EFC Industry Program Strategy (2020-2022)

This strategy was presented to EF China board in June 2020, and subjects to regular updates.

OUTLINE

01 **Background: Challenges and Opportunities in China's Industry Sector**

02 **Pathways for Achieving the well-below 2°C Goal**

03 **EFC's Vision, Goals, and Initiatives**

- Iron and Steel Sector
- Cement Sector
- Petro-Chemicals Sector
- Non-Ferrous Metals Sector
- Cross-Cutting Issues

Conceptual Framework of the Strategy

EFC's Vision: Accelerate the deep decarbonization of China's industry sector in support of achieving the well-below 2°C goal while tripling China's total industrial value added by 2050

Assessment of Challenges and Opportunities

Identification of Key Pathways

Structural Transformation → **Demand Reduction** → **EE Improvement** → **Low-Carbon Energy**

Identification of Key Industry Sectors

- Iron and Steel
- Cement
- Petro-Chemicals and Chemicals
- Non-Ferrous Metals

Analysis and Assessment: **Measures & Tactics**

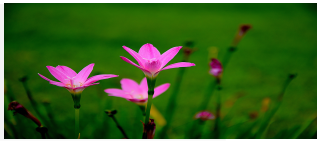
Project Selection Criteria: **Emission Reduction & Feasibility**

EFC Goals → **EFC Initiatives** → **Key Interventions**, **Potential Partners**

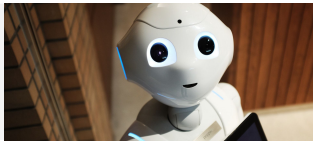
Opportunities in China’s Industry Sector

01 The Industry Sector is a Key Driver for China’s Economic and Social Development

02 China is Moving Fast towards High Quality Development



03 Strategic Emerging Industries are Gearing Up for China's High-Quality Development



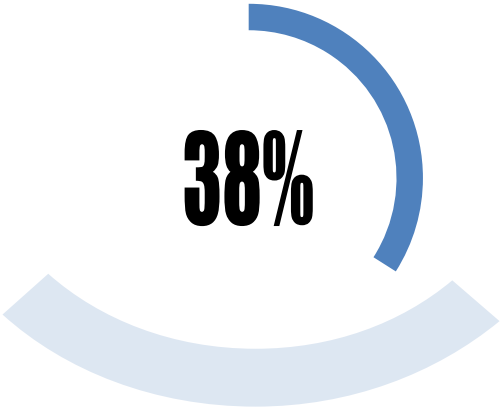
04 Green Manufacturing System is One of China's Top Priorities

05 New IT Technologies Will Reinvent the Industry Sector

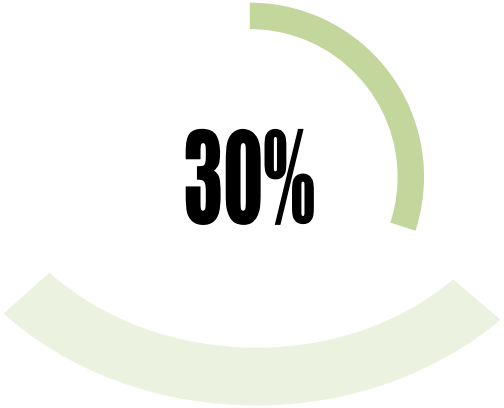
06 Restructuring of SOEs Promotes Efficiency and Competitiveness

07 China’s Roles in the Global Industry Production and Supply Chains are Irreplaceable in the Coming Decade

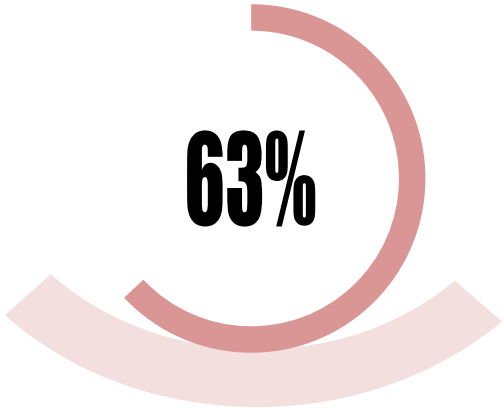
Opportunity 1: The Industry Sector is a Key Driver for China's Economic and Social Development



Share of GDP



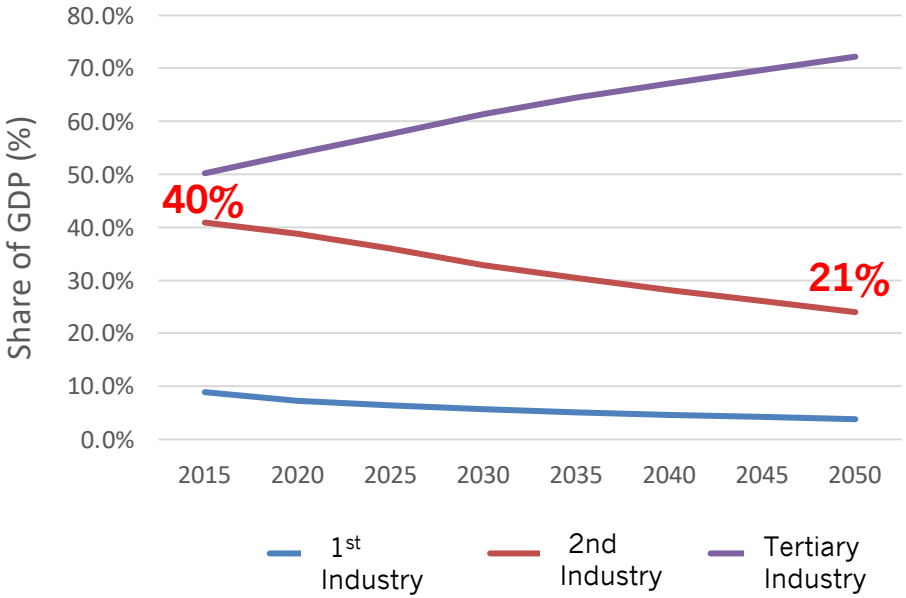
Share of Employment

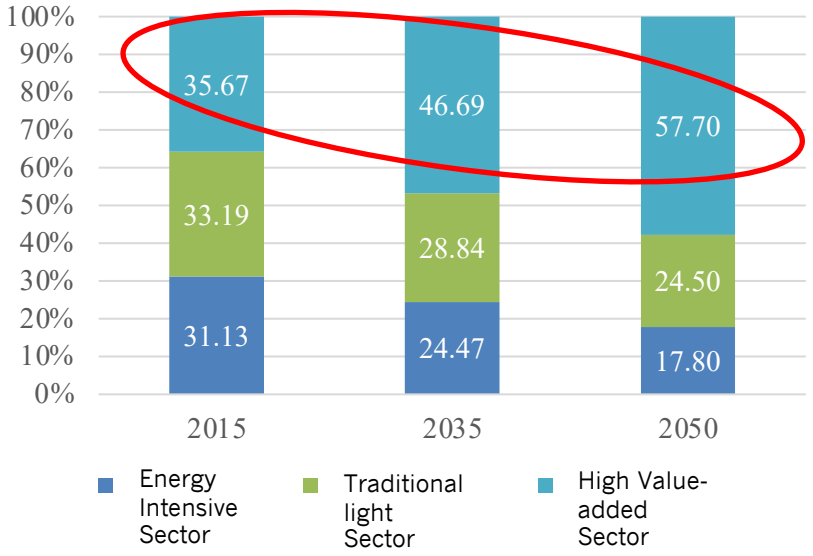


Share of Energy Consumption

Source: China Statistics Yearbook 2019

Opportunity 2: China is Moving Fast towards High Quality Development





❑ **Decreasing Share of GDP by 2nd Industry**

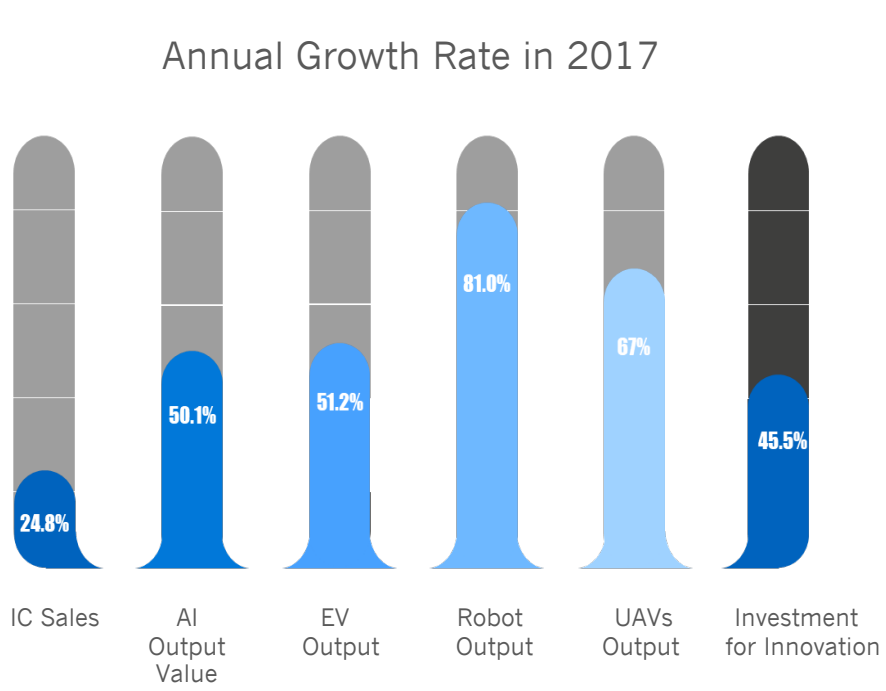
40% ➡ 21%

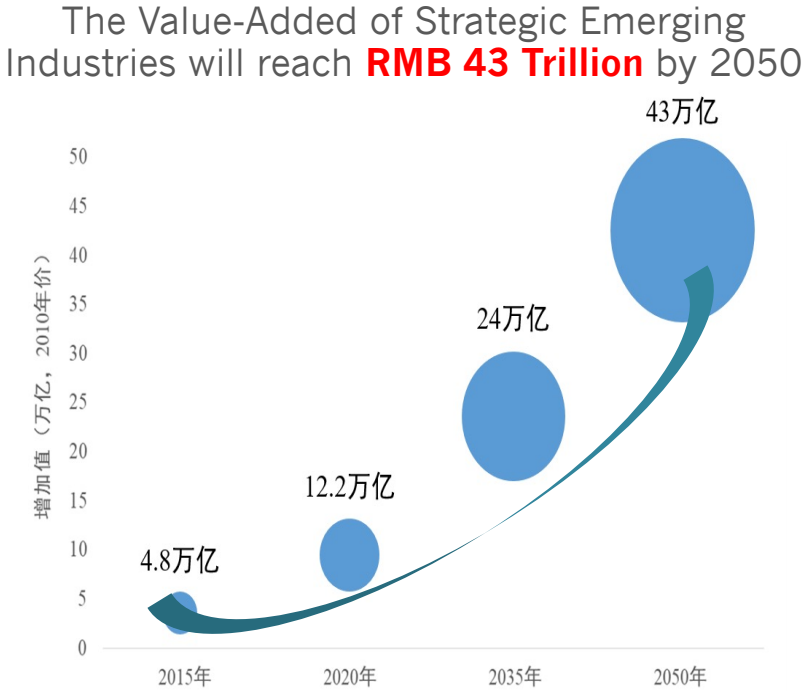
❑ **Increasing High Valued-Added Production**

36% ➡ 58%

Source: China Statistics Yearbook 2019 and ERI Estimations

Opportunity 3: Strategic Emerging Industries are Gearing Up For China's High-Quality Development



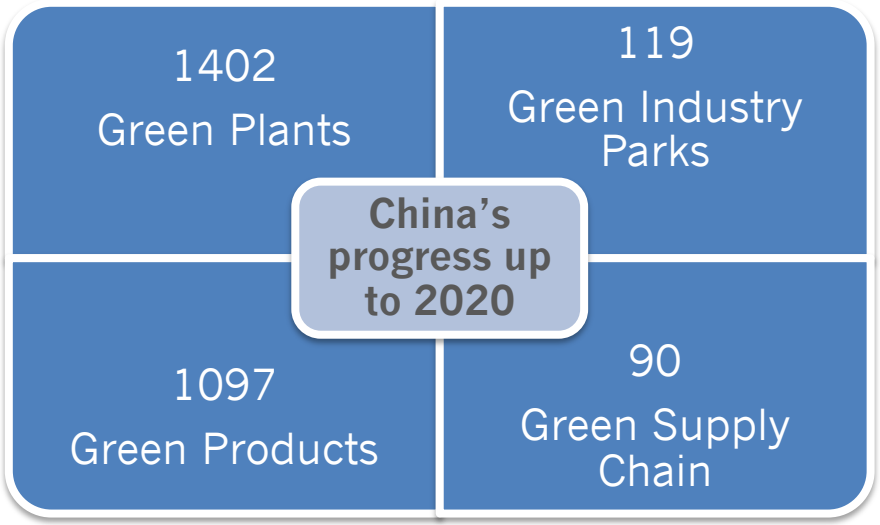


China's on-going efforts:
17 Sector Action Plans
60 National Projects

Source: China Statistics Yearbook 2019 and ERI Estimations

Opportunity 4: Green Manufacturing System is one of China's Top Priorities

Less Pollutant Emissions, High Energy Efficiency, High Efficiency of Resources Recycling



Opportunity 5: New IT Technologies Will Reinvent the Industry Sector

The application of Big Data, AI, 5G, and IIOT will enhance efficiency and reduce costs significantly

Company	Production efficiency	Operating cost	Energy efficiency	Defective Product
Yili Group	+20%	-20%	+10%	-20%
Changan Auto	N.A	-10%	+5%	-16%
Sungrow	+383.1%	-30%	N.A	N.A
Six intelligent steel manufacturing pilot projects of MIIT	+20%	-20%	+10%	-10%

Source: Ministry of Industry and Information Technology, 2019

Opportunity 6: Restructuring of SOEs Promotes Efficiency and Competitiveness

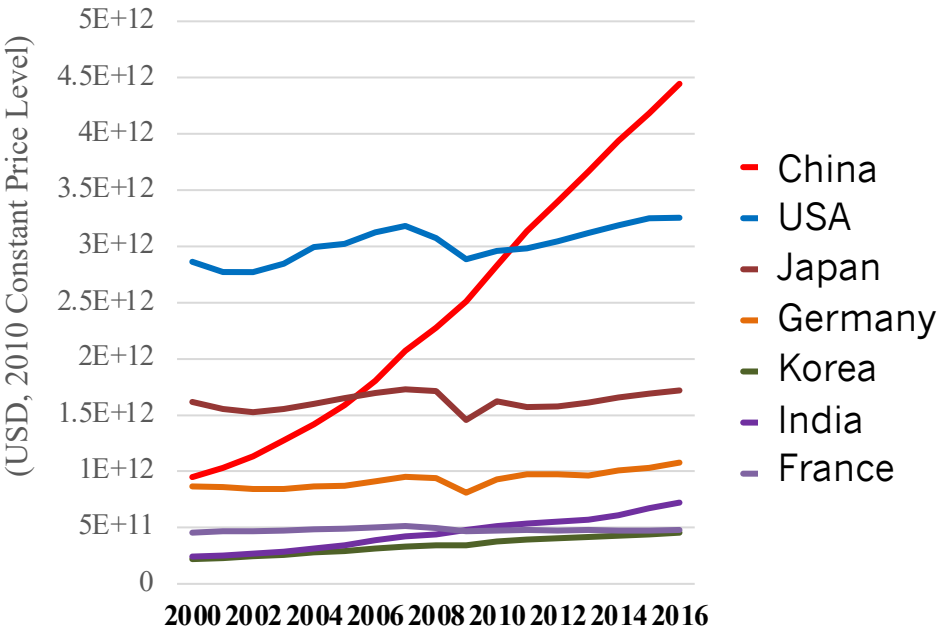
41 SOEs were merged into 21 since 2013

- 3-Year Action Plan of SOE Reform is under Development: Goals, Timetable, & Roadmap
- Mixed-Ownership Restructuring (MOR) will refocus government responsibility from the management of people, businesses, and assets to the management of capital.
- Anticipation of more fundamental changes to come, particularly in competitive industries where the government will be more willing to give up control
- SOE reform safeguards the balance and dynamic of the market economy, the efficient allocation of resources, and fair opportunities for private and foreign investors

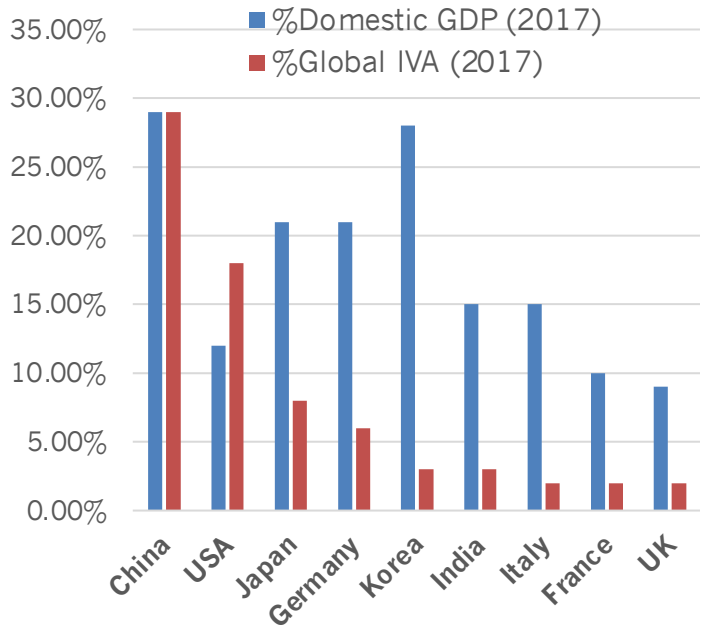
Source: State-Owned Assets Supervision and Administration Commission (SASAC), 2019

Opportunity 7: China's Roles in the Global Industrial Production and Supply Chain Are Irreplaceable in the Coming Decade

China's Industry Value Added Increased ~4.8 Times From 2000 to 2016



Largest Share of Global Industry Value Added in 2017: 29%

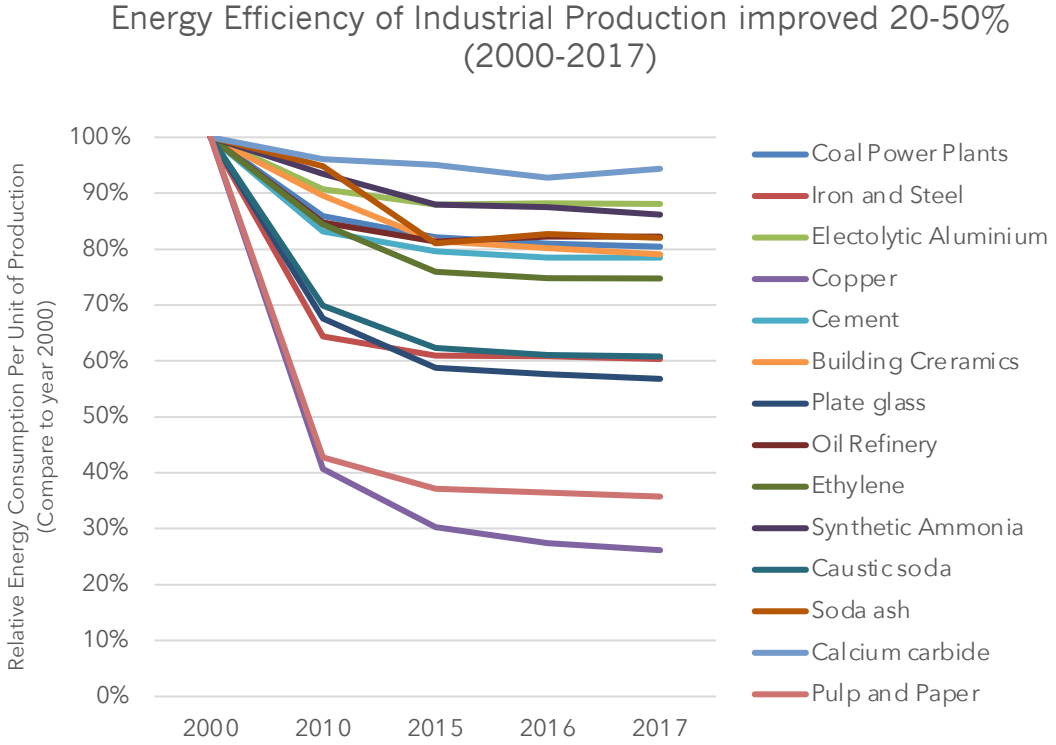


Source: Forward-The Economist, https://www.qianzhan.com/wenda/detail/181210-d4d2c29d.html, and Energy Research Institute, 2020

Challenges in China's Industry Sector

1. Industrial Energy Efficiency Keeps Improving but Remains Largest Carbon and Air Pollution Emitter
2. Energy-Intensive Products Dominate Energy Consumption of the Industry Sector
3. China is the World's Largest Manufacturer, but Exports Mainly Low Value-Added Products
4. Gaps are Huge between China and Developed Countries in Resources Recycling
5. Energy and Resource Efficiency Improvement is Not Easy to Integrate into China's Economic Stimulus
6. Key Industrial Sector-Specific Barriers Exist for Achieving Deep Decarbonization

Challenge 1: Industry Keeps Improving Energy Efficiency But Remains the Largest Carbon and Air Pollution Emitter



Share of Carbon Emission 70%

Share of Air Pollution Emissions 65%

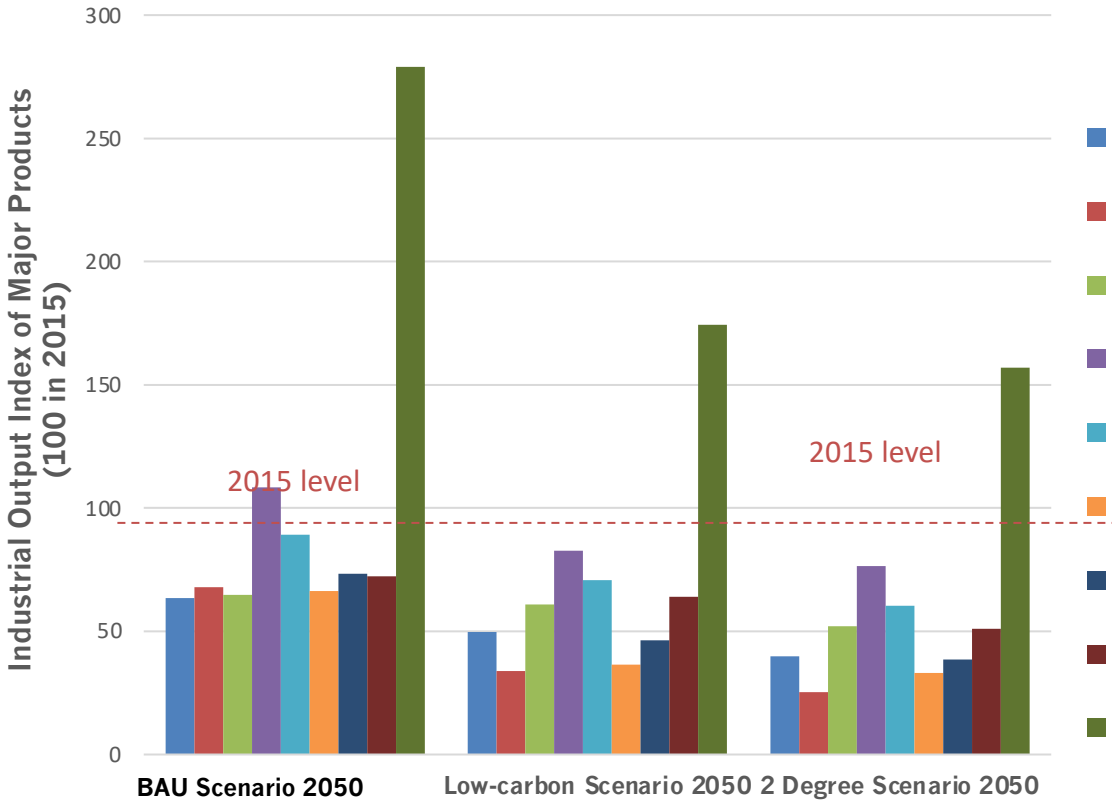
Share of Coal Use 78%

Share of Energy Consumption 63%

Share of Electricity 62%

Source: 1. Wang Qingyi, China Energy Data, 2018, 2. China Statistics Yearbook 2019, China Energy Statistics Yearbook 2018, China Environmental Quality Bulletin, ERI Estimation

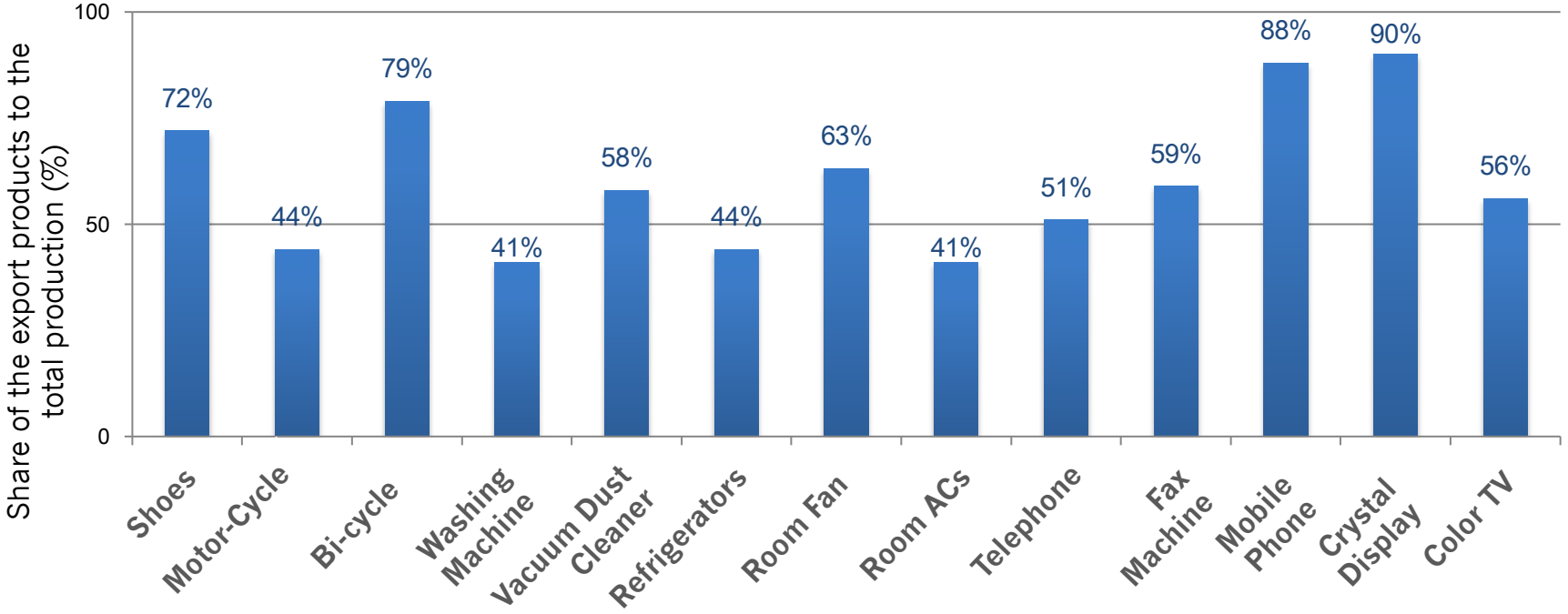
Challenge 2: Energy-Intensive Products Dominate Energy Consumption of the Industry Sector



	2015 (Mt)	BAU (Mt)	LC (Mt)	2°C (Mt)
Crude Steel	804	510	400	320
Cement	2360	1600	800	600
Flat Glass	787	510	480	410
Alumimum	31	34	26	24
Synthetic Ammonia	58	52	41	35
Caustic Soda	30	20	11	10
Soda Ash	26	19	12	10
Paper and Pulp	117	85	75	60
Ethylene	17	48	30	27

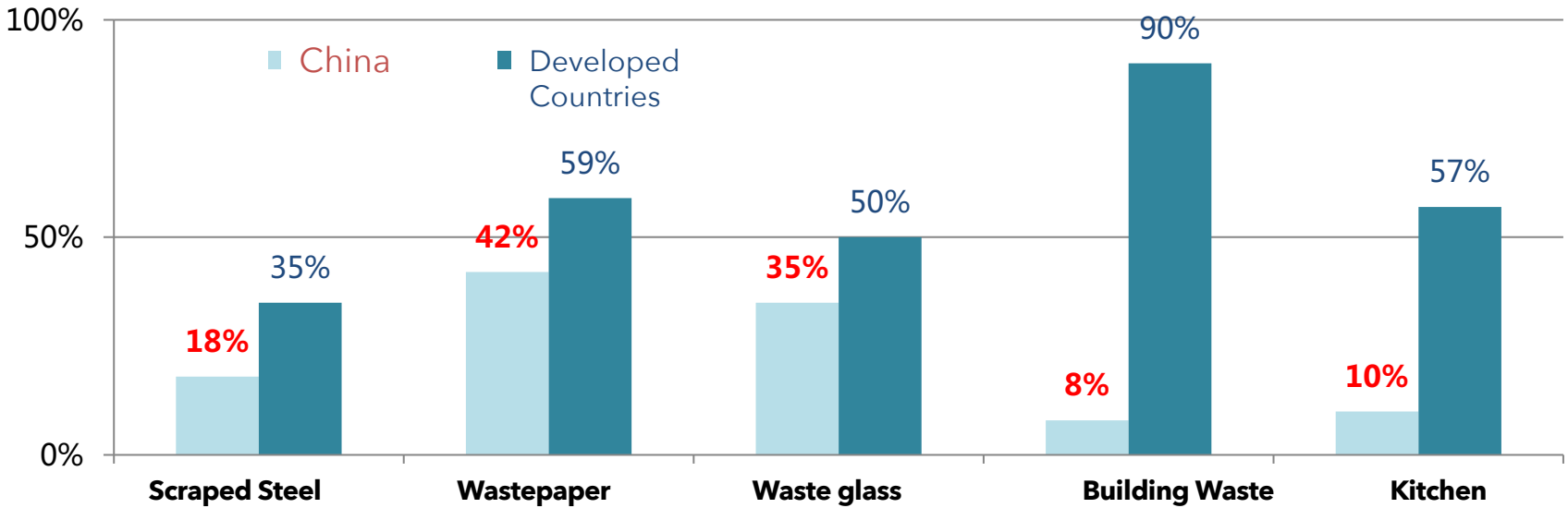
Source: Research on Industry Sector Transformation and Low-carbon Emission Strategy, Energy Research Institute, NDRC, 2019.

Challenge 3: China is the World's Largest Manufacturer, but Export Mainly Low Value-Added Products



Source: Research on Industry Sector Transformation and Upgrading and Low-carbon Emission Strategy, Energy Research Institute, NDRC, 2019

Challenge 4: Gaps Are Huge between China and Developed Countries in Resources Recycling



Source: Energy Research Institute, 2020

Challenge 5: Energy and Resource Efficiency Improvement is Not Easy to Integrate into China's Economic Stimulus

China New Infrastructure Investments: 5G Base Station, Big Data Center, IIOT, AI, Charging Station for New & RE Vehicles, High Speed Train and Urban Transit, UHV Power Translon

New Infrastructure Investments only share

15-20%

of the Total Investments

China Total Investments in 3-5 Years:

- 50 Trillion RMB in total of 22,000 Projects
- 25 Provinces/Municipalities announced
- The Investments include retrofit of old buildings, infrastructure, upgrade of traditional industry and strategic emerging industry

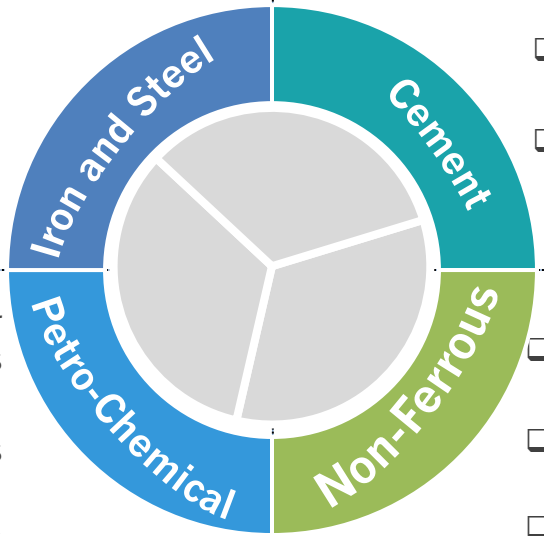
Key Focus of the Economic Stimulus:

- Raising the level of ambition and delivering early stimulus impacts, e.g. high energy consumption of 5G and Data Center
- Balancing short-term and long-term perspectives by leveraging energy and resource efficiency improvement
- Choosing the strategic emerging industrial sectors and technology upgrade for investment
- Ensuring stricter enforcement of EE and EP standards in the economic stimulus

Source: Special Report of China NPC 2020 Annual Session, China News Services, May 2020，China Industry On-Line (IOL)

Challenge 6: Key Industrial Sector-Specific Barriers Exist for Achieving Deep Decarbonization

- ❑ Lack of standards and design specifications for high quality steel use
- ❑ Early stage of information technology (AI, IIOT, 5G) in the sector
- ❑ Insufficient funding support for promotion of low and zero carbon technologies



- ❑ Lack of national strategy and institutional coordination on alternative fuels
- ❑ Insufficient funds and weak implementation of incentive polices
- ❑ High cost of CCS application and still in a small scale

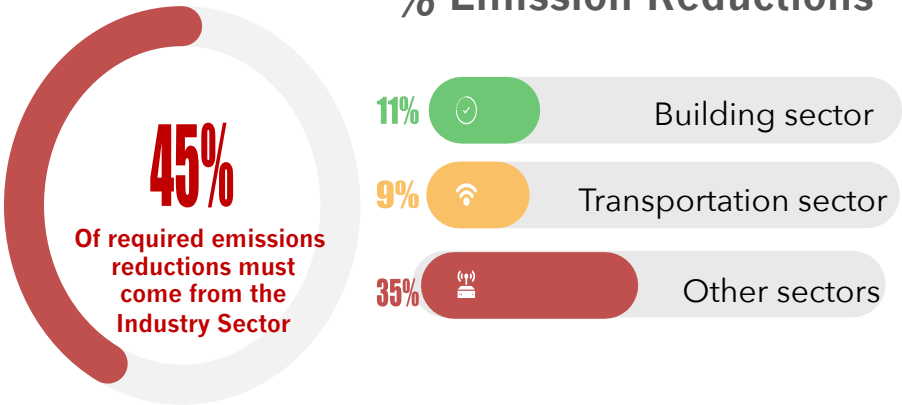
- ❑ No well-established recycling system for Petro-chemical products
- ❑ Waste sorting and classification implementation only in some metropolises
- ❑ Lack of designed national strategy and action plans for fuel switching and CCS application
- ❑ No standards and specifications developed on hydrogen and CCS application

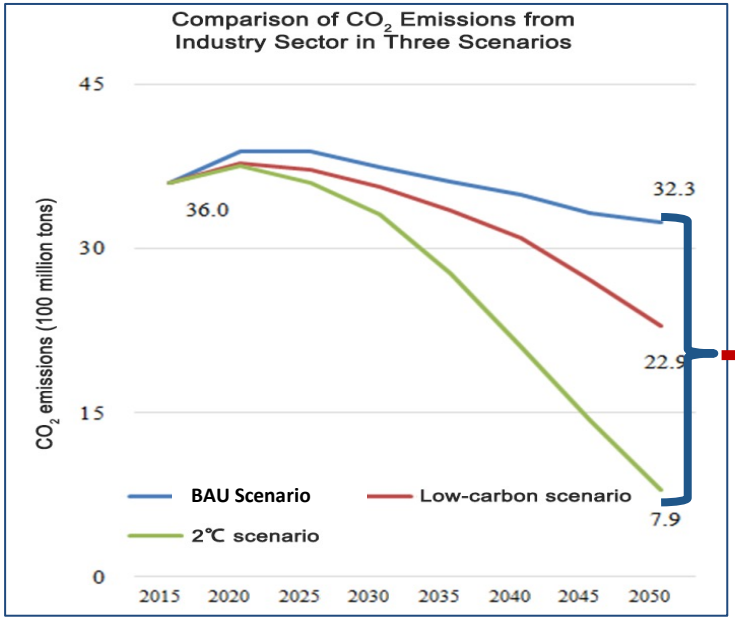
- ❑ Incomplete regulations, policies and standards of recycling of products
- ❑ Lack of enforcement of Extended Producer Responsibility System
- ❑ Insufficient funding and incentives to encourage recycling
- ❑ Lack of supervision for recycling

2. Pathways for Achieving the 2°C goal

CHINA: Based on EFC-supported LTS Project, to achieve the well-below 2°C goal, China's total CO2 emissions need to be reduced **5.40 Gt CO2e** by 2050 compared to the BAU scenario.

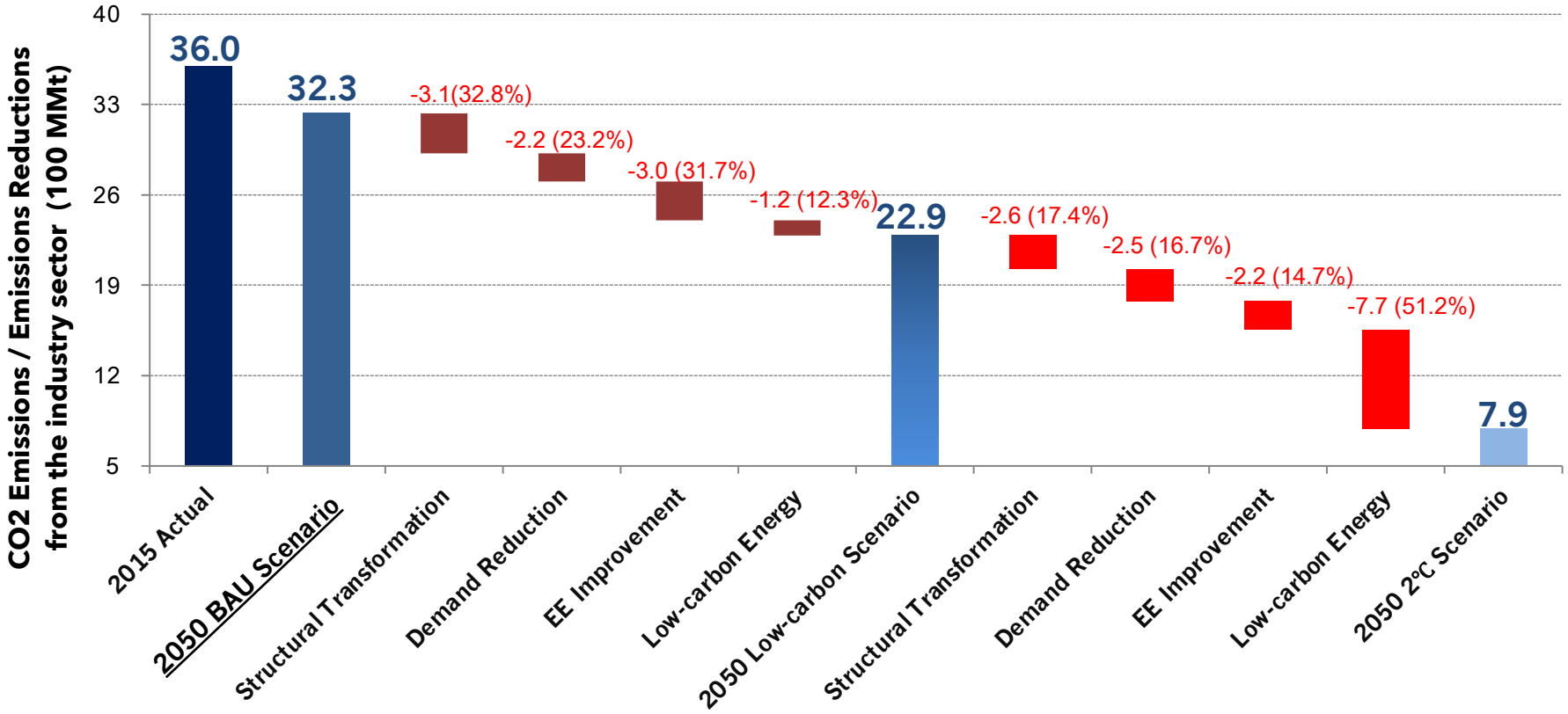
INDUSTRY: To achieve the 2°C goal, CO2 emissions from China's industry sector need to be reduced **75% (2.44 Gt CO2e)** by 2050 compared to the BAU scenario.





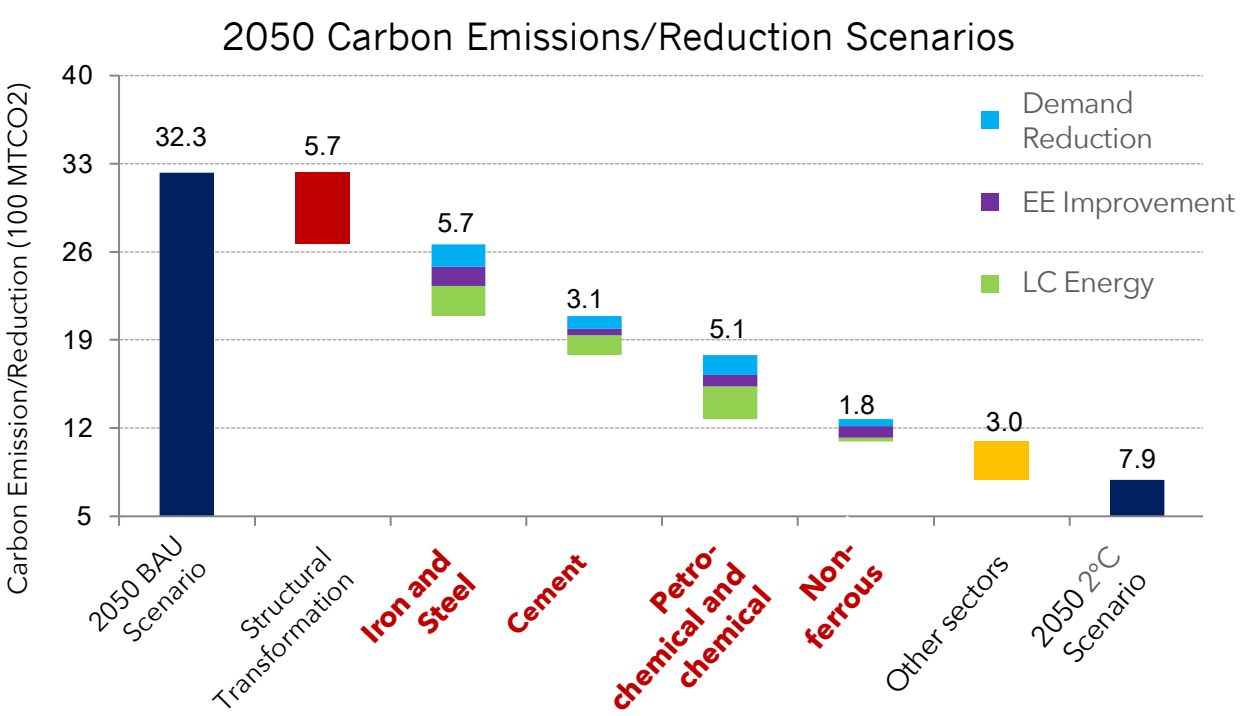
Source: EFC-supported LTS project; Research on Industry Sector Transformation and Upgrading and Low-carbon Emission Strategy, Energy Research Institute, NDRC, 2019

Achieving the well-below 2°C Goal: 4 Key Pathways



Source: Research on Industry Sector Transformation and Low-carbon Emission Strategy, Energy Research Institute, NDRC, 2019

Top 4 Sectors: Major Contributors to the well-below 2°C Goal



To achieve the 2°C Goal,

28%

of required emissions reductions must come from the Top 4 sectors

Top 4 sectors account for

38%

of China's total energy consumption in 2018

Top 4 sectors account for

42%

of China's total CO2 Emission in 2018

Source: Research on Industry Sector Transformation and Low-carbon Emission Strategy, Energy Research Institute, NDRC, 2019. Note: Direct carbon emission included only from each sector

Measures within Key Pathways for Top 4 Sectors

	Structural Transformation	Demand Reduction	EE Improvement	Low-carbon Energy
Iron and Steel	• Promote strategic emerging industries • Upgrade conventional products/high value-added industrial products • Strengthen service-oriented economy	• Extend Life of Buildings • Reduce direct export of steel products • Increase the grade of steel strength	• Increase electric furnace and scrap steel use • Implement EE retrofits • Prioritization of energy management	• Low carbon steel production technologies • Zero carbon steel production technologies • CCS/CCUS
Cement		• Extend Life of Buildings and infrastructure • Reduce unnecessary use and demand • Increase strength grade of cement.	• Apply EE technologies to reduce thermal and electricity intensity • Replace cement clinker with sludge and fly ash • Smart Energy Management	• Increase level of electrification • Promote fuel switching • CCS/CCUS
Petro-chemicals		• Improve recycling, reuse, and comprehensive energy utilization • Export less low value-added products • Import more raw materials	• Improve EE further for maximizing the potential • Apply and innovate high-efficient technologies	• Diversify the source of low-carbon raw materials • Large-scale adoption of “Green Hydrogen” • CCS/CCUS
Non-ferrous metals		• Extend infrastructure and consumer product life • Reduce waste and unreasonable demand • Improve material strength level, optimize material structure and usage	• Strengthen the recycling of non-ferrous metals • Implement advanced EE and low-carbon retrofit technologies	• Preplace coal use by clean energy • Increase significantly the use renewable energy

3. EFC Vision, Goals, and Initiatives

VISION: Accelerate the deep decarbonization of China's industry sector in support of achieving the well-below 2°C goal while tripling China's total industrial value added by 2050

2030	2050
GDP: **2.5 times of 2015**	GDP: **5 times of 2015**
Total Industrial Value Added: **Doubled from 2015**	Total Industrial Value Added: **Tripled from 2015**
Total energy consumption <**2.4 Btce**	Total energy consumption <**1.5 Btce**
Carbon emissions <**3.4 GtCO2**	Carbon emissions ≤**0.8 GtCO2**
Coal consumption <**1.4 Btce**	Coal consumption <**300 Mtce**
Electrification ratio >**28%**	Electrification Ratio >**45%**
Energy consumption per unit of industrial value-added: **55% of 2015 level**	Energy consumption per unit of industrial value-added **20% of 2015 level**

Source: 1. EFC Industry Strategy Team, 2. Research on Industry Sector Transformation and Low-carbon Emission Strategy, Energy Research Institute, NDRC, 2019, 3. Calculation Results from ERI CGE (Computable General Equilibrium) Model, 2019

GOALS

01 **Iron and Steel Sector**: Assist to control and reduce production capacity, promote dematerialization by using high quality steel significantly and steel electrification greatly in China's iron and steel industry

02 **Cement Sector:** Promote near net-zero coal use in China's cement industry by applying alternative fuels, achieve near net-zero carbon emission by deployment of Carbon Capture and Storage (CCS) technology.

03 **Petro-Chemical and Chemical Sector:** Enhance dematerialization and recycling in China's petro-chemical sector, strengthen innovative production and process, and accelerate use of natural gas, renewable, green hydrogen, and CCUS.

04 **Non-Ferrous Sector:** Establish an integrated circular economy system in China's non-ferrous sector and maximize the energy productivity and material efficiency.

05 **Cross-cutting Issues**: Support China to develop national/sector strategies and roadmaps, set up ambitious goals and standards, promote energy efficiency significantly, establish near-zero emission industrial parks for achieving deep decarbonization of China's industry sector.

Theory of Change

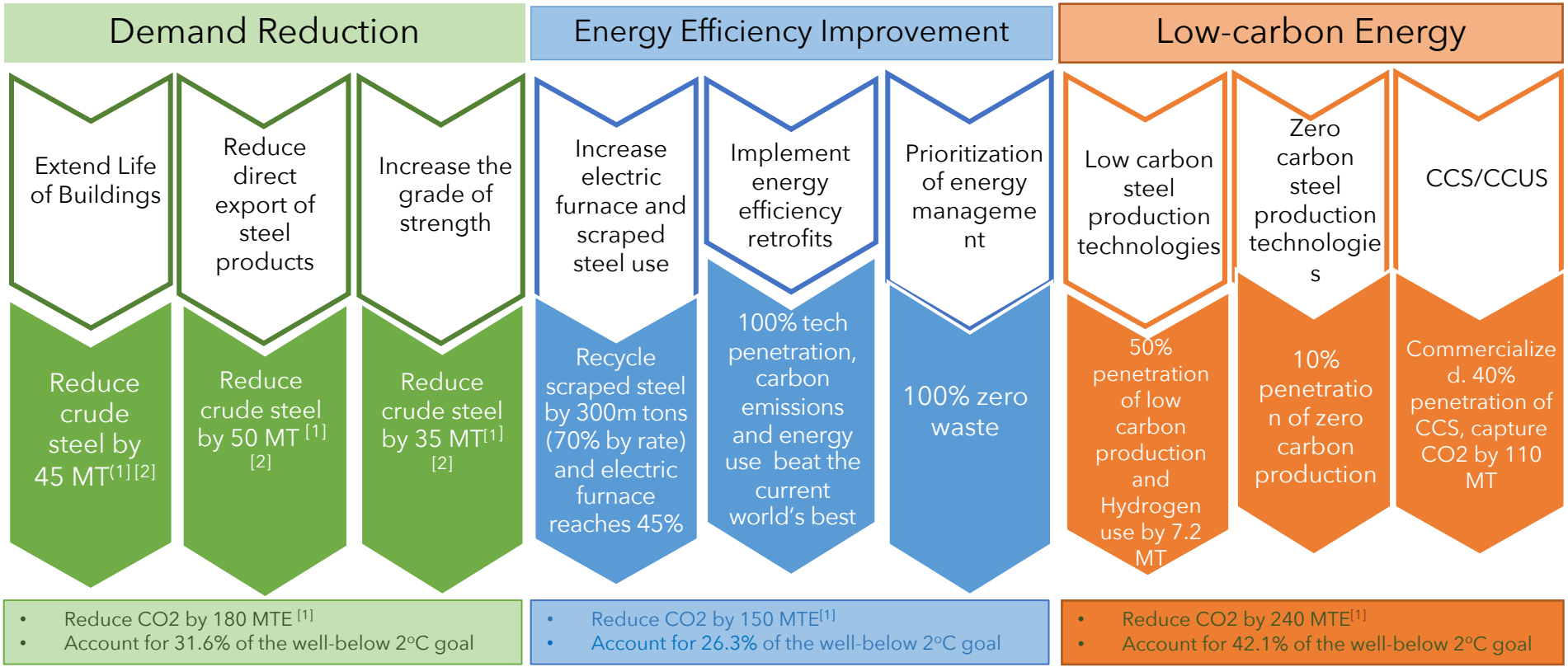
Sectors	Initiatives	Sector Outcomes
Iron and Steel	01. High Quality Steel and Dematerialization 02. Steel Electrification	• Carbon Reduction: 570MtCO2 • Dematerialization: 130Mt • Share of EAF use: 80% • Crude Steel Production: 380Mt • Scrap Steel Utilization: 70% • LC technology penetration: 60%
Cement	03. Coal-Free and Fuel Switching 04. Near Zero-Carbon Emission and CCS	• Carbon Reduction: 300MtCO2 • Fuel Switching: 70% • CCS Penetration: >40% • Dematerialization: 530Mt • EE Improvement: >18%
Petro-chemical	05. Dematerialization and Recycling 06. Fuel Switching and CCUS	• Carbon Reduction: 510MtCO2 • Dematerialization: 30% • Material Recycling: 60% • Green Hydrogen Ratio: 80% • CCS Penetration: >40%
Non-ferrous	07. Integrated Circular Economy System	• Carbon Reduction: 180MtCO2 • Recycled Copper: 30% • Recycled Aluminum: 78%
Cross-cutting	08. Strategy, Policy, and Standards 09. Energy Efficiency Improvement 10. Near-zero Emission Industrial Parks	• National/Strategy and Roadmaps • Ambitious targets and standards • Integrated demonstrations and scaling up

Impacts

- China's industry sector achieves early peaking of carbon emissions and contribute to achieving the well-below 2°C goal while tripling China's total industrial value added by 2050
- China's Industry Sector achieves co-benefits of both carbon emission reduction and pollution reduction for dramatically improving air quality
- China's industry sector achieves high quality development through deep decarbonization

Iron and Steel

Contributions to the well-below 2°C Goal by 2050



[1]Compared to the BAU; [2] To produce one ton of crude steel: 2.5 tons CO2 emission and 570 kgce energy use.

Cement

Contributions to the well-below 2°C Goal by 2050

Demand Reduction

- Extend life of buildings and infrastructure . Reduce unnecessary demand and use → Reduce Cement by 350 Mt[1]
- Increase strength grade of cement → Reduce Cement by 180Mt[1]

- Reduce CO2 by 100 Mte[1]
- Account for 33% of the well-below 2°C goal

Energy Efficiency Improvement

- Apply EE technologies to reduce thermal and electricity intensity → Decrease thermal intensity and electricity intensity by 10-15%
- Replace cement clinker with acetylene sludge and fly ash → 60% Cement Clinker
- Smart Energy Management → 100% large-scale and smart and digitization

- Reduce CO2 by 50 Mte[1]
- Account for 17% of the well-below 2°C goal

Low-carbon Energy

- Increase level of electrification → Electrical heating, NG+H2
- Promote fuel switching → Alternative fuel to 70% from current 5%
- CCS/CCUS → 40% penetration of CCS/CCUS

- Reduce CO2 by 150 Mte[1]
- Account for 50% of the well-below 2°C goal

[1] Compared to the BAU

Petro-Chemical and Chemical

Contributions to the well-below 2°C Goal by 2050

Reduce Demand

- Improve recycling, reuse, and comprehensive energy utilization → Produce 4 million tons less of Ethylene[1]
- Export less low value-added products → Produce 7 million tons less of Ethylene, and 1 million tons less of Sodium Hydroxide[1]
- Import more raw materials → Product 8 million tons less of Ethylene &5 million tons less of Ammonia[1]

- Reduce CO2 emission by 160 million tons[1]
- Contribute 30.6% to sectorial deep-decarbonization goal

Improve Energy Efficiency

- Improve EE further for maximizing the potential → Energy consumption of overall refining, Ethylene, Sodium Hydroxide and Sodium Carbonate production decline ~10%
- Apply and innovate high-efficient technologies → Innovative technologies application rate reaches 30%

- Reduce CO2 emission by 90 million tons[1]
- Contribute 18.5% to sectorial deep-decarbonization goal

Use Low Carbon Energy

- Diversify the source of low-carbon raw materials → Reduce 80 million tons of CO2 emission [1]
- Large-scale adoption of "Green Hydrogen" → Reduce 120 million tons of CO2 [1]
- CCS/CCUS → 40%+ adoption of CCS/CCUS, reduce 80 million tons of CO2 emission[1]

- Reduce CO2 emission by 260 million tons[1]
- Contribute 50.9 % to sectorial deep-decarbonization goal

[1]Compared to the BAU scenario

Cross-Cutting Issues

CLIMATE
Accelerating the deep decarbonization of China's industry sector in support of achieving the well-below 2℃ goal

GROWTH
Driving China's long-term economy development and growth quality by tripling China's total industrial output value

GOVERNANCE
Assisting cross government initiatives: goal setting, planning, finance, environment protection

TRANSITION
Speeding up China's industry green transition and upgrading through technological innovation, development of emerging industries, transformation of traditional industries, and product quality upgrade

Energy Efficiency

Low carbon Energy

Demand Reduction

Structural Transformation

THANK YOU