

*Promoting energy transition in
China through successful
integration of renewable energy
with a focus on power sector
towards 2050*

Xue Han, Ph.D
Energy Research Institute of NDRC
China Renewable Energy Center



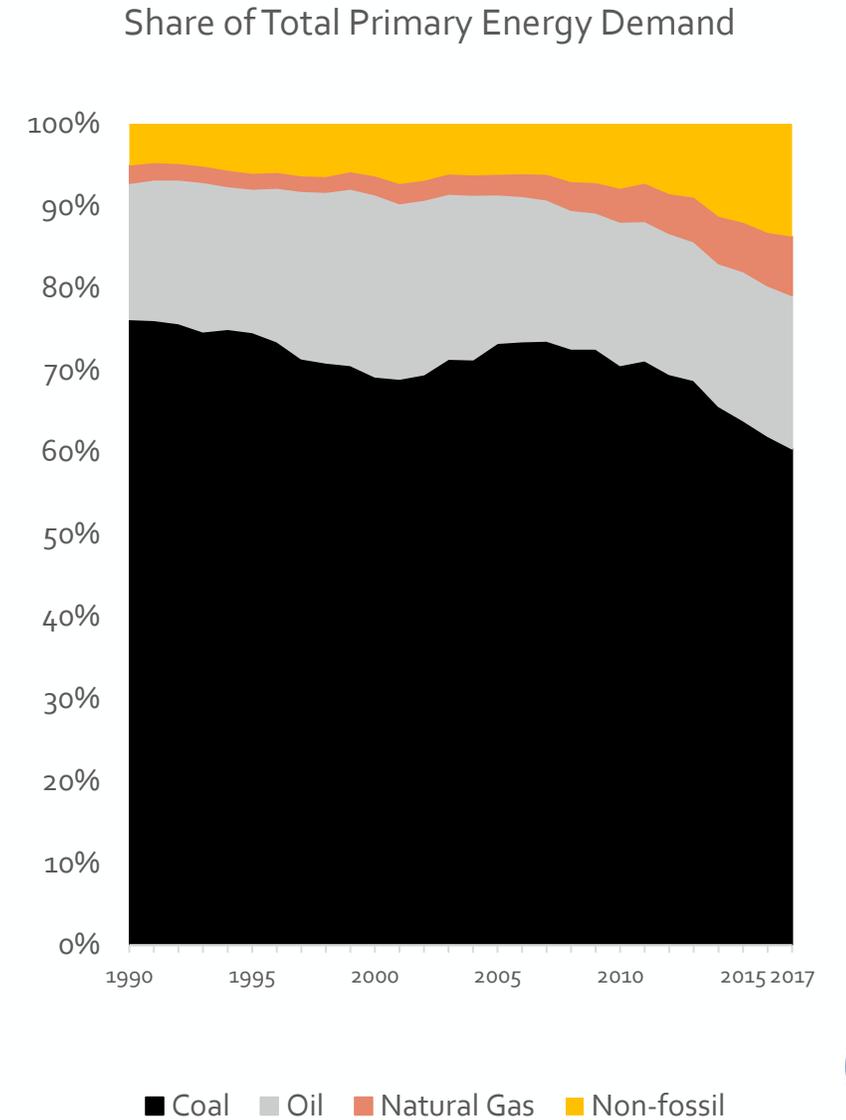
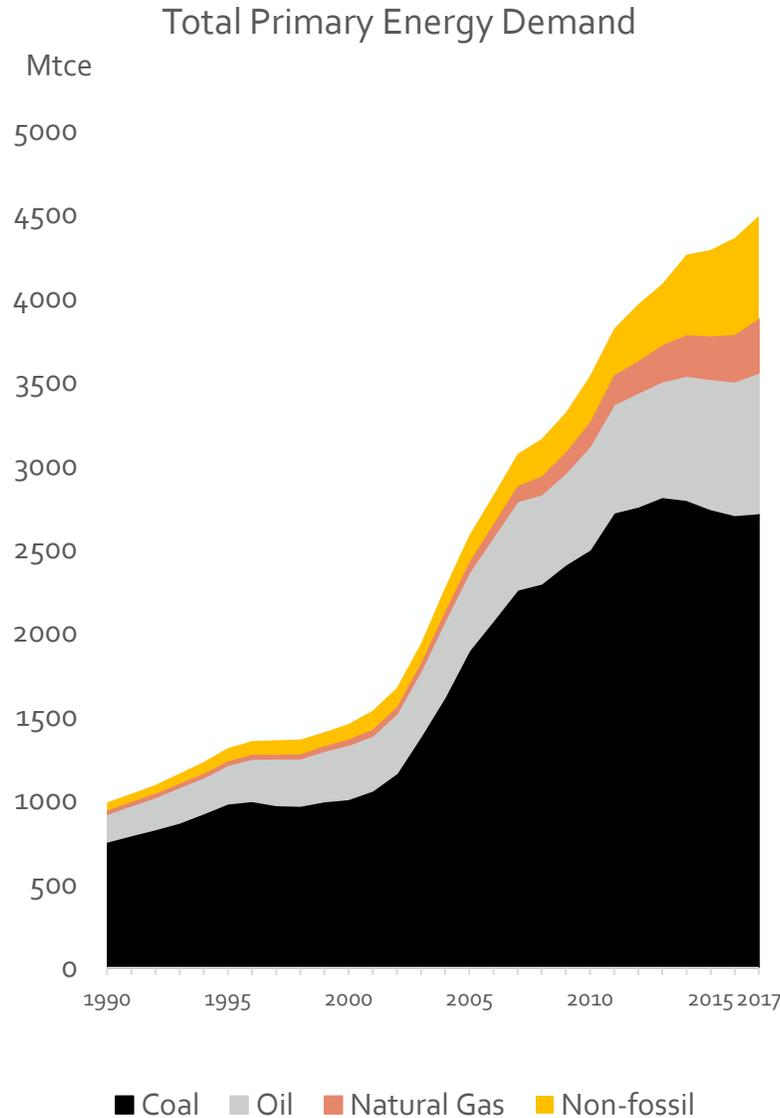
BACKGROUND & SCOPE



Tremendous growth in energy consumption – coal dominates

China's energy consumption has grown from **572 Mtce** in 1978 to **4490 Mtce** in 2017

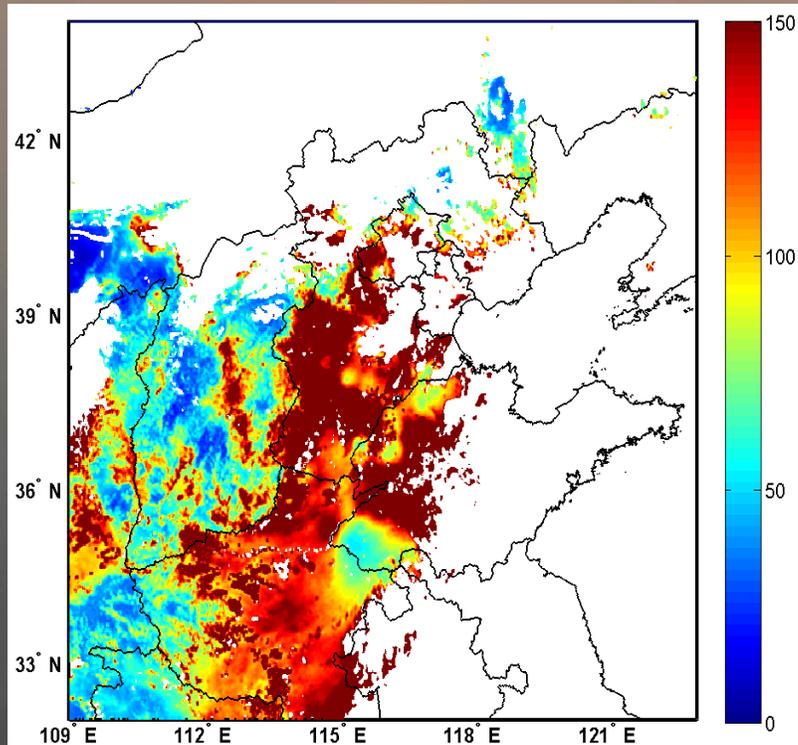
Coal share always **higher than 65%** until 2015 and the total coal consumption peaks in 2013 with **2810 Mtce**



The statistics is based on coal substitution method

Air pollution

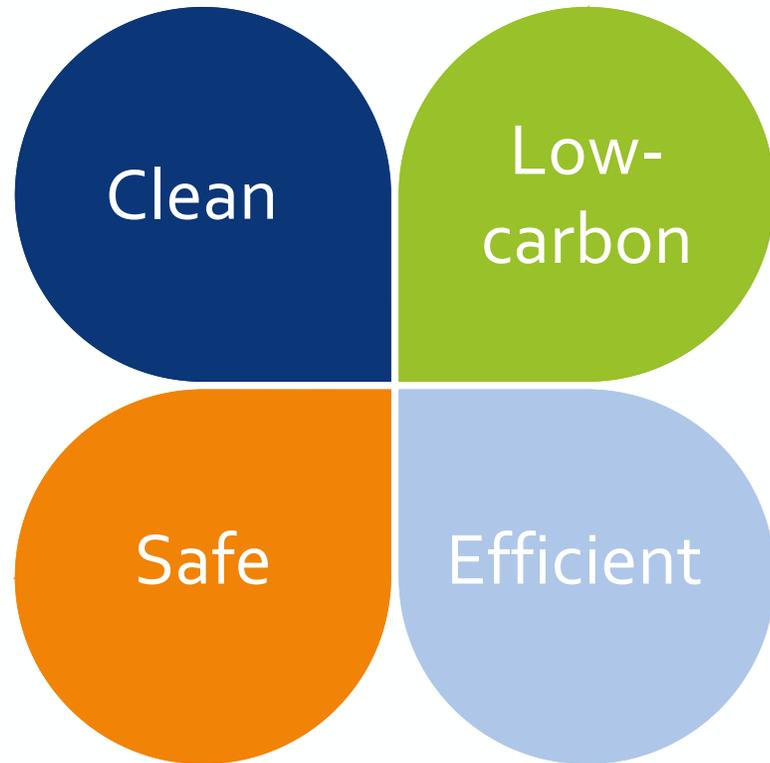
The PM_{2.5} intensity in Jingjinji region, by satellite retrieval on 20 December 2017



The air quality of cities all over the country on 29 December 2017



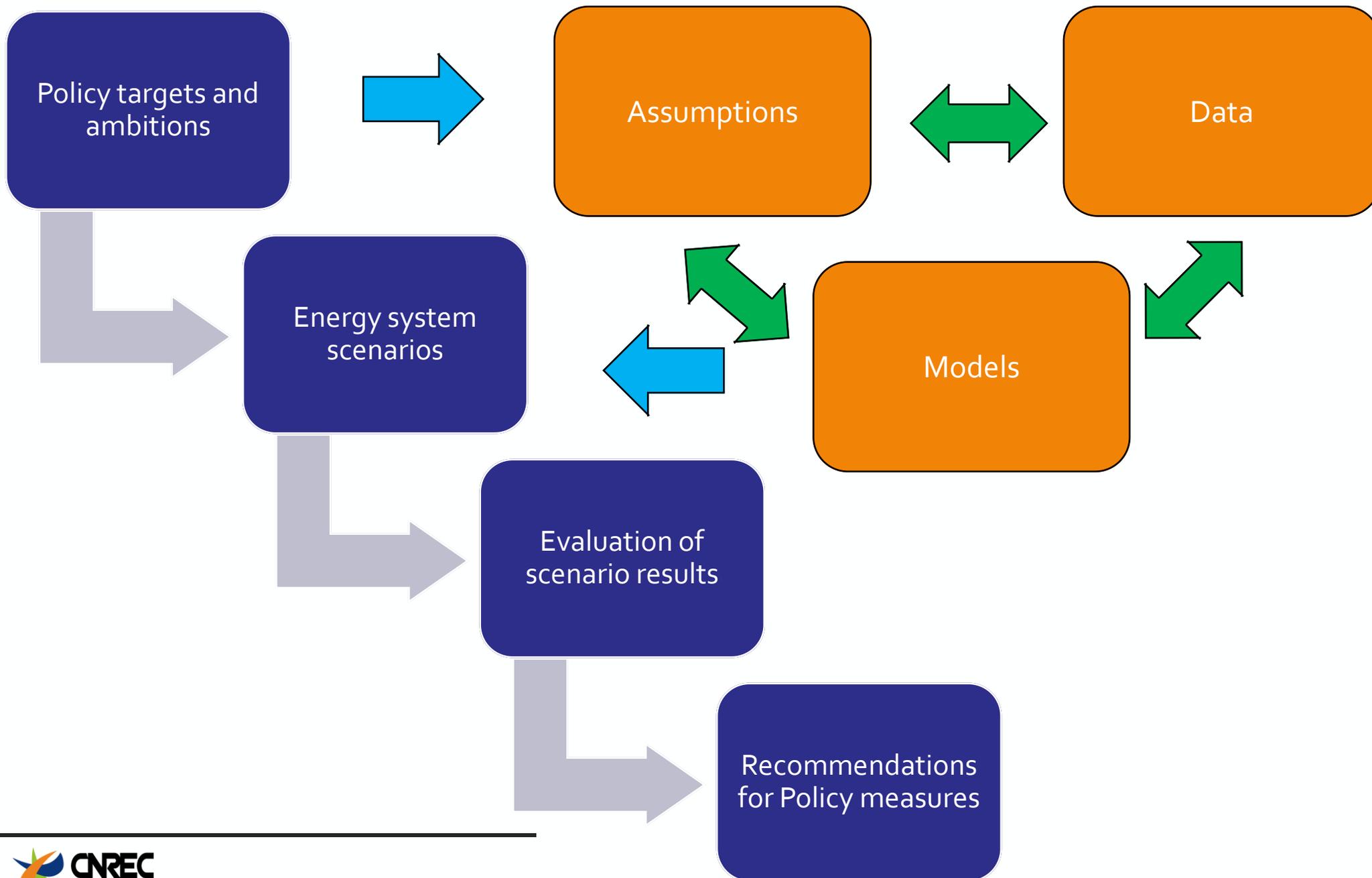
New era for China



- Goal:
 - A decisive victory in building a moderately prosperous society in all respects
 - moving on to all-out efforts to build a great modern socialist country
- Applying a new vision of development & deepening reform
 - “Ecological civilisation” as the guiding principle for the development of the society
 - Modernizing China’s system and capacity for governance
- Developing a modernized economy
 - Improving the quality of the supply system
- A revolution in energy production and consumption
- **Ambitious targets:** “We will build a modern energy system that is **clean, low-carbon, safe,** and **efficient,** and will safeguard the country’s energy security”.

*CHINA RENEWABLE
ENERGY OUTLOOK
- METHODOLOGY*





CREO approach

Two main scenarios in CREO

- **Stated Policies scenario**, estimating the energy system development based on current and stated policies
- **Below 2 °C scenario** with added restrictions on CO₂ emission to comply with the Paris agreement goals

Scenarios for the whole Chinese energy system

Bottom-up models for the energy demand and for the power system

Detailed power system model simulating the current dispatch rules as well as an efficient wholesale market dispatch

Use scenario analyses as basis for policy strategy research and policy recommendations

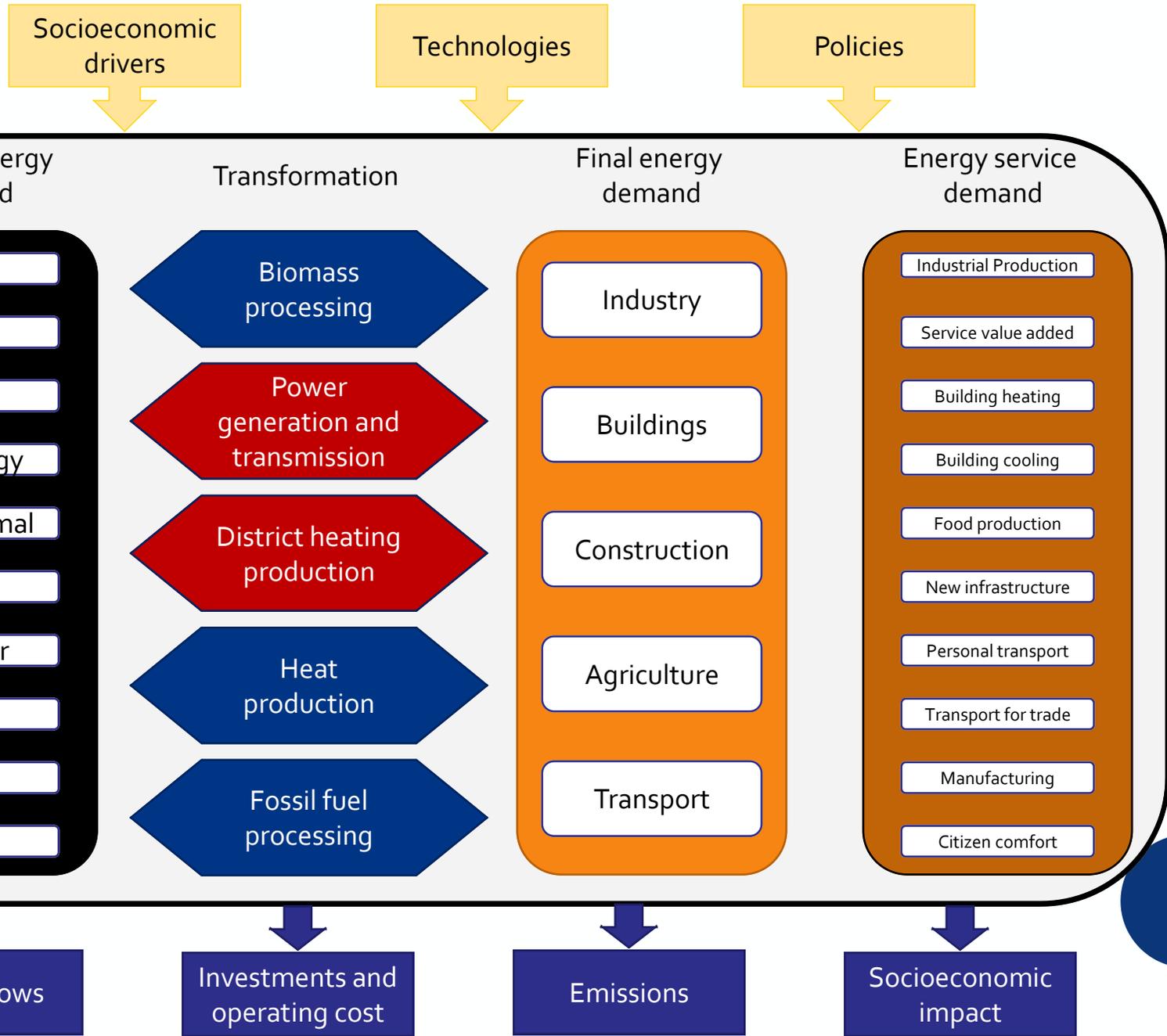
Energy system modelling

The scenarios are modelled in the CNREC modelling suite, covering energy supply, energy transformation and end-use sectors.

The **production of power and district heating** is modelled in the bottom-up, least-cost optimisation model **EDO** in order to reflect cost effective integration of variable energy production.

The end-use sectors and the other energy transformation is modelled in **END-USE** model based on the LEAP modelling tool and a bottom-up approach.

The socioeconomic impact of the transformation of the energy system is modelled in the **CGE** model – a computerised general equilibrium model with special focus on the energy and RE sector.



CREO 2018 results

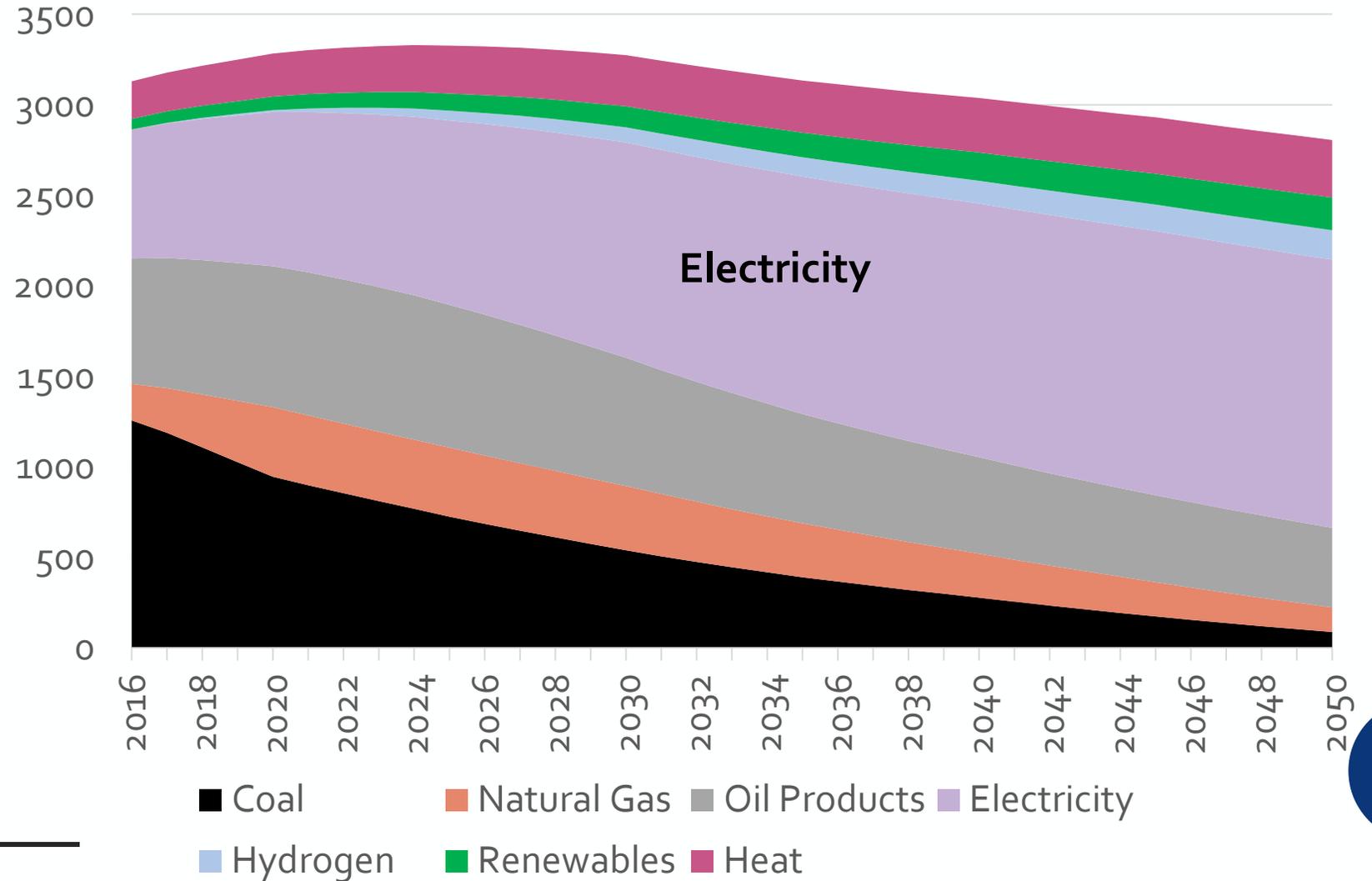
RESULTS AND KEY MESSAGES



Below 2 scenario:

- Electrification is the key driver in the energy consumption revolution
- Quick shift from coal to electricity in the end-use sector
- Electricity: 25% to 53% (1.5 billion tce)
- Electricity + Renewables = 65%
- Coal: 40% to 3%.

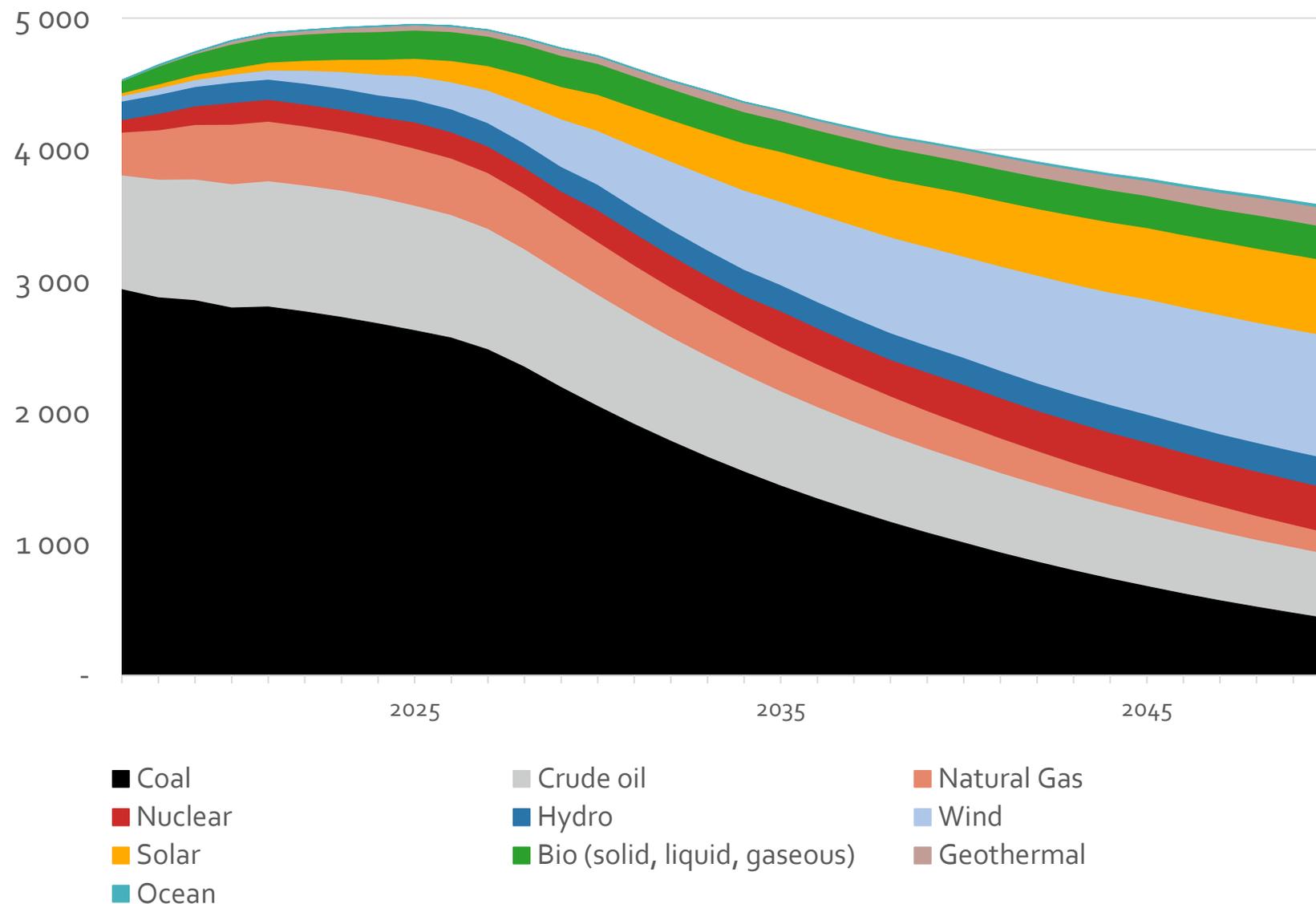
Final Energy Consumption (million tce)



Development in final and primary energy consumption in the Below 2 °C scenario

- Primary energy consumption peaks around 2027
- Renewable energy supplies the incremental (增量) energy consumption before 2025, and replace fossil fuel in the stock (存量) part afterwards
- In the power sector coal consumption is significantly reduced, solar and wind power production increased

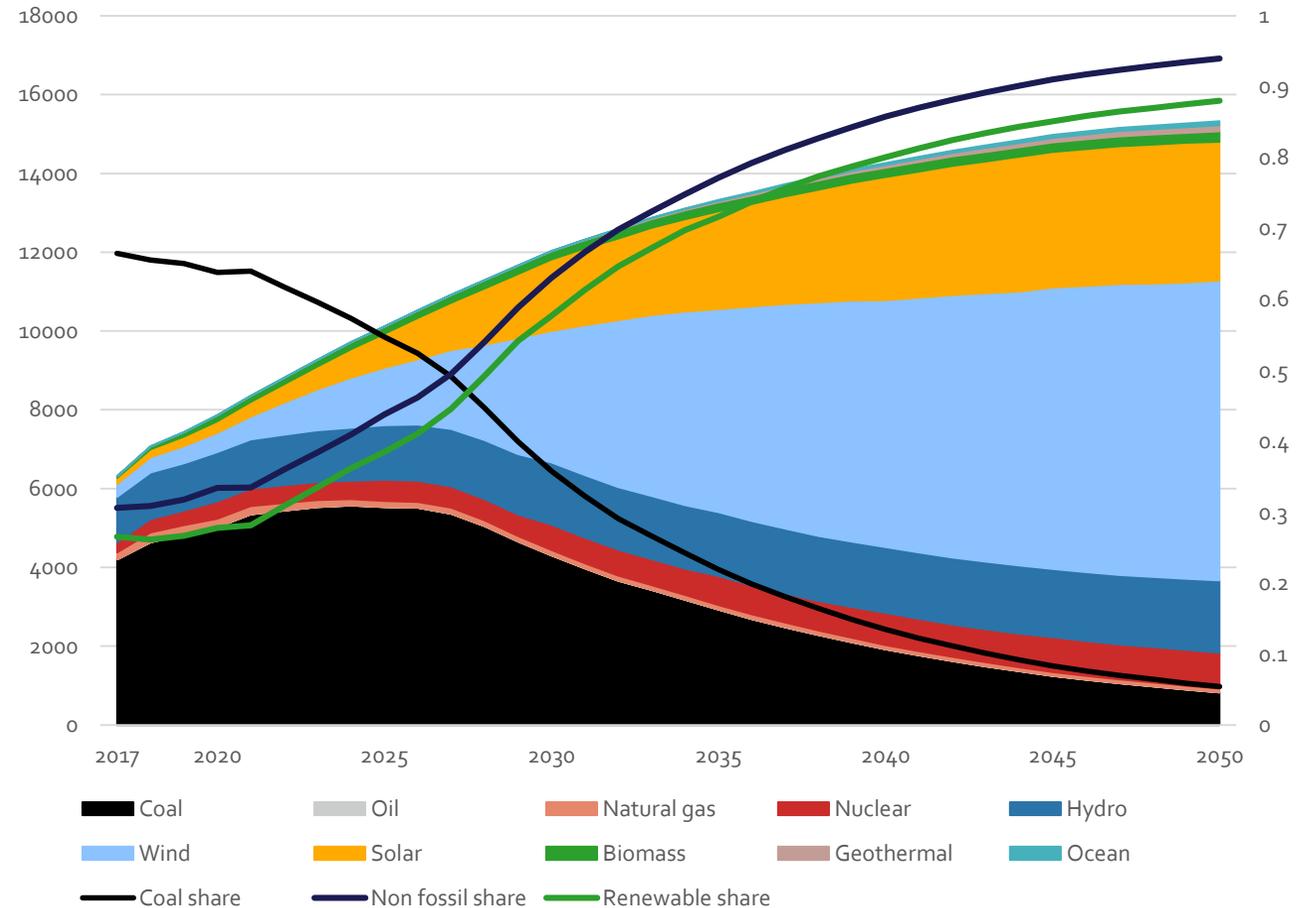
Total Primary Energy Demand 2017 – 2050 (mtce)



Power supply transformation

- The 2050 power system is so dynamic we must begin to imagine running it today
- Integrated planning of generation, transmission and distribution grids, energy storage, and demand response are essential rapid transformation of the bulk power system in China
- Market is essential to mobilize the flexibility in the system and thus to achieve economic efficiency

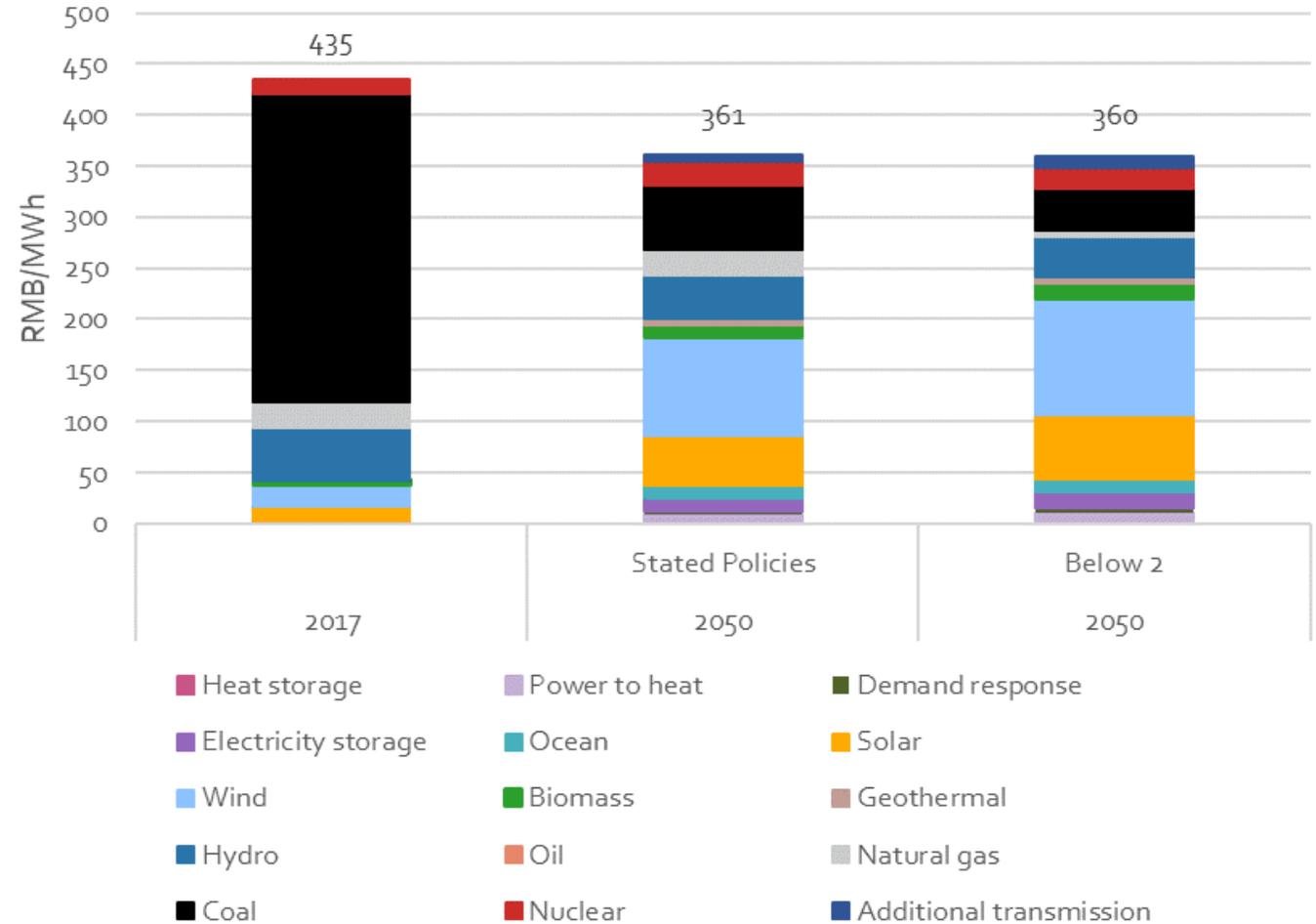
CREO 2018: Below 2 °C Scenario



Power cost

Long term benefits

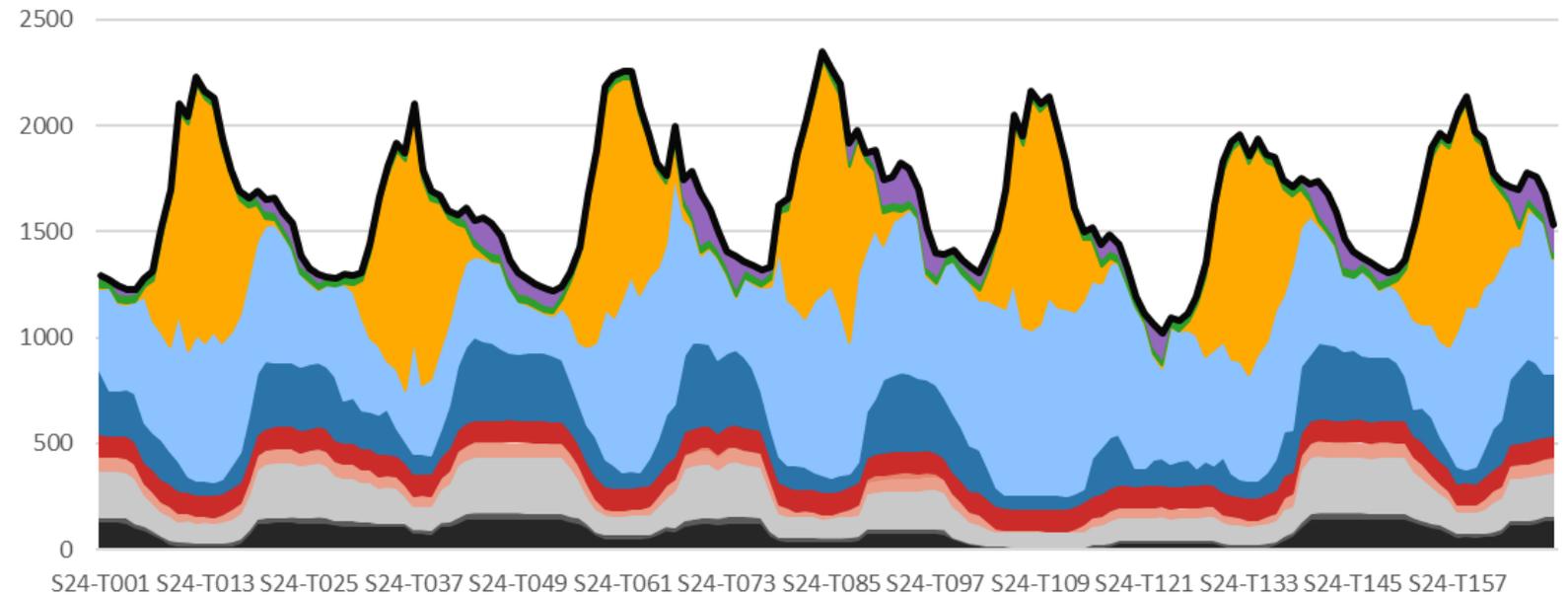
- Cost of power production shift from fuel costs to capital cost
- Both scenarios have lower power cost in 2050 compared with today's prices (in fixed prices)
- The huge investments in RE technologies will give higher power cost in the short run, but also benefits in form of job creation, RE industry development and better environment



Large amount of RE can be integrated by enhancing flexibility

Supply side measures

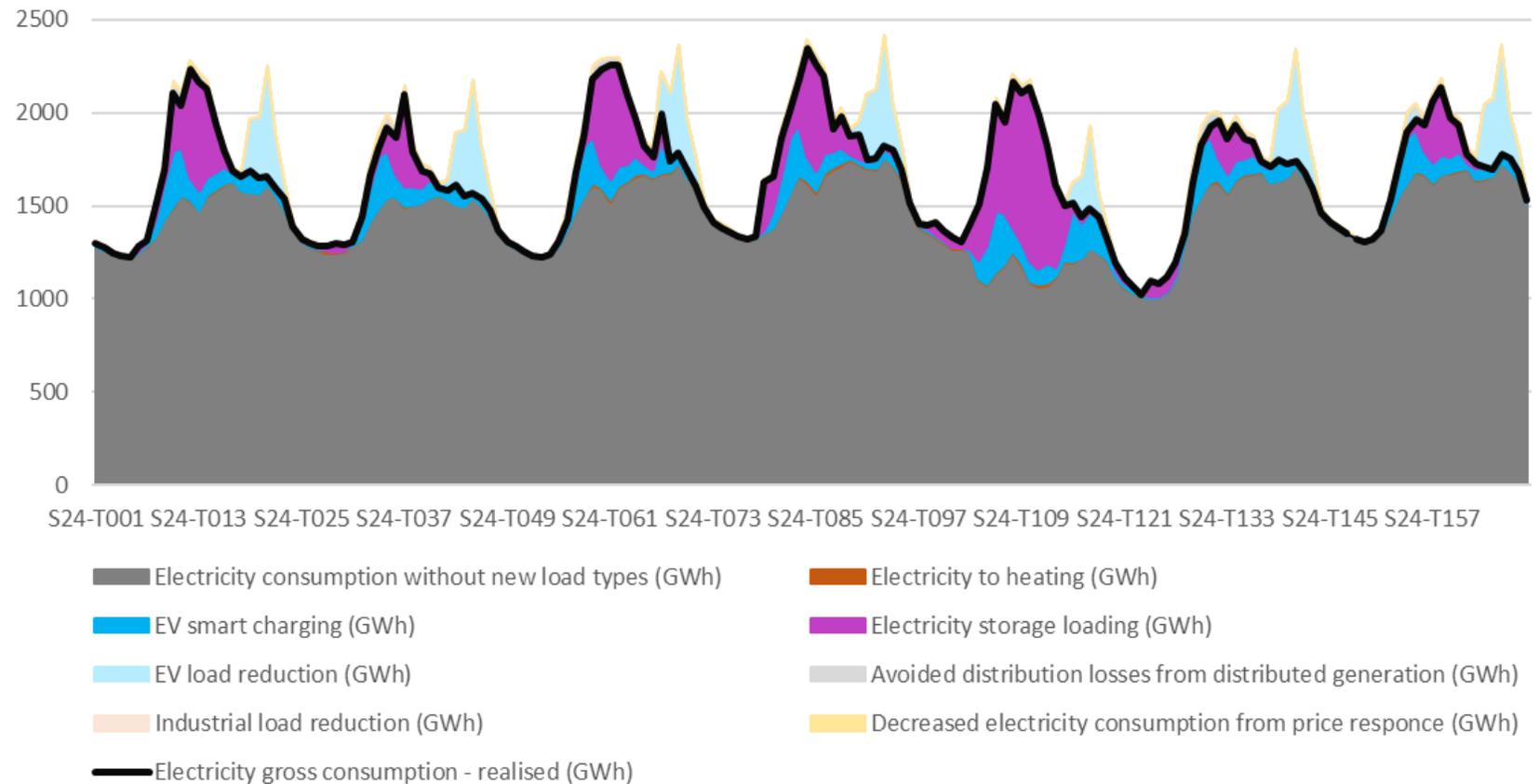
- Flexible thermal power plants
- Flexible hydro
- Storage discharging
- Market value based VRE remuneration incentives



Large amount of RE can be integrated by enhancing flexibility

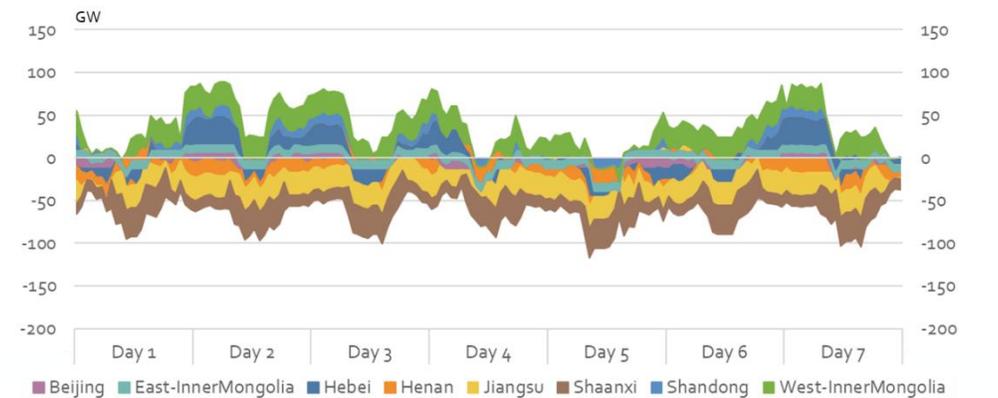
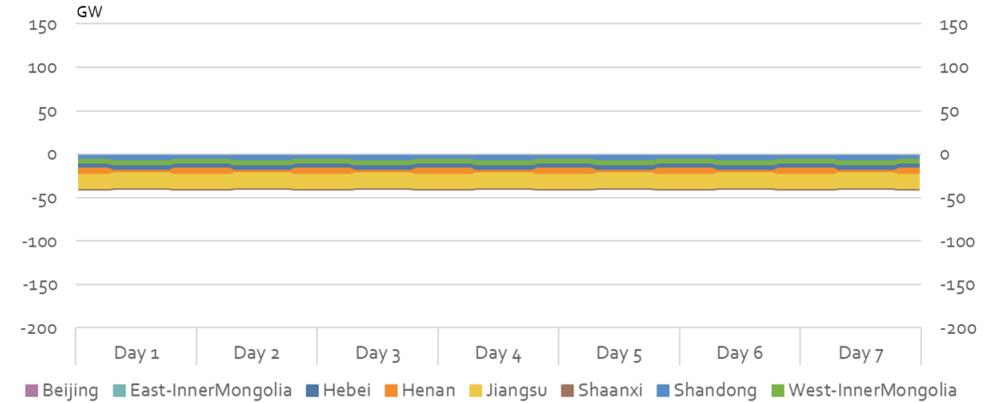
Demand side measures

- Peak load shaving
- Industrial load shifting
- EV smart charging
- Storage loading
- Electricity to heat



Grid expansion and inter-regional balancing is essential

Interregional transmission



Key recommendations

Strictly enforce coal reduction

- Efforts to reduce coal usage must be accelerated by halting new coal power, promoting electrification in industry and clean heating in buildings, efficiently pricing carbon, and providing targeted support to coal-dependent provinces for energy and economic transition.

Create a level playing field for renewable energy

- The current barriers for promoting renewable energy must be removed by improving coordination between authorities, giving adequate incentives for developers, de-risking investments, and rapidly implementing power markets that work for renewables.

An institutional reform process towards ecological civilisation

- The 19th Party Congress emphasised the overall targets towards 2050 of building an ecological civilisation. These ambitions must be anchored in all administrative levels.
- The power sector reform must ensure that the incumbent players become driving forces for renewables, that grid companies develop planning methods to ensure full uptake of variable renewables, and that local governments have strong motivation to take a proactive role in the transformation process.
- Electricity market & power system planning

THANK YOU.

*26th June 2019 @Beijing
Link to the report (in English):*

