

CLP 中電

Response to the

FUTURE FUEL MIX FOR ELECTRICITY GENERATION

Public Consultation
May 2014

A MESSAGE FROM THE MANAGING DIRECTOR OF CLP POWER

On 19th March 2014, the HKSAR Government issued a public consultation document titled "Future Fuel Mix for Electricity Generation". CLP is one of the largest privately-owned electricity utilities in Asia and the largest in Hong Kong and in this response we set out our views on the various considerations involved in the fuel mix options and how the measures proposed by Government can best be implemented.

CLP has been serving Hong Kong for more than 100 years, not only in providing a highly reliable and cost-effective power supply but also by supporting many community initiatives.

Many of our customers and stakeholders have also asked us for more background information to help them understand the Fuel Mix consultation document. In response, we have put together more detailed information, which we hope will help in providing more of our understanding of the key issues surrounding this consultation.

As a member of the Hong Kong community, we always bear in mind the long-term interests of Hong Kong's people and look to create long-term value for our city. CLP is ready to facilitate and deliver the fuel mix decision that is eventually made by the community in the usual professional, reliable and efficient manner.

It is important that you give your views, as policy decisions taken by the Government after the consultation are likely to affect not only Hong Kong's future environmental performance but also the reliability of our electricity supply and our tariffs for many years to come.

I hope you find this document useful. Please make your voice heard by responding before the end of the consultation period on 18th June 2014.

Yours sincerely,



Paul Poon

Managing Director
CLP Power

CLP's RESPONSE

The Government has recently published an important consultation on the future fuel mix for electricity generation in Hong Kong. Two alternatives are identified: Option 1 assumes that approximately 30% of future needs are met through grid imports of power from the Mainland; and in Option 2 these needs are met by using more natural gas for local generation.

CLP's View:

Both options present opportunities and challenges. CLP believes that a phased and flexible approach, which combines both planning for initial gas units and intensive study for a new cross-border interconnector, would deliver the best long-term value for Hong Kong

Hong Kong has benefited from a highly reliable electricity supply at relatively low cost for many years. When looking at options for change, we need to consider an appropriate balance between the main objectives of reliability, environmental performance and costs. That balance also needs to take into account preserving the flexibility and optionality in the long-term interests of Hong Kong as annual fuel costs represent a significant part of electricity bills. The best protection for Hong Kong consumers against volatility in energy prices is to have the capability to use local gas generation when it is cheaper than imported low carbon energy or vice versa. In this way, over the longer term, it may make sense to have both Option 1 and Option 2 available.

We believe that a small number of highly efficient new gas units could be needed by 2020, regardless of whether Option 1 or Option 2 is pursued in the longer term, to further reduce air and carbon emissions.

At present, Option 2 provides a more certain result in terms of maintaining electricity supply reliability as well as real improvements in emissions performance. Although untested, Option 1 has the potential to provide more opportunities in the longer term for importing lower carbon electricity as the Mainland's reliability continues to improve. This would need both careful planning and further studies to ensure that our current reliability will not be compromised and that it is acceptable to the community.

The first stage of Option 1 for the new cross-border interconnector is to study how it might be done, at what cost and how much low carbon energy Hong Kong could purchase, by when. We believe that this detailed technical and commercial study should commence now, since it will take considerable time to complete properly.

The first stage of Option 2 is to begin the planning and engineering design work for the initial gas fired generating units in time to support the local air quality and carbon objectives set by the Government for 2020.

CLP's RESPONSE

Before committing to build further gas units under Option 2, or to approve the financial investment in a new interconnector with the Mainland, we can look at circumstances at that time, including relative energy prices and whether there is still strong demand growth for electricity in Hong Kong, even with the efforts of the Government and the Community to reduce energy use in the next few years. If our electricity demand is still growing and reliable supplies of low carbon energy are available from the Mainland at the right price compared to local gas generation, we can move closer to a decision for the new interconnector.

The decision (and more importantly, the commitment) for the investment in Option 1 does not need to be made now, given that the lead time for a new cross-border interconnector is at least 10 years. As detailed studies must come first, the community can make a more informed decision later on whether to pursue Option 1, or to continue with Option 2, depending on Hong Kong's needs, energy prices and the performance of the Mainland grid at that time.

Both options have opportunities and challenges. We do not believe that the community should have to make a once and for all definitive choice between Option 1 and Option 2 now, nor do we believe both should be implemented at once. A phased and flexible approach in a long-term plan that seeks to maximise the advantages of each proposal at the minimum cost to customers would allow Hong Kong more time and options to gauge what is the best way forward whilst maintaining the reliability and security of our electricity supply, allowing a choice in energy supplies, delivering environmental performance improvements and minimising over-investment in energy infrastructure until more certainty on costs and benefits is available.

In summary, CLP's position is:

- **Start NOW on planning the initial phase of Option 2 to meet Hong Kong's immediate electricity needs by building a small number of new gas units in Hong Kong**
- **Start NOW on a detailed study for Option 1 to see how the Mainland could provide highly reliable supplies of low carbon energy at a reasonable cost**
- **Avoid over-investment by reviewing the future demand for electricity and relative energy prices when this work is completed, before deciding whether to build the new interconnector or further gas units in Hong Kong, or a selective combination of the two**

We have choices for our energy future and Hong Kong has the option to make these decisions more effectively as we get more information in a progressive manner, rather than having to make them all in one go now.

PLANNING AHEAD FOR A BETTER FUEL MIX

Details of our Considerations and Views

OUR CONSIDERATIONS

Ensuring long-term value for Hong Kong

- The consultation's planning horizon is looking at 2023, a decade from now. However, the decisions made for our electricity generation fuel mix will have an impact on a time frame far longer than that.
- The focus should be on ensuring the greatest long-term value for Hong Kong. Given the volatility of fuel costs which are a significant portion of electricity bills, CLP believes this can be achieved by having the ability to choose the best-priced fuel according to the prevailing circumstances.

Reliability is critical to Hong Kong

- Our way of life in Hong Kong, based on the high rise buildings where we live and work, means that we are uniquely dependent upon an extremely reliable electricity supply. Hong Kong can only function in the way that it does with a heavy reliance on a stable and secure power supply and any decisions made on our future fuel mix should not compromise this.
- At present, we ensure that high reliability is achieved in several ways. We control dedicated generation plants to meet demand and maintain an adequate reserve margin of generation units to cater for any breakdowns or incidents. We have a dedicated connection enabling power imported from Daya Bay to be still under CLP's control in the event of emergencies when our grid has to be disconnected from the Guangdong grid.
- The control of generation capacity under the two options proposed by the Government could be very different with implications for Hong Kong's electricity supply reliability.

- Option 1 connects CLP's grid to CSG's grid without a dedicated transmission line to specified generation units. This would connect Hong Kong to a much wider pool of generation on the Mainland which would mean that the risk of a serious impact from individual generation unit failure is lower. However we would be placing greater reliance on the resilience of the CSG and Guangdong transmission grid to deliver the 30% power that Hong Kong needs. Large integrated transmission systems introduce new supply risks, the main one being cascade failure, where supply problems in one area rapidly spread. The likelihood of this happening may be low, but the effects can be significant, as recent experience has shown in places such as India, New York and Italy. Currently, CSG and Guangdong's supply reliability is not at Hong Kong levels.
- Option 2 involves more local gas generation. Providing that sufficient capacity is available, this would maintain Hong Kong's high level of reliability. However, additional sources of natural gas at competitive prices would need to be arranged.
- More information on reliability considerations can be found in the attached Appendix.

Emissions and their impact

- For additional power imports, consideration should be given to any impact on global greenhouse gas emissions as well as on the shared regional air quality between Hong Kong and South China.
- Option 1 would provide more opportunities in the longer term for importing lower carbon electricity. However, if clean sources of generation are not planned or allocated specifically for Hong Kong, then great care must be taken to ensure that this option does not result in Hong Kong merely exporting its emissions to the Mainland.

OUR CONSIDERATIONS

- Option 2 provides more certainty and control of emissions performance and would lower the carbon intensity of our electricity generation. However, further future improvements in emissions performance may be limited in the longer term as gas, although much cleaner than coal, still entails emissions.
- Flexibility in what carbon intensity reduction targets are to be achieved in each year from 2020 onwards, as long as they fall between the lower and upper bounds of the targeted reduction ranges, would allow the actual fuel mix in each year to be optimised. This can minimise total fuel costs for the benefit of customers.
- More information on emissions can be found in the attached Appendix.

Our customers and their views

- Since the most important stakeholder involved in any changes to Hong Kong's fuel mix is the community, the Hong Kong Polytechnic University was commissioned to conduct an independent survey on the views of our customers.
- Approximately 1,100 of our customers, from all groups including residential, small and medium businesses and large power users, were surveyed and the results compiled in early May 2014.
- For respondents who indicated a preference, almost three times as many supported Option 2 (more local gas generation) compared to those who supported Option 1 (grid import). However, it was also noted that the majority of the respondents also desired more information and more fuel mix options for consideration.

Retaining local expertise and experience

- The power industry requires a very high level of expertise and the technical personnel at both CLP and Hongkong Electric, as well as their supporting business partners and suppliers, have developed their skills over decades of hands-on experience in the electricity generation, transmission and distribution and planning fields.
- Regardless of the decisions taken for the fuel mix moving forward, it is important for Hong Kong to ensure it has and maintains a healthy level of local experience, talent and know-how for ongoing sustainability.

The value of flexibility and having choices for our future fuel mix

- Power infrastructure and equipment require long lead times to plan and build. Once they are built and with proper maintenance, they can last for long periods up to 40 - 60 years.
- As international fuel markets are highly volatile and technology changes over time, it is important for Hong Kong to retain its agility to adapt to changing circumstances in the future. Hong Kong should carefully evaluate all options to ensure the highest degree of flexibility in delivering the optimal fuel mix over the long term in terms of reliability, environmental performance and affordability.

OUR VIEWS

A “Phased and Flexible” approach is recommended

- CLP sees benefits in elements of both of the Government’s proposed options. The options are not mutually exclusive and we need not rule out choices right away.
 - It is important to look carefully at the best and most flexible aspects of both options so we can look after the best long-term interests of the community.
 - Because of these issues, CLP has reservations in adopting either option on its own. Instead, we consider that the best long term approach for Hong Kong is to adopt a **“phased and flexible”** approach taking the best elements of both options in a way that maintains current levels of high reliability and delivers appropriate reductions in emissions at the lowest overall cost to customers in the long term.
 - This phased and flexible approach will also allow flexibility and optionality in the future as relative fuel prices and technology change, so that over time Hong Kong could switch between local gas-fired generation and purchased power imports from the Mainland, according to circumstances at the time.
 - As reliability levels continue to improve in Guangdong, this approach would allow Hong Kong, if we so chose to do so in the future, to place progressively greater emphasis on power supplies from the Mainland whilst at the same time preserving an appropriate degree of local backup.
- We believe that a small number of highly efficient new gas units could be needed by 2020, regardless of whether Option 1 or Option 2 is pursued in the longer term, to further reduce air and carbon emissions; later this new capacity can also replace the oldest of our coal fired units as they reach the end of their operating lives. These are early steps that need to be taken into account in either option.
 - Option 1, grid imports, is untested in the form proposed for Hong Kong and given its complexity and cross-border infrastructure programme, comprehensive studies on technical and commercial arrangements are recommended to look into:
 - a) the required elements to ensure Hong Kong’s continued high levels of reliability – including the local back-up generation needed and the technical, commercial and coordination framework with our Mainland counterparts to manage potential emergencies and supply issues;
 - b) the most cost-effective, reliable and efficient infrastructure to import the electricity to Hong Kong;
 - c) the timing, scale and costs for the required financial and commercial commitments;
 - d) the type of imported power available and if it is base load or available to help meet peak summer demand periods in Hong Kong, as well as the timing, quantity available, supply stability, emissions reductions and costs;
 - e) other issues related to pricing, planning, coordination, operations and accountability.

Comprehensive study and a carefully developed implementation plan is needed

- Both options require further careful consideration before the best elements of both can be properly implemented and both have important policy implications to be considered.

OUR VIEWS

- Option 2, using more natural gas for local generation, is a simpler and well-proven model that has more certainty and control. For further units eventually required under Option 2, it would still require further study on:
 - a) how much more additional natural gas can be made available to Hong Kong both now and in the future;
 - b) the most cost-effective, reliable and efficient infrastructure to bring more natural gas to Hong Kong at competitive prices;
 - c) the exact timing, scale and costs of additional local gas generation units;
 - d) how to mitigate or take advantage of any price fluctuations of natural gas over the long term.
- The results from these studies should then be integrated into a comprehensive phased and flexible implementation plan which looks beyond 2023 and sets out a delivery pathway of the appropriate elements of both options in a way that provides their principal benefits with the least overall cost to customers.

A phased and flexible approach does not mean maximising investments

- In proposing a phased and flexible approach, it is important to note that it does not mean investing in all facilities required for both Option 1 and Option 2.
- Specifically, we should start now on planning the initial phase of Option 2 to meet Hong Kong's immediate electricity needs by building a small number of new gas units in Hong Kong. We should proceed with full scale studies both locally and with our Mainland counterparts (including technical assessment and commercial arrangements) related to the interconnection in Option 1.
- As there is more information available regarding this concept, Hong Kong can then assess the best way forward before making further significant commitments in either more gas units in Hong Kong or building the interconnector or adopting a combination of these two options.

Costs of further study are minimal and this can be done before Hong Kong makes any major commitments

- Technical feasibility studies and commercial discussions with Mainland counterparts would not require significant costs compared to actual physical infrastructure construction costs.
- Because new capacity is not needed immediately, Hong Kong has the time to conduct further detailed studies and to use the resulting information to determine the best way forward.

The initial investment in the right infrastructure at the right time helps Hong Kong optimise its long-term fuel costs and provides more flexibility

- Although at some point in the future, decisions would have to be made on upfront investments required for infrastructure, these must be put into perspective against the longer-term, ongoing and far greater costs of fuel, which is a significant portion of electricity bills to customers.
- Power infrastructure investments have long asset lives – e.g. transmission lines could last up to 60 years. So, spread out over their lifetime, new infrastructure costs will represent a much smaller element of customer costs than fuel costs in customer bills.
- Since the costs of various fuels today may not be the same tomorrow and it is difficult to predict what they will be over the long term, having the right infrastructure in place gives Hong Kong the capability to use different fuels when the price is attractive and to ensure reliability is not compromised. In other words, having the right infrastructure in place would allow Hong Kong to “shop around” for the best priced energy at any time.
- More information on cost and flexibility considerations can be found in the attached Appendix.

APPENDIX

PLANNING AHEAD FOR A BETTER FUEL MIX

**Supplemental Information –
CLP's Understanding of Key Issues**

THE PUBLIC CONSULTATION

What is the Government's consultation about?

The Government has proposed revamping the fuel mix for our electricity generation with the aim of lowering Hong Kong's carbon intensity and air emissions.

What options are proposed in the consultation?

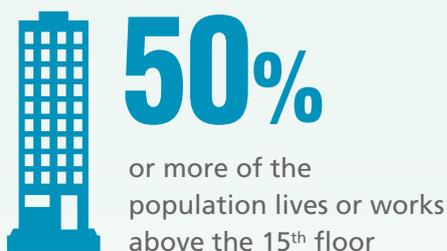
The Government's consultation has proposed two options for Hong Kong's future fuel mix.

Fuel Mix		Import		Natural Gas	Coal (& RE)
		Nuclear (Daya Bay)	Grid Purchase		
Existing (2012)		23%	–	22%	55%
Option 1	Importing more electricity through purchase from the Mainland power grid	20%	30%	40%	10%
		Total: 50%			
Option 2	Using more natural gas for local generation	20%	–	60%	20%

RELIABILITY

Hong Kong *needs* world-class supply reliability

The economic and social well-being of Hong Kong depends on the continuous availability of a highly reliable electricity supply which is essential to our daily lives. Hong Kong is a very unique city which demands a uniquely high standard of reliability.



Hong Kong *has* world-class supply reliability

CLP serves approximately 80% of the Hong Kong population and delivers a high level of reliability with:

- a diversified fuel mix comprising gas, coal and nuclear for generating electricity which helps in effectively managing fuel supply risks.
- local control of adequate generation capacity which allows us to cope with both planned and unplanned generator outages without affecting supply reliability, even at times of maximum customer demand.
- best-in-class standards and practices in the design, development, operation and maintenance of our network.

CLP's world-class supply reliability

CLP's customers experience an average unplanned power interruption of



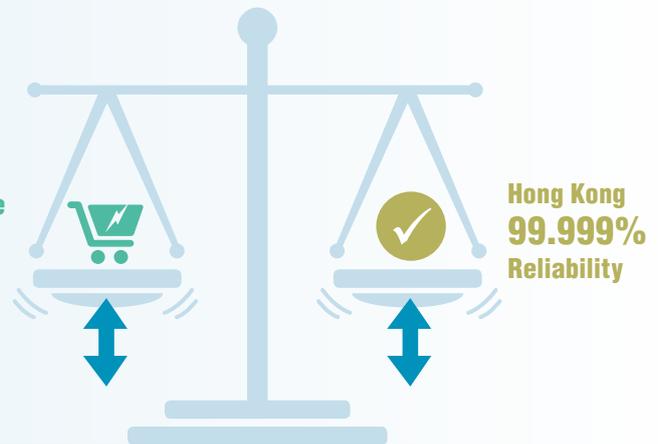
amongst one of the best in the world

RELIABILITY

FOR OPTION 1:

If more electricity was to be imported from the Mainland grid, what considerations should there be for Hong Kong's **reliability**?

Option 1
Import more electricity from the Mainland grid



South China's power network

Duration of power interruptions in China Southern Grid area (cities)

~138 minutes per customer

In 2013 (measured at 10kV & above)

Source: CSG CSR Report 2013

Supply reliability (at over the 10,000 volt level) in the China Southern Grid (CSG) region has seen improvement over the last few years but is still less reliable than Hong Kong's. For example, CLP's average unplanned customer minutes lost per year was 2.3 minutes versus approximately 138 minutes in the city areas of CSG. Major cities, such as Guangzhou and Shenzhen, have better reliability than the CSG average. In addition, CSG's reliability at the high voltage transmission level is generally better.

Although commercial arrangements for Option 1 could be made with CSG, the physical connection would need to be with the Guangdong grid. Therefore, when considering reliability issues, it is important to consider the characteristics of the Guangdong grid. It is important to note that Guangdong itself also has a high reliance on power imports from other provinces

and, as with all large interconnected power systems, it is vulnerable to cascading power shortages in certain extreme conditions such as ice storms, super typhoons or severe droughts.

In addition, the design and planning standards for its transmission system are different from Hong Kong's and it also has much higher operational complexity, with large power transfers over many thousands of kilometres of power lines utilising both High Voltage Direct Current and High Voltage Alternating Current components.

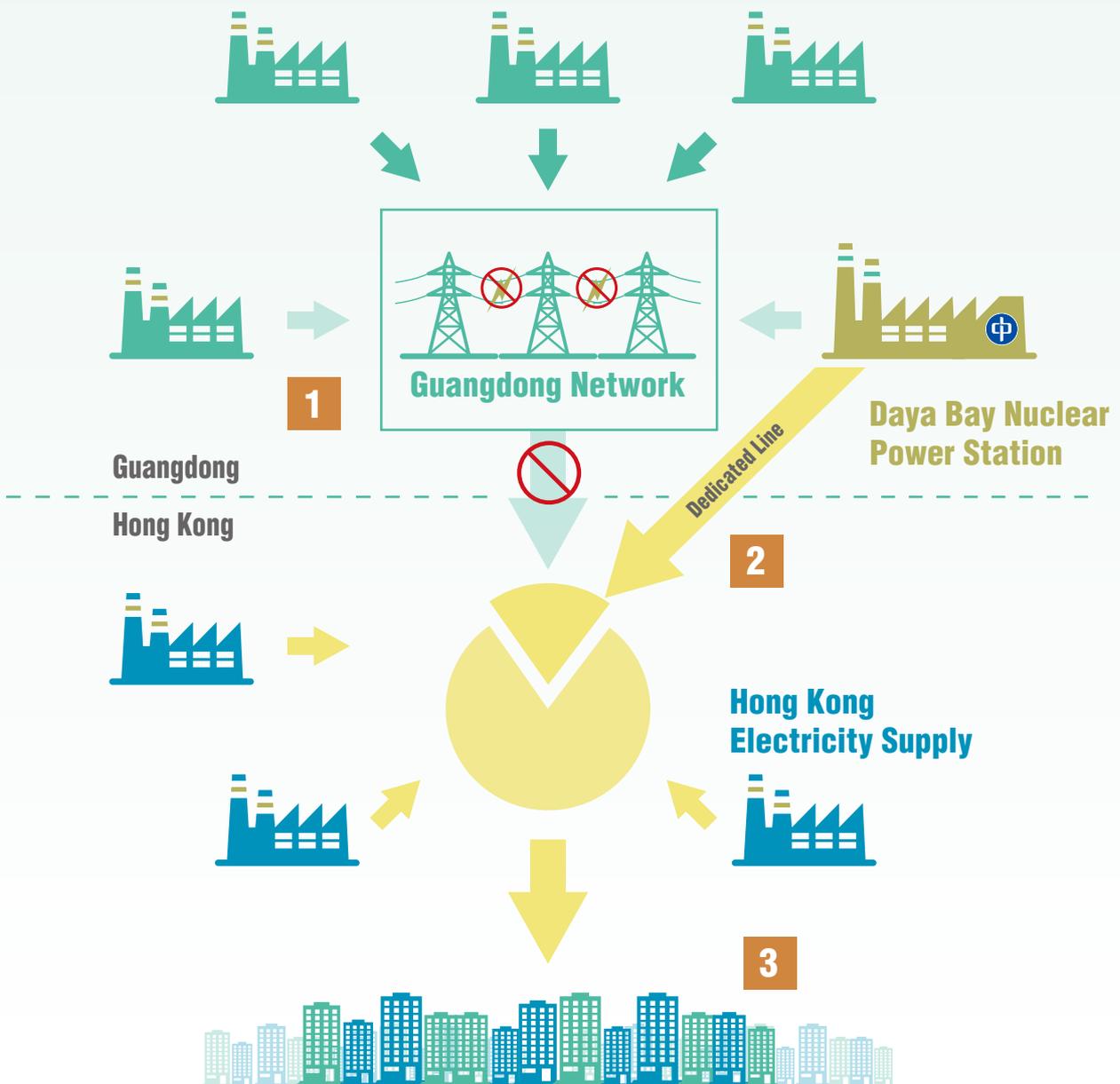
But isn't Hong Kong importing electricity from the Mainland already?

In fact Hong Kong has been importing around a quarter of its electricity supply from the Daya Bay Nuclear Power Station since 1994, so power imports are not new. But despite blackouts and supply shortages in Guangdong over this time, the power supply from Daya Bay to Hong Kong has been uninterrupted because it has been carefully designed and operated in such a manner that this level of reliability would be guaranteed. The most important design feature is the use of **dedicated lines** from the Daya Bay Nuclear Power Station that ensures a higher level of reliability and allows Hong Kong the capability to **decouple** (basically to separate or detach) from the Mainland grid in case of emergencies.

RELIABILITY

What is decoupling?

- 1** In the event of electricity supply being insufficient to meet demand, blackouts would occur in an area which might cascade to neighboring areas, resulting in cascading blackouts.
- 2** Our connection to Daya Bay is made in a special way so that CLP can take all its output for its customers in Hong Kong. In the event of any widespread blackout in Guangdong, CLP can effectively decouple (basically separate) from the Guangdong grid.
- 3** The electricity generated by Daya Bay will continue to flow to our Hong Kong customers and our grid will not be affected by any instability in the Guangdong grid.



RELIABILITY

If Hong Kong were to import an additional 30% power from the Mainland grid, what would be involved? Could we decouple or maintain our high reliability levels if there was an emergency or problem?

Currently, CLP's transmission grid is interconnected to Guangdong's grid via two 400,000 volt double overhead line transmission circuits to Daya Bay Nuclear Power Station.



New interconnection would be required if we are to import additional 30% power from the Mainland, which is technically feasible, but would involve additional costs.



This additional interconnection can be done in two ways

Dedicated interconnection to a defined generation source

-  installation of dedicated transmission lines connecting a defined power station in Guangdong to CLP's network
-  control of the additional generation capacity as in the current Daya Bay arrangement
-  ability to decouple to maintain supply reliability to Hong Kong

Grid-to-grid interconnection to Guangdong

-  transmission lines built without having specific generation sources in mind
 -  no control of additional generation capacity to ensure reliability
 -  no ability to decouple in the event of network problems in the Guangdong grid
- To ensure reliability**

Sufficient back-up generation in Hong Kong

If Hong Kong were to physically connect to the Guangdong grid without a dedicated generation source, adequate local back-up capacity would be required to maintain the current level of supply reliability.

RELIABILITY

FOR OPTION 2:

Using more gas for local generation

Is it more reliable?
Can we do it?

Option 2
Using more gas for local generation



Hong Kong
99.999%
Reliability

What is CLP's current local generation portfolio?

Castle Peak Power Station



Station A: 4 x Coal-fired units
Station B: 4 x Coal-fired units equipped with emission control facilities (2 units can use gas)

Black Point Power Station



8 x High Efficiency Combined Cycle Gas Turbines

Penny's Bay Power Station



3 x Diesel Oil fired units to meet peak demand

Could we build more generation facilities in Hong Kong?

There is sufficient room in the existing plant sites at Castle Peak and Black Point to build new generation units. This would moderate issues with environmental permitting, site selection and impact on the community rather than if generation plants were to be built on new sites. If our coal plants at Castle Peak were to

be retired, even more space would be available for additional generation.

Is there a difference in reliability compared to Option 1?

We have full control of local generation capacity to meet customer demand, which offers the highest degree of reliability. Our track record shows that Hong Kong enjoys world class reliability.

RELIABILITY

What are the considerations with Option 2?

Since more natural gas will be required for Option 2, some of the considerations include:



- **Availability of gas:** since natural gas is subject to both regional and international supply and demand, the certainty of gas availability to Hong Kong is important.
- **Fluctuating gas prices:** the international price of natural gas fluctuates since it is affected not only by supply and demand but also by technological and regulatory developments.
- **Adequate gas infrastructure:** other than the availability of natural gas, there must be adequate and timely gas infrastructure to bring it to Hong Kong.

Some of the measures available to Hong Kong are:



- **Integration of gas supply with the Mainland:** Hong Kong's gas infrastructure is already integrated with the Mainland. Pipelines bring in natural gas supplies for CLP via the Second West-to-East Natural Gas Pipeline (WEPII) and from the Yacheng gas field near Hainan Island.
- **New regional sources of natural gas are being developed:** new Liquefied Natural Gas (LNG) Terminals being developed in the region such as Eastern Shenzhen and Zhuhai will open up new opportunities to bring in additional supplies of natural gas to Hong Kong.
- **New Technologies:** Floating Storage Regasification Units (FSRU) potentially present additional gas options for Hong Kong compared to conventional land-based LNG terminals in accessing competitive gas supplies from world markets.

Regional challenges, regional solutions

Although natural gas prices are relatively high at the moment in Asia, there may be opportunities to tap into natural gas markets overseas with the right regional infrastructure. An example is the development of shale gas in the United States which has seen the price of natural gas in their markets fall dramatically. Some of this may be available for export in due course. The Mainland is also looking to further explore and develop its own domestic shale gas.

Though there are upfront investment costs for infrastructure, these are relatively small when seen in the perspective of the longer-term, ongoing and far greater costs of fuel. Having the right infrastructure in place across the region allows more flexibility to source natural gas from around the world, at the best prices.

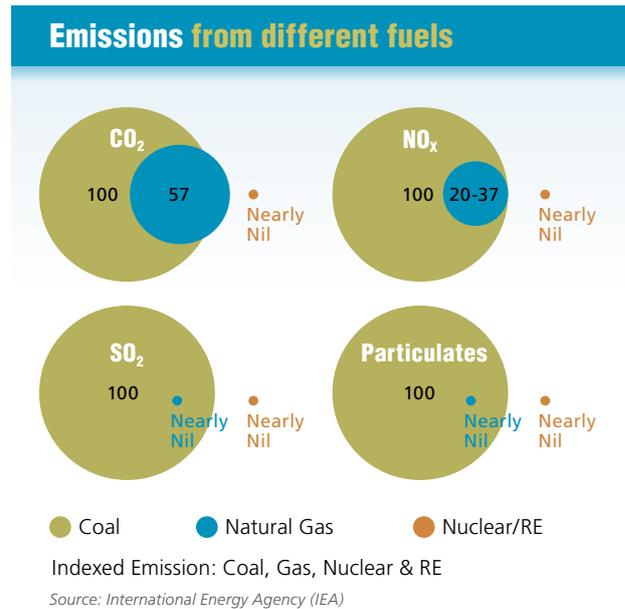
The challenge of securing sufficient quantities of natural gas at the right price is not a unique one to Hong Kong. It is a regional challenge and the region as a whole can potentially benefit in the future from the continued developments in overseas natural gas markets.

EMISSIONS

Fuel types for electricity generation and emissions

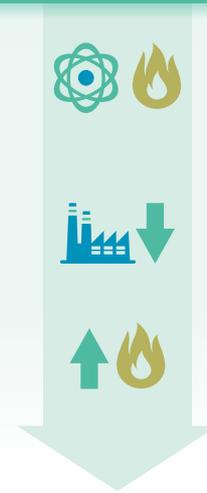
The process of generating electricity gives rise to Carbon Dioxide (CO₂) and other air emissions with different levels of intensity for different fuels. CO₂ is a greenhouse gas which is related to climate change. Other air emissions such as Sulphur Dioxide (SO₂) Nitrogen Oxide (NO_x) and Respirable Suspended Particulates (particulates) affect our local air quality.

- Per unit of energy, coal produces the most emissions, followed by natural gas
- Nuclear and renewable energy (RE) such as hydro, solar and wind do not generally have emissions when producing electricity



Reducing emissions from power generation while meeting rising electricity demand

- Before** With the use of emission abatement technologies in the early 1990s, import of nuclear power starting 1994 and use of natural gas in 1996, CLP had achieved significant emissions reductions by 2000 compared to 1990.
- Now** Emission caps have been set by the Hong Kong Government for 2010 and 2015, and further tightened from 2017 onwards. CLP installed emission control equipment in the four largest coal-fired units at Castle Peak Power Station and increased usage of low emissions coal so as to meet the 2010 emission caps.
- Future** Looking forward, CLP will need to significantly increase its usage of gas to further reduce its emissions to meet the new 2015 & 2017 emission caps.



CLP emissions reduction (1990 – 2017)*



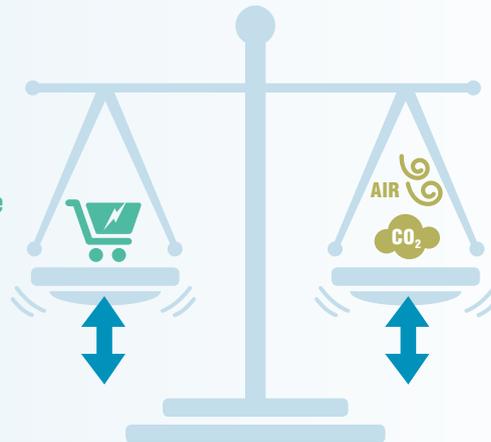
* Actual and forecasted emissions to meet emission caps up to 2017

EMISSIONS

FOR OPTION 1:

If more electricity was to be imported from the Mainland grid, how would this impact Hong Kong's emissions performance?

Option 1
Import more electricity from the Mainland grid



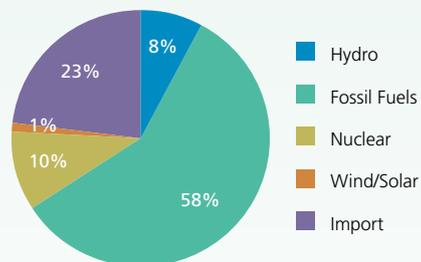
Hong Kong's air quality & CO₂ emissions

Fuel mix of the Guangdong grid and CSG

For the Guangdong grid, to which we would be physically connected to if Hong Kong were to take up Option 1 (import 30% of our power from the Mainland grid):

- 58% of energy is produced from fossil fuels (mainly coal)
- 10% from Nuclear
- 8% from Hydro
- 1% from Wind and Solar
- 23% is imported from outside of Guangdong

2013 Guangdong Fuel Mix

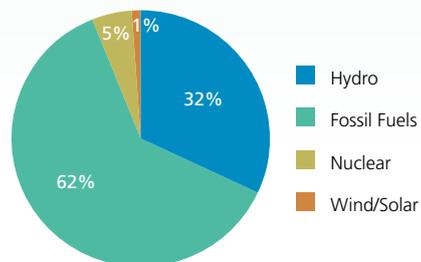


Source: 2013 Report, China Electricity Council

For the CSG network as a whole:

- 62% of energy is produced from fossil fuels (mainly coal)
- 5% from Nuclear
- 32% from Hydro
- 1% from Wind and Solar

2013 China Southern Grid Fuel Mix



Source: 2013 Report, China Electricity Council

Since the marginal fuel on the Mainland is generally coal, additional energy imports into Hong Kong may simply increase emissions on the Mainland unless there are new sources of clean energy supply dedicated for Hong Kong.



EMISSIONS

Would the additional imported electricity be zero emissions?

Regional air quality is shared: will the relocation of the source of air pollutants from electricity generation (via Option 1) contribute to cleaner air in Hong Kong? Unless additional new capacity of clean energy is planned for Hong Kong specifically, the marginal fuel is likely to be coal in Guangdong. Consideration should be given to the impact on shared regional air quality.

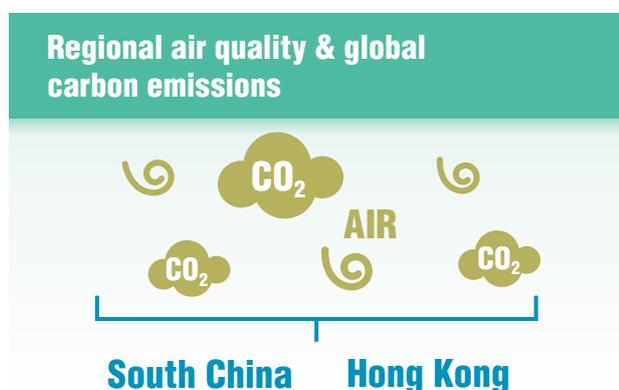
Climate change is global: if the intent of reducing Hong Kong's carbon intensity is to help mitigate climate change, shifting the source of carbon emissions to the Mainland would not reduce global emissions.

Control of emissions performance: if the imported electricity is not from a defined source of generation in the Mainland then it is difficult to be certain about both the current and future emissions performance of the additional imported power.

Opportunities with importing more clean power from the Mainland

Although CSG's fuel mix is mostly coal at the moment, the option of importing more power from the Mainland grid (Option 1) would open up more opportunities for a range of energy purchases in the longer term future, if the reliability, emissions performance and energy costs of future new suppliers are attractive.

For example, in the future it may be possible to consider imports of hydroelectric or nuclear power to supplement Hong Kong's energy mix. Nuclear power would be a stable source of electricity and it can provide a firm level of capacity year round to reliably meet Hong Kong's demand. For hydroelectricity, the capacity to deliver power when needed is not certain and the quantity from year to year would depend on the weather and rainfall at the plant. Another approach would be to provide additional local gas generation capacity under Option 2 and also purchase hydroelectricity through enhanced interconnection when it is available at the right price.



EMISSIONS

FOR OPTION 2:

Using more gas for local generation

How would this impact Hong Kong's emissions performance?

Option 2
Using more gas for local generation



Hong Kong's air quality & CO₂ emissions

Increasing local gas generation capacity (Option 2) would allow us to have more control and certainty about our emissions performance and can contribute to the 2020 reduction targets. But further improvements in the much longer term may be limited since natural gas, although relatively clean, is still a fossil fuel.

Option 1 has the potential to deliver greater local emissions reduction than Option 2 in the longer term. However, additional clean energy planned specifically for Hong Kong would be needed to ensure that Option 1 would contribute to cleaner air in Hong Kong and lower carbon emissions globally.

How well will both the options meet carbon intensity reduction targets?

The Government has committed to meeting the air pollutant emission reduction targets already set to improve our air quality, both locally and regionally. It also remains committed to the carbon intensity target proposed for 2020 as part of the public consultation on Hong Kong's climate change strategy and action agenda in 2010.

COSTS

What are the costs of generation using different fuels today?

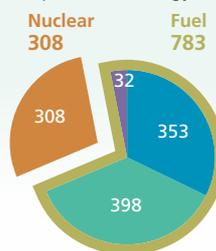
CLP has been publishing the costs of the fuel used to generate our electricity. For April 2014, coal was the cheapest fuel at 26 cents per kWh, nuclear the next at 47 cents and gas at 89 cents. Future prices may be different but in general we have found coal the cheapest unit cost over many years, followed by nuclear and then by gas.

Convergence of Mainland's energy prices toward international levels

Although it is difficult to predict what fuel prices will be in the future, there are growing views that energy prices on the Mainland will move increasingly towards international levels. Continued reform of its energy markets, sustained economic development and the

Monthly energy costs breakdown (Local sales)

April 2014 Energy Cost (\$ Million)

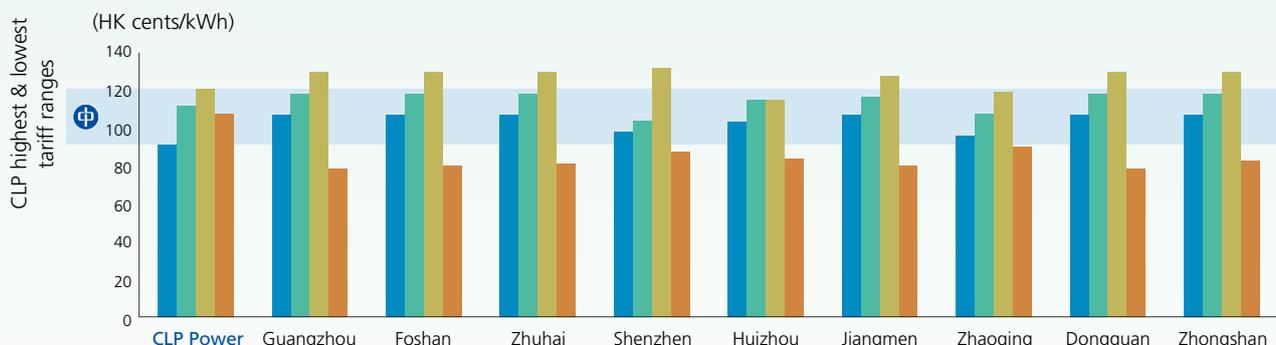


Energy Cost per Unit Sent Out	¢/kWh
Coal	26
Gas	89
Others (e.g. oil)	246
Nuclear	47

move to cleaner energy will spur the convergence of the Mainland's energy prices with world prices as it also competes with other countries for new sources of cleaner energy.

As shown by the chart below, the electricity tariffs of CLP and various major cities in Guangdong are already very similar.

2014 Tariff comparison between HK and PRD cities



- Large Industrial based on monthly consumption of 4,600,000 kWh
- Small Industrial based on monthly consumption of 120,000 kWh
- Commercial based on monthly consumption of 3,000 kWh
- Residential based on annual consumption of 3,300 kWh

Tariffs and exchange rate as of Jan 2014.

COSTS

The cost of fuels will change

The costs of fuel today may not be the same tomorrow. Over the past ten years, coal prices have been the most volatile, followed by oil and then natural gas. The price of nuclear power from Daya Bay has been very stable, remaining at lower levels than local inflation over the entire period. Looking forward, future nuclear prices are likely to be relatively steady if CLP Power were to bring in new long term supplies from the Mainland through a new off-take contract similar to that signed with Daya Bay. Although benchmark prices are expected to be higher than those for Daya Bay with the use of new Third Generation nuclear technology, they are still expected to be competitive with gas. Volatility means that fuels which are expensive today may be cheaper tomorrow and vice versa.

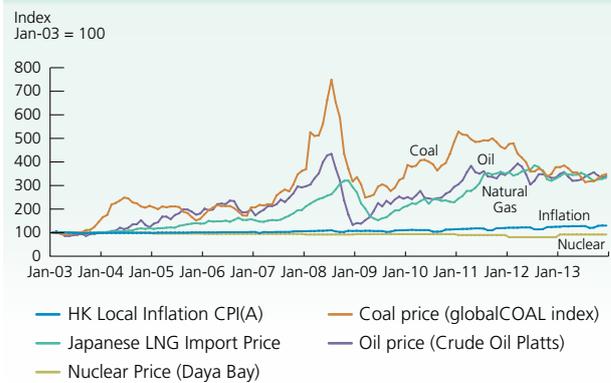
What are the costs involved in the different options?

The Government’s consultation has mentioned that the costs involved in both Option 1 (additional import from the Mainland grid) and Option 2 (more local gas generation) are similar with unit generation costs doubling over the planning horizon of ten years. Our initial view is that we concur with these broad estimates.

Looking forward, it is possible that Mainland power prices may fluctuate with:

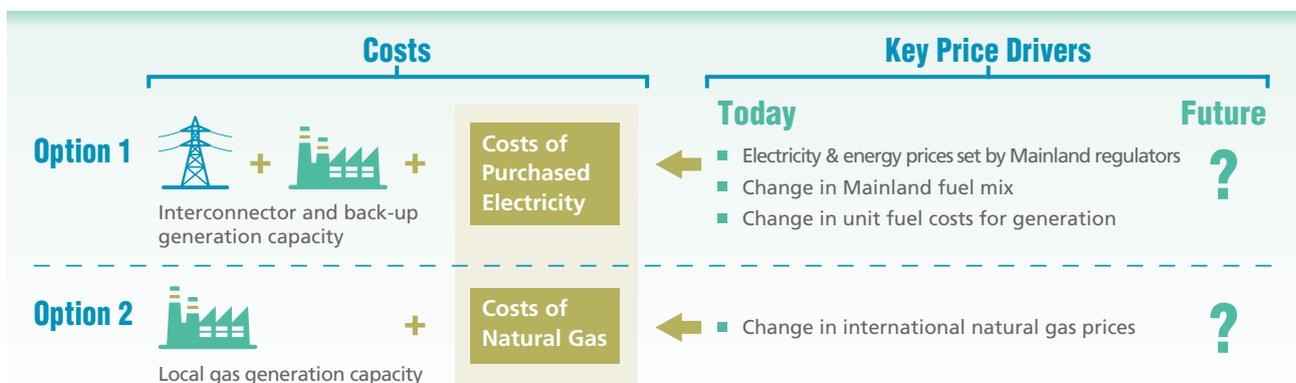
- changes in the cost of fuels used in electricity generation
- changes in on-grid electricity prices set by Mainland regulators

Volatility of fossil fuel prices over last decade



- changes in grid transmission prices set by Mainland regulators
- the balance of electricity supply and demand in the Mainland
- the conversion rate of the renminbi (RMB) into Hong Kong Dollars
- changes in the rate of VAT payable by Hong Kong to the Mainland
- any carbon or emissions trading costs imposed on electricity in the Mainland as it moves to a cleaner fuel mix for electricity generation

None of these costs are controllable by the power companies importing electricity into Hong Kong. On the other hand, Hong Kong is not able to control the price of gas used to generate electricity here, although other costs of power generation may be more within our control.



The Mainland is expected to move towards a cleaner fuel mix over time and its price for fuel is likely to converge with international prices.

COSTS

Lead time for new infrastructure

Another consideration is the lead times for the required power infrastructure under the two different options.

For importing more electricity from the Mainland grid (Option 1), the lead time for a new interconnector is about 10 years, subject to further feasibility studies. This is because a new interconnector between Hong Kong and Guangdong would be a cross-border project that would be fairly complex and involve many stakeholders in the Mainland electricity supply system.

The timing to build additional local gas generation capacity (Option 2) is quite certain even for 2020 with a lead time of about 4-5 years.

Estimated lead time for infrastructure

10 years  New Transmission Line for Grid Import

New High Efficiency Combined Cycle Gas Turbine **4-5** years 

More cross-border stakeholders involved:

The Mainland electricity supply industry is far larger and more complex than the stand-alone electrical system that we currently have here in Hong Kong. For any increased integration with the Mainland power system, Hong Kong would be one of many stakeholders involved and it may not be able to appreciably influence the planning and development of the electricity supply to cater specifically for the needs of our own local system.

Mainland's electricity planning and coordination is complex and of a massive scale

Hong Kong is just one of many stakeholders in the supply chain

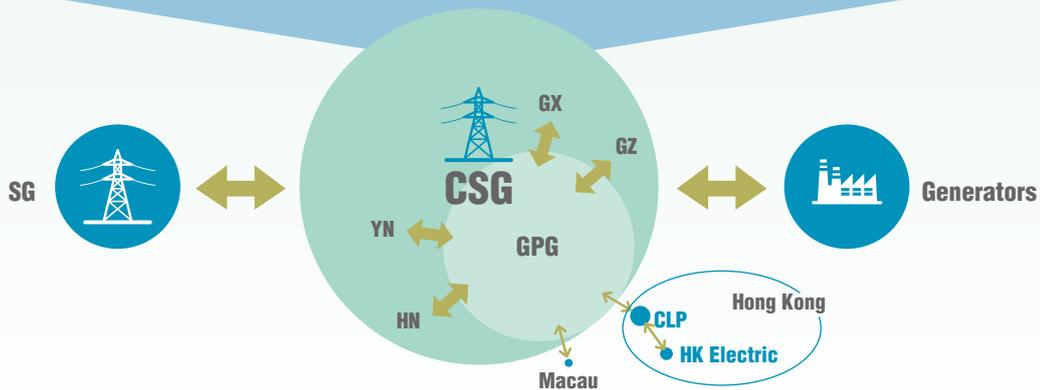
 NDRC

 NEA

 PB

 SASAC

 SCSERC



 Regulatory Stakeholders

 Grid Stakeholders

 Generation Stakeholders

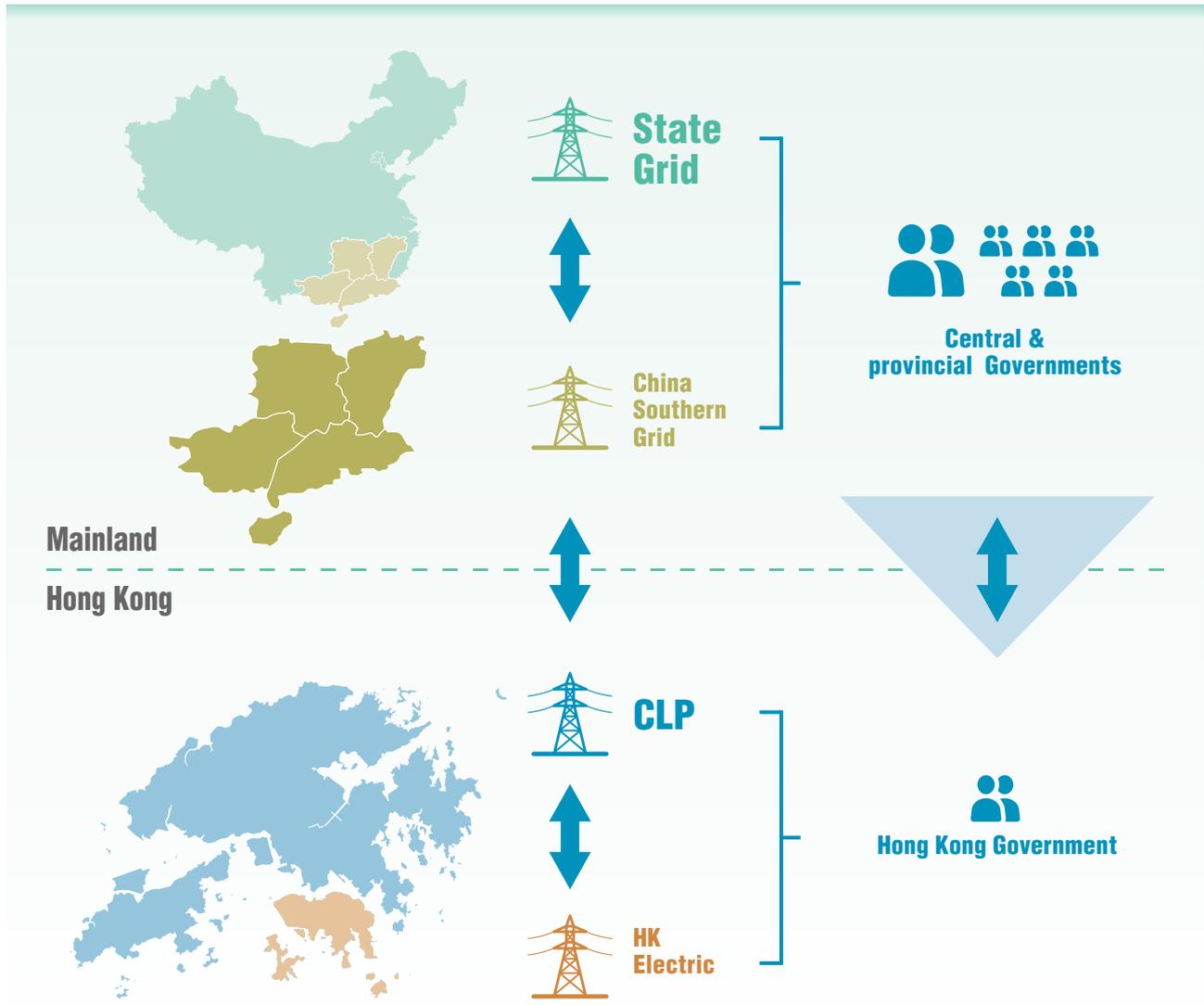
NDRC (National Development & Reform Commission), NEA (National Energy Administration), PB (Price Bureau), SASAC (State-owned Assets Supervision & Administration Commission of the State Council), SCSERC (South China Energy Regulatory Bureau of National Energy Administration of the People's Republic of China).

SG (State Grid), CSG (China Southern Power Grid) including GPG (Guangdong Power Grid), HN (Hainan Power Grid), GZ (Guizhou Power Grid), GX (Guangxi Power Grid), YN (Yunnan Power Grid)

Yudean Group, CGN (China General Nuclear Power Corporation), Other Generators

COSTS

Strengthening the interconnection between Hong Kong and the Mainland as well as contracting for additional supplies of imported grid power are cross-border tasks that would be complex and involve many provincial and national government organisations and industry participants.



Increased integration with the Mainland

More options for Hong Kong: Increasing our energy infrastructure integration with the Mainland can be beneficial and provides more options for Hong Kong. The overall direction of the Central Government is to

move towards an increasingly cleaner and lower carbon electricity fuel mix in the longer term and by having access to this, Hong Kong may have more choices to enjoy a more diversified fuel mix, providing that there is a clear roadmap on how and when this will be done and we are clear as to the generation source of any imported power.

COSTS

Value of flexibility to use the best priced fuels



A **diversified mix** of fuel comprising coal, gas and nuclear has served Hong Kong well for decades, in terms of safety, reliability, environmental performance and affordability. Since fuel prices can fluctuate, the ability in

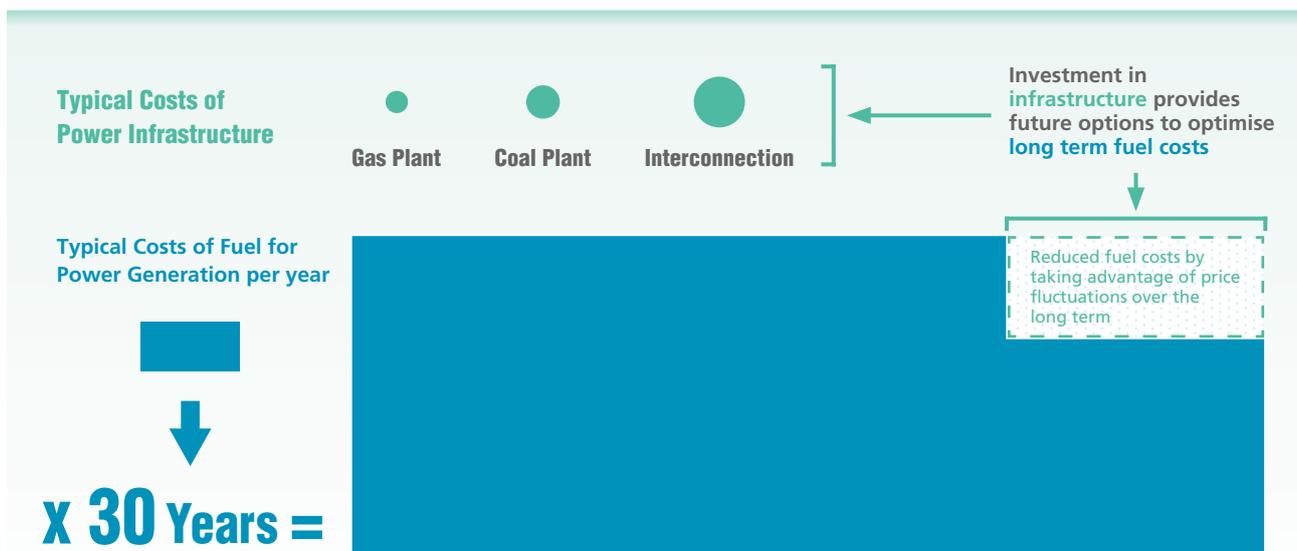
the future to use whatever fuel is the most affordable at the time provides the greatest value to Hong Kong in terms of maintaining the affordability of electricity prices while maintaining high levels of reliability.

In 2013, CLP spent almost 10 billion Hong Kong Dollars just on the fuel needed to generate electricity to meet electricity demand from our customers and to meet the emissions caps set by the Government. Option 1 and Option 2 will both need additional capital investment to build a new interconnector or new highly efficient combined cycle gas turbine(s). Such investments will have long asset lives – perhaps 40 to 60 years. So, spread out over their lifetime, the new infrastructure costs will represent a much smaller sum per annum than our fuel bill.

Options to use the best priced fuels: this means that investing in more than one option (or in parts of both) may mean that if, in future, the unit cost of importing power from the Mainland or in using gas for local generation were to rise or fall significantly, the ability to switch to using less or more imported power or gas for local generation could still give very significant savings for consumers.

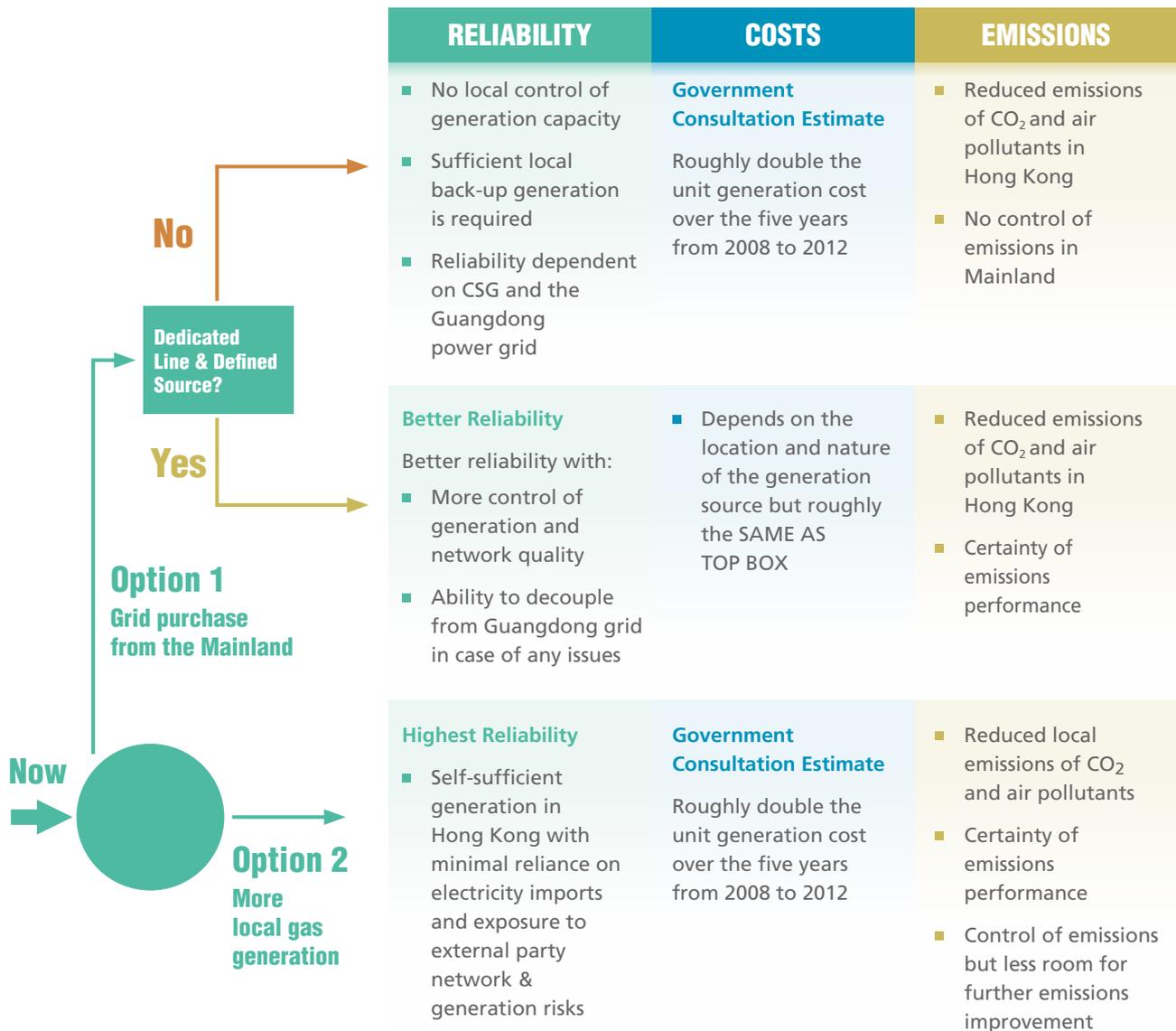
Long-term fuel costs are the biggest component:

the diagram below illustrates costs for power infrastructure including generators and enhancing the network between Hong Kong and Guangdong. Then it shows the typical annual costs of fuel used for generation by CLP at the moment. Over the long term, the costs of fuel are by far the largest single cost component in supplying electricity. The ability to flex the types of fuel used over the long term allows the optimisation of fuel costs with the ability to reduce the total cost of fuel used for electricity generation. The initial investment for power infrastructure may seem large but does create value through the capability of using different fuels when the price is attractive.



Note: proportions are for illustrative purposes and not representative of exact costs

FUEL MIX CHOICES AT A GLANCE



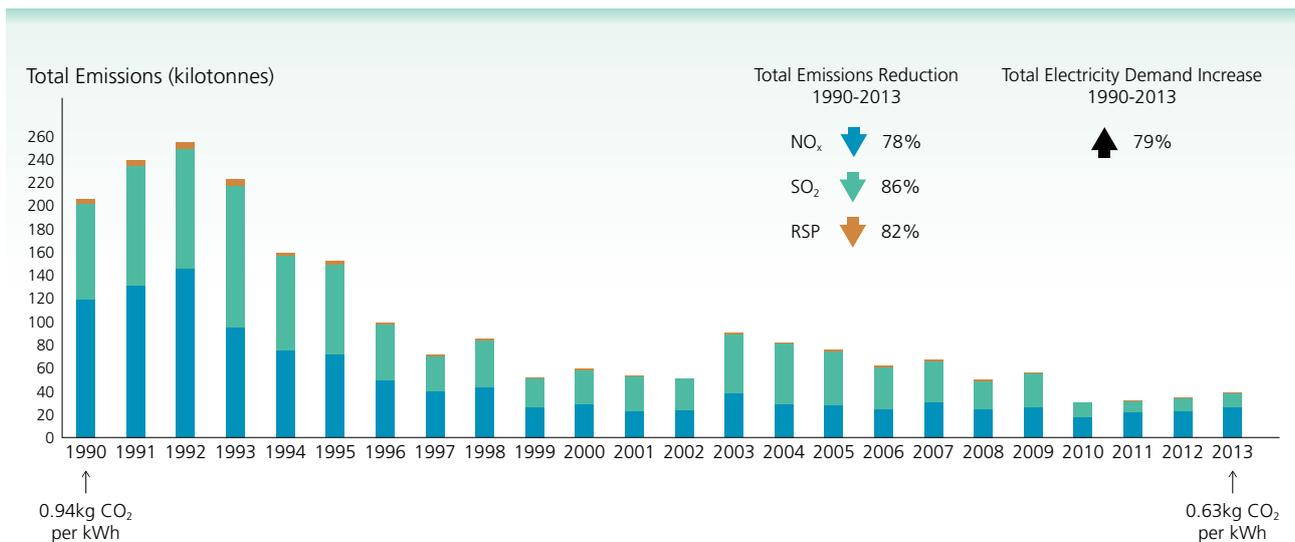
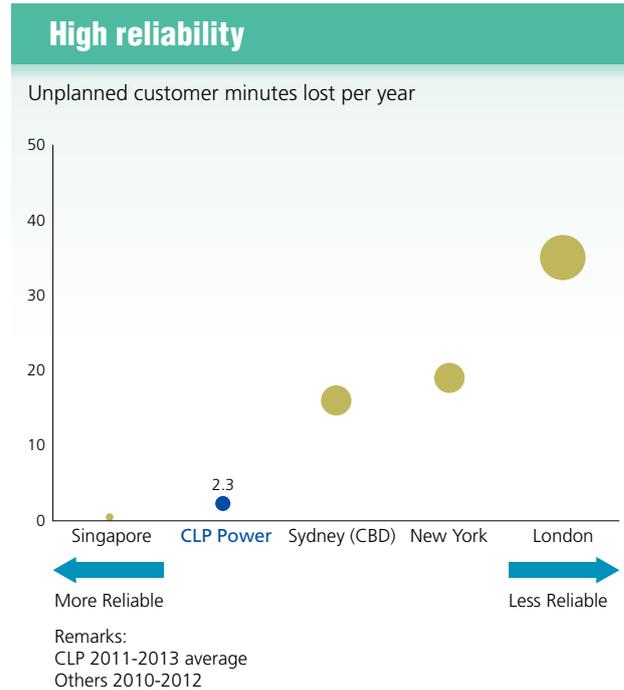
OUR PERFORMANCE: PAST AND PRESENT

High reliability

Our city enjoys world-class reliability with the supply of electricity that is under Hong Kong's control.

Emissions reduction

The Scheme of Control mechanism has constantly evolved since its beginnings in the 1960s to meet the changing needs of Hong Kong. This is seen in its flexibility to plan and bring about significant reductions in emissions from electricity generation during a time when demand for electricity was growing. The chart below illustrates CLP's emissions reduction performance over the past two decades.



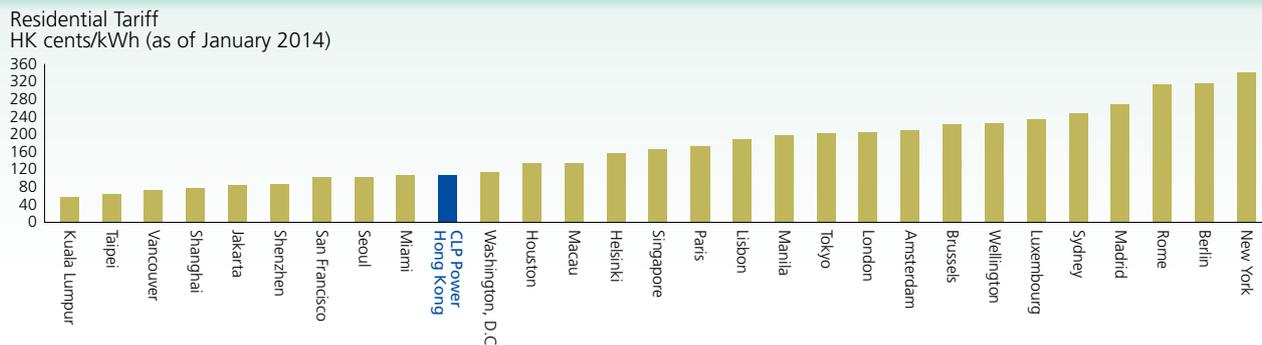
CLP's air emissions have reduced significantly over the last twenty years, falling by 80% at the same time as demand for electricity has risen by 80%.

OUR PERFORMANCE: PAST AND PRESENT

Reasonable tariffs

By international standards, Hong Kong enjoys low electricity tariffs particularly in light of the high-level of reliability that is delivered.

Residential tariff comparison with other cities



Notes:
 1. Comparison based on average monthly domestic consumption of 275kWh
 2. Tariff and exchange rate at January 2014

Source: Web Search

The costs of electricity as an input component are disproportionately small when compared to the wealth and prosperity that it helps create. The cost of 99.999% reliable electricity for Hong Kong consumers amounts to approximately 2% of Hong Kong's GDP. The exact value derived from this reliability is difficult to quantify but has a crucial role in the proper functioning of Hong Kong's economy and our day to day lives.

Value of Hong Kong's GDP (2012)

Cost of electricity to Hong Kong consumers (2012) for 99.999% supply reliability

~2% of Hong Kong's GDP

GDP
~\$2 trillion HKD

To put this into perspective, if by reducing reliability, electricity costs were cut by say 10% (perhaps an unrealistically high number), that would amount to only 0.2% of Hong Kong's GDP. It would take only a tiny reduction in GDP as a result of that lower reliability for this to be an uneconomic proposition.

Seen in this light, Hong Kong's high levels of reliability should be the prime consideration in any future fuel mix decision or regulatory change.

Energy efficiency and conservation

In addition to moving towards a cleaner fuel mix, CLP believes that energy efficiency and conservation has a fundamental role to play in addressing climate change and that we all need to do our part and use energy more wisely. CLP's *Towards a Greener Pearl River Delta – a Roadmap for Reliable Clean Energy Generation for Hong Kong*, sets out our Energy Vision which highlights promoting energy efficiency as a key initiative.

CLP takes a four-step approach towards energy efficiency and conservation (EE&C):

- educating the public
- providing customers with information and energy-saving tips
- equipping customers with tools and technical support
- helping with enablers to make greater energy efficiency possible

A wide range of services are available to our Hong Kong customers (more details on our website: www.clponline.com.hk) to both homes and businesses.



Smart meter

COMPARING HONG KONG AND MACAU

The consultation document refers to Macau as an example for grid import (Option 1). It may be useful to look at how the two cities differ to see if Macau is a good reference for Hong Kong to consider.

Hong Kong	Macau
<p>14x  the population</p> <p>10x  the electricity consumption</p>	<p> </p>
<p> 5,000,000 passenger trips via rail system</p> <p> Extreme high-rise city</p>	<p>—</p>
<p> International banking centre</p> <p> 6th largest stock exchange in the world</p> <p> Fast growing data centre industry</p> <p> 60,000,000 passengers via airport</p> <p> Air cargo & container cargo industry</p>	<p> Fast growing tourism & entertainment industry</p> <p> Over 35+ casinos</p>
<p> Average net electricity tariff (CLP, 2013) 1.05HKD/kWh</p>	<p> Average net electricity tariff (2013) 1.32MOP/kWh</p>



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Disclaimer:

Information contained in this document is based on the latest available estimates, subject to certain assumptions and is provided for reference purposes only.

May 2014