Energy Smart Communities Initiative

Knowledge Sharing Platform

APEC Energy Working Group

Working Paper

The Development of Energy Smart Communities in the APEC Region

Published by

PennIUR
Penn Institute for Urban Research

Taiwan Institute of Economic Research

With support from

國家發展委員會
National Development Council

The Development of Energy Smart Communities in the APEC Region

Report prepared by Penn IUR for the Energy Smart Communities Initiative

October 2014

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Table of Contents

About the Energy Smart Communities Initiative

The Energy Smart Communities Initiative (ESCI), established in 2010 by U.S. President Barak Obama and Japanese Prime Minister Naoto Kan and hosted by APEC's Energy Working Group, is a resource for energy efficient development adopted in response to the need to reduce energy demand in the APEC economies. ESCI aims to help APEC economies reduce energy intensity (energy use per economic productivity, measured as kg of oil equivalent per GDP in USD) 45% by 2035 (from a 2005 baseline) and to encourage additional savings through the exchange of information on best practices.

APEC, whose economies represent 55% of world energy demand, meets the majority of its energy needs with carbon-emitting fossil fuels. APEC strives to reduce its energy intensity for three reasons: to achieve economic benefits (cost savings), to improve energy security (protection from energy price volatility and greater independence from energy imports), and to enhance environmental sustainability (lower greenhouse gas emissions).

ESCI's central feature is an internet-based knowledge-sharing platform, ESCI-KSP (www.esci-ksp.org), that contains case studies and other resources for researchers, scientists, academics, and the public to learn, engage, and share the latest place-based information on energy efficiency. It originally had four pillars—Smart Transportation, Smart Buildings, Smart Grid, Smart Jobs—but added a fifth pillar, Industrial Innovation, in late 2013 to encourage knowledge transfer from the private sector. The ESCI-KSP also covers the Low Carbon Model Town project, a cross-cutting investigation tracking best practices in all ESCI smart energy pillars.

The Taiwan Institute for Economic Research (TIER), funded by Taiwan's National Development Council, has partnered with the Penn Institute for Urban Research (Penn IUR) to develop and maintain the ESCI-KSP. To date, the ESCI-KSP has 350 case studies representing 18 economies, of which 53% address Smart Transportation (ST), 24% address Smart Buildings (SB), 16% address Smart Grid (SG), 4% address Smart Jobs (SJ), and 4% address Low Carbon Model Towns (LCMT). In order to recognize superior accomplishments exhibited by the ESCI-KSP projects, the Energy Working Group (EWG) has hosted an ESCI-KSP Best Practice Awards Program announced at the 45th meeting of the Energy Working Group (EWG 45), Samui Island, Thailand in 2012. Selected by an international jury, award winners presented their projects to the Energy at EWG 46 in Danang, Vietnam, November 2013.

Introduction

The pressures of resource constraints—both geographical and material—as well concerns about energy security and the environment have prompted municipalities around the globe to develop technologies and applications to conserve energy. Over time, many of the techniques for conserving energy have proven effective and been adopted more broadly. An assortment of comprehensive, city-wide energy conservation technologies and policies are available. Some APEC economies have been leaders in the development and implementation of these types of programs, while others are just beginning to advance their own frameworks.

Cities boast an increasingly large portion of economies' populations and economic output. However, as the International Panel on Climate Change (IPCC) has found, urban regions also account for up to 76% of energy use and energy-related CO2 emissions and up to half of global greenhouse gas emissions.[1] *Chapter 8: Urban Areas* of the 2014 IPCC report characterizes 21st century urban growth and the risks posed and ability to adapt to climate change for the world's cities. Most importantly, the report brings to the fore research evaluating the efficacy of mitigation measures and policies. In her evaluation of the IPCC report, Dr. Eugenie Birch writes of the report's acknowledgement of the role of city and regional planning as "a strong force for mitigation and adaptation" to climate change.[2] Further, the Low Emissions Development Strategies Global Partnership explains that "huge opportunities exist for mitigating climate change through actions delivered at city and subnational level…the largest mitigation opportunities are likely to be in rapidly urbanizing areas where urban form and infrastructure are not yet locked in."[3]

Penn IUR – through work sponsored by the Taiwan National Development Council – conducted this research summary to examine the growth of low-carbon and energy smart communities in the APEC region and assess their success. This report reviews APEC economies' efforts toward creating the conditions necessary to drive energy conservation at the sub-national and local level. The sub-national level includes all government efforts below the national level, including province, state, county, etc. The report authors contextualize each economy's efforts towards promoting energy-conserving communities through an examination of its economic conditions, fuel mix, and other factors. The report features case studies of energy-conserving municipalities in all economies where they were available.

[1] Intergovernmental Panel on Climate Change. (2014) Climate Change 2014: Impacts, Adaptation, and Vulnerability (Contribution of Working Group II o the Fifth Assessment Report of the IPCC). New York, NY: Cambridge University Press. Available at http://ipcc-wg2.gov/AR5/report/final-drafts/

[2] Birch, E. Journal of American Planning Association. Climate Change (2014)

[3] LEDS. What National Governments Can do to Accelerate Subnational Action on Climate. (2014) Available at http://www.greengrowthknowledge.org/sites/default/files/downloads/resource/ledsgp_subnational_action_climate_change.pdf

This research report begins with an overview of three programs, which provide frameworks for the development of energy smart (efficient) communities: APEC's The Concept of the Low Carbon Model Town; World Bank's Ecological Cities as Economic Cities; and OECD's Green Growth in Cities. These programs define what makes an "energy smart communities" and present metrics to chart their implementation. These APEC, World Bank and OECD programs are reviewed because these organizations are widely respected leaders in this field. The analysis of this program review is presented in Section 1.

This report then looks to answer the question: What drives the proliferation of low-carbon towns? That is, are there are a set of metrics that can show progress towards national-level deployment of energy smart communities? The Green Growth in Progress primer, "What National Governments Can do to Accelerate Subnational Action on Climate" suggested that the question be posed in the form of whether national strategy guidelines are adequately addressing the barriers to creating low-carbon towns.[4] [5] These barriers, identified from the analysis in Section 1, include: access to funding from the public or private sectors (or a combination); presence of monitoring instruments (metrics to track progress of local-level progress); capacity and skills to implement best practices; and integration of policies between subnational governments and national governments.

Section 2 of the report reviews each economy, including case studies of urban settlements within those economies in order to assess their support for energy smart community development. The 21 APEC economies[6] were evaluated through the lens of their national policies related to the development of energy smart communities. Several major findings came from the review. Foremost is that all APEC economies have some policy activity related to energy smart community development. This development is occurring both in new greenfield contexts, as well as through the adaptation of historically energy intensive urban areas into energy smart communities.

The review revealed a main division between economies: while some economies had a strong connection between national and sub-national policy, other economies lacked national government leadership or cohesiveness between levels of government to drive energy smart development. In these latter cases, energy smart development was being initiated at the sub-national or local level and not by national efforts. While the research found that energy smart development would occur in spite of the absence of a strong national effort, it was also evident that such strong national leadership will lead to a higher level of deployment and greater levels of verification of proper energy performance through monitoring of key metrics.

[4] Ibid.

[5] Green Growth Best Practice. Green Growth in Practice: Lessons from Country Experiences. (2014) http://www.ggbp.org/sites/all/themes/ggbp/uploads/Green-Growth-in-Practice-062014-Full.pdf

[6] APEC members are referred to as economies due to political sensitivity related to the sovereignty of some members.

The paper's major finding was that APEC economies do generally address barriers to the development of energy smart communities. This is especially true when considering the first three barriers—access to funding, presence of monitoring instruments, and ensuring capacity and skills for implementation.

Section 1: Frameworks for Developing Energy Smart Communities

The following is a short evaluation of three programs established to promote that adoption of smart urban development. The programs—The Concept of the Low Carbon Model Town (LCMT), Green Growth in Cities, and Ecological Cities as Economic Cities (Eco2 Cities), sponsored by APEC, OECD, and World Bank, respectively—share similar recommendations, but differ in their metrics and program execution. These programs all focus on cities since cities carry considerable weight in meeting multi-lateral and central government goals for attaining sustainability, both environmental and economic. The Low Emissions Development Strategies Global Partnership, a partnership of over 100 countries and international programs, explains the important role that local and subnational governments—specifically cities—play by directly implementing central government policies: "national governments often depend on cities and subnational governments to deliver mitigation action through directly implementing policies."[7]

These three programs were chosen for evaluation, because they represent the views of leading influential bodies in the APEC region. It is important to note that these program's frameworks are not formally adopted by the economies in APEC. Their body of knowledge is a readily available resource to decision makers at all levels of government and the private sector who are responsible for progressing the mission of developing energy smart communities. Each program is reviewed below and a fourth sub-section describes the core finding that is applied to the evaluation of each APEC Economy in Section 2.

1.1 Asia Pacific Economic Research Center (APERC) Concept of the Low-Carbon Town (LCT)

The LCT program encourages towns to set clear targets for CO2 emissions reduction and adopt comprehensive measures to achieve these targets. APERC's LCT program focuses on towns, referring to urban settlements of varying size, and explicitly takes into consideration a town's particular characteristics (rather than offering generalized recommendations). APERC's *Concept of the Low Carbon Town* report describes the importance of understanding a town when prescribing best practices for low carbon development: "There are two types of low carbon town development, namely, greenfield development and brownfield development. In the case of greenfield development, it will make sense to make a low carbon development plan covering a whole city. In the case of brownfield development, it is not practical to make a whole existing city low carbon at one time.

Instead, a low carbon development will normally proceed on a step by step basis, for example, from one district to another or from one part of city to another." [8]

The LCT goes on to describe how differences in towns' characteristics mean that "low-carbon measures and available non-fossil energy resources" will be different for each case.

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[7] LEDS What National Governments Can Do to Accelerate Subnational Action on Climate (2014)

[8] Asia Pacific Economic Research Center. The Concept of the Low Carbon Town, Third Edition. (2014) Available at http://aperc.ieej.or.jp/publications/reports/lcmt/LCMT_Concept_Third_Edition.pdf

Figure 1**Error! Reference source not found.** illustrates APERC's recommended path for bringing Low Carbon Towns from inception into reality. This is the process that would be followed in order to qualify a town as an APEC Low Carbon Model Town. Once a town is selected, the process moves into creating a LCT development strategy and this 2nd Stage relies on setting CO2 baselines and targets for the future development.

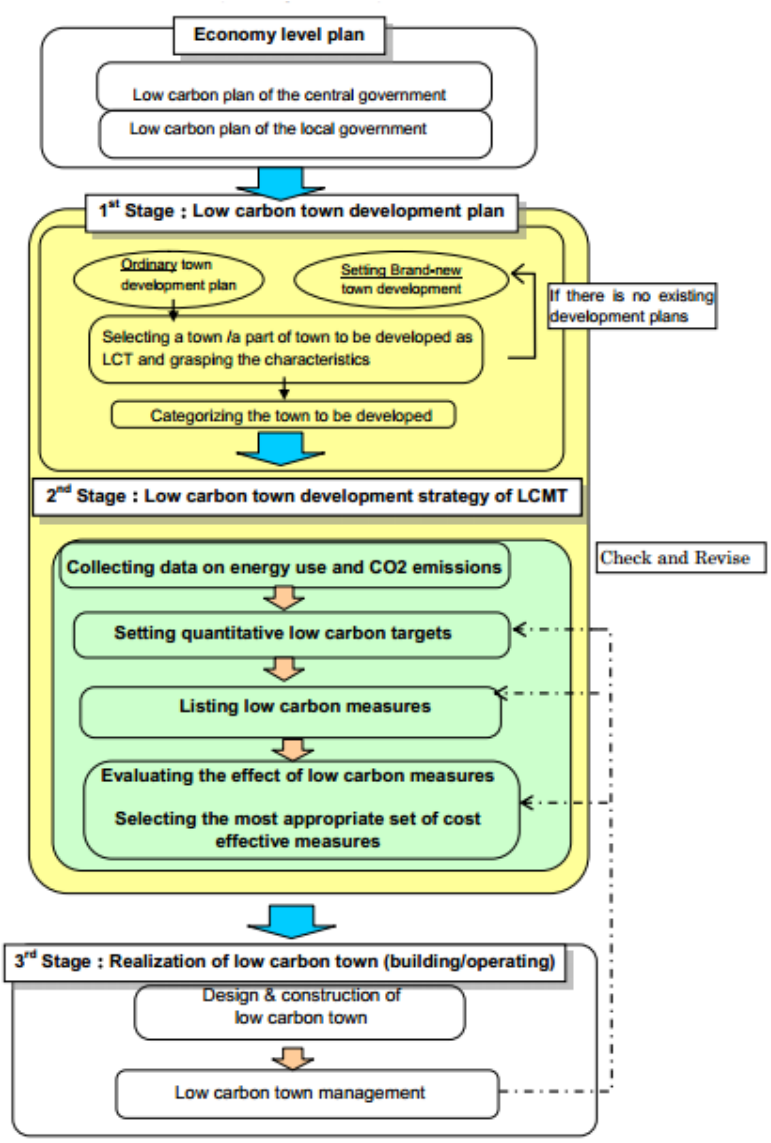


Figure 1 Overall planning processes to develop a Low Carbon Town. Source: Concept of the Low Carbon Town, APERC.

Evaluating the effect of low carbon measures relies on the selection of the proper indicators. These indicators will also be used to measure the progress toward the targets in the implementation stage. The APERC Concept of the LCT offers the following indicators to measure CO2 reduction:

- Reduction in CO2 emissions: t-CO2 / year, t-CO2 / year- floor space
- Reduction in CO2 emissions per GDP
- Reduction in CO2 emissions per person
- CO2 emissions reduction rate (%)
- Reduction in primary or secondary energy consumption: GJ / year

Complimentary indicators that could also enable a multi-dimensional assessment of low carbon targets:

- Reduction in the amount of traffic
- Public transportation conversion rate
- Reduction in wastes produced
- Water recycling rate

Figure 2 and Figure 3 show two Low Carbon Model Towns that have been vetted by APERC. The two projects exemplify how varied LCT projects may be—Yujiapu, China is a greenfield site planned as a financial district, while Koh Samui, Thailand is a brownfield tourist island.

Figure 2 Rendering of Yujiapu, China - Low Carbon Model Town

Figure 3 Coast of Koh Samui, Thailand - Low Carbon Model Town

1.2 Organization for Economic Co-operation and Development (OECD) Green Growth in Cities

OECD has laid out a conceptual framework called Green Growth in Cities, which they define as "fostering economic growth and development through urban activities that reduce negative environmental externalities, the impact on natural resources and the pressure on ecosystem services." The greening of the traditional urban economy and expanding the green urban sector can generate growth (through increased supply and demand), job creation, and increased urban attractiveness. These effects are in part the result of stronger interactions at the urban level among economic efficiency, equity, and environmental objectives.

OECD's framework prioritizes green growth initiatives that contribute to positive growth as opposed to those that have a negative impact or no impact on growth, as illustrated in Figure 4. OECD identifies three scenarios—green sector growth, economic greening, and multi-sector growth—in which "the level of economic activity triggered by a greening strategy is sufficient to grow the entire regional economy by some amount," two that do not affect growth, and one that results in a decline in growth. Scenario 1 envisages no growth occurring, whilst Scenario 5 indicates displacement. This negative growth scenario is the "greatest fear of policymakers, implying that environmental protection and economic growth are incompatible goals."[10] The Green Growth in Cities framework, therefore, provides guidance on creating

[10] OECD (2013), Green Growth in Cities, OECD Green Growth Studies, OECD Publishing. http://dx.doi.org/10.1787/9789264195325-en

conditions that are conducive to the three growth scenarios, while avoiding greening with negative growth.

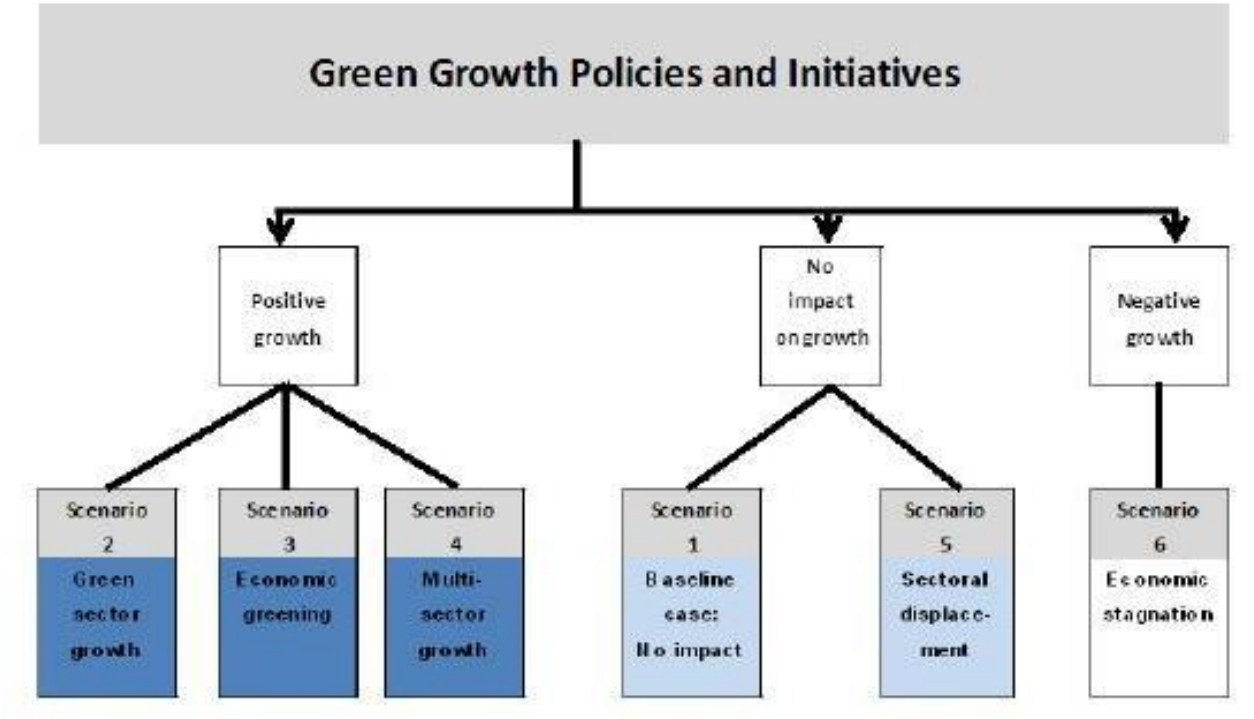


Figure 4 Possible outcomes resulting from implementation of green growth policies and incentives yield 6 possible scenarios grouped by their impact on growth. Source: OECD Green Growth in Cities

OECD's proposed indicators for tracking Green Growth in Cities (shown in Figure 5) consider a wide array of factors that represent both greening and growth of cities. This set of indicators looks beyond the productivity of energy use and CO2 production to consider resource productivity in general, preservation of a natural asset base, environmental quality (as related to human quality of life), and the economic growth opportunities of greening.

1	**The environmental and resource productivity of the economy**	• Carbon and energy productivity • Resource productivity: materials, nutrients, water • Multi-factor productivity
2	**The natural asset base**	• Renewable stocks: water, forest, fish resources • Non-renewable stocks: mineral resources • Biodiversity and ecosystems
3	**The environmental dimension of quality of life**	• Environmental health and risks • Environmental services and amenities
4	**Economic opportunities and policy responses**	• Technology and innovation • Environmental goods & services • International financial flows • Prices and transfers • Skills and training • Regulations and management approaches
●	**Socio-economic context and characteristics of growth**	• Economic growth and structure • Productivity and trade • Labour markets, education and income • Socio-demographic patterns

Figure 5 Green Growth in Cities Indicators. Source: OECD (2011). Towards Green Growth: Monitoring Progress: OECD Indicators.

1.3 The World Bank Ecological Cities as Economic Cities (Eco2 Cities) Initiative

The World Bank's Eco2 Cities program aims to help developing economies build cities that create economic opportunities for their citizens in an inclusive, sustainable, and resource-efficient way, while also protecting and nurturing the local ecology and global public goods (i.e. the environment) for future generations. Eco2 Cities is structured around four principles:

- "A City Based Approach," which enables local governments to lead a development process that takes into account their specific circumstances, including their local ecology;
- "An Expanded Platform for Collaborative Design and Decision Making" that accomplishes sustained synergy by coordinating and aligning the actions of key stakeholders;
- "A One System Approach" that enables cities to realize the benefits of integration by planning, designing, and managing the whole urban system; and
- "An Investment Framework that Values Sustainability and Resiliency" by incorporating and accounting for lifecycle analysis, the value of all capital assets (manufactured, natural, human, and social), and a broader scope of risk assessments in decision-making.

A crucial element of Eco2 is a package of methods and tools that help cities implement the four Principles. The methods simplify the process of analysis and decision-making, enhance group engagement, and are accompanied by tools whenever possible. The tools are templates, checklists, diagrams, maps, specialized software applications, and workshops that can help apply the methods effectively and quickly. "Life Cycle Costing" for new investments and "Looping and Cascading" for efficient resource use are examples of methods and tools. They enable a systems perspective and reveal how alternative development plans affect spatial attributes, resource flows, emissions, costs, and other

elements of urban systems. Figure 6 illustrates the integrated design process for decision-making for the creation of a greenway corridor in Ho Chi Minh City, Vietnam.

Figure 6 This series of photos illustrates the integrated solutions methodology for a project in Ho Chi Minh City, Vietnam. The photos clockwise from top right show existing conditions, the final conceptual sketch, the working group reviewing plans, and an analysis of existing conditions. Source: World Bank

The Eco2 Cities framework does not explicitly dictate a set of indicators that should be adopted, but does express the importance of selecting indicators and benchmarks to "assess and reward the performance of all stakeholders." The framework goes on to explain qualities that adopted indicator sets should possess: "All four categories of capital assets (manufactured, natural, human, and social) and the services they provide must be appropriately valued or priced and monitored through indicators. The combination of indicators should be viewed as a whole so that the qualitative dimensions of city life (cultural, historic, and aesthetic) are not ignored in assessing costs and benefits."

As an example, the Eco2 framework gives a preliminary proposal for energy indicators and benchmarks, shown in Figure 7.

SECTOR	INDICATORS[a]	BENCHMARKS[b]
Long-term and strategic goals	• Share of renewable energy supply in final energy consumption • Carbon content of final energy consumption (kilogram equivalent CO_2 per megajoule) • Urban density indicator • Energy cost and affordability indicator	Benchmarks should draw on a group of comparable cities in terms of climate conditions and indicate the medium-level practice and best practice, respectively.
Municipal services	• Electric distribution losses • Energy used for delivering and treating one cubic meter of water • Technical and nontechnical water losses • Public lighting energy efficiency • Methane recovery from landfills and wastewater treatment plants	See above.
Buildings	• Residential buildings: cooling, heating, and lighting efficiency • Office buildings: cooling, heating, and lighting efficiency • Government buildings: cooling, heating, and lighting efficiency • Energy efficiency of key appliances	See above.
Transport	• Carbon emissions of passenger traffic (kilogram equivalent CO_2 per person-kilometer)	See above.

Source: Author compilation (Feng Liu).
Note: In the table, urban energy does not include industrial energy consumption. CO_2 = carbon dioxide
a. Indicators represent the current performance of a city.
b. The benchmarks and indicators are the same set of metrics, but the benchmarks represent the medium-level practice and best practice, respectively, among a set of cities that are comparable in terms of climate conditions.

Figure 7 Recommended indicators for Eco2 Cities. Source: World Bank

1.4 Frameworks Findings

The three examined frameworks present variations on specific methods for pursuing and verifying energy efficient community development. All three programs present their frameworks for greening within the context of economic growth. The OECD Green Growth in Cities framework highlights that governments should not pursue green growth at the expense of economic viability.

Beyond their focus on continued economic growth, these frameworks address the barriers to developing energy smart communities or low carbon towns, which include:

- Access to funding from the public or private sectors (or a combination);
- Presence of monitoring instruments (metrics to track progress of local-level progress);
- Capacity and skills to implement best practices; and
- Integration of policies between subnational governments and national governments.

In addressing these barriers, the guidance available within each of these documents may enable governments throughout the world to green their cities and towns and grow their economies in doing so. A major factor, however, in the realization of this growth is government action and the policy landscape that either enables or frustrates such efforts. The next section examines each APEC economy to analyze their potential for such green growth.

Section 2. APEC Economy Reviews

Given the importance of cities and other subnational governments in mitigating climate change and enhancing global sustainability, this report looks at the conditions that promote actions by cities and other subnational governments. The three programs examined in Section 1 recognize these conditions, which are[11]:

- Access to funding
- Integrating policies between subnational governments and national governments
    - Alignment of political incentives across levels of government
    - Bureaucratic capacity to manage programs
    - Consistent political ideologies and cultures
- Knowledge and information availability for local conditions
    - Metrics to track local-level progress
- Capacity and skills to implement best practices

This report examines how well central government actions in the APEC economies support these conditions. This examination clarifies the current state of energy smart development in the APEC region, as well as prospects for development of energy smart communities in the future. The economy reviews are summarized in Table 7 in the Conclusion section, indicating whether the economies have existing conditions necessary to foster a growth of energy smart communities.

This section is organized around the 21 APEC Economies. Each economy's section gives a brief background of its energy and economic conditions, followed by an economy-level (i.e. national-level) policy brief. Summary tables describing characteristics of all of the APEC economies (except for Chinese Taipei, which the World Bank does not track) are included in Appendix A. Finally, case studies of sub-national and local examples of energy smart communities are included for every economy, where available. The case studies offer perspectives on the various ways that energy smart communities are being implemented throughout the APEC region. Note that this report does not offer a comprehensive collection of energy smart community in the APEC region.

2.1 Australia

Background

The Australian Department of Industry and Science in its 2014 Energy Statistics explains that economy's rising energy consumption has remained below the economic growth rate. Put another way, Australia has been shrinking its energy intensity. "This can be attributed to two key factors: improvements in

[11] LEDS. What National Governments Can Do to Accelerate Subnational Action on Climate. (2014)

energy efficiency associated with technological advancement; and a shift in industry structure towards less energy-intensive sectors such as commercial and services." [12]

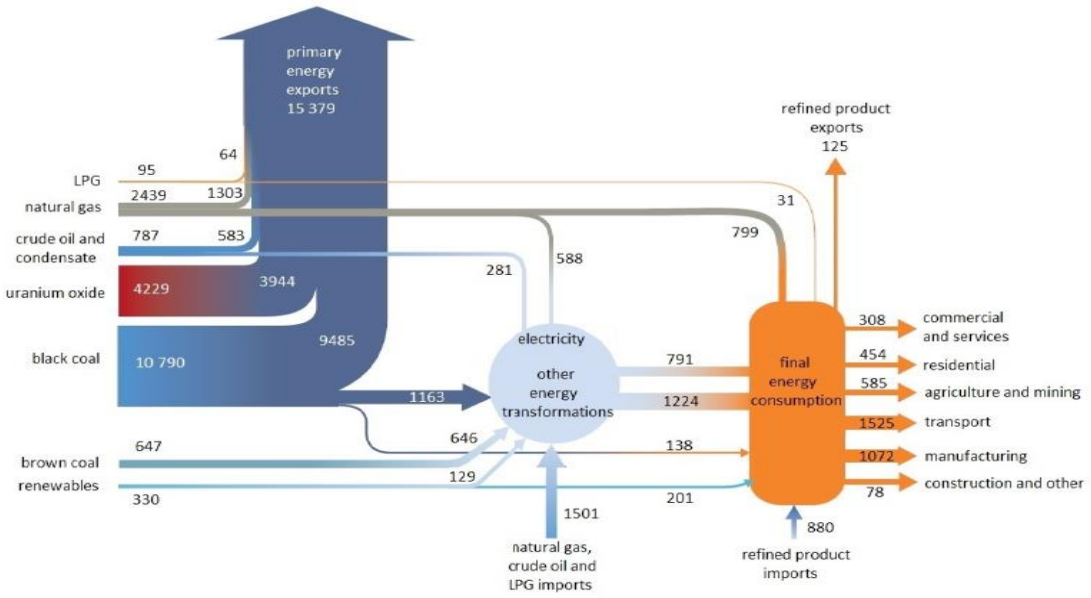
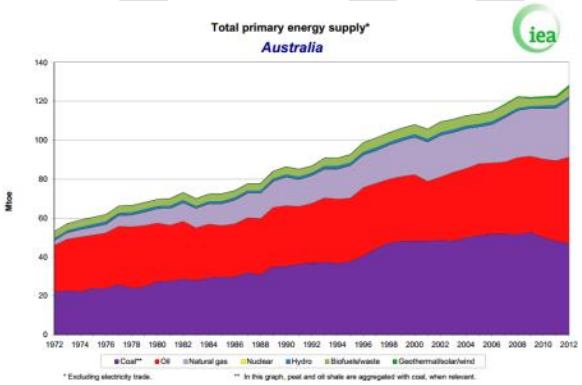
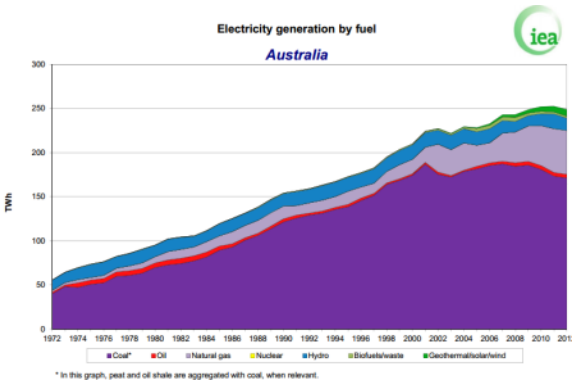


Figure 8 Australia's energy flow from extraction to consumption, including exports. Source: Energy Statistics 2014

Australia is a net energy exporter, exporting coal, crude oil, and natural gas. Energy consumption totaled 122.9 million tons of oil equivalent (Mtoe) to a resultant economy energy use intensity (EUI) of 132 kg of oil equivalent per $1000 GDP (USD 2011 PPP). Australia's electricity demand is met largely by burning coal, which as a highly polluting generation source leads to Australia having one of the highest CO2 emission intensities in APEC of 0.41 kg CO2 per $ GDP (2011 PPP). Thus, despite its falling energy intensity, Australia remains a high emitter.





[12] Australian Government. Department of Industry and Science. Australian energy statistics (2014). Retrieved from http://www.industry.gov.au/Office-of-the-Chief-Economist/Publications/Documents/aes/2014-australian-energy-statistics.pdf

Figure 9 Australia's energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

Australia is among a large cohort of APEC economies that have enacted national energy policies with long-term targets. Australia's National Strategy on Energy Efficiency (NSEE) was passed in 2009 (updated 2010) and establishes a 10-year strategy to drive energy efficiency at the national scale, predicated upon an intergovernmental agreement for cooperation between the Commonwealth, State, and Territorial governments.[13] NSEE is aimed at a variety of sectors, including: residential, private commercial, and government buildings; demand-side management and smart grid technologies; and vehicle efficiency.

Local and Subnational Case Studies

Brisbane

Brisbane, the capital city of the Australian state of Queensland, had a population of just over 1 million in 2007. Brisbane has seen increasing energy consumption (a 2% growth between 2012 and 2013) owing to its sprawling development pattern and its housing stock, which is not well suited to its subtropical climate and creates high air conditioning loads.

In its Eco2 Cities Reference Guide, the World Bank offers Brisbane as a case study of a successful approach to improving the energy performance of an existing community in this subtropical region.[14] In response to its currently increasing energy consumption, Brisbane is following a long-term planning effort entitled *Living in Brisbane 2026*, which outlines a vision for growing Brisbane into an economically vibrant and energy smart city. *Living in Brisbane 2026* has an overall goal of reduced greenhouse gas emissions of 38% by 2026 from a 2006 baseline and approaches this challenge by laying out a regional infrastructure plan (including transportation and utility infrastructure). Of particular note, transportation improvements are not purely focused on energy efficiency, but rather balance economic development needs with those to reduce energy use.[15] In the plan, public transport would be available 24-hours per day and accessible within a 15 minute walk for 90% of the population. The plan sets a goal of 41% of morning peak rush hour trips to be made by walking, cycling or public transport by 2026.

[13] Australia Government, Department of Industry. National Strategy on Energy Efficency (2009). http://industry.gov.au/Energy/EnergyEfficiency/StrategiesInitiatives/Pages/NationalStrategyEnergyEfficiency.aspx

[14] Brisbane City Council. Vision and Strategy. Available at http://www.brisbane.qld.gov.au/about-council/governance-strategy/vision-strategy

[15] Brisbane City Council. Infrastructure for Brisbane. Available at http://www.brisbane.qld.gov.au/sites/default/files/Brisbane_Long_Term_Infrastructure_Plan-part3.pdf

Additionally, Brisbane's Plan for Action on Climate Change and Energy[16] proposes 31 actions covering land use (such as promoting transit-oriented development by the private sector), transport (such as improving public transit, implementing travel demand management, encouraging fuel switching to reduce GHG emissions), and public education.

While land use and transportation energy sectors are covered, energy efficiency in building construction and retrofits in either residential or commercial building sectors is not formally targeted in Brisbane's urban planning efforts. Similarly, smart grid applications for electricity peak shaving are merely acknowledged, but with no discrete actions stipulated.

Brisbane's water shortages have turned the city's planning efforts to water conservation and green infrastructure aimed at keeping water from flowing away or evaporating, such as Brisbane's plan to plant 2 million trees. This green infrastructure has the secondary benefits of reducing the heat island effect as well as offering aesthetic benefits.

Melbourne

The City of Melbourne, capital of the state of Victoria, has a population of just over 100,000.[17] The City of Melbourne reported an emission of 4.1 million tons of carbon dioxide equivalent (CO_2e).

The City of Melbourne has set an ambitious agenda to become an Energy Smart Community with its strategic plan, Zero Net Emissions by 2020, originally published in 2002 and updated in 2014. The strategy focuses on six sectors:

- Council operations
- Commercial buildings and industry
- Residential buildings
- Stationary energy supply
- Transport and freight
- Waste management

The figure below shows how the various different energy efficiency and renewable energy scenarios compare with 2010 levels and a business as usual scenario. Ultimately, the plan aims to reach zero net emissions by procuring offsets on a carbon trade market.

[16] Brisbane City Council. Brisbane's Plan for Action on Climate Change and Energy 2007 (2010) Available at http://www.brisbane.qld.gov.au/sites/default/files/20140414%20-%20Brisbanes%20Plan%20for%20Action%20on%20Climate%20Change.pdf

[17] CDP. C40 City of Melbourne review. Available at http://c40-production-images.s3.amazonaws.com/other_uploads/images/80_CDP_Cities_2013_Melbourne_small.original.pdf?1401861839

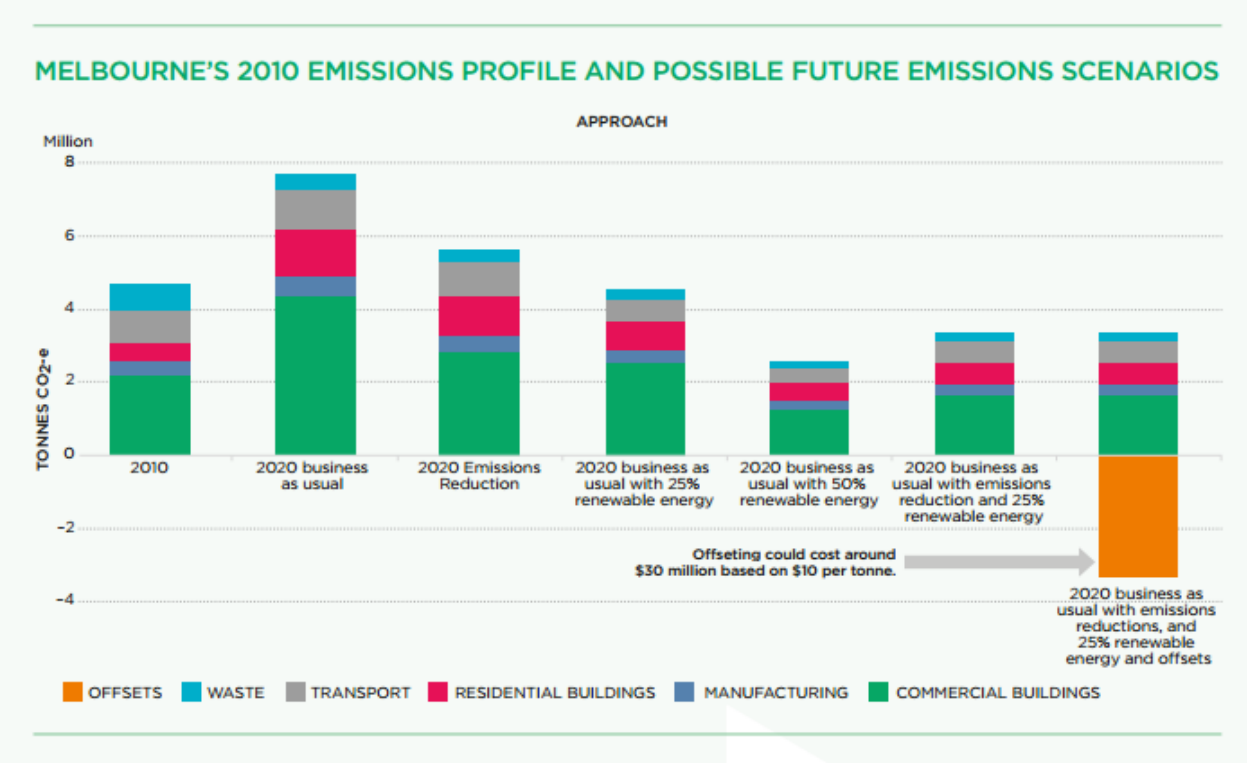


Figure 10 Melbourne's 2010 Emission Profile and Possible Future Emissions Senarios. Source: C40

This strategy is much more ambitious than Australia's central government target (5% from 2000 levels[18]). However, this program relies on state and national government programs and legislation. For example, building energy performance standards are implemented through a national building code, and governed by the State of Victoria. The City of Melbourne does not have enough power to require building energy efficiency, and thus promotes it through financial incentives, education programs, and demonstration projects, as well as through planning code. Similarly, the transportation efficiency improvements are built upon the National Greenhouse and Energy Reporting System, renewable energy on the Renewable Energy Target.

2.2 Brunei Darussalam

Background

Brunei Darussalam, with a population of over 400,000, boasts one of APEC's largest economies based on per capita GDP. Brunei's economy is highly reliant on the energy sector (accounting for 60% of GDP), which is driven by oil and gas production activities.[19] Brunei's domestic energy consumption has

18 Australia Government Department of the Environment. Australia's emissions reduction targets. http://www.climatechange.gov.au/climate-change/greenhouse-gas-measurement-and-reporting/australias-emissions-projections/australias

19 Prime Minister's Office Brunei Darussalem, Energy Department. Energy White Paper (2014)

developed amidst the abundant availability of fossil fuels, which account for nearly 100% of consumption.[20]

It should be noted that, for clarity and fair comparison, Brunei is divided into four districts; over 90% of the population is concentrated in the coastal sub-districts, the majority of which are comprised of Bandar Seri Begawan and surrounding suburbs. This suggests that Brunei's national policy will lead to energy smart community development more readily than would be expected in a larger economy, where separation between levels of government are greater in scale.

Economy-Level Policy Brief

Brunei articulates its vision of an economically sustainable future in this way: "Brunei Darussalam supports the implementation of strategies related to energy security, diversification of supply, energy efficiency and conservation. … Brunei Darussalam recognizes the importance of a low carbon economy in strengthening energy security, creating green jobs and generating new sources of economic growth to help achieve our energy intensity goal. The intensification of greenhouse gas emissions reduction efforts will place increased emphasis on utilization of cleaner fuels such as natural gas and renewable forms of energy."[21]

Wawasan Brunei 2035 (Brunei's National Vision 2035) looks to leverage Brunei's energy sector to ensure long-term economic sustainability and high quality of life. One of the three main strategic goals is to "ensure safe, secure, reliable and efficient supply and use of energy." Three key performance indicators track this goal, which include:

- Energy Intensity (to be reduced by 45% by 2035), and
- Renewable Energy in Total Power Generation Mix (to be increased to 2.7% by 2017 and 10% by 2035).

The Energy Intensity targets are to be met by focusing on:

- Residential and commercial buildings (energy intensity reduction of up to 16% from residential sector and 18% from commercial sector)
- Industrial sector (energy intensity reduction of up to 4.5%)
- Transport (energy intensity reduction of up to 6%)
- Power Generation efficiency

[20] Brunei Darussalam: Electricity and Heat for 20112 Statistics. International Energy Agency. http://www.iea.org/statistics/statisticssearch/report/?year=2012&country=BRUNEI&product=ElectricityandHeat

[21] Prime Minister's Office Brunei Darussalem, Energy Department. Energy White Paper (2014)

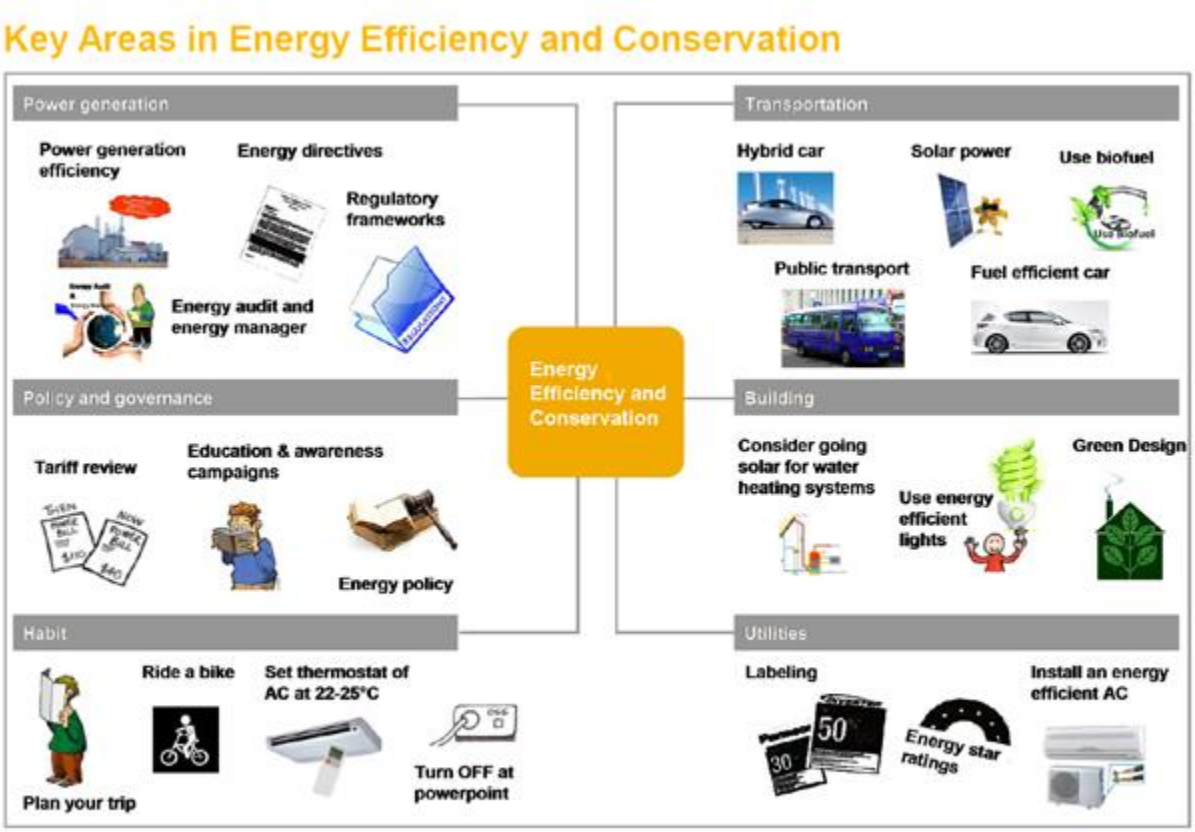


Figure 11 Areas of energy effiicency and conservation. Source: Wawasan Brunei 2035

Brunei does not currently have a case study of an energy smart community development. Strategies laid out in the National Vision 2035 should lead to more efficient development; however, the National Vission lacks an explicit focus on local development as a means to achieve national goals.

2.3 Canada

Background

In its latest Federal Sustainable Development Strategy report, Environment Canada notes that, progress in air quality and climate. Canada has seen a reduction in GHG emissions intensity as well as reduction in absolute GHG emissions between 2005 and 2011. Specifically, during this period, Canada saw a 4.8% GHG reduction with 8.4% economic growth. The report finds that "further work is still needed to reach Canada's GHG reduction target of 17% below 2005 levels by 2020, as well as to reduce emissions of air pollutants to help achieve some Canadian Ambient Air Quality Standards in certain regions."[22]

[22] Environment Canada. Planning for a Sustainable Future: A Federal Sustainable Development Strategy for Canada 2013-2016. Sustainable Development Office. Environment Canada. (2013) Available at

Economy-Level Policy Brief

Canada released their national-level sustainable development strategy in 2010 and released a revision in 2013, Planning for a Sustainable Future: A Federal Sustainable Development Strategy (FSDS) for Canada 2013–2016. The FSDS includes four priority themes:

- Addressing Climate Change and Air Quality;
- Maintaining Water Quality and Availability;
- Protecting Nature and Canadians; and
- Shrinking the Environmental Footprint – Beginning with Government.

The leading theme, addressing climate change, is centered on a target of reducing total greenhouse gas emissions 17% by 2020 from 2005 levels.

The actions in the FSDS are meant to compliment subnational government actions, which are important in Canada, where these governments have made their own commitments that amount to a 20% increase in energy efficiency by 2020. As noted in the FSDS, "Within Canada, in addition to federal actions, provincial, territorial, and municipal governments play a significant role in limiting emissions of air pollutants and GHGs." However, the FSDS does not lay out specific roles for subnational governments to establish sustainability plans or other master planning efforts around energy conservation or renewable energy production.

To facilitate more intergovernmental cooperation between federal level and provincial governments, as well as the private sector, the Energy Council of Canada organizes annual summits and regional meetings.[23]

Individual programs do span the various levels of government, such as the ecoENERGY Efficiency initiative, which provides funding for energy efficiency in transportation, buildings, equipment standards, and industrial processes. These efficiencies are components of energy smart communities, but this program, as is generally the case with Canadian national policies, does not address holistic community planning needs.

Local and Subnational Case Studies

The Federation of Canadian Municipalities (FMC), a lobbying group that represents over 2000 Canadian municipalities, has been an advocate for local government led green growth. They highlight a set of priority areas where municipalities have a significant degree of control [24]:

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https://www.ec.gc.ca/dd-sd/A22718BA-0107-4B32-BE17-A438616C4F7A/1339_FSDS2013-2016_e_v10.pdf

[23] Energy Council of Canada. About the Energy Council of Canada. (2014) Available at http://www.energy.ca/content/energy-about-energy-council-canada

- Sustainable transportation
- Energy efficiency of buildings
- Renewable electricity and conservation
- Wastewater treatment and water conservation
- Efficient urban land use
- Solid waste management

A host of subnational government case studies demonstrate Canada's subnational leadership. For this analysis, three programs were reviewed: Sustainable Kingston, Edmonton's Environmental Strategic Plan, and Vancouver's 2020 Action Plan.

Kingston

Sustainable Kingston has a simple, but ambitious, vision: to make Kingston Canada's most sustainable city. This vision echoes the language often seen in subnational sustainability plans and reflects the economic benefits and global competitiveness that municipalities expect to attain from their efforts at greening their economies. Kingston's plan is built upon four pillars of sustainability: cultural vitality, economic health, environmental responsibility, and social equity. The plan acknowledges the interrelated benefits of economic greening, economic growth, and societal health—a perspective that is core to the Concept of Low Carbon Town, Eco2 Cities, and Green Growth in Cities programs. Kingston spent much time gathering stakeholder input during its plan development in order to ensure that its goals aligned with community needs.[25] Sustainable Kingston's progress is being tracked with a set of 40 indicators tied to 20 themes, with baselines for each indicator. Here, the role of national level support is clear, as much of the data needed to track progress is collected at the national level.[26] For example, indicators for the environmental pillar include energy use, greenhouse gas emissions, air quality, solid waste landfill diversion, green space, and urban dwelling density; for all of these, data is collected nationally.

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[24] Federation of Canada's Municipalities. Building Canada's Green Economy: The Municipal Role. Federation of Canadian Municipalities. (2011) Available at http://www.fcm.ca/Documents/reports/Building_Canadas_green_economy_the_municipal_role_EN.pdf

[25] Corporation of the City of Kingston. Sustainable Kingston Plan 2010. (2010) Available at http://sustainablekingston.ca/userfiles/html_file/sk-plan-final-f-112310.pdf

[26] Sustainable Kingston Baseline Indicator Report – Brief http://sustainablekingston.ca/userfiles/html_file/indicator_report.pdf

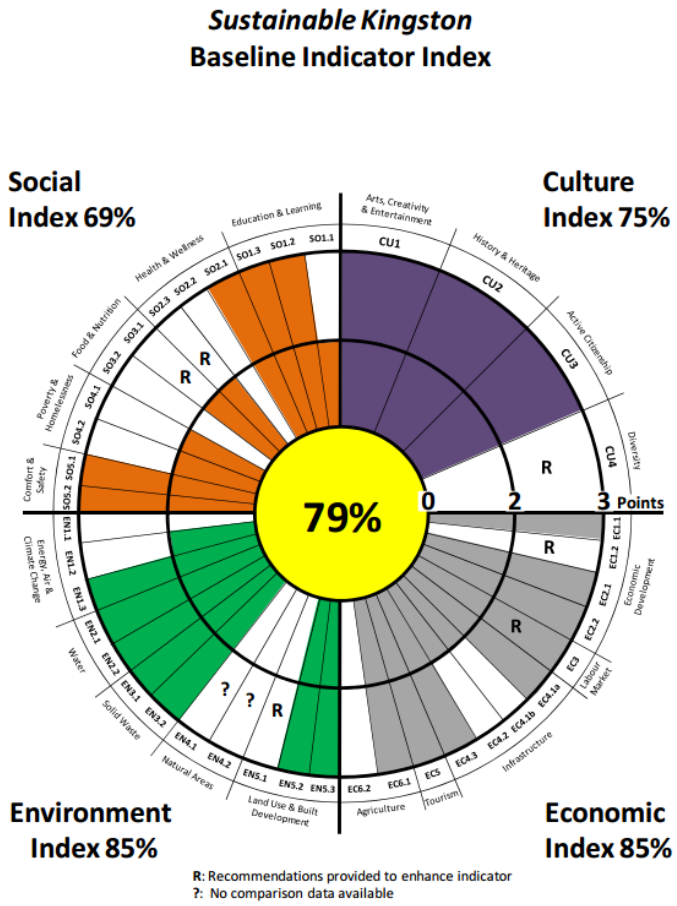


Figure 12 Sustainable Kingston Baseline Indicator Index

Edmonton

The City of Edmonton's long-term sustainability strategic plan looks out to 2040 and prioritizes energy smart development. In creating this plan, Edmonton built on its existing energy-smart programs, using the plan to formalize and aggregate these various programs into a cohesive whole.[27] Like Kingston, Edmonton conducted extensive public engagement, identifying public engagement as an essential strategic element for implementation.

[27] The Way We Green: The City of Edmonton's Environmental Strategic Plan. 2011 http://www.edmonton.ca/city_government/documents/TheWayWeGreen-approved.pdf

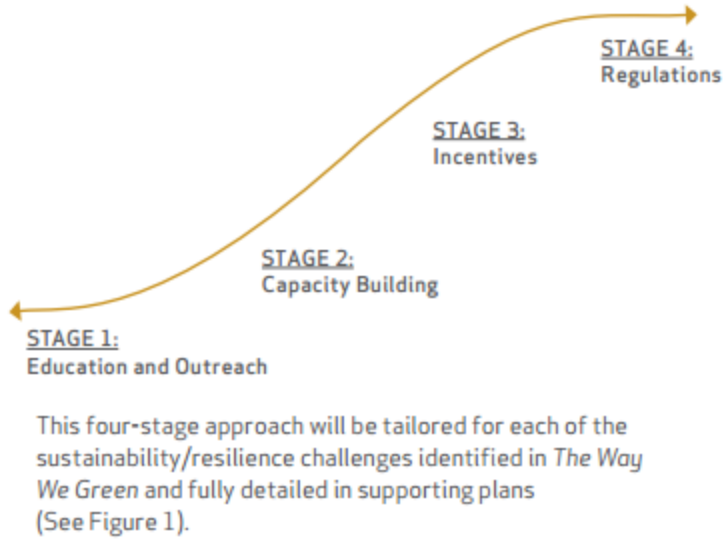


Figure 13 The Community Transformation "S" Curve begins with education and outreach to eventually build up to regulation

The city adopted the plan in 2011 and committed to support it in part by "monitor[ing], measure[ing], report[ing], and publicly communicat[ing] Edmonton's progress in implementing *The Way We Green*." Edmonton continues to engage its citizens through the creation of the Citizen Dahsboard, an interactive online portal for tracking progress in achieving the plan's goals.[28] The portal also includes an annual "State of the Environment" report.[29]

The City of Edmonton is undertaking initiatives to reduce GHG emissions that include: composting (versus landfill), collection of landfill gases (and conversion to energy), energy efficient retrofits of City buildings, construction of new City facilities to LEED silver, LRT construction, purchase of green power, operation of energy-efficient fleet vehicles, community outreach, and financial incentives for various green objectives.[30]

[28] The City of Edmonton. Citizen Dashboard: City by the Numbers. (2014) Available at https://dashboard.edmonton.ca/green

[29] The City of Edmonton. State of the Environment Report. (2014) Available at https://dashboard.edmonton.ca/reports/env-2014/Introduction

[30] The Way We Green: The City of Edmonton's Environmental Strategic Plan. 2011 http://www.edmonton.ca/city_government/documents/TheWayWeGreen-approved.pdf

Figure 14 Screen capture of Citizen Dashboard. Source: City of Edmonton

Vancouver

Vancouver, too, seeks to become Canada's greenest city, as its 2020 Action Plan attests.[31] The Green City Action Plan (GCAP) is organized into 10 goal areas that are integrated into a holistic plan. Individual action items, like composting and gardening help to achieve a multitude of goals such as the Green Economy, Zero Waste, Access to Nature, and Local Food targets. Each goal comes with a set of measurable targets (e.g. Green Economy targets doubling the number of green jobs over 2010 levels by 2020), baselines, and priority actions. More specifically, these ten goals are: Green Economy, Climate Leadership, Green Buildings, Green Transportation, Zero Waste, Access to Nature, Lighter Footprint, Clean Water, Clean Air, Local Food.

[31] City of Vancouver. Greenest City 2020 Action Plan. (2012) Available at http://vancouver.ca/files/cov/Greenest-city-action-plan.pdf

Percentage of jobs in key sectors*

KEY SECTORS	PER CENT OF JOBS
Wholesale & Retail Trade	13%
Health Care & Social Assistance	11%
Tourism (Accommodation & Food Service)	9%
Manufacturing	5%
Public Administration	5%
Construction	4%
Transportation & Warehousing	4%
Green Jobs	3+%

*SOURCE: Statistics Canada 2006 and VEC Green Economy Study 2010. Due to overlap of some industry sectors and multiple sources, the data do not sum to 100 percent.

Figure 15 An example baseline figure for Green Jobs. Source: Vancouver Green City Action Plan

2.4 Chile

Background

Chile's National strategy projects a growth of electricity consumption of 6-7% through 2020. This growth translates to nearly 100,000 GWh of demand by 2020, necessitating 8,000 MW of new generation. [32]

Economy-level policy brief

The Chilean Government has delivered a National Energy Strategy, which will be the navigation guidance for the next 20 years. This Strategy aims to "achieve a cleaner, safer, and cheaper energy, and meets the energy requirements of our country."[33] Chile's strategic goal of 12% reduction in energy consumption by 2020 is premised on increased generation from renewable energy sources and accelerated energy efficiency strategy implementation. Chile has directly modeled its smart energy growth plan on the OECD Green Growth framework, following an Environmental Performance Review conducted by OECD and UN ECLAC (1990 and 2004).[34] [35]

The program is effectively broken into three main pillars:

[32] Energy for the Future: Chile's National Energy Strategy 2012-2030. (2012) http://kallman.com/shows/iftenergy_2012/pdfs/Energy-for-the-Future-Chile's-National-Energy-Strategy-2012-2030-English.pdf

[33] Asia Pacific Economic Research Centre. Compendium of Energy Efficiency Policies of APEC Economies, Chile. (2012). Available at http://aperc.ieej.or.jp/file/2014/1/27/CEEP2012_Chile.pdf

[34] National Green Growth Strategy (2013). Chile Ministerio del Medio Ambiente.

[35] Environmental Performance Reviews: Chile. (2005) http://www.oecd.org/env/country-reviews/34856244.pdf

- implementation of environmental management instruments
- promotion of the market for environmental goods and services
- monitoring and measurement of progress

The first pillar encompasses the various instruments for green growth: command and control strategies, economic and complimentary instruments, sectoral sustainability strategies, and regulatory best practices. The promotion of the market really looks at fostering entrepreneurship and jobs training. The final pillar is the establishment of national and local indicators as well as the infrastructure to collect the necessary data.

Chile's subnational government is structured around regional governments, which orchestrate their own long-term development plans and manage public infrastructure investment through various decentralized central government funds. It is the role of these regional governments and the Ministerial Regional Secretaries of Energy (SEREMIs) in particular to lead the implementation of central government energy efficiency strategies in the various regions of the country.[36]

2.5 People's Republic of China

Background

China is the third-largest economy in the world after the US and Japan with a real GDP of USD 8.26 trillion (in 2005 USD PPP) in 2009. It has sustained high rates of economic growth since the early 1990s; the average annual growth rate for the period 1990–2009 was 10.5%. Economic growth rate is projected to slow down as China's economy matures. The projected average annual growth rate is about 6.6% between 2010 and 2035.[37]

Globally, China is the fourth-largest economy in terms of geographic size (9.6 million km2), and has the largest population of any economy (1.33 billion). By the end of 2011, there were 657 cities in China, including 4 municipalities directly under the central government, 15 sub-provincial cities, 268 prefecture level cities and 370 county-level cities. The total area of administrative regions of the cities at various levels accounted for about half of China's land area. The number of the designated towns increased to 19,683. There were 30 cities with a permanent resident population of over 8 million, among which 13 cities were with a population exceeding 10 million. According to the latest statistics, the population living in cities and towns surpassed the population in rural area for the first time in China to reach 690 million (with an urbanization rate of 51.27%), representing a historical change of China's social structure.[38] The urban population is currently concentrated in the eastern areas due to more industrial

[36] Asia Pacific Economic Research Centre. Compendium of Energy Efficiency Policies of APEC Economies, Chile. (2012). Available at http://aperc.ieej.or.jp/file/2014/1/27/CEEP2012_Chile.pdf

[37] Asia Pacific Energy Research Center. APEC Energy Demand and Supply Outlook 5th Edition. (2013).

[38] The Chinese Science Center of International Eurasian Academy of Science. (2012). The State of China's Cities 2012/2013. Beijing: Foreign Languages Press.

development and more employment opportunities. However, it can be expected that more balanced development in the future will mean higher residential energy demand in the western and rural areas.[39]

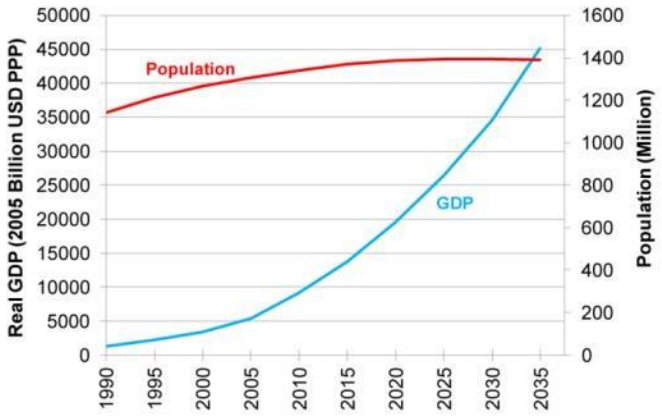


Figure 16 China's GDP and Population. Source: (APERC, 2013)

In 2009, China surpassed the United States to become the world's top energy consumer, according to the International Energy Agency.[40] In 2011, the total energy consumption of energy reached 3480 million tons Standard Coal Equivalent (SCE), which is 240% greater than the consumption in 2000.

Table 1 China's Total Consumption of Energy and Its Composition. Source: China Statistical Yearbook

Year		*2000*	*2005*	*2009*	*2010*	*2011*
Total Energy	Consumption (10,000 tons of SCE)	145531	235997	306647	324939	348002
As Percentage of Total Energy Consumption (%)	Coal	69.2	70.8	70.4	68	68.4
	Crude Oil	22.2	19.8	17.9	19	18.6
	Natural Gas	2.2	2.6	3.9	4.4	5
	Hydro-power, Nuclear Power, Wind Power	6.4	6.8	7.8	8.6	8

[39] Asia Pacific Energy Research Center. APEC Energy Demand and Supply Outlook 5th Edition. (2013)

[40] Hays, Jeffrey. "ENERGY IN CHINA: CONSUMPTION, PRODUCTION, RURAL USAGE, SHORTAGES AND CONSERVATION". Facts and Details: http://factsanddetails.com/china.php?itemid=324&catid=12#400

China's energy demand was driven mainly by the rapid growth of industry, as the urbanization expedites, the demand for energy is even soaring as the road transportation sector, household electricity consumption are significantly increasing. For example, the domestic transport sector accounted for around 11% of final energy consumption in 2009; this increased at 7.8% annually from 2000 to 2009.

This growth in demand was driven mainly by road transport, which consumed 76% of this sector's energy use in 2009. The 'other' sector, which is mainly residential and commercial use, accounted for 33% of the economy's final energy demand in 2009. Residential energy use dominates (73% of this sector's energy use in 2009), followed by commercial at 12% and agriculture at about 6%.[41]

China has significant energy resources, particularly coal. In 2010, China was the world's largest producer and consumer of coal, as well as its fifth-largest producer and second-largest consumer of oil. Most of the economy's existing power generation is coal based, with coal accounting for 79% of electricity production in 2009. Much of the growth in China's domestic energy demand for crude oil and gas is being met by imports.[42]

Table 2 China's total production of energy and its composition. Source: China Statistical Yearbook

Year		*2000*	*2005*	*2009*	*2010*	*2011*
Total Energy	Production (10 000 tons of SCE)	135048	216219	274619	296916	317987
As Percentage of Total Energy Production (%)	Coal	73.2	77.6	77.3	76.6	77.8
	Crude Oil	17.2	12.0	9.9	9.8	9.1
	Natural Gas	2.7	3.0	4.1	4.2	4.3
	Hydro-power, Nuclear Power, Wind Power	6.9	7.4	8.7	9.4	8.8

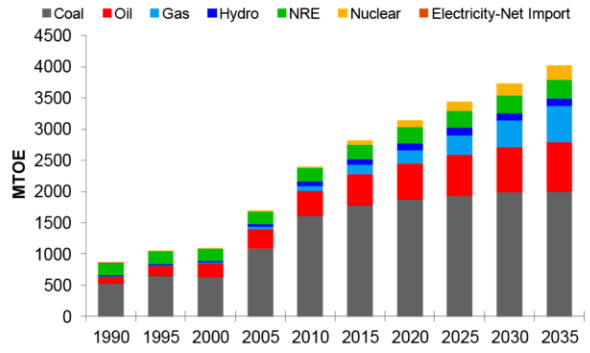
*The coefficient for conversion of electric power into SCE (standard coal equivalent) is calculated on the basis of the data on average coal consumption in generating electric power in the same year.

According to IEA, China's total primary energy supply is projected to grow at an average annual rate of 2.1% over the outlook period (2010–2035). This is slower than the average annual growth rate of 5.2% from 1990–2009. This deceleration in energy growth is mainly due to a projected slowdown in the GDP growth rate coupled with efforts to improve energy efficiency.[43]

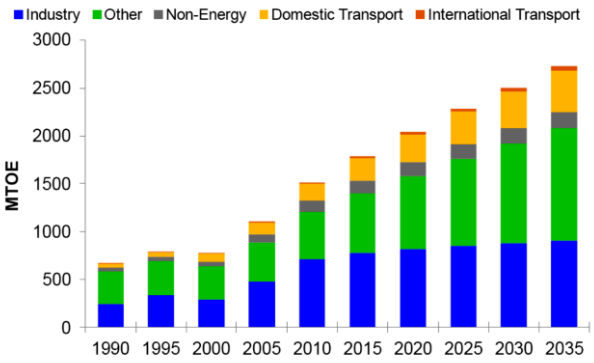
[41] Asia Pacific Energy Research Center. APEC Energy Demand and Supply Outlook 5th Edition. (2013).

[42] Ibid.

[43] Ibid.



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011



Source: APERC Analysis (2012)
Historical Data: *World Energy Statistics 2011* © OECD/IEA 2011

Figure 17 Energy Supply and Demand Projection of China. Source: APERC

Economy-Level Policy Brief

In a context of rising demand and constrained supply, China has made energy security the top priority in its energy policy objectives. China's 12th Five-Year Plan for National Economic and Social Development (2011–2015) sets out a program for the enhancement of energy security, with a strong emphasis on clean energy and energy efficiency. A number of measures have been implemented to this end. These measures include the promotion of non-fossil fuel as an energy source as well as lower carbon energy sources (especially gas); the modernization of energy industries, with the closure of inefficient small coalmines, power plants, refineries, and iron-and-steel production plants; and the introduction of efficient technologies throughout the energy supply chain, i.e. from production and transport through to consumption.[44] [45]

China had considerable success under the 11th Five Year Plan in meeting the 20% energy intensity reduction goal, achieving a 19.1% reduction during that time. This was accomplished through the implementation of a variety of policy, legal and economic methods.

China stands out within APEC as having implemented an energy intensity improvement strategy that reaches through all levels of government, from national to local. This has been done by setting both economy-wide goals and subnational goals. China, recognizing the economic, environmental, and social impacts of its rapid urbanization, has "include[d] strategies to promote —city clusters, strictly regulate land use and advance public transport infrastructure construction."[46]

[44] Ibid.

[45] OECD (2013), "Urbanisation and Green Growth in China", OECD Regional Development Working Papers, 2013/07, OECD Publishing. http://dx.doi.org/10.1787/5k49dv68n7jf-en

[46] ibid

Local and Subnational Case Studies

Given its incredible rate of urbanization (requiring the equivalent of about a city of 1 million people every week), China stands out in the APEC region, because much of its energy smart community development is new, not the adaptation of historic cities. The potential for implementing best practices is far greater in this context. Several projects are reviewed to identify trends in China's present energy smart community development.

Tianjin's Binhai New Area, a state-level new area for high-priority development in China. Tianjin's Binhai New Area's population of 2.48 million is expected to more than double by 2020. Its GDP in 2010 was 355 Billion Chinese Yuan. Two of China's smart community case studies lie in the Binhai New Area: Yujiapu Financial District and Tianjin Eco-City.

Yujiapu Financial District

In 2010, the meeting of APEC's Energy ministers in the Japanese city of Fukui commenced with a declaration giving directions to improve energy efficiency, advance energy security and increase the clean energy supply in the APEC region. Among the new initiatives prescribed by the Energy Ministers is the *Low Carbon Model Town* project, aimed at developing the best practices to achieve low-emissions urban communities. Yujiapu Financial District was the first to be selected for Low Carbon Model City project.

Today, Yujiapu is sometimes referred to as the Chinese version of Manhattan's business district, however, historically Yujiapu operated as a fishing village. Construction to transform the area into an urban development began in 2008. Yujiapu Financial District (YFD) is located adjacent to the fourth largest port in the world and encompasses an area of 3.86 square kilometers.

The 120 plots within the YFD adopted the method of overall planning and phased construction, and the overall development and construction is planned to be basically completed in 15 years. Since the construction investment promotion was fully launched in 2009, the starting area has already taken initial shape. YFD is scheduled for completion in 2019. Construction cost of RMB 200 billion, it will provide some 9.5 million square meters of office space. The complete development will have a daytime population of 500,000 and nighttime population of 50,000. In the daytime, it is a prosperous business district, but mixed-use development to add the residential component was not as much of a focus during planning. In addition to business development, YFD aims to be a "green ecological zone" through careful urban environmental planning, green architectural design, and the optimization of construction techniques. The goal of Yujiapu Financial District is to reduce CO2 emission by 30% in 2020 and 50% in 2030 (compared a 2010 business as the baseline).

YFD's features careful land use planning: approximately 60% commercial zone and 30% open space. The prominent green open space feature is a green apron along YFP's entire riverfront, featuring 4 marinas and a multitude of leisure and entertainment areas. Mixed use for housing is lacking, with only two areas allocated for mixed use (mainly housing).

The transportation system relies on public-transit. High density development will surround the five train stations (one express train station and four subway stations) containing a mixture of uses in close proximity including office, residence, retail, and civic uses. YFD will integrate the inter-city express railway, city subway, and city bus systems, enhancing the urban agglomeration effect of Beijing and Tianjin. At the same time, five subway-routes (three transversal and two longitudinal) and a green bus system are planned within the city. Yujiapu will adopt a world-leading underground transportation system consisting of trains, railways and pedestrian walkways thus reducing the use of motor vehicles and consumption of fossil fuels in order to reflect sustainable development and human-oriented planning concepts. The studies made forecast a use of public transportation by 80% of the people in the area, 60% by rail and 20% by bus.

Figure 18 Land use plan and zoning map of The Yujiapu Financial District (YFD). Source: The Tianjin Innovative Finance Investment Co. Ltd (TIFI)

Figure 19 The greenbelt, housing, and commercial area of The Yujiapu Financial District (YFD). Source: APEC

Figure 20 The public-transit system of the Yujiapu Financial District (YFD). Source: APEC, 2011, Low Carbon Model Town (LCMT) Project Tianjin Yujiapu Feasibility Study

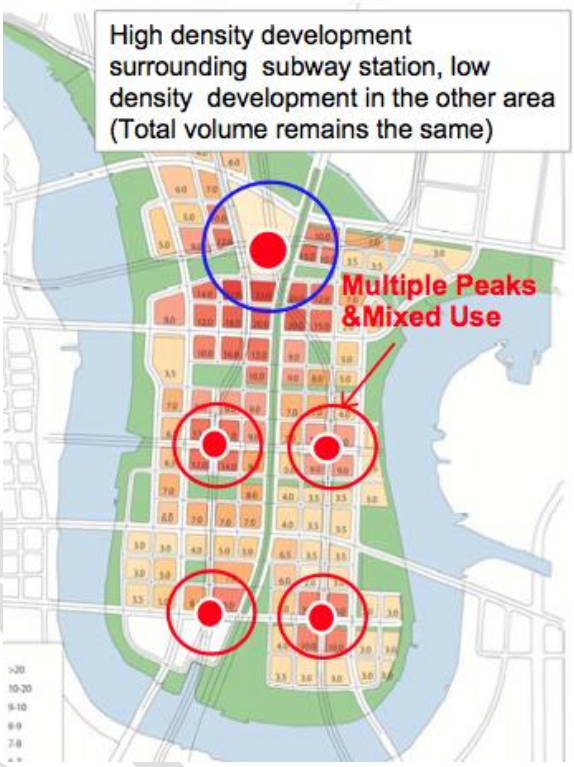


Figure 21 The transit-oriented development (TOD) within the 5 stations the Yujiapu Financial District (YFD). Source: APEC

Table 3 Indexes of Load reduction of Yujiapu LCMT. Source: APEC

Category	Item (Reasons for selection)	indexes	2020	2030
Environment	1) Greenery, Biodiversity - Increase comfortableness, green scenery	Greenery coverage rate	Over 30%	Same as on the left
		Biodiversity rate	Select multiple kind of plants considering biodiversity	Same as on the left
	2) Heat Island - Improve the thermal environment	Decline of temperature	1.5 - 2.0 degree lower than BAU	
		Cool spot coverage rate	Over 40%	Over 60%
Transportation	3) Transportation - Encourage the use of public transportation systems	Modal split of public transportation	50%	80%
		Coverage rate of barrier-free design	50%	80%
		Coverage rate of 5 minutes walkable area from bus stop	50%	90%
		Accuracy of public transportation	80%	Over 90%
Business foundation as a financial center	4) Safety, Security - In order to promote investment and corporate expansion from all over the world	Surveillance camera coverage rate	50%	80%
		Traffic accident rates	Approximately the same level as advanced nations	Same as on the left
	5) Economic Activity - Assess the international competitiveness as a financial district	GDP/working person	Around 60 – 70% of average level in financial centers in developed nations	Approximately the same level as financial centers in developed nations
		Occupancy rate of finance company	Over 50%	70%
	6) Information Technology - Assess the stability of enterprise-grade information technology infrastructure	Coverage rate of optical fiber LAN	90%	100%
		Rate of data center and server downtime	Aiming for 0%	0%

Table 4 Indexes of Value increase of Yujiapu LCMT. Source: APEC

Category	Item (Reasons for Selection)	Indexes	2020	2030
New Energy	1) Area energy - Effect of intensive energy system in urban area	District Heating and Cooling (DHC) Utilization rates	50%	80%
	2) Renewable energy, - Untapped energy as CO2 emission "Zero" energy system	Utilization rates	15%	25%
		Utilization rates	15%	25%
Resources circulation	3) Water resources - Encouraging the preservation of water resources	Gray water; recycle rates	40%	80%
		Sewage water; recycle rates	–	30%
		River water (rain water); recycle rates	15%	30%
	4) Reuse, Recycle of waste - Boosting waste reduction and preservation of water resources	Waste, kitchen waste; recycle rates	40%	80%
		Waste plastic; recycle rates	40%	80%
		Paper; recycle rates	40%	80%
		Recyclable waste; recycle rates	60%	90%
Pollution abatement	5) Pollution	Air pollution	Conforms to National Standard	Aiming for WHO standard
		Water	Conforms to National Standard	Aiming for WHO standard
		Soil	Conforms to National Standard	Aiming for WHO standard
		Chemicals	Conforms to National Standard	Aiming for RoHS standard

Yujiapu has identified the following strategies to meet its energy goals:

- Central business districts: low-carbon construction, untapped energy, solar and wind power generation.
- Housing districts: low-carbon housing, solar power generation.
- Farming districts: low-carbon housing, biomass power generation.
- Transit: intercity railways, light rail transit, and electric vehicles EV

The planning also identifies a design methodology for low-carbon architecture:

- Energy-Conservation and Low-Carbon Emission Measures;
- Example of best practice for Low-Carbon Building;
- Setting CO2 Emission Baseline as BAU;
- Prediction for Potential of CO2 Reduction effect

Yujiapu Financial Area actively encourages carbon trading institutions to settle there in an attempt to turn itself into a low-carbon economic and finance cluster. Through joint investment with China Galaxy Securities, Yujiapu Financial Area has organized the first low-carbon investment fund company and low-carbon industry fund to provide a convenient financing platform for low-carbon enterprises.

Tianjin Eco-City

The second bilateral project between Singapore and China, the Sino-Singapore Tianjin Eco City, began in November 2007 when Singapore Prime Minister Lee Hsien Loong and Chinese Premier Wen Jiabao signed a Framework Agreement for Singapore and China to jointly develop the area. In this agreement Singapore and China have committed to share expertise and experience in urban planning, environmental protection, resource conservation, water and waste management and sustainable development, as well as policies and programs to engender social harmony in the Tianjin Eco-city.

The site of Sino-Singapore Tianjin Eco-City is located 40 km from Tianjin city center and 150 km from Beijing city center. It is located within the Tianjin Binhai New Area as a special development zone. The project construction began in September, 2008. The Chinese government and Singapore government signed an agreement to build an ecological model city for 350,000 residents on 30 km^2 in 10 to 15 years.

Sino-Singapore Tianjin Eco-city is also the world's first cooperative eco-city project between two countries. Because of its unique development framework, collaboration occurs at two levels – at the government-to-government level and at the private sector level. Its vision is to be a thriving city which is "socially harmonious, environmentally-friendly and resource-efficient".[47]

Sino-Singapore Tianjin Eco-City is devoted to being a model of a sustainable city, while providing an international platform for demonstration of ecological innovation, energy conservation, and environmental protection technology and ecological civilizations. The development visions for Sino-Singapore Tianjin Eco-City are as follows: [48]

- PLATFORM: A research, implementation and promotion platform for ecological and environmental protection technology.
- CENTER: A national promotion center for ecological and environmental protection training.
- BASE: A modern ecotype high-tech industry base.
- WINDOW: An international demonstration window for the international experience exchange of ecological environment construction.
- NEW CITY: A model city for environmentally-friendly and resource-efficient.

Moreover, when the cooperation framework was signed, the Eco-City is also dedicated to implement the concepts of "Three Harmonies" and "Three Abilities".[49]

"Three Harmonies" refers to:

- People living in harmony with other people, i.e. social harmony
- People living in harmony with economic activities, i.e. economic vibrancy

[47] Tianjin Eco-city: A Model For Sustainable Development: http://www.tianjinecocity.gov.sg/index.htm

[48] Ibid.

[49] Ibid.

- People living in harmony with the environment, i.e. environmental sustainability

"Three Abilities" refers to the Eco-city being:

- Practicable - the technologies adopted in the Eco-city must be affordable and commercially viable
- Replicable - the principles and models of the Eco-city could be applied to other cities in China and even in other countries
- Scalable - the principles and models could be adapted for another project or development of a different scale

Jointly developed by the China Academy of Urban Planning and Design, the Tianjin Urban Planning and Design Institute, and the Singapore Urban Redevelopment Authority, the Tianjin Eco-city's Master Plan attempts to strike a balance between competing needs, including the social, economic, and environmental needs of the Eco-city.

The Master Plan can be summarized as "1 Axis – 3 Centers – 4 Districts".[50]

Figure 22 Tianjin Eco-City Spatial Structural Layout

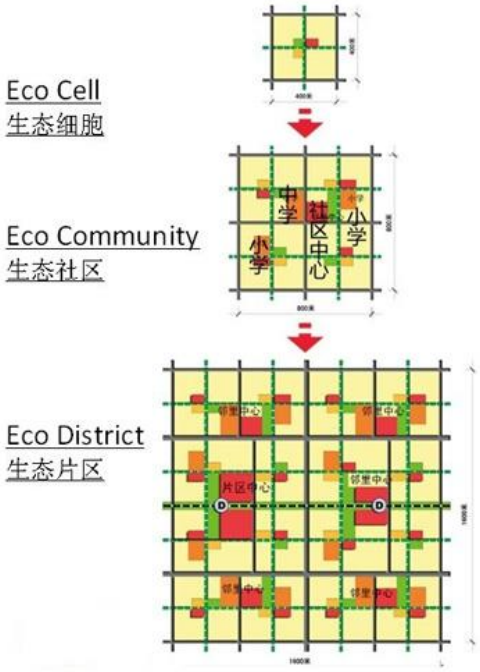


Figure 23 Tianjin Eco-City Conceptual Diagram of Eco-Cell

1 Axis refers to the Eco-valley cutting across the Eco-city, which is the green spine of the city. It links up the City Centre, the 2 sub-centers and the 4 districts in the Eco-city, and provides a scenic trail for pedestrians and cyclists. The tram system, which will be built to meet the Eco-city's transport needs, will run along the Eco-valley.

[50] Ibid.

3 Centers refers to the main City Centre on the promontory on the south bank of the Old Ji Canal and the two sub-centers in the south and the north.

4 Districts refers to the residential districts in the southern, central, northern, and north-eastern parts of the Eco-city. Each district contains several housing neighborhoods comprising a variety of housing types, as well as their respective commercial and amenity centers serving their communities.

The Eco-cell is a key concept in the Master Plan. Eco cells are basic building blocks of the Eco-city. Each cell is about 400m by 400m large, generally accepted as a comfortable walking distance. Four Eco-cells make an Eco-neighborhood. Several Eco-neighborhoods come together to form an Eco-district. There are 4 Eco-districts in the Eco-city.

The Eco-city is planned to be compact, with a good mix of land uses and based on Transit-Oriented Development (TOD) principles. Each district is planned with amenities and jobs located nearby. Local and centralized facilities are provided to serve the needs of residents in each neighborhood. Each district is served by urban centers. Business Parks are located close to residential areas to provide employment for residents, which is within access of their homes.

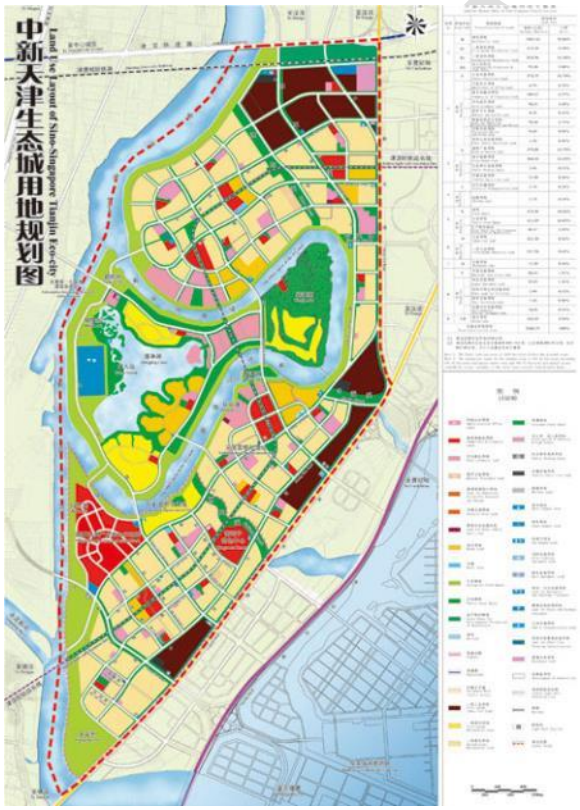


Figure 24 Master Plan. Source: Sino-Singapore Tianjin Eco-city

The Eco-city is dedicated to focus on green industry which features in R&D, energy-saving and environmental friendly industry, cultural and innovative industry, and advanced service industry. Five

Industrial Parks, including National Animation Industrial Park, National Flm Park, Technology Park, industrial Park, as well as IT Park.

All the construction of buildings in Eco-city will have to reach the green building standards. Integrated use of renewable energy, water resource utilization, green building materials, ventilation, daylighting, garbage disposal, etc. will be applied in the buildings to reduce building energy consumption and emissions and the industrialization of green building will be promoted.

An emphasis on green transport is a key feature in the transport planning of the Eco-city. The aim is to increase trips via public transport and non-motorized modes of transport, such as via bicycles and walking, within the Eco-city. To achieve this, non-motorized and motorized networks will be separated to minimize conflict between pedestrians, cyclists, and vehicles, with priority given to pedestrians and non-motorized transport, as well as public transport.

Tianjin Eco-city will actively promote the new energy technology, strengthen the energy utilization and improve its efficiency. Tianjin Eco-city is devoted to develop the generation of renewable energies, including geothermal energy, solar power energy, wind power energy, biomass power energy, etc., so that renewable energy utilization rate are anticipated to reach 20% by 2020. At the same time, all buildings in Tianjin Eco-city will apply energy efficiency technology and reach green building standards.

The Eco-city is planned with extensive green (vegetation) and blue (water) networks in mind to provide an endearing living and working environment. The green network will comprise a green lung at the core of the Eco-city and green-relief eco-corridors emanating from the lung to the other parts of the Eco-city. Water bodies in the Eco-city will be linked together for greater water circulation to enhance the ecology and to provide an attractive environment for waterfront development and water-based recreational activities. A wastewater pond will be rehabilitated and transformed into a clean and beautiful lake.

The planning and development of the Eco-city is guided by a comprehensive set of Key Performance Indicators (KPIs) covering its ecological, economic and social development. The KPIs were jointly formulated by experts from Singapore and China and endorsed by the Ministerial-level Eco-city Joint Working Committee. In formulating the KPIs, due consideration was given to the national standards in China and Singapore, and the higher of the two standards was adopted, wherever feasible. Prevailing best international practices and the local conditions in Tianjin were also taken into account.

There are 22 quantitative and 4 qualitative KPIs. The start-up area and the entire Eco-city are targeted for completion by end-2013 and 2020 respectively. It is for this reason that reference is made to these years in the KPIs.[51]

[51] Ibid.

Figure 25 Quantitative KPIs of Sino-Singapore Tianjin Eco-city. Source: Tianjin Eco-city: A Model for Sustainable Development

The metrics that are most relevant to this discussion include:

- Green Building Ratio: 100% (Now)
- Usage of Renewable Energy: ≥20% (2020)
- Usage of Water from Non-Traditional Sources: ≥50% (2020)
- Proportion of Green Trips： ≥90% (2020)
- Carbon Emission Per Unit GDP: 150 tonne-C per US$1 million
- Net Loss of Natural Wetlands: 0 (Now)
- Per Capita Public Green Space: ≥12 ㎡ (2013)
- Per Capita Daily Domestic Waste Generation： ≤0.8 kg (2013)
- Overall Recycling Rate：≥60 (2013)
- Proportion of Affordable Public Housing： ≥20% (2013)

Guangming New District

Guangming New District is one of the seven districts of Shenzhen City in Guangdong Province. The total planned area of Guangming New District occupies 156.1 km², of which 72 km² is designated for urbanization (46% of the total area); the remaining area lies within the official Basic Ecological Control Line (2005).[52] Guangming New District currently has a population of about one million.

[52] Guangming New Town. http://www.newtowninstitute.org/spip.php?article756

Since its establishment in 2007, Guangming New District has developed rapidly, with its GDP nearly doubling in the first three years. It has developed in alignment with low-carbon principles, earning three national nominations of green development, namely National Green Building Model Town (2008), China's first low-impact development model town in storm water management (2011), and National Green and Ecological Model District (2013).

Guangming New District is envisioned to be a "Green New City, Entrepreneurship New City, and Harmonious New City", jointly driven by new type of urbanization and industrialization.[53] Guangming wants to strengthen its service function towards Hong Kong by creating an environment for innovative technological and research companies, developing a high quality living environment and high quality public facilities, and exploring tourism industry.

The New Town is divided into three zones: ecological industry development zone, high-tech industry development zone, and traditional industry development zone.

The ecological zone is suitable for agriculture activities and eco-friendly tourism. The high-tech zone is planned to accommodate companies specialized in flat panel display equipment, new energies, as well as headquarters of small to medium-sized businesses. The traditional zone has been filled with a number of existing manufacturing factories. The main goal in this zone is to upgrade them to more advanced modern manufacturing types of industry.

Spatially, the strategies to develop a low-carbon city include: [54]

- A convenient network of public transport and a slow-traffic system
- Compact and transport-oriented development (TOD) in station areas
- Introducing greenery from the ecological zone and surroundings by green wedges
- The use of recycled energies, waste, and rainwater
- Green building technologies

[53] Society for Urban Studies Chinese. (2012).China Low-Carbon Eco-city Development Report 2012. Beijing: China Architecture & Building Press.

[54] International New Town Institute. Guangming New Town. Available at http://www.newtowninstitute.org/spip.php?article756

Figure 26 Plan Layout of Guangming New District. Source: Guangming New District to Be the First Green District of China, 2008

More than 40 green plans have been adopted by Guangming New District (e.g, Green New Town Comprehensive Plan, Green Building Specialized Plan, Green New City Construction Plan, etc.), so the ideas of green industry, green transport, green building, green community, and green space, are incorporated in the local development.[55]

2.6 Hong Kong, China

Background

The Hong Kong Special Administrative Region of China is located in the Pearl River Delta, one of the world's most significant economic regions. Hong Kong has a population of 7.1 million encompassed in the single-city economy with a landmass of 1.1 thousand km^2. In 2013, Hong Kong's economy had grown to a GDP of $274 billion USD ($10,500 per capita), an annual growth rate of 3% from 2012.

Hong Kong imports nearly 100% of its energy use in the form of coal, oil, and natural gas as described in the figure below. This usage amounted to nearly 15,000 kt of oil equivalents in 2011 or an energy intensity of 42 kg oil equivalent per $1000 GDP (2011 PPP). Hong Kong has made considerable progress in reducing its energy intensity, with a 31% decline between 2000 and 2010.

[55] Society for Urban Studies Chinese. China Low-Carbon Eco-city Development Report 2012. (2012) Beijing: China Architecture & Building Press.

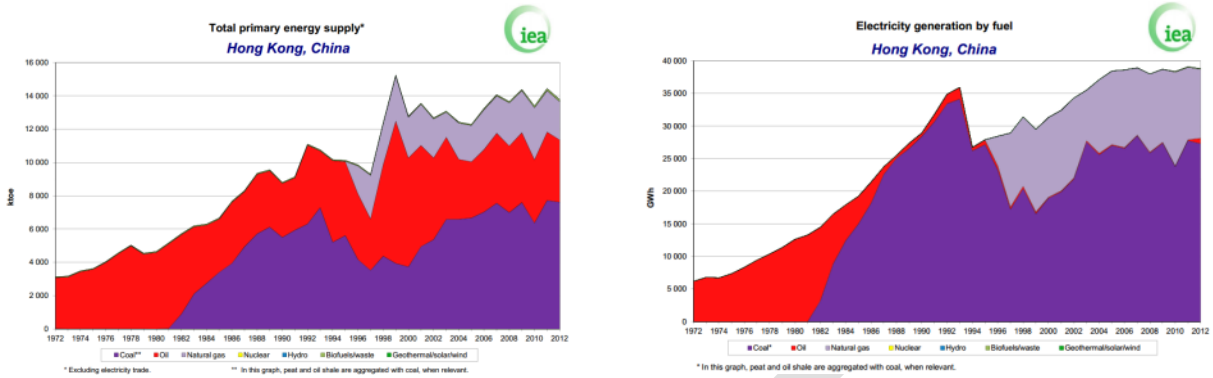


Figure 27 Hong Kong's energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

Hong Kong is a special case in this report, since it is a single-city economy making some of the policy analysis not applicable. Specifically, there is no need to examine whether there is integration between economy-level and subnational policies to promote energy smart community development, as this division does not exist.

Hong Kong's energy smart development is driven by a set of local ordinances: Energy Efficiency Ordinance (labeling of products); Building Regulation; Building Energy Efficiency Ordinance.[56] These local provisions account for demand-side management practices and include the following measures:

- The promotion of building energy efficiency through legislation for mandatory implementation of Buildings Energy Codes, and the provision of subsidies under Building Energy Efficiency Funding Schemes
- The implementation of the first phase and second phase of the Mandatory Energy Efficiency Labelling Scheme
- The provision of incentives in the post 2008 Scheme of Control Agreements with power companies to encourage investment in renewable energy facilities and enhance energy efficiency
- To enhance utilization of landfill gas for town gas production
- To implement a district cooling system at the Kai Tak Development to supply chilled water to buildings in the new development area for centralized air-conditioning
- To promote environmental protection and energy conservation in government buildings through setting targets in various environmental aspects of new government buildings and through identifying demonstration projects
- To promote environmental protection and energy conservation in government buildings through setting targets in various environmental aspects of new government buildings and through identifying demonstration projects to promote the replacement of incandescent light

[56] Asia Pacific Economic Research Centre. Compendium of Energy Efficiency Policies of APEC Economies, Hong Kong. (2012). http://aperc.ieej.or.jp/file/2014/1/27/CEEP2012_Hong_Kong_China.pdf

bulbs by more energy-efficient lighting products through various means, including launching of voluntary measures to provoke phasing out energy-inefficient incandescent light bulbs on both supply and demand sides.

Several municipal plans were released in 2013: Blueprint for Sustainable Use of Resources 2013-2022 and A Clean Air Plan for Hong Kong.[57] [58] Already a world leader in urban transportation infrastructure – ten mass transit rail lines with 83 traditional rail stations and 63 light rail stations – Hong Kong is still stricken with air quality challenges associated with vehicle emissions. Air quality challenges are a product of regional as well as local conditions. As noted, currently even with no local emissions, Hong Kong would not meet WHO air quality guidelines. These air quality concerns are pushing Hong Kong to push for a strict reduction in roadside air pollution as well as reduced emissions from power generation. The elements for reduced air quality match Green/Smart City Master Plans seen around the APEC region and include:

- Transport management solutions – low emission zones, bus route rationalization, and vehicle inspection and maintenance
- Urban planning solutions - urban greening, cycling networks, pedestrian schemes
- Financial solutions – green transport fund, taxation as funding tool

As a prominent port city, Hong Kong is also working to reduce freight transportation emissions. Measures proposed include upgrading locally supplied fuel and on-shore power facilities for docked ships. Finally, power plant emissions reduction is really focused on a fuel mix change with reduced dependence on coal. The difference is intended to be made by nuclear energy.

2.7 Indonesia

Background

Indonesia, home to a population of over 250 million, is an archipelago located in the South Pacific composed of more than 10,000 islands and with a landmass totaling 1.9 million km^2. Indonesia's GDP was $868.3B USD in 2013 with an annual growth rate of 6%. A net energy exporter, Indonesia consumed energy at a rate of 101 kg of oil equivalent per $1000 GDP (constant 2005 PPP).

Over half (51%) of Indonesia's population lived in urban settlements in 2012. The economy is divided into 34 administrative provinces and then subdivided further into regencies and cities.

[57] Environment Bureau. A Clean Air Plan for Hong Kong. (2013). Available at http://www.enb.gov.hk/en/files/New_Air_Plan_en.pdf

[58] Environment Bureau. Hong Kong Blueprint for Sustainble Use of Resources 2013-2022. (2013). Available at http://www.enb.gov.hk/en/files/WastePlan-E.pdf

As evident from the figure, Indonesia's energy production is heavily supported by the burning of coal. Renewables have held fairly consistently, but have lost their relative contribution to the fuel mix as Indonesia's energy production has increased.

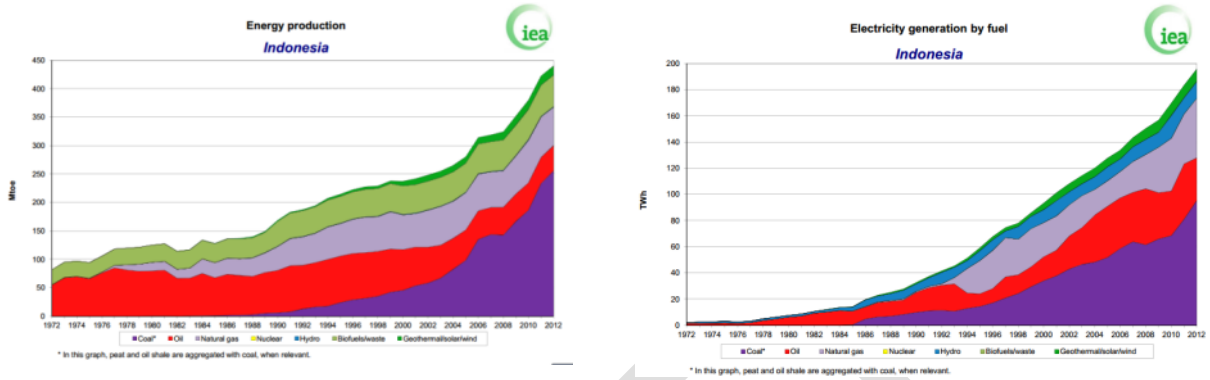


Figure 28 Indonesia's energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

Indonesia has set two energy reduction goals. First, in its 2005 National Energy Conservation Master Plan, the government set a goal to reduce energy intensity by 1% annually through 2025. A complimentary goal was set in 2006's National Energy Management Blueprint, which seeks to reduce primary energy supply in 2025 by 41% as compared to the business as usual scenario described in the National Energy Conservation Master Plan.

Indonesia issued the Presidential Regulation No. 61 on the National Action Plan for GHG Emissions Reduction (RAN-GRK) in 2011. The regulation also requires Indonesia's Provinces to produce Local Action Plans for GHG Emissions Reduction (RAD-GRK): "The RAD-GRK is to be used in conjunction with the RAN-GRK to improve coherence between the sub-national and national level, especially with regard to data relevant to GHG inventories and emission scenarios." [59] The RAN-GRK targets actions by sector: Agrictultural, Forestry and Peat Land, Energy and Transportation, Industrial, and Waste Management.

Following the establishment of the local RAD-GRK at the provincial level, the government planned to set up a monitoring, evaluation, and reporting framework that would allow subnational governments to track progress. The document, *Project of Capacity Development for Climate Change Strategies in Indonesia,* lays out how to improve the country's monitoring and reporting system. The plan is to improve measurement indicators, include GHG in the environmental survey and data collection system and to establish GHG emission survey and monitoring system in accordance with global standards.[60]

[59] International Partnership on Mitigation and MRV. Development of Local Mitigation Action Plans in 33 provinces in Indonesia. (2012) http://mitigationpartnership.net/development-local-mitigation-action-plans-33-provinces-indonesia#_ftn1

[60] JICA. Project of Capacity Development for Climate Change Strategies in Indonesia (2013) Available at http://www.greenclimateproject.org/files/index.php?action=downloadfile&filename=sumnote-RAN%20-%20RAD%20rev%202.pdf&directory=Summary%20Notes&

Local and Subnational Case Studies

Surabaya

Surabaya is Indonesia's second-largest city located in the province of East Java and had a population of 3.1 million in 2012 and an area of 374 km^2.

The Project on Low Carbon and Environmentally Sustainable City Planning in Surabaya, Indonesia was carried out in partnership by the City of Surabaya and the Institute for Global Environmental Strategies (IGES) in 2013. The project's aim is to enable low carbon development in Surabaya by targeting the energy management, transport and traffic management, solid waste management and water and wastewater management sectors and aligns with the RAN-GRK and RAD-GRK.[61] The project is one of a series of projects between Surabaya and the Japanese city of Kitakyushu, which became Sister Green Cities in 2012.

The Surabaya/IGES project had three main aims:

- Compose a city sustainability or green plan for low carbon development
- Identify large low carbon demonstration projects that could be implemented immediately
- Establish a measurement and verification system to track CO_2 emissions and progress towards the goals set up in the plan

[61] Institute for Global Environmental Strategies. Low-Carbon and Environmentally Sustainable City Planning Project in Surabaya, Indonesia – Inception Workshop. (2013) Available at http://www.iges.or.jp/en/sustainable-city/20130710.html

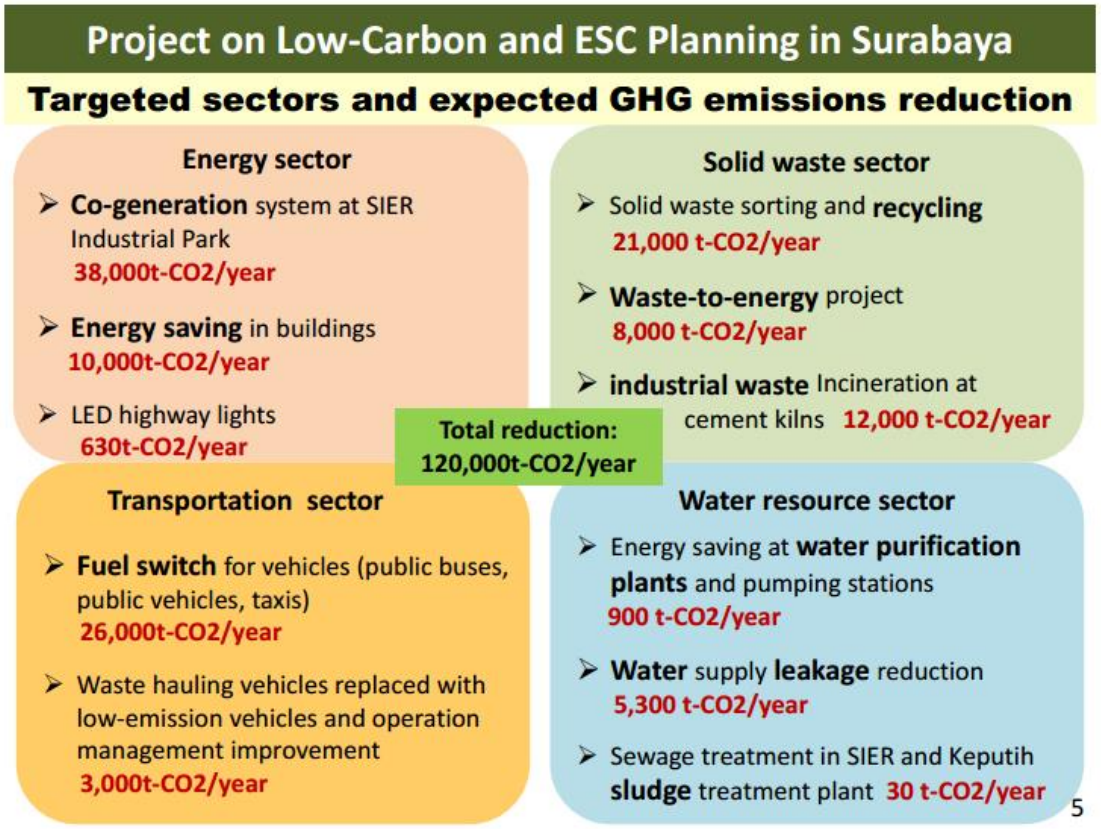


Figure 29 Overview of Low-Carbon planning in Surabaya. Source: Institute for Global Environmental Strategies

The project was successful in establishing sectorial carbon emissions reduction goals and also identifying measures within each sector to at least begin to demonstrate the impacts of the long-term plan.

Within the energy sector, the project identified a few high-impact activities, which included installation of a combined heat and power plant in Surabaya's industrial area that provided natural gas powered electricity and steam to local factories, replacing the factories' in-house steam generators. Four large energy consuming buildings were identified for energy efficiency retrofits: a shopping mall, hotel, hospital, and data center. Finally, the project suggested installing LED lighting along a 14km stretch of highway.

The transportation sector looked to both switching to higher-efficiency vehicles - especially for high-use vehicles like buses, trash collectors, and taxis - and at improving operational efficiency, such as revising bus routes. Long term plans for mass transit additions of a monorail and tram line were also identified.

The program plans to upgrade the solid waste system to single-stream with sorting for composting and recycling at transfer stations. This project aims to achieve a 70% landfill diversion rate from business as usual. Further, the project notes that some waste diversion products could be harnessed for waste to energy or for use as material for cement plants.

Some savings were identified in the city's water supply and wastewater treatment infrastructure through smart upgrades that reduce leakage in water supply and high efficiency equipment replacement at end of service.

2.8 Japan

Background

Japan is an archipelago of thousands of islands, however nearly 97% of its land mass is contained in its four largest islands. Japan has a population of 127 million of which 92% live in urban areas. Japan's GDP reached over $4,900 billion in 2013, a 1.5% growth from 2012. Japan's four largest islands (plus the smaller island of Okinawa) are divided into 47 prefectures, which are further subdivided into cities, towns and villages. Both prefectures and sub-prefectures have individual administrative governments.

Japan is a net energy importer, importing 89% of its energy use. Total energy use amounted to 461.5 million metric tons of oil equivalents or an energy use intensity of 105.21 kg of oil equivalent per $1000 GDP (2011 PPP). Japan's fuel mix underwent significant changes after the 2011 Fukushima nuclear station disaster, which resulted in a government halt on the use of nuclear energy. The change meant Japan experienced a greater reliance on fossil fuels for electricity generation. Thus the most recent emissions data available (2010) does not reflect present conditions in Japan. In 2014, Japan approved an energy plan to reinstate nuclear power, which marked a departure from the previous administration's commitment to eliminate all nuclear power use.[62]

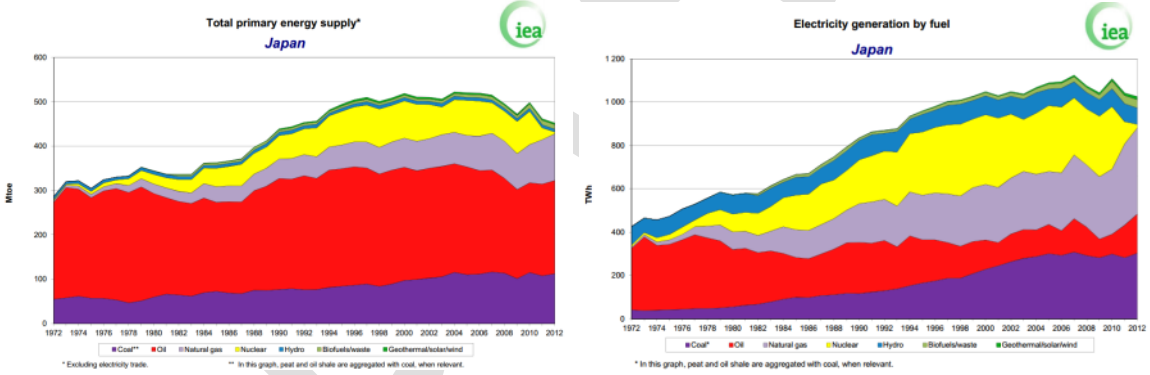


Figure 30 Japan's energy supply and electricity generation by fuel type. Source: IEA

[62] Reuters Japan approves energy plan reinstating nuclear power. (2014) Available at http://www.reuters.com/article/2014/04/11/us-japan-energy-nuclear-idUSBREA3A02V20140411

Economy-Level Policy Brief

Japan's energy efficiency and conservation legislation is among the more developed in the APEC region.[63] The Law Concerning the Rational Use of Energy (Energy Conservation Law) was originally enacted in 1979 and has been amended periodically, most recently in 2012.

Industrial energy conservation is voluntary, though the Keidranren Voluntary Action Plan on the Environment in 1997 set goals for voluntary action plans, such as CO2 and energy intensity reduction. There was also a provision to improve efficiency of electric power facilities to promote implementation of cogeneration and utilize ESCOs.

Product energy efficiency is promoted by the Top Runner Program, which applies to 23 products, including vehicles. This program is complemented by an energy savings labeling program, which applies to 16 products, such as HVAC, appliances, and consumer electronics.

Building code requires that all new construction or renovation over 2000 m^2 must report energy conservation measures and provide periodic report on the state of maintenance of the building.

Financing for energy efficiency and conservation is provided through tax schemes (promote investment in structural reform of energy supply and demand, and vehicle greening based on emissions and fuel efficiency). Low interest loans are also available to small and medium-sized businesses to install energy conservation or pollution control equipment. Finally, subsidies are available for residential and commercial energy efficiency as well as energy management systems; PV installation; energy conservation technology development; and refurbishment of building structures.

Local and Subnational Case Studies

Yokohama City

Background

Japan's second largest city, Yokohama has a population of 3.7 million (1.6 million households, per capita income $31,600 dollars) in 435 square kilometers land area.. It's a beautiful, highly-developed international port city conveniently located 30 minutes from Metropolitan Tokyo by both road and rail.

In the last 60 years, the population of Yokohama City has increased 3.5 fold reaching 3.7 million. According to City of Yokohama, its population peaked during the early 21st century. And during the past decade population increase by year is shrinking. There was 30,000 persons increased in 2003, however, there was only about 3,000 persons increased in 2012. Therefore, the demographic projection will be expected to decrease in the future. In 2050, the expected demographic will decrease down from 3.7 million to 3.4 million. Seniors over age 65 will comprise from 40% of the population.

[63] Asia Pacific Economic Research Centre. Compendium of Energy Efficiency Policies of APEC Economies, Japan. (2012). http://aperc.ieej.or.jp/file/2014/1/27/CEEP2012_Japan.pdf

According to Yokohama's Economic Affairs Bureau the city's total gross product is $115 billion dollars. There are secondary industrial sectors (mining and quarrying sectors, manufacturing sector, electricity and gas sectors, construction sector, etc.) and tertiary industrial sectors (wholesale and retail trade, transportation and warehousing, accommodation and food, information and communication, finance and insurance, real estate, professional, scientific, and technical services) in Yokohama.

There are three major development centers in Yokohama. Commercial buildings are clustered around the Yokohama Station area. Factories concentrate around the bay. Residential areas are situated inland. The diverse topographical areas of the city include the commercial district centering on Minatomirai, with its numerous high-rise buildings on the site of a redeveloped bay area that used to be a shipyard; the large-scale "new town" area, developed between the 1970s and the 1990s and covering 2,000 km^2; and the bay around which large-scale apartment and industrial complexes are concentrated.

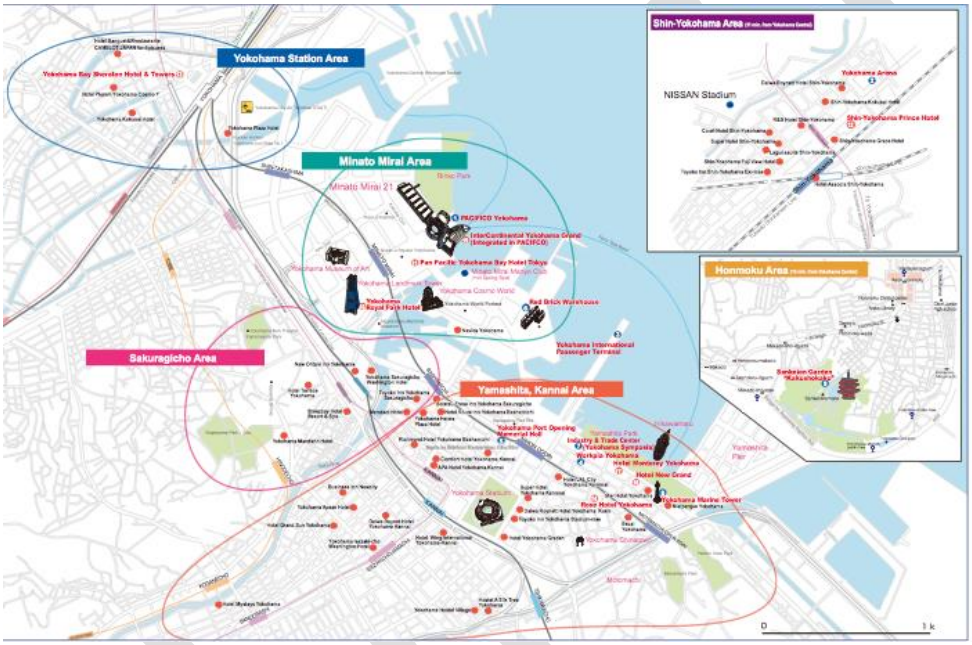


Figure 31 The station, port, new town, and industrial areas of Yokohama city Yokohama's Urban Management and Planning Bureau http://www.city.yokohama.lg.jp/seisaku/senryaku/en/policies/urban/.

City of Yokohama is committed to being a city that is beneficial for both people and the environment, and it works with communities in pursuing the development of an accessible urban milieu. Some of the specific ways in which it is doing this are by developing hub areas around the railway stations that play a central part in people's everyday lives, redeveloping the center of the city that has supported Yokohama's development since the opening of its port, promoting the development of safe, comfortable neighborhoods in partnership with local residents, developing and promoting the use of public transport infrastructure built around the railway network that forms the city's "skeleton," and

developing as a sustainable city capable of responding to global environmental concerns and other changes in social conditions.[64]

- Development of comfortable urban environment

Yokohama seeks to develop its urban infrastructure in order to provide a safe and secure urban environment. Among the ways it is doing this are by improving traffic access to and around the railway stations that function as traffic nodes, and by improving crowded city blocks, all while taking advantage of each district's particular characteristics and features, such as its local history and resources.

In parallel with these projects, communities are being made more vibrant and accessible by making them more attractive places to work, play, do business, shop, and raise families, each according to its own diverse needs and features.

- Economic revitalization and cosmopolitan development

Taking advantage of resources that the heart of Yokohama (the Kannai and Kangai districts, the Minato Mirai 21 district, and the area around Yokohama Station) has to offer, including its proximity to Haneda Airport (soon to take considerably more international flights), while preserving its distinctive character by protecting its historic buildings and nurturing an openness that is receptive to new and pioneering initiatives, Yokohama is developing its presence and its identity as an urban innovator on the global stage.

- Urban development in partnership with local residents

In order to raise awareness of resident-led community development and contribute to the development of safe and attractive neighborhoods, Yokohama has enacted the “Ordinance to Promote Community Development.” This sets forth the responsibilities of residents, city authorities, and other parties, procedures for community development (group registration, organization accreditation, plan development, and rule making), and other necessary matters to assist community-led action to develop local communities.

- Sustainable urban development for both people and the environment

Yokohama is working in an integrated manner to pursue a number of initiatives to build a city that will sustain both attractive human lifestyles and the environment. The railway network and other elements of the public transport infrastructure are being developed to make stations and surrounding facilities accessible to all. A mobility management campaign is also underway to encourage people to become less dependent on their cars and make greater use of other forms of transport, particularly walking, cycling, and public transport. A study is in progress in preparation for the introduction of community cycles in the center of the city.

[64] Yokohama Urban Development Bureau. Policies of the City of Yokohama. Available at http://www.city.yokohama.lg.jp/seisaku/senryaku/en/policies/urban/

The "FutureCity" model in Japan

In December 2011 Yokohama City was selected by the national government as a FutureCity aimed at creating and promoting solutions for a variety of social issues related to the environment and a super-aging society.

Japan is facing challenges of both a rapidly decreasing birthrate and rapid aging. It is projected that in 2050 seniors over age 65 will comprise 40% of the population. Realizing cities and regions where senior citizens can live a fruitful, healthy and secure life in a vital society is an acute challenge. Japan is in a position to be one of the first nations to tackle this problem and to offer solutions to common human challenges.

The Japanese government identified the FutureCity Initiative as one of the National Strategic Projects in its New Growth Strategy in June 2010. The objective of this initiative is to challenge common human problems and to try to propose model solutions as a forerunner. [65]

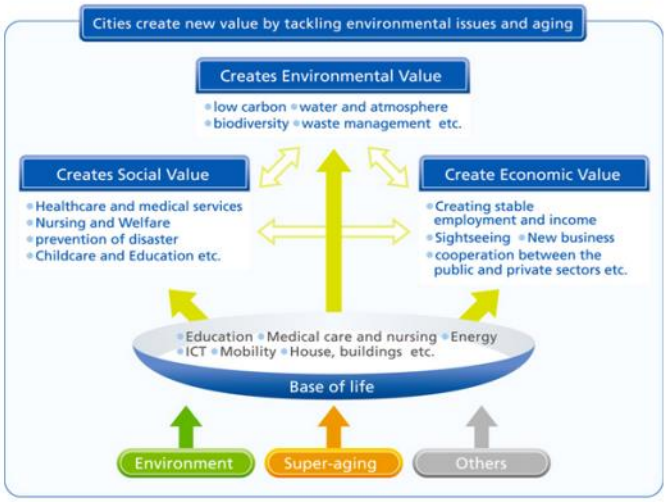


Figure 32 The concept of FutureCity Initiative in Japan. Source: http://futurecity.rro.go.jp/en/about/

The most important thing for the creation of a vibrant city in such circumstances is economic activity. FutureCity initiative is to create a vibrant city through comprehensive initiatives that address the above challenges. This is exactly the kind of future Yokohama City is aiming for. Yokohama City is making efforts in 5 categories: 1. low carbon and energy conservation; 2. water and environment; 3. super-aging society; 4. creativity; 5. challenge.

By taking advantages of synergistic effects to grow a wide range of areas, Yokohama City is working to develop a well-balanced and vibrant city. The initiatives of FutureCity Yokohama are characterized by

[65] Prime Minister's Office. Environmental model city and environmental future city. Available at http://futurecity.rro.go.jp/en/about/

"citizens' power" and "city renovation." The diversity of Yokohama City can also be seen in its cityscape. The city center provides convenience for business activities as well as numerous attractions for tourists, including beautiful districts and historical buildings centered by the port. Moreover, the tranquil residential area is extensive and agriculture flourishes in suburban areas. Based on its diversity, Yokohama City will advance "city renovation" to introduce the latest technologies and systems in a number of areas including the environment, medicine, welfare and the economy.

- Making Yokohama where everybody can live in peace and harmony

Many problems are rising up to the surface, such as the declining birth rate and aging population within the residential sectors near the railways and massive housing estate. Making these housing estates a model area, city developments are preceding where many generations help each other in familiar and nearby places, making a city where everybody can live in peace and harmony.

As an example of a model area, in the Tama Plaza Station North Area (Aoba Ward), the district residents and Yokohama city, railway business operators (Tokyu Corporation), university, related institutions are trying to face regional problems such as renewable energy, medical services, public welfare, multi-generation communication and regeneration of housing estate, in a work-shop format to exchange opinions to create a vision for the city.

- Renovating the existing city to a sustainable city

Every year the CO2 emissions from households increase and in the last 20 years, it has increased forty percent. The key to strategies against it are the basis of daily life, "residence and way of living". We are taking action into disseminating and establishing an energy-saving lifestyle and housing. For example, we are promoting the implementation of HEMS (A system that allows the user to know just how much energy their house is using.), improvement of the energy-saving features of existing housing and construction of models of eco-renovations that make for an easier way of living. Also, it has been proven that living in a super-insulated house is beneficial and we are conducting PR activities to let people in the city know that energy saving housing and an energy saving lifestyle is gentle with the environment, comfortable, healthy and economical.

Yokohama achieved its goal of a 30 percent reduction by 2006, four years before its target, and a reduction of almost 40 percent was achieved by 2007. As a result, Yokohama was able to close two waste incinerators, which allowed them to avoid future incinerator renovation costs of $1.2 billion) and annual running costs of $33.3 million). This is a successful example of achieving both environmental protection and economic benefit through the cooperation of residents, businesses and local government.

The Yokohama Smart City Project (YSCP)

The Yokohama Smart City Project (YSCP), an initiative to establish overseas expansion of Japan's smart grid, was selected as a Next Generation Energy Infrastructure and Social System Demonstration Area by the Ministry of Economy, Trade and Industry in April 2010.

The City of Yokohama is in charge of YSCP from FY2010 to FY2014. Its annual budget is approximately $740 million per year (for five years). The implement of YSCP is a public-private partnership model. The City of Yokohama collaborates with the diverse private enterprises, such as Accenture, Tokyo Gas, Toshiba, Nissan Motor, Panasonic, Meidensha, TEPCO, etc. to work on various projects such as introduction of renewable energy, energy management of households, buildings and local communities and next generation transportation systems.[66]

YSCP is an effort to develop a model for smart cities by means of cooperation between citizens, private companies, and the municipality, and to export the successful model to Japan and the rest of the world. Large-scale operational experiments are being held with Yokohama, a large, advanced city with a diverse topographical range of districts, as the stage. There are three areas included in YSCP: 1) highly developed urban center: Minatomirai 21Area; 2) residential area: Kohoku New Town; 3) industrial cluster: Yokohama Green Valley.

Table 5 The basic information of Yokohama Smart City Project (YSCP). Source: City of Yokohama

Name of city	City of Yokohama
Area	434.98km^2(as of August 2012)
Population	3,697,426 (as of August 2012)
Locations for the operational experiments	City of Yokohama as a whole, with a focus on three districts: The Minatomirai 21 district, the Kohoku New Town district, and the Yokohama Green Valley district
Area covered by the operational experiments	434.98km^2(as of August 2012)
Number of households involved in the operational experiments	Two housing complexes (16 and 24 houses), one apartment complex (177 apartments), 83 houses for technology verifications, 4,000 houses and apartments for social verifications
Number of workplaces involved in the operational experiments	4 office buildings, 2 commercial buildings, 1 large-scale factory
Number of EV/PHV involved in the operational experiments	50 EV for demand response (DR) verifications (including 10 EV for charging/discharging; 2-3 charging stations with PV/storage batteries)
Target for introduction of photovoltaic generation, etc.	Photovoltaic (PV) generation: 27MW; HEMS: 4,000 households; EV: 2,000 vehicles

The project's ambitious vision is to cut down on greenhouse gas (GHG) emissions per person by over 60% from the FY2004 level by FY2050, by over 30% from the FY2004 level by FY2025. A secondary goal is to achieve 10% renewable energy in primary energy supply by 2020.

[66] Japan Smart City. The Yokohama Smart City Project (2014). Available at http://jscp.nepc.or.jp/en/yokohama/

YSCP's aim is to transform a city already provided with social infrastructure into a low-carbon city while maintaining the comfort of its residents. In order to do so, we will introduce a CEMS and develop and operate energy management systems optimized for this specific region. Together with these efforts, we will use PV generation and other forms of renewable energy, and work to change the way that citizens relate to energy. Specifically, we will introduce home energy management systems (HEMS), building energy management systems (BEMS) for offices and commercial buildings, factory energy management systems (FEMS), and electric vehicle (EV) and charging stations for the transport sector, and we will curb peak energy demand and conserve energy through their mutual linkage.

The aims also include the creation of large-scale renewable energy, a free market for private investors, more choices for consumers, creation of security through dispersed power networks. By the end of 2014, it aims to reduce CO2 emissions by about 64,000 t-CO2, introduce about 27 MW of photovoltaic systems,{ the HEMS to about 4,000 households, about 2,000 units of electric vehicles, etc.}

The hierarchical bundling of energy management systems (EMS) enables energy management at the level of individual EMS and demand-side management at the level of the overall system.

Each of the EMS considers its respective environment in managing energy and making energy use visible. There are a number of different types of EMS: HEMS for houses, HEMS for residential complexes, HEMS for apartments, integrated BEMS, and FEMS, which optimally control factory operation. Integrated BEMS offer group management of BEMS for office buildings and commercial facilities. In addition to these, the CEMS brings together elements including the electric vehicles (EV) for charging and discharging verifications, charging stations, and the SCADA storage batteries that contribute to system stabilization, which will form the nucleus of next-generation transport systems, and offer optimal management of energy at the level of the community as a whole.

Wide-area energy management combines three systems: the community energy management system (CEMS) for the community as a whole, home energy management system (HEMS) for houses, and building energy management system (BEMS) for commercial districts. HEMS will be introduced into 4,000 homes to make power consumption visible and encourage households to save electricity and reduce CO2 emissions through DR.

Yokohama Green Power (YGP) Project, an intensive introduction of PV (over 2kW) and Home Energy Management System (HEMS) for 3 designated areas of YSCP in 2012 have reduced the cost up to $2,000 dollars for every household (achieved 1,000 households).

The Yokohama Smart City Project is a typical example of smart community development that uses all three systems: CEMS, HEMS, and BEMS. The results obtained from the experiment during the period up to FY2014 will be utilized for even larger-scale community planning.

2.9 Republic of Korea

Background

Korea has a total land area of around 100 thousand km^2 and a population of 24.9 million, over half of which reside in the Seoul Metropolitan region. In fact, the vast majority of the population (82%) lives in urban areas. Korea had a GDP of $1.305 billion in 2013.

Korea's administrative division is an important consideration in understanding the promotion of energy smart communities. Along with the capital city of Seoul, which is designated as a special city, there are seven metropolitan cities, which are self-governed apart from the eight provinces. Sejong is a special self-governing city and Jeju Island is a special self-governing province.

Energy use in 2011 was 260 million metric tons of oil equivalent or an energy intensity of about 167 kg of oil equivalent per $1,000 GDP (constant 2011 PPP) and the breakdown of fuel mix is shown below. Major industries that carried economic growth include semiconductor, shipbuilding, steel, automobile, petrochemicals, digital electronics, and machinery. Much of Korea's fuel is imported (82%) coal, crude oil, and natural gas; nuclear energy is the largest power source produced domestically. Korea experienced an emission intensity of 11.5 metric tons of CO_2 per capita in 2010.[67]

In an effort to promote energy self-reliance, the Korean government has invested in new and renewable energy development since 1999. While the total primary energy supply increased by 34% between 1999 and 2009, the renewable energy supply has tripled from 1.9 MTOE to 6.2 MTOE. The renewable energy sources include biofuels, landfill gas, biogas, and other biomasses.[68]

The energy demand of the nation is expected to grow by 0.6% annually over the next 20 years. Between 2010 and 2035, energy demand is projected to grow by 0.6% annually in the industrial sector, 0.3% in the transportation sector, 1.6% in the electricity demand, and 0.7% in the natural gas demand.

According to the Korean Statistics Information Service, coal and petroleum energy consumption accounted for 64.5% in the entire national final energy consumption. Between 2009 and 2012, percentages of city gas and electricity grew steadily reaching 12.1% and 19.8% respectively. The portion of thermal and renewable energy consumptions remained about the same during this period.[69]

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[67] International Energy Agency. Korea: Indicators for 2012. Available at http://www.iea.org/statistics/statisticssearch/report/?year=2012&country=KOREA&product=Indicators

[68] Chung, Woohyun, Jangmin Chu, Jo Jihye, Kim Chaghyun , and Albert Tonghoon Han. *Building the Green Village based on Biomass Energy in Guatemala(I): Preliminary Study of BIomass and Environment.* Seoul, Korea: Korea Environment Institute (2012)

[69] Statistics Korea. Korea Statistical Information Service. (2012) Available at www.kosis.kr

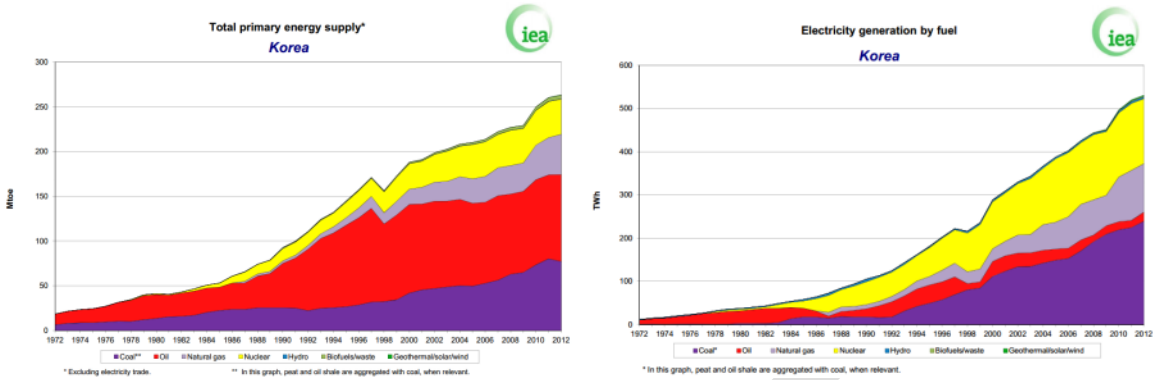

Figure 33 Korea's energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

It is worth noting that rapid economic growth and urbanization of Korea has resulted in substantial increase in the greenhouse gas emissions; emission levels increased by nearly 200% between 1990 and 2005. Korea has a central government energy efficiency improvement goal of a 46% reduction in energy intensity by 2030 from 2005 levels. Goals were also set for individual sectors to be met by 2017 from a 2007 base and measured in million tons of oil equivalent (Mtoe): 34.4 Mtoe by Industry sector; 12.3 Mtoe by Transport sector; 15.5 Mtoe by Residential and Commercial sectors; and 1.9 Mtoe by Public sector. These goals are laid out in the 5th Rational Energy Utilization.[70]

One of the major national policies established to accomplish this goal was the National Strategy for Green Growth in 2009 by President Lee Myung Bak. By implementing this national policy through 2050, Korea not only aims to mitigate climate change, but also create new engines for economic growth and improve quality of life (Jones & Byungseo, 2011). After the establishment of the new growth policy focused on sustainability, Korea's energy policy has shifted from ensuring a stable energy supply for economic growth to considering the environment as well. Administered by the Ministry of Trade, Industry and Energy (formerly the Ministry of Knowledge and Economy), and other relevant government agencies, the primary goal of this new policy focuses on improving energy intensity by 47% and reducing the economy's dependency on fossil fuels. In addition, the government plans to increase the share of new and renewable energy from 2.2% in 2008 to 11% by 2030 and 30% by 2050.[71]

At the economy-level, specific programs for energy efficiency and conservation include:

- The Energy Use Rationalization Act – stabilize energy supply and demand through promotion of conservation and efficient use.

[70] Asia Pacific Economic Research Centre. Compendium of Energy Efficiency Policies of APEC Economies, Korea. (2012). http://aperc.ieej.or.jp/file/2014/1/27/CEEP2012_Korea.pdf

[71] Asia Pacific Energy Research Center. APEC Energy Demand and Supply Outlook 5th Edition. (2013)

- Energy Efficiency Label and Standard Program – consumer good energy labeling
- Building energy codes – passed by national government and executed by local government building officials. Includes requirements for energy efficiency measures in order to obtain building permits for buildings over a certain size.
- Vehicle fuel economy standards
- Energy auditing – mandatory specifically for commercial and industrial sectors for buildings over certain level of energy use.

Financing of programs is provided by a tax reduction and exemption for commercial and industrial sectors for installation of energy efficiency facilities. Low-interest loans (at a rate of 2.0 – 2.2% APY, as of 2011) are made available through the aforementioned Energy Use Rationalization Fund. Finally subsidies are available for certain products, such as lighting fixtures and lamps.

Korea's economy-level programs are important to drive energy smart development at the local level. However, as of the writing of this report, there was not a specific national-level policy to promote holistic smart energy community development.

Local and Subnational Case Studies

Songdo International Business District

Background

The Incheon Metropolitan City located in northwest South Korea is Korea's third largest city followed by Seoul and Busan. The city's development started when Jemulpo Port was built in 1883 which functioned as a gateway to foreign trade. Because of its geographical advantage as a coastal city located close to the capital, Seoul, the city has grown rapidly ever since. Total land area of the city was about 202.2 km^2 in 1981 when it first became an incorporated city. Then after incorporating adjacent municipalities and reclaiming lands the city's administrative boundary has been expanded to 1,040.82 km^2 in 2013.[72]

Because of the geographic and economic advantages of the city, Korean government designated a total of 209 km^2 of lands around the airport and the port as the International Free Economic Zone (IFEZ) in 2003. The area is only about 6km away from the city center of Incheon and 20 km away from Seoul and it is well connected by public transit and expressways. Upon completion, the IFEZ will become an international business city, which will guarantee tax supports, free economic activity, high-quality administrative service, and a comfortable and convenient living environment.[73]

[72] Incheon Metropolitan City. Incheon Metropolitan City Official Website. (2013) Accessed at www.incheon.go.kr

[73] IFEZ. International Free Economic Zone Official Website. (2013) Accessed at http://ifez.go.kr/jsp/eng/about/about1.jsp.

Figure 34 Map of IFEZ

The IFEZ consist of three subareas – Songdo, Yeongjong, and Cheongna. Songdo Area - often referred to as the New Songdo City - is currently being developed on 53.4 km^2 of reclaimed land. This $9.5 billion project is expected to be completed in 2020 and upon completion will accommodate a total of 252,000 people and function as the center for international Information Technology (IT) and Biotechnology (BT) businesses. Yeongjong area development is a $4.2 billion project on a 98.3 km^2 of reclaimed land located right next to the Incheon International Airport. The area will be the center for tourism and logistics. The Cheongna area development was completed in 2012 on a 17.8 km^2 land located on the northeast corner of the IFEZ, which cost $5.8 billion to complete. The area is now home to 90,000 people and it has multiple urban functions that include business, finance, tourism, leisure and advanced industry.

The energy consumption of the city only accounts for 4.4% of total nationwide energy consumption. The highest energy consumption of Incheon is from electricity (431,549 TOE) followed by city gas (164,523 TOE) and petroleum (55,256 TOE). The following table summarizes the energy consumption of Incheon in 2008.[74]

The Songdo International Business District (IBD) is located on 6.28 km^2 of land of the New Songdo City which has been developed by Gale International and Korea's POSCO E&C. At the initiation of the project, the City of Incheon and the Korean Government promised full support and complementary endorsement. The city agreed to provide basic infrastructure such as sewage, streets, and electricity costing USD 1 billion. The land was sold from the city to the developers at discounted rate between 25% and 50%. Kohn Pederson Fox Associates (KPF), the US architectural firm based in NYC did the master plan for the city core, the Songdo IBD which was approved in 2002. The two developers, Gale International and POSCO E&C established a joint venture called New Songdo City Development, LLC (NSC) in 2002 to manage the project. Gale International Korea, LLC has been in charge of development and operation of the project under the agreement with NSC while the POSCO E&C has managed the construction. The first round financing of USD 90 million was completed in October 2003 by syndicated

[74] Korea Statistical Information Service. Statistics Korea. (2012) Accessed at www.kosis.kr

loans from Woori Bank, a Korean commercial Bank, and ABN, AMRO, the Bank of Nova Scotia and other foreign investors. The groundbreaking of the project was in May, 2005 with construction of a convention center named Convensia. And construction of the first residential towers was initiated in the following month. The project went through additional financing in 2004 and 2005 to construct additional buildings and infrastructure.[75]

Today the project is about 50% completed and 2.9 km^2 of the project area has been developed. A total of 14 buildings have been constructed, including Northeast Asia Trade Tower, Convention Center, Chadwick International School, Jack Nicklaus Golf Club and Canal Street, as well as an art center, retail mall, and hotels.[76]

Songdo IBD was chosen as an exemplary case for the Low Carbon Model Town, because of the sustainable and energy efficient designs of the district. KPF, working with the government and the developers, crafted a vision for the project in the master plan that established goals and objectives for creating the most sustainable planned city. The development has been in compliance with KPF's master plan. The following describes the key components of the plan incorporating sustainability principles.[77]

Site & Transportation

- Achieve "complex" sustainability and make city plan a "green framework."
- Connect sea into the canal system to increase biodiversity.
- Revise transportation plan to emphasize mass transit and deter automobile use.
- Provide accessible, preferable multimodal alternative transportation.
- Create social incentives to reduce car-centric behaviors, such as better mortgage rates for families with fewer vehicles.
- Investigate the potential for free public transportation systems at the city center.
- Create a City Bikes network of free bicycles and plentiful storage areas similar to systems in Amsterdam and Copenhagen.
- Enhance pedestrian experience.
- Seek to balance water collection with water use and reuse.

Upstream & Downstream Impacts

- Optimize waste stream.
- Implement source separation: recyclables, organics, and solid waste.

[75] Lee, Junho, and Jeehyun Oh. "New Songdo City and the Value of Flexibility: A Case Study of Implementation and Analysis of a Mega-Scale Project." Master's Degree Thesis. MIT, 2008.

[76] IFEZ. International Free Economic Zone Official Website. (2013) Accessed at http://ifez.go.kr/jsp/eng/about/about1.jsp.

[77] KPF. "New Songdo Green City Master Plan." New York: Kohn Pederson Fox Asssoicates PC, 2002.

- Pursue large-scale composting initiatives.
- Foster industrial ecology and green business opportunities to both build the city and support its occupants.

Energy & Resources

- Create buildings that are carbon neutral and net-energy producers.
- Employ personalized living management technologies (U-Life) to design efficient, high-performance energy systems.
- Upgrade existing infrastructure to maximize energy and resource efficiency.
- Institutionalize industrial ecology to create closed-loop cycles of material and energy use within New Songdo City.
- Invest in national renewable energy infrastructure, while reinforcing the ecological goals of New Songdo City. Explore wind and tidal power opportunities.
- Use a whole systems design approach to achieve maximum energy performance and materials efficiency.
- Harvest energy from wastewater piping by using turbines and heat recovery devices.
- Install ice storage units in all foundations to reduce refrigeration and energy loads.
- Optimize power generation to a load factor of one.
- Specify materials that are regionally produced and manufactured to minimize embodied energy.
- Substitute blast furnace slag for cement to reduce emissions of cement production.
- Design all buildings with ultra-high-performance façades beyond current standards.
- Investigate solid-oxide fuel cells for distributed power.

Quality of Life

- Connect people with the local environment both natural and cultural.
- Promote environmental awareness throughout the public realm.
- Help homeowners to understand the benefits of healthy living.
- Make New Songdo City the safest city in the world.
- Establish links with existing cities to mediate New Songdo City's edge condition.

According to KPF, in pursuing these goals and objectives, through energy efficient design of buildings and transport the city will achieve an estimated reduction in overall annual greenhouse gas (GHG) emissions from energy use amounting to levels 67% lower than that of the typical low-density development. For example, its LEED-certified buildings will enable the city to significantly lower the GHG emissions (250,000 tons) compared to equivalent conventionally designed buildings (674,000 tons). Assuming that about 70% of the residents of the city will use hydrogen buses, the city will only generate 7,740 tons of GHG annually which is far smaller than the same percentage of population using diesel-fueled buses in high-density urban areas (17,290 tons) and even smaller than GHG emissions of typical low density, car dependent areas (109,200 tons). The following figure illustrates the comparison.

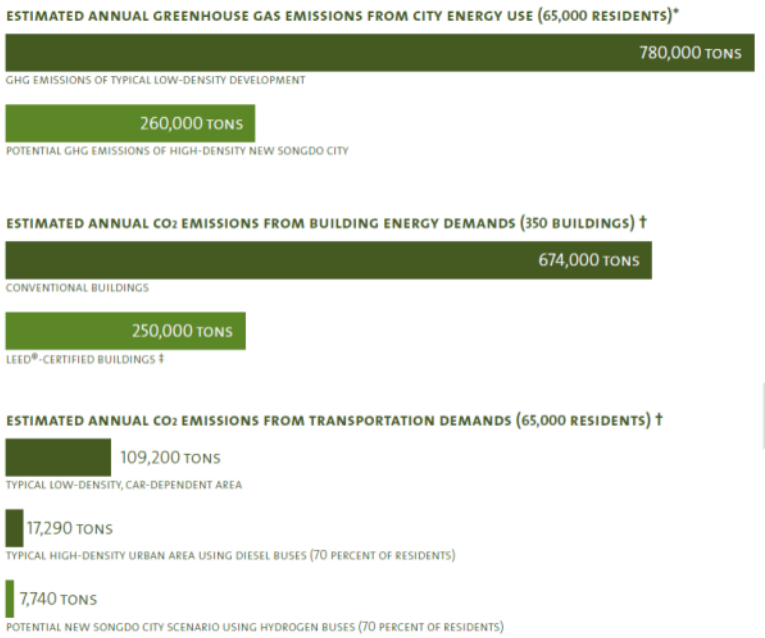

Figure 35 GHG Emissions by Scenarios. Source: KPF

The land use and transportation/infrastructures plans and building design and codes for NSC yield a high density, compact city design that will accommodate 65,000 residents in 107.7 hectares consisting of 76.85 hectares of multi-dwelling housing and 30.84 hectares of mixed use residential housing. The residential land use accounts for 18.8% of total development area. A total of 58.46 hectares of land is allocated for business and commercial use with floor area ratio of 6.3 taking 10.2% of the project area. One of the distinctive features of the district is the 208.78 hectares of green spaces consisting of a 29.7 hectare of Central Park, 77.2 hectare of Golf Course, several small parks, residential green spaces, commercial green spaces, and canal green.

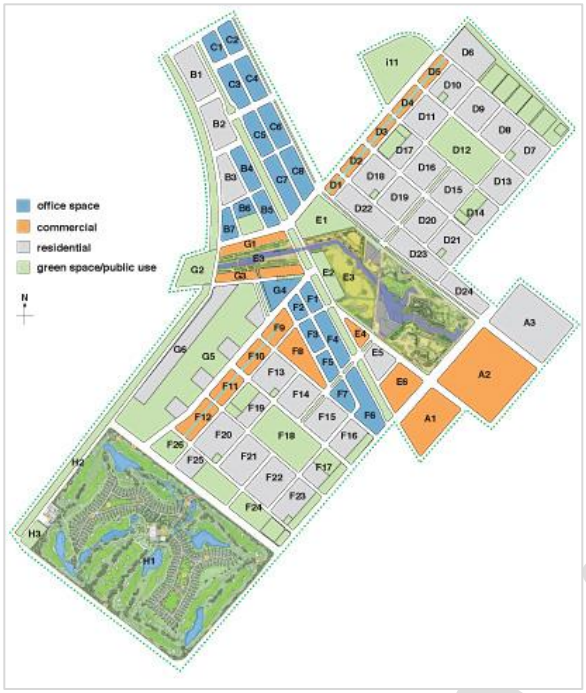

Figure 36 Land Use Map of the Songdo IBD

The New Songdo City IBD development has several low carbon model town features related to transportation, infrastructure and building design that will enhance energy efficiency. The infrastructure part of the development plan consists of four components: 1) Transportation, 3) Water Use Network, 4) Waste Collection and 5) Energy Network. The building strategies part also consists of four components: 1) High Performance Building, 2) Materials and Resources, 3) Building Energy Strategy, and 4) Indoor Environmental Quality.[78]

Infrastructure

The first component focuses on creating public transportation friendly environment where bus services are extended throughout the city with bus stops located within one-quarter mile of all residential and commercial buildings. The city is also planning on introducing fuel cell buses to promote energy efficiency in the public transportation and minimize the GHG emissions. The subway lines will be extended to provide connections to Seoul, Incheon, and the airport and the lines will be within a half-mile walk of most residents. Other energy smart transportation approach includes promoting walkability and bikeability through streetscape design. For example, hardscape and softscape barriers are being installed to segregate bike lands and sidewalks from automobile-filled streets to provide safe and comfortable pedestrian-friendly environments. The city is also considering introducing bike-share and car-share systems to discourage individual automobile uses.

[78] KPF. "New Songdo Green City Master Plan." New York: Kohn Pederson Fox Asssoicates PC, 2002.

The water use network component is about implementing a tiered approach to freshwater usage. Potable water involving direct human contact use will be separate from non-potable water uses. The effluent from the potable water uses will be treated and used in a tiered graywater network of non-potable water activities. Rainwater will be collected to be used for landscape irrigation and cooling tower operations. Sewage water will also be recycled after the high-end filtering and treatment at a treatment facility. The treated sewage water will be used for toilet flushing, road cleaning, and irrigation of public parks and urban green spaces. The KPG estimated that this water recycling system can save up to 13,000 cubic meters per day of freshwater consumption.

The city is currently building a state of the art waste collection system. Because the conventional waste collection and carriage generates significant amount of GHG emissions, the city is installing a pneumatic waste collection system to transport solid waste to a central waste processing facility using large pneumatic pipes. Once collected, the waste is compacted, dehydrated, and sorted with recyclables removed from the waste stream. Separated waste either goes to landfills or incinerators. The heat generated from in the incineration process is delivered back to buildings in New Songdo City via a district hot-water system. In addition, contractors constructing buildings in the city are required to recycle cardboard, metal, brick, acoustical tile, concrete, plastic, clean wood, glass, gypsum wallboard, carpet, insulation, and other construction materials.

A combined-cycle power plant of the city supplies power and district heat to the city. This power plant consists of two gas turbines. Waste heat, which produces heat in the form of hot water, is distributed throughout the city for building uses such as heating, domestic hot water, and cooling.

Building Strategy

Design of new buildings in the city takes an integrated multidisciplinary approach that views the building as a system made up of interdependent architectural and engineering components yield higher performance and optimizes management of energy and other resources. Building orientation, façade design and passive ventilation strategies responding to the unique climate of Korea is applied to the building design to reduce HVAC loads and energy use. Through the proper application of integrated design, the buildings of the city will yield values of optimized building performance including improved air quality, conservation of resources, reduced waste, lower operation costs, increased asset value and decreased strain on local infrastructure.

Because the construction of buildings typically consumes approximately 40 percent of raw materials, the project aims to cautiously select building systems and materials that are regionally manufactured through energy-efficient means to minimize the embodied energy of a building and reduce a building's overall carbon footprint.

For the building energy strategy, the city will employ various techniques to control solar heat gain such as high-performance glazing with low solar heat-gain factors, external shading devices, internal shading devices, and ventilated double facades. Depending on the energy use for cooling and heating of different building types various energy conservation designs are implemented to the buildings such as

the use of conventional variable air-volume systems in buildings like the Northeast Asia Trade Tower, water-cooled direct expansion systems for residential buildings, stratified air systems in the convention center, and under-floor air-conditioning and chilled beams in the U-Life Complex.

Indoor air quality improvement is one of the major elements of the building strategies. HVAC systems and passive cooling and heating strategies are configured and integrated with the building architecture to maximize indoor environmental quality and ventilation effectiveness. Through enhanced ventilation techniques and the use of low- or no-VOC paints, adhesives, sealants and materials, the city will have the best indoor air quality freed from unhealthy pollutants.

Overall, the New Songdo City uses both Korean and international green building rating systems, notably the LEED certification from the US Green Building Council, to ensure that projects are built to a high standard of sustainable design and construction. By implementing the building strategies, the city will reduce energy consumption, increase energy efficiency, utilize recycled and natural materials and generate clean or renewable electricity. This project is a unique among the report's cases as its measured success is based on an external guideline, the LEED Neighborhood Development (ND) standard.

Gangneung City

The City of Gangneung is located on the east coast of Korean Peninsula with Taebaek Mountain Range located on the west side of the city. The city covers about 6.1% of the total area of the Gangwon Province located on the northeast of region of South Korea (1,039.8km2 out of 16,874.6km2). The land cover of the city consists of 80.8% of forest and 10.0% of farm which means that there are very few developable lands. However, the geographical feature of having both coastal and mountain areas as well as historical and cultural resources have made the city one of the most popular tourist attractions in Korea. Annually about 20 million tourists visit the city. Population of the city in 2011 was 217,571 which accounts for 14.1% of the entire population of the province. The population density was 211.7 people per squared kilometer in 2011.[79]

Major sources of energy production of the city are petroleum, coal, and natural gas. In response to the climate change and international environmental treaties including the Kyoto Protocol, the city has increased the proportion of new and renewable energy supply over the years. New and renewable energy supply of the city in 2011 consisted of 7,926 m^2 of solar heat generation, 4,943kW of photovoltaic, 289 kW of geothermal, 2,750 kW of wind energy, and 340 kW of small hydro plant electricity generations.

As part of the Green Growth agenda of the Korea's former President, Lee Myungbak, the Ministry of Environment (ME) and the Ministry of Land, Transport, and Maritime Affairs (MLTM) initiated a pilot project in City of Gangneung to build a Low-Carbon Green City in 2009. The project site is located in the

[79] City of Gangneung. City Report 2010-2011. (2012)

Gyeongpo area of Gangneung City. It is about 17.5 km^2 in size and well-connected to other regions by major expressways and railways. Upon completion, the green city will house 19,000 people.[80]

The Gangneung Low-Carbon Green City pilot project is currently managed by an Intergovernmental Project Taskforce headed by the deputy secretaries of the Ministry of Environment and the Ministry of Land, Transport, and Maritime Affair. The taskforce consists of two sub-organizations – Intergovernmental Cooperation Committee consists of policymakers from all ministries and the Ministry of Environment Green City Project Management Group consists of environmental experts from public, private and academic sectors.

The Intergovernmental Project Task Force oversees the planning and implementation of the project and makes necessary policy decisions to support the project. The Intergovernmental Cooperation Committee takes care of administrative process and financing of the project. And finally Ministry of Environment Green City Project Management Group develops and implements the Green City Master Plan.

A total estimated cost of the project is about $900 million USD 35% of which will be funded by the national budget, 14% by local budget from the province and the city, and 51% from the private investment. About 7.6% of the total budget will be allocated for green transportation, 11.8% for the ecology preservation, 50.8% for energy, 7.6% for water and water recycle and recovery, and 22.2% for eco-tourism and green Practices.

The master plan of the project developed by Ministry of Environment and Ministry of Land, Transport, and Maritime Affairs contains a detailed land use map showing how the areas will be developed. The land use of the site includes single and multifamily residential areas, commercial, tourist accommodation, neighborhood center, school, cultural facilities, and green spaces including parks, stream, lake, forest, and landscape agricultural areas.

[80] Ministry of Environment, Ministry of Land, Transport, and Maritime Affairs. Gangneuong Low Carbon Green City Pilot Project Master Plan. (2011)

Figure 37 Land Use Map of Gangneung Low-Carbon Green City

The vision of the master plan is “Creation of a Global Leading City in Low-Carbon Green Growth” with the following major objectives:

- Creation of Zero-Carbon City in response to the climate change
- Creation of livable Eco-City
- Green Tourist City in harmony with historic and cultural assets.

The plan sets the following five strategies to accomplish these objectives:

- Preserve and restore the natural environment
- Utilize cultural and traditional assets to enhance the tourism industry
- Transform the city into a test-bed for green technologies
- Retrofit transportation and buildings to low-carbon ones
- Induce citizen participation in green practices

By implementing these strategies, the ministries have estimated that the city will be able to reduce greenhouse gas (GHG) emissions by 49.0% of BAU (8,614 tCO_2 equivalent) which will be achieved by 6.9% reduction from the transportation sector, 67% from the energy sector, and 26.1% from green infrastructure and green practices. The city will also decrease energy usage by 35.9% of BAU (41,778 TOE) which will be accomplished by 6.9% reduction from green transportation, 65.1% from green energy (infrastructure and buildings), and 28% from green technology and green practices. Upon completion, about 9.3% of the total city energy will be produced from renewable sources.[81]

A total of 28 sub-projects constitute the national Low-Carbon Green City pilot project in Gangneung which will be implemented in three stages. All projects in each stage are classified into five categories: 1)

[81] Ministry of Environment, Ministry of Land, Transport, and Maritime Affairs. Gangneuong Low Carbon Green City Pilot Project Master Plan. (2011)

Green Transportation, 2) Ecology Preservation, 3) Energy, 4) Water and Waste Recycle and Recovery, and 5) Eco-Tourism and Green Practices. The list of sub-projects is presented in Table 3.6 below.

Table 6 Gangneung Low-Carbon Green City Sub-Projects. Source: ME & MLTM

Stage	Category	Projects
Stage 1 (2011~ 2012)	Green Transportation	Eco-Trail Project Constructing 10th largest bike network
	Ecology Preservation	Gyeongpo Wetland Restoration Project Wichon Stream Reservoir Construction
	Energy	Environmental Foundation Facility Carbon-Neutral Program
	Water and Water Recycle and Recovery	Water Recycle Pilot Project (R&D)
	Eco-Tourism and Green Practices	Green Renaissance landmark construction Carbon-Zero School construction Environmental Machine-to-Machine (M2M) project
Stage 2 (2012~2016)	Green Transportation	Environmental-friendly vehicle infrastructure construction Green transportation system reform Eco-Forest Trail Project
	Ecology Preservation	Soonpogae Lake Wetland Restoration Project Gyeongpo Eco-Tourism Promotion Project Gyeongpo Stream Refurbishment Project Gyeongpo Stream Historic Preservation Project
	Energy	Seawater Heat Source Energy Utilization Project (R&D) LED Streetlight Installation Green City Renewable Energy Installation Green Village Development
	Water and Water Recycle and Recovery	Green City Sewer System Improvement Project
	Eco-Tourism and Green Practices	U-City Construction Healing Forest Development Eco-Agricultural Industry Promotion
Stage 3 (2016~2020)	Energy	Green Technology-themed Park Project Smart Green City Project
	Water and Water Recycle and Recovery	Resource Recovery Project
	Eco-Tourism and Green Practices	Green Business and Industry Park

As of 2011, four projects - Carbon-Zero School Construction, Environmental Machine-to-Machine (M2M) Project, Water Recycle Pilot Project (R&D), and Eco-Trail Project – were completed at a combined cost of USD 8.4 million.

The city redeveloped Gyeongpo Elementary School into a carbon-zero School and constructed 3,874 m^2 of eco-park and 453 m^2 of playground where children can learn about climate change. Photovoltaic panels, solar heat panels and LED lights were installed at the school. The redevelopment cost about USD 2.3 million and was funded with both national and local budgets. The Environmental M2M project cost about USD 0.6 million and was funded by national and local budget as well as private investment. The M2M facility installation equipped the city with consolidated environmental control systems that monitor parks and meteorology, and transmit real-time information. The Water Recycle Pilot project was a USD 2.65 million project. The city installed sewage treatment and recycling facilities with the capacity of processing 100 m^2 of sewage per day and rainwater recycling facilities with the capacity of 10m2 per day. Lastly the city completed construction of an 11.5 km long eco-trail with biotopes, forest,

bike trails and amenities in 2011 which cost USD 1.1 million. Central government, Gangwon Province, and the city jointly funded the project.

2.10 Malaysia

Background

Generally separated into east (East Malaysia or Malaysia Borneo) and west (Peninsular Malaysia) regions, Malaysia is composed of 13 states and three federal territories. The federal government has direct administrative control over the three territories, while states have separate governance. States are divided into districts and further subdivisions with local administrations. Malaysia has a total landmass of approximately 330 thousand km^2 and a population of 29.7 million in 2013. Nearly three quarters (73%) of the population is urbanized. Malaysia's economy has seen growth (despite a slowdown in 2009) over the last decade and its GDP reached $312 Billion USD in 2013.

Malaysia is a net energy exporter, exporting 6.2 Mtoe, while consuming 75.9 Mtoe. Malaysia's energy use intensity was at 125.2 kg of oil equivalent per $1000 GDP (constant 2011 PPP) and its CO_2 intensity was 0.38 kg per $ GDP (2011 PPP). Malaysia's primary energy supply is composed predominantly of fossil fuels with an increased dependence on natural gas, which is a major export product. Coal and natural gas are the major sources for electricity production.

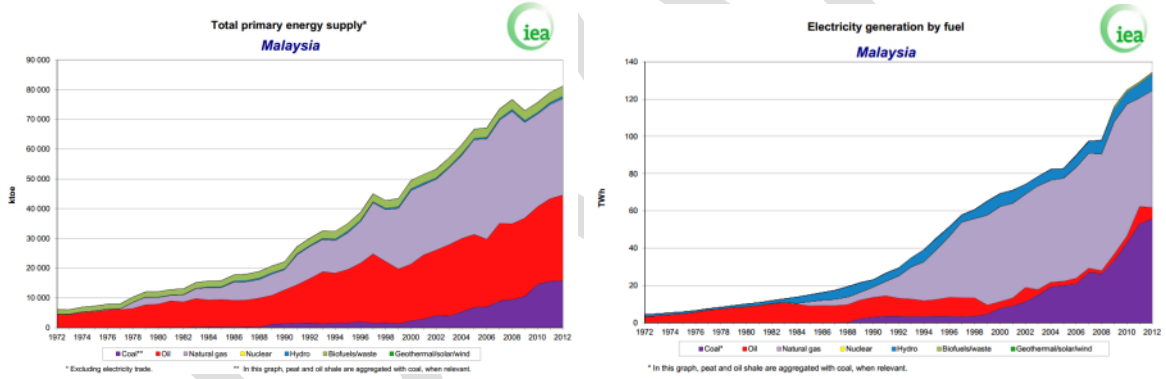

Figure 38 Malaysia's energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

Malaysia is in the process of drafting a National Energy Efficiency Master Plan, which is available as a draft version for comment at the time of the writing of this report.[82]

Economy-level programs:

[82] KeTTHA. National Energy Efficiency Action Plan. (2014) Available at http://www.kettha.gov.my/kettha/portal/document/files/NEEAP%20For%20Comments%20Final%20January%202014.pdf

- Efficient Management of Electrical Energy Regulation – requires energy management consultation for all users of 3 million kWh or more.
- Building code insulation requirements for conditioned spaces over 4,000 m^2.
- Minimum Energy Performance Standards (MEPS) – for electric appliances and lighting.

Financing has been available through tax incentives in the form of waiver of import duty and sales tax on energy efficiency equipment or for leaders in implementation of energy efficiency. Government guaranteed loans and cash rebates are also available.

The newly designed National Energy Efficiency Mater Plan looks to overcome barriers identified in achieving greater energy efficiency. Actions include:

- Further funding
- Government-led initiatives for pioneering implementation by government institutions
- Capacity building through education and training as well as expanded research and development
- Expanded monitoring framework per recommendations in the APEC Peer Review on Energy Efficiency

2.11 Mexico

Background

Mexico, located in North America, has a landmass of nearly 2 million km^2 and a population of 122.3 million as of 2013, of which 79% reside in urban settlements. Mexico had a GDP of $1.261 billion USD in 2013. Mexico is divided into 31 states, which are directly governed by locally elected representatives. States are further divided into municipalities, which are likewise governed by a mayor or municipal president, also elected by the local residents. Finally, Mexico City is governed by the federal government, not a particular state, and has more limited local rule than other municipalities.

Mexico is a net energy exporter of 22.9 Mtoe in 2012 and a total energy use of 186 Mtoe; its energy intensity was 98 kg of oil equivalent per $1,000 GDP (constant 2011 PPP). Further, Mexico had a CO_2 emission intensity of 0.24 kg per $ GDP (2011 PPP). Mexico's fuel mix is dominated by oil, followed by natural gas and coal. The balance is met by a combination of biofuels, nuclear, and renewables. Mexico's export surplus is owed to its significant crude oil production.

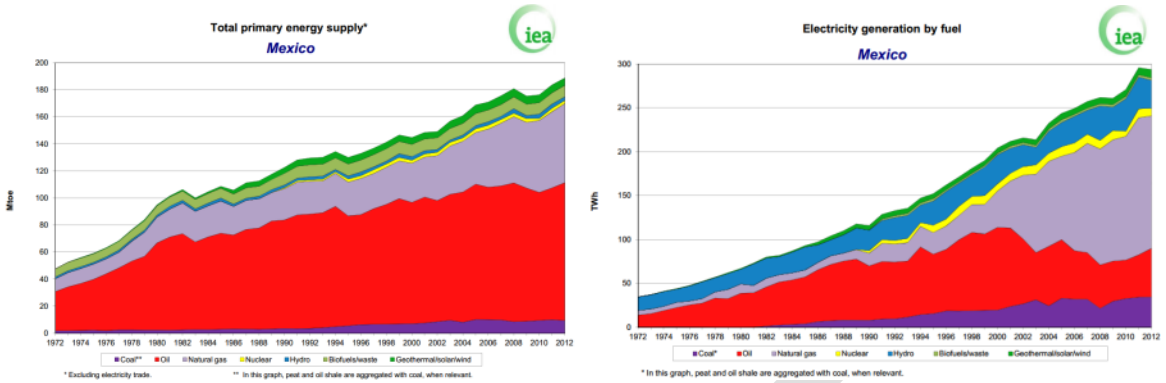

Figure 39 Mexico's energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

Mexico has released a National Energy Strategy (ENE) 2013-2027, which identifies a set of actions to address the need for energy efficiency. Among these are programs that address the need for sustainable cities, including design of high efficiency mobility schemes, and incorporating energy criteria in urban planning. In fact this characteristic is the most striking in Mexico's planning, as it addresses the need to adjust to urbanization. "Consequently, the demand for higher services such as water pumping systems, street lighting, public transport, space conditioning and infrastructure concentrated energy in the form of electricity and fuel in big cities…" [83] Many economy-level initiatives are executed by the National Commission for Efficient Energy Use (Conuee). Conuee's feature programs include the National Project on Energy Efficiency for Street Light Systems, Solar Water Heating Program, and the Energy Efficiency General Provisions for the Federal Public Administration.[84]

Local and Subnational Case Studies

Mexico City

Mexico City is a successful case of climate action planning. Along with the City's Green Plan, the Climate Action Plan 2008-2011 set out to reduce GHG emissions by 7 million tons of CO_2 equivalent and implement a climate change adaptation program. The plan laid out 26 GHG mitigation measures aimed at reducing CO2 emissions by 4.4 million tons CO_2e per annually and funded with a budget of $56.1 million pesos. Actions fell into four categories with the following relative contribution to the GHG reduction goal: Energy (10%), Water (12%), Transportation (42%), and Waste (35%).[85]

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[83] SENER. Estrategia National De Energia 2013-2027. Available at http://www.sener.gob.mx/res/PE_y_DT/pub/2013/ENE_2013-2027.pdf

[84] SENER. Conuee's Work Progamme. (2014) Available at http://www.conuee.gob.mx/wb/Conuee/conueework

[85] Mexico City Ministry of the Environment. Mexico City Climate Action Program 2008-2011 Summary. (2008) http://www.sma.df.gob.mx/sma/links/download/archivos/paccm_summary.pdf

The specific actions for each sector are listed below:

Energy Sector

- Sustainable housing – Funding for new housing in the Multifamily Housing Program, integrating sustainability criteria such as the installation of solar collectors, energy saving systems, water saving systems, systems for the utilization of rainwater and soapy water, waste-water treatment plants, and absorption wells
- Sustainable buildings – Establishing environmental certification systems for commercial and residential property in Mexico City
- Renewable energy programs – Promoting solar energy water heating in Mexico City government buildings – Promoting the exploitation of solar energy in businesses and services through existing relevant environmental norms
- Energy efficiency program in Mexico City government – Efficient Lighting in Buildings (ESCO's) – Efficient Street Lighting – Efficient operation of Electrical Transportation System – Replacement of fluorescent lighting with energy-saving lighting in the subway
- Efficient home lighting program – Distribution of 10 million compact fluorescent lamps in Mexico City homes

Water Sector

- Improvement of MCWS (Mexico City Water System) water pump control systems to avoid unnecessary equipment use during low demand hours – Equipping, reconditioning and/or repair of the pump station control systems and unitary pumping equipment now used at different points of the MCWS, with the aim of minimizing operation hours and thus reducing electrical energy consumption associated with these systems
- Reduction of emissions from septic systems – Construction and provision of sewerage and water treatment services in areas where the best cost-benefit relation and reduction of methane gas is possible
- Energy improvement of MCWS water pump system equipment – Infrastructure maintenance of potable water, sewerage, and water treatment and reuse systems of the MCWS, with the aim of reducing electrical energy consumption associated with their operation
- Electrical energy generation in hydroelectric plants installed at existing MCWS waterfalls – Exploitation of hydroelectric potential in an electrical energy generation plant
- Infrastructure improvement through leak suppression and pipe rehabilitation and sectioning at water distribution facilities – Reinforcement of leak and water loss detection, as well as reduction activities at different plants of the MCWS, with the aim of reducing electrical energy consumption associated with their operation
- Home water saving programs – A permanent water culture campaign to encourage water savings and efficiency, geared towards reducing demand by at least 2.2 m3/s by 2010, promoting the installation of low-flow toilets and water saving accessories

- Reduction of mud emissions from city biological treatment plant – The inclusion of greenhouse gas reduction criteria in the reduction of mud emissions from biological treatment plants in Mexico City

Transportation Sector

- Construction of non-motorized mobility corridors – Strategic plan for the creation of a bike path network in Mexico City; construction of 300 km of bike paths and initiation of "Travel by Bike" project
- Implementation of streetcar corridor, Historic Center to Buenavista – An increase in electrical transportation in Mexico City through the implementation of a streetcar corridor from the Historic Center to Buenavista
- Renovation of vehicle stock for Passenger Transportation Network – Pilot project to test clean technologies and evaluate the best vehicle renovation technology – Renovation of 920 units; Acquisition of 200 units for new routes; Acquisition of 700 joint units for Metrobus use
- Renovation of obsolete vehicle stock for Mexico City government and District offices – 100% replacement of vehicle stock for the Mexico City government with energy efficient, low contamination units by 2012
- Establishment of vehicle inspection program for freight trucks – Application of vehicle inspection program for freight transportation in Mexico City
- Replacement of medium capacity vehicle service concession with new high capacity vehicles – Replacement of 20,000 medium capacity units with high capacity vehicles
- Bus Rapid Transit Corridors (Metrobus) – Implementation of 9 transportation corridors in Mexico City with 200 km of restricted lanes and 800 tandem buses to replace 3000 microbuses
- Replacement of passenger taxi service concession with new vehicles – Replacement of 75,000 2-door vehicles with 4-door vehicles, including in the former taxi fleet
- Expansion of Collective Transportation System, Subway Line 12 – Construction of Subway Line 12
- Obligatory School Transportation System – Gradual change from the use of private transportation by students to obligatory public transportation

Waste Sector

- Construction of Compost Production Plant in Central de Abastos market in Mexico City – The creation of a compost center is proposed in the Central de Abastos market to exploit the 700 tons of organic waste generated on a daily basis
- Capture and exploitation of biogas from the Bordo Poniente Stage 4 landfill – The capture and exploitation of the biogas emitted from the Bordo Poniente Stage 4 landfill and the eventual installation of an electrical power plant
- Construction of Integrated Waste Recycling and Energy Center in Mexico City – Construction and operation of an integrated recycling and energy center for appropriate solid waste management in Mexico City

- Modernization and automation of waste transfer stations and selection plants and renovation
- of vehicle fleet – A modernization and automation program for the best management and operation of transfer centers, separation plants, compost plants, energy savings, and energy efficiency in these facilities – Renovation of the vehicular stock for the waste collection and transfer

In 2012, Mexico City released the results of its Climate Action Plan, showing that the overall GHG emission reduction goal was exceeded by 10% yielding 7.7 million tons of CO_2e.

During the 2008-2012 period guided by the Program, Mexico City has achieved C02e reductions across multiple sectors, including: [86]

- Transportation: 4.8M tons CO2e (62% of total emissions reductions)
- Waste management: 1.2M tons CO2e (15.3% of total emissions reductions)
- Carbon sequestration by reforestation: 893,471 tons CO2e (11.6% of total emissions reductions)
- Energy efficiency: 834,529 tons CO2e (10.8% of total emissions reductions)
- Water management: 4,670 tons CO2e (0.1% of total emissions reductions)

Mexico City's planning efforts won it a Sustainable Transportation Award from the Institute for Transportation and Development Policy in 2013. ITDP recognized Mexico City for its Bus Rapid Transit (BRT) system, as well as its bike and pedestrian infrastructure.[87] IN 2013, Mexico City's mayor signed an agreement with C40 to develop the next phase of its Climate Action Plan for 2013-2020.[88]

2.12 New Zealand

Background

Located in the southwestern Pacific Ocean, New Zealand is comprised of two islands with a total landmass of 268 thousand km^2. Though the economy was historically divided into subnational regions, these were abolished and New Zealand is now local administration is set by the central government. This local administration is split into two tiers: 67 territorial authorities responsible for local infrastructure and development; and 11 regional councils that regulate the natural environment. New

[86] C40. Mexico City meets, exceeds Climate Action Program goals (2012) http://c40.org/blog_posts/mexico-city-meets-exceeds-climate-action-program-goals

[87] Institute for Transportaion and Development Policy. Mexico City Wins 2013 Sustainable Transport Award. (2013) https://www.itdp.org/mexico-city-wins-2013-sustainable-transport-award/

[88] C40. Mayor of Mexico City Signs Agreement with C40 Chair. (2013) http://c40.org/blog_posts/mayor-of-mexico-city-signs-agreement-with-c40-chair

Zealand had a population of 4.5 million in 2013 with 86% residing in urban areas. Its GDP was $186 billion USD in 2013.[89]

New Zealand is a net energy importer, relying on oil product imports for the transportation sector. Notably, New Zealand's electricity generation is dominated by renewable energy in the form of hydro, geothermal, and wind to a smaller extent.[90] As a consequence of its considerable renewable energy generation, New Zealand has a fairly typical energy use intensity for APEC's developed economies (130 kg of oil equivalent per $1000 GDP [constant 2011 PPP]), but has a CO_2 intensity more comparable to the developing economies (0.23 kg per $ GDP [2011 PPP]).

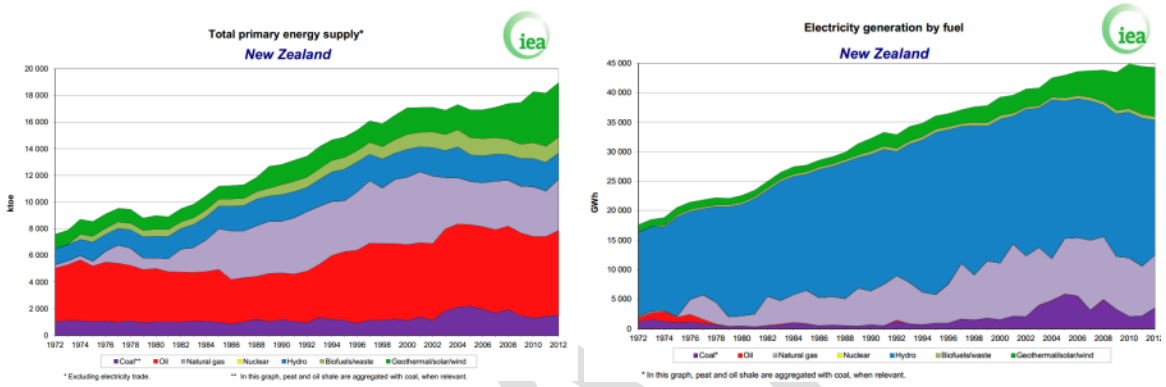

Figure 40 New Zealand's energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

New Zealand has both a national energy efficiency goal to reduce EUI by 1.3% per year, and a set of sectorial goals. While not impacting energy intensity, New Zealand also aims to produce 90% of electricity from renewable sources by 2025. This renewable energy goal will have a profound effect on its GHG emissions. Its overall energy strategy is laid out in the New Zealand Energy Strategy (NZES), governed by the Energy Efficiency and Conservation Authority and has a vision of creating "a reliable and resilient system delivering New Zealand sustainable, low emissions energy services." This strategy looks at producing lower emission energy and heat, establishing a secure grid, and using energy more efficiently. Goals and strategies for the latter point are laid out in the New Zealand Energy Efficiency and Conservation Strategy (NZEECS). Specific energy efficiency and conservation measures include:

- Minimum energy performance standards (MEPS) and labeling
- Vehicle fuel efficiency standards (for light and heavy vehicles)
- Residential energy efficiency improvement (Warm Up New Zealand)
- Efficient lighting for residential and commercial sectors

[89] World Bank. Indicators. Available at http://data.worldbank.org/indicator

[90] International Energy Agency. New Zealdn: Balances for 2012. Available at http://www.iea.org/statistics/statisticssearch/report/?year=2012&country=NZ&product=Balances

An important focus of the NZES is low carbon transport with a goal of halving carbon emissions from the transportation sector by 2040.

The Resource Management Act 1991 requires local government decision makers to have particular regard to the efficiency of the end use of energy, the effects of climate change, and the benefits to be derived from the use and development of renewable energy resources. Regional councils are encouraged to produce a 'regional policy statement' that addresses the NZEECS. These regional strategy documents have been completed for five regions and one is examined in the case study below.[91] Sub-regional local governments are also encouraged to create energy management plans and promote energy efficiency through government leadership.

Local and Subnational Case Studies

Hamilton

Hamilton is the regional seat of New Zealand's Waikato Region and is a case study in policy development towards achieving energy smart development in New Zealand. Waikato's Regional Energy Strategy is strongly focused on its energy production capacity and ability to supply energy nation-wide. However, a large emphasis of the plan is focused on demand-side energy efficiency measures for business and industry, homes, and local governments. Further, the strategy discussed smart growth planning. "Throughout the Waikato, a number of territorial authorities are increasingly looking to 'smart-growth' concepts as a means to create more compact, less motor-vehicle dependent cities." [92]

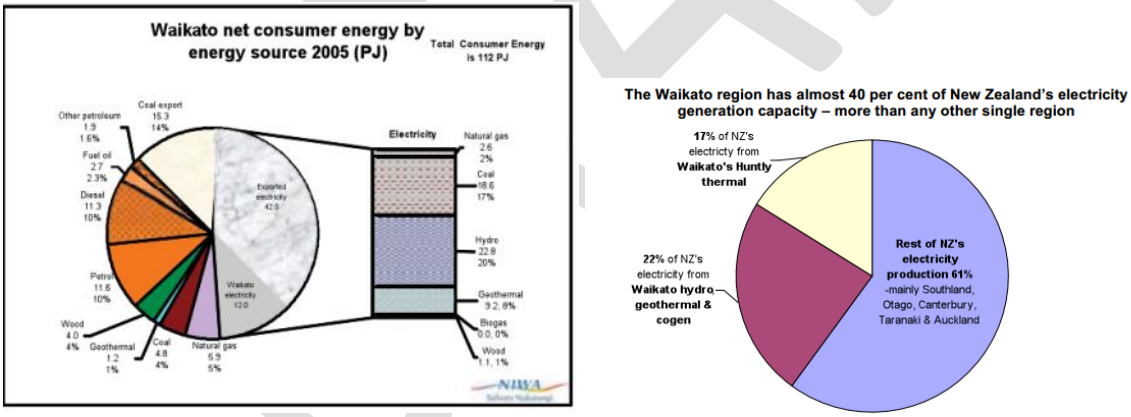

Figure 41 Waikato energy consumption and generation capacity graphs. Source: Waikato Regional Energy Forum

Within the larger goals of the Waikato Region, Hamilton has developed its own Sustainability Action Plan. The plan has three priority areas: City Living and Business; Healthy Natural Environment; and Leadership

[91] New Zealand Energy Efficiency and Conservation Authority. Local government. (2014) Available at http://www.eeca.govt.nz/central-and-local-government/local-government

[92] Waikato Regional Energy Forum. Waikato Regional Energy Strategy. Available at http://www.eeca.govt.nz/sites/all/files/waikato-regional-energy-strategy1.pdf

and Collaboration. City Living and Business is the most relevant to this topic of Smart Community Development with the following measures: [93]

- District Plan Monitoring - water and energy tracking
- Smart Energy – training for experts and for homeowners to upskill housing knowledge
- Reducing Waste – review of waste management master plan and opportunities to divert organics from landfills
- Water Efficiency – implement actions in the Water Conservation and Demand Management Plan
- Reducing Car Use – promote public transit, walking and cycling; support non-car options for school transport
- Reducing Impact through Urban Design – develop community food; sensitive property development; teaching sustainable urban design
- Responding to Climate Change – develop a city climate change plan

Key Performance Indicators:

1. Waste to landfill
2. Waste recycled from curbside
3. Organic waste collected
4. Average daily water use
5. Number of homes insulated under EECA funding
6. Property development density (green, low, high)
7. Air pollution level - as per Waikato Region Council current monitoring program
8. Cycle use
9. Bus patronage
10. Business travel plans developed – includes increase in carpooling rates

2.13 Papua New Guinea

Background

Papua New Guinea (PNG) is comprised of the eastern portion of the island of New Guinea, as well as a set of islands off New Guinea's shore. PNG's landmass totals 462 thousand km^2 with a 2013 population of 7.3 million, with only a small fraction (13%) living in urban regions. PNG's GDP reached $15 billion USD in 2013 and grew at a rate of 5% making it among the fastest developing APEC economies.

[93] Hamilton City Council. Sustainable Hamilton Action Plan. (2013) Available at http://www.hamilton.govt.nz/our-city/city-strategies/environmentalsustainability/Documents/Sustainable%20Hamilton%20Action%20Plan%202013-21-05.pdf

Economy-Level Policy Brief

PNG's National Strategy Vision 2050 is framed by seven strategic focus areas, including environmental sustainability and climate change. The plan calls for a set of sustainable development measures to [94] [95]

- increase resilience to the impacts of climate change;
- conserve and use natural resources for the collective benefit and future generations;
- improve understanding of environmental sustainability, including educational awareness, economic opportunities;
- conserve and widely use our natural resources and environment;
- effective partnership and cooperation with international communities

This strategy calls for developing policies and an organizational framework, and as such is in a nascent stage.

2.14 Peru

Background

Peru, with a landmass of 1.29 million km^2, is located in South America bordering the Pacific Ocean. It has a population of 30.4 million with 78% living in urban areas. Peru is divided into 25 regions, subdivided into provinces, and further subdivided into districts. The exception is the province of Lima, which does not belong to any of the regions. The Province of Lima, while less than 1% of Peru's landmass, holds nearly a third of its population and is a major economic driver.

Peru is a net energy exporter due to its crude oil and natural gas production. Generally, Peru is a large consumer of natural gas and oil, the latter mainly by the transportation sector. While hydro power makes up a large share of electricity generation, this share has not kept up with rising demand, which has been met by increased natural gas consumption since the early 2000s. Peru consumes 20.5 Mtoe and has an economy EUI of 66.6 kg of oil equivalent per $1000 GDP (constant 2011 PPP). Due in large part to meeting its electricity demand with hydro and natural gas, Peru's CO_2 emission intensity is fairly low at 0.2 kg CO_2 per $ GDP (2011 PPP).

[94] Papua New Guinea. Papua New Guinea Vision 2050. (2011) Available at http://www.treasury.gov.pg/html/publications/files/pub_files/2011/2011.png.vision.2050.pdf

[95] Promoting Energy Efficiency in the Pacific. Papua New Guinea. Available at http://www.ee-pacific.net/index.php/database/country-information/papua-new-guinea

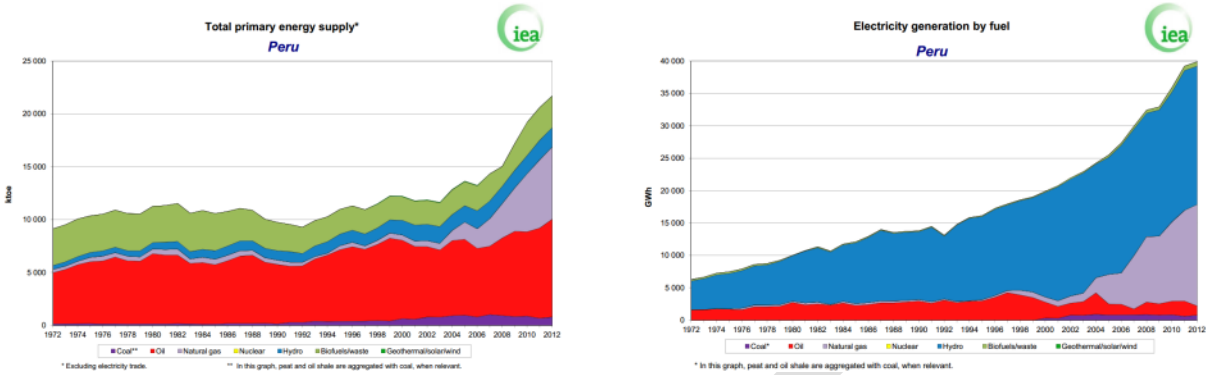

Figure 42 Peru's energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

Peru's energy policy is driven by the Energy Policy of Peru 2010-2040 with the vision of having an energy mix that meets Peru's future demands. A recent study by the Ministry of Energy and Mines produced the New Sustainable Energy Matrix for Peru (NUMES) with a goal of reducing energy use by 15% by 2040 from a 2010 baseline.

Residential sector:

- Modernization of lighting
- Improved energy consumption habits of people
- Replacement of electric water heaters with solar water heater systems
- Replacement of traditional wood stoves with improved wood stoves.

Industry sector (productive and service sector):

- Replacement of conventional motors with efficient electric motors
- Optimization and modernization of high-pressure heaters
- Modernization and improvement of lighting
- Implementation of cogeneration projects.

Public sector:

- Efficient building,
- Energy efficiency labelling,
- Efficient house appliances

Transport sector

- Efficient Driver Project
- One Day without a Car Project.

Along with these programs, the strategy also includes minimum energy performance standards (MEPS) and labeling.

Local and Subnational Case Studies

Trujillo

Located in Northwestern Peru, the City of Trujillo and the surrounding metropolitan area is the second most populous region in Peru with a population of about 750 thousand in 2011.[96] Trujillo's experienced rapid and unstructured sprawling growth during the latter portion of the 20th century, which resulted in a large urban footprint, diminished green space, and lack of space for future development. In its 2012 Sustainable Trujillo Plan of Action, the Inter-American Development Bank (IBD) diagnosed the city with having a water imbalance, poor air quality, inadequate solid waste disposal, and water and wastewater infrastructure issues. Further there was no system in place to measure emissions. Worst of all, there were no rules in place for urban planning going forward. Thus, the Action Plan was formulated around Climate Change, Solid Waste, Water and Sanitation, Transportation, Public Safety, Performance Management, and External Monitoring.[97]

The plan was divided into five phases: i. assessing and diagnosing action areas; ii. prioritizing action areas; iii. Identification and prioritization of solutions and actins; iv. creating the action plan; and v. monitoring and disseminating. The Action Plan set up actions, timelines, and indicators to track progress. These indicators included:

- Emissions baselines
- % of households separating solid waste
- % of irrigation water obtained from treatment plant
- % of ridership through mass transit
- Implementation of a development master plan

This last indicator from the IBD Action Plan was realized with the release of the Action Plan 2013-14 for the Trujillo Metro Region to Strengthen the Management of Public Finances. Further, studies of GHG emissions (established emissions baselines by sector), climate vulnerability, the water system, and urban mobility have been conducted. [98]

[96] Peru National Institute of Statistics and Information. Peru, Estimates and Projections of Total Population by Sex Top Cities 2000-2015 (2012) Available at https://www.scribd.com/doc/189489690/Peru-Estimaciones-y-Proyecciones-de-Poblacion-Total-por-Sexo-de-las-Principales-Ciudades-2000-2015

[97] Inter-American Development Bank. Sustainable Trujillo Action Plan. (2012) Available at http://goo.gl/b5OZK (translated with Google Translate)

[98] Provincial Muncipality of Trujillo. Study of greenhouse gas emissions from Trujillo (2013) Available at http://www.munitrujillo.gob.pe/portal/archivos/trujillo_sostenible/Estudio%20de%20emisiones%20de%20GEI_Trujillo.pdf

2.15 The Philippines

Background

The Philippines is comprised of over 7,100 islands with a landmass of 300 thousand km^2. The nation is divided into 17 regions, 81 provinces, 144 cities, 1,491 municipalities. Provinces may fall directly under the central government or under regions. Similarly, cities may either be part of provinces or independent of them. Municipalities fall under provinces. A notable example is Metropolitan Manila, which is a region that contains the city of Manila. Provinces have governors and a legislature, while cities and municipalities are governed by mayors and legislative councils. The Philippines has a population of 98.4 million and 45% are located in urban areas.

The Philippines economy has grown to $272 billion USD in 2013. The Philippines relatively minor domestic oil production and subsequent need to import oil for transportation makes it a net energy importer. Electricity generation is fairly evenly divided between coal, natural gas, and renewable energy sources. In all, the Philippines consumes 40.5 Mtoe of energy, an economy EUI of 74.4 kg of oil equivalent per $1000 GDP (2011 PPP), and has a CO_2 emission rate of 0.16 kg of CO_2 per $ GDP (2011 PPP).

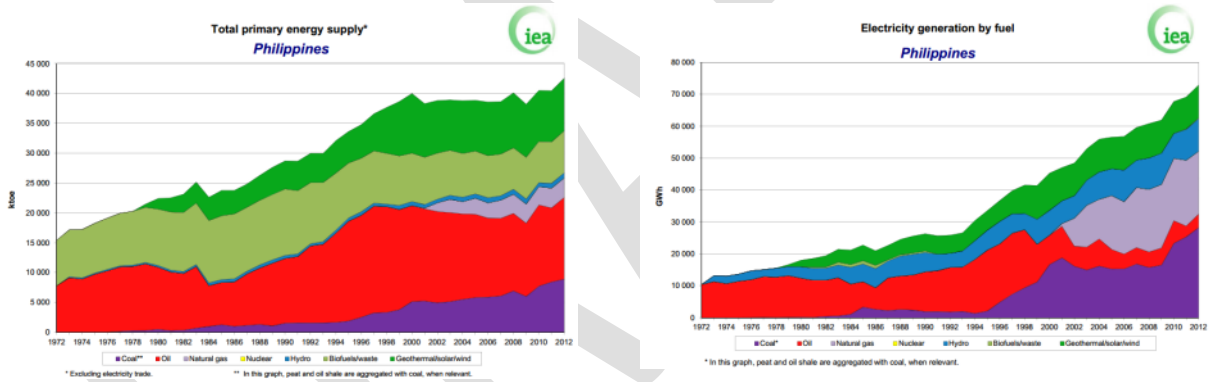

Figure 43 The Philippines' energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

The Philippine Government launched the National Energy Efficiency and Conservation Program (NEECP) in August 2004 in support of the implementation of energy efficiency plans and programs under its long term 2011–2030 Philippine Energy Plan with a goal of reducing energy demand by 70.6 Mtoe by 2030. [99]

The broad program initiatives for meeting this goal are:

- Social Mobilization, Information, Education and Communication Campaign
- Energy Efficiency Standards and Labelling Program

[99] https://www.doe.gov.ph/doe_files/pdf/01_Energy_Situationer/2012-2030-PEP-Executive-Summary_revised.pdf

- Government Energy Management Program (GEMP)
- Energy Management Services/Energy Audits
- Voluntary Agreement Program
- Recognition Award Program
- Fuel Economy Run Program (currently part of the IEC program; however, necessary to establish/generate significant data for a vehicle labelling program in the future)
- Locally Funded Projects that promote Energy Efficiency and Conservation include:
    - Fuel Conservation and Efficiency in Road Transport (FCERT)
    - Power Conservation and Demand Management (Power Patrol)
- Foreign Assisted/Technical Assistance.

2.16 Russia

Background

With a landmass of 17.1 million km^2, Russia is one of the largest APEC economies and stretches from Europe to Asia. Russia's population was 143.5 million in 2013 and 74% lived in urban areas. Its GDP grew to $2,097 billion USD in 2013.

Russia's fuel mix is dominated by fossil fuels and it is also a significant exporter of these fuels. Hydro and nuclear powers are meaningful contributors to Russia's electricity generation mix. Russia consumed 731 Mtoe in 2011, an economy EUI of 265 kg of oil equivalent per $1000 GDP (2011 PPP). Due to its strong reliance on fossil fuels, especially coal and oil, Russia had the second highest CO_2 emission rate in 2010, of 0.56 kg CO_2 per $ GDP (2011 PPP).

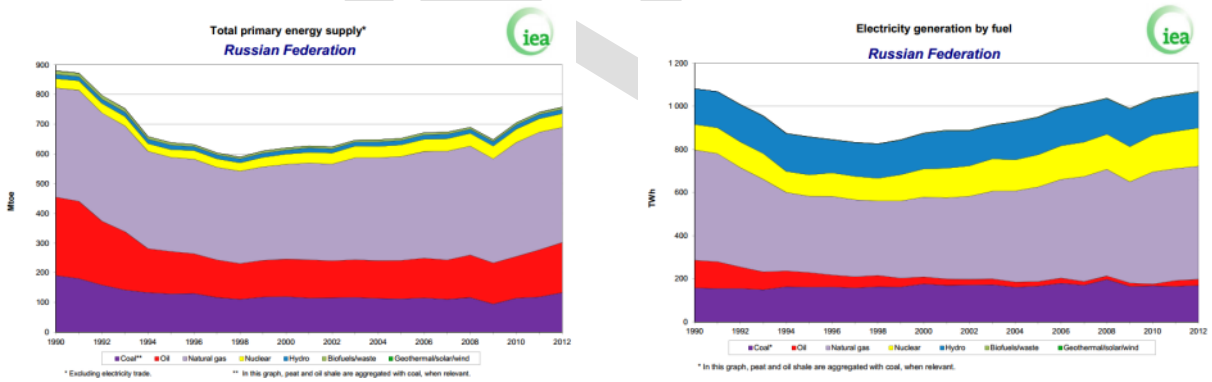

Figure 44 Russia's energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

While its energy use is among the highest in the APEC region, Russia also has among the most significant energy savings potentials. In part, the Energy Strategy of Russia for the period up to 2030 includes a basic strategy to achieve the aim of transitioning to the path of innovative and energy-efficient

development.[100] The program sets out a goal of reducing energy intensity by 50% by 2030 from a 2005 baseline. Energy efficiency measures include:

- Development of economy-wide building codes
- Energy labeling scheme
- Industry energy efficiency
- Phase-in of higher efficiency vehicles from European market

2.17 Singapore

Background

Singapore is a city-state located in Southeast Asia with a landmass of 718 km^2 and a population of 5.4 million. The entire economy is considered urbanized. Singapore's economy grew to a GDP of $298 billion in 2013.

Singapore relies heavily on imports for its energy consumption, which is predominantly oil and gas for electricity generation and oil for transportation. In recent years, Singapore has shifted much of its electricity consumption from oil in favor of natural gas. Singapore's energy consumption is 33.4 Mtoe, yet given its relatively high GDP, its economy EUI is fairly low at 86.5 kg oil equivalent per $1000 GDP (2011 PPP). Likewise, its CO_2 emission intensity is the lowest in APEC at 0.04 kg CO_2 per $ GDP (2011 PPP), though some of this is also a result of its transition to natural gas.

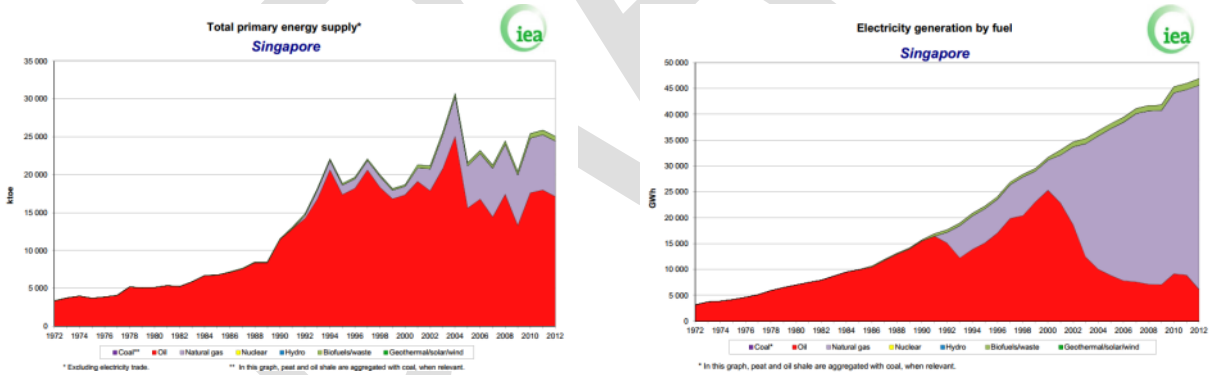

Figure 45 Singapore's energy supply and electricity generation by fuel type. Source: IEA

[100] Ministry of Energy of the Russian Federation. Energy Strategy of Russia for the Period up to 2030. (2010) Available at http://www.energystrategy.ru/projects/docs/ES-2030_(Eng).pdf

Economy-Level Policy Brief

In its 2014 Sustainable Singapore Blueprint report, Singapore set an energy efficiency target of reducing economy EUI by 35% by 2030 from 2005 levels.[101] Singapore's geography and geology does not allow it to make use of renewable energy and so it is reliant on energy efficiency to meet its energy goals. To this end, Singapore's efficiency measures have been consolidated into the Energy Conservation Act, with publically funded provisions including:

- Requires large energy consumers to implement energy management measures
- Mandatory energy labeling
- Minimum energy performance standards and requirements for residential installations.
- Vehicle fuel economy standards
- Vehicle quota system to limit ownership rate
- Improved public transit
- Requirement that all new and existing public buildings must meet platinum and gold standards of BCA Green Mark green building labeling scheme.
- All new and existing construction over 2000 m^2 must meet Green Mark standard

Singapore's efficiency programs are being administered by the city's Energy Efficiency Programme Office (E^2PO). In promoting efficiency, the E^2PO seeks to

1. Stimulate demand for energy efficiency through regulation and standards, incentives and open information.
2. Develop human and institutional capabilities by developing local knowledge base and expertise in energy management and collaborating with Institutes of Higher Learning (IHLs)
3. Promote emerging energy efficient technologies and innovation through supporting the research development and demonstration of new energy efficient technologies, innovations and business process improvements
4. Profile and promote energy efficiency internationally through various platforms such as Singapore International Energy Week (SIEW).

2.18 Chinese Taipei

Background

Taiwan is located in the middle of a chain of islands stretching from Japan in the north to the Philippines in the south. Its position, just 160 kilometers off the southeastern coast of China, makes it a natural gateway to East Asia. The economy is made up of the islands of Taiwan, Penghu, Kinmen, Matsu, and several islets, with a total area of about 36,188 km^2 and a population of 23 million.

[101] Asia Pacific Economic Research Center. Compendium of Energy Efficiency Policies in APEC Economies: Singapore. (2014) Available at http://aperc.ieej.or.jp/file/2014/6/10/Singapore_s_Compendium_14-May-2014.pdf

The projected average rate for 2010–2035 is below the high average annual GDP growth rate of 4.7% in the 1990–2009 period, indicating that Taiwan is becoming a highly developed economy. At the same time, GDP per person is projected to grow from $29,200 USD in 2009 to USD 70,611 by 2035, at an average annual growth rate at 3.2%. The rapid economic development since 2000 has resulted in substantial changes to the economic structure, with the emphasis moving from industrial production to the service sector. In 2010, 67.1% of domestic production was in the service sector, with industry accounting for 31.3% and agriculture 1.6%. In comparison, in 1990 services made up 57.0% of production, and industry 38.9%. This gradual change in the economic structure over last two decades is expected to continue in the future. Future challenges will include further restructuring of the economy's traditional manufacturing industry into high-value-added industry, and expansion of the information and communication technology (ICT) and service industry sectors.

According to APEC Energy Demand and Supply Outlook (5th Edition), Taiwan has very limited indigenous energy resources: domestic natural gas provides just 0.1% of the economy's primary supply, while hydro provides 0.3%, and geothermal, solar and wind power combined provide 0.2%. Instead, it relies on imports for most of its energy requirements and is a net importer of fossil fuels—in 2010 its import dependency was 99%. On an energy equivalent basis, oil formed the biggest part of the imports, at about 50% (coming mainly from Saudi Arabia, Kuwait and Iran); coal made up 38% (mainly from Australia, Indonesia and China), while imported LNG, mainly from Indonesia and Malaysia, made up 12%.

According to International Energy Agency (IEA), the total primary energy supply (TPES) in Taiwan is 101 million tons of oil equivalent (Mtoe). The energy production is 12.8 Mtoe. The net import of energy supply is 90.73 Mtoe, almost reaching 8 times as much as its production in Taiwan. [102]

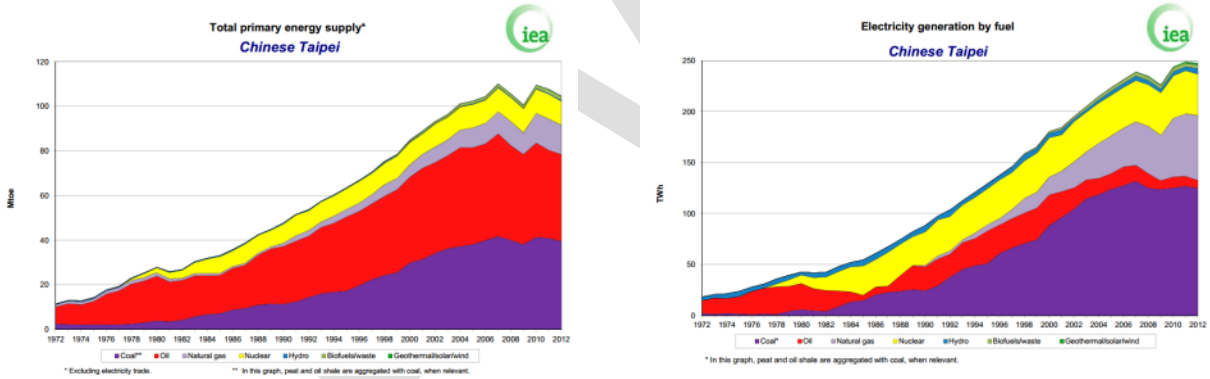

Figure 46 Chinese Taipe's energy supply and electricity generation by fuel type. Source: IEA

Chinese Taipei's final energy demand is expected to grow 0.7% per year over the outlook period. The slowing of demand growth compared to earlier periods is due to energy conservation efforts in all sectors and the economy's overall industry restructuring. The 'other' sector (which includes commercial, residential, and agricultural use) shows the highest annual growth rate of 1.5%, followed by industry at

[102] International Energy Agency. Chinese Taipei: Balances for 2012. Available at http://www.iea.org/statistics/statisticssearch/report/?country=TAIPEI&product=balances&year=2012

0.6%. The economy's final energy intensity is expected to decline by about 52% between 2005 and 2035.[103]

To reduce carbon emissions, Taiwan is gradually reducing coal's share in its primary energy supply (from 38% in 2009 to 25% by 2035). Another recent policy initiative requires reduction in dependence on nuclear energy. The reduction in the use of coal and nuclear power will require an increase in the gas share of the primary supply (from 10% in 2009 to 23% by 2035) and more aggressive exploitation of renewable energy sources (from 1% in 2009 to 5% by 2035).

When we analyze the energy intensity, a measure of the energy efficiency of a nation's economy, it is calculated as units of energy per unit of GDP. High energy intensities indicate a high price or cost of converting energy into GDP. Low energy intensity indicates a lower price or cost of converting energy into GDP. Taiwan's highest energy intensity index was in the 1990s. From 2005 to 2015, the energy intensity index decreases sharply. Taiwan's energy intensity index is projected to decrease by 50% in 2035 (from the 2005 baseline).

Economy-Level Energy Policy

Taiwan's Energy Commission, which was established in 1979 under the Ministry of Economic Affairs (MOEA), became the Bureau of Energy in 2004. The Bureau is responsible for formulating and implementing the economy's energy policy. Policy development since 2008 has included the establishment of a suite of energy-related regulations defining the rules for markets in renewable energy, petroleum products, natural gas, and electricity. The aim is to create a better energy business environment.

The fundamental goal of Taiwan's energy policy is to promote energy security, supported by secure imports of oil, natural gas and coal as well as the development of domestic energy resources including nuclear, fossil fuels, and new renewable energy sources. On 5 June 2008, the Ministry of Economic Affairs released the Framework of Taiwan's Sustainable Energy Policy (BOE, 2012c). This presents a 'win-win-win' solution for energy, the environment, and the economy. The framework addresses the constraints that Chinese Taipei faces in terms of its insufficient natural resources and limited environmental carrying capacity. It states that sustainable energy policies should support the efficient use of the economy's limited energy resources, the development of clean energy, and the security of energy supply. The framework establishes three goals:

- Reductions in energy intensity from 2005 levels—by 20% by 2015 and by 50% by 2025.
- Reductions in total CO_2 emissions, so that total emissions return to the 2008 level between 2016 and 2020, and are further reduced to the 2000 level by 2025; at the same time, the share of low-

[103] Asia Pacific Economic Research Center. Compendium of Energy Efficiency Policies in APEC Economies: Singapore. (2014) Available at http://aperc.ieej.or.jp/file/2014/6/10/Singapore_s_Compendium_14-May-2014.pdf.

carbon energy in the electricity generation system will be increased from the current 40% to 55% by 2025.

- Secure and stable energy supply, achieved by building a secure energy supply system to meet economic development goals, specifically 6% average annual GDP growth rate from 2008 to 2012, and USD 30,000 per capita income by 2015.

To achieve these goals, Chinese Taipei has set these energy conservation targets and strategies:

- Industry sector: raise boiler efficiency, expand cogeneration, and increase the share of high-value-added industries.
- Power sector: replace old coal-fired and gas-fired units with high-efficiency generating units and reduce line losses by improving power dispatch and transmission facilities.
- Transportation sector: raise the fuel efficiency standard for private vehicles by 25% (compared to 2005 levels) by 2015.
- Residential and commercial sectors: raise appliance efficiency standards to a range of 10% to 70% in 2011; completely eliminate incandescent lights and replace them with LED lighting by 2025.

Local and Subnational Case Studies

Penghu Islands

The Penghu Islands are an archipelago off the western coast of Taiwan in the Taiwan Strait consisting of 64 small islands and islets covering an area of 126 square kilometers. The population is about 98,000 (a population density of 779 persons/km^2) and they compose about 36,000 households. With its long coasts and beautiful landscapes, the Penghu Islands have become a popular tourist destination, attracting more than 600,000 tourists per year.

The vision for Penghu Islands is summarized in the slogan, “Happy Penghu, Blissful Homeland.” Penhu focuses on the balanced development of the city and rural communities, to create strong links among and between residents. Tourism is one of the areas to be developed, along with protections of the natural environment. The goals of Penghu are to:

- **Maintain a balanced development between people, industries and nature.** This can be facilitated through the protection of nature, active promotion of environmental protection awareness and implementation, and transformation to nature-appreciating tourism from traditional fishing and gathering.
- **Enhance protection of natural resources.** The only way to sustainable development is to properly protect natural resources and to maintain the balanced co-existence between people and natures.
- **Promote a green wonderland.** The focus shall be to improve the shortage of water and electricity supply by making advantage of local solar energy and wind, combining renewable energy and seawater desalination technology to improve water quality, developing organic farming and fishing, improving industrial environments and enhancing daily diets. Waste shall be

more effectively collected and recycled. Such measures shall decrease pollution and wastes significantly, which help maintain the local natural landscapes.

- **Increase the people's happiness in Penghu.** Preserve the wellbeing and happiness of resident, while enabling economic growth on the islands. Also work to support socially and financially disadvantaged citizens and promote quality of education, culture, medicine and social welfare.

To meet its goals, Penghu has established development strategy with the following key principles:[104]

- **To maintain sustainable development via step-by-step integration**. The right direction for Penghu development shall be the combination of nature and tourism, by which to create economic opportunities for residents. The short-term priority is to make Penghu an affordable place for relaxing and leisure, while the long-term goal is to promote Penghu as an internationally tourist destination. The long-term result shall be that the leisure area shall improve the surrounding areas and provide opportunities for developing local commerce.
- **To develop renewable energy and to be financially self-sufficient.** In light of increasing prices of petroleum, take advantage of the strong sunshine, winds and sea-waves prevalent in the Penghu Islands. The development of renewable energy will assure self-sufficiency and provide additional revenues. For example, the extensive public land and territorial seas can be utilized by working with Tai-power or other organizations to develop wind power stations, and to sell the electric powers generated for additional financial returns.
- **To optimize tourist packages, to attract investors.** Development projects, such as large-scale leisure village, sightseeing hotel and recreational spot, are on the way to implementation, since Penghu-based National Scenic Areas Management is reviewing the proposals submitted by interested investors. The Chinese Taipei government is encouraging private investments and has signed contracts with contractors for operations of tourist areas.
- **To protect cultural legacy and to refresh obsolete traditions.** Village, building and others places of historic interest shall be effectively protected. Local festivals shall be held to promote the spreads of cultural traditions and folk customs, while new elements are added to continue viable developments of unique islanders' heritage, including: holding artistic activities to richen the inner life of the residents; encouraging cooperation between officials and practitioners to create Penghu Museum Resource Center; protecting cultural legacy; reshaping cultural tourism; and promoting international cultural exchanges.
- **To create more opportunities for sustainable development on the basis of existing infrastructure.** The natural environment in Penghu remains fairly pristine. In order to protect this asset, future development shall largely make uses of existing infrastructure to minimize new large land disturbances. Possible frameworks for sustainable development shall be investigated to capitalize the right opportunities for a promising future.

[104] PengHu Low Carbon Island. (2011) Available at http://www.re.org.tw/penghu/en/index.aspx

To accelerate the realization of a low carbon society, the government of Chinese Taipei is planning to transform Penghu Island into the country's first model renewable energy community. The central government agency, Bureau of Energy, under the Ministry of Economic Affairs, is in charge of the development. In addition to the central government leadership, local government of Penghu County is also involved in the development. This project has been named the Penghu Low Carbon Island (PLCI).

The project implementation is planned to take five years (FY2011 - FY2015). The PLCI project will involve eight aspects, as shown in the figure below.

Figure 47 The eight planning aspects of Penghu low carbon island. Source: Peng Hu Low Carbon Island

The implementation of the PLCI project will introduce green energy and recycling system into all aspects, including technology, equipment, measures, behavior, demonstration, service, and R&D accomplishments.

Over 50% of all the islands' energy demand will be met by renewable energy, so as to make the island not only clean low carbon communities but a world-class paradigm for all low carbon island projects.

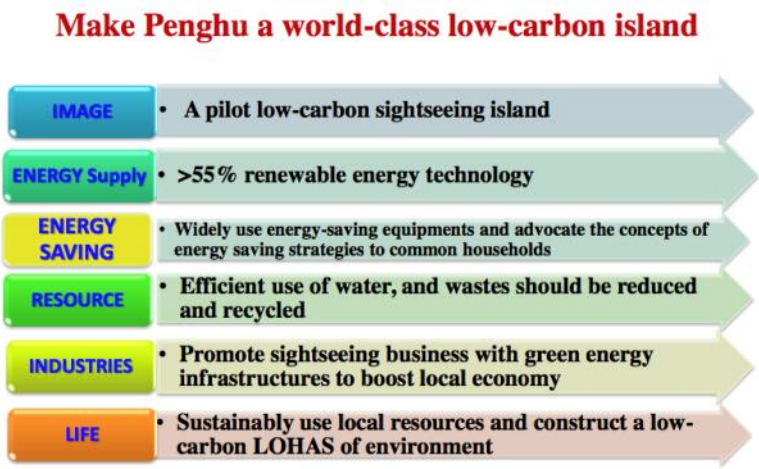

Figure 48 The content of Penghu Low Carbon Island project. Source PengHu Low Carbon Island

The aim of the PLCI project is to bring every kind of low carbon technology, equipment, method, behavior, demonstration, service, and R&D result - including green energy and resource reclaiming and recycling system- into use so as to demonstrate a clean living environment for the entire nation. Economic development can further be achieved by incorporating local features into the project, thus making these low carbon islands a tourist attraction of international renown. Through the implementation of this project, low carbon living services and low carbon technology will be applied. The application of green energy products will be broadened. Related industries are thus expected to be boosted.

The measures of the Penghu Low Carbon Island project can be summarized in five major themes: renewable energy, energy saving, green transportation, green building, and resource recycling. The implementation of the full suite of PLCI measures is estimated to reduce the emission of greenhouse gas by 62%.

1. Renewable Energy

PLCI will take advantage of the local natural resources, such as wind and solar energy, by installing multi-megawatt wind turbines with a total capacity of 96MW, constructing a demonstration 1.5 megawatt level photovoltaic structure as well as 6,400 m^2 solar water heaters, and developing a “renewable energy community,” the HoLiao Renewable Energy Park. The goal will be providing 50% of energy demand from renewable energy.

2. Energy saving

PLCI will install smart meters, LED street lights, and promote energy-efficient house appliances. Maximize commercial, residential, and utility-supply related energy efficiency by installing 2,160 smart meters, 4,000 LED street lights, and 14,000 energy efficient house appliances.

3. Green transportation

PLCI will encourage motorcyclist to trade their two-stroke scooters for electric ones and make all the fuel used on all the islands be B2 diesel and E3 alcoholic gasoline. It demonstrates the use of high fuel-efficiency yet low carbon emission vehicles - by promoting the use of 6,000 electric scooters and other electric vehicles, encouraging drivers to use B2 bio-diesel, etc.

4. Green building and greenery area

PLCI will make sure that all newly constructed public structures and all major non-governmental investment projects be constructed with 100% certified green buildings. In addition to green building, Penghu Island will protect an area of 200 hectares for green space.

5. Resource recycling

PLCI will work to diversify water resources using a smart water supply network, rainwater storage, water-saving appliances, and sewage water reclaiming. Water leakage rate be reduced from 32% in 2010 to 25%. When the project is complete, about 5,700 tons of water will be saved per day. A zero-waste policy will also be achieved by promoting garbage recycling and reuse systems.

6. Low carbon life

PLCI will conduct low carbon education for communities, engaging residents' participation at the grass-roots level. To construct a low carbon tourist environment, public institutions, hotels, hostels and restaurants will be graded based on energy-efficiency management and use a Penghu-specific low carbon certification scheme. Chi-Mei, HuJing, Tongpan, and Jibei will be zero-carbon islands and the Longmen community of HuSi village will be a low carbon community.

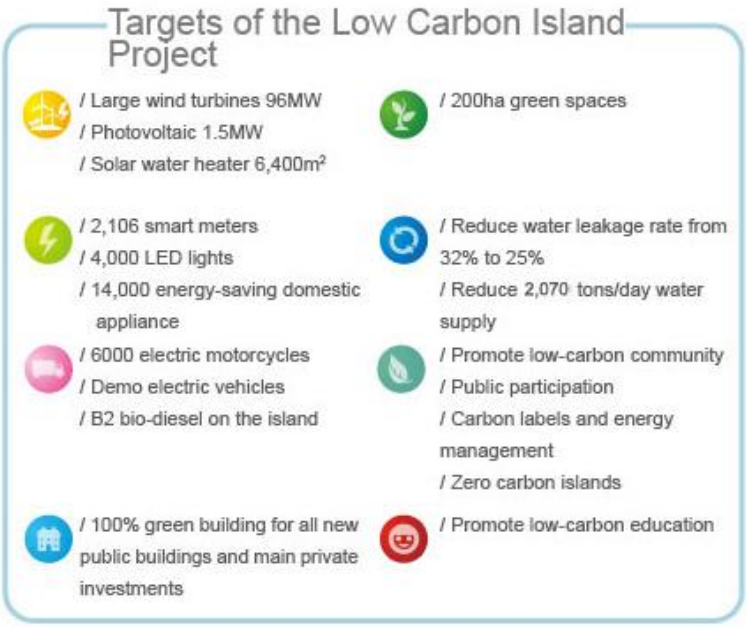

Figure 49 The targets Penghu Low Carbon Island Source: PengHu Low Carbon Island

The achievement of Penghu Low Carbon Island in 2012

According to the Ministry of Economic Affairs (MOEA), after more than a year of effort, the project to make Penghu a world-leading low-carbon island chain is producing results:

- With subsidies from the MOEA, in 2011 the Public Buildings Photovoltaic Demonstration Program was passed to help the Penghu County Government set up 20 facilities with a solar power generation capacity of 1,541 kWh through subsidies amounting to NT$364.92 million (US$12.17 million).
- As of August 2012, subsidies had been granted for 4,000 energy-saving family electric appliances, and 54 households had installed a total of 268.46 square meters of solar water heater panels.
- A total of 1,310 LED streetlights had been installed as of the end of 2011, and 4,000 are expected to be installed by the end of 2012.
- As of mid-September 2012, 1,848 electric scooters were in use, and 551 sets of battery charging facilities were available at 71 locations.
- The area of afforestation has amounted to 15.98 hectares.

2.19 Thailand

Background

Thailand is located in the Indochina Peninsula and has a landmass of 513 thousand km^2. Its population of 67 million was nearly half urbanized (48%) in 2013. Thailand is divided into 47 administrative provinces, each of which is further divided into local districts. Bangkok is considered a special administrative zone. It is important to note that Thailand's monarchic leadership has periodically interceded into political affairs.

Thailand's economy has seen consistent growth since the early 2000s with the exception of the global downturn in 2009. Its GDP grew to $387 billion USD in 2013.

Thailand is a net energy importer, reliant on imports of coal and oil for its extensive fossil fuel consumption. The exceptions are natural gas and biomass/waste, which are derived domestically. Thailand has seen a steady rise in energy demand and has met it with increased reliance on oil and natural gas, and coal to a lesser extent. In 2011, Thailand's demand grew to 119.1 Mtoe, its economy EUI was at 140 kg of oil equivalent per $1000 GDP (2011 PPP) and its CO_2 emission intensity was at 0.35 kg CO_2 per $ GDP (2011 PPP).

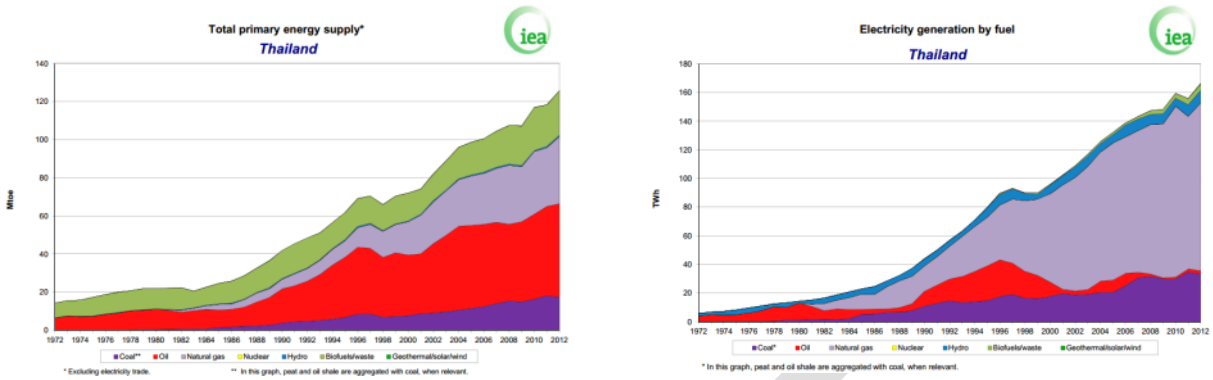

Figure 50 Thailand's energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

Thailand released its 20-year Energy Efficiency Development Plan in 2011. The plan sets discreet goals for energy intensity – reduce by 25% by 2030 from 2005 levels - and total energy reduction – reduce by 20% by 2030.[105] The plan prioritizes savings from the industrial and transportation sectors, which together account for more than half of Thailand's energy consumption and which are heavily reliant on imported coal and oil.

Mandatory Requirements via Rules, Regulations and Standards, comprising four measures as follows:

- Enforce the Energy Conservation Promotion Act to actualize an energy management system that is responsible for energy consumption reporting and verification in designated buildings and factories.
- Mandatory energy efficiency labeling to provide options for consumers to buy or use highly energy-efficient equipment/appliances, vehicles and buildings.
- Enforcement of the Minimum Energy Performance Standards (MEPS) for equipment/appliances, buildings and vehicles to prevent the distribution and use of low energy-efficient products. In this regard, the government will consult with product manufacturers and retailers to determine an appropriate lead time prior to the enforcement of MEPS for each product.
- Determination of the Energy Efficiency Resource Standards (EERS), or the minimum standards for large energy businesses to implement energy conservation measures encouraging their customers to use energy efficiently (with a penalty clause for those whose implementation outcome is lower than the specified standards and rewards for those whose achievement is greater than the specified standards in each year), which will be an important mechanism to provide both technical and financial assistance to small and medium enterprises (SMEs).

[105] Ministry of Energy. Thailand 20-Year Energy Efficiency Development Plan 2011-2030. Available at http://www.eppo.go.th/encon/ee-20yrs/EEDP_Eng.pdf

Other measures include promotion of public transit, subsidies for verifiable energy conservation measures, support for the cooperation of ESCOs, and promotion of public awareness and behavior change.[106]

Local and Subnational Case Studies

Bangkok

The Bangkok Metropolitan Area is the most populous region in Thailand with over 20% of the nation's population. Bangkok suffers from insufficiently planned, rapid growth in the 1980s and 1990s, which left the region with a disconnected urban landscape and inadequate infrastructure. The metropolitan region's roadway network and high rate of private car ownership have resulted in massive congestion and a resultant increase in GHG emissions. The Bangkok Municipal Administration now manages the region's development, including enforcing the urban master plans, including the 12-year Bangkok Plan (2009-2020) "focusing on becoming a livable and sustainable mega-city."[107] [108]

"Bangkok Metropolitan Administration (BMA), being aware of the global warming crisis and the necessity to take initial action to be part of the global effort in mitigating the problem, has prepared the Action Plan on Global Warming Mitigation 2007 - 2012, which comprises of 5 initiatives: 1) Expand the Mass Transit Rail System within Bangkok Metropolitan Area; 2) Promote the Use of Renewable Energy; 3) Improve Building Electricity Consumption Efficiency; 4) Improve Solid Waste Management and Wastewater Treatment Efficiency; and 5) Expand Park Area. This action plan aims at GHG emission reduction by at least 15% of the total GHG emission anticipated in the year 2012 under business as usual projection."[109] The plan gives CO2 reduction estimates for each planned action as well as totals for each of the fives initiatives.

[106] Asia Pacific Economic Research Center (2012) Compendium of Energy Efficiency Policies in APEC Economies: Thailand. Available at http://aperc.ieej.or.jp/file/2014/1/27/CEEP2012_Thailand.pdf

[107] Bangkok City Planning Department. History. (2012) Available at http://www.bangkokplan.org/website/index.php?option=com_wrapper&view=wrapper&Itemid=54&lang=en

[108] Bangkok Metropolitan Administration. Department of Environment. Bangkok State of the Environment 2012. Available at http://203.155.220.174/pdf/BangkokStateOfEnvironment2012RevisedEdition.pdf

[109] Bangkok Metropolitan Administration. Action Plan on Global Warming Mitigation 2007-2012. Available at http://office.bangkok.go.th/environment/pdf/plan-en.pdf

Activity	Target CO_2 Emission Reduction (million ton p.a.)
Action Plan 1	
Activity 1: Support the Implementation of Mass Transit Rail Systems in the Bangkok Metropolitan Area	2.4
Action Plan 2	
Activity 2.1: Implement a Bus Rapid Transit System (BRT)	0.19
Activity 2.2: Support Improvements to the Existing Public Bus System	1.24
Action Plan 3	
Activity 3.1: Improve the Road Network	1.7
Total	**5.53**

Figure 51 Example summary table for the initiative "Expand the Mass Transit and Improve Traffic System". Source: Action Plan on Global Warming Mitigation

The results of the Action Plan were summarized in Bangkok's State of the Environment 2012. The plan aimed for a CO2 emissions reduction of 15%, and the evaluation found an actual reduction of 14%. [76] The State of the Environment lays out BMA's next steps, which include planning for the next phase of the Bangkok Master Plan on Climate Change 2013-2023 in partnership with the Japan International Cooperation Agency (JICA).[110] Bangkok has partnered with a host of other international organizations to promote low-carbon development, including C40 Cities on a project to improve energy efficiency in buildings; World Bank on a strategic implementation of waste management and preparation on the feasibility study to improve energy efficiency in buildings; United Nationals Environmental Program for its Assessment Report on Climate Change 2009[111], and others.

2.20 The United States

Background

The United States is located in North America and has a landmass of 9.6 million km^2 and a population of 316.1 million in 2013. The majority of the U.S. population (81%) reside in urban areas with populations concentrated on the east and west coasts. Administratively, the U.S. is divided into 50 states, which are subdivided into counties and further into cities and other municipalities. A governance structure is in place at each of these levels of government with local responsibilities distributed between states,

[110] Japan International Cooperation Agency. Outline of the Project. (2012) Available at http://www.jica.go.jp/project/english/thailand/016/outline/index.html

[111] United Nations Environmental Program. The Evaluation Report on Climate Change in Bangkok (2009) Available at http://www.unep.org/dewa/Portals/67/pdf/BKK_assessment_report2009.pdf

counties and local municipalities differently throughout the economy. The U.S. economy has grown steadily for decades and GDP reached $16800 billion in 2013.

The U.S. has been a net energy importer, but recent exploitation of domestic natural gas is increasingly moving it towards becoming a net exporter. As of 2011, the U.S. consumed 2191 Mtoe, which was a slight drop from the previous year. The U.S. has a diverse portfolio of energy sources and this is matched by current energy policy, which favors an "all of the above" strategy for energy production in order to hedge market risks. The U.S. economy EUI was 141 kg of oil equivalent per $1000 GDP (2011 PPP) and its CO_2 emissions intensity was 0.36 kg CO_2 per $ GDP (2011 PPP).

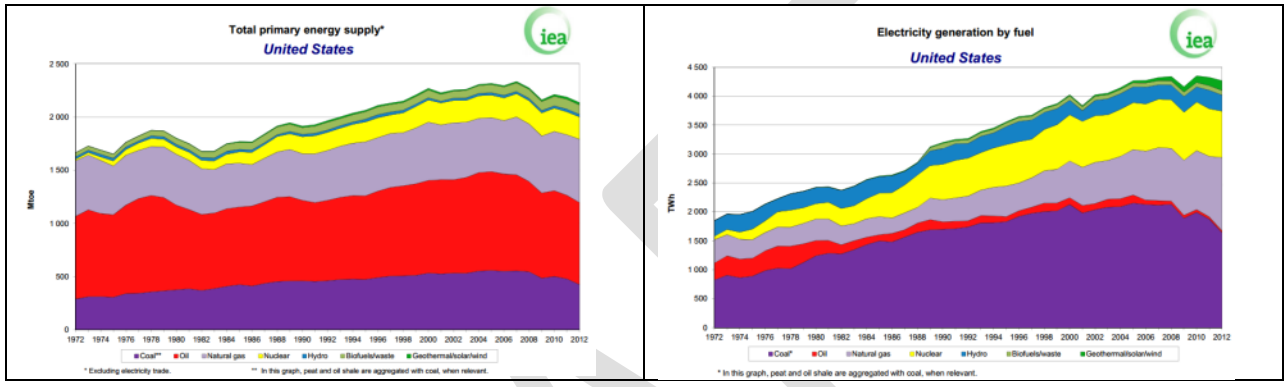

Figure 52 The United States' energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

The U.S. adopted the APEC aspirational goal of 25% energy intensity reduction by 2030. While the U.S. does not have a single long-term energy policy, there are a variety of policies and programs that address energy efficiency and conservation efforts. The Department of Energy is driving much of the programs, including the Building Technology Program, which aims to reduce new building energy consumption by 50% and existing building energy consumption by 30% by 2020.

Other notable measures include:

- Minimum energy performance standards and labeling, which applies to appliances and commercial equipment.
- Energy efficiency standards for buildings
- Vehicle Fuel Efficiency Standards

Financing for energy efficiency is provided through incentives, such as the Federal Tax Credits for home energy efficiency, manufacturers of energy-efficient appliances, fuel-efficient vehicles, and fuel cells. The federal government also securitizes bonds for subnational governments.

At the subnational level, states and utilities offer loans, rebates and incentives for energy efficiency, though these are not uniform throughout the economy. The Department of Energy also supports

subnational energy efficiency development through the State and Local Energy Efficiency Action Network (SEE Action).[112]

Local and Subnational Case Studies

Minneapolis

The City of Minneapolis is the largest city in the state of Minnesota and contains around 400 thousand residents. The greater Twin Cities metropolitan area, which includes the city capital city of Saint Paul has approximately 3.4 million residents. While only the 14th largest metropolitan area in the United States, the Twin Cities area is an important economic center for the nation, ranking 7th for per capita GDP.[113]

Minneapolis was selected as a case study, because of its leadership in setting strong climate change goals. As noted in the city's Climate Action Plan, the Twin Cities adopted the Urban CO2 Project Plan in 1993. The latest targets adopted by Minneapolis' city council seek to reduce emissions a further 15% by 2015 and 30% by 2025, from a 2006 base year. The subsequent Climate Action Plan to hit these targets looks at three sectors: Buildings and Energy; Transportation and Land Use; and Waste and Recycling. Council also adopted a goal to reduce GHG emissions from municipal activities by 1.5% annually.[114]

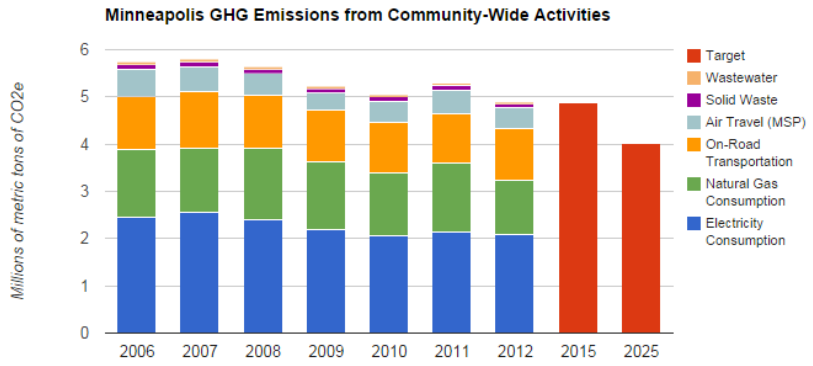

Figure 53 Minneapolis GHG emissions from community-wide activities. Source: Minneapolis Climate Action Plan

Emission reduction strategies and targets were based upon an emissions inventory completed in 2012 for the years 2006-2010. The inventory also yielded some insight into achievements already attained,

[112] Asia Pacific Economic Research Center (2012) Compendium of Energy Efficiency Policies in APEC Economies: United States. Available at http://aperc.ieej.or.jp/file/2014/1/27/CEEP2012_United_States.pdf

[113] Bureau of Economic Analysis. U.S. Department of Commerce. Economic Growth Widespread Across Metropolitan Areas in 2013 (2014). Available at http://bea.gov/newsreleases/regional/gdp_metro/2014/pdf/gdp_metro0914.pdf

[114] Minneapolis City Coordinator Minneapolis Climate Action Plan. (2013) Available at http://www.ci.minneapolis.mn.us/www/groups/public/@citycoordinator/documents/webcontent/wcms1p-113598.pdf

including a 13% reduction in emissions from 2006 to 2010 with electricity-related emissions showing the most significant reduction (17%), followed by transportation (16%).

The city then set individual goals for each target sector along with strategies for achieving these goals. An example, as shown in the figure below, for the Buildings and Energy sector sets very specific strategies, such as developing a Green Zone Initiative that classifies neighborhoods by their climate change vulnerability and provides green infrastructure funding based on the determined need.

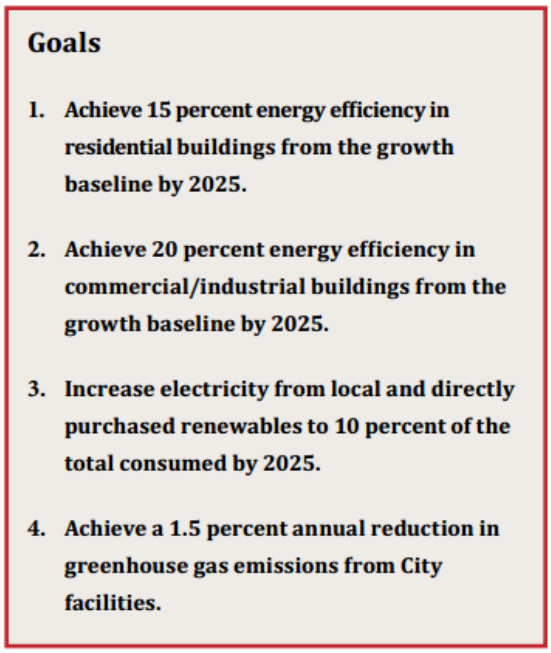

Figure 54 Goals of the Minneapolis Climate Action Plan. Source: Minneapollis Climate Action Plan

Progress for Minneapolis' Climate Action Plan is measured by 26 indicators and reported in an annual Sustainability Report and on the Sustainability Office website.[115]

2.21 Viet Nam

Background

Located in the Indochina Peninsula, Vietnam has a landmass of 332.1 thousand km^2 and a population of 89.7 million. Vietnam has one of the lowest urban population proportions (32%) in the APEC region and likewise low economic development with a GDP of $171 billion USD in 2013. However, Vietnam is

[115] City of Minneapolis. Sustainability Indicators. (2014) Available at http://www.minneapolismn.gov/sustainability/indicators/index.htm

urbanizing and its economy is growing rapidly. With regard to energy smart community development, Vietnam has greater potential for high impact adoption than more developed economies.[116]

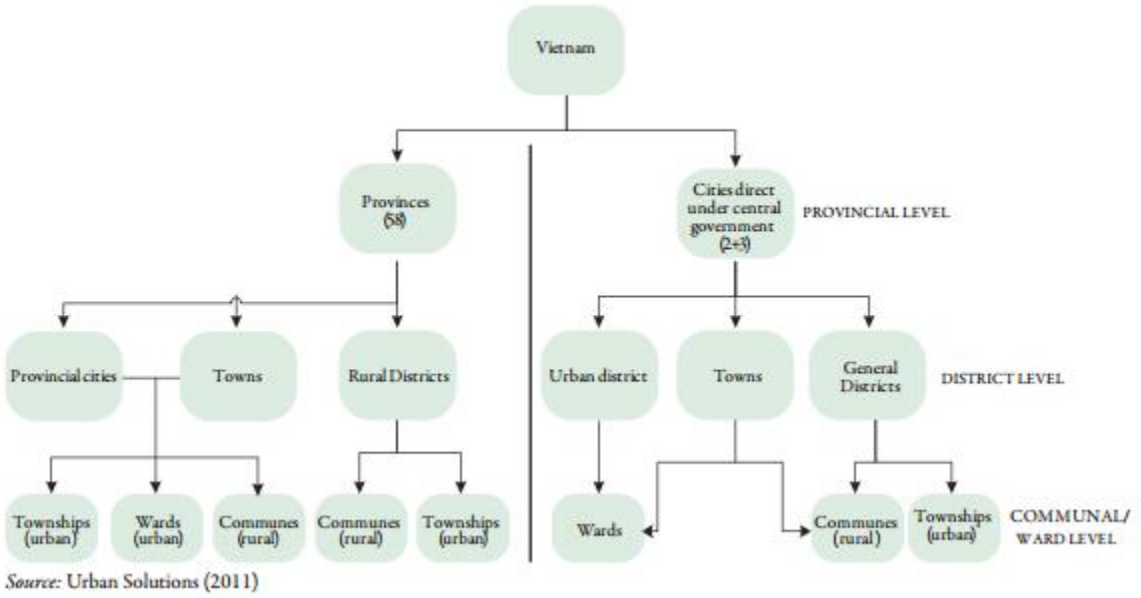

Figure 55 Vietnam's government structure. Source: World Bank

[116] World Bank (2011) Vietnam Urbanization Review. Available at https://openknowledge.worldbank.org/bitstream/handle/10986/2826/669160ESW0P1130Review000Full0report.pdf?sequence=1

Category	Population	% of Country	Urban Population	% of Country	GDP in millions of VND	% of Country
Country	85,846,897	100.0%	25,436,896	100.0%	1,860,296,198	100.0%
Special class cities	13,614,773	15.9%	8,612,920	33.9%	567,505,959	30.5%
Class 1 cities	5,286,453	6.2%	3,106,983	12.2%	128,554,679	6.9%
Class 2 districts	3,538,283	4.1%	2,812,254	11.1%	96,993,428	5.2%
Class 3 districts (B)	5,354,288	6.2%	3,986,014	15.7%	105,498,464	5.7%
Class 4 districts (C)	3,522,553	4.1%	1,739,495	6.8%	55,980,660	3.0%
Special, class 1, 2, 3 and 4 urban areas as a % of Total Population in Country						36.5%
Special, class 1, 2, 3 and 4 urban areas as a % of Total Urban Population in Country						79.6%
Special, class 1, 2, 3 and 4 urban areas as a % of Total GDP in Country						51.3%

Notes:

1. Numbers were estimated for sub-province level urban areas as only provincial data was available
2. Excluded Hoa Binh Township in Tuong Duong District of Nghe An, a sub-district class 3 urban area for which population data is unavailable.
3. Excluded class 4 urban areas at the sub-district level, including: Cam Duong, now a part of Lao Cai Province; Binh Dinh Township in An Nhom District of Binh Dinh; Bong Song township is in the Hoai Nhon District of Bin Dinh; Phu Phong Township in Tay Son District of Binh Dinh; Phu Phong Township in Tay Son District of Binh Dinh; Lien Nghia in Duc Truong District of Lam Dong; Hat Lot Township in Mai Son District of Lam Dong.
4. Constituent cities and urban areas in each class are based on the 2009 urban classification system

Source: General Statistics Office (GSO) provincial statistics yearbook.

Figure 56 Vietnam population and economy statistics. Source: World Bank

Vietnam is a net energy exporter owing to its domestic coal and oil production. Domestically produced natural gas is a growing portion of the electricity generation mix along with coal and hydro power. In 2011, Vietnam consumed 62 Mtoe of energy, an economy EUI of 147.7 kg of oil equivalent per $1000 GDP (2011 PPP). CO_2 emissions intensity was 0.39 kg of CO_2 per $ GDP (2011 PPP).

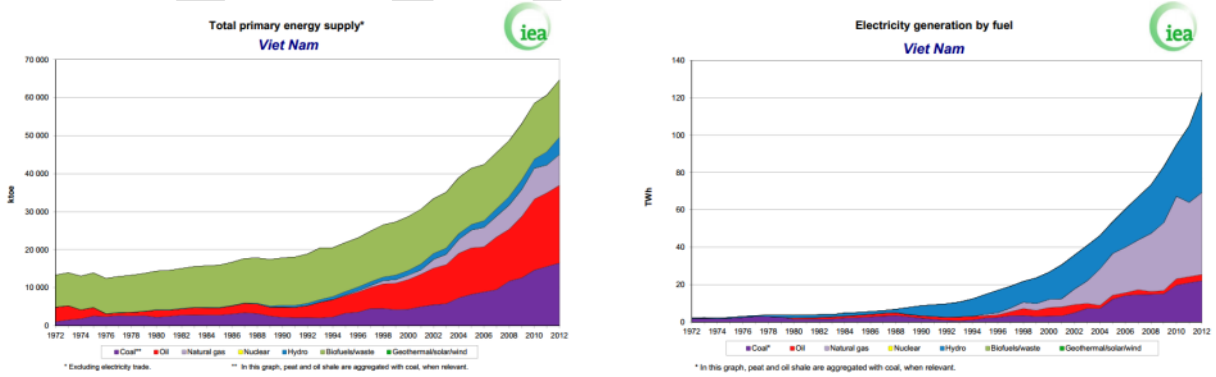

Figure 57 Viet Nam's energy supply and electricity generation by fuel type. Source: IEA

Economy-Level Policy Brief

Vietnam National Energy Efficiency Program was adopted in 2006 as the economy's first long-term energy efficiency strategic plan. The program's energy savings goal is 3%-5% of total energy consumption (compared to the BAU case) by 2010 levels and 5%–8% of total energy consumption by 2015. [117] While it does not dictate sectoral energy efficiency targets, the program was written to promote energy efficiency through a combination of enabling legislation (such as the Law on Energy Conservation and Efficient Use), awareness, and capacity building through measures such as developing equipment standards.

The aforementioned Law on Energy Conservation and Efficient Use applies to large energy consuming sectors – Industry, Construction, and Transportation – and states that the government is to regulate these consumers with enforced regulations to be defined.

Local and Subnational Case Studies

Da Nang

Da Nang City is the largest city in central Vietnam, and is one of Vietnam's major ports. It had a population of 993 thousand in 2013 and an area of 1285 km^2. Land use in Da Nang, as outlined in the General Land-use Plan 2011-2015, is characterized as agricultural and non-agricultural, with the latter signifying urban land, tourism and trade, and conservation areas. Da Nang's land use is 55% agricultural, 43% non-agricultural and 2% unused. Urban land use is expected to rise to about 100 km^2 by 2020. [118]

Da Nang has developed a series of development policies that address sustainability, which include its Master Plan for Socio-economic Development up to 2020, A General Plan for 2000 – 2020 in Da Nang City, and Building Da Nang City as an Environmental City. As noted in the Low Carbon Model Town Policy Review, these plans and policies do not set a scope or specific measures for addressing GHG emissions and creating a low-carbon city.[119]

Da Nang City has proposed an APEC Low Carbon Town model for its Ngu Hanh Son District (NHSD). The proposal incorporates new technologies and a "policy of an effective dissemination" to accomplish the ambitious goal of incorporating the use of biomass energy, effective transportation systems, and energy efficient buildings to achieve model LCMT status.

[117] Asia Pacific Economic Research Center (2012) Compendium of Energy Efficiency Policies in APEC Economies: Vietnam. http://aperc.ieej.or.jp/file/2014/1/27/CEEP2012_Viet_Nam.pdf

[118] Asia-Pacific Economic Research Center. Policy Review for Low-Carbon Town Development Project in Da Nang, Viet Nam. (2014) Available at http://aperc.ieej.or.jp/publications/reports/lcmt.html

[119] Ibid.

Beyond the APEC LCMT project, Da Nang is collaborating with a host of international organizations to develop as an energy smart community: [120]

- Japan International Cooperation Agency. 2010 – Study on Integrated Development Strategy for Da Nang City and its Neighboring Area in Viet Nam.
    - The study provided a development strategy for Da Nang that identified future land uses, a transportation network, environmental concerns and priority projects.
- Asia Institute of Technology. 2011 – Carbon Emission Situation Study at Da Nang City, Vietnam.
    - Comprehensive carbon emissions analysis for Da Nang.
- Da Nang Asian Cities Climate Change Resilience Network (led by Rockefeller Foundation and others) – Plan for Responding to Climate Change and Sea Level Rise in Da Nang by 2020.
    - Identifies climate change impacts and priority action items to address them.
- Da Nang's Department of Industry and Trade along with Australia's Department of Foreign Affairs and the World Bank. 2011-2013 – Sustainable Urban Energy Program
    - Evaluate energy use and GHG emissions and offer policy and technical measures for long-term development strategies
- Asia Development Bank. 2011-2013 - National Target Program Challenging Climate Change Mitigation.
    - Estimated GHG emissions produced by each sector in Viet Nam
- World Bank and Da Nang City People's Committee. 2013-2019 – Da Nang Sustainable City Development.

    US $202 million financing to support development in five stages: 1) drainage and wastewater improvement; 2) bus rapid transport development; 3) urban strategic roads to improve the connectivity of the urban arterial system; 4) technical assistance and capacity building; and 5) support completion of some major priority infrastructure

As the APERC report states, the existing planning documents do not specifically address low carbon development, and as such the report gives a set of 75 recommendations to be implemented in the short, medium, and long term. The overall vision for transforming Da Nang City into a LCMT is described in the figure.

[120] Ibid.

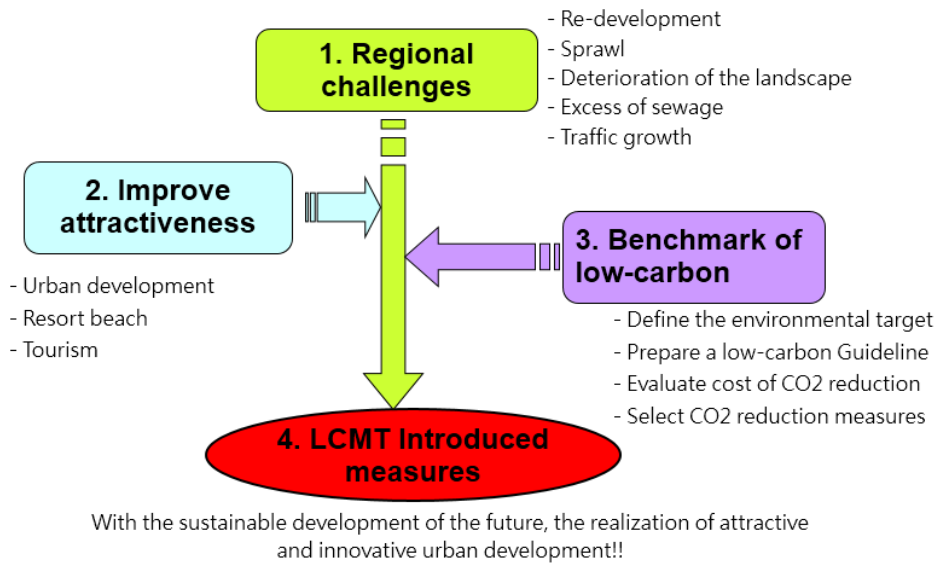

Figure 58 The LCMT process flow diagram. Source: APERC

Some measures recommended by the LCMT review team for Ngu Hanh Son District included:[121]

1. Methane recovery and effective utilization of biomass energy
    a. Utilize methane generated from a sewage disposal and a kitchen waste for a fuel material of Bus Rapid Transit (BRT).
    b. Utilize bio-diesel produced from seed oil of plant for a fuel material of BRT.
2. Low carbon-emission transportation system
    a. Promote electric motorcycle: Establishing a restricted area for engine motorcycles in NHSD, and building free plug-in stations.
    b. Establish a low-carbon transportation system using BRT along trunk road which runs from the airport and urban area to NHSD.
3. Introduction of technologies of energy saving and CO2 saving into buildings
    a. Encourage employing the technologies into public facilities
        i. Air conditioning system with heat pump using river water or sea water,
        ii. BEMS, HEMS and CEMS,
        iii. Photovoltaic power plants,
        iv. Eco-friendly landscape design
    b. Promotion policy introducing the technologies into the facilities of private sector
        i. Comprehensive assessment system for built environment efficiency,
        ii. Environment-consideration guideline for buildings.
4. Encouragement of dissemination of LCMT
    a. Visualization of eco-friendly actions for urban residents,

[121] APERC. The Implementation Plan of the Low Carbon Model Town.

b. Encouraging people's participation to eco-friendly action.

Conclusion

APEC's 21 economies vary in their policies for low carbon development.

This variation is especially apparent among economy-level policies directed at promoting energy smart development at the local and subnational level. Generally, the various energy efficiency and conservation policies recognize that energy smart or low carbon development at the local level is essential to achieving economy-level goals, whether it is constructing more efficient buildings or the purchase of energy efficient appliances. However, few of these policies promote comprehensive planning at the community or city level, although it is at this level that mechanisms such as transit-oriented development and green stormwater management are implemented.

In other words, economy-level policies are typically frameworks and strategies for efficiencies for individual sectors. Taken as a whole, these policies can achieve energy smart and low carbon towns, but seldom does the national policy specifically promote this kind of holistic strategy.

Several economies lie outside of this general norm. These economies' energy policies stipulate—either as a requirement or a voluntary measure—the creation of local and/or subnational energy plans. Planning at the local and subnational level allows for better alignment with local economic and social conditions, while still maintaining the prerogatives set forth in the economy-level plans. New Zealand stands as an example of this type of alignment of national and subnational energy planning. Subnational governments are required to "have particular regard to the efficiency of the end use of energy, the effects of climate change, and the benefits to be derived from the use and development of renewable energy resources" by the Resource Management Act 1991 and regional councils are encouraged to produce a "regional policy statement" that addresses the New Zealand Energy Efficiency and Conservation Strategy.

Table 7 Evaluation of Economy Energy Efficiency and Conservation Policies

Economy	World Bank Income Categorization (GNI)	Latest Energy Policy (year)	Economy-Level Energy Goal?	Subnational Energy Goal Provision?	Public Funding?	Metrics?	Skills?
Australia	High	2010	X	X	X	X	X
Brunei	High	2014	X			X	
Canada	High	2013	X	X	X	X	X
Chile	High	2012	X		X	X	
China	Upper-Middle	2011	X	X	X	X	X
Hong Kong*	High	2013	X		X	X	X
Indonesia	Lower-Middle	2011	X	X	X	X	X
Japan	High	2012	X		X	X	X
Korea	High	2009	X		X	X	X
Malaysia	Upper-Middle	In Development			X	X	X
Mexico	Upper-Middle	2013			X	X	X
New Zealand	High	2011	X	X	X	X	X
Papua New Guinea	Lower-Middle	2011					
Peru	Upper-middle	2010	X			X	
The Philippines	Lower-Middle	2012	X		X	X	X
Russia	High	2010	X		X	X	X
Singapore*	High	2014	X		X	X	X
Chinese Taipei	NA	2008	X		X	X	X
Thailand	Upper-Middle	2011	X		X	X	X
The United States	High	N/A	X		X	X	X
Viet Nam	Lower-middle	2006	X		X	X	X
* single city economies							

Examining the collection of case studies compiled for this report, we find several important threads. At the most general level, energy smart communities are unequivocally being planned and actions are under way to achieve planned goals. These communities are more commonly located in the high income APEC economies, though many communities in APEC's developing economies are also actively planning for energy smart development. The exceptions to this norm are generally those economies that have only recently passed energy efficiency and conservation policies.

Perhaps unsurprisingly, the impetus for implementing the majority of these projects has come from local or subnational governments. Surely, most such projects will need to be planned from the local level, as these governments are most knowledgeable of local conditions and are best able to balance energy efficiency and conservation with societal, environmental, and economic needs. Yet, what is notable is the degree to which local and subnational governments are implementing such plans despite the relative lack of central government policies that either mandate them or even promote voluntary energy smart planning. While energy smart communities are progressing in the absence of these central government policies, having such policies in place will accelerate the creation of new communities.

As the APERC Concept of the Low Carbon Town notes, there are two types of towns: greenfield (new) and brownfeld (existing). The case studies contained in this report include several new communities, while the remaining cases are existing communities that are adapting energy efficiency and conservation strategies to existing assets. Planning for these two differing kinds of projects is drastically different. Whereas energy efficiency and conservation measures can be incorporated at the outset in new construction, existing development requires staged implementation. As the scale of the existing development increases, so too does the amount of staging. Typically the planning is staged both

spatially and temporally, which is to say that energy efficiency is implemented in different parts of a project area (and often one system at a time); and it is also implemented over time, often with increasing efficiency goals spread out over time.

More time is necessary for the energy smart community projects in APEC to mature so that lessons may be learned from their successes and failures. Fortunately, all case studies in this report include some provision for measuring progress towards energy and/or emissions goals. Most projects include specific indicators of success with associated metrics. Policies at the economy-level have often established the infrastructure for collecting necessary data, while some indicators will require new measurement infrastructure to be developed. The next edition of this report will feature a closer examination of the progress of these case studies and others, as well as considering advances in the policy landscape to promote energy smart community development across APEC.

Appendix A: Summary Tables of World Bank Indicators for APEC Economies.

Source: World Bank. World Development Indicators (2014). Accessed at http://databank.worldbank.org/data/databases.aspx

	GDP (2013)			Population (2013)		
	GDP growth (annual %)	GDP per capita	$billion GDP (current US$)	Population (millions)	Population growth (annual %)	Urban population (% of total)
Australia	2.66	67,468.1	1,560.6	23.13	1.78	89.15
Brunei Darussalam	-1.75	38,563.3	16.1	0.42	1.34	76.56
Canada	2.02	51,958.4	1,826.8	35.16	1.16	81.47
Chile	4.07	15,732.3	277.2	17.62	0.88	89.18
China	7.67	6,807.4	9,240.3	1357.38	0.49	53.17
Hong Kong SAR, China	2.93	38,123.5	274.0	7.19	0.46	100.00
Indonesia	5.78	3,561.7	868.3	243.80	1.29	50.71
Japan	1.54	38,492.1	4,901.5	127.34	-0.17	92.49
Korea, Rep.	2.97	25,977.0	1,304.6	50.22	0.43	82.25
Malaysia	4.69	10,513.7	312.4	29.72	1.62	73.28
Mexico	1.07	10,307.3	1,260.9	122.33	1.22	78.69
New Zealand	2.50	41,555.7	185.8	4.47	0.85	86.22
Papua New Guinea	5.40	2,088.4	15.3	7.32	2.13	12.98
Peru	5.82	6,659.8	202.3	30.38	1.28	77.95
Philippines	7.16	2,764.6	272.0	98.39	1.73	44.63
Russian Federation	1.32	14,611.7	2,096.8	143.50	0.22	73.85
Singapore	3.85	55,182.5	297.9	5.40	1.62	100.00
Chines Taipei	-	-	-	-	-	-
Thailand	1.77	5,779.0	387.3	67.01	0.34	47.94
United States	1.88	53,142.9	16,800.0	316.13	0.72	81.28
Vietnam	5.42	1,910.5	171.4	89.71	1.05	32.31

	Energy (2011)				CO2 (2010)	
	Energy imports, net (% of energy use)	Energy use (kt of oil equivalent)	Energy use (kg of oil equivalent per capita)	Energy use (kg of oil equivalent) per $1,000 GDP (constant 2011 PPP)	CO2 emissions (metric tons per capita)	CO2 emissions (kg per 2011 PPP $ of GDP)
Australia	-141.46	122,888	5,501	132.01	16.93	0.41
Brunei Darussalam	-387.83	3,832	9,427	130.95	22.87	0.32
Canada	-62.41	251,845	7,333	177.42	14.68	0.36
Chile	70.57	33,574	1,940	96.24	4.21	0.22
China	10.82	2,727,728	2,029	202.12	6.19	0.67
Hong Kong SAR, China	99.64	14,894	2,106	42.05	5.17	0.11
Indonesia	-88.78	209,009	857	101.60	1.80	0.22
Japan	88.80	461,468	3,610	105.21	9.19	0.27
Korea, Rep.	81.96	260,440	5,232	167.01	11.49	0.38
Malaysia	-11.01	75,907	2,639	125.24	7.67	0.38
Mexico	-22.58	186,171	1,560	98.18	3.76	0.24
New Zealand	11.23	18,167	4,124	130.16	7.22	0.23
Papua New Guinea	-	-	-	-	0.46	0.22
Peru	-13.56	20,582	695	66.64	1.97	0.20
Philippines	40.95	40,452	426	74.41	0.87	0.16
Russian Federation	-79.88	730,970	5,113	226.55	12.23	0.56
Singapore	97.21	33,447	6,452	86.50	2.66	0.04
Chines Taipei	-	-	-	-	-	-
Thailand	42.30	119,147	1,790	139.84	4.45	0.35
United States	18.55	2,191,193	7,032	141.06	17.56	0.36
Vietnam	-8.80	61,210	697	147.73	1.73	0.39