



China Council for International Cooperation on Environment
and Development (CCICED)

**Goals and Pathways for Environmental Improvement by
2035**

CCICED Special Policy Study

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SPECIAL POLICY STUDY MEMBERS

Co-chairs*:

HU Baolin	former Deputy Director, Office of Three Gorges Project Construction Committee of the State Council
Maria Krautzberger	President, German Environment Agency (UBA)

Special Policy Study Members*:

SUN Youhai	Dean of Law School, Tianjin University
WU Shunze	Director, Center for Environmental and Economic Policy Research (PRCEE), Ministry of Ecology and Environment (MEE)
WANG Yi	Vice President, CAS Institutes of Science and Development
ZHU Baoliang	Director, Economic Forecasting Department, National Information Center
Wolfgang Seidel	International Deputy Team Leader; Head of Department, President's Office, German Environment Agency (UBA)
Brendan Gillespie	Partner and Consultant, Green Solutions Network; former Head of Division, OECD Environment Directorate
Robyn Kruk	Chair, Food Standards Australia and New Zealand and Member, Independent Planning Commission; Former Secretary / Vice Minister Environment Australia and New South Wales Health
Hideki Minamikawa	President, Japan Environmental Sanitation Center; former Vice Minister, Ministry of the Environment of Japan
Jan Bakkes	Senior Strategic Advisor to the Director-General, Netherlands Environmental Assessment Agency (PBL) and Vice-President, The Integrated Assessment Society

Research Support Team:

WANG Fengchun	Deputy Director, Law Office, NPC Environment and Resources Protection Committee
LU Dongsun	Director, Circular Economy Division, Department of Resource Conservation and Environmental Protection,

	National Development and Reform Commission
YU Fang	Director, Environmental Risk and Damage Identification and Evaluation Research Center, Institute of Environmental Planning
YU Hai	Director, Department of Environmental Strategy and Theoretical Research, Center for Environmental and Economic Policy Research, Ministry of Ecology and Environment
GUO Hongyan	Director, Environmental and Social Governance Research Center, Center for Environmental and Economic Policy Research, Ministry of Ecology and Environment
CHEN Shaofeng	Researcher, Institutes of Science and Development, Chinese Academy of Sciences
ZOU Lele	Associate Researcher, Institute of Policy and Management of Chinese Academy of Sciences
LI Jifeng	Director, Economic Forecasting Department; Director, Economic Model Office, National Information Center
WEI Qijia	Deputy Director, Industrial Economics Research Office, Economic Forecasting Department, National Information Center
TAN Shan	Lecturer, School of Law of Tianjin University

Coordinators:

SHI Cheng	Lecturer, School of Law of Tianjin University
Anna Rosenbaum	International Affairs Officer, President's Office, German Environment Agency (UBA)

*Co-chairs and Special Policy Study members serve in their personal capacities.

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China Council for International Cooperation on Environment and Development (CCICED)

Goals and Pathways for Environmental Improvement by 2035

SUMMARY OF KEY FINDINGS

In line with the objectives established by China’s leaders, this report examines how to ensure that there will “be a fundamental improvement in the environment by 2035, and the goal of building a Beautiful China will be basically attained.” It examines some of the main obstacles for achieving this goal and how they could be overcome, taking account of experience from developed countries and the most economically advanced regions of China. The economic and social implications of the green transformation are also analyzed as well as how environmental governance and the Chinese legal system will need to be adapted to help achieve the 2035 goal.

Some of the key recommendations emerging from the report include:

1. China’s future economic development should be guided by the need to protect and enhance the natural assets on which it depends, and well as people’s well-being.
2. Achieving these objectives will require:
 - reducing the carbon-, material- and pollution-intensity of the economy so as not to exceed critical environmental thresholds (“planetary boundaries”) nor to endanger human health;
 - conserving, and ensuring the sustainable use of, natural resources;
 - enhancing the resilience of natural systems, including their ability to adapt to climate change; and
 - Minimizing the exposure of people and the environment to toxic substances, including from chemicals and waste.

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3. China should seize the economic opportunities associated with the green transition while ensuring that those adversely affected receive appropriate support. This requires achieving a better balance between economic, environmental and social policy objectives and ensuring that financing mechanisms are available to support the economic, environmental and social dimensions of the green transition.
 4. A coherent set of binding targets should be established for achieving the key ecological environmental and environmental health objectives that underlie a Beautiful China. Targets should be established for 2035 and be aligned with China's pathway to 2050. They should be ambitious, clear, measurable, outcome-based, use SMART-related criteria, and focus on absolute ambient-level targets.
 5. The targets should be established using foresight methods such as quantitative scenarios of economic, social and environmental trends, and through a wide consultative process. All sectors of the economy will need to be involved.
 6. The targets established for 2035 and 2050 should guide how environmental objectives are integrated into Five Year Plans, starting with the 14th Five Year Plan. The targets established in all the main policy and planning documents should be consistent and mutually reinforcing, and provide a stable policy framework for investors.
 7. Targets for emission of greenhouse gases towards 2035 should be expressed in terms of absolute emissions control as well as intensity, potentially with regular updates to retain flexibility. We should step up coal control to win the blue-sky battle with determination.
 8. We shall elaborate a national long-term zero-emission strategy. In the process of achieving the zero-emission goal, China shall advocate reducing the use of coal in a progressive way and promoting cleaner and more efficient use of coal. At the same time, China shall take efforts to develop renewable energy resources that are finally capable of replacing coal. Accelerate the phase-out of all non-industrial coal use by around 2020 in the Beijing-Tianjin-Hebei and Fenhe-Weihe River Plain regions. Priority for non-fossil fuel energy grid connection and modern energy dispatch systems should be enforced.

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9. The strategy for achieving a Beautiful China should take account of the different capacities and resources in China's diverse regions and use spatial and urban planning as instruments. A new strategy for urbanization should be formulated based on ecological civilization and a redefinition of the relations between urban and rural development. Integrated, holistic approaches should be developed to green river basin development.
 10. Establishment of one or more Beautiful China Demonstration Zones could provide valuable lessons and a reference for other regions within China. Some poorer regions, and regions affected by structural change, will require additional support. Processes should be established to align national ecological and environmental targets with regionally differentiated targets, taking account of cumulative impacts.
 11. Appropriate methods should be developed to encourage some enterprises to be front-runners and to show how proactive environmental management can create new markets, drive company performance and promote green development. Support for research and development should be strengthened as well as for the diffusion of cleaner technologies and new, greener business models.
 12. Achieving a Beautiful China will require environmental governance to become more consistent, systematic and effective, particularly at the local government level. It also requires the establishment of a robust and independent monitoring system to monitor progress and to adjust the strategy and measures for achieving a Beautiful China.
 13. Economic, sectoral and environmental policies should be well-aligned and appropriate mechanisms established to ensure policy coherence. Cooperation between health and environmental authorities in formulating environmental laws and policies should be strengthened so as to ensure that they provide adequate protection for human health as well as the environment.
 14. China's legal system also needs to be adapted to support the achievement of a Beautiful China, including by strengthening the capacity of the judiciary and enhancing access to justice.
 15. It will be essential to raise public awareness and increase public support for the measures needed to achieve a Beautiful China. Promoting green consumption and

lifestyles should be strategic objectives in the green transition.

16. Strengthening global environmental governance and environmental cooperation in Asia can help China to achieve a Beautiful China. The Belt and Road Initiative presents a new and important platform that should be used to green China's trade and investment activities.

PROJECT BACKGROUND

The policy framework for this report is provided by several decisions taken by Chinese leaders to improve environmental conditions and to work toward a new balance of economic, environmental and social policy objectives.

The report delivered at the 19th CPC National Congress proposed that “there will be a fundamental improvement in the environment by 2035, and the goal of building a Beautiful China will be basically attained.” At the National Ecological Environment Protection Conference held in May 2018, Xi Jinping emphasized that “we should step up efforts to establish an ecological civilization system to ensure that there will be a fundamental improvement in the environment by 2035, and the goal of building a Beautiful China will be basically attained.” The Opinions of the CPC Central Committee and the State Council on Comprehensively Strengthening Ecological Environment Protection and Taking Tough Steps to Prevent and Control Pollution issued on June 16 mentions that, “we should step up efforts to establish an ecological civilization system to ensure that by 2035, the spatial layouts, industrial structures, and ways of work and life that help conserve resources and protect the environment will be basically developed, there will be a fundamental improvement in the environment, and the goal of building a Beautiful China will be basically attained.”

In addition, the goal of environmental quality improvement by 2020 was defined, that is, “by 2020, the overall environmental quality will be improved, the aggregate emissions of major pollutants will be greatly reduced, environmental risks will be effectively controlled, and the level of environmental protection will be compatible with the goal of building a moderately prosperous society in all respects.” On July 10, 2018, the Standing Committee of the National People’s Congress passed the Resolution on Comprehensively Strengthening Ecological Environment Protection and Taking Tough Steps to Prevent and Control Pollution according to Law, mentioning that “our overall goal is that by 2020, the overall environmental quality will be improved, and the aggregate emissions of major pollutants will be greatly reduced.”

The thought on ecological civilization put forward by Xi Jinping provides a conceptual direction and a fundamental guideline for building a Beautiful China and realizing modernization featuring the harmony between human and nature. Its principles and five systems provide ideological and practical guidelines for achieving the goal of environmental quality improvement by 2035.

Under the “new normal” economic situation, environmental goals of global sustainable development also provide added pressure on, and increased responsibilities for, China’s environmental governance system. The UN’s 2030 Agenda for Sustainable Development provides a new requirement to the transformation, upgrading and sustainable development of China’s economy, and promotes China to take tougher measures. Therefore, it is necessary to analyze the critical impact that the environmental goals will have on China’s environmental governance in the next 20 years, and to strengthen the research on global environmental governance.

Analysis of China’s mid- and long-term environmental quality improvement goals, and the pathways for achieving them, is of great significance. It will not only help to clarify the basic logic, institutional constraints and systematic challenges facing the current environmental governance operations in China, but also help to guide the future development of China’s environmental governance system.

The research team supporting the work of the SPS on Goals and Pathways for Environmental Improvement by 2035 identified three overall objectives for the project: to analyse in depth the implications of China’s goal of environmental quality improvement by 2035; to assess the obstacles to achieving the goal, and; to explore the effective pathways for how it could be achieved.

Guided by these overall objectives, the research team organized its work around four main issues: (1) Implications of China’s goal of environmental quality improvement by 2035 and assessment of the obstacles to the achieving the goal; (2) China’s green transformation by 2035, its mechanisms and paths; (3) Strategic Path for a Fundamental Improvement in the Environment by 2035; (4) Rule of law measures for the realization of China’s goal of environmental quality improvement by 2035.

Since the launch of the project in July 2018, the research team has held 4 Sino-foreign joint meetings and 2 Chinese expert meetings, participated in academic exchanges in Germany and the United Kingdom, and conducted domestic field research. Extensive information on German experiences in environmental policy was compiled in response to ten questions by the Chinese team members. This compilation is not included in this report and is available upon request. A preliminary draft report was submitted the CCICED AGM held in Hangzhou, 2-4 June 2019. Preparation of this final report benefitted from comments provided during and after the AGM. The policy recommendations of this report prioritize its messages. Chapters 1 and 2 of the main report provide background; chapters 3-6 provide an overview of policy options.

POLICY RECOMMENDATIONS

I. China may face four major challenges during the 14th Five-Year Plan period and needs to achieve five major changes

By 2035, China's economic and social environment will be still in the process of transformation, and ecological environmental protection is an inextricable part of this transformation. Therefore, China's pathway to ecological environmental targets for 2035 must reflect both improvement for current gaps in environmental quality and 'must have' changes enabling further achievements on the way to 2050.

During the "13th Five-Year Plan" period (2016-20), China has made remarkable achievements in the battle of ecological environmental protection and pollution control. Ecological environmental protection and management are on the right track. At the same time, however, China still faces severe challenges, and the existing problems and solutions are full of Chinese characteristics. Therefore, the policy focus towards 2035 should be twofold: (i) persistence and implementation (ii) while developing a number of important innovations. On the latter, see the text box at the end of this section.

1.1 By 2035, China's ecological environmental protection will face the following four major challenges:

- The transformation of the industrial, energy and transportation sectors as well as land-use structure will continue. The improvement of China's ecological environment quality must be based on the greening of production and consumption patterns, including lifestyles. Equal attention shall be paid to improving the economic structure and environment.
- The ways of integrating ecological environment protection into economic, political, cultural and social fields is still agreed or being implemented, and more needs to be done to provide incentives that make integration spontaneous and self-sustaining.
- We shall pay more attention to the public's ecological environment needs and interests, in view of China's social development, including environmentally related health impacts. The scope of ecological environment governance should be gradually expanded from the battle against pollution to solving more comprehensive and difficult problems such as climate change, resource efficiency,

water management, air quality, soil pollution legacy, waste and chemicals management, biodiversity, environmental health, marine environment, environmental risks, as well as environmental justice.

- From the 14th Five-Year Plan period to beyond 2035, target setting, the implementation path, policy formulation and supporting measures for ecological environmental protection shall be consistent and forward-looking. The ecological and environmental protection strategy should seek synergy with China's economic changes without compromising on environmental progress. Planning tools need to be utilized to ensure that existing and future Beautiful China targets will be achieved. Monitoring networks are necessary to assess baseline and progress.

1.2 Therefore, it is recommended that, by 2035, China achieves the following five changes:

- Achieving the goals of ecological environmental quality improvement, including environmentally related health, is a long-term and continuous process (sustainability);
- The environmental quality improvement shall be steady and free from fluctuations or relapses (stability). Because of this, China's leadership would be advised to formulate and quantify its green transformation pathway for the full period between now and 2050, and on that basis specify the targets and instruments for the 14th FYP.
- It is necessary to balance and coordinate the three key systems of sustainability, namely, economy, society and environment, so that environmental improvement keeps pace with economic and social development (coordination);
- "Beautiful" and "Green" shall be systematic and consistently implemented. Not only the environmental quality indicators must meet their targets, but also economic and social development should become green (essence);
- Policy measures shall be efficient, effective, comprehensive and innovative, and include administrative, legal, technical, economic and social means (comprehensiveness).

II. Overall considerations regarding the 2035 goals and the goals of the 14th Five-Year Plan period

- The medium- and short-term goals must be consistent in direction and well connected. That is: consistent over time, space, and levels of government; as well as connected to the foreseen changes in economy, social environment and urbanization. Planning tools will assist in identifying priority actions to achieve the 2035 goals. The goals of the 14th Five-Year Plan shall refer to the 2050 and 2035 goals and be defined based on the goals of Beautiful China 2035 in order to link the short- and medium-term goals. Some of the target indicators of the 13th Five-Year Plan still need to be improved steadily, and it is necessary to continue to meet and simultaneously increase the requirements for rural areas, ecosystems, climate change, and environmental health (especially the health problems of vulnerable groups such as women and children), so as to make relevant work done in advance.
- The 2035 targets should align with China's pathway to 2050. This is particularly important for slow-changing and long-lived systems, such as the energy, urban layout and the education systems. Methods of foresight such as scenario tools, quantitative models and other forward-looking analytics need to be applied in order to enable timely initiatives, for example in large traditional manufacturing areas. Foresight methods are also required to avoid, as much as possible, painful write-offs of systems that may be of some use towards 2035 but have no role thereafter. The need for a strategy to reduce emissions and use of coals is a case in point. We shall step up coal control to win the blue-sky battle with determination. We shall elaborate a national long-term zero-emission strategy. In the process of achieving the zero-emission goal, China shall advocate reducing the use of coal in a progressive way and promoting cleaner and more efficient use of coal. China shall at the same time take efforts to develop renewable energy resources that are finally capable of replacing coal. Priority for non-fossil fuel energy grid connection and modern energy dispatch systems should be enforced. In addition, a timely understanding of the challenges and opportunities of adaptation to climate change is needed in order to minimize eventual cost, and disruption and public health risks.
- Regional differences should be taken into account when working toward the 2035 goals. Due to the wide differences among regions, it is unrealistic to expect all regions to achieve the goals of Beautiful China by 2035. For developed and underdeveloped regions, on the condition that they have met the same

environmental standards and requirements, the principle of “common but differentiated responsibilities” shall also be determined; that is, we shall encourage some regions to achieve the goals of Beautiful China first while giving more support to poor and vulnerable regions so as to avoid the further deterioration of the ecological environment, for example avoiding displacement of high polluting industry to central and west China. Environmental governance should put more emphasis on sharing positive experiences and win-win benefits. It is recommended to establish Beautiful China demonstration zones at province, city, county and district level to play leading and demonstration roles. In line with this, and as far as possible, the target indicators and policy measures for the 14th Five-Year Plan shall be differentiated by region, and the related implementation guidance and capacity building shall be strengthened. Regional differentiation should be accompanied with a timetable showing the eventual application of ambitious protection to all regions of China and allowing investors and other actors to anticipate on this. Policies that provide perverse incentives for investments in regions with less stringent environmental requirements should be avoided.

- We shall establish a target and indicator system that is oriented by ecological priorities and green development, so that a high-quality development can be supported. This shall be the core guiding principle of the 14th FY plan. The SPS recommends targets that are ambitious, clear, measurable, outcome-based, use SMART-related criteria, focusing on absolute ambient-level targets rather than intensity targets. In terms of emission targets, it underscores the importance of setting and then sticking with long-term emission targets, to enable different actors to meet them.
- We shall review targets and indicators regularly and independently and establish a tracking system. E.g. It is suggested to strengthen long-term tracking of the goal of achieving Beautiful China, build an evaluation system for achieving Beautiful China goals, implement assessment and early warning, establish improvement mechanism, and strengthen policy preparations.

III. Green transformation of the economy

- The key task is to realize the structural green transformation, such as the green transformation of the energy, industrial and transport sectors, as well as land-use and agricultural inputs. An effective economic policy is built upon an effective environment policy. We shall strengthen environmental impact analysis, taking

advantage of China's considerable experience in strategic environment assessment. We shall also strengthen economic and technological policies, including scenario tools, enhance the ecological and environmental protection orientation, strengthen the role of environmental protection departments in promoting comprehensive policies, and achieve a high degree of integration of environmental, social and economic policies. We shall also promote innovation of technologies (in particular environmental-friendly technologies) and business models to facilitate economic transformation and high-quality economic development.

- On the one hand, we shall improve the green process of China's existing industries (including but not limited to manufacturing, construction, transport and services) by introducing a green evaluation system. This will require enterprises' environmental behavior and use of environmental credits to be evaluated, and publicly reported and an incentive scheme to be developed that includes reward and punishment measures. On the other hand, we shall also draw on international good practices in developing environmental protection industries, cultivating new economic growth points and increasing the effective supply of green products.
- With respect of the economic transformation, we shall carry out preparatory work and form a long-term strategy and cultivate economic green growth points, as was done in the industrial areas of the Ruhr Valley. This will take time and requires a strategic focus and early investment in high-quality technological research and development. When justified, financial support from the central government will support the green transformation process and help to stimulate the active participation of both small, medium and large enterprises. Of particular concern is China's legacy of soil pollution in a time of extensive economic restructuring and urbanization.
- Encouraging a group of core enterprises to be front-runners can help to drive the green transformation of regional economies, give full play to the self-discipline and self-learning capacity of the industry, and integrate the concept of environmental protection into design, layout, products, technologies and processes, rather than acting after pollution once caused. Further thought should be given to effective, realistic ways of achieving this.

IV. Further innovate some methods for eco-environmental governance

- We shall strengthen the consensus and alignment between central and local governments, and among governments and enterprises, and between the society and the public on environmental governance and the shared need to improve the ecological environment. The key is to strengthen and encourage local governments and enterprises to actively participate in environmental protection, thus changing the passive compliance of enterprises and insufficient financial support from local government. We shall support local governments to implement ecological compensation, assessment and promotion of local public officers, environmental property rights and other effective measures, using regulatory and incentive policies at the same time. We will also pay more attention to the role of various economic instruments such as taxation, finance and pricing in improving environmental conditions. It is also necessary to provide more certainty on key goals and targets to increase green investment, improve the environmental management model, and give full play to the long-acting market mechanism. Integrated and holistic approaches for promoting green development in river basins is also needed.
- On the basis of consolidating the battle against pollution and the achievements of the blue sky, clear water and pure land defense, we should continue to expand the achievements and deepen the construction of ecological civilization. We shall strengthen the protection and restoration of ecologically fragile areas, environmentally sensitive areas, and important ecological functional areas through tools such as red-lining and risk-based impact assessment. We shall maintain the overall stability of ecosystems, consolidate the ecological security barrier, and enhance the overall capacity of ecosystems. We shall do so taking into account trends and uncertainties regarding, for example, climate change, urbanization and transport. We shall develop capacities for planning and oversight jointly for environment and spatial planning.
- We shall attach importance to the enhancing participation of stakeholders, strengthen the disclosure of environmental information, and pay special attention to the social impact of policies. Local governments should be assisted to put in place environment monitoring that efficiently matches the requirements of implementing relevant national and local eco-environmental policy plans, the assessment of policy implementation, environmental public information and health impact assessments, forward-looking policy effects, and model studies.

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- At the same time, in view of the growing importance of China's domestic consumption as a driver of its economy, we shall strengthen public awareness of green consumption, and encourage people to appreciate the environmental and health benefits and pay for green products. Green consumption will create demand for green production and help to strengthen environmental governance.
 - We shall give priority to the rule of law and focus on its implementation. We shall also further improve the legislation, law enforcement, observance of law, and judicial systems regarding the ecological environment, and focus on the formulation of good laws, strict law enforcement, conscious observance of law, and the synergy between environmental law enforcement and the judiciary. This includes that we shall strengthen the training of legal personnel.
 - During the past decade, China inventoried the soil pollution status of land and implemented laws and guidelines for dealing with contaminated land. In other countries, cleaning up even the most urgent contamination has proven to be costly. Towards 2035, China will feature widespread spatial shifts due to urban expansion, creation of new towns and fast economic developments. At the same time, its population will be better educated, informed and assertive. This threefold combination of developments suggests that is beneficial at this particular point in time to (i) develop a government funding system for orphan sites, that is contaminated sites for which no polluter or owner can held financially responsible; (ii) develop a priority system to guide the clean-up of contaminated sites in a manner that is both fair and cost-efficient; (iii) build a contaminated-land register that is on-line available for all stakeholders and officials.

IMPORTANT INNOVATIONS REQUIRED

1. A target and indicator system that uses binding targets for key ecological and environmental indicators, so that a high-quality development can be supported
2. A process to align national ecological and environmental targets with regionally differentiated targets
3. Placing the 2035 targets in a 2050 perspective, using storylines and quantitative analysis
4. Strong emphasis on integration of environment policy with economic and social change, and adaptation to climate change
5. More emphasis on health impact and environmental justice
6. Bringing together environmental management and spatial planning
7. Stepping up the active use of information tools, including scenario tools and information for the public
8. Improving the capacity of the legal system to handle environmental issues, including access by third parties to the system
9. Promoting green front runner enterprises
10. A nation-wide priority system to guide the clean-up of contaminated land sites and a contaminated-land register on-line available for all.

Special Policy Study on the Goals and Pathways for Environmental Improvement in 2035

MAIN REPORT

1. MAJOR CHALLENGES AND CHANGES CHINA FACES TOWARDS 2035

General Secretary Xi Jinping pointed out in the report delivered at the 19th National Congress of the Communist Party of China that: "We must continue the Beautiful China initiative to create good working and living environments for our people and play our part in ensuring global ecological security." At the National Ecological Environmental Protection Conference held in 2018, he emphasized that "we should step up efforts to establish an ecological civilization system to ensure that there will be a fundamental improvement in the environment by 2035, and the goal of building a Beautiful China will be basically attained". He attaches great importance to the establishing a Beautiful China and has delivered a series of important speeches, especially at the National Ecological Environmental Protection Conference in 2018, during which he highlighted the practical requirements for strengthening the construction of ecological civilization and building a Beautiful China.

Xi Jinping pointed out that "moving towards a new era of ecological civilization and building a Beautiful China is an important part of the Chinese dream of realizing the great rejuvenation of the Chinese nation." "Strongly promote the construction of ecological civilization and implement the "blue water and clear sky" project to make the ecological environment better and better. Strive to build a beautiful China." **Beautiful China is premised on the construction of a beautiful natural environment, and is measured by the development and progress of ecological civilization. Beautiful China refers to developing China with a high degree of ecological civilization. It is the goal of China's ecological civilization construction.** Xi Jinping stated that the goal was to "realize environmental protection and build China into a country with a sound ecological environment." "The modernization of harmony between man and nature requires not only creating more material and spiritual wealth to meet people's growing demand for a better life, but also providing more high-quality ecological products to meet people's growing demand for a beautiful ecological environment."

Vigorously promoting the construction of ecological civilization and building a Beautiful China is a fundamental plan for the sustainable development of the Chinese nation. It is a major political issue that affects the Communist Party of China's mission and a major social issue concerning the development of people's livelihood. A Beautiful China is a strategic goal of ecological civilization construction based on China's national conditions and future development.

How to define the goals of Beautiful China, how to realize the fundamental improvement of environmental quality, is the task of our SPS.

1.1 An Analysis of the Trend of China's Green Transformation in Economic and Social Development towards 2035

The Chinese economy is making the transition from a high-speed growth phase to a high-quality development phase. Leading sectors are shifting from heavy and chemical industries to the high-tech industry and the modern service industry. The driving force of economic growth is shifting from material factors to technological innovation and more skilled human capital. The factors driving the economy are shifting from investment and exports to consumption. Actively cultivating new drivers of economic growth toward green transformation is the only route to high-quality economic development.

A scenario analysis of China's economic and social development in the three periods to 2020, 2035 and 2050 was made based on the existing production model and using the dynamic Computable General Equilibrium (CGE) model of State Information Center. It followed the goal of "basic implementation of socialist modernization by 2035, and buildup of a great modern socialist country by 2050", in accordance with the spirit of the 19th National Congress of the Communist Party of China. Through balancing measurement of indicators in all fields, the main results are shown as follows.

1.1.1 Population to peak and aging trend

1.1.1.1 Total population of China.

Total population of China will be about 1.41 billion by 2020, reach peak (about 1.43 billion) around 2028, and drop to about 1.35 billion by 2050.

1.1.1.2 Population age structure.

The population above 60 years old will reach 261 million, or 18.5% in proportion by 2020; the aging population of China will grow to 371 million by 2035, when the country starts to enter into the moderate aging phase; and grow to 448 million, or 33.2% in proportion by 2050.

1.1.1.3 Urbanization level

The urbanization rate will reach around 60.6% by 2020, when China enters into the medium-level urban society; around 68.5% by 2035, when China enters into the later phase of the urbanization process; and around 72% by 2050, when the urbanization matures and stabilises.

1.1.2 Economic aggregate and structural trend

1.1.2.1 Macro-economic growth rate shifts, and drive for growth gradually changes

In view of GDP growth rate, during 2021-2035, China's economy will be growing at a moderate speed ranging between 4% and 6% per annum, about 5% on average. The socialist modernization will be basically realized by 2035; during 2036-2050, China's economy will step into the phase of low-speed stable growth between 3% and 4%, averaging 3.5% per annum. A great modern socialist country will be built by 2050. In view of demand-side pull, consumption will become a key driver in the future. By 2035, the consumption rate is estimated to hit 65%, and investment rate 32%; by 2050, the consumption rate 70%, and investment rate 29%. Per capita consumption is estimated to grow gradually from USD 2,700 at present to USD 16,000 in 2035, and to USD 40,000 in 2050. Especially in the areas of household facilities and articles, resident service, etc., the potential for growth is tremendous. Taken civilian car as an example, it is estimated that there will be approximately 500 million cars by 2035, equivalent to 330 vehicles per 1,000 people. Subsequently, growth will become stable, and by 2050, the total number will be about 550 million, equivalent to 370 vehicles per 1,000 people.

New energy vehicles, including all-electric, hybrid and fuel-cell vehicles, will enter into a high-speed growth phase. Their number is estimated to be 140 million by 2035, about 28% of private car ownership; and 270 million by 2050, about 50% of private car ownership.

China's stock of civil buildings is expected to peak in around 2035. Accordingly, the added building area per annum from now on till 2035 will decline gradually. This means that the role of real estate investment, the key driver of China's economic growth for a long time ago, will fall progressively.

1.1.2.2 To adapt to the shift of demand structure, the future industrial structure needs to be gradually optimized

From the perspective of industrial structure development trend, during 2016 - 2020, industrialization will be upgraded toward medium-to-high end, where the weight of the service industry will be continuously increased, positive results will be achieved in agricultural modernization. The share of primary, secondary and tertiary industries will shift from 8.8:40.9:50.2 in 2015 to roughly 7.5:37.5:55.0 in 2020. During 2021 - 2035, as the tertiary industry will sector gradually account for the largest share of economic development, and it will exceed 60% of GDP around 2030. By 2035, the shares of the three main sectors in the economy will be roughly 5:28:67. During 2036 to 2050, when China is among the most developed countries in the service sector, it will become the center of high-end service industries across the globe, and it will lead and guide the global value chain, with much greater economic power. The tertiary industry will exceed 70% of GDP around 2050, and the shares of the three main sectors will be roughly 3:24:73 at that time.

1.1.3 Total energy demand and structure

In line with the main spirit of ecological civilization in the report of the "19th National Congress of the Communist Party of China", and based on the judgment of economic and social development trends, China's total primary energy demand will continue to increase. By in 2020, 2030, 2035 and 2050, it will reach nearly 4.8 billion tons, nearly 5.4 billion tons, 5.5 billion tons, and nearly 5.8 billion tons of coal equivalent respectively. Subsequently, it will remain at a similar level.

The demand for coal and oil will peak successively. The demand for coal will remain stable until 2020, and is then expected to continuously decline. The non-coal share of

energy demand is expected to climb from 35.7% in 2015 to 55% in 2030, 60% in 2035, and further to 73% in 2050. The demand for oil will remain stable until 2030, and will gradually decline as the scale of electric vehicles expands rapidly. At the same time, clean energy will gradually become a major source of energy demand. The proportion of non-fossil energy is expected to gradually rise from 11.8% in 2015 to 22.5% in 2030, 28% in 2035 and over 40% in 2050. In addition, increased electrification will lead to an increase in the share of energy used for electricity generation. The figure will rise from 40.9 percent in 2015 to 48.5 percent in 2030, over 50 percent in 2035 and 54.8 percent in 2050.

Based on the projection of the total energy demand and structure in primary energy, it is, tentatively estimated that China's energy-related carbon dioxide emissions will peak at about 10 billion tons around 2025. Thereafter, it is estimated that total carbon emissions will be basically stable. By 2035, the total amount of carbon emissions is estimated to gradually drop to 9 billion tons. Thereafter, the pace of carbon emission reduction will increase. By 2050, carbon dioxide emissions are estimated to fall to around 7 billion tons.

Table 1-1 Future demand for primary energy and CO₂ emissions trend in China

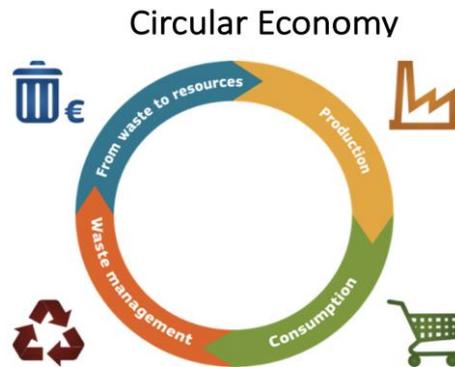
		2015	2020	2030	2035	2050
Total primary energy demand (in 100 million tons of coal equivalent)	Coal	27.5	26.7	24.3	22.3	15.7
	Oil	7.7	9.0	9.4	9.1	8.4
	Natural gas	2.5	4.6	8.0	8.6	9.0
	Non-fossil	5.1	7.5	12.1	15.4	24.2
Total		42.8	47.8	53.8	55.5	57.3
CO ₂ emissions (in 100 million tons)		91	97	96	90	71
Proportion of non-coal energy (%)		35.7	44.2	54.8	59.9	72.6
Proportion of non-fossil energy (%)		11.8	15.7	22.5	27.8	42.3
Primary energy used for electricity generation	In 100 million tons of coal equivalent	17.5	21.0	26.1	28.3	31.4
	Proportion (%)	40.9	44.1	48.5	51.0	54.8

Note: According to China's existing calculation method for determining the primary energy demand, if included in the category of primary energy, non-fossil energy used for electricity generation shall be converted into coal consumed in electricity generation.

Actively encouraging and supporting high-end, green manufacturing development will become a critical direction for China's industrial transformation and upgrading. In view of China's industrial development and industrial structure at present, in 2016, industrial added value accounted for 33.3% of gross domestic product in China, and energy consumption and resource consumption per unit of output were apparently higher than those of developed countries. Currently, the energy consumed per USD 1 of added value in China is 4.3 times of that in USA, 7.7 times of that in Germany and France, and 11.5 times of that in Japan. Technology and environmental factors have become two obstacles that impede the industrial development of China and its product competitiveness. Actively promoting green technological innovation, driving green transformation of traditional industries, and realizing modernization and green development of manufacturing are inevitable directions for China's industrial development. By 2035, the green enterprise standard system and the green manufacturing system will be formed gradually. By 2050, the intelligent and green manufacturing industries such as the new generation of information technology, new energy, new material, and high-end equipment will become key drivers of China's economy. Therefore, green transition shall be promoted in three ways: supply-side policy, demand-side policy and the transformation of institutional mechanisms.

1.1.4 Material use and the circular economy

In recent years, policy makers in China and the international community have become increasingly concerned that the rapid growth and inefficient use of natural resources is creating unsustainable pressures on the environment and may result in disruptions in the supply of inputs to some production processes. As a result, they have given an increasing priority to moving from a linear to a circular economy. A linear economy is one that “takes-makes-disposes” of materials. In contrast, a circular economy aims to keep materials in the economy for as long as possible in order to extract the maximum value from them. The objectives of the circular economy and China’s green transition; are mutually supportive. Accordingly, promoting the circular economy should be an important building block in creating a Beautiful China.



A major driver for the circular economy has been concern about the adverse environmental consequences associated with the rapidly increasing use of materials. These include:

- More than half of all greenhouse gas (GHG) emissions are related to materials management activities. It has been estimated that global GHG emissions related to materials management will rise to approximately 50 Gt CO₂-equivalents by 2060.
- Fossil fuel use and the production of iron & steel and construction materials lead to large energy-related emissions of greenhouse gases and air pollutants.
- Metals extraction and use have a wide range of polluting consequences, including toxic effects on humans and ecosystems.
- The extraction and use of primary (raw) materials is much more polluting than secondary (recycled) materials.

In addition, there are economic considerations that support the transition to a circular economy:

- Reduced risks of disruptions and price volatility in the supply of raw materials and reduced dependency on imports
- Reduced manufacturing costs resulting in enhanced productivity and competitiveness

-
- New business opportunities, markets and job opportunities, e.g. the recycling and reuse of materials.

Of the 17 Sustainable Development Goals (SDGs), 12 directly depend on the sustainable, economy-wide management of a whole range of natural resources.¹

The OECD recently prepared a global outlook to 2060 for future materials use at the sectoral and regional level.² It projected that global primary materials use, and global primary materials extraction, would double between 2011 and 2060, from 79 to 167 Gt. In the case of China, it projected that materials use would increase from 27 to 38 Gt in the same period. In 2011, China accounted for about one-third of global material consumption. By 2060, China's share of global material consumption is projected to fall to less than one-quarter.

High levels of investment, infrastructure and construction have been important drivers of China's materials use. The continued convergence of GDP per capita with that in OECD countries will sustain a high demand for materials. However, this will be offset as the current investment boom comes to an end; as the share of services in the economy increases; and as technological change enables more efficient use of materials. As a result, the material intensity of the Chinese economy will decrease while the absolute volume of materials used will stabilize at a high level.

¹ UNEP (2016) Resource Efficiency: Potential and Economic Implications. A report of the International Resource Panel. Ekins, P., Hughes, N., et al.

² OECD (2019), Global Material Resources Outlook to 2060: Economic Drivers and Environmental Consequences, OECD Publishing, Paris, <https://doi.org/10.1787/9789264307452-en>.

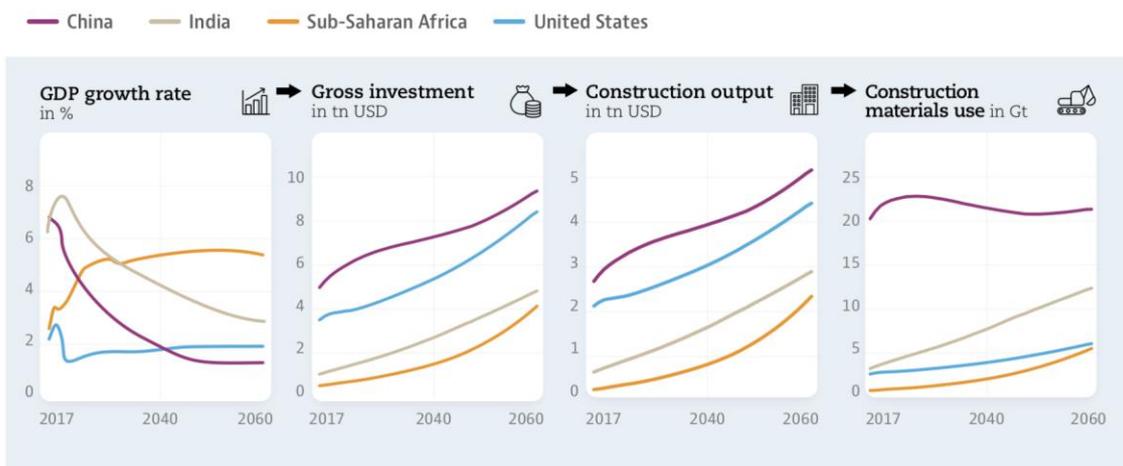


Figure. 1-1 Economic growth drives use of construction materials
 Source: OECD, 2019. These projections are based on a business-as-usual scenario

The report identifies several other trends. The increased use of motor vehicles and electronics - which have low total materials intensities but are relatively large users of metals - will drive a fast increase in metals use. Recycling will gradually become more competitive than mining of minerals thanks to projected technological developments and changes in relative prices of production inputs. However, the increase in total demand for materials can only be easily met through increasing both primary and secondary materials use.

1.2 Challenges China faces by 2035

By 2035, China's economic and social environment will be still in the process of transformation, and the ecological environmental protection is an inextricable part of this. Therefore, China's pathway to ecological environmental targets for 2035 must reflect both improvement in addressing current gaps in environmental quality and 'must have' changes enabling further achievements on the way to 2050.

During the "13th Five-Year Plan" period (2016-20), China has made remarkable achievements in the battle of ecological environmental protection and pollution control. Ecological environmental protection and management have been on the right track. At the same time, however, China still faces severe challenges, and the existing problems and solutions are full of Chinese characteristics. Therefore, the focus in the future lies in persistence and implementation.

By 2035, China's ecological environmental protection will face the following problems and challenges:

- The transformation of the industrial, energy and transportation sectors as well as land-use structure will continue. The improvement of China's ecological environment quality must be based on the greening of production and consumption patterns, including lifestyles. Equal attention shall be paid to economic structural and environmental improvement.
- The ways of integrating ecological environment protection into economic, political, cultural and social fields is still not obvious, and more needs to be done to provide incentives that make integration spontaneous and self-sustaining.
- We shall pay more attention to the public's ecological environment needs and interests, in view of China's social development, including environmentally related health impacts. The scope of ecological environment governance will be gradually expanded from the battle against pollution to solving more comprehensive and difficult problems such as climate change, resource efficiency, water management, air quality, soil, waste and chemicals management, biodiversity, environmental health, marine environment, environmental risks, etc.
- From the 14th Five-Year Plan period to beyond 2035, target setting, the implementation path, policy formulation and supporting measures for ecological environmental protection shall be consistent and forward-looking. The ecological and environmental protection strategy should not be affected by pressure from economic trends. Planning tools need to be utilized to ensure that existing and future Beautiful China targets will be achieved. Monitoring networks are necessary to assess baseline and progress.

1.3 Phased approach to ecosystems and environmental protection in 2020-2035

The combination of a long-term view and near-term urgency helps to outline a phased approach. It identifies key tasks for improving the eco-environmental quality during the period 2020-2035. In turn, these tasks can help to guide the direction of ongoing policy adjustment and optimization. They are as follows.

- Air quality nationwide must be brought up to national consistently agreed standards. The air quality of metropolitan areas around Beijing, Shanghai and

Guangzhou will reach the current level of the air quality of, for example, London, the UK. The control of conventional pollutants such as PM_{2.5}, PM₁₀, SO₂, NO_x, etc. will be completed by 2025, and the stabilization phase will begin by 2035. Incorporating new pollutants such as ground level ozone and volatile organic chemicals into the air quality management system requires the deployment of relevant action plans in advance.

- Focus on the treatment of seriously polluted water bodies and complete the restoration of water environment. The government should pay attention to key areas such as organic pollution control of water bodies, disposal of heavy metal pollution, underground construction such as pipe networks, sediment pollution control, marine pollution control, etc., and completely eliminate black and odorous water bodies in urban built-up areas. These measures can make the quality of centralized urban drinking water sources in line with Class III or above. In addition, the water quality of major rivers should reach the current quality of, for example, the Rhine River. The water quality of offshore areas should be comprehensively improved, and the water quality of key sea areas should be as good as that of developed countries or regions. The water quality management system will still be dominated by end-of-pipe treatment and restoring the restoration functions of water environmental systems. The effectiveness of joint prevention and control of the upstream and downstream components of river basins will be further strengthened. Increasingly the management of the development of river basins should be based on integrated, holistic approaches.
- Strictly protect the soil environment and extend the restoration work from pilots to the whole country. China inventoried the soil pollution status of land and implemented laws and guidelines for dealing with contaminated land. By 2025, China will have established a soil pollution control system that focuses on controlling sources and risks, and comprehensively controls the environmental risks of contaminated land that is not being developed as well as contaminated land that is being redeveloped and utilized.
- Towards 2035, China's legacy of soil pollution from past decades will require special attention. In other countries, cleaning up even the most urgent contamination has proven to be costly. Towards 2035, China will feature widespread spatial shifts due to urban expansion, creation of new towns and fast changes in manufacturing. At the same time, its population will be better educated, informed and assertive. This combination of developments suggests that is

beneficial at this particular point in time to (i) make budgetary reservations and budget rules for priority clean-up, in particular for ‘orphan sites’; (ii) develop a priority system to guide the clean-up of contaminated sites in a manner that is both fair and cost-efficient; and (iii) build a contaminated-land register that is on-line available for all stakeholders and officials.

- Ecosystems enter a comprehensive recovery phase. The forest coverage rate and the proportion of ecological public welfare forests are continuously increasing, biodiversity reduction has been halted, and ecological service functions have been greatly improved. By 2035, there will be an improvement of various ecological restoration measures. The self-restoration and adjustment capabilities of the key ecosystems starts to be fully restored, and various regional ecosystems will be stable.
- Towards 2035, China like all other countries needs to initiate a comprehensive programme of adapting to climate change. This includes urban size and layout as well as urban water management; agriculture; management of rivers, lakes and coastal areas; and the exact location of nature reserves. Long-term vision and adaptive planning can often help to limit year-to-year budgetary impacts and disruption in people’s living environment.
- Public health should become one of the cores of the eco-environmental protection system, and a corresponding environmental health management system will be established. Air quality (outdoor and indoor), noise, chemicals, drinking water and climate change may all have an impact on public health and should be accounted for.

2. BACKGROUND AND PRINCIPLES FOR FUNDAMENTALLY IMPROVING ENVIRONMENTAL QUALITY GOALS BY 2035

Considering the basic economic and social features of the green transition to 2035, and the main challenges and changes China may face by then, this chapter examines the connotation and setting for fundamentally improving environmental quality by 2035 and realizing a Beautiful China.

2.1 Connotation of the fundamental improvement of environmental quality by 2035

General Secretary Xi Jinping proposed two, phased goals for realizing a Beautiful China at the National Ecological Environmental Protection Conference in 2018: First, by 2035, there will be a fundamental improvement in the environment, and the goal of building a Beautiful China will be basically attained. The second goal is, by the middle of this century, there will be harmonious coexistence between man and nature, and the modernization of China's governance system and capacity is basically achieved in the field of the ecological environment, and a Beautiful China will be built.

Specifically, a fundamental improvement in the environment involves solving the outstanding ecological and environmental problems, including: (1) Air quality shall be clearly improved (binding requirement), and heavy pollution events are basically eliminated; (2) the Action Plan for Water Pollution Prevention and Control will be implemented to ensure water safety and basically improve the black and odorous water bodies in urban areas; (3) the Action Plan for Soil Pollution Prevention and Control will be fully implemented with a focus on key areas, industries and pollutants, and strengthening soil pollution control and restoration; (4) economic and energy structures will be adjusted to achieve green development; and (5) land and spatial development will be optimized to adjust the regional, river basin and industrial layout.

2.1.1 There will be a fundamental improvement in the environment, and the goal of building a Beautiful China will be basically attained

In respect of the first goal “there will be a fundamental improvement in the environment, and the goal of building a Beautiful China will be basically attained” - this concerns the continuous improvement in the ecological environment, and ultimately achieving a certain standard by a specific time and for a specific space, so that the various elements of the ecosystem and the environment are in line with human survival and sustainable

socio-economic development. A fundamental improvement in the environment is not just a change or improvement at a certain time point, but a long-lasting process or state. The natural ecosystem will basically restore its carrying capacity, and the environment will begin to realize self-regulation. The improvement in air quality in China's Pearl River Delta region provides a useful case study of this type of process (see Annex 3).

The following five features shall be realized in order to achieve a fundamental improvement in the environment over the coming decades:

Firstly, compliance. The quality of the ecological environment shall first of all reach the national standards of the time. This is the basic feature and the bottom-line requirement for the fundamental improvement in the environment. To evaluate whether the quality of the ecological environment is up to standard, efforts shall be made to quantify the applicable targets. By determining the standard and quantitative indicators, it is possible to formulate operational and detailed tasks for evaluation and assessment. "Laggards" shall catch up and achieve compliance with the quality standards; "front-runners" shall maintain the lead and move toward higher standards.

Secondly, stability. On the basis of compliance, the quality of the ecological environment must be maintained in a state of continuous compliance or above the standard with a small fluctuation range (which shall be agreed subject to minimizing any exceedances). This is the most essential feature that distinguishes it from the overall improvement goal of the ecological environment in 2020, and is the fundamental requirement for improving the environment and consolidating pollution control. Take air quality as an example: the goal is to achieve at least three consecutive years of compliance, 90% of days per year with quality air, basically no "off-the-charts" levels of pollutants such as PM_{2.5}, and no return of heavy pollution. It should be normal to have blue sky and white clouds. To achieve this goal, it is necessary to both mitigate the risk and actively respond to environmental risks, enhance early warning capability and prepare for a prompt response to reduce the ecological and environmental impacts of major incidents.

Thirdly, balance. The quality of the ecological environment should be comprehensively improved. This is the main feature, and a difficult task, in achieving the fundamental improvement in the environment. To achieve balanced development, it is necessary to improve the quality of the ecological environment on three levels. Firstly, comprehensively improve all elements in the environment, including air, water, soil, forest, wetland and biodiversity to meet the standards without any outstanding points of weakness. Secondly, efforts to improve the environment shall fully cover

China's extensive areas. The natural resource endowment and level of social-economic development varies greatly among different regions, as does the degree of eco-environment damage, resulting in very different governance tasks. As far as the current environmental governance is concerned, emissions of conventional pollutants in the eastern region have reached their peak, showing slow yet steady improvement. The central region is experiencing its worst conditions and may require a longer treatment time. Emissions in the western region continues to increase, posing the biggest challenge. Based on the status quo, a fundamental improvement in the environment by 2035 requires narrowing the gap in environmental quality between regions and achieving balanced development, so as to realize a comprehensive and thorough improvement to the ecological environment. A whole-of-China approach is required to minimize the risk of high polluting industries being displaced to central and western China and a worsening of their ecological environment. Finally, we shall decouple environmental pollution from economic growth. Efforts shall be made to coordinate the development, and truly follow the principle that "green mountains and clear water are as good as mountains of gold and silver", which is the inherent requirement for achieving a fundamental improvement in environment.

Fourthly, comparability. We should regard the improvement of China's eco-environment from an international perspective. Its governance outcome and quality standards shall be comparable with those of developed countries such as the United States and Europe, and can provide a reference for late-developing countries. With growing globalization, China needs to gradually integrate itself into the global environmental governance process. As a responsible country, China shall ensure comparable quality of the eco-environment in the global context. The meaning is threefold. The first is that China shall have a comparable environmental agenda and concerns. In addition to the local outstanding eco-environmental issues, it is necessary to gradually incorporate key environmental issues of concern in international environmental governance into our national governance system, or further enhance our efforts in this regard. This includes issues such as climate change issues, marine micro-plastics, migration and diffusion of atmospheric pollutants, and biodiversity conservation issues. Secondly, it is necessary to gradually improve the quality standards and bring them in line with those of the developed countries, enhance international recognition of our environmental governance performance, and strengthen our bargaining power. Finally, it is essential to gradually apply data monitoring technologies that are comparable to the developed countries.

Fifthly, consistency. According to the main contradictions in China's current society and the fundamental purpose of the Communist Party of China, the ultimate goal of

people-oriented development, and to achieving a fundamental improvement in the environment, is to meet the people's desire for a better life. Therefore, the goal is not only an improvement in the statistics, but also an overall improvement in the feelings of the people about the environment. A sound eco-environment can thus truly become the growth point for a better life for the people. For example, we shall pay special attention to the current issues, e.g. decreasing concentrations of major pollutants in the atmosphere yet no significant improvements in visibility; environmental monitoring data showing compliance with environmental requirements yet persistent odors; water complying with environmental requirements but with low clarity; clear water but posing a risk to human health, etc. Greater use of health-related data may be a useful means of demonstrating China's progress in addressing the less visible pollutants and minimizing public concerns. An important feature of achieving a fundamental improvement in the environment by 2035 is to ensure that the general public feels that its environmental quality of life has improved.

2.1.2 A beautiful China will be built by the middle of this century

By the middle of this century there will be harmonious coexistence between man and nature, and the modernization of China's governance system and capacity is basically achieved in the field of the ecological environment, and a Beautiful China will be built. Near-term steps follow from this long-term guiding vision and will be outlined in section 2.2.

To modernize the national governance system in the field of ecological environment, the policy framework shall include the following:

- **Developing an ecological and cultural system based on ecological values.** The main objectives include: Popularization of ecological civilization education; construction of national forest parks; construction of natural and wetland protected areas to strengthen research of ecological cultural systems; development of ecotourism and cultural tourism.
- **Establishing an ecological and economic system with eco-development of industries and industrialization of eco-development.** It is required to closely integrate, coordinate and optimize the industrial, ecological and social systems within a specific regional space and to do so within the carrying capacity of natural systems, making full use of resources, ending environmental damage, and coordinating the sustainable development of nature, society and economy.

-
- **Establishing an ecological civilization system that guarantees the modernization of the governance system and capacity.** The ecological civilization system mainly includes systems for natural resource property rights, the development and protection of land, spatial planning, total resource management and comprehensive conservation, payments for use of resources and ecological compensation, environmental governance, ecological civilization performance evaluation and responsibility, investigation and accountability, etc.
 - **Establishing an ecological protection system focusing on the virtuous cycle of ecosystems and the effective prevention and control of environmental risks.** The requirements for the construction of an ecological protection system include restoring ecological space, improving the quality and area of ecosystems, improving and maintaining air quality, water environment, water resources, and soil resources, maintaining biodiversity and slowing down biodiversity degradation.

2.2 Eco-environmental quality and Beautiful China's milestone targets

2.2.1 Target for the next 5 years

The main task until 2020 is to achieve the environmental goals included in the “13th Five-Year Plan for Ecological Environmental Protection” and the climate change targets established by the NRDC.

2.2.2 2035 target

According to China's social and economic development, the goal building a Beautiful China by 2035 includes the following indicators:

Indicator		2035	[Cumulative] compared to 2015	Attributes
1. Air quality	Prefecture and above cities ² : ratio of days with good and moderate air quality (%)	90	-	Binding
2. Water environmental quality	The ratio of water body with surface water quality ³ that is or better than Class III water (%)	80	-	Binding
	Water quality compliance rate of important rivers and lakes in the functional area (%)	90		Expected
	Proportion of water quality (Class I and II) in coastal regions (%)	85	-	Expected
3. Soil quality	Cultivated land safe use rate (%)	100	-	Binding
4. Ecological status	Forest coverage rate (%)	27	[1.38]	Binding
5. Reduction of total discharge of major pollutants (%)	Chemical oxygen demand	-	[25]	Binding
	Ammonia nitrogen	-	[25]	
	SO ₂	-	[20]	
	NO _x	-	[25]	
6. Reduction of total regional pollutant emissions (%)	Volatile organic compounds in key industries in key regions ⁵	-	[20]	Expected
	Key area total nitrogen ⁶	-	[20]	Expected
	Key area total phosphorus ⁷	-	[20]	
7. National key wildlife protection rate (%)		-	-	Expected
8. National natural shoreline retention rate (%)		-	-	Expected
9. Newly restored desertified land (10,000 square kilometers)		-	[30]	Expected

2.3 Overall considerations regarding the 2035 goals

2.3.1 The medium- and short-term goals must be consistent in direction and well connected

The medium- and short-term goals should be consistent over time, space, and levels of government; as well as connected to the foreseen changes in the economy, social context and urbanization. We shall carry out relevant work based on the 2035 goals. The goals of the 14th Five-Year Plan shall refer to the 2030 and 2035 goals and be defined based on the goals of Beautiful China 2035. Some of the target indicators of the 13th Five-Year Plan need to be improved steadily, and it is necessary to continue to meet and simultaneously strengthen the requirements for rural areas, ecosystems, climate change, and environmental health (especially the health problems of vulnerable groups such as women and children), so as to carry out relevant work in advance. A three-year moving average could be considered for setting some targets.

2.3.2 The 2035 targets should align with China's pathway to 2050

The 2035 targets should align with China's pathway to 2050. This is particularly important for slow-changing and long-lived systems, such as the energy system, urban layout and others. Methods of foresight need to be applied in order to enable timely initiatives, for example in large old-style manufacturing areas. Foresight methods are also required to avoid, as much as possible, painful write-offs of measures that may be of some use towards 2035 but have no role thereafter ('stranded assets'). For example, any strategy involving 'clean coal' requires a planning horizon well beyond 2035³. In addition, a timely understanding of the challenges and opportunities of adaptation to climate change is needed in order to minimize the eventual cost and disruption as well as potential public health risks.

2.3.3 Regional differences should be taken into account when working toward the 2035 goals.

Due to the wide differences among regions with different levels of economic and endowments of natural resources and biodiversity, it is unrealistic to expect all regions

³ Bakkes, J. et al. (2017), The worldwide context of China's Green Transition to 2050. PBL Netherlands Environmental Assessment Agency, The Hague. Box on p. 37

to achieve the goals of Beautiful China by 2035. For example, the Pearl River Delta region may complete the goal by 2030, while it may take longer in central and western regions. For developed and underdeveloped regions, on the condition that they have met the same environmental standards and requirements, the principle of “common but differentiated responsibilities” shall also be determined; that is, we shall encourage some regions to achieve the goals of Beautiful China first while giving more support to poor and vulnerable regions so as to avoid the deterioration of the ecological environment. Environmental governance will put more emphasis on sharing positive experiences and win-win benefits. It is recommended to establish a Beautiful China demonstration zone. This could be done by establishing ecological provinces, cities, counties and districts that could play leading and demonstration roles. In line with this, and as far as possible, the target indicators and policy measures for the 14th Five-Year Plan shall be differentiated by region, and the related implementation guidance and capacity building shall be strengthened. Regional differentiation should be accompanied with a timetable showing the eventual application of ambitious protection to all regions of China and allowing investors and other actors to anticipate on this. Policies that provide perverse incentives for investments in regions with less stringent environmental requirements should be avoided.

2.3.4 We shall establish a target and indicator system that is oriented to ecological priorities and green development, so that a high-quality development can be supported.

This shall be the core guiding idea of the 14th FY plan. The SPS recommends targets that are ambitious, clear, measurable, outcome-based, use SMART-related criteria, focusing on absolute ambient-level targets rather than intensity targets. In terms of emission targets, it underscores the importance of setting and then sticking with long-term emission targets, to enable different actors to meet them. This approach could assist other countries in achieving environmental and development goals.

2.3.5 Regular and independent review of targets and indicators and establishment of the tracking system

As the general conditions for achieving sustainable development may change, new problems and possibilities may arise or new and better data may become available, a regular independent revision of indicators, targets and measures required is necessary. In terms of the Beautiful China demonstration zone, it is suggested to strengthen long-term tracking of the goal of achieving Beautiful China, build an evaluation system for

achieving Beautiful China goals, implement assessment and early warning, establish improvement mechanism, and strengthen policy preparations.

Box 2-1 German Sustainable Development Strategy: Targets and indicators

Targets and indicators reflect the status of sustainable development and form the basis for assessing the success of the measures taken.

The German Sustainable Development Strategy is not based on a single index per SDG but on several key indicators. The number of these key indicators is kept relatively small (in comparison to the UN SDGs, with a total of 232 indicators) in order to provide a quick overview of the current state of sustainable development in Germany. After the current revision of the strategy in 2018, 67 indicators have been established to track progress in 36 areas among the 17 SDGs. These key indicators also serve as points of entry for other national indicator systems, for example the indicators of the National Biodiversity Strategy.

Most indicators are linked to quantitative targets (e.g. “indicator x shall reach value y in year z”). Other indicators are linked to qualitative targets (e.g. “indicator x shall increase in the future”). Progress towards the target is evaluated in an independent report by the Federal Statistical Office of Germany. For a quick overview and better comparison, the result of the evaluation for each indicator is illustrated by weather symbols in four categories (e.g. sun for very good performance, thunderstorm for very poor performance).

1.Principles of Target and Indicator Development

Specifying adequate long-term goals and indicators is a requirement for the successful implementation of any sustainability strategy. They reflect the status of sustainable development and form the basis for monitoring the success of measures taken.

2.Embedding national targets into the international framework (of SDGs)

The 2030 Agenda’s SDGs provide an exceptional framework for the development of national targets and indicators. Linking national indicators and targets to a well-

established international process leads to a broader relevance and acceptance of the strategy and facilitates the international exchange of experiences.

3.Highlighting the relevance of the targets

In order to promote acceptance and support for newly developed targets, it is important to link them to internationally agreed goals such as climate protection and to underpin them with recognized scientific findings.

4.Reflecting national priorities

Political priorities must include ambitious targets and indicators. This is the only way to link ambitious policy measures to targets and ensure successful monitoring. The number of indicators and targets should be limited.

5.Illustrating interdependencies, synergies and conflicts of social, environmental and economic targets

While targets are often assigned to one specific dimension of sustainability, they have interdependencies with the other two dimensions. These interdependencies and possible synergies and conflicts must be taken into account when developing indicators for the targets. An ecological economic system not only has a positive impact on the ecologic dimension of sustainability, e.g. reduced CO₂ emissions or reduced resource consumption. It may also contribute to achieving economic targets, e.g. by improving competitiveness through more efficient use of energy and decreasing dependence on potentially depleting resources.

6. Scaling down goals and indicators in order to be relevant for action and linking measures to them

Since overarching goals are generally broad in scope, the design of more specific sub-goals and related indicators is important in order to enable detailed monitoring. Targets and indicators should then be chosen in such a way that they can be linked to and affected by policy measures.

The goal of reducing CO₂ emissions for example can be divided into reductions in the sectors of industry, private households and transportation. A further subdivision would be possible for the different pathways for achieving this goal:

Increasing energy efficiency and increasing use of renewable energy sources. As a result very specific targets and indicators (linked to specific measures) can be developed.

It has to be noted though that indicator-based monitoring is not the only instrument for the evaluation of the strategy and its implementation. Not all domains and measures that are relevant to sustainable development can be reflected in an indicator-based monitoring system.

Further feedback regarding the success of the strategy and its measures is given by all the relevant stakeholders (e.g. the Council for Sustainable Development, the Parliamentary Advisory Council for Sustainable Development, other social actors and international experts within the framework of the Peer Review).

7. Defining clear responsibilities and establishing transparent and credible monitoring

It is indispensable to monitor the progress towards achieving the targets and to take subsequent action. In Germany, the Federal Statistical Office is responsible for monitoring. It enjoys a high degree of recognition in the sense of high data quality assurance. The quality and acceptance of monitoring is also a decisive success factor.

8. Regular and independent review of targets and indicators

As the general conditions for the sustainable development process may change, new problems and possibilities may arise or new and better data may become available, a regular independent revision of indicators and targets is necessary. In Germany, this revision process is carried out by international experts as part of the peer-review process of the sustainability strategy. In the current revision of the 2018 strategy, 3 new indicators were introduced and 2 targets revised to better reflect the current state of science and policy.

3. TRANSITION TO A LOW-CARBON, RESOURCE-EFFICIENT ECONOMY

3.1 Mitigating climate change

3.1.1 To realize the structural green transformation of energy

3.1.1.1 Continuing to deepen the reform of the power system

Efforts in this regard include accelerating the establishment of transparent and efficient national and provincial power trading platforms, improving the medium- and long-term power trading mechanism, and further promoting the construction of auxiliary power service markets and pilots of the spot market. The work also includes speeding up system reform of power generation and electricity use plans, increasing the proportion of market-oriented power transactions, further reducing the energy costs of enterprises, accelerating the innovation of power distribution/marketing and improving the fairness and openness of incremental distribution networks to the public. We shall also put in place a price and distribution mechanism that is conducive with the on-grid consumption of power generated from renewable energy, and gradually implement the power allowance assessment of renewable energy and green certificate trading mechanism, etc.

3.1.1.2 Continuing to deepen oil and gas reform

The reform of the oil and gas exploration and exploitation management systems shall be deepened, and detailed rules shall be issued as soon as possible; the exit mechanism of oil and gas exploration areas shall be strictly implemented, the competitive transfer of blocks shall be comprehensively put into practice, transfer of mineral rights in a market-oriented manner shall be encouraged, and the rules of transfer of mineral rights, reserves, and value assessment, among others, shall be improved. A mechanism for the disclosure and sharing of oil and gas geological materials shall be established and improved; the reform of the pipeline operation mechanism shall be promoted, the independence of the pipeline shall be realized, and the natural gas pipeline network and other infrastructure shall be available to third-party market entities in a fair manner. The price scheme of residential natural gas gate station and the sales price of residential natural gas shall be rationally implemented; differentiated price policies such as seasonal price difference and interruptible gas price shall be implemented to promote load shifting; price regulation of natural gas transmission and distribution links shall be

enhanced, excessively high transmission and distribution price in provincial regions shall be reduced, etc.

3.1.2 Setting a carbon price: taxes and emission trade systems (ETS)

The most cost-effective way to reduce carbon emissions and to promote the investments needed to drive the green transition is by putting a sufficiently high price on carbon.

Environmentally related taxes are one type of market-based instrument. In the context of mitigating climate change, they can take the form of a carbon tax whereby a tax is applied to the amount of carbon emitted by specified activities. Generally, a carbon tax aspires to improve the alignment between the cost of the polluting activity and the environmental cost.

Environmentally related taxes may also work indirectly when they are applied to activities that have an environmental impact but without targeting the environmental externality directly. In the climate field, taxes applied to energy and transport fuels are the most common form of this type of environmentally related tax. Indeed, in OECD countries, about 90% of the revenues generated by environmentally related taxes are from these sources.⁴ These taxes are often applied to generate revenues rather than for environmental purposes. Nevertheless, the level of tax applied to these fuels puts a price on carbon: an effective carbon prize.

Emission trading systems (ETS) are another type of market-based instrument, and work is currently under way in China to develop a national trading emissions system based on several pilot studies. In an ETS, a cap on the total amount of carbon emissions is set and then permits, or emission allowances, are allocated specifying how much pollution each permit holder can emit. Permit holders with insufficient emission allowances can purchase permits from those with an excess at a price determined by the market. This enables emitters to find the most cost-effective way to reduce carbon emissions and in a way that helps achieve the overall target. An ETS creates certainty about the emission reduction goal, but the price of carbon (permits) will vary, sometimes significantly. In contrast, a carbon tax creates certainty about the price of carbon, but the level of

⁴ Comprehensive information on the taxation of energy in OECD and G20 countries can be found in OECD (2018), *Taxing Energy Use 2018: Companion to the Taxing Energy Use Database*, OECD Publishing, Paris, <https://doi.org/10.1787/9789264289635-en>

emissions reduction will depend on the response of consumers and producers.

Box 3-1 Tax incentives⁵

Market-based instruments aim to increase the relative price of production and consumption to better reflect their environmental costs. However, it is often argued that the same result could be achieved by providing tax relief or subsidies to environmentally friendly activities; for example, VAT exemptions for energy-efficient appliances or favourable depreciation rates for capital investments in renewable energy or pollution abatement. The use of such incentives is most effective where there are “positive externalities”; that is markets provide too little of a socially desirable activity. A good example is R&D where companies tend to invest too little due to concerns that some of the benefits will be captured by other companies. However, tax and other incentives generally are not effective in addressing “negative externalities” like carbon emissions: they often subsidise activities that would have been undertaken anyway; it is difficult and often costly to identify all of the environmentally beneficial alternatives that may merit support; incentivising some activities may actually result in increased pollution; and, while taxes and ETS generate revenues, incentives are a form of public expenditure.

When well-designed and implemented, environmental taxes and tradeable permits are more or less equivalent. As such they share the advantages of market-based instruments over regulations.

First, whereas regulations specify how carbon emissions are to be reduced, market-based instruments allow for a wider range of abatement options. This in turn creates incentives to identify the least-cost, most cost-effective option. A 2013 OECD study tested this proposition empirically and confirmed that market-based instruments were the most cost-effective means for reducing carbon emissions.⁶

Second, whereas target- or technology-based regulations provide no incentive to abate

⁵ Source: Greene, J. and N. Braathen (2014), "Tax Preferences for Environmental Goals: Use, Limitations and Preferred Practices", OECD Environment Working Papers, No. 71, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/5jxwrr4hkd6l-en>

⁶ OECD (2013), Effective Carbon Prices, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/9789264196964-en>

once the standard has been met, market-based instruments provide an ongoing incentive to do so. This creates incentives to innovate and find the least-cost approach for meeting the environmental requirement. A 2012 OECD study confirmed that price signals have played an important role in stimulating innovation in technologies that reduce carbon emissions.⁷

Third, in contrast to regulations, market-based instruments generate revenues that can be used in socially beneficial ways. Carbon and other environmentally related taxes can be collected as part of the established process of collecting national taxes. In the case of ETS, they generate revenues when permits are auctioned. In 2017, the OECD estimated that, in the OECD area, environmentally related taxes generated about 5.2% of total tax revenues, equivalent to 1.6% of GDP.⁸ In 2016 in China, the corresponding ratios were 3.59 and 0.7% respectively.⁹

Whereas *charges* for water, waste or other environmental services are used to finance the provision of those services, *tax revenues* should normally accrue to the national treasury. The traditional argument is that “earmarking” tax revenues for specific purposes will ultimately result in inefficient expenditures. On the other hand, earmarking can increase policy transparency and help to offset opposition from those who will be subject to the tax.

A recent OECD study examined how countries have used the revenues generated by carbon pricing, both taxes and ETS.¹⁰ It found that carbon taxes were often linked to broader tax reform; that is, carbon taxes were often linked to reductions in personal or corporate income taxes. Such approaches aim for a “double dividend” involving improved environmental quality and a reduction in more distortionary taxes. Excise taxes on energy and transport fuels – which account for the largest share of carbon-related revenues – were the least earmarked. In some countries they are used to finance

⁷ OECD (2012), *Energy and Climate Policy: Bending the Technological Trajectory*, OECD Studies on Environmental Innovation, OECD Publishing, Paris, <https://doi.org/10.1787/9789264174573-en>.

⁸ OECD (2017), *Green Growth Indicators 2017*, OECD Green Growth Studies, OECD Publishing, Paris, <https://doi.org/10.1787/9789264268586-en>.

⁹ <https://www1.compareyourcountry.org/environmental-taxes>.

¹⁰ Marten, M. and K. van Dender (2019), "The use of revenues from carbon pricing", *OECD Taxation Working Papers*, No. 43, OECD Publishing, Paris, <https://doi.org/10.1787/3cb265e4-en>.

transport infrastructure, suggesting that in those countries they are seen as form of user charge. Revenues from auctioned tradable emissions permits are almost exclusively earmarked to support energy efficiency, low-carbon mobility and other green spending measures, with the second highest share dedicated to compensating energy users for the higher costs they must bear.

While environmentally related taxes and ETS share some common benefits, they have different characteristics which make them better or worse suited for different tasks. Emissions trading systems may be preferred to taxes in cases where attaining a particular level of pollution is essential. They also work well when there is a well-defined set of large emitters potentially interested in trading permits. A carbon tax may be preferable if a wider, more diverse set of emitters is targeted. While there may be uncertainty about the environmental outcome, knowing the price of pollution helps investors make abatement decisions, so taxes can give stronger abatement incentives than emission-trading systems.

Another important consideration when choosing between taxes and ETS is administrative costs. Establishing an environmental tax system generally incurs less costs than ETS, though the costs may still be significant. The costs of monitoring taxable emissions may also be significant. Administrative costs can be reduced by integrating the collection and management of revenues into the existing tax administration. In contrast, the start-up and administrative cost associated with ETS can be significant. The management of the trading system to ensure its integrity and transparency may also be a challenge. However, given the level of effort and engagement in establishing an ETS, once it is up and running, it is likely to enjoy the support of participants.

In terms of environmental effectiveness, taxes will be most effective when they target carbon emissions most directly. Thus, a carbon tax will provide better incentives to reduce carbon emissions than taxing energy use or vehicles that use energy fuels. The environmental effectiveness of taxes has sometime been weakened by granting exemptions and when the real value of the tax is not adjusted in line with inflation.

In the case of ETS, permits should be auctioned rather than allocated for free (grandfathered). Auctioning makes sure that the rents linked to permits go to public authorities rather than existing polluters. Free allocation of permits weakens incentives

to invest in less carbon-intensive technology. It may result in the oversupply of permits and a carbon price that is not sufficient to drive the low-carbon investments originally envisaged. Free allocation of permits may also enable some firms to make large windfall profits and foster corruption in the trading system which erodes the credibility of the system. This was the case in the early phases of the EU's ETS.

Application of ETS internationally requires that all participating jurisdictions have declared, for specific points in the future, a limit ('cap') on carbon emissions in absolute terms. Carbon prices in trading are based on that. China's current climate policy has no absolute cap, but a commitment in terms of intensity: emission per unit of added value. Such an intensity commitment is arguably better suited to a dynamic economy like China's. But China could someday declare an emission cap in absolute terms as a policy option at an appropriate time, thereby removing one obstacle to international ETS trading as a means of cost reduction on the way to 2035. In that situation, as a means to retain some flexibility, it could seek the privilege of periodically revising its carbon cap, for example in function of its five-year planning¹¹.

Whether taxes or ETS are used, the most important determinant of environmental effectiveness will be the price these instruments put on carbon. A 2018 study examined the effective carbon rate in OECD and G20 countries.¹² It also calculated the carbon pricing gap using EUR 30 as a reference price for a tonne of carbon. This was considered to be at the low end of the possible price range if international climate targets are to be achieved.¹³ The carbon price gap is a measure of the difference between the actual and reference carbon price. The report showed that 46 % of CO₂-emissions from all energy use in the 42 countries are not subject to any carbon price, and only 12% to a rate of at least EUR 30 per tonne. 88% of emissions are priced below EUR 30 per tonne.

The picture was a bit more nuanced when broken down by sector. The road transport

¹¹ ZENG Yingying (2018) Obstacles to Linking Emissions Trading Systems in the EU and China. A comparative law and economics perspective. PhD Thesis, University of Groningen.

¹² OECD (2018), *Effective Carbon Rates 2018: Pricing Carbon Emissions Through Taxes and Emissions Trading*, OECD Publishing, Paris, <https://doi.org/10.1787/9789264305304-en>.

¹³ At the beginning of 2018, the price of carbon in the EU ETS was less than 8 EUR/tonne. In August 2019, it was almost 29 EUR/tonne. The results presented here should take this development into account. The change in the price of carbon illustrates the volatility that can occur within and ETS.

sector had the highest effective carbon rate and carbon pricing gap of 58%. This contrasts with industry and the residential and commercial sectors that had carbon price gaps of 95 and 93% respectively. Somewhat surprisingly, coal which is the most carbon-intensive energy source, was taxed at the lowest rates or not taxed at all in almost all countries.

The table below shows the carbon price gap by country. China's carbon price gap belongs to one of the countries with the largest gaps.

Table 3-1 Carbon Price Gap¹²

Norway	34
UK	42
Germany	53
Poland	67
USA	75
China	90
Indonesia	95

Two factors have been important in preventing a higher a price being levied on carbon: concerns about its impact on the competitiveness of industry and concerns about how it might affect the affordability of energy for lower-income groups.¹⁴ However, competitiveness impacts appear to have been exaggerated and affordability issues can be offset by flanking policies. This suggests that these concerns are not justified in preventing a higher price being put on carbon.

There is growing body of evidence that the immediate competitiveness impacts of existing carbon pricing mechanisms are negligible or nil. This includes carbon and energy taxes as well as ETS. While this can be partly explained by the low prices and free allocation prevailing in most mechanisms, these same prices nevertheless have reduced emissions, and windfall profits have occurred. This suggests that the prices have not been so low as to be ineffective environmentally or trivial economically. Other

¹⁴ OECD (2017), Environmental Fiscal Reform: Progress, Prospects and Pitfalls, <https://www.oecd.org/tax/tax-policy/environmental-fiscal-reform-G7-environment-ministerial-meeting-june-2017.pdf>.

analysis suggests that a higher carbon price could boost the short-term productivity growth and longer-term competitiveness of the most productive firms and industries.

Regarding the impact on households, it depends on the type of tax involved. An OECD study found that that taxes on transport fuels tend to be progressive on an expenditure basis (higher for high-income groups compared to low-income groups). However, experience from France suggests that this likely to be the case for urban dwellers: taxes on transport fuels may be regressive for rural residents who are dependent on privately-owned vehicles for transport. Taxes on heating fuels were slightly regressive, and taxes on electricity were more regressive on both an income and expenditure. However, if an energy tax increase was complemented by income-tested compensation, this could improve energy affordability for the poorest population groups using just a third of the additional revenues raised. Thus, a higher effective carbon rate could be applied, and after implementing effective flanking policies, substantial amounts of revenues could still be available for other us

As with any policy instrument, side-effects, distributive impacts and sufficiency of a carbon price change under consideration should be quantitatively investigated. That is before and during implementation. Sufficiency questions include, most prominently, whether the envisaged intervention is likely to produce change that not only goes in the desired direction but is deep and fast enough, compared with alternative policy instrument mixes.

3.2 Enhancing material productivity and resource efficiency /Circular Economy

Global material resource consumption is projected to double by 2060. Unless environmental management and resource efficiency policies are significantly improved, natural assets will continue to degrade and become scarcer, with potentially serious adverse economic, social and environmental consequences. The underlying policy objective should be to decouple resource consumption from economic growth; at first relatively and ultimately absolutely.

Like other countries, China should carry out a careful analysis, in consultation with stakeholders, of the resource-consuming sectors that pose the greatest economic, environmental and social threats. On this basis, it can develop a national plan with targets and indicators. An effective national plan requires concerted and coherent policy action by the government, supported by effective governance arrangements at a sufficiently high level in order to respond to the systemic challenge in transitioning to

a circular economy. Several OECD countries, including Finland and the Netherlands, have established overarching mechanism to support the coordination and coherence of resource productivity policies.

Drawing on country experience, a recent OECD report has suggested that national strategies should include four main policy approaches:¹⁵

Apply mixes of policy instruments so as to provide a coherent set of incentives for resource efficiency along the product value chain.

Policy mixes could include a set of complementary regulatory, market-based, finance and information instruments. Many countries have found it easier to apply instruments downstream in the value chain, e.g, taxes on waste going to landfill. It has proven more difficult to apply instruments that effectively target product design and that increase demand for resource-efficient products. Yet, influencing how products are designed, and creating demand for resource-efficient products, are potentially some of the strongest instruments to achieve resource efficiency objectives.

Box 3-2 Possible policy mixes for plastics¹⁶

Regulations can be used: to ban or restrict certain components of plastic; to bans some of the uses of single-use plastics; to require a minimum recycled content or uptake of secondary plastics; and to establish recycling targets and landfill bans.

A variety of *market-based instruments* are available. Taxes can be applied to penalise specific products (or chemical additives) and less preferable waste treatment practices (i.e. landfilling or incineration). Well-designed deposit refund schemes and extended producer responsibility policies can recover the costs of waste management, and help

¹⁵ OECD (2016), *Policy Guidance on Resource Efficiency*, OECD Publishing, Paris <https://doi.org/10.1787/9789264257344-en>.

¹⁶ Source: Watkins, E., et al. (2019), "Policy approaches to incentivise sustainable plastic design", OECD Environment Working Papers, No. 149, OECD Publishing, Paris, <https://doi.org/10.1787/233ac351-en>.

to create a market for secondary plastics.

Finance can be used: to support the development of waste management infrastructure; to fund R&D in areas like product design; and green public procurement.

Information by means of certification and labelling can help to inform the purchasing choices of businesses and consumers.

Implement policies that promote resource efficiency across the lifecycle of products.

Several approaches are available to achieve this objective: extended producer responsibility (EPR); green procurement; and partnerships involving business working along value chains.

EPR involves producers taking responsibility for collecting, sorting and treating end-of-life products, in line with the polluter-pays principle. This approach is now used by a majority of OECD countries for electric and electronic equipment, packaging and tyres. These policies have helped to reduce landfilling of waste and increase material recovery. However, a recent review of EPR systems in OECD countries suggested that there was scope to improve the operation of these policies and provided recommendations for how this could be done.¹⁷

Green Public Procurement (GPP) aims to establish resource efficiency criteria for public purchases. General government procurement accounts for 12% of gross domestic product and nearly one third of government expenditures in OECD countries. As a result, greening public procurement can provide important leverage to stimulate innovation and increase demand for green products. However, much remains to be done to integrate resource efficiency considerations – including the use of lifecycle analysis – into public procurement programmes. Furthermore, it is crucial that appropriate capacity is built in relevant agencies at national and subnational level.

¹⁷ OECD (2016), *Extended Producer Responsibility: Updated Guidance for Efficient Waste Management*, OECD Publishing, Paris, <https://doi.org/10.1787/9789264256385-en>.

One example of partnerships involving business is industrial symbiosis. This involves engaging companies in a network to foster eco-innovation and knowledge sharing in order to make one operator's waste another one's material input. Another approach involves large companies working with the smaller supply companies to ensure that inputs produced along the value chain meet resource efficiency and other environmental criteria.

Treat resource efficiency as an economic policy challenge and integrate it into cross-cutting and sectoral policies.

The transition to a circular economy requires a comprehensive set of policy measures at the macroeconomic and sectoral level. Opportunities should be sought to exploit synergies with other policies, including climate change: there are many win-win opportunities in pursuing low-carbon and resource efficiency objectives, such as in the area of sustainable mobility. At the same time, some of the main barriers to achieving resource efficiency goals are linked to the incentives embedded in policies in other sectors. Analysing the major resource consuming sectors – agriculture and food, transport, energy – can help to identify policy misalignments with resource efficiency objectives and how they might be overcome. Unless this analysis is performed, resource efficiency policies may be ineffective.

Governments can also support resource-efficient structural change by mainstreaming the pursuit of resource efficiency into cross-cutting policies:

- Innovation is an essential means for decoupling resource consumption and growth. Accordingly, measures should be taken to mainstream resource efficiency into R&D programmes. Some OECD governments are also targeting innovation support on small- and medium-sized enterprises (SMEs) as these are often the source of radical innovation. Innovation may also be important in relation to business models. Indeed, the circular economy is closely associated with new business approaches for managing materials. Governments have a role to play in establishing a supportive policy framework while guarding against any unacceptable economic, environmental or social practices.

Box 3-3 Five headline business models for a more circular economy¹⁸

Circular supply models, by replacing traditional material inputs derived from virgin resources with bio-based, renewable, or recovered materials, reduce demand for virgin resource extraction in the long run

Resource recovery models recycle waste into secondary raw materials, thereby diverting waste from final disposal while also displacing the extraction and processing of virgin natural resource

Product life extension models extend the use period of existing products, slow the flow of constituent materials through the economy, and reduce the rate of resource extraction and waste generation

Sharing models facilitate the sharing of under-utilised products, and can therefore reduce demand for new products and their embedded raw materials

Product service system models, where services rather than products are marketed, improve incentives for green product design and more efficient product use, thereby promoting a more sparing use of natural resources.

Investment in housing, transport and other infrastructure will continue to be a major driver of the Chinese economy until 2035 and beyond. It is crucial that these investments are resource-efficient and do not lock China into a high-carbon, resource-inefficient pattern of development. Public investors should set the example by integrating resource efficiency objectives into standards for buildings and other infrastructure. Private investors should be incentivised to integrate resource efficiency objectives into their investment strategies.

¹⁸ Source: OECD (2018), *Business Models for the Circular Economy: Opportunities and Challenges for Policy*, OECD Publishing, Paris, <https://doi.org/10.1787/g2g9dd62-en>.

Strengthen policy development and evaluation through better data and analysis.

The development of policies for a circular economy requires the development of appropriate metrics. To this end, many OECD countries have developed material flow analysis as well as new indicators to support their policy efforts. Better information is needed for both the environmental and economic aspects of the circular economy.

4. STRENGTHENING, PROTECTING AND RESTORING ECOLOGICAL SYSTEMS AND THE HUMAN LIVING ENVIRONMENT

4.1 Reinforce the conservation and restoration of ecologically vulnerable areas and ecological function areas

- Firstly, to perform systemically ecological conservation and restoration in key regions in line with the characteristics of different vulnerable areas. To develop basic measures and technical countermeasures of ecological restoration in accordance with the principles of adaptation to local condition, combination of natural restoration and artificial measures, and benefiting livelihood, etc., based on comprehensive consideration of resources, environment, economy and other factors of the vulnerable areas.
- Secondly, to implement ecological restoration and conservation projects in an orderly manner, and promote the governance of ecological systems as a whole. To strengthen conservation of ecological systems such as forest, grassland, wetland, lake, etc. as a whole, and embark demonstration projects for typical damaged ecological system restoration first in the ecological conservation red line areas with vulnerable ecological environment.
- Thirdly, to carry out the supervision and management mechanism of ecological conservation and restoration, and strengthen subsequent regulation. Governments at all levels should clarify departmental duties and management requirements of ecological restoration and conservation by the managerial principle of no change of subject responsibility, realize the overall management of mountains, waters, forests, fields and lakes as well as grassland. Establish the "sky and land integration" monitoring and supervision system and achieve supervision normalization. Establish technical specifications for monitoring and warning of ecological restoration and conservation in typical ecologically vulnerable areas. Form a monitoring and warning network fully covering the restoration areas and conservation areas, and grasp dynamic changes in ecological restoration and conservation in a timely manner. Complete the ecological conservation compensation mechanism. Execute the compensation policies based on category and level. Properly integrate the ecological conservation compensation and targeted poverty alleviation. Develop innovative ways to use funds. Carry out comprehensive ecological compensation trial in poor areas and explore new paths to ecological poverty alleviation. Stringently perform evaluation and assessment.

Reinforce subsequent supervision of ecological restoration projects. Regularly monitor and inspect the use of special funds for ecological restoration and project implementation. And formulate a regular reporting system.

- Fourthly, to underpin technological research for ecological conservation and restoration, and drive technological innovation. According to the dominant ecological functions in ecologically vulnerable areas, to undertake research on the ecological function based evaluation technology and diagnostic methods of degraded ecological systems. Identify key indicators of regional ecological degradation, establish the ecological function based evaluation index system, class determination criteria and corresponding technical methods of degraded ecological systems. Analyze driving factors of regional ecological degradation and ecological service function weakening. Search for suitable restoration modes for different types of ecological vulnerable areas through the restoration modes of integration of regional control and local restoration technology and coordination between regional ecological function improvement and economic development.

4.2 Sustain ecological security barriers, enhancing overall service capacity of the ecosystem

- To maintain holistic stability of the ecosystem, consolidate ecological security barriers, and enhance overall service capacity of the ecosystem. To adhere to the overall planning of land and sea, aiming at fundamental improvement of the quality of the ecological environment and achieving “beautiful China”, to increase the protection and restoration of ecosystems, optimize the ecological security barrier system, and achieve the improvement of ecological environment quality and sustainable use of resources.
- To implement important ecosystem protection and restoration major projects, to build ecological corridors and biodiversity conservation networks, and improve ecosystem quality and stability. To complete the work of delineating the three lines of ecological protection red line, permanent basic farmland and urban development boundary. To carry out national greening actions, promote comprehensive management of desertification, rocky desertification, and soil erosion, strengthen wetland protection and restoration, and strengthen prevention and control of geological disasters. To improve the natural forest protection system and promote the return of farmland to forests and grasslands.

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- To make overall planning on marine ecological conservation and development, and build a "One Belt Multiple Spots" marine ecological security structure with coastal belts, island chains and all kinds of reserves as the support. To conserve marine living resources, strengthen monitoring and early warning of marine ecological environment, and prevent environmental risks.
 - To anticipate on already 'committed' climate change, starting now and continuing during the remainder of this century. This requires, among many other things, ample buffer zones around some nature reserves, on land and elsewhere, as they may need to be redefined spatially or otherwise adapted. It also requires to carry out foresight-based monitoring and periodic evaluation, in order to timely prepare for new zoning procedures.

4.3 Protect human health from environmental risks

Strengthen cooperation between health and environmental authorities in formulating environmental laws and policies to ensure they provide adequate protection for human health as well as the environment

Key possible steps:

- **Public safety.** Strengthen the cooperation between health and environmental authorities in the setting and monitoring of key environmental standards, goals and milestones so as to ensure that they provide adequate protection for human health as well as the environment.
- **Managing environmental health incidents.** Establish mechanisms involving health and environmental authorities to manage health risks associated with environmental health incidents, for example, incidents related to air, water and soil pollution/food safety. For example, Health Response Protocols between public health and environment agencies and water utilities to guide their joint responses following the detection of physical and chemical characteristics that exceed the safe drinking water guidelines and adversely affect public health
- **Public awareness.** Increasing information available to the public about the adverse effects of air, water and soil pollution on human health to increase understanding of the need to act.
- **Public access to real time data** supported by health advice to encourage community members to keep their exposure levels to a minimum, with a focus on vulnerable populations.

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- **Key health metrics** included in the proposed target and indicator system to support high quality development and good health/well being.
 - **Data coordination and sharing arrangements** formalized between health and environment agencies and the public dissemination of this information.
 - **Food safety.** Adopt a holistic approach to food safety and environmental health risks in partnership with industry and strengthen the food regulatory system to improve food security and food safety.
 - **Governance issues.** Embed public health considerations in key environmental legislation supporting China's goal of environmental quality improvement.
 - **Capacity building.** Build human and institutional capacity in health and environmental authorities to manage environmental health issues, including by investing in data linkages.

Potential benefits:

- Improves the well-being of the population by reducing premature deaths and illness related to environmentally related health risks.
- Reduces the economic costs related to environmentally related mortality and morbidity.
- Provide the population with precise and reliable information about environmental health risks thereby minimizing impacts of unfounded environmental or food safety scares.
- Assists in raising public understanding of the need for policy changes and supports well informed behaviours and consumption choices.
- Strengthen accountability of officials and enterprises
- Provide key population health data to inform regionally differentiated targets and milestones.
- Assists in monitoring progress and where necessary, adapting pollution action plans based around risk to human health.
- Increasing public confidence in food safety and improving public health outcomes by strengthening food safety regulation; supporting increased focus on domestic consumption.

Four summaries of important background:

1. The role of health data in improving environmental outcomes

The health of a population is inextricably linked to the state or health of the natural environment and health considerations have been a major driver of environmental improvements in most jurisdictions. Environmental health encompasses the assessment and control of environmental factors that can potentially affect health. Extensive research has documented the health impacts associated with air and water pollution, unsafe food products, contamination of food and water by chemical products such as pesticides and pharmaceuticals, waste collection/sanitation, population growth and distribution, extreme weather events and climate change.

Health related impacts of air quality, noise levels, chemical concentration, water quality, soil contamination and climate change are uniformly acknowledged worldwide to be one of the most significant issues of environmentally-related public concern to communities. The major aim of monitoring and reducing air pollution is to reduce its impact on human health. Health data is increasingly utilised to inform the public about levels of risk, report progress on key environmental policy goals and provide individuals with the necessary information to change their behaviours to mitigate risk of exposure and reduce harm, for example through targeted alerts to vulnerable community members regarding air or water quality alerts. Costs of pollution to human health outcomes are also well documented and increasingly utilised to provide insight into the shape and stringency of key regulatory and policy responses and building awareness and community acceptance of the need for stringent policies.

Role of health agencies has been increasingly embedded in resource use and pollution control related decision-making through legislation, standard setting processes, action plans and reporting dashboards. All jurisdictions are progressively seeking to strengthen monitoring and analytical capabilities to identify and manage exposure to public health risks and to relate the exposure to indoor and outdoor air pollutants with mortality.

Annex 2 identifies targets and indicators utilised in Europe, USA and Australia and outlines their utility to environmental goal achievement and advantages and disadvantages of various indicators. Indicators take the following form; environmental indicators to parts or processes in the physical environment; physiological indicators (changes in human body related to exposure); health indicators related to the occurrence

or prevention of pathophysiological changes, disease or death in a population; integrated health indicators (to express the disease burden of a population) and diverse indicators showing the relationship between the quality of environment and health.

II Trends in environmental health data

Data comparably internationally has been enhanced by the increasing use of common methodologies and indicators. Studies on the short term effects of air pollution commonly adopt the Air Pollution and Health: A European Approach (APHEA)¹⁹ protocol to assess associations between air pollution concentrations and health effects outcomes. Longer term studies such as the Global Burden of Disease Study provides an independent estimation of population health of 195 countries utilising standardised approaches which increasingly inform the achievement of Sustainable Development Goals²⁰. Linking of data at jurisdictional and international levels allows accurate data to be collected about the key risk factors that drive death/disability and the broader health and economic impacts of pollution. Air pollution is identified by the World Health Organisation, “the world’s largest single environmental health risk”. It is a major risk factor in several diseases leading to disabilities and deaths including cancers, lower respiratory infections and heart disease and strokes – with the latter two accounting for the greater share of the deaths attributable to air pollution. The World Health Organisation’s current position is that evidence no longer supports the notion that there is a safe level of pollutant concentrations.

A site or project specific focus has increasingly been extended to consider population health level considerations, including cumulative impacts of exposure to health risks, supported by a growing use of human bio monitoring and geospatial analysis. This includes investing in advanced monitoring technology for measuring emissions and ambient concentrations of pollutants as well as a more comprehensive and rigorous methodology for relating exposure to pollutants with health impacts including mortality. Priority has been given to the development of ‘policy relevant’ human bio-monitoring indicators and the increased utilisation of focussed human bio-monitoring and

¹⁹ Katsouyanni K, Schwartz J Spix C, et al. Short term effects of air pollution on health: a European approach using epidemiological time series data: the APHEA protocol. www.ncbi.nlm.nih.gov

²⁰ GBD 2017 Resources. <http://www.healthdata.org/node/6778>

geospatial analysis to identify and manage exposure risks to public health such as exposure to chemicals.

The European Union's 7th Environmental Action Program (EAP)²¹ aims to minimize environmental health risks from the use of hazardous chemicals. Focus on policy questions like whether an implemented policy to reduce chemical exposure has had an effect over time, whether the health of the people in specific regions or subpopulations is at risk. Indicators can help to synthesis complex scientific information in to a few key descriptors to help inform a non-expert audience. Human bio-monitoring indicators for Europe are being developed to help summarise internal exposure to chemical substances among the population and communicate to what degree environmental policies are successful in keeping internal exposure sufficiently low²².

Australia is progressing exposure mapping combining waste water analysis with human bio-monitoring to spatially resolve human exposure to chemicals at the catchment level. The integration of waste water and bio-monitoring data will allow the creation of a national hazard specific exposure map that can be compared with geospatial data on disease risk and socio-economic indicators.²³

III. Economic and human costs of pollution

Successive Global Burden of Disease Studies have identified air pollution –indoor and outdoor combined –as the biggest environmental cause of premature deaths overtaking poor sanitation and a lack of clean drinking water, killing more than 3.5 million across the world every year. In addition to health consequences impacts on crop yields, biodiversity and ecosystems have significant economic consequences which affect economic growth as well as welfare. The integration of environmental health data with broader economic, social and environmental metrics provides useful guidance to governments when assessing the costs and benefits of possible measures to reduce

²¹ European Union 7th Environment Action Program to 2020 <https://www.eea.europa.eu/7th-env>

²² Buekers, J.; David, M.etc. Development of Policy Relevant Human Biomonitoring Indicators for Chemical Exposure in the European Population. *Int. J. Environ. Res. Public Health* 2018, 15, 2085.

²³ Müller J.; Thomas K.; Project: Exposure mapping - combining wastewater analysis with human biomonitoring (2018–2022). The University of Queensland. <https://researchers.uq.edu.au/research-project/33222>

pollution from the main sources of air pollution.

The OECD Report, *The Rising Cost of Ambient Air Pollution thus far in the 21st Century: results for the BRIICS and the OECD Countries* utilises epidemiological data from the Global Burden of Disease Study 2015 to estimate the cost of ambient air pollution in 41 countries²⁴. Cost for OECD societies plus China and India were estimated at USD3.5 trillion a year in terms of lives lost and ill health. In OECD countries the total number of deaths, from ambient pollution experienced a relatively modest reduction (approx. 4 per cent) in deaths between 2000 and 2010, which was more than offset by the increase in the OECD countries subsequently in the five years up to 2015. The mortality data also reflects improved measurement and analytical techniques for measuring emissions and ambient concentrations of pollutants, as well as a more comprehensive and rigorous methodology for relating exposure to air pollutants with mortality.

In the BRIICS there was an uninterrupted increase in the total of deaths, with a plateauing out in the five-year period from 2005 to 2010. In China, deaths increased by about 5% in this period and in India by 12%. China is home to one fifth of the world's population but accounts for nearly two fifths of the global death toll linked to outdoor air pollution. India has far fewer air pollution related mortalities but deaths from ambient air pollution are rising more quickly linked to the much higher use of diesel vehicles in India.

In the last five-year period, from 2010 to 2015, deaths from ambient air pollution (APMP) increased across the board: by 1% globally, by 2% in the BRIICS and by 9% in the OECD countries as a whole. The cost of death from ambient air pollution has increased in the past five-year intervals for both BRIICS and OECD countries when considered as a block (see Table 4-1). In most OECD countries the cost is within an average of 3.7% of GDP.

Table 4-1 Cost of premature deaths from APMP in the BRIICS and OECD countries, 2015

²⁴ OECD (2007), *Rising Cost of Ambient Air Pollution thus far in the 21st Century: Results from the BRIICS and the OECD Countries*, OECD Environment Working Papers, Paris, DOI:<https://doi.org/10.1787/d1b2b844-en>

	USD2015 millions	Compared to GDP
BRIICS:		
Brazil	98 551	3.1%
China	1 507 189	7.9%
India	803 538	10.6%
Indonesia	96 415	3.5%
Russia	447 658	12.5%
South Africa	37 314	5.2%
OECD:		
Australia	14 935	1.4%
Austria	16 840	4.1%
Belgium	22 106	4.4%
Canada	29 277	1.8%
Chile	14 645	3.7%
Czech Republic	23 541	6.8%
Denmark	8 872	3.3%
Estonia	1 866	5.1%
Finland	5 887	2.6%
France	75 533	2.9%
Germany	178 558	4.6%
Greece	16 516	5.7%
Hungary	23 091	9.1%
Iceland	265	1.7%
Ireland	5 861	1.9%
Israel	7 043	2.3%
Italy	115 669	5.3%
Japan	207 795	4.4%
Korea	64 117	3.7%
Latvia	5 031	10.5%
Luxembourg	1 315	2.3%
Mexico	58 620	2.7%

Netherlands	30 047	3.7%
New Zealand	2 106	1.2%
Norway	7 699	2.4%
Poland	73 046	7.3%
Portugal	10 285	3.4%
Slovak Republic	10 300	6.5%
Slovenia	3 034	4.7%
Spain	44 075	2.8%
Sweden	9 117	2.0%
Switzerland	11 175	2.2%
Turkey	70 255	4.6%
United Kingdom	106 594	3.9%
United States	431 598	2.4%
Total of all 35 OECD countries in USD and compared to OECD GDP	1 768 666	3.5%

Source: Epidemiological data extracted from IHME (2016)²⁵ and economic data extracted from OECD (2016)²⁶.

While air pollution has fallen in many OECD countries helped by stricter policies on emissions on vehicles, this has in part been offset by a switch to more polluting diesel vehicles. In OECD and in the United States road transport is estimated to be responsible for about half of this. Diesel and gasoline account for 95% of energy used for road transport in the OECD, and diesel fuel is taxed at lower rates in 33 of 34 EOCED countries. OECD studies have documented why this is not justifiable from an environmental perspective and why policies favouring diesel over gasoline should be phased out. Emissions are increasing in China and India because of rapid growth of traffic is outpacing the adoption of tighter controls on emissions from vehicles in the

²⁵ IHME (2016), Global Burden of Disease Study 2015 (GBD 2015), Online database – Viz Hub – GBD Compare, Institute for Health Metrics and Evaluation, University of Washington, Seattle, <http://vizhub.healthdata.org/gbd-compare/>.

²⁶ OECD (2016), OECD Stat Extracts [online database], OECD, Paris, <http://stats.oecd.org/>

period 2005-2010 deaths in China increased by 5% and India by 12%. Evidence suggests that air pollution from both from heavy industry and energy generation particularly coal fired power plants play a larger role in several BRIICS than in the case of the OECD countries. Motorisation is also an increasing driver of air pollution especially associated with the shift to diesel.

Given the dominant role of road transport as a contributory factor in ambient air pollution the OECD has supported the following measures; **remove incentives** for purchase of diesel cars; **maintain and tighten regulatory regimes**; **promote less polluting forms of transport** including public transport; **mitigate** the effect of air pollution on vulnerable groups such as the young and the old; BRIICS moving rapidly to the higher OECD standards; and enhanced coordination in research and policy between BRIICS and OECD to consider ambient air pollution as a collective problem.

IV. Food safety and health risks

Food safety and environmental pollution are highly interlinked with food potentially contaminated through exposure to microbes, chemicals, bio toxins and other pollutants in the air, water or soil. Food risks are heightened by the scarcity of water and utilization of pesticides. Food borne illnesses have increasingly become notifiable diseases and in the case of Australia are reported by a National Notifiable Diseases Surveillance System which underpins comprehensive food safety system with responsibility shared between national and state health and agricultural agencies.

The Food and Agricultural Organisation of the United Nations Global Symposium 2018 Outcome Report noted that soil pollution threatens agricultural productivity, food safety and human health. It noted that there was no systematic assessment of the status of soil pollution at global level despite agricultural intensification, industrial output and urbanization. China has categorized 16 percent of its soils and 19 percent of its agricultural soils as polluted reinforcing the need to address soil pollution related to industrial as well as agricultural sources. Soil pollution constitutes a potential risk on both food safety and security. Emerging pollutants are of growing concern worldwide and include pharmaceuticals, endocrine disruptors, hormones and biological pollutants. Food safety and security is highly dependent on the level and effectiveness of regulatory controls.

4.4 Innovate spatial and urban planning

Reformulate the Urbanization Strategy: The 14th FYP should formulate an urbanization strategy based on ecological civilization. The strategy should move away from the quantity-based model to a quality-based model where green urbanization becomes a key driver of China's high-quality economic development. The Strategy should mainly comprise a green transformation with the focus on city clusters and metropolitan areas, and a green urbanization with the focus on counties.

Actively explore the intersection of environment management and spatial planning. Many of the changes in China towards 2035 and beyond imply environmental and spatial changes: expanding and changing cities; hundreds of new towns; the rural revitalization programme; old manufacturing giving way to new economic activities; expanding infrastructure and changing harbor areas; adaptation to climate change, and so forth. Increased attention for human health and equity in environmental conditions, as advocated in this report, will also have a strong spatial component. For example, in terms of neighbourhood exposure to environmental risks. Very large environmental and spatial changes will take place with the Green Development of the Yangtze Economic Basin; and similarly Jing-Jin-Ji, Pearl River Delta and various BRI projects.

As a matter of strategy, it is therefore required to actively explore the intersection of environment management and spatial planning. This is a matter of policy coherence (delivering better government service to citizens and enterprises) and better use of existing and new tools from both domains. For example,

- exposure mapping, big data and risk analysis for vulnerable groups in relation to permits;
- strategic environment impact assessment as a framework for subsequent monitoring and accountability;
- strategic uncertainty analysis of economic, social and environmental development at city level;
- optimized use and protection of pre-existing green and blue infrastructure in the development of new towns;
- transport-oriented development (TOD) in relation to 'green development' of larger

areas

- an official on-line register of the contamination status of land plots (as recommended in this report).

4.5 Take further action on China's legacy of soil pollution

China has inventoried the soil pollution status of agricultural land and implemented laws and guidelines for dealing with contaminated land. Urban expansion, creation of new towns and fast economic developments are characteristic for present-day China. As a consequence, land use change, including bringing industrial and agricultural land into residential land use, is common practice. Between now and 2035, the spatial dynamic will be at least as widespread. Therefore it will be important to step up action to address, prioritize and manage China's existing soil pollution and land resources in addition to ongoing protection efforts.

Further steps to be taken in the future could include:

- Prevention. Setting a date for **a ban on bringing pollutants in or on the soil or groundwater**. For contaminations that do occur after that date, the duty of care principle should be followed. It means that the polluter is fully liable and responsible for restoring the soil to its natural conditions.
- The review of potentially contaminated site should not be restricted to agricultural land and **should include former industrial sites**.
- Soil quality management. Developing **a priority system** in the form of a decision support system, enabling the identification of contaminated sites that cause the most negative societal impact. Criteria for societal impact could include the impact on human health and the environment and the risks from spreading of contaminants in the groundwater, financial aspects and perception of stakeholders.
- Remediation. Implementing legislation on and developing procures for **sustainable – green - remediation approaches**. These approaches are based on natural attenuation processes, which next to dig&dump remediations, can contribute to long term soil quality objectives, accounting for cost-effectiveness.
- Public and stakeholder involvement. **Building a contaminated land register**

and making it available to all stakeholders, on the internet, using maps, coordinates and further information about the soil contamination. This would enable building contractors and other parties to anticipate on soil contamination in their building activities (e.g., residential development, road construction, transfer of industrial or harbour areas into other use). This register could include the results from the first national soil pollution survey (2006-2014) and the current 'Detailed national soil pollution survey'.

- A (governmental) **funding mechanism** must be developed to be able to deal with so-called orphan sites, that is: sites for which no polluter can be found and no owner can be held financially responsible.
- Communication. **Awareness raising** regarding the impact of soil pollution among stakeholders, including farmers and the general public. Awareness raising must include information about the adverse effects of soil pollution of human health and the environment and costs involved. It might lead to realization of the negative impact of polluting actions and can promote prevention. Moreover, awareness raising contributes to public support regarding public expenditure.

Potential Benefits

The steps mentioned above, would provide the following potential benefits:

- The possibility to anticipate better on the enormous land developments and corresponding huge shifts in land use that will take place in China in the period until 2035 and the period between 2035 and 2050.
- A more efficient and fair approach towards managing soil pollution, resulting in a better soil quality status in the year 2035, against the lowest possible costs.
- A better chance for success of reaching policy targets of the CCICED Task Force on China's Green Transition to 2050.

Background

I. *Existing soil policy in China*

Like every country in the world, China has a legacy of polluted soil and groundwater from the past. Moreover, current activities contribute to future soil and groundwater pollution. Initiatives in an early stage are needed to guarantee an optimal status of soil and groundwater pollution in the year 2035, regarding an efficient use of resources and budget.

In 2014, the first results of a nationwide soil pollution survey in China revealed the pollution of one fifth of agricultural land in China. In an analysis of these data, Wan et al.²⁷ concluded that metals were the major pollutant group, both from anthropogenic sources (arsenic, mercury, lead) as from natural sources (chromium, copper, nickel, zinc and also lead). After 2014, more ambitious sampling programs have been initiated, but the results have not yet been published. In 2016, the Soil Pollution Prevention and Control Action Plan was released, which stipulated that almost 7000 square kilometers of contaminated agricultural land should be remediated before 2020.²⁸

In 2014, the Ministry of environmental Protection published a series of technical guidelines on environmental site investigation²⁹, environmental site monitoring³⁰, risk assessment of contaminated sites³¹ and on site soil remediation³². These guidelines were developed for the purposes of enforcing the “Law of the People’s Republic of China on Environmental Protection”, protecting the ecological environment, safeguarding the public health, tightening the environmental supervision and management of contaminated sites, and setting standards for risk assessment of contaminated sites to the public health.

²⁷ Wan, X., J. Yang, W. Song (2018). Pollution Status of Agricultural Land in China: Impact of Land Use and Geographical Position. *Soil & Water Res.*, 13, 2018 (4): 234–242

²⁸ CSC (2016). Soil Pollution Prevention and Control Action Plan. Beijing, CPC State Committee and State Council.

²⁹ Ministry of Environmental Protection (2014a). Technical Guidelines for Environmental Site Monitoring, HJ 25.1-2014, 19 February 2014.

³⁰ Ministry of Environmental Protection (2014b). Technical Guidelines for Environmental Site Monitoring (HJ 25.2-2014)

³¹ Ministry of Environmental Protection (2014c). Technical guideline for risk assessment of contaminated sites, HJ 25.3-2014, 19 February 2014

³² Ministry of Environmental Protection (2014d). Technical Guidelines for Site Soil Remediation, HJ 25.4-2014, 19 February 2014.

In 2018, soil screening values for non-agricultural land ('Soil Environmental Quality Risk Control Standard for Soil Contamination of development Land') were released³³. They are based on human health risk assessment.

As part of its 'war on pollution', China issued its first law addressing soil pollution, the Law on the Prevention and Control of Soil Pollution, which took effect on 1 January 2019. This law brings attention and action towards addressing soil pollution by all stakeholders in China. It provides guidance and systematic mechanisms for preventing, investigating, and controlling soil pollution and clarifies responsibilities and liabilities of all stakeholders. The Law contemplates, and requires the development of, a system of comprehensive standards for implementing soil pollution control and prevention. The Ministry of Environment and Ecology is required to establish national standards for soil pollution risk control according to soil contamination status, public health risks and ecological risks. Local governments are authorized to develop additional, stricter standards. These will be mandatory standards. Finally, the Law advocates public participation in soil pollution management and establishes a framework for greater transparency and increased disclosure in relation to soil pollution.

II. Experiences from abroad

In Europe more than three decades after soil pollution became a recognized threat to the environment more than 130 thousand sites have been identified that (might) need remediation³⁴. It illustrates that cost-efficiency is a major aspect of dealing with contaminated land. Contaminated sites policies in the world underwent an evolution since the late 1970s, often from a maximum risk control philosophy towards a more functional approach. Generally, the procedures became more pragmatic and cost efficiency became an important aspect. An interesting general characteristic of mature soil and groundwater policies is the function-specific approach. The basic principle of this approach is that land must be suited for its purpose. Consequently, the appraisal of a contaminated site in a residential area, for instance, follows a much more stringent

³³ The Standardization Administration of the People's Republic of China (2018). Soil environment quality risk control standard for soil contamination of development land, National standard of the People's Republic of China, gb 36600-2018, 13 July 2018.

³⁴ Payá Pérez, A., N. Rodríguez Eugenio (2018). Status of Local Soil Contamination in Europe. JRC Technical reports EUR 29124 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-80072-6, doi:10.2760/093804, JRC107508

concept than that of an industrial site. This has a major impact on soil quality assessment when the land use function changes into a more sensitive use, e.g., residential developments in a former industrial area. Experience from western countries shows that there can be serious health risks when these sites are redeveloped, particularly for residential housing.

Another development is to approach soil contamination and certainly groundwater contamination on a larger scale than one site or one plume, but rather consider risks on a more regional scale. In short, it focusses on the soil and groundwater quality of a region as a whole instead of the quality of individual volumes of contaminated soil or groundwater. Regarding remediation, sustainable – green - remediation approaches³⁵, in which organisms participate in contaminant removal, become more and more accepted as cost-efficient alternatives.

III. Possible new beneficial developments

Prevention of soil pollution is by far the most (cost) efficient way for dealing with soil pollution. However, currently, there is no ban on bringing pollutants in or on the soil in China. Given the large number of (potentially) contaminated sites in China, progress of soil quality management between now and 2035 would benefit from a priority system which identifies the most serious cases of soil contamination³⁶. Given the urban expansion, creation of new towns and fast economic development in China, the review of potentially contaminated sites should not be restricted to agricultural land. It should include former industrial sites and waste disposal and treatment locations, which contributed most to soil pollution in European countries³⁴.

In China, many data on soil pollution status are available and many more will come available in the near future. China could benefit from a contaminated land register with the purpose to make these data available to all stakeholders, on the internet, using maps,

³⁵ Peter, A., Th. Held, N. Hüßers, F.A. Swartjes (2011). Natural attenuation. In: F.A. Swartjes (Ed.), *Dealing with contaminated sites. From theory towards practical application*, pp 979–1014. Springer Science+Business Media BV, Dordrecht, The Netherlands (Chinese version: pp 692-715. National Defense Industry Press, China)

³⁶ Swartjes, F.A., M. Rutgers, J.P.A. Lijzen, P.J.C.M. Janssen, P.F. Otte, A. Wintersen, E. Brand, L. Posthuma (2012). State of the art of contaminated site management in the Netherlands: policy framework and risk assessment tools, *Science of the Total Environment* 427–428 (2012): 1–10

coordinates and further information about the soil contamination. Moreover, a (governmental) funding mechanism much be developed to be able to deal with orphan sites.

Finally, Chinese soil quality management could benefit from awareness raising among the general public and stakeholders such as (municipal) policy makers, consultants and the research community.

5. SEIZING THE ECONOMIC OPPORTUNITIES AND MANAGING THE SOCIAL IMPACTS OF THE GREEN TRANSITION

5.1 New technologies and markets: changing production

5.1.1 Focusing early on high-quality technological research and development and strengthening support for green technology

Building a public service platform for green technology.

We shall strengthen the development of public service platforms and intermediary service institutions that promote the green upgrading of traditional industries, accelerate the establishment and improvement of innovative platforms such as green technology centers, etc., promote the dissemination and application of key and common industrial technologies, and enhance the green technology capacity of traditional industries as a whole; we shall develop technology service institution of various kinds, enhance the supportive role of platforms for science and technology, for instance, by building green technology literature service platforms, policy information service platforms, technology data and green technology information platforms, as well as sharing of large scientific research equipment; we shall develop some data bases on green science and technology commercialization achievements, focus on promoting the development of green innovation and entrepreneurship service centers to accelerate the commercialized application of scientific and technology achievements.

Improving an Industry-University-Research collaboration mechanism

Innovations in Industry-University-Research integration shall be made focusing on pillar industries such as green high-end equipment manufacturing and new energy, etc. This could include encouraging enterprises to establish academician workstations, post-doctoral workstations and engineering technology research centers with universities and research institutes at home and abroad; and to form a scientific research & development & production collaboration mechanism with complementary advantages and benefit and risk sharing by making full use of technology achievements from universities and research institutes and production capabilities from enterprises.

Focusing on building a talent guarantee system.

Optimizing the range of disciplines at higher education institutions to foster various talents needed for the green transformation and upgrading of manufacturing, and to develop a group of professionals and engineers in science and engineering. The curriculum design shall be aligned with fundamental, cutting-edge, and key generic technologies and applications, and combined with production practice; practical teaching of basic theory courses shall be strengthened, by incorporating the assessment in the practice session into the assessment for the entire course. **Shifting the talent selection from a “degree over skill” mindset.** The green upgrading of traditional industries cannot happen without frontline skilled workers. We shall improve the vocational training system, popularize the vocational training for mid- and low-end labor force; improve support of resources for higher vocational and technical colleges, and enhance the status of higher vocational and technical colleges in the current collegiate system; accelerate the development of equivalent job title evaluation for skilled workers to enable skilled workers to enjoy the same benefits as senior engineers (researchers, professors); form an interactive dynamics with a view to cultivating skilled workers comprising government incentives, increased enterprise investment, and active participation by training institutions and workers.

To strengthen intellectual property rights protection.

Putting in place an intellectual property rights protection system suitable for China’s national conditions and based on the key principle of equity. We must make bold explorations and implementations of the commercialization mechanism of scientific and technological achievements to protect and stimulate the enthusiasm of the market for scientific and technological innovation; strengthen the crackdown on intellectual property infringement, increase the penalties for infringers, by strictly cracking down on any infringement activities, exposing typical cases and incorporating infringement information into social credit records; we shall reform the patent examination and approval system and shorten the patent review cycle; To reform the patent royalties charging system, it is recommended that fees shall be charged reasonably according to the size of the economic benefits of the patent. Unreasonable fees shall be eliminated to avoid reducing incentives for invention. **Speeding up the establishment of intellectual property rights protection assistance system for green innovation.** Priority shall be given to the development of an intellectual property rights protection system and dispute settlement mechanism for green technologies by drawing experience from intellectual property rights protection issues faced by China’s

manufacturing enterprises in international trade and investment. A deep cooperation mechanism among administrative departments, judicial departments, and large internet platforms shall be built to realize effective protection of intellectual property rights from the industry's green innovation by the administrative and judicial authorities in the context of spatial network.

5.1.2 To stimulate the active participation of enterprises.

Encouraging a group of core enterprises to be front-runners can help to drive the green transformation of regional economies, give full play to the self-discipline and self-learning capacity of the industry, and integrate the concept of environmental protection into design, layout, products, technologies and processes, rather than acting after pollution once caused. In particular, it is proposed to foster green and innovative enterprises. The status of enterprises as the actors of innovation shall be further defined. With a view of making breakthroughs in key and common technologies, resources shall be consolidated to strengthen support for the development of R&D centers of green technology businesses, provide guidance to enterprises to improve apparatus and equipment for scientific researches, upgrade their equipment capabilities, continuously enhance the level of technology in their products, to accelerate the cultivation of innovative enterprises; relevant tax policies, such as tax-deductible R&D costs, accelerated depreciation of fixed assets, custom duty exemption for introduced technical equipment, customer and import VAT exemption for key raw materials and components of major technical equipment, VAT deduction for enterprises purchasing machines and equipment, etc., shall be implemented. The development of the National Emissions Trading System shall be completed as soon as possible including the development and improvement of implementing rules and regulations, to encourage enterprises to increase investment in green technology innovations and enable to enjoy returns as soon as possible.

Box 5-1 Environmental technology as win-win for ecology and economy

As experience of environmental policy in the last century shows, relatively low hanging fruits for environmental policies are measures leading to a win-win-situation for ecology and economy.

1. Win-win measures in Germany

For example, Germany's long-standing pioneering role in the field of environmental technologies has both opened up export opportunities and brought longer-term dynamics to environmental policy. The substitution of fossil energies and other critical resources with renewable energies/material is a key area for harmonizing ecological and economic interests. The German Renewable Energy Act (EEG) from 2000 originally provided a feed-in tariff scheme to encourage market entry for electricity from renewable sources with a guaranteed tariff for 20 years. Since 2014, this scheme is being transferred to an auction system. The EEG led to a boom in renewable energy production (currently 36% of German electricity supply originates from renewables), numerous technological developments and generated more than 300.000 jobs. Another important field are all kinds of efficiency improvements optimizing the input-output-relation of resources on the one side and goods/services on the other side. Around one fourth of Germany's total final energy consumption is consumed by private households, most of it for space heating. Measures improving thermal insulation are accordingly effective. Since 1976, several energy conservation acts, regulations and funding programmes were passed by the German government, leading to a relative reduction of the specific final energy consumption for space heating by more than a third (per m²) from 1996 to 2016. This is not only beneficial for environmental reasons but also implies important potential economic savings for residents and income for companies and workers. However, the decrease in specific final energy consumption (per m²) for space heating is partly compensated by an increase in living space per person.

2. Top-runner approach in Japan

The top-runner approach, first implemented in Japan, helps the most environmentally friendly technology within a certain product group to penetrate the market in short time. The best available product on the market is declared standard which has to be met by other products of the same group within a certain time frame. Products which fail to meet the standard within the specified time frame can no longer be placed on

the market. Besides ecological benefits, this instrument furthers technological development and leadership of certain industries. Although not implemented up to date, the German government has been advocating a top-runner approach at EU level since 2007 in order to increase energy efficiency of products.

5.1.3 Vigorously promote green finance

To speed up the green transition, we will also pay more attention to the role of various economic instruments such as taxation, finance and pricing in improving environmental conditions. It is also necessary to increase green investment, improve the environmental management model, and give full play to the long-acting market mechanism.

5.1.3.1 Improving tax and financial policies

We shall implement relevant tax incentives for eligible energy-saving, water-saving, environmental protection and comprehensive resource utilization projects or products, and include energy-intensive and high-pollution products and some high-end consumer goods in the scope of consumption tax collection. We shall also implement the electricity price policy for electric vehicles and improve the tiered pricing system for household electricity, water and gas.

We shall encourage banking and financial institutions to implement green credit guidelines, innovate financial products and services, and provide credit for green consumption. We shall also study and introduce progressive policies to support green consumption credit such as for energy-saving vehicles and new energy vehicles, green buildings, new energy and renewable energy products and facilities, etc., and encourage financial institutions to increase credit support.

Stepping up efforts to develop financial products and service models needed for green transformation and upgrading. for example, by lowering business risks through the implementation of performance bonds, and encouraging businesses to lease advanced green technology equipment; by supporting green finance products and service model innovation, to facilitate financing for manufacturing enterprises, etc.

5.1.3.2 Establishing a mechanism in which the price of green elements is determined by the market as soon as possible

We shall urge enterprises to transform their competition from one that is driven by excessive depletion of energy and resources, as well as low costs, to one that relies on innovation and differentiation. The focus of the policy is to curb irrational investment and investment promotion methods such as low-cost land supply, tax reduction and exemption, and low-cost allocation of resources to avoid blind expansion of production capacity and homogeneous competition. We shall complete the development of the carbon emission trading market as soon as possible, and give full play to the carbon price discovery mechanism of the ETS, so that the economics of green innovation will be made explicit.

5.1.3.3 Accelerating resources tax reforms

We shall correct the abnormal current situation of “low-cost at front-end” and “low final price” by accelerating the price reform of resource products such as water, petroleum, natural gas, electricity, minerals, etc. This could be done for example by an orderly opening up of feed-in tariffs, and an appropriate timing to deregulate the price of refined oil products. The aim would be to form a relatively reasonable relationship between primary resource products and manufactured goods, reasonably compensate for environmental damage costs, and rationalize upstream and downstream price adjustment linkage mechanism for resource products. We shall correct the abnormal current situation of “coexistence of multiple pricing methods”, by focusing primarily on the dual track approach for coal, electricity and gas pricing, and rationalize the terminal pricing mechanism for resource products.

5.2 New products and markets: changing consumption

5.2.1 Promoting the green consumption transition

In view of the growing importance of China’s domestic consumption as a driver of its economy, we shall speed up the reform of the systems and mechanism concerning green products and services in order to accelerate their effective supply; perfect the green product standard system; strengthen public awareness of green consumption, and encourage people to have green low-carbon lifestyles and consumption patterns and vigorously promote green consumer products. Green consumption will create demand for green production and help to strengthen environmental governance.

Promoting the effective supply of green products and services in the production sector

Speeding up the reform of the systems and mechanism concerning green products and services and increasing their effective supply

We shall remove institutional barriers to the supply of green products and services, and guide and support more social capital to invest in the weak fields of green products and services. We shall also loosen the restriction on market access for green products and services, encourage all types of capital to invest in green industries, and increase the supply of green products and services.

Increasing the effective supply of green products and services

We shall guide and support enterprises to enhance their innovation capacity, increase investment in research and development, design and manufacturing of green products, reduce the cost of green products and services, and strengthen the core competitiveness and effective supply of green products and services. We shall also support enterprises in the research, development and storage of green technology, and accelerate the application of advances in science and technology. In addition, it is necessary to require manufacturing enterprises to reduce the use of toxic hazardous and volatile substances and substances which are difficult to degrade and dispose of, and to encourage them to build green supply chains, so as to reduce the environmental impact of the whole life cycle of products.

Building a diversified supply system of green products and services

We shall support enterprises to focus on improving the quality of green product supply, enhance the diversified competition among medium- and high-end brands, and build a diversified supply system of green products. In addition, we shall diversify the production of green consumer goods such as energy- and water-saving products, resource recycled products, environmental protection products, green building materials, new energy vehicles, etc. It is necessary to popularize the use of “Internet Plus” to promote green consumption, support the direct selling business of e-commerce enterprises or cooperate with bricks-and-mortar enterprises to supply green products and services, and encourage selling green products on the network.

5.2.2 Improving green standards and label certification in the market

Perfecting the green product standard system

We shall improve the standard system of green products and services, expand the coverage of standards, speed up the revision of standards for energy consumption, water consumption and material consumption in the production process, and dynamically adjust and continuously improve the resource and environment access criteria for products. We shall speed up the implementation of the top-runner approach for energy efficiency and environmental protection, and study and establish the top-runner approach for water efficiency. We shall also prioritize consumer products that are closely related to consumers, develop evaluation standards for green products, and organize certification to improve product quality.

Establishing a sound green product certification system

We shall promote China's certification program for environmental labeling, improve the labeling system for green buildings and green building materials, implement the certification management measures for energy-saving and low-carbon products, and accelerate the implementation of low-carbon and organic product certification. We shall also integrate environmental protection, energy conservation, water conservation, recovery, low carbon, recycling and organic products that have been established separately into green products, and establish a unified green product system containing certification, labeling, etc., so as to strengthen the quality supervision of green products.

Establishing a supervision mechanism in and after the fact

We shall establish a quantitative evaluation mechanism for green product standards and assess the effectiveness of certification implementation, propose basic requirements for implementing extended producer responsibility and the joint and several liability of the implementing agency for testing and certification results according to China's practice, and enhance the in-process and post-mortem regulation of green standards and label certification.

5.2.3 Promoting the practice of green lifestyles and patterns in the consumer sector

Establishing a sound incentive mechanism for consumers

We shall enhance the efforts to support the comprehensive promotion of energy-efficient vehicles and new energy vehicles and accelerate the construction of electric vehicle charging infrastructure. We shall implement the “old products for remanufactured products” pilots, promote remanufactured engines and transmissions, put in place an incentive mechanism for consumers, and study the consumption points system of green products.

Advocating a green and low-carbon lifestyle

We shall encourage low-carbon mobility methods such as walking, bicycle and public transport. We shall also establish reasonable controls on building temperatures by setting the indoor air-conditioning temperature higher than 26°C in summer and lower than 20°C in winter, except for specific purposes. We shall encourage consumers to travel with their own toiletries and reduce the use of disposable daily necessities. We shall encourage large- and medium-sized cities to make use of mass leisure places and public welfare venues to set up flea markets for residents to exchange goods they no longer use. We shall improve the recycling system of renewable resources in residential communities and encourage the sharing of goods that are infrequently used. We shall also carry out in-depth actions against waste, over-packaging, food waste and excessive consumption.

Encouraging green product consumption

We shall encourage the purchase of water-saving products such as water-saving faucets, water-saving toilets, water-saving washing machines, as well as energy-saving products such as energy-efficient motors, energy-saving and environmentally-friendly cars, efficient lighting products. We shall promote products with environmental labels and encourage the use of coatings and dry cleaning agents with low VOCs. We shall promote green consumption in public institutions and improve the efficiency of using office equipment and assets by encouraging double-sided printing and working in paperless offices. We shall improve the evaluation criteria for conservation-oriented public institutions and rationally formulate indicators for water and electricity consumption. We shall promote the use of various green building materials and environmentally friendly decoration materials including energy-saving doors and

windows, C&D waste recycled products, etc. We shall also implement green building standards for public buildings, install rainwater recycling systems and recycled water utilization facilities.

Pay attention to the gender dimension of “green consumption”

Further investigate the influence of consumption by women to guide future green consumption policy development. Chinese women are usually the main managers of household consumption. Their consumption patterns will directly affect the social production structure; womens’ consumption choices can effectively improve the deteriorating urban and rural environment; womens’ own consumption is becoming a major driving force for social and economic development and is expected to become greener; women as the main educator for the next generation influence the expansion of green consumption behavior. It is necessary to consider the factors influencing women in green consumption, and prepare policy guidance.

5.2.4 Promoting the cultivation of green consumer awareness, information, publicity and education

Green consumption education

We shall advocate traditional virtues, carry out green consumption education starting with children, and integrate the awareness of thrift, green and low carbon into family education, pre-school education, primary and secondary education, etc. We shall also regard green consumption as an important part of family ideology and moral education, ideological and political education for students, continuing education for employees and civil servant training, and incorporate it into the requirements for civilized cities, civilized villages and towns, civilized organizations, civilized families, civilized campuses and related educational demonstration bases.

Green consumption promotion

We shall incorporate green consumption into various thematic publicity and education activities such as the National Energy Conservation Propaganda Week, the Science and Technology Week, the National Low Carbon Day, the National Environment Day, etc. We shall carry out actions advocating energy conservation and emission reduction and traditional virtues, and organize activities on building green families, green shopping malls, green scenic spots, green hotels, green canteens, conservation-oriented

institutions, conservation-oriented campuses, conservation-oriented hospitals, etc. We shall also give full play to the role of labor unions, the Communist Youth League, the Women's Federation and relevant industry associations and environmental protection organizations, and strengthen publicity and promotion, so as to create a good social atmosphere for green consumption.

5.2.5 Improving the green procurement system

We shall strictly implement the government's preferential and compulsory procurement system for energy-efficient and environmentally friendly products, expand the scope of public green procurement, improve standards and the implementation mechanism, and expand the scale of public green procurement. In addition, it is imperative to make clear the institutional arrangements for green production, distribution, consumption and resource recovery. In particular, the Government Procurement Law establishes binding regulations for public green procurement and the need to develop supporting by-laws and systems.

Government procurement preferentially sources domestically produced products that have the same or similar performance as foreign products. A compulsory purchase ratio may be adopted for key innovative products in China, so that the government-supported green technology and industry development financial funds are more targeted. In terms of the negotiation on the entering into the Government Procurement Agreement under the framework of WTO, it is required to reserve the right to give priority to the procurement of products that are friendly to ecological and environmental protection.

Box 5-2 German Green Consumption

Sustainable consumption means living within the Earth's carrying capacity and ensuring that today's consumption patterns do not jeopardize the ability of current and future generations to meet their needs. It is vital that our consumption behavior becomes significantly more sustainable. This challenge must be tackled by society as a whole.

1. International Initiatives

At the World Summit on Sustainable Development in Rio de Janeiro in 1992, first discussions were held on sustainable consumption. Then in Johannesburg in 2002, the Marrakesh Process was launched. Industrialized countries in particular were

urged to promote sustainable consumption and production. At the World Summit on Sustainable Development in Rio de Janeiro (Rio+20) in 2012, the 10-Year Framework of Programmes on Sustainable Consumption and Production Patterns was approved. It provides a global framework for measures in the area of consumption and production patterns.

In September 2015 at the UN headquarters, the heads of state and government adopted the 2030 Agenda for Sustainable Development, which sets out the global sustainable development goals. A number of chapters deal with the implementation of sustainable consumption and production patterns, and there is also a specific goal (SDG12: ensure sustainable consumption and production patterns).

Also the European Commission has launched numerous initiatives on environmental product policy. These include the Communication on integrated product policy (IPP) of June 2003, which laid foundations for taking into account the environmental impacts of products over their entire lifecycle. The European Ecodesign Directive ensures that environmental requirements are also observed in product design. Furthermore, there are numerous EU initiatives such as the EU eco-label, green public procurement initiatives and the eco-management and audit scheme (EMAS).

2. The National Programme on Sustainable Consumption

In 2016, the German Government adopted an updated National Sustainable Development Strategy, which is aligned with the UN's 17 sustainable development goals. In the same year, the German government launched the National Programme on Sustainable Consumption (NPNK), which describes the relevant fields of action and details over 170 specific measures. The programme with its whole-of-government approach, including all ministries and many stakeholder groups, is tackling consumption in a cross-cutting approach. The programme sets out how the German government plans to systematically strengthen and expand sustainable consumption in various areas, with various stakeholders at national level.

When it comes to sustainable consumption there are six areas (fields of need) with the greatest potential for reducing pressures on environment, such as mobility, food, housing and households, office and work, clothing, tourism and leisure.

3. Developing and improving green standards and label certification

The Blue Angel was launched in 1978 as the world's first eco-label. It is regarded as a pioneer of product-related environmental protection and has been providing reliable guidance for many years for the purchase of environmentally friendly goods and services. The eco-label is now available for 120 different product groups, making it one of the most comprehensive eco-label programmes in the world. A total of 12,000 products from around 1,500 companies are currently labelled with the Blue Angel. So also the German Sustainable Development Strategy formulated the target, that eco-labelled products reach a market share of 34 % until 2030.

4. Innovating to ensure the effective supply of green products and services

Social innovations for sustainable consumption comprise new organizational forms, services, products and practices, which are able to make consumption habits more sustainable. Examples are sharing -formats for cars, tools or other products, urban gardening projects or other collective initiatives. The Federal Environment Agency (UBA) carried out research about sustainable consumption through social innovations, to systematize social innovations for sustainable consumption and derive recommendations for promoting the ones with potential to reduce environmental effects.

5. Sustainable public procurement

The state can also play a decisive role in the sustainability turnaround with its actions. Its huge economic potential gives sustainable public procurement major leverage to promote sustainable products and services. Furthermore, with an appropriate procurement policy the public sector can lead by example and contribute to the credibility of a sustainable consumption policy.

6. Institutional Monitoring

For Implementation of the German National Programme on Sustainable Consumption and its measures, an interministerial working group and a competence center has been set up. With this institutional structure, Germany wants to contribute to anchor sustainable consumption firmly in the public debate. To this end, there has been put in place a major information platform in order to establish an exchange between all stakeholders, including companies, local authorities, consumer

protection agencies, associations, ministries and other public agencies and of course, citizens and to create a strong link between various organizations working on sustainable consumption as well.

For a more effective policy to promote sustainable consumption, there is a need for comprehensive and continuous monitoring that shows what is happening with sustainable consumption in Germany and whether corresponding political measures are having an effect. For this monitoring the UBA, together with some other institutions, has now developed two new indicators for sustainable consumption in the national sustainable development strategy (the market share of products with government eco-labels and the energy consumption and CO₂ emissions of private consumption). To develop a tool to systematically track the market for green products, to provide an estimate of the growth in green products and to evaluate measures and instruments of promoting green products, since 2013 a report is periodically published.

5.3 Helping those adversely affected by the green transition

The green transition in China and other countries will affect producers and consumers by changing relative prices. As a result, some will be better off and others less so. To some extent this is part of the usual churn generated by structural change. However, in some cases there may be good reasons to support those adversely affected.

The transition to a low-carbon, resource-efficient and more environmentally resilient economy will generate new jobs and destroy some traditional sources of employment. Most studies suggest that the net effect will be small; perhaps slightly positive or slightly negative. However, the negative impacts may be concentrated in specific sectors, particularly those associated with fossil fuels, and in specific localities. The affected firms and their workers may need support to ensure that they do not suffer unduly and that some people and communities do not “get left behind.” Not addressing the needs of displaced workers and communities would not only be unfair and a waste of resources, it could also result in a political backlash against the public authorities.

Structural change is a feature of all dynamic economies and creates “winners and losers.” For example, it is estimated that 10% of Sweden’s 5 million jobs are lost and slightly more are created every year. Industrial structures and labour markets may undergo even greater change in the future as the “new industrial revolution” results in

the wider use of artificial intelligence, robotics and a range of new technologies. This underlines the need, independent of the green transition, for social welfare provisions and mechanisms that allow workers to adapt to changes in the labour market.

When companies are required to reduce capacity or close for environmentally related reasons, engaging workers in discussion is an important factor in effectively managing the transition. Explaining the rationale, including any health and environmental impacts, is a first step. But this needs to be supported by specific measures to assist workers to find new employment. These include providing opportunities for learning, supporting new skills development and entrepreneurship, and re-locating public sector services to the affected areas.

However, in practice many OECD countries have found it difficult to support the redeployment of workers who lose their jobs due to structural change. Some of the challenges include the difficulty or unwillingness of workers to relocate to other regions and the difficulty of attracting new industries to areas with declining industries and high levels of unemployment, even when substantial incentives are offered. In addition, the experience from OECD countries suggests that a large share of the workforce affected by the low-carbon transition are men. The possible implications of this gender-specific impact, including possible second round consequences on female employment, should be analysed further.

Another approach that is frequently advocated is to provide financial support to ailing companies with a view to maintaining their operations and the associated employment. However, experience from OECD countries suggests that this is usually not an effective approach, particularly when the underlying challenges are related to over-capacity, insolvency and structural change. Targeted support may be effective when companies are undergoing a major restructuring to become more competitive and when the benefits of providing support outweigh the costs of not doing so. However, this involves governments having to “pick winners” which is often not successful. The provision of a large volume of state aid may also distort competition and result in a challenged within the WTO.³⁷ Financial support is often most effective when used to accelerate the exit of inefficient firms from the market. This could include establishing special funds to help to retrain or to relocate affected workers, or to manage potentially serious

³⁷ Rules concerning state aid within the EU are much stricter than those within the WTO. See <https://researchbriefings.parliament.uk/ResearchBriefing/Summary/SN06775>.

environmental risks, rather than providing unconditional support to the company.

In an international context where the effective carbon rate levied on companies varies widely among countries, it is often argued that support should be provided to sectors that are energy-intensive and trade exposed, particularly when there is a risk that they may relocate to a jurisdiction with a lower effective carbon rate. However, there are no simple solutions to this challenge. Support measures that lower the effective carbon price would also weaken incentives to reduce emissions and to develop cleaner technologies. Alternative approaches targeting trade, such as border tax adjustments, may provoke retaliatory trade measures.

Regarding consumers, climate mitigation policies, particularly taxes on energy and transport fuels, may result in increased energy prices. These may affect the affordability of transport and energy services for lower-income groups. An empirical study of this issue by the OECD suggested that higher income groups would tend to be more affected by higher transport fuel taxes as they generally had more cars and drove greater distances.³⁸ However, recent experience in France suggests that while this may be true for urban dwellers, it may not be the case for rural dwellers who are often totally dependent on private vehicles for transport. Taxes on heating fuels and electricity will tend to have a greater impact on the poorer households as these services constitute a higher share of income and expenditure than in richer households. However, the study suggested that if a tax on heating fuels and electricity was complemented by income-related compensation it would be possible to maintain the environmental incentives associated with the tax and, after compensating affected households, still have sufficient revenue to allocate for other purposes.

³⁸ Flues, F. and A. Thomas (2015), "The distributional effects of energy taxes", *OECD Taxation Working Papers*, No. 23, OECD Publishing, Paris. DOI: <http://dx.doi.org/10.1787/5js1qwkqrbv-en>

6. REFORMING ENVIRONMENTAL GOVERNANCE

6.1 Improve the legal system for ecological protection

6.1.1 Improve environmental legislation

Accelerate the process of environmental legislation

Regarding environmental protection, the Communist Party of China and the State, during the new round of institutional reform, will formulate the “Basic Environmental Law” to improve the current system and resolve fragmented and contradictory content. Meanwhile, we shall speed up the formulation of “Environmental Damage Compensation Law”, “Environmental Insurance Law”, “Nature Reserve Law”, “Climate Change Law”. This legislation will help legalize major reform measures while modernizing the national governance system and capacity of ecological protection

At present, with regards to energy, priority shall be given to the formulation of the Atomic Energy Law which defines duties and powers of competent authority and supervision agencies, nuclear research and industrial development, nuclear deposit mining, nuclear material control, supervision and management of nuclear facilities, nuclear waste disposal, radiation protection, application of nuclear devices and radioisotopes, nuclear accident emergency management and damage compensation, and applicable legal liability. The Atomic Energy Law shall be in close connection with the “Nuclear Safety Law”, among other applicable laws.

Revise existing laws in a timely manner

Amend or revise the Environmental Protection Law, Forest Law, Grassland Law, Water Law, Water Pollution Prevention Law, Air Pollution Prevention Law and Environmental Impact Assessment Law to satisfy the latest demand for environmental protection.

6.1.2 Recommendations on strengthening ecological environment law enforcement guarantee

Recommendations on improving the reform of the ecological environment supervision system and mechanism

Optimize environmental management system to achieve a combination of centralization and decentralization for the regulatory approach and an integration of legal implementation and supervision. Bring environmental management system reform onto the track of rule of law, clearly distinguishing the powers and responsibilities of environmental authorities and other relevant authorities; optimize the division of labor between the central and local environmental supervision systems by carrying out a new round of reform of administrative power in environmental protection and decentralizing administrative licensing and regulatory authority, giving intermediary organizations technical service rights; establish high-standard environmental management coordination agencies for specific problems, e.g. by setting up the national environmental protection committee at the central level, and office of the environmental protection committee under the Ministry of Ecology and Environment, and setting up the river basin environmental protection coordination agencies at river basins and coordination agencies at key air pollution prevention and control areas, etc. Implement the system and mechanism of “equal liability for CPC and governments, dual liability for one post, and accountability for negligence”, and improve the system and mechanism of supervision by the people’s congress, so that governments and CPC committees at all levels can exercise environmental protection duties according to law.

Recommendations on improving the performance appraisal and evaluation mechanism

Firstly, improve the local government’s eco-performance appraisal & incentive compatibility mechanism, primarily by improving the civil servant performance & promotion mechanism, the explicit material incentive mechanism, the implicit reputation incentive mechanism, and by establishing an eco-performance quality credit rating system. Second, improve professional supervision mechanism for local government eco-performance appraisal. In the evaluation of eco-performance, it is necessary to avoid behaviors such as political fraud, exaggerating, and false reporting by establishing professional supervision mechanisms, to achieve institutionalization of supervision authority, specialization of supervision institutions, specialization of supervision talents and supervision comprehensiveness. Thirdly, improve the

accountability mechanism for evaluation of local governments' ecological performance appraisal, whereby a sanction ladder from low-key or informal lesser punishment to severe measures, establishing a list of assessment responsibilities to strengthen disciplinary function

Recommendations on promoting the development of environmental health risk management mechanism

Assess the environmental health risks based on China's environmental realities and goals of environmental governance by 2035, design China's environmental health management mechanism by applying the risk management theory, and provide constructive advice for the country to gradually establish an environmental health risk management system: Establish an environmental health risk monitoring system; establish an environmental health benchmark standard; integrate and link the basic system of environmental management; improve environmental health technical support capabilities; and establish an environmental health risk communication mechanism. The system should provide information at two scales:

- strategic priority setting and allocation of resources, typically at the level of five-year plans and government work plans;
- risk monitoring in concrete situations, such as industrial development, transport infrastructure and performance appraisal of cadres.

Recommendations on establishing a long-term mechanism for gender mainstreaming in environmental rule of law

Firstly, it may set up a special gender equality coordinator in general and branched departments concerning environmental protection management, which is responsible for coordinating and supervising the gender mainstreaming of the department, issuing expert opinions on gender impact assessment of environmental legislation and decision-making, implementing the environmental protection gender equality program and maintaining communication with the coordinators of other relevant departments, and carrying out relevant international cooperation. Secondly, carry out gender budgeting in general and branched departments concerning environmental protection management. Analyze existing environmental budgets, fully consider the different impacts on men and women, and select gender-sensitive factors in the budget as a focus to promote gender equality and environmental protection in this area. Thirdly, collect

gendered data as a basis for gender equality decision-making as adding necessary gender specific data to existing environmental data, integrate the gender perspective into the environmental rule of law.

6.1.3 Recommendations on strengthening judicial safeguards for ecology and environment

Recommendations on establishing a diversified resolution mechanism for ecological and environmental disputes

Firstly, the top-down design of a diversified resolution mechanism for ecological and environmental disputes shall be strengthened. Based on the characteristics of China's system and social conditions, priority shall be given to the development of various types of public welfare settlement services, while gradually exploring the development model of market-oriented mechanisms and building a rational management system. Secondly, adopt a progressive, categorized and step-by-step approach starting from specific systems and procedures based on actual needs and conditions, establish effective and coordinated ecological and environmental dispute resolution system through special laws, separate regulations, legal amendments, etc.; and strengthen the coordination and integration of all material aspects including civil and administrative mediation and litigation, Thirdly, cultivate a new culture of dispute resolution, starting from education, popularization and the transformation of legal concepts.

Promoting centralized jurisdiction over environmental resource cases

The reform and exploration of centralized management and trial of environmental resource cases is of great importance. The judiciary shall summarize experience seriously and gradually form a sound legal system to promote it. At the same time, relevant judicial organs and relevant departments should actively build a multi-jurisdictional mechanism which aims at a joint mediation mechanism, and improve the judicial identification mechanism by strengthening the convergence of environmental justice and environmental administrative law enforcement. The judiciary must communicate and coordinate with the public security organs and the environmental administrative departments in a timely manner to create a good external environment for environmental resource trials.

6.1.4 Strengthen public observance of law

Firstly, make efforts to create a social atmosphere in which all people consciously learn, abide by and utilize the law. The staff of CPC and government organs at all levels, especially those closely related to the sustainable development of the economy and society, shall take the lead in observing the Constitution and laws, and actively take advantage of emerging online media for its supervisory role. It is recommended that universities offer environmental law education courses. Secondly, adequately consider female factors in the design of public participation system and increase the proportion of women. Thirdly, propose a program for corporate law observance assistance and incentive mechanism to improve the legal self-consciousness

It is suggested the competence of the law governance team be strengthened. For judicial and law-enforcing departments with high work intensity and heavy tasks, the government should appropriately expand the staffing structure to ensure the competency. In addition, the government should establish a sound standardized training system to normalize the training and assessment mechanism towards the professional team, so as to improve the overall skills and professional quality of the staff of relevant departments.

6.2 Reforming environmental policies and instruments

Optimizing eco-environment governance structure, building long-term mechanism of green development

6.2.1 Building the consensus on the governance and improvement of ecological environment of the whole society

Consensus and public awareness are the foundations for promoting ecological environmental governance. This requires the transmission of ecological culture and ecological ethics, and fostering the public's collective consciousness and overall awareness. The government shall play a leading role and decentralize its power. The enterprises shall take the initiative to take the responsibility by promoting a better development of enterprises with green production; social organizations and the public shall be encouraged to take the initiative to participate in the environmental governance. The government should regard culture as an essential part of the eco-environmental governance system. Cultural transmission enables ecological civilization to be the mainstream value of social development, fostering ecological characteristics, and thus

forming a good atmosphere for protecting the ecological environment in the whole society.

6.2.2 Streamlining administration and delegating power, enhancing primary-level capacity building of eco-environment governance

Strengthening government guidance mechanism

Local governments should make overall arrangements for eco-environment governance. They should not only allow and mobilize residents to actively participate and innovate in the primary-level eco-environment governance, but also keenly identify and promote models in extensive primary government practices. They should also, lead in the formulation of rules and regulations to standardize eco-environment governance. The key is to establish a strong organization dedicated to eco-environment governance in cooperation with the government's internal governance activities. At the same time, consolidate government rules and regulations, implement laws, regulations, policies, environmental standards, assessment mechanisms and other means to regulate the conduct of all economic entities, and in particular, to guide local government officials to correctly handle the relation between economic development and environmental protection.

Innovative mechanisms for enterprises to participate in governance

By actively guiding enterprises and exploiting their state-of-the-art and innovative approaches, local governments and communities should contribute to the primary-level government practice of joint building and enjoyment by diverse subjects. They should use market mechanisms to allow enterprises to assume social responsibilities during production and environmental governance. Firstly, to apply the principle of economic leverage, clarify ownership of ecological resources, improve market trading mechanism of ecological resources, put into practice the idea of beneficiary pays through levy of resource tax and eco-environment tax so as to realize market deployment of ecological resources and arouse enterprises' motive of eco-environment governance; secondly, to drive industrial transformation and upgrading, which requires governments' positive promotion and guidance, and continuously push forward the development of strategic emerging industries like energy conservation and environmental protection, new energy, new material, and high-end equipment manufacturing by constantly adjusting economic structure and by strengthening technological innovation.

Driving extensive public participation in primary-level eco-environment governance

To enable residents and various social organizations in primary communities to participate extensively in the management of primary-level eco-environment affairs, jointly push forward community building and share governance results. It should also make sure that all interests of the public are secured from participation in eco-environment governance; expand the mechanisms for public participation in democratic decision making so that the public ecological policies can reflect people's interests and guarantee the public's rights to know; reinforce the monitoring and feedback mechanisms of public ecological policies; allow the public to know and conduct supervision through implementation of the environmental information disclosure system. The public can support the development and implementation of policies by tracing, evaluating and overseeing the policy implementation performance. At the same time, through supervision and feedback, exposure of ecological issues should be strengthened to generate strong pressure from public opinion and the whole of society for effective eco-environment governance.

6.2.3 Transfer the focus of eco-environmental governance from end-of-pipe treatment to source control

From 2020 to 2035, China's eco-environment governance process will continue to advance in line with industrialization, urbanization and agricultural modernization. Therefore, it is necessary to change the ideas of eco-environmental governance based on end-of-pipe treatment. The focus when establishing environmental governance, designing policies and allocating human resources should be transferred to the control of pollution at source control to achieve sustainable governance. This would promote green development and the goal of a fundamental improvement in the environment.

Supply-side reform should continue to have a major role in eco-environmental governance

Starting from the production side, the government should further promote the adjustment of industrial, energy, and investment structures. In addition, the government should increase the proportion of emerging industries, especially environmental protection industries, in the industrial structure. The focus of subsidy policy has been transferred from supporting the industries to stimulating green production behaviors. The government should also build an energy utilization system consisting of the most clean, efficient and centralized utilization of coal, petroleum, natural gas, as well as

renewable energy (especially biomass energy, solar energy and wind energy).

Enhance the attention to the demand side in eco-environmental governance

Starting from the consumption side, the government should further adjust the trade structure and improve infrastructure at the municipal and community level (e.g. establishing a sound green public transportation supplying system, etc.). This would make the external conditions of green consumption in line with the green consumption concept.

Loosening control over market access, encouraging investment diversification

Various types of capital can support investment, construction and the operation of public products and services for environmental governance and ecological conservation. The market can help to diversify investors. First, improvements could be made to the operational mechanisms of PPP environmental infrastructure project and competition transparency improved. The principle of risk sharing between the parties should be established to optimize the whole project process including financing, engineering design and construction, and operation, maintenance. It is expected that this would improve environmental service performance. Secondly, improve third-party mechanisms by setting up a national environmental protection fund, establishing a bi-directional incentive mechanism to promote pollution reduction, and introducing a corporate environmental blacklist system as a part of the social credit system. Thirdly, improve the economic components of environmental governance, such as improving the price composition and adjustment policies of environmental service products, strengthening the verification and price supervision of environmental public service costs, and improving the tax incentives for environmental protection industries in a non-operating environment with poor return on investment, such as the areas of groundwater, soil, watershed management, etc. When justified, to implement tax exemption and reduction policies for a certain year, and introduce tax incentives for environmental industries.

Box 6-1 Multi-level Governance in EU Countries

Take air treatment and control in London as an example. Air governance in the UK involves three levels: the EU, the UK government and the the local government. Among them, the EU mainly plays a regulatory role. At the UK level, the Department for Environment, Food and Rural Affairs (Defra) plays the main role in carrying out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU limit values for the specified pollutants.

I. EU supervision. It mainly includes three aspects:

(1) The European Union has set the goal of achieving air quality that does not give rise to significant negative impacts on human health and the environment. EU policy to control air pollution rests on three main pillars. Each of these is the result of extensive inputs by member states, and joint decision making by the European parliament and member states.

The first pillar comprises the ambient air quality standards set out in the Ambient Air Quality Directives for ground level ozone, particulate matter, nitrogen oxides, dangerous heavy metals and several other pollutants;

The second pillar consists of national emission reduction targets established in the National Emissions Ceiling Directive for the most important trans-boundary air pollutants: sulphur oxides, nitrogen oxides, ammonia, volatile organic compounds and particulate matter;

The third pillar comprises emissions standards for key sources of pollution, from vehicle and ship emissions to energy and industry.

However, the EU standards are generally more lenient than those set globally by the WHO. National governments though have the freedom of choice to set stricter national standards.

(2) A variety of measures exist at the level of the EU to help promote compliance with Directives concerning air pollution. These measures include: financial mechanisms; advisory services to facilitate access to technical and financial assistance (e.g. URBIS that is supported by the European Commission and European Investment Bank); peer reviews of performance through environment

implementation reviews; dialogue between the European Commission and EU Member States on how to improve compliance; and mechanisms for exchanging experience and good practices.

(3) Judicial means. When countries remain not in compliance with EU air quality legislation, both the European Commission and citizens have recourse to courts in order to require governments to take the actions necessary to achieve compliance. At the EU level, the European Commission may launch infringement procedures which involve documenting non-compliance and requesting information on measures that the Member State will take in order to achieve compliance. If the country still doesn't comply, the Commission may refer the matter to the European Court of Justice which may impose penalties. The European Commission has filed lawsuits against 16 Member States, including Germany, and 13 countries including Germany and the United Kingdom have been accused for nitrogen dioxide. The EU and its Member States can coordinate their policy framework and implementation. Countries with valuations for several consecutive years may face penalty.

2. Supervision of the British government.

The air quality commitments contained in EU Directives were agreed at UK level. However, implementation is devolved to the four national administrations within the UK. Scotland has already produced its own Air Quality Strategy, and Wales and Northern Ireland are currently in the process of drafting their own. At the UK level, Department for Environment, Food and Rural Affairs (Defra) is responsible for implementing air quality related EU directives and general policies, and plays the main role in carrying out an annual national assessment of air quality using modelling and monitoring to determine compliance with EU limit values for the specified pollutants.

Some of the main policies to be implemented at the national level include: phasing out the sale of vehicles using fossil fuels by 2040 and requiring vehicles to be basically 'zero-emission' by 2050; providing financial support for various measures including: vehicle charging infrastructure, cleaner buses and taxis; and measures for reducing emissions generated by major roads; and grants to assist local authorities to improve air quality. Note that the term 'zero-emission' is slightly misleading. It refers to the absence of tailpipe emissions of carbon oxides, nitrogen oxides and hydrocarbons. A 'zero-emission' vehicle in this sense will still cause significant

emissions of fine particles (pm_{2.5} and pm₁₀) as most these come from brakes, tyres and road surface.

3. Supervision and measures of local government.

Local authorities shall regularly review and assess air quality in their area, and to assess whether national objectives have been, or will be, achieved at relevant locations, by an applicable date. If national objectives are not met, or at risk of not being met, the local authority concerned must declare an air quality management area and prepare an air quality action plan.

4. Civil environmental organizations play a supervisory role.

NGOs are granted judicial remedies. Therefore, they have been active in using the courts to pressure the UK into complying with EU air quality standards. In particular, Client Earth has played a major role in using the courts, not just in the UK but in a range of other EU countries including Germany. In 2016, the UK Supreme Court referred a case that Client Earth had brought concerning the interpretation of air quality plans in the EU Ambient Air Quality Directive. The ruling by the European Court of Justice on this interpretation is now binding on all national courts in the EU.

6.3 Attaching importance to the all-round participation of stakeholders, strengthen the disclosure of environmental information

6.3.1 Nurturing public consciousness of ecological environment protection

To cultivate the concept of ecological civilization in the whole society, raise public awareness of ecological environment, cultivate ecological culture, and consolidate the platform of ecological environment education and turn the eco-environmental protection into all people's conscious action. To enhance all people's consciousness of saving, environmental protection and ecology. The relevant competent authorities shall make the top-level design on ecological environment education, and root the ecological environment education in the national education system. To strengthen dissemination of scientific knowledge related to environmental protection, and make environmental protection a genuine conscious activity of the whole public. To make great efforts in youth education on environmental protection knowledge, set real and believable samples that practice ecological civilization, at the same time enable penetration of the "green" ecological culture through various education and training systems, and bring

into play the key role of community groups, public media, etc. in spreading scientific knowledge on environmental protection, make great efforts to disseminate and report scientific knowledge on environmental protection, knowledge and accomplishments of green development, increase the public attention, elevate the public environmental consciousness, set up the concept of green development, and create a favorable atmosphere that advocates ecological civilization and environmental protection.

6.3.2 Initiating national green actions

To initiate national green actions and to create an ecological environment sharing and co-governing pattern to mobilize the whole society to reduce consumption of energies and resources and pollution emissions through practical actions and make contributions to the ecological environment protection. To establish climate neutral foundations, add inputs in scientific research, set prices through market mechanism, employ flexibly rewards, punishments, incentives, etc., expand and satisfy the public demand for green products, guide the public to practice the concept of green development and improve consuming habits and behaviors step by step, and promote all-round development of green production and consumption. The government should leverage the gender advantages of women by enhancing their participation in developing and implementing policies of green life, green consumption and other aspects. To create new eco-environment management systems, build communication platforms with the public on a regular basis, develop the approaches and channels for the public to take part in the green development, complete the systems and stages of public participation. To implement responsible entities, strengthen work collaboration, and ensure public participation in environmental decision-making. To establish an effective eco-environment public participation evaluation system, conduct regular evaluation and make feedback on public participation in the eco-environment through hearings, symposiums, questionnaires, telephone and letter return visits. It may also take advantage of technologies such as big data and cloud computing to control the quality and effectiveness of public participation in the ecological environment.

6.3.3 Underpinning eco-environment information disclosure

Governments should, in accordance with the laws, delegate environmental supervision powers to social organizations to benefit them to supervise the waste discharge behavior of enterprises and publish information to the society; strengthen the development of the corporate environmental information disclosure system, establish a public directory of corporate environmental information, including classification of information,

differentiation of degrees of disclosure, information disclosure using standardized templates, etc., improve the remedy mechanisms, penalties and incentives for all parties involved in the disclosure of corporate environmental information; open clear channels for the public to appeal, adopt the hearing system to key projects and policies, and initiate the round-table mechanism for hot topics. For the pattern of environment information disclosure, to build unified environment information disclosure platforms and formulate uniform disclosure assessment systems and criteria.

Box 6-2 EU Countries emphasizing on information disclosure and public participation

1. Legislation guarantees citizens' right to know regarding environment.

The German government attaches great importance to ensuring citizens' right to know in the legal provisions. Taking sustainable chemicals management as an example, Germany has introduced a series of laws and regulations, such as environmental protection laws and preventive protection laws, to ensure the public's right to know regarding the environment, including factory site selection and environmental protection measures.

2. Government at all levels pays attention to the disclosure of environmental information

First, the legislative departments of the EU and Member States have passed legislation to protect the public's right to know.

Second, government agencies such as the German Environment Agency have established public dialogue mechanisms, which ensures close contact with the general public. While drafting the Integrated Environment Program the Ministry for Environment held five dialogues are held each year in different cities in Germany with local public participation.

Third, the government joins universities and colleges to jointly publish environmental information. In the United Kingdom, for example, several open channels have been established for the disclosure of air quality information, including: UK-Air, NAEI and "CityAir" mobile app to share environmental

information with the public, and announce early warning in the event of heavy pollution incident through subway and bus.

3. The concept of protecting citizens' right to know is deeply rooted in enterprises, and enterprises attach importance to public relations.

Take the chemical industry park in Germany as an example. Enterprises in the park attach great importance to maintaining a good and trustful relationship with the residents, actively disclosing relevant information to the public, and never rejecting anyone's right to know. Thus, enterprises establish themselves as trustworthy.

4. Paying great attention to the impact of the environment on human health in disclosing environmental information

The environmental information disclosure in the UK attaches great importance to the impact of environmental pollution on human health, and is intended to raise people's attention to environmental protection. UK-Air contains information on the network of monitoring sites and how they function, data on local concentrations of air pollutants, including datasets on air quality trends and real-time air quality assessments, short-term forecasts for air quality, and information on how air quality affects human health and the environment. "CityAir" mobile app includes information about which roads are polluted, when and how much are the pollution is at highest. It informs the public by dos and don'ts under each pollution level, and helps plan a route with least exposure to heavily polluted areas before leaving the house.

6.3.4 Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters

Developing environmental policies in an open, participatory way is a fundamental element of good environmental governance. These measures enhance the quality of decisions, contribute to public awareness of environmental issues, give the public the opportunity to express its concerns, and enable public authorities to take due account of such concerns, so that public decision-making on environmental issues can be more transparent and accountable, and strengthen public support for environmental policies and their implementation.

The Aarhus Convention on Access to Information, Public Participation in Decision Making and Access to Justice in Environmental Matters now provides the key international reference and benchmark in this policy area. It was originally adopted by members of the UN Economic Commission for Europe in 1998 and now has 47 Parties.³⁹ The Aarhus Convention explicitly recognizes that everyone, including future generations, has the right to live in an environment adequate for their health and well-being. It calls on public authorities to enable citizens to exercise this right by guaranteeing their access to information, public participation in decision making and access to justice in environmental matters.

6.3.4.1 Access to information

The Aarhus Convention obliges governments to provide environmental information requested by the public. They should do so as soon as possible, and generally within a month of receiving a request. However, governments may refuse some types of requests; for example, if the request is “manifestly unreasonable or too general”, or disclosure could prejudice ongoing proceedings or damage commercial confidentiality or national security. The authorities should explain a refusal to provide information. If they do not have the information requested, they should direct the requester to the appropriate source. The public authority may charge the requester for providing information. However, it should not exceed “a reasonable cost” and a schedule of charges should be available beforehand.

Public authorities are also obliged to collect information that they need to carry out their responsibility to protect human health and the environment, and to disseminate that information to the public. Information should be made available in a transparent way and be effectively accessible. Governments are also expected to ensure the integrity and reliability of environmental information. Many have done so by assigning

39 UN Economic Commission for Europe (2014), *The Aarhus Convention: an Implementation Guide*, UNECE, Geneva,
https://www.unece.org/fileadmin/DAM/env/pp/Publications/Aarhus_Implementation_Guide_interactive_eng.pdf.

responsibility for the collection and treatment of environmental information to independent institutions, such as an Environment Agency or National Statistical Office, that are managed at arms' length from political control. Over the last decade, many governments have made increasing use of the internet and devised more user-friendly methods for disseminating environmental information.

6.3.4.2 Public Participation

Public participation provides an opportunity for governments to have access to accurate, comprehensive, up-to-date information when making a decision that has significant environmental consequences. The Aarhus Convention recommends that, for specified activities, public authorities should conduct public participation early, and give the public notice, including time frames for the different phases of the process. The public should have access to all relevant information and opportunities to provide comments. The authorities should take the comments into account and inform the public of the decision eventually adopted, including the reasons. One of the key challenges in many countries is to ensure that public participation processes are not just formal exercises and that the public has a real opportunity to influence the decision.

According to the Convention, the main activities that should involve public participation are:

- the proposed siting, construction and operation of certain types of facilities, often over a certain size. Such *projects* would generally be required under national law to undergo an Environmental Impact Assessment procedure including public participation;
- the development of *plans, programmes and policies* relating to the environment, including sectoral or land-use plans, environmental action plans, and environmental policies at all levels. In many countries, such plans would be subject to Strategic Environmental Assessment. In these cases, there may be a need to develop clear criteria for who can participate; and
- the preparation of *laws and regulations*. Again, criteria for participation may need to be established as well as a procedure for receiving comments on successive drafts.

In many countries, environmental NGOs can fulfil an important public function by bringing information and perspectives to decision making. Recognising this, many governments provide financial and other support to NGOs; for example, free office

space, or contracts to perform defined tasks such as information collection or conducting surveys. In such cases, it is important to ensure that NGOs receiving government support remain independent of the government.

6.3.4.3 Access to Justice⁴⁰

Provisions for access to justice provide the public with the opportunity to seek legal review of alleged violations of environmental law. Effectively they enable the public to play a role in the enforcement of environmental law. The provisions on access to justice in the Convention apply to all matters of environmental law, but a distinction is made between three types of violation:

- Requests for access to environmental information;
- Public participation rights (e.g. permits, decision-making for specific activities);
- All other acts, decisions and omissions affecting the environment.

For the first two categories, governments must provide a review procedure involving a court or court-like body established by law. For the third category, access to justice may also be provided by means of administrative procedures.

In addition to procedures, governments must also ensure that appropriate remedies can be applied. They should include “injunctive relief”, that is a remedy that prevents the harm from (re)occurring. In accordance with the provisions of the Convention, the government should clarify who has “standing”, that is who is authorized to initiate a legal review. The government should also set the standards so that the procedures, decisions and remedies are fair, equitable, timely, not prohibitively expensive, and that decisions are publicly available in writing.

⁴⁰ For further information on experience in Europe with access to justice see Client Earth (2019), *Access to Justice in European Union Law: a legal guide to access to justice in environmental matters*, <https://www.documents.clientearth.org/library/download-info/16209/>

ANNEX 1: THE NEED FOR SCENARIO-BASED OUTLOOKS

This SPS highlighted a need for foresight, in order to align the Beautiful China 2035 targets with China's vision for 2050 and to identify a critical path towards achieving both. A recommendation to this end is put forward by the SPS, specifically advising scenario methodology to guide China's environment policy.

In addition, **focusing on CCICED itself**, SPS members noted that a common base of mid- and long term scenarios would provide great leverage to the whole programme of CCICED studies. Previous, summary work in this direction was undertaken by the CCICED task forces exploring the connections between China's environment policy and its social development and its economic transition, respectively. ⁴¹This annex summarizes the potential for CCICED.

1. Potential for the CCICED programme of studies

A common base of scenarios, underlying the whole programme of work, would conceivably provide the following potential to CCICED:

- a common baseline, or set of baselines, in order to **facilitate comparison between all studies** and combine their findings. It is a bit late in phase VI to establish this, but perhaps something of the sort can still be done.
- A softer variant, applied at a later phase in the development of the studies would be: **stress testing draft recommendations** from all current CCICED studies, against a simple set of contrasting scenarios, spanning the width of conceivable futures
- back casting in order to **align the 2035 goals with the 2050 vision**. Scenario work in this style was recommended as a first priority by the 2013 task force on the interplay between environment policy and China's social development.
- input into the drafting of the **annual issues paper**.

Any relevant scenario for environment and development in China has to consider

⁴¹ Study on China's Environmental Protection and Social Development, CCICED executive report 2013; The New Era of Green development – China's Green Transition to 2050, CCICED discussion paper 2017.

multiple geographical scales, including the wider region and the globe. The same goes for the associated modelling. A pragmatic way to accomplish this, instead of building your very own worldwide scenarios and models, is to use the existing Shared Socio-Economic Pathways as context⁴². More detailed work for China's domestic developments, based on Chinese knowledge, can then be elaborated within that framework. Such an approach has recently been followed in analytical work for the CCICED Task Force on China's Green Transition to 2050.

3. *Background: what is a scenario-based outlook?*

Scenario methods belong to the larger domain of foresight. That is the ability to know about the future. Specifically, scenarios are used to build consistent stories about the future, with a consistent timeline. Typically, the various actors and forces interact, as in the theater. Hence the name. The key objective is to have thought through the future before it arrives so that you are better prepared.

What scenarios do NOT deliver are predictions. The world is too uncertain for that. In fact, scenario methods are key in exploring precisely the big uncertainties and their policy implications.

Thus, a scenario is a story, imagining how things could develop over time. It is NOT necessarily a story how things should develop, although important variants exist that have this character.

In matters of environment and sustainable development, scenarios are often composed of a narrative plus numbers, the latter based on models. The models should NOT be understood as a rigid law, but they are often useful in illuminating, for example, maximum rates of improvement and the longevity of 'stuff' such as energy installations and spatial patterns.

Many types of scenarios exist and there is abundant literature. The simplest distinction

⁴² O'Neill BC, Kriegler E, Ebi KL, Kemp-Benedict E, Riahi K, Rothman DS, ... and Solecki W. (2017). The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century. *Global Environmental Change*, 42, 169–180. <https://doi.org/10.1016/j.gloenvcha.2015.01.004>. Part of special issue on the Shared Socio-Economic Pathways.

is in terms of the reasons why one would want to know about the future. The technical characteristics follow from this (plus of course, time and money budgets, the audience, etcetera). Three archetypal reasons/purposes exist, as follows.

(1) **Policy optimization:** what policy variant is most effective, cost-efficient, fast, acceptable, and so forth.

(2) **Advocacy:** what are the positive changes we are going to fight for? Importantly, one flavour here is back casting, exploring how to reach the vision. Back casting is NOT planning. It is much more strategic, for example identifying ‘must-haves’ and ‘dead alleys’ to be kept in mind when making near-term decisions.

(3) **Strategic orientation:** for what alternative worlds do we need to prepare ourselves? What if our current assumptions were wrong? What would be robust strategies? Importantly, this is the archetype where the client is NOT in control, but wants to prepare strategically for what could come his/her way.

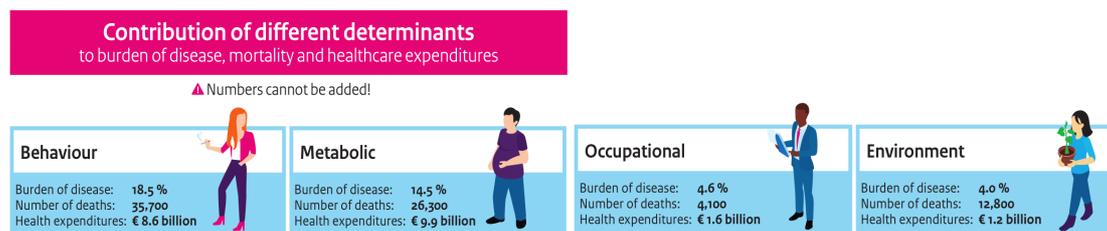
ANNEX 2: HEALTH IMPACT ASSESSMENT

Health impact assessment is a multidisciplinary approach and instrument to analyze and estimate potential effects of projects/programs/policies on the health of a population and the distribution of those effects within the population⁴³.

Health impact assessment in environmental policies

Health impact assessment has a potential role in strategy setting and situating environmental targets in the broader societal agenda; performance evaluation nationally as well as locally; preparing decisions on project variants, including through consultation of stakeholders.

- *Health impact assessment* is an effective procedure **to assess or evaluate** the health impacts of environmental exposures and policies, using burden of disease as an integrated health measure or other indicators like health expenditures and changes in the number of deaths attributable to improved environmental conditions.
- *Assessment of disease burden* enables quantitative **comparison** between impact of different policy measures or exposure from street level to national or international regions, with the option to take into account combinations of environmental pollutants or location specific characteristics like the population structure and changes therein.
- *Health impact assessment* can support insight into the **achievement of sustainable development goal** for ensuring healthy lives and well-being (SDG#3) as result of policies and interventions on environmental factors as well as on climate change.



Figures for the netherlands 2018⁴⁴, according to WHO.

⁴³ WHO (2014): Health Impact Assessment (HIA): <https://www.who.int/hia/en/>

⁴⁴ RIVM - National Institute of Public Health and the Environment (2018). Public Health Foresight

Target and indicator based systems

Environmental policies depend on the geographical scale, local conditions and prioritized vulnerable target groups or ambitions. Monitoring achieved or aspired progress in environmental conditions by health impact assessment or burden of disease quantifications require a relevant target and indicator system suitable to the presented situation or ambition:

1. A **framework** of relation between environment and health. Some examples are DPSEEA framework⁴⁵ and specifically the ecosystem enriched model eDPSEEA framework⁴⁶, INHERIT framework⁴⁷ and the INTARESE framework⁴⁸.
2. Relevant and useful **indicators**, depending on the aim of the health impact assessment and their specific advantages and disadvantages for monitoring environmental conditions and policies – see table below.
3. **Validation norms**: for instance, established EU environmental standards and/or WHO recommend values for health impact of environmental conditions⁴⁹.

2018, a healthy prospect; synthesis. (RIVM - National Institute of Public Health and the Environment, Ministry of Welfare, Health and Sport); https://www.vtv2018.nl/sites/default/files/2018-11/LR_116406_010947_VTV_kernboodschappen_ENG_V5.pdf

⁴⁵ Corvalán, C., Briggs, D.J. and Kjellstrom, T. (1996). Development of environmental health indicators. In: Linkage methods for environment and health analysis. General guidelines. (Briggs, D., Corvalán, C. and Nurminen, M., eds). Geneva: UNEP, USEPA and WHO.

Morris, G.P., Beck, S.A., Hanlon, P. & Robertson, R. (2006). Getting strategic about the environment and health. *Public Health*, Vol. 120, pp. 889-907.

⁴⁶ Reis, S. Morris, G et al, Integrating health and environmental impact analysis, *Public Health*, Available online 4 October 2013.

⁴⁷ EuroHealthNet EU Horizon 2020 project: <https://www.inherit.eu/project/caf/>

⁴⁸ Briggs, D.J. (2008). A framework for integrated environmental health impact assessment of systemic risks. *Environmental Health* 7, 61.

⁴⁹ WHO recommend values for health impact of environmental conditions: <https://www.unenvironment.org/global-environment-outlook/integrated-environmental-assessment>

	Indicator type	Indicator examples	Utility of indicators	Advantages	Disadvantages
PHYSICAL ENVIRONMENT	Environmental indicators; related to parts or processes in the physical environment	Air quality, noise level, chemical concentration (including nano-parts), water quality, soil quality; climate change indicators; distance of location to a source; <i>GES-score</i> ¹	*Determination of impact of policies focused on the source or on the burden of agents, substances or stressors *Determination of goal realization in environmental quality *Determination of 'most healthy variant'	-Data mostly available -Relatively little insecurities -Approaches available to monetise health impact of air pollution ²	-No direct insight into health impact -No information about the extent to which people are actually exposed/affected
	Physiological indicators; changes in the human body related to internal exposure	Level of lead contamination in the blood, concentration beta-2 microglobuline in the urine; <i>biomonitoring</i> ³	*Internal exposure as proxy to exposure in the environment *Physiological indicators as proxy to health impact	-Integrates contribution of different sources and routes -Potential indicators of early health effects ('effect monitoring')	-Gathering data relatively difficult -No direct insight into the long term health impact
HEALTH	Health indicators; related to the occurrence or prevention of pathophysiological changes, disease or death in a population	Number of (extra) asthma cases among children, number of fatal traffic accidents, number of people with (extra) severe noise annoyance, <i>ambulatory monitoring</i> ⁴ , etc.	*Description of the extent of environment related health impact and monitoring of the consequences of interventions	-Direct insight into health impact -Intuitively understandable	-Not useful for balancing shifts in multiple heterogeneous health impacts
	Integrated health indicators; combination of various factors to express the disease burden of a population	<i>DALY</i> ⁵ ; loss of life expectancy, population average years of life lost (yll), <i>MGR</i> ⁶ , etc.	*Prioritizing and comparing of different heterogeneous environmental related health impacts *Comparison of health impact of various policies	-Only possibility to judge the net effect of disparate environmental health impacts (see additional information on DALY below)	-Sometimes difficult to interpret -Abstract figures -Shifts in the indicator cannot directly be related to a specific cause -More uncertain than other indicators as result of more necessary input -Not useful for risks with a small chance of occurring but potential large impact (incidents/calamities) - better evidence can lead to a larger burden

Based on: RIVM - National Institute of Public Health and the Environment 2014⁵⁰. Precision and (minimum) scale, the environmental changes covered, as well as the utility of indicators for projection vary and should be taken into account for proper use. For an example of future scenario calculations on the relationship between climate, water and health: see BlueHealth EU Horizon 2020 project.⁵¹

Additional information on specific indicators (1-6)

1. **GES-score:** an environmental quality-indicator based on established norms to assess and weigh various options for spatial planning on environmental and health impacts⁵². Scores are projected in maps and are easy to interpret. Characteristics of housing or population numbers can be added to the map and use of colors give an indication of the combination of risks factors. Advantage: comparison of various factors of environmental quality is possible. Disadvantage: the score categories are rather wide; scores cannot be added up. Not a scientific method, but based on consensus considering scientific acceptability, practical reality and political usability⁵³.
2. **Monetise health impact of air pollution:** an air pollution cost indicator, based on combining calculations on the consumption people are willing to forgo to avoid all mortalities from air pollution, with estimated numbers of mortalities derived from the Global Burden of Disease study (GBD) and estimates of the Value of a Statistical Live (VSL). Advantage: it allows for some comparison within and among countries. Disadvantage: both the GBD study and the VSL estimates rely on some important assumptions.⁵⁴

⁵⁰ RIVM - National Institute of Public Health and the Environment (2014), Gezondheid en veiligheid in de omgevingswet, doelen, normen en afwegingen bij de kwaliteit van de leefomgeving. Based on: Knol, A.B. (2010), Health and the Environment: assessing the impacts, addressing the uncertainties (PhD, Utrecht University).

⁵¹ BlueHealth EU Horizon 2020 project: <http://bluehealth2020.eu/projects/bluehealth-scenarios/>

⁵² Fast, T., P.J. van den Hazel en D.H.J. van de Weerd (2012). Gezondheidseffectscreening. Gezondheid en milieu in ruimtelijke planvorming. Versie 1.6. (Utrecht: GGD Nederland).

⁵³ Factsheet GES 2018 (RIVM – National Institute of Public Health and the Environment): <https://www.rijksoverheid.nl/documenten/brochures/2018/03/02/factsheet-gezondheidseffectscreening>

⁵⁴ Further information: OECD (2014), The cost of air pollution – health impact of road transport:

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3. **Human Biomonitoring:** indicators on internal occurrence of chemical substances in the human body, meant to summarize the exposure among populations and to communicate to what degree environmental policies are successful in keeping internal exposures sufficiently low. The main aim of HBM indicators is to allow follow-up of chemical safety in Europe. This involves ‘sum indicators of internal exposure’ derived directly from HBM biomarker concentrations and ‘indicators for health risk’, comparing HBM concentrations to HBM health-based guidance values. In the latter case, calculations can feature both the percentage of the studied population exceeding the guidance values (PE) and the extent of exceedance (EE). The extent of exceedance is calculated as the population’s exposure level divided by the guidance value.⁵⁵
 4. **Ambulatory monitoring:** data collected by hospitals, for instance avoidable hospitalizations for conditions especially in children and other diagnosis associated with pollution risks.
 5. **DALY (Disability-Adjusted Life Year):** an integrated ‘burden of disease’ indicator based on the loss of life years due to premature mortality and years lived with disability (expressed in the amount of life years lost: DALY). It can be applied to assess and weigh environmental impact on health. The burden of disease is calculated by using a combination of both objective numbers of illnesses as well as weight factors based on judgements regarding the impact of the illness and changes

<http://dx.doi.org/10.1787/9789264210448-en>

OECD (2017), Roy, R. and N. Braathen, *The Rising Cost of Ambient Air Pollution thus far in the 21st Century: Results from the BRIICS and the OECD Countries*”, OECD Environment Working Papers, No. 124, OECD Publishing, Paris: <http://dx.doi.org/10.1787/d1b2b844-en>

⁵⁵ Further information: Albertini, R., Bird, M., Doerrer, N., Needham, L., Robinson, S., Sheldon, L., Zenick, H. (2006). The use of biomonitoring data in exposure and human health risk assessment. *Environmental Health Perspectives*, Vol. 114, No. 11, November 2006: <https://doi.org/10.1289/ehp.9056>,

Angerer, J., Aylward, L.L., Hays, S.M., Heinszow, B., Wilhem, M. (2011). Human biomonitoring assessment values: Approaches and data requirements. *International Journal of Hygiene and Environmental Health*, Vol. 214, Issue 5, September 2011, p. 348-360: <https://doi.org/10.1016/j.ijheh.2011.06.002>,

Becker, K., Conrad, A., Kirsch, N., Kolossa-Gehring, M., Schulz, C. Seiwert, M. Seifert, B. (2007). German Environmental Survey (GerES): Human biomonitoring as a tool to identify exposure pathways. *International Journal of Hygiene and Environmental Health*, Vol. 210, Issue 3-4, May 2007, p. 267-269: <https://doi.org/10.1016/j.ijheh.2007.01.010>

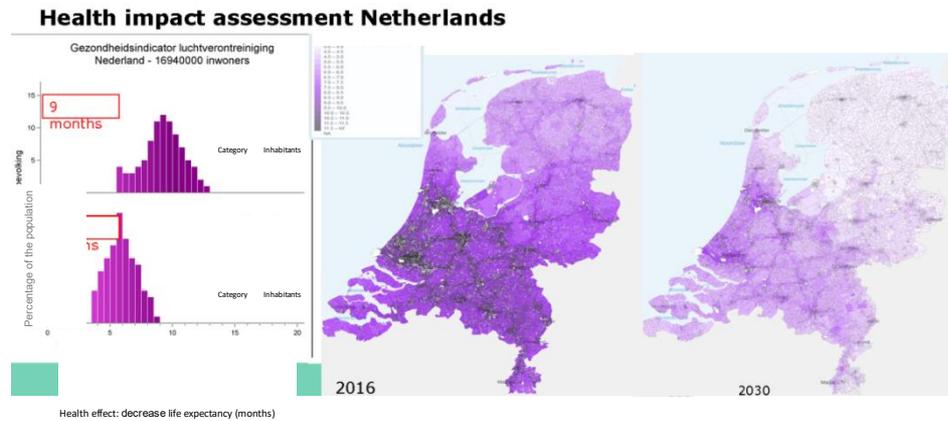
in life expectancy. Weighing factors of years lived with disability are based on consensus gained by protocols in national and international studies. Advantage: comparison of effectiveness of various measures and plans on environmental quality and applicable to various geographical scales – the extent of reliability is dependent on availability of data on exposure and impact, and on the consensus for weighting the burden of disease to calculate DALYs. Disadvantage: In absolute numbers DALY is less useful. ⁵⁶

6. **MGR (Environmental Health Risk)**: an environmental health-risk indicator for specific locations. It is based on DALY combined with GES-scores and shows environment-related health risks as a percentage of total expected health risks. Advantage: MGR enables identification of groups with ‘high-risk’ health impact as result of cumulative environmental exposure. Supports comparison and prioritization of environmental policy options, as impact of exposures are calculated in comparable units. MGR is also applicable as environmental quality indicator. It can be displayed in maps on detailed geographical scale. Disadvantage: MGR is not useful for setting environmental norms. Prerequisite to determine the MGR are data on local environmental exposure (actual or as a result of scenario calculations).⁵⁷

⁵⁶ Further information: Murray, C.J.L. and A.D. Lopez (1996). The global burden of disease: a comparative assessment of mortality and disability from disease, injuries, and risk factors in 1990 and projected to 2020. Cambridge (MA): Harvard University Press on behalf of the WHO and the World Bank, 1996.

⁵⁷ Further information (in Dutch): Factsheet MGR 2017 <https://www.gezondeleefomgeving.nl/sites/default/files/2018-06/Factsheet%20Milieugezondheidsindicator.pdf> and article in Nature today 2019 <https://www.naturetoday.com/intl/nl/nature-reports/message/?msg=25290>. ‘MGR’ is the Dutch acronym.

In addition to these quantitative environment and health indicators, various other indicators are relevant to assess health impact of environmental conditions, directly or indirectly. For example, indicators on environmental quality (e.g. healthy urban



design⁵⁸), social-economic status, safety of the neighbourhood and a sustainability index. They provide insight into the broader picture, including important contextual factors and factors of well-being that can reinforce the impact of the environmental conditions on health⁵⁹.

⁵⁸ Heart Foundation 2012:

<https://www.heartfoundation.org.au/images/uploads/main/Programs/Healthy-by-Design-a-planners-guide-to-environments-for-active-living-web.pdf>

⁵⁹ For an overview of quantitative, qualitative and integral instruments for a healthy living environment by RIVM – National Institute for Public Health and the Environment (in Dutch):

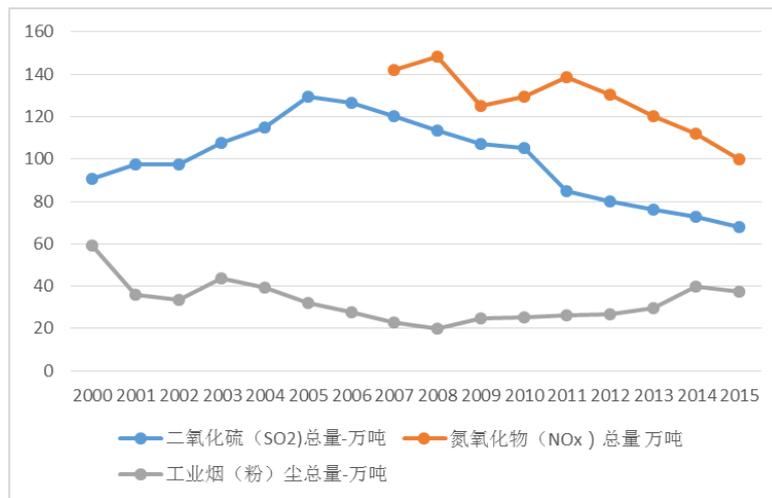
<https://www.gezondeleefomgeving.nl/instrumenten>

ANNEX 3: AIR POLLUTION IN THE PEARL RIVER DELTA: A CASE STUDY IN SUSTAINABLE ENVIRONMENTAL IMPROVEMENT

An improvement in air pollution in China's Pearl River Delta region provide a useful case study, provides tracking the historical process of environmental quality improvement, the characteristics of the staging various stages, and the driving forces of the economic and social development of the region. It also helps to distinguish identify the macroeconomic and social development strategies of the Pearl River Delta region at different stages from the "10th Five-Year Plan" period, as well as the top-level design route for the overall ecological environmental protection and the policy priorities at each stage. Based on the case study, the following conclusions: Guangdong's macro development strategy is gradually moving from isolated environmental governance and resource conservation to integrated environmental, economic and social development. On the whole, the green development of Guangdong Province during the "10th Five-Year Plan" period was still relatively isolated. During the "11th Five-Year Plan" and "12th Five-Year Plan" periods, Guangdong Province started to transform economic and social development through resource conservation and environmentally friendly development. During the "13th Five-Year Plan" period, efforts are being made to build an ecological civilization.

Trends and Developments of Air Quality and Social-Economic Progress in Guangdong Province

Guangdong Province is of great reference for the study of the Pearl River Delta in terms of changes in air quality and economic and social development. The following is a study on Guangdong Province, which can be used as a reference for information.



—●— SO2-10,000 tons —●— NOx-10,000 tons
—●— Industrial smoke (powder) dust-10,000 tons

Figure 7-1 Total emissions of major pollutants from 2000 to 2015 in Guangdong Province

Data for Guangdong Province show that sulfur dioxide emissions continued to decline after reaching a peak in 2005, with an especially significant decline in 2011; industrial smoke (particles) dust emissions began to decline in 2003, but there was a small increase after 2008; nitrogen oxides emissions fell sharply in 2009, then increased, and again started to decrease after 2011.

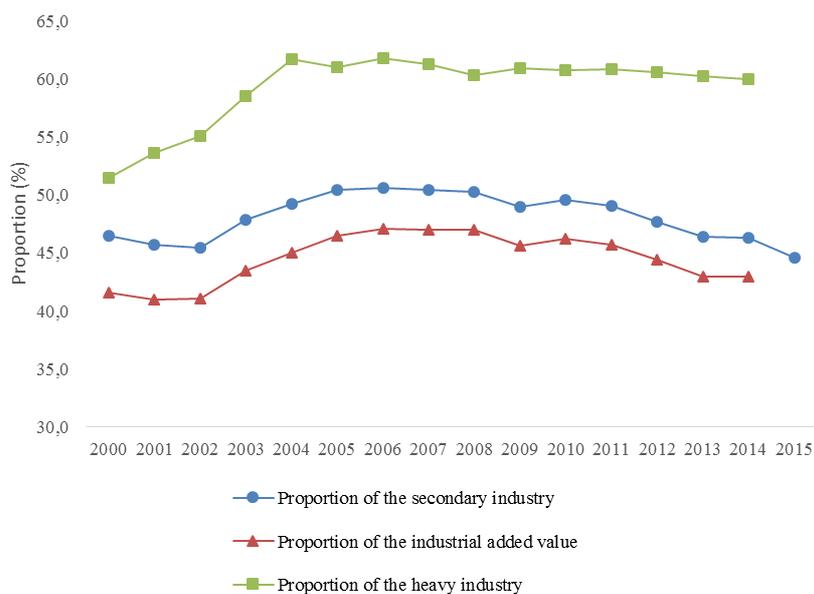


Figure 7-2 Trends in the industrial structure development in Guangdong Province

The proportion of the added value of the secondary sector, the proportion of industrial added value, and the proportion of heavy industry in industrial added value in Guangdong Province continue to decline after peaking in 2006. Specifically, the proportion of value added of the secondary sector dropped from 50.6% in 2006 to 44.6% in 2015. The proportion of industrial added value dropped from 47.1% in 2006 to 43% in 2014. The proportion of heavy industry in industrial added value fell from 61.8% in 2006 to 60% in 2014

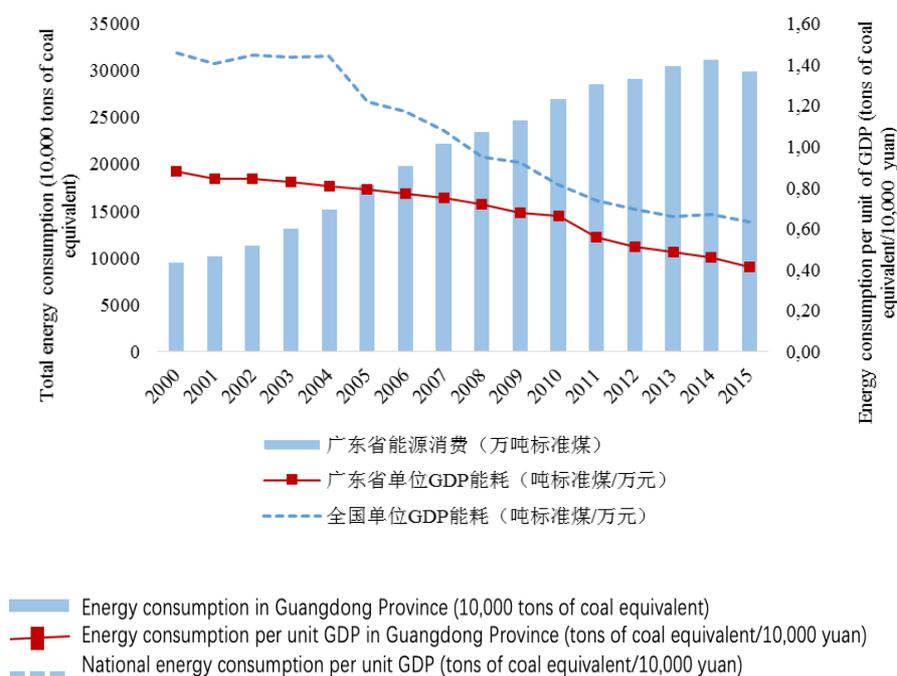


Figure 7-3 Trends in energy consumption in Guangdong Province

The total energy consumption of Guangdong Province continues to rise. In 2014, it reached 311.48 million tons of coal equivalent, 3.3 times that of 2000. The total energy consumption in 2015 decreased for the first time, down 4.2% from 2014. At the same time, the energy consumption per unit of GDP has been declining, from 0.88 tons of coal equivalent per 10,000 yuan in 2000 to 0.41 tons of coal equivalent in 2015.

While the overall changes in the Pearl River Delta are consistent with that of Guangdong Province, there are still some differences, and further detailed analysis is needed.

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