Energy Foundation China

Low Carbon Cities Program Strategy:

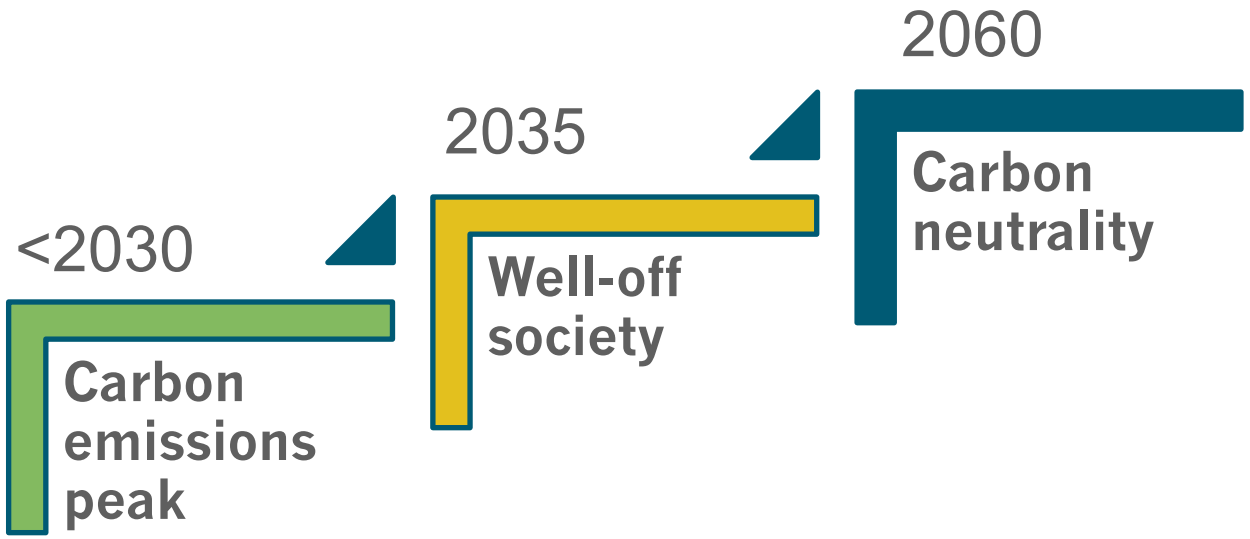
Catalyzing Carbon Neutrality for Chinese Cities

Energy Foundation China

This strategy was presented to EF China board in Mar 2021, and subjects to regular updates.

Background

President Xi's new commitment reveals a new horizon for climate control



The Philanthropic World, has to:

- Set up ambitious goals to response the call
- Think about leapfrogging rather than marginal improvement
- Identify key arenas and make intensive investment
- Pursue profound and real-world changes

Background

Cities are the most important battlefield for China's carbon neutrality

Chinese cities will accommodate more than **one billion people** by 2050

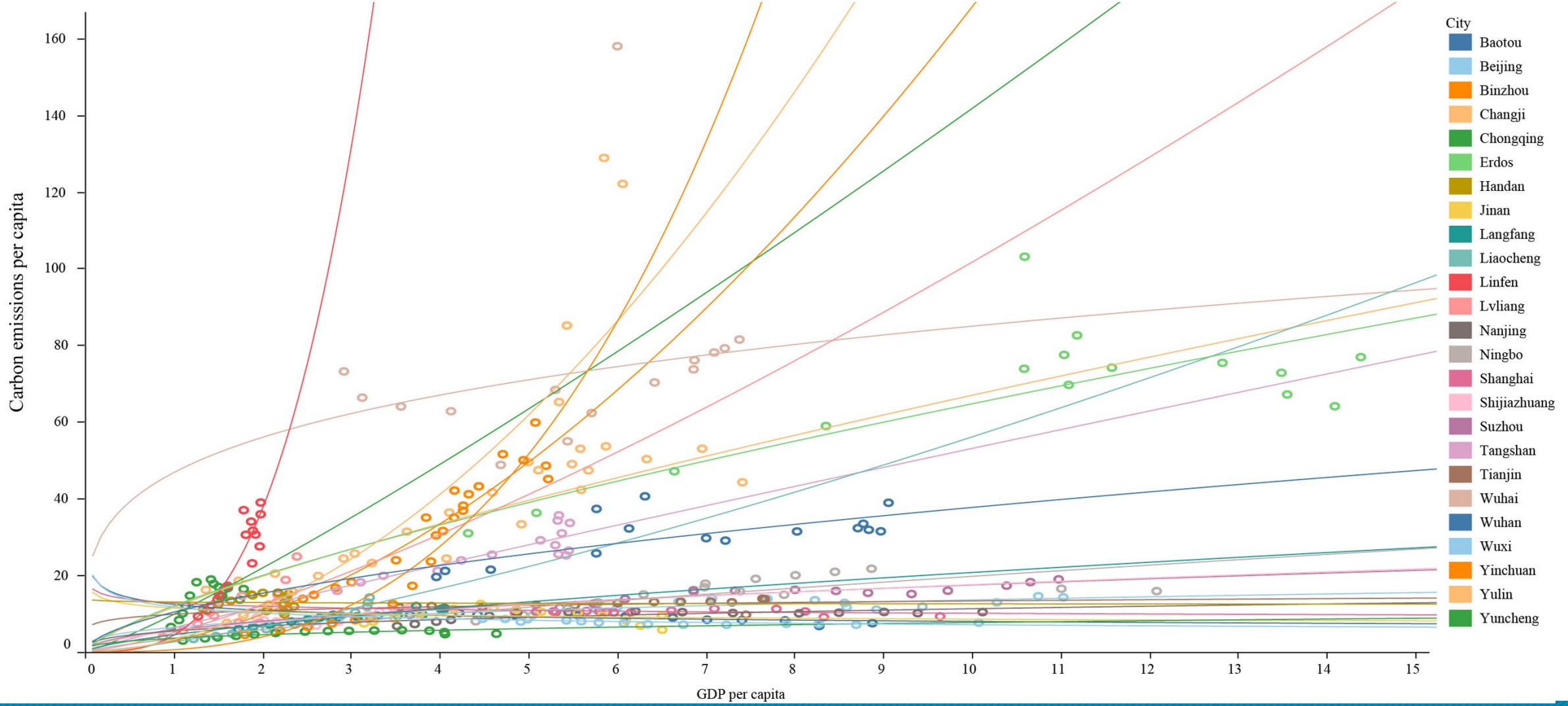
Cities account for over **75%** of China's carbon emissions

Cities are central for **infrastructure and industrial investment** that contribute significantly to city carbon emissions

City development pattern has large impact on carbon emission and is highly lock-in for the future

Challenge

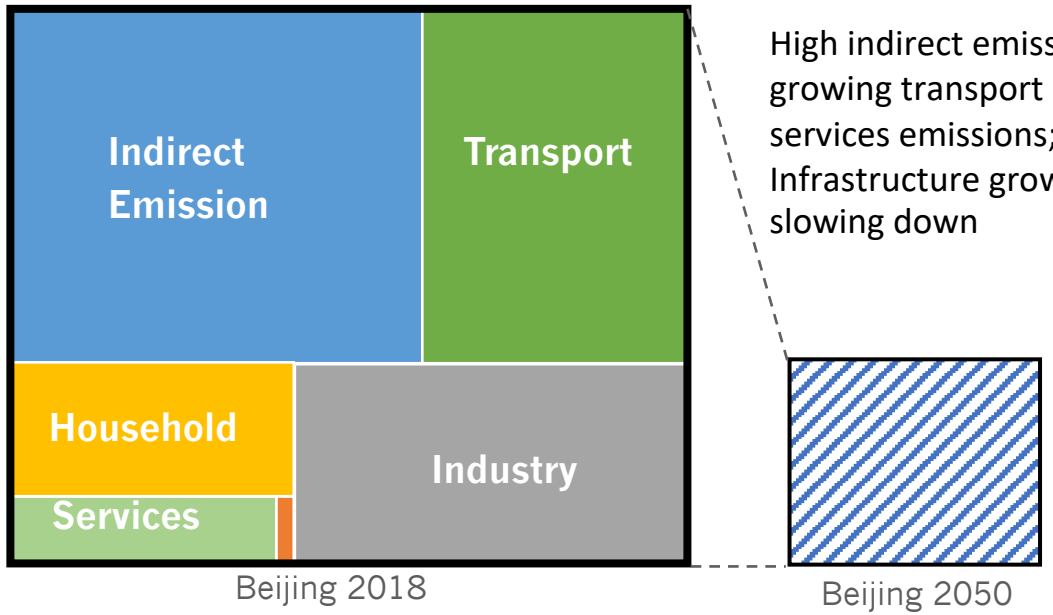
Status quo: many top emitters continue to show a strong trend of carbon growth



Challenge

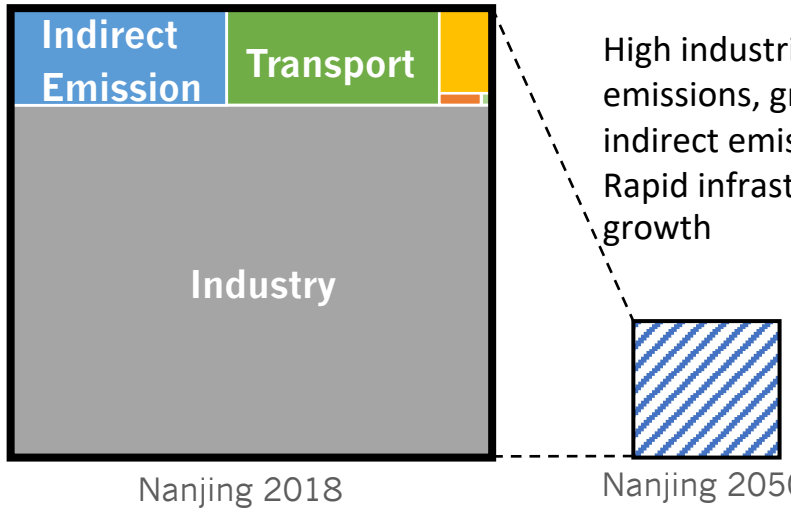
Complexity: different cities need varied mitigation strategies

Developed City (e.g. Beijing)



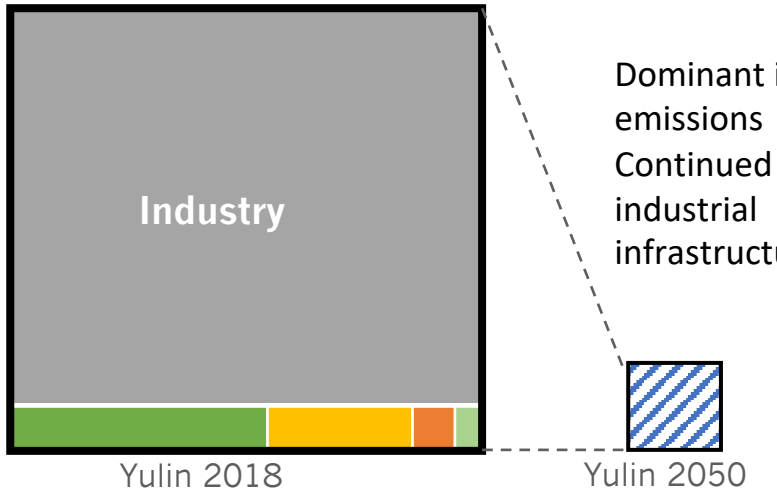
High indirect emissions, growing transport and services emissions; Infrastructure growth slowing down

Fast Developing City (e.g. Nanjing)



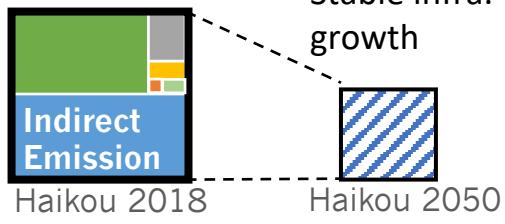
High industrial emissions, growing indirect emissions; Rapid infrastructure growth

Resource-based City (e.g. Yulin)



Dominant industrial emissions
Continued heavy industrial infrastructure growth

Service/Tourism City (e.g. Haikou)



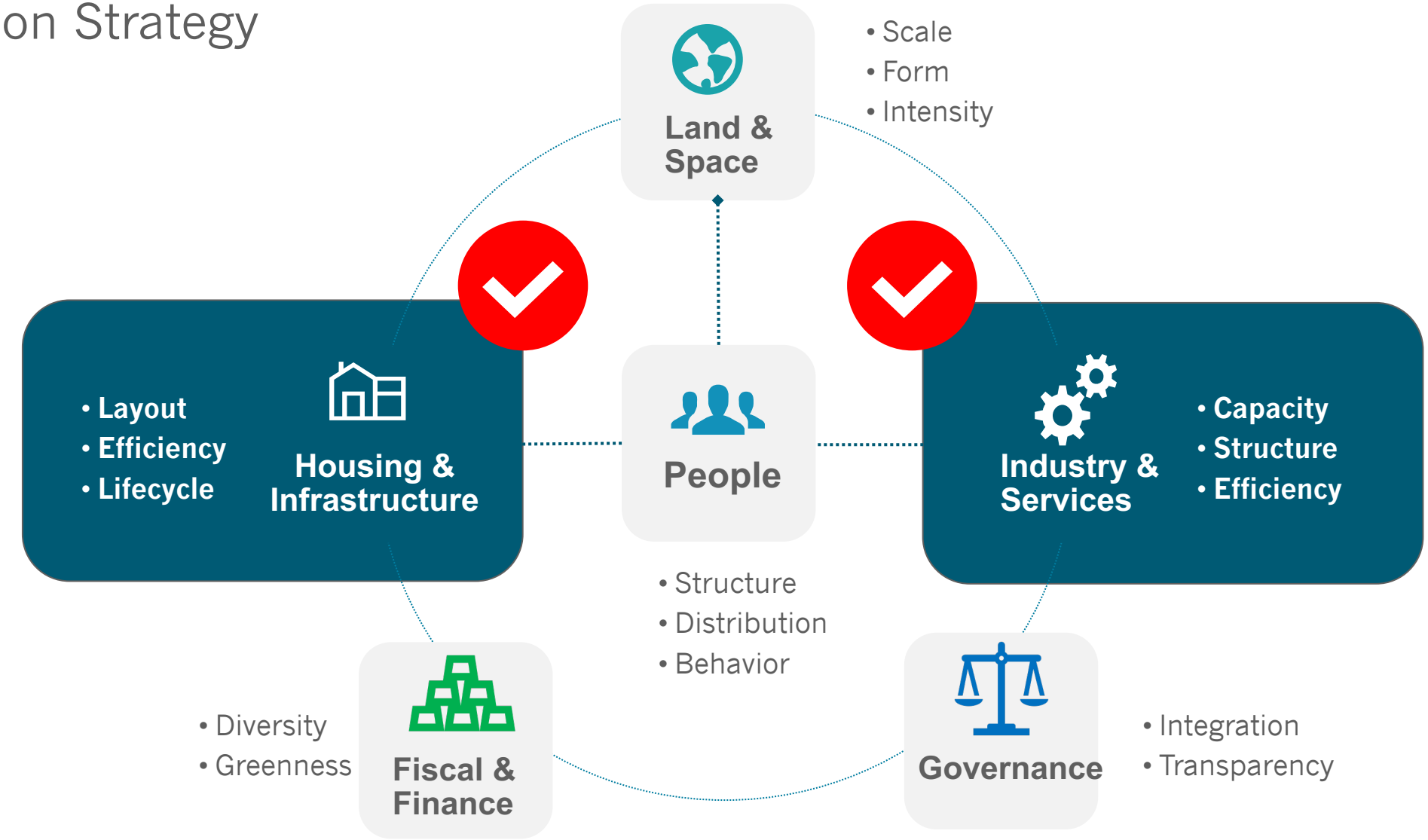
High transport and services emissions; Stable infra. growth

Legend

- Indirect Emission
- Emission from **Industry**
- Emission from **Transportation**
- Emission from **Services**
- Emission from **Agriculture**
- Emission from **Household**
- Future Vision for CO_2 Emission (1t/capita)

Technical Approach

Mitigate by transforming key urban physical elements identified in EF China's Urbanization Strategy



6 Strategic Priorities and 18 Working Areas

Structural Change & Integration

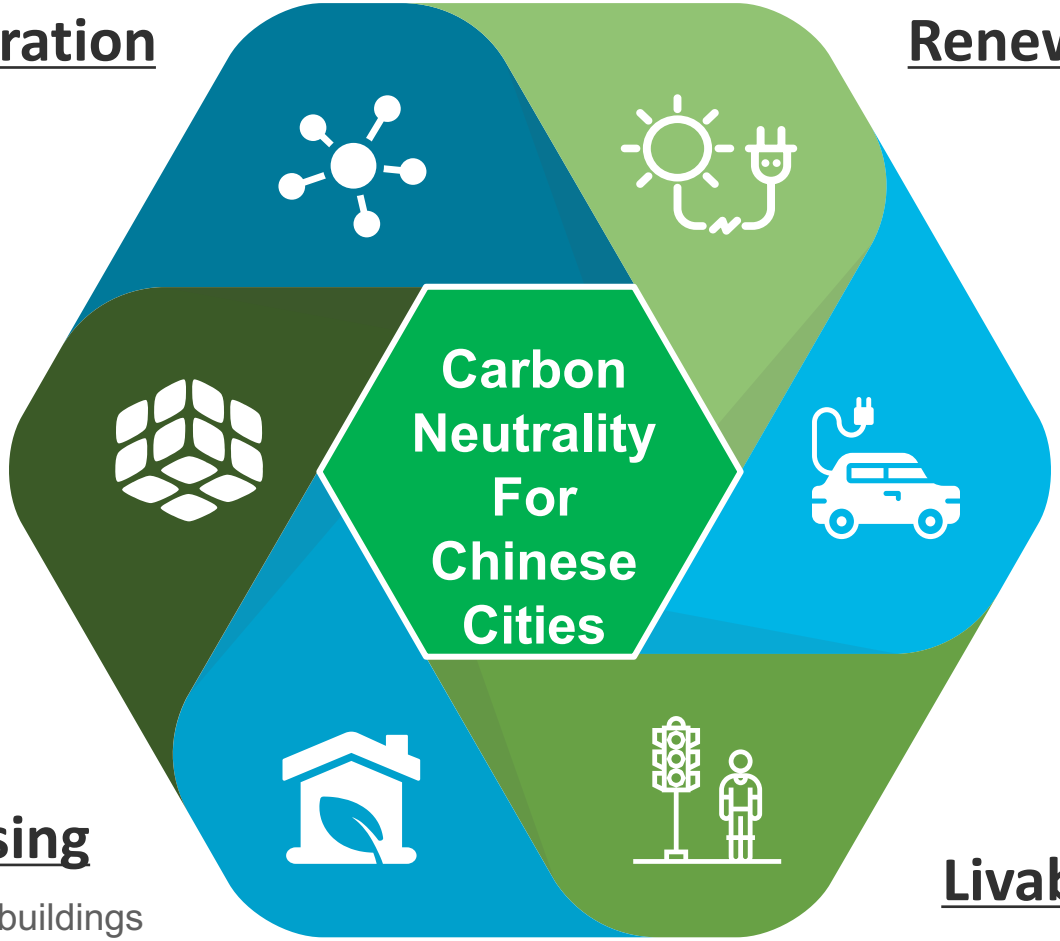
17. Zero Emission Zones
18. Structural change

Future Looking Data Infrastructure

15. City MRV system
16. Big data system for low carbon, smart public services

Green Building and Housing

11. Green/ultra-low energy/zero carbon buildings
12. Direct current buildings
13. Built-in distributed renewable energy
14. Clean heating and cooling



Renewable Energy Infrastructure

1. Micro smart grid
2. Co-generation center with renewables
3. User-side energy storage and cascade utilization
4. Prosumers and virtual power plants

Sustainable Transportation Infrastructure

5. EV charging facilities
6. Right-of-ways for urban green transport
7. City cluster green transport facility

Livable Service Infrastructure

8. Comfortable streets and public spaces
9. Urban green and eco-system
10. Urban amenities and service facilities

Theory of Change

LCCP Strength & Legacy → **Identify Partners** → **Build Mitigation Measures Into Pathways** → **Intervene and Invest in Strategic Priorities** → **Catalyze Real World Change**

Deeply Understand the Population Growth and Migration

LCCP
Vision & Goals

+

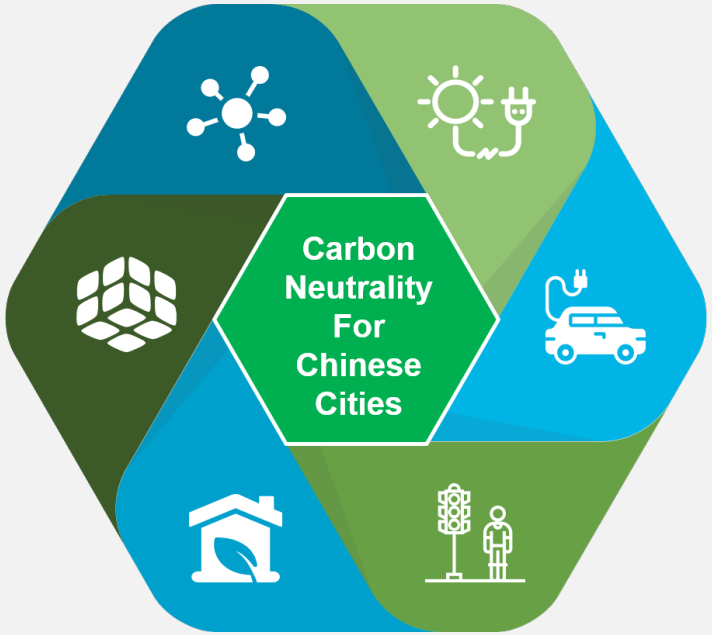
Stakeholders

State Council
NDRC/NEA
MEE
MNR
MOHURD
MOT
MIIT
Local Cities
Market Players
Financers
Peer EFC Programs
Peer iNGOs

Emerald Cities+

- Laws & Regulations
- High-level Directives
- Standards & Codes
- Cross sec. Planning
- Pilots
- Fiscal, Finance& Carbon Market
- MRV
- Capacity Building

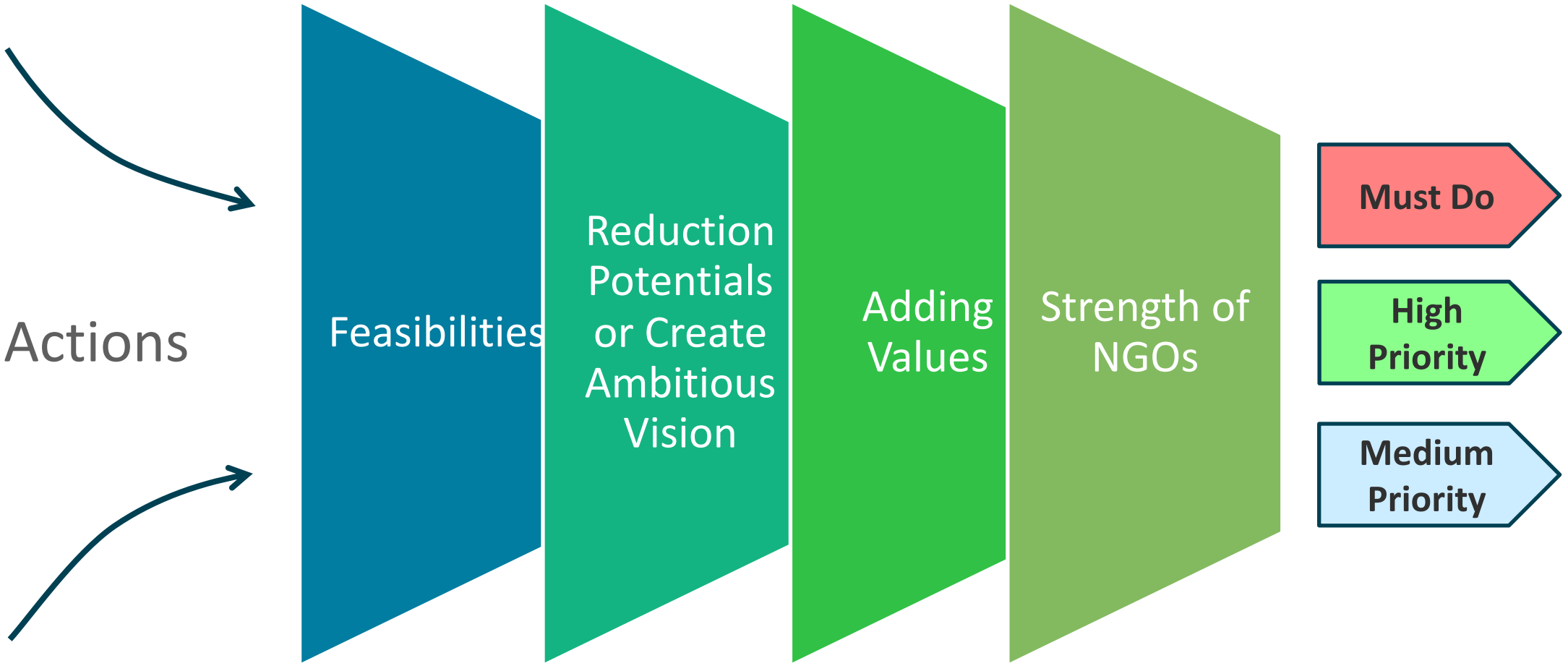
Strategic Priorities



City Carbon Neutrality

Actions

Implementable actions for each specific Strategic Priorities are selected by interviewing top experts in related fields.



“Must Do” Actions

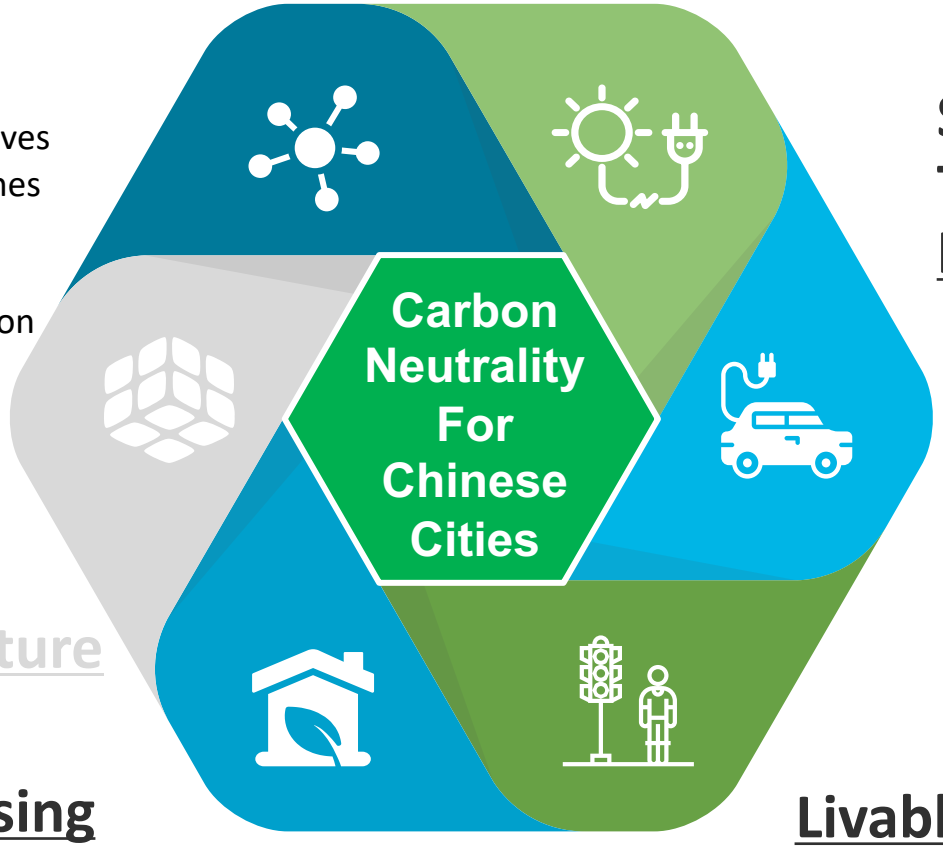
Structural Change & Integration

9. Territory planning integrating low carbon development
10. Low carbon city regeneration technical guideline
11. Zero buildings & district pilots
12. Carbon-neutral district promotion policies and incentives
13. Cross-sector integration standards and design guidelines
14. Regional and cities zero emission goals, roadmap and measures
15. Zero emission cities and zones pilots and demonstration
16. Incentive policy, mechanism /assessment for reaching the emission peak in advance
17. Provincial and city level tri-reach planning pilot
18. Roadmap, policy and tech tools of carbon neutrality
19. Carbon neutrality city vision and strategy development pilots

Future Looking Data Infrastructure

Renewable Energy Infrastructure

1. Pilot of distributed energy system



Sustainable Transportation Infrastructure

2. Policies, guideline and standards on public transportation, logistic and inter-city passenger
3. E-vehicle infrastructure development policies & planning
4. Public transit and NMT development pilot

Green Building and Housing

7. Clean heating pilots in north China city and rural areas
8. Green buildings, green districts and green city pilots

Livable Service Infrastructure

5. City regeneration pilots
6. Territory planning guidelines and standards

High Priority Actions

Structural Change & Integration

10. Green financing for new building, green building and energy saving
11. Financial incentive mechanism to distributed energy
12. Carbon-neutral TOD and compact development pilots
13. Tri-reach analysis model
14. Investment criteria for carbon-neutral cities
15. Carbon-neutral pathway and policy analytical tools
16. Develop future city planning guideline

Future Looking Data Infrastructure

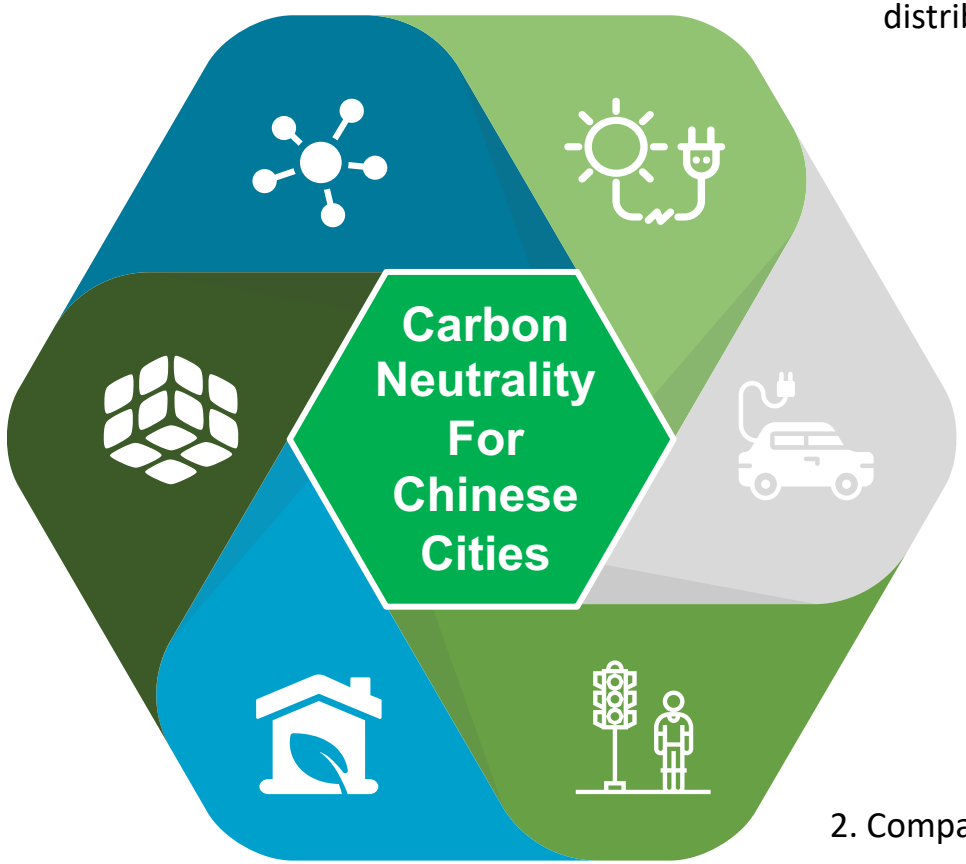
6. Policies & technical standards for smart construction industry
7. Establishment of city development database
8. Integrated big data methods and analysis tools
9. Establishment of city carbon neutrality tracking and ranking system

Green Building and Housing

3. Building demolition protocol
4. Guidelines on clean heating in south China
5. Direct current buildings & prefabrication buildings pilots

Renewable Energy Infrastructure

1. Guideline on design of distributed energy system



Sustainable Transportation Infrastructure

2. Compact development guideline

Livable Service Infrastructure

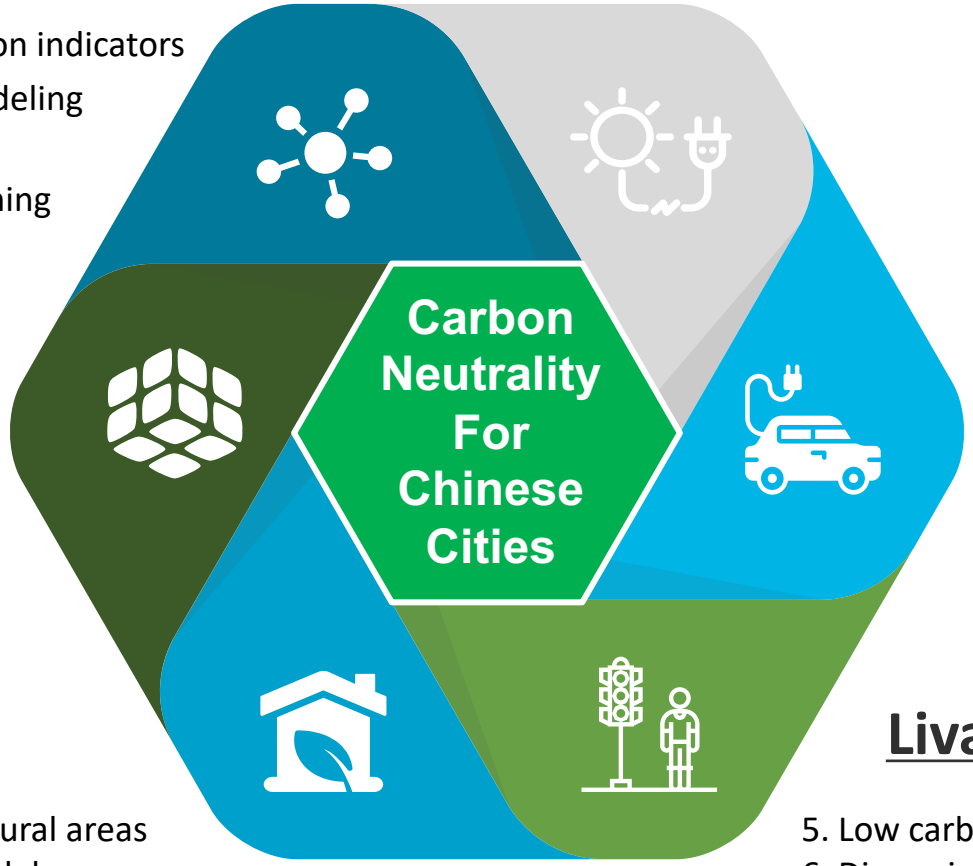
Medium Priority Actions

Structural Change & Integration

10. Land circulation policy integration with low carbon indicators
11. Land pattern and carbon emissions intensity modeling
12. Knowledge sharing and dissemination
13. Multi-plan integration capacity building and training
14. Training and international communication

Future Looking Data Infrastructure

9. Big data and transportation model



Renewable Energy Infrastructure

Sustainable Transportation Infrastructure

1. E-bike management and promotion guideline
2. E-bike management and promotion pilot
3. Develop urban car use restricting policy;
4. Support autonomous vehicle and smart transportation pilot

Green Building and Housing

7. Pilots of clean heating in north China city and rural areas
8. Building energy service& business big data model

Livable Service Infrastructure

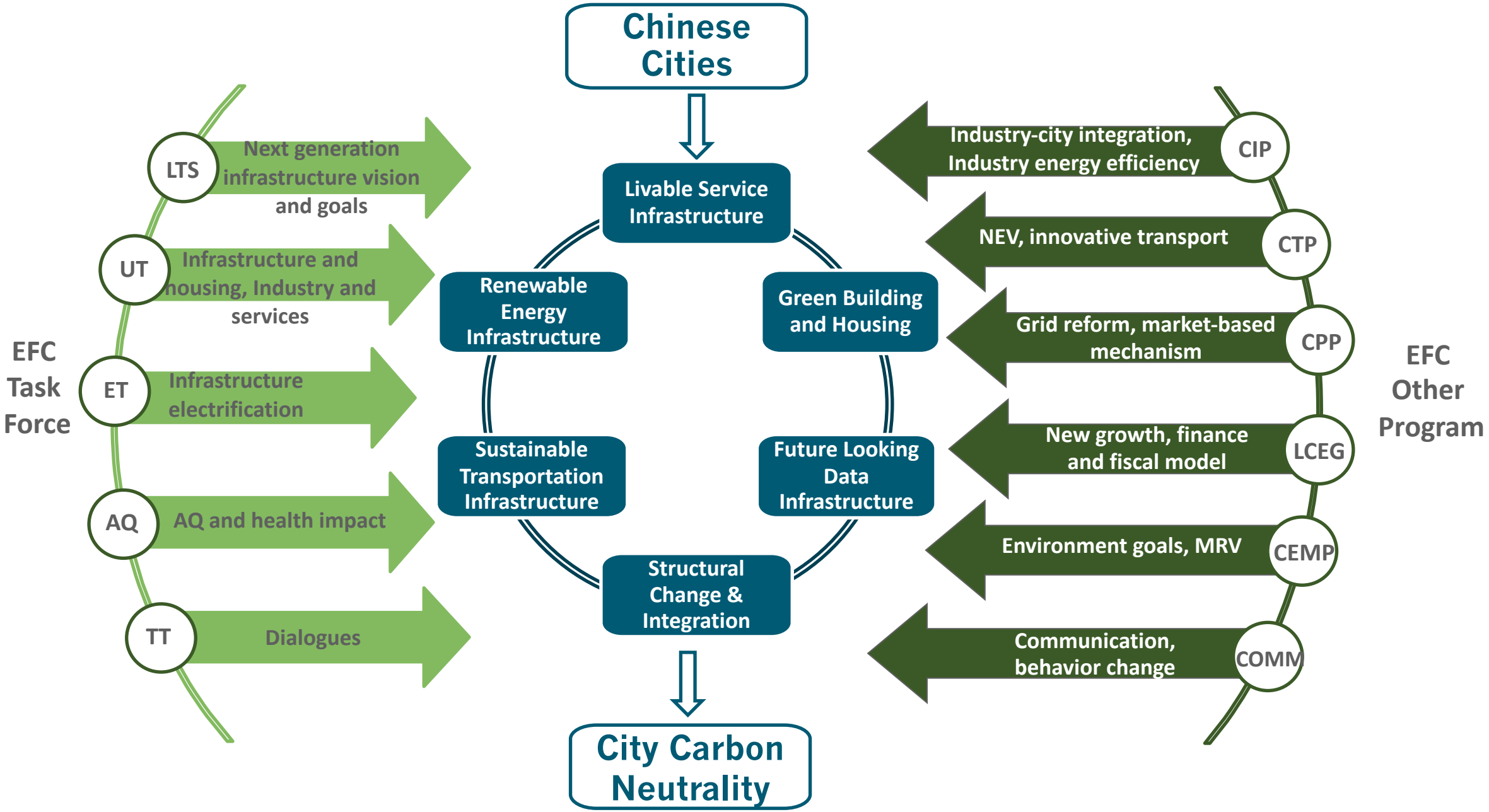
5. Low carbon city regeneration financial incentives
6. Disseminate land use policies and technical guidelines

Geographic Priority Mapping by City Type

H High M Medium L Low

Strategic Priorities	Working Areas	Developed cities e.g. Beijing	Fast developing cities e.g. Nanjing	Resource-based Cities e.g. Yulin	IV. Cities with specific theme, e.g. tourism
Renewable Energy Infrastructure	1. Micro smart grid	M	H	L	M
	2. Co-generation center with renewables	M	H	L	M
	3. User-side energy storage and cascade utilization	M	H	M	M
	4. Prosumers and virtual power plants	H	H	M	M
Sustainable Transportation Infrastructure	5. EV charging facilities	H	H	M	M
	6. Right-of-ways for urban green transport	H	M	M	M
	7. City cluster green transport facility	H	M	L	M
Livable Service Infrastructure	8. Comfortable streets and public spaces	H	M	M	H
	9. Urban green and eco-system	H	H	L	H
	10 Urban amenities and service facilities	H	M	M	H
Green Building and Housing	11. Green/ultra-low energy/zero carbon buildings	H	H	M	M
	12. Direct current buildings	M	H	M	M
	13. Built-in distributed renewable energy	M	H	M	M
	14. Green heating and cooling	M	H	M	M
Future Data Infrastructure	15. City MRV system	H	H	H	M
	16. Big data system for low carbon, smart public services	H	M	L	M
Integrated Infrastructure	17. Zero Emission Zones (community/industry park/campus, etc.)	M	H	M	H
	18. Structural change	M	H	H	M

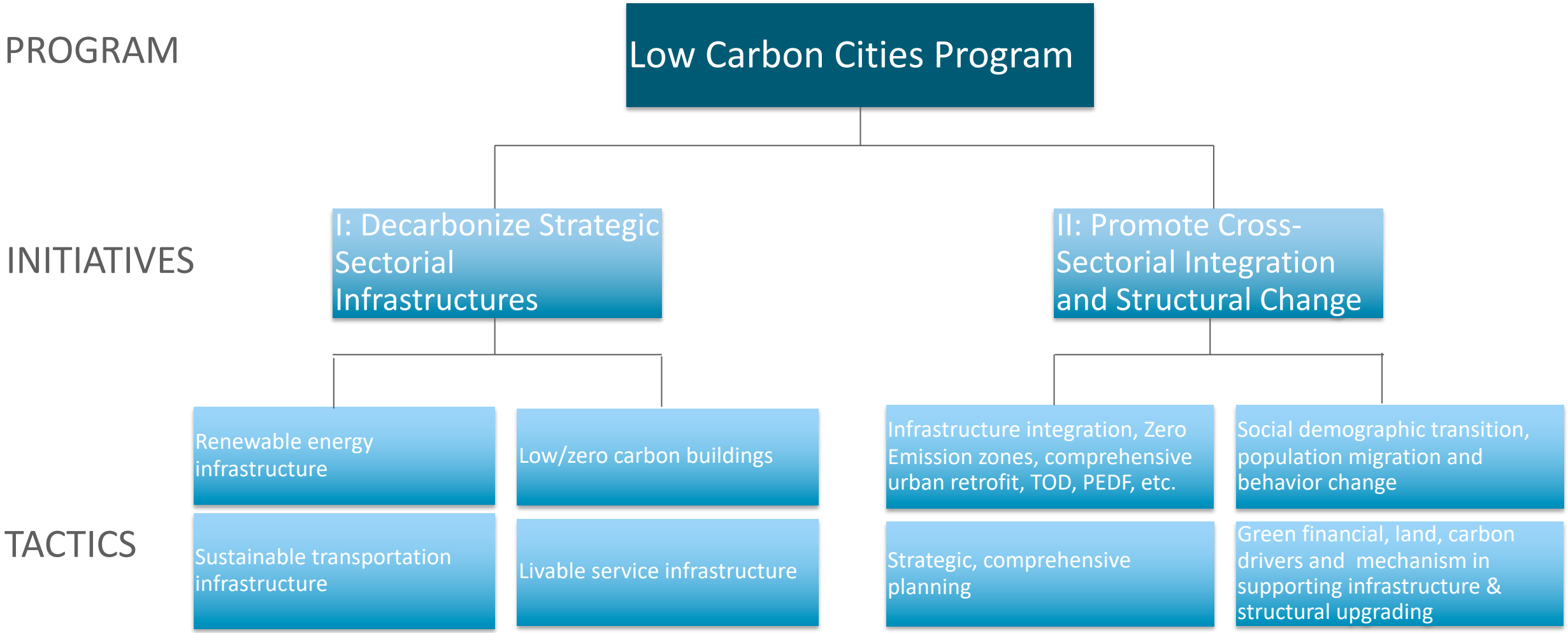
Internal Collaboration



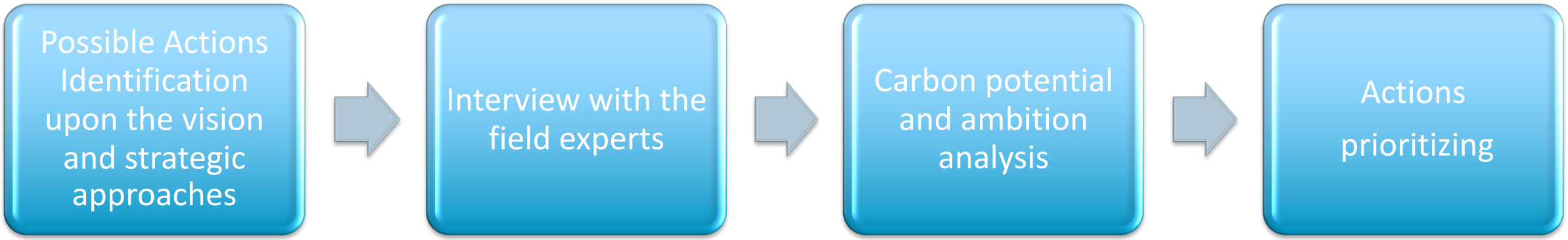
THANK YOU

Attachment

Initiatives and Tactics



Action Development



Actions Leading to The Changes (1)

Decarbonize Sectorial Infrastructure

Sustainable Transportation Infrastructure	Green Buildings And Housing	Livable Services Infrastructure	Future Data Infrastructure	Renewable Energy Infrastructure
● Policies, optimization planning guideline and standards on public transportation, logistic and inter-city passenger ● E-vehicle infrastructure planning and policies ● Future city planning guideline and policies ● E-bike management and promotion guideline ● Urban car use restricting policies ● E-vehicle infrastructure planning ● Public transit and NMT development pilot ● E-bike management and promotion pilot ● Autonomous vehicle and smart transportation pilot ● Training and education ● Development of big data and transportation model	● Key tech, policy and financing of clean heating in north China city and rural areas ● Building demolition protocol to extent the lifetime of buildings ● Clean heating in south China (cold winter & hot summer climate zone) ● Policy and technical standards for smart construction industry ● Green financing for new building, green building and energy saving ● Scale up policies for green buildings, green districts and green city ● Pilots of clean heating in north China city and rural areas ● Zero buildings & district pilots ● Direct current buildings ● Prefabrication buildings pilots ● Big data supported building energy service& business model ● Training	● Public facility standards ● Life-circle guidelines ● Public space and public life demonstration, e.g., Huangpu river public space system demonstration	● Guidelines and standards for future data center energy efficiency ● Energy/emission MRV systems guidelines	● Guideline on design of RE distributed energy system ● Financial incentive mechanism to distributed energy implementation ● Distributed energy system pilot

Actions Leading to The Changes (2)

Promote Cross-sectorial Integration and Structural Change

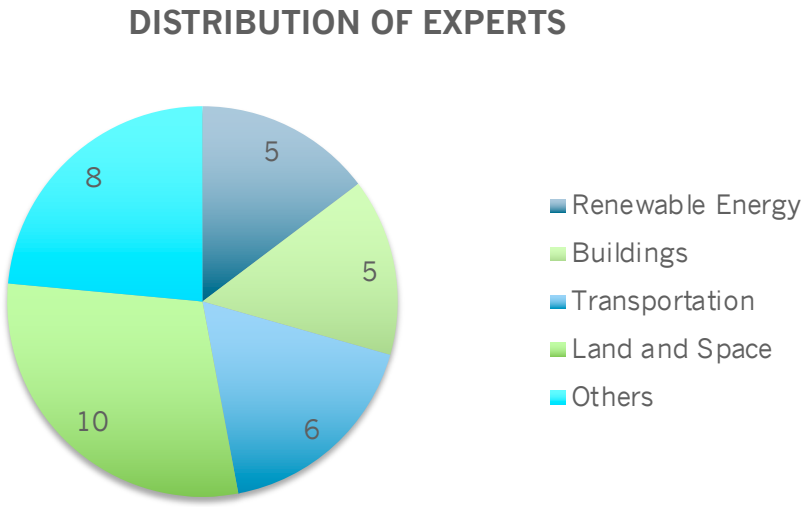
Zero Emission Zones, Comprehensive Urban Retrofit, TOD, etc.	Strategic Planning	Social Demographic Transition, Population migration and behavior change	Green Fiscal And Financial Mechanism
● Carbon-neutral district promotion policies and incentives ● Cross-sector integration standards and design guidelines ● Regional and cities zero emission goals, roadmap and measures ● TOD and compact development guideline ● Zero emission cities and zones pilots and demonstration ● Carbon-neutral TOD and compact development pilots ● Knowledge sharing and dissemination ● Establishment of city development database ● Multi-plan integration capacity building and training ● Integrated big data methods and analysis tools	● Incentive policy, mechanism /assessment for peaking/dual reach/trip reach/neutrality ● Multi-plan integration development planning guidelines ● National infrastructure plans ● TSP technical policy system, e.g., standards ● Provincial and city level peaking/dual reach//tri-reach/neutrality planning pilot ● TSP planning pilots ● Training and International communication ● Peaking/dual reach/tri-reach/neutrality analysis model and tools ● TSP evaluation tools ● Training and international idea exchange	● Urban demographic and population migration database ● Communication towards behavior change	● Natural capital driven fiscal policies ● New taxation policies for fiscal alternatives ● Green financial policies for sectors ● Green financing pilot for new infrastructure and retrofit projects

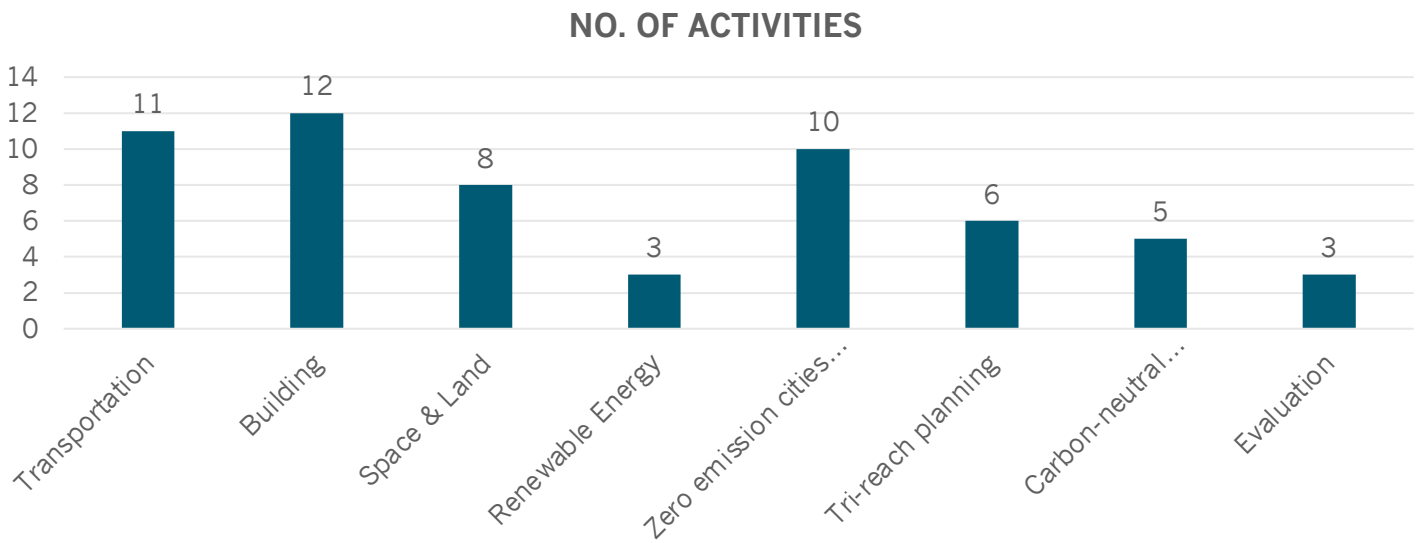
Action Prioritizing – Interview From Field Leading Experts

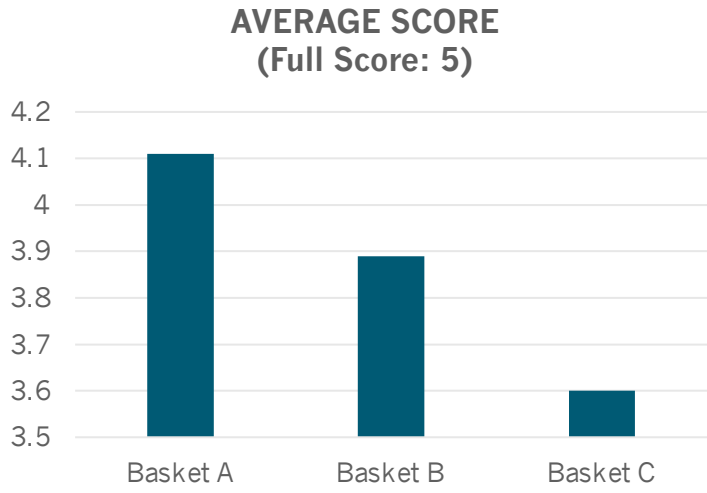
34 experts from the areas of economy and society, industry, building & energy, transportation, city planning and funders;

66 recommendations

58 activities are selected and put into 3 baskets: A, B,C in sequence of importance.

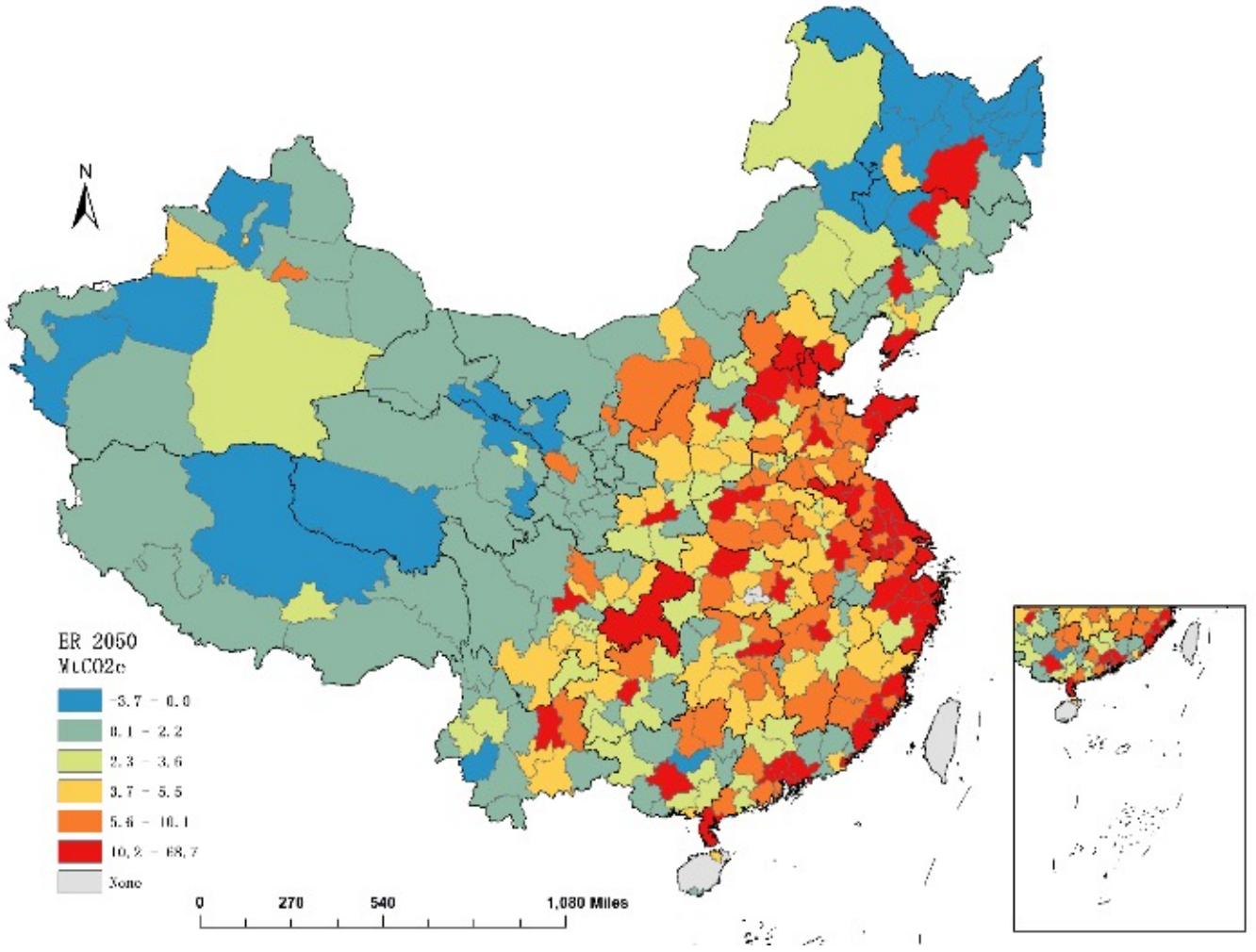






Pilots Selection

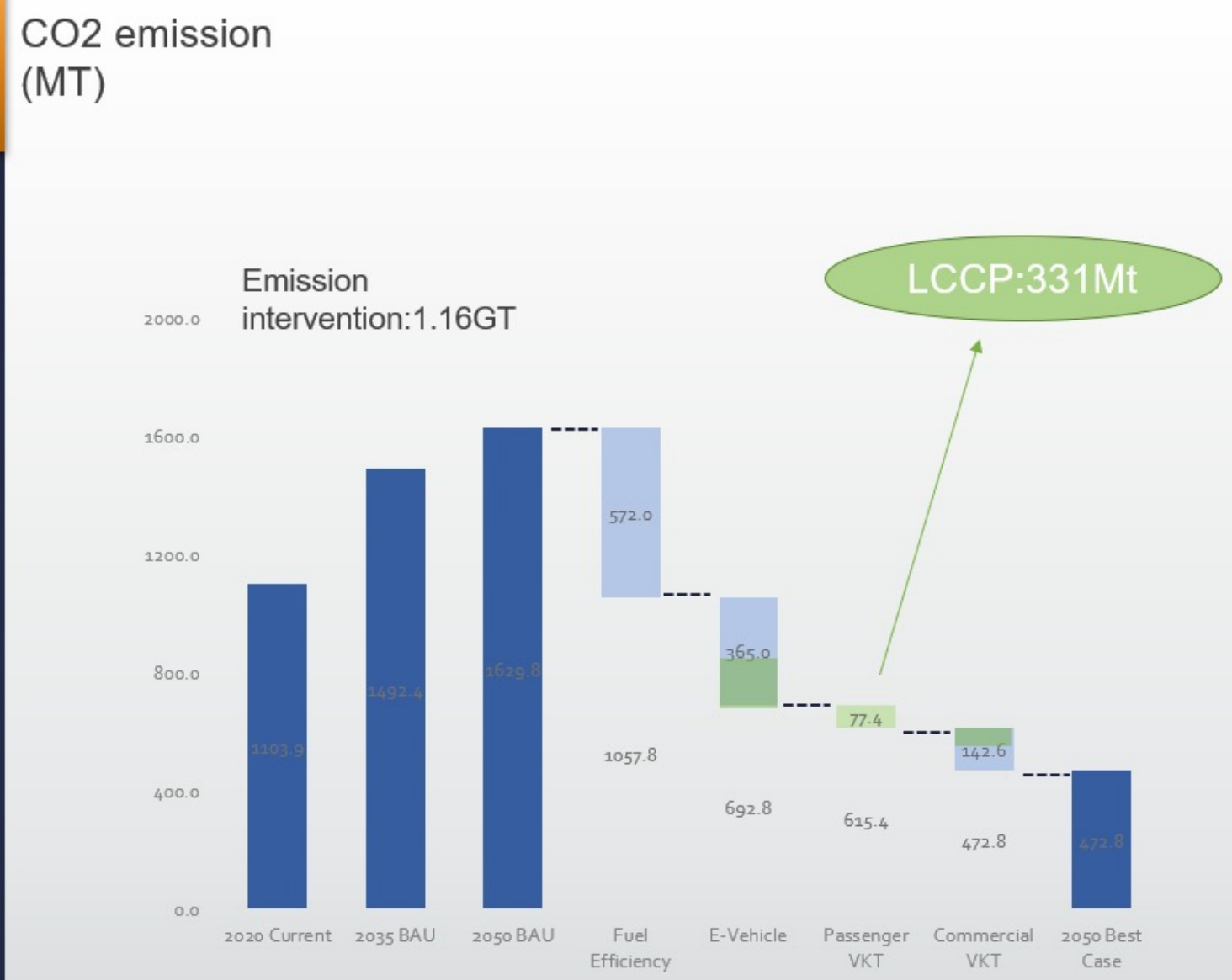
- Carbon reduction potentials
- Carbon neutrality feasibility
  - local political supports
  - local development status
  - local technical implementation capacity
- Typicality
  - Developed cities approaching carbon peaking or peaked, e.g., BJ, SH, SZ, GZ
  - Rapidly developing cities facing critical pathway transition, e.g., QD, NJ
  - Less developed, industrial-heavy, energy and resource intensive cities, e.g., YL
  - Key area with specific theme: i.e. zero emission island of Hainan



Impacts - transportation

CO2 emissions and reduction potential

-- Vehicle Transportation Sector



Impacts - Building & Distributed renewable energy

CO2 emissions and reduction potential
-- 1335 MtCO2e

Zero-emission building -- 459 Mt

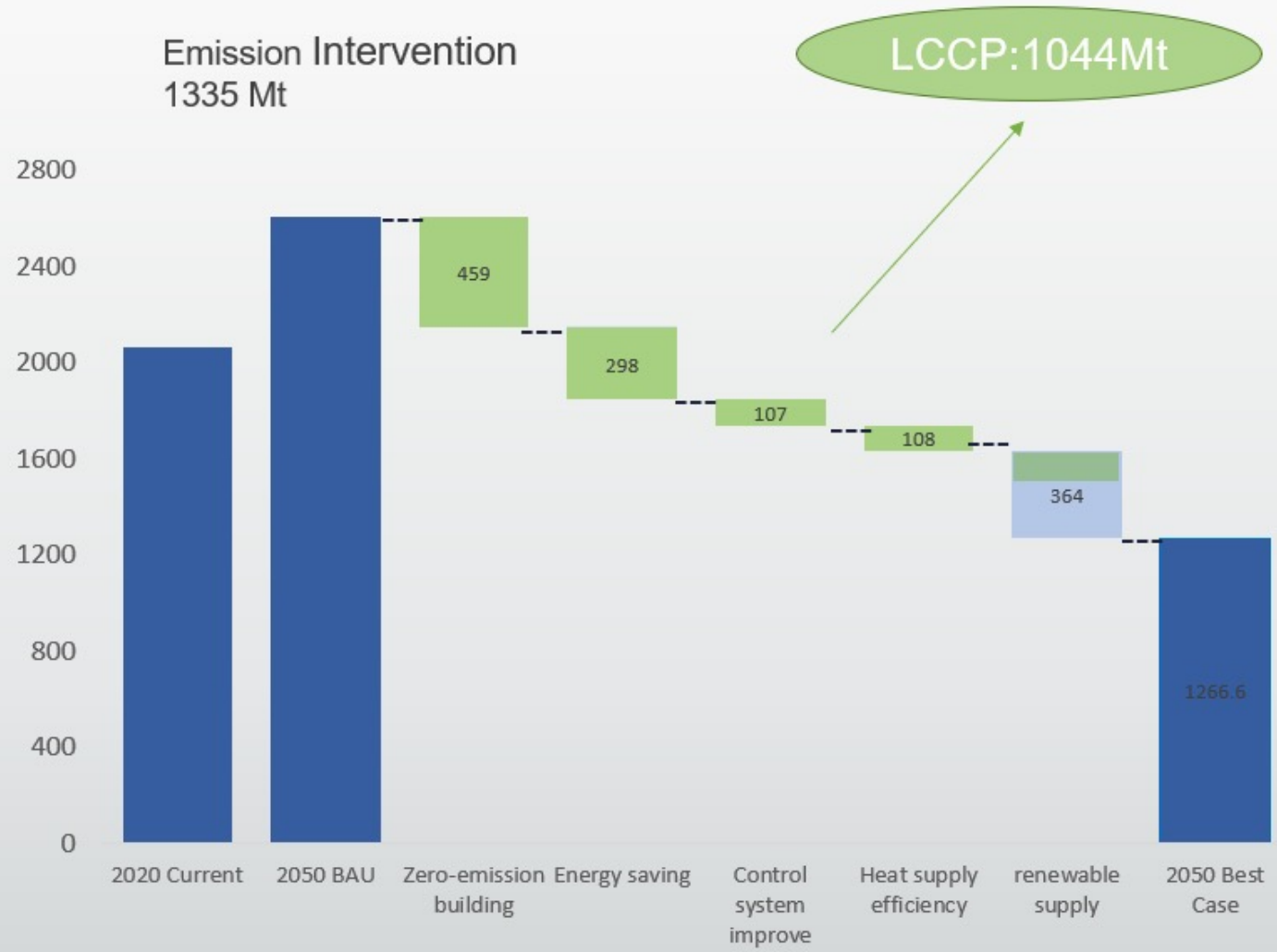
Energy saving -- 298 Mt

Control system improve -- 107Mt

Heat supply efficiency -- 108Mt

renewable supply -- 364Mt

CO2 emission reductions (MtCO2e)



Impacts - Industry & Services

CO2 emissions and reduction potential

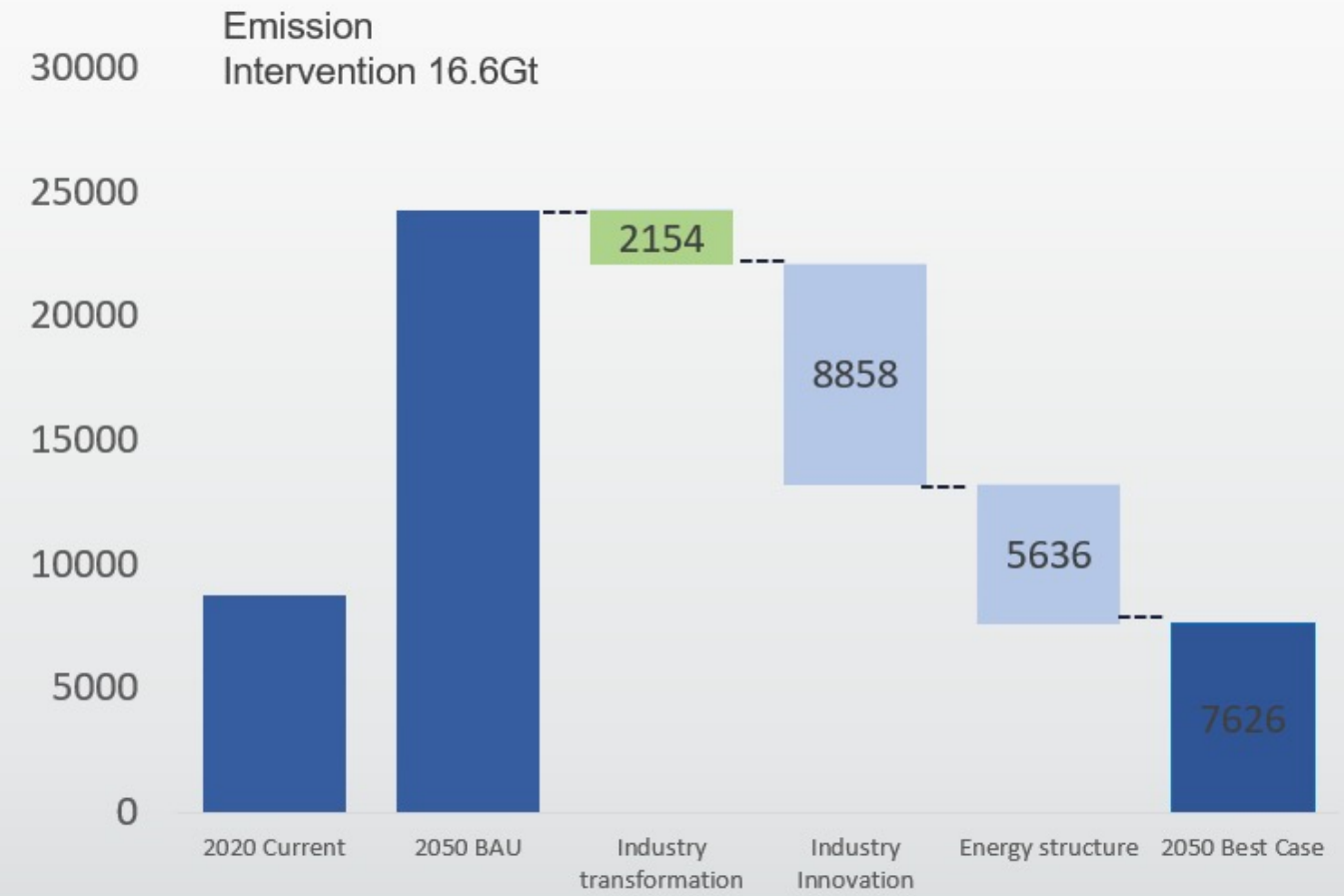
-- 16648 MtCO2e

Industry transformation
-- 2154 MtCO2e

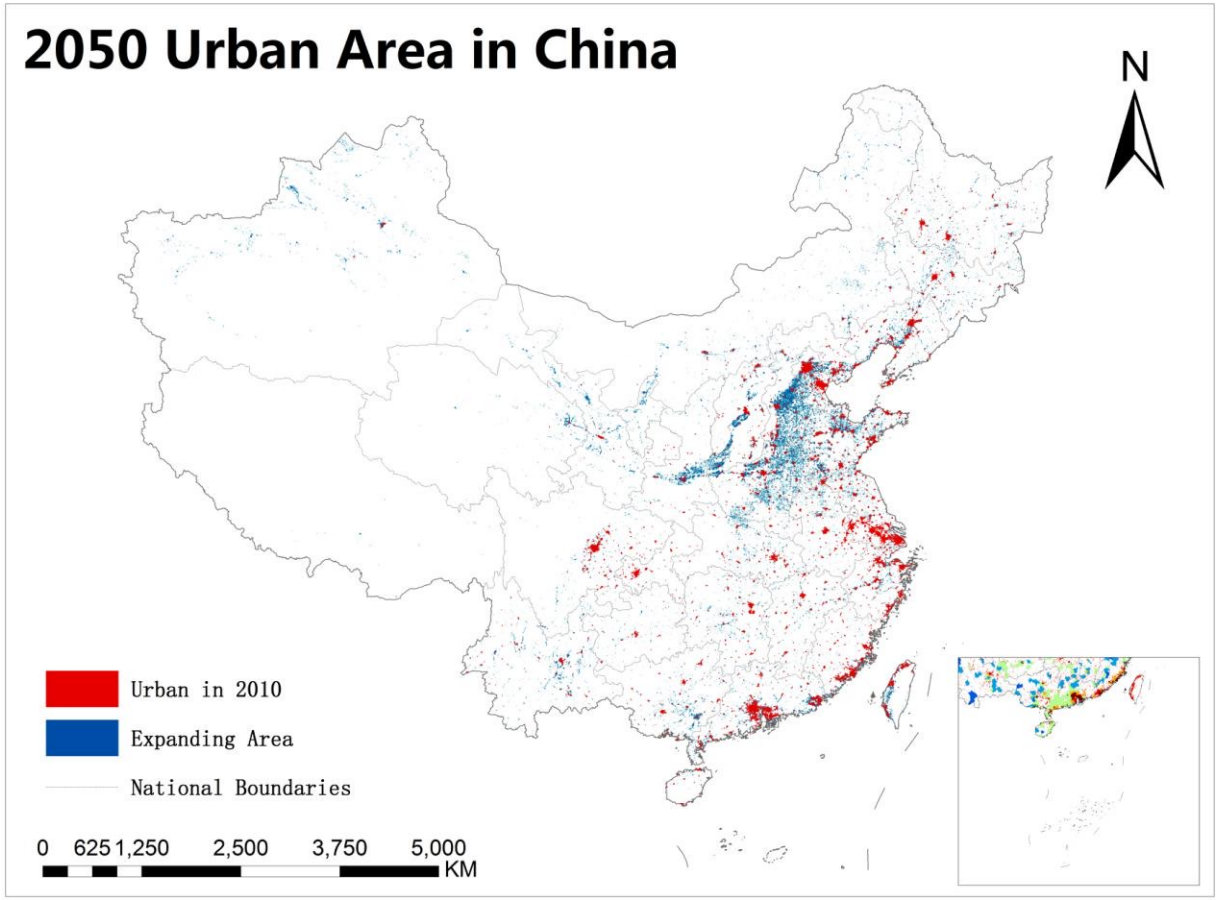
Industry innovation
-- 8858 MtCO2e

Energy
-- 5636 MtCO2e

CO2 emission reductions (MtCO2e)

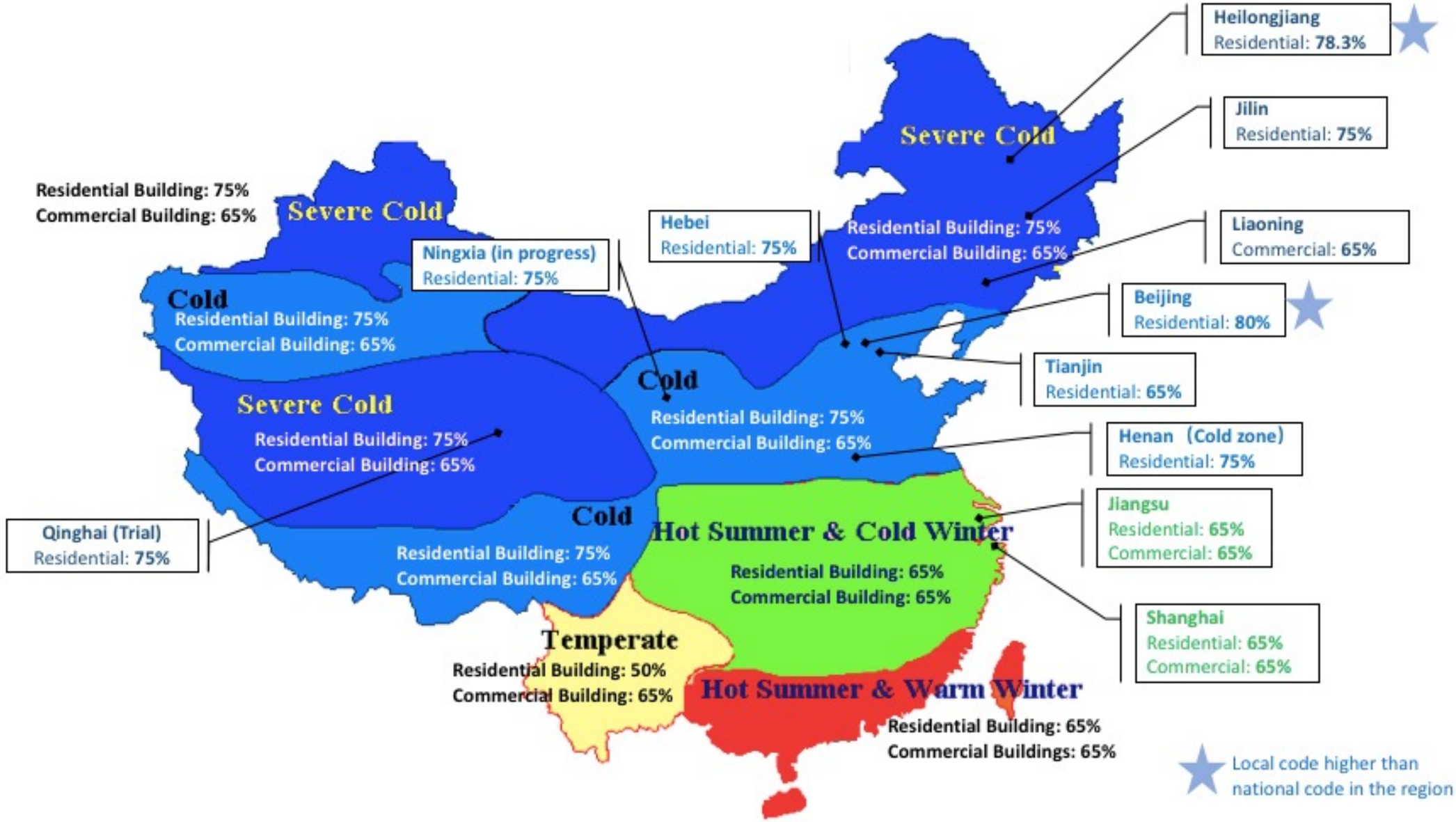


Urban expansion: where are we and where could we end?

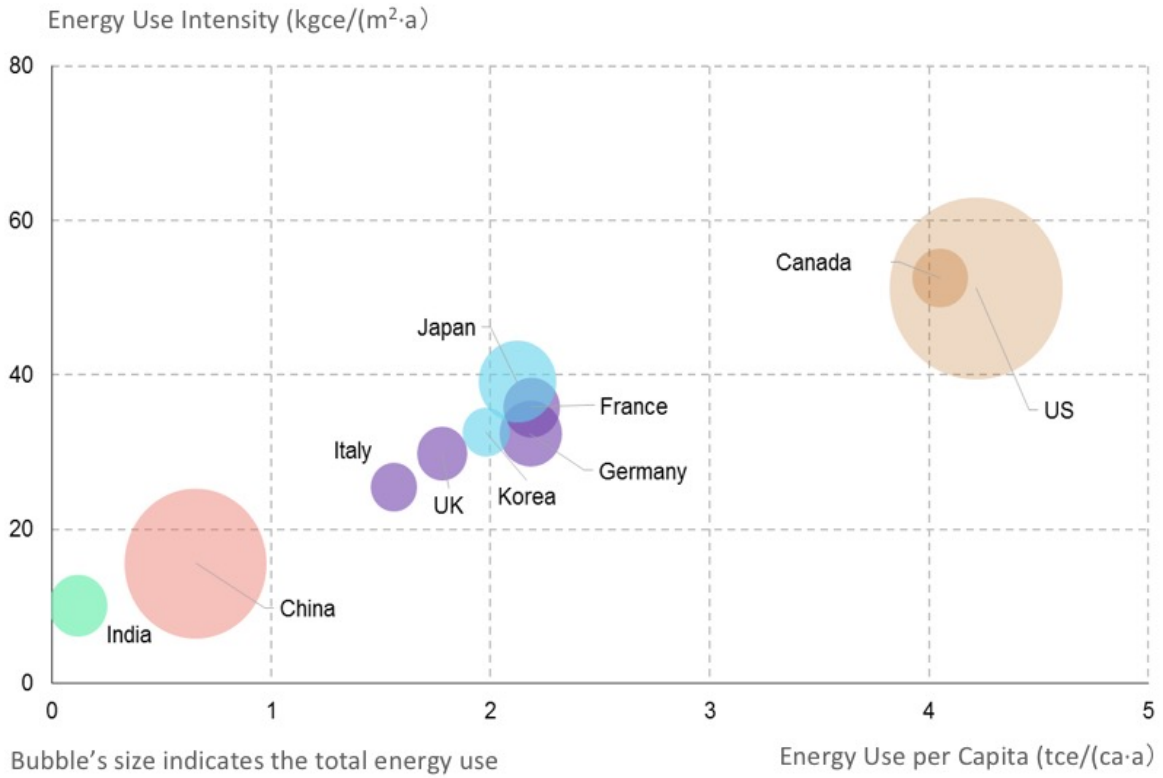


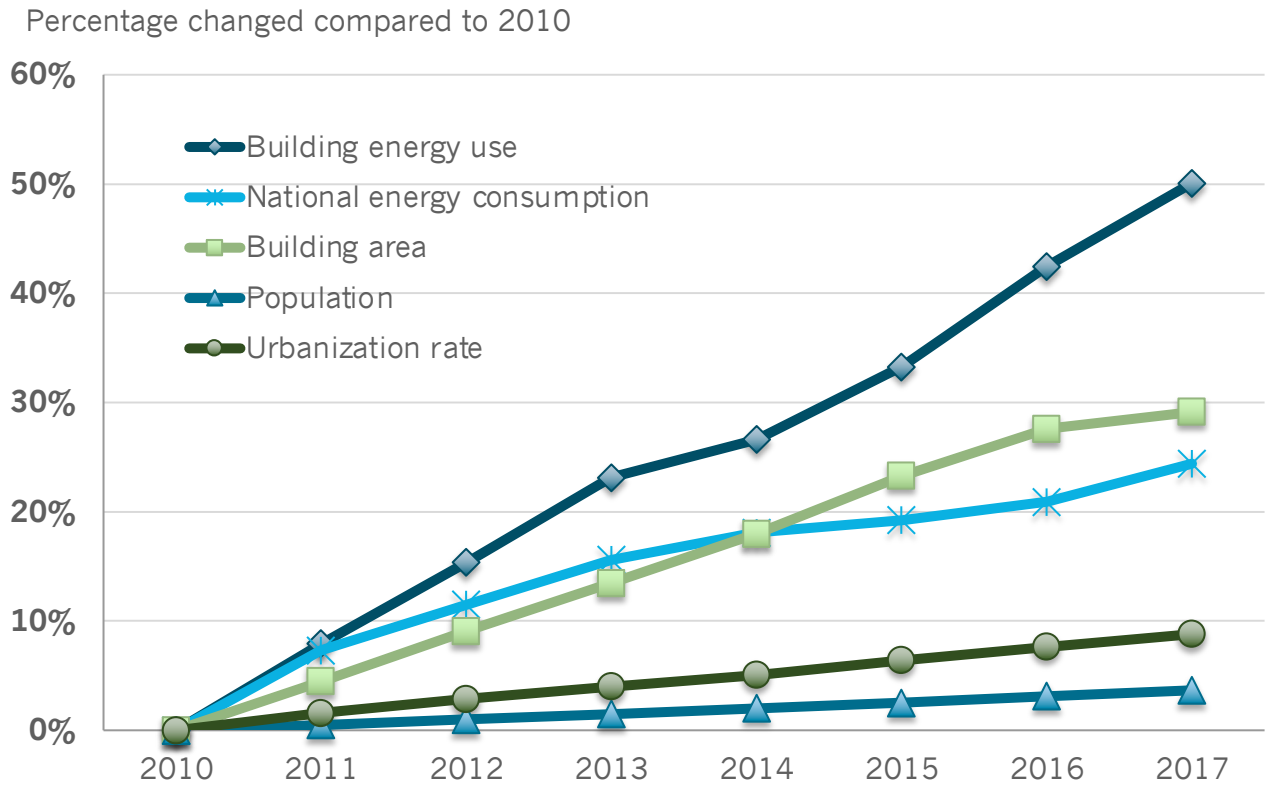
118,200 km²(100%) +56,300 km²(47.6%) = 174,500 km²(147.6%)

City/regional buildings codes map: where are we?



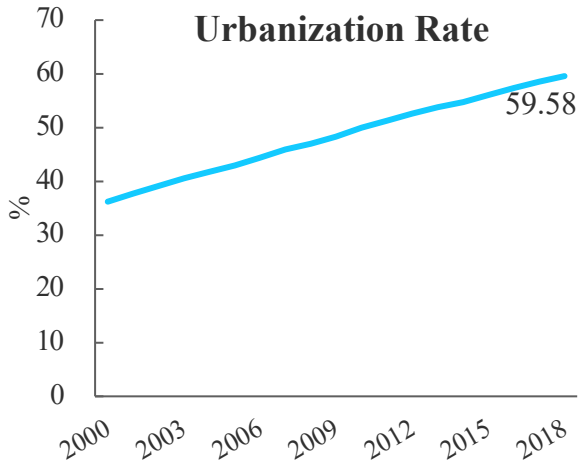
Buildings energy: where are we?

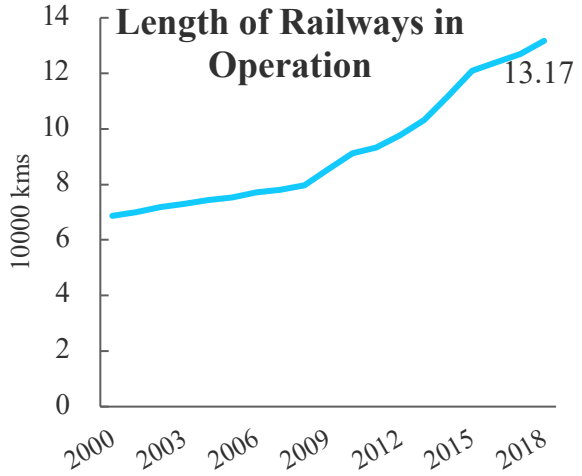


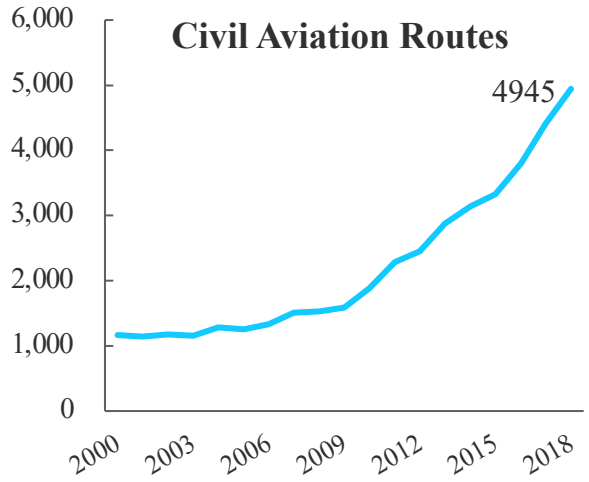


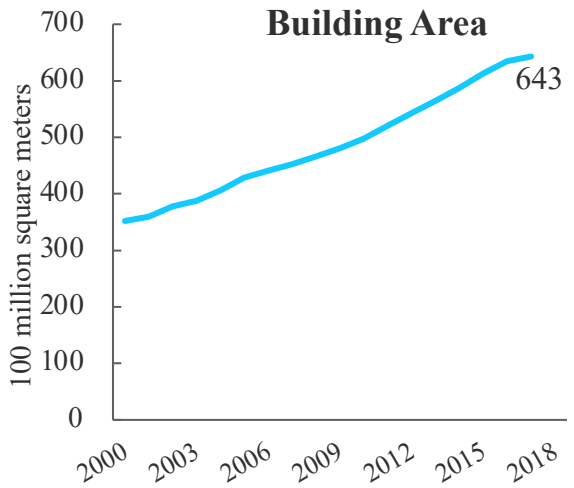
Infrastructure and related industry growth

1) Urbanization rate and infrastructure construction

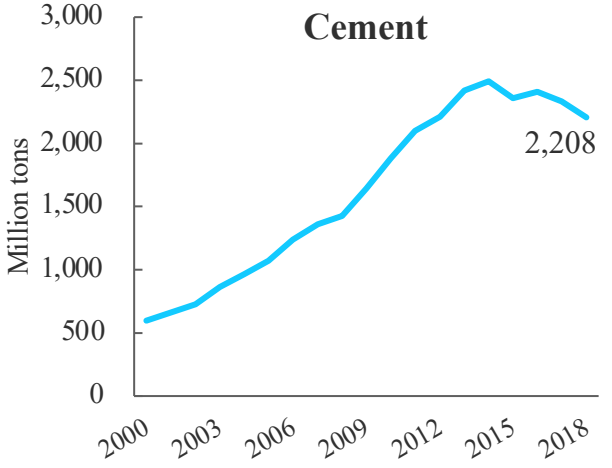


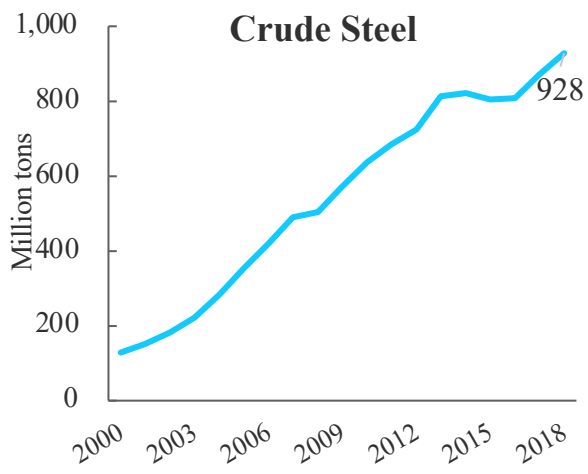


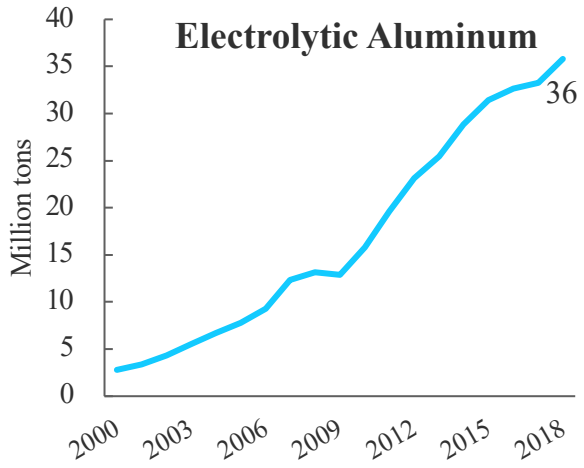


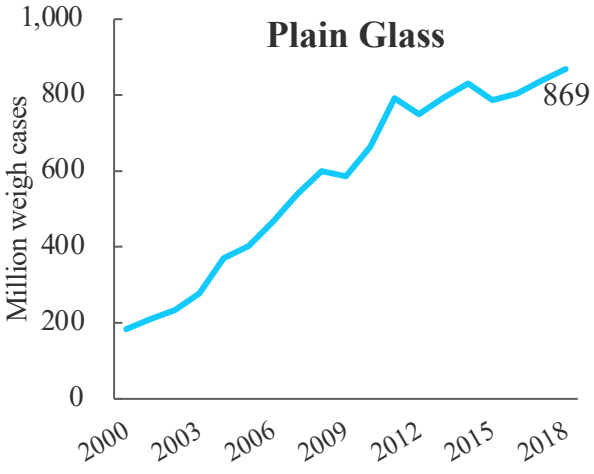


2) Output of industrial products

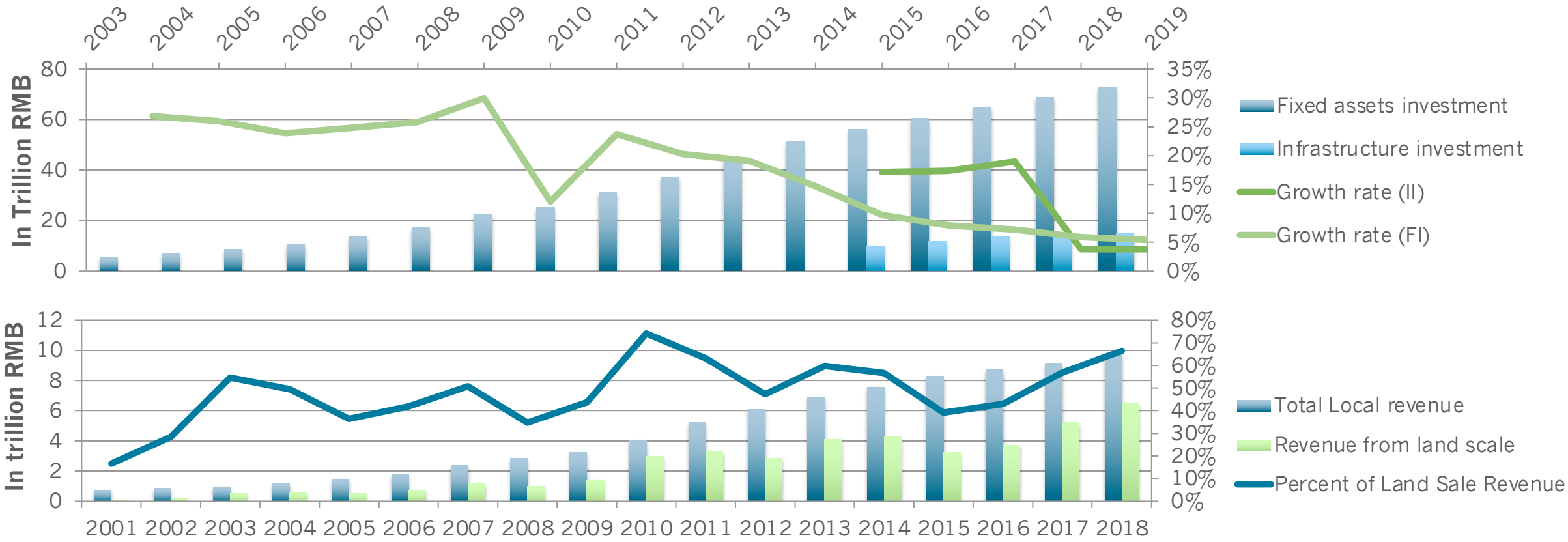






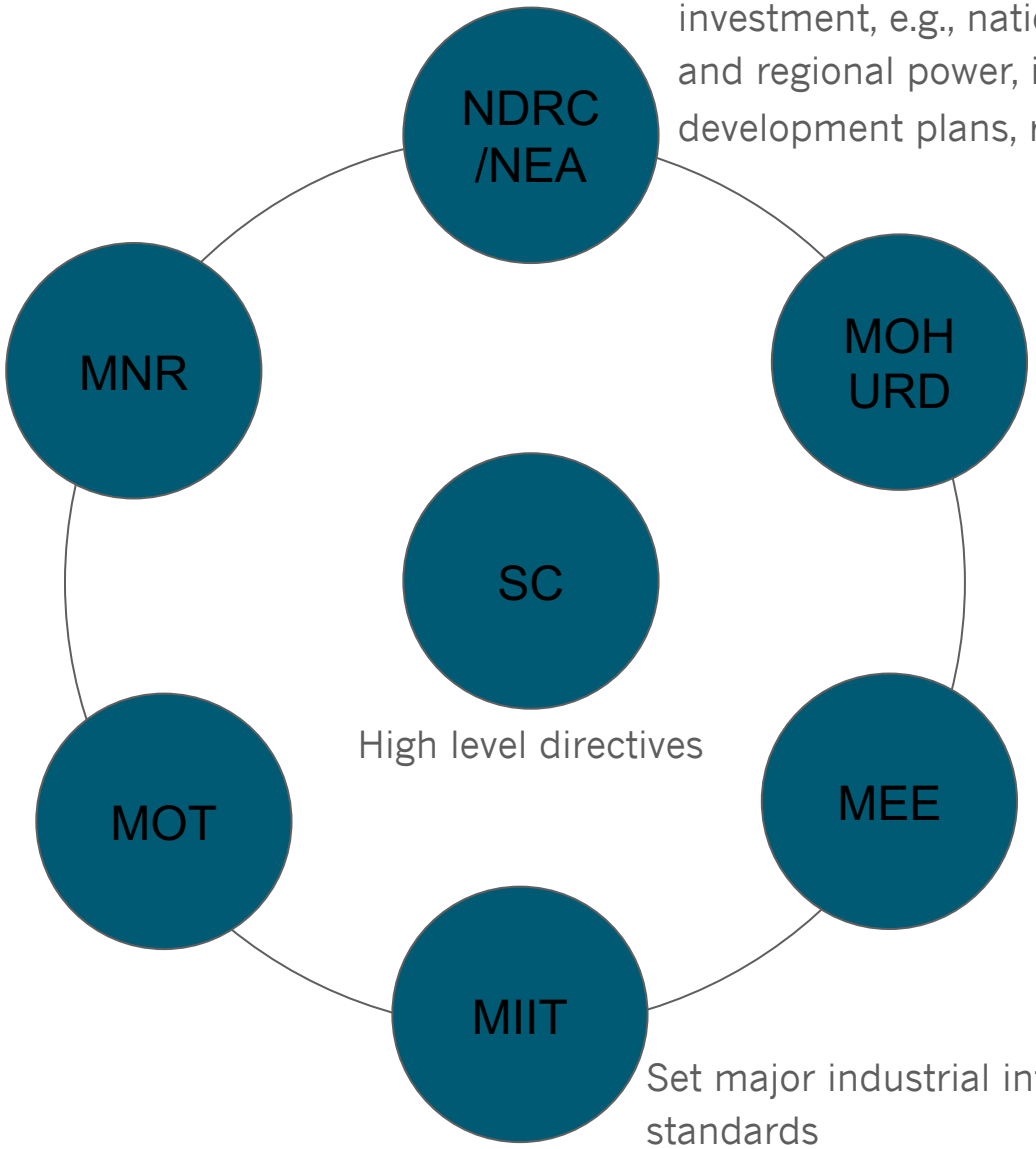


City fiscal map: where are we?



High percentage of fixed assets investment drives the overall growth, where 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

Infrastructure decision makers at national level



Decide and coordinate strategic infrastructure investment, e.g., national and urban rail, national and regional power, industry, transport infrastructure development plans, renewable energy plans

Set buildings (including district heating) energy efficiency standards, municipal infrastructure design, construction and maintenance standards, urban retrofit guidelines

Set environment and carbon standards for sectors, cities and regions

Set major industrial infrastructure standards

Set major transportation infrastructure standards

Decide spatial layout and Right-of-Way (ROW) of all infrastructures

21 Priorities in THE URBANIZATION STRATEGY

1 POPULATION MIG-RATION AND AGGLOMERATION

2 NEW CONSUMP-TION PATTERNS AND LIFESTYLES

3 URBAN SPRAWL/SHRINK-ING

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