



# Alternative Fuels

## The Road to Greener Driving

part of the Smart City Smart Environment Series

Organizers:



Co-hosting Chambers:



Venue sponsor:





Moderator:

**Michiel Mak**

CEO of EMCS Limited Hong Kong



**Chin-wan Tse, BBS, JP**

Under Secretary for the Environment  
Bureau Hong Kong SAR

An aerial photograph of Hong Kong at dusk, showing a dense urban landscape with numerous skyscrapers and residential buildings. The city is situated on a peninsula with a large harbor in the background. The sky is a deep blue, and the city lights are beginning to glow. The title "The Clean Energy Challenge for Hong Kong" is overlaid in large, bold, yellow text across the center of the image.

# The Clean Energy Challenge for Hong Kong

# Air Quality



# Carbon Emissions



# Air Quality

$\text{SO}_2$

$\text{O}_3$

$\text{CO}$

$\text{NO}_2$

$\text{PM}$

.....

# Carbon Emissions

$\text{CO}_2$

$\text{CH}_4$

.....

An aerial photograph of a city skyline, likely Hong Kong, featuring numerous high-rise buildings and a large body of water in the background. The image is split vertically into two halves. The left half has a semi-transparent white overlay where the text is placed. The right half shows the city skyline more clearly.

# **Air Quality Guidelines**

**World Health  
Organization**

# **Paris Agreement 2015**

**United Nations  
Climate Change**

# 2013

# CLEAN AIR PLAN

FOR HONG KONG  
2013-2017 PROGRESS REPORT



Environment Bureau | June 2017

# 2017

# HONG KONG'S CLIMATE ACTION PLAN 2030+



January 2017

...2030

[www.climate-ready.gov.hk](http://www.climate-ready.gov.hk)

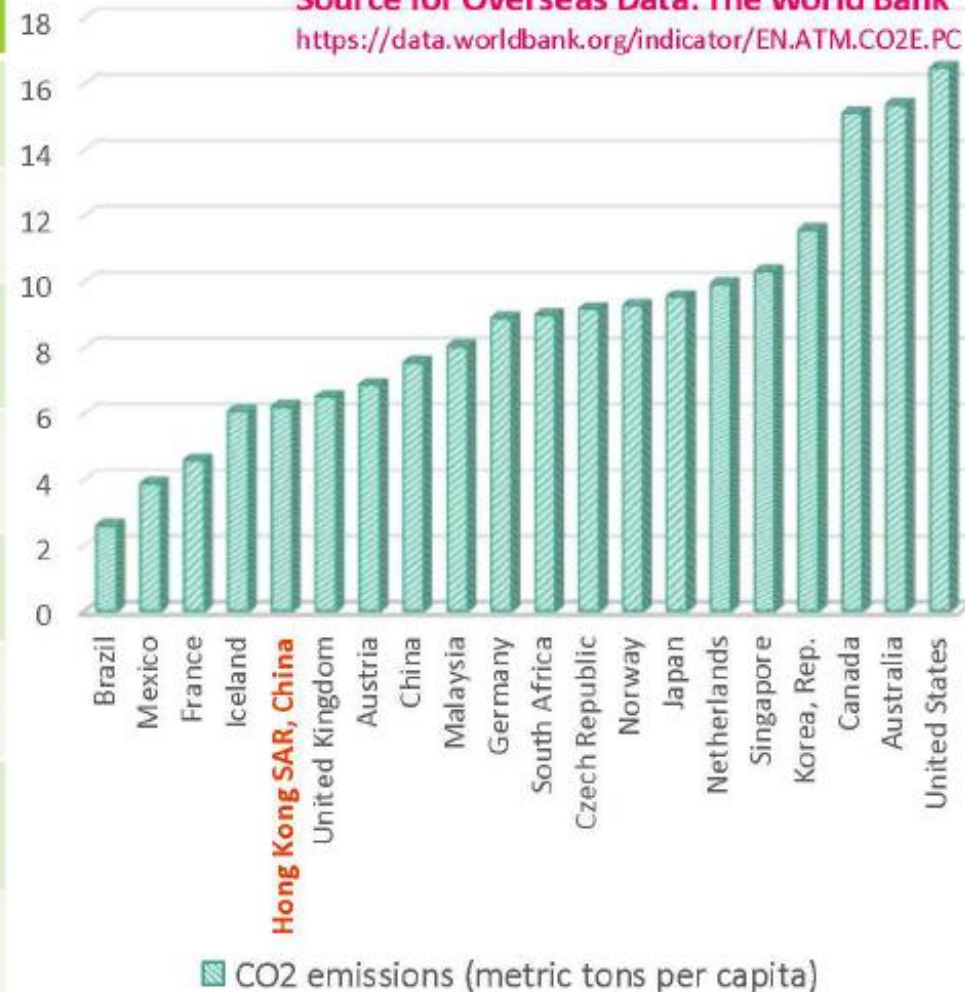


# 2016/7

# 2014

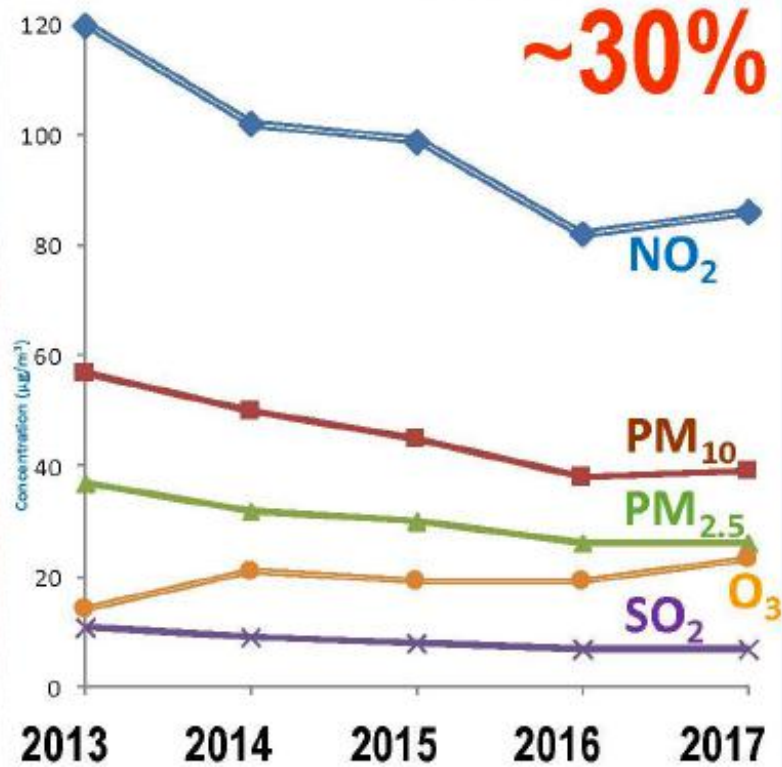
Annual Averages ( $\mu\text{g}/\text{m}^3$ )	Air Pollutants				
	PM <sub>10</sub>	PM <sub>2.5</sub>	NO <sub>2</sub>	SO <sub>2</sub>	O <sub>3</sub>
Seoul (2017)	44	25	57	13	50
Singapore (2017)	25	14	25	12	N.A.
Hong Kong SAR (2017)	35	22	40	8	51
Taipei (2017)	32	17	38	7	54
Tokyo (2016)	17	13	31	5	N.A.
London (2017)	16	12	33	2	35
New York (2017)	N.A.	7	30	1	N.A.

Source for Overseas Data: The World Bank  
<https://data.worldbank.org/indicator/EN.ATM.CO2E.PC>

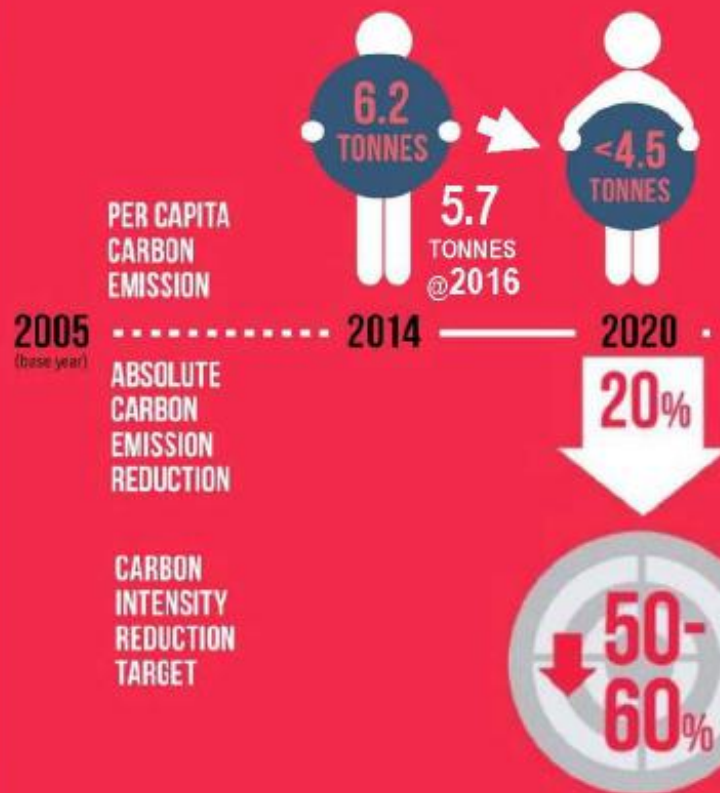


# ...2017

In the last 5 years,  
roadside & ambient levels  
of  $PM_{10}$ ,  $PM_{2.5}$ ,  $NO_2$  and  $SO_2$   
reduced by  
**~30%**



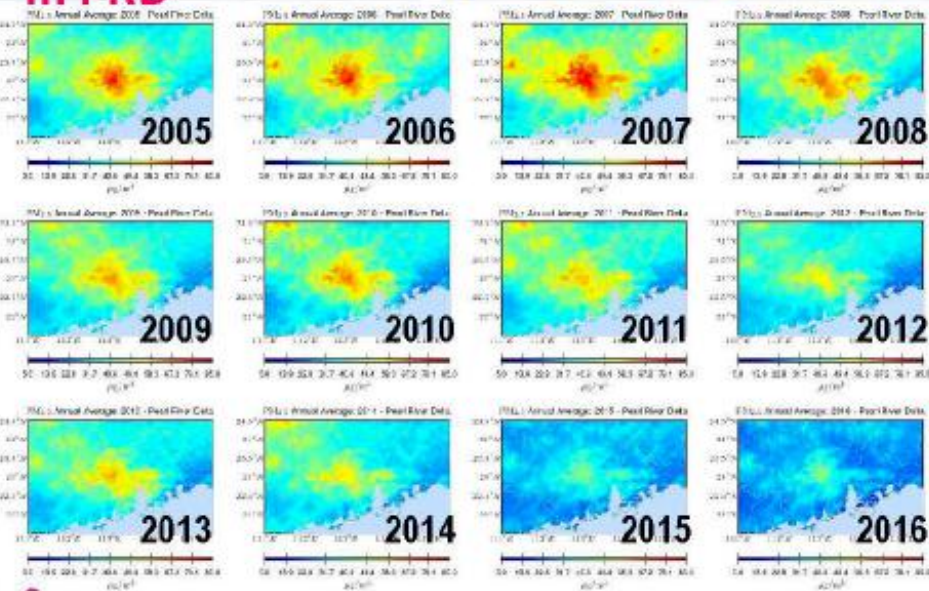
# ...2020



# ...2020

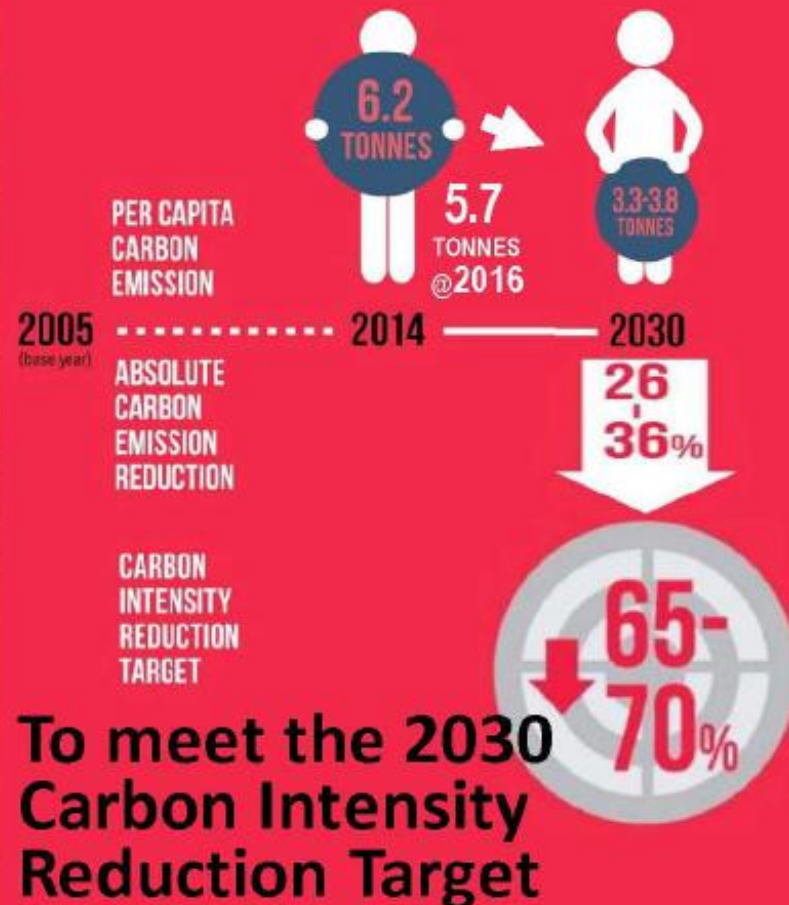
## To broadly attain the Air Quality Objectives (AQOs) by 2020

PM2.5 level lowered in PRD

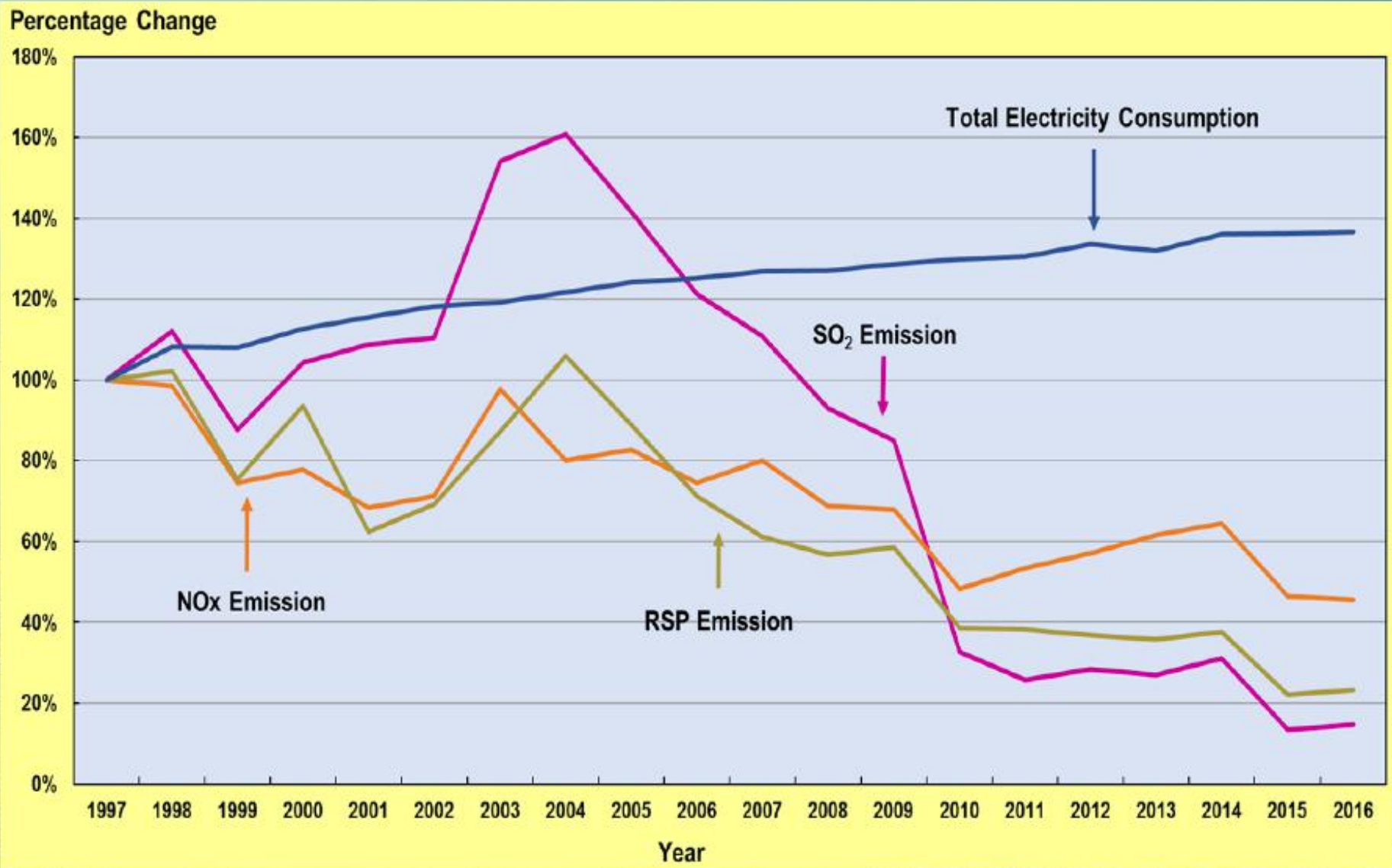


Source: Satellite images from HKUST

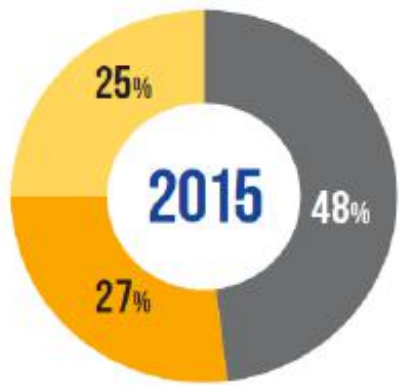
# ...2030



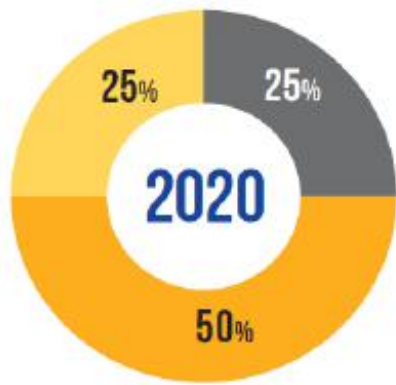
# Electricity Consumption and Emissions from Power Plants



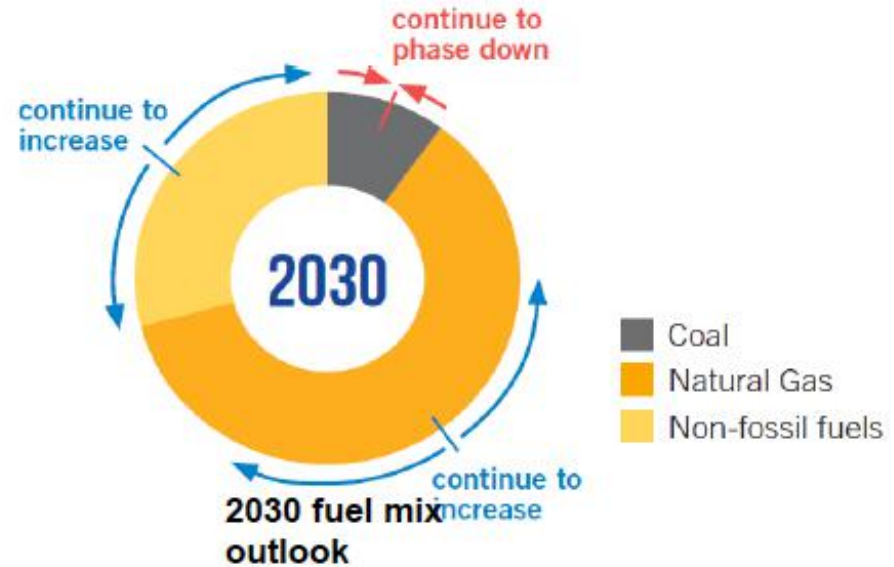
# Further decarbonize the electricity generating sector



Hong Kong  
2015 fuel mix



2020 fuel mix  
target



2030 fuel mix  
outlook



# Air Quality

**AQOs Review every 5 years led by Environment Bureau**

**Benchmarking against the interim & ultimate targets of WHO AQGs**



# Carbon Emissions

**Public engagement on Long-term Decarbonization**

**..2050**



An aerial photograph of a coastal city, likely Hong Kong, showing a dense urban area with numerous high-rise apartment buildings. In the foreground, a large, lush green park with a winding river or stream flows through it. The city is situated on a peninsula with a harbor and a large ship in the water. The text "Search For Green Energy" is overlaid in the center of the image.

# Search For Green Energy

# New Ideas





# New Ideas **Renewable Energy**



# New Ideas **Renewable Energy**



# RE Potentials

WTE



T • Park Sludge  
Treatment Plant

Organic Waste  
Treatment  
Facilities

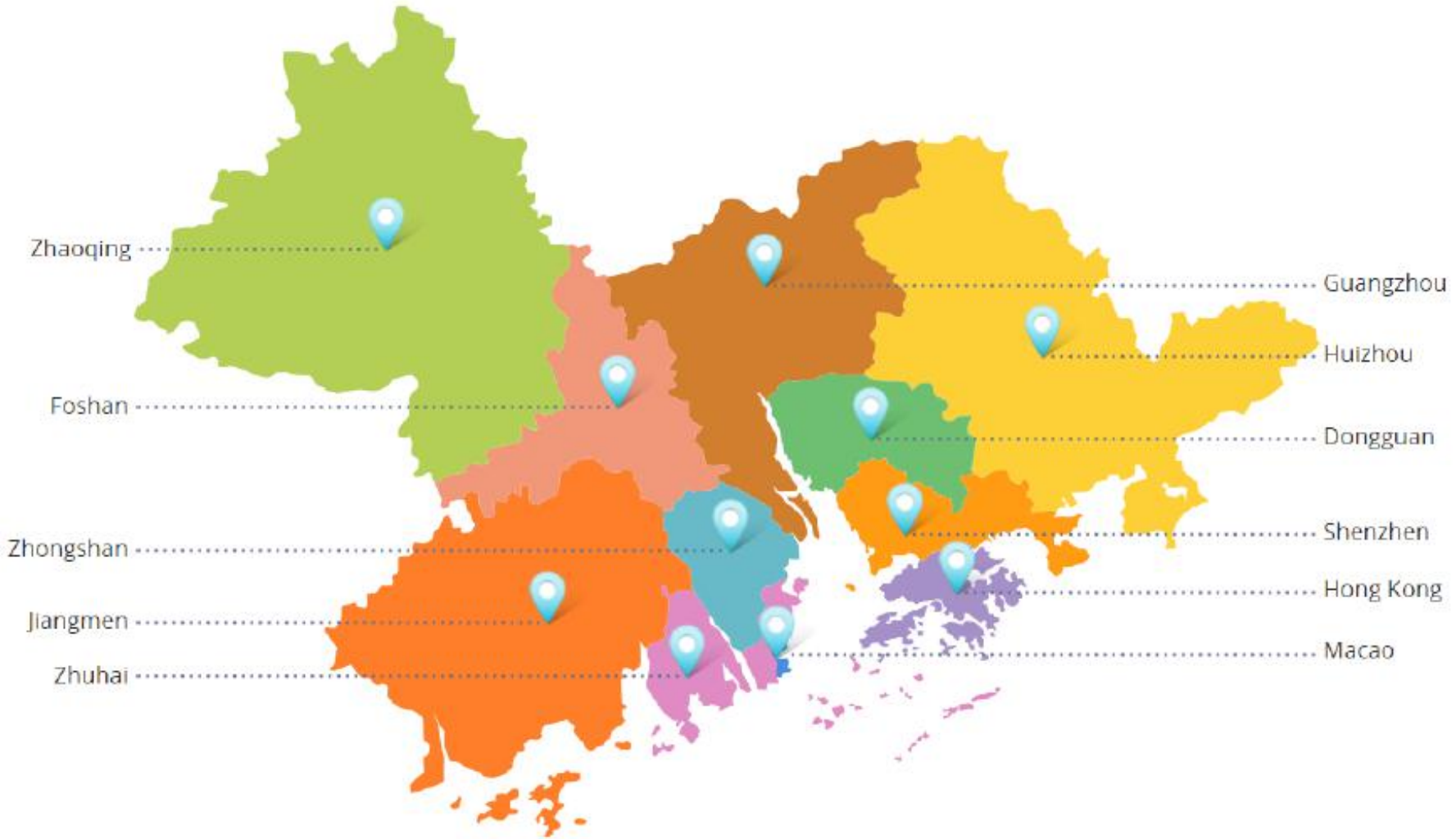


Integrated Waste  
Management  
Facility



Landfill Gas  
Utilization

## New Opportunities?



# New Energy Vehicles - Electric Vehicles

🚗 Electric vehicles (EVs) have no tailpipe emissions

🚗 Replacing conventional vehicles with EVs can improve roadside air quality

🚗 Commercial vehicles account for 95% of emissions from vehicle fleet. The challenge is to promote commercial EVs



## Government Policy Initiatives for EVs

### The Steering Committee on the Promotion of EVs chaired by the Financial Secretary

- ✓ Tax concession and Incentives
- ✓ Pilot Green Transport Fund
- ✓ Trial of electric franchised buses
- ✓ Government leading by examples
- ✓ Charging facilities in new buildings
- ✓ Charging support for EVs and Guidelines






# 2018 Policy Address

## Vehicular Emission Control

The Government plans to -





-  Prepare to **tighten emission standards for newly registered motorcycles to Euro 4 in 2020**
-  Launch an incentive-cum-regulatory scheme to **progressively phase out Euro IV diesel commercial vehicles by end 2023**
-  Fully subsidise a **trial on retrofitting Euro IV and Euro V franchised buses with enhanced selective catalytic reduction systems** to reduce their NOx emissions

# 2018 Policy Address

## New Energy Vehicles

**NEW**

-  **Review the scope of the Pilot Green Transport Fund** to further facilitating the transport sector's wider use of green transport technologies, including commercial and public electric vehicles
-  **Continue to encourage the use of new energy vehicles** in the hope that all newly registered private cars in Hong Kong will ultimately become new energy vehicles in the long run (As the first step, we may consider ceasing the first registration of diesel private cars subject to consultation with stakeholders.)



**THANK YOU**



# Supplementary Information



## Use of Biodiesel as Motor Vehicle Fuel

- Introduced legislation to set out specifications for motor vehicle biodiesel from 1 July 2010
- Using biodiesel does not contribute significant benefit in improving roadside air quality because:
  - Motor vehicle diesel: adopted stringent Euro V standard
  - Newly registered vehicles: Euro VI emissions standard
  - After-treatment devices like Selective Catalytic Reduction Devices (SCR) and Diesel Particulate Filters (DPF) are commonly adopted by Euro V and Euro VI diesel vehicles



**Thomas Wu**  
CEO of ASB Biodiesel

# ASB Biodiesel (Hong Kong) Limited



## KEY ADVANTAGES of biodiesel

- Key solution in food safety
- Low carbon Renewable, waste to energy
- Technology development for future biofuels platforms
- Lower reliance of fossil fuels: trade balance and geopolitical considerations
- Social benefits: Value remains in local community: restaurant payments, collection labour force, plant operation.

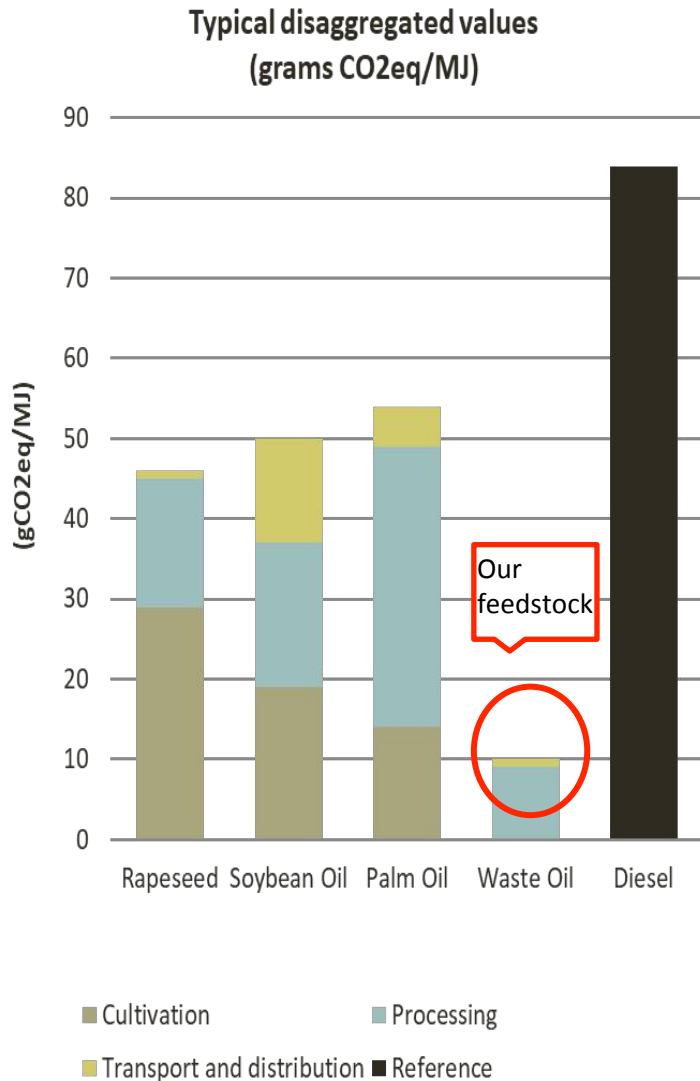
## KEY ADVANTAGES of ASB

- Biggest biodiesel producer
- Strongest logistic infrastructure (biodiesel storage capacity 4,700 m3, overall +10,000 m3, wharf 3,200 DWT)
- Proven technology (+30 plants worldwide)
- Most reliable quality assurance program, supplying biodiesel internationally to key oil players (Shell, Chevron, Gunvor, PetroChina)
- Distilled quality, 100%. Total contamination 6ppm, MG 0.15%, water 200ppm
- Specific sulphur reduction unit
- Only biodiesel plant with bonded warehouse status
- ISCC, RSB and LCFS certified, with actual trading of UCOME into Europe and US

<b>Lead investor:</b>	Al Salam Bank Bahrain
<b>Locations:</b>	Hong Kong, Malaysia, Singapore
<b>Production capacity:</b>	100,000 tons / year
<b>Technology:</b>	Integrated GTW, WWTP and biodiesel plant: pretreatment, high FFA esterification, distillation, biogas
<b>Feedstock:</b>	Waste cooking oil, gutter oil (grease trap oil), waste animal fat, other waste oils.
<b>Fuel Quality:</b>	EN14214/ASTM 6751/China B100 standard



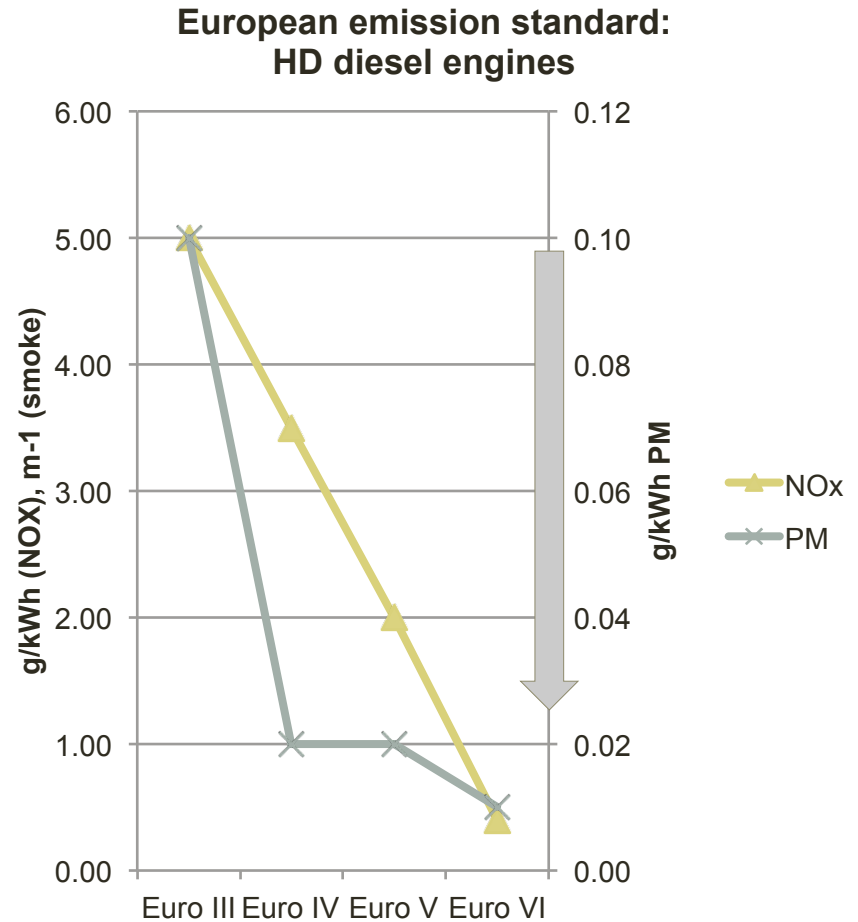
# Biodiesel: a green fuel for HK



Source: EU Renewable Energy Directive Annex V

Both Euro V and Euro VI have been qualified using biodiesel blends (B5 to B7). Engine performance and emissions are optimized for this fuel.

In 2018 HK policy Address, government fully subsidise franchised bus companies in conducting a trial on retrofitting Euro IV and Euro V

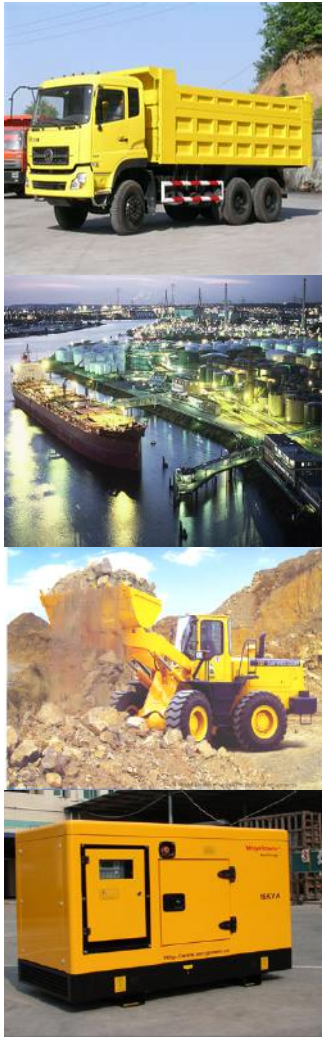


Source: Euro VI

(\*) Regulation (EC) No [443/2009](#) establishes average CO<sub>2</sub> emissions performance Requirements of 130 g CO<sub>2</sub>/km for new passenger cars.

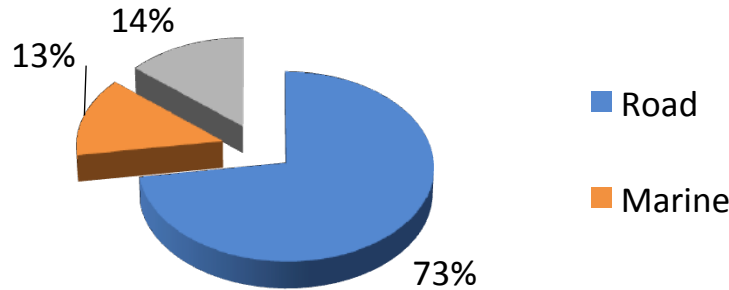
From 2020, this is reduced to 95 g CO<sub>2</sub>/km

# Hong Kong potential market for Biodiesel



Biodiesel is a clean substitute for diesel fuel in diesel engines – trucks, buses, construction equipment, ships, stationary generators.

Fossil Diesel consumption in Hong Kong:  
1,440,000 tons per year



***If the 1,440,000 tonnes total annual consumption of conventional diesel in Hong Kong is replaced by B5 diesel, this would equate to substituting a total of about 72,000 tonnes of conventional diesel with pure biodiesel per annum- all of which can be met from local production.***

**Hong Kong market now:**  
In 2014 and 2015, about 900 tonnes of pure biodiesel is used in Hong Kong per annum. Main users include the Government, private construction companies and the Airport Authority of Hong Kong. The biodiesel they use is B5 diesel, a blend of 5% pure biodiesel and 95% conventional (Euro V) diesel.

In Hong Kong, the “Specifications of **Motor Vehicle Diesel**” already includes the provision for 5% of ester content in regular diesel (Air Pollution Control (Motor Vehicle Fuel) (Amendment) Regulation 2010), and there are no marking requirements, and is suitable for use in all vehicles.

## **Tax Incentive**

To promote the use of biodiesel as motor vehicle fuel, motor vehicle biodiesel is duty-free.



# Alexander Mastrovito

Head of Sustainable Transport  
Solutions at Scania Asia & Oceania





# The future of mobility

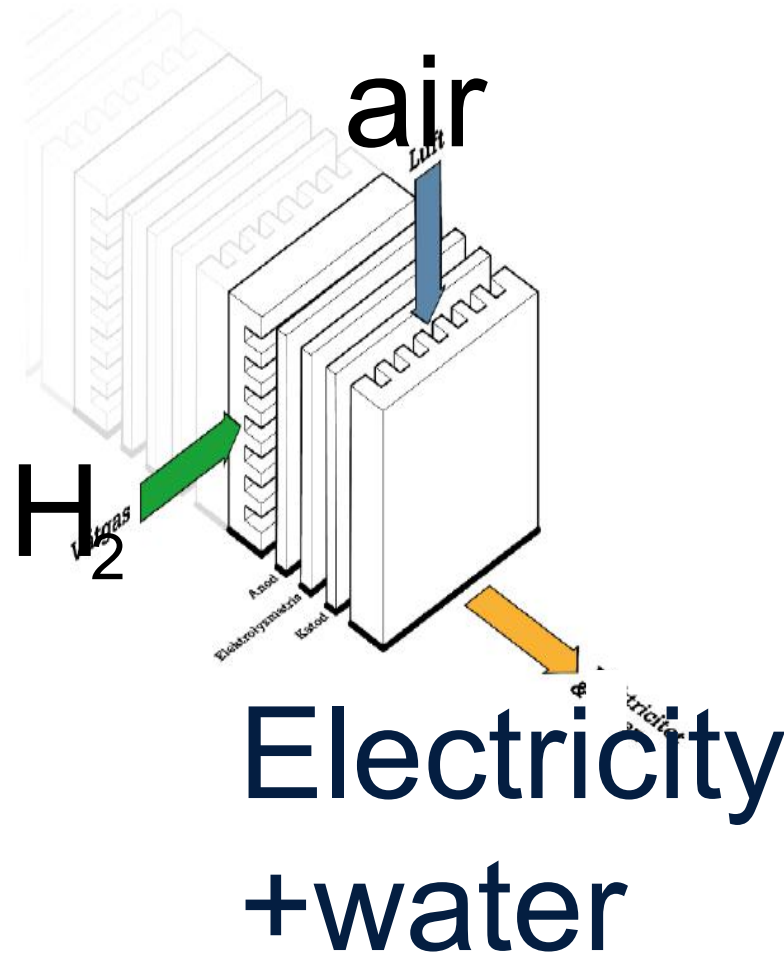
clean, convenient, and in the service of humanity

# H<sub>2</sub> Fuel cells for transportation

Alexander Mastrovito  
Head of sustainable transport solutions  
Scania asia & oceania

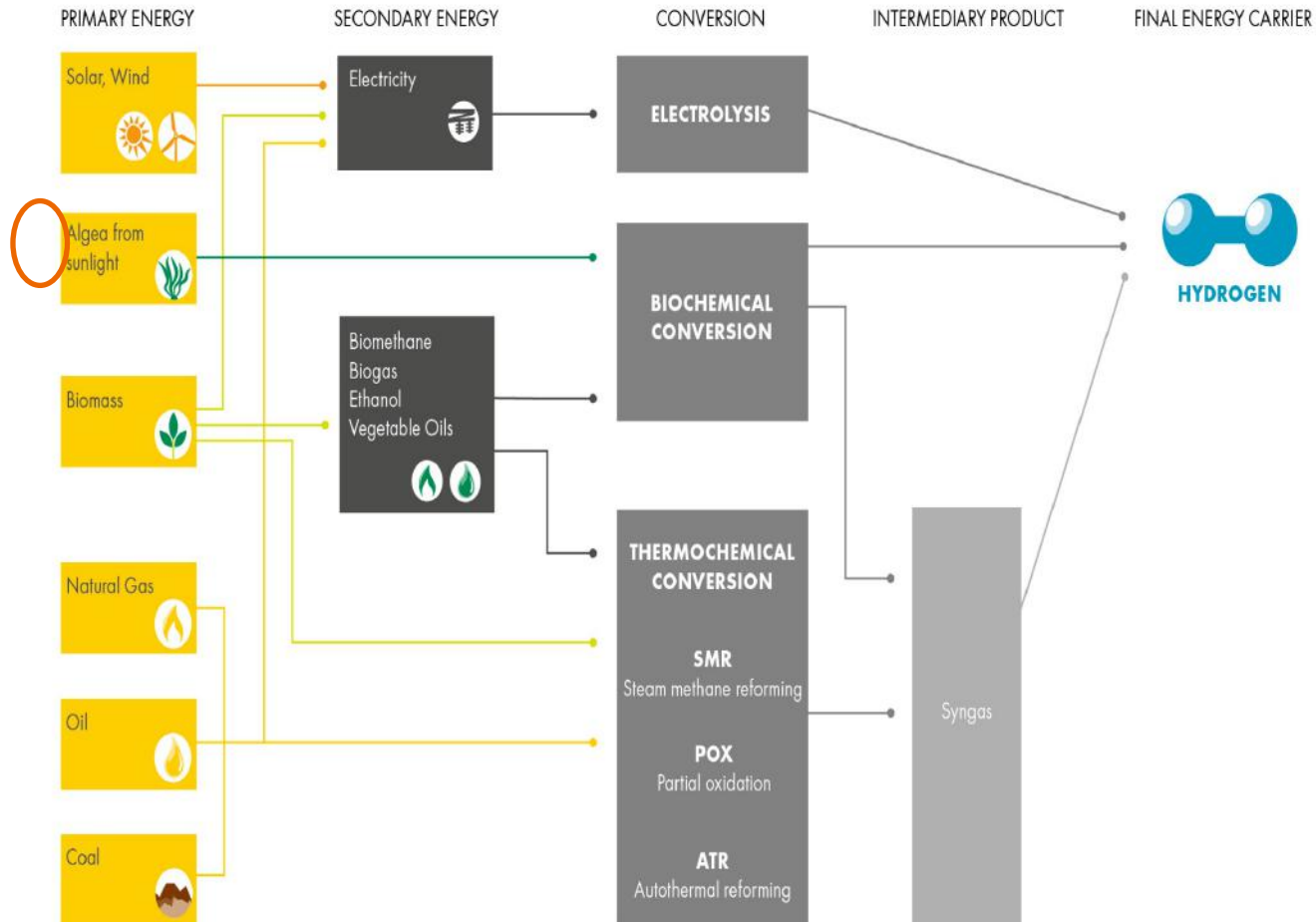


# What are hydrogen fuel cells?



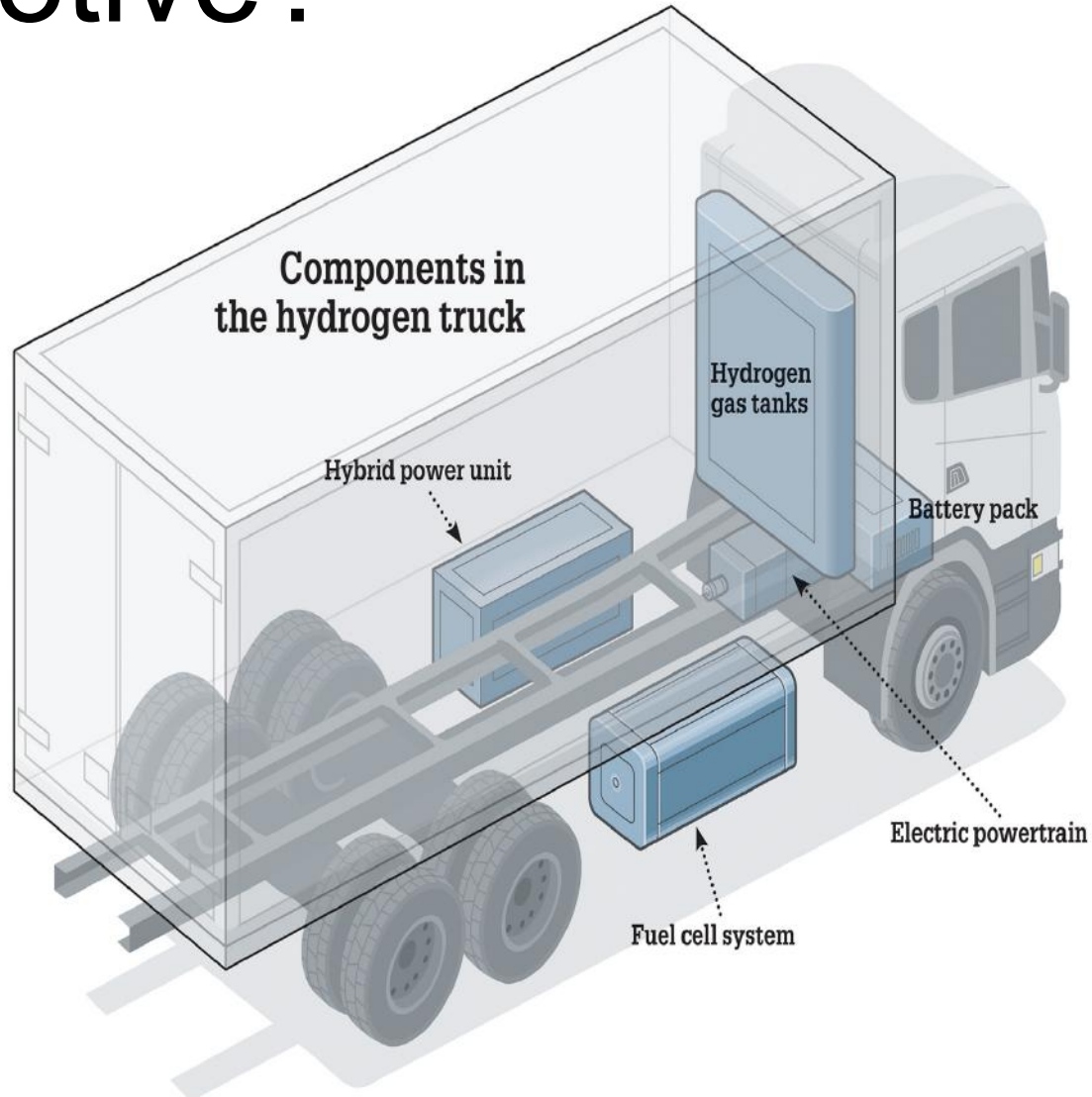


# Where do we get hydrogen fuel from?





# How do they apply to automotive?





# Benefits to transport

## 1. Zero emission tailpipe transport



## 2. Quick refuelling times (similar to petrol)



## 3. Long potential range with less payload penalties than BEVs





# Seeing is believing



**A driver drinks pure water from a hydrogen fuel cell bus along Route 727 in Zhengzhou, capital of Central China's Henan Province, to show that the bus' hydrogen energy is clean and eco-friendly. The country's first two hydrogen fuel cell buses started operation in the city on Wednesday. The number of such buses will reach 10 by end-October. Hydrogen consumption of the bus is less than 7.2 kilograms per 100 kilometers, while the driving range can reach more than 500 kilometers.**



# Challenges to overcome

## 1. Longevity of fuel cells

2500 hours of life for a fuel cell would mean yearly replacements

## 2. distribution of hydrogen

A single truck can carry fossil fuel for 800 cars, but only enough h<sub>2</sub> for 60 cars,  
And h<sub>2</sub> can't be pipelined

## 3. Current reality is h<sub>2</sub> is a fossil fuel

Over 90% of all hydrogen is produced by reforming methane gas

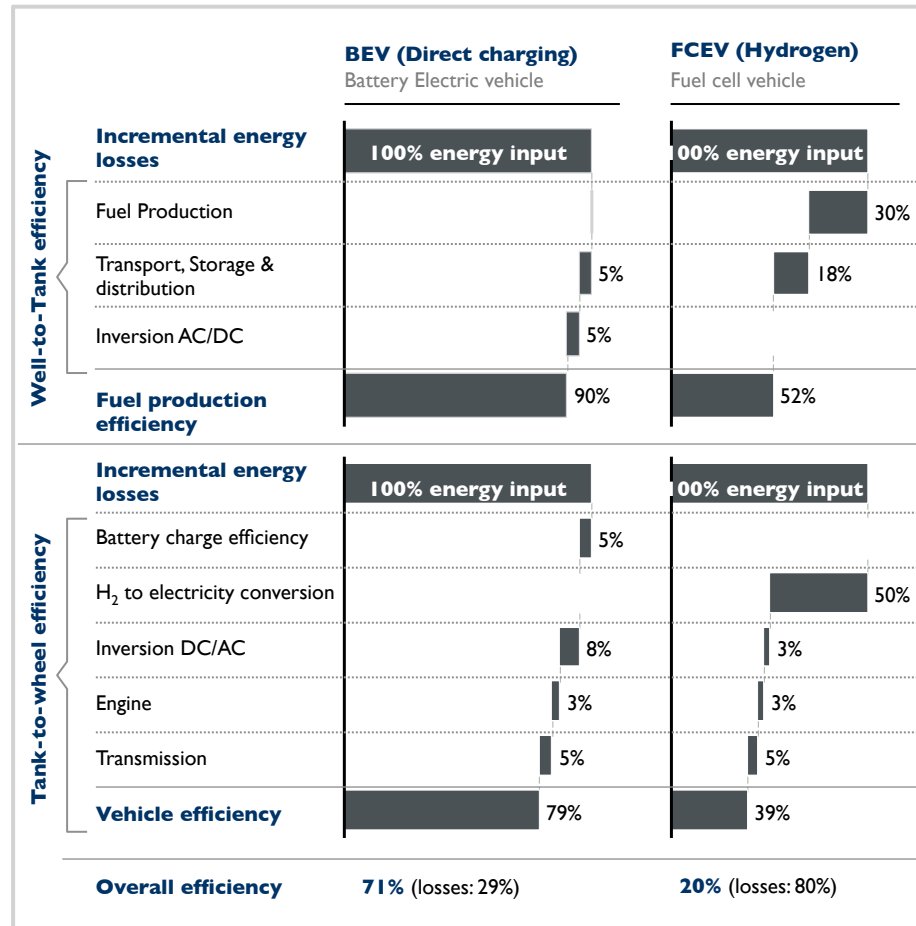
## 4. Costs

FCVs are currently roughly three times as expensive as BEVs

*“You have to put energy in to get energy out,  
and producing H<sub>2</sub> puts you in negative energy territory immediately”*



# Comparison with bevs







# The potential of fcv's

- Potential to run heavy loads over long distances with zero emissions
- In societies with an abundance of renewable energy Hydrogen could work as a way to electrify transportation and deal with intermittency issues
- Unlimited energy from Fusion could enable a Hydrogen powered future and reduce environmental strain that the resource intense Li-Ion batteries give rise to



# DRIVING THE SHIFT

TO A SUSTAINABLE TRANSPORT SYSTEM



**SCANIA**



**Paul Bromley**  
Managing Director  
of Phoenix Business Consultancy



# **The E-volution of Electric Transport**

**Paul Bromley – Managing Director**

**Phoenix Business Consulting**


**30<sup>th</sup> October 2018**

# E-Vehicles are not new.....



WDRG SOUTH SHIELDS Electric Bus No. 1 1914  
(CJ319)



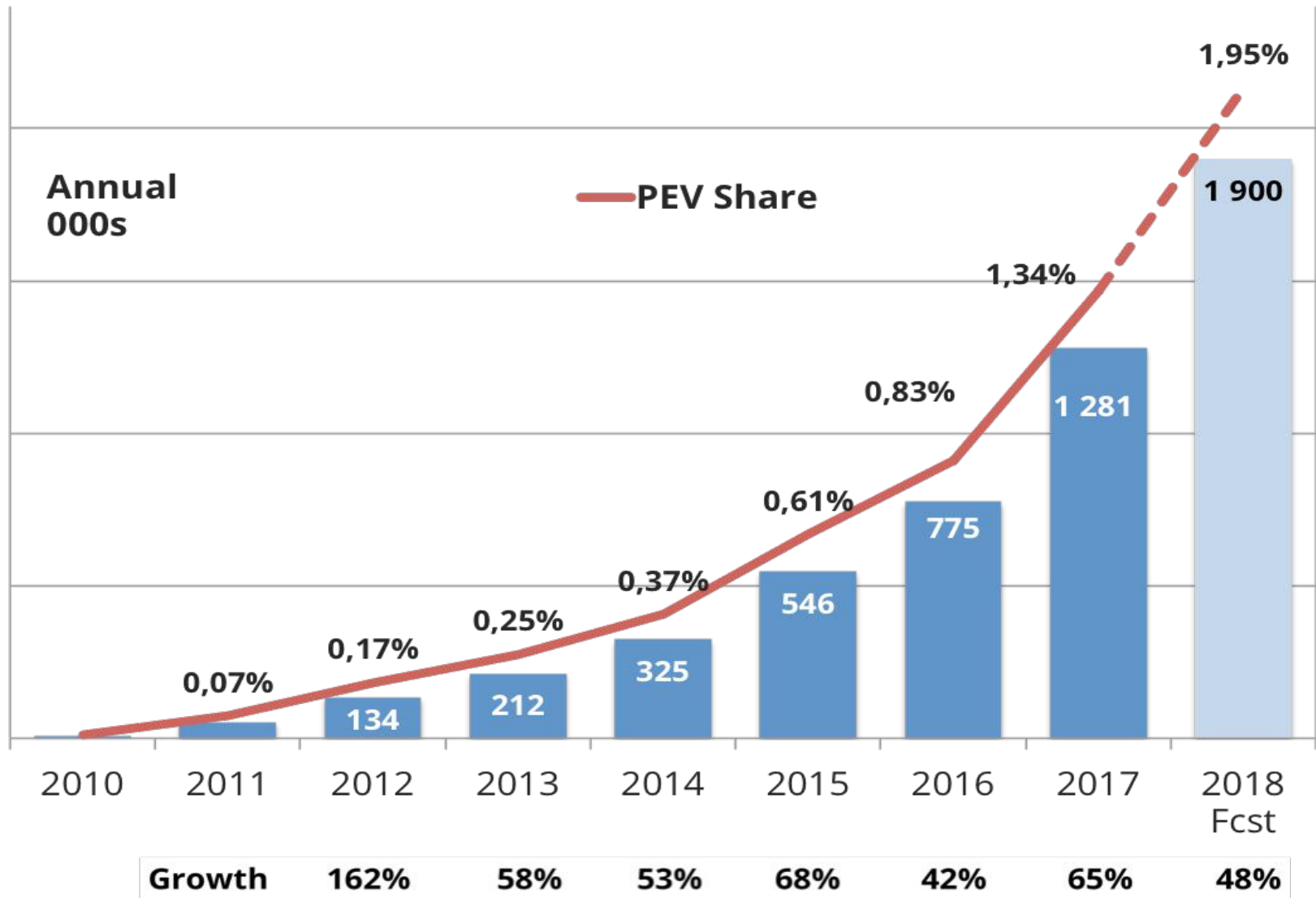
Pencil Prints  
Croydon Old Tram 

# E-Vehicle History

- In 1900 38% of vehicles sold in the US were electric powered
- Commercial vehicles used a model of battery swapping with the vehicle owner / operator owning sets of lead-acid batteries
- Road building encouraged longer distance travel and gasoline stations could charge in relatively short time
- Break up of Standard Oil in 1911 introduced competition to the market
- Mass production of the Model-T Ford cost \$650 versus \$1,750 for the equivalent electric vehicle
- 1912 - invention of the electric starter motor
- By 1930's fossil fuelled vehicles predominated

# Global EV Growth

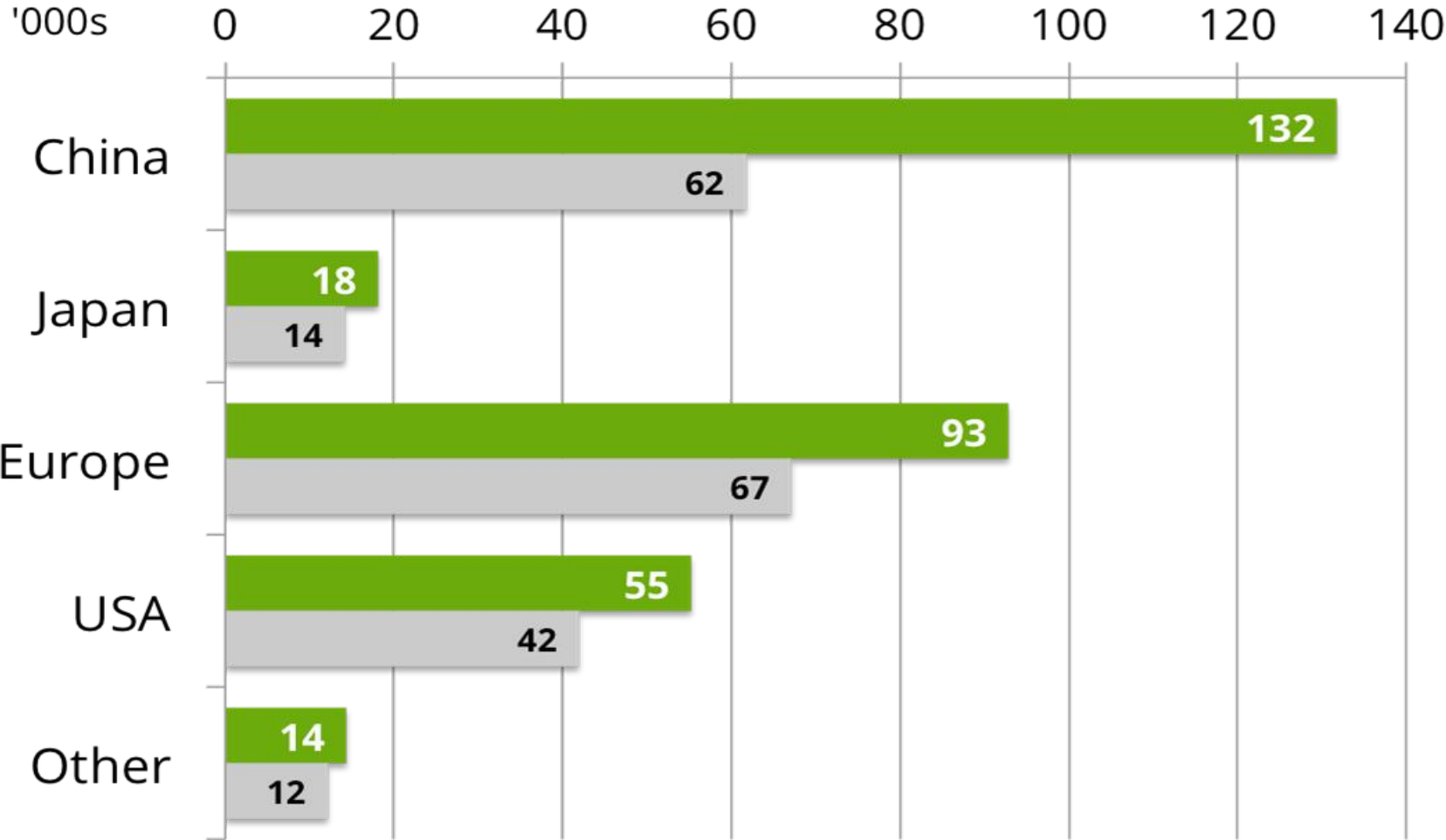
## Global Plug-in Vehicle Sales & Share



# By Region

## Plug-in Sales and % Growth

■ 2018 Q1  
■ 2017 Q1





# Current China Market

- China has annual sales of approximately 750,000 E-Vehicles
- Total e-bus fleet up to 316,978 as of December 2017 representing around 92% of the global e-bus fleet
- 9 out of top 10 suppliers are local Chinese
- The major suppliers are BYD, Yutong, Shanghai SunLong, Foton, Zhongtong and Yinlong
- Historically there has been up to 1,000,000 RMB available in subsidy in China but this creates it's own problems
- Shenzhen has a full electric fleet of 16,359 e-buses with 510 charging stations and a total of over 8000 charging points



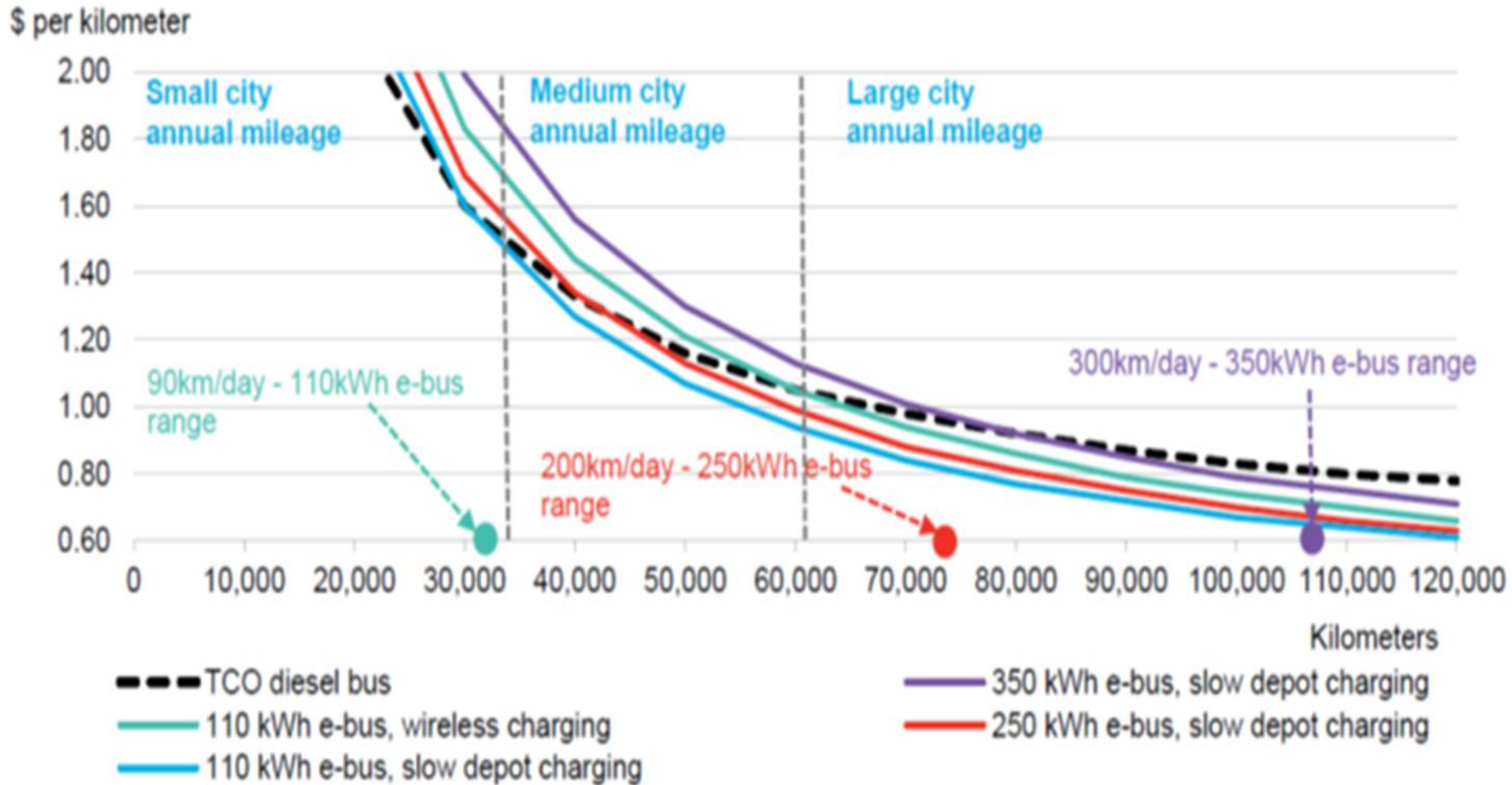
# Shenzhen Experience

- Shenzhen, a city of 12 million+ citizens was chosen by the China government to be 1 of 13 cities to trial new energy vehicles in 2009
- 510 Charging stations with over 8000 charging points
- Buses running 60,000km per year which attracts an extra government incentive of 500,000RMB (USD 80k)
- Battery charging is sub-contracted and charged back at RMB 0.6/kWh (USD 10c) which is a lower cost than diesel.
- Less maintenance and more reliable
- Latest policy is to fully electrify the taxi fleet



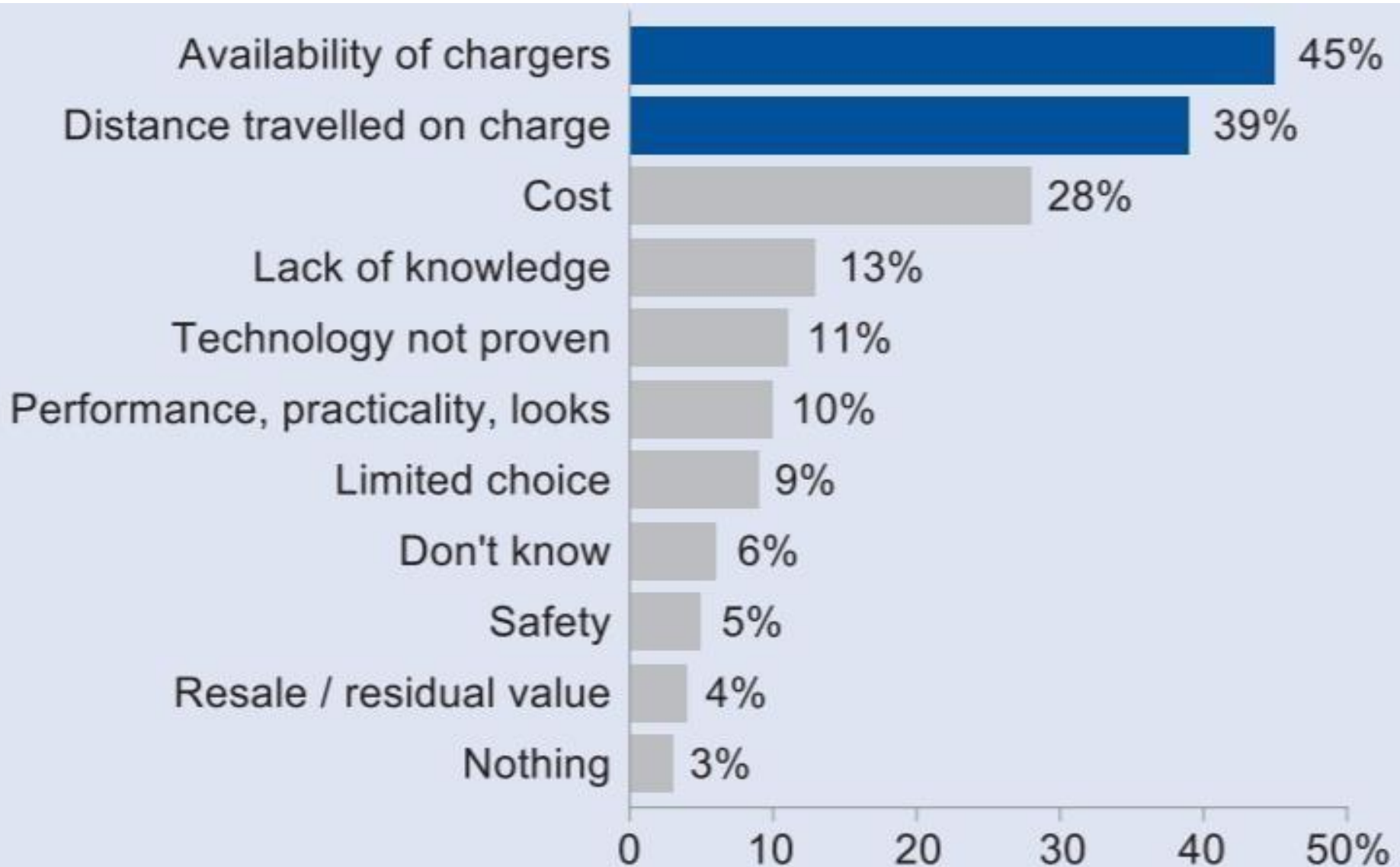
# Cost of Ownership

Figure 1: Total cost of bus ownership comparison with different annual distance



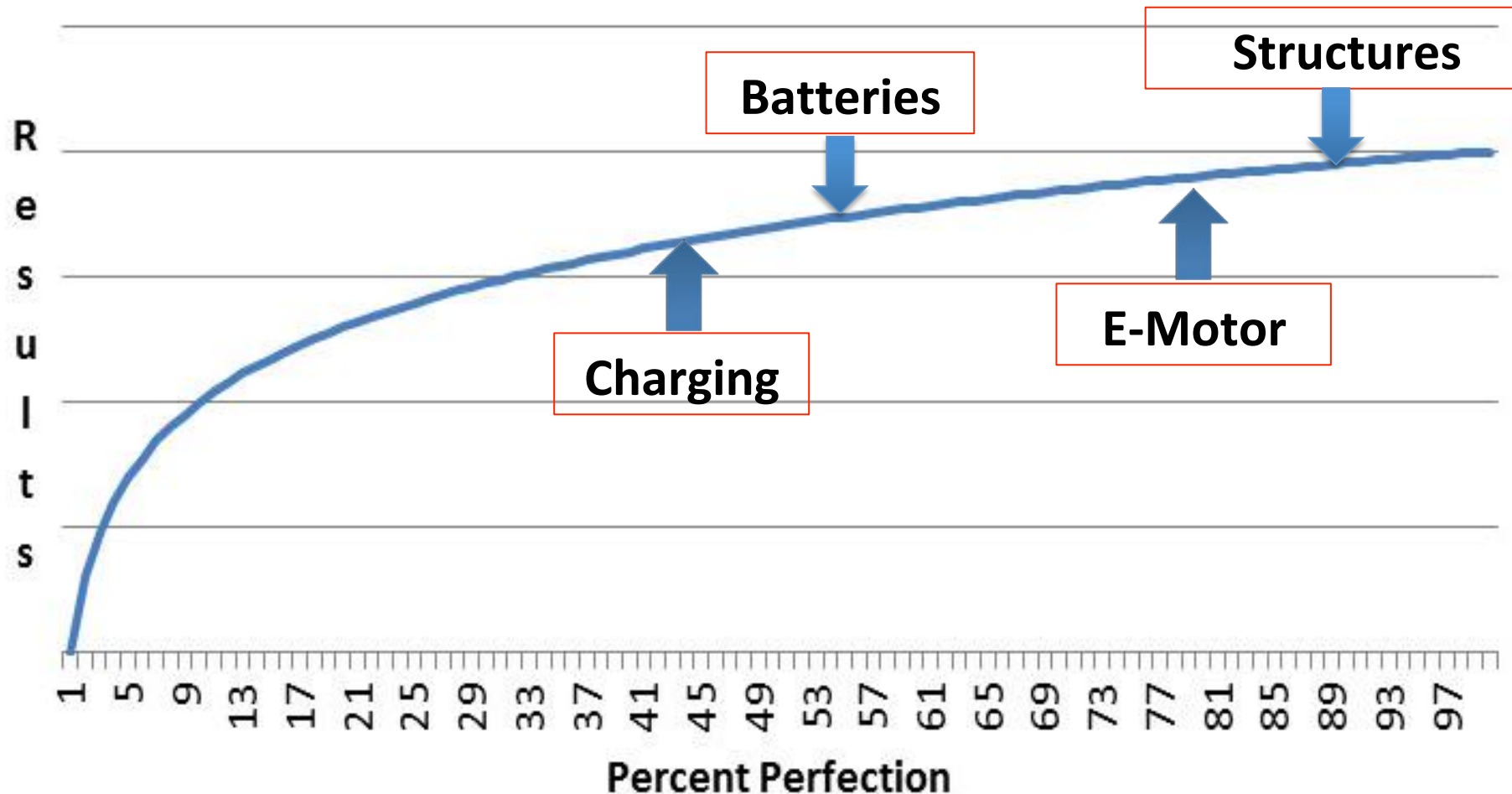
Source: Bloomberg New Energy Finance, AFLEET, Advanced Clean Transit Notes: Diesel price at \$0.66/liter (\$2.5/gallon), electricity price at \$0.10/kWh, annual kilometers traveled – variable. Bus route length will not always correspond with city size.

# Barriers to EV Adoption



# Key Elements of E-Vehicles

## Striving for Perfection



# Charging

## Plug-In Recharge

- Low cost for equipment
- Trailing cables
- One vehicle for several hours
- Typically based around parking facilities
- Any substantial numbers require sub stations



## Opportunity Recharge

- Overhead or Inductive
- Infrastructure is shared so costs are ammortised
- Typically en-route although can be depot based similar to fuel pump arrangement
- Higher Charge rates available up to 10C

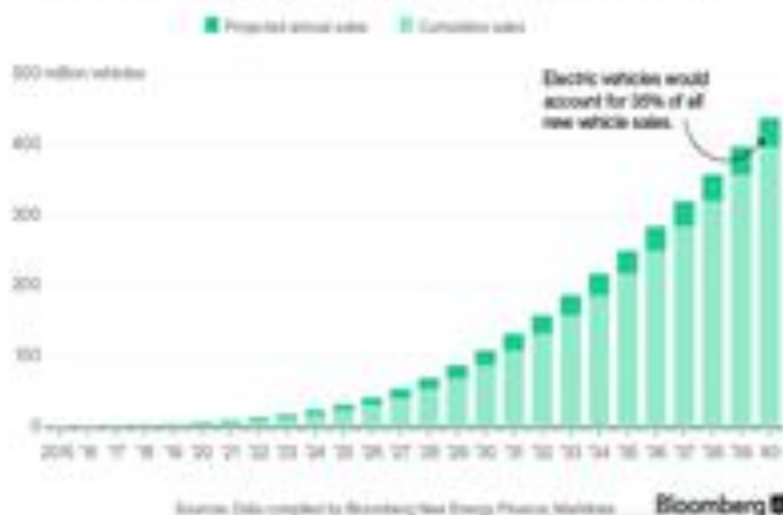
# E-evolution Summary

- China has lead the way in EV introduction initially through subsidy
- Wider scale adoption in demand economies will require incentives rather than subsidy (ref. Norway @32% all car sales)
- E-Vehicles now capable of demonstrating lower costs of ownership
- Battery and charging technologies still advancing
- Key consideration for the wider acceptance is facilitating an intermodal shared infrastructure to meet the demands of increased global urbanisation



## The Rise of Electric Cars

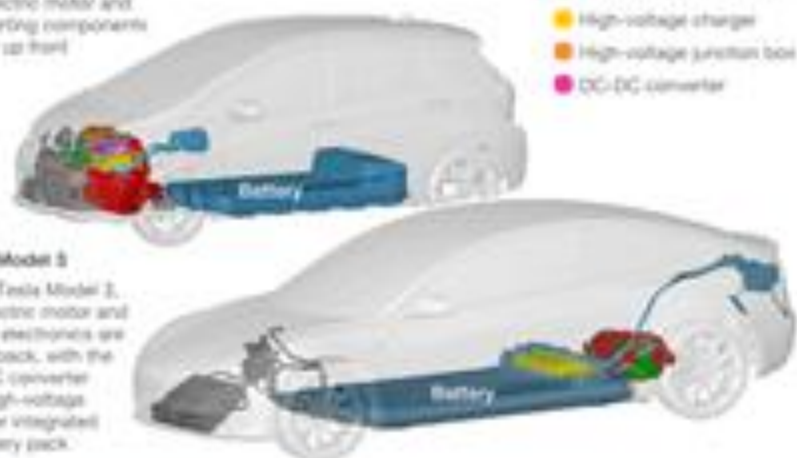
By 2022 electric vehicles will cost the same as their internal-combustion counterparts. That's the point of liftoff for sales.



Electric-vehicle powertrain architectures vary, even among the newest models.

### Opel Ampera-e

In the Opel Ampera-e, the electric motor and supporting components are all up front.



### Tesla Model S

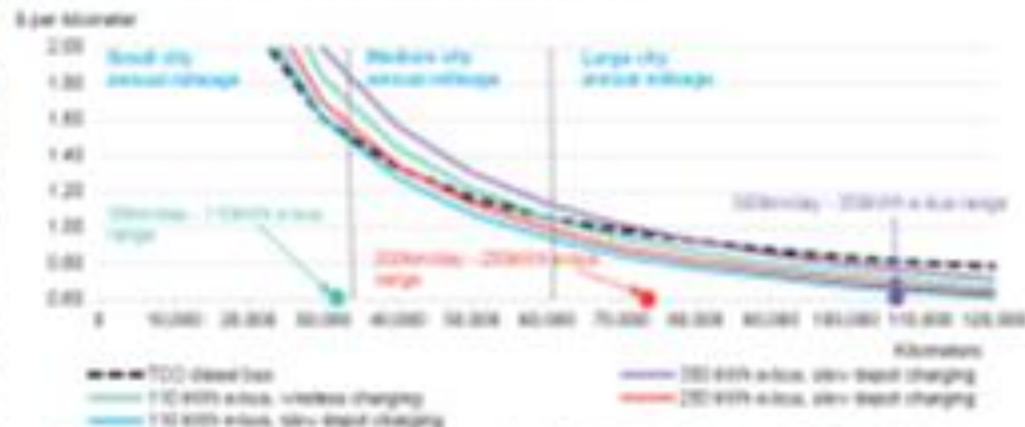
In the Tesla Model S, the electric motor and power electronics are in the back, with the DC-DC converter and high-voltage charger integrated in battery pack.

Source: Global V. McKinsey Quarterly Future Mobility

Global Electric Vehicle Market Looks To Fire On All Cylinders In 2018

# Thank You

Figure 1: Total cost of bus ownership comparison with different annual distance







# Jonathan Beard

Head of Business Advisory, Asia; Head  
Transportation & Logistics, Asia at Arcadis

# Alternative Fuels – The Road to Greener Driving

Dr Jonathan Beard  
Hong Kong, 31<sup>st</sup> Oct 2018

IMPROVING QUALITY OF LIFE  
[arcadis.com](http://arcadis.com)



# Alternative Fuels – The Road to Greener Driving... ...Yes, but How do we Also Achieve Smarter, Greener *Mobility?*

**Life without Electric Vehicles (EVs)**



**Life with Electric Vehicles (EVs)**

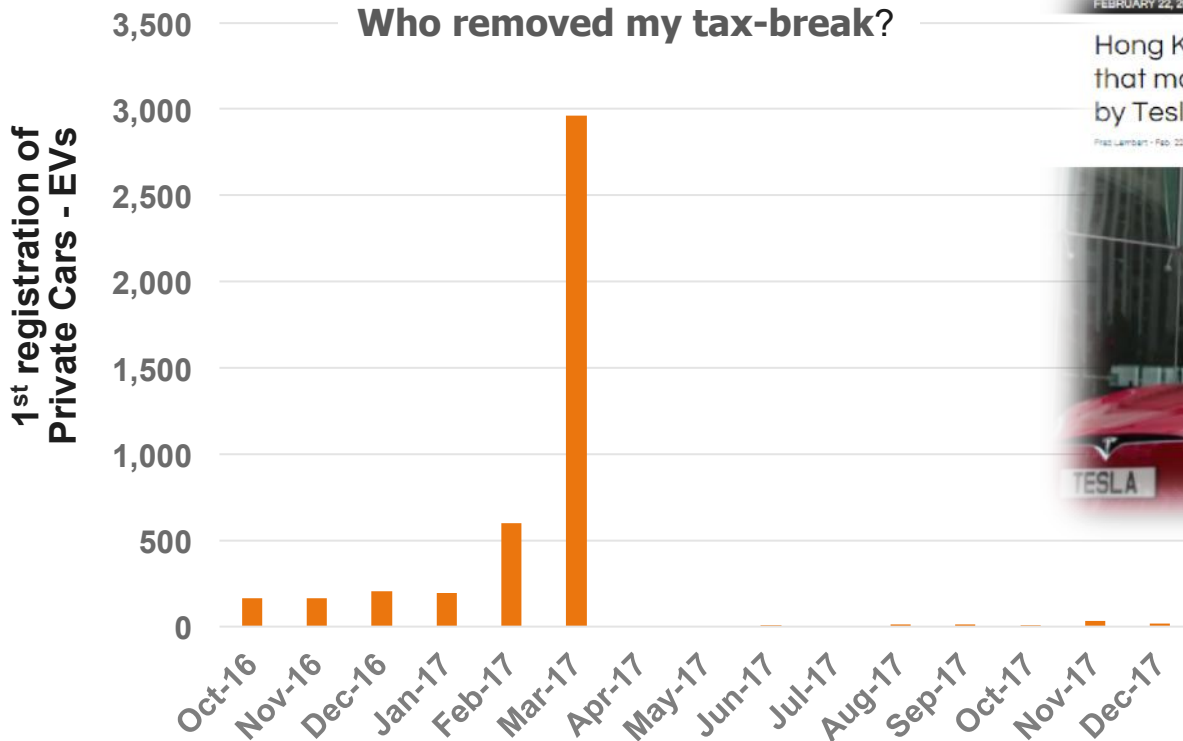


*Some thoughts on Urban Mobility in a World of Alternative Fuels & Connected Autonomous Vehicles (CAVs)*

# Complex Systems - Strategies Need to be Holistic and Integrated

## Lessons from Hong Kong’s Policy Support of Electrical Vehicles (EVs) – PART I

- HKSAR Government offered 100% waiver on first registration tax for EVs.
- Tax saving = HKD435,000 (~USD56,000) for basic Tesla Model S or nearly 100% of the price; therefore considerably cheaper than, for example Mercedes S-Class
- 2017 Budget, the waiver was reduced to HKD97,500 (~USD12,500). Introducing a subsidised ‘one-for-one’ replacement scheme capped at HKD250,000 (~USD32,200)



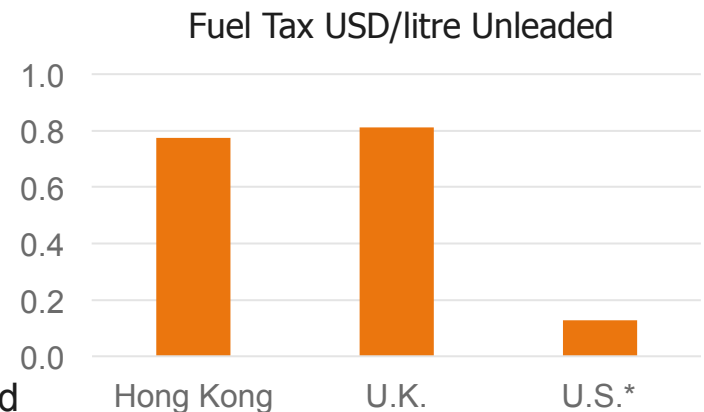
Source: Arcadis; HKSAR Transport Department

# Complex Systems - Strategies Need to be Holistic and Integrated

## Lessons from Hong Kong's Policy Support of Electrical Vehicles (EVs) – PART II

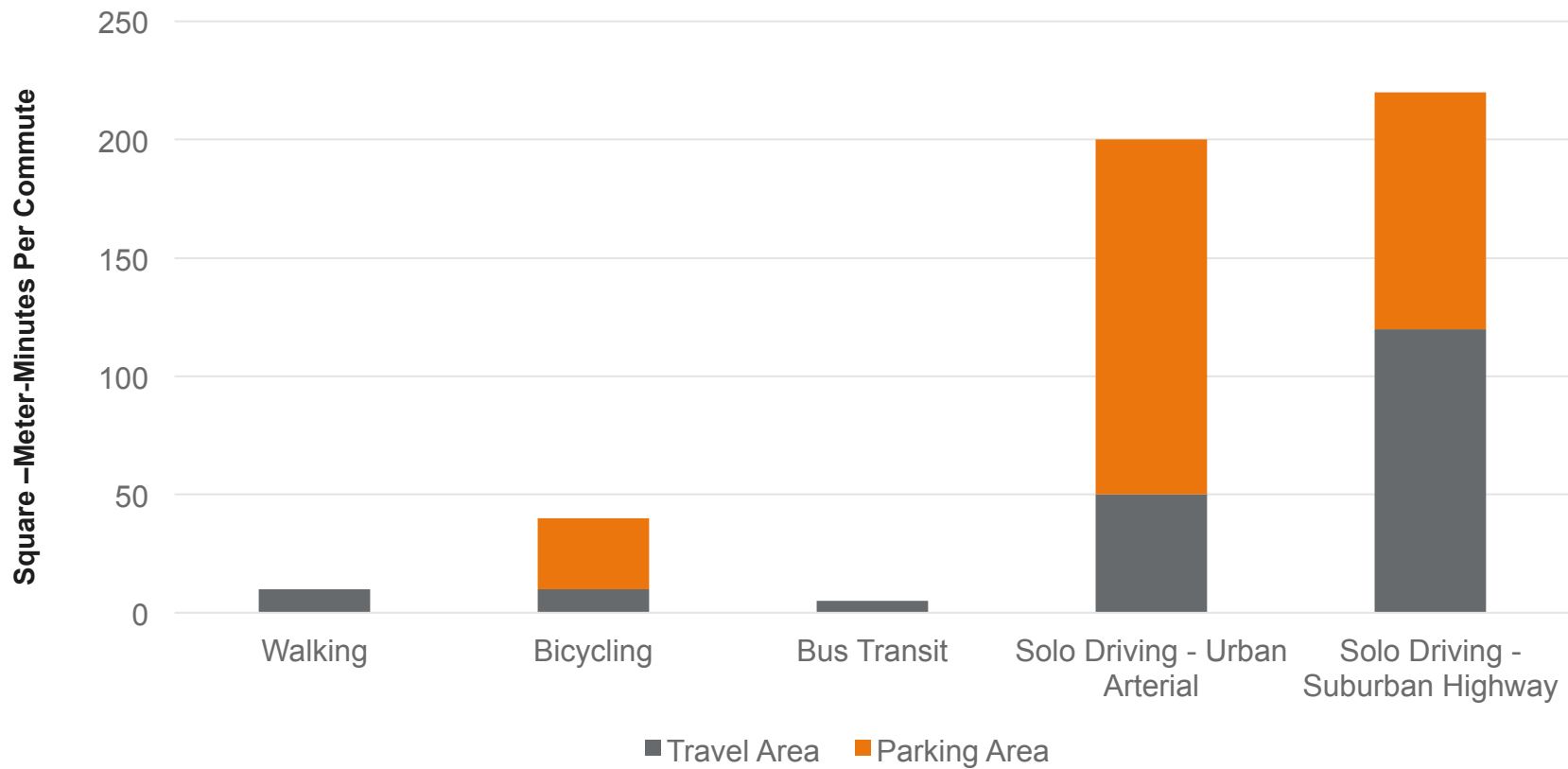
What was the rationale and where was the integrated strategy for promoting smart urban mobility?

- Reduce emissions and encourage smart mobility?
- However, no pro-rata waiver for hybrids
- And little of Hong Kong's electricity used for EV charging comes from **renewable sources**
- **Does not address main roadside pollution source:** commercial diesel vehicles (buses and trucks) contribute 80-90% of roadside RSP and NOx. Commercial fleet, including buses, still includes old and dirty pre EURO IV standard vehicles
- Hong Kong scores highly on measures of urban mobility - best performing city for Arcadis [Sustainable Cities Mobility Index, 2017](#). An efficient, cheap, safe, reliable, comprehensive integrate public transport system has underpinned this performance.
- In addition to “carrot” of excellent public transport, government has used a “stick” to regulate private car use:
  - High first registration tax
  - High fuel tax
- With the tax waiver and EV charging at work (&/or relatively low electricity tariff), both these “sticks” were curtailed...with cheaper EV models coming, private car ownership & usage could have soared



# Even with CAVs powered by green electricity, is the “private car” the smartest use of scarce space?

Road and Parking Space Required By Travel Mode



Source: Eric Bruun and Vukan Vuchic; 'The Time-Area Concept: Development, Meaning and Applications'



Source: [www.cyclingpromotion.org](http://www.cyclingpromotion.org)

# Non-motorised Mobility

Improved urban environment, plus health & well-being upsides

[FITNESS / fitness](#) / [Walking / Tage / Walking](#)

## The Amazing Health Benefits Of Walking Outside Every Day

From stronger bones to a trimmer physique, there are countless reasons to start walking.

by [The Editors of Prevention](#) / [author/the-editors-of-prevention](#) | October 25, 2017



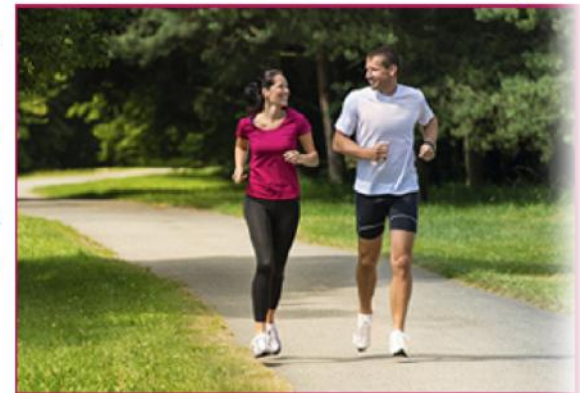
### Walk, Don't Run, Your Way to a Healthy Heart

Share 0 Like 239 Tweet G+ Share 1.5K Updated: Dec 14, 2017

OK, so you're not much into running? Or maybe you've had an injury and can't run. Then just walk — every step you take is part of your journey to good heart health.

In fact, walking briskly can lower your risk of **high blood pressure**, **high cholesterol** and **diabetes** as much as running, according to a new study conducted at Lawrence Berkeley National Laboratory, Life Science Division in Berkley, Calif. All three conditions are risk factors for **heart disease and stroke** — and you can do something about them.

Researchers analyzed 33,060 runners in the National Runners' Health Study and 15,045 walkers in the National Walkers' Health Study. They found that the same energy used for moderate-intensity walking and vigorous-intensity running resulted in similar reductions in risk for high blood pressure, high cholesterol, diabetes, and possibly **coronary heart disease** over the study's six years. The more people walked or ran each week, the more their health benefits increased.



### New Study: Daily Walk Can Add 7 Years to Your Life

#### Story at-a-glance

- ▶ Regular daily walking has been found to trigger an anti-aging process and help repair
- ▶ Those who engaged in daily moderate exercise, such as a brisk walk, experienced anti-aging benefits that



## Thank you – Any Questions?



### **DR JONATHAN BEARD**

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Head of Business Advisory, Asia**

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**CITIZENS  
IN MOTION**

 **ARCADIS**

.....\_CONNECTED AND AUTONOMOUS VEHICLES

**REPORT OUT NOW**

<https://bit.ly/2OSgk4f>



## Panel discussion:

Thomas Wu

Paul Bromley

Alexander Mastrovito

Jonathan Beard

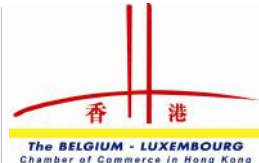


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