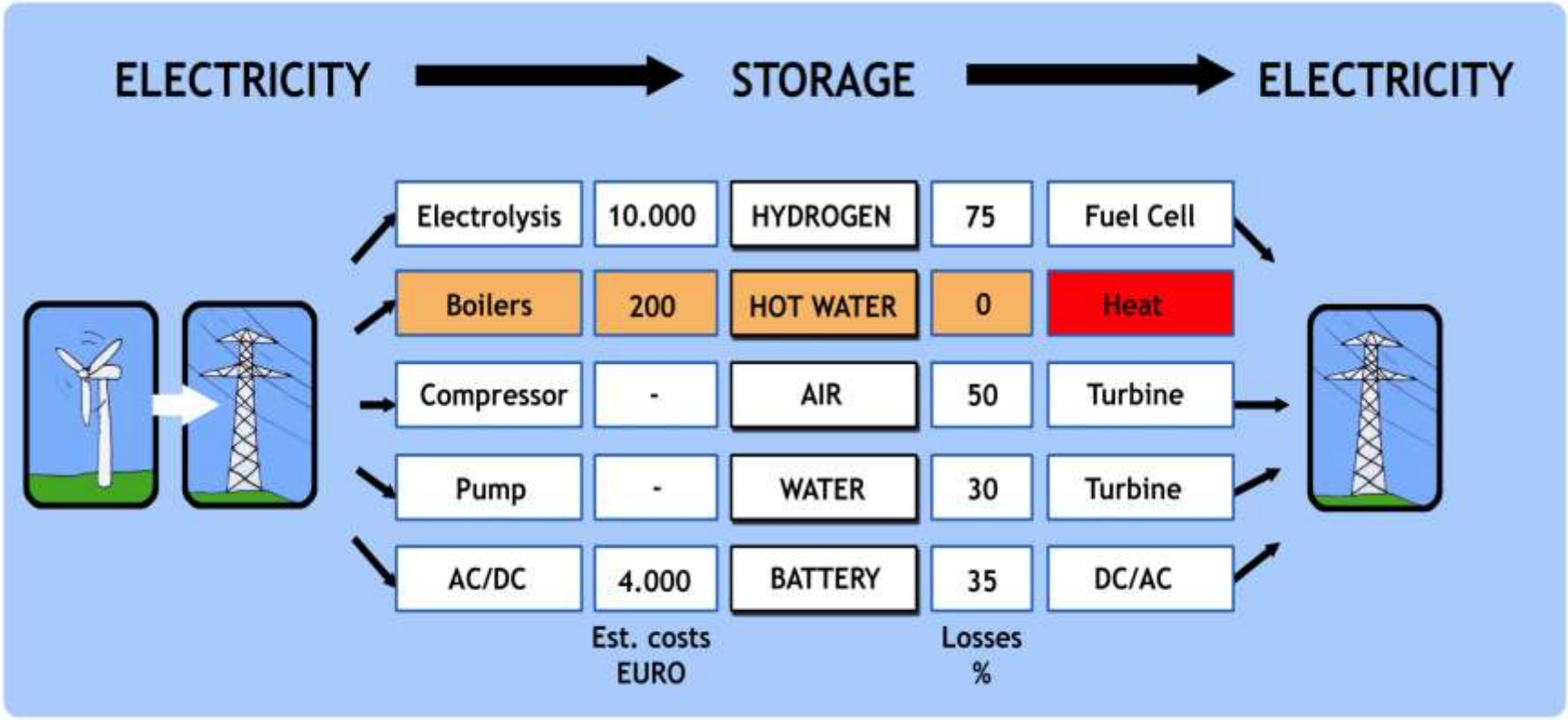
Figure 3.2 Electricity production by energy source (adjusted for electricity trading)

Energy Denmark 2011

Energy key figures for 2011

	Denmark	
Wind share of net generation in area		29.4 %
Wind share of consumption in area		28.3 %
RE-share of net generation in area		41.1 %
Electricity accounts for the grid	**GWh**	
Electricity generation ex facility (Gross including own consumption)		35,040
Electricity generation ex facility (net including own consumption)		33,210
Imports, gross		11,728
Exports, gross		10,410
Grid loss in transmission grid		934
Sale to distribution		33,594
Specification of electricity generation	**GWh**	
Electricity from wind turbines		9,765
Electricity from hydropower and photovoltaics		18
Electricity from thermal production on RE-fuels		3,851
Electricity from thermal production on non-RE-fuels		19,577

Wind Heat and Power, WHP

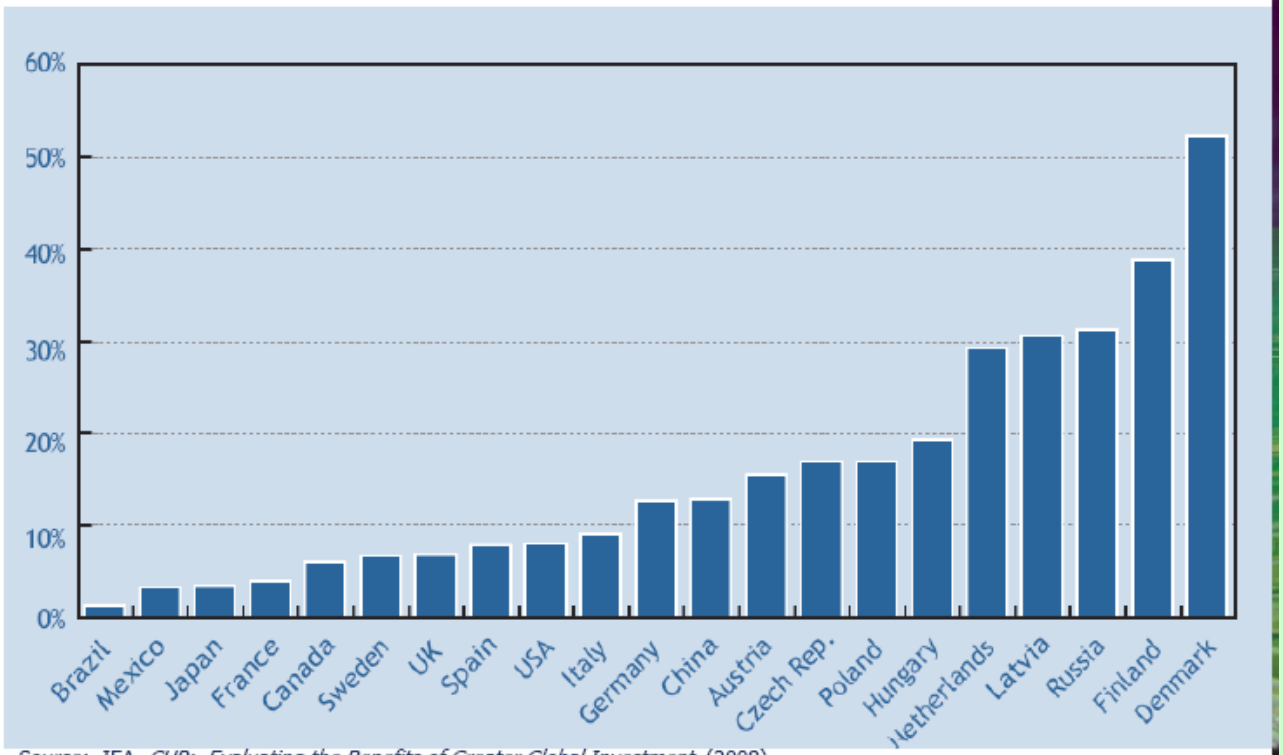


NEXT STEP

Integrating wind and CHP

CHP in Selected Countries

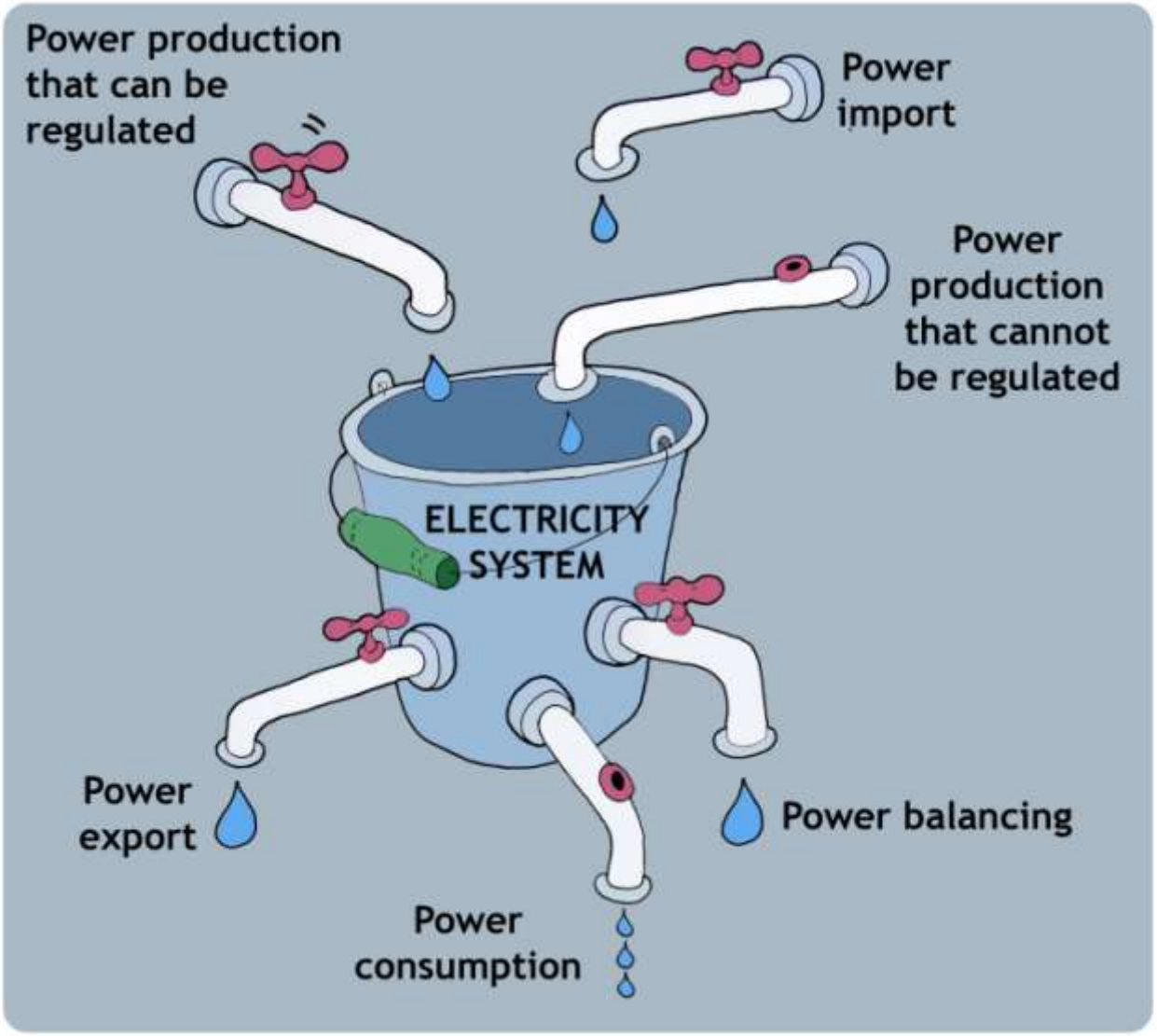
CHP as a Share of Total National Power Generation



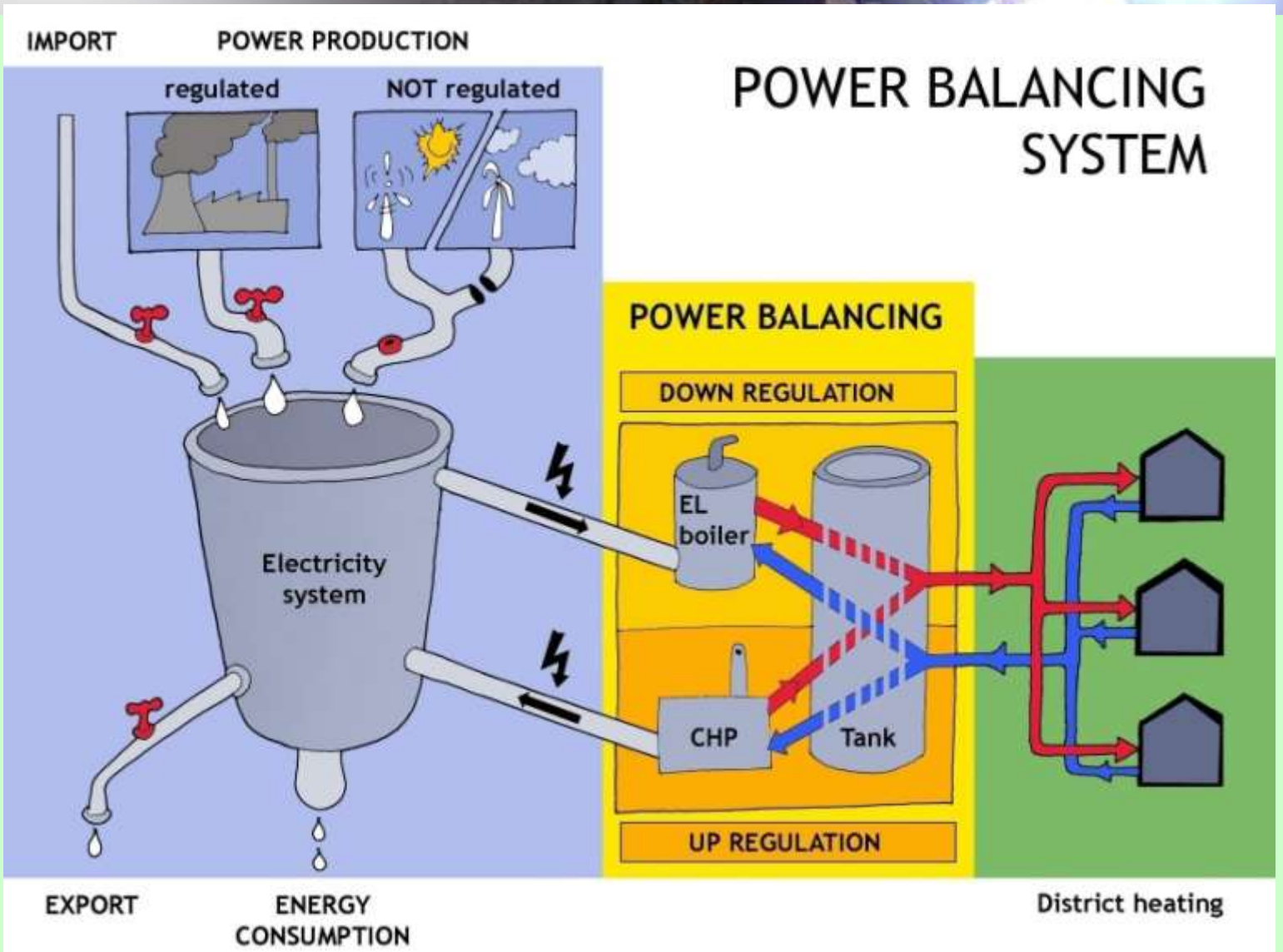
Source: IEA, *CHP: Evaluating the Benefits of Greater Global Investment* (2008).

Average use of CHP is just 9%

The Need for Power Balancing



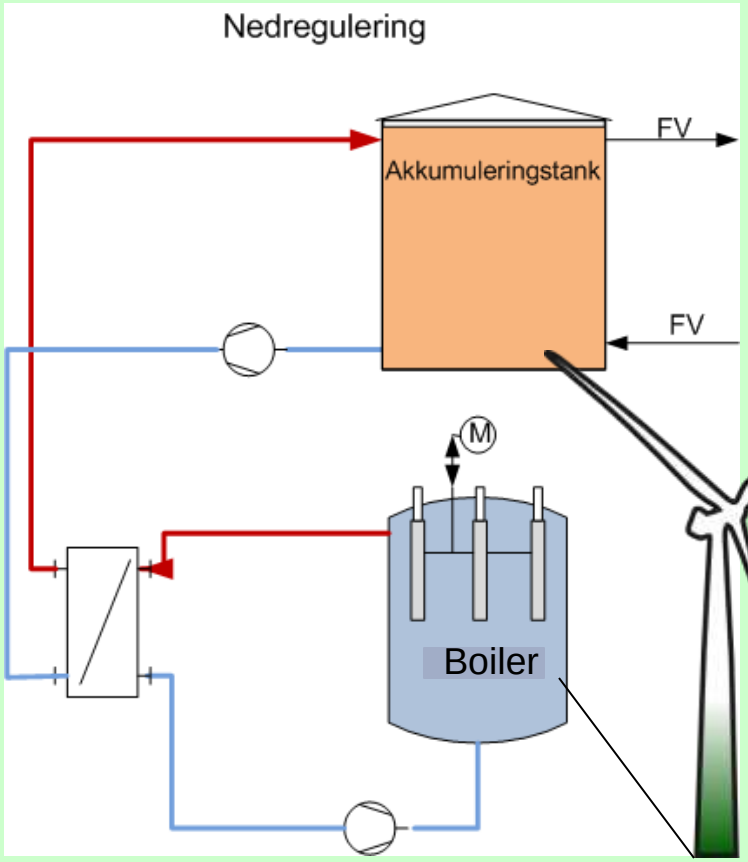
Power balancing must happen in the communities



Basic down-regulating technologies

WCRE

Hot water storage



20 MW electric boiler

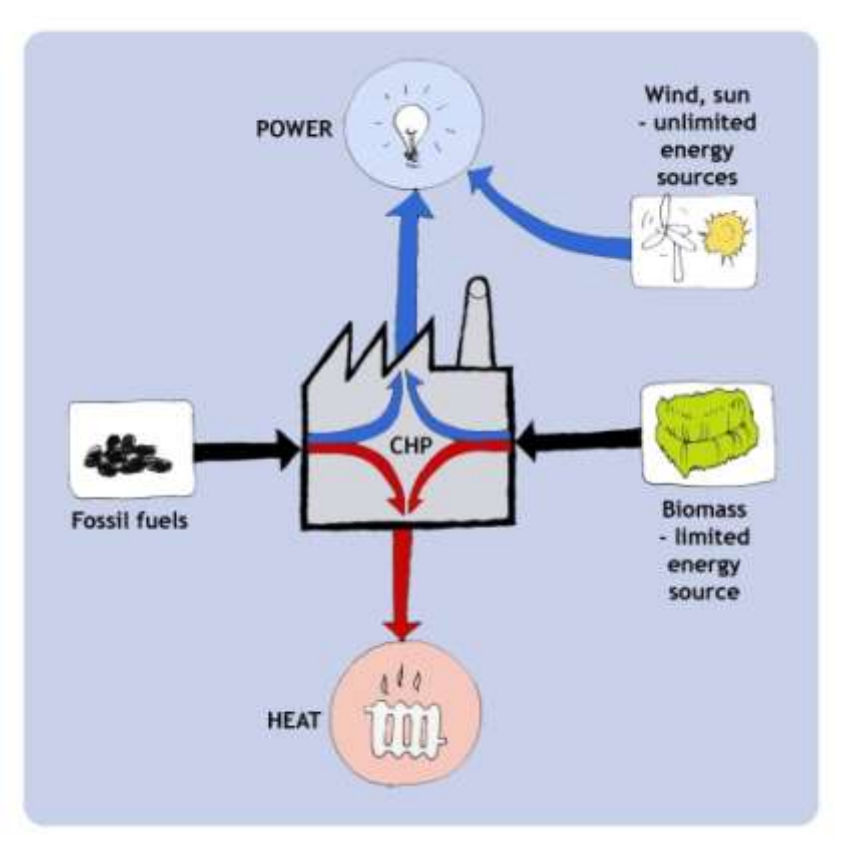
Vorupör, 1,8 MW_{el}, 800 Inhabitants

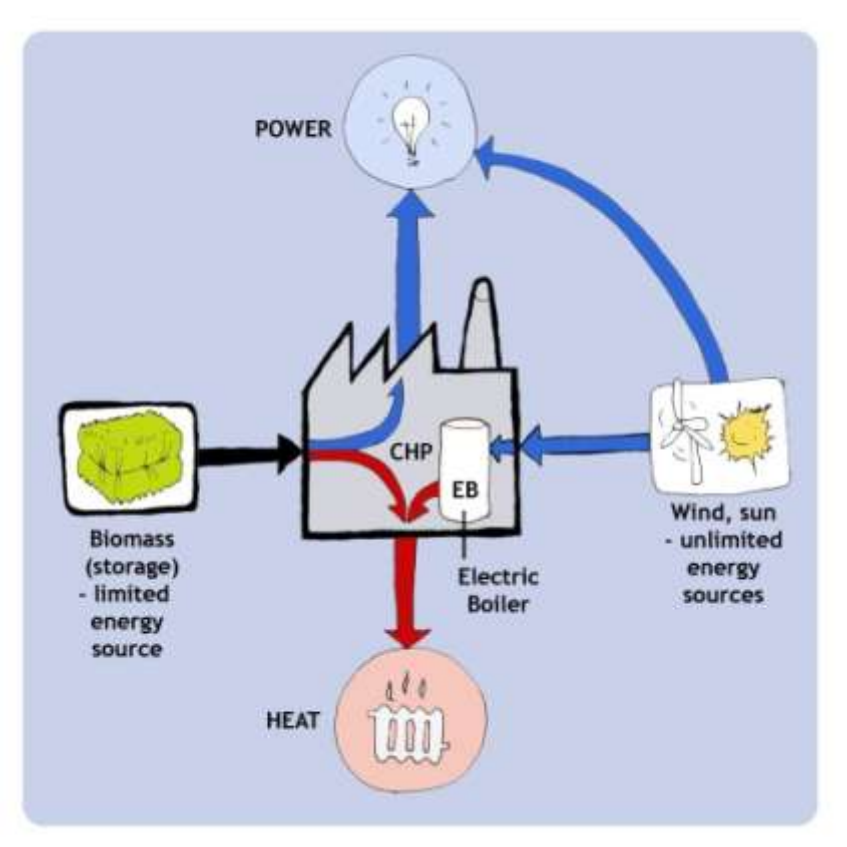
Faaborg, 7 Mw_{el}, 7.000 Inhabitants

Wind Power for Heating in Hanstholm

6 MW Electric Boiler in Snedsted

Replacement of Fossil Fuels by stored Biomass



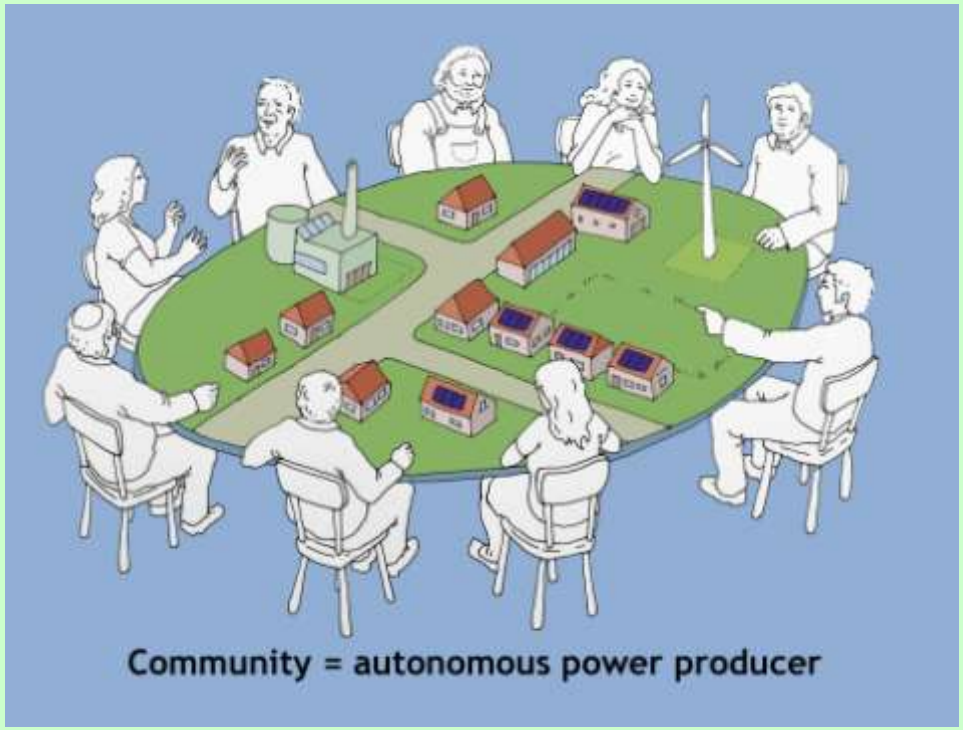


The Supply Doctrine

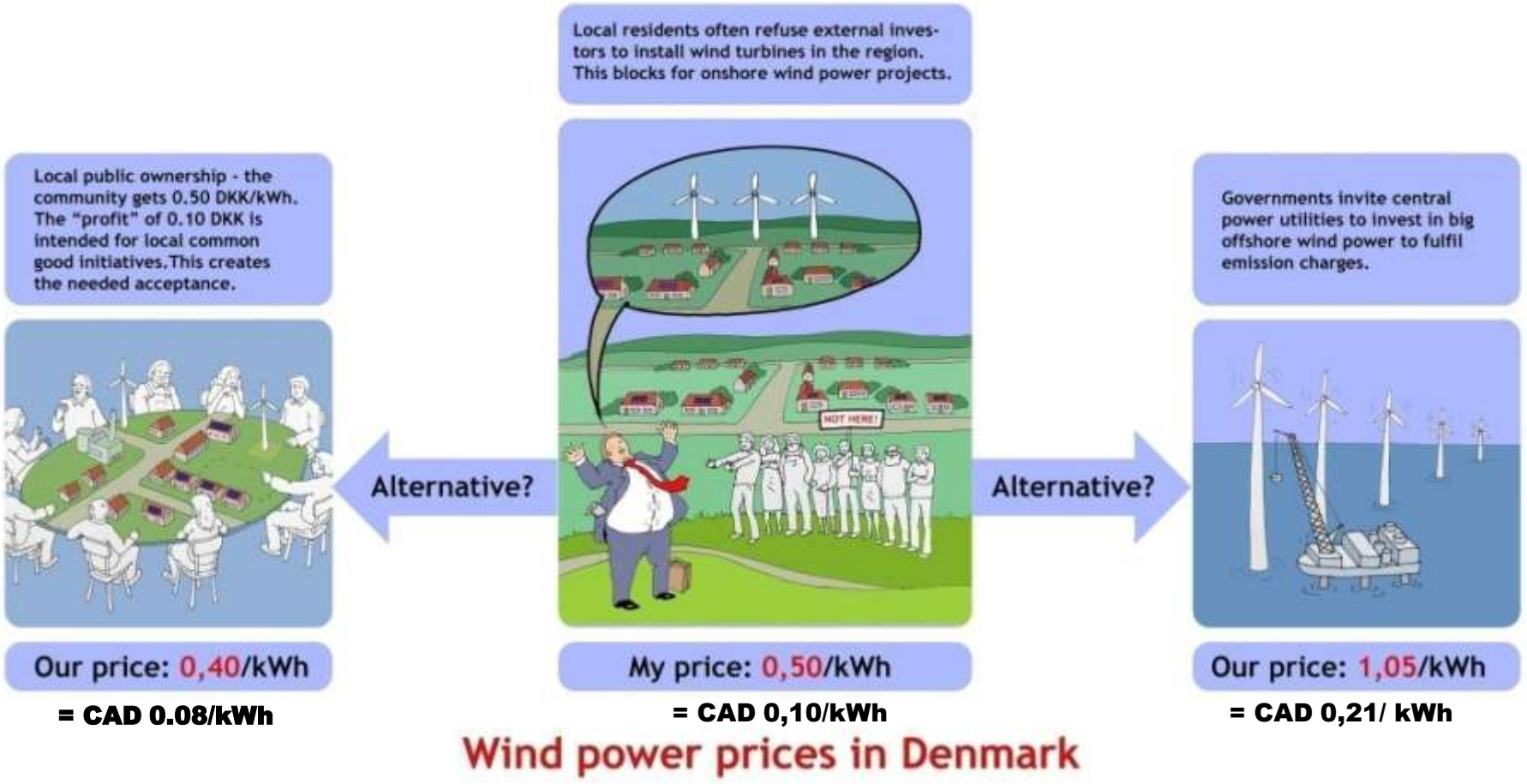
1. Further development can make wind & solar power the primary source for electricity and heating
2. Excess power will be used in local CHP plants and replace biomass and natural gas.
3. Biomass and natural gas will be back-up storage when wind- and solar energy is not sufficient.
4. Biomass and NG are limited resources and should not be used when sufficient solar and wind is available.

WCRE

WCRE



Welcome to Community Wind Power. It is cheaper as well!



WCRE

Wind is a natural ressource!

The answer. . . . . .

End of the Presentation

Thank you for listening!

Questions and comments are welcome.

www.folkecenter.net

Email: pm@folkecenter.dk