Energizing Green Cities in Southeast Asia

THREE CITY SYNTHESIS REPORT

OVERVIEW

THE WORLD BANK

Australian AID

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Table of Contents— Energizing Green Cities in Southeast Asia

Note: The following represents the contents of the full report, *Energizing Green Cities in Southeast Asia*, Three City Synthesis Report which is included on the CD inserted at the end of this Overview.

Appendixes

Figures

Tables

Boxes

Table of Contents— Sustainable Urban Energy and Emissions Planning Guidebook

The following represents the contents of the *Sustainable Urban Energy and Emissions Planning Guidebook, A Guide for Cities in East Asia and Pacific*

CD-ROM SUEEP Toolkit

Organizational Toolkit Documents

Stakeholder Documents

1 SUEEP Stakeholder Contact Sheet.doc
2 Stakeholder Consultation Record.doc

Sample Letters for SUEEP Process

3 Sample SUEEP announcement from the Mayor.doc
4 Sample letter for data request to Electricity Company.doc

Project Assessment Template

5 Blank Project Assessment Sheet.doc
6 Example Project Assessment Sheet.doc

Sample Consultant Terms of Reference

7 Sample Consultant TORs.doc
  a Energy and Emissions Inventory Consultant
  b Project Assessment Consultant
  c Energy Planner for Scenario Development Consultant
  d Project Prioritization Consultant
  e Graphic Design and Report Writing Consultant
  f Public Relations and Press Release Consultant
  g Energy Project Development Consultant

Technical Toolkit Spreadsheets

A Energy Balance and GHG Inventory Spreadsheet.xls
B Project Assessment and Prioritization Toolkit.xls

Foreword

Cities currently account for about two-thirds of the world's annual energy consumption and about 70 percent of the greenhouse gas (GHG) emissions. In the coming decades, urbanization and income growth in developing countries are expected to push cities' energy consumption and GHG emissions shares even higher, particularly where the majority of people remain underserved by basic infrastructure services and where city authorities are underresourced to shift current trajectories. These challenges are facing many cities and hundreds of millions of people in the East Asia and Pacific (EAP) region, which is experiencing unprecedented rates of urbanization, as the region's urban population grows almost twice as fast as the world's urban population.

This report lays out the challenges and proposes strategies for sustainable urban energy and emissions planning (SUEEP) and development. It shows that the above challenges also present a unique opportunity for EAP cities to become the global engines of green growth by choosing energy efficient solutions to their infrastructure needs and avoiding locking in energy-intensive infrastructure that has accompanied economic growth in the past.

The SUEEP studies in the three pilot cities—Cebu City (the Philippines), Da Nang (Vietnam), and Surabaya (Indonesia)—show a clear correlation between the scaling up of energy efficiency in all major infrastructure sectors and economic growth. This relationship is recognized by the municipal governments in the three pilot cities and has been incorporated into their visions of green urban development. Achieving this vision requires institutional reforms and capacity building, including strengthening energy governance at the municipal level. Furthermore, to ensure effective implementation of their green growth plans, municipal governments will have to foster alliances and closely collaborate with a coalition of actors from the national, state, and local levels, and from civil society and the private sector, who share a commitment to advance the green economy.

The SUEEP framework presented here is designed to facilitate such collaboration and the development of capacity-building programs to strengthen energy governance and maximize energy efficiency across municipal sectors, as well as to help define actions and prioritize investments in energy efficient infrastructure. For this purpose, this report is accompanied by the *Sustainable Urban Energy and Emissions Planning Guidebook: A Guide for Cities in East Asia and Pacific*, which provides step-by-step guidance to help a city develop its own energy and emissions plan and link its aspirations to actionable initiatives to improve energy efficiency and reduce emissions.

The World Bank is committed to providing support to EAP cities for sustainable urban energy and emissions planning, and for mobilizing financing for priority investments in green infrastructure. We look forward to working hand in hand with cities to facilitate capacity building and public and private investments in programs that help them achieve their green growth objectives and a sustainable future for the generations to come.

John Roome
Director
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East Asia and Pacific Region
The World Bank Group

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The core team, which was led by Dejan Ostojic, Energy Sector Leader, EAP, comprised Ranjan K. Bose, Holly Krambeck, Jeanette Lim, and Yabei Zhang.

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During the course of the project, the team gained considerable knowledge and benefited greatly from a wide range of consultations in Indonesia, the Philippines, and Vietnam and wishes to thank the participants in these consultations, who included government officials, nongovernmental organization and civil society representatives, and the private sector. We would like to express particular appreciation and gratitude to municipal officials in Cebu City, Da Nang, and Surabaya for their active participation in the pilot studies and numerous invaluable comments and suggestions.

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The team would like to acknowledge the continued generous support from the government of Australia, which funds the EAP Energy Flagship Report series. This series includes *Winds of Change: East Asia's Sustainable Energy Future* (2010); *One Goal, Two Paths: Achieving Universal Access to Modern Energy in East Asia and the Pacific* (2011); and the present volumes, *Energizing Green Cities in Southeast Asia: 3 City Synthesis Report;* and *Sustainable Urban Energy and Emissions Planning Guidebook: A Guide for Cities in East Asia and Pacific.*

Abbreviations and Acronyms

AusAID	Australian Agency for International Development
CO_2	carbon dioxide
EAP	East Asia and Pacific
ESMAP	Energy Sector Management Assistance Program
GDP	gross domestic product
GHG	greenhouse gas
IEA	International Energy Agency
LPG	liquid petroleum gas
M	million
PJ	petajoule
SUEEP	Sustainable Urban Energy and Emissions Planning
toe	ton of oil equivalent
TRACE	Tool for Rapid Assessment of City Energy
US	United States

Table of Contents—Overview

KEY MESSAGES

1. **Fast-growing cities in the East Asia and Pacific (EAP) region will define the region's energy future and its greenhouse gas (GHG) footprint.** Rapid urbanization and growing standards of living offer a major opportunity to EAP cities to become the global engines of green growth by choosing modern energy efficient solutions to their infrastructure needs and by avoiding locking in the energy-intensive infrastructure of yesterday. The underlying studies in three EAP pilot cities (Cebu City [the Philippines], Da Nang [Vietnam], and Surabaya [Indonesia]) show a clear correlation between investments in energy efficient solutions in all major infrastructure sectors and economic growth—by improving energy efficiency and slowing GHG emissions, cities not only help the global environment, but also support local economic development through productivity gains, reduced pollution, and more efficient use of resources.

2. **Mainstreaming energy efficiency on a citywide scale and introducing low-carbon policies require municipal governments to reform institutions, build capacity, and strengthen energy planning and governance.** The report reveals that a common barrier to implementing cross-sectoral urban energy efficiency and emissions mitigation programs is the absence of institutional mechanisms that support coordinated project evaluation, planning, and investment across infrastructure subsectors. However, the need for institutional reforms and capacity building is increasingly being recognized and brought to the top of urban development agendas in many EAP cities. This is clearly demonstrated in the three pilot cities, which are strongly committed to implementing their vision of green urban development. To ensure effective implementation of their green growth plans, municipal governments will have to foster alliances and collaborate closely with a coalition of actors from the national, state, and local levels, and from civil society and the private sector, which share a commitment to advance the green economy, placing it centrally within top strategic priorities for the city.

3. **The cross-cutting nature of energy efficiency offers a unique platform for the identification and prioritization of green investments across all infrastructure subsectors as demonstrated through case studies in this report.** The Sustainable Urban Energy and Emissions Planning (SUEEP) process and methodology used in this study and outlined in the accompanying SUEEP Guidebook is designed to help city leadership formulate long-term urban green growth strategies and identify and evaluate investments in energy efficient infrastructure, thereby maximizing return on investment, relative green impact, and contributions to other social and economic development goals. The result is a high-quality pipeline of green investment projects across all key infrastructure subsectors that can be effectively communicated to local stakeholders, private investors, financing institutions, and the international donor community.

4. **Investments in green infrastructure require financing from both public and private sources in a coordinated manner.** Investments in the transportation and buildings sectors present some of the largest opportunities for scaling up energy efficiency at the city level. Financing these large investments in fast-growing EAP cities will require partnerships and coordination between public and private investors. SUEEP can help foster such public-private partnerships and mobilize green infrastructure financing by helping to prioritize and coordinate investment projects, as well as through systematic monitoring, reporting, and verification of the impact of the projects on the overall efficiency of energy use and GHG emissions at the city level.

5. **The World Bank Group is committed to providing support to EAP cities in building capacity, creating long-term green growth plans, and attracting public and private investments in modern energy efficient infrastructure.** The Bank has accumulated global knowledge and experience in supporting institutional development and building capacity for planning and implementing green infrastructure investments in cities around the world, including successful urban development projects in the EAP region. Thus, the Bank is well positioned to assist municipal governments in building institutions, creating policies, and developing long-term green growth plans that will attract financial support and investments from both the private sector and the donor community. The SUEEP process and methodology presented in this report will serve as a starting point for transferring some of the best international practices and for providing a platform for such support and collaboration with all players in the local, national, and global arenas in achieving the green growth objectives at the city level.

Overview

Fast-growing cities in the East Asia and Pacific (EAP) region will define the region's energy future and its greenhouse gas (GHG) footprint. Rapid urbanization and growing standards of living offer a major opportunity to EAP cities to become the global engines of green growth by choosing energy efficient solutions to suit their infrastructure needs and by avoiding locking in energy-intensive infrastructure. The underlying studies in three EAP pilot cities show a clear correlation between investments in energy efficient solutions in all major infrastructure sectors and economic growth—by improving energy and GHG emissions efficiency, cities not only help the global environment, but they also support local economic development through productivity gains, reduced pollution, and more efficient use of resources.

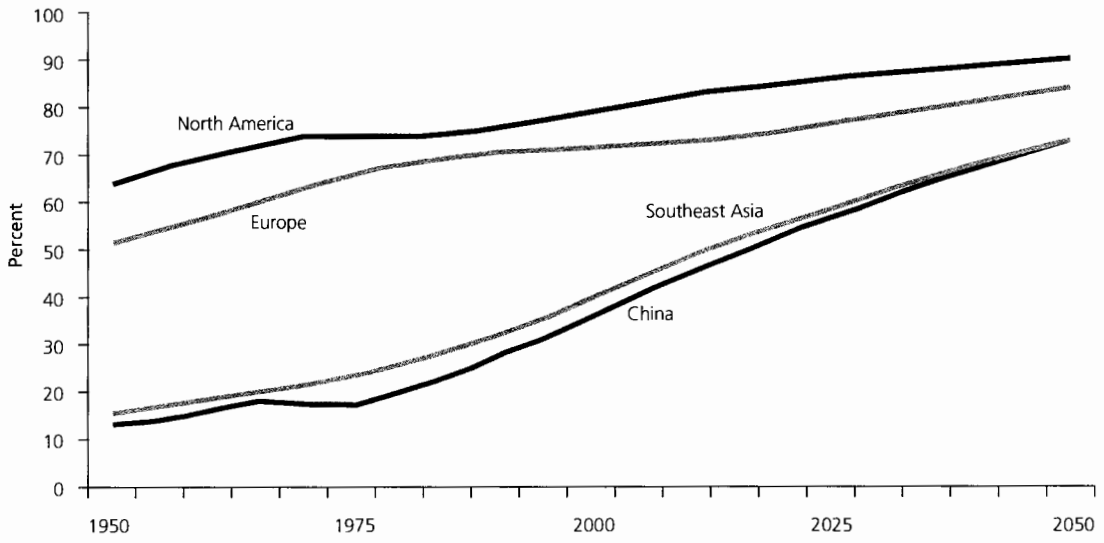
Mainstreaming energy efficiency on a citywide scale and introducing low-carbon policies requires city governments to reform institutions, build capacity, and strengthen energy planning and governance. The report reveals that a common barrier to implementing cross-sectoral urban energy efficiency and emissions mitigation programs is the absence of institutional mechanisms that support coordinated energy project evaluation, planning, and investment. However, the need for institutional reforms and capacity building is increasingly being recognized across the region, as demonstrated by the governments in the three pilot cities, Cebu City (Philippines), Da Nang (Vietnam), and Surabaya (Indonesia), which are strongly committed to implementing their visions of green urban development. To ensure effective implementation of their green growth plans, city governments will have to foster alliances and close collaboration with a coalition of actors from the national, state, and local levels, and from civil society and the private sector, which share a commitment to advance the green economy, placing it among the top strategic priorities for the city.

It is within the power of cities to develop policies and establish institutions to support citywide energy efficiency programs and green urban development. With the right institutional framework, cities can develop and implement policies supporting the next generation of urban infrastructure, which must be more efficient, smarter, and socially and environmentally sustainable. Such green infrastructure requires changing the way systems are designed and decisions are made, as well as the application of advanced infrastructure solutions conducive to long-term energy efficient and low-carbon development paths.

The cross-cutting nature of energy efficiency offers a unique platform for the identification and prioritization of green investments in modern infrastructure across all infrastructure subsectors, as demonstrated through the case studies in this report. The Sustainable Urban Energy and Emissions Planning (SUEEP) process and methodology used in this study and outlined in the accompanying SUEEP Guidebook is designed to help city leadership formulate long-term urban green growth strategies and identify and evaluate investments in energy efficient infrastructure, thereby maximizing return on investment, relative green impact, and contributions to other social and economic development goals. The result is a high-quality pipeline of green investment projects across all key infrastructure subsectors that can be effectively communicated to local stakeholders, private investors, financing institutions, and the international donor community.

Investments in green infrastructure require financing from both public and private sources in a coordinated manner. Investments in the transportation and buildings sectors present some of the largest opportunities for scaling up energy efficiency at the city level. Financing these large investments in fast-growing EAP cities will require partnerships and coordination between public and private investors. SUEEP can help foster such public-private partnerships and mobilize green infrastructure financing by helping to prioritize and

FIGURE 1.1. URBANIZATION RATE



coordinate investment projects, as well as through systematic monitoring, reporting, and verification of the impact of the projects on the overall efficiency of energy use and GHG emissions at the city level.

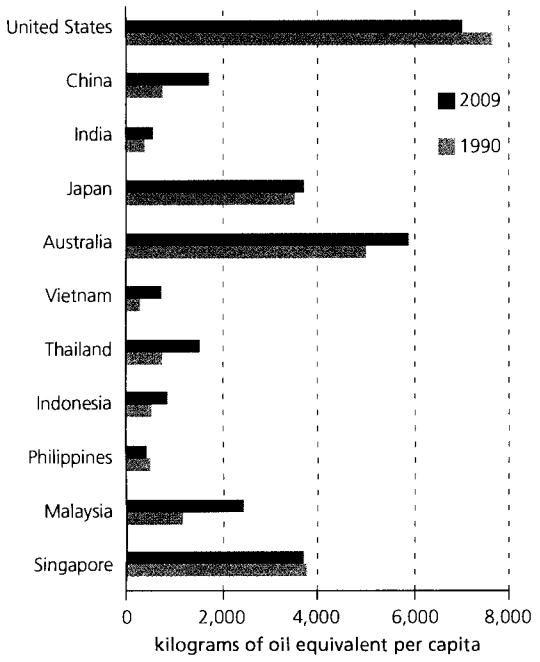
The World Bank Group is committed to providing support to EAP cities in sustainable urban energy and emissions planning, as well as to mobilize financing for priority investments in green infrastructure. The World Bank Group has accumulated global knowledge and experience in supporting institutional development and building capacity for planning and implementing green infrastructure investments in cities around the world, including successful urban development projects in the EAP region. Thus, the Bank is well positioned to assist municipal governments in building institutions, creating policies, developing long-term green growth plans that will attract financial support and investments from both the private sector and the donor community, and linking efficiency and low-carbon programs to international concessional financing and funding, as well as to the private sector investors who will play an important role in achieving green growth objectives.

Urbanization, Economic Growth, Energy, and Emissions Trends

Cities around the world account for about 70 percent of global GDP, 67 percent of global energy consumption, and nearly 70 percent of world GHG emissions (IEA 2008). These figures are trending ever upward, and about 80 percent of global growth in urban energy use and 89 percent of growth in GHG emissions is expected to come from developing countries, and from EAP cities in particular. As rapid urbanization in EAP countries continues (see figure 1.1 for urbanization rates for Southeast Asia and China), national and city authorities will have to make decisions that will fundamentally define how cities will source and use their energy for decades to come.

Urban consumers require more energy as the economy grows and their standards of living rise. Urban growth and increased energy use are strongly linked to the economic growth required for cities to meet their diverse energy needs. In Southeast Asia, which is one of the world's least urbanized regions but whose population is expected to grow 1.75 times faster than the worldwide urban population (Yuen and Kong 2009), the rapid pace of urbanization is posing huge challenges for city governments to meet increasing energy demand in a

FIGURE 1.2. CHANGES IN ANNUAL ENERGY CONSUMPTION PER CAPITA (1990 AND 2009)



Source: IEA 2012.

sustainable manner. Given this, the report focuses on Southeast Asia.

Annual real GDP growth in Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam (which collectively account for close to 95 percent of GDP and 86 percent of the population for all ASEAN countries)[1] is projected to average 6 percent between 2011 and 2015. Income growth in urban areas is also leading to increased demand for new services, particularly those that use electricity. City sprawl, which has increasingly led to the development of areas not easily served by public transportation and has discouraged pedestrians, has resulted in an explosion of personal motor vehicles like cars and motorized two-wheelers. In addition, the lifestyles, and corresponding energy use profiles, of urban middle- and upper-income residents in the developing world increasingly mimic those of their counterparts in the developed world. These factors, coupled with EAP countries' low per capita energy consumption (see figure 1.2), ensure continued strong increases in urban energy demand across the region—demand that is expected to double during the next two decades.

Urbanization and economic growth in Southeast Asia have not only resulted in a continued increase in energy consumption, but also a profound shift in the energy mix. Although oil and gas will remain major sources of primary energy supply in Southeast Asia (accounting for 35 percent and 16 percent, respectively, in the ASEAN energy mix by 2030), coal is expected to have the fastest annual growth rate, 7.7 percent on average for the next 20 years in the business as usual scenario. This rate of increase would double the share of coal in the ASEAN energy mix from about 15 percent in 2007 to 30 percent by 2030. With a movement toward more carbon-intensive fuels, carbon dioxide (CO_2) emissions per unit of energy consumption will increase from 0.49 tons of CO_2 equivalent per ton of oil equivalent (tCO_2/toe) in 2007 to 0.63 tCO_2/toe in 2030 in a business as usual scenario. Even in an alternative policy scenario considered by ASEAN countries to mitigate the rise of GHG emissions, the carbon intensity of energy consumption is expected to increase to 0.59 tCO_2/toe by 2030. The main reason for the rapid increase in the share of coal and the carbon intensity of energy consumption is the quickly growing demand for electricity in the expanding urban areas—which are supplied by coal-fired power plants.

The region's governments and city authorities are capable of maintaining economic growth, improving environmental sustainability, and enhancing reliability of energy supply. Because energy efficiency and GHG emissions are influenced directly and permanently by urban form and density, cities' planning and infrastructure investment choices will have a substantial impact on energy and emissions trends (World Bank 2005). Furthermore, large EAP cities are increasingly vocal and influential in formulating national policies that will shape the energy future and the ways in which the cities source and use energy. Finally, cities will be the main arena for economic transformation and mainstreaming of energy efficiency policies and practices, which are the backbone of sustainable energy development in the region—a

1. The Association of Southeast Asian Nations, or ASEAN, consists of 10 member countries: Brunei Darussalam, Cambodia, Indonesia, the Lao People's Democratic Republic, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam (OECD 2010).

TABLE 1.1. SUMMARY OF STRUCTURAL AND ECONOMIC DATA FOR THE PILOT CITIES

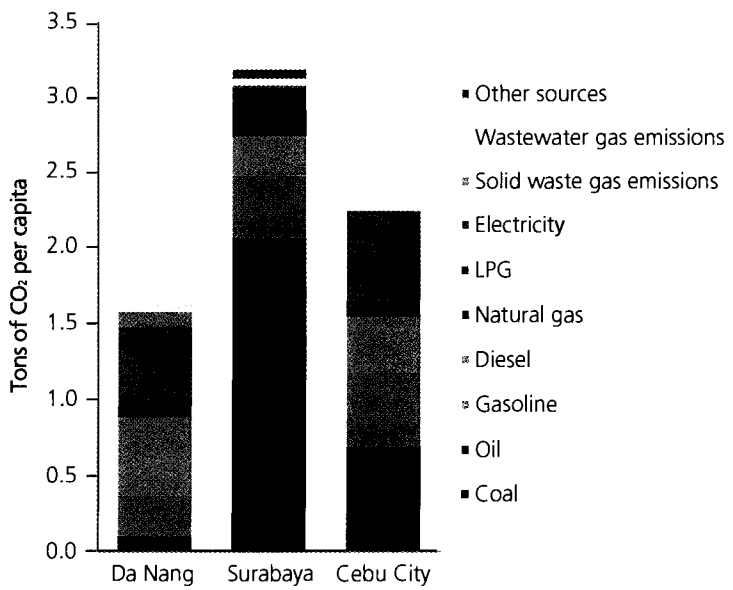
Parameter	Cebu City	Da Nang	Surabaya
Population (m)	0.8	0.9	2.8
City area (km²)	291	1,283	327
Population density (000's/km²)	2,748	711	8,458
GDP/cap/year ($)	5,732	1,627	8,261
Economic structure (%)			
Services	73	56	50
Industry	19	42	32
Agriculture/other	8	2	18

Source: Authors.

sustained improvement in energy efficiency under an alternative energy scenario (ACE 2011) can provide a reduction of energy intensity of GDP from 580 toe/million US dollars in 2007 to 408 toe/million US dollars in 2030, compared with 501 toe/million US dollars under the business as usual scenario in 2030.

This alternative energy path requires a paradigm shift to new low-carbon development models and lifestyles. EAP cities need to avoid the carbon-intensive path and pursue sustainable lifestyles for their citizens by promoting novel urbanization models (World Bank 2010c) focusing on compact city design, enhanced public transportation, green buildings, clean vehicles, and distributed generation. Smart urban planning—higher density, more spatially compact, and more mixed-use urban design that allows growth near city centers and transit corridors to prevent urban sprawl—can substantially reduce energy demand and CO_2 emissions and help cities become greener and more prosperous (World Bank 2009c). With support from AusAID, the World Bank Group initiated a regional program—East Asia and Pacific Sustainable Urban Energy and Emissions Planning (SUEEP) Program—to provide support and guidance to city governments in the EAP region to formulate such long-term urban energy strategies within cities' overall development plans.

FIGURE 1.3. GHG EMISSIONS BY FUEL SOURCE



Source: Phase I pilot study.

Understanding the Cities: Energy Use and GHG Emissions

The first phase of SUEEP was implemented in three Southeast Asian pilot cities—Cebu City, Philippines; Surabaya, Indonesia; and Da Nang, Vietnam. Pilot city key statistics are summarized in table 1.1.

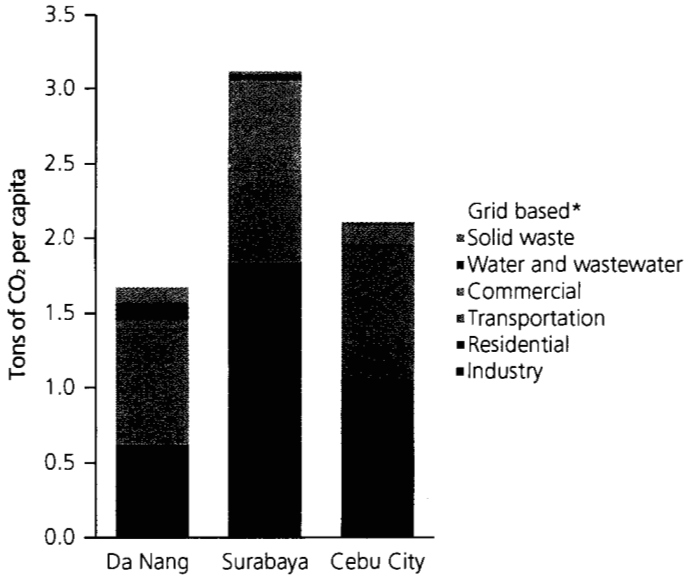
The rapid population increase and rising standards of living in the three pilot cities are causing a considerable increase in city energy consumption. Da Nang is currently experiencing 11.7 percent yearly increases in energy consumption, which will lead to a doubling of energy demand in six years' time. The increases in Surabaya and Cebu City's yearly energy use are 4.9 percent and 4.3 percent, respectively, still notably high. The main drivers of the strong energy demand are the transportation sector and industry, which account for about 87 percent of energy consumption in Cebu City, about 66 percent in Da Nang, and 68 percent in Surabaya. Consequently, transportation and industrial emissions account for more than 53 percent of emissions for all pilot cities. Transportation alone is responsible for more than 40 percent of emissions in both Cebu City and Da Nang (see chapter 4 for more details).

Understanding the city energy balance and carbon footprint is the first step in formulating a long-term sustainable urban energy development strategy. The SUEEP approach uses three different city-level diagnostic tools to assess the city energy

profile. These include (i) the energy balance to analyze energy sources and uses across all sectors and categories of consumers, (ii) the GHG emissions inventory to determine the main sources of GHG emissions from energy use, and (iii) the Tool for Rapid Assessment of City Energy (TRACE) to evaluate energy efficiency opportunities in city sectors and identify priority areas for further investigation and intervention. An example of a GHG emissions inventory based on fuel source and sector for the pilot cities is shown in figures 1.3 and 1.4.

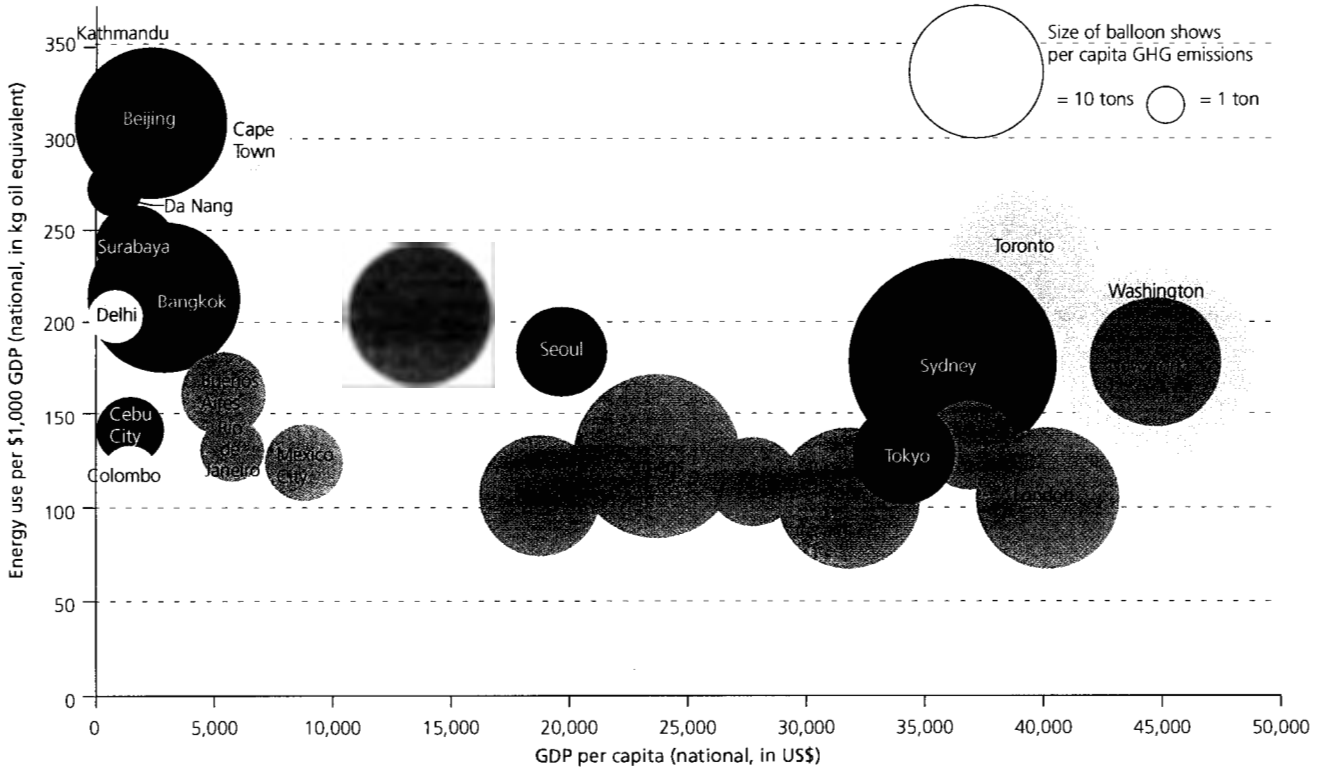
Most EAP cities, including the three pilot cities, have relatively low energy consumption and GHG emissions per capita. Figure 1.5 illustrates that the current level of energy consumption and associated GHG emissions is relatively modest in the three pilot cities when compared with many cities around the world and also suggests that countries can follow different paths in energy consumption and GHG emissions as GDP per capita increases. For example, the paths taken by Seoul and Tokyo

FIGURE 1.4. GHG EMISSIONS BY END USE



Source: Phase I pilot study.
Note: *Grid based refers to electricity internally generated by the city. This is a separate category for Cebu City because data on end-use sector for electricity generated within the city were not available.

FIGURE 1.5. ENERGY INTENSITY AND GDP PER CAPITA IN SELECT CITIES



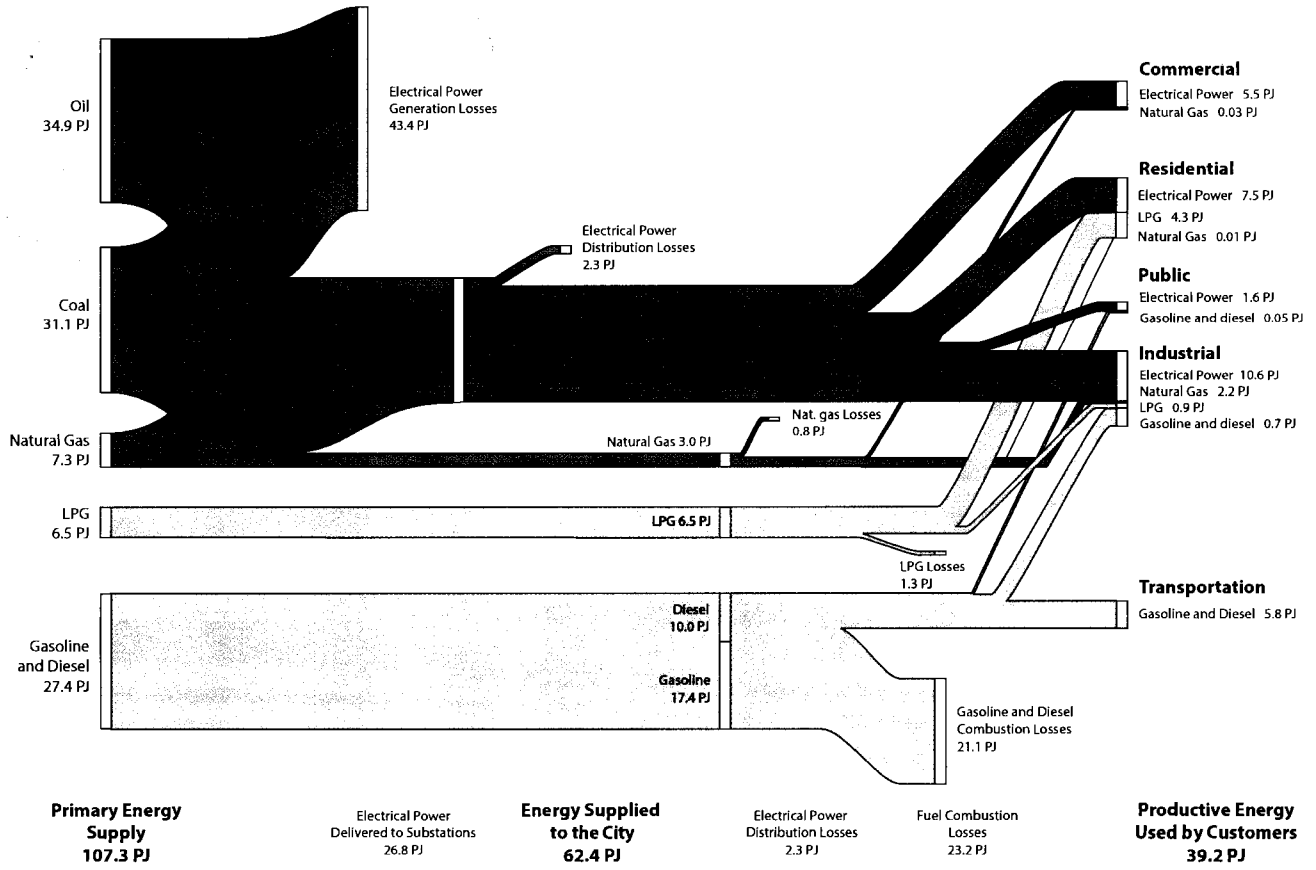
Source: Authors.

offer a greener alternative that calls for a significant reduction of energy intensity of economic activities (energy use per unit of GDP) and improvements in energy efficiency. Only Cebu City is currently at the level of energy intensity that makes such a path relatively straightforward, whereas Da Nang and Surabaya have longer paths to reduce the energy intensity of their economies.

The fuel used for electricity generation is a key determinant of the intensity of GHG emissions from energy. In Surabaya, electricity generated from coal-fired power plants is responsible for 36 percent of the city's emissions. Cebu City and Da Nang both have significant amounts of renewable electricity generation (49 percent of electricity in Cebu City is generated by geothermal and hydro, and 30 percent of electricity in Da Nang comes from hydropower). Thus, GHG emissions in Cebu City and Da Nang are significantly lower (per capita) and are caused mainly by diesel and gasoline fuels used for transportation and local (diesel-based) electricity generation.

All three cities source the vast majority of their electricity from the national grid. The use of distributed renewable energy production (such as solar photovoltaic) is at a very early stage in all three pilot cities. Apart from local power production, which is particularly prominent in Cebu City (11 percent of the electricity supply), most electricity is supplied by the national power grid. Therefore, the cities have limited influence over the choice of primary fuel and over the efficiency of energy conversion processes associated with the production and delivery of electricity. Furthermore, electricity tariffs and pricing policies (such as subsidies), which are key tools for demand-side promotion

FIGURE 1.6. SURABAYA SANKEY DIAGRAM



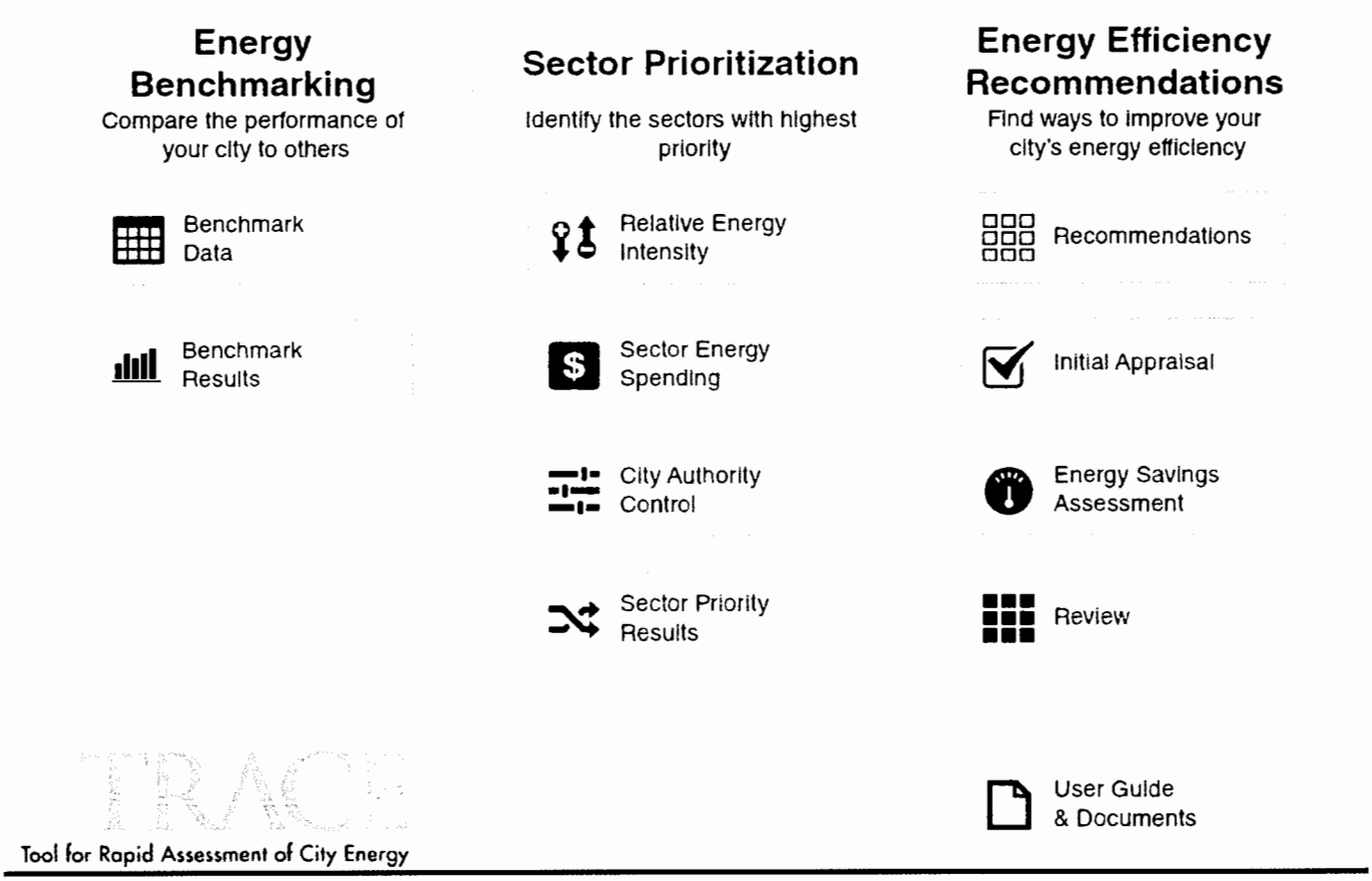
Source: SUEEP Pilot City Studies 2011.
Note: PJ = Petajoule. "Public" includes the end-use energy of city buildings, street lighting, city vehicles, water, wastewater, and solid waste management.

of energy efficiency, are outside city control. Thus, close collaboration between the city and national authorities is needed for developing an optimal approach to meet fast-growing urban electricity needs in a reliable, efficient, and environmentally sound manner.

Breakdowns of GHG emissions roughly match the three cities' energy use patterns but with some variation. Surabaya's energy balance (figure 1.6) illustrates the importance of fuel choice and conversion efficiencies in GHG emissions and the relative importance of energy efficiency in the industrial and buildings sectors. All three pilot cities will face challenges for achieving their economic development aspirations while managing growing energy demand and developing local generation capacity. More consistency in the cities' approaches to energy planning and better coordination across departments would solidify the basis for improving energy efficiency and reducing GHG emissions on a citywide scale. Therefore, EAP cities will benefit from establishing strong sustainable urban energy and emissions planning approaches that take a comprehensive view of energy needs to future proof against unsustainable increases in energy consumption and GHG emissions.

There is a strong need in the pilot cities for further development of energy efficiency governance and capacity. The planning and management of energy is usually a multi-agency function, but none of the pilot cities demonstrated a cohesive approach that encouraged communication among the relevant agencies. In addition, some cities lacked any means of, or concentration on, coordination between national- and city-level initiatives.

FIGURE 1.7. COVER PAGE OF TRACE WEB-BASED TOOL

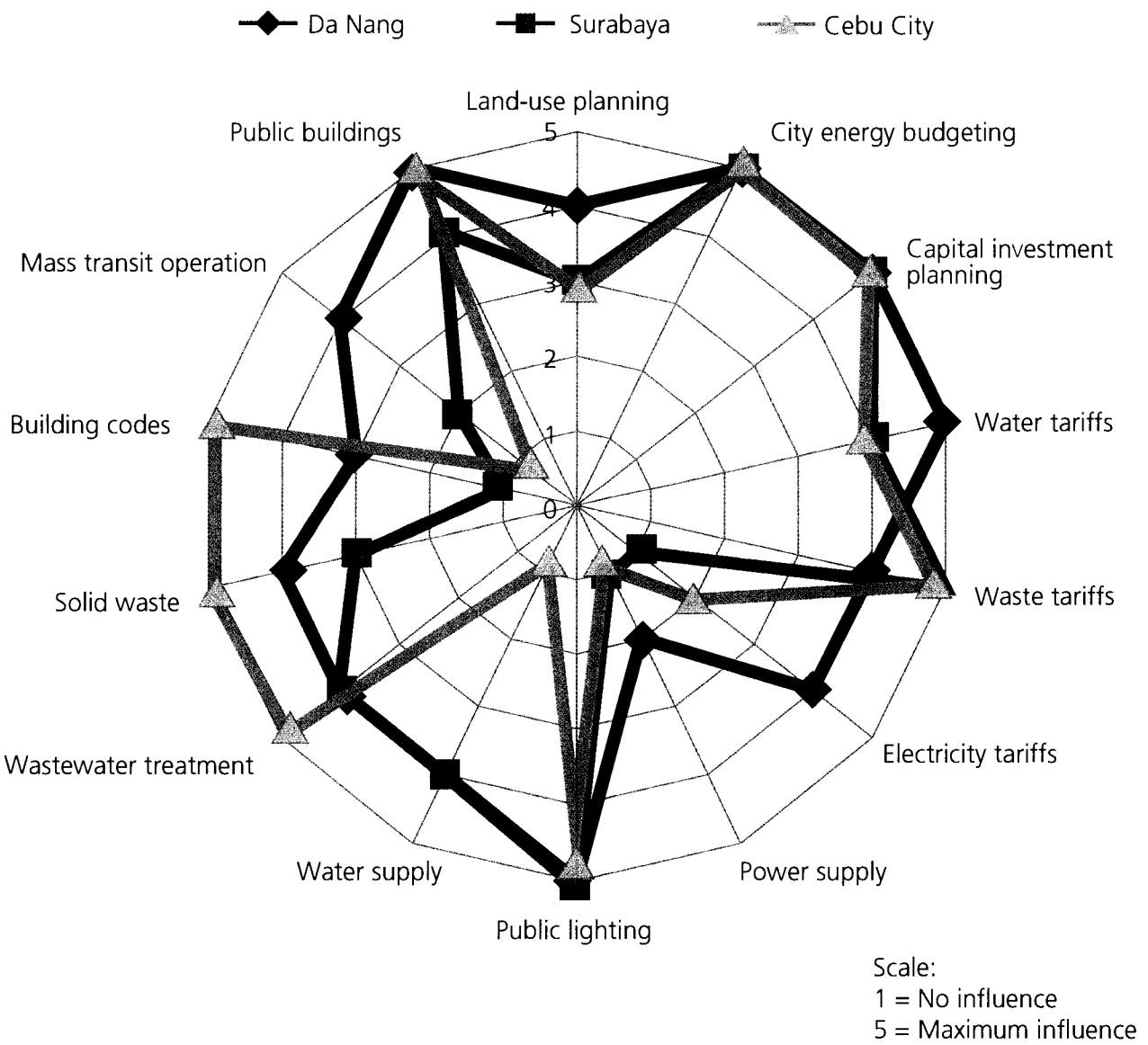


If conflicts between national and local policies, programs, and initiatives exist, cities are advised to proactively lobby the national government for action in areas that are outside of the city's control or in which the government has promised action, but delivery is absent or ineffective in the city. The ability to influence the national government effectively requires cities to build energy governance into their institutional fabric and use it to lead and guide the planning and implementation of citywide energy efficiency programs.

The Tool for Rapid Assessment of City Energy (TRACE), developed by the World Bank Group's Energy Sector Management Assistance Program (ESMAP),[2] offers a quick diagnosis of energy efficiency performance across a city's systems and sectors. It prioritizes sectors and presents a range of potential solutions along with implementation guidance and case studies. TRACE is a software

2. For further details please visit http://www.esmap.org/esmap/node/235.

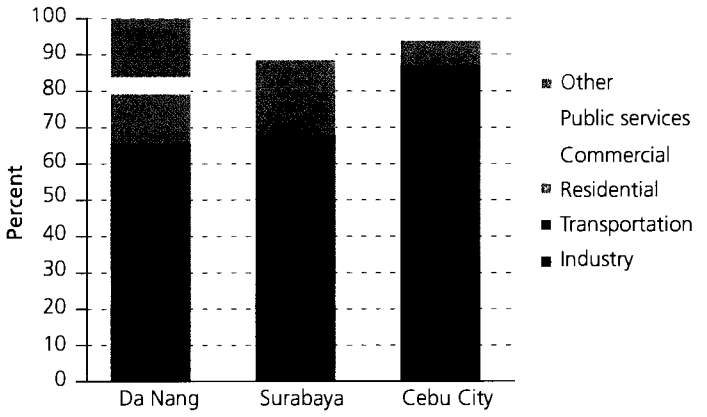
FIGURE 1.8. LEVEL OF INFLUENCE OF CITY GOVERNMENTS IN VARIOUS SECTORS



Source: Authors.

platform for assessing the energy efficiency performance of six city sectors or services: urban passenger transport, city buildings, water and wastewater, public lighting, solid waste, and power and heat. As shown in figure 1.7, TRACE consists of three principal components: an energy benchmarking tool that compares key performance indicators among peer cities, a sector prioritization process that identifies sectors with the greatest potential for energy efficiency improvements, and a "playbook" of tried and tested energy efficiency recommendations that helps in the selection of appropriate interventions. The TRACE deployment is a three-month assessment process that includes several weeks of upfront data gathering and benchmarking, sector meetings, and preparation of a final report. Based on TRACE results, city governments can identify early wins in key sectors and start developing citywide energy and emissions strategies.

FIGURE 1.9. PRIMARY ENERGY CONSUMPTION BY SECTOR



Source: Phase I pilot study

Sector Diagnostics: Identifying Opportunities

The transportation and buildings sectors present the largest opportunities for scaling up energy efficiency at the city level. The buildings sector was found to have the most potential for success of energy efficiency measures based on city authorities' high degree of control or influence, and the transportation sector accounted for significant energy consumption and GHG emissions (figures 1.8 and 1.9). The three pilot cities showed the potential to benefit from integrated transportation planning and the deployment of green building codes. However, public lighting has the most impact on city authorities' budgets; therefore, energy efficiency improvements in this sector are a priority.

A comprehensive approach to integrated transportation planning is needed in all three pilot cities. The transportation sector in all pilot cities is responsible for significant energy consumption and GHG emissions and is thus a key target for action. The transportation sector is the single largest user of energy in Cebu City (51 percent), Da Nang (45 percent), and Surabaya (40 percent) and contributes significantly to GHG emissions in each of the three cities (Cebu City 40 percent, Da Nang 46 percent, and Surabaya 20 percent). Plans to implement public transportation systems in the pilot cities were generally not aligned with wider city-level planning strategies, giving rise to the potential for unforeseen challenges affecting the overall energy performance of the sector. Furthermore, trends in the three cities show a shift from nonmotorized and public transportation to private vehicles. Compounding the problem of growing demand for private transportation, all three cities experience problems with the low fuel efficiency of their current vehicle fleets. Public transportation has the potential to reduce energy consumption and GHG emissions as well as to alleviate growing congestion and pollution problems, but the quality of public transportation in each of the three cities is deteriorating. High-capacity transit systems are absent in all pilot cities.

Building stock is set to double in the region during the next 20 years, and the sector's energy consumption is projected to grow by 30 percent under a business as usual scenario (IEA 2010b). EAP cities have low building energy intensity (kWh/m^2) because the existing building stock consists predominantly of smaller, low-rise buildings with basic lighting, air conditioning, and appliances. However, new buildings are responsible for a rapid increase in energy consumption in the sector because they have larger floor areas, and increased air conditioning, ventilation, lighting, appliances, and computers. Therefore, of all energy-consuming sectors, the buildings sector holds the most promise for cost efficient energy reduction. Voluntary

green building codes, which exist in all three pilot cities, reflect this opportunity. However, none of the green building codes have been implemented within city boundaries yet because most developers and financiers still perceive the associated market risks to be too high.

EAP cities are recycling waste through informal methods, but action is needed to capitalize on energy recovery and composting potential. As household income grows within the region, waste generation is expected to increase, underscoring the future need for formalized methods of waste processing. However, landfill gas capture projects appear to be difficult for the pilot cities—proposals for old landfills in two of the three pilot cities were not successfully concluded largely as a result of technical and institutional challenges. Cities need to be better equipped to take advantage of specialized procurement and funding arrangements such as public-private partnership opportunities and carbon finance.

The water and wastewater sectors face numerous challenges, including high leakage rates, lack of city-scale infrastructure, and low demand-side efficiency awareness. EAP cities can take action to improve or develop their centralized infrastructure by prioritizing energy efficient water resources, upgrading pumps, and addressing the high leakage rates that characterize the region. On the demand side, lack of awareness is a major challenge. Some EAP cities are implementing awareness campaigns, but as personal wealth and demand for resources increase, more aggressive demand-side management initiatives will be required.

Managing electricity peak load and increasing the efficiency of electricity supply are major challenges for the three pilot cities, and also provide opportunities for the application of smart grid technologies. Within the power sector, direct city-driven interventions to affect energy efficiency performance are limited to the demand side and to the provision of decentralized renewables, underscoring the need for cities to leverage their influence systematically at the national level to shape this sector. Cities can, however, successfully manage the demand side to reduce the extent of capacity expansion and can level off peak loads, mitigating the risk of rolling blackouts. The recent advances in smart metering and grid-control technologies offer opportunities for cities to work with electricity suppliers to promote and harness demand-side energy efficiency and reduce distribution losses.

Many cities in Southeast Asia, including the three pilot cities, have the capability to increase the use of renewable energy and distributed generation. However, none of the pilot cities has a renewable energy master plan that can guide a scale-up of renewable energy production at the city level. Another way in which cities can improve efficiency of energy conversion and reduce GHG emissions is by increasing the use of natural gas and liquefied petroleum gas, including for distributed generation and other applications where it can cost-effectively replace other fuels and coal-fired grid-based power generation. However, these options are fairly limited at the moment because subsidies (at the national level) favor large power producers.

In the public lighting sector, EAP cities can take advantage of potential energy efficiency gains by replacing existing metal halide bulbs with more efficient technologies such as high pressure sodium bulbs or light-emitting diodes. In addition, optimized operation (on and off times) and maintenance regimes can further reduce energy consumption by this sector. The public lighting sector is characterized by a high level of city government influence and accounts for a considerable proportion of overall city energy expenditure. However, limited awareness of technology benefits and available financing are major barriers. All cities displayed some confusion about the benefits of energy efficient lighting technologies and concern about the capital funds required for replacement programs. Cities can address these issues through pilot studies to demonstrate improved energy performance and financial viability.

The Role of Institutions

The institutional and policy environment is emerging, but EAP cities still lack cohesive, citywide regulatory frameworks in the energy sector. The degree of regulation and government oversight in the energy sector varies by country, but national and regional governments are always critical for

energy sector management and regulation, and the role of city government in setting energy sector policies and regulations is limited. However, this limitation does not prevent cities from planning and deciding what, where, and how urban energy infrastructure should be built. Furthermore, cities can take steps to influence national policies while continuing to influence local behavior through voluntary programs and incentives. Because city governments are intimately involved with every aspect of urban development and management and wield power and influence over urban energy demand, they have the unique ability to tie urban energy supply to demand.

Promoting sustainable urban energy development requires cities to build institutions, strengthen energy governance, and create conducive regulatory frameworks. Despite their significant regulatory powers, most cities in Southeast Asia have not effectively pursued sustainable energy planning and management practices. Several development gaps need to be bridged, including improvement of legal and fiscal frameworks, land-use planning, and development practices; leveraging of emerging technologies and innovations; and improvement of the institutional structures for effective monitoring, reporting, and management of city energy use and emissions. Filling the institutional gaps will help EAP cities to ensure that urban energy supply is reliable, efficient, and affordable, and that energy demand and emissions are efficiently managed. Cities can optimize operating costs, improve air quality, and improve quality of infrastructure services, while concurrently supporting economic development and climate change mitigation objectives. Given energy and GHG emissions' cross-sectoral nature, city governments need to evaluate options holistically. Within the urban planning framework, options must be assessed across sectors as well as across time because sustainability initiatives do not always have immediate impacts or quick roll-out strategies.

During Phase I of SUEEP, an institutional mapping exercise was undertaken in each city to establish the principal agencies and actors involved in the delivery and management of services that affect the city's energy efficiency and GHG emissions profile. The outcome, presented in figure 1.8, shows that each pilot city generally has control of investment, budgets, and several local energy efficiency activities, as well as of certain aspects of public lighting, public buildings, and wastewater treatment and water tariffs. The main areas in which the city authorities' influence is limited relate to power supply and electricity tariffs. Significantly, in most other energy-related areas there is a mix of influence concentrated at the city level, with coordination between local agencies more likely if facilitated by the city government. This situation reinforces the need for city governments to be aware of their local circumstances so as to tailor their plans to their own needs and governance structures. The institutional mapping exercise is also useful for understanding the range of stakeholders that are involved in energy planning, delivery, and management, and serves to communicate to all parties the relevant responsibilities, ensuring that all understand why each stakeholder is involved. Furthermore, the institutional mapping exercise provides a means for understanding the interplay between agencies.

The limited number of policies enacted at the city level stems from the requirement to coordinate and institutionalize energy policies at a national level as part of the sustainable energy planning process. Implementing energy policies at the national level is more efficient and effective, and ensures consistency in application throughout the country. It is in the national government's best interests to work with individual cities on national-level policies and plans, because the efforts of city governments will be essential in the effort to achieve national energy and emissions policy goals and targets. National governments should provide clear guidance to cities on the direction they will take on sustainable development to enable cities to plan and, where possible, cooperate on issues for which national and city goals are aligned. In these areas, policies implemented by both the city and national governments can serve to reinforce each other, thus making efforts to develop the city sustainably more effective. The city government's key task would be to take the lead in energy and emissions planning and to implement and advocate for

changes that contribute to the advancement of its goals. City governments must recognize the level of influence they have in implementing policies at the city level and be fully responsible for sectors over which they have significant control (for example, street lighting, public buildings, and wastewater treatment). For sectors in which national policies affect the city, the city government should work closely and establish a strong dialogue with the national government. The city can seek support or financing for measures that are compatible with national goals and can ensure that city policies are not negatively affected by national ones. City governments should also work with national agencies and departments to coordinate activities and develop a mutual understanding of responsibilities and expectations.

A comprehensive sustainable urban energy and emissions plan should demonstrate a clear understanding of which of its components can be aided through national programs, and its leaders should engage with national agencies from the outset to determine the level of support that may be forthcoming. In discussing areas of common interest between the city and the national governments, cities can use the opportunity to secure support or financing from the national government to implement national policies. For example, in Da Nang several programs with significant energy efficiency components were implemented at the city level with coordination and cofinancing by a national agency.

Governance Mechanisms

SUEEP results in a strategic plan guided by a "vision" and a set of objectives that city authorities seek to achieve. Reliability, efficiency, and affordability of energy supply; reduction of GHG emissions; and the city's adaptation to climate change should be strongly featured as strategic objectives in this process. An integrated strategic planning process enables providers of public services, from mass transportation to wastewater treatment, to contribute and identify opportunities that would lead to greater energy efficiency, cost savings, and reduced GHG emissions, while helping to define investment programs that respond to future demand projections.

To maintain momentum and traction after development of the plan, an institutional governance mechanism is required to formalize and govern its implementation. One of the principal institutional recommendations is for each of the pilot cities to establish a citywide energy and emissions task force to improve coordination and establish an integrated approach to energy planning and management. In all three cities, a committee or like group has already been entrusted with the governance of various aspects of energy and emissions management. Existing committees can be used by extending their mandates through broader terms of reference and enhanced powers (if necessary) to take on the role of the energy and emissions task force.

Because existing urban planning processes in the pilot cities rarely include a comprehensive citywide assessment of and plan for energy needs and systems, the pilot cities could consider proposing the plan for formal review and agreement by an executive authority to embed the energy and emissions plan into a long-term citywide strategy. By doing so, projects would no longer be at the mercy of political cycles, and the responsibility to follow through on the plan must be taken seriously. The pilot cities will have to consider the appropriateness of this route based on their respective governance structures.

Monitoring and reporting systems are crucial for providing credibility to energy and emissions management; therefore, policies need to be implemented carefully to ensure they do not increase costs unnecessarily, and that they address the needs of investors who may, at some point, become involved in financing SUEEP components. The establishment of a city-level platform for monitoring and managing energy and emissions is one of the first practical steps in implementing the vision of sustainable urban energy development, and is a prerequisite for mobilizing "green financing," which requires verification and certification of reductions in GHG emissions.

Of the pilot cities, Da Nang had the most readily available energy data from a variety of government agencies; collection of energy data was much less routine in Cebu City and Surabaya. Even when data were available, sharing of data across departments was limited in all three cities. Sharing of information, experiences, and knowledge will be

a major opportunity for improvement of energy efficiency for all three cities. For example, analysis of trending information on population, vehicle use, traffic, economic growth, and industry would help all city agencies to make better decisions with regard to energy consumption and energy policy.

Effective monitoring and reporting systems should be structured and formalized in a way that demonstrates a high level of integrity and reliability and should cover the following:

- *Institutional arrangements*, roles and responsibilities assigned to individual agencies and personnel.
- *Boundaries*, defining what the energy and emissions inventories have included and excluded.
- *Sources of data*, including data from national agencies to city government collection arrangements and so forth. How data are collected and reported (for example, through surveys or meters), and the frequency with which data are collected, should all be defined clearly.
- *Data collation methods*, to provide transparency to the way in which raw data are processed. This is particularly important if proxy data or extrapolations have been used, or where data are incomplete.
- *Quality assurance processes*, to demonstrate that the methods, processes, and sources used have been adequately audited or reviewed to identify gaps, omissions, and potential improvements to the monitoring and reporting process.

Monitoring and reporting systems should strive for continual improvement to make them accurate, reliable, consistent, transparent, and complete.

Next Steps

The results of the three pilot city studies demonstrated that there are significant opportunities for energy management and GHG mitigation in EAP cities, but challenges to achieving improvements remain. Lack of coordination and planning, and deficiencies in technical know-how, funding, and procurement capability all impede progress. Cities can address these challenges through improved energy governance and a robust energy efficiency and GHG planning framework.

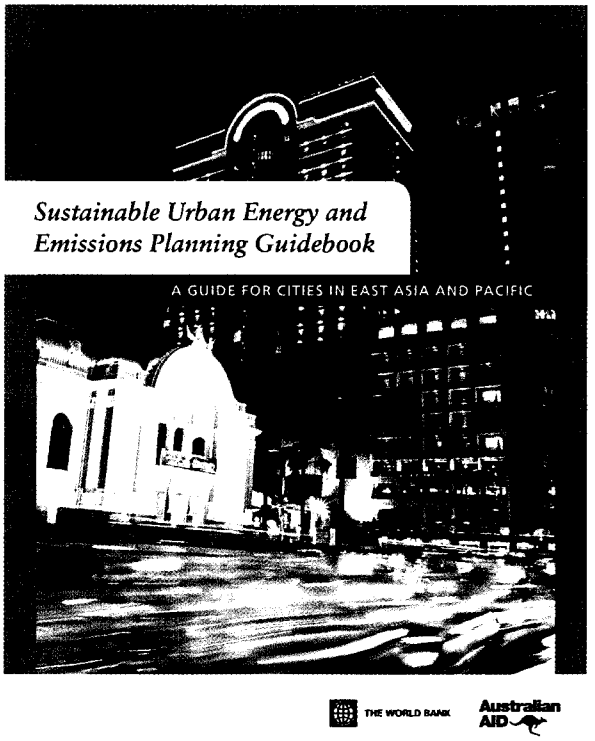
Institution building enables cities to deploy effective energy efficiency programs by improving oversight and coordination of various energy-related initiatives across sectors. All three pilot cities had begun creating appropriate governance structures, but it did not appear that they had adopted a comprehensive approach by, for instance, actively engaging a broad range of stakeholders and legislatively formalizing the energy planning bodies. Cities need to ensure that energy governance is adequately structured to allow effective communication, coordination, and action.

The pilot cities also demonstrated a need for a SUEEP process to achieve improved energy management and GHG mitigation. The SUEEP process provides a comprehensive approach to planning to maximize energy efficiency across sectors, with the intent of helping cities to develop their own initiatives using different mechanisms. The SUEEP process also defines governance systems for implementation and for monitoring and reporting, which are important outcomes because they improve energy governance in the city and create a common platform for collaboration between the city and donors, civil society, and the private sector. The SUEEP process also provides a framework enabling city governments to prepare a pipeline of investments in energy efficient infrastructure (from mass transportation to wastewater treatment) as well as to mobilize "green financing" support. Despite the benefits of such a holistic approach, none of the pilot cities had established an integrated approach to energy planning or GHG mitigation, and the study revealed significant conflicts between various city plans, for example, transportation planning and land-use planning.

Although a comprehensive approach to planning, like the SUEEP process, is ideal, cities have different levels of capacity, resources, and priorities. Given this, city governments could engage with energy planning at three different levels. At the first level, the pilot cities could undertake a high-level, rapid assessment of its energy efficiency measures (for example, TRACE). The second level entails deeper sectoral engagements in selected areas (for example, public-private partnerships [PPPs] and sector-wide interventions). A city that is fully committed to comprehensive planning could approach it from the third level—implementation of the full SUEEP guidelines.

City governments are in a unique position to achieve SUEEP goals through their own activities.

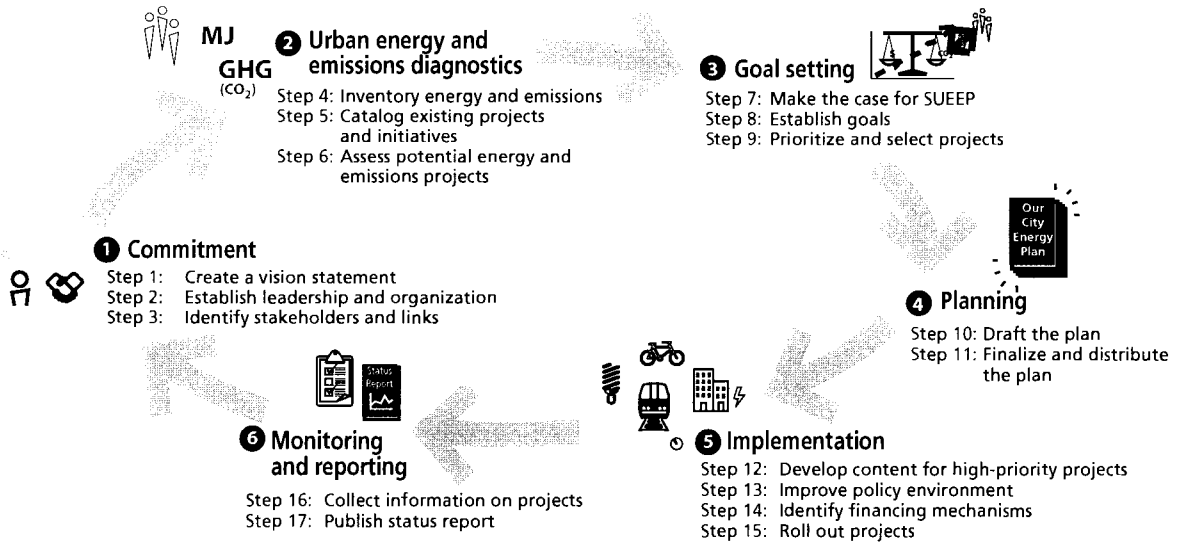
FIGURE 1.10. COVER OF SUSTAINABLE URBAN ENERGY AND EMISSIONS PLANNING GUIDEBOOK



Although their institutional arrangements and capacity are still works in progress, city governments perform several roles, including policy making, regulation and enforcement, and leading and facilitating across a broad range of stakeholders. A city government is the only body with this unique blend of roles and relationships, reinforced by the credibility and tenure to facilitate citywide, comprehensive, and strategic energy and emissions planning. City governments should also engage in strong dialogue with national governments, and where appropriate, align SUEEP with national and regional programs. This would attract broader support for SUEEP, which could be channeled to locally led initiatives and specific projects driven by the priorities and unique set of circumstances in each city.

SUEEP is a continuous process that evolves through institutional reform, capacity building, and implementation of priority investments. To develop a successful SUEEP process, cities must establish sustained city government commitment,

FIGURE 1.11. SUSTAINABLE URBAN ENERGY AND EMISSIONS PLANNING PROCESS



create a baseline based on energy and emissions diagnostics, articulate a vision and goals, prioritize projects, develop an implementation plan, and regularly monitor and report on implementation progress. SUEEP has many benefits, including the following:

- identification of the principal energy and emissions issues facing the city;
- establishment of what can be achieved by the city government, as well as with the aid of other agencies, and how it can be achieved;
- integration of energy and emissions issues into wider city planning processes;
- coordination across sectors and agencies and the establishment of shared goals; and
- establishment of governance, monitoring, and reporting processes essential to future management of the issues, and that are prerequisites for third-party involvement in project and carbon finance.

Building on the three-city pilot work completed in Phase I, the project team developed a SUEEP Guidebook and Toolkit that cities can use to facilitate the development of their institutional capacity-building programs and sustainable energy and emissions plans. The Guidebook (see figure 1.10) and Toolkit are designed to give cities a starting point to begin planning for a more energy efficient development path, guiding leadership through each key step of the process, including crafting a vision statement, forming a task team, communicating with stakeholders, measuring urban energy consumption and emissions, setting green targets, preparing a sustainable urban energy and emissions plan, implementing and financing the plan, and ongoing monitoring and reporting (see figure 1.11).

The SUEEP Guidebook will be tested by the pilot cities and refined to support regionwide replication. In addition to assisting pilot cities to develop their own SUEEP processes and create and start implementing their own sustainable urban energy and emissions plans, the next phase of the program will be the creation of a web-based platform that cities can use to measure and report energy consumption and GHG emissions, which is essential for the creation of carbon assets (such as GHG emissions reduction credits) and mobilization of carbon financing support.

Looking ahead, the attainment of long-term, sustainable urban energy and emissions development is not a goal easily defined or achieved. But the SUEEP process and its partners bring EAP cities one step closer through three critical contributions:

Institutional Development and Capacity Building

The SUEEP process introduces a number of key foundation-building activities required to support long-term urban green growth strategies. The SUEEP guidelines bring clarity and international best practices to the institutional reform, policy development, and stakeholder outreach processes necessary to achieve targets. The SUEEP process also includes accounting tools cities can use to quantify their energy consumption and GHG emissions for use in target-setting, as well as for ongoing monitoring and reporting of results and implementation progress.

Creation of a High-Quality Pipeline of Green Investments

Policy and institutions alone will not create green growth outcomes—investments in energy efficiency improvements and GHG mitigation activities will also play an important role. Through the SUEEP process, city leadership can evaluate investments comprehensively, based not only on their fiscal return, but also on their relative green impact and contribution to other social and economic development goals. The result is a well-defined pipeline of green investment projects that can be communicated not to just local stakeholders and financing institutions, but also to the international donor community and potential partners, including private investors.

Mobilization of Financing

The international donor community's interest in supporting sustainable infrastructure for green growth in rapidly developing EAP cities is substantial. However, there have been many challenges:

defining green city goals; identifying those activities that would optimally support green growth goals; ensuring local governments have the capacity and institutional structures needed to support both construction and maintenance of green investments; and identifying means to measure success. The SUEEP process attenuates these challenges by (i) building an institutional and policy foundation for supporting green investments; (ii) setting up a quantitative system of indicators for identifying green growth targets and monitoring and reporting progress over time; and (iii) creating a long-term green growth plan and a well-defined, thoroughly evaluated pipeline of bankable investments that can be easily communicated to potential investors and financiers.