Background

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 vast majority of people remain underserved by basic infrastructure services and where city authorities are under-resourced to shift current trajectories.

Urban growth is particularly notable in East Asia and Pacific (EAP) region. While EAP is one of the world's least urbanized regions, its urban population is growing at unprecedented rates; almost 2 times faster than the world's urban population.

In an effort to promote solutions that would help delink high levels of carbon-intensive energy use from urban growth the World Bank initiated a regional program—*EAP Sustainable Urban Energy and Emissions Planning, or SUEEP*—with support from AusAID in January 2011.

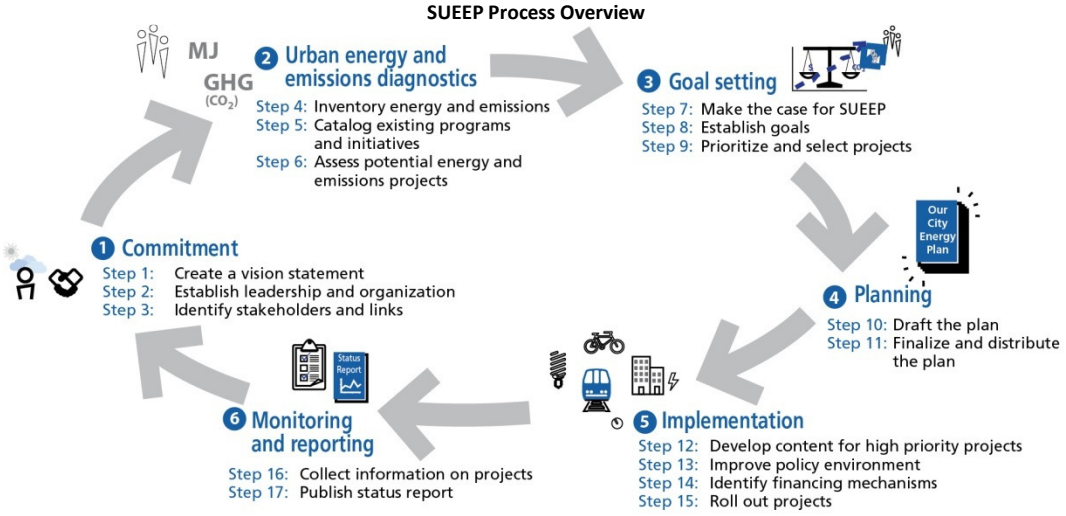
What is SUEEP?

SUEEP is a comprehensive framework and a step-by-step guideline to help a city to develop its own energy and emissions plan. Building on the three-city pilot work in Southeast Asia (namely, Da Nang, Vietnam; Cebu, Philippines; and Surabaya, Indonesia) together with best practices in sustainability planning in other cities, the SUEEP Guidebook and Toolkit is designed to facilitate the development of city's institutional capacity-building programs to maximize energy efficiency across municipal sectors and defines actions the city can take to improve energy and emissions performance. The SUEEP process is designed in such a manner that energy and emissions planning are aligned with overarching city goals. By linking a city's aspirations with actionable initiatives to improve energy and emissions performance, SUEEP enables a city to foster local economic growth, improved quality of life, environmental protection, financial savings, new jobs, and new partnerships across city agencies and the private sector. The intent is to help cities to develop their own SUEEP using different mechanisms and to help them to define a governance system for its implementation, monitoring, and reporting. These 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.

Process Overview

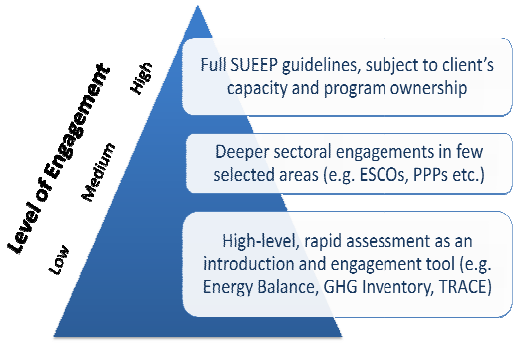
The 17-step process in SUEEP is broken down into six main stages as shown below. The process is meant to give cities a framework to begin planning for a more energy efficient development path, walking leadership through each key step of the process, including: crafting a vision statement; communicating with stakeholders; measuring urban energy consumption and emissions; setting green targets; preparing a sustainable urban energy and emissions plan, implementing and financing the program, and on-going monitoring and reporting.

SUEEP Process Overview



Multi-level Engagement

Given that comprehensive frameworks like SUEEP can be resource-intensive, additional flexibility is built into the program through a multi-level engagement process (see diagram below), with a high-level, rapid assessment as an introduction, followed by deeper sectoral engagements in few selected areas, and then, subject to client's demand and program ownership, implementation of the full SUEEP guidelines.



Three Diagnostic Tools with Three Objectives

The SUEEP framework uses 3 different toolkits to assess the city energy use and emissions profile.

1) *Energy Balance:* Maps primary and secondary energy supply and use in a city.
2) *GHG Emissions Inventory:* Determines the main sources of GHG emissions from city energy use.
3) *Tool for Rapid Assessment of City Energy, or TRACE:* Offers cities quick diagnoses of energy efficiency performance across a city's systems and sectors and identifies priority areas for further investigation and intervention.

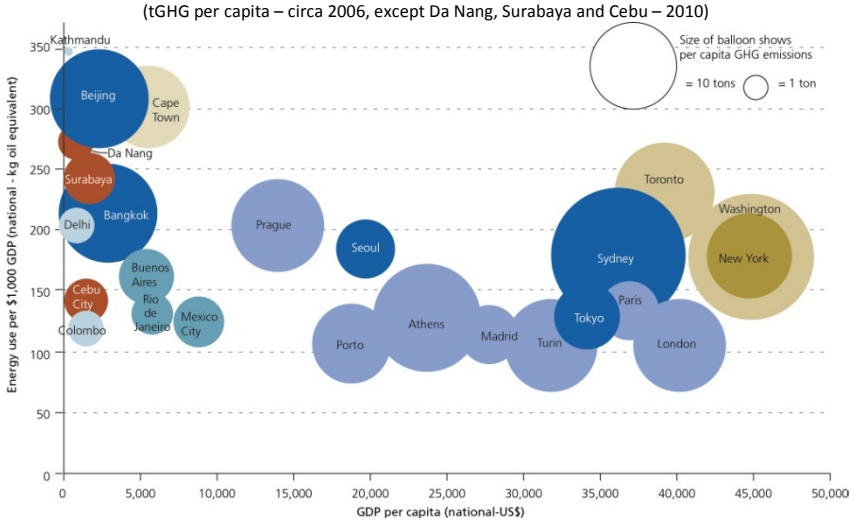
Target Audience

The SUEEP framework is targeted at mayors and municipal planning agencies in the EAP region, but it is also relevant for government officials who are involved with utility services delivery, transportation, economic development, housing, environmental management, government facilities management, government procurement, financial planning, risk assessment and public health.

Understanding Cities: Energy Use & GHG Emissions

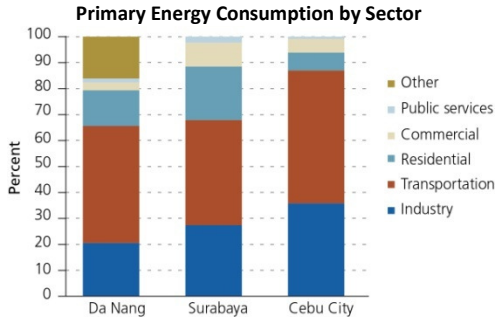
The following figure illustrates that most developing cities in Southeast Asia, including all three pilot cities (i.e. Da Nang, Cebu and Surabaya) currently have relatively low energy consumption and GHG emissions per capita when compared to many cities around the world. However, as their GDP per capita increases, the energy consumption and GHG emissions may take different paths as illustrated by other EAP cities such as Bangkok, Seoul and Tokyo. Clearly, the path taken by Seoul and Tokyo offers a greener alternative which calls for significant reduction of energy intensity of economic activities (energy use per GDP) and improvements in energy efficiency. Only Cebu is currently at the level of energy intensity which makes such path relatively straightforward, while Da Nang and Surabaya have a longer path to reduce energy intensity of their economy. The chart below also demonstrates that investments in energy efficiency alone are not

Per Capita GHG Emissions in Select Cities
(tGHG per capita – circa 2006, except Da Nang, Surabaya and Cebu – 2010)



sufficient to keep cities on a sustainable path and that for the most developed cities, GHG emissions per capita may "plateau" or even start increasing with GDP growth unless more comprehensive measures are implemented. Such measures or plans must take into consideration other drivers of energy demand and emissions, for instance land use, public transport, distributed power generation and its mix etc. – which are part of a comprehensive SUEEP.

The rapid population increase and rising standard of living in the three SUEEP pilot cities are driving a considerable increase in energy consumption. In terms of their population size, Surabaya is the largest city with 2.8 million in 2010, and Da Nang being 0.9 million and Cebu 0.8 million. Da Nang is currently experiencing 11.7% yearly rises in energy consumption, which will lead to a doubling of energy demand in 6 years time. The increases in Surabaya and Cebu's annual energy use are 4.9% and 4.3% respectively, still notably high. Transportation is a key driver of energy demand (see chart below). This sector as well as the building sector presents the largest opportunities for scaling-up energy efficiency at the city level particularly in Da Nang given the city authorities' high degree of control or influence over these two sectors.



GHG emissions breakdowns roughly match the three cities' energy use patterns but with some variation. The fuel type for electricity generation is a key factor determining the intensity of GHG emissions from energy uses. In Surabaya, electricity generated mainly from coal-fired power plants dominates the GHG profile and is responsible for 36% of the city's emissions. Cebu and Da Nang both have significant amount of renewable electricity generation (Cebu has 36% of electricity production from geothermal and hydro, and Da Nang has 16% of electricity produced from hydropower). Because of that, the GHG emissions in Cebu and Da Nang are significantly lower (per capita) and dominated by diesel and gasoline fuels used for transportation and local (diesel-based) electricity generation. The use of distributed renewable energy production (such as solar PV) is at a very early stage in all three pilot cities. Furthermore, the electricity tariffs and pricing policies (such as subsidies) are outside city control which is one of key tools for the promotion of energy efficiency on the demand side. This shows the importance of close collaboration between the city and national authorities in developing an optimal approach to meet fast growing urban electricity needs in a reliable, efficient and environmentally sound manner.

Da Nang, Vietnam

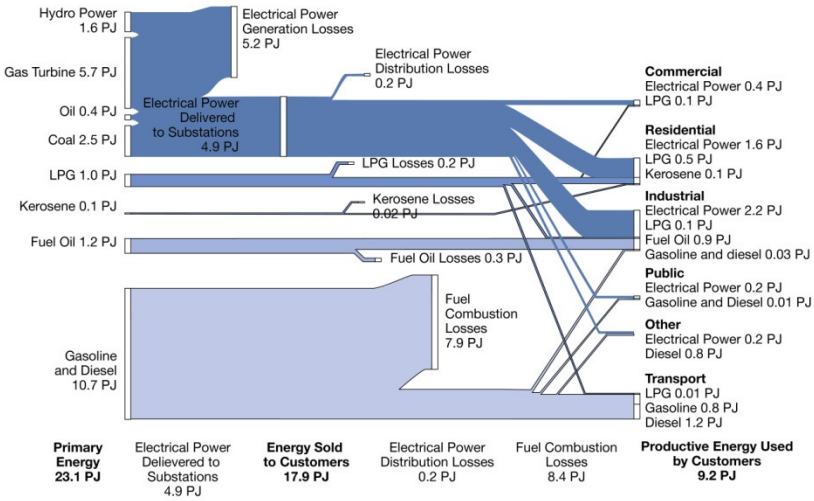
Da Nang is a major harbor city and the largest urban center in central Vietnam. With the fourth largest seaport in the country, Da Nang is an important gateway city to the Central Highlands of Vietnam, the Lao People's Democratic Republic, Cambodia, Thailand, and Myanmar. After relatively slow population growth (1.7% annually) between 2000 and 2007, Da Nang appears poised for a significant increase in the next 10 years with a population of about 1.65 million by 2020.

There is a desire by the progressive leadership of Da Nang to take the city into a direction of green growth and higher energy efficiency, which is also a national priority. The City People's Committee decision to adopt "The Plan for Developing Da Nang – The Environmental City" lays the foundation for city planning in the context of sustainability and encourages resource efficiency. By pursuing ambitious energy efficiency policies at city level, the city would be able to take a competitive lead at not just the national level, but potentially even at the wider Southeast Asia regional level. There is also significant current engagement with the World Bank and a strong government support for the sustainable development of Da Nang.

Energy Balance

Energy balance of Da Nang as shown below illustrates the city's energy flows and profile. In 2010, city used roughly 17.9 PJ of energy in various forms. About 45% of the city's energy use involved various fuels used for transport applications, while industry was responsible for 21% of the city's energy use. Residential energy use accounts for 13% of all energy consumed, while commercial and government services currently use only a very small fraction of the city's energy. The remaining 16% of energy is consumed in other sectors.

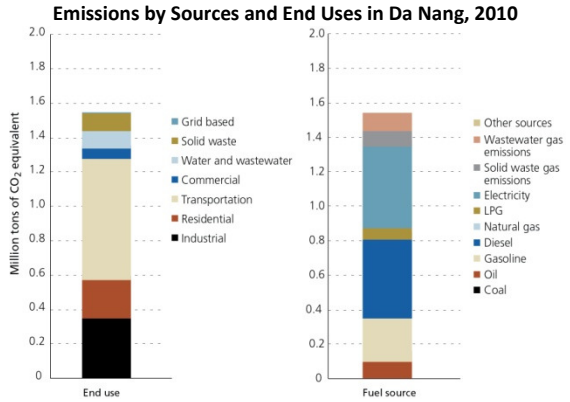
Da Nang's City Wide Energy Balance Sankey Diagram, 2010



GHG Emissions Inventory

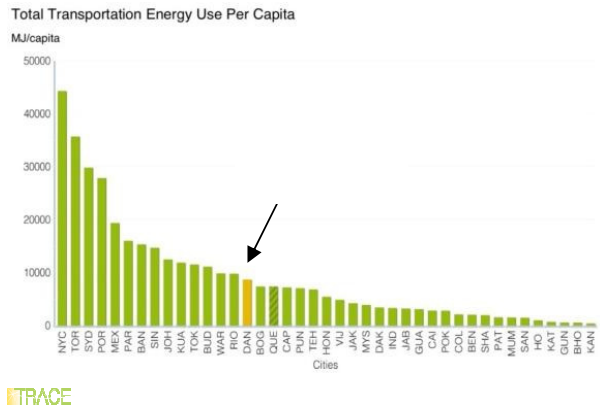
GHG emissions tell a similar story. A total of 1.54 million tons of CO_2 equivalent were emitted by all sectors in Da Nang in 2010. Transport fuels are responsible for 46% of citywide GHG emissions, while the city's electric supply is responsible for 31% of local emissions. These figures point to a need for the Da Nang People's Committee to ramp up its already impressive focus on energy to tackle transport-related growing energy use and emissions.

Emissions by Sources and End Uses in Da Nang, 2010



Sector Diagnostics: Identifying Opportunities

Transport: Despite the fact that a majority of Da Nang's overall energy use and carbon emissions is transport-related, Da Nang currently consumes less per capita energy on transportation than many other cities in the TRACE database shown below. Nonetheless, considering the rate at which private motor vehicle ownership is growing in the city, Da Nang would like to see a Bus Rapid Transit (BRT) system deployed in one or more parts of the city by 2016. The city needs an integrated land-use and transportation planning approach in the medium to long term to ensure that plans for BRT, land use, street signals, parking policies, vehicle registration pricing, and sidewalk policies are coordinated. However, in the short-term it would be important for the city to encourage greater use of bicycles and electric bikes.



Municipal Buildings: Energy consumption in Da Nang's municipality buildings is relatively low (97 kWh/m^2) in the TRACE database. However, electricity use in municipal buildings is on the rise. A number of efforts in the city's municipal buildings have been undertaken to improve energy performance, such as lighting replacement programs and the implementation of air conditioning schedules. However, replacing old air conditioning units and other inefficient appliances, and improving

the design and construction of building envelopes, provide additional opportunities for energy performance improvement. The Da Nang People's Committee is reportedly planning to build a tall office tower that would bring together into a single building the local government departments currently dispersed across the city. By constructing a model green building that achieves LOTUS (a Vietnam-specific green building rating system) or other preeminent building performance standards, the People's Committee would send a powerful message to others of the importance of this type of design and its viability in Da Nang's economic environment and climatic conditions.

Solid Waste: Waste generation in Da Nang is approximately 0.68 kg/person/day, which ranks in the middle of cities in the TRACE database. The landfill in Da Nang is not currently set up to capture methane gas (thus missing an opportunity to make use of this resource), and is expected to reach full capacity by 2025 to 2030. Most landfills experience peak gas availability 5-10 years after the facility is closed and capped; gas levels then decline over time until the point is reached when the quantity of gas recovered is too low to support power generation or the quality of gas declines to a point whereby it begins to degrade the power generation equipment. The city may like to consider electricity production from waste as a long-term measure given its significant energy generation potential.

Water: Per capita water use in Da Nang totals approximately 118 liters/day, which is on the low end of cities in TRACE database. However, water losses from the system were approximately 25 percent in 2011. The sector faces numerous challenges, including high leakage rates, lack of city-scale infrastructure, and low demand side efficiency awareness. The city can take action to improve or develop their centralized infrastructure by prioritizing energy efficient water resources, upgrading pumps, and addressing the high leakage rates. On the demand side, lack of awareness is a major challenge.

Power: Current peak power demand in Da Nang is approximately 250 MW; this is a significant increase from 2007, when peak demand totalled just 176 MW. Managing electricity peak load and increasing efficiency of electricity supply are major challenges, as well as opportunities for the application of smart grid technologies. Within the power sector the number of directly city driven interventions to affect energy efficiency performance is limited to the demand side and provision of decentralized renewable generation, underscoring the necessity for cities to systematically leverage their influence at the national level to impact on this sector. Within city's direct scope, successfully managing the demand side reduces the extent of required capacity expansion and can level off peak loads. The recent advances in smart metering and grid control technologies offer significant opportunities for city to work with the electricity suppliers to promote and harness demand side energy efficiency.

Public Lighting: Da Nang has relatively low electricity consumption per light pole (416 kWhe/pole) when compared to other cities in TRACE database. This is due to the use of low energy fixtures and various dimming regimes implemented throughout the city. There is still room for improvement in the public lighting sector, including the mass roll out of light emitting diodes (LEDs) and development of procurement codes with more stringent energy efficiency requirements. It is important to consider the speed with which Da Nang is growing and quality of life improving. It is likely that lighting preferences will change in the future, putting more demand on the system to provide higher levels of lighting in more areas. Da Nang can prepare for this shift by continuing its excellent efficiency programs and pushing them even further. In addition, optimized operation (on and off times) and maintenance regimes can further reduce the energy consumption of this sector.

Governance

Da Nang City government has already undertaken an impressive amount of work on energy matters that serve as a foundation for future efforts. This work has already slowed the rate of energy demand growth, although given anticipated population changes in the next 10-20 years, much more action is necessary. Utility stakeholders in the water, waste, and power sectors have done an excellent job at identifying opportunities for energy efficiency improvements, in addition to exploring ways to potentially capture energy from different renewable sources. These efforts clearly show the considerable talent the city can bring to bear on future energy policy and planning initiatives.

In the future, energy governance should be prioritized 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 practice strategies for the benefit of local businesses and households. Therefore, it is important that Da Nang establish a citywide energy task force to improve coordination and establish a streamlined approach to energy. In keeping with Da Nang's current policy structure, this task force should operate under the auspices of the Department of Industry and Trade. The citywide task force should not limit its focus to government operations, nor should its membership be restricted to government officials.

Looking Ahead

Moving forward, the World Bank is working with pilot cities to determine appropriate levels of SUEEP engagement, by preparing and implementing a comprehensive demand-driven dissemination plan for the SUEEP. The dissemination plan will include a launch of the study, presentation of study results at a regional forum and follow-up dialogue with the pilot cities. Upon testing of the SUEEP framework by the pilot cities, the guideline will be refined to support region-wide replication. The next phase of the program will also involve 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 emission reduction credits) and mobilization of green financing support for cities.

The World Bank also will reach out to interested donors and development partners, as well as the private sector, to leverage on-going efforts to scale-up green financing in support of investment projects generated by SUEEP.

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.

Policy and institutions alone will not create green growth outcomes; investments in energy efficiency improvements and GHG mitigation activities are also needed. Through the SUEEP process, city leadership can evaluate investments comprehensively, based on their fiscal return, 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 to local stakeholders and financing institutions, and the international donor community, potential partners, and private investors.

Principal Findings for Da Nang

1. Electricity demand in Da Nang will double in the next 6 years. Future challenges to meet economic development aspirations would require introducing low-carbon policies, managing energy demand efficiently by mainstreaming energy efficiency on a city-wide scale, and increasing the share of renewable energy in the generation mix.
2. Transport and Buildings sector are responsible for the vast majority of energy demand and GHG emissions. These sectors should be the primary focus of future policy and program development.
3. Currently, acceptance of public transport is very low due to heavy reliance on motorcycles. Public transportation development is undoubtedly a medium to long term priority. In a shorter-term, initiatives should centre on scaling up the use of bicycles and electric bikes.
4. Recently developed national green building codes (LOTUS) can be implemented relatively swiftly by the city government. Adoption of green building codes will boost improvements in water and energy efficiency, and facilitate the integration of distributed (building integrated) renewable energy.
5. Opportunities for decentralized low carbon energy generation should be investigated to help meet rising energy demand and lower carbon emissions. One such example is the waste landfill at Khanh Son where methane can be captured and used to generate electricity.

The SUEEP brings the donor and investor communities and city governments one step closer, 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.

Suggested Readings

Tool for Rapid Assessment of City Energy (TRACE): Helping Cities Use Energy Efficiently, 2010. Developed by the Energy Sector Management Assistance Program,

World Bank. Full document and further information available at www.esmap.org/esmap/TRACE

Sustainable Urban Energy Planning: A Handbook for Cities and Towns in Developing Countries, 2009. Developed by ICLEI (Local Governments for Sustainability), UN-Habitat, and UNEP (United Nations Environment Programme). Full document and further information available at www.iclei.org

How to Develop a Sustainable Energy Action Plan (SEAP), 2010. Developed by The Covenant of Mayors, European Union. Full document and further information available at www.eumayors.eu

Eco^2 Cities Guide. Ecological Cities as Economic Cities, 2012. Developed by the World Bank. Full document available at http://siteresources.worldbank.org/INTURBANDEVELOPMENT/Resources/336387-1270074782769/Eco2_Cities_Guide-web.pdf

This brief is based on a World Bank's flagship report which is currently under editing and design stage. The full report will be uploaded at the World Bank website once it is published.

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