

The Future of Hong Kong Energy – Reliable, Affordable & Low Carbon

Where Do We Go From Here?
Electricity Generation for Now and Beyond 2020

Event Organizer



ENVIROSERIES

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Outline

1. Brief Overview of Hong Kong Electricity Generation Sector
2. Issues and Challenges (Reliability, Fuel Supply, Tariff, Emissions, Fuel/Energy mix and RE)
3. Now and Beyond 2020 - What can be Considered?

Electricity Supply in Hong Kong

Electricity in Hong Kong has always been supplied by two investors-owned power companies operating in a vertically integrated electricity market:

- The Hongkong Electric Company Ltd (**HEC**) incorporated in 1890 
- CLP Power Hong Kong Ltd (**CLP**) incorporated in 1901. 



- 1 • 發電
• (Generation)
- 2 • 輸電
• (Transmission)
- 3 • 配電
• (Distribution)
- 4 • 零售
• (Retail)

Vertically-integrated
Market Structure

Both power companies do not have a franchise but their operations are regulated by the **Environment Bureau** under two separate 10-Year Scheme of Control Agreements (SCAs) with **CLP** and **HEC** : Valid till 2018 with interim review in 2013.

Sources: CLP Power, Power Assets and Environment Bureau Websites.

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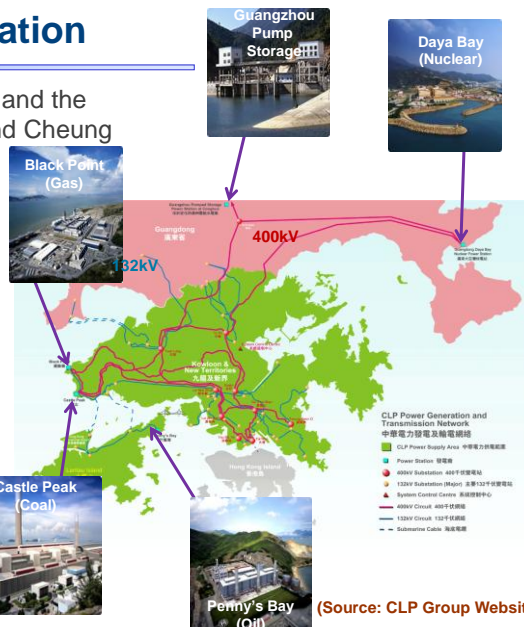
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CLP Electricity Generation

CLP supplies electricity to Kowloon and the New Territories, including Lantau and Cheung Chau (**green areas**).

Electricity is generated from Black Point Power Station, Castle Peak Power Station, Penny's Bay Power Station, Daya Bay Nuclear Power Station and Guangzhou Pump Storage Power Station.

CLP currently has a total installed capacity of **8,888MW**. In 2012, maximum demand was **6,769MW** (31.3% reserve margin) and sales of electricity for local consumption was **31.995 billion kWh** (74.4% of Hong Kong total)



(Source: CLP Group Website)

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HEC Electricity Generation

HEC supplies electricity to Hong Kong Island and Lamma Island.

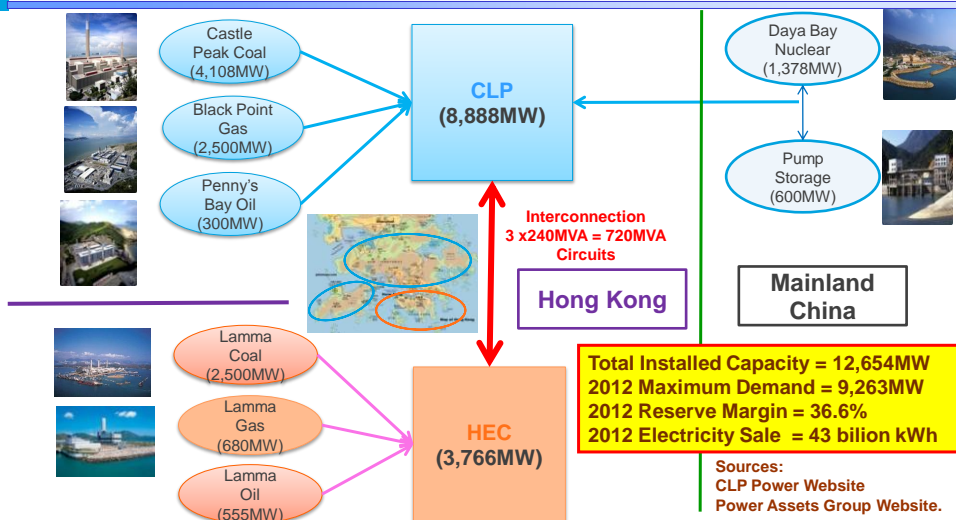
Electricity is generated at **Lamma Power Coal-Fired and Gas-Fired Stations** plus Hong Kong's first grid-connected 800kW **Wind Power** and largest 1,000kW **Solar PV System**.

HEC currently has a total installed capacity of **3,766MW**. In 2012, maximum demand was **2,494MW** (51% reserve margin) and sales of electricity for local consumption was **11.036 billion kWh** (25.6% of Hong Kong total)



(Source: Power Assets Group Website)

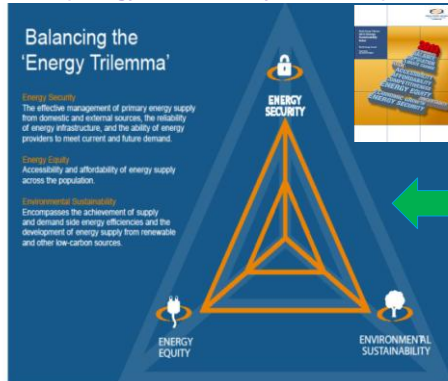
Hong Kong Electricity System - Overview



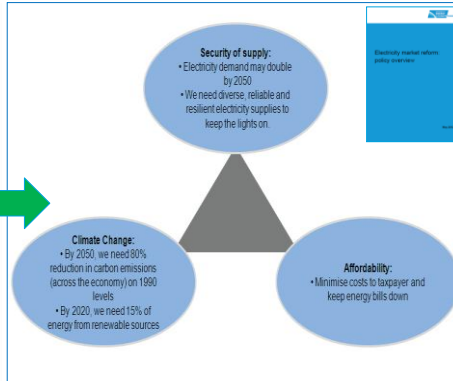
The **720MVA** Interconnector is mainly used for emergency backup and sharing of spinning reserve (**2,000MVA** required for full power transfer with N-1 Contingency).

Energy Trilemma / Electricity System Objectives

World Energy Council – Energy Trilemma (Energy Sustainability Index 2013)



UK Electricity System Objectives (Electricity Market Reform Policy Review 2012)



- Energy Security ⇔ Security of Supply
- Energy Equity ⇔ Affordability
- Environmental Sustainability ⇔ Climate Change

Sources:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/48371/5349-electricity-market-reform-policy-overview.pdf
<http://www.worldenergy.org/publications/2013/world-energy-trilemma-2013>

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Issue 1 : System Demand/Reserve Margin ⇔ Reliability

Year	Installed Capacity (MW)	Electricity Local Consumption (billion kWh)	Maximum Demand (MW) / Reserve Margin	GDP (Current Price (HK\$million))	Population
2006	12,654	40.33	9,032/40.1%	1,503,351	6,857,100
2007	12,654	40.85	8,836/43.2%	1,650,756	6,916,300
2008	12,654	40.94	9,338/35.5%	1,707,487	6,957,800
2009	12,654	41.50	8,926/41.8%	1,659,245	6,972,800
2010	12,654	41.86	9,278/36.4%	1,846,505	7,024,200
2011	12,654	42.06	9,200/37.5%	1,936,083	7,071,600
2012	12,654	43.03	9,263/36.6%	2,041,900	7,154,600
Change (6 Yrs)	No Change	+6.7%	+2.6%	+35.8%	+4.3%

- **Consumption:** 6.7% over a period of 6 years (~1% per year) .
- **Max Demand:** 9,338MW in 2008 (influenced primarily by weather, not GDP)
- **Reserve Margin:** 35.5%+ (level dictates the need for new Installations)

Unplanned customer minutes lost per year



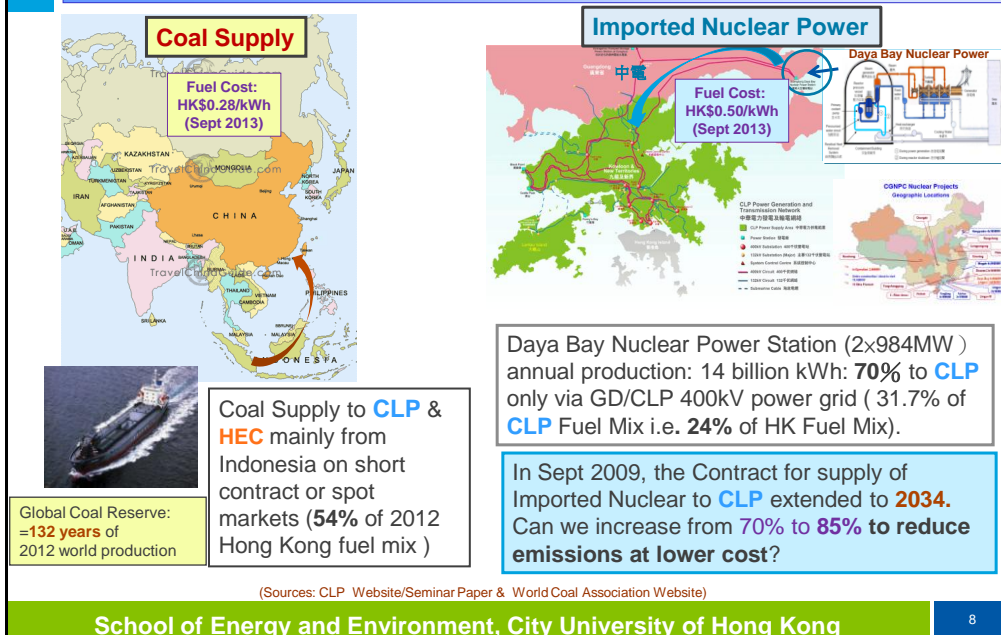
- **2,150MW Coal Fired Units** will retire towards 2020, i.e. total capacity reduces to **10,500MW**.
- Some or all have to be replaced by Gas-Fired units or Imported Nuclear Power?
- Reserve Margin: **35.5% to 25%** (If) can minimize/defer Replacements ? Can retain 99.999% reliability beyond 2020?

(Sources: LegCo Paper LCQ15 (2011) , HK Annual Digest of Statistics, CLP/Power Assets Annual Reports)
<http://www.legco.gov.hk/yr12-13/english/panels/dev/papers/edev0108cb1-401-1-e.pdf>

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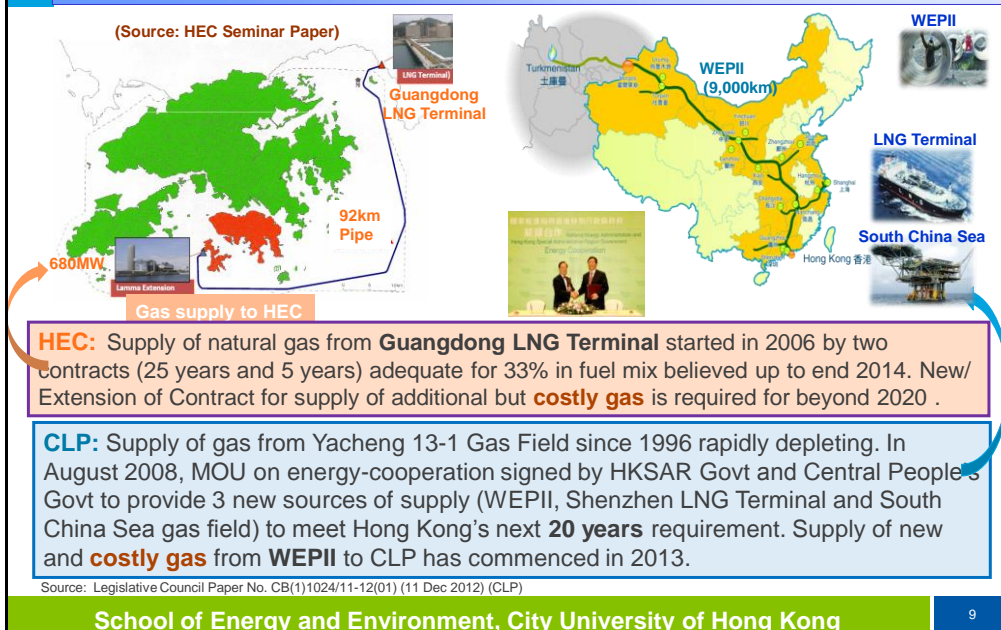
Issue 2: Fuel/Energy Security (Coal & Nuclear Beyond 2020)



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Issue 2: Fuel/Energy Security (Natural Gas Beyond 2020)

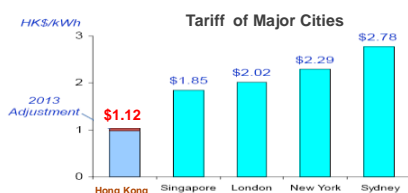


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Issue 3: Affordability (Electricity Tariff – Current)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	Changes
CLP (HK\$ ¢/kWh)										
Av. Basic Tariff	-	-	-	-	77.4	80.0	80.0	85.0	84.2	Steady
Fuel Clause Charge	-	-	-	-	11.8	11.5	14.1	17.8	22.4	double
Rebate								-3.3	-2.1	
Av. Net Tariff	87.2	87.3	87.1	91.1	89.2	91.5	94.1	98.7	104.5	+19.8%
HEC (HK\$ ¢/kWh)										
Av. Basic Tariff	-	-	-	-	94.5	94.5	93.1	94.1	94.7	Steady
Fuel Clause Charge	-	-	-	-	25.4	25.4	30.2	37.0	40.2	1.5 times
Av. Net Tariff	103.3	110.0	117.4	127.4	119.9	119.9	123.3	131.1	134.9	+30.6%
Hong Kong (HK\$ ¢/kWh)										
Av. Net Tariff (weighted)	89.2	93.0	94.7	100.2	96.9	98.6	101.4	106.8	112.1	+25.6%



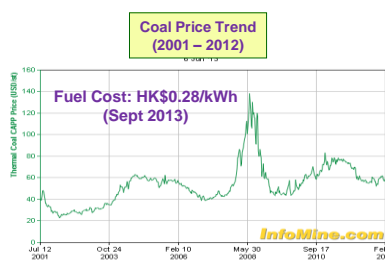
- Basic Tariff: steady over 8 years
- Fuel Cost: nearly double over 4 years
- Average Net Tariff: Still Highly Competitive

Sources:
LegCo Paper LCQ15 (2011), CLP Group and Power Assets Websites
<http://www.legco.gov.hk/yr12-13/english/panels/edev/papers/edev0108cb1-401-1-e.pdf>

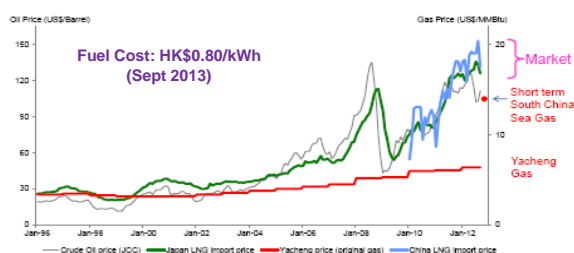
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Issue 3: Affordability (Impact of Fuel Cost) Beyond 2020



Gas Price Trend(1996-2012)



CLP Gas Prices : Yacheng ~\$6 ; Short term South China Sea ~\$14. Market ~\$18-\$21

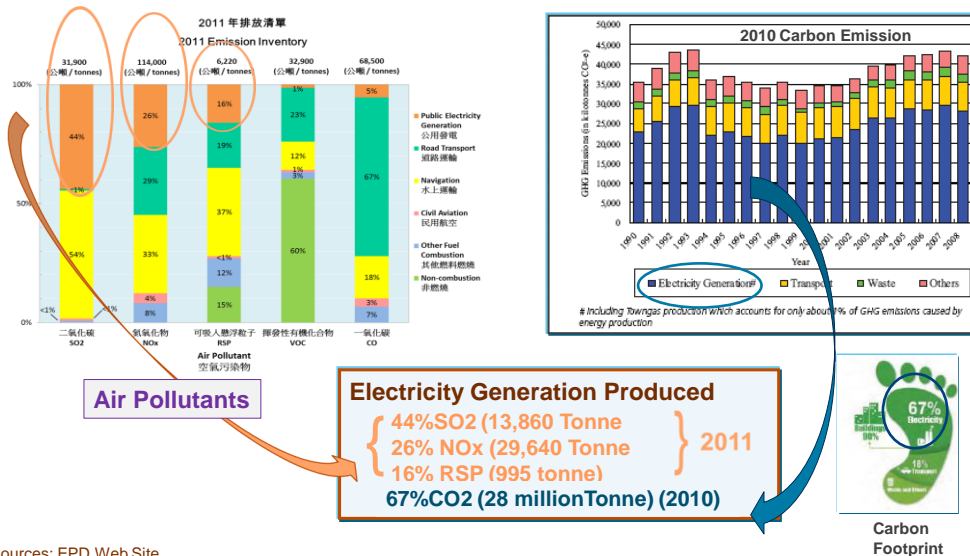
- All new gas contracts signed/or to be signed by power companies are long term "Take or Pay Contract" and based on Asian Market price of **US\$18-21/mmBtu** i.e. about 3 to 4 times of old gas contracts (1996 & 2006) of around US\$6/mmBtu.
- Current Tariff will have to go up significantly from 2015 onwards due to using **more quantity of costly gas** to meet increasingly tightened emission caps in 2015, 2017, 2020 and beyond.

Sources: <http://www.infomine.com>
Legislative Council Paper No. CB(1)1024/11-12(01) (11 Dec 2012) (CLP)

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Issue 4: Pollutants & Carbon Emissions



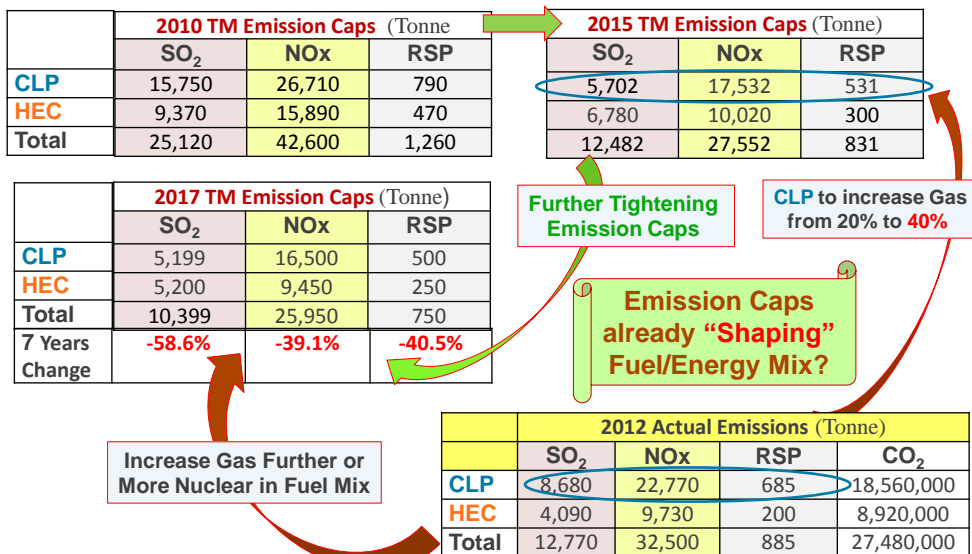
Sources: EPD Web Site

Hong Kong's Climate Change Strategy and Action Agenda Consultation Document (Sept 2010)

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Issue 4: Emission Caps (Now and Towards 2020)



Sources: EPD Web Site; CLP 2012 Sustainability Report; Power Assets 2012 Sustainability Report

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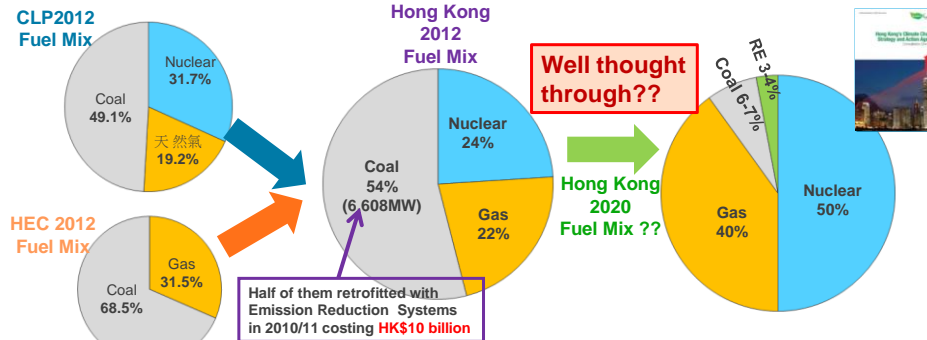
Issue 4: Emission Caps/Fuel Mix (Now and Beyond 2020)

Carbon Emission	2005	2020
Carbon Footprint	6.2T/Capita	3.6 – 4.5T/Capita
Total Carbon (kT)	42,000	28,140 – 34,020
Carbon Intensity (kg/HK\$GDP)	0.029 (Base)	0.0116 – 0.0145 (Reduction 50% - 60%)

Hong Kong's Climate Change Strategy and Action Agenda Consultation Paper (Sept 2010)

Emissions	SO ₂	NO _x	RSP	VOC
2010 (Tonnes)	35,500	109,000	6,340	33,700
2015 Targets	-25%	-10%	-10%	-5%
2020 Targets	-35% to -75%	-20% to 30%	-15% to 40%	-15%

Tackling Regional Air Pollution (Nov 2012)
(Further "Shaping" Fuel/Energy Mix)



Sources: EPD Web Site; CLP Group Website; Power Assets Website

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Issue 5: RE for Electricity Generation Now & Beyond 2020



HEC Proposed 100MW Offshore Wind Farm



CLP Proposed 200MW Offshore Wind Farm

Propose 300MW offshore wind farm at capital cost over **HK\$10 billion** can generate about **580million kWh** electricity (**1.2%** HK's electricity supply) with capacity factor of 22% due to low wind speed (5 to 6m/s) close to Equator. (*Intermittent Nature...Worth?*)



Proposed Waste to Energy Incineration Plant

Proposed 3,000t/day waste to energy incineration plant (HK\$15B): part of Waste Management System to tackle waste disposal can generate about **500million kWh** electricity ... Bonus (**1%** of HK's total).

300MW Wind Farm + Two (2) Waste to Energy Incineration Plant can produce about 3% of Hong Kong electricity supply using Renewable Energy.

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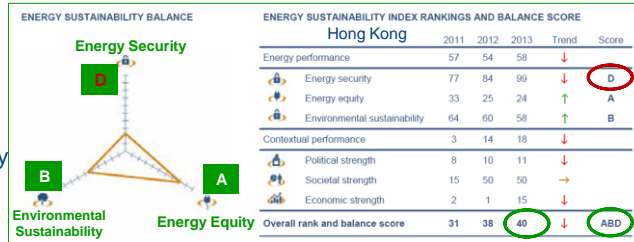
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HK Electricity Market - Now : How Good or How Bad?

STATUS QUO: Vertically Integrated – Regulated thro' SCAs till 2018

- **Reliability?** 99.999% one of the **Best** in the world (*Can we trim down Reserve Margin?*)
- **Accessibility?** Almost **100%** coverage ..one of the best in the world
- **Affordability?** One of the **Lowest** among developed economies with limited resources endowment (*To go up soon due to use more costly gas.....Fuel Mix policy?*)
- **Pollutants Emission?** Most coal-fired plants fitted with state-of-art emissions reduction systems + world class CCGT gas-fired plant (*Huge reductions made already!*)
- **Carbon Emission?** 67% of Hong Kong (**6T/Capita** below world average of 7T/capital) (*can reduce by using less coal.....Fuel Mix Policy?*)

World Energy Council
Energy Sustainability Index
Hong Kong Ranking: **40**
(**ABD**) in 2012 due to
Deteriorating Energy Security
(*Imported Fuels & Electricity*)



Source: <http://www.worldenergy.org/publications/2013/world-energy-trilemma-2013>

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Now and Beyond 2020 – What can be Considered?

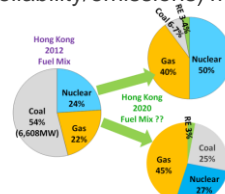
What do Hong Kong People want or What do they complaint about?

- **Huge Profits Made?** HK\$44.3 billion Revenue => **HK\$13.2 billion** Profits after tax in 2012 but electricity prices often go up higher than inflation (*Pressure Groups?*)
- **Price Disparity?** Why consumers on Hong Kong Island pay about **30%** more
- **Consumer Choice?** Why consumers in many developed economies have choices of suppliers but **NOT** in Hong Kong? (*Competition => Lower Price?*)



1. Setting Right Fuel/Energy Mix (Impacted tariff/reliability/emissions) must consider:

- Market structure/size
- Generation plant mix/residual life
- Fuel sources/security/cost
- Maturity /safety of green/clean-energy technology
- Projected electricity consumption
- Levels of air pollutants/carbon emissions reductions
- Time line for implementation



2. Establishing Energy Authority: statutory body responsible for formulating sustainable **Energy Policy**, regulating electric power/gas industries with clear regulatory framework; addressing "energy poverty"; promoting energy efficiency/conservation/demand side management, studying viability of bringing in electricity from the Mainland and introducing some forms of competition; etc.

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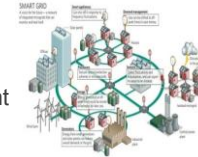
Now and Beyond 2020 – What can be considered?

3. Upgrading Interconnector : To increase the existing capacity from 720MVA to **2,000MVA** (N-1 Contingency) for full energy transfer

- To reduce Spinning Reserve and scale down Reserve Margin
- To Integrate power grids of CLP & HEC for bringing electricity (nuclear power or viable RE) from the Mainland to Hong Kong Island => reduce use of coal or rely less heavily on **costly gas** for emissions reduction.



4. Introducing Smart Grid: To make best use of exiting assets, enhance reliability and efficiency, introduce **demand response** and **off-peak/real time tariffs**, facilitate “peak shaving”, reduce/defer replacement of retired units or new additions, and **cap/slow down price increase**.



5. Gradually Opening Up Generation Sector: Integrate CLP and HEC Power Grids to form an **Integrated Power Grid** owned and operated by a **New Entity** (including CLP, HEC & others); **67%** of electricity demand covered by **Vesting Contracts** leaving 33% for contesting to reduce current **price disparity** and later on to facilitate 3rd party entry (*Wholesale Market requires huge set-up cost and ISO in place to connect all market players*).



Lessons Learned from Overseas Experiences*

- Regulated or Deregulated Electricity Market : No **“MODEL”** can fit all (market size, capacity mix, market players, political/economic/social settings, etc)
- Get **Stakeholders** Involved and seek consensus (open, transparent.....)
- Promote **consumers** awareness & education: Most Consumers think price of electricity must drop once the Market is deregulated - An Incorrect Concept
- **Electricity** is part of our lives. Sound policy and clear regulatory framework are needed for Hong Kong to support its transition to a clean, low carbon economy.

Don't be afraid to
CHANGE.
You may lose
something good
but you may gain
something better.



Thank You !

Sources:

*Li, Raymond 2013 "Evolution of Electricity Markets in Alberta, Canada" Seminar on Deregulation of Small Electricity Markets, HKBU, 11/11/2013)
<http://www.discoverhongkong.com/eng/see-do/highlight-attractions/index.jsp>
<http://obaid-tips.blogspot.hk/2012/05/dont-be-afraid-to-change.html>