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Key Points

- Rates of urbanization and new small and medium-sized cities (SMCs) rise at an unprecedented pace in rapidly growing countries like the PRC.
- Given the limitations in financial and human resources, and opportunities for growth, low-carbon development in small and medium-sized cities is much more complex than in megacities owing to the expectations and unique challenges SMCs face.
- SMCs are endowed with opportunities that will help foster an enabling environment for low-carbon development in parallel with socioeconomic growth.

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Low-Carbon Development in Small and Medium-Sized Cities in the People's Republic of China: Challenges and Opportunities

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Why are small and medium-sized cities important?

Asian cities are projected to contribute to two-thirds of the world's urban population growth over the next decade. Yet, half of Asia's urban population, who still lives in cities with populations of less than 500,000, needs proper infrastructure and basic services for balanced development.[2] In the People's Republic of China (PRC), the country was nearly 50% urbanized in 2011 and is expected to reach 70% within the next 20 years. Urban areas in the PRC account for almost 75% of the country's total energy consumption, contributing to an equivalent of 85% of the country's total energy-related greenhouse gas emissions.[3]

While the degree of urbanization in the western and eastern regions of the PRC is uneven, the most dynamic changes with profound implications on growth and resource use are projected to take place in its small and medium-sized cities (SMCs).[4] In 2011, SMCs in the PRC were home to about 75% of the country's population. Newly formed small towns and the growth of existing SMCs play an important role in poverty reduction by improving access to urban services for rural migrants and the poor. However, they will add significant pressure to the environment by increasing

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[2] UN Habitat. 2010.

[3] International Energy Agency. 2008.

[4] In the PRC, a small city is a county-level city with an urban population of less than 0.2 million, while a medium-sized city has a population of 0.2–1.0 million.

Key Government Actions for Promoting Low-Carbon City Development in the People's Republic of China

Urban Management	*Twelfth Five-Year Plan (2011–2015)* – Guide to address greenhouse gas emission by inventory, pilot program, emission trading, and awareness raising – Guide to promote coordination between regional and urban development *Initiatives and Programs* – Green, low-carbon, key small pilot town project (MHURD/MOF/NDRC 2011) – Provincial greenhouse gas emission inventory pilot project (NDRC 2011) – Integrated energy-saving and emission reduction financial policy demonstration project (MOF/NDRC 2011) – Five provinces and eight cities low-carbon pilot project (NDRC 2010)
Energy	*Twelfth Five-Year Plan (2011–2015)* – Carbon reduction targets to reduce energy and carbon intensity – Renewable energy targets to achieve installed capacity for wind, solar, biomass, and hydropower – Energy-saving targets to deploy biogas digester, solar water heater, and solar cooker *Initiatives and Programs* – Top 10,000 energy-consuming enterprises program (NDRC 2011) – Efficient light bulb subsidy program (MOF 2008) – Monitoring and evaluation of energy conservation and emission reduction plans (State Council 2007) – Energy conservation management in government offices and large-scale public buildings (MOC/MOF 2007) – Conversion of exhaust heat and pressure (NDRC 2006) – Medium- and long-term energy conservation plan (NDRC 2004) – Rules on the development of heat and power cogeneration (NDRC 2000)
Land Use and Transportation	*Twelfth Five-Year Plan (2011–2015)* – Energy-saving and emission reduction targets from road and water transport *Initiatives and Programs* – Guidance for the development of low-carbon transport system/low-carbon transport pilot programs (MOT 2011) – Special funds for energy saving and emission reduction in the transport sector (MOT/MOF 2011) – Pilot program of promoting new energy vehicles (MOIIT/NDRC/MOF/MOST 2009) – General outline for national land use (2006–2020) (State Council 2008)
Waste and Resource Management	*Twelfth Five-Year Plan (2011–2015)* – Waste-recycling targets to improve utilization rate of industrial, construction, forestry, and agricultural waste – Municipal solid waste treatment target to promote environmentally sound treatment of municipal solid waste *Initiatives and Programs* – Guidelines for Environmental Protection Model Cities and Eco-cities (MEP 2007/2011) – Opinions on strengthening the municipal solid waste disposal (State Council 2011) – Policy guidelines and standards for treatment and disposal of municipal wastewater sludge (MHURD 2009) – Administrative measures to prevent and control environmental pollution by e-waste (MEP 2007) – Guidance on pollution control for electronic IT products and technical policy for pollution prevention and control for home appliances and e-waste (NDRC 2006)

IT = information technology, MEP = Ministry of Environmental Protection, MHURD = Ministry of Housing and Urban–Rural Development, MOC = Ministry of Construction, MOF = Ministry of Finance, MOIIT = Ministry of Industry and Information Technology, MOST = Ministry of Science and Technology, MOT = Ministry of Transport, NDRC = National Development and Reform Commission, SDPC = State Development and Planning Committee, SEPA = State Environmental Protection Administration.

greenhouse gas emissions and exacerbating air, water, and solid waste pollution.[5] Although all developed countries experienced a growing number of SMCs, this is a unique phenomenon particularly in rapidly growing countries such as the PRC, where rates of urbanization and new SMCs rise at an unprecedented pace.

The Government of the PRC is committed to address the challenges associated with urbanization. Driven by a mandate that recognizes urbanization as an opportunity to expand economic growth while promoting pollution-free, resource-efficient, low-carbon urban development, the PRC government has committed in its previous national five-year plans to protect the environment by reversing the prevailing trend of increasing energy intensity per gross domestic product (GDP). In November 2009, the State Council announced a national target to reduce the intensity of carbon dioxide emissions per unit of GDP by 40%–45% from the 2005 level by 2020. However, while notable efforts are under way in megacities such as Beijing, Shanghai, and Shenyang, a large knowledge gap exists in most SMCs, where financial resources and capacities are more limited and significant socioeconomic challenges exist compared with those in megacities. For the PRC, this is an emerging challenge that hinders its efforts of promoting low-carbon economic growth aligned with its socioeconomic development goals. The table shows some key initiatives of the government with the Twelfth Five-Year Plan, 2011–2015 as the overarching plan that cuts across all sectors. This policy note highlights the challenges and opportunities SMCs face in the four key urban sectors—urban management, energy, transport, and waste and resource management—as they transition to a low-carbon trajectory.

Key Trends and Challenges for Low-Carbon Development in SMCs

Urban and low-carbon development challenges of SMCs are rooted at the PRC's urbanization trend and SMCs' local characteristics, which differ significantly from megacities. It is most important for policy makers to clearly realize the key trends and challenges for their SMCs, especially in urban management and key urban sectors of energy, land use and transportation, and waste and resource management.

Urban Management

Unprecedented growth. Compared with megacities, SMCs grow faster in terms of economy, demography, and size. In the PRC, out of a total of 657 cities, 532 or 81% were classified as SMCs in 2011.[6] The most dynamic changes occur in SMCs and even in the smaller 33,270 towns and townships as they interface with rural areas geographically, socially, and economically. Considering the current growth rate, many smaller towns and townships will join the classification of SMCs, tripling their number in 2030 when urbanization rate exceeds 70%.

Competing development priorities. Most SMCs find themselves in conflict with competing socioeconomic goals while pursuing the path to an environmentally sustainable and low-carbon future.[7] Even while some SMCs have shown strong political will and a desire to pursue low-carbon economic growth, they usually face the dilemma of meeting short-term revenue goals alongside long-term sustainability gains.

Diversified economic structure. Compared with megacities, SMCs are much more diverse in nature. In terms of economic structure, growth in some SMCs is mainly driven by the development of its own economic base, whether it is industrial, agricultural, or a mix of both. In other SMCs, their economy relies on playing a supporting role to the adjacent or nearby megacities. In the latter case, the SMCs' activities are aligned and, to a large extent, are dependent on the neighboring larger economy. As a result, SMCs have difficulty selecting and formulating city-specific strategies for low-carbon development.

Increasing urban functions and limited capacities. As the socioeconomic and environmental conditions rapidly change in urbanizing SMCs, emerging policy concerns

[5] Lou. 2011.

[6] NBS, PRC. 2012. In the PRC, a city is classified under an administrative hierarchy of provincial-level city, prefecture-level city, county-level city, statutory town, and township.

[7] Ren. 2011.

are more multisectoral and interdisciplinary than those of megacities. In many cases, there is still a weak scientific basis in designing and integrating urban functions, facilities, and resource allocation. These become a challenge that SMCs did not have to address during the earlier stages of their development. Many SMCs struggle to integrate emerging urban functions and facilities related to energy, transport, and waste to efficiently deliver basic services. Moreover, their lack of technical and financial capacity hinders their ability to respond to these challenges in a timely manner.

Growing institutional governance functions. Despite their size, SMCs in the PRC have a relatively large number of organizations and agencies with extensive government functions numbering about 30, compared to about 40 in megacities.[8] This trend aligns with the needs of a rapidly changing socioeconomic environment brought about by accelerated urbanization. While many SMCs start addressing the emerging urban challenges along with their economic growth, the management structure—typically a uniform silo structure—is usually not flexible enough to cope with basic urban development issues.

Unstable long-term vision for urban development. An overall urban development strategy and related policies in SMCs are prone to be affected by various external factors, including sudden changes in political environment and development opportunities.[9] Compared with that in megacities, policy making of SMCs is unstable because there are many social and economic development paths available. This makes it difficult for the SMCs to draw and maintain a long-term vision of low-carbon urban development that is socially and economically sustainable.

Low-level public and other stakeholders' participation. In the PRC, public and stakeholder participation has become essential in urban management. Although gradually increasing, most SMCs still have low public participation in urban management, resulting in little support for low-carbon and environment-friendly activities for SMCs.

Limited data availability for decision making. The collection of local statistics is fundamental to formulate appropriate policies and targets for sustainable low-carbon and socioeconomic city development. The current datasets in SMCs, however, are either absent or insufficient. SMCs need to collect and manage the local data to analyze various development options and formulate low-carbon development strategies.

Energy

Coal-fired and outdated heating supply system. Heating is one of the most energy-intensive utilities in SMCs. In northern regions, heating energy makes up 50% of building energy consumption. These SMCs depend on obsolete coal-fired heating boilers and heating systems. Poor technical performance and hot water leakages reduce the transmission efficiency of the heat distribution system to less than 70%. The figure is considered to be lower in many SMCs.

Low building turnover rate. Most buildings in SMCs are not energy efficient and they do not meet the national standards. In the PRC, there are still over 2 billion square meters (m^2) of floor space to be transformed into energy efficient with most of them located in SMCs.[10] The economy of SMCs does not allow a high rate of scrap-and-build, which is the common trend in megacities. A low scrap-and-build rate of poorly performing buildings complicate SMCs' efforts to reduce their rising energy consumption. Because the capital investment needed for retrofitting is high and often not affordable for SMCs, many energy-inefficient buildings in SMCs are "locked in" as their energy consumption can only be improved

[8] Bo. 2007.

[9] Wang, Zhang, and Tang. 2010.

[10] ADB. 2012.

through prudent energy use through energy-efficient home and office appliances.

Constraints to energy saving and control. Urbanization and industrialization in the PRC result in rapid increase of energy consumption in SMCs. The trend is expected to accelerate even further compared with energy consumption in megacities. In the PRC, a unit energy consumption of the industrial production still remains much higher than that of developed countries.[11] Historically, energy-intensive industries tend to choose SMCs as a less-expensive alternative site. In some cases, SMCs have little control over these enterprises because they are under the jurisdiction of higher government authorities, and their contribution to the local socioeconomic development is significant.[12]

Increasing per capita energy demand. The PRC's average living space per capita almost doubled—from 15.5 m^2 per person to 29.8 m^2 per person—in 2000–2010. In SMCs, the average living space per capita is expected to grow faster because of relatively cheaper prices per unit land area and floor space compared to those in megacities. Moreover, use of home electric appliances would also increase faster in SMCs because (i) SMCs are the first destination for poor rural migrants, and (ii) ownership of home electric appliances in rural households remains at 23%–63%, much lower than 97%–122% in urban households.[13] These potentially trigger a sharp increase in energy demand for heating, lighting, and electricity consumption per capita, resulting in a more energy-intensive lifestyle. Although the heat energy consumption per square meter of district heating floor area improves, the current heating tariff structure, which is not based on customer's consumption, fails to incentivize a shift to an energy-saving lifestyle in some SMCs.

Less diverse energy demand pattern. Deployment of energy-efficient technologies such as a district heating system and utilization of waste heat are often not technically and financially supported in SMCs. This is because the integration of energy management into SMCs' urban and land use planning is weak. Many urban centers in SMCs still have low building density and little diversity in their land use, where commercial and office buildings are surrounded by residential buildings, and factories and warehouses are in city outskirts. An energy demand pattern of such urban district is too simple and uniform to gain large energy savings from the energy-efficient technologies.

Land Use and Transportation

Rapid land resource consumption. Greenhouse gas emissions increase sharply with urban expansion. A total of 5.3 million hectares of land in the PRC have been developed to meet the land resource demand of urban expansion at an annual increase of 1% from 1997 to 2009.[14] Due to the availability of relatively cheap land resources, a rapid expansion of low density areas especially at the periphery of city areas is a common trend in SMCs. For many SMCs, urban and peri-urban land resources are seen as potential sources of income and are auctioned off to local developers. For instance, the developed urban area of the 10 sampled SMCs increased by 61% in 2006–2010.[15]

Weak integration of regional, urban, and transport planning. Urban planning in SMCs, in many cases, is still shortsighted and lacks the long-term vision that respects unique local characteristics.[16] The economic activity of some SMCs is often not self-contained, whereas others depend largely on a single or a few industries because of historical reasons (e.g., mining cities).[17] Under the rapidly changing PRC economy, SMCs' land use and transport

[11] Liu, Liu, and Sun. 2011.

[12] Draugelis. 2012.

[13] NBS, PRC. 2012. Home electric appliances include a washing machine, an air conditioner, and a refrigerator. Figures more than 100% means owning more than one appliance per person.

[14] Mao. 2011.

[15] Bai and Yang. 2011.

[16] Deng. 2003.

[17] Geng, Zhang, and Zhang. 2011.

planning are more vulnerable, making it extremely challenging to hold a long-term vision. Low-carbon and efficient land use and transport planning, therefore, require a clear understanding of SMCs' roles on a regional scale as well as the functions of urban districts to serve the overarching objectives of the city. However, there is often a disconnect between broader regional plans and an SMC's urban plan, resulting in poor coordination of urban functions and inefficient delivery of transport services in SMCs.[18]

Increasing motorization in and around a city. Although the rate of nonmotorized transportation is much higher in SMCs than in megacities, motorization in SMCs is increasing along with the rapid demographic changes and rising GDP per capita. Current trends suggest that while private car ownership increases, the nonmotorized mode of walking and bicycling is gradually dropping.[19] This accelerates the emission of greenhouse gases. Along with increasing urbanization rate, the total passenger-kilometer (km) grew faster from about 9 billion passenger-km in 1996 to 28 billion in 2010. Meanwhile, total freight ton-km increased fourfold from 37 billion ton-km to 142 billion ton-km.[20]

Waste and Resource Management

Localized waste characteristics. In SMCs, the characteristics of waste vary significantly depending on local economic activity. SMCs with an agriculture-based economy have very different volume and waste generation patterns from those with an industrial-based economy.[21] Moreover, because SMCs lack long-term vision in their city development, they tend to realize the necessity of waste management only when a new waste-related problem arises in their city. This does not allow SMCs to plan and invest to their waste management system proactively.

Increasing the volume and variety of municipal solid waste. In the PRC, 1,633 counties with a total urban population of 140 million generated 63.1 million tons of municipal solid waste in 2010. The average rate of increase of municipal solid waste is 8%–10% annually, and more than 70% is not disposed through environmentally sound methods. Although the per capita waste generation rate in SMCs is still lower than in megacities, it is gradually increasing as their economy takes off. The waste composition is also quickly diversifying due to the increasing number of goods available to them. Many SMCs start facing significant volumes of new types of waste, including e-waste, construction waste, and sewage sludge. Generally, municipal solid waste has high organic content, and proper management is therefore necessary to avoid greenhouse gas emission.

Inefficient treatment and disposal options. The municipal solid waste handling system in many SMCs is still characterized by inefficient sorting, collection, and transport system; obsolete treatment facilities; and limited disposal options. In 2010, the PRC's municipal solid waste disposal method of landfilling accounted for about 88.7%; incineration, 6.7%; and composting, 2.1%. In SMCs, however, simple landfilling is still the primary disposal option. While small-scale sanitary landfills are becoming more common, their operational capacity cannot yet cope with the increasing volume of municipal solid waste. For many SMCs, material recycling, material recovery, and energy recovery options are still technically and financially not viable. Incineration is also mostly limited to megacities. The technical reasons for not adopting incineration are the high water content and low heat value of municipal solid waste in SMCs.[22] Inefficient and inappropriate disposal of municipal solid waste increases the risk of greenhouse gas emission.

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[18] Luo and Shen. 2008.

[19] China Urban Sustainable Transport Research Center. Unpublished.

[20] NBS, PRC. 2012.

[21] Ren. 2011.

[22] Chen, Geng, and Fujita. 2010.

Opportunities for Low-Carbon Development in SMCs

Responding to the urban and low-carbon development challenges, a number of opportunities are available for SMCs. These include a combination of how to improve general urban management and strengthen the management of key urban sectors.

Urban Management

Strengthen coordination among national, provincial, and local governments for low-carbon development. The national and provincial governments play a key role in supporting SMCs in their pursuit of low-carbon development as they achieve the desired socioeconomic growth. As an impetus to low-carbon initiatives at the local level, national policies and targets provide the policy direction not only for local governments but also for key stakeholders, including the private sector and the public. This commitment has been translated through key initiatives such as the Twelfth Five-Year Plan (2011–2015). Building on this foundation, any new policies and policy instruments following after this commitment should be considered in promoting low-carbon growth that is appropriate in SMCs.

Driven by the national mandate, some SMCs have already started developing their low-carbon development plans and targets. Yet, coordination among the national, provincial, and local governments needs to be strengthened. SMCs need to have a clearer understanding and appreciation of their role in meeting the national targets while leading local efforts in reconciling low-carbon development goals and socioeconomic development goals. Partnerships can be forged among stakeholders when government is perceived to be committed to pursue socioeconomic growth through a low-carbon development path.

Empower SMCs by developing institutional and personnel capacities. Even as many SMCs have expressed a strong desire to pursue low-carbon development, they are more often faced with capacity constraints. Creating an enabling environment that will allow optimization of local resource endowments for SMCs is needed. The local technical capacity is needed to draft a sound framework and an urban plan that effectively integrates the key sectors such as energy, transport, and waste. A strengthened institutional capacity tailor-made for each SMC will be critical in policy analysis, formulation, reform, and implementation. Understanding the city as a system will help policy makers envision and formulate suitable policies that can effectively address the challenges of low-carbon urbanization in the SMC context.

Rationalize urban planning and its implementation through policy mix. For SMCs to guide their urban development through proper allocation of land and spatial resources, urban planning must be undertaken with due consideration of the city's distinctive characteristics. For instance, SMCs' urban planning should strategically incorporate the idea of mixed land use planning in terms of the intensity and variety of energy demand, population density, public and private transport demands, and generation and collection of solid waste. Such idea offers an opportunity to take full advantage of various technology options. Integrating appropriate technical, financial, and socioeconomic policies will also be critical in gaining support and mobilizing the needed finance to pursue low-carbon development. Policy making, therefore, must be able to effectively catch up and anticipate the rapidly changing socioeconomic conditions and environment of the SMC. The SMCs' local resource endowments must be evaluated in weighing the suitability of a policy and its overall benefits, as well as assessing how the other policies within or across the sectors will interact.

Support financial mobilization and better investment opportunity. The SMCs must be supported by a financial mechanism that will help stimulate and incentivize low-carbon development paths sustainably. In contrast to megacities that have greater access to financial support and investment from the public and private sectors, the SMCs' development paths and financial sources are limited and less diverse. Though some SMCs have pursued low-carbon development even ahead of national and provincial governments, financial and investment constraints sometimes makes it difficult for them to follow such path. Some technological options can be too costly for a cash-strapped city, especially when the upfront capital cost is high. However, if SMCs can successfully formulate city-specific strategies for low-carbon development path based on their economic base (e.g., industrial, agricultural, or a mix of both), they may be able to offer various investment opportunities for private sectors.

Involve the public and other stakeholders. An effective low-carbon development plan must ultimately translate to

a behavioral change in the individual. Since community-level interactions and activities are stronger in the SMCs than in megacities, opportunities for public participation are higher in the former. Education campaigns and raising awareness on low-carbon options and lifestyle are usually effective when individual consumers are empowered through informed decision making. When provided with channels where they can participate or provide feedback, the public and other stakeholders participate more easily because they have ownership of the process, awareness of the issues, and the capacity to act and help resolve the challenges.

Establish a scientifically grounded database to support local policy making. Improving the diversity, accuracy, and reliability of a database for monitoring and reporting is fundamental and cannot be overemphasized for SMCs' low-carbon development. This is the foundation for assessing the local condition and the basis for drafting an integrated urban plan, undertaking policy analysis, and implementing policies, especially in SMCs where urbanization proceeds at a much faster pace.

Energy

Improve heating energy efficiency. Decreased heat loss and use of fossil fuel in boilers are important low-carbon options for SMCs, particularly in the northern region. This can be achieved by using engineering and non-engineering solutions. Technical improvements in heat generation, distribution, and consumption will be critical. Meanwhile, financial reform should also give more incentives to promote efficient heat utilization as well as to ensure cost recovery in district heating in SMCs.

Identify locally tailored green buildings. Retrofitting of existing buildings and installation of energy-efficient technologies in new ones produce desirable long-term energy savings. For SMCs, some options are very costly and not financially feasible. SMCs, therefore, need to carefully review the available technology options to promote affordable green buildings. Although little attention has been given to energy-saving buildings, many low-cost options are still available in SMCs.

Promote an energy-efficient lifestyle. SMCs are the first destination for rural migrants' access to an improved quality of life. They typically jump from a low-energy lifestyle to an energy-intensive one. This can be avoided through the right mix of market-based and voluntary-based policy instruments, which may include consumption-based heating tariffs, simple and inexpensive energy-saving options for home appliances, and public education and campaign for saving energy.

Land Use and Transportation

Select suitable low-carbon transport development options. SMCs must carefully review their options based on their urban context and capacity, and make the right decisions for land use and transport planning. The construction of basic urban infrastructure for transport and urban development is often the largest and most important public investment for SMCs. Inefficient transport networks, which can potentially lock in high-carbon emissions, must be avoided. Moreover, solutions should also be technically feasible and financially sustainable. For example, rail-based, intracity public transport systems may be less affordable for SMCs. With the limited financial and technical feasibility of public transport services, use of private vehicles, to some extent, can be an inevitable choice of mobility. In such cases, the SMCs' low-carbon option would be to find ways to minimize the distance of car use as well as reduce emissions from private vehicles as a realistic solution.

Make "low-carbon" a preferred choice. Despite gradual motorization, many SMCs still have a large portion of nonmotorized transport in their total modal share. They are very much in a position to avoid the path to the carbon-intensive lifestyle taken by many megacities. Raising public awareness on the benefits of a low-carbon lifestyle must be supported by education, and the provision of infrastructure and services that allow the preferential use of low-carbon transport.

Waste and Resource Management

Improve overall system efficiency. Central and provincial governments strongly support SMC efforts to improve a municipal solid waste management system. Where solid waste management system is still weak and insufficient, a large reduction in greenhouse gas emission can be achieved by implementing proper solid waste management. SMCs that are upgrading their solid waste management systems from traditional decentralized systems to modern centralized treatment facilities have a large opportunity to improve material reuse and recycling and, where appropriate, energy recovery. This has to be accompanied with improved municipal solid waste management system efficiency based on sound planning and strategy.

Diversify waste recovery and disposal options. SMCs should design sound solid waste management systems that are appropriate to local conditions and characteristics. A municipal solid waste management policy that integrates efficient technology and sound management strategies and practices has to be developed and practiced in households and industries. A city's economic structure and waste generation should also be considered in designing an efficient waste management system. Feasibility of simple technology options, such as landfill gas recovery, must be considered carefully by analyzing waste composition and its methane generation potential.

Promote a resource-efficient consumption. In SMCs, the people's consumption pattern and generation of municipal solid waste per capita are not on the same level as those living in megacities. How products and services are manufactured, packed, advertised, delivered, and consumed have serious implications on the way wastes are generated and disposed. An opportunity exists for the SMCs to gain public support and promote behavioral change in producing and consuming materials without sacrificing quality of life.

The Way Forward

This policy brief revealed the challenges and opportunities for SMCs in the PRC to pursue low-carbon development in urban management and key urban sectors. Unlike in megacities where common policies and approaches are generally applicable, no uniform set of policies can guarantee a successful low-carbon economic development path for SMCs. Given the fact that financial and human resources, as well as opportunities for development, are substantially limited in SMCs, policy makers should understand that low-carbon development in SMCs is a complex issue owing to the expectations and unique challenges they are facing.

This policy brief demonstrated that SMCs are also endowed with opportunities that will help foster an enabling environment for low-carbon development in parallel with socioeconomic growth. It is easy to conclude that each SMC is unique. But a typology of SMCs shows several common characteristics among SMCs in terms of pursuing their low-carbon paths: (i) local meteorology and climatic condition (e.g., hot summer, cold winter, wet or dry seasons); (ii) population distribution and density (e.g., densely or sparsely populated); and (iii) city's economic structure (e.g., industry-based, agriculture-based or supporting role to the adjacent megacities). SMCs with similar characteristics can learn from each other.

To transform the opportunities into actual practice, SMCs' low-carbon and socioeconomic development challenges require multidisciplinary thinking across key urban sectors supported by stakeholders. There is both an interplay of factors and dynamics of key stakeholders. Since SMCs confront more limitations in their capacities, the necessity of engaging and gaining support from other stakeholders, including the private sector and the public sector, is much higher compared to larger cities.

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