Challenges in Global CCS Projects and Coping Strategy

Research Institute of Petroleum Exploration and Development, PetroChina

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Outline

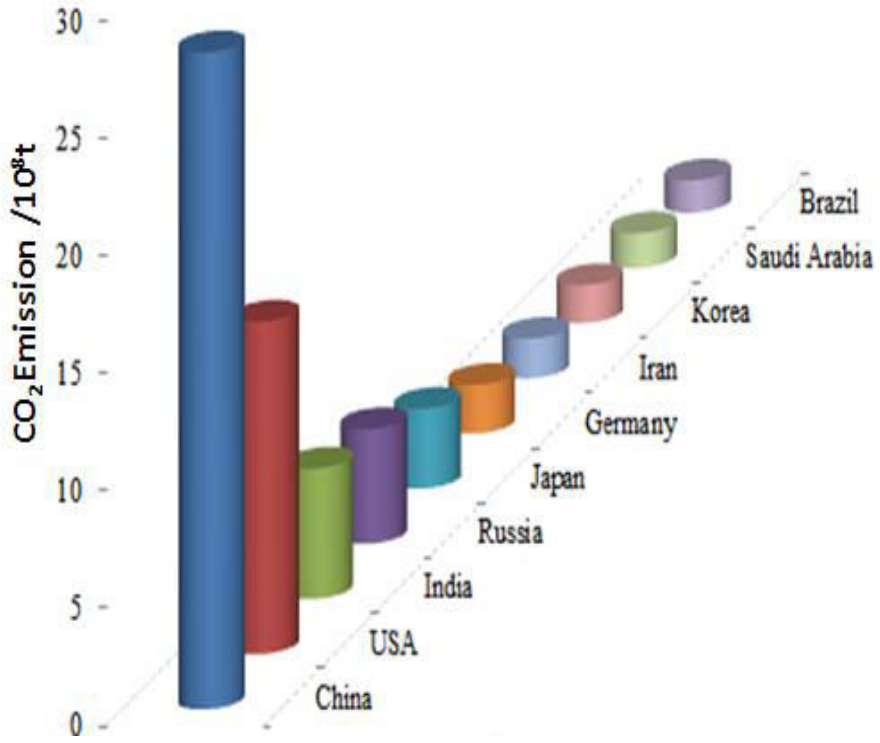
1. Why do we do CCS/CCUS
2. Global CCS projects
3. Challenge for CCS
4. Coping strategy for CCS
5. Conclusions

1. Why do we do CCS/CCUS

- Because we have only one earth in the universe, we need to protect it to save human being
- Since the industrial revolution, human activity is more and more dependent on fossil fuels, which emit a great of greenhouse gas

1. Why do we do CCS/CCUS

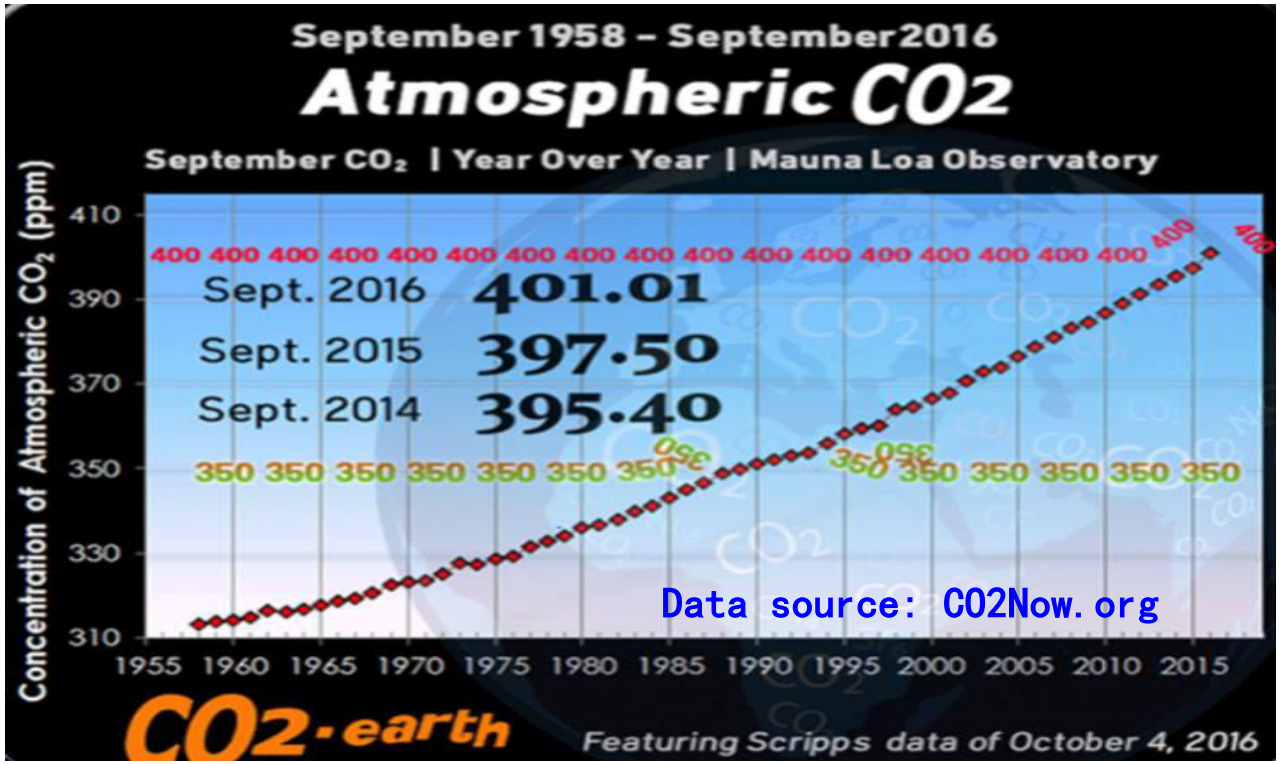
CO_2 emissions in the world in 2014



Country	CO_2 emission /10^8t
China (mainland)	27.95
USA	14.14
India	5.55
Russia	4.88
Japan	3.39
Germany	2.07
Iran	1.68
Koren	1.62
Saudi Arabia	1.48
Brazil	1.37
Mexio	1.33
Indonesia	1.31
Canada	1.30
South Afiica	1.29
United Kingdom	1.25
Australia	1.03

1. Why do we do CCS/CCUS

CO_2 Concentration on the earth in the atmosphere



- Temperature increase with CO2 concentration
- By the end of the century, we could expect the planet's average temperature to rise anywhere between about 1.5 and 2°C

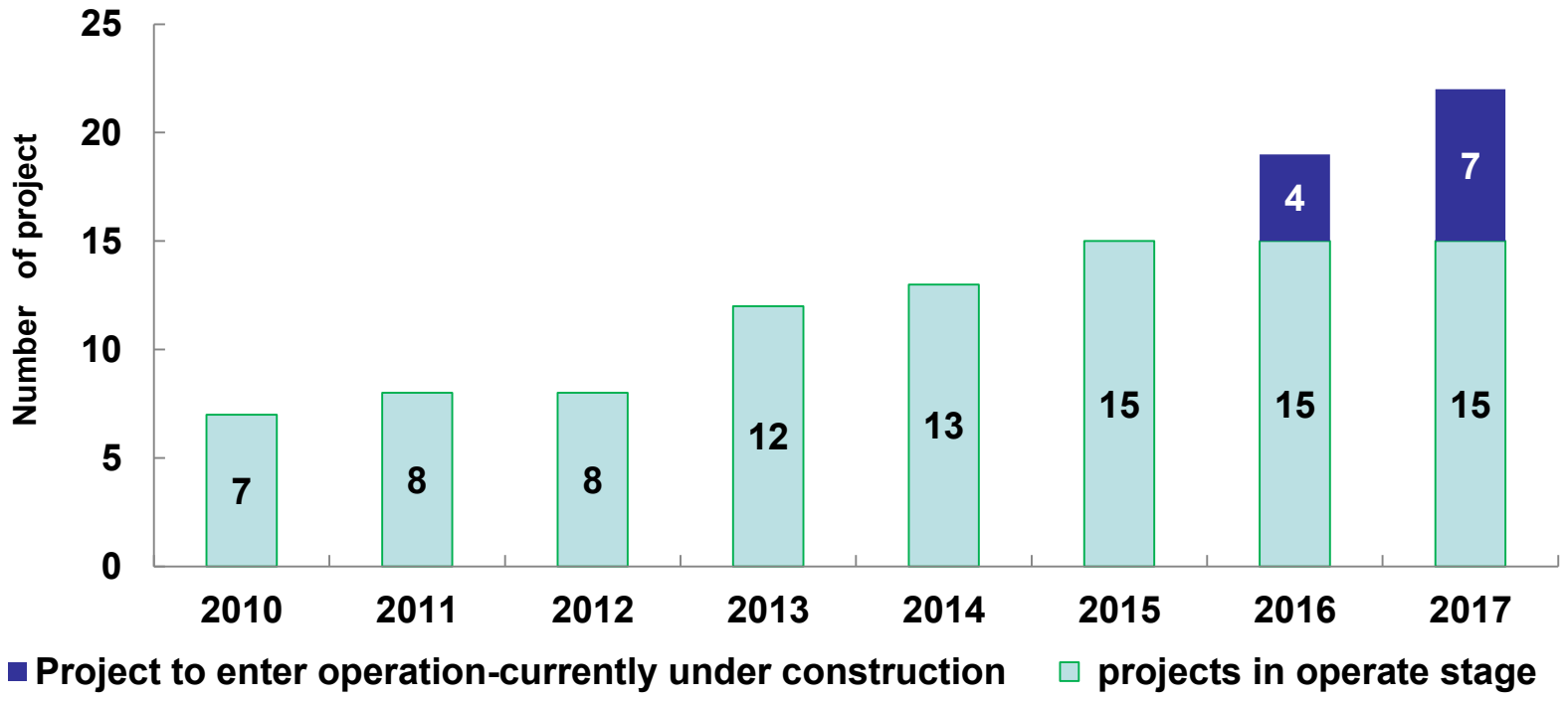
2. Global CCS projects

Large-scale projects in the world

Projects	Country	Capture	Size/Mtpa	Industry	Transport	Storage	Starting Time
Sleipner	Norway	Pre-combustion	0.9	Gas processing	None Direct Injection	Deep saline	1996
Weyburn	Canada	Precombustion	3.0	Natural gas synthetic	Pipeline 315 km	EOR	2000
Salah	Algeria	Precombustion	0	Gas processing	Pipeline 14 km	Deep saline	2004
Snøhvit	Norway	Precombustion	0.6-0.8	LNG production	Pipeline 152 km	offshoresaline	2008
Century Plant	England	Pre-combustion	8.4	Gas processing	Pipeline 69 km	EOR	2010
Coffeyville plant	USA	Industrial separation	1.0	Fertilizer production	Pipeline 112 km	EOR	2013
Boundary Dam	Canada	Post-combustion	1	Power generation	Pipeline 100km	EOR	2014
Kemper County	USA	Pre-combustion	3.5	Power generation	Pipeline	EOR	2014
Quest	Canada	Pre-combustion	1.08	hydrogen processing	Pipeline 65km	Deep saline	2015
Uthmaniyah	Saudi Arabia	Pre-combustion	0.8	Gas processing	Pipeline 700km	EOR	2015
Gorgon	Australia	Pre-combustion	3.4-4.0	Natural gas processing	Pipeline 7km	onshore saline	2016
Illinois Industrial	USA	Industrial separation	1.0	Ethanol production	Pipeline 1.6km	onshore sali	2016

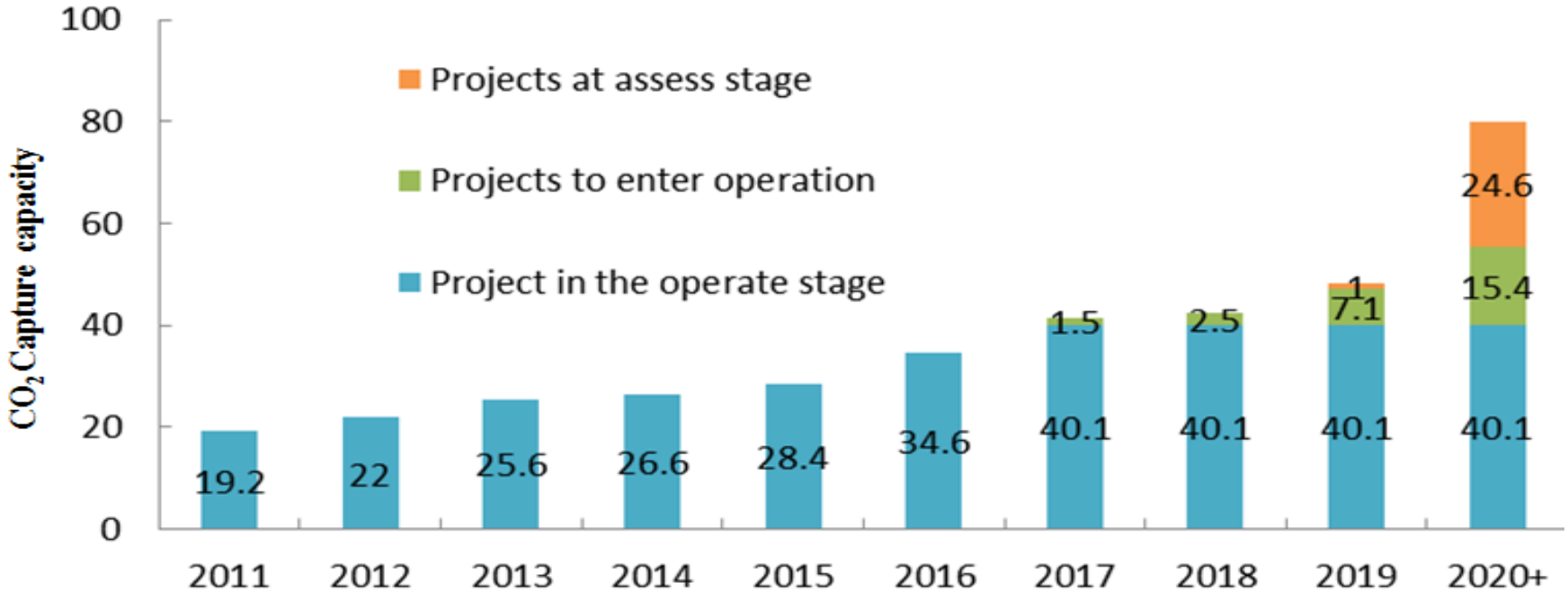
2. Global CCS projects

In recently years, the large-scale CCS projects continues to the steady increase



2. Global CCS projects

Total CO_2 capture capacity in the World



CO_2 capture capacity by actual and expect year of operation

2. Global CCS projects

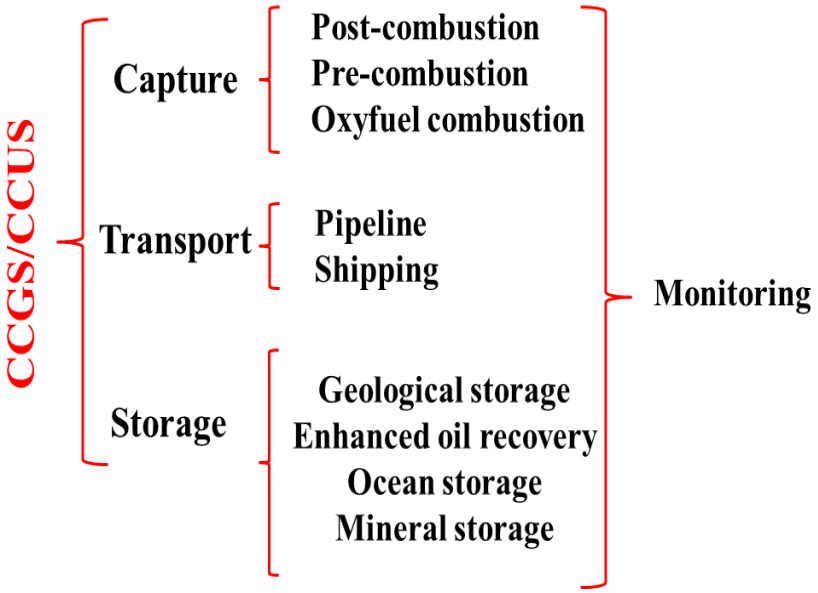
Global CO_2 storage potential

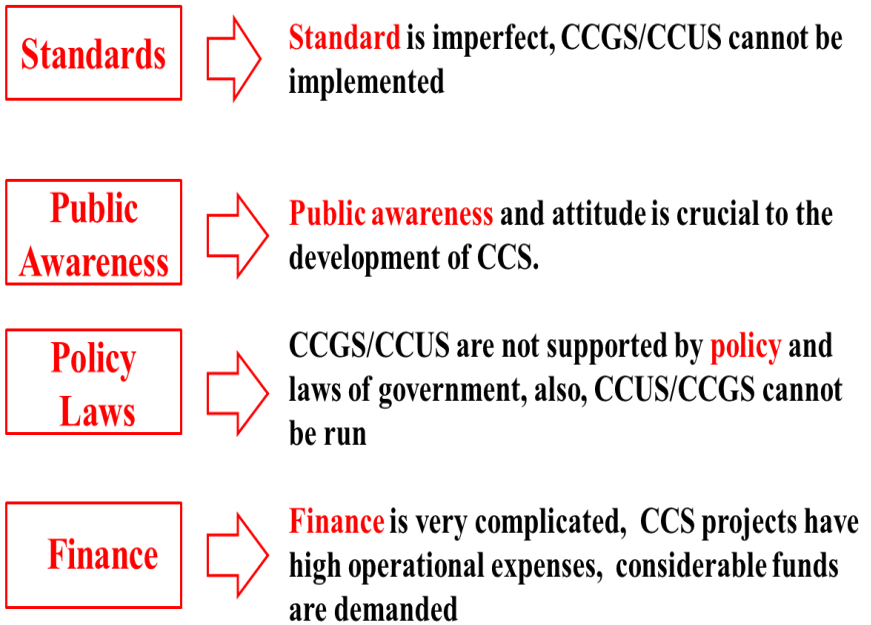
Type	CO_2 storage capacity/Gt
Depleted Oil reservoirs	690
Depleted Gas reservoirs	120
saline aquifers	400-10000
coal beds	40
total	1160-10760

IPCC special Report on Carbon dioxide Capture and Storage

3. Challenge for CCS

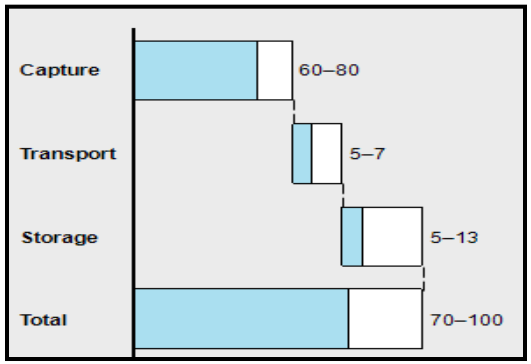
CCS is a systematical engineering, also, it has good prospects, CCS faces a large number of critical challenges in the future, including four technology challenges and four environment challenges, as shown in below figures



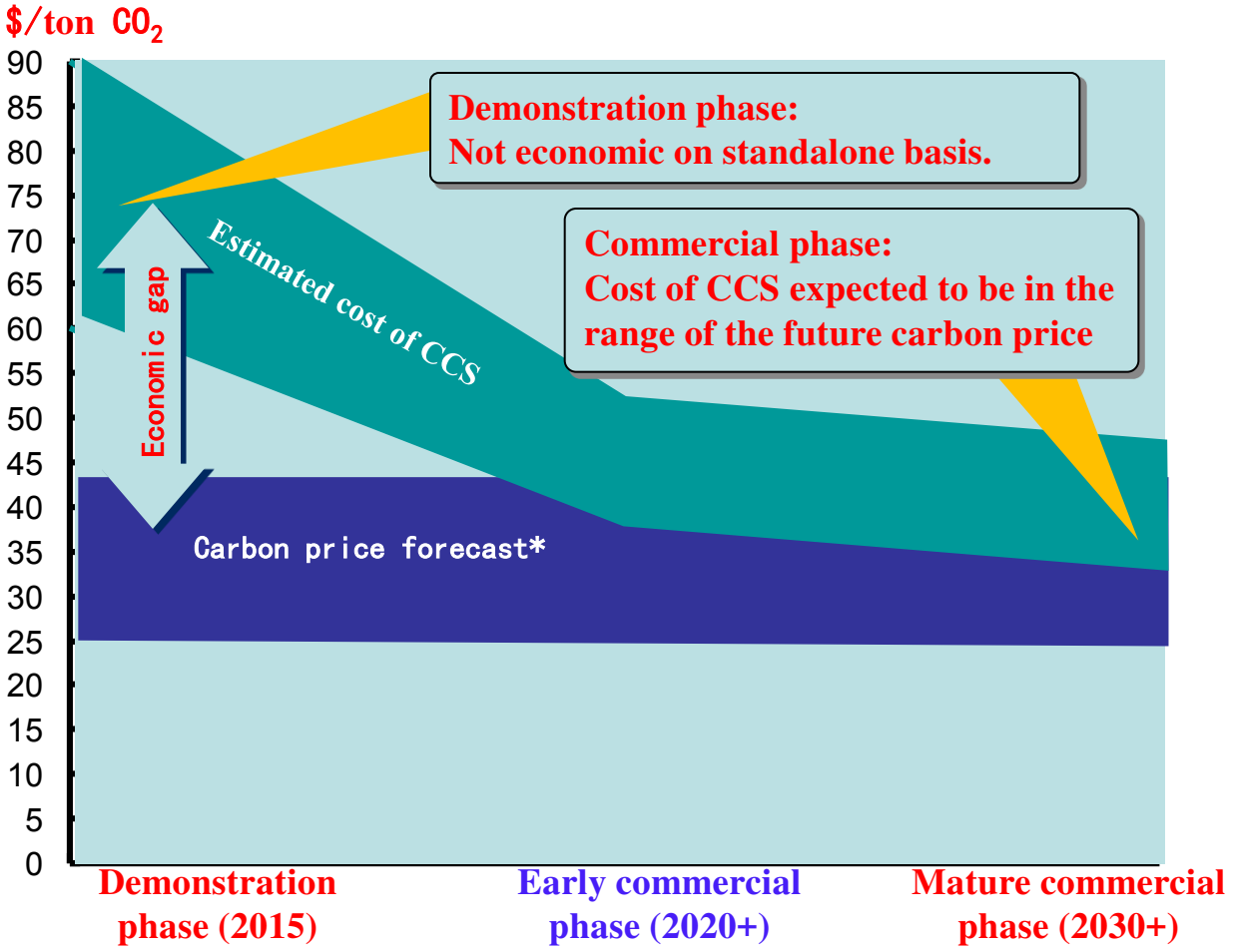


3. Challenge for CCS

CCS price impacts on its commercial development



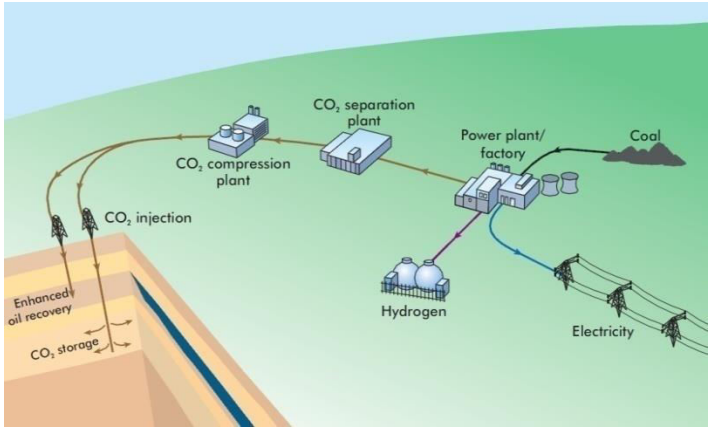
Cost ratio of CCS projects

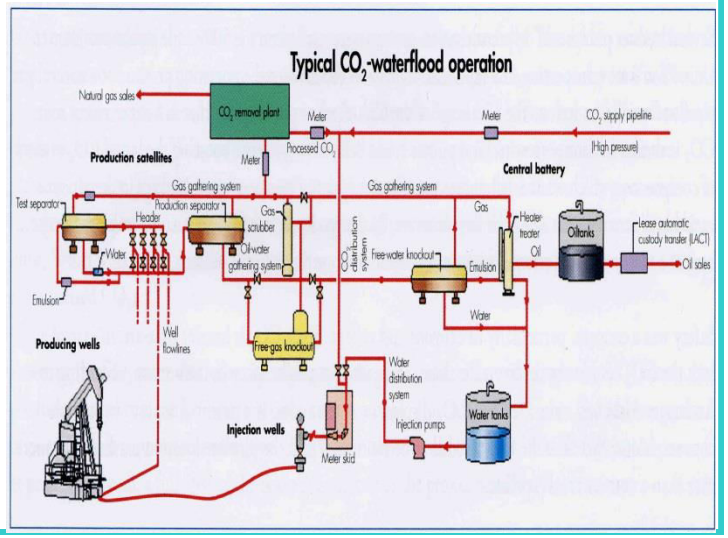


4. Coping strategy for CCS

Four ways for reducing CO_2 emission

- CO_2 capture and geological sequestration (CCGS)
  - Depleted Oil & Gas reservoirs, saline aquifers and coal beds for CO_2 Storage
- CO_2 Capture, utilization and Storage (CCUS)
  - Oil & Gas reservoirs for EOR, EGR, ECBM, EWR

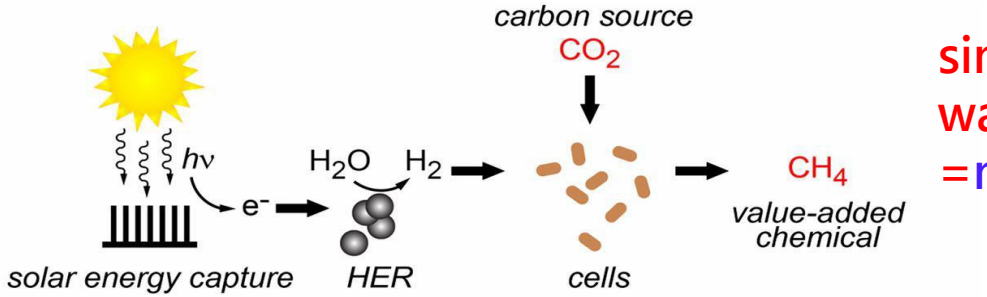




4. Coping strategy for CCS

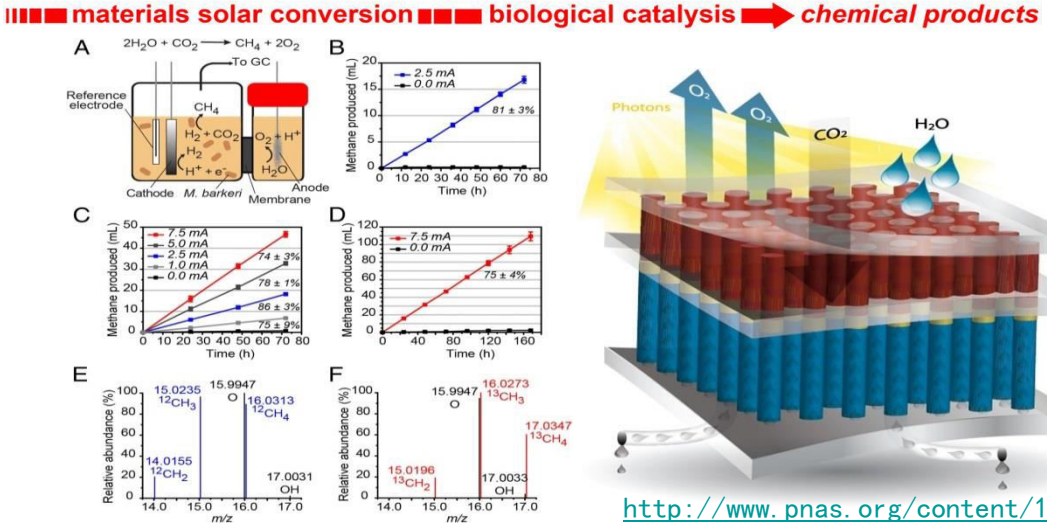
◆CO2 Capture and Utilization (CCU)

◆CO_2 capture for developing renewable energy, food and new material and so on



simple equation:

simple equation: sunlight+ water + carbon dioxide =methane= sustainable fuel

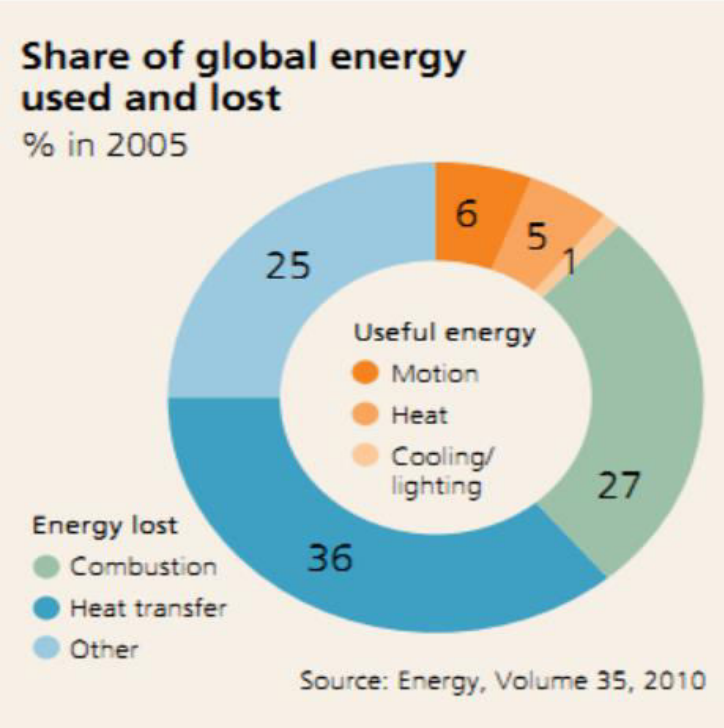


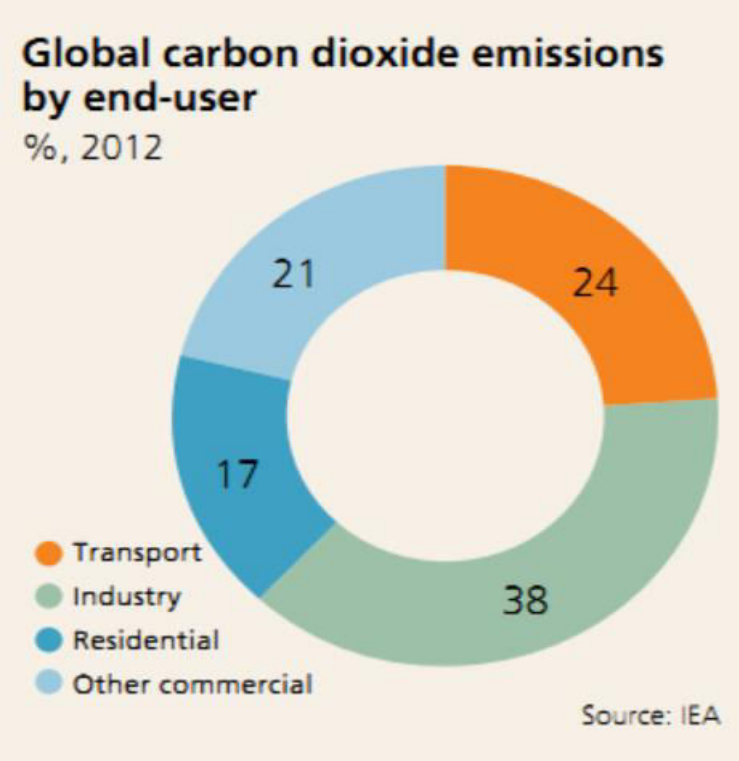
http://www.pnas.org/content/112/37/11461.full

http://www.pnas.org/content/113/17/4545.full

4. Coping strategy for CCS

◆Energy saving and CO2 emission reduction and improved energy efficiency (ESCR)





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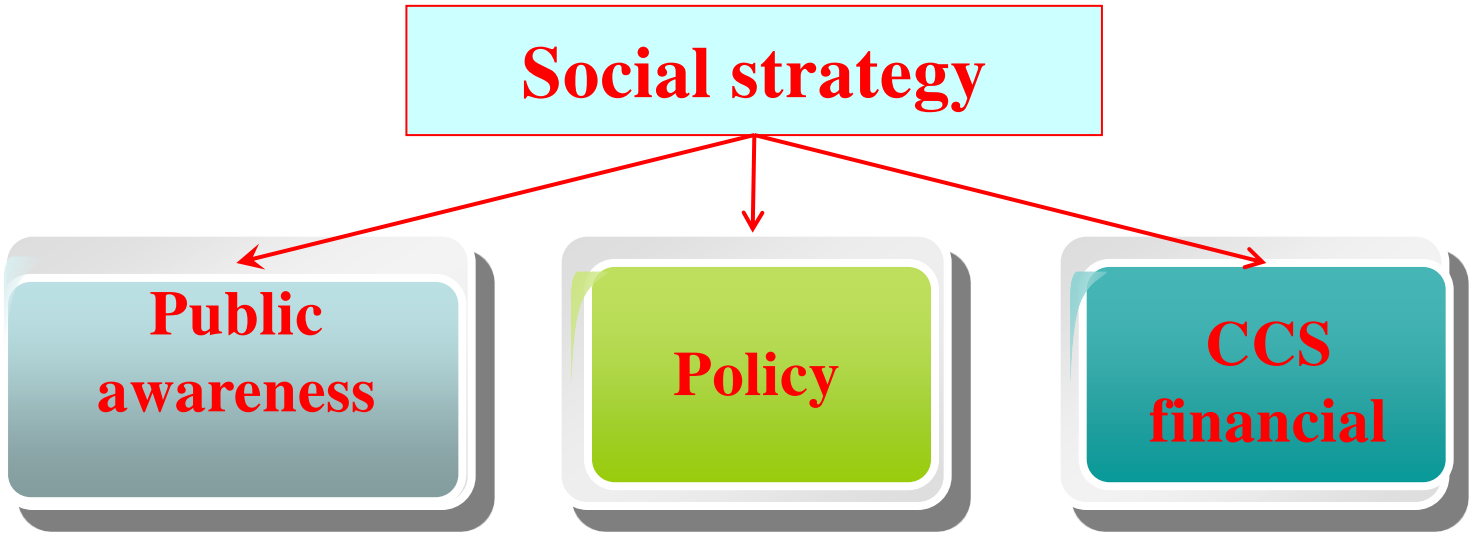

5. Conclusions

(1) Distinguish the CCGS, CCUS, CCU and SECR , in order to make full use of these technology

(2) Develop the new CCS/CCUS technology to reduce the Cost of CCS/CCUS chain and improve the energy utilization efficient

(3) Accelerate the CCGS and CCUS technology innovation, construct the CO2 hub, cluster and transportation network, and establish the long-term mechanism of monitoring and management to reduce the risk of CO2 storage

(4) Introduce the mitigate CO2 knowledge, organizing public education of CCS chain, promoting exchange between governments, improve public awareness, build good finance channel for developing practical CCS technology

(5) According the different country policy, perfect carbon regulations and laws, build international standards of carbon management, aiming to ensure the implement of the large-scale CCGS and CCUS projects

Thanks !

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