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Global & Hong Kong Clean Energy Challenges?

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Imperial College Grantham Stakeholder Committee

University College London China Advisory Board

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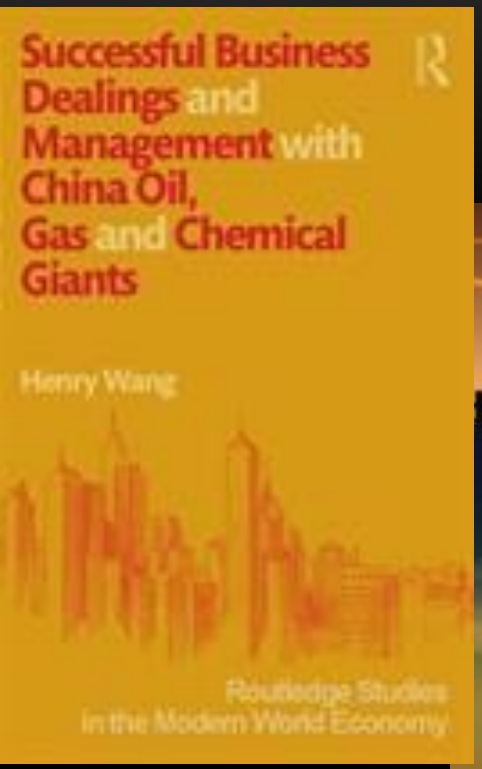
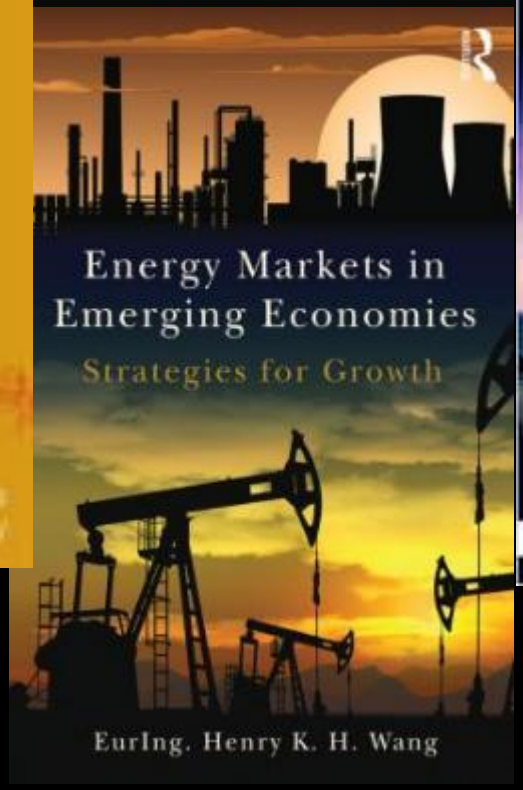
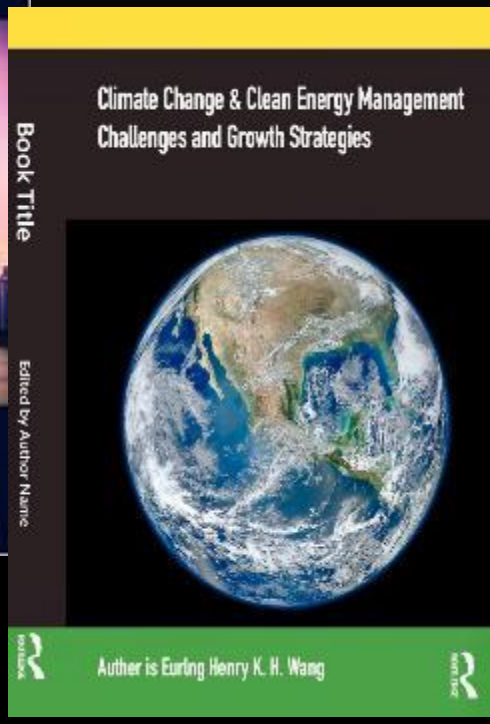
International Advisor, Author & Speaker







- London University SOAS SCI Advisory Board
- Imperial College Grantham Institute Stakeholder Committee
- University College London China Advisory Board
- New books on Climate Change & Renewables in 2019/2020

Global & HK Clean Energy Challenges – Agenda

- Global Climate, Energy & Carbon Mega Trends?
- Fossil Renewable Transformation
- Carbon Solution CCS/CCU?
- HK Climate, Energy Challenges?
- HK Power Carbon Challenges?
- China Climate Energy Actions?
- International Co-operations
- Corporate Improvements?
- Paris Agreement, New Plans

Global Climate, Energy & Decarbonisation Mega-Trends

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Ref:sky, B2

Climate, Energy & Decarbonisation Megatrends

- Climate Change key global issue requiring urgent joint actions
- Energy Demands rising but tempered by energy efficiency
- Energy Transform with fossils declining & renewables rising
- Coal declines & Clean Coal in Emerging Economies & Steel
- Decarbonisation Renewables innovations & cost reductions

Key Cliimate & Energy Pathways: Key Licenses to Operate?

1. Government Policy: Energy, Carbon, CETS, TCFD
2. Renewables DDD (Digitised, Decarbonised, Decentralised)
3. Improving Energy Efficiency & Savings
4. Electrification rising: rates need to triple in 20-30 years.
5. Carbon Solutions: CCS, CCU & CCSU options
6. Low carbon industrial transformations & innovations?
8. Green Low Carbon Cities, Transport & Hydrogen rising?

Global Energy Transformations - Renewables Growths

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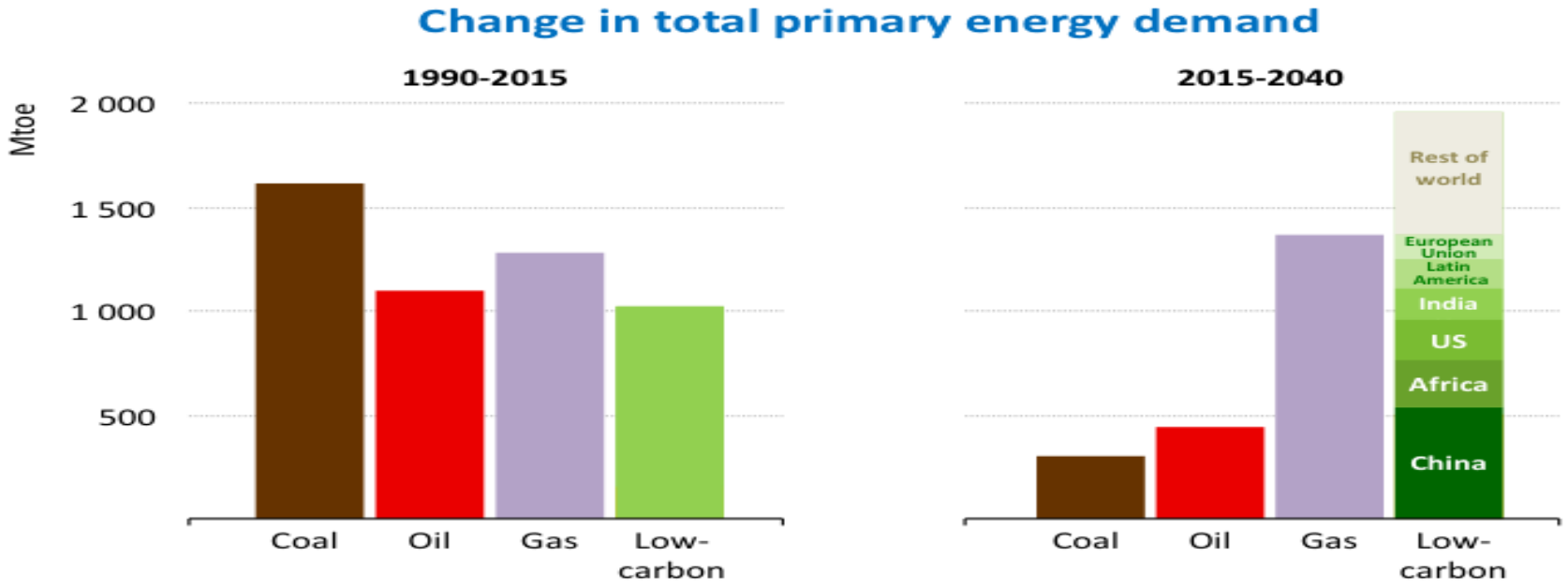
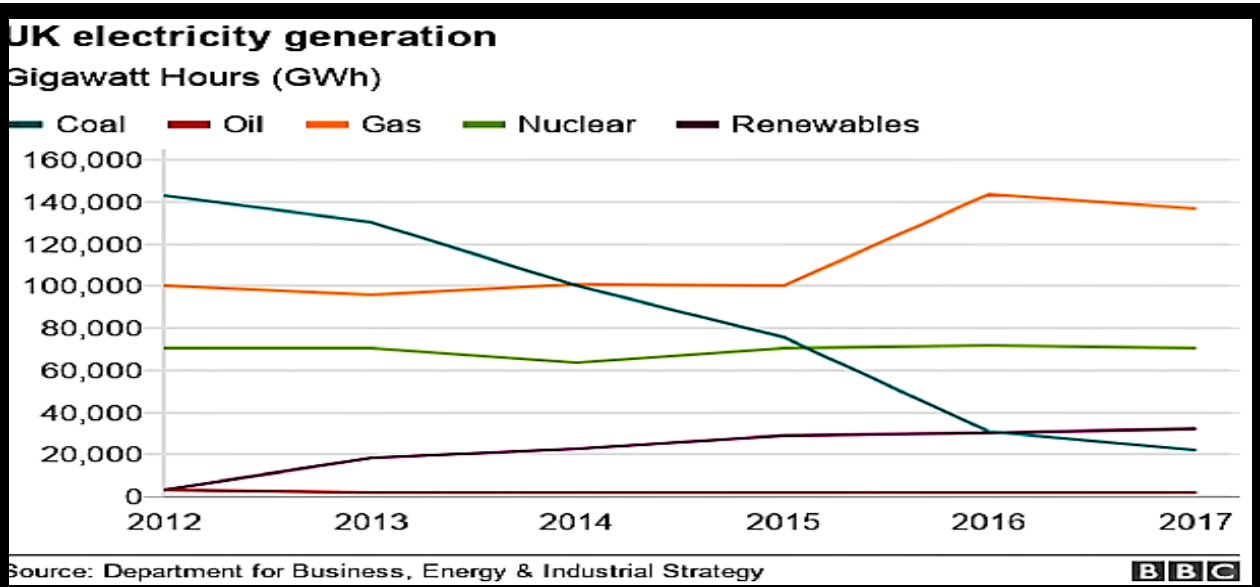
Ref: IEA, B2



Low-carbon fuels & technologies, mostly renewables, supply nearly half of the increase in energy demand to 2040

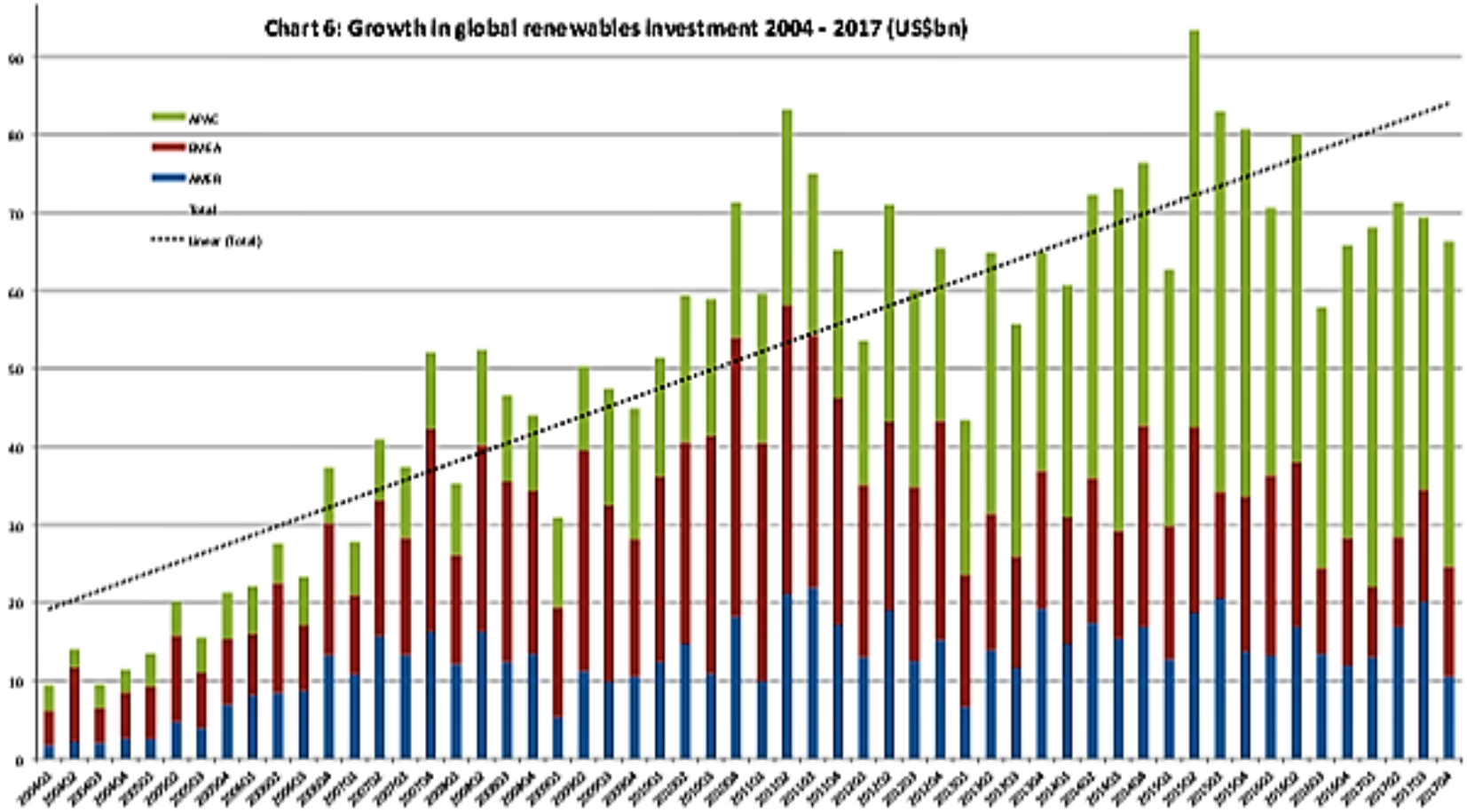


- **Fossil fuels declining**
- **Renewables growing**
- **Solar, Wind rising**
- **Emission reductions**
- **Green Finance ($1T+)**
- **Hybrid & PPP growths**

Global Renewables Growths & Green Investments Rising

Ref: GTI, B2

CHART 4.
Growth in global renewables investment 2004-2017 (US$bn)
Source: Bloomberg New Energy Finance



Renewables investments of $1+Trillion since 2013 & $200+B/year investments

Solar PV Renewables Growths with Strong Asia Growths

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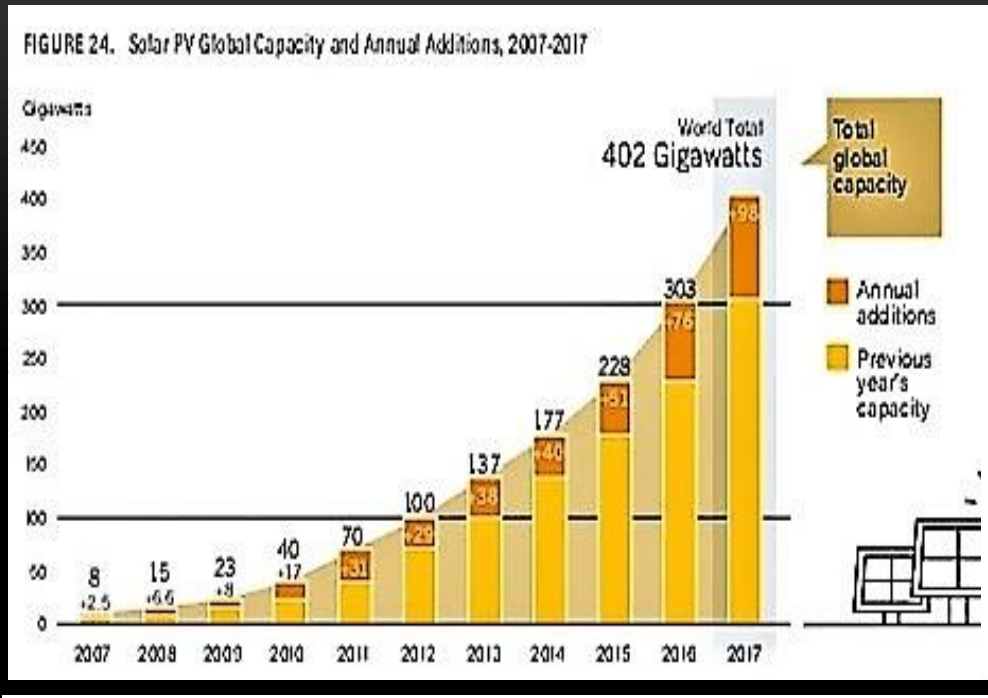
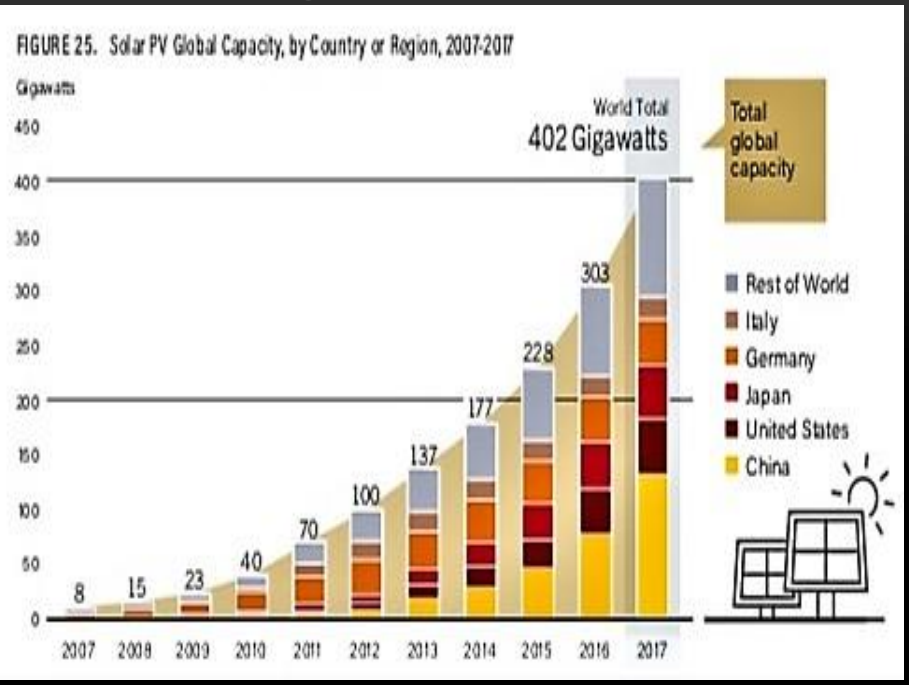
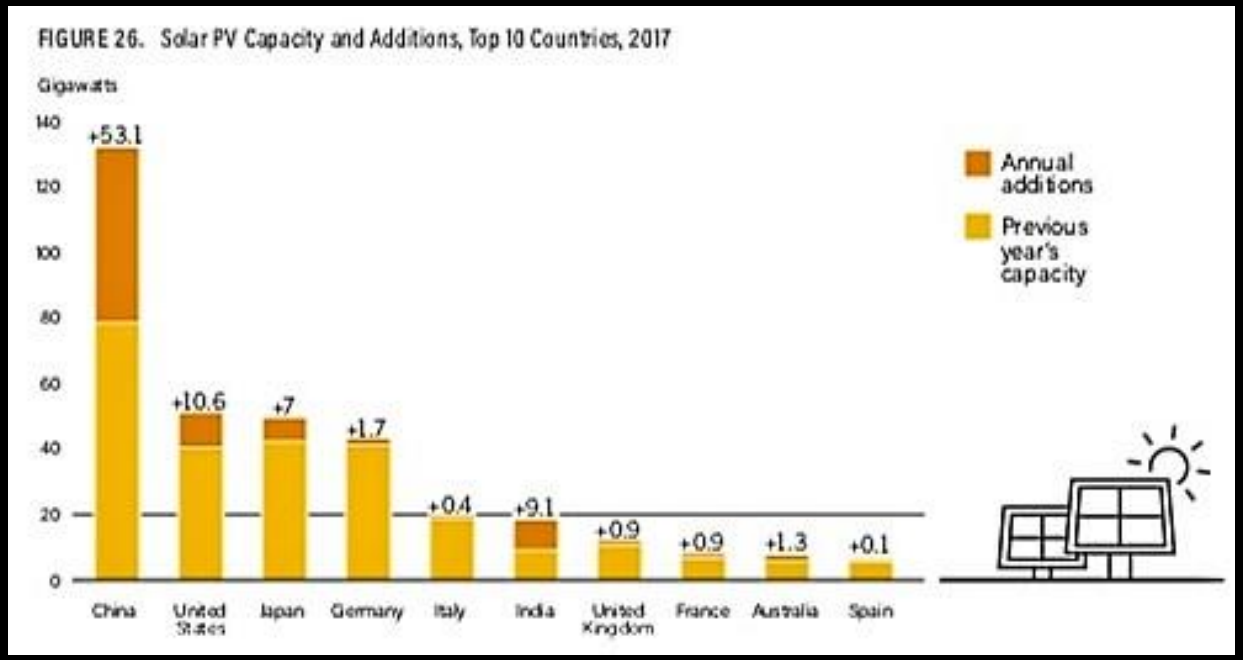
Ref: REN, B2



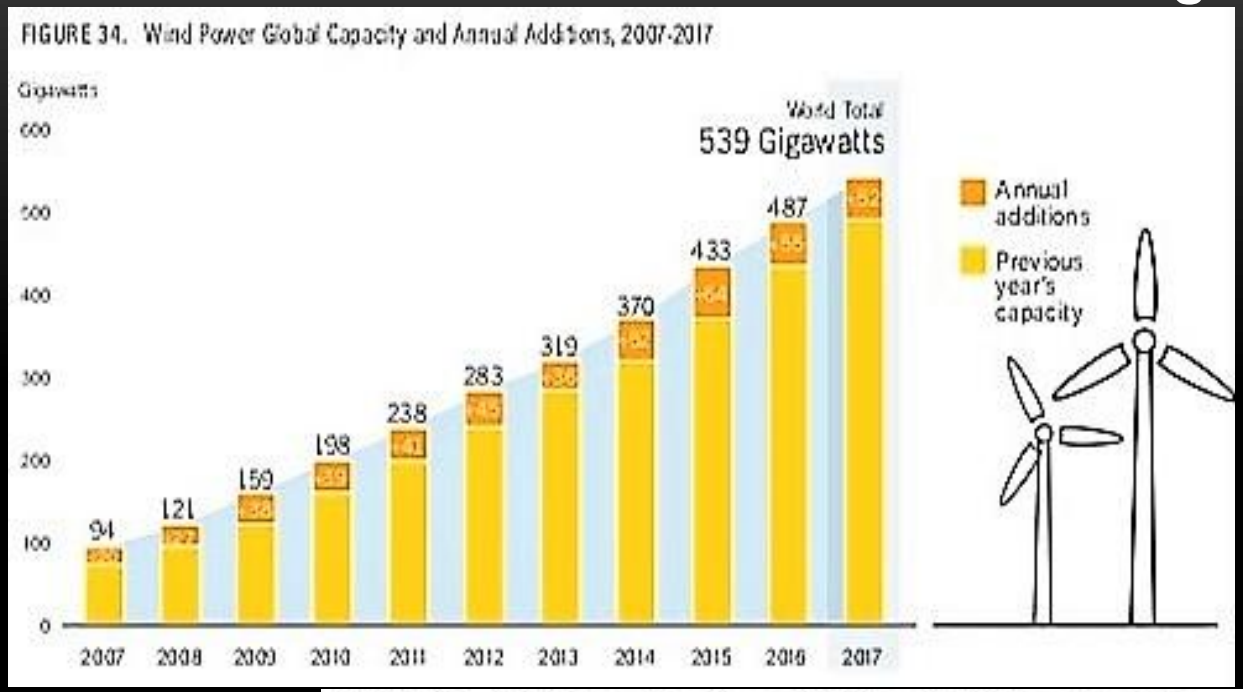




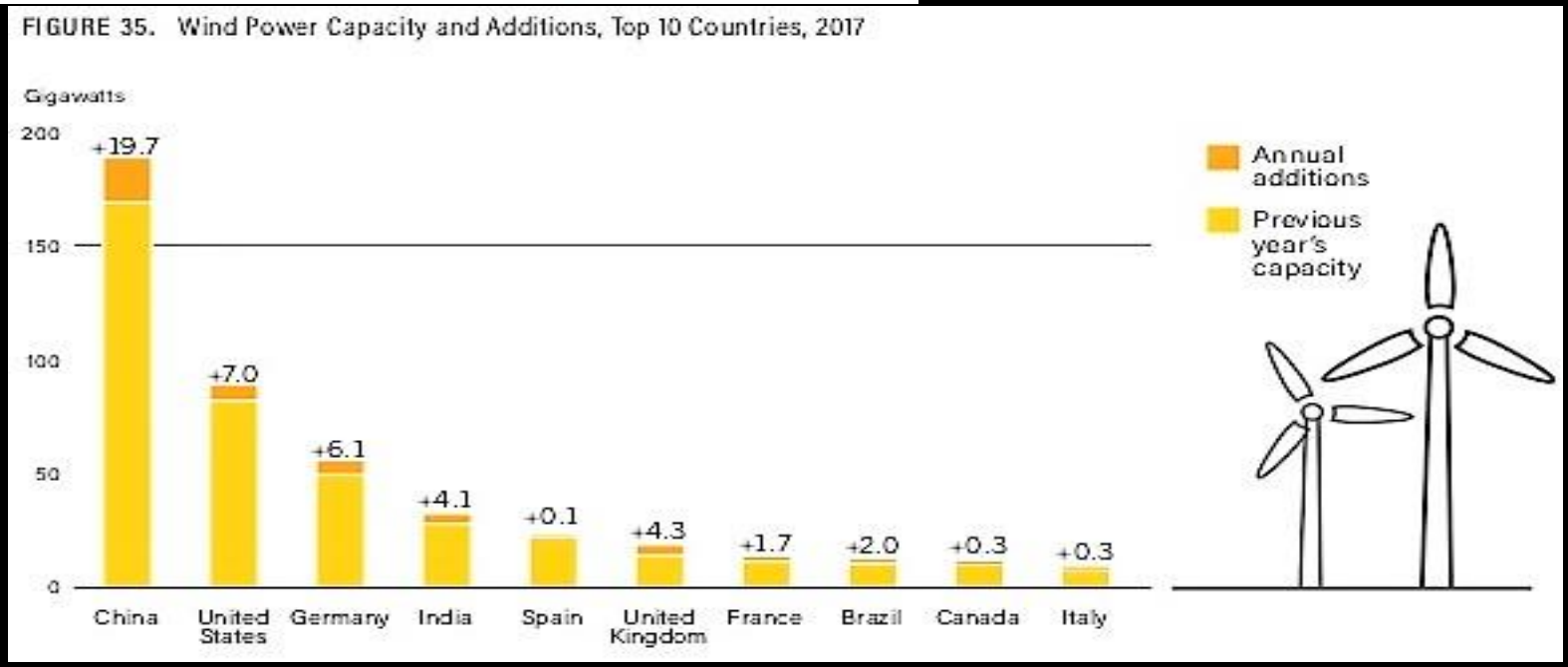
- Solar growth (400+GW)
- China lead (130+GW)
- Japan 3rd after USA
- Cost reduction (-73%)
- Distributed power
- Hybrid energies
- Social Improvements

Wind Renewables Growths with Strong Asia Growths

Ref: REN, B2

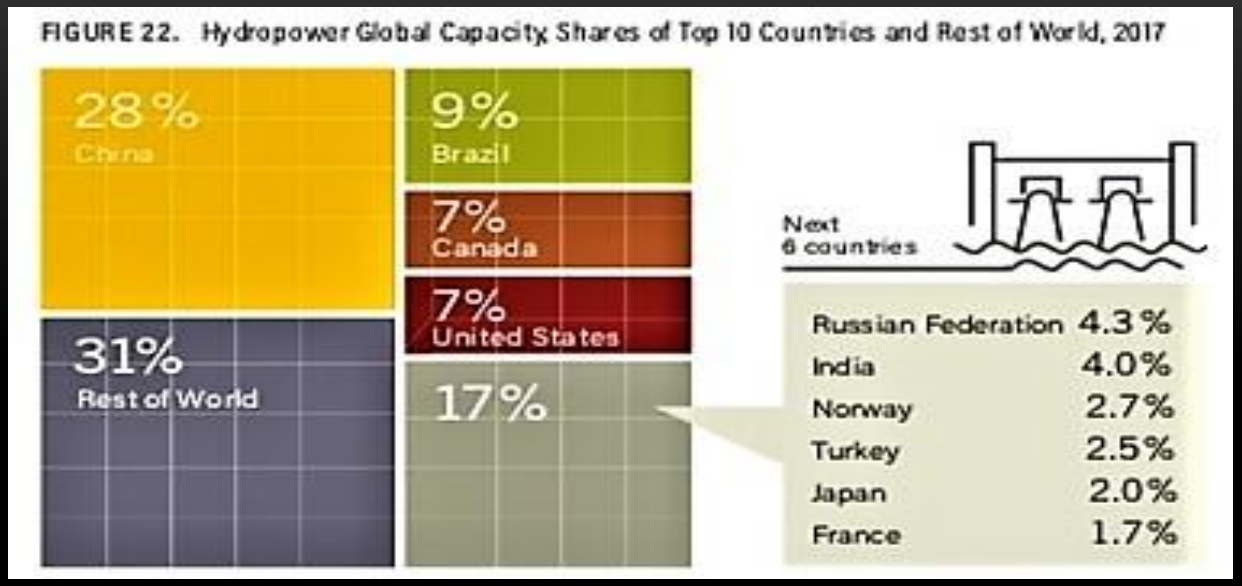


- Wind growth (540+GW)
- China lead (180+GW)
- India 4rd after US & DL
- Cost reductions (-23%)
- Onshore wind vs fossil
- Distributed power
- Hybrid Energies

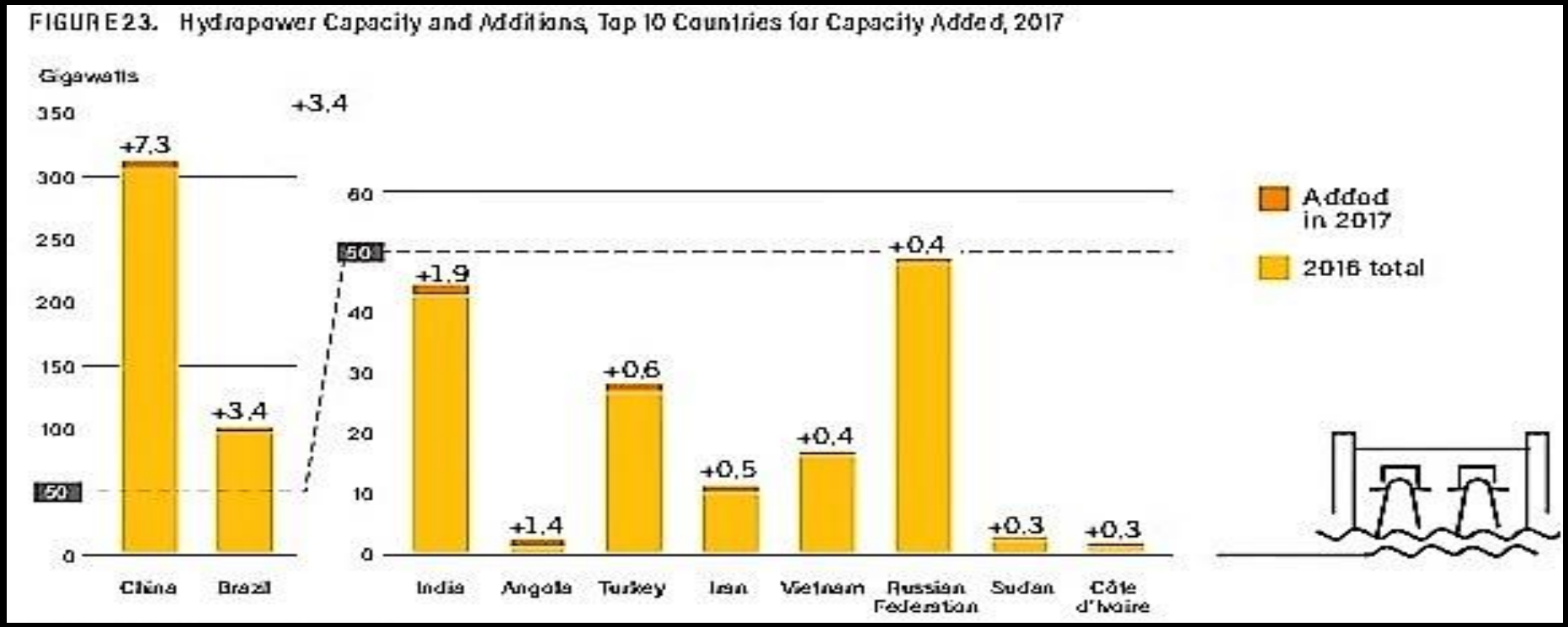


Hydro Renewable Power Growths with Asia Growths

Ref: REN, B2



- Hydro supply 16+% of global power
- China lead (28%)
- India 3rd after Brazil
- Japan, Vietnam rising
- Emission reductions



Renewables Technology Investments & Cost Reductions

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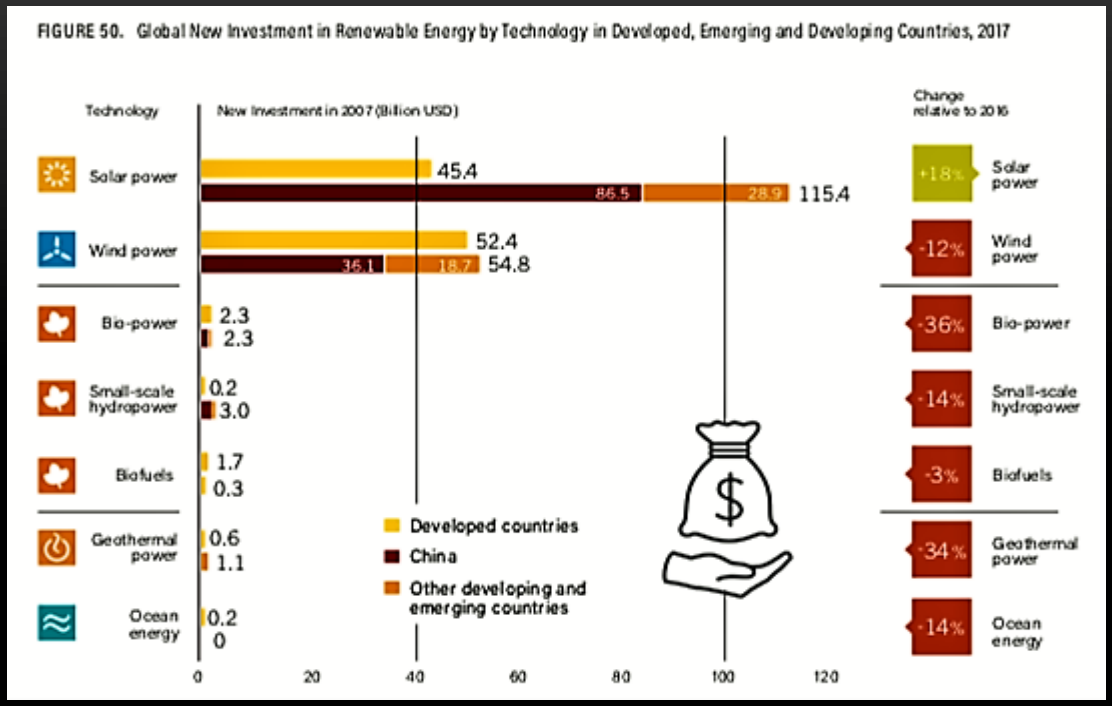
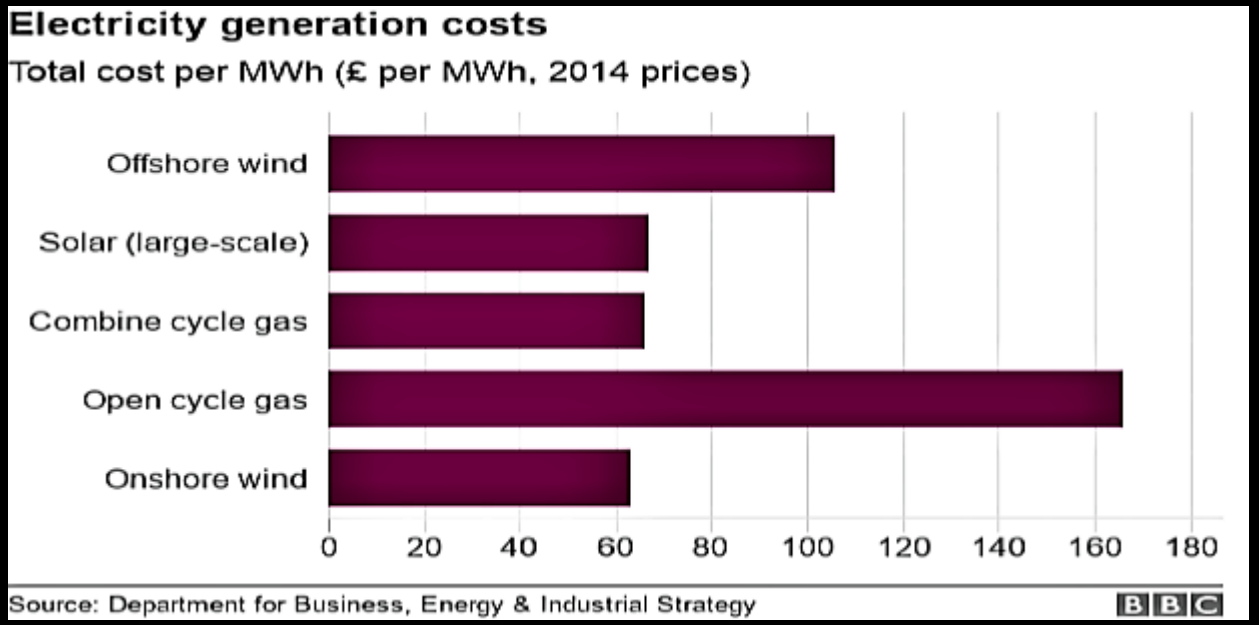
Ref: REN, B2



Globally, onshore wind schemes are now costing around $0.04-0.06 per kilowatt hour (kWh) & is competitive vs fossil.
The cost of solar PV is down to $0.10 per KwH.
In comparison, the cost of electricity generation based on fossil fuels typically falls in a range of $0.05 to $0.17 per KwH
IRENA estimates that offshore wind and concentrating solar power should cost in a range of $0.06-$0.10 per KwH by 2020-22 which are competitive with fossil fuels.

IRENA said the cost of generating power from onshore wind has fallen by around 23% since 2010 while the cost of solar photovoltaic (PV) electricity has fallen by 73% in that time. With further price falls expected for these and other green energy options, IRENA forecasted that key renewable energy technologies should be competitive on price with fossil fuels by 2020.



CCS Carbon Capture & Storage Solutions & Innovate?

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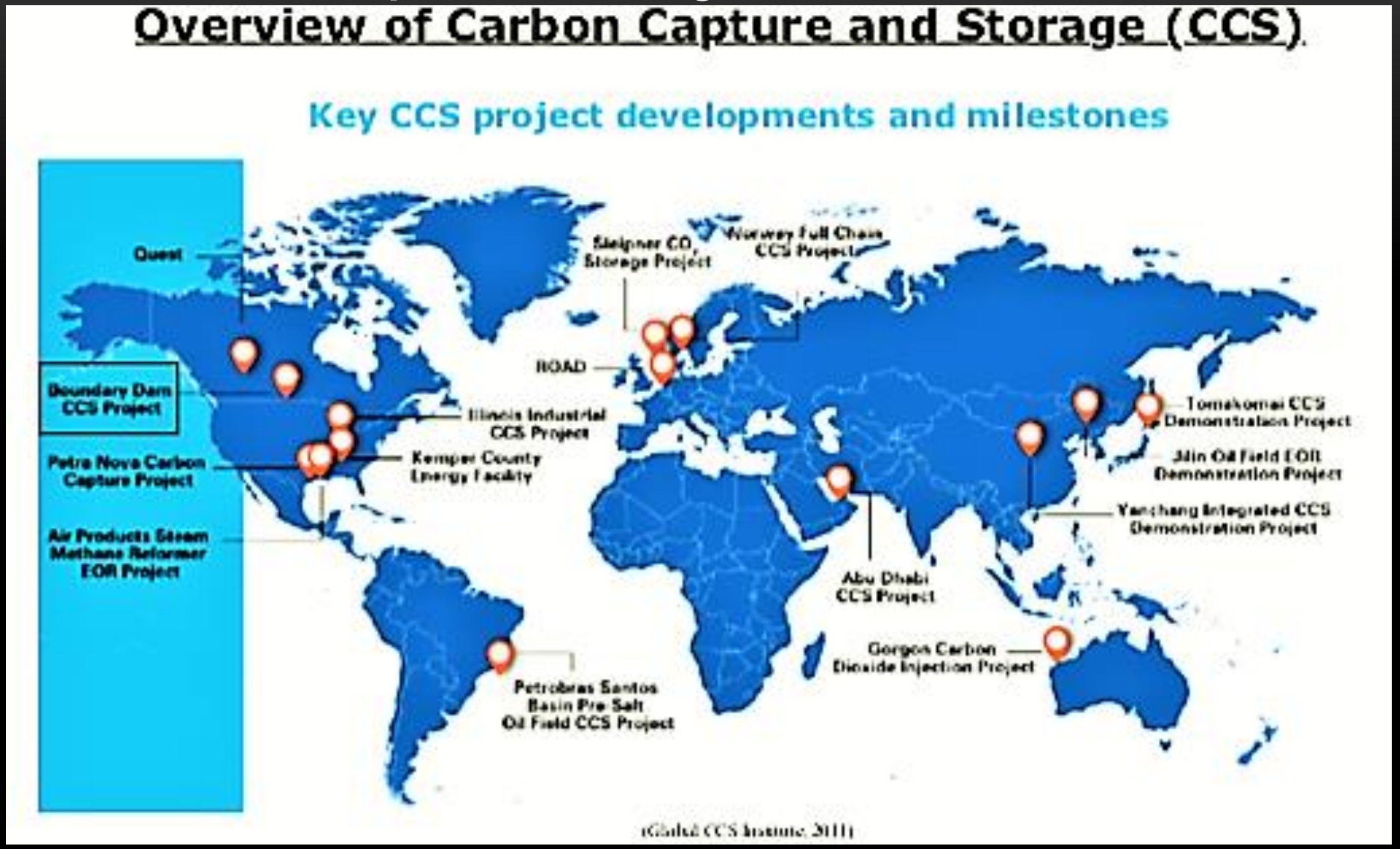
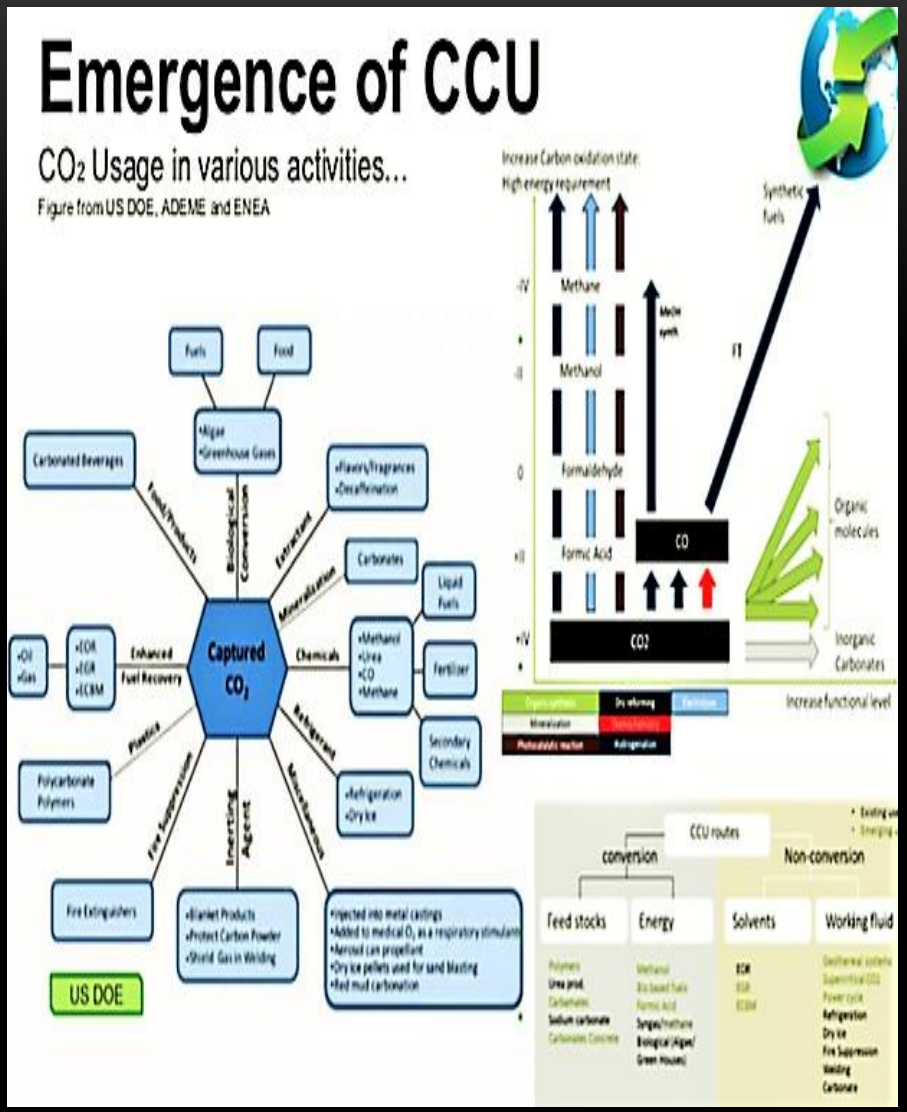
Ref: REN, B2

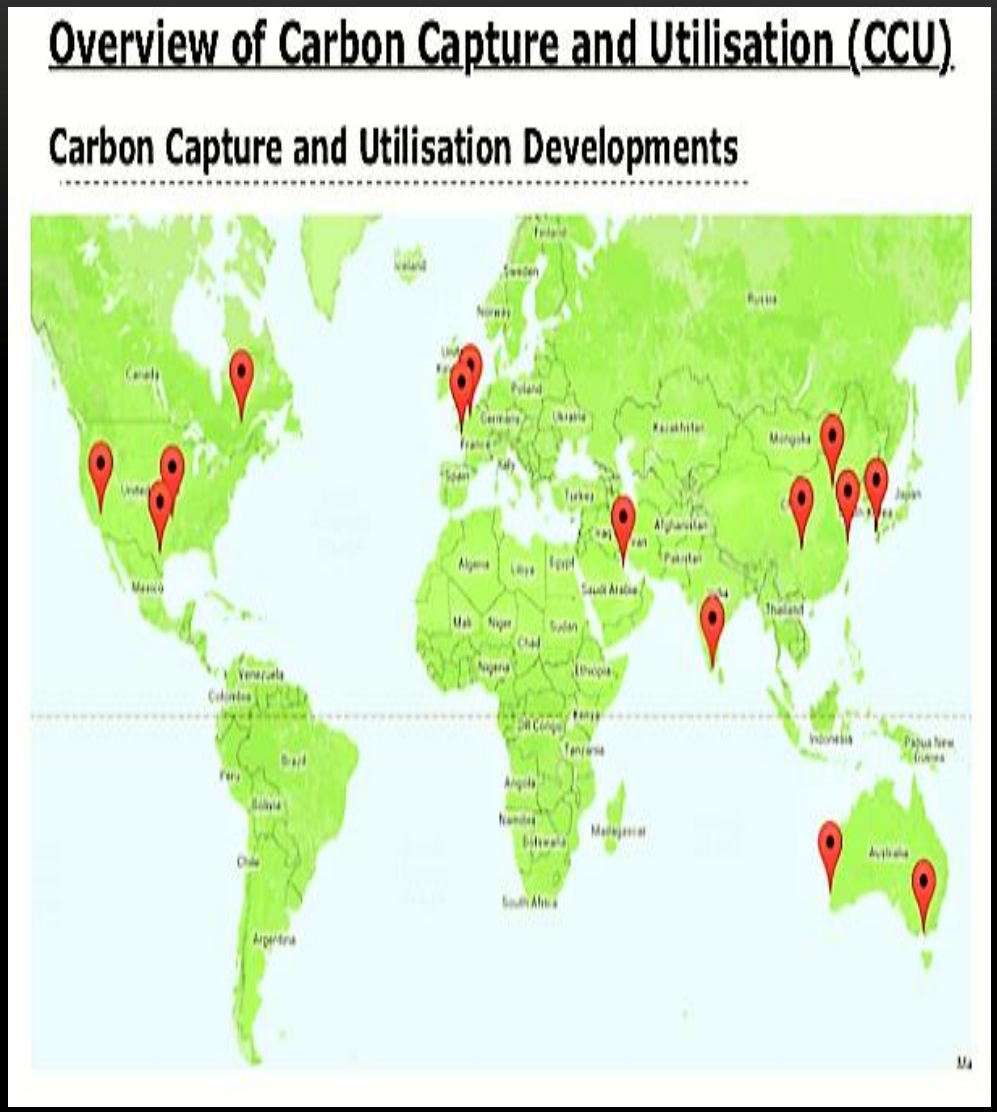


- **Boulder Dam plant 1 post-combustion CCS running 4 years sequestering 1 million tonnes CO2/year at 97% capture. Boulder Dam plant 2 expected US$45/t & close to viability at CAD 50/tonne.**
- **China Pilots & evaluate potential CCS geological sites, eg HK & Guangdong S China Sea?**

Carbon Capture & Utilisation CCU Solutions & Innovate?

GI
Ref: REN, B2





- **New Carbon Capture & Utilisation CCU** Solutions developing globally.
- **China innovations & research + new start-ups + trial?**
- **New CCU/CCS solutions in new Carbon Neutral Plans 2050/70**?

Low Carbon Economy Create 10M+ New Jobs Globally

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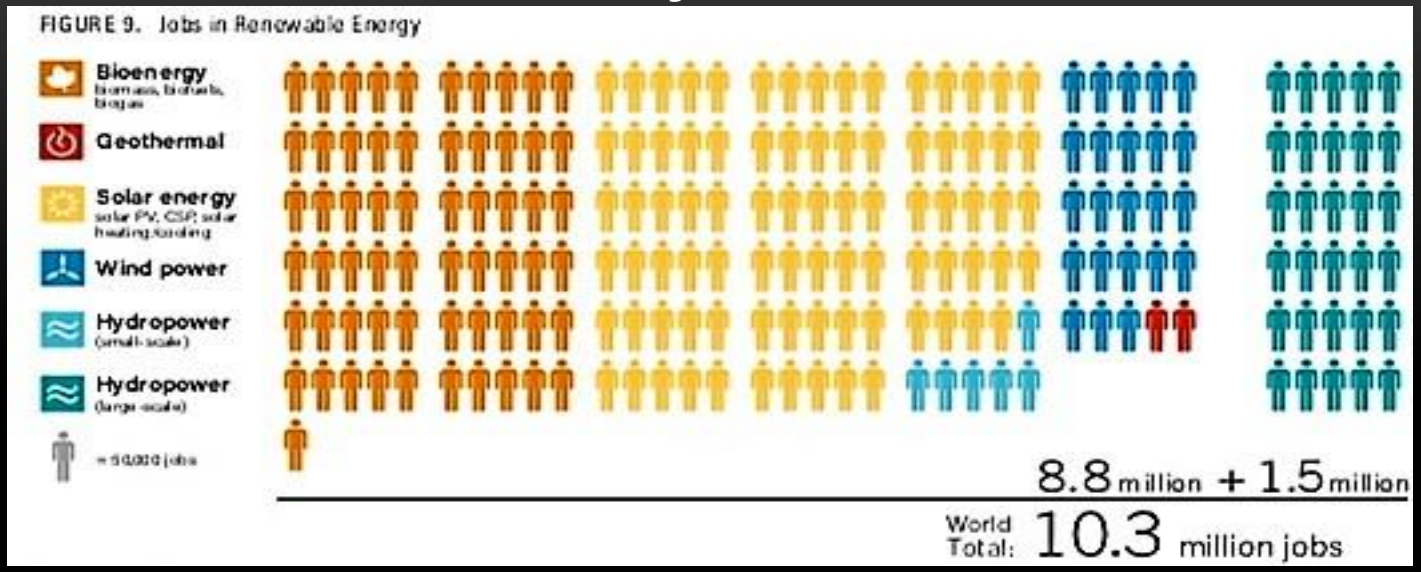
Ref: REN, B2



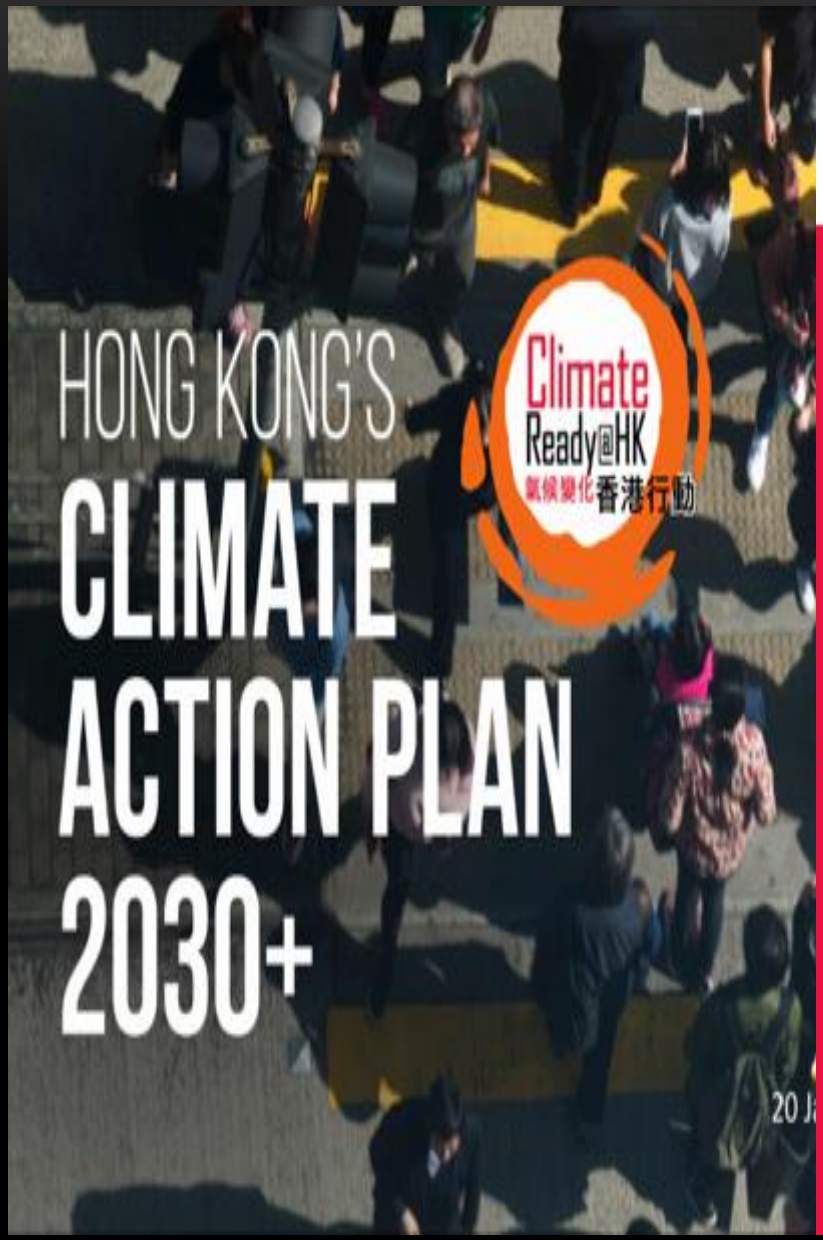
IRENA estimated that since 2013 more than $1 trillion has been invested in renewable energy globally & the industry now provides nearly 10 million jobs globally.

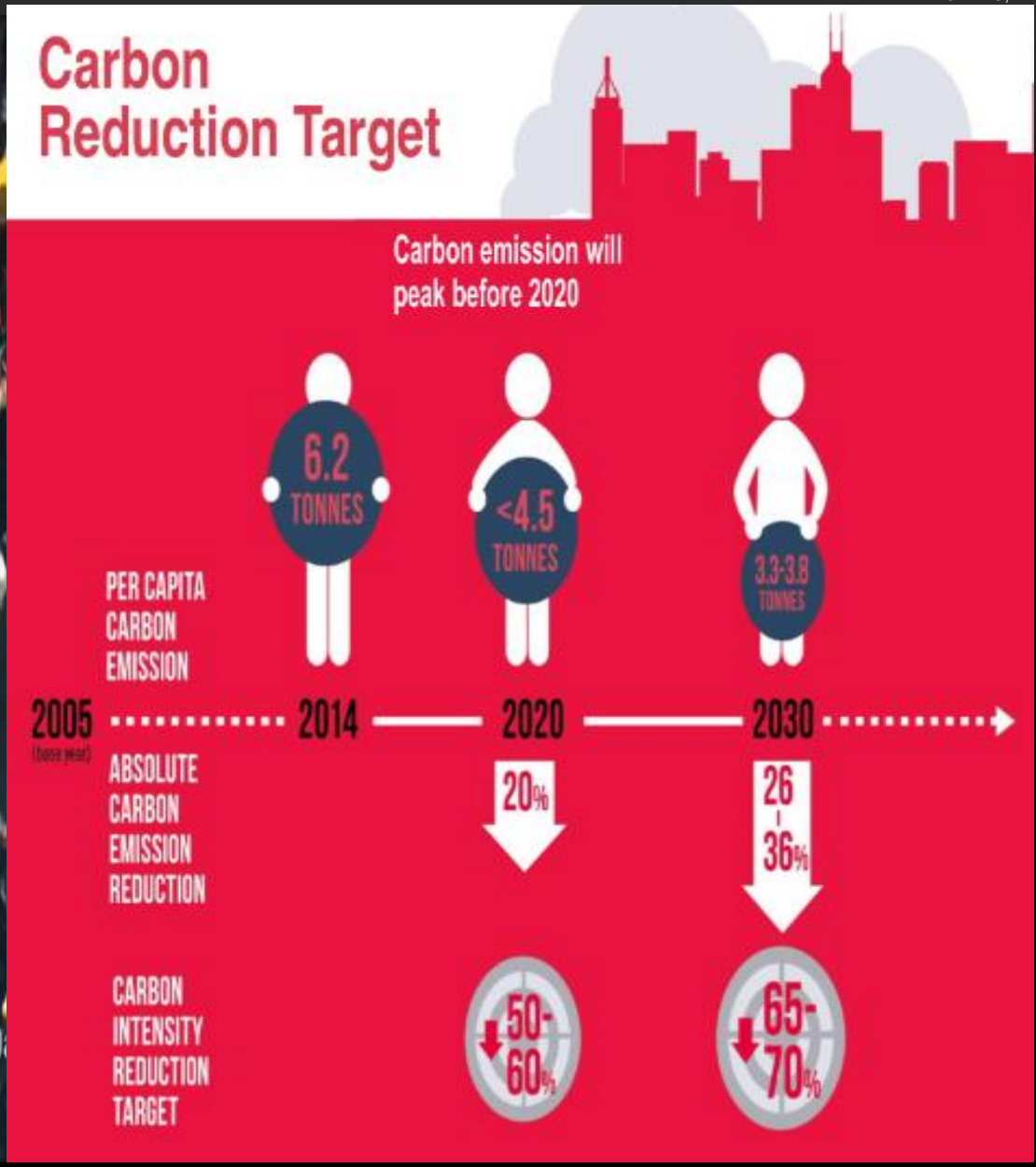
TABLE 1. Estimated Direct and Indirect Jobs in Renewable Energy, by Country and Technology

	World	China	Brazil	United States	India	Japan	Germany	Total EU[a]
	Thousand jobs							
Solar PV	3,365	2,216	10	233	164	272	36	100
Liquid biofuels	1,931	51	795[a]	299[b]	35	3	24	200
Wind power	1,148	510	34	106	61	5	160	344
Solar thermal heating/cooling	807	670	42	13	17	0.7	8.9	34
Solid biomass[a,b]	780	180		80[c]	58		41	389
Biogas	344	145		7	85		41	71
Hydropower (small-scale)[c]	290	95	12	9.3	12		7.3[d]	74[d]
Geothermal energy[a,d]	93	1.5		35		2	6.5	25
CSP	34	11		5.2			0.6	6
Total	8,829[e]	3,880	893	786	432	283	332	1,268
Hydropower (large-scale)[e]	1,514	312	184	26	289	20	7.3[d]	74[d]
Total (including large-scale hydropower)	10,343	4,192	1,076	812	721	303	332[d]	1,268

Hong Kong New Climate Action Plan 2030

Ref: HKG, B2





HK Climate Change costs H$22B+. Carbon reduction target of 70% by 2030

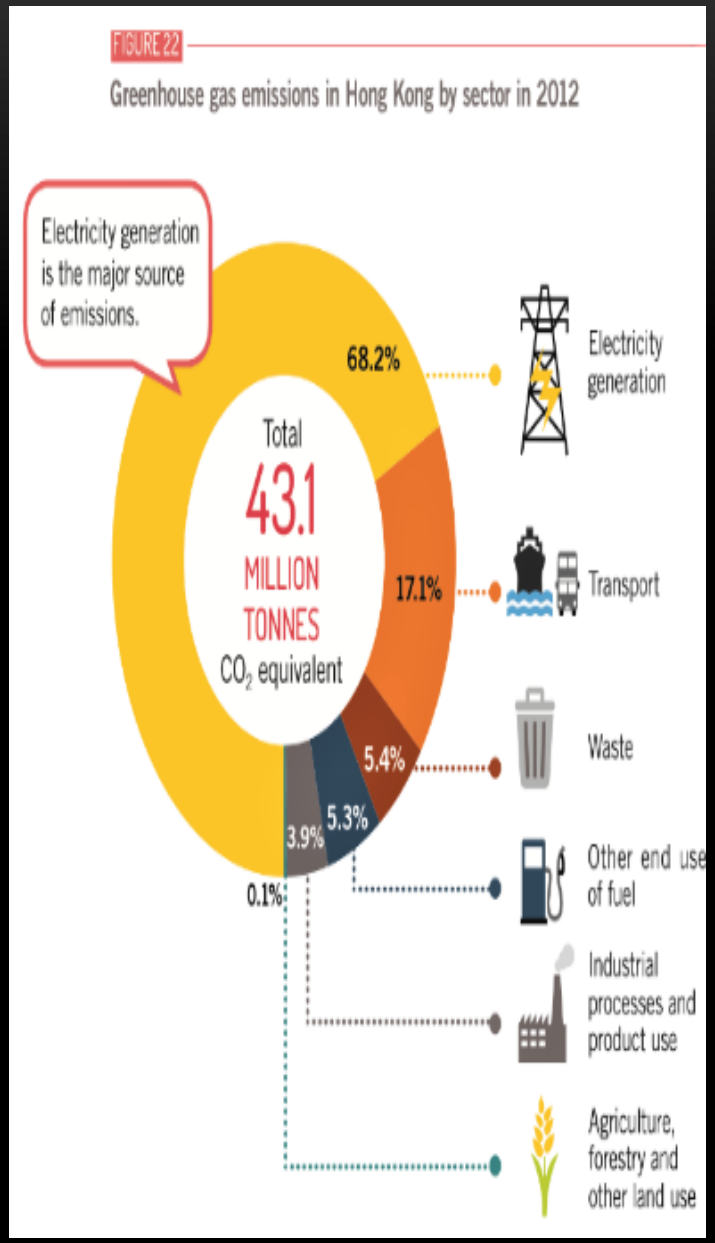
HK Climate & DeCarbonisation Plans & Actions Required!

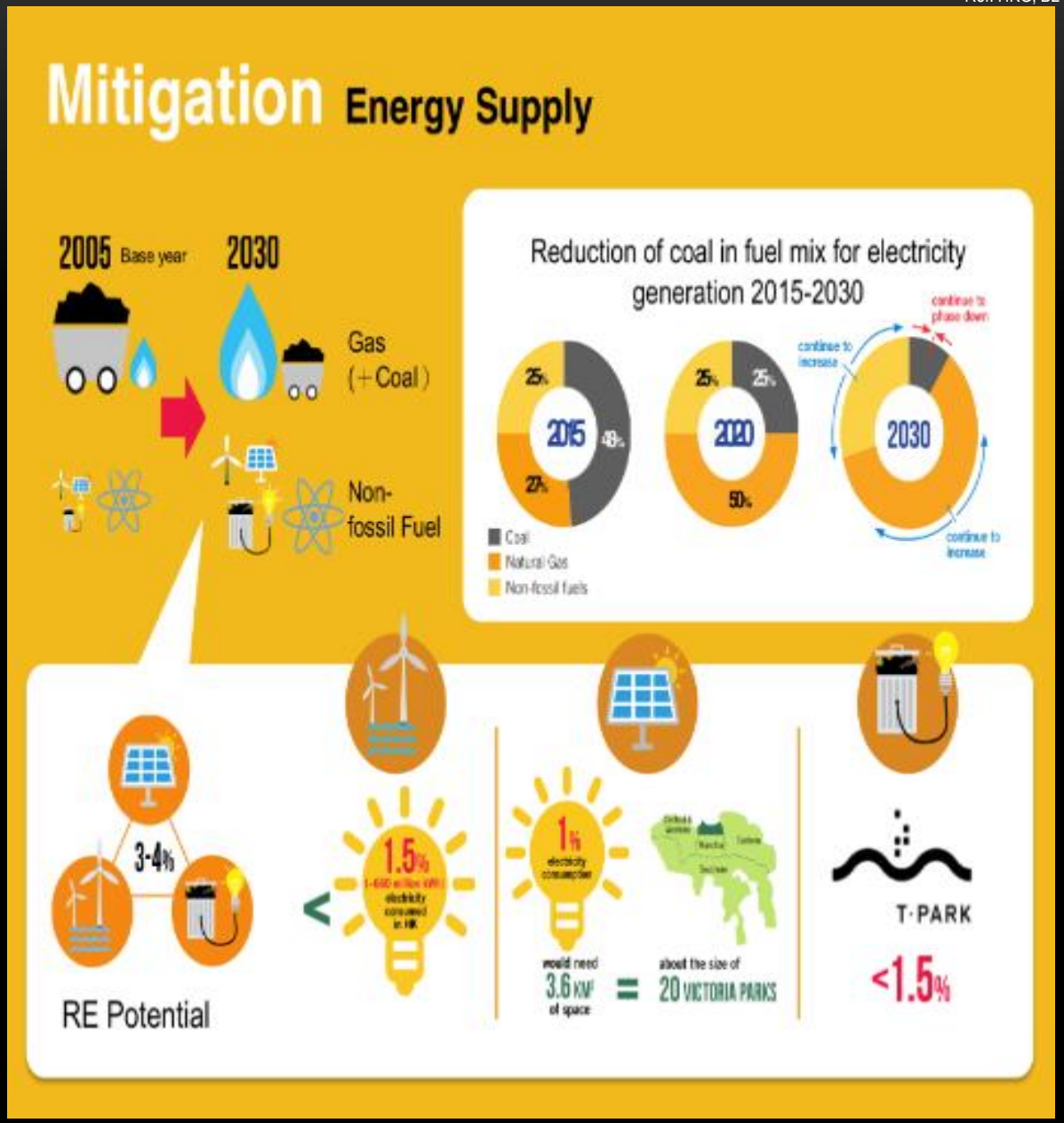
Ref: REN, B2

- HK has to move further to **achieve Carbon Neutrality by 2050/2070**.
- **Tough target** but both the **UN IPCC and IEA said necessary**.
- Also **inline with the Paris Agreement** requirements
- "All Parties should strive to formulate and communicate long-term low greenhouse gas emission development strategies (Article 4 para 19) and are invited to communicate them, with reference to 'mid-century' by 2020 for publishing by the UNFCCC secretariat (Decision 36)"
- The **Paris Agreement requirement & C40 Cities commitments** both **require the HKSAR Government to act on these**.
- The **HKSAR Government must provide report & plans for inclusion in the PRC's submission to the UNFCCC** secretariat.

Hong Kong Electricity Major CO2 Emitter, Decarbonisation Key!

Ref: HKG, B2





Reduce Coal & Fossil Electricity! Increase Gas, Renewables & Clean Power?

How HK might achieve Carbon Neutral Energy by 2050/70?

Ref: REN, B2

- Increase **Renewables** & Clean Powers?
- Increase **Waste to Energy**?
- Improve **Energy Efficiency & Savings**?
- Increase natural **Gas Imports**?
- **PRC Gas, Renewables & Nuclear** Imports
- **Digital Distributed Power** systems?
- HK Carbon Solutions **CCS, CCU, CCSU**?
- Promote **Green Low Carbon Transports**?
- Promote **Smart Low Carbon City** designs?
- Promote green **innovation, technology & employment**?
- Improve Cos **Climate strategy & reports, ESG & TCFD**?

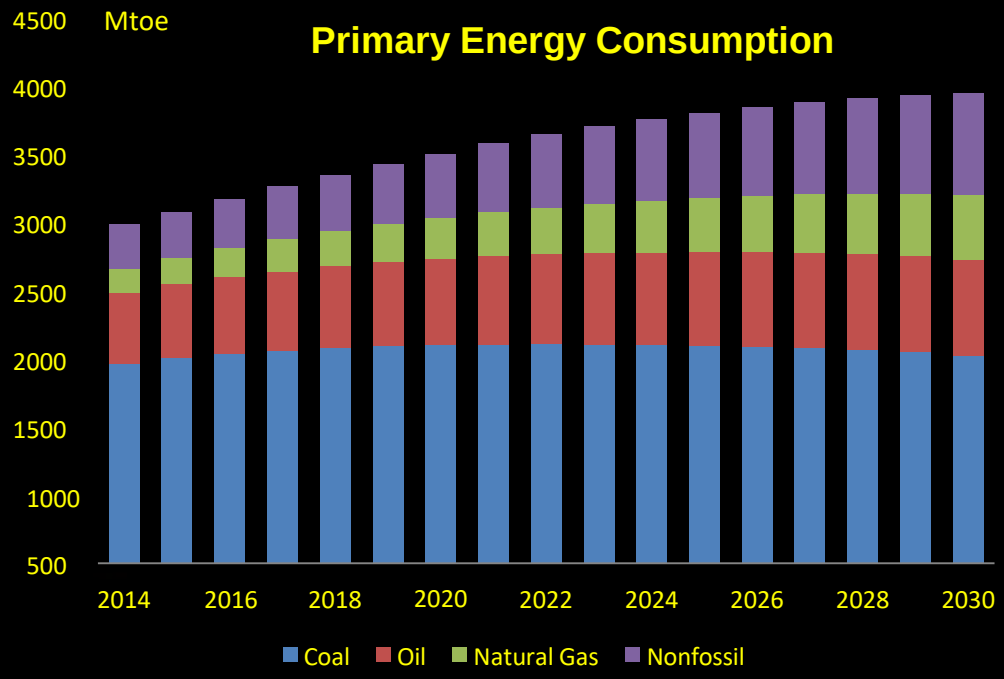
China's 13th Five Year Plan (2016-2020) – Climate & Renewables

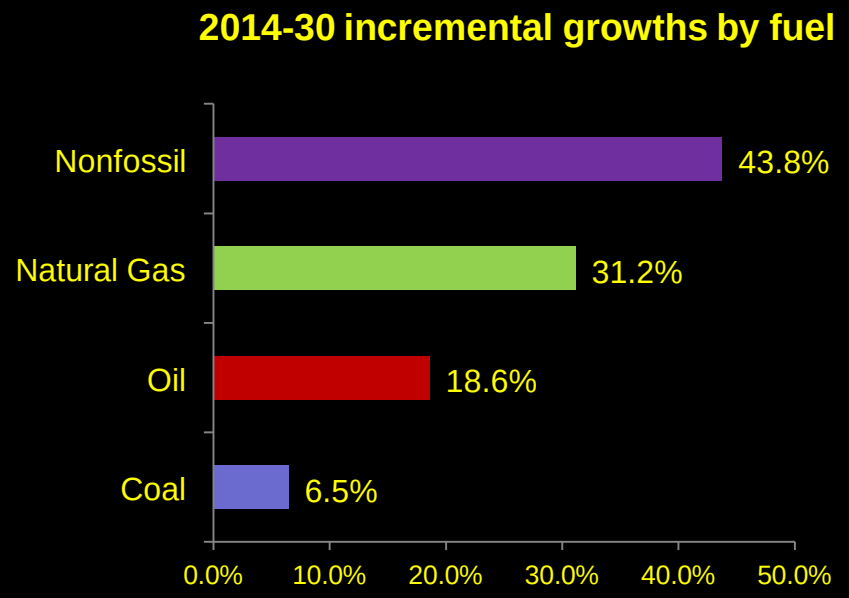
Ref: REN, B2

- New 'Ecological Civiliztion' Transformations ($630B+)
- Sustainable Growths & Restructuring
- Environment & Carbon (CETS, TCFD)
- Renewables investments ($ 360B+)
- Strategic Innovations & Growths
- Social Stability & Job Creations (4M+)
- Belt & Road Initiative (U$ 500+ B)

China Energy Growths Slowing down

- Energy growth lower 1.8% 2014-2030 (8.3% 2000-14).
- Oil growths slower but gas growths & imports rising
- Renewables & Clean Energy growths & employments.
- Top crude (10mbpd) & 2nd LNG (50bcm) imports.
- Coal in energy mix but growths low plus clean coal focus.





Source: NBS, CNPC

China New Energy & Electric Car Program & Incentives

Chinese Battery Electric crossover car in US LA

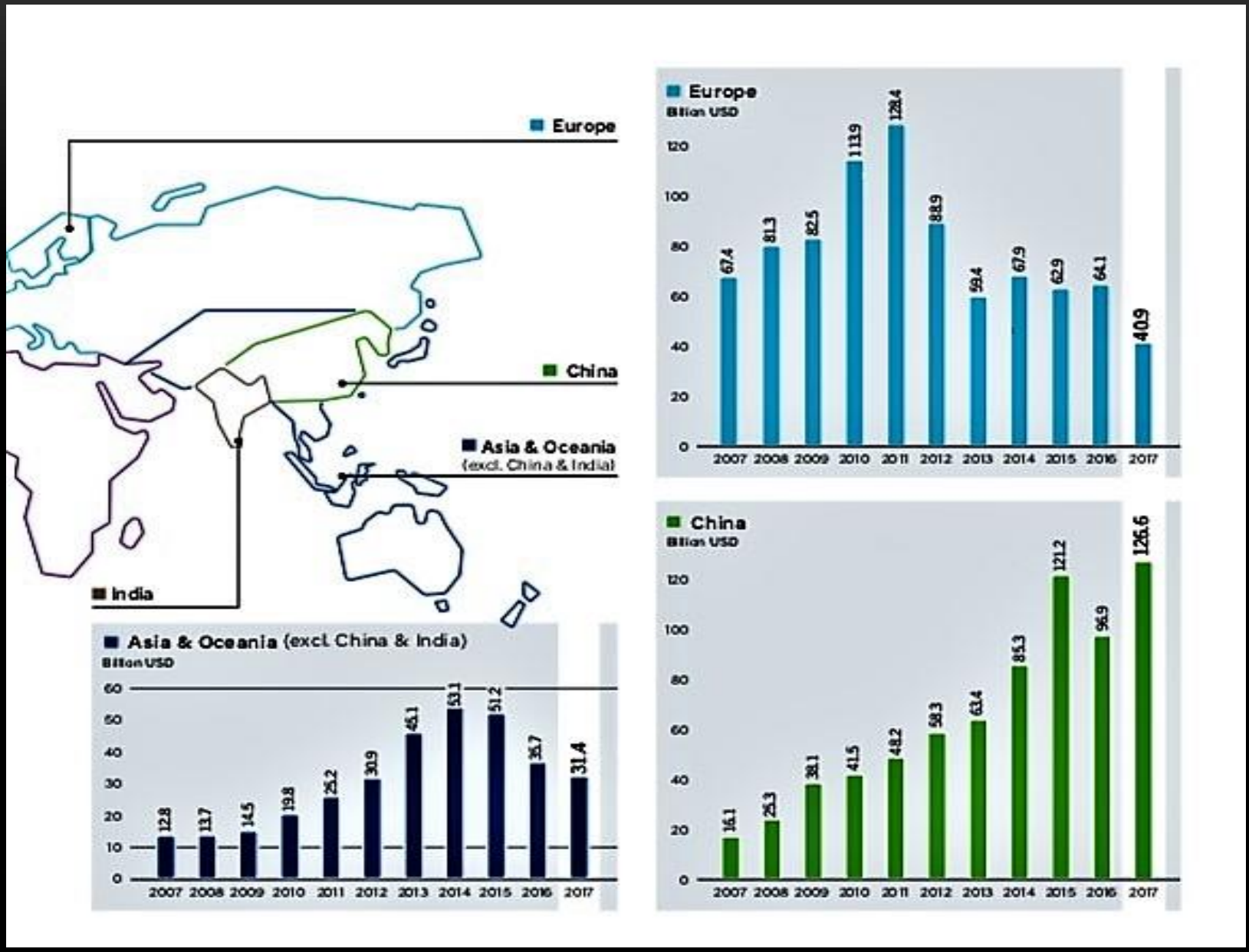
- New incentives program to 2020
- Subsidies upto 55000 rmb
- Priority sales & registration
- Target 5 million EV by 2020
- Innovations & Employments
- China UK Graphene NGP

Japanese Electric car for China market

Chinese Battery Electric compact car

Ref B2

Renewables Transformation & Investments Growths



Asia investments led by China, India, Japan plus Thailand, Singapore, Vietnam etc

ESG & G20 TCFD Climate Risk Financial Disclosures

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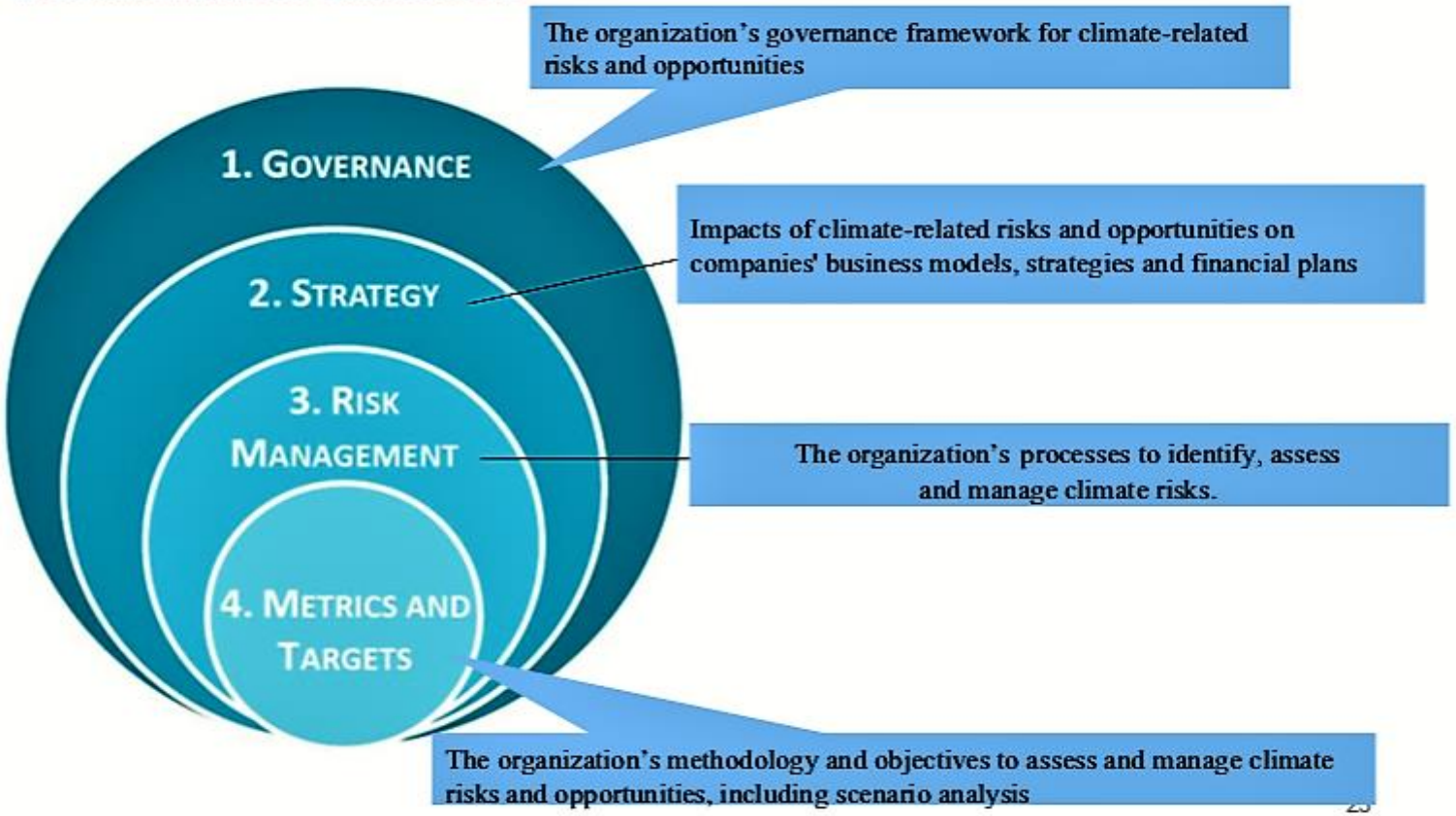
Ref: REN, B2

TCFD | TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

Phase II Roadmap of the TCFD

i. Framework for disclosures

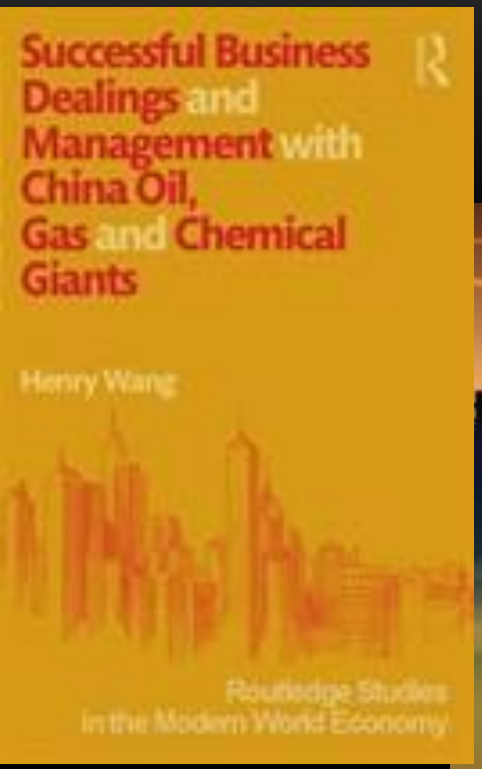


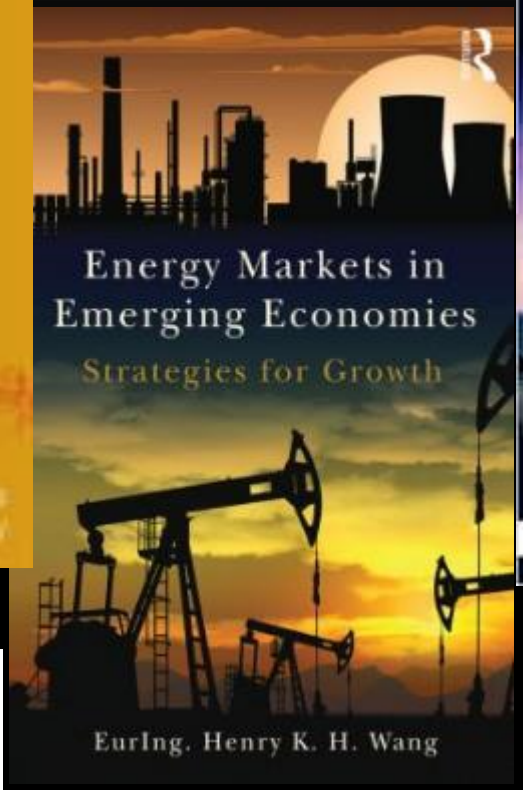
Leading Stock Markets, Corporates adopting new G20 TCFD reporting China UK Climate Disclosure Pilot to improve TCFD ESG reporting,

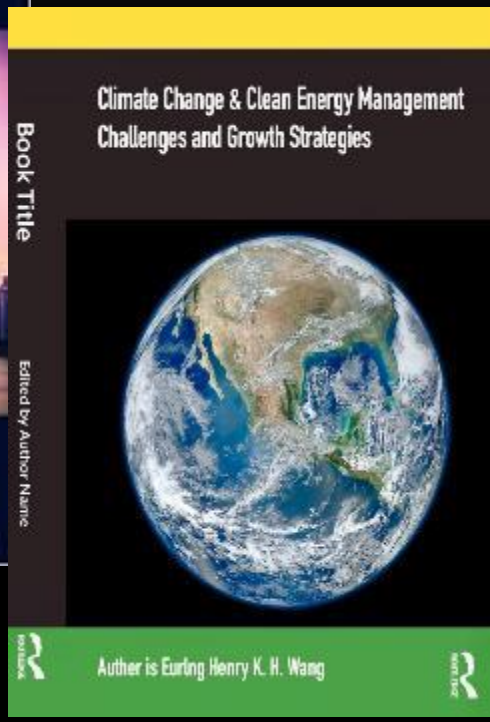
Global & HK Clean Energy Challenges Summary

- Global Climate & Carbon Actions
- Fossil Renewables Transformations
- Carbon Solution? CCS/CCU?
- Low Carbon Economy, Innovations
- HK Climate & Energy Challenges
- Electricity Carbon Neutral Plans?
- China Climate Energy Action Plans
- Carbon Plans & Paris Agreement
- International Cooperations
- Essential for Sustainable Environment & Economic Growths

Henry Wang, FRSA, FIChE, C. Eng., MCMI
International Advisor, Author & Speaker







➢**Thanks and welcome questions**

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