Assessment report on CO_2 utilization technology in China

2013.12.05

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1. Background

CCU can break the bottlenecks of CCS

✓ **Research suggests CCS will play important role to address climate change in mid- and long-term.**

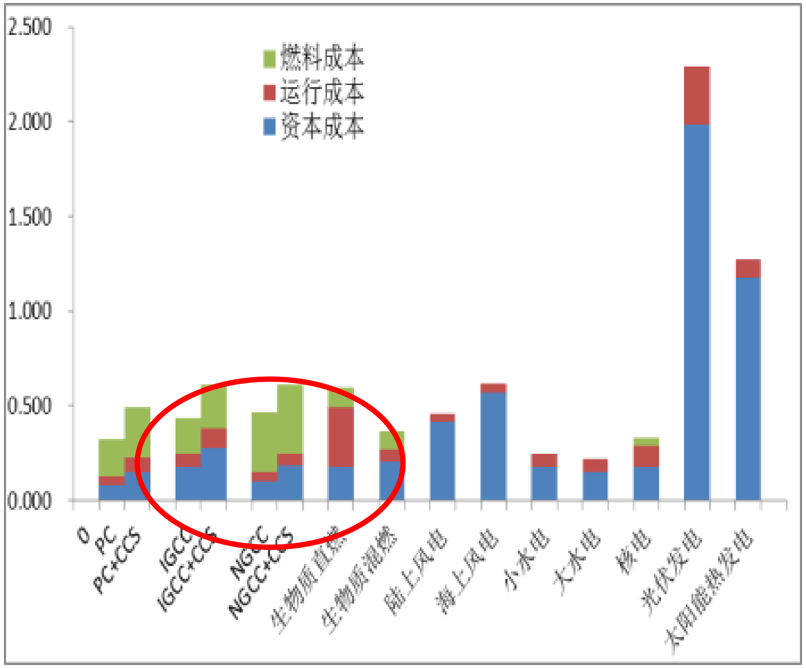
✓ **Carbon capture and storage is not a substitute, but a necessary addition to other low-carbon energy technologies and energy efficiency improvements in addressing climate change.**

- **High costs**

  A big portion of fuel costs in total cost.

- **High energy penalty**

- **High risks**



Lack of systemic assessment of CO2 utilization technologies in a Chinese Context

Currently, the assessments of CCU technologies either focuses on the purpose of advancing CCS, or take direct emissions reduction capacity as the sole assessment criterion.

Resent research does not provide significant guidance for China.

Assess the comprehensive role of CCU in a Chinese context

Accurate assessment CO_2 Utilization Technology should be based on China's national conditions and its contribution to multiple goals of economic development and environmental protection.

Emphasize on the substitutive emissions reduction capacity.

- **China's energy mix is dominated by coal.**
- **The heavy industry takes up a big share in China's economic structure.**

Contribution to various goals related to China's economic development

- **Enhanced energy (resources) recovery**
- **Economic development**
- **Promote industrial development**
- **Improve energy utilization pattern**
- **...**

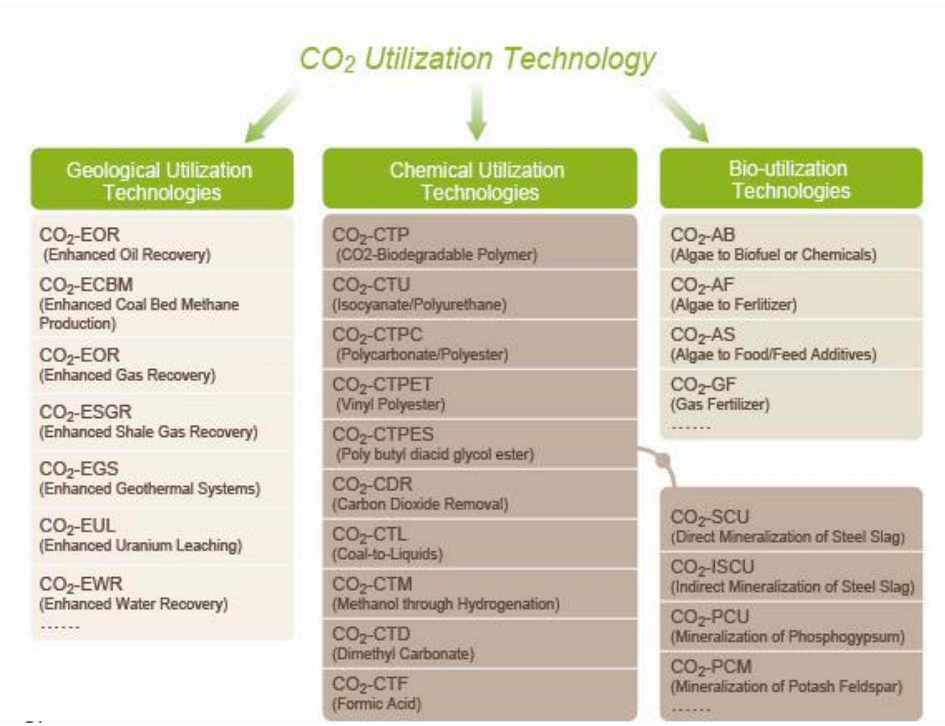
Facilitate the transition towards CCS

- **Many CO2 utilization technologies are part of CCS.**
- **We should view CO2 utilization technology as a strategic technical reserve.**

2. SCOPE AND METHODOLOGY

Definition and Scope

CO_2 utilization technology refers to the industrial and agricultural utilization technologies that apply physical, chemical or biological functions of CO_2 to produce products with commercial value, which can reduce emissions compared to like products or other similar processes.



Scope of CCU

Applications and Typical End Products

Methodology used in this report

- **The basic principles of the assessment**
  Multiple targets, Objectivity, Foresight
- **Clarify and standardize related definitions and classification**
- **Set up a comprehensive assessment indicator system**
  Technology maturity, emission reduction potential, industrial output, economic feasibility, safety and stability, geographical features, environmental and social benefits

Metrics

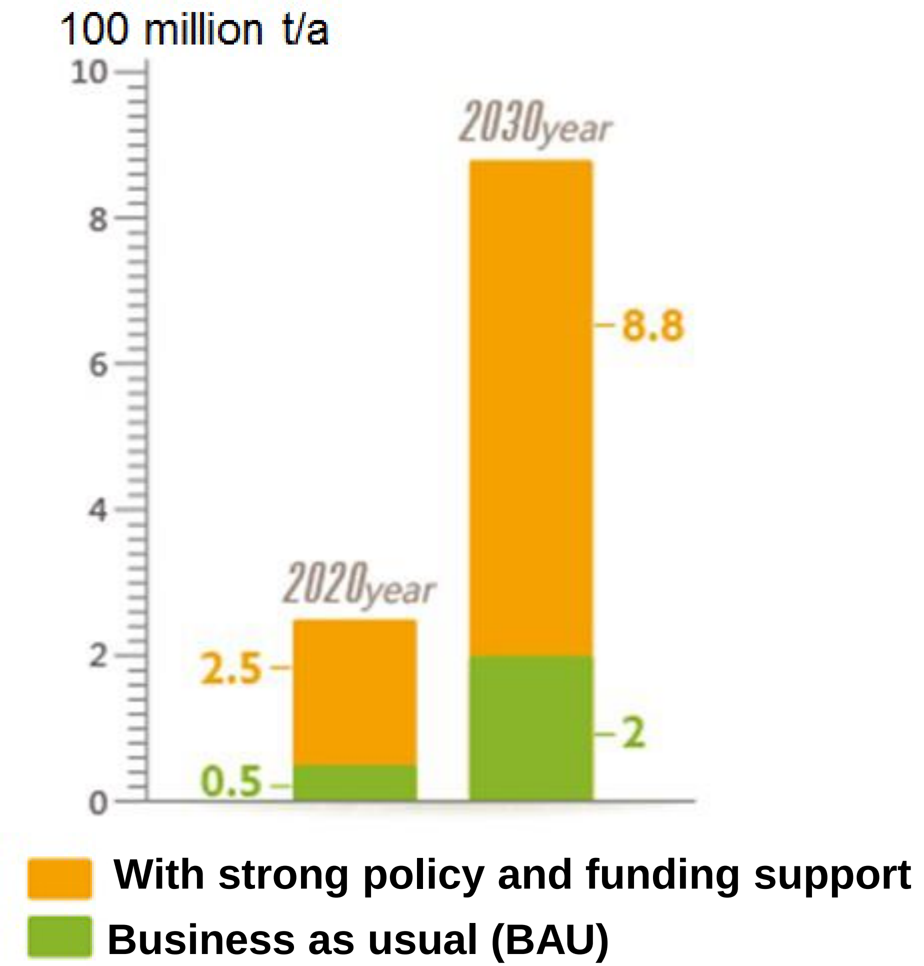
emission reduction potential (direct + indirect)	• Direct emission reduction (CO2 utilized- emission in the utilization process) • Emission reduction (due to the alternative raw materials) • Emission reduction (due to product substitution)
Benefits	• Emission reduction potential • Economic benefits • Environmental protection • Social benefits
Market potential (the industrial output)	• Production volume • Production value • Unit price

3. POTENTIAL AND BENEFITS

Huge emission reduction potential

- **Under BAU scenario: By 2020 and 2030, CO2 utilization technology may achieve CO2 emission reduction 50 million T/A and 200 million T/A respectively.**

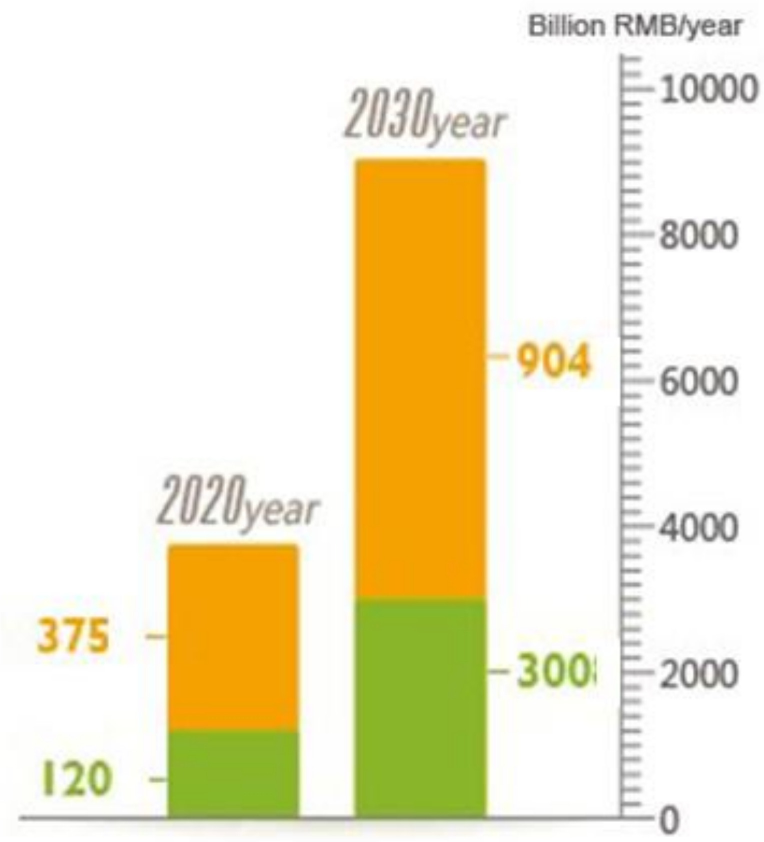
- **If policy support and investment are strengthened: By 2020 and 2030, CO2 utilization technology may achieve CO2 emission reduction 250 million T/A and 900 million T/A respectively, which is equivalent to 17% and 60%of the average annual emission reduction in the eleventh five-year plan period in China.**



Considerable economic benefit

- **Under BAU scenario: By 2020 and 2030, CO2 utilization technology may create an industrial output of 120 and 300 billion Yuan per year respectively.**

- **If policy support and investment are strengthened, by 2020 and 2030, CO2 utilization technology may create an industrial output of 375 and 900 billion Yuan per year respectively.**

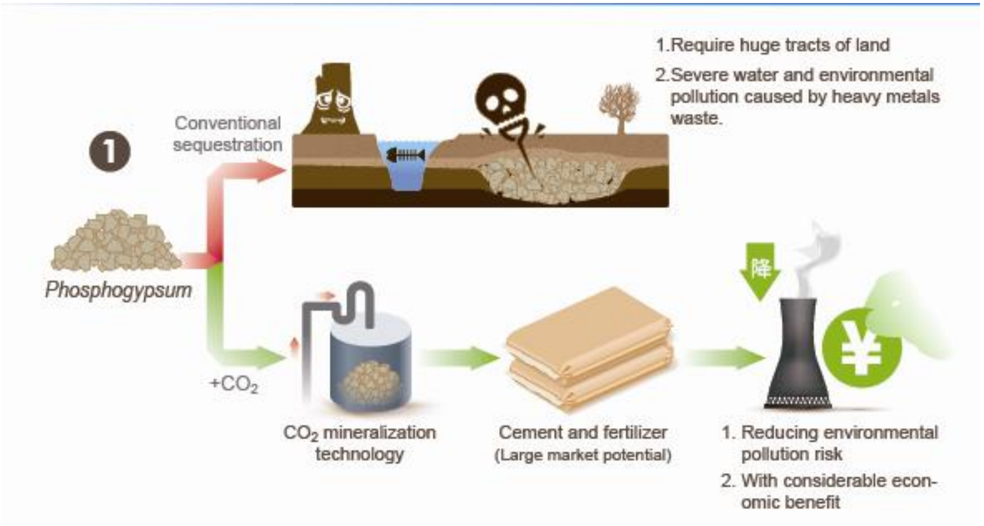


With strong policy and funding support

Business as usual (BAU)

Remarkable environmental benefits

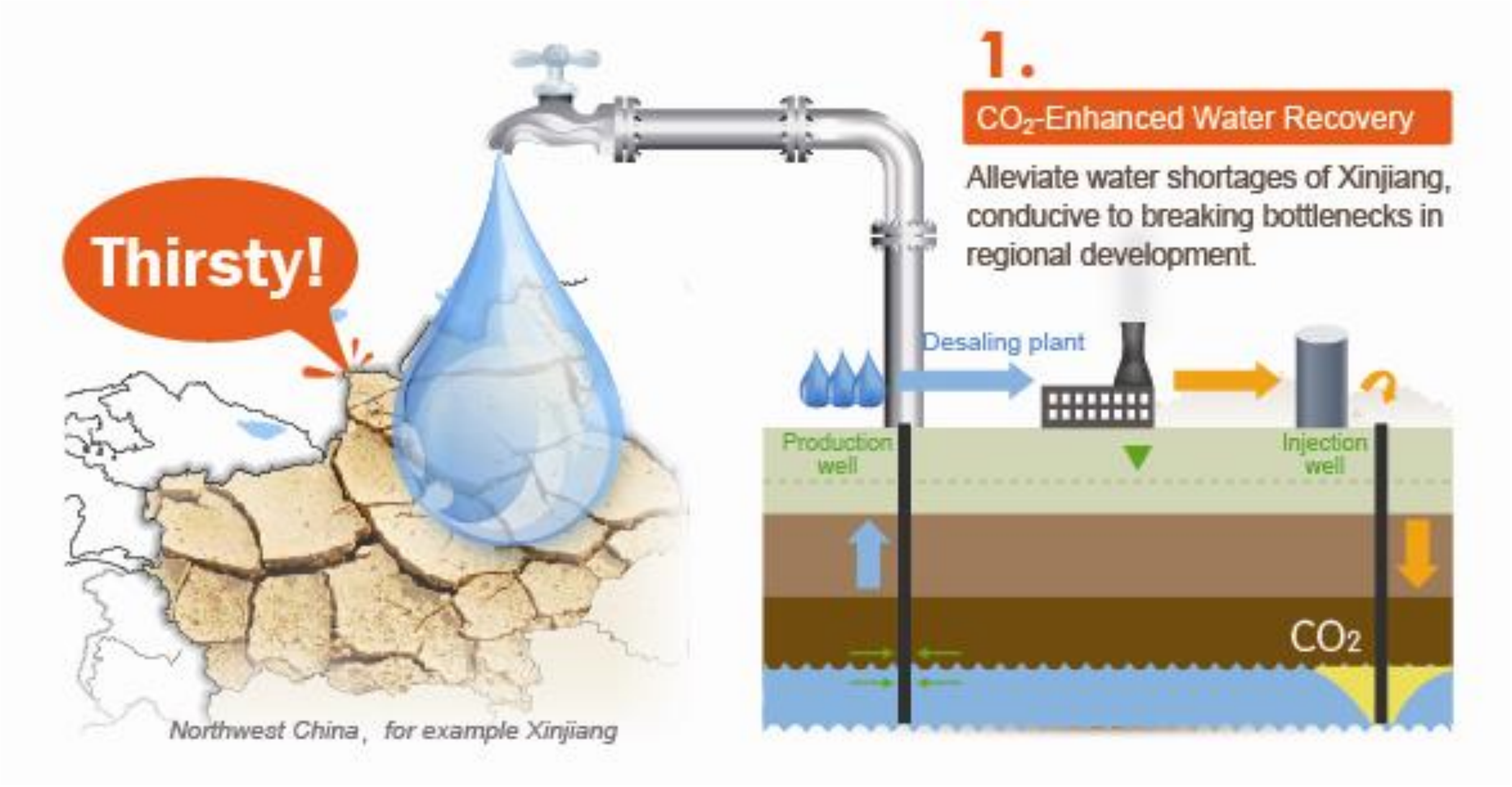
- **enhance the production efficiency of chemical and agricultural products,**
- **facilitate recycling of industrial waste,**
- **reduce industrial water consumption and ensure agriculture water supply,**
- **reduce the discharge of sulfides, nitrides, solid waste and other pollutants.**



E.g. CCU technologies for biological and agricultural products sequestrate CO2 biologically in an environmentally friendly manner and do not use chemicals in the conversion and utilization processes, which do not generate secondary pollution to the soil and are conducive to soil improvement.

Alleviate resource constraint

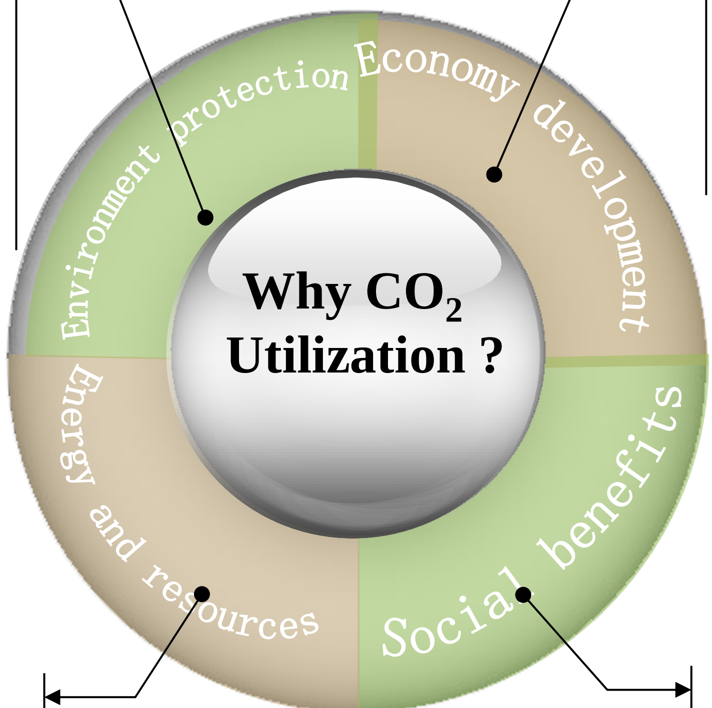
With a wide-range of technologies that are complementary to different regions, CCU technologies can facilitate in-situ utilization of CO2 emissions and create new sources of economic growth for the regions.



Role of CO_2 Utilization Technology in China

Environment protection
-CO_2 reduction
-Address climate change
-Reducing industrial water use
-Discharge of pollutants

Economic benefits
- Cost-effective
-Additional output value
-New economy growth point



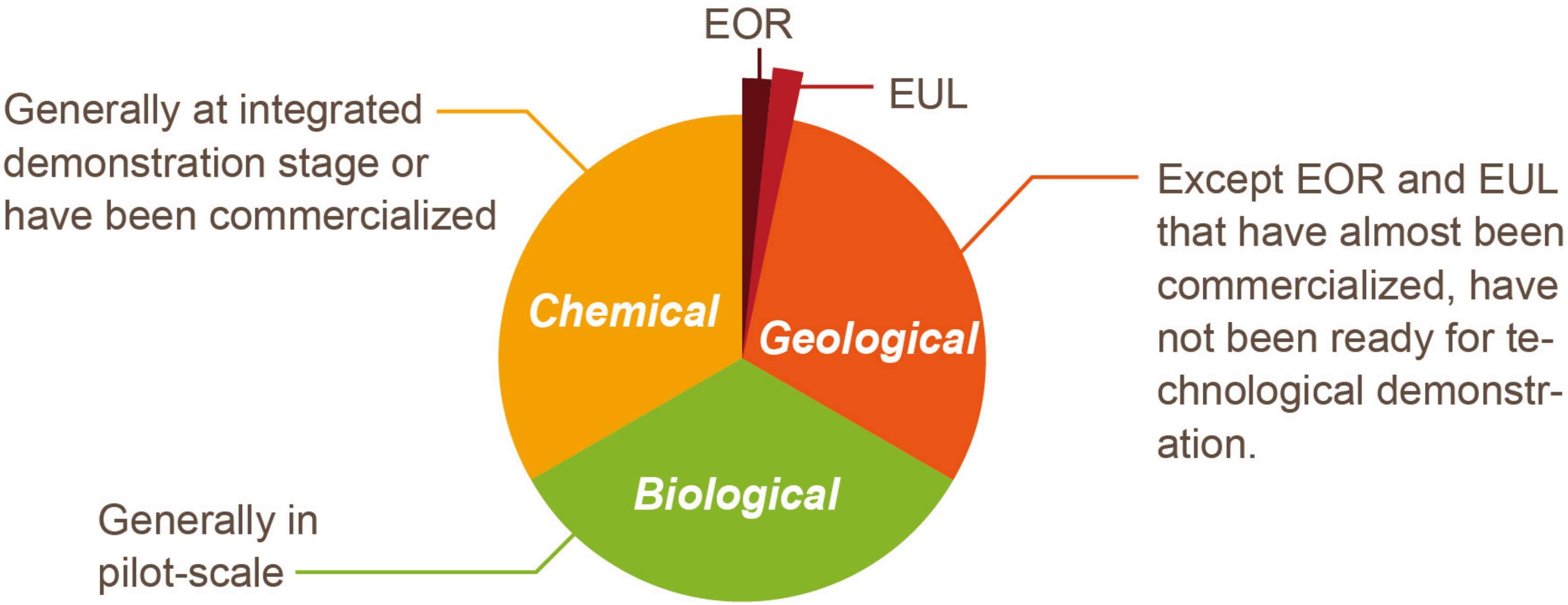
Energy and resources
-Energy security and safety
-Resource recovery
- Improve productivity of chemical products and agricultural products

Social benefits
- - Create more job opportunities
- - Improve people living standard

4. CURRENT STATUS, PROSPECTS AND EARLY OPPORTUNITIES

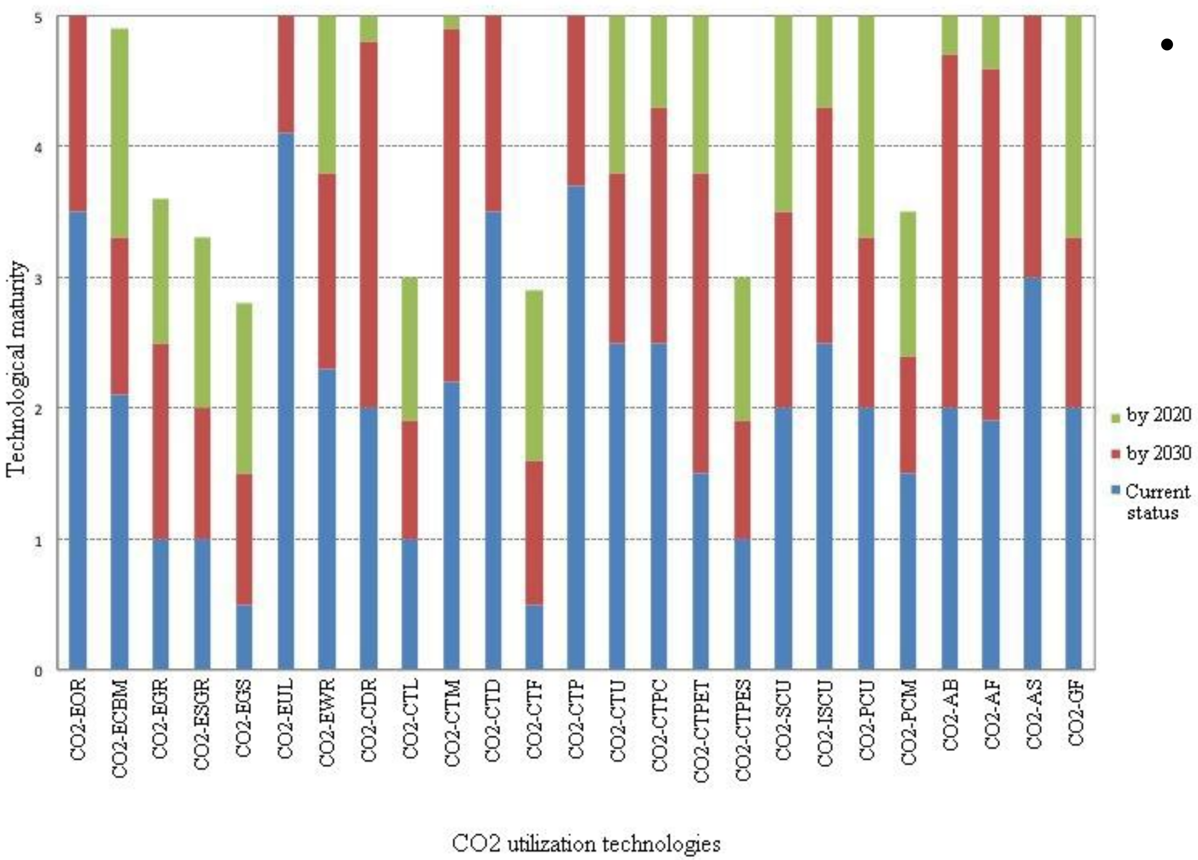
Current status

The current status of CO_2 utilization technologies differs considerably from each other.



Prospects

- **By 2020, CCU technology will probably have made great progress, with most technologies reaching industrial application or commercialization.**

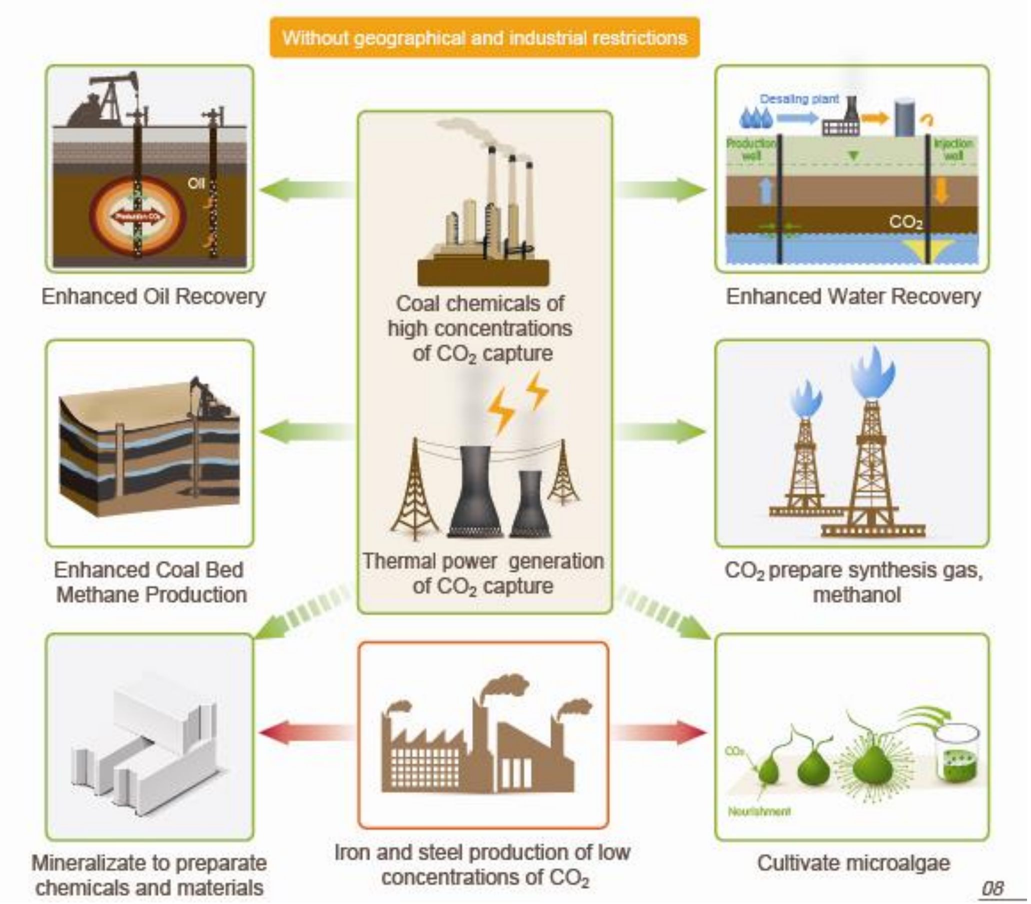


- **By 2030, CCU technologies will probably have made further progress, with most technologies being or coming close to commercialization.**

Early stage opportunities

We suggest that emphasis should be put on the following new industrial clusters, integrating CCU technologies and cement, steal, power generation, and coal chemical industries:

- **Cluster of thermal power generation, CO_2-EOR, and water-soluble mineral output enhancement;**
- **Cluster of coal chemistry, CO_2-ECBM, chemical conversion of CO_2 and carbon recycling;**
- **Cluster of iron and steel production, mineralization, microalgae and ecological agriculture;**



5. KEY CHALLENGES AND RECOMMENDATIONS

Key Challenges of CCU Development

- **In terms of science and technology, breakthroughs in basic theoretical research and key technologies need to be achieved.**

- **In terms of policy and institutional arrangement, the current R&D management system cannot accommodate the inter-disciplinary and cross-sectoral nature of CCU technologies. And a commercial operation model is yet to be formed.**

- **In term of motivation and incentives for enterprises, with the huge investment needed and uncertain revenues, enterprises are not motivated under the current incentive mechanisms.**

Policy Recommendations

- **The importance of CO2 utilization technologies shall be highlighted in the national energy and environment strategy.**

- **A coordination mechanism for science and technology shall be established to capture early stage opportunities.**

- **CCU technologies shall be included in the national strategic emerging industries and be granted relevant supporting policies.**

- **A roadmap of science and technology development of CCU shall be developed.**

- **A pre-feasibility study shall be conducted on building a national key R&D platform for CCU technologies.**

Thank you!