China's CCUS development and demonstration actions: a key part of the global initiative to lower carbon emissions

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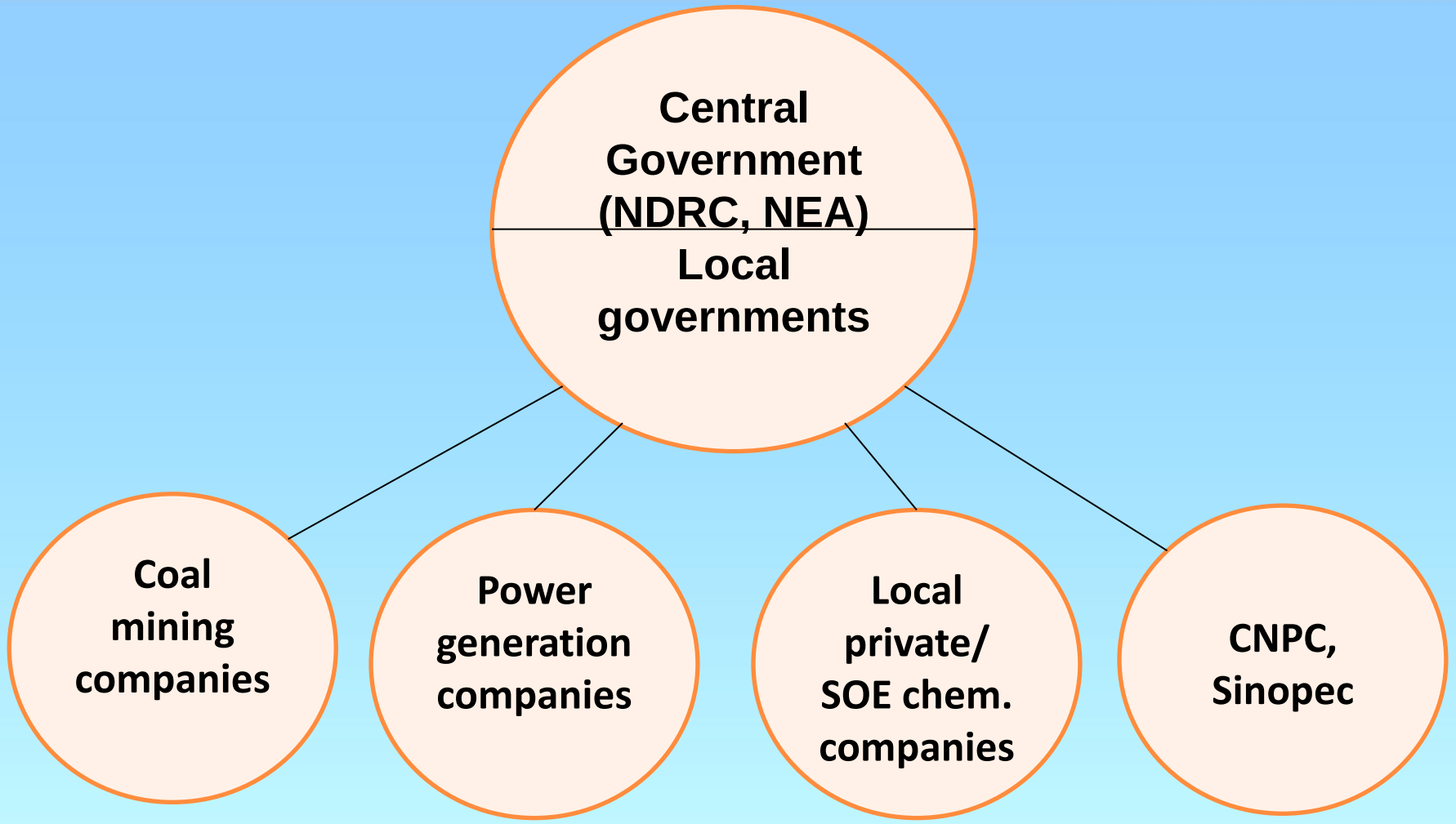
Scope of presentation

- China's energy challenges
- China's lower carbon policies
- CCUS drivers for China
- CCS and CCUS development initiatives so far
- CCUS demonstration prospects
- Possible timescales to implementation
- Final thoughts

Key players in the energy sector

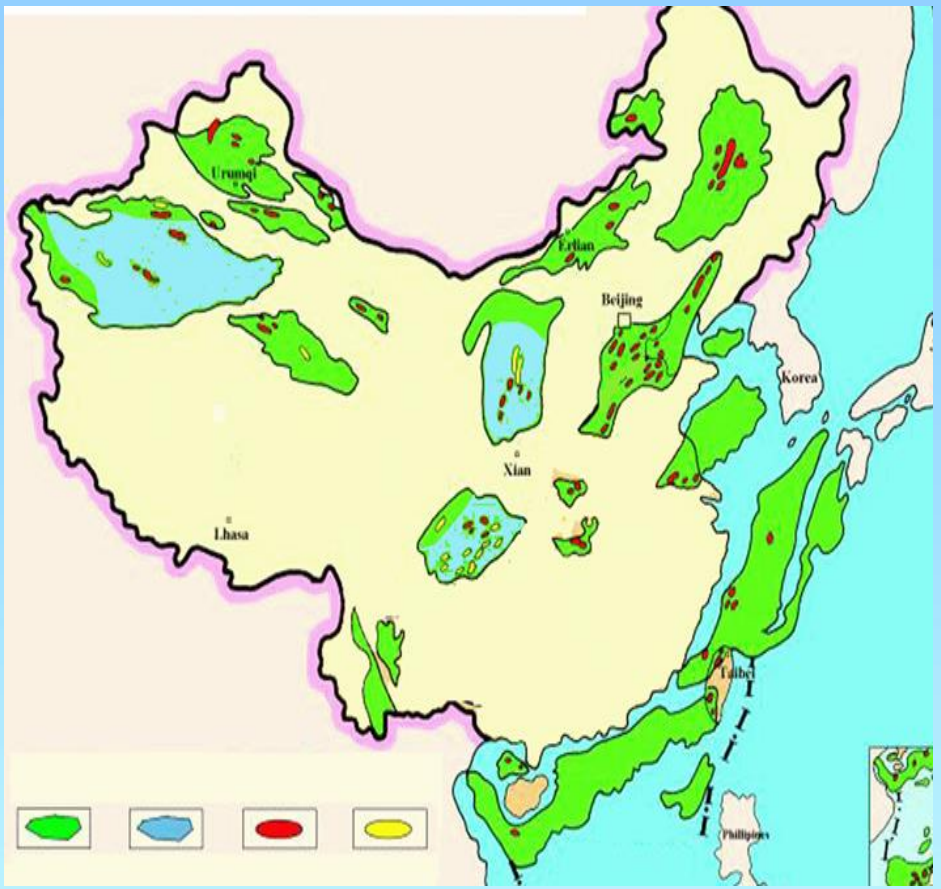


Energy sources and challenges for China

- China is rich in coal, has very limited oil supplies and lacks significant developed sources of gas
- China is diversifying supply sources for oil and gas and even for coal, due to internal transport limitations

Great potential of CO_2-EOR and storage in China

- China has a proved OOIP of low-permeability reservoirs as 6.32 billion tonnes, which is 28.1% of the proven OOIP.
- CO_2 injection could improve the oil recovery of these oil fields.
- CO_2 is a potentially valuable resource for oil recovery and 60% of CO_2 injected could be stored in the reservoirs.



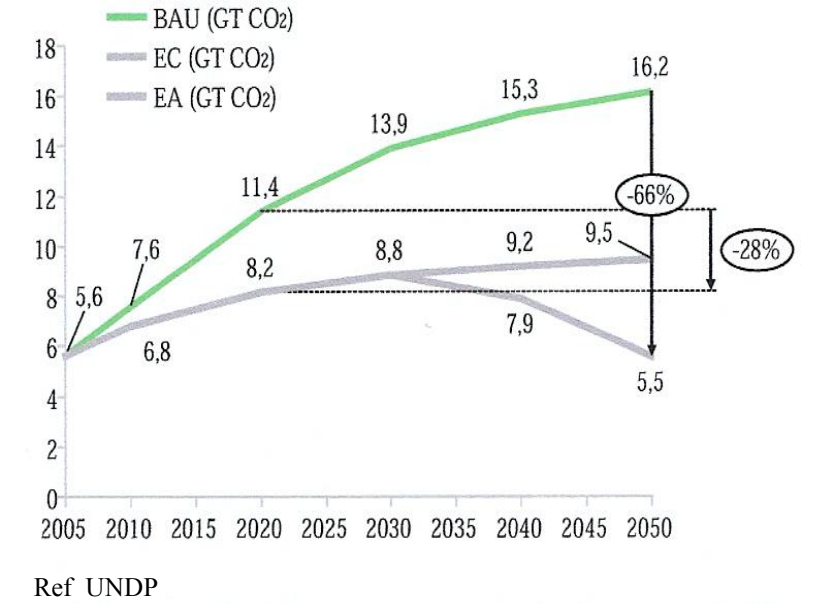
Main oil/gas fields in China

China's energy and environmental policy initiatives (2011-2015)

Key themes are rebalancing the economy, addressing social inequality and protecting the environment.

- GDP is expected to grow by 7 percent annually on average
- Energy consumption per unit of GDP to be cut by 16 percent from 2010 levels
- Sulphur dioxide and nitrogen oxides emissions to be cut by 8 percent and 10 percent respectively from 2010 levels
- Carbon dioxide emissions per unit of GDP to be cut by 17 percent from 2010 levels
- Non-fossil fuel use to account for 11.4 percent of primary energy consumption;
- Expenditure on R&D to account for 2.2 percent GDP

Current and future CO_2 emissions



In the near term, coal use will continue to dominate power generation sector, with its capacity rising from ~700 GWe (2010) to ~935 GWe (2015)

In 2010, CO_2 emissions were 8.3 Gt with those from coal in excess of 6Gt.

Studies indicate that absolute CO_2 emissions will rise but at decreasing rates.

With further introduction of low/zero carbon technologies, emissions may reach a plateau by about 2030.

CCS will be required if emissions are to subsequently decline.

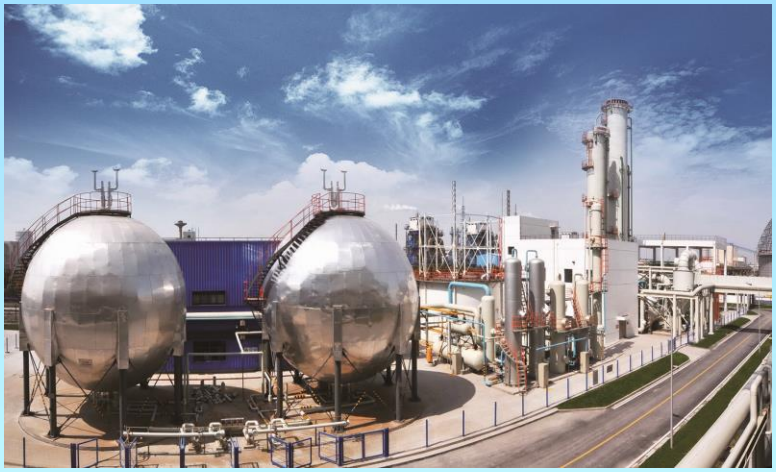
Status of CCS for China

Does not feature in the economic goals of 12th FYP but is included as a high technological priority within the R&D programme

- CO_2 capture, utilisation and storage technologies, namely through the development of key technologies and measures for capturing, utilising and storing CO_2;
- the design of a technology roadmap for CO_2 capture, utilisation and storage;
- the implementation of capacity building;
- the establishment of an engineering and technical demonstration project.

Mixture of domestic R&D programmes plus larger scale industrial trials and significant international cooperation for capacity building

CO_2 capture and utilisation trials in the coal fired power sector



In 2008, Huaneng Group established a side stream post-combustion capture unit on the 800MWe Gaobadian PC CHP plant in Beijing, with an annual CO_2 capture capacity of 3000 tonnes.

In 2010, Huaneng installed a larger unit on the 2x660 MWe Shidongkou No. 2 Power Plant in Shanghai, which can capture 120,000 tonnes of CO_2 each year.

In both cases, captured CO_2 is sold to the food and beverage industries.

Low cost CCUS potential in the coal to chemicals sector

There is a growth in scale and extent of application in the coal to chemicals sector, with the opportunity to capture, at relatively low cost, concentrated streams of CO_2, ideally for EOR applications.

The first major coal gasifier CCS trial in China is underway at the Shenhua CTL Demonstration Plant, close to Erdos, Inner Mongolia Autonomous Region. for storage in a nearby aquifer.

Greengen IGCC CCS project

The aim is to establish a high-efficiency, coal-based IGCC polygeneration system and efficient treatment of pollutants with near-zero emissions of CO_2.

Phase 1 is to prove the scale-up of the Chinese gasifier design and to ensure overall reliability and acceptability of the integrated IGCC power plant.

For Phase 2, the aim is to improve the IGCC polygeneration technology, together with a sidestream of syngas to determine how best to take forward the fuel cell power generation technology, and to produce up to 30-60,000 tonnes/year of CO_2 for EOR trials.

Phase 3 will comprise a 400 MWe demonstration of the overall concept.

CCUS demonstration rationale

Aims are to:

- establish the technology, including process integration and optimisation, at a scale that is large enough to allow subsequent plants to be built with confidence at commercial scale;
- prove that CCUS works and is safe, thereby building public confidence; and
- accelerate technology development in order to gain experience that will lead to subsequent cost reduction on larger scale plant.

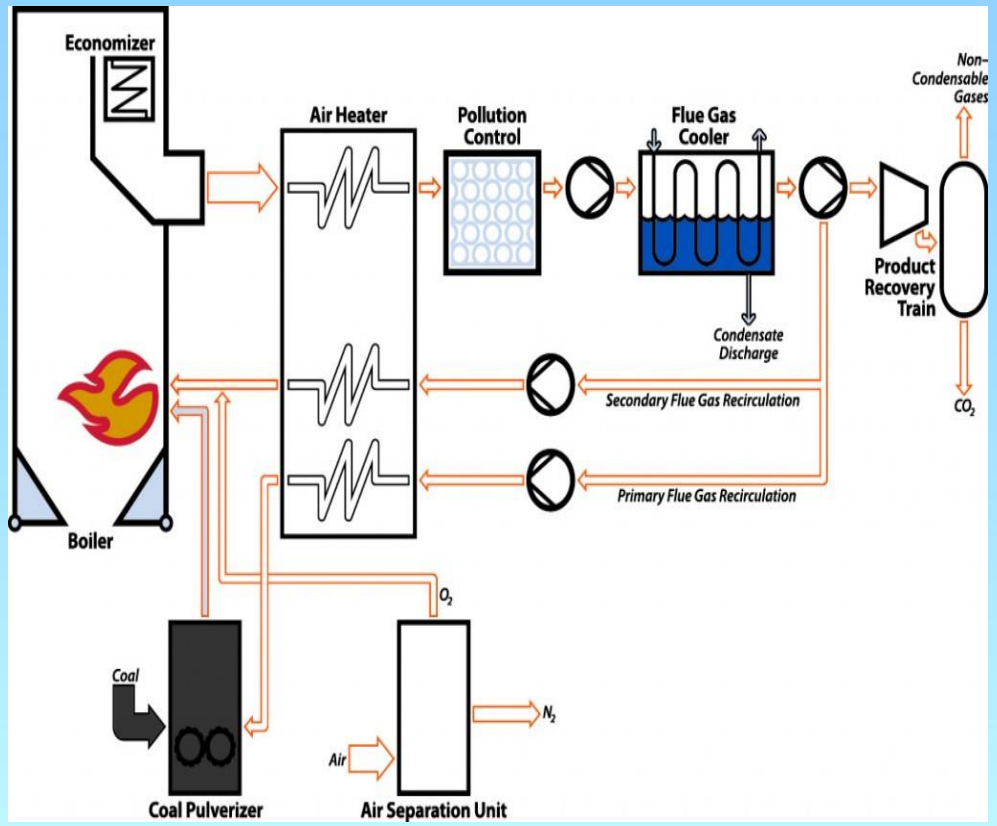
Likely components are:

- Near term low cost opportunities in the coal to chemicals sectors
- Introduction of CCS-ready for new power plants located to mega power bases, especially in Ordos basin region
- Move to establish some coal power demonstration projects, perhaps as side-stream actions

Post-combustion capture with EOR

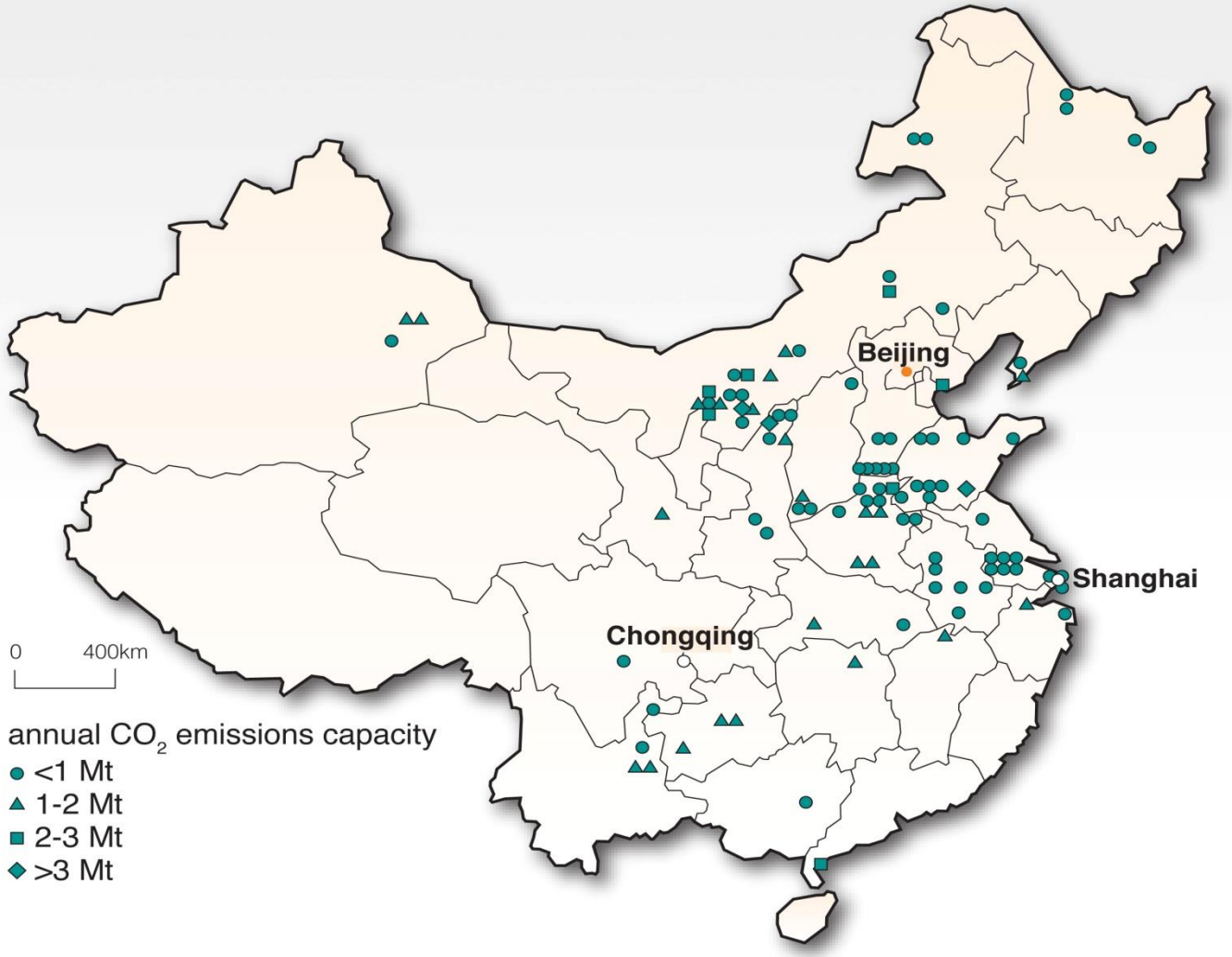
- Sinopec are carrying out a feasibility study for a 1Mt/year CO_2 EOR demonstration project, with CO_2 being captured at a coal power plant near to the Shengli oil field in Shandong Province

Oxyfuel combustion demonstration



- 200 MWe retrofit planned in Ordos region with CO_2 storage in a saline aquifer plus some CO_2-EOR
- Pre-feasability undertaken by Shenhua-Guohua Power with Dongfang Boilers

CCS opportunities for the modern coal to chemicals sector in China



Possible hurdles for CCS deployment

Technical issues are not the main worry. All three capture routes will work; they will get better and cheaper from learning by doing

Big issues are non-technical

- Regulation – especially long term liability for storage
- Finance – incentives are needed for investment, at least in the power sector
- Public acceptance of overland transport and underground storage

China – the future?

- Needs to pursue a low carbon development path with Chinese characteristics, with clearly defined targets and priority actions
  - Reduction in energy use per unit of GDP, with consequent reduction in CO_2 emissions
- Recognition that China can fulfil a leadership role in clean coal technology with carbon capture and storage
  - China already a growing provider of equipment and know-how in power generation, both domestically and overseas
  - Tremendous scope to build on the base to integrate CCS techniques as necessary
  - Build on joint ventures and licensing arrangements already in place
- It is essential that the rest of the international community continues to work with and support China, as part of a global initiative to ensure CCS is established on a viable basis