ENERGY FOUNDATION
能源基金会

Energy Foundation China Urbanization Taskforce Strategy: Decarbonizing China's Urbanization via Systematic Intervention

Energy Foundation China

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

Why does the field need a new urbanization strategy?

- Chinese cities are already home to over half of its 1.4 billion population. About 350 million more people will move to cities from 2020-2050
- Cities account for over 75% of China's carbon emissions, and urbanization will continue to be the main driving force of China's emission growth
- Systematic interventions in key areas of urbanization could help reduce at least 5.4Gt carbon in year 2050, and put China on a pathway of carbon emission early peaking (by 2025, at 7.5t per capita) and significant long-term reductions (~1t per capita by 2050)

Outline

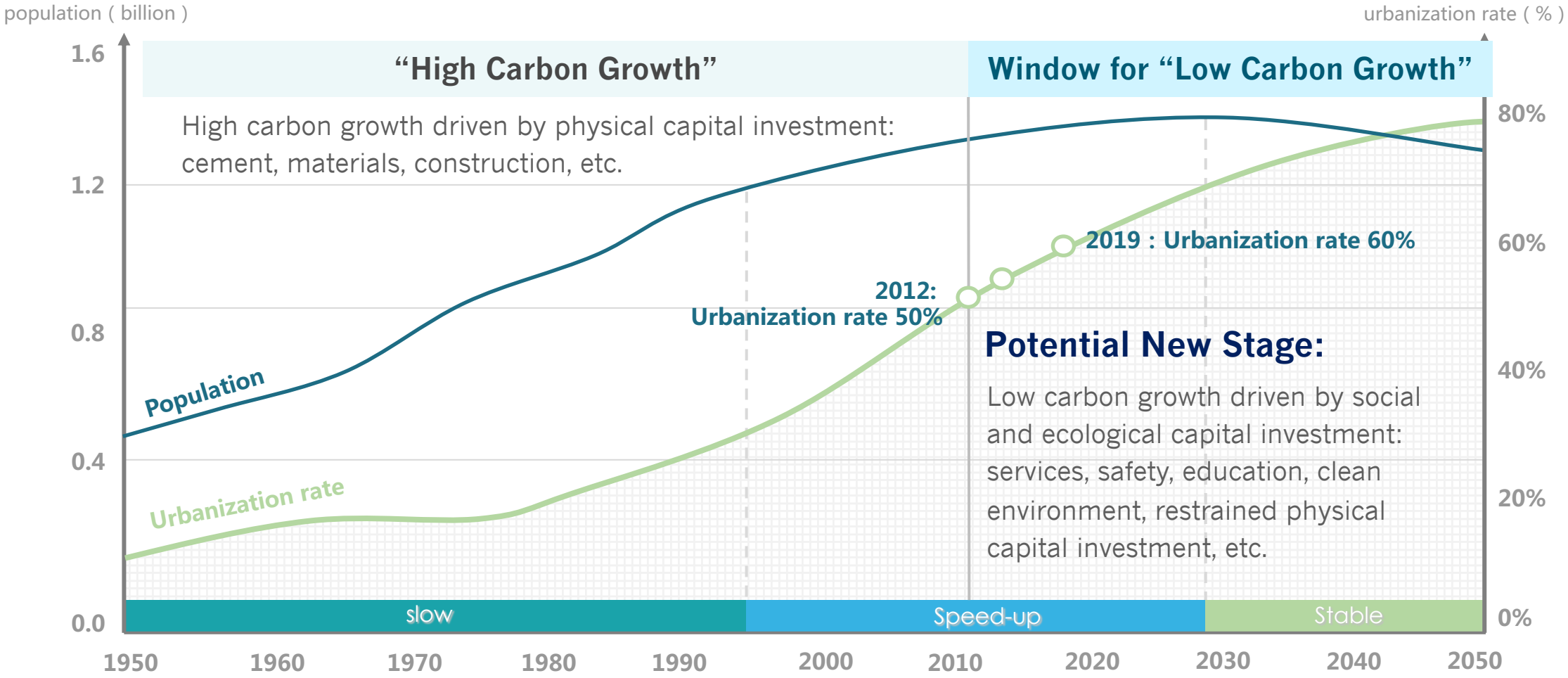
1. China needs to transition to a new stage of urbanization: high carbon → low carbon

2. Shifting to a new urbanization stage requires focusing on 6 key areas:
    - ***People***
    - ***Land & Space***
    - ***Housing & Infrastructure***
    - ***Industry & Services***
    - ***Fiscal & Finance***
    - ***Governance***

3. Overall challenges in the six key areas

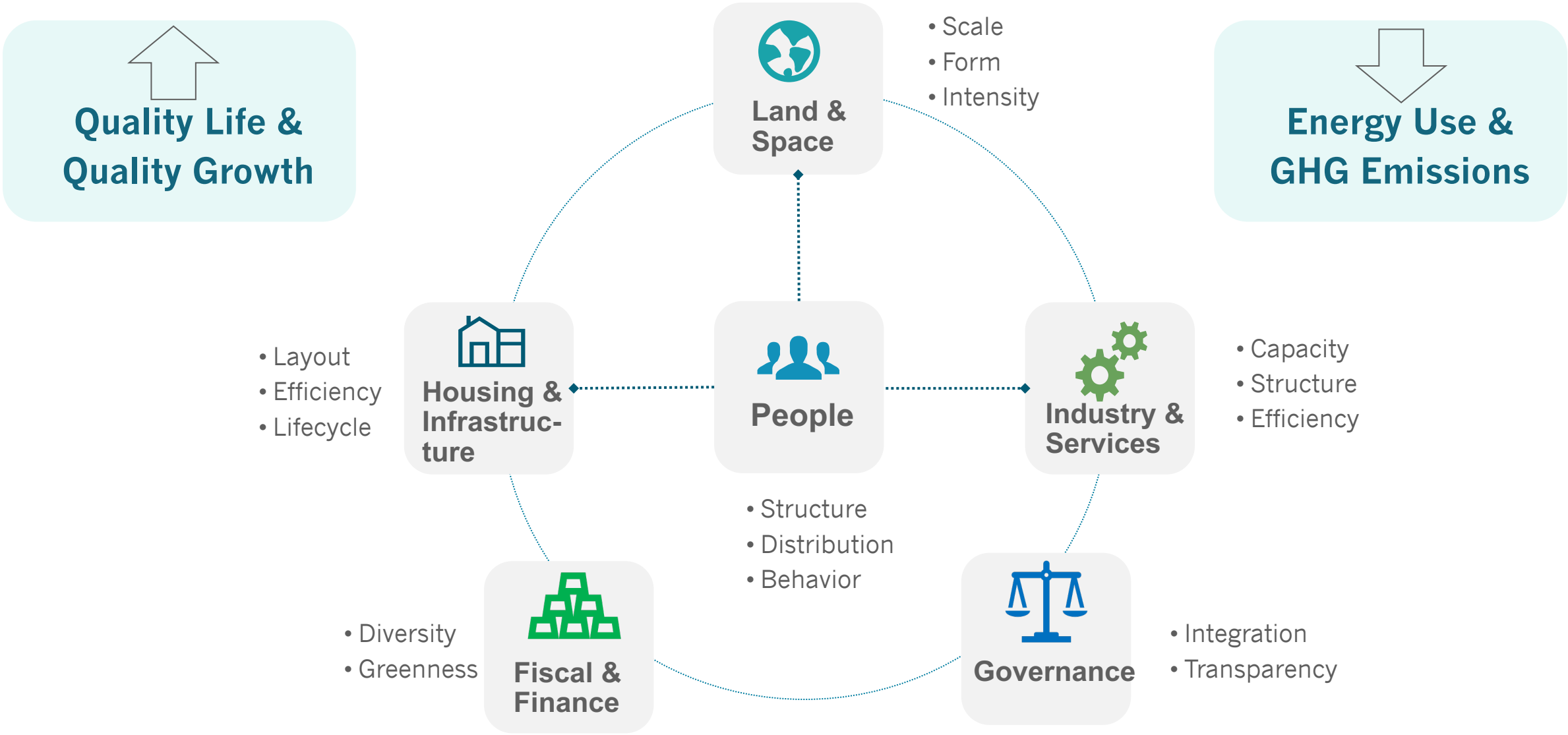
4. EF China's strategy

Background: China needs to transition to a new urbanization stage

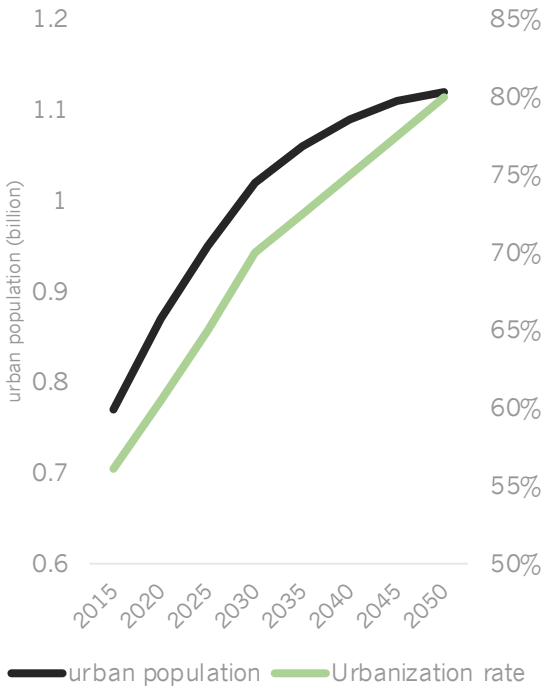


Systematic interventions have to happen quickly to avoid further high carbon lock-in.

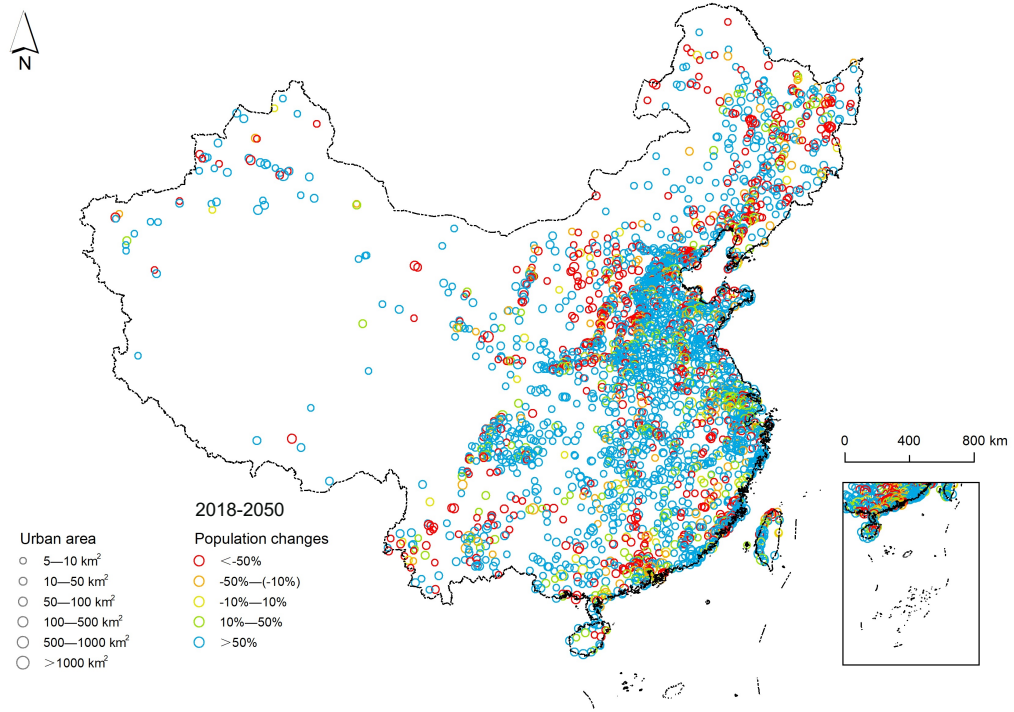
The six key areas of low carbon urbanization



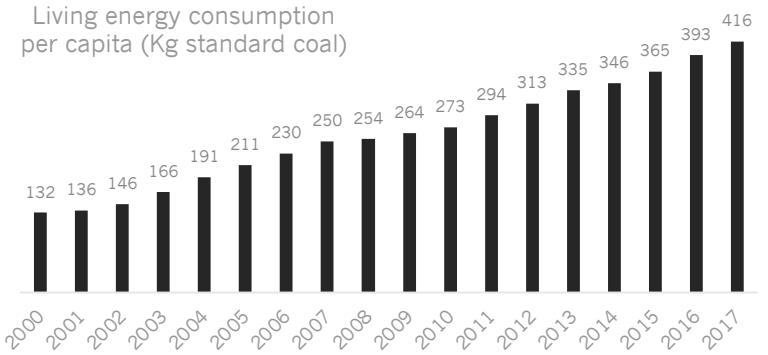
People: Rapid urban population increase, massive population migration among cities, and dramatic growth of consumption demand lead to sky-rocketing carbon emissions

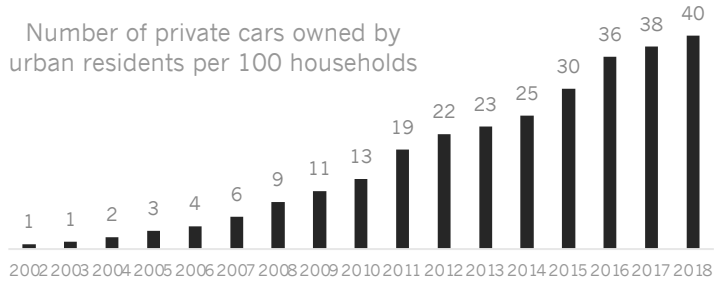


Urban population will keep rising before 2050s.



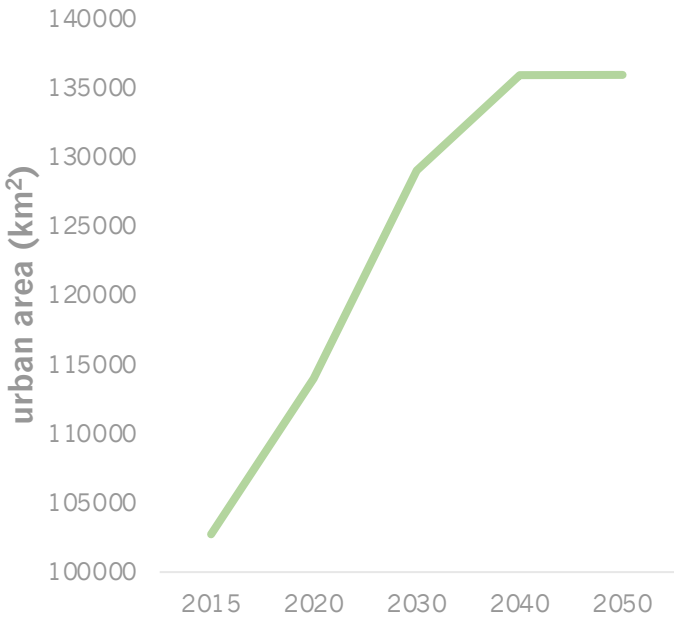
Massive # of people will migrate from small cities to larger ones, leading a dynamic population landscape in future.



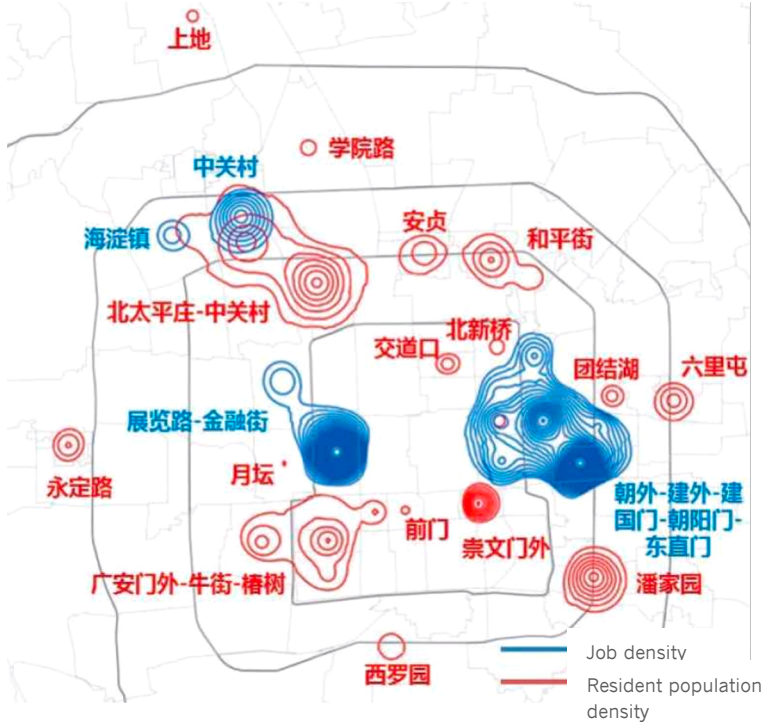


Increasing and widespread middle income group will lead to higher consumption demand.

Land & Space: Surging urban footprint, imbalanced urban structure, and low quality existing urban space are all major risks for long-term carbon lock-in



Urban land demand will keep increasing before 2050s; promoting in-fill development is critical



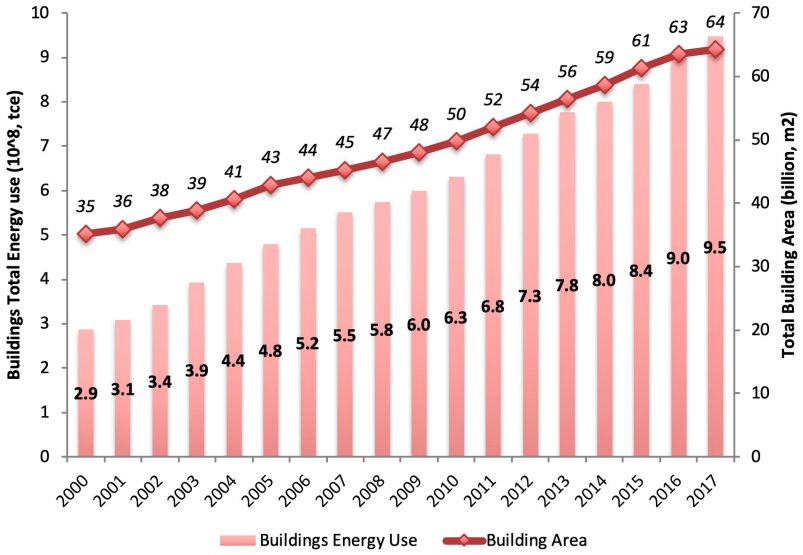
Distribution of permanent population and jobs in Beijing Central City

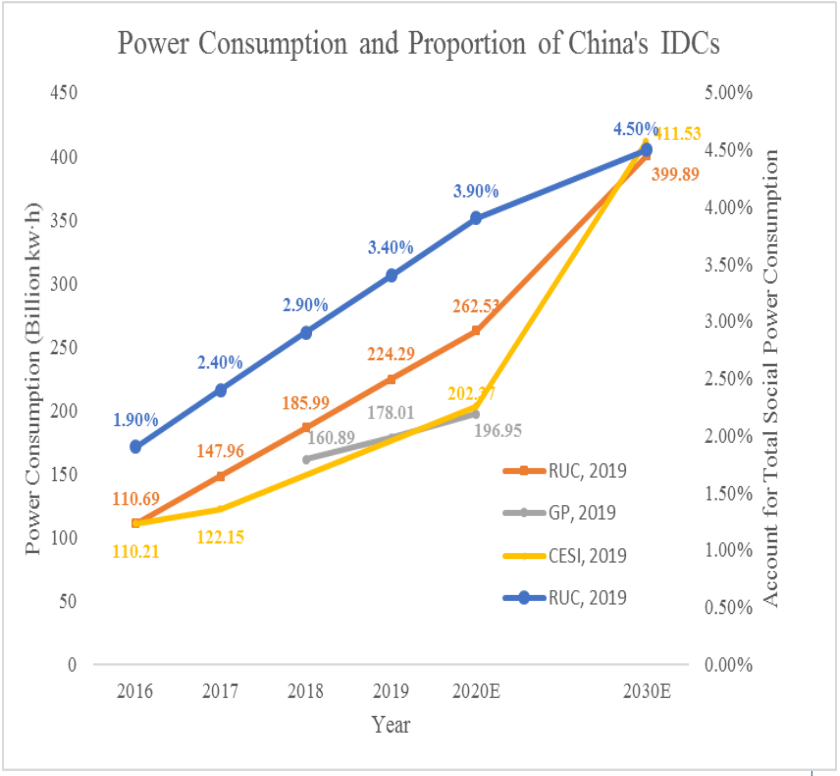
source: Shi et al., 2018

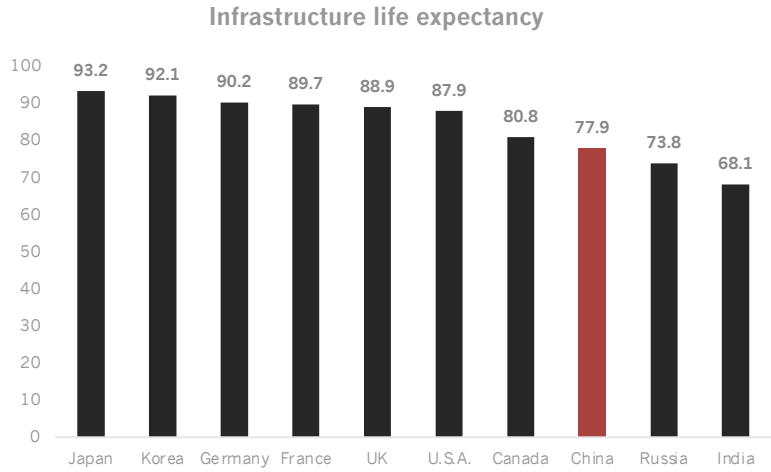
Urban structure requires substantial optimization (e.g. mitigating jobs-housing imbalance)

Quality of existing city space is limited and needs a lot of improvements.

Housing & Infrastructure: Increasing housing floor area, fast expansion of traditional infrastructure, and large room for existing infrastructure optimization are major sources of carbon emission





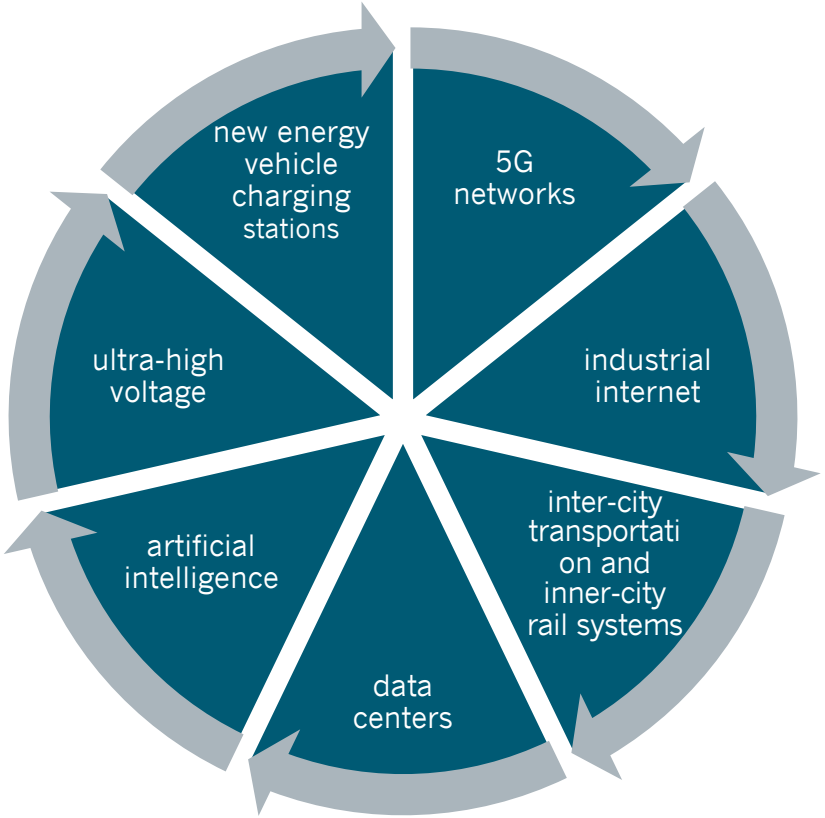


Building area and building energy use has been increasing and will continue in the foreseeable future.

Infrastructure will keep expanding, as does its energy consumption, e.g., surging electricity use of IDCs

Existing infrastructure lacks maintenance and needs substantial upgrading.

Housing & Infrastructure: China is launching a "New Infrastructure" campaign to offset the economic impact of the coronavirus pandemic and boost sustainable growth



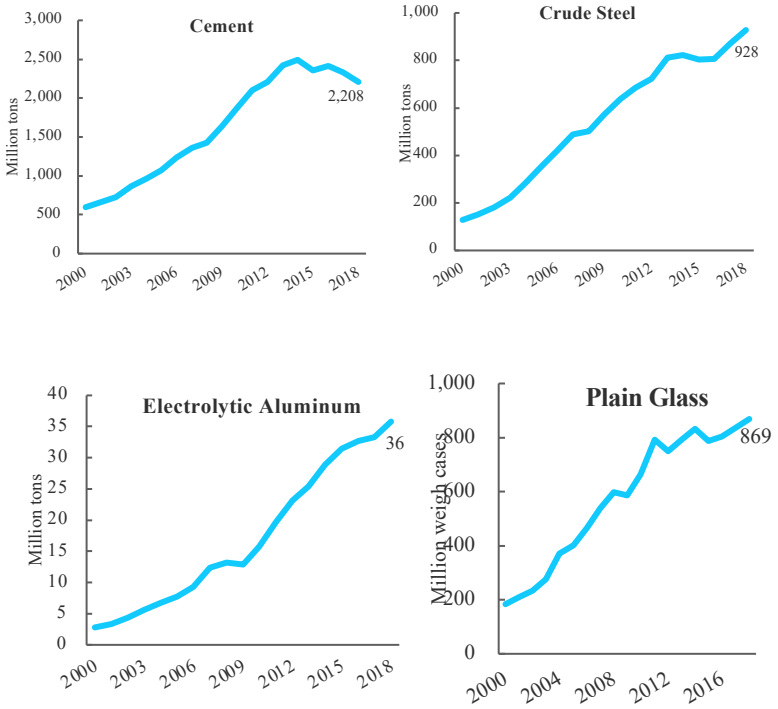
Seven areas of China's "New Infrastructure"

- We have a responsibility to '**recover better**'. This crisis provides a watershed moment… for the effective delivery of global public goods. We have a framework for action – the 2030 Agenda for Sustainable Development and the Paris Agreement on Climate Change.

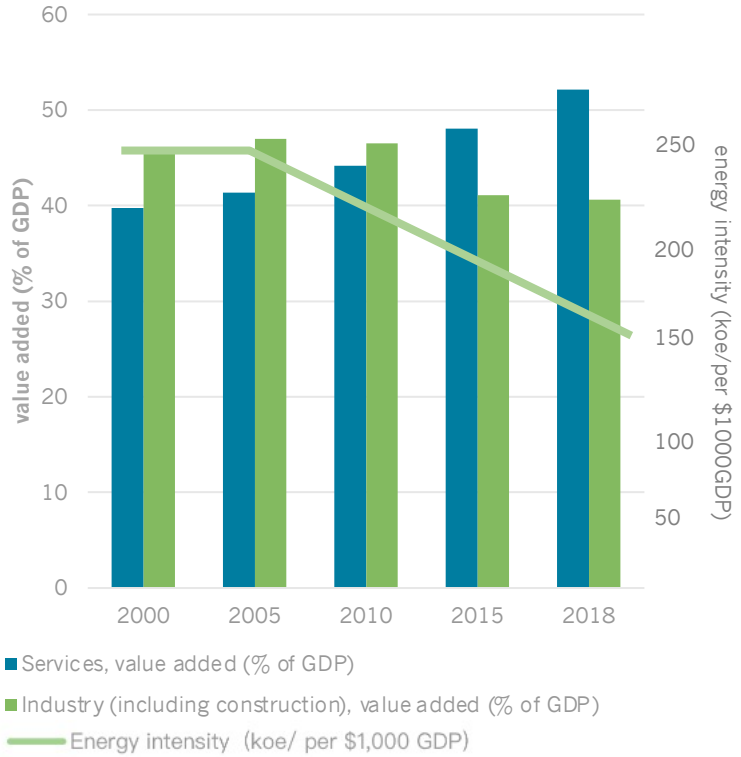
—UN Secretary General Antonio Guterres, 19 March 2020

Note: Important components of "new infrastructure", such as ultra low energy buildings, human-oriented public spaces, distributed energy solutions, low-income housing, etc. are missing from the official definition. Green or not is up to how the new infrastructure will be implemented.

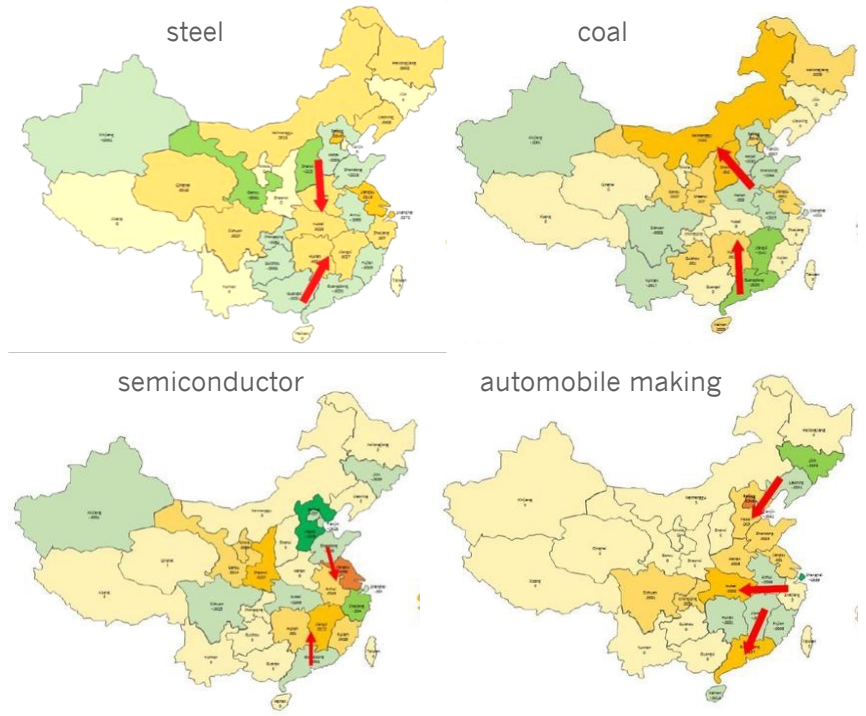
Industry & Service: Slow de-capacity of traditional industry, quantity to quality model picking up, and risk of carbon "leakage"



Traditional high energy-consuming industry will keep expanding.



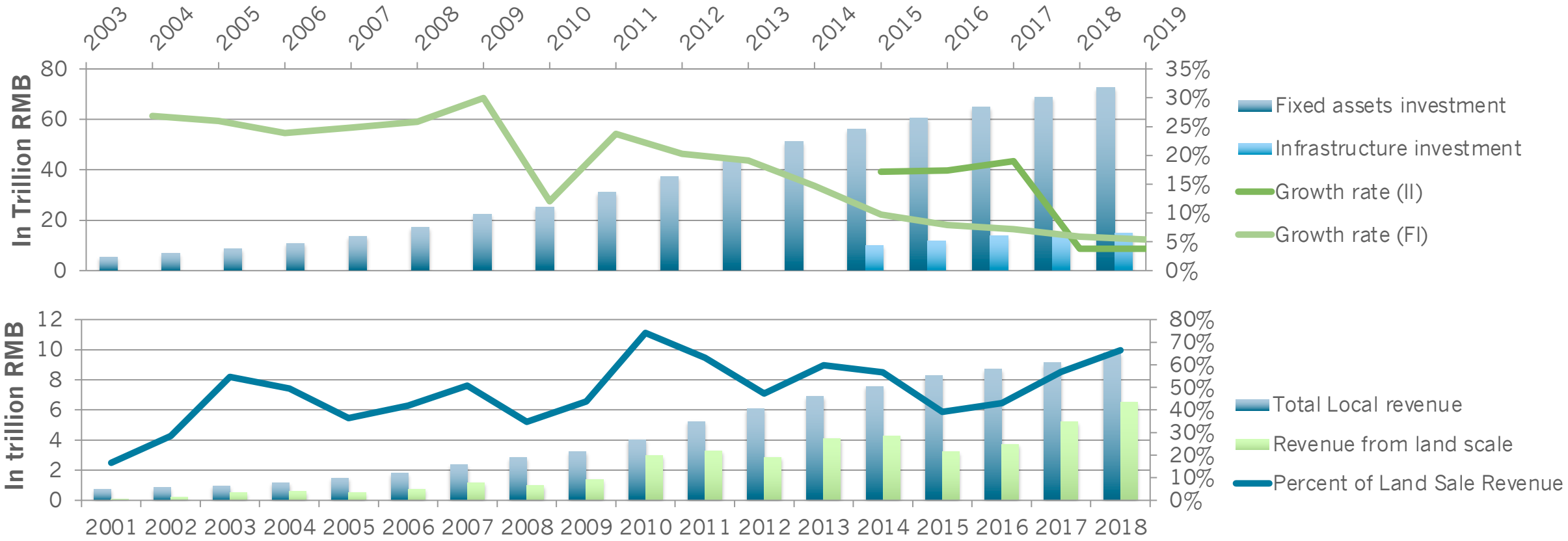
Energy intensity is reducing through economic structural upgrading (from quantity to quality) and new technologies.



Industry regional shift from 2014-2016
source: Wind Research & Consulting

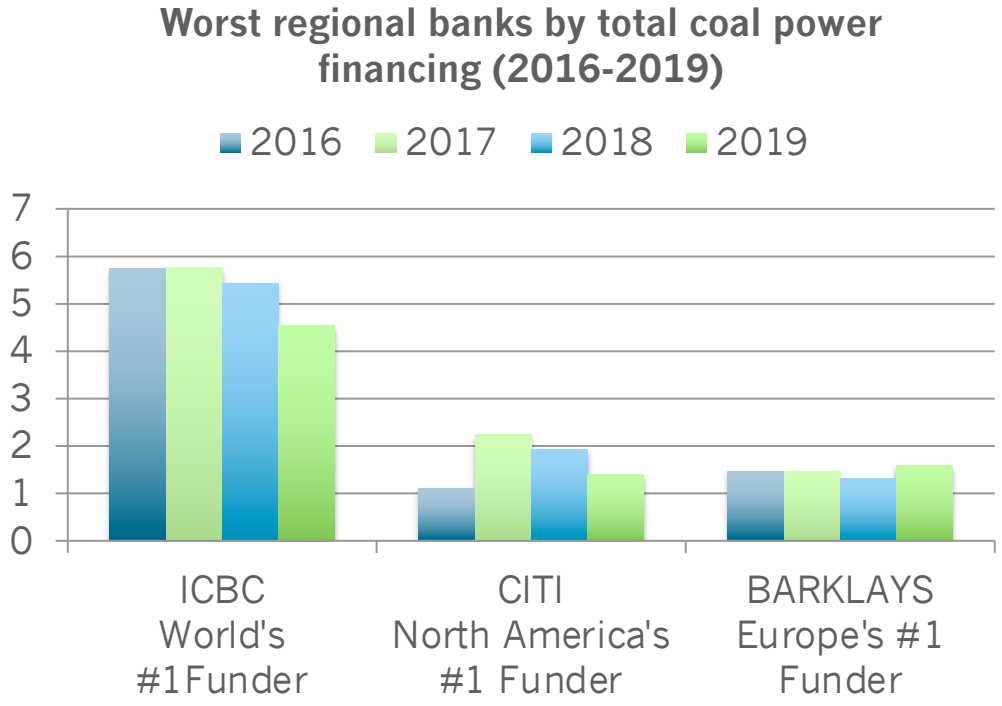
Regional shifts (mainly from east coast to inland) may lead to pollution transfer and technological upgrade.

Fiscal & Finance: Land revenue-based urban finance, physical capital-driven urban development models



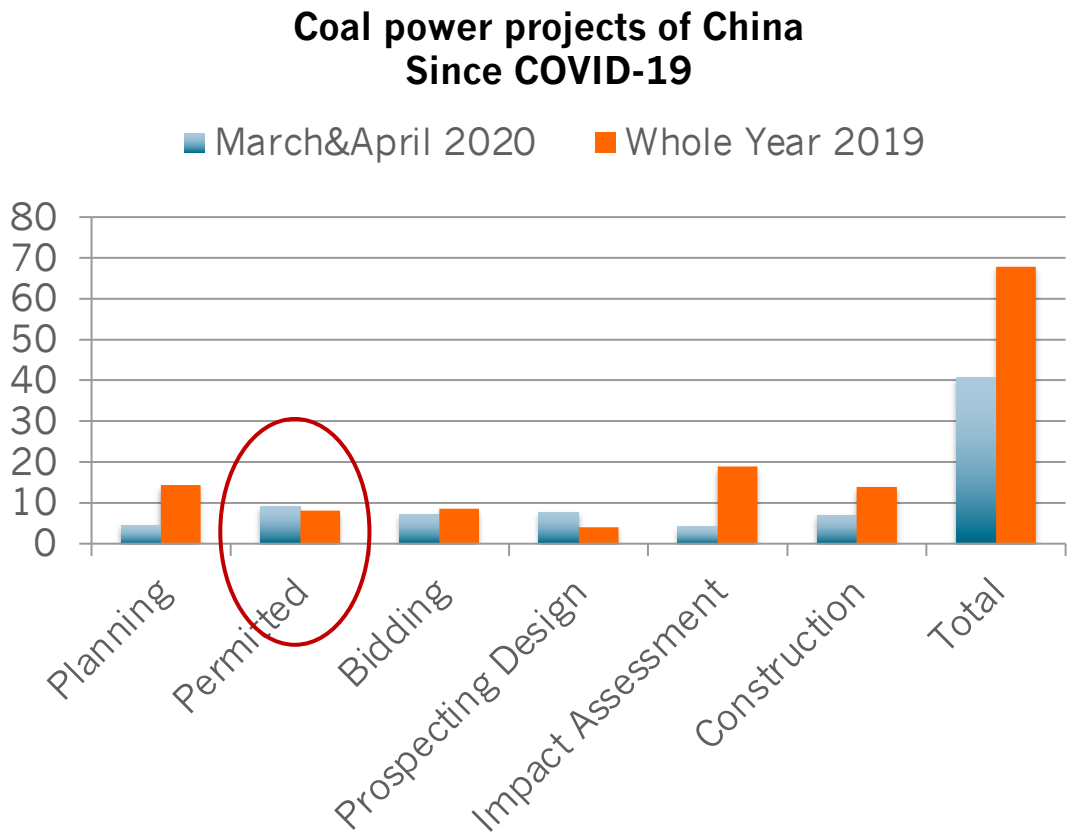
High percentage of fixed assets investment drives the overall growth, in which around 20% are infrastructure investments. Local public infrastructure investments mainly rely on land revenue (>50% of local total revenue in recent years), which drives the fast expansion of urban land and infrastructure

Fiscal & Finance: An economic stimulus scheme that incorporates green fiscal and finance instruments in response to coronavirus is necessary to avoid carbon lock-in effects.



Although the scale of investment has declined in recent years, ICBC remains the world's largest funder of coal power projects.

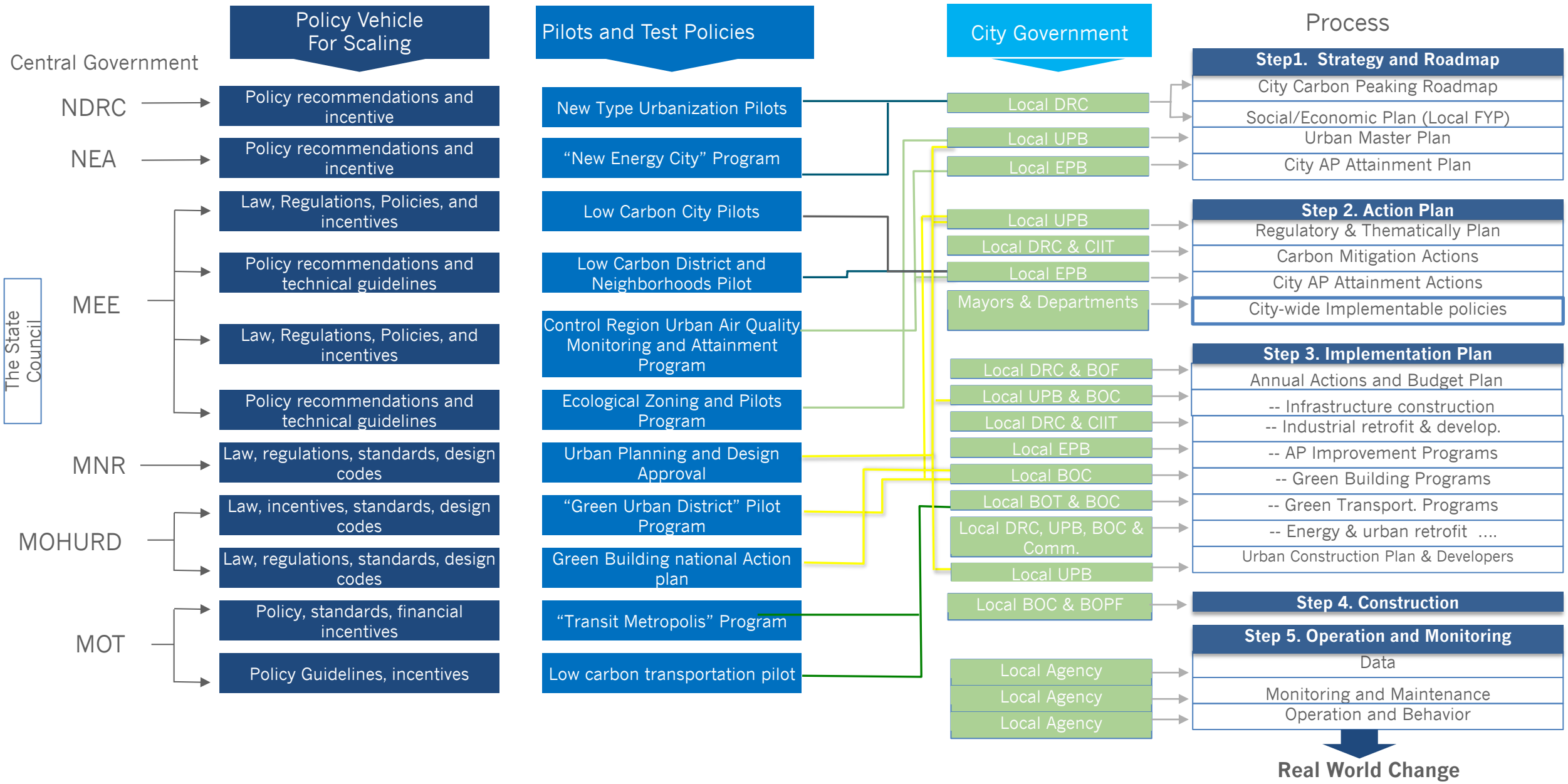
Source: Banking on Climate change: Fossil fuel finance report 2020.



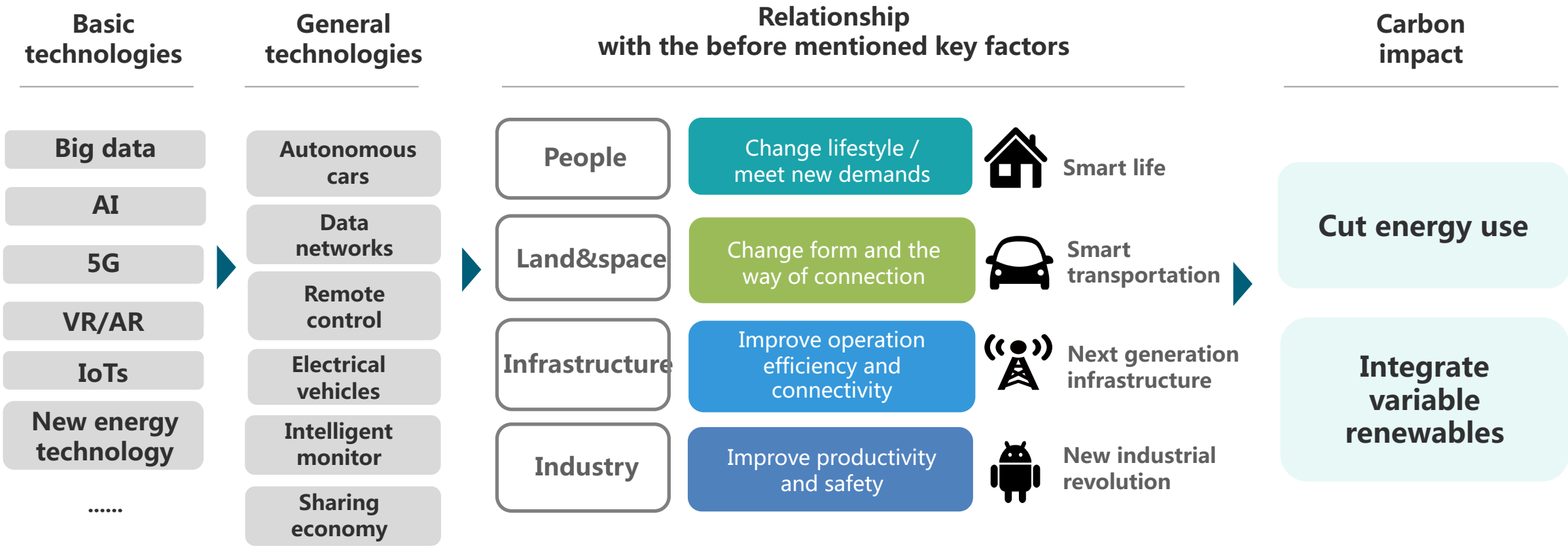
Coal power projects are speeding up since COVID-19

Data source: sorting based on Polaris power grid (http://www.bjx.com.cn/)

Governance: Silo-based governance predominant, hard for integration



New Technologies: Playing important role for urbanization and carbon emissions via impacts on people, land/space, housing/ infrastructure, industry, and services.



New technologies need to be taken into account in all areas and processes of urbanization strategy

Overall Challenges

+ GOVERNACE
- Silo-style
- Non-transparency

+ PEOPLE
- Rapid urban population increase
- Shrinking & agglomerating
- Growing income and consumption
- Aging

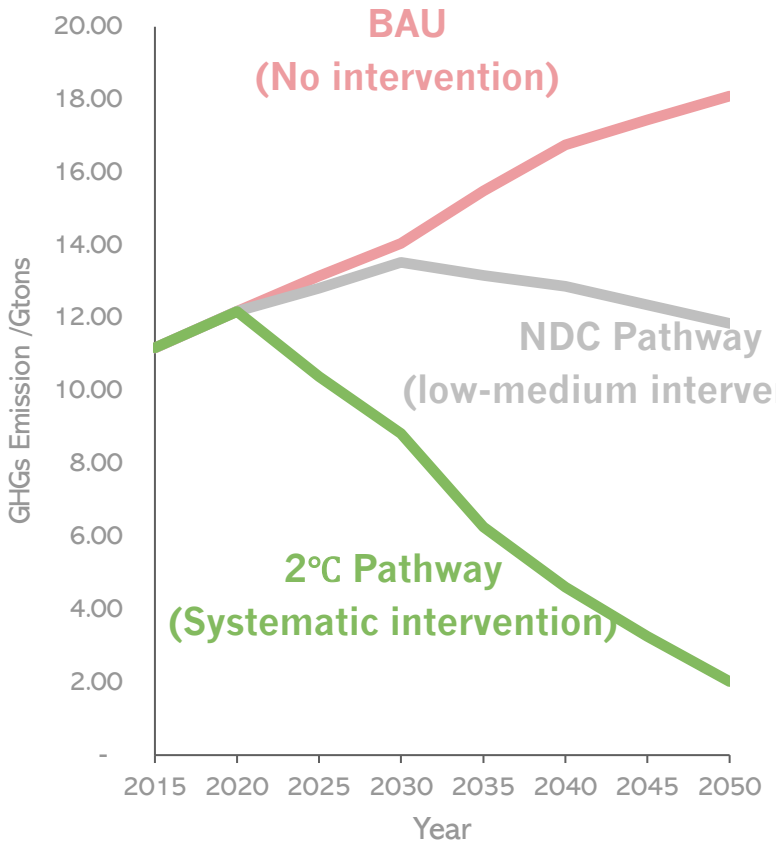
+ LAND & SPACE
- Sprawl
- Non-human scale
- Low efficiency

+ FISCAL & FINANCE
- Addiction to land revenue
- Lack of diversity
- Lack of innovation

+ HOUSING & INFRASTRUCTURE
- Floor area and energy increase
- Huge potential of "old" infrastructure
- Massive regeneration
- Vast ‘new’ infrastructure

+ INDUSTRY & SERVICES
- Heavy industry expansion
- Quantity to quality transition
- Regional shift

Systematic intervention in focus areas could put China's urbanization well onto a 2° C pathway



Scattered, energy-intensive lifestyle	High land demand, sprawling	Stereotypical, low energy efficiency, short life cycle	Energy & resource-intensive, low value-added	Land revenue dependent, single-sourced	Silo-based, Non-transparency
Agglomerated, low carbon lifestyle	Low land demand, compact	Integrated, smart, energy efficient, and longstanding	Innovation-based, high-value adding	Diversified, green finance, natural capital-based	Integrated, holistic, transparent

Note: The graph shows China's national emissions under different scenarios. NDC and 2℃ pathways are consistent with EFC's LTS task force analysis. BAU comes from Renmin University. Since future urban emissions account for more than 80 percent of total emissions, this graph largely reflects the different emission pathways corresponding to different urbanization strategies.

Theory of Change

Vision / Goal

Help re-define China's urbanization and put it onto a 2ºC pathway through systematic intervention, so that low carbon urbanization helps reduce 5.4Gt CO2 per year by 2050, compared to BAU

Area / Sector

- People
- Land & Space
- Housing & Infrastructure
- Industry & Services
- Fiscal & Finance
- Governance

Key Interventions

- Foster free migration and agglomeration
- Promote low carbon behaviors and life-styles
- Control urban foot print
- Improve urban form
- Optimize "new" infrastructure development
- Manage traditional infrastructure growth
- Advance performance standards
- Reduce heavy industry capacity
- Coordinate urbanization and industry upgrading
- Innovate urban finance
- Create municipal fiscal alternatives
- Strengthen integration and data transparency
- Accelerate new technology application

Three Key Pathways

Outcomes

- 2025: free migration realized
- 2035: "agglomeration" scenario realized
- 2035: low carbon lifestyle mainstreamed
- 2025/35/50: urban land capped at 110k/ 130k/120k km^2
- 2025: people scale prioritized over car scale
- 2035: "Eight Principles" fully adopted
- 2025: world class EE standards established.
- 2035: major infrastructure (road, airport, etc.) peaked
- 2025/35: energy intensity of GDP reduced by 3.2% / 3.8% annually from 2021
- 2035: Eco-capital, green finance dominate F&I
- 2025: human centered, data transparent, integrated governance established

21 Key Priorities/Opportunities in the Coming 5 Years

1 POPULATION MIGRATION AND AGGLOMERATION

2 NEW CONSUMPTION PATTERNS AND LIFESTYLES

3 URBAN SPRAWL/SHRINKING

4 URBAN RETROFIT AND RENEWAL

5 URBAN RAIL & LAND/SPACE INTEGRATION (TOD)

6 ENERGY INTENSIVE INFRASTRUCTURE CONTROL

7 NEW SERVICES & DIGITAL INFRASTRUCTURE

8 DISTRICT-LEVEL NEAR ZERO SOLUTIONS

9 BUILDING ELECTRIFICATION & RE-ES-EV INTEGRATION

10 BUILDING ENERGY RETROFIT & 100% ULTRA LOW ENERGY BUILDINGS

11 INNOVATIVE HEATING SOLUTIONS

12 INTEGRATED CITY CLUSTER TRANSPORT SOLUTIONS

13 LOW CARBON MOBILITY AND HOUSING FOR SUPER DENSE AREAS

14 NEV-CHARGING INFRASTRUCTURE

15 DC/RE-BASED DISTRIBUTED ENERGY SOLUTIONS

16 INDUSTRY PARK REVITALIZATION & INTEGRATION WITH CITIES

17 ENERGY AND RESOURCE INTENSIVE INDUSTRY TRANSITION

18 INDUSTRY UPGRADING TO SERVICES AND HIGHER VALUE CHAIN

19 INNOVATIVE FINANCING, e.g., NATURAL CAPITAL ACCOUNTING

20 NEW GOVERNANCE CO-MANAGEMENT MULTI-PLAN INTEGRATION (MPI)

21 DATA DISCLOSURE AND NEW TECHNOLOGY APPLICATION

People

Land & Space

Housing & Infrastructure

Industry & Services

Fiscal & Finance

Governance

"New infrastructure" in the Stimulus Plan

Area/Sector Priorities Vary by Geography, Size and Development Level of Cities/City Clusters

KEY OPPORTUNITIES	Eastern cities	Western cities	Southern cities	Northen cities	City clusters (super mega regions)	Super mega and mega cities	Large and medium cities	Small cities, counties and towns	Developed Cities	Rapidly developing cities	Transforming cities	Under developed cities
Population migration and agglomeration	✓		✓		✓	✓			✓	✓		
New consumption pattern and life style									✓			
Urban sprawl/shrinking	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Urban retrofit and renewal	✓		✓			✓	✓		✓			
Urban rail & land/space integration (TOD)					✓	✓				✓		
Energy intensive infrastructure control	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
New service and digital infrastructure	✓		✓						✓			
District-level near zero solutions	✓		✓						✓			
Building electrification, RE-ES-EV integration	✓		✓		✓	✓			✓			
Building energy retrofit and 100% ultra low energy new buildings	✓	✓		✓					✓	✓		
Innovative heating solutions	✓			✓								
Integrated city cluster transport solutions					✓							
Low carbon mobility and low-income housing solutions for super dense areas	✓		✓		✓	✓						
NEV-charging infrastructure	✓		✓		✓	✓			✓	✓		
DC/RE-based DE solution		✓		✓				✓			✓	✓
Industry park revitalization and integration with cities	✓		✓						✓		✓	
Energy and resource intensive industry transition	✓	✓									✓	
Industry upgrading to services higher value chain	✓		✓		✓	✓			✓		✓	
Innovative financing, e.g., NC accounting	✓		✓						✓			
New governance, co-management, MPI	✓		✓		✓	✓			✓			
Data disclosure and new technology application	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

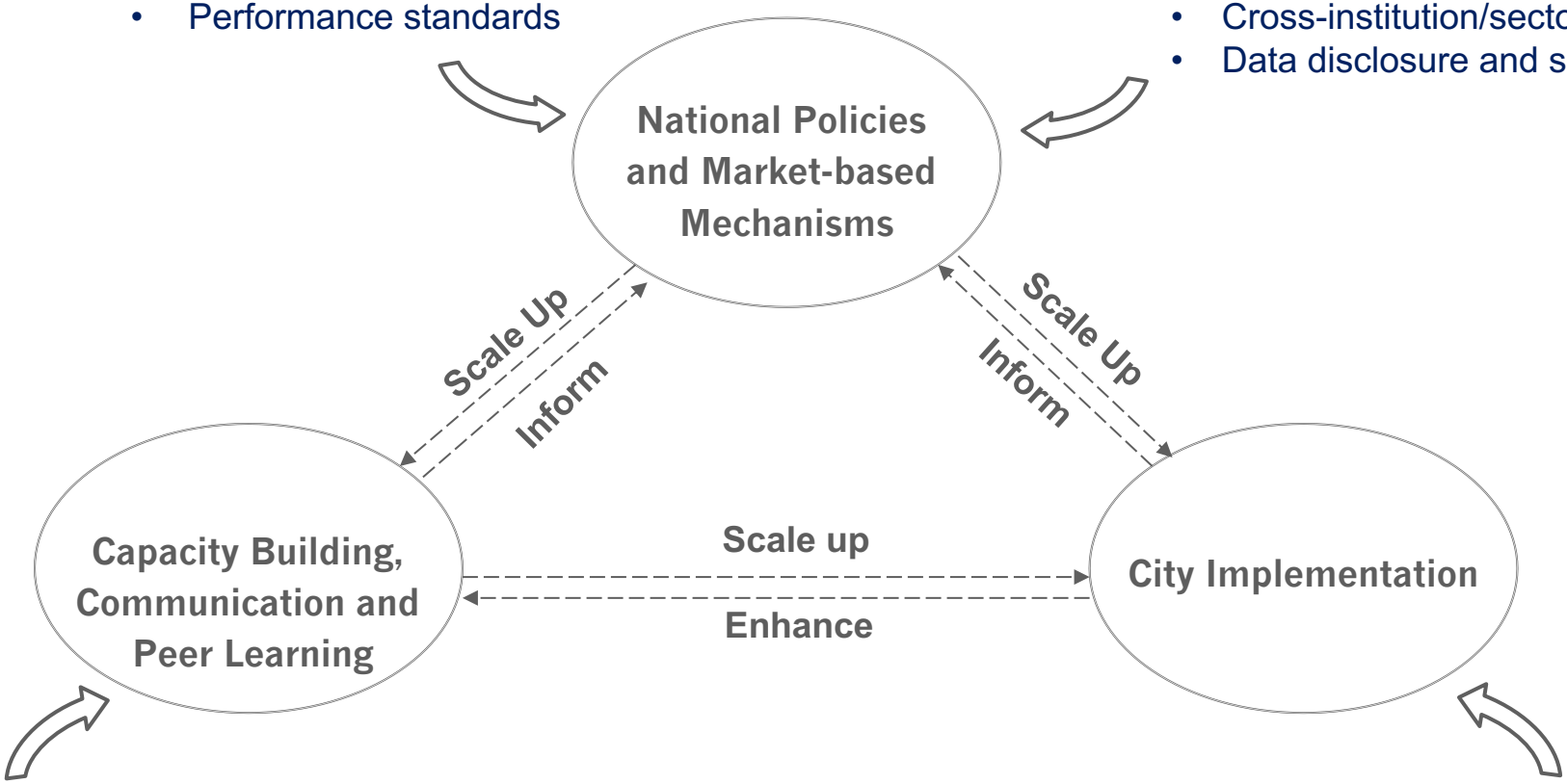
Priorities by Targeted Geographies

Initiative	Priorities/Opportunities	Geographies
	Population migration and agglomeration	
	New consumption patterns and lifestyles	
	Urban sprawl/shrinking	
	Urban retrofit and renewal	
	Urban rail and land/space integration (TOD)	
	Energy intensive infrastructure control	
	New services & digital infrastructure	
	District-level near zero solutions	
	Building electrification, RE-ES-EV integration	
	Building energy retrofit and 100% ultra low energy new buildings	
	Innovative heating solutions	
	Integrated city cluster transport solutions	
	Low carbon mobility and housing for super dense areas	
	NEV-charging infrastructure	
	DC/RE-based, distributed energy solutions	
	Industry park revitalization and integration with cities	
	Energy and resource intensive industry transition	
	Industry upgrading to services and higher value chain	
	Innovative finance, e.g., natural capital accounting	
	New governance, co-management, MPI	
	Data disclosure and new technology application	

Key Pathways for Intervention

- Development plans
- Regulations and policy directives
- Performance standards

- Fiscal alternatives
- Green finance
- Cross-institution/sector integration
- Data disclosure and sharing



- Best practices, tools, knowledge
- City learning platforms
- Study tours, training courses, etc.

- Lessons, policy gaps and technical know-hows
- Prototype pilots

Key Stakeholders

01 EFC Programs

CEMP COMMS CTP LCEG CIP CPP LCCP

02 Areas / Sectors

People Housing & Infrastructure Land & Space Industry & Services Fiscal & Finance Governance

03 Key Ministries

NDRC MNR MOHURD MOT MIIT MEE MST CBIRC PBC CSRC

04 Key Grantees

ERI, CCUD, ISPRE, ICT, … CATS, TPRI, … MST
CLPSI, CANRE, CRC, CLSS, … MIIT CBIRC PBC
CABEE, CABR, CSTC, CAUPD, … CAEP, NCSC, PRC, THU CSRC

ISP-CEP + Peer Organi-zations

CCICED MDB: WB, ADB, AIIB,… UN: ESCAP, Habitat,… WHO
RMI WRI ISC ITDP ICCT
…

Key Regions & Cities

JJJ,
Pearl River Delta,
Yangtze River Delta,
Shandong province,
Guangdong province,
Hainan province, …

National, regional, city think-tanks, e.g., DRC, CASS, CAS, and local branches

Initiatives and Tactics

People: understand social demographic and demand patterns, foster healthy agglomeration, and decarbonize consumption through behavior change

Land & Space: minimize urban footprint and optimize urban form

Housing & Infrastructure: optimize housing key urban infrastructure supply in terms of quality, scale, structure, and energy efficiency

Industry & Services: coordinate urbanization and industry transition

Fiscal & Finance: reform municipal fiscal policy and innovate urban finance mechanisms

Governance: promote cross-sector, cross-department integration, data transparency, and new technology application in urban governance

Initiative 1: People

Tactics	Drivers/Barriers	Outcomes /Impacts
• **Understand** population characteristics (spatial distribution, social demographics, economic situation), demand pattern and their carbon implications • **Foster** free migration and healthy level of population spatial agglomeration • **Promote** low carbon consumption behavior on key areas through accurately targeted communication, low carbon oriented design of infrastructure, products/services and incentive mechanism	• Pursuit of high quality life and demand upgrading • China's ambition for eco-civilization • The impact of production and consumption trends from the developed world • Governance innovation due to breakthrough application of big data, IoT / • Non-market-based factors that hinder free flow of people • Culture to pursue material well-being • Urbanization reversal • Carbon is a low priority in production and consumption • Unbalanced development • Population aging	• 2025, free migration realized; carbon becomes an important factor in demand and supply decision-making; momentum built in decarbonizing key consumption sectors • 2035 massive migration comes to an end and "agglomeration" scenario is realizing; low carbon life style mainstreamed • 2050, healthy and stable population agglomeration realized; consumption carbon near to be neutralized.

Initiative 2: Land & Space

Tactics	Drivers/Barriers	Outcomes /Impacts
• **Manage** urban sprawl and shrinking • **Improve** land use structure • **Optimize** urban form in macro, meso and micro level to increase efficiency and livability (clustering, connectivity, accessibility, compactness, vitality, and human friendliness)	• Institutional reform and new space governance mechanism, e.g., new MNR, city clusters, etc. • People's pursuit of high quality spaces • Deterioration of city "illness", such as congestion and pollution / • Out-of-date land and urban form standards • Land revenue driven growth model • Lack of consensus on spatial model, e.g., aggregation vs. disaggregation	• 2025, China established a low carbon land and space technical policy system that prioritize people-scale over car-scale; urban land capped at 11k km^2; industry land reduces while residential land increases steadily • 2035, Emerald Cities principals becomes typical practice; China peaks its urban footprint, urban land capped at 13k km^2; land structure continue to improve • 2050, China established an compact, efficient urban system, urban space meet people's high quality life demand; urban land capped at 12k km^2; land structure optimized

Initiative 3: Housing & Infrastructure

Tactics	Drivers/Barriers	Outcomes /Impacts
• **Accelerate** the development of new low carbon urban infrastructures, including those in the Stimulus Plan after COVID-19 • **Manage** the growth of old, carbon intensive infrastructures, e.g., airports, highways, power plants, and high-rises, etc. by stringent evaluation and approval policies • **Enhance** infrastructure efficiency through cross-sectorial integration and innovation • **Advance** infrastructure energy efficiency and life-span through advanced performance standard and regulation system	• COVID-19 and the Stimulus Plan • New theme, e.g., high quality development, innovation • Energy and climate security • Consumption upgrading / • Out-of-date technical policy system • Capital investment driven economic development model • Silo-based governance • Lack of “green” approval tools and procedures	• 2025, China develops and implements green “New Infrastructure” plans for COVID-19 recovery stimulus; China established world class infrastructure development standards in terms of quality, energy efficiency and level of integration • 2035, China peaks its major infrastructure development, with optimized quantity and structure, e.g., buildings peaked at 72 billion m^2 • 2050, China established high quality, energy efficient infrastructure systems that well meet people’s demand

Initiative 4: Industry & Service

Tactics	Drivers/Barriers	Outcomes /Impacts
• **Reduce** capacity of carbon and energy intensive industries • **Coordinate** high quality urbanization and industry upgrading to services and high-value chain • **Transform** industry parks	• National ambition for economic upgrading and de-capacity • Air-quality and climate pressure / • Growth (GDP) and employment pressure • Inertia to successful models in the past	• 2025, China reduces 15-20% industry carbon from its peak reached at 2020; traditional energy and carbon intensive industries are on a de-capacity track; land from traditional industry parks continue to be released and re-developed • 2035, China's industry reaches higher-value chain and services play major roles; wasted land from industry parks redeveloped/recovered for urban in-fill development • 2050, China industry energy efficiency and CO2/GDP reaches world's top tier

Initiative 5: Fiscal & Finance

Tactics	Drivers/Barriers	Outcomes /Impacts
• **Phase out** land revenue driven urban finance • **Create** new urban financial source and mechanism, e.g., value capture of green and eco-development, non-fiscal taxation, climate finance, etc. • **Accelerate** application of green finance tools on ground-level sectorial solutions, e.g., building energy retrofit and green buildings	• Strong quest for eco-civilization • Pressure of increasing local debts • Dwindling marginal contribution to economic growth for physical capital investment / • Lack of new business models and market enablers • Inertia to the land revenue models	• 2025, Land revenue urban finance phased out (less than 10%) • 2035, Urban finance sources diversified, non-traditional fiscal and financial mechanism mainstreamed • 2050, Cities reach high degree fiscal sustainability

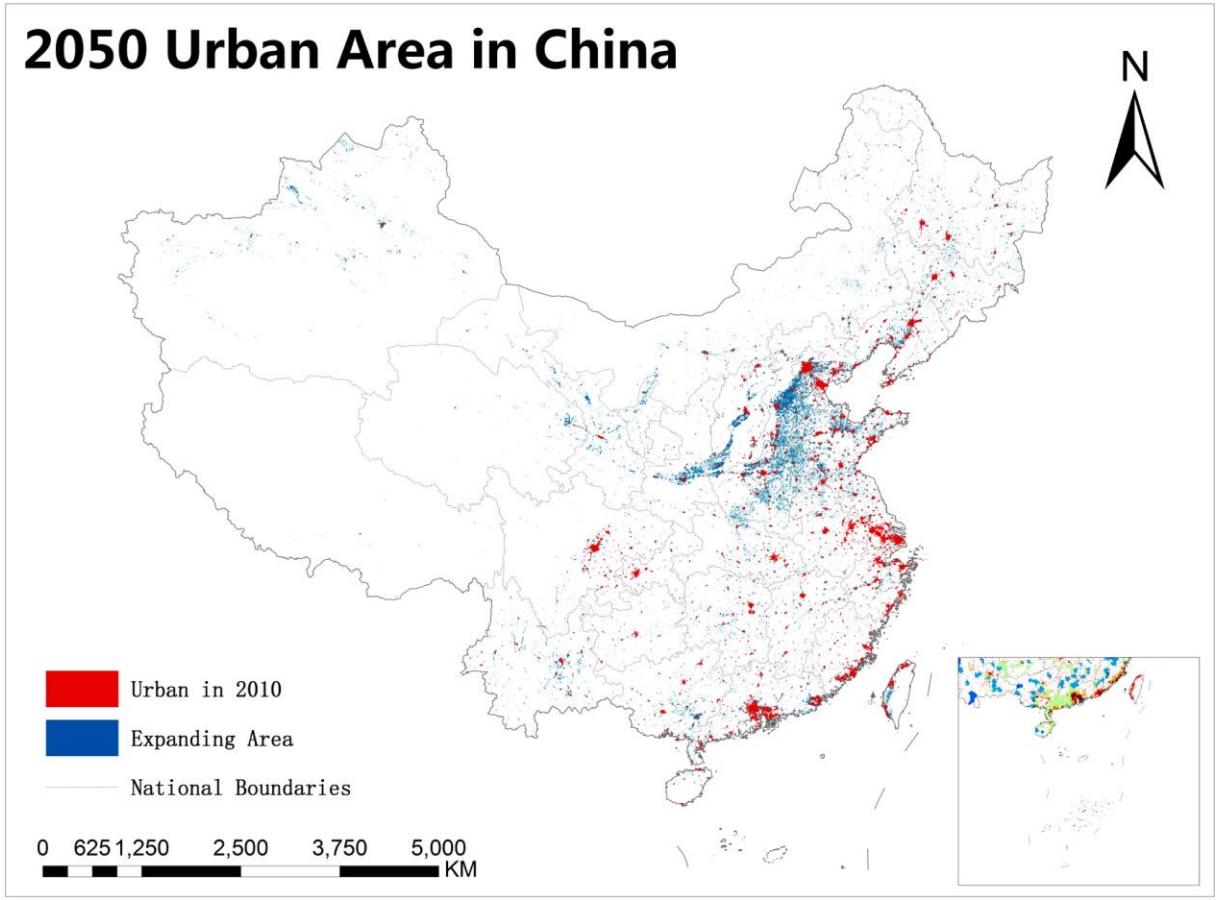
Initiative 6: Governance

Tactics	Drivers/Barriers	Outcomes /Impacts
• **Reform** urban governance towards coordinated inter-municipal, inter-institutional, cross-sectorial, multi-purpose solutions, e.g, “dual reach”, “triple achievements ”, multi-plan integration (MPI) • **Increase** data transparency by increasing mandatory disclosure and new technology application	• New form of urban governing: city-clusters, mega-polis, metropolis, and urban-rural integration • Growing quest for multiple development indicators in addition to GDP • Advancement of information sharing technologies • Silo-based performance evaluation indicators, and lack of detailed policy guidance and standards for integration	• 2025, Enabling policy systems for information sharing and integration are well established • 2035, Coordination and integration becomes the mainstream • 2050, China fully modernized its urban governance system in terms of efficiency, transparency and integration

SUSTAINABLE ENERGY, PROSPEROUS FUTURE

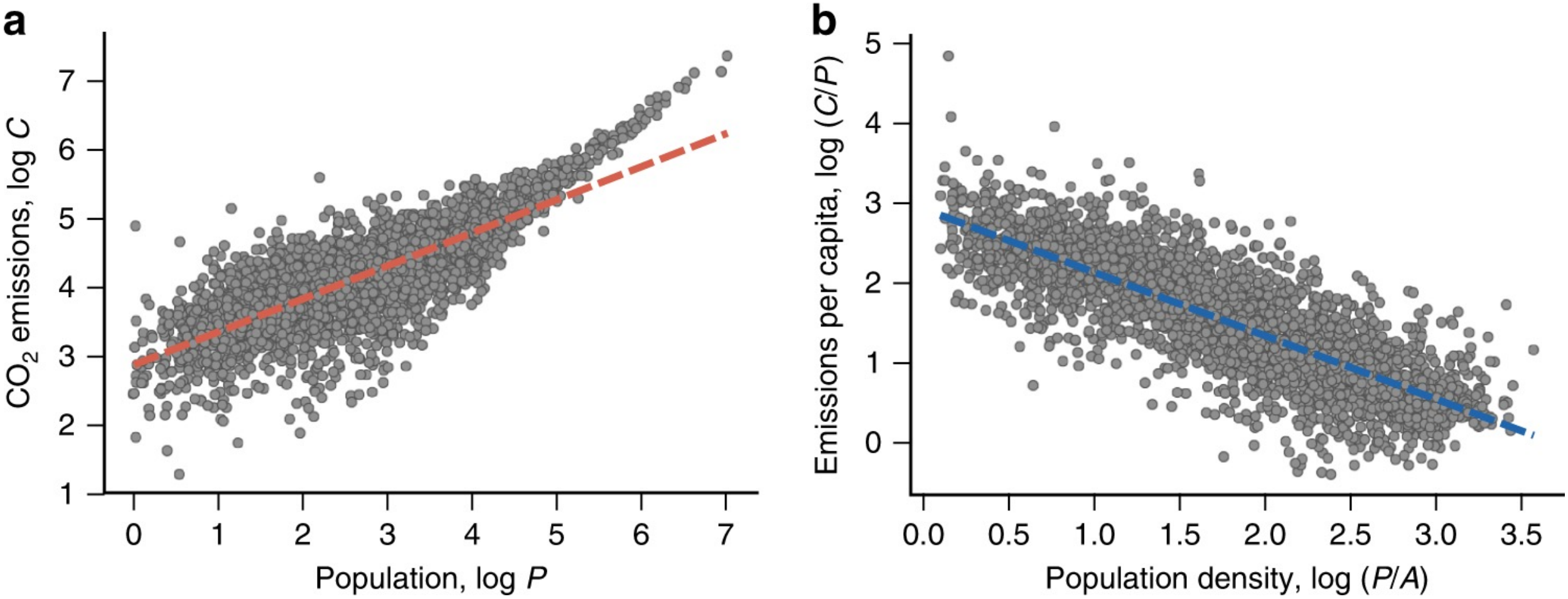
THANK YOU

ANNEX I: potential urban land expansion



118,200 km²(100%) +56,300 km²(47.6%) = 174,500 km²(147.6%)

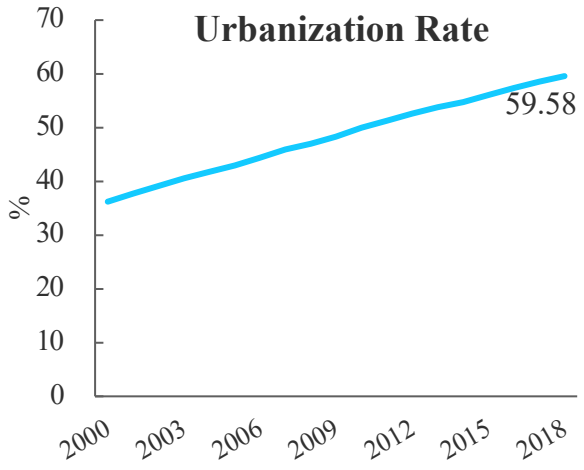
ANNEX II: impact of urban density on CO2 emissions

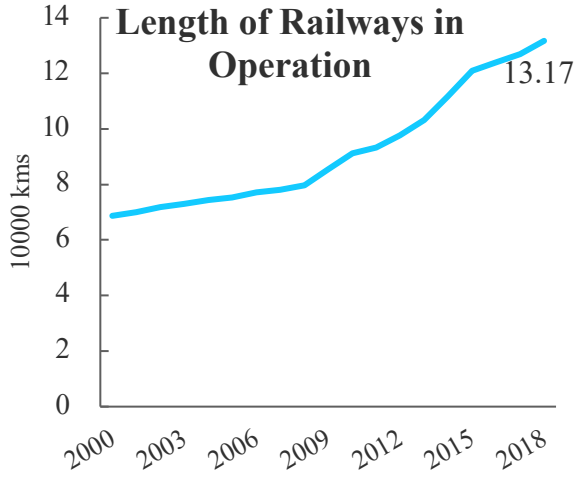


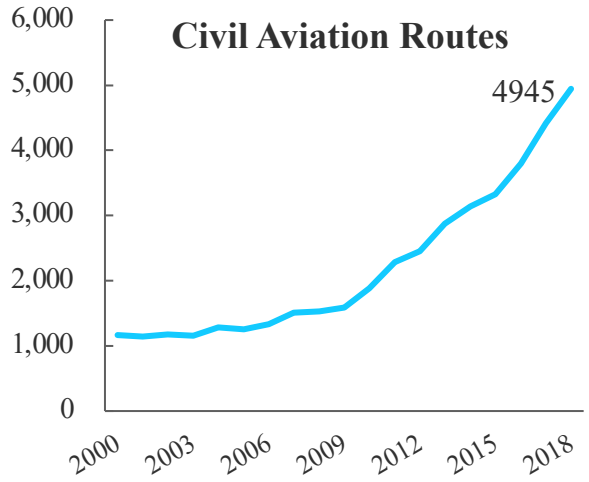
Source: https://www.nature.com/articles/s41467-019-11184-y

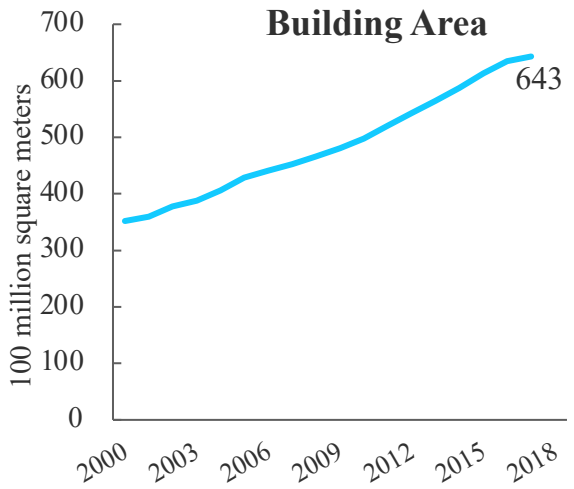
ANNEX III: infrastructure and related industry growth

1) Urbanization rate and infrastructure construction

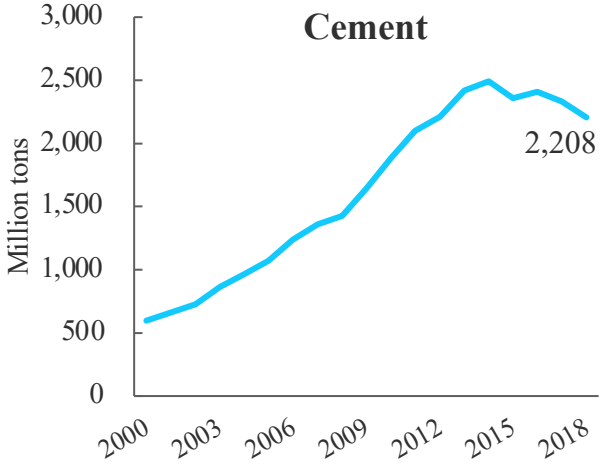


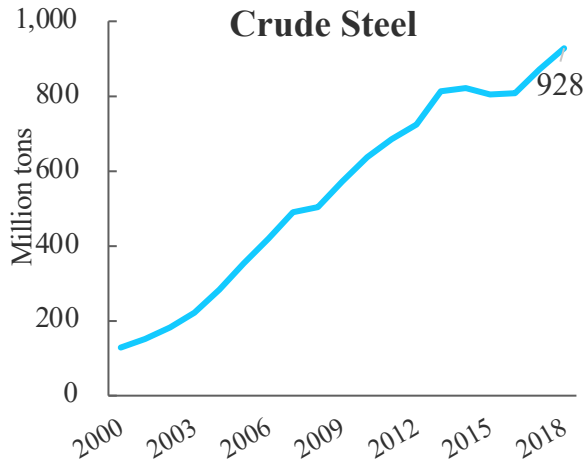


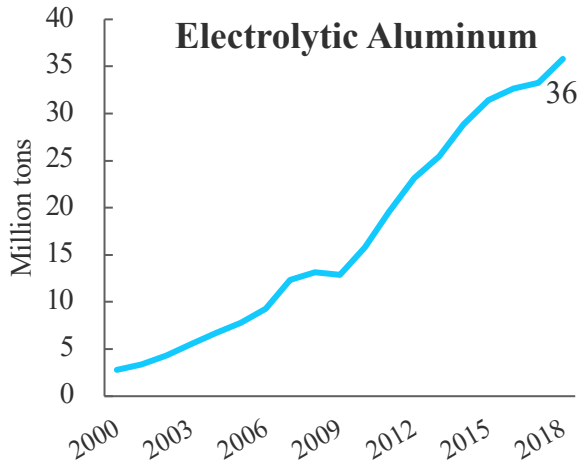


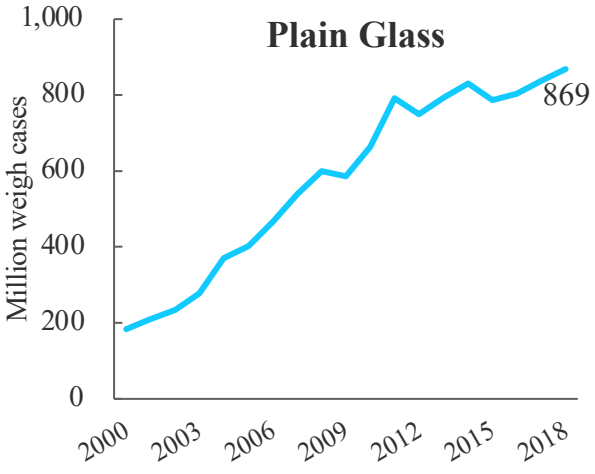


2) Output of industrial products









ANNEX IV: Targeted National Policies

Area/Sectors	Type of Intervention	Examples of key national policies
People	• Foster free migration and agglomeration • Promote low carbon behavior	Hukou; personal carbon accounting; low carbon consumption incentives; etc.
Land & Space	• Manage sprawl and shrinking • Improve land use structure • Optimize urban form	Land & space planning law; national land & space planning outline; urban growth boundary; multi-planning integration regulation; planning and design standards; land-carbon productivity; etc.
Infrastructure	• Accelerate next generation infrastructure • Align infrastructure and pop distribution • Manage traditional infrastructure growth • Enhance infrastructure integration • Advance performance standards	Plans (e.g., FYPs, Specialized plans) guidelines, standards, regulations, incentives for next generation infrastructure development; scientific evaluation standards and approval process for traditional infrastructure investment; market-based mechanism and private participation; energy performance standards; etc.
Industry & Service	• Reduce heavy industry capacity • Coordinate urbanization and industry upgrading • Transform industry parks	Energy and emission cap/intensity for key industries; nation-wide de-capacity and new capacity control for key industries; performance-based industry access control for industry park; industry park resource (land, water, electricity,..) supply policy reform; etc.
Cross-sector issues	• Strengthen integrated governance • Innovate urban finance • Increase data transparency • Enable new technology application	Co-control; “dual reach”; “triple reach”; multi-plan integration; institutional integration; guidelines, standards for infrastructure integration; eco-accounting; green finance; non-fiscal taxes; public data disclosure; performance benchmarking; etc.