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LTES
LONG-TERM SCENARIOS FOR THE ENERGY TRANSITION
A CAMPAIGN BY THE CLEAN ENERGY MINISTERIAL

Long-term Energy Scenarios for the Clean Energy Transition: Case Study of China

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SGERI Introductions

Energy and Power Development and Energy Economics

Energy Structure and Policy

4 major research fields
30 research specialties

Grid Development and Management Decision-Making Support

Corporate Development and Management Decision-Making Support

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National Strategies and Objectives in Energy transition

- **Energy consumption**：in 2020, within 5 billion tce; in 2030, within 6 billion tce; in 2050 keep stable
- **Non-fossil ration**： in 2020, up to 15%; in 2030, up to 20%; and in 2050, up to 50%
- **Carbon emission**：emission reach peak before 2030
- **Carbon emission per GDP**：compared with 2005, in 2020, it will decrease 40%-45%; in 2030, it will decrease 60%-65%.
- **Energy efficiency**：in 2020, energy consumption per GDP will decrease 15% compared with 2015; in 2030, energy efficiency will be in average level of the world; in 2050, reach advanced level.

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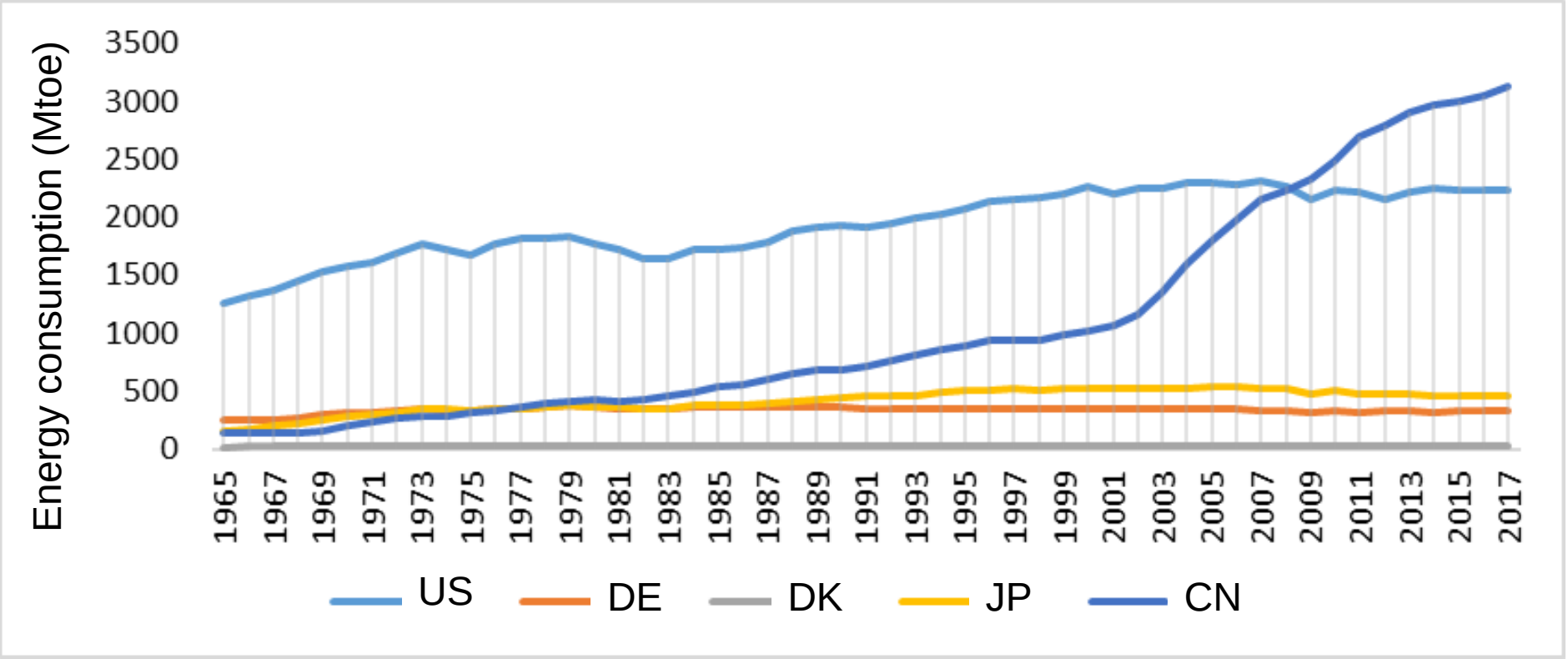
Great Challenges for Clean Energy Transition in China

- The road of energy transition in China is different from other countries due to the structure of energy production and consumption. There might a leap from coal to renewables.
- There will be great potential in energy-saving and emission reduction in the long-term transition.

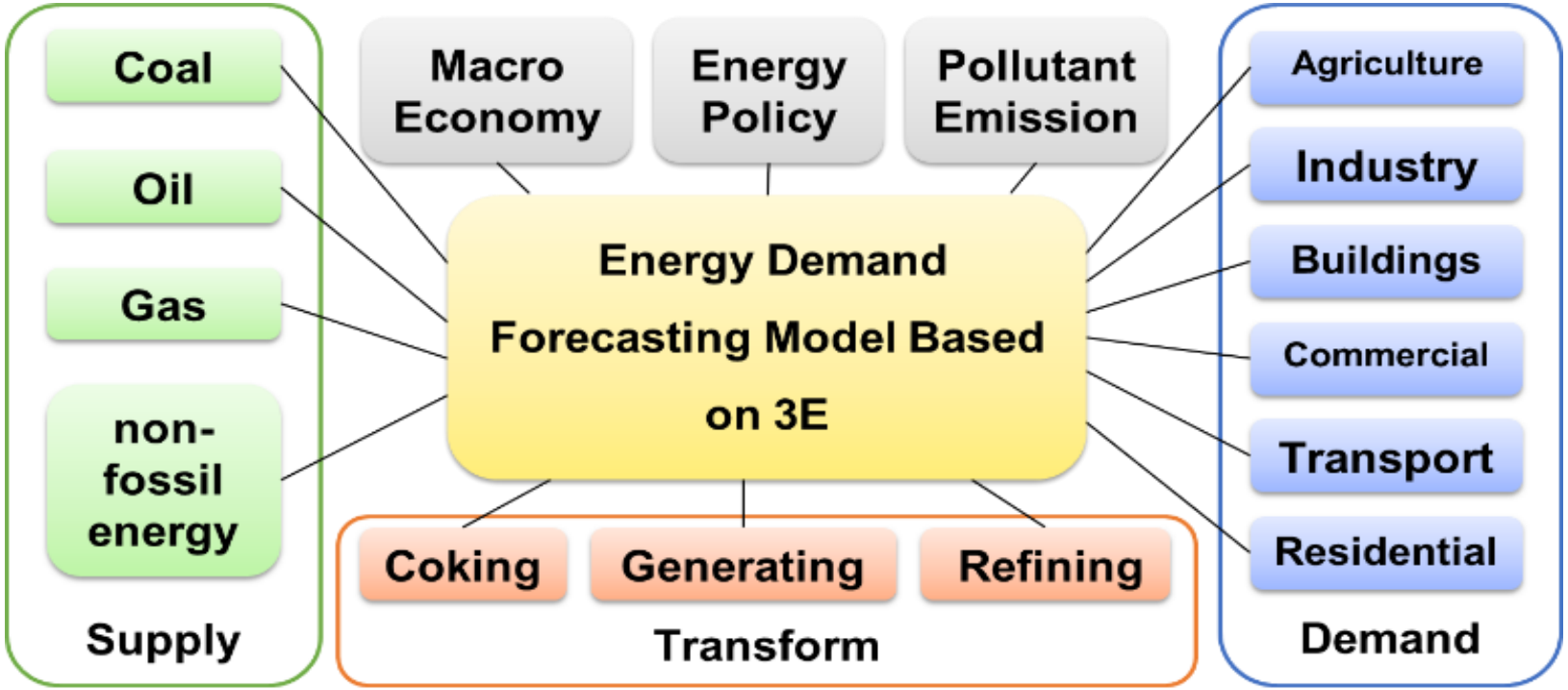
– The optimization of energy structure in energy transition have been and will be conducted along with the growth of energy consumption.



- Reformation and market mechanism will be promoted simultaneously with the transition process.
- Regional differences in energy transition will occur due to imbalance development.

Methodology and modelling

Demand Side Model: The medium and long term energy demand forecasting model based on energy, economy and environment (3E) system optimization is applied to meet the constraints of total quantity control, pollution emission and efficiency improvement.



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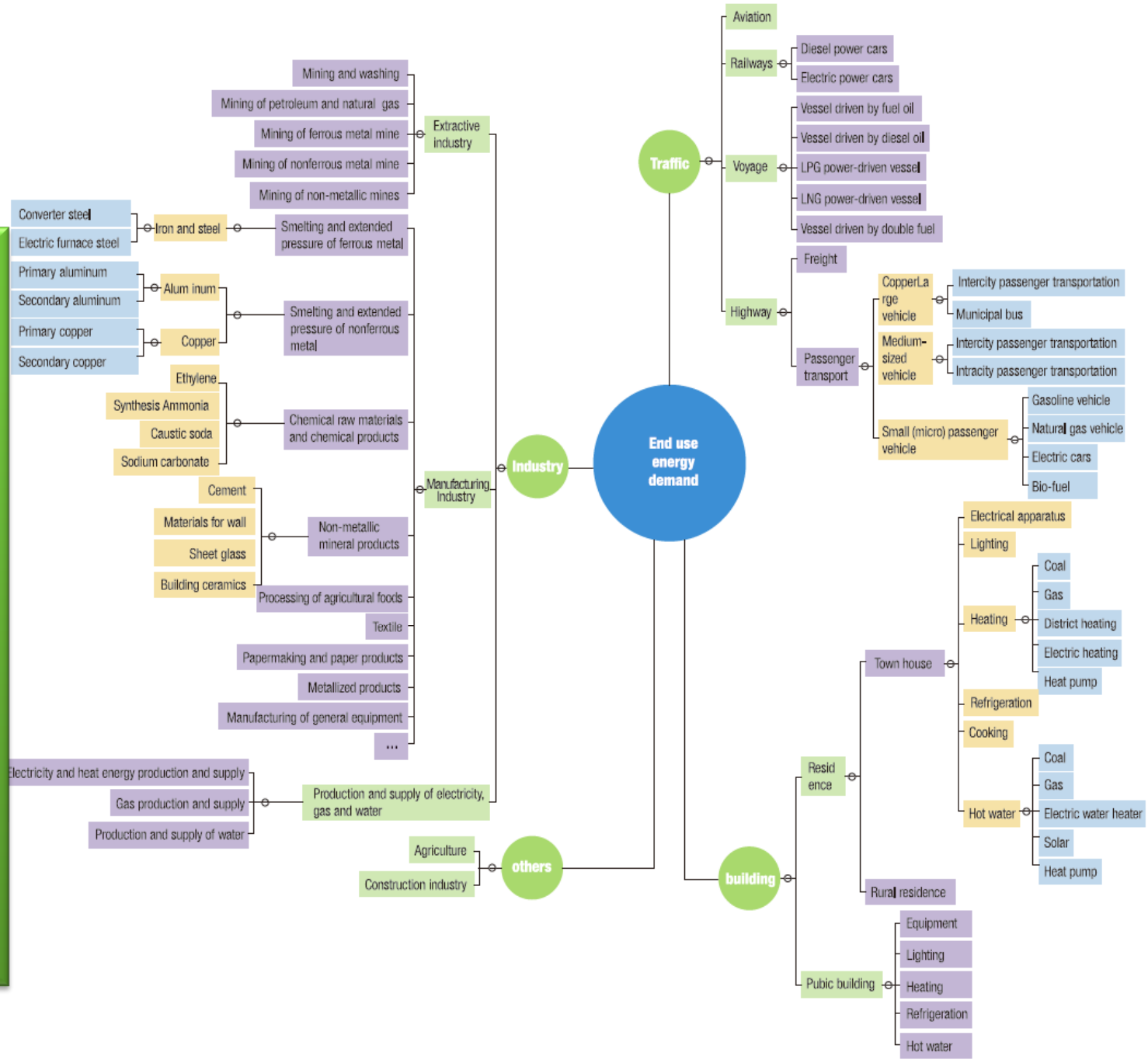
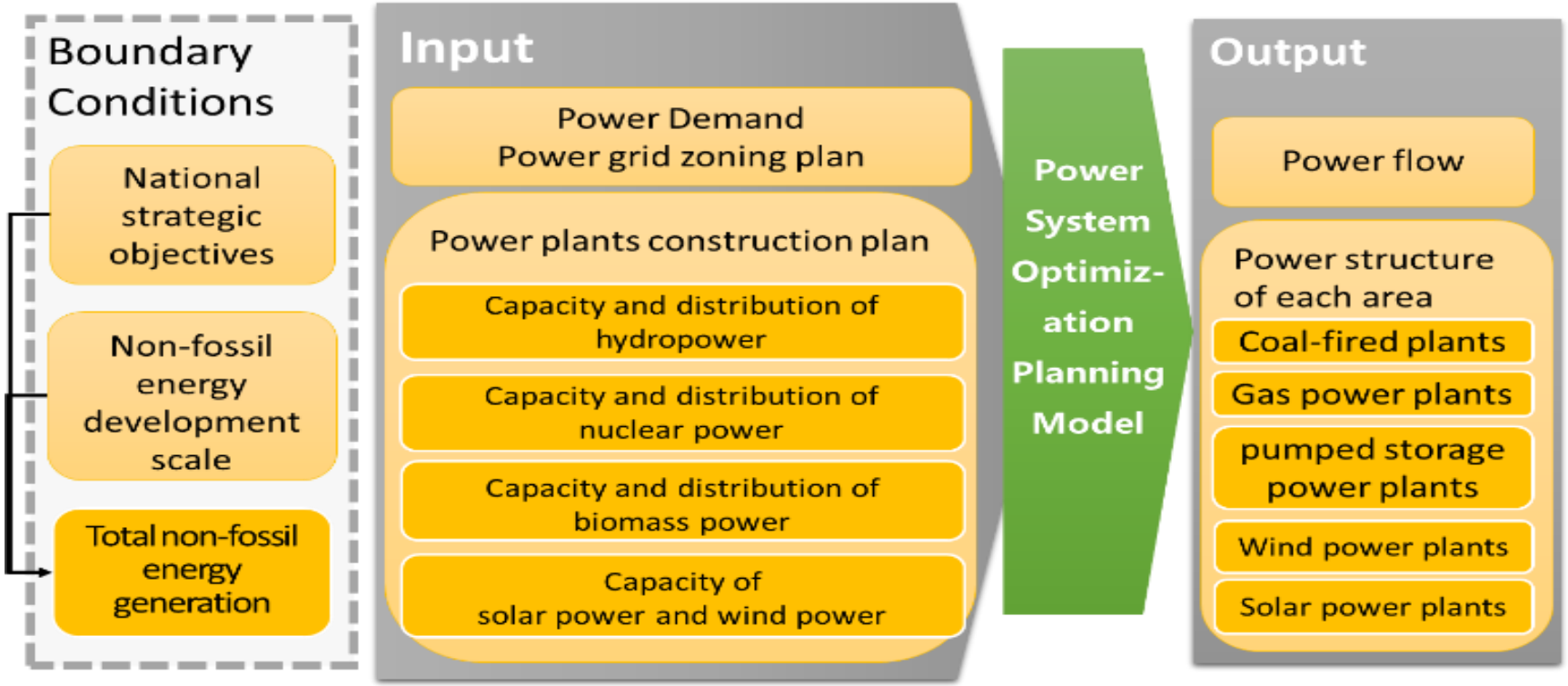
End-use energy demand forecasts are based on LEAP model

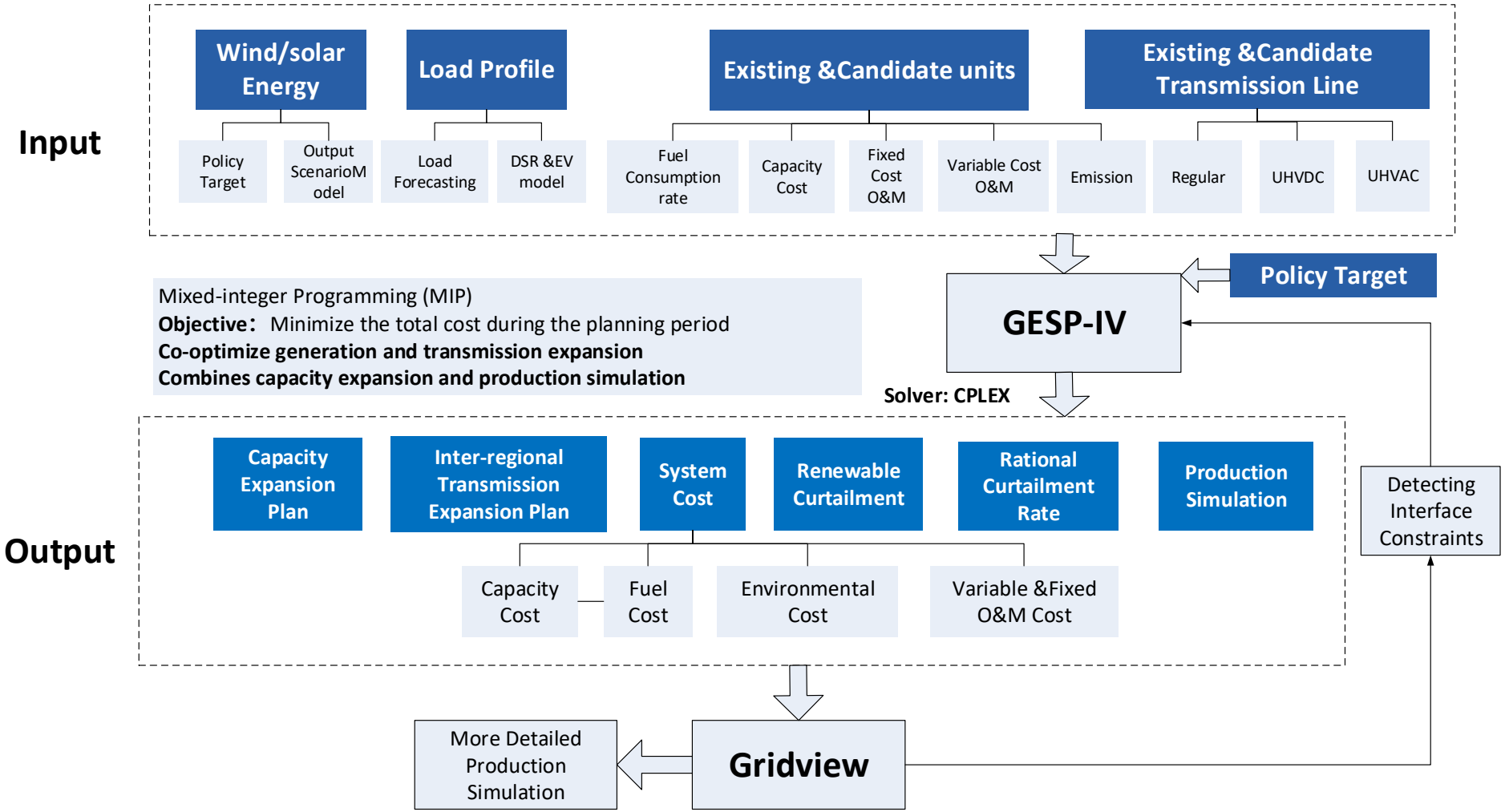
- **Industrial sector**: 30 sub-industries
- **Building sector**: urban, rural, public
- **Transportation**: aviation, shipping, railways, road
- **Other sectors**: agricultural and construction industry



Supply side model: Based on the national energy development strategy and the supply capacity of non-fossil energy resources, the total amount, distribution and inter-regional power flow of various types of power supply are optimized.



(1) Framework of GESP



(2) Variable renewable energy (VRE) Model

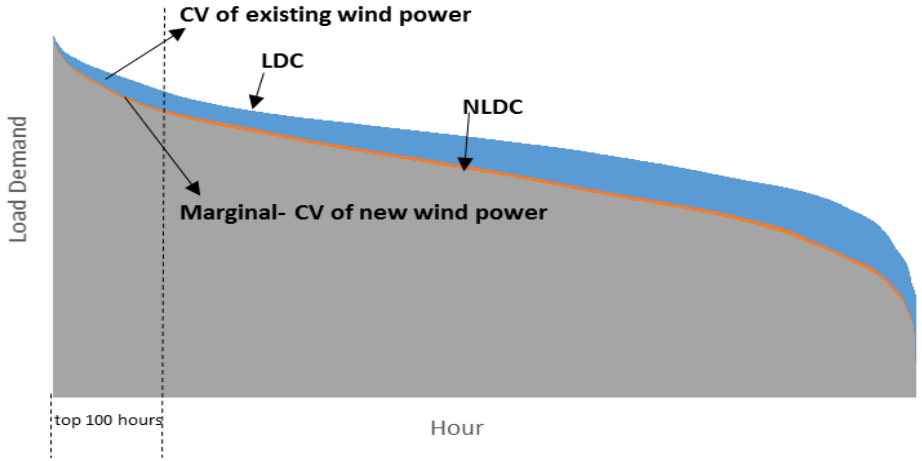
Capacity value – describe the contribution to system adequacy

- Wind/solar CV in each modeled area and investment period:

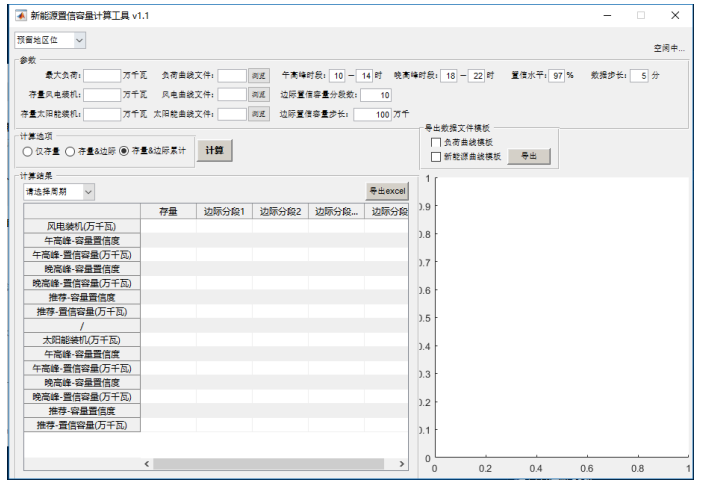
✓ noon-peak and evening-peak CV

✓ marginal CV

✓ calculated based on forecasted and historical load curves and VRE profiles.



Calculation of capacity value



VRE Scenario generation:

For each area and each typical day/week during the planning period, GESP can generate 1-4 wind and solar profiles based on:

- Historical data
- Generate wind/solar curve without curtailment from real curve with curtailment – tool Developed by CEPRI
- MCMC time series simulation module

- **wind speed probability distribution, fluctuation, seasonal property, daily property and correlation between wind farm**
- **Generate state transition matrix**
- **Generate times series of wind speed based on MCMC**
- **Amend the wind speed based on daily feature and seasonal feature**
- **Generate wind power output time series**

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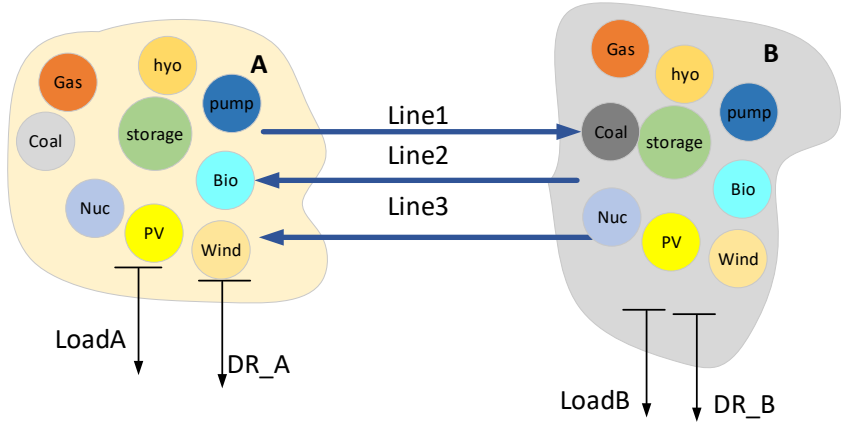
(3) Transmission model

- GESP allows transmission expansion on existing or user-defined corridors.
- Investments of converter stations and emergency reserve requirements are considered for ultra-high voltage lines



- The operation of transmission lines have two types of representation

a) DC - hydro line: 3-piecewise output: forced output, average output, or expected output.

b) Other: can participate in peak-shaving or peak-shifting. They can be operated at a fixed rate or to be optimized by GESP.

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Use of Energy Scenarios for Decision Makers

- The planning of large scale energy base, including coal, nuclear, wind and solar, which was studied around 2007.
- Research on the roadmap of 15% share of non-fossil energy by 2020 in China, which was carried out in 2012, helps NEA to determine capacity expansion of non-fossil generation.
- Capacity expansion of cross-regional transmission lines helps SGCC to plan power grids in mid-term and long-term.
- ……

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Thank you!