CHAPTER 7

Surabaya, Indonesia

Surabaya is a large city with a population of 2,765,908 people. The city occupies coastal terrain and has a land area of 327 square kilometers (km^2). The highest point in Surabaya reaches an elevation of about 30 meters. Surabaya is located in the Brantas River Delta, an area that has a high hazard of flooding.

Surabaya's population density is 8,458 inhabitants per km^2. The city is highly urbanized, and the numerous industries located in the city have attracted migrants, contributing to growth of slum areas. The city's annual population growth rate is 0.65 percent, and much of the city's center is densely populated.

Surabaya is a tropical city characterized by distinct wet and dry seasons. The city enjoys plenty of sunny weather, with temperatures regularly peaking at more than 30 degrees C (centigrade, or 86 degrees Fahrenheit). The city's wet season runs from November through May, and the dry season covers the remaining five months. Surabaya on average sees approximately 1,500 millimeters (more than 59 inches) of precipitation annually.

Surabaya is located in the northeastern corner of Java (see map 7.1), and is a key node in various national and international air, water, and land transportation networks. Surabaya is less than two hours away from Jakarta (the country's capital) by plane and within a few hours of any city in Southeast Asia. It is served by Juanda International Airport and Perak Port, one of Asia's largest and busiest seaports. These two international nodes serve as important gateways to the province of East Java not only for passengers, but also for the transport of goods. Surabaya has a large shipyard and numerous specialized naval schools.

As the provincial capital, Surabaya is also home to many offices and business centers and is an educational hub for Indonesian students. Surabaya's economy is also influenced by the recent growth in foreign industries and the completion of the Suramadu Bridge. Surabaya is currently building high-rise apartments, condominiums, and hotels as a way of attracting foreigners to the city.

The city has a gross domestic product (GDP) of US$22,850 million, which grew at the rate of 6.3 percent in 2008 (compared with national GDP growth of 6.1 percent). The primary industries contributing to the city's GDP are the trade, hotel, and restaurant (together accounting for 36 percent) and

Map 7.1 Surabaya, Indonesia

Source: World Bank.

manufacturing (32 percent) sectors, with smaller contributions by the transport and communication, construction, financial services, and services sectors.

The formal sector accounts for 44.1 percent of employment. A significant factor in Surabaya's economic profile is the large contribution of the informal sector to employment (22 percent). The main employment sectors (both formal and informal) are trade, hotel, and restaurant (41.5 percent); community and personal services (21.2 percent); and industry (15 percent). Historical employment data were only available for the manufacturing industry, which saw a decline of 2.8 percent in the 2000–07 period.

Surabaya city governance (Kota Surabaya) comprises the city government and the city's parliamentary body. A decentralization policy implemented in Indonesia in 1998 has devolved public services provision to district and city levels; details of the structure and institutional relationships between central and local government are articulated in Law No. 32/2004. In Surabaya, it is primarily the departments and agencies, under the guidance of the main coordinating planning body, Bappeko, that implement policy changes and actions that could affect energy supply and consumption. Figure 7.1 provides an overview of Surabaya's institutional structure and the relationships involved in the city's energy management.

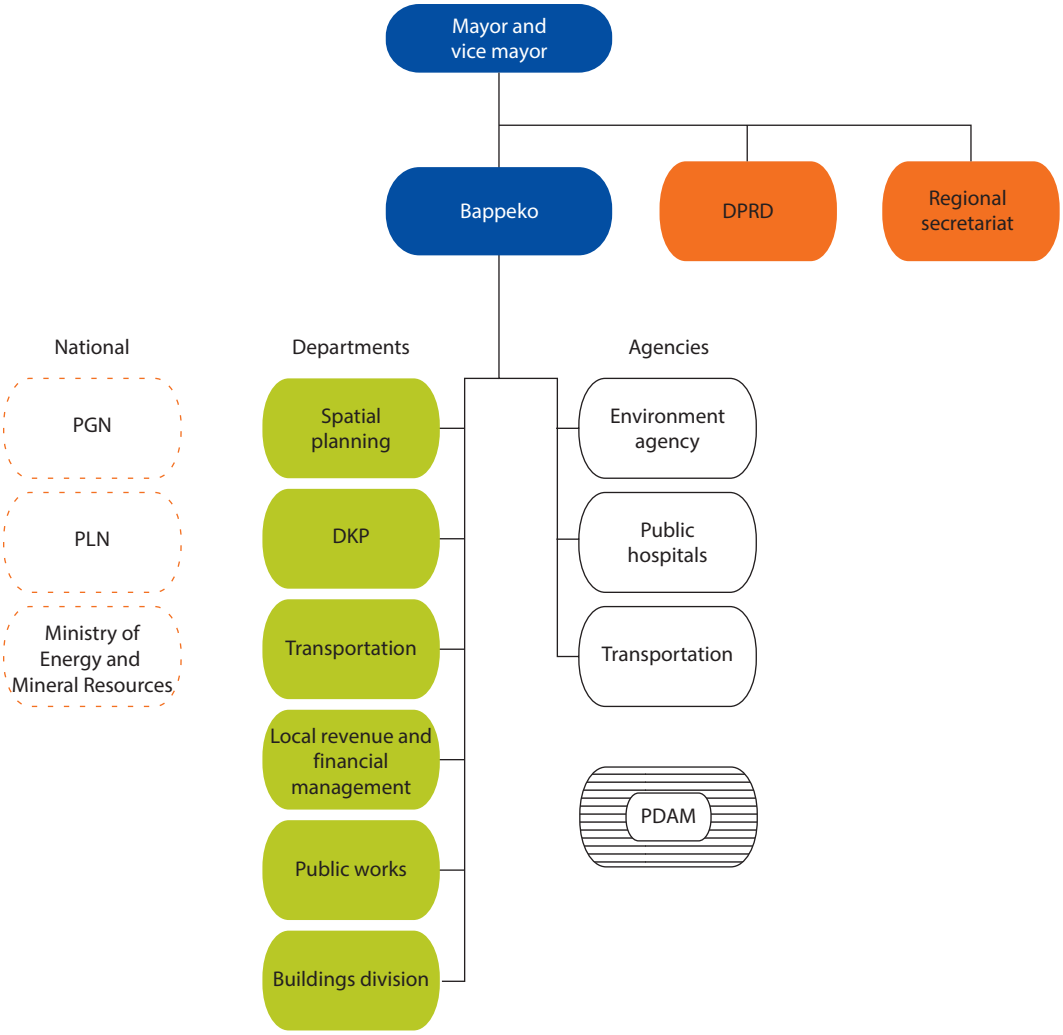
Energy Efficiency Initiatives

National Level

At the national level, energy policies are formulated by the National Energy Council. Energy efficiency and conservation programs are implemented by the Ministry of Energy and Mineral Resources. The Indonesian government has initiated a number of energy efficiency programs, including the following:

- *National Energy Conservation Master Plan (RIKEN) (2005)*. RIKEN stipulates a target for Indonesia to decrease its energy intensity by about 1 percent per year on average. It identifies sectoral energy savings potential: 15–30 percent

Figure 7.1 Surabaya Government Structure for Energy-Consuming Agencies



Source: Phase I pilot study.
Note: Bappeko = city spatial and development agency; DKP = Cleansing and Park Department; DPRD = city parliament; PDAM = Regional Drinking Water Company; PGN = state-owned gas company; PLN = state-owned electricity company.

in industry, 25 percent in commercial buildings for electricity, and 10–30 percent in the households sector. Without this plan, energy use is projected to increase rapidly under a business-as-usual scenario by 41 percent in 2025.

- *National Energy Management Blueprint (PEN) (2006)*. PEN supports the RIKEN through the implementation of energy efficiency and conservation measures. It provides development road maps for various sectors that involve the implementation of supply- and demand-side management, intensification of efforts to search for and use renewable energy sources, implementation of fiscal measures such as tax allowances, development of energy infrastructure,

community participation in commercial energy, and the restructuring of energy institutions.

- *National Energy Policy (2006)*. This policy stipulates national targets for an optimal energy mix in 2025: less than 20 percent from oil, more than 30 percent from gas, more than 33 percent from coal, more than 5 percent from biofuel, more than 5 percent from geothermal, and more than 5 percent from other renewables. It further stipulates a national energy elasticity target of less than 1 by 2025.

- *Presidential Decree No. 2/2008 on Energy and Water Efficiency*. This decree mandates energy conservation practices in government office buildings. Government departments and agencies and regional governments are required to implement best-practice energy-saving measures outlined in the government's guidelines and directives and are mandated to report their monthly energy use in buildings to the National Team on Energy and Water Efficiency every six months.

- *Building energy codes*. Indonesia has four energy standards for buildings that cover the building envelope, air conditioning, lighting, and building energy auditing.

- *Fuel and electricity subsidies*. Fuel and electricity subsidies were scheduled to be phased out by 2014, mainly prompted by an increasing deficit in the state budget—electricity subsidies peaked at 83.9 trillion Indonesian rupiah (Rp) (US$11.05 billion) in 2008 and were estimated to be Rp 65.6 trillion (US$8.6 billion) in 2011. Currently, all categories of customers pay for electricity at rates far below market price—the average electricity tariff is about Rp 655 per kilowatt-hour (kWh) (US$8.62 per kWh), whereas the market price is about Rp 1,030 per kWh (US$13.5 per kWh). In May 2011, the government announced an increase in the base tariff of 10–15 percent to reduce the swelling subsidy. Funds formerly used for subsidies will be used to fund energy investments, including geothermal electricity generation, energy efficiency, and other low-carbon energy generation projects. These will be implemented via the Clean Technology Fund, which has amassed more than US$4 billion since its establishment in 2008. The change in policy and approach from energy subsidy to investment in low-carbon, highly efficient technologies is a major component to the background in which energy policy decisions will be made in the future in Surabaya. Despite the government's aspirations and efforts to phase in the reduction of subsidies, the threat of faster inflation amid gains in oil prices have delayed the national government's plans, which will likely impact the timeline for the proposed phasing out of subsidies.

The primary national focus is to transition public transportation to using gas and the household sector from kerosene to liquefied petroleum gas (LPG). In June 2010, the government planned to improve fuel efficiency for private cars by imposing limits on engine capacity to no greater than 2,000 cubic centimeters.

However, this plan was delayed for reconsideration. Although the national government has long promoted LPG and compressed natural gas for transportation, uptake will continue to be limited as long as fuel and power continue to be underpriced.

City Level

Currently, the city has neither an energy plan nor a policy directed at issues of energy efficiency. However, a number of relevant energy efficiency initiatives have been enacted by the city government, including the following:

- *Surabaya Development Plan 2010–14 (RPJMD)*. This is the city's urban development plan, which is renewed every five years. It addresses several issues, including the development of clean water networks for the city, utilities development, development of the transportation system, and spatial planning in the city. (There is a separate Surabaya Spatial Plan 2009–29; however, it has yet to be codified.) The development plan does not explicitly deal with issues of energy management.

- *Bus rapid transit (BRT) studies*. The city has prepared several transportation studies for the development of a BRT system in the next few years.

- *Mayor's letter*. Following Presidential Decree No. 2/2008 on Energy and Water Efficiency, the mayor issued a letter to city departments mandating the implementation of energy efficiency measures such as energy efficient light bulbs.

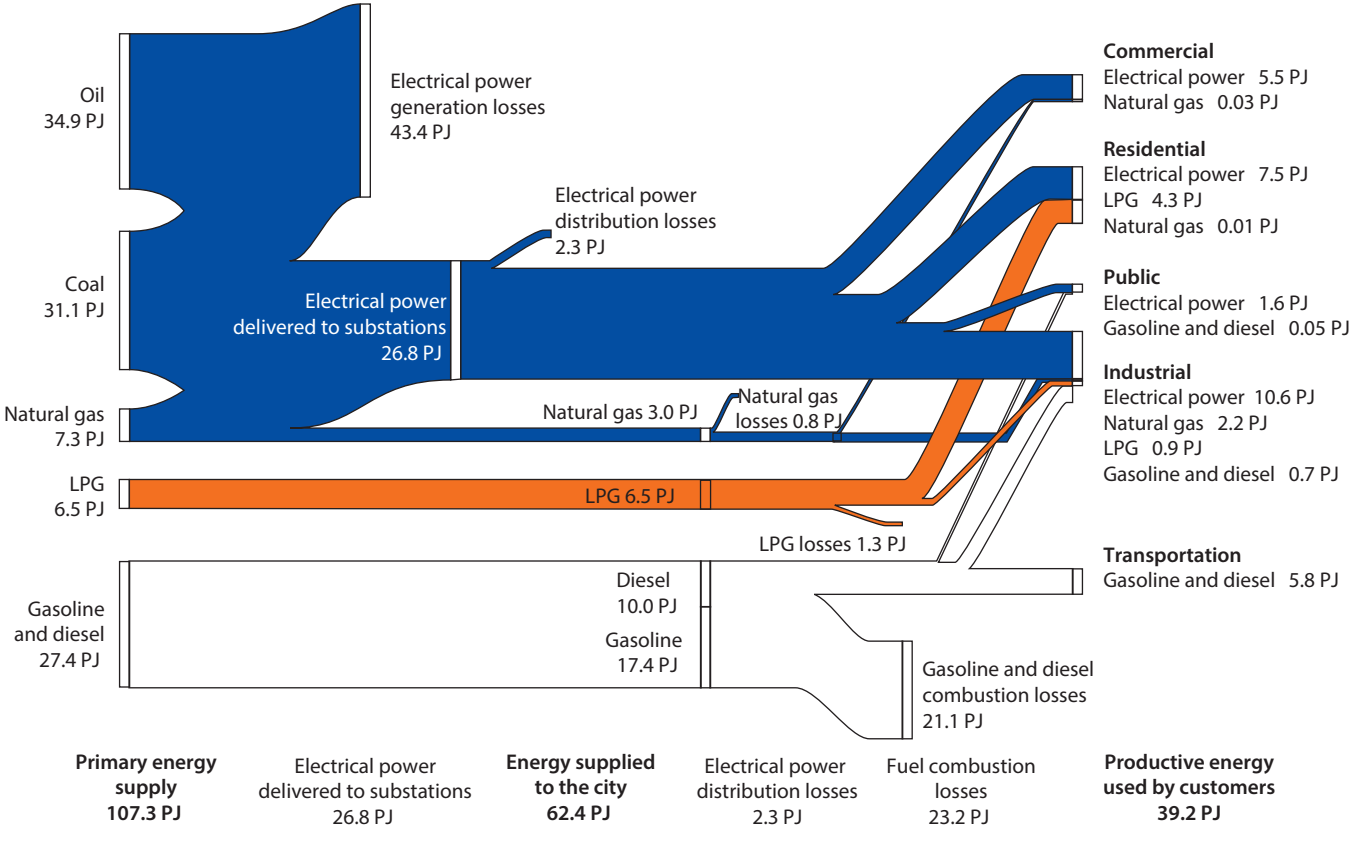
- *Eco*^{2} *Cities*. Surabaya is hosting a pilot World Bank Group Eco^2 Cities program, which will focus on strengthening its core urban planning, management, and finance capacities while investing in a catalyst waterfront redevelopment project. The waterfront redevelopment will enhance environmental and quality of life aspects of the city while increasing accessibility and social inclusiveness, and will revitalize the urban economy.

Energy Use and Carbon Emissions Profile

Surabaya's 2010 energy flows and profile are summarized in a Sankey diagram, shown in figure 7.2, to illustrate the citywide energy supply and demand characteristics of its different sectors.

Although 62.4 billion megajoules of primary fuel energy is supplied to Surabaya, a substantial portion is lost through thermodynamic conversion processes in vehicles (about 77 percent) and in electrical power generation. Similarly, low-efficiency combustion motors in the transportation sector result in only 6.3 out of 27.4 petajoules of gasoline and diesel energy supplied to the sector being used effectively. In comparison, LPG use clearly shows its efficiency advantage because no conversion is involved until its final use. Thus, it would be beneficial both to increase the use of LPG and to locate gas-fired distributed

Figure 7.2 Surabaya Energy Flows, 2010



Source: Phase I pilot study.
Note: LPG = liquefied petroleum gas; PJ = petajoule. "Public" includes the end-use energy of city buildings, street lighting, city vehicles, water, wastewater, and solid waste management.

generation closer to consumers. In particular, the industrial sector can make further efficiency gains by using heat (through cogeneration), which is otherwise wasted in coal-fired plants.

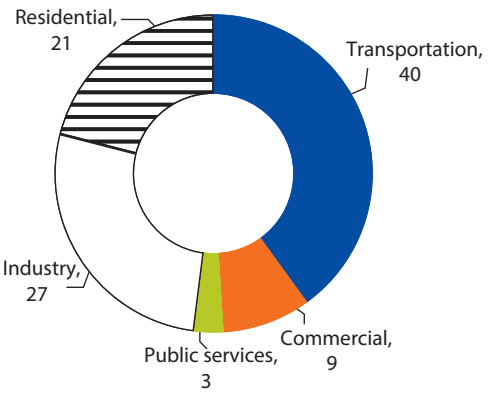
Although the transportation sector accounts for the highest proportion of Surabaya's primary energy consumption, the proportions of energy consumed in the commercial, industry, and residential sectors are also significant (see figure 7.3). In contrast, energy use is insignificant for city public services (solid waste, public lighting, water supply).

Apart from analyzing the energy end-use profile, an overview of Surabaya's energy supply profile can provide the city government with valuable insights for strategic planning with respect to issues of energy security and economic growth. A negligible amount of energy is currently generated from renewable energy sources or primary energy fuels sourced from within the city boundary, but this could be a major potential source of energy production (through thermal solar) for residential, industrial, and hotel uses.

Of the energy supplied to the city, 58 percent is in the form of petroleum products. The majority (68 percent) of the petroleum products consumed in Surabaya is used in the transportation sector; another 18 percent of the city's petroleum use occurs in the industrial sector. The remaining 42 percent of energy imported is electricity. Currently, only 2 percent of energy supplied to Surabaya is generated within the city boundaries. For electricity generation both within and outside its city boundaries, Surabaya relies on oil, natural gas, and coal.

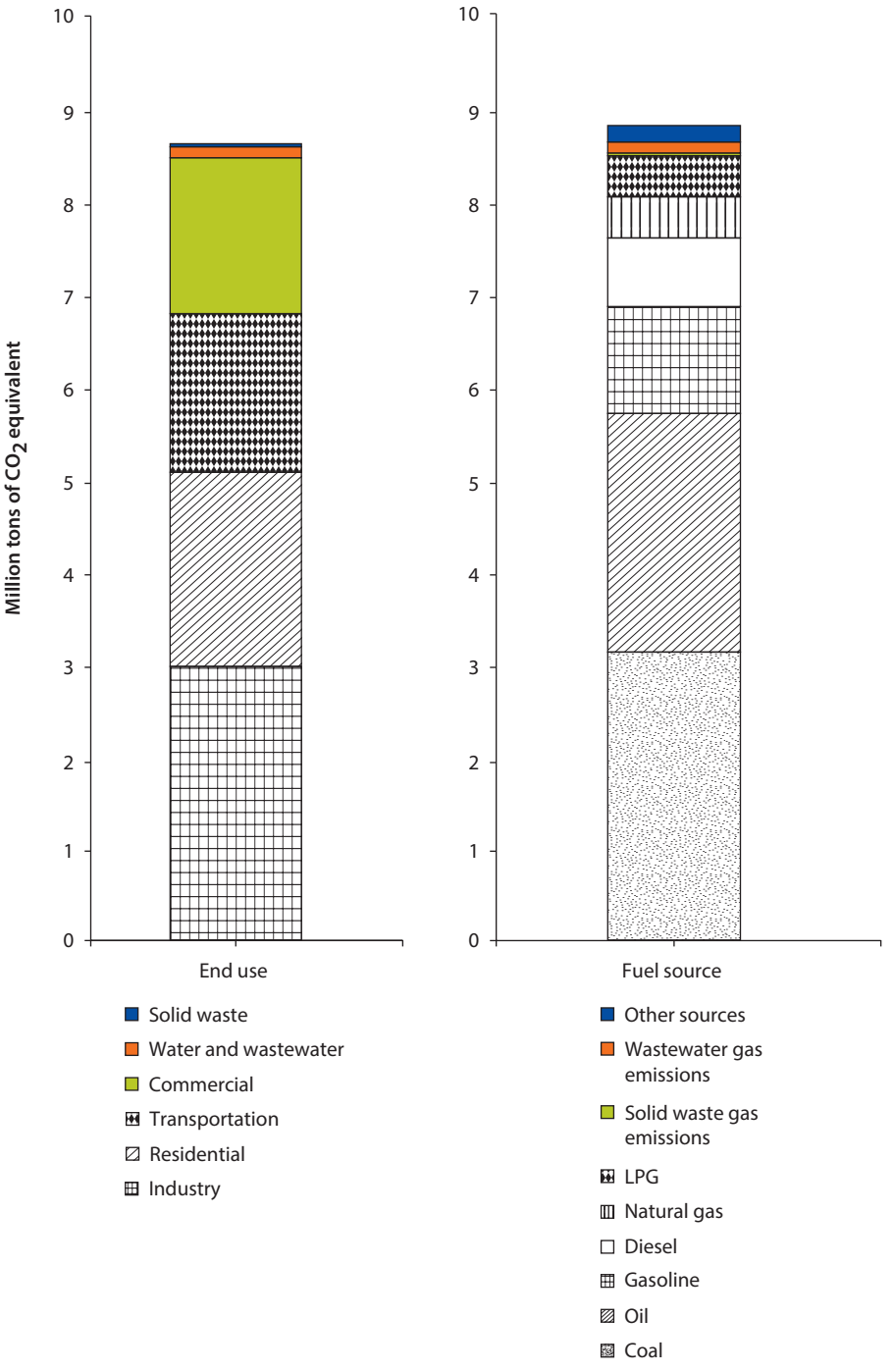
Greenhouse gases (GHG) totaling 8.6 million tons of carbon dioxide (CO_2) equivalent were emitted by all end-use sectors in Surabaya in 2010 (see figure 7.4). Industrial energy use represents 35 percent of GHG emissions. Commercial and residential energy use represents 43 percent of GHG emissions. Transportation fuel results in 20 percent of the city's GHG emissions, with the remaining emissions emanating from methane released from the city's wastewater treatment operations and local landfills. On a fuels basis,

Figure 7.3 Surabaya Energy Consumption by End Use
Percent



Source: Phase I pilot study.

Figure 7.4 Surabaya GHG Emissions by End Use and Fuel Source



Source: Phase I pilot study.
Note: CO_2 = carbon dioxide; GHG = greenhouse gas; LPG = liquefied petroleum gas.

coal is the dominant contributor to GHG emissions in Surabaya (36 percent) and oil the second-largest contributor (29 percent). Gasoline, diesel, LPG, and natural gas collectively account for another 31 percent of emissions from fuel use.

Sector Review and Prioritization

Surabaya's interest in pursuing the Tool for Rapid Assessment of City Energy (TRACE) underscores its commitment to achieving optimal energy efficiency. The analysis was carried out across six city sectors: passenger transportation, city buildings, water and wastewater, public lighting, solid waste, and power and heat. These were, in turn, assessed against the performance of a range of peer cities through a benchmarking process. This review provided a number of significant findings that helped to focus activities during the early part of the study and contributed to the definition of priority sectors for further analysis.

Key findings of the Surabaya diagnostics in comparison with the cities in the TRACE database are the following:

- High electricity use per capita and high energy use per unit of GDP
- Relatively low energy consumed by transportation due to the low level of automobile use and high usage of relatively fuel-efficient motorcycles
- Low use of public transportation coupled with growing private vehicle ownership and widespread use of private motor scooters, resulting in relatively low operating energy intensity for mobility
- High per capita water consumption and relatively high water losses from the distribution system, but midrange energy density for potable water production
- Low electricity consumption per light pole but room for improvement in public lighting
- Low energy consumption in city buildings but electricity use is on the rise
- Low level of recycling and high amount of solid waste that goes into one landfill
- Low levels of transmission and distribution losses in the electricity network

The TRACE analysis identified priority areas for which significant energy savings are possible. Table 7.1 indicates the energy spending in each of these sectors, the relative energy intensity (the percentage of energy that can be saved in each sector, based on the TRACE benchmarking), and the level of influence the city has over these sectors. The savings potential is calculated by multiplying the three factors. The TRACE contains a playbook of 58 energy efficiency recommendations applicable across all sectors analyzed.[1] The recommendations are not meant to be either exhaustive or normative. The recommendations only outline a number of policies and investments that could help local authorities achieve higher energy efficiency standards. Following the sector-by-sector analysis, each recommendation was reviewed to establish its applicability to Surabaya. This filtering process helped concentrate the process on those recommendations that are both viable and practical.

Table 7.1 Surabaya Sector Prioritization Results

Priority ranking	*Sector*	*2010 energy spending (US$)*	*Relative energy intensity (%)*	*Level of city authority control*[a]	*Savings potential (US$)*[b]
City authority sector ranking					
1	Street lighting	6,089,000	20	1.00	1,217,000
2	City buildings	2,237,000	10	0.95	212,515
3	Public vehicles	1,617,840	10	0.05	6,235
Citywide sector ranking					
1	Potable water	6,528,000	36	0.96	2,256,000
2	Public transportation	68,889,000	5	0.38	1,309,000
3	Power	Unknown	12	0.05	Potentially large
4	Solid waste	1,306,000	15	0.75	146,000

Source: Phase I pilot study.
a. 0 = no influence; 1 = maximum influence.
b. Based on TRACE (Tool for Rapid Assessment of City Energy) benchmarking; these figures are indicative of the savings that may be possible, but not necessarily practicable.

Table 7.1 shows priorities with respect both to sectors over which the city authority has maximum influence and to citywide issues over which the authority has limited influence.

The rankings suggest that the city government should prioritize street lighting, followed by city buildings, and then public vehicles. On a citywide basis, potable water supply is clearly deserving of attention, followed by public transportation, power, and solid waste.

Recommendations

The recommendations to improve the city's energy efficiency concentrate on areas over which the city has direct influence and are, for the most part, derived from TRACE. Many of the recommendations are targeted at reducing energy use to lower the city's energy expenditure. The recommendations will help city officials identify how the initiatives can be implemented in Surabaya. The recommendations are embedded in TRACE and their details can be made available. The recommendations are expected to be refined by the city and the Sustainable Urban Energy and Emissions Planning (SUEEP) team as further analysis and discussions occur. Although the energy balance and GHG emissions inventory provide an overview of the energy and emissions profile of Surabaya, additional analysis beyond the public sector is required to develop a sustainable urban energy and emissions plan that includes sectors outside the direct influence of the city government.

Transportation

More than 1.3 million motorcycles and motor scooters dominate private vehicle transportation in Surabaya as they do in many cities in Southeast Asia. The other important modes of transportation in Surabaya are private automobiles, taxis, and angkot buses (minibuses). Surabaya currently experiences a high-volume rush hour, during which traffic flow is severely impeded.

Although motor scooters in Surabaya are predominantly new and fuel efficient, a shift toward private cars—influenced by higher wages and increasing standards of living, as well as the lack of restrictions on new vehicle registration (although progressive taxes apply to second, third, and fourth vehicles)—is driving up fuel usage. Fuel usage is rising despite the fact that new vehicles tend to be smaller and more fuel efficient than cars in other developed cities.

No high-capacity public transit system serves Surabaya aside from regional commuter trains that run only three or four times each morning and account for a very small share of mode split, estimated at less than 1 percent. Angkot minibuses, another mode of public transportation in Surabaya, generally have older and inefficient engines, and typically use kerosene fuel that may be blended with gasoline, which can damage the engine and is highly polluting. Despite the low usage of public transportation in the city, transportation energy intensity per capita remains fairly low because of the widespread use of fuel-efficient motor scooters.

These factors point to significant potential for improvement in the energy and operational efficiencies of the public transportation system. Furthermore, the lack of access to nonmotorized modes as well as safety concerns regarding the use of crowded streets have made nonmotorized modes of transportation such as bicycling unattractive. Bicycle lanes could potentially be established on a few main thoroughfares wide enough to accommodate them, though the vast majority of streets in Surabaya are too narrow to safely make room for bicycle lanes.

With respect to Surabaya's city operations, its fleet vehicles are maintained at a single facility so projects to improve maintenance and energy efficiency could be easily implemented at this location. The city government is responsible for more than 500 vehicles that support the following services: garbage collection and transfer, official vehicles, street sweeping, and street light maintenance.

Public Transportation Development

The traffic congestion in Surabaya, which is exacerbated by growth in private vehicle ownership, has led city officials to enhance planning efforts to increase public transportation networks. Irregular public transportation schedules and a declining perception of the attractiveness of road-based transit have been identified as the main challenges. Therefore, the city is focusing its planning efforts on the implementation of multimodal transportation systems based on a light rail transit line, the development of an Intelligent Transportation System, and park-and-ride facilities. Campaigns to increase public awareness include programs such as car-free days and license plate restrictions. A recent increase in the use of bicycles has also prompted plans for the development of bicycle and pedestrian path networks.

One of the most notable observations was the need for an integrated planning approach to ensure that plans for public transportation systems, land use, street signals, parking policies, vehicle registration pricing, and sidewalk policies are adequately integrated and that there is an effective means for turning plan into practice. Integrated planning is especially important for transportation planning. Encouraging nonmotorized modes alongside the development of robust public

transportation will be critical to mitigating congestion and improving the quality of transportation in Surabaya.

Coupled with nonmotorized transportation, the promotion of public transit should be part of an energy efficient strategy for Surabaya. Various proposals for enhancing the public transportation system have been in development for a number of years. A BRT pre-feasibility study was completed with the support of Japan International Cooperation Agency (JICA), and the World Bank Group is involved in helping Surabaya conduct more detailed studies. Because of the complexity involved in the development of public transportation and the level of documentation available for the proposed BRT, this report will not go into detail on this issue. Surabaya is also developing plans for a mass transportation system comprising tramway and monorail systems to serve heavy traffic corridors into the city center and is initiating studies to integrate the rest of its public transportation network with this system.

Vehicle Emissions Standards

Surabaya's transportation system is dominated by motorcycles and cars, which are currently fairly new and fuel efficient. However, vehicle emissions standards testing could be more effectively applied to encourage and enforce better vehicle emissions, which will be important as vehicles begin to age. This, in turn, will lead to better air quality and reduced energy consumption. The current system of testing and enforcement of vehicle emissions is fragmented because different city and national government departments regulate (license) test centers, and enforcement is either weak or ineffective because cars can be back on the road after a few simple measures are applied to get the vehicle to pass. New testing equipment that meets standards for measuring an engine's efficiency would be required. Enforcement activities and resulting sanctions should also be revised to ensure that poorly performing vehicles are identified and removed from service. The implementation of such a measure is potentially difficult because of the fragmented nature of Surabaya's existing testing system and the magnitude of enforcement required.

It is highly recommended that the Bappeko lead a city vehicle fleet efficiency program. Procurement and maintenance policies should be implemented to maximize the efficiency of the city's fleet.

In response to the limited transportation data available to support the Department of Transportation's decision making for energy efficiency issues, a data collection program is also recommended. A variety of informal and inexpensive data collection systems are now becoming available with software applications that collect data from cell phones or city vehicles and do not rely on manual counts to collect transportation data.

Finally, the establishment of a Surabaya regional transportation planning authority is highly recommended to study all types of regional transportation issues and to allocate funds to the lowest-cost solutions for the most pressing problems.

Solid Waste

Surabaya has one landfill, which accepts hazardous, septic, and noncompostable waste. The landfill is fairly new and has capacity for approximately 10 years, with

expansion sites nearby. Residential waste is collected by the kampungs[2] and brought to transfer stations. Dinas Kebersihan dan Pertamanan (DKP), or Cleansing and Park Department waste transfer trucks take waste from the transfer stations to the landfill.

Sludge from wastewater treatment is collected from private wastewater treatment companies and processed by DKP. Composted sludge is used as soil fertilizer for city parks.

Landfill leachate currently remains untreated, posing contamination and disposal issues. Surabaya produces nearly 707,000 tons of domestic solid waste annually, giving rise to approximately 37,800 tons of carbon dioxide equivalent (CO_2e) from landfill gas emissions.

Programs have started in four of the transfer stations to extract compostable waste to be turned into soil for use as fertilizer in parks throughout the city. Kampungs are also engaged in small-scale composting with thousands of residential-scale composting bins distributed to households. Surabaya has reviewed numerous energy-from-waste proposals for the landfill, and proposals for a number of different technologies by a variety of bidders are being evaluated; however, no projects have yet been implemented. The landfill in Surabaya is currently set up to capture methane gas, but the gas is not being used as a resource.

Vehicle Maintenance Program and Vehicle Operations Program

The first easy win for energy efficiency in the waste sector is a vehicle maintenance program for the collection and transfer vehicles under control of the city government. These vehicles, if tuned up and operated with the correct tire pressure and with clean fuel, could run at least 10 percent more efficiently.

An effective vehicle operations program would improve the efficiency of routes for the trucks by running them through less-congested areas and making the routes shorter and more direct.

Composting Program

The existing composting programs should be expanded and be run at all of the waste transfer facilities, not just the four sites where composting is already happening.

Landfill Gas Capture Program

Finally, the proposal for a landfill gas capture program should be executed. The program would provide quick and easy energy and reduce GHG emissions at a very low cost to the city.

Water

The regional drinking water company (PDAM) produces and distributes Surabaya's drinking water and manages the treatment and distribution infrastructure. PDAM is owned and operated by the city government. About 70 percent of the population has access to clean drinking water. Domestic wastewater is mostly treated with septic tanks and absorption technology.

Industrial wastewater is often discharged directly into the Surabaya River without treatment. However, a small number of companies install and manage their own facilities to treat their wastewater discharge. The Surabaya River is a primary source for the city's drinking water, so coordination and action on upstream industrial sites is particularly necessary.

Raw water is gravity fed to the two potable water treatment facilities by the Surabaya River; thus, the energy intensity of potable water is fairly low because no energy is required for transmission pumping or groundwater pumping. Because the water consumption rate in Surabaya is relatively high at 290 liters per person per day, reflecting both actual consumption and loss, water leakage reduction programs and water conservation will be effective.

Surabaya has no citywide wastewater infrastructure and wastewater is currently managed through household, or clusters of household, septic tanks. Seventeen private wastewater treatment companies run treatment facilities for large buildings or campuses. For this reason, Surabaya's energy use for wastewater is very low. However, in the interest of public health, it is expected that a more comprehensive system will eventually be developed.

Surabaya has a large number of storm water ejector pumps in the canals to move water through and out to the sea during rain events. Although many of these facilities are quite old and use large, inefficient pumps, the limited time that these pumps are operated each year means that total energy savings potential is unlikely to be significant.

The city is facing significant challenges in wastewater management, including the contamination of water supply from septic tank seepage, contaminated landfill leachate, and the lack of treatment of wastewater sludge. However, the Surabaya city government has the opportunity to overcome these issues because it owns PDAM (as is common in Indonesia). The large leakage rates and the low water pressure in the east and north sectors of the network also provide opportunities to greatly reduce nonrevenue water losses.

Pump Replacement Program

Considering the age of Surabaya's water network and water treatment facilities, a pump replacement program is strongly recommended for Surabaya.

Leak Reduction Program

The city should implement a leak reduction program and hire a long-term partner to deliver a performance-based contract.

Water Awareness Program

A public water awareness program would also be a productive complement to the water use reduction efforts in Surabaya.

Power

Surabaya is primarily an importer of electricity, with only one 57 megawatt power plant in Perak (in northern Surabaya), which is fueled by natural gas.

PLN (Perusahaan Listrik Negara) Distribution East Java is the state-owned enterprise that provides electricity to meet Surabaya's needs. Hence, although Surabaya can make recommendations and ask for improvements to the electrical network, the city government cannot make direct decisions or even allocate funding for improvements in this sector.

With respect to transmission and distribution, Surabaya has relatively low losses (1.8 percent for transmission and 6.7 percent for distribution). PLN has implemented energy efficiency programs and performs ongoing maintenance on transformers in substations and seems to have a good program for addressing transmission and distribution losses. Because the PLN network is performing relatively well, any improvements would be incremental.

JICA recently provided technical assistance to PLN for the study of "smart metering" in Jakarta. This concept would be beneficial to Surabaya as well.

Distributed Generation Program

In light of the city government's limited influence in the power generation sector, the SUEEP team recommends that a distributed generation program, which would use the capacity of the natural gas network and the nearby natural gas fields to generate low-cost, local electricity within the city, be developed. A distributed generation program would produce additional benefits, such as the use of waste heat for hot water heating, generation of chilled water with waste heat, and reductions of distribution losses in the electrical grid.

Public Lighting

Public lighting in Surabaya is in the remit of the DKP. Responsibility for street lights on most city streets is under DKP, whereas small roads in residential areas are maintained by the kampung or by the local developer. Surabaya has good street lighting coverage at 79 percent, but its implementation of a program to achieve 100 percent coverage does not suggest that it is a top priority. The SUEEP team noted that the program did not appear to have significant funding.

Surabaya has 40,000 street lights, 95 percent of which use high pressure sodium lamps, which is good practice today, although not the most energy efficient lamp on the market. The lighting levels do not meet international standards, hence electricity consumed per km of road lit is low. A bulb replacement program to ensure all street lights use high pressure sodium lamps was nearly complete.

Only 12 maintenance vehicles were identified for street lighting repair and lamp replacement for the entire city. The team of people assigned to maintenance was also quite small for a city of close to 3 million people. Construction costs for new street lamps can be high, and fitting new wiring and poles into already crowded streets filled with old existing pipes and wires can be difficult. Despite the above, there is scope for improving public lighting in Surabaya (see below).

Public Lighting Assessment Program

The first recommendation for public lighting is to improve data collection processes and data availability through a public lighting assessment program so that future programs and funding allocations can be adequately informed with accurate data.

Lighting Timing and Dimming Program

There is an opportunity to create a lighting timing and dimming program that would test and install new technologies for new street light installations and replacement lamps.

Public Lighting Research and Development Program

Because DKP does not have the capacity or funding to test new technologies, the most important recommendation in this sector is the public lighting research and development program. This program could accept demonstration poles and lamps from manufacturers and measure their performance and test their lighting output to satisfy decision makers that new low-energy technologies can perform satisfactorily.

City Buildings

The city buildings category covers all buildings owned by the city, including government offices, city schools, and city hospitals. The city building stock is generally characterized by the use of natural daylight, fans and natural ventilation, compact fluorescent lighting fittings, and limited meeting rooms and offices augmented by air conditioning on a timed basis. Hallways, lobbies, and open-plan offices are generally open air and naturally ventilated. Very few buildings in Surabaya have central air conditioning, and the SUEEP team did not identify any city buildings with chillers or central ventilation. These are excellent examples of sustainable design—on the sea coast, where natural ventilation is quite good, not every facility should be fully enclosed with sealed windows and air conditioning. The city buildings in Surabaya consume very little energy, and the opportunities to further enhance energy efficiency seem to be very limited.

No new construction projects were under way for city buildings during the time of the SUEEP mission, and no new building construction projects were identified. Only minor renovation projects were under way to improve city buildings.

No green building codes or ordinances were identified, nor were any building energy code revisions. National-level green building guidelines have not been set up in Indonesia.

Surabaya's city buildings are low energy users, so maintaining this low consumption while increasing the quality of buildings and services will be a challenge. For example, the SUEEP team's walk-throughs of the hospitals in Surabaya showed that the old hospital was open to the air in all hallways and had minimal air conditioning and lighting, whereas the new hospital was fully air

conditioned and overlit through all lobbies, hallways, and spaces. This trend presents both a challenge and an opportunity.

Each department has control over the buildings it uses. There is no central facilities management group within the Surabaya government. Neither is there a formalized refurbishment cycle for government buildings, which poses a significant challenge for achieving energy efficient performance in the existing building stock. In addition, energy-efficiency-oriented capital investment planning and life-cycle costing are not used, hindering the uptake of those energy efficiency initiatives that require higher upfront investment but yield long-term savings.

Any new city building design and construction projects would be good opportunities for the city to show leadership in energy efficient building design practices. The city has the power to pass ordinances for building codes, which will be advantageous for any agency that wishes to mandate compliance with green building codes. The current mayor has been a vocal proponent of energy efficiency and it has been through her leadership that the existing energy efficiency projects have been implemented.

Because of the low energy use by city buildings in Surabaya, only two recommendations are put forward for this sector.

Computer Power Save Program

First, based on the walk-throughs of more than a dozen city buildings, the computer power save program was deemed to have the most potential because of the large number of desktop computers in evidence.

Energy Efficient Building Code

Second, because of the growing stock of higher-quality and higher-energy-using buildings, the SUEEP team recommends development of an energy efficient building code to appropriately address the construction industry in Surabaya and mitigate the trend of increasing energy consumption in new buildings. The city government can use future new building projects to demonstrate the techniques and benefits of energy efficient buildings.

Conclusion

Robust energy planning and management will help shape Surabaya's future. Without a formal energy and emissions strategy, Surabaya's economy and quality of life will not reach their full potential. A comprehensive and strategic approach to energy now will pay dividends by future proofing the city's infrastructure against increases in energy use, a growing population, and the pitfalls of energy-intensive development that have hindered so many other cities.

Surabaya's government has recognized the need for a sound energy and emissions strategy through the many existing excellent energy initiatives reviewed above.

In the future, energy governance should be prioritized by the city government because it will help strengthen the city's internal energy management practices as well as engage other key stakeholders who have not played a significant role in the city's energy planning efforts to date. Better governance practices include not just enhanced oversight and data tracking but also improved procurement practices and a willingness to "lead by example" by showcasing best practices for the benefit of local businesses and households.

Notes

1. For further details on TRACE, see chapter 3.
2. Kampungs are the local neighborhood level of city governance.