Integration of renewable energy in China - status and challenges

Kaare Sandholt
Chief expert
China National Renewable Energy Centre

About me

- Chief Expert at the China National Renewable Energy Centre
- International Advisor for the Sino-Danish Renewable Energy Programme.
- Director of System Operation Department in the Eastern Danish TSO 2004 – 2005
- Working with energy planning and renewable energy in Denmark and Europe for more than 30 years.
- working with integration of renewable energy in China since 2009

China National Renewable Energy Centre

- Assist China's energy authorities in RE policy research, industrial management and coordination
- Located in Energy Research Institute of NDRC

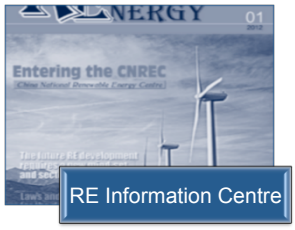
CNREC
CHINA NATIONAL RENEWABLE ENERGY CENTRE

Policy Research

Industry Development

Demonstration Projects management

International cooperation



RE Information Centre

Testing centre

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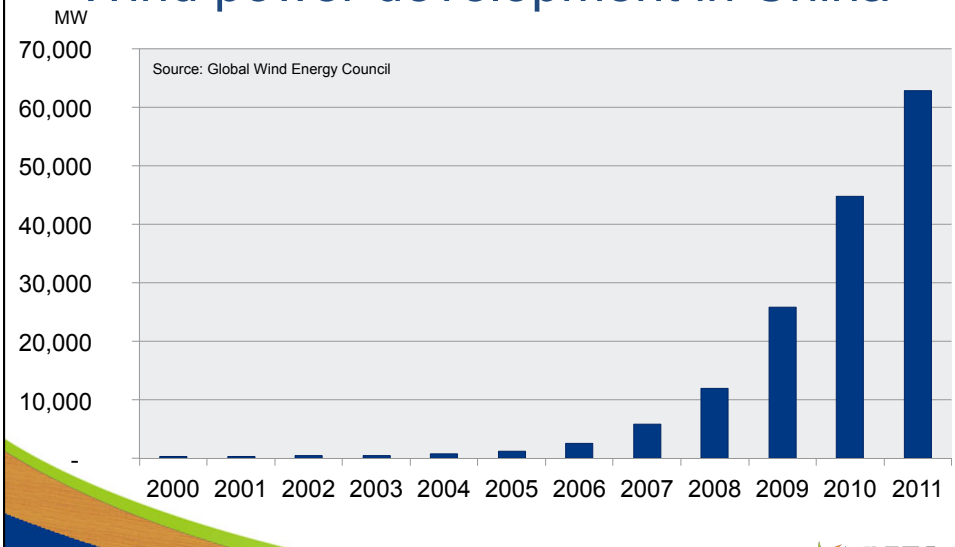
Integration of renewables in China

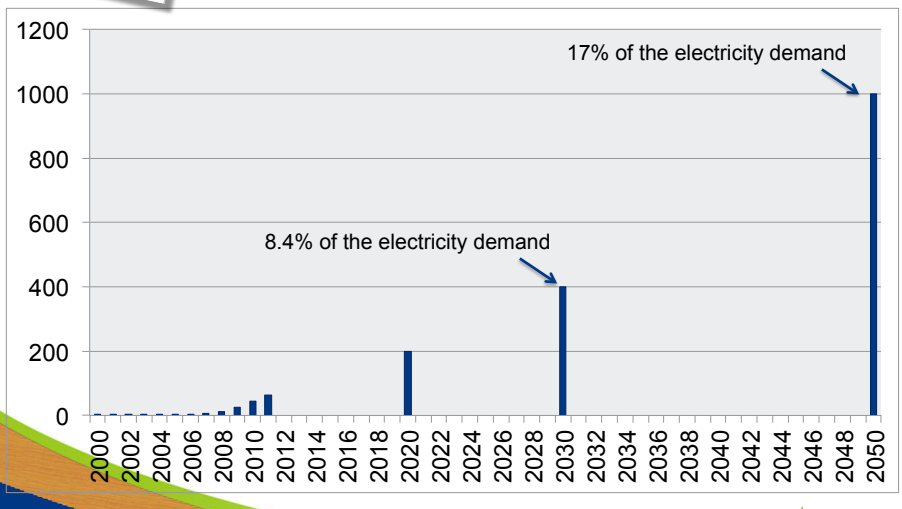
FOCUS ON WIND INTEGRATION

Recent studies

Wind power development in China



Future projections



Recommendations

- Reform the power market to achieve market-based power pricing, reflecting environmental externalities, the value of flexibility, and integration costs.
- Strengthen priority grid access and dispatch of wind power; maximise the ability of northern provinces to accommodate locally produced wind power; facilitate inter-provincial transmission using the smartest available technology.
- Accelerate deployment of flexible resources; deploy the best available output forecasting techniques.
- Establish public R&D platforms. Develop and deploy cost-competitive 5 MW technology by 2015, and near offshore technology by 2020. Strengthen supply chains, especially offshore transport and installation infrastructure.
- Develop specialist wind power training courses and university curricula by 2015.

Technology roadmap

		2011	2015	2020	2030	2050
Wind turbine	Common technology	Application of testing platform for semi-physical and numerical simulation				
		New arrangement of wind turbine and advanced drivetrain				
	< 3MW	Lighter-weight design and adaptability to environment				
	3-5MW	Design optimization				
	5-10MW	Conceptual design and key technology study	Prototype validation			
	>10MW	Conceptual design and key technology study		Prototype validation		
Key components	Blade	Advanced airfoils , lower load and weight, segmented blade, new materials, and design on higher tip speed blade for offshore application				
		Smart and active control over blade				
	Gearbox	Solutions to gearbox with lower transmission ratio and acoustics and design on planet gear and balancing flexible axis				
		New technology for gearbox manufacturing				
	Generator	Application of medium-voltage generator				
		Application of high-voltage generator				
		Study on high-temperature superconducting generator	Application of high-temperature superconducting generator			
	Convertor	Medium-voltage convertor with high power				
		High-voltage converter with high power				
		Application of new power electronic devices				
Offshore foundation, construction, operation and maintenance		Intertidal zone				
		Offshore				
		Deepwater offshore				
Wind plant	Design	Modeling large-scale wind plant system and design				
	Grid adaptability	Sophisticated wind power forecasting				
		Fault-ride-through capability and active and reactive power control				
		Direct application of wind power in distributed wind farms and large-scale energy storage				
	Dispatching	Automation				
		Intellectualisation				

Successful wind integration 1

- Strengthen technological innovation
  - Grid-friendly wind farms with features like conventional power plants
- Structuring a wind friendly power system
  - Enhanced flexibility, strengthened power grid, use of wind power forecasting, flexibility on the demand side
- Setting technical standards
  - Strict grid code requirements for new wind turbines
  - Testing and certification of wind turbines

Successful wind integration 2

- Strengthening policy and management guidance
  - Improvements in management and planning mechanisms and processes
  - Coordinated policy incentives for wind power development, grid development and wind power integration
- Setting near- and long-term integration priorities
  - Short-term focus: increased flexibility in the power system using proper polcy incentives and effective control measures.
  - Long-term focus: Principles for sharing burdens and benefits of power system flexibility anmong all related stakeholders

EXAMPLES OF CHALLENGES

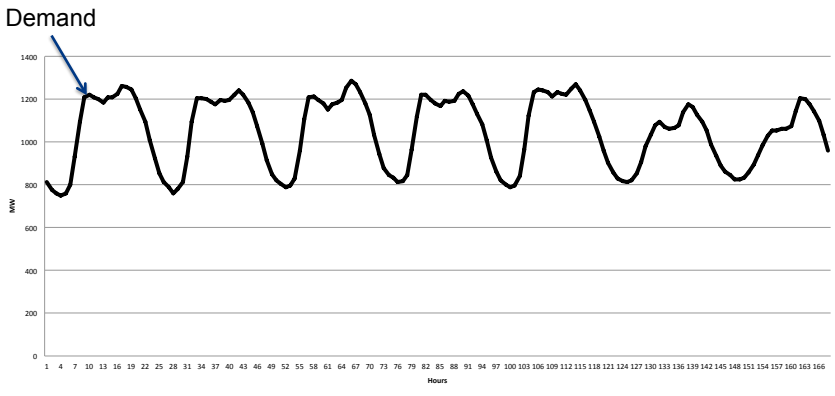
MORE FLEXIBLE THERMAL POWER PLANTS

Priority dispatch – in principle

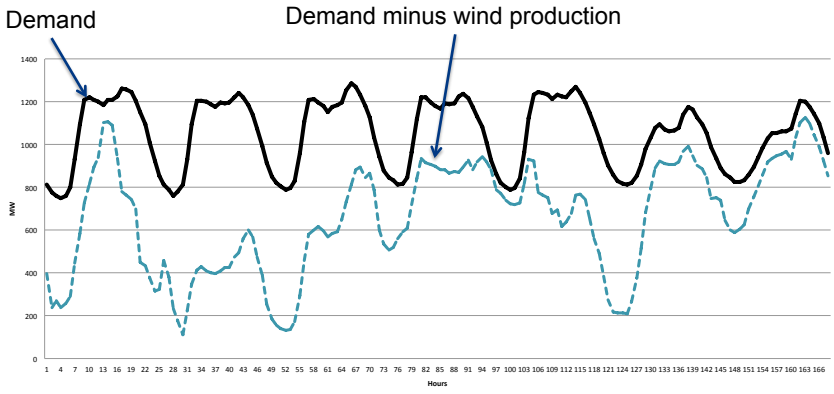
- Renewable energy – wind and solar should in general have first priority
  - Low marginal cost of power production
  - No fuel cost
  - No or low pollution
- Hydro power should be used for balancing and for efficient use of the water resources
- Thermal power plants with high investments, high efficiency and low operational cost should have second priority
- Thermal power plants with low efficiency, high operational cost and/or high pollution should have third priority

But these principles have implication for the thermal power plants

Example: One winter week



Example: One winter week



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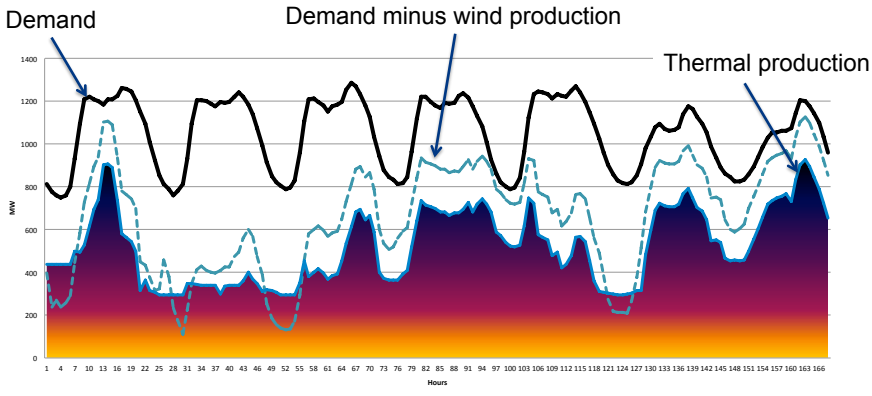

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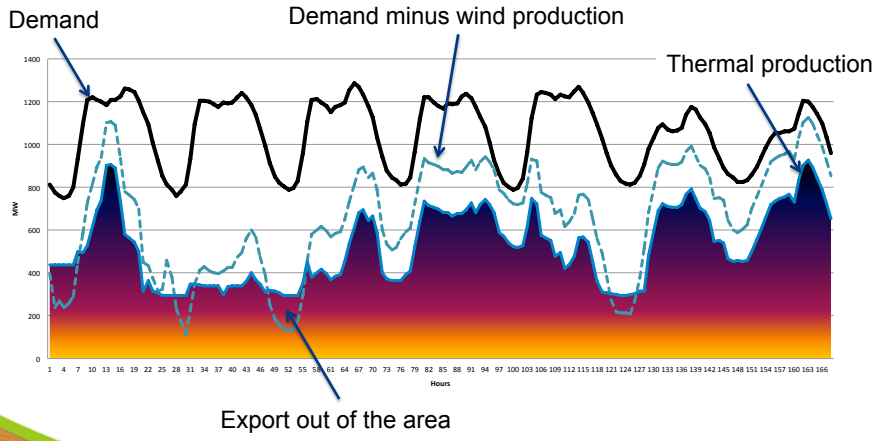
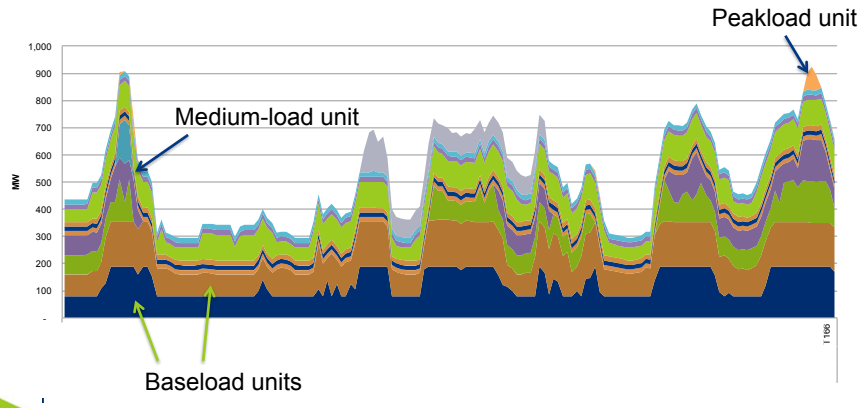


Production on each thermal power unit

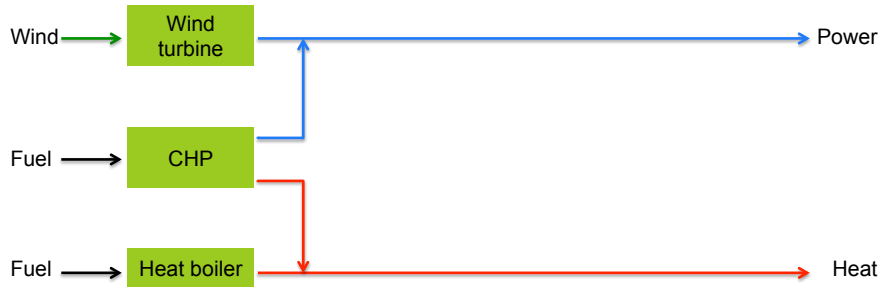


Consequences for thermal power plants

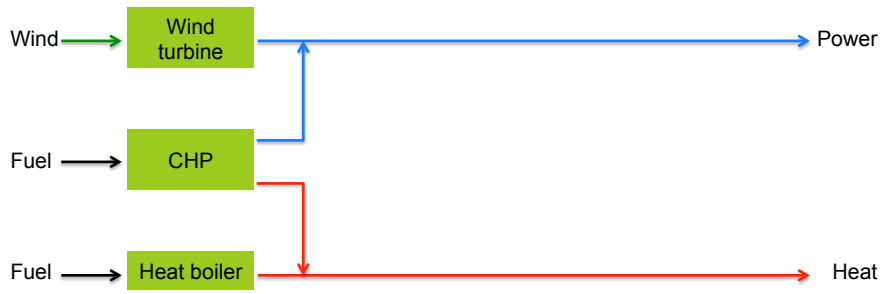
- Solutions:
  - One-time compensation
  - Payment for other services for the power system
  - More income from heat production
  - Others?

FLEXIBLE HEAT- AND POWER PRODUCTION

Current system

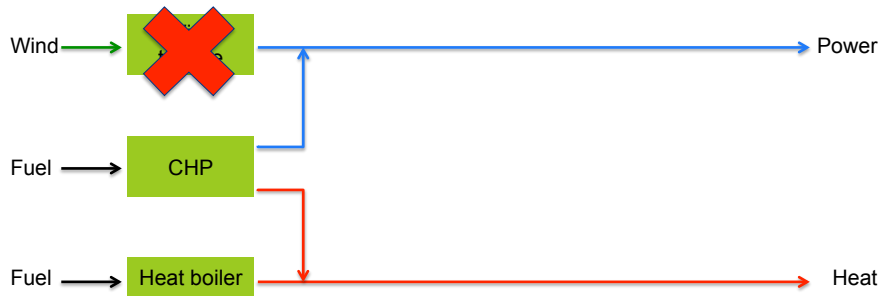


Much wind and need for heat



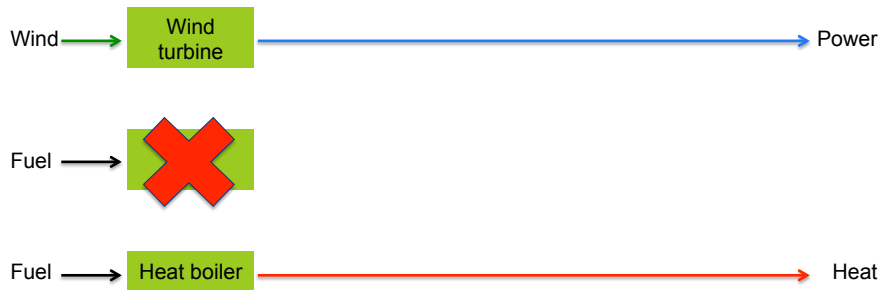
Much wind and need for heat

Curtailment of wind - or

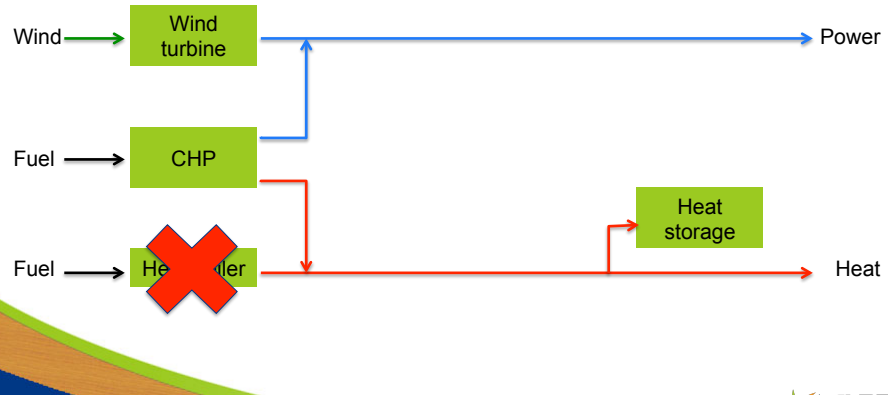


Much wind and need for heat

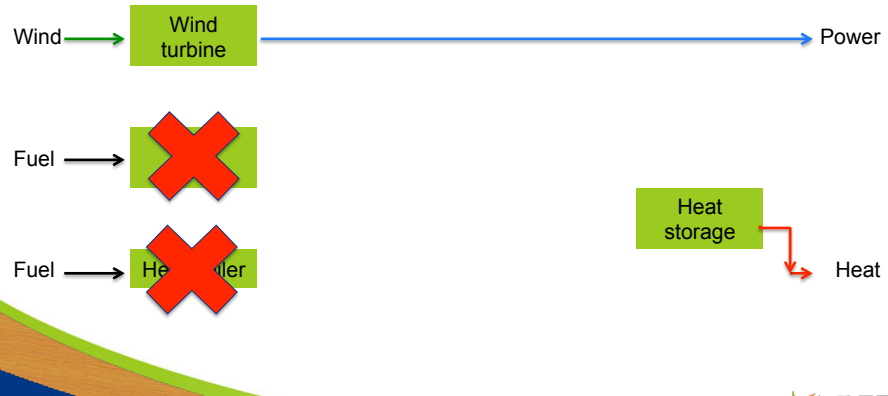
Curtailment of CHP-plant?



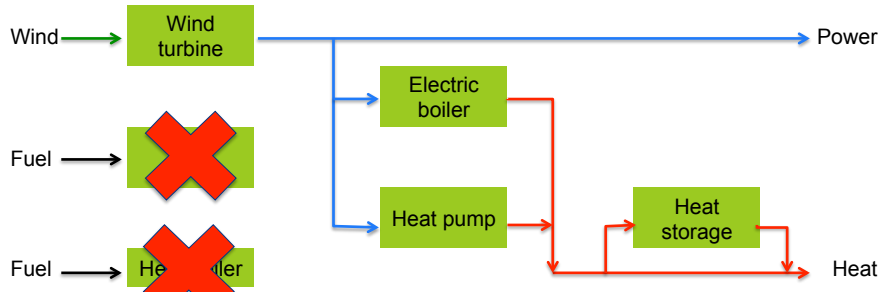
Need for power – less need for heat



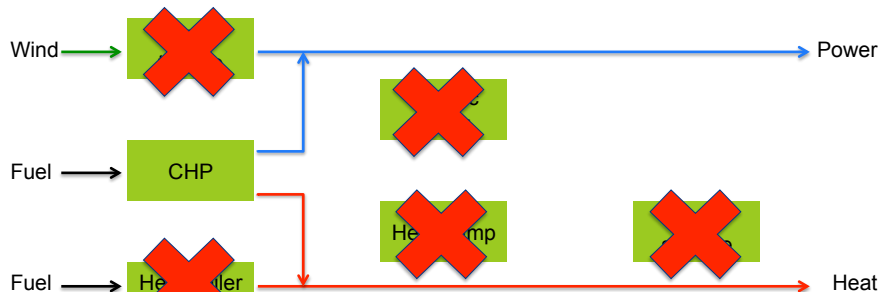
Need for heat – less need for power



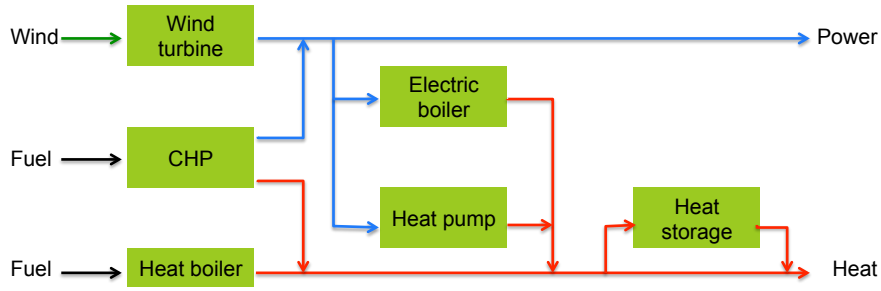
Much wind – less need for power



No wind

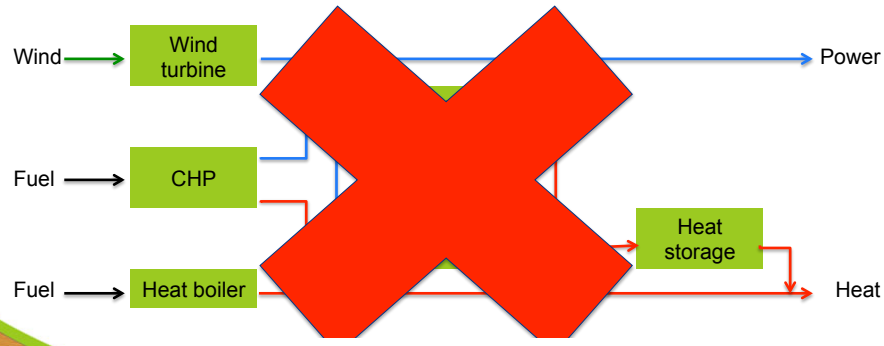


A flexible power and heat system



BUT -

A flexible power and heat system



The current incentives do not support such flexibility

My top 5 focus areas

1. Incentives for a flexible energy system
   - Flexible thermal power plants
   - Flexible use of district heating
   - Better use of interconnectors
2. Good wind power forecasts integrated in the system dispatch
3. Reliable wind turbines
   - Grid code
   - Testing and certification
4. New transmission grids
5. Smart grids