Powering a Carbon Neutral Hong Kong

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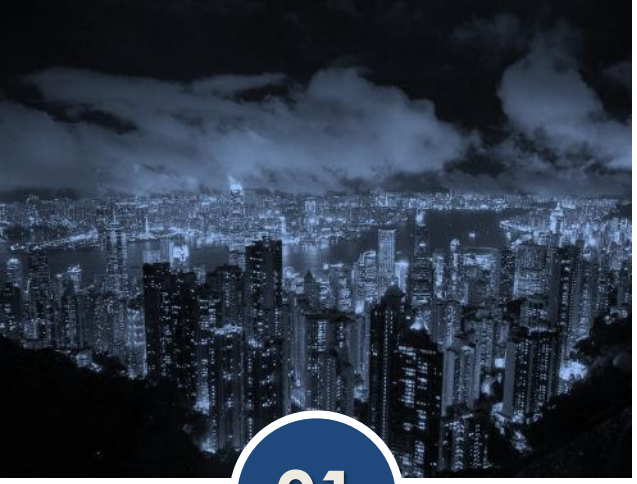
17th Feb 2025



Agenda

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Our Decarbonisation Journey to Date

02

Net Zero Electricity Generation by 2050

03

Electrification and Energy Efficiency

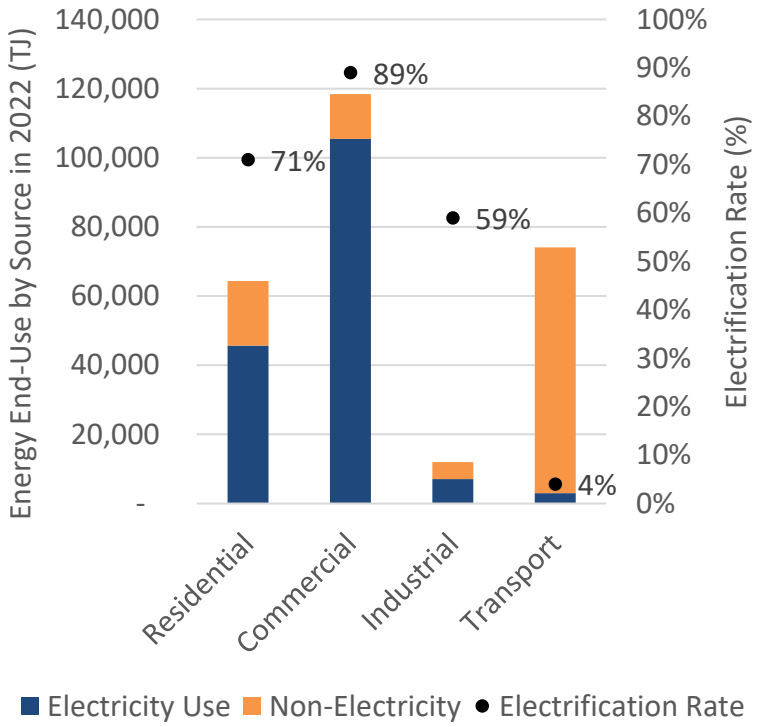
Our Decarbonisation Journey to Date

CLP is serving 80% of Hong Kong's population across Kowloon, New Territories, and Lantau Island

Electricity Supply	Transmission	Distribution	Retail
9,648 MW Generation Capacity^	> 16,800 km Cables and Network	>15,700 Power Substations	Annual electricity sales 34,824GWh*, 2.75 million customers

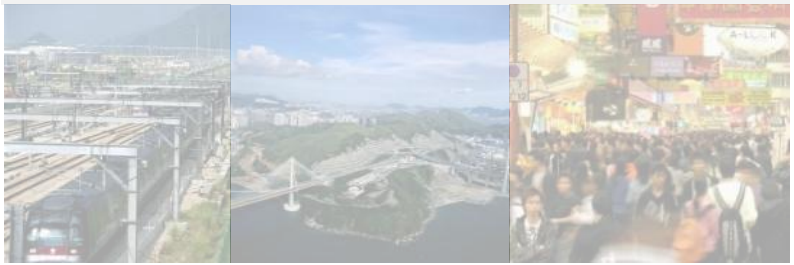
^ Castle Peak Power Station Unit A1 with 350MW capacity entered into reserve since 31st May 2022, and only operated as emergency backup. If not counted towards generation capacity, total generation capacity would be 9,298MW
** 2022 data*

With highly electrified residential and commercial sectors, electricity plays a crucial role in Hong Kong



Electricity made up 60% of total energy consumption in Hong Kong in 2022.

Reliable electricity supply drives economic development and quality of life.



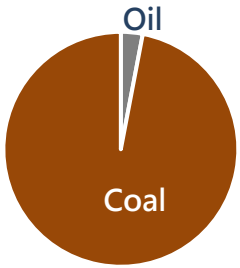
Source: Hong Kong Energy End Use Report 2024, EMSD

CLP started its journey to reduce carbon emissions 30 years ago

Evolution of CLP electricity fuel mix and average carbon intensity (in kgCO2/kWh)

1990

~0.9 kg CO2/kWh

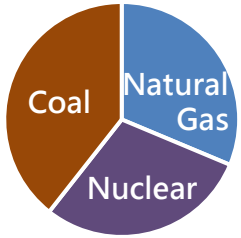


Introduce Nuclear

Introduce Natural Gas

2005

~0.5 kg CO2/kWh

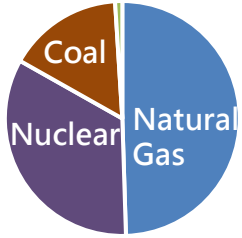


Increase Nuclear

Increase Natural Gas

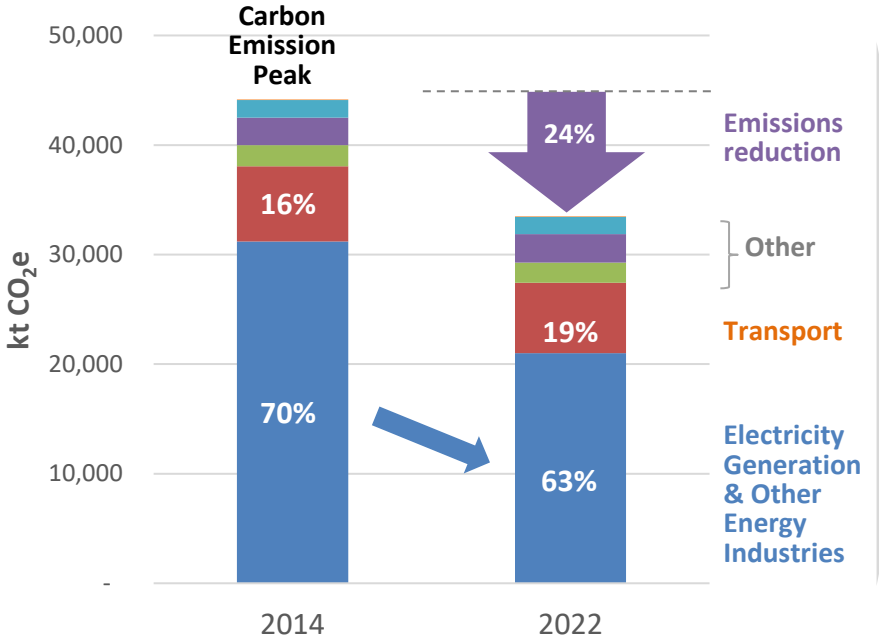
2024

~0.4 kg CO2/kWh



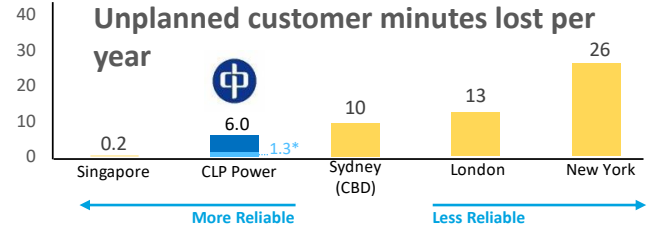
Delivering decarbonisation with high reliability and reasonable tariff

HK's Greenhouse Gas Emissions have been reducing…

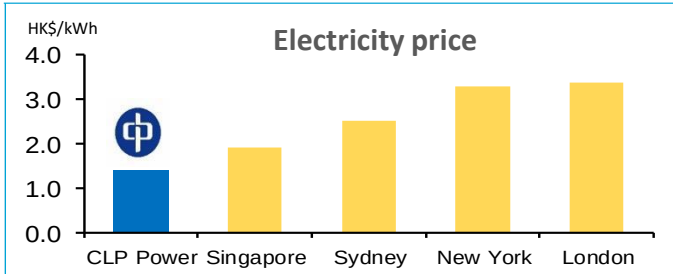


SOURCE: Greenhouse Gas Emissions in HK (by Sector) up to 2022, EPD, Nov 2023

…with high reliability and reasonable tariff



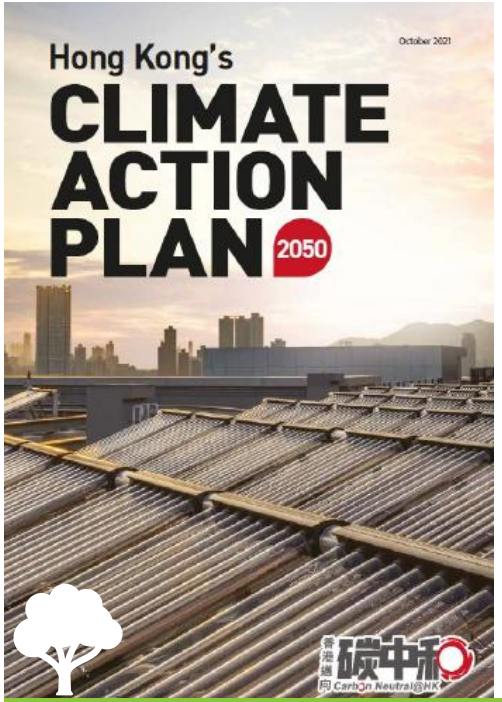
Remarks:
(1) *2021-2023 average for CLP Power was 6.0 minutes; Taking out the impact due to cable bridge fire incident in Yuen Long, the three-year average was 1.3 minute
(2) 2020-2022 average for all other cities
(3) There are no overhead lines in Singapore



Remarks:
Comparison based on monthly domestic consumption of 275kWh
Tariff and exchange rate in Jan 2024

Net Zero Electricity Generation by 2050

Clear decarbonisation pathway for electricity supply has been set out under the Climate Action Plan 2050



No Coal for Electricity Generation

2035

Cease using coal for daily electricity generation, to be replaced by low to zero-carbon energy

Zero-carbon Energy

2035 **60-70%**

Trial of new energy and closer cooperation with neighbouring areas to increase the supply of zero-carbon electricity

Electricity Saving in Buildings

2035

Electricity consumption (Compared with 2015)

COMMERCIAL BUILDINGS 15-20%

(Reduce by 30-40% subsequently)

RESIDENTIAL BUILDINGS 10-15%

(Reduce by 20-30% subsequently)

Renewable Energy (RE)

2035 **7.5-10%**

(Increase to 15% subsequently)

Public and private sectors to develop RE proactively to increase its share in the fuel mix for electricity generation

Cooperation and Innovation

Seek investment and development opportunities, participate in and operate zero-carbon energy projects near Hong Kong

RE Potential (Until 2035)

Wind 3.5-4% + Waste-to-energy 3-4% + Solar 1-2% = 7.5-10% (Increase to 15% subsequently)

Net zero electricity generation by 2050

SOURCE: Hong Kong's Climate Action Plan 2050, Oct 2021

2035: Orderly transition to low carbon electricity

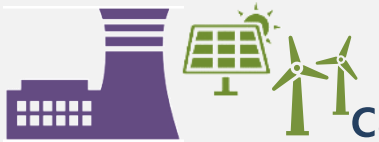
By 2035

50%

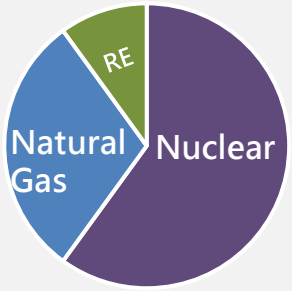
Total carbon emissions for HK

(Compared to 2005)

Phase out coal generation



60-70% zero carbon electricity



~0.1

kg CO2/kWh

Hong Kong has limited RE potential for fully decarbonising power generation, particularly land resource needed for solar

Shek Pik Floating PV

Li Po Chun College Rooftop PV

Case studies | CLP Sustainability Report 2020

Solar PV cost have been decreasing at rate faster than many previous predictions

But large amounts of land is required for large contribution, and HK's land supply is limited

Wind energy also has potential to contribute but low wind speed requires large turbines and spatial requirement

Model	Cap	Rotor
MySE 16.0-242	16MW	242m
GE Haliade-X	14MW	220m
SG 14-222 DD	14MW	222m

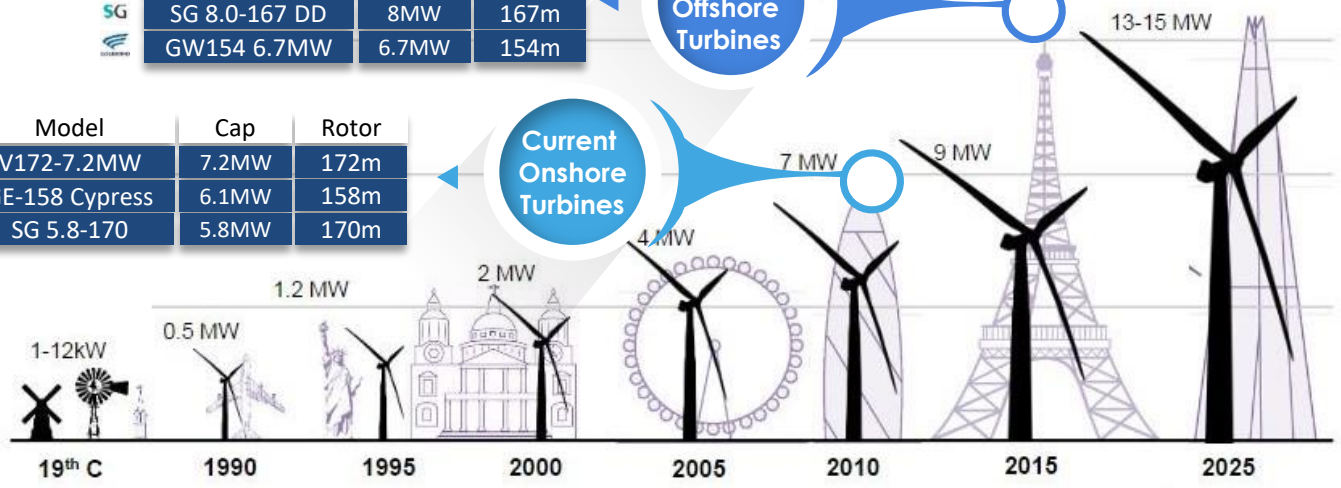
Offshore Prototype

Model	Cap	Rotor
V164-9.5MW	9.5MW	164m
SG 8.0-167 DD	8MW	167m
GW154 6.7MW	6.7MW	154m

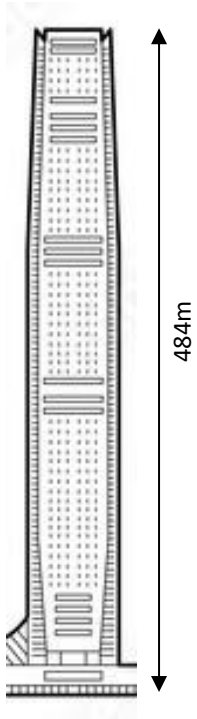
Current Offshore Turbines

Model	Cap	Rotor
V172-7.2MW	7.2MW	172m
GE-158 Cypress	6.1MW	158m
SG 5.8-170	5.8MW	170m

Current Onshore Turbines

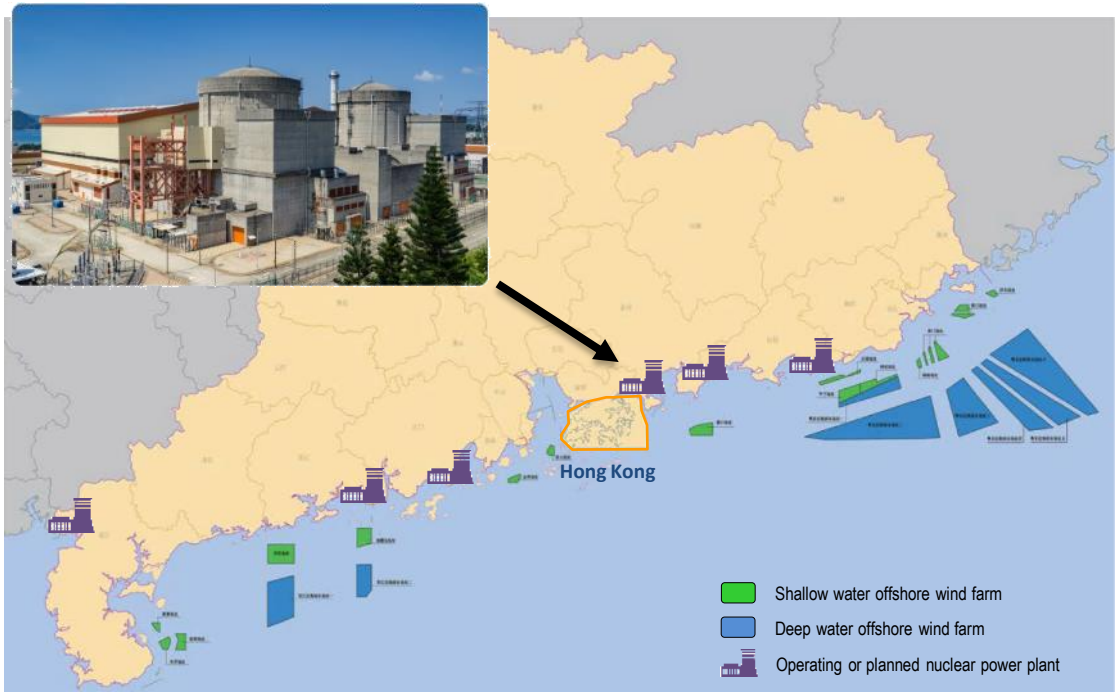


Sources: Various; Bloomberg New Energy Finance



Source: Adobe Stock

Nuclear power will play a key role in our decarbonization journey, regional cooperation and interconnection enhancements are key



Existing power interconnection between HK and Guangdong being upgraded to enable more zero-carbon energy (RE and nuclear) for HK.

"Nuclear power plays a significant role in a secure global pathway to net zero. Less nuclear power would make net zero ambitions harder and more expensive"

International Energy Agency, Nuclear Power and Secure Energy Transitions, Jun 2022

SOURCE: Guangdong Offshore Wind Development Plan (2017-2030) 广东省海上风电发展规划 (2017-2030年) World Nuclear Association, updated October 2022

As zero-carbon energy sources increase, our local generation assets will evolve to maintain supply reliability and security

Black Point Power Station – gas fired combined cycle gas turbines

Castle Peak Power Station – coal fired steam turbines

Penny's Bay Power Station – oil fired open cycle gas turbines

Highly flexible gas power generation to complement increasing share of inflexible nuclear and intermittent RE

Maintaining some fossil fuel units as reserve will help safeguard system security at lowest possible cost

Additional measures could be developed to further enhance system flexibility

Pumped Storage Hydropower

Guangdong Pumped Storage Hydropower Facility

Battery Energy Storage System

CLP Qian'an Windfarm BESS

Source: Honeywell Process Solutions

Demand Side Management

Smart Charge by HKT and CLP

Summer Savers Rebate

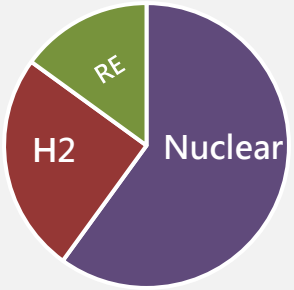
2050: Early planning for net zero electricity

2050年前

Net Zero Carbon

Repurpose gas to zero-carbon hydrogen

(may also retrofit carbon capture to natural gas power generators)



0

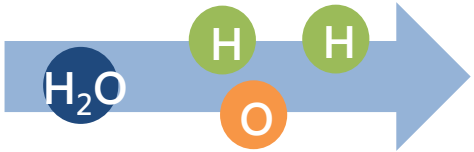
kg CO2/kWh

Zero-carbon hydrogen could potentially enable deep decarbonization

Zero Carbon

"Green Hydrogen"

Produced with water and **zero carbon electricity**, through electrolysis.



Low Carbon (intensity)

"Blue Hydrogen"

Produced with fossil fuels, through chemical reformation, **requires carbon capture and storage**.

High Carbon (intensity)

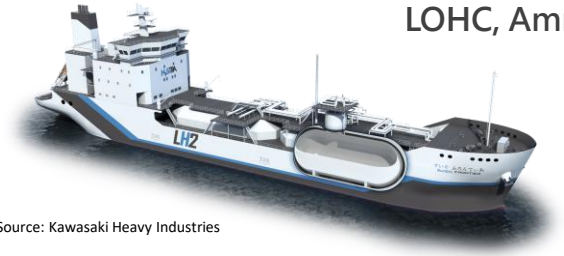
"Grey Hydrogen"

Produced with fossil fuels, through chemical reformation, does not include carbon capture and storage. **High carbon intensity**.

Hydrogen power generation technology may be ready in 2030s but zero-carbon hydrogen supply and cost would improve towards 2050

Liquified Hydrogen

LOHC, Ammonia

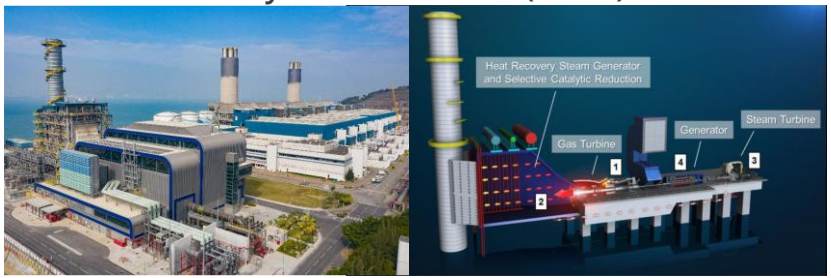


Source: Kawasaki Heavy Industries

Hydrogen Pipeline

Source: NREL

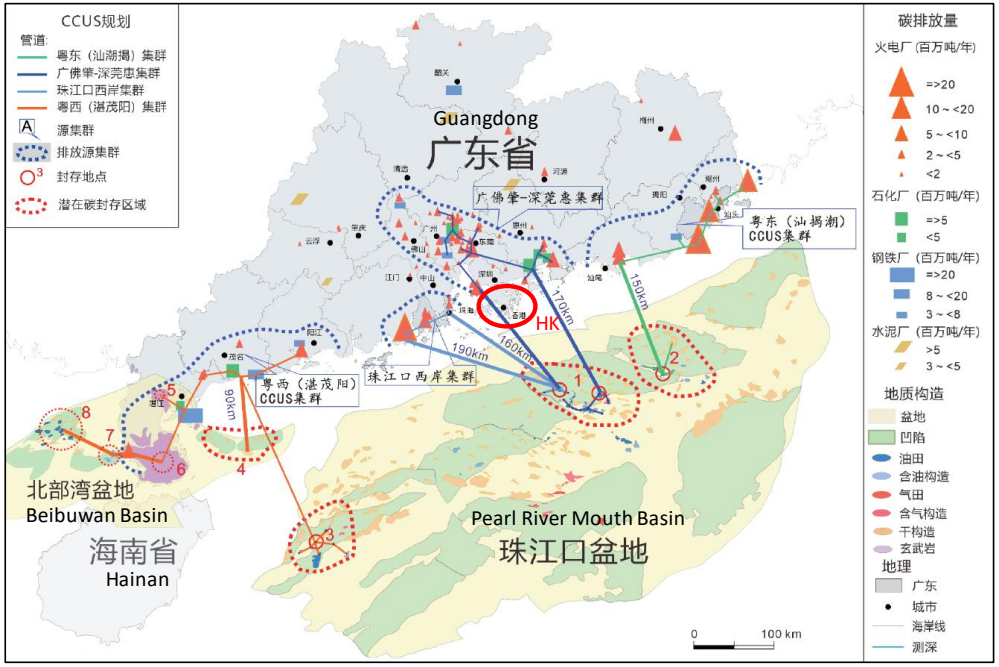
CLP Combined Cycle Gas Turbine (CCGT) Unit D1



Siemens H-Class Turbine

Source: Siemens

Carbon Capture Utilization and Storage may be an alternative to hydrogen if Guangdong develops carbon utilization and permanent carbon storage sites



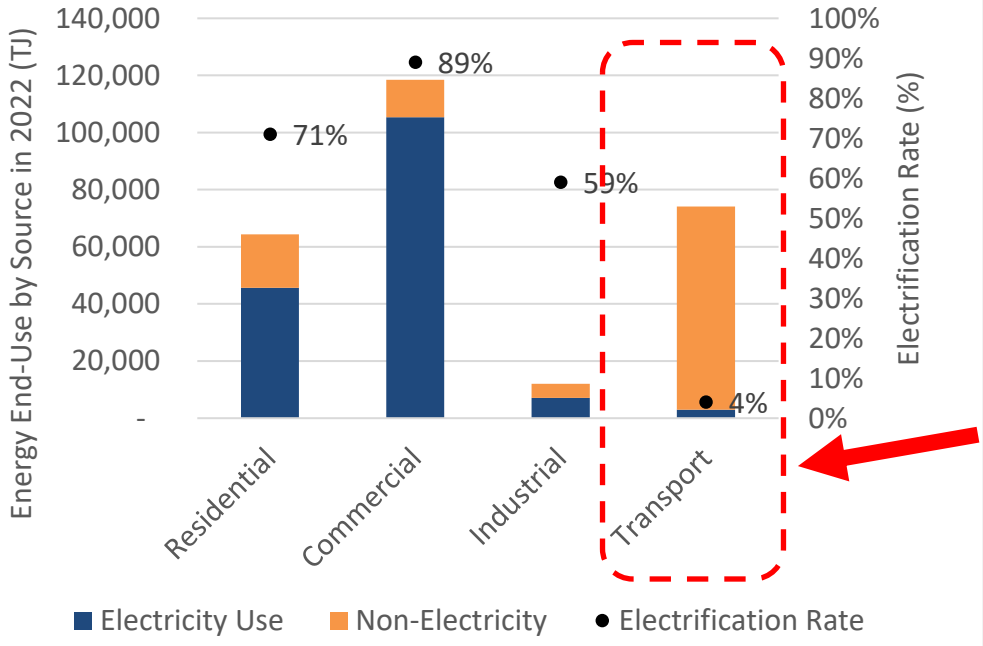
- Continuation of using fossil fuel is possible with CCUS
- Carbon capture removes ~90-95% of emission. Carbon offset would be required for residual emission
- HK does not have industries that would use substantial amount of carbon dioxide. GD couldn't utilize all captured CO_2
- Pipeline may be built to transmit CO_2 to GD offshore for permanent storage

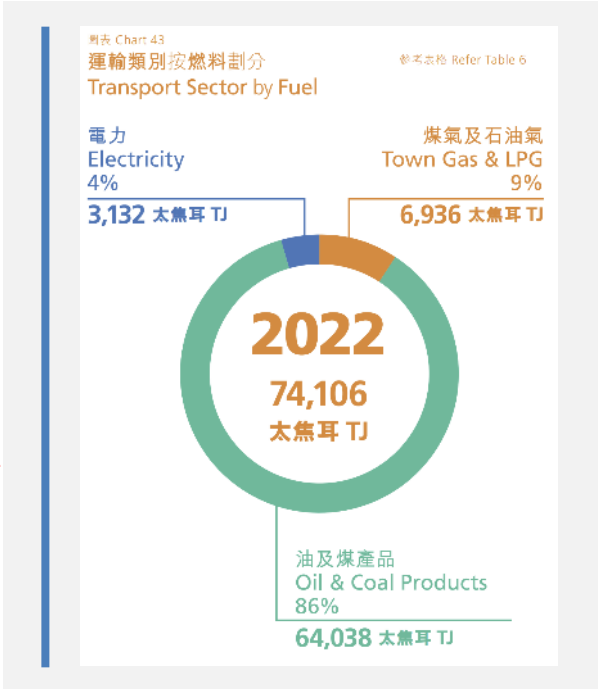
SOURCE: 广东省二氧化碳捕集利用运输与封存规划研究报告 Guangdong CCUS Study Report, Sep 2022

Energy Efficiency and Electrification

28% of total energy consumed in HK is for transport, 96% of which is being met by carbon intensive fuels

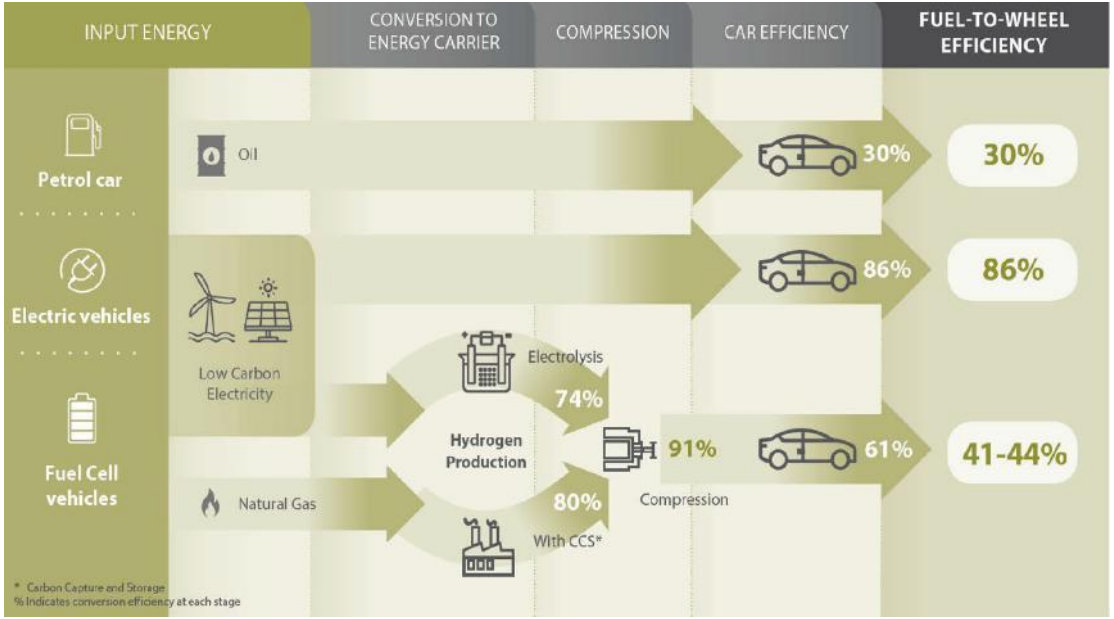
But this is changing, as road transport electrification gathers pace



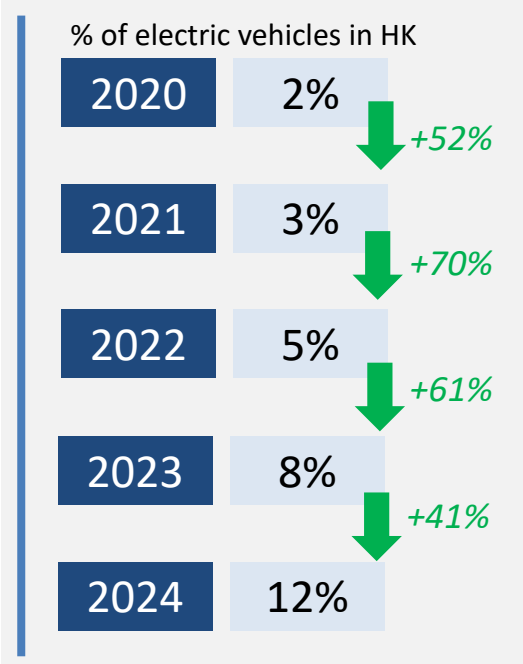


Electrification to decarbonise the transport sector: most direct, cost-effective, and mature approach

Adoption of electric vehicles is gathering pace because they are ~3x more efficient than petrol cars



SOURCE: Hydrogen in a Low-carbon Economy, UK Committee on Climate Change, Nov 2018



SOURCE: Transport Department

EV is the most mature form of low or zero carbon transport that is widely available in the market now

EV technologies have been improving rapidly, and new innovations will make transition even smoother

300

Models for private passenger cars and motorcycles models type approved by Transport Department

87

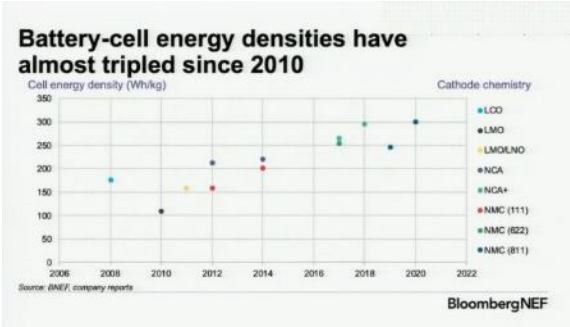
Models for public transport and commercial vehicles types approved by TD

3,000

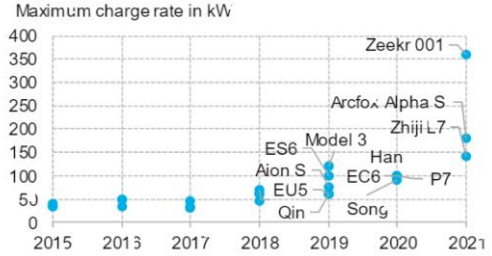
e-taxis targeted by 2027

700

e-buses targeted by 2027



Charging speed has increased 7-folds

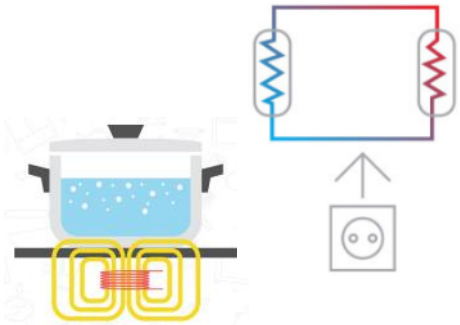


Eternally five years away? No, batteries are improving under your nose - Ars Technica

Multipronged approach for decarbonization

Energy Efficiency

Electrification



Zero-carbon Electricity

Thank you