

# Cleaner Energy Greener Future

Improving Environmental Performance of HK from a Power Utility Perspective

**Ir Paul POON**  
**Vice Chancellor – CLP Power Academy**

**13 January 2021**

---

# CLP Grows with Hong Kong – History and Development

# CLP's History & Development in Hong Kong



CLP's first power station at the junction of present-day Chatham Road and Princess Margaret Road.

- Founded in 1901 and is an investor-operator in the Asia-Pacific Region – Hong Kong, Mainland China, Australia, India, Southeast Asia and Taiwan
- Listed in Hong Kong before World War 2
- Governed by a Scheme of Control since 1964

*Photos courtesy of Hong Kong Heritage Project*



Repair of street lights on Nathan Road in the 1960s

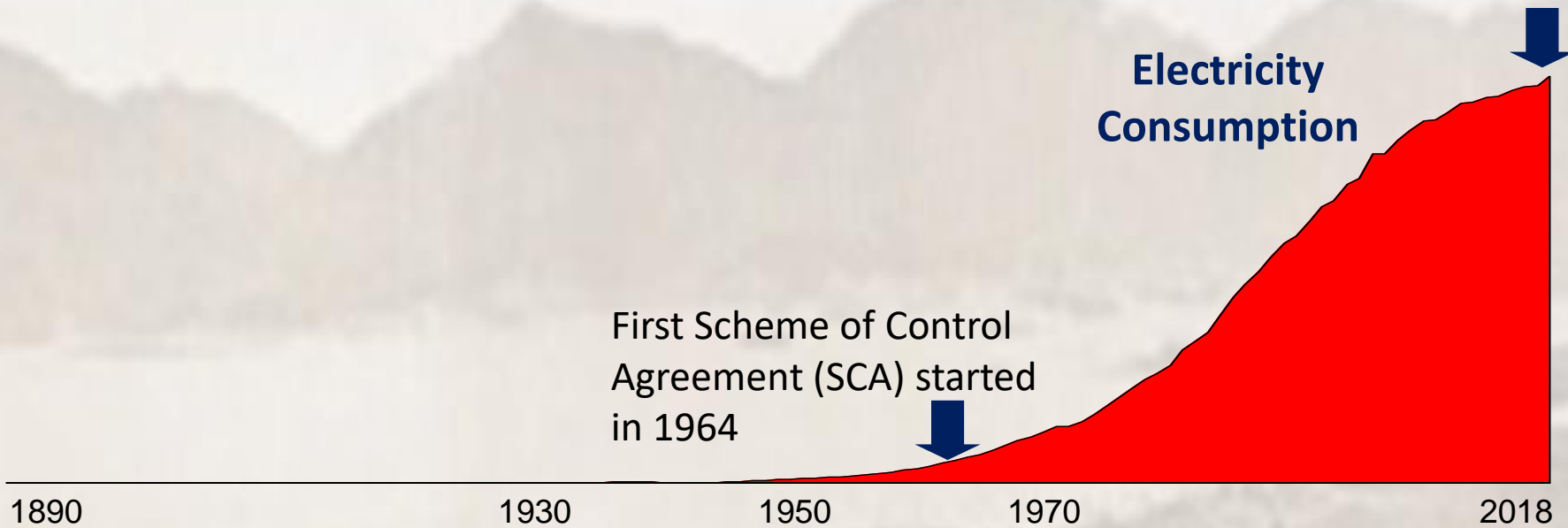


China Light's 1 millionth customer, 1982

Meeting demand for power and serving Hong Kong in good and bad times

# Electricity Consumption Growth in Hong Kong

Scheme of Control Renewed

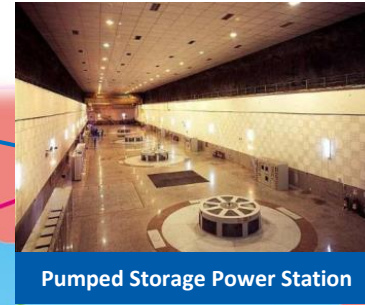




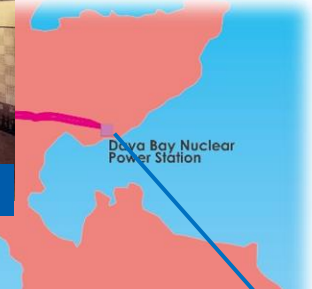
# CLP's Business and Operations



Black Point Power Station



Pumped Storage Power Station



Daya Bay Nuclear Power Station



Daya Bay Nuclear Power Station



System Control Centre



Castle Peak Power Station



Penny's Bay Power Station



Transmission and Distribution Network

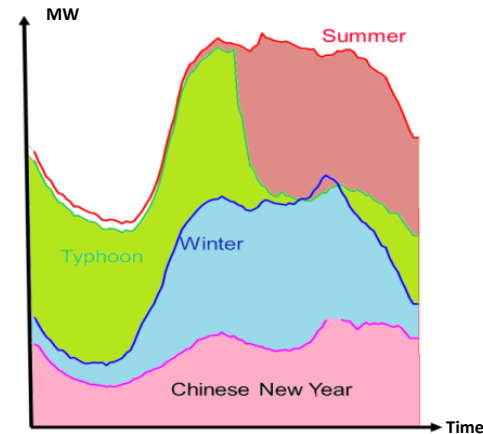
# CLP's Regional Presence

- Leading investor and operator in the energy business in Asia-Pacific
- Presence in Mainland China, India, Australia, Taiwan and South-east Asia
- Largest foreign investor in China in the sector
- Long-term goal to reduce CLP carbon intensity by over 75% by 2050 (from 2007 levels)
- CLP has a large portfolio of renewable energy in the region:
  - Wind farms in the Mainland, India and Australia
  - Hydropower projects in Mainland China
  - Solar projects in Thailand, China and India



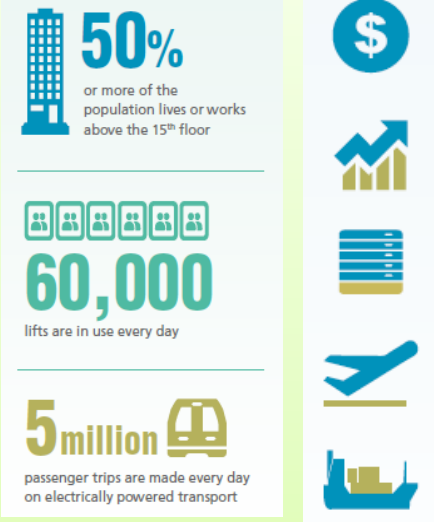
# Features of the Electricity Supply Industry

- Electricity cannot be stored economically on a large scale
- Electricity must be generated and delivered in real time
- Electricity infrastructure is capital intensive and the asset life generally lasts for decades



## Special Features of the Hong Kong's Electricity Industry

- No indigenous resources for electricity generation
- Limited land resources for large-scale RE generation
- Special reliability requirement due to:
  - Extremely high rise city with more than 50% of the population living or working above 15<sup>th</sup> floor relying over 60,000 lifts working every day
  - Over 5 million+ passenger trips are made every day on the electrically powered transport
  - International business hub with heavy reliance on reliable power supply



All requires  
high  
reliability



---

# The Government Plan



# The Government Plan on Air Emission Control

**Reducing Roadside Air  
Pollution**

**Reducing Marine  
Emissions**

**Emission Control of  
Power Plants**

**Emission Control of Non-  
Road Mobile**

# The Government Plan on Air Emission Control

Reducing Roadside Air Pollution

Reducing Marine Emissions

Emission Control of Power Plants

Emission Control of Non-Road Mobile

Climate Change Strategy and Action Agenda

↓ **50-60% Carbon Intensity**

By 2020 compared to 2005

Emission Reduction Plan up to 2020

↓ **35-75% SO<sub>2</sub>**   ↓ **20-30% NO<sub>x</sub>**

↓ **15-40% respirable suspended particulates**

By 2020 compared to 2010

# Recent Development on the Work on Combating Climate Change

## Paris Agreement is Important for Mankind

### COP21 – Paris 2015

UN Climate Change Conference



Source: ClimateReady@HK, Environmental Bureau, 2016

### COP22 – Marrakech 2016

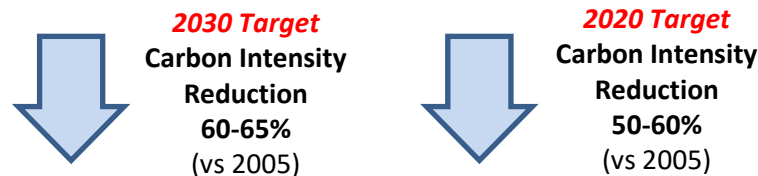
Start the important process of turning the UN's Paris Agreement into a detailed blueprint for action



- 3-year process for Paris Agreement
  - Completed by 2018
  - Reviewed in 2017



- 195 countries made commitments
- China's pledge
- Hong Kong's pledge



### HKSAR Government Action Agenda



- Launched ClimateReady@HK in 2016
- Developing the 2030 target

### COP25 – Madrid 2019



# Recent Development on the Work on Combating Climate Change



As a Response to COP21

### Greening the City

Better landscape networks  
Enhance biodiversity and native planting / urban agriculture  
Explore blue-green

### Greening Transportation

promote electric and energy efficient vehicles and cleaner fuel

- Extend rail and prioritise public transport
- Energy saving across transport sector
- Promote energy efficient vehicles and cleaner fuels
- Improve pedestrian experience

### Turning Waste-to-Resources

- Implement waste reduction, reuse and recycling plans
- Recover energy from waste treatment, including organic waste
- Maximise use of landfill gases
- Capture energy from waste water treatment

### MAJOR MITIGATION MEASURES

#### Revamping Electricity Fuel Mix

- Reduce coal usage
- Use cleaner fuels (e.g. natural gas) develop RE and distributed power

### Practicing Energy Saving in Buildings

Reduction targets and actual reduction on electricity consumption

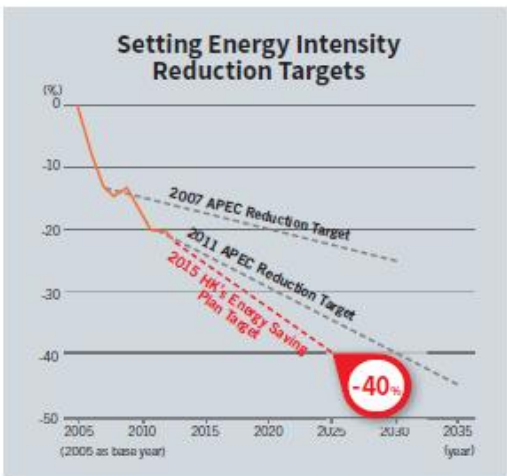
2003-07 (4 years): target -6%, actual result -7%

2009-14 (5 years): target -5%, actual result -9.2%

2015-20 (5 years): target -5%

Government buildings:

- Green building standards, design and construction
- Better air conditioning performance
- More energy efficient electrical appliances
- Improve building management
- Extend life span of buildings



Source: ClimateReady@HK, Environmental Bureau, 2016

Hong Kong's Climate Action Plan 2030+

*CLP supports HKSAR Government's mitigation measures in combating the climate change.*

# CLP's Achievements – Committed to Reducing Emissions

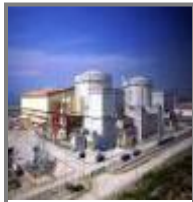
Over 85% emissions reduction even with over 83% increase in electricity demand since 1990



**1990**  
Installed electrostatic precipitators at Castle Peak Power Station



**1993**  
Installed Low NOx burners at Castle Peak Power Station



**1994**  
Import Nuclear from Daya Bay



**1996**  
Natural gas - fired Black Point Power Station established



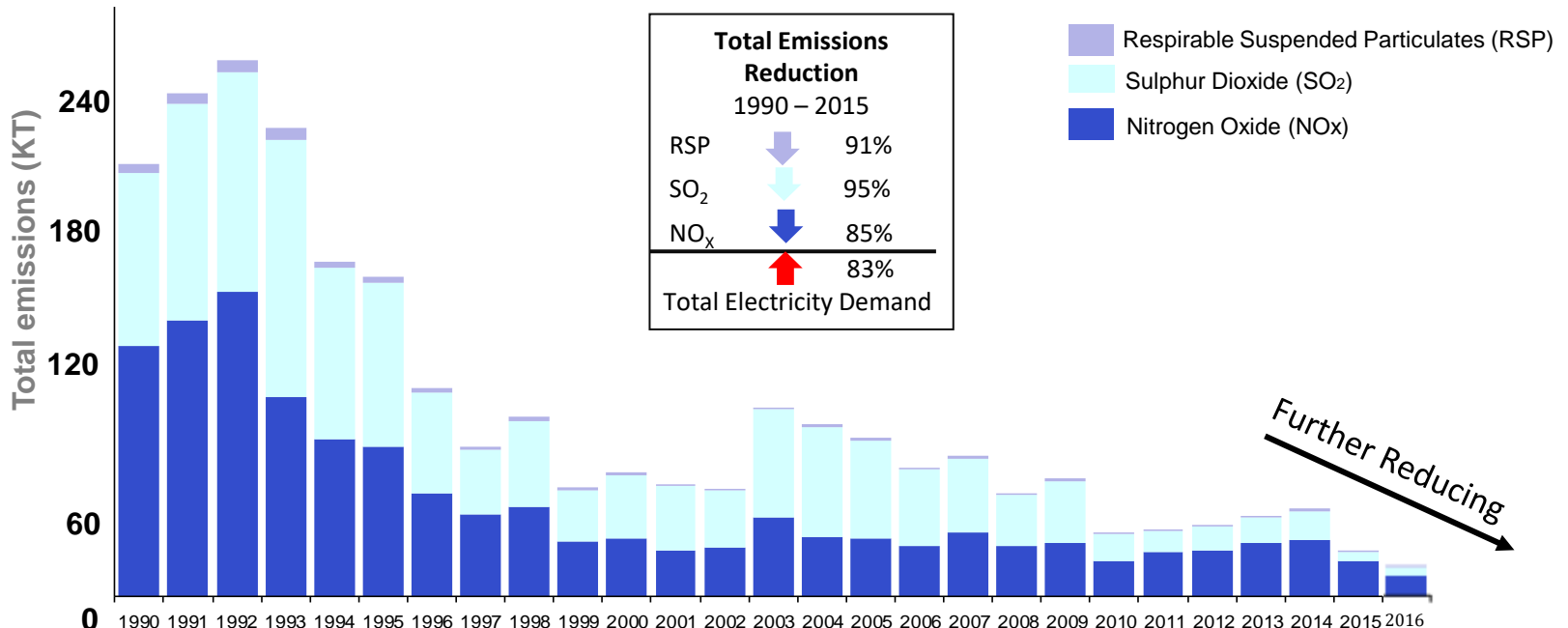
**2005**  
Increased use of Ultra Low Sulphur Coal



**2010-2011**  
Castle Peak Power Station Emissions Control Equipment commissioned

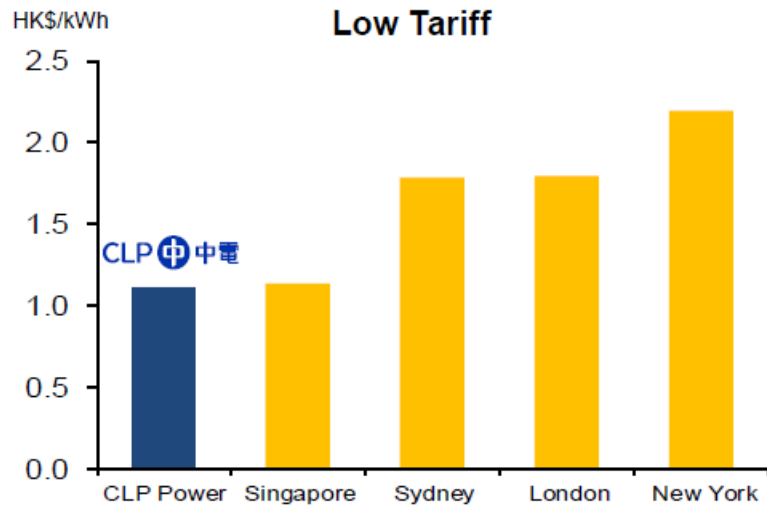


**2013**  
Black Point Power Station began using West-East Pipeline Gas for power generation

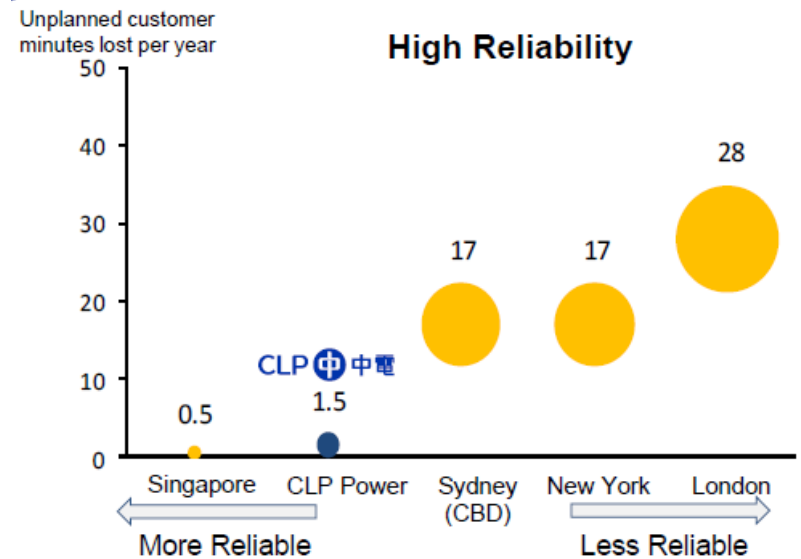




# CLP's Achievements – Reasonable Tariff with World-class Reliability of >99.999%



Remarks:  
 Comparison based on average monthly domestic consumption of 275kWh  
 Tariff and exchange rate at Jan 2016



Remarks: 2013-2015 average for CLP Power, 2012-2014 average for all other cities  
 There is no overhead lines in Singapore

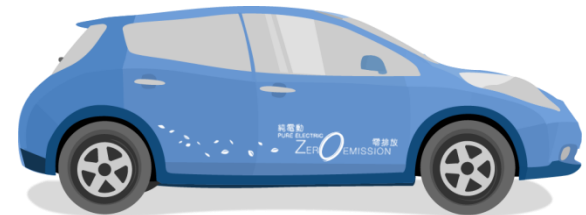
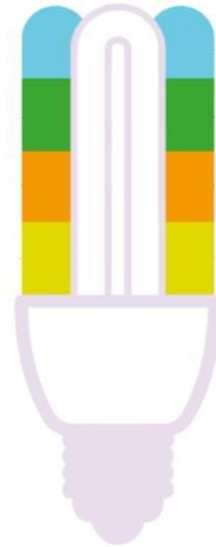
# Cleaner Energy Greener Future

CLP fully supports the Government's plan on combating climate change

**Supply Side  
Management –  
Fuel Mix &  
Renewable Energy**

**Demand Side  
Management –  
Energy Efficiency &  
Conservation**

**Green  
Transportation:  
Electric Vehicle**



---

# Towards a Cleaner Fuel Mix

CLP Power fully supports the Government's plan to improve Hong Kong's air quality

# The Energy Trilemma

The World Energy Council's definition of **energy sustainability** is based on three core dimensions – energy security, energy equity, and environmental sustainability

## The Energy Trilemma



- There are obvious tensions among them. Balancing these policy drivers is not always easy, in HK and elsewhere.
- Reliability is often paramount.
- Cleaner energy generally costs more.
- Over-dependence on one fuel supply source does not help with energy security.

All countries around the world are facing the Energy Trilemma

# HK Energy Policy Objectives

HK government's 4 Energy Policy Objectives:



Driving the same outcome as World Energy Council's "Energy Sustainability"

## HK Fuel Mix:

- Managing the HK generation fuel mix is critical to achieving Energy Sustainability and balancing the Energy Trilemma





# Choices of Fuel



## Coal



- High reliability
- Relatively low cost at the moment but its price may change in the future



- High CO<sub>2</sub> and other emissions



## Natural Gas



- High reliability
- Low CO<sub>2</sub> and other emissions



- Relatively high cost at the moment but its price may change in the future



## Nuclear



- High reliability
- Steady base-load generation on a large scale
- Virtually zero CO<sub>2</sub> and other air emissions



- Public concern over its safety



## Renewable Energy

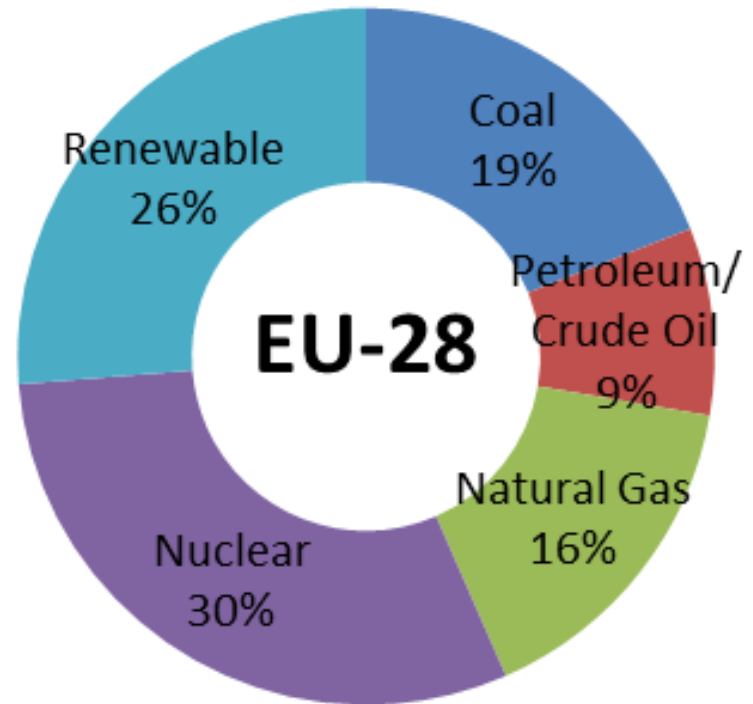
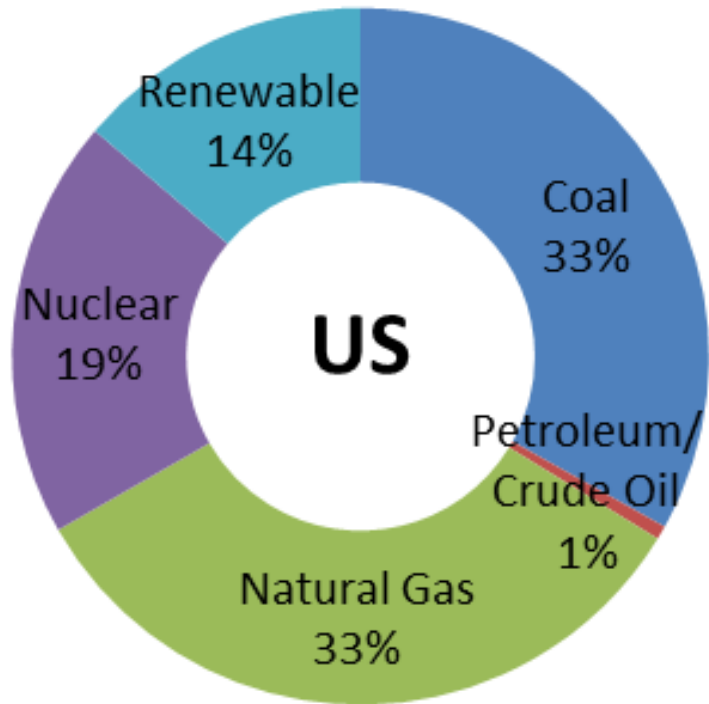


- Zero emissions



- High generation cost
- Large amount of land required
- Suitable levels of renewable resources may not be available such as in Hong Kong
- Intermittent nature requires back-up from conventional generation

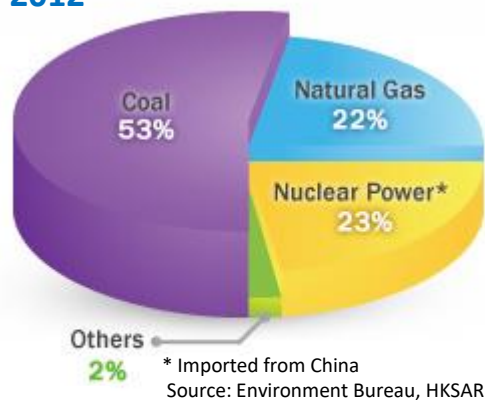
# Fuel Mix in Overseas Electricity Markets



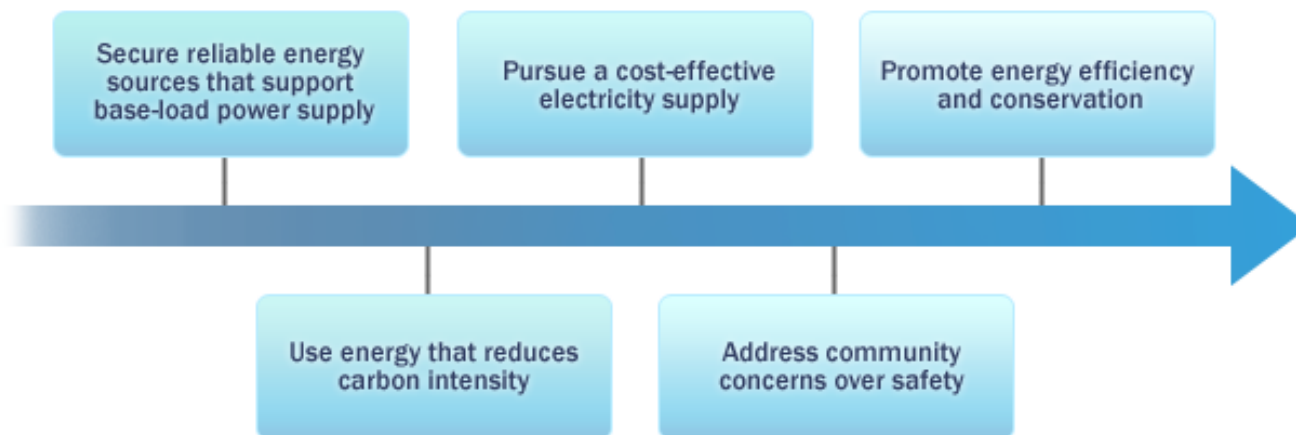
Source EIA 2015, Eurostat 2015

# Fuel Mix in Hong Kong

Fuel Mix for Electricity Generation in 2012

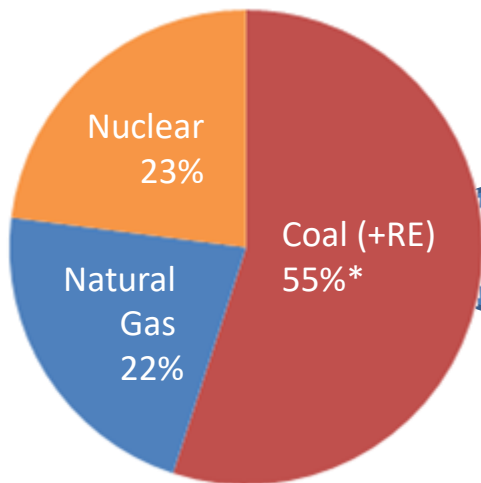


- No single solution to the energy issue
- Different fuel / generation technologies have different characteristics and play different roles in the fuel mix.
- Appropriate combination of fuel types can provide a diversified energy solution



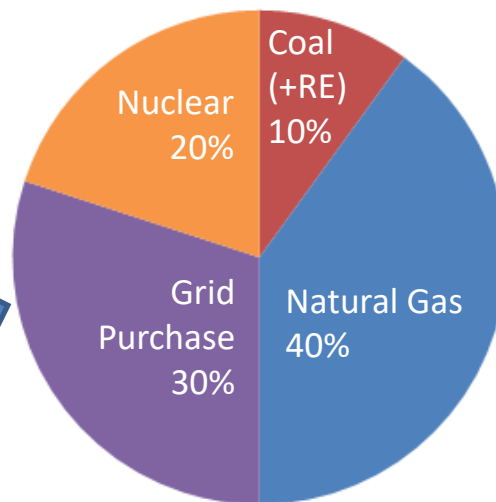
# Proposed Options

## Fuel Mix HK (2012)

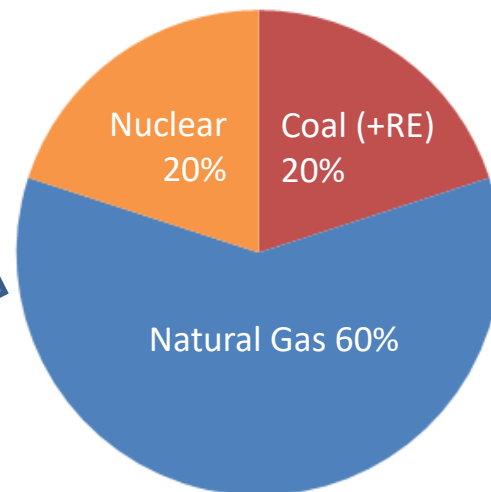


\*Inclusive of a small percentage of oil

### Option 1 Purchase from the Mainland power grid



### Option 2 Using more natural gas for local generation



The ultimate decision on fuel mix shall affect Hong Kong's future reliability of electricity supply, environmental performance and tariff for many years to come

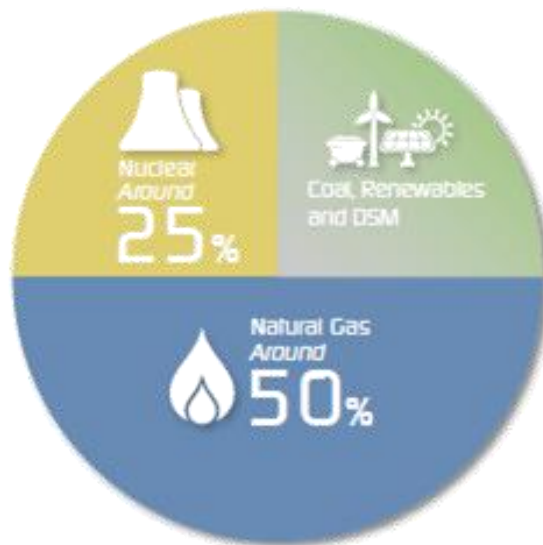
# Consultation Results

- The report from the government consultation concludes that the public has opted for Option 2 – local build generation.

## Measures to be taken:

- (a) Increase gas usage to approximately 50%, and maintain the current level of nuclear power at 25%.
- (b) Meet the balance of requirements with coal fired generation, more local renewable energy and enhanced demand side management (DSM) efforts

Possible Hong Kong 2020 Fuel Mix



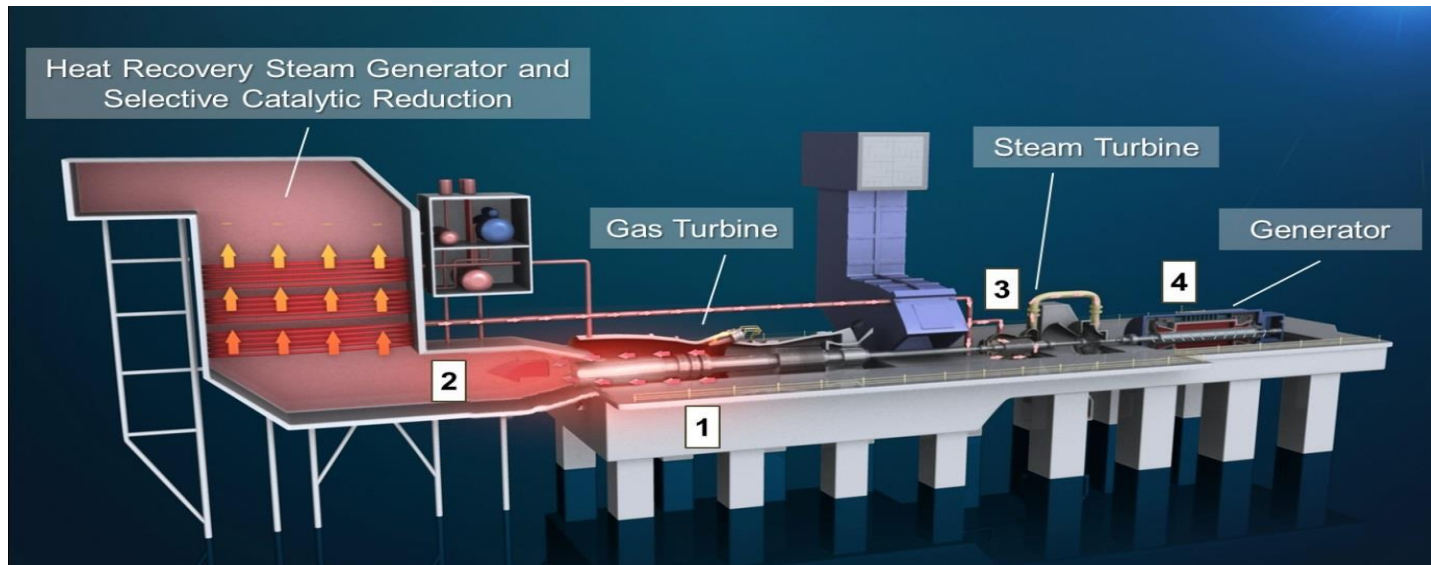


# Updates on Option 2 (13 Dec 2016)

Government approves construction of new gas-fired generating units:

"CLP's proposal will help the Government achieve the 2020 Fuel Mix Target of **increasing the use of gas to around 50 per cent** of the total fuel mix for electricity generation. This will enable the Government to meet its pledged environmental targets and the carbon intensity reduction target for 2020. With less reliance on coal-fired generation, the emission of air pollutants from coal-fired generation can be reduced significantly. This will improve air quality and reduce respiratory diseases. In addition, the reduction in carbon emission will make a positive contribution to combating climate change"

Source: <http://www.info.gov.hk/gia/general/201612/13/P2016121300652p.htm>



# Fuel Mix in Hong Kong: Gas Supplies

## Yacheng 13-1 gas field (Y13-1)

- Supplying BPPS since 1996
- Y13-1 gas field started depleting in 2012

## Yacheng 13-4 gas field (Y13-4)

- Supplying BPPS since Q2 2012
- A small gas field located ~20km East to the Y13-1 platform, with subsea pipeline to tie the field to the platform

## Wenchang gas field

- A small gas field located midway of the subsea pipeline



# Fuel Mix in Hong Kong: Gas Supplies

## Second West-East Gas Pipeline (WEPII)

- Gas supply beginning in 2013
- WEPII transports gas from Central Asia (Turkmenistan) to different parts of China and lastly to Hong Kong.
- 20 year supply duration
- New facilities are required to receive the WEPII gas supply
  - Gas launching station in Dachan Island in Shenzhen
  - Gas receiving station at BPPS in Hong Kong
  - A 20-km sub-sea pipeline connecting the two locations
  - Extensive BPPS modification and engineering upgrades

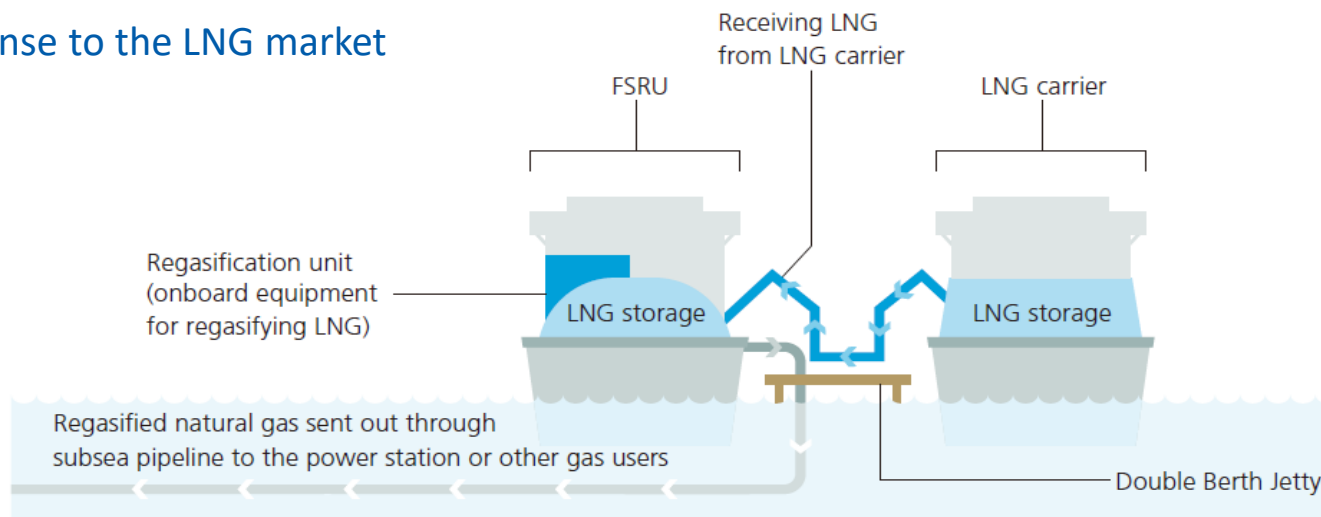


- |          |  |
|----------|--|
| Length   | <ul style="list-style-type: none"> <li>• Approx. 9,000km, the world's longest gas pipeline</li> <li>• 1 trunk line &amp; 8 branches</li> <li>• Cover 15 provinces &amp; regions including Hong Kong</li> </ul> |
| Serving  | <ul style="list-style-type: none"> <li>• 500 million people</li> </ul>   |
| Capacity | <ul style="list-style-type: none"> <li>• 30 billion cubic metres annually</li> </ul>   |

# Fuel Mix in Hong Kong: Potential Gas Supplies

## Floating Storage & Regasification Unit (FSRU)

- Potential gas source for the future in HK
- Technology advancing quickly
  - >20 projects operational or awarded
  - ~30 projects under development
- No large on-shore permanent structure
- Flexibility to respond to the LNG market





# Fuel Mix in Hong Kong: Renewables

## Town Island Project:

- “Zero emission” project
- 1<sup>st</sup> commercial-scale standalone renewable energy (RE) generation and storage system

672 Solar Panels

2 Wind Turbines

576 Batteries

- Installed generating capacity up to 192kW
- One of 10 Hong Kong People Engineering Wonders in the 21<sup>st</sup> Century

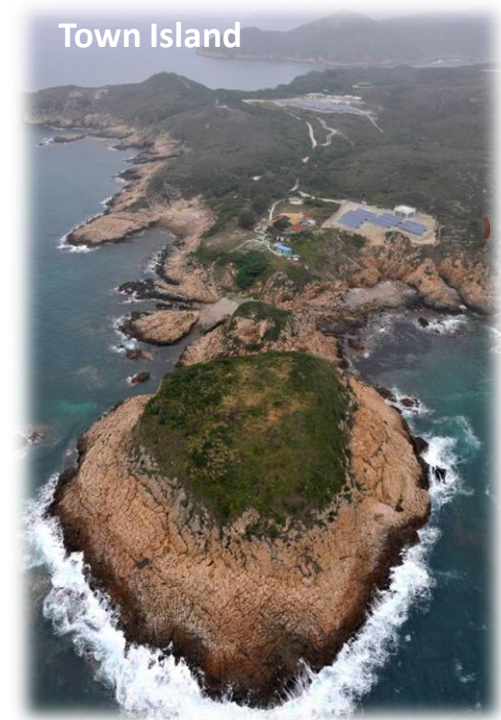
## Grid Connection:

- Support customers to install small renewable energy systems by:
  - Offering technical advice
  - Assisting them to connect to CLP’s power grid for back-up supply

## Renewable Energy Application Audit Service:

- On-site inspections to assess renewable energy resources
- Recommendations for viable renewable energy technologies
- Assess the saving of the carbon emissions and energy consumption after the implementation of renewable energy

## Solar Solutions by CLP Engineering



# Fuel Mix in Hong Kong: Renewables

## New Local Renewables:



DSD's Solar Farm at Siu Ho Wan

Source: Press release, HKSAR, 2016



WENT Landfill

Source: Environmental Protection Department, 2015



IWMF in Shek Kwu Chau (Under Planning)

Source: Building.hk, 2011

## 1 Solar Farm at Siu Ho Wan Sewage Treatment Works

- Over 4,200 solar panels
- An installed generation capacity of 1,100KW
- Meets about a quarter of the annual electricity consumption of the plant

## 2 Landfill Gas Generation in West New Territories (WENT) Landfill

- To be constructed with total generation capacity of around 10MW, largest in Hong Kong

## 3 Integrated Waste Management Facilities (IWMF) in Shek Kwu Chau

- To be constructed on an artificial island off Shek Kwu Chau
- Recover energy from Municipal Solid Waste to supply electricity to more than 100,000 households

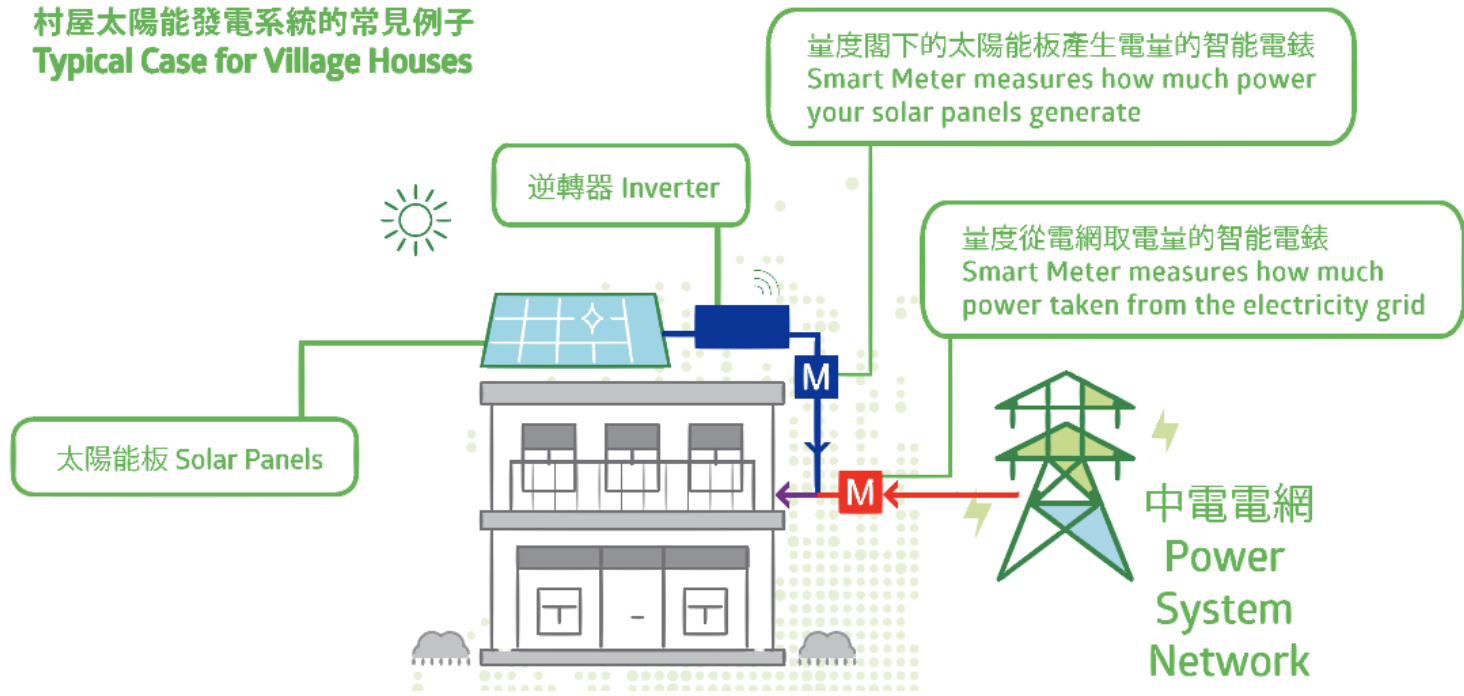
## 4 Floating PV in Reservoirs

# Fuel Mix in Hong Kong: Renewables

## Feed-in-Tariff (FiT) for local renewables and RE Certificates

### 可再生能源上網電價 Renewable Energy Feed-in-Tariff

#### 村屋太陽能發電系統的常見例子 Typical Case for Village Houses



Capacity of the Renewable Energy System	≤ 10 kW	> 10kW - ≤ 200 kW	> 200kW - ≤ 1MW
FiT rate (per unit of electricity -kWh) ^	HK\$ 5	HK\$ 4	HK\$ 3

^ The rates listed above are effective from 1 Oct 2018 onwards and will be reviewed regularly.



# Report on Public Engagement on Long-term decarbonization Strategy by Council for Sustainable Development (Nov, 2020)

## Recommendation 2. Accelerating the shift to zero carbon energy

Investing in climate-friendly power generation:

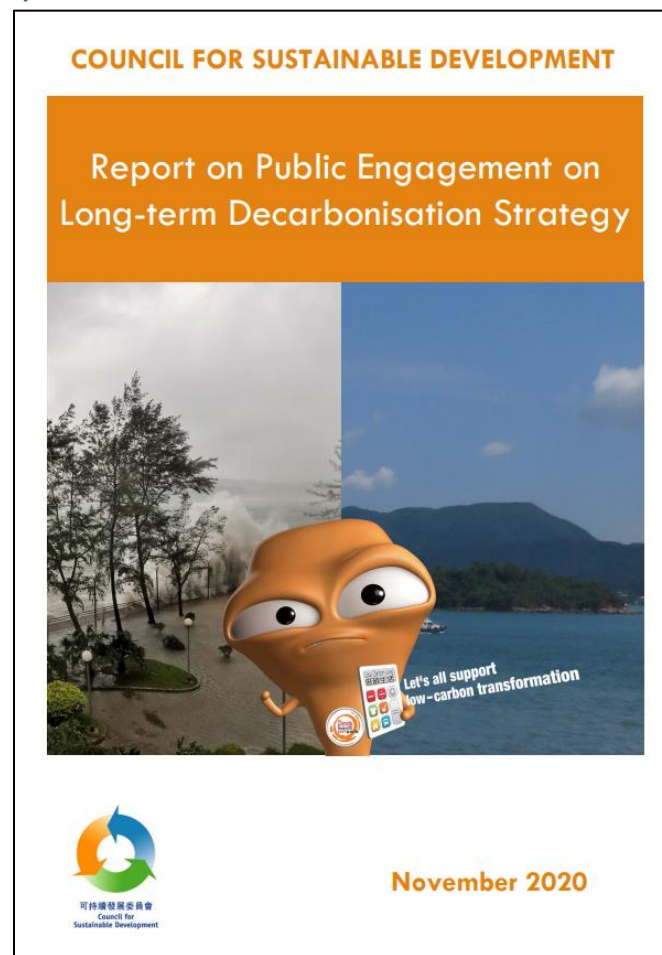
- Promotion of research & development (R&D) and adoption of RE technologies (generation and storage).
- Ramping up local RE production and storage to the greatest extent practicable.

Sourcing zero-carbon energy globally:

- Enhancing global sourcing capacity through investment, cooperation, importation, etc., with special attention to developments and opportunities (e.g. green hydrogen) in nearby regions.
- A blend of both RE and nuclear energy as a viable option, at least in the short to medium term, to help stabilise or reduce carbon emissions.

Securing interim low-carbon energy option (e.g. Liquefied Natural Gas (LNG)) while exploring long-term zero-carbon solutions.

Having due regard to the four objectives of Hong Kong's energy policy, namely, safety, reliability, affordability and environmental (including climate change) considerations.



---

# Energy Efficiency and Conservation Initiatives

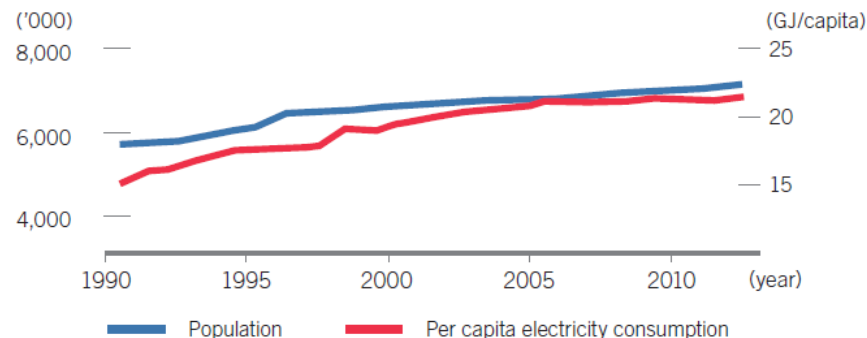
CLP Power is committed to combating climate change by promoting energy efficiency

# Energy Efficiency & Conservation

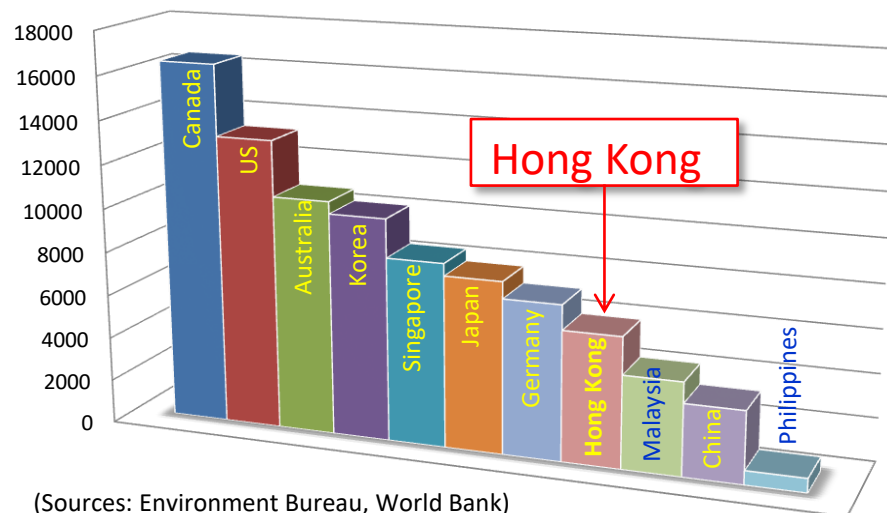
Working on supply side alone is not sufficient. Demand side efforts are also important.

- Hong Kong saw rapid increase in per capita electricity consumption in the 1990's (26.1%)
- The rise slowed down in the 2000's (9.2%). Energy efficiency and conservation (EE&C) likely played an important role in this process
- Today, Hong Kong has already made considerable progress in reducing energy intensity
- CLP will look for opportunities for further EE&C initiatives to enable more demand side management

Population increase VS per capita electricity consumption (GJ/capita) in Hong Kong, 1990-2012



Electricity Consumption Per Capita

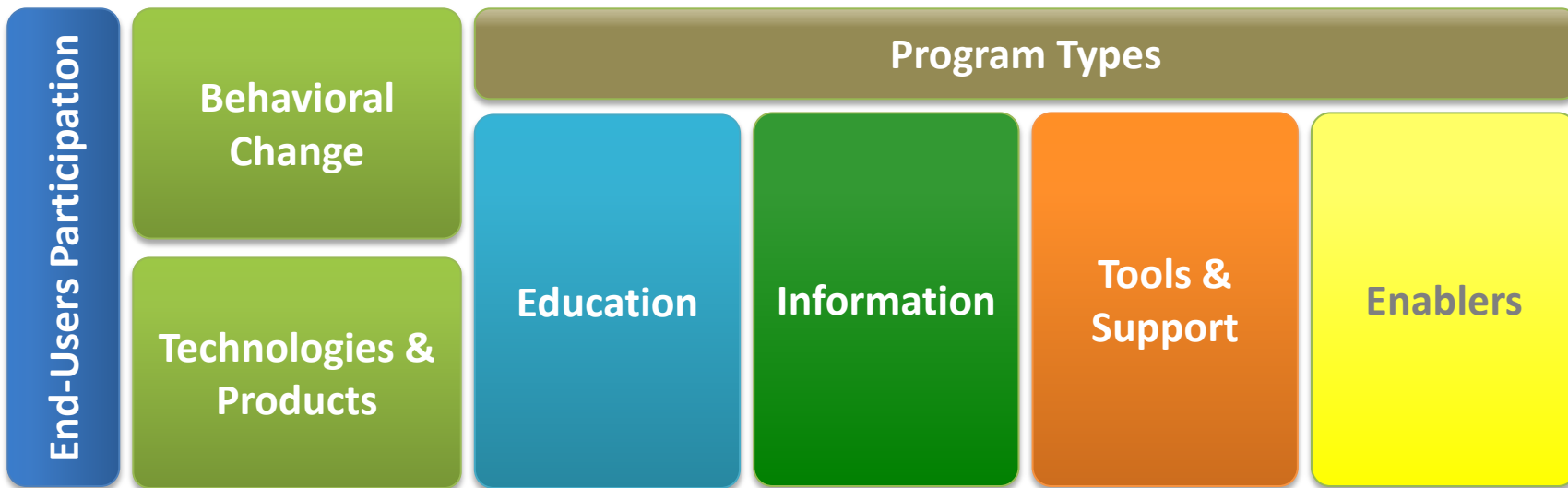


(Sources: Environment Bureau, World Bank)

# CLP's Approach in Promoting EE&C

A four-step approach

- (i) Public **education**
- (ii) Giving customers **information** and energy-saving tips
- (iii) Providing **tools** and technical **support**
- (iv) Providing **enablers** to make greater energy efficiency possible

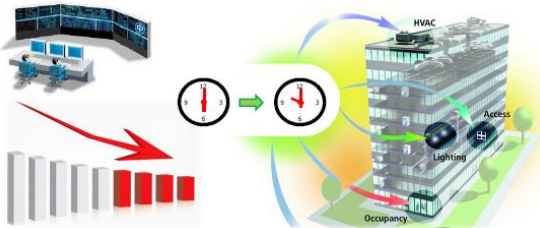


# Other EE&C Initiatives – Demand Side Management

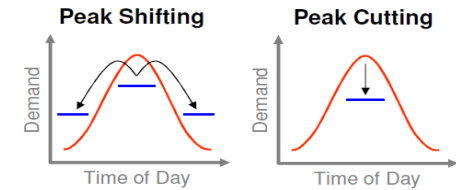
## Objectives

- Empower customers to save energy and money (e.g. timely provision of consumption data)
- Enhance the asset performance of our power grid

## Programs Offered



myEnergy. Like Never Before



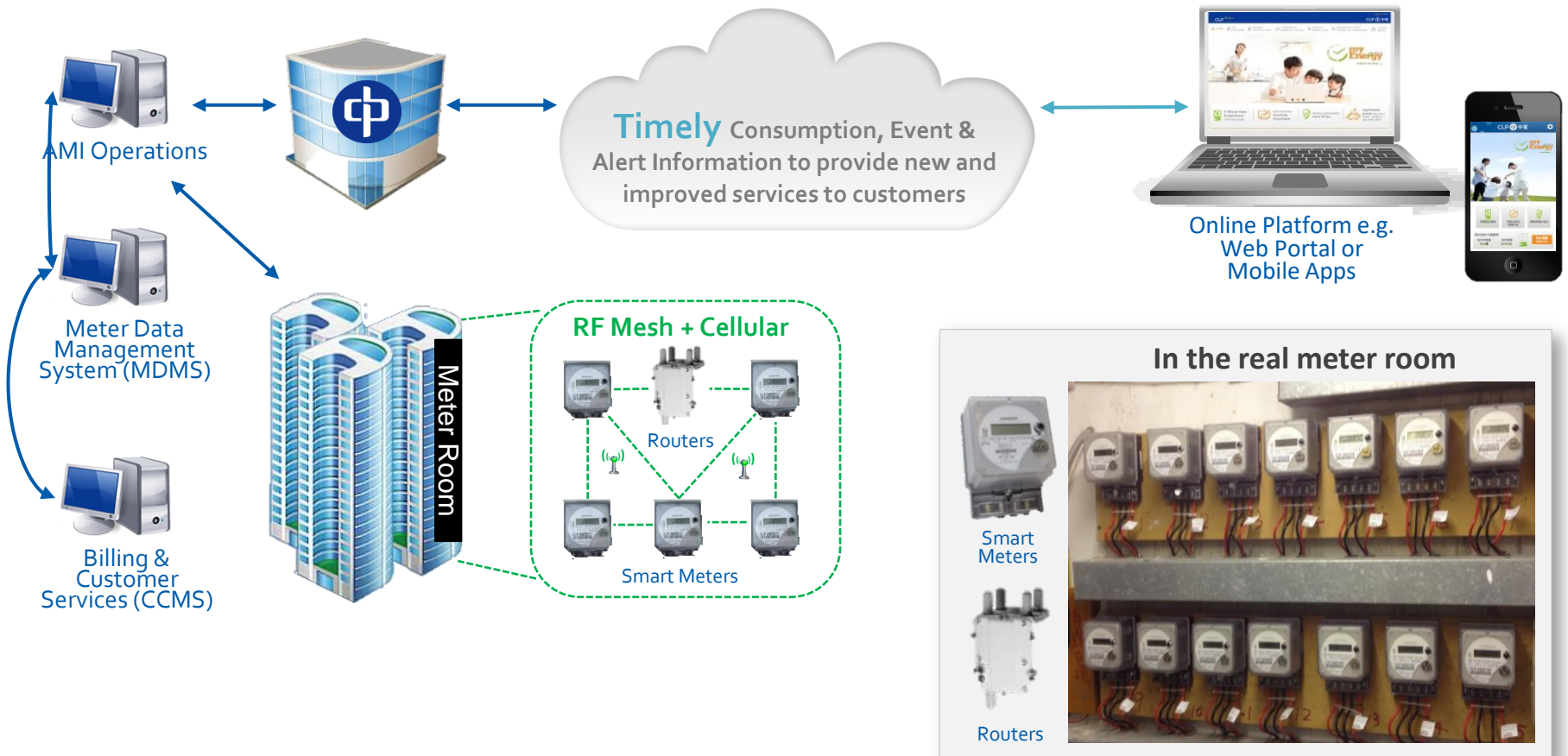
### DSM measures enable

- **Utility** to moderate peak demand which helps deferring capital investment in new generating plants and reduce fuel cost
- **Customers** can optimize their energy usage, giving them savings in energy bills

- Automatic Demand Response and Bilateral Contract for large scale commercial and industrial customers
- myEnergy Pilot Programme for residential and SME commercial customers (*enabled by AMI*)
- Full roll-out of Smart Meters

# Other EE&C Initiatives – Demand Side Management

Advanced Metering Infrastructure (AMI) and smart meters enable demand response.



# Smart Meters Drives a Greener and Better World

Different countries have different drivers for smart metering, e.g., peak clipping, electricity theft reduction, safety improvement, etc. For CLP, there are five key drivers for smart metering:

## (1) Improved Products and Services to Customers





# New AMI-Enabled Services



Lifestyle choices

## 1) Customer Choices and Experiences

- Near-real time consumption data
- Consumption alerts
- Energy-saving tips specific to lifestyle choice
- Benchmarking reports



## 2) Operational Efficiency



- Remote meter reading
- Meter condition monitoring

## 3) Safety & Security

- Broken overhead line conductors
- Broken neutral
- Meter Tampering alarm



## 4) Reliability

- “Last-gasp” signals (outage alert) from smart meters to reduce emergency response time in case of power outages

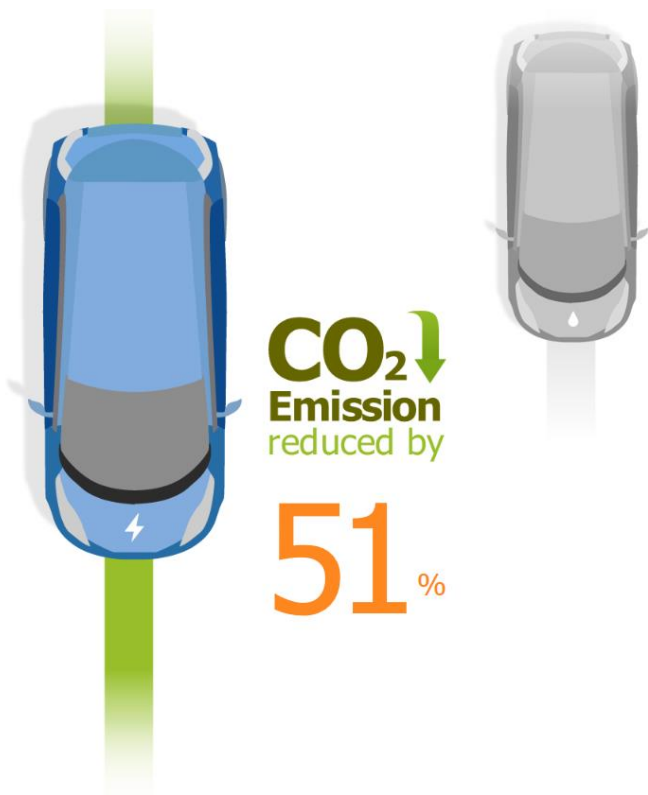
---

# Electric Vehicle for Low Carbon Driving

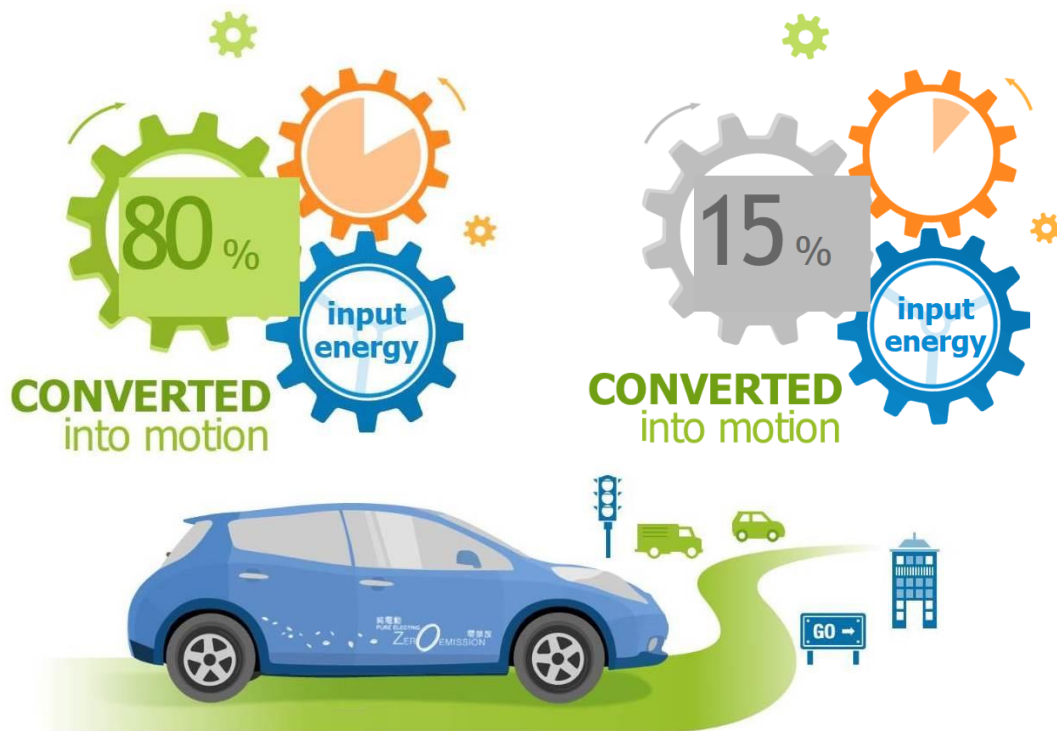
CLP Power is committed to promoting clean transportation in Hong Kong

# How Electric Vehicles Help

## Improve Roadside Air Quality



## More Energy Efficient



---

# The Way Forward

# The Way Forward

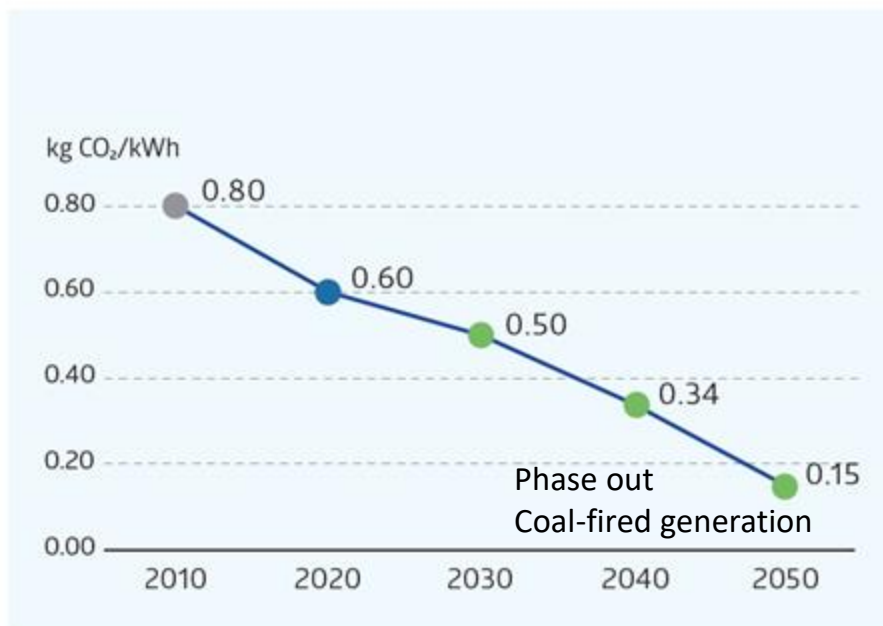
CLP continues to strive for its best to support the environmental protection initiatives while balancing the energy trilemma, based on the three guiding principles:

## Greener & Smarter Electricity



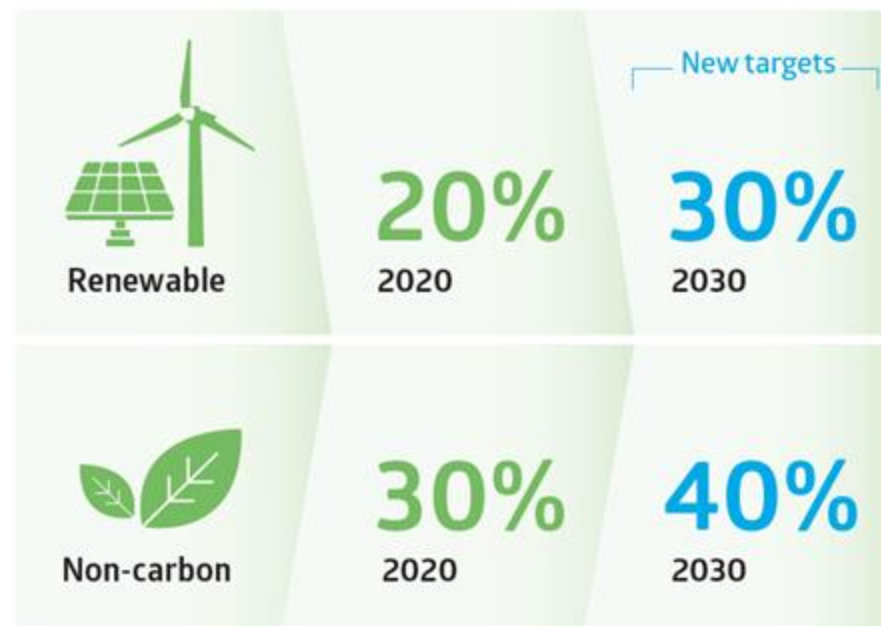
# Strengthening CLP's Decarbonisation and Clean Energy Targets Over Time

## Decarbonisation Targets (in terms of carbon intensity)



## Clean Energy Targets

(in terms of renewable and non-carbon emitting energy share of CLP's generation portfolio)



Note: The targets are on an equity plus long-term capacity and energy purchase basis.

# Summary

- **CLP supports the Government plan** to improve air quality through:
  - Switching to more cleaner fuels in the fuel mix strategy
  - Promoting local renewables
  - Encouraging energy efficiency and conservations
  - Supporting electric vehicle charging network development for preparation of wider adoption of electric vehicles
  - Applying Innovative Digital Technologies for better energy efficiency and savings
  - Supporting Long-term Decarbonisation Strategy
- To deliver a balance in the **energy trilemma** towards a sustainable solution for HK:
  - The SOC can evolve to meet HK's needs for cleaner fuel
  - More renewable energy, demand side, energy efficiency & conservation and customer initiatives in the new SoC
- CLP's Decarbonisation and Clean Energy Targets Over Time



---

# Questions?

# Our Climate Action

## Our current generation capacity

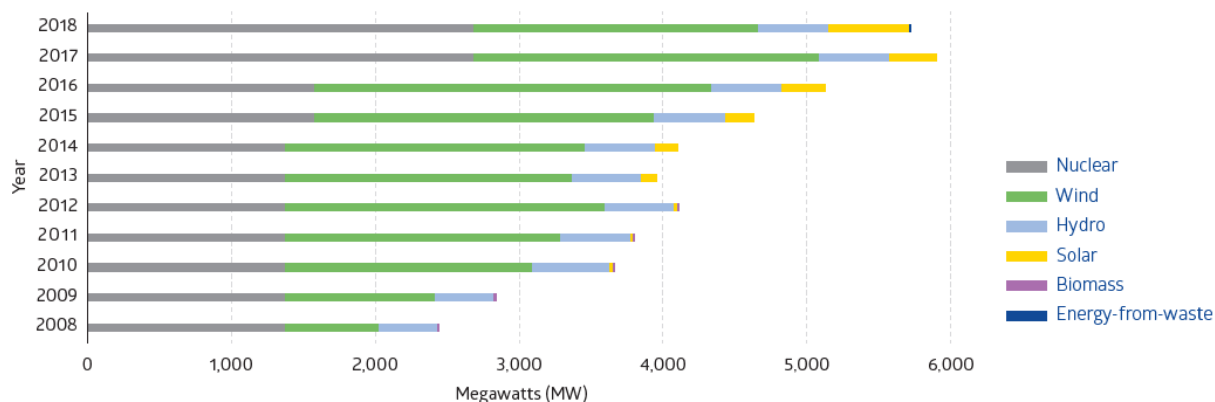
In the past, we grew our renewable portfolio by investing in, and directly constructing, new projects primarily in Mainland China, India and Australia. We have now begun to make capacity purchases of renewable energy and will continue to explore such opportunities where appropriate.

We started building our renewable energy portfolio back in 2004 and, as of 31 December 2018, we had 2,387MW of equity generation capacity and 652MW of long-term capacity and energy purchase in renewable energy. CLP is currently one of the largest foreign direct investors in renewable energy in Mainland China and India.

We also have a long history of developing and operating non-carbon emitting generation capacity which began with our investment in Guangdong Daya Bay Nuclear Power Station in the 1990s. In 2017, we expanded our nuclear portfolio with a 17% equity investment in Yangjiang Nuclear Power Station in Guangdong, China.

The overall share of non-carbon generation capacity decreased in 2018 as compared to 2017, due to CDPQ having taken a 40% equity share in our CLP India business and a recent slowdown in our growth in renewable energy as markets move from being predominantly subsidy driven to experiencing market pricing at large. This may present a challenge in terms of meeting our clean energy targets by 2020, but we are on track to meet our decarbonisation targets.

## CLP Group's non-carbon emitting generation capacity



Note: The capacity is on an equity plus long-term capacity and energy purchase basis as of the end of each year.

## CLP's progress towards our 2020 targets

	On an equity plus long-term capacity and energy purchase basis		
	Carbon Intensity	Renewable Energy Capacity	Non-carbon Emitting Energy Capacity
2018 Performance	0.66kg CO <sub>2</sub> /kWh	12.8%	24.1%
<b>2020 Target</b>	<b>0.60kg CO<sub>2</sub>/kWh</b>	<b>20%</b>	<b>30%</b>

---

# Appendix

# Features of the Electricity Supply Industry – Generation



- Conventional generation: coal, natural gas, nuclear, fuel oil. Factors include:
  - Availability of water, infrastructure links, space
  - Costs influenced by type of generation, unit size, location, role of plant, technologies employed and regulatory requirements
  - Fuel: international markets, spot vs long-term, influenced by supply & demand as well as environmental / regulatory / market developments
- Renewable energy: solar, wind, geothermal, hydro
  - Highly dependent on location and renewable resources (sun, wind, water)
  - Low power density -> high land requirement
  - Back-up generation
  - Low Carbon

# Features of the Electricity Supply Industry – Transmission and Distribution



- Transmission: high voltage, long distances -> “highways”
- Distribution: low voltage, shorter distances, finer networks & connections to end-users -> “streets and roads”
- Substations & transformers
- Involves sophisticated control, communications, protection, monitoring and real-time system balancing



# Features of the Electricity Supply Industry – Customer



- Metering / Point-Of-Connection
- Customer services: technical support, billing, connection and disconnection of supply, emergency services, energy efficiency
- Revenue collection via electricity tariffs
- Energy Efficiency & Conservation
- Education & Awareness

