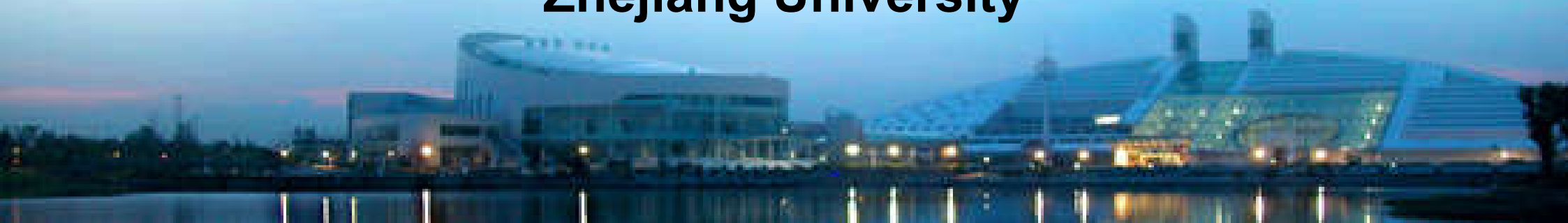




CO₂ Mineralization Curing Technology for Coal Based Industrial Solid Wastes

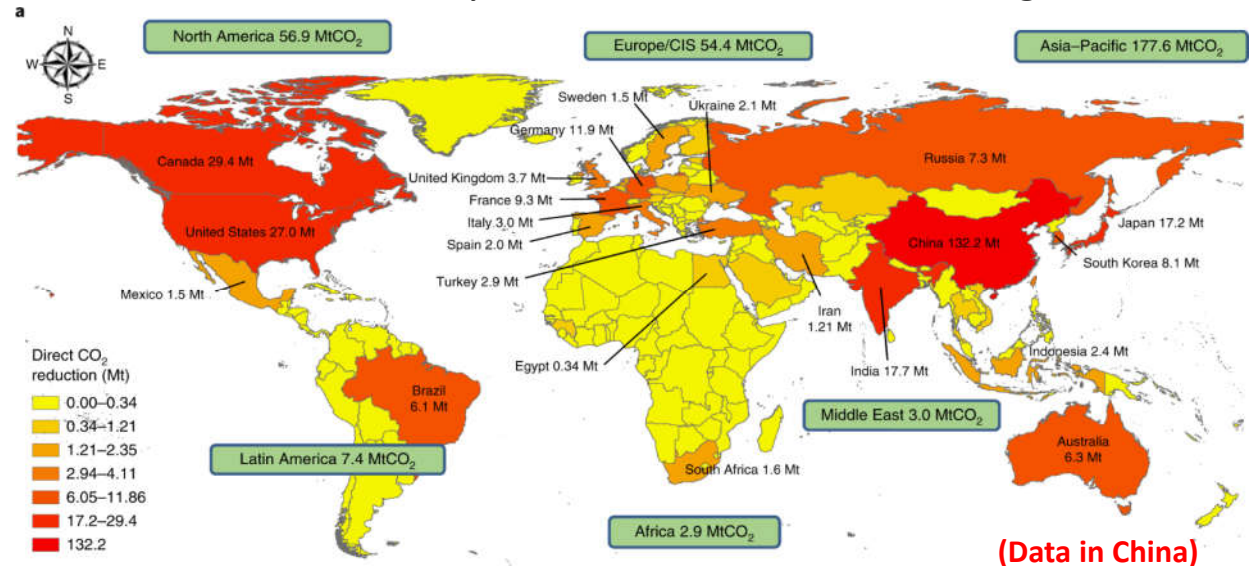
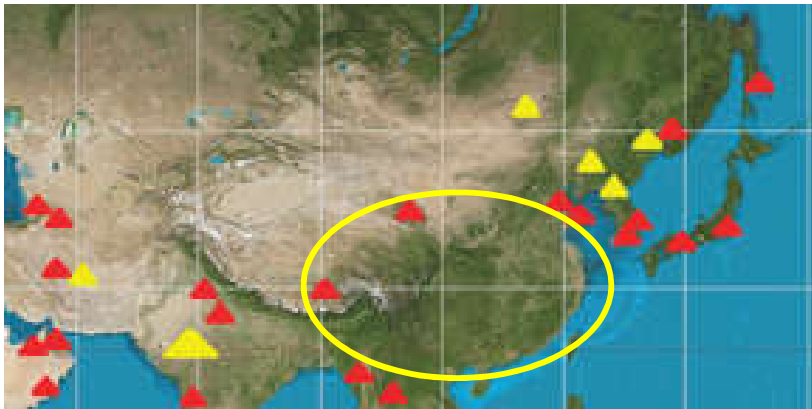
Prof. Tao Wang
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Zhejiang University



Potential of CO₂ Mineralization for Industrial Solid Waste in China

- China has identified few reactive geological reservoirs, such as basalt. Coupled with the high costs of mineralization, these factors have resulted in low CO₂ storage potential and poor engineering feasibility.
- The CO₂ sequestration potential of industrial solid waste in China reaches 130 million tons/year, CO₂ mineralization of industrial solid waste in China is characterized by its massive scale and strong economic viability.

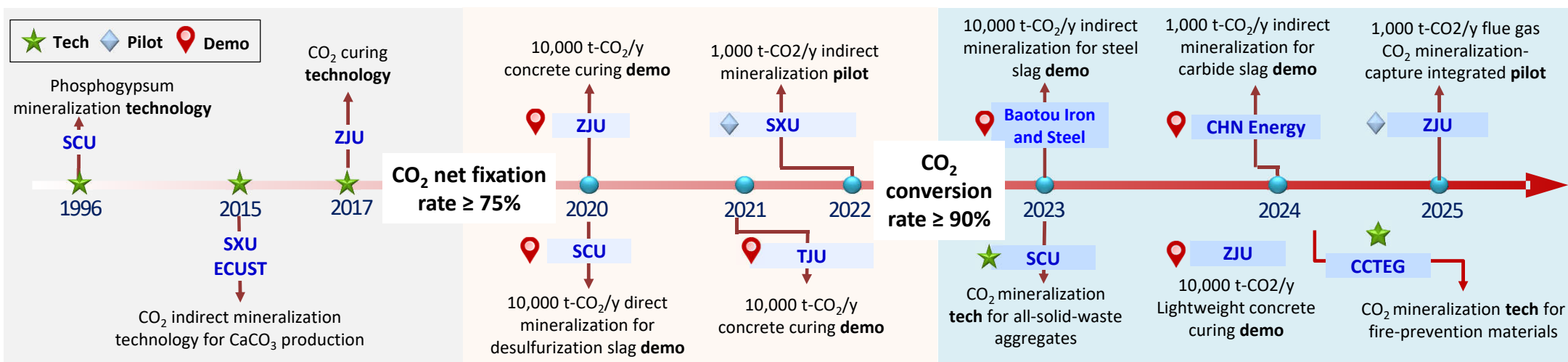


The reserves of minerals such as basalt in China are relatively scarce (about 1% of the world's total).

	Waste Emission (Mt)	CO ₂ Sequestration (Mt)
Fly ash	500-600	50-200
Steel slag	400-500	80-200
Waste concrete	~700	~100

History of CO₂ Mineralization Technology Development in China

- China's coal-based solid waste CO₂ mineralization technology has established diverse R&D pathways targeting products such as ultrafine calcium carbonate, fly ash blocks, and mine fire-prevention materials, achieving significant breakthroughs in key technical indicators



1,000 t-CO ₂ /y indirect mineralization	10,000 t-CO ₂ /y direct mineralization	20,000 t-CO ₂ /y indirect mineralization	10,000 t-CO ₂ /y concrete curing	10,000 t-CO ₂ /y Fire-prevention materials
 <p>CHN Energy, 2024</p> <p>CO₂ conversion rate ≥ 90%</p>	 <p>SCU, 2021</p> <p>CO₂ net fixation rate ≥ 75%</p>	 <p>Baotou Iron and Steel, 2023</p> <p>Capacity > 20,000 t-CaCO₃</p>	 <p>ZJU-2024</p> <p>CO₂ uptake > 5%</p>	 <p>CCTEG, 2025</p> <p>CO₂ conversion rate ≥ 65%</p>

CO₂ Mineralization Technology Demonstrations in China

- Established a 1000-ton scale expansion project of flue gas CO₂ mineralization of desulfurization slag, and carried out an industrial demonstration of 10,000-ton CDQ flue gas CO₂ mineralization and desulfurization slag, which can achieve 15,000 tons of CO₂/year sequestration and a value of more than 5 million RMB/year.



Research on 1000-ton engineering of CO₂ mineralized desulfurization slag



10,000-ton demonstration project of CO₂ mineralization desulfurization slag

▲ Xichang, Sichuan



Device Technical Indicators:

- Flue gas treatment capacity: ~15000 tons CO₂/year
- CO₂ removal rate: >90%
- Annual Steel Slag Sand Production: 80,000 tons (>10 million RMB output value)
- CO₂ net fixation rate $\geq 75\%$

CO₂ Mineralization Technology Demonstrations in China

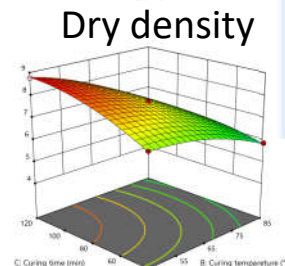
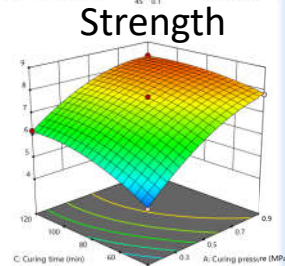
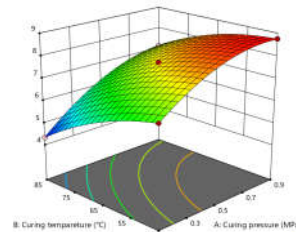
- The CO₂ mineralization curing for concrete technology has completed full-system retrofitting for 10,000 t-CO₂ of annual capacity across multiple concrete plants in Henan, Zhejiang, and Shaanxi provinces. The CO₂ uptake of the resulting concrete blocks can reach 5% to 10%.



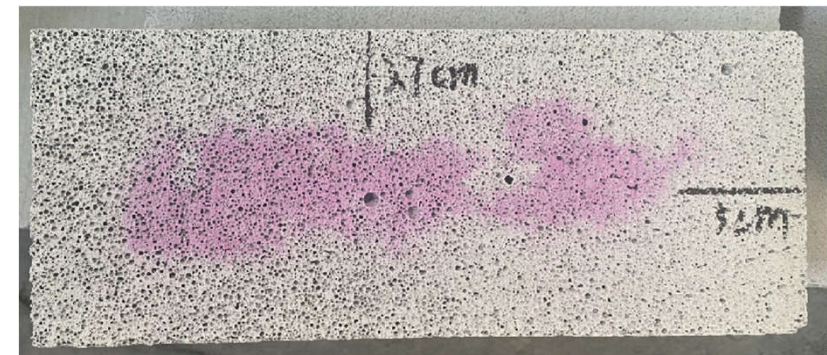
CO₂ Capture Unit



CO₂ Mineralization Curing Unit



Index	Value
CO ₂ sequestration	10,000 t/y
Product	200,000 t /y
Compressive Strength	3.5Mpa
Dry Density	~650 kg/m ³



CO₂ Mineralization Technology Demonstrations in China

- ❑ **Baotou Iron and Steel** has established a 20,000 t-CO₂/y scale demonstration plant for the indirect CO₂ mineralization of steel slag in Baotou.



20,000 t-CO₂/y demonstration



- ❑ **CCTEG** completed the pilot study of CO₂ mineralization fly ash preparation for fire prevention, and installation for the CO₂ mineralization preparation of all-solid-waste fire prevention material engineering demonstration.



10,000 t-CO₂/y demonstration

Device Technical Indicators:

- CO₂ Processing Capacity: >20,000 tons CO₂/year
- Absorption Conversion Rate: >90%
- Annual Steel Slag Consumption: 100,000 t/y
- Annual High Purity CaCO₃ Production: 40,000 t/y

Device Technical Indicators:

- CO₂ Processing Capacity: >50,000 tons CO₂/year
- Absorption Conversion Rate: >90%
- Annual Fly Ash Processing: > 100,000 tons
- Annual Fire Prevention Material: > 500,000 tons

The Emergence of Startups Driving Commercialization

- Early commercialization opportunities for CO₂ mineralization technology have already emerged in China, giving rise to a group of outstanding startups such as CleanCO₂, Greenore, and Yuanchu Technology.



Since 2021

Valuation: \$ 20,000,000

Tech Source:
Zhejiang University



Concrete
6 startups



Since 2018

Valuation: \$ 50,000,000

Tech Source:
Columbia University in the
City of New York



Chemical
5 startups

**Ecological
restoration**
3 startups



Since 2014

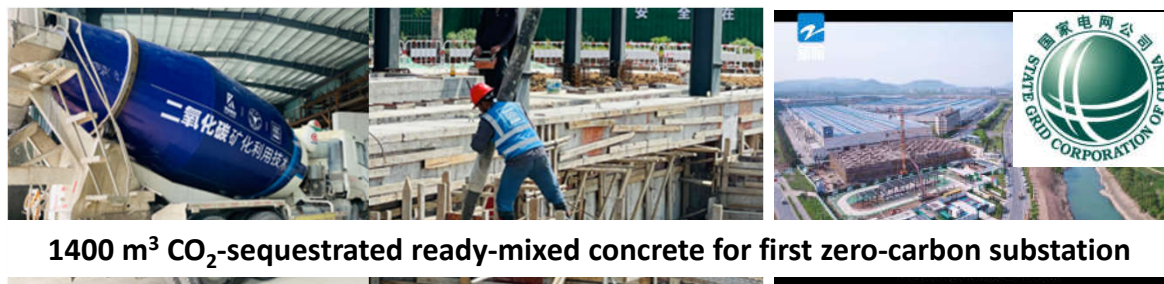
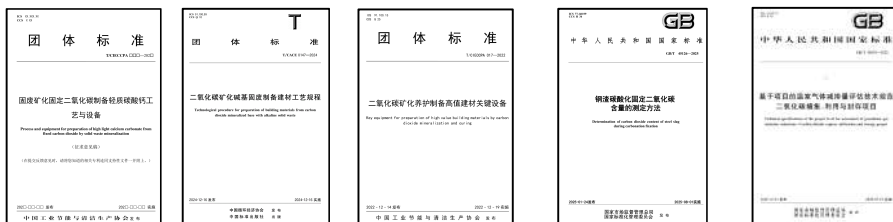
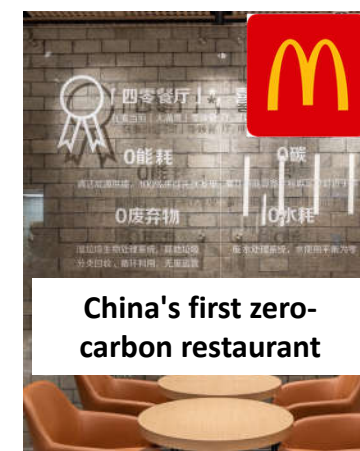
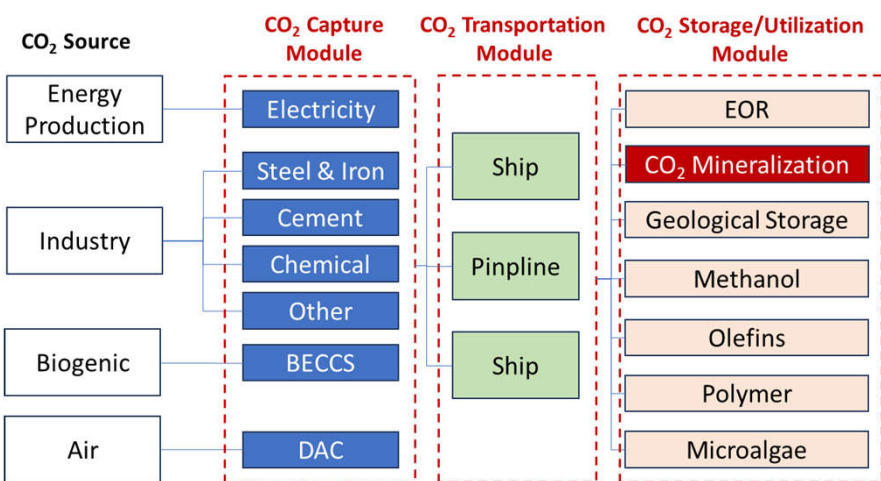
Valuation: \$ 20,000,000

Tech Source:
Tsinghua University



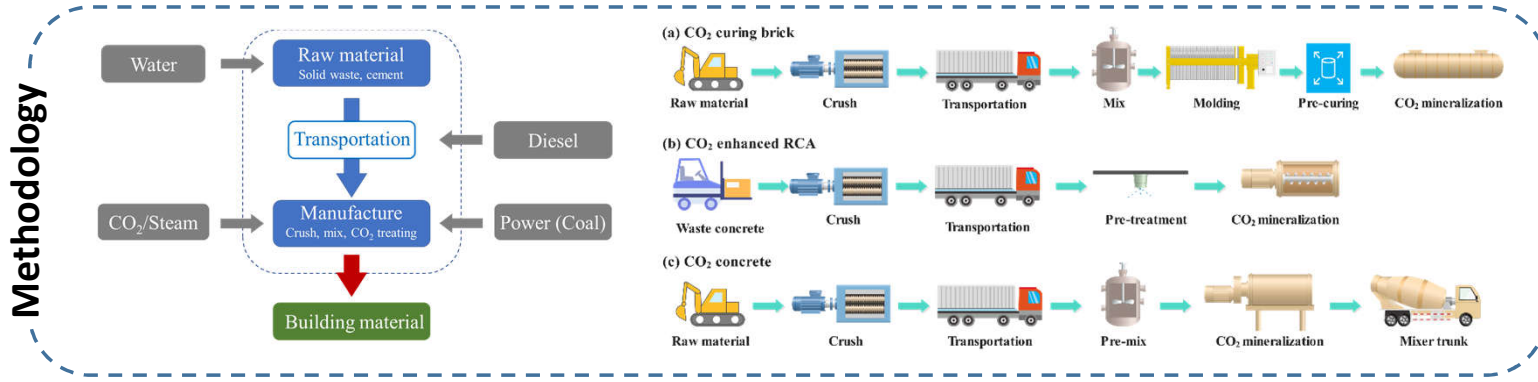
Public policies and Private entities are accelerating technology deployment

- To encourage enterprises to engage more extensively in industrial decarbonization based on CO₂ mineralization technology, relevant Chinese authorities are advancing the development of emission reduction methodologies and standard specifications for CCUS.
- Sustainability objectives of corporations and social entities have become key drivers for both innovation and the commercial scaling of CO₂ mineralization technologies.



Appendix. Technical CO₂ Emission Reduction Potential

- Carbon footprint assessments conducted on three types of product processes—solid bricks, recycled aggregates, and ready-mix concrete—demonstrate emission reduction effects of 195.34kg CO₂/m³, 30kg CO₂/m³ and 21.68kg CO₂/m³, respectively.
- Sensitivity analysis indicates that reducing cement consumption, implementing lightweight design, and enhancing CO₂ sequestration effects can further effectively lower the carbon footprint of these products.



Direct CO₂ reduction: 40% for Brick; 160% for RCA 5% for Ready-mixed concrete

