China's Experience in Implementing the UN 2030 Sustainable Development Agenda: A Case Study of Shenzhen

Shenzhen's exploration for a "low carbon & blue sky & high quality growth" pathway

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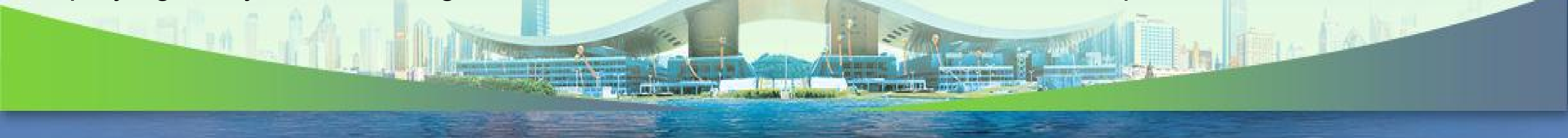
Research objectives and main contents

On August 9, the CPC central committee and the state council issued the document on supporting Shenzhen to build a pilot demonstration zone of socialism with Chinese characteristics, which clearly requires Shenzhen to be a pioneer in sustainable development, to build comfortable and livable and ecological urbanization with clear water and blue sky, and provide Chinese experience for the implementation of the UN 2030 agenda for sustainable development.

In general speaking, we name a new strategy of the three targets to be reached at the same time: Carbon emissions peak, air standards & economic growth high quality.

Shenzhen obviously achieves the double goals of carbon emissions peak and air quality standards, because of carbon emission and environmental pollution as the typical homologous based on burning of fossil carbon emissions and harmful gas emissions. The dealing with climate change and environmental pollution control have the significant synergistic effect, measures the effect ratio of nearly 80%.The sustainable development policy promotes industrial upgrading, and vice versa, the up-industry is playing a key role reducing carbon emissions and control environmental pollution.



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1.1 Research Background

Climate change

- The largest emitter of GHGs in the world
- The most vulnerable to climate change

Air pollution

- Air pollution as one of the most dangerous environmental issues
- Blue Sky Defense

Dual pressures to combat climate change and improve air quality

Features of GHGs and air pollutants from common sources and in the same atmosphere

Co-control of GHG and air pollutant emissions

1.1 Research Background

Environmental cost

- Resource and environmental cost accounts for 3%-5% in GDP

Green GDP

Ecological civilization construction

- Highlight the construction of ecological civilization
- Pursue sustainable development and modernization

Transforming and upgrading，from high-quality development to environmental protection

Intensifying environmental regulation, from high-level protection to force high-quality growth

Co-improvement of economic growth and environmental protection

1.1 Research Background

Shenzhen Energy intensity is about half of the national average value

Air quality ranks at the forefront of mid-large cities

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Great environmental loadable pressure and bottleneck for further emission reduction and pollution prevention

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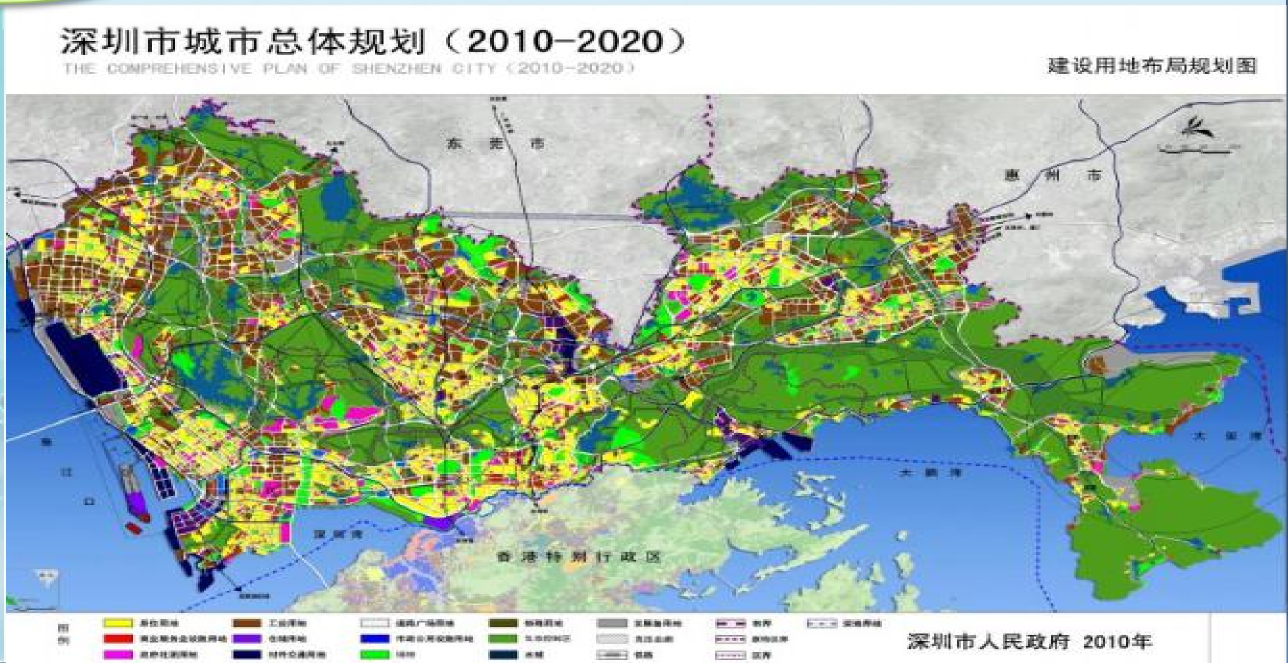
2020

Reach a peak of GHG emissions Make the annual concentration of $PM_{2.5}$ below $25ug/m^3$



1.2 Three Key Scientific Questions

（1）Coupling mechanism and unified accounting system for urban-scale GHG and air pollutant emissions

（2）Quantitative evaluation and optimization of alternative technologies for synergic emission reduction

（3）Integrated modeling of regional climate change and air quality as well as synergic governance across regions

1.3 Major research methods

(1) Econometric analysis and EKC analysis

(2) Emitting source and inventory analysis

(3) LEAP based simulation for GHG and air pollutant emissions, as well as for assessment of synergic emission reduction effect of alternative technologies

(4) SMOKE-WRF-CMAQ based platform for regional air quality simulation and forecast

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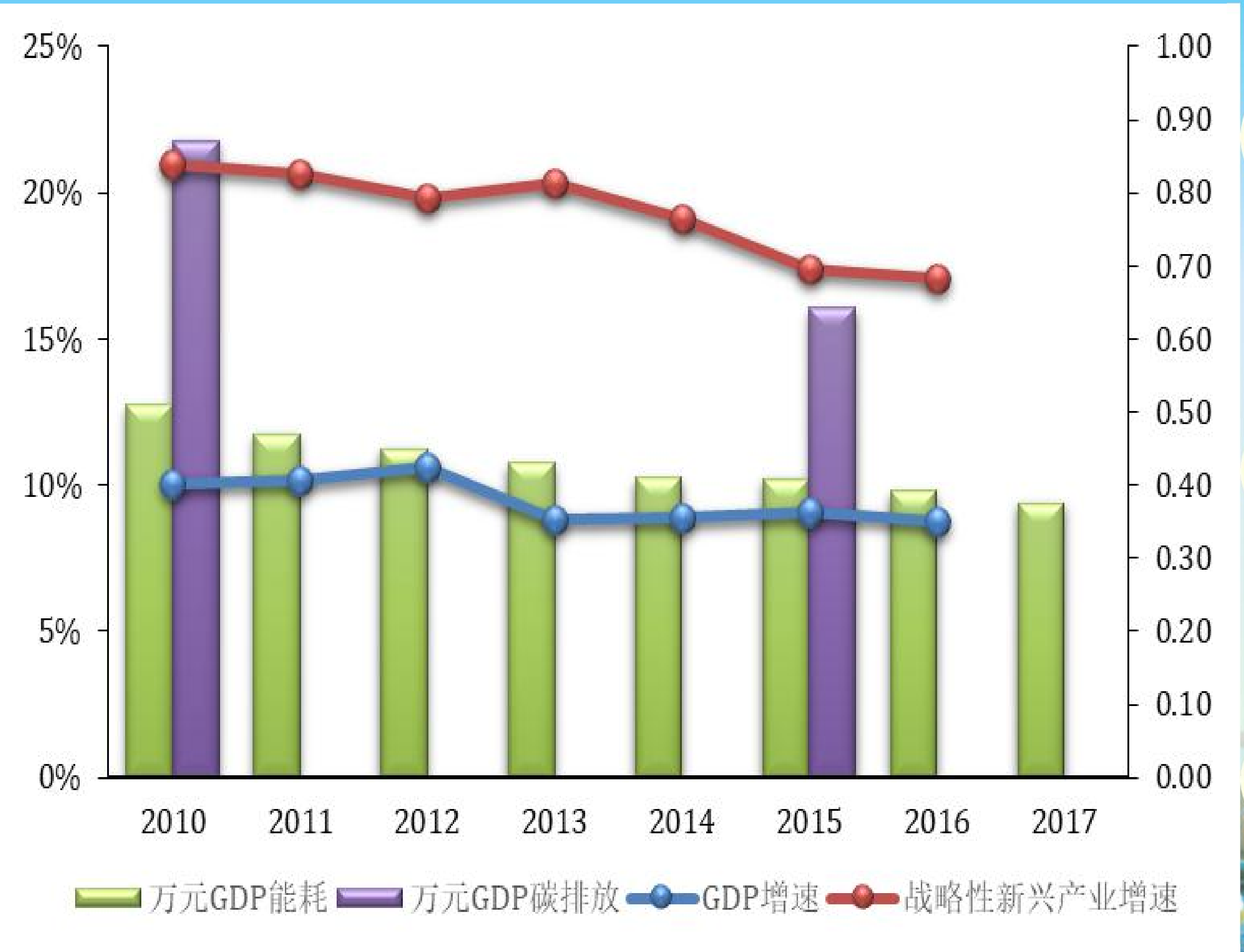
Relationship Analysis Between Economy and Environment and Between GHG and Air Pollutant Emissions

2.1 Relationship analysis between economic growth and environmental quality

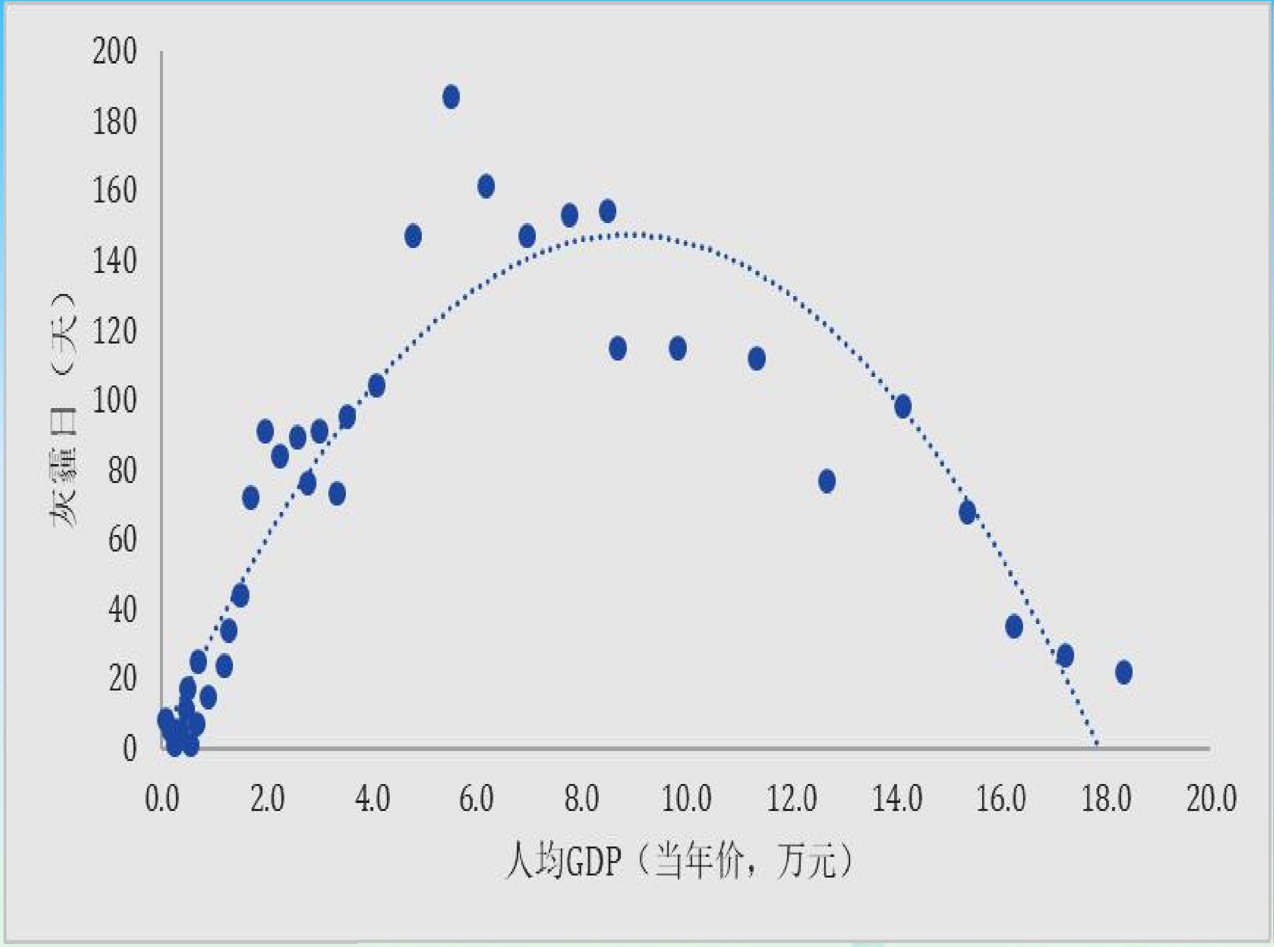


Economy: the annual growth of GDP between 8-10% while that of strategic emerging industries between 16-20% since 2010

Carbon intensity: far below the national average of China, with a decline rate of 5% annually

Industrial upgrading and high-quality growth positively promote carbon intensity decline

Per capital GDP V.S. the number of haze day yearly



Number of haze day yearly and annual concentration of $PM_{2.5}$

The industrial upgrading and green development strategy of Shenzhen have largely promoted urban air quality improvement

2.1 Relationship analysis between economic growth and environmental quality— based on LMDI model

2012-2017 Driving factor decomposition of GHG emission change in Shenzhen

Decomposition analysis	Population effect	Per capita GDP effect	Industrial structure effect	Energy intensity effect
	83.9%	261.6%	-73.3%	-172.2%

Contribution of sector in industrial structure effect

Sector contribution	Primary industry	Mining industry	manufacturing industry	Electric & heat & water supply	Construction	Service industry
	-0.4%	-8.2%	-15.2%	-68.6%	-1.3%	-6.4%

Contribution of sub-divided sector in industrial structure effect

Contribution of sub-divided sector	Primary industry	Mining industry	Compute Electronics Industry	Electrical machinery industry	Rubber and Plastic Product	Other manufacturing	Electric & heat & water supply	Construction	Service industry
	-0.4%	-8.2%	-15.8%	7.3%	-2.6%	-4.1%	-68.6%	-1.3%	-6.4%

By driving factor analysis, energy structure optimization and industrial structure upgrading significantly abate GHG emissions

2.1 Relationship analysis between economic growth and environmental quality— based on ETS

The impact of ETS on urban electricity structure

Share in electricity production	2013	2015	2017
coal power	46.3%	42.4%	39.1%
gas power	53.7%	57.6%	60.9%

The impact of ETS on carbon intensity of urban electric production

Carbon intensity Tonne /10^4 KWh	2013	2017	Rate of decline
coal power	8.98	8.75	2.5%
gas power	4.74	4.32	8.9%
sector	6.70	6.06	9.6%

The implementation of carbon emission regulation and ETS has built a forcing mechanism on energy structure optimization in Shenzhen.

During 2013-2017, in addition to carbon intensity decline, carbon emissions a half of million tonnes.

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Scenario Analysis of Emission Reduction Based on Synergic Governance and Green Upgrading

3.1 Collection of alternative emission reduction technologies

Classification of sector from the perspective of synergic emission reduction	
Critical sectors for synergic emission reduction	Electricity
	Road - passenger
	Road - freight
	Water transport
	Manufacturing - electricity
	Manufacturing -boiler
Critical sectors for GHG emission reduction	Building
Critical sectors for air pollution prevention	Dust
	Others

Technologies/measures for GHG emission reduction

Sector	Category	Number of specific technologies
Electricity	6	19
Manufacturing	7	56
Transport	8	34
Building	9	35
In sum	30	144

Technologies/measures for air pollution prevention

Sector		Number of specific technologies
Electricity		1
Manufacturing		3
Transport	Road - passenger	12
	Road - freight	4
	Water transport	11
In sum		31

3.2 Scenario setting for simulation

Taking 2015 as baseline year to simulate energy demand and GHG-air pollutant emission during 2016-2030

Comparison between two scenarios

(1) Reference scenarios

(2) Synergic scenarios

3.3 2020 Scenario analysis

	2020 synergic scenario VS 2015 baseline year		2020 synergic scenario VS 2020 reference scenario	
	Change of GHG emissions (Thousand t)	Share of contribution	Emission reduction (Thousand t)	Share of contribution
Manufacturing	830	19.1%	2060	23.8%
Building	**2170**	50.0%	2680	31.0%
Transport	**2030**	46.9%	3580	41.4%
Others	-690	-16.0%	320	3.7%
In total	4330		8650	

(1) During 2016-2020, Building is the largest source of GHG emission growth.

(2) Transport, building and manufacturing are top sectors for emission reduction.

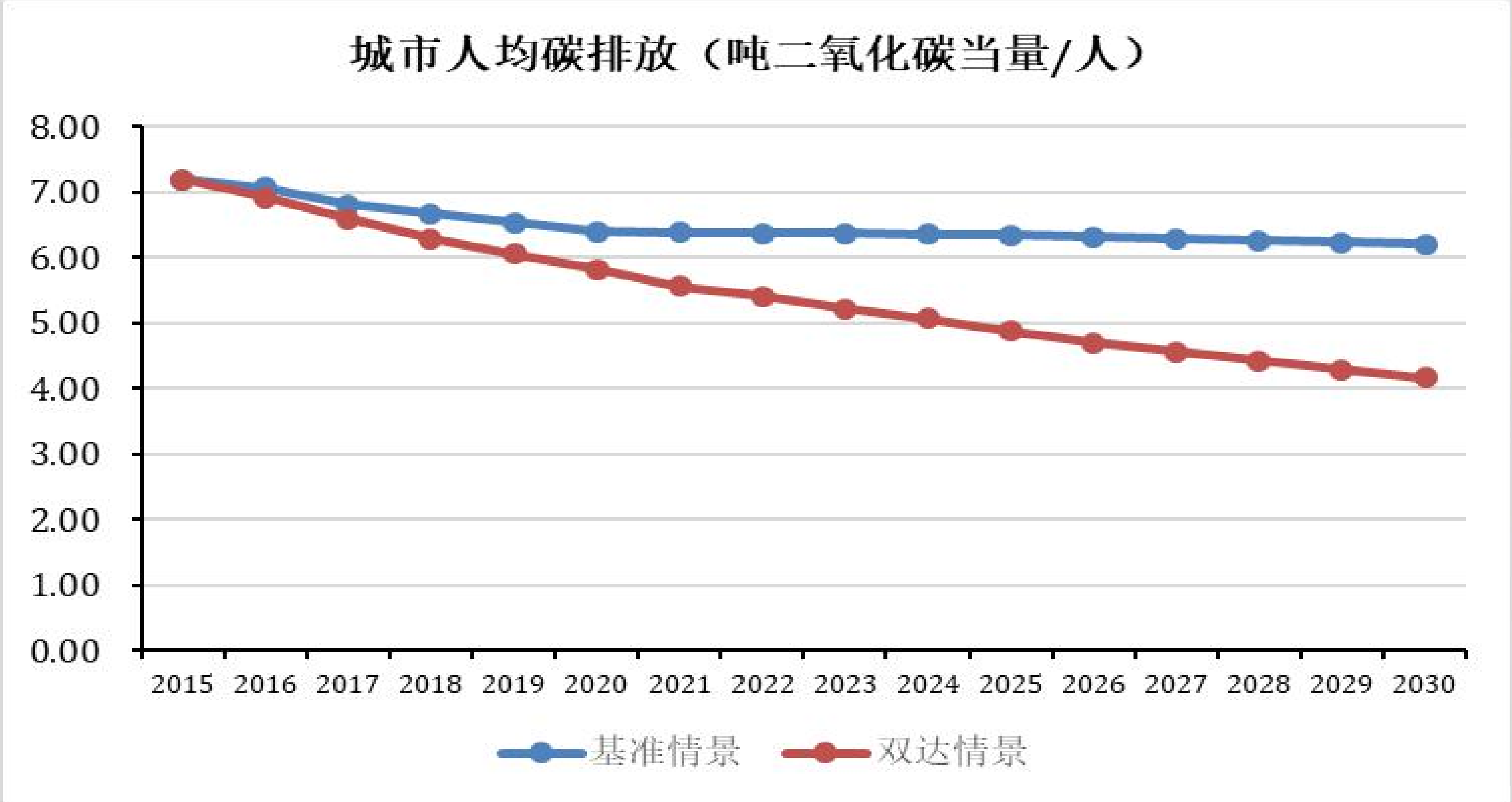
3.3 2020 Scenario analysis

Relative to 2015, the amount of major air pollutant emissions has largely reduced by synergic emission reduction.

SO_2、NOx、VOCs、PM_{10} $PM_{2.5}$ will respectively decrease 37.3%、23.5、32.0%、26.9% and 35.0%

The comparison of major air pollutant emissions between 2015 and 2020

3.4 2030 Scenario analysis

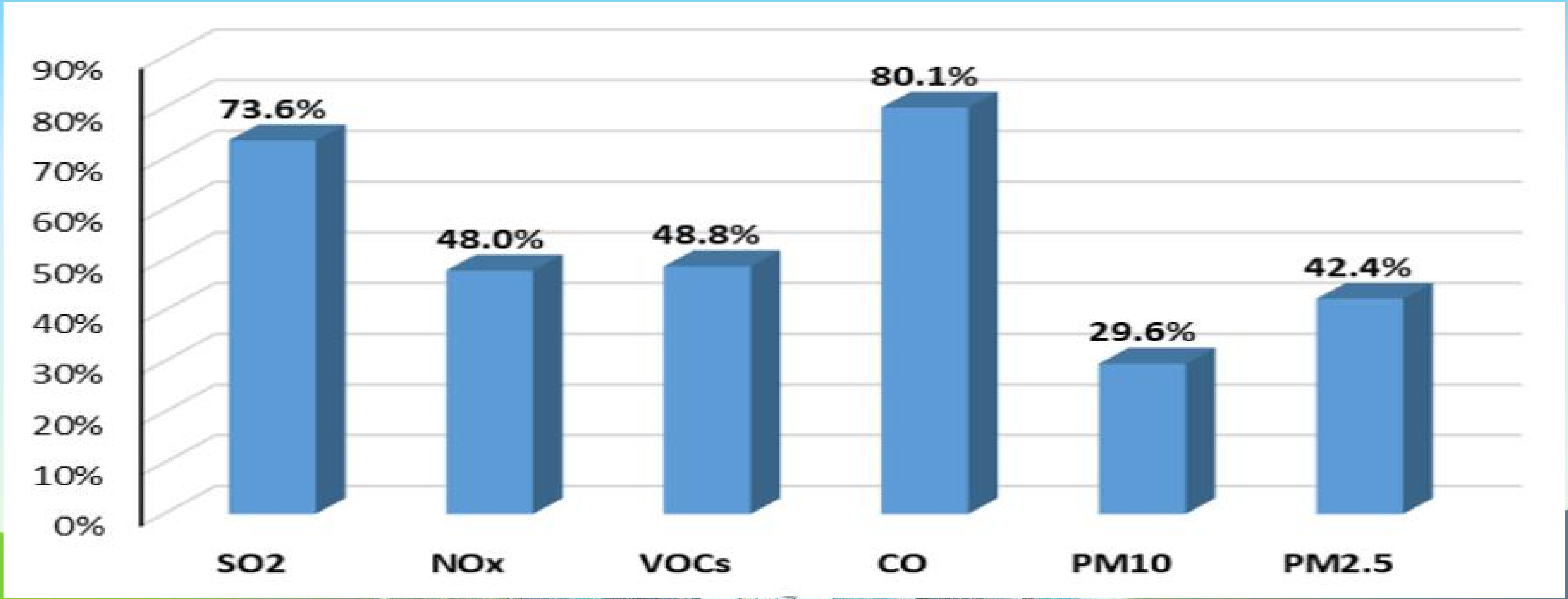


- 2030 per capita GHG emissions decline to 4.17 tonne CO_2-e
- Arriving the global leading level

Per capita GHG emissions of Shenzhen under different scenarios

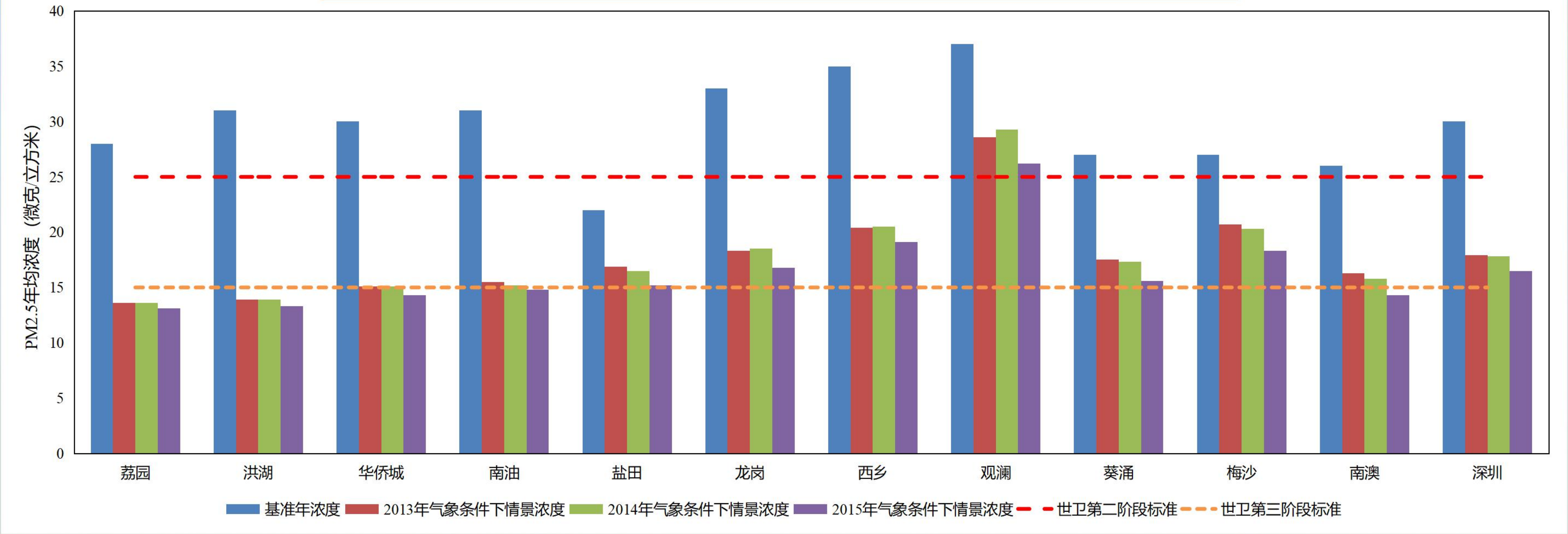
3.4 2030 Scenario analysis

2030 emission reduction of major air pollutants compared with 2015



3.4 2030 Scenario analysis

2030 Shenzhen annual average concentration of $PM_{2.5}$



- **Under different meteorological conditions, 2030 annual average concentration of $PM_{2.5}$ in Shenzhen is all below 18 ug/m^3 but cannot meet the 3th standard of WHO (15 ug/m^3).**
- **To realize the 3th standard of WHO, Shenzhen must strengthen its cooperation with surrounding areas on synergic governance.**

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4.1 Proposed technologies for synergic emission reduction

(1) Nearly all 144 technologies for GHG emission reduction show significant synergic effects on cutting air pollutant emissions and improving air quality

(2) The synergic effects of 31 technologies for air pollution prevention are positive but not as significant as low-carbon technologies

(3) Technologies/measures on demand management, efficiency Improvement, energy and transport structural adjustment show significant synergic effect on GHG and air pollutant emission reduction

End-of-pipe control technologies for air pollution usually do not have significant synergic effects on GHG emission reduction, or even, they may increase GHG emissions by increasing energy consumption

4.2 Major policy proposals

Significant synergic effect between GHG and air pollutant emissions	Strengthening the synergic governance of multiple pollutants to reduce the overall costs
High synergic effect from demand management and structural adjustment measures	Increasing efforts on demand management, source control, optimization of energy and transport structure
Extremely high initial investment, requiring 760 billion RMB	Urgent needs of green finance and market-based investment and financing mechanisms
Cross-regional synergic governance has great impact on Shenzhen GHG emissions and air quality but not yet well develop	Urgent needs of institutional and mechanism innovation and data sharing to enhance regional environmental collaboration


Thanks for
your suggestions!