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Hong Kong Energy Vision 2050

An Interconnected Solution for Carbon Emissions and Electricity Pricing

Preface

The government has set out four guiding energy policy objectives: safety, reliability, affordability and environmental performance. Although the government acknowledges the individual significance of these objectives, they also admit that they are competing objectives. The current emphasis on reliability allows Hong Kong to enjoy a supply reliability of over 99.999 per cent; however improvement is needed in terms of environmental performance – particularly in terms of reducing carbon emissions.

Responsibility for Climate Change

According to the Fifth Assessment Report published by the Intergovernmental Panel on Climate Change (IPCC), in 2013 the global average atmospheric CO_2 level rose to 390.5 parts per million[i], 40 per cent higher than in 1750. This is primarily due to the burning of fossil fuels to meet the worlds growing energy demand.

In the United Nations Framework Convention on Climate Change, world leaders committed to limiting the global temperature rise to less than two degrees Celsius to avoid irreversible consequences to the world's ecological systems. To facilitate this temperature limit, developed countries and regions such as the European Union have committed to reducing emissions to 40 per cent below 1990 levels by 2030, and further reducing this to 80 per cent by 2050. Developed cities have made similar commitments – London has endorsed an objective of reducing emissions by 60 per cent by 2025 compared to 1990 levels; while New York has set a target of reducing its emissions by 30 per cent by 2030, using 2005 as the base year.

Compared to other parts of the developed world, Hong Kong lags behind in terms of its carbon emissions reduction targets, having only committed to reducing its emissions by between 19 and 33 per cent before 2020, using 2005 as the base year. To mitigate climate change and appropriately plan for future changes in the electricity market, a more positive and proactive vision is needed. To fulfill our obligations and become part of the global response to climate change, the electric power industry – which accounts for over 60 per cent of Hong Kong's carbon emissions – needs to change. Only through such change can the industry ensure a reliable electricity supply for the next 30 years while simultaneously reducing carbon emissions.

Hong Kong Energy Vision 2050

WWF-Hong Kong believes that the Hong Kong government should set a target of improving energy efficiency by one to two per cent annually while progressively increasing the use of renewable energy sources. This will allow the city to enjoy a clean, stable and affordable supply of electricity, while concurrently greatly reducing the carbon emissions from power generation.

In this briefing, WWF proposes its *Hong Kong Energy Vision 2050* (*Vision 2050*), which provide suggestions for the fuel mix, a regulatory policy for the electricity market, and energy infrastructure. Vision 2050 will allow Hong Kong to reduce carbon emissions by 41 per cent by 2020, with a base year of 2005; and then further reduce these emissions by 58 per cent by 2035 using the same base year. In long run, this vision will reduce emissions by 93 per cent by 2050, a long-term target which is much more ambitious and positive than the current goal set by the Hong Kong government.

1. Reason for changes

In early 1997, the Hong Kong government banned the two electric utility companies from building new coal-fired generating units. Starting from 2015, the coal-fired generating units will be retired and natural gas will replace coal as a major generation fuel. At the same time, the government's current energy policy largely neglects demand-side management, no meaningful energy saving target has been set, and electricity consumption has been allowed to grow naturally. Under the current conditions, or the "business as usual scenario" (BAU) provided by the HKSAR government, we predict that the total electricity consumption and costs will be as follows:

BAU Scenario

Using the government's *Future Fuel Mix for Electricity Generation Consultation* document as a benchmark, assuming that annual electricity consumption and maximum electricity demand will continue to increase as population grows, the government forecasts the annual growth rate will be between one and two per cent. Taking these projections further, the annual growth rate will be 1.5 per cent up to 2025. The growth rate will then presumably decrease by 0.6 per cent every 15 years[1ii]; meaning that electricity demand growth rate will drop by 0.9 per cent between 2025 and 2040, and further reduce by 0.3 per cent after 2040.

Under these growth projections, Hong Kong's electricity consumption will increase from 43 billion kWh in 2012 to 57 billion kWh in 2035 (an increase of 35 per cent over current levels), and further increase to 61.5 billion kWh in 2050 (an increase of 43 per cent). If natural gas is used as the sole major fuel, in 2050 Hong Kong's carbon emissions from power generation will be 26,626

[1] Taking reference from the average increase in Hong Kong population in 1981-2011, the increase in 1981-1995 and 1996-2000 are 1.3per cent and 0.74 per cent respectively, thus every 15 years one average the projected population growth rate drops by 0.6 per cent.

kilotonnes – 16 per cent higher than 1990 levels – leaving the goal of cutting carbon emissions far from accomplished.

Using natural gas as the sole generation fuel not only fails to reduce carbon emissions, it also involves high costs, which include the cost of building new gas-fired generating units, the cost of importing natural gas, and the social cost of carbon emissions.

	Accumulated costs of new gas-fired generating units[2iii]	Annual cost of importing natural gas[3iv]	Annual social cost of carbon emission[4v]
2015	N/A	17.8 billion	6.4 billion
2035	87.1 billion	60.4 billion	6.7 billion
2050	N/A	65.1 billion	7.3 billion

2. Hong Kong Energy Vision 2050

Under the above natural growth scenario, if electricity demand is allowed to increase unchecked, replacing coal with natural gas to generate electricity will not be enough to reduce carbon emissions and mitigate climate change. Huge costs will also be involved. To attain international carbon emissions reduction standards, Hong Kong needs to simultaneously develop renewable energy sources, while promoting both energy saving and demand-side management. Hence, WWF proposes the *Hong Kong Energy Vision 2050*. If fully implemented, this vision will allow Hong Kong to reduce carbon emissions to 90 per cent below 1990 levels by 2050.

The success of the vision described below is dependent on energy-saving policies and demand-side management being fully implemented, and annual targets of energy efficiency by between one and two per cent being met.

The following assumptions have been made: the annual growth rate in electricity consumption before 2025 will be -0.5 per cent; -1 per cent between 2025-2040, and -1.5 per cent after 2040. *Hong Kong Energy Vision 2050* has therefore set a target of reducing electricity consumption by between one and two per cent per year, allowing consumption to be reduced by 50 per cent below the BAU scenario by 2050.

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[2] According to the information provided by Hong Kong Electric to the government in 2013, the projected cost of building L10 gas-fired generating units is 3 billion HKD; the number is based on building generating units of 335MW.

[3] According to information provided by CLP that the cost of West-East Gas Pipeline is 18-20 USD Per million British thermal units

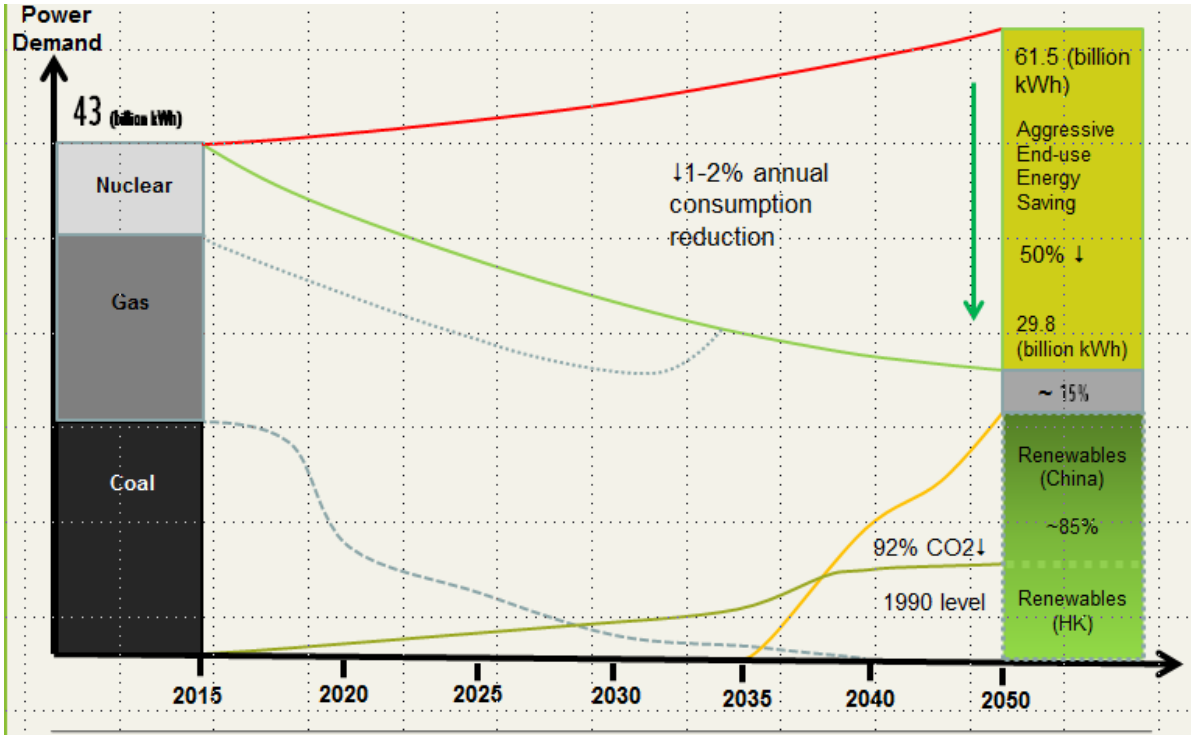
[4] Calculated using the method adopted by Airport Authority Hong Kong when calculating the carbon emissions involved in the third runway construction, 35 USD per tonne of carbon emissions and according to the 2013 emissions level of Black Point Power Station.

Vision 2050 also advocates developing domestic renewable energy (solar power and wind power). Its success also envisions importing renewable electricity from mainland China, which will be contingent on the local development of renewable energy and carbon emissions management.

Fuel Mix for Electricity Generation proposed by WWF

	2015	2020	2025	2030	2035	2050
Natural Gas	37.5%	55%	60%	70%	65%	~15%
Coal	37.5%	18%	12%	5%	5%	0
Nuclear	25%	25%	25%	20%	0	0
Renewable Energy (local)	0	2%	3%	5%	10%	~30%
Renewable Energy (mainland China)	0	0	0	0	20%	~55%

WWF Hong Kong 2050 Energy Vision

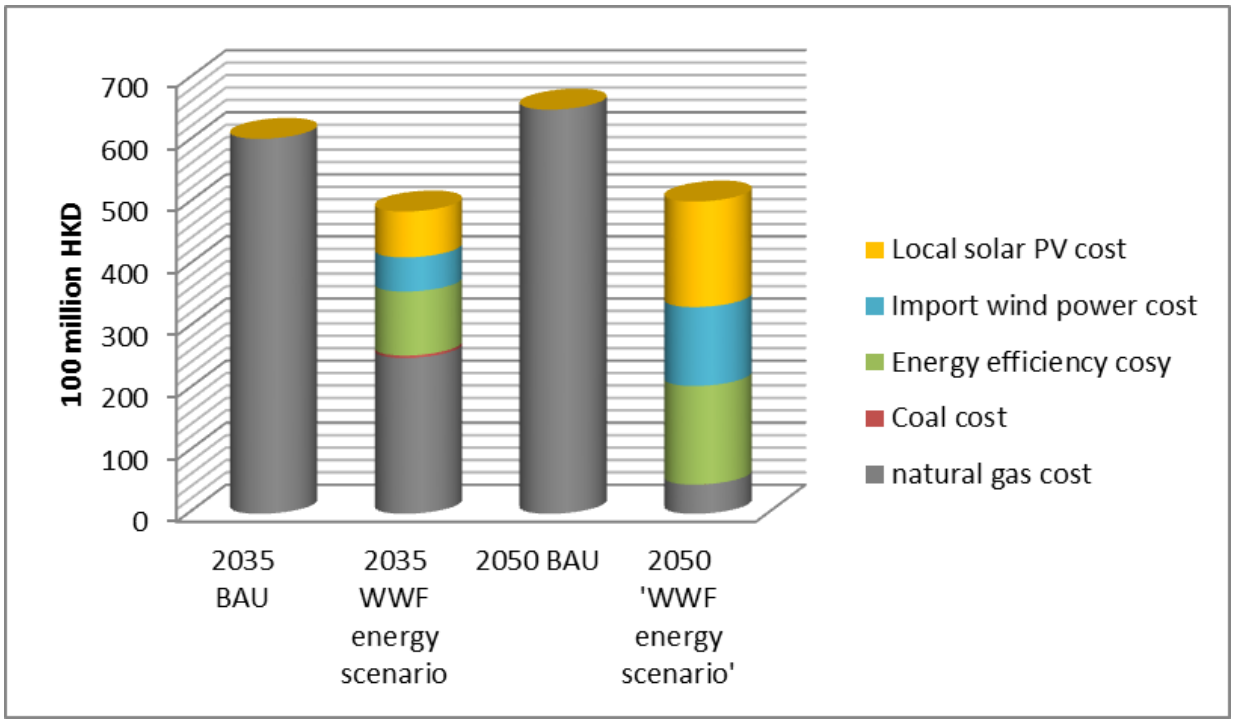


	2015	2020	2025	2030	2035	2040	2045	2050
emission reduction level of	3%	26%	32%	41%	48%	64%	79%	92%

1990								

If the above vision is actualized, Hong Kong will incur significant savings in terms of the three costs of electricity generation mentioned earlier: the cost of building new gas-fired generating units, the cost of importing natural gas and the social cost of carbon emissions.

This paper calculates the costs of importing natural gas and wind power from mainland China[vi], energy-saving[vii], and domestic solar power[viii]. In 2035 and 2050 – not including the costs involved in carbon emissions and constructing gas-fired generating units – the implementation of *Hong Kong Energy Vision 2050* is projected to save at least 11.7 billion HKD and as much as 14.8 billion HKD per year.



Why do we need to develop energy-saving technology and set energy efficiency targets?

Energy-saving technology has been recognized by the IPCC as the most environmentally-friendly and cost-effective way[ix] to reduce carbon emissions. In the *Buildings Energy Efficiency Funding Scheme* introduced by the Hong Kong government, an investment of 356 million HKD is expected to save 150 million HKD per year, and take 2.4 years to break even[x]. Making reference to different energy-saving schemes adopted in the United Kingdom, France and Italy, saving one kWh of energy costs between 0.15 and 0.5 HKD[xi]. In 2005, the Singaporean government introduced an energy efficiency improvement assistance scheme, discovering that for every Singapore dollar (SGD) invested in an energy-saving project, five SGD was saved in energy expenses[xii]. It logically follows that increasing the amount of money invested in energy-saving technology will provide a cost-effective solution to the carbon emissions problem.

Why do we need to develop renewable energy? Is it worth it?

In 2012, the Hong Kong Polytechnic University conducted research on local renewable energy resources. The study found that local solar energy could provide 5.9 billion kWh of electricity annually, while offshore wind power could generate a further 8 billion kWh. In terms of technological know-how, as suggested in a study conducted by the Electrical and Mechanical Services Department in 2002[xiii], local renewable energy resources reserves would allow 1.5 billion kWh of electricity to be generated per year. Therefore, the target set for renewable energy suggested in *Vision 2050* is feasible in both the short and long term.

With respect to the costs of renewable energy generation, as predicted in the *China Wind Energy Development Roadmap 2050* published in 2014 by the Energy Research Institute of the National Development and Reform Commission of China, annual wind power energy produced in China will exceed 800 billion kWh in 2030[xiv]. The expected tariff lies between 0.48 and 0.6 RMB[xv]; lower than the cost of generating electricity via natural gas.

3. Policy advocacy

In order to realize this vision, Hong Kong's electricity market needs to be gradually improved, and the following infrastructure put in place:

Year	Policies and Infrastructure
By 2020	Build two offshore wind farms and launch a pilot feed-in tariff scheme; Set aggressive demand-side management (DSM) and alternative regulatory regime for renewable energy (RE) in the post-2018 Scheme of Control Agreement (SCA); Review the permitted rate of return; Launch a smart meter and periodical tariff system.

Explanation:
By 2020, the government will have completed its review of the Scheme of Control Agreement with the two power companies, requiring them to share responsibility for reducing pollution and inserting provisions encouraging energy-saving and the development of renewable energy. Effective energy efficiency targets shall introduce in SCA. Besides that, an alternative regulatory regime shall be adopted to provide funding for RE development.

The introduction of smart metering and time-based pricing will help reduce the demand for electricity, ensuring that Hong Kong will not need to build new generating units before coal-fired units are eliminated in 2025.

By 2025	Open the grid to small-scale distributed generation of RE (less than 30 KW); Set up a feed-in tariff policy for RE projects Implement a mandatory building energy code.

Explanation:

As coal-fired generating units are decommissioned, Hong Kong will need to set up a feed-in tariff for renewable energy**,** requiring two power companies the open the electricity grid and oblige power companies to buy any power generated at a set price which reflects the fact that the power generated is non-polluting. The application process for the installation of solar panels needs to be simplifed, so as to lower the cost of renewable energy. This will allow renewable energy to begin to replace coal.

Meanwhile, by introducing a mandatory Green Buildings standard, buildings will be required to reach at least a "silver" level during their renovation work, thus reducing the electricity consumption of older buildings. Newly-constructed buildings will be required to install solar power systems. In conjunction with the feed-in tariff, the economies of scale of the solar power industry will improve, thus reducing the price of installing solar power systems.

By 2030	Develop a "smart grid" system; Increase the "interconnection capacity" between the two utilities; Build up a carbon trading system or introduce a carbon tax.

Explanation:

As the old power generating units are decommissioned, it will become essential for the two power companies to expand their transfer capacity, in order to avoid the need to invest in emergency generators or to control the electricity price by reducing capital investment. As the two power companies expand their network, the electricity grid should be upgraded to a "smart grid", where electricity is better managed by a distributed generation system, which will include renewable energy, electric vehicles, or even small-scale co-generation. This will ensure that there will be enough electricity to cope with the challenges brought by the retirement of the coal-fired generating units.

The reduction in coal burning can be seen as an opportunity to introduce a carbon tax. By collecting this carbon tax from enterprises, which will naturally be calculated according to the amount of carbon emitted, the social costs of carbon emissions will be reflected in the electricity price. By way of example, Denmark started collecting a carbon tax in the 1990s to help balance the development of the electricity market. The introduction of carbon tax in Denmark compensated for the expenses of the feed-in tariff, allowing the use of renewable energy to be increased to five per cent, and providing capital for providing solutions to climate change and tackling the problem of "energy poverty".

By 2035	Connect with the China Southern Grid and import additional electricity generated from renewables; Extend the current contract for a large Pumped Storage Power Station with Guangdong province; Complete the Smart Grid System

Explanation:

By this date, the Daya Bay Nuclear Power Plant will be retired. The government should thus make use of the existing electrical grid that connects the plant to Hong Kong, and use it as an interconnection point with the China Southern Grid. This will save on the cost of importing electricity and allow Hong Kong to import electricity from various mainland China renewable energy projects. By connecting to the China Southern Power Grid and implementing proper carbon accounting, Hong Kong will be able to replace 20 per cent of the electricity derived from nuclear power with imported renewable energy starting from 2035.

In order to address potential fluctuations in renewable energy, Hong Kong should extend the current Pumped Storage Service Contract that is now used to regulate the electricity supply from the Daya Bay Nuclear Power Plant. When there is a sufficient supply of renewable energy, water will be pumped to a high reservoir in order to save electricity, and when more electricity is needed then it can released to generate hydro-electrcity. The government should also develop a new pumped storage system as renewable energy and the smart grid progress. This will lay the groundwork for when more than 50 per cent of Hong Kong's renewable energy is imported from mainland China.

Conclusion

Hong Kong Energy Vision 2050 is not solely concerned with environmental factors. This vision also takes into account the stability and cost-effectiveness of our future electricity supply. Whether this vision can be achieved is dependent on whether our electricity market will see enough structural improvements. Stronger regulation of the power utility monopolies will be needed.

WWF suggests that any future discussion regarding the Hong Kong electricity market should be based on the interests of society as a whole, and on our international obligations to cut CO2 emissions. Having a 30-year plan as a framework will help the government and society develop a solution that helps cut carbon emissions while maintaining an affordable electricity price.

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