UNIVERSITY OF CAMBRIDGE | Energy Policy Research Group

Is nuclear the key to global decarbonisation?

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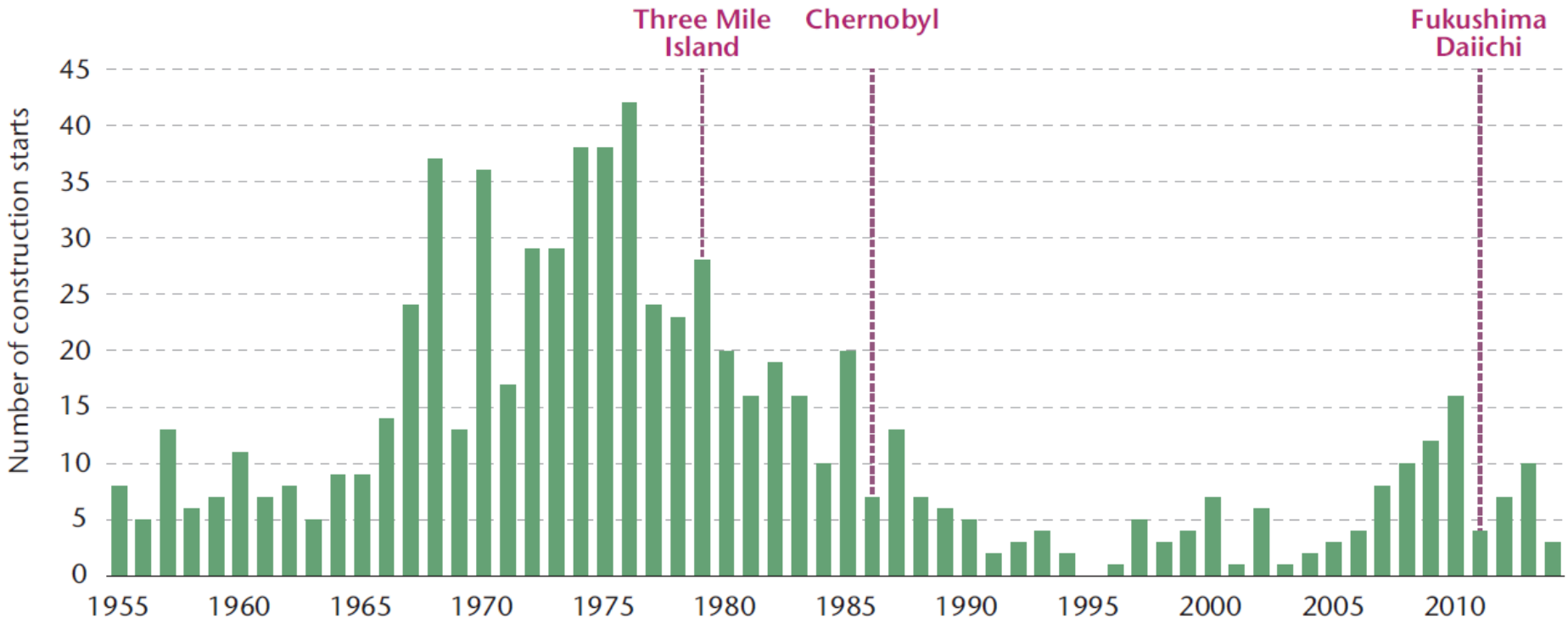
Is nuclear the key to global decarbonisation?

No

Nuclear build remains very low outside China

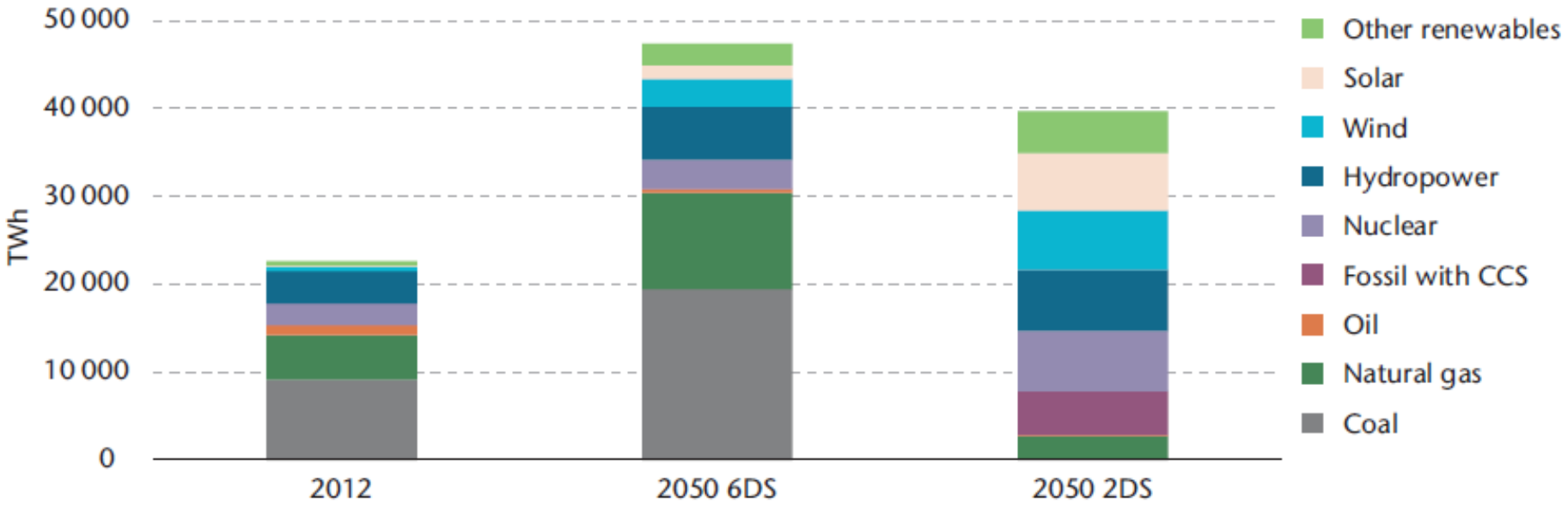
Figure 1: Nuclear reactor construction starts, 1955 to 2014



Source: IAEA Power Reactor Information System (PRIS).

IEA vision of decarbonised power sector 2050 (1)

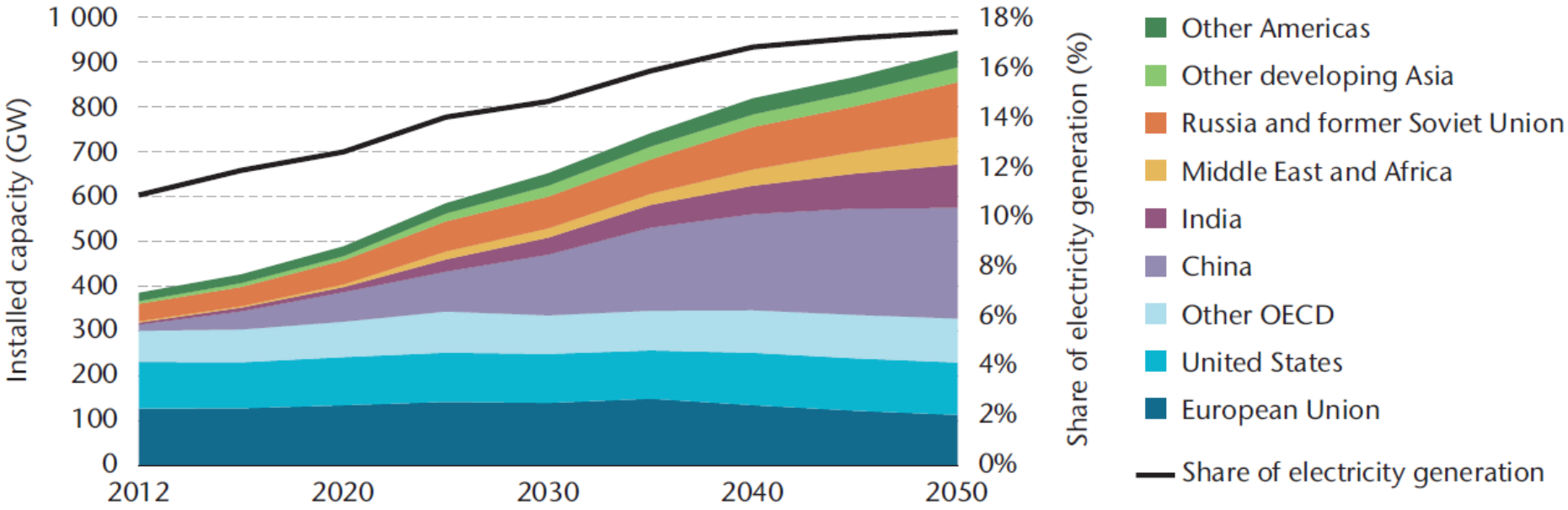
Figure 3: Electricity production by technology in the 6DS and the 2DS



Source: IEA Nuclear Technology Roadmap 2015
http://www.iea.org/publications/freepublications/publication/Nuclear_RM_2015_FINAL_WEB_Sept_2015_V3.pdf

IEA vision of decarbonised power sector 2050 (2)

Figure 4: Nuclear generation capacity in the 2DS by region



Source: IEA Nuclear Technology Roadmap 2015
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The nuclear scorecard

Strengths	Weaknesses
Proven source of low carbon energy	Expensive
Reliable operation	Inflexible
Continuous supply	State role essential
Dense	Long term waste storage not dealt with
Low import dependency	Catastrophe risk

Concepts of cost

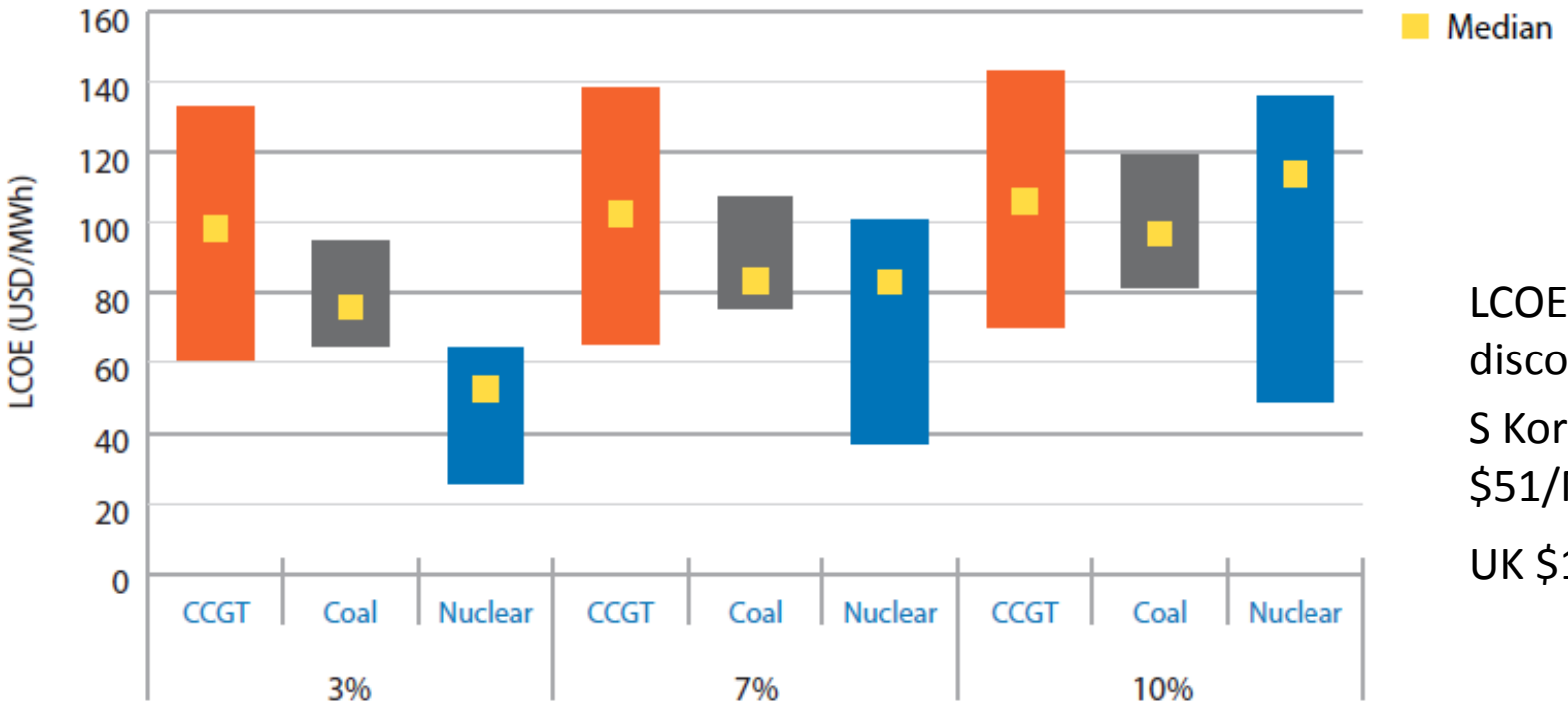
Overnight construction cost (no financing)

Levelised cost of energy(LCOE) over lifetime, discounted

Ex ante price charged to customer to justify investment

OECD estimates of levelised cost

Figure ES.1: LCOE ranges for baseload technologies (at each discount rate)



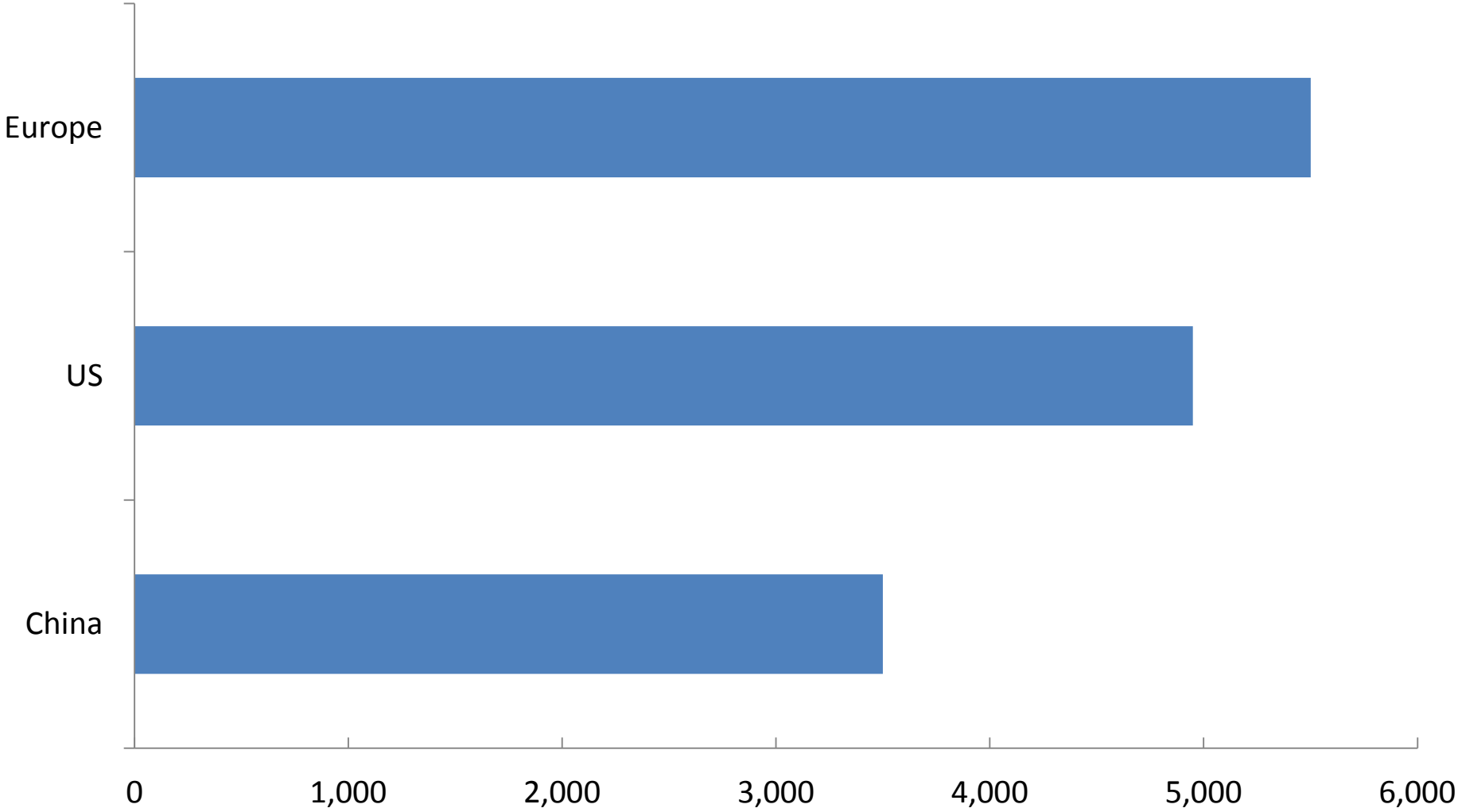
LCOE at 10% discount rate:

S Korea $51/MWh

UK $136/MWh

Source: OECD ***Projected Costs of Generating Electricity*** **– 2015 Edition** http://www.oecd-nea.org/ndd/pubs/2015/7279-proj-costs-electricity-2015-es.pdf

IEA estimated overnight cost ($/kW)



The troubled EPR

Olkiluoto 3 – Finland
Original scheduled operation – 2009
Latest estimate – 2018
Original cost – €3.2 bn
Latest estimate - €8.5 bn

Flamanville 3 - France
Original scheduled operation – 2012
Original cost - €3.6bn
Latest estimate €10.5 bn
Expected operation 2018 Q4

Taishan 1 & 2 – China
Unit 1 original scheduled operation – 2014
Construction finished December 2015
Testing in 2016

Source: EDF

State involvement in current projects

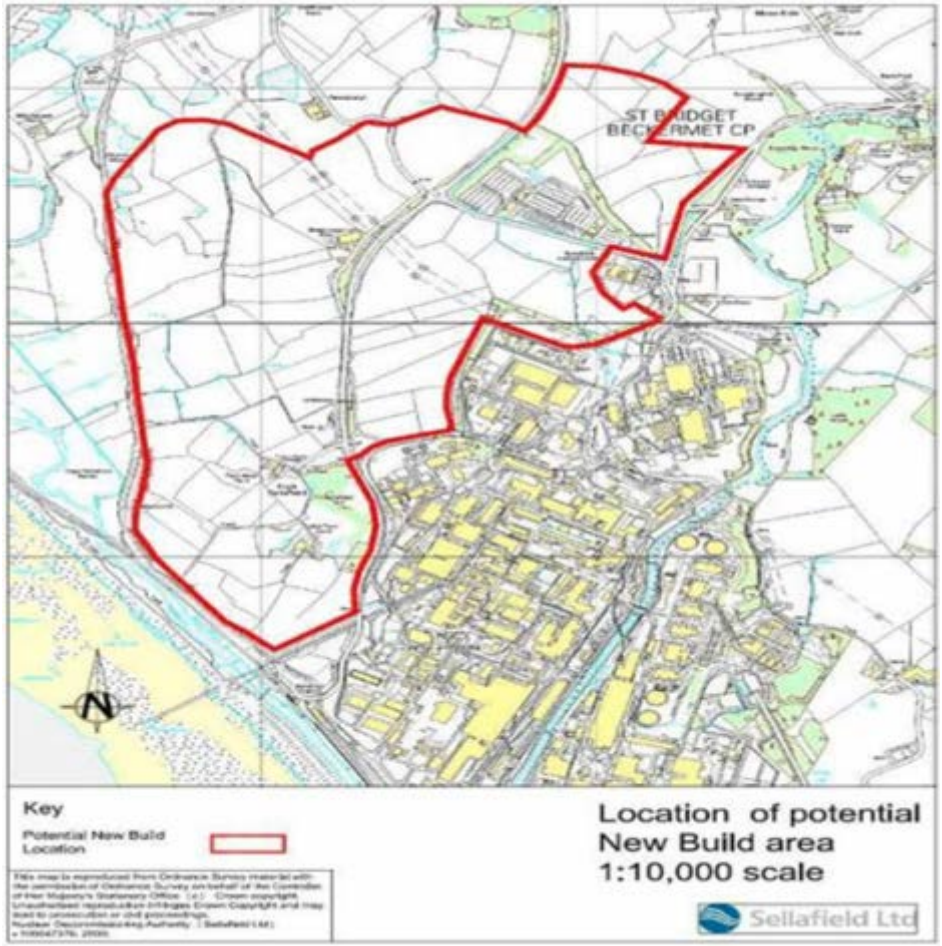
Comparisons of risk bearing among current and likely new nuclear projects

Reactor	Country	Status	Construction risk	Power price risk	Debt guarantee?
Olkilotuo 3	Finland	Under construction	Contractor (Areva)	Customers	None
Flamanville 3	France	Under construction	Sponsor (EDF)	Customers (via regulation)	No
Vogtle	USA	Under construction	Customers	Customers (via regulation)	Federal US government
Hinkley Point C	UK	Awaiting final decision	Sponsor (EDF and CGN)	Customers (mediated by government)	UK government

Source: Taylor, S. in R. Heffron, G. Little (2016) *Delivering Energy Law and Policy in the EU and the US - A Reader* https://edinburghuniversitypress.com/book-delivering-energy-law-and-policy-in-the-eu-and-the-us.html

Risk management in a "private project"

Moorside, Cumbria



Source and ©: NuGen

3.4-3.8GW AP1000
Toshiba (60%) and ENGIE (40%)
Projected sources of funding:
UK state debt guarantee
Japanese Bank for International Cooperation
US Ex-Im Bank
Korea

China and nuclear

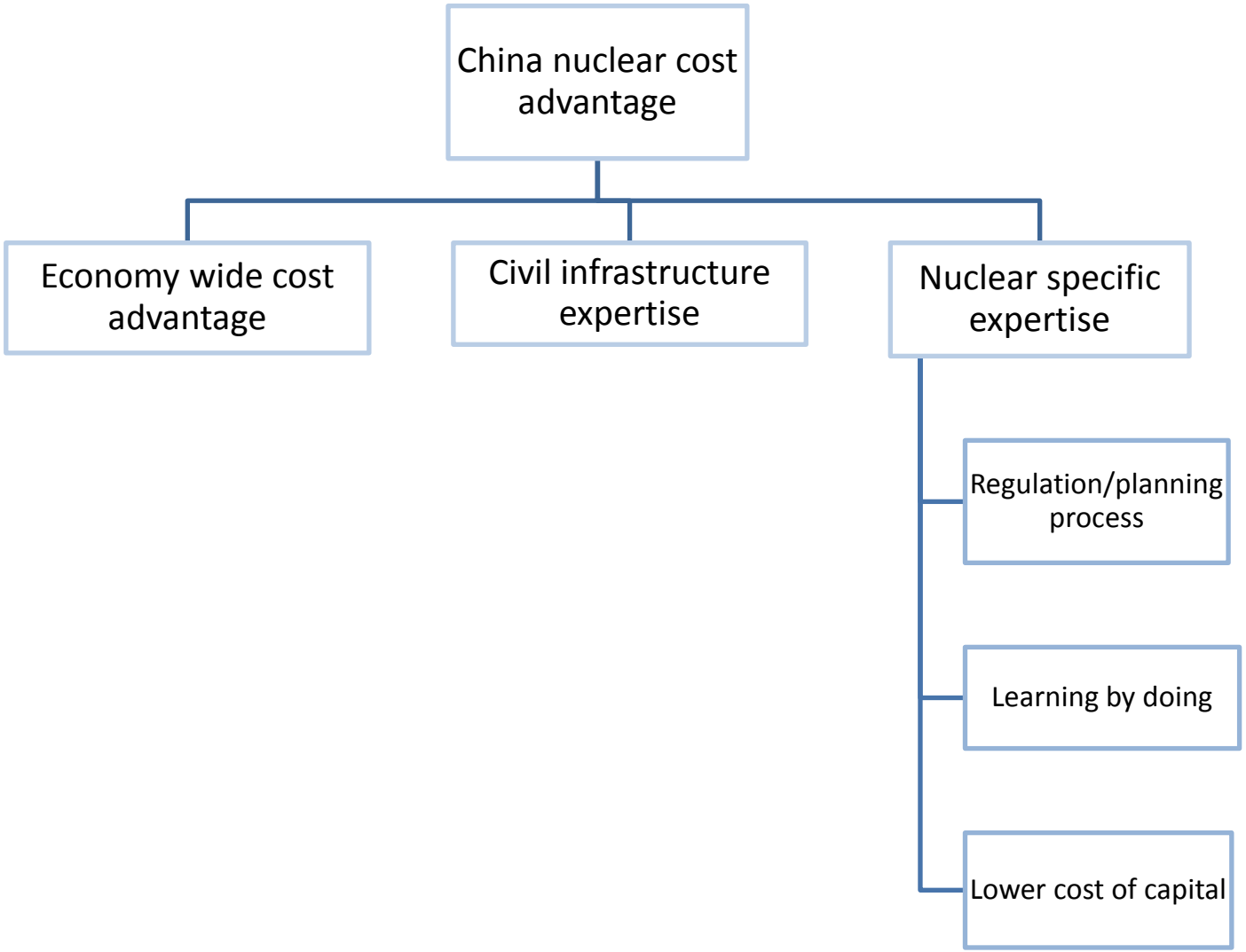
A brief history of Chinese nuclear

French PWR, Daya Bay, Guangdong

Russian PWR, Tianwan, Jiangsu

Chinese Hualong One PWR, Fengchenggang, Guangxi

Sources of China's nuclear cost advantage



Small Modular Reactors

Table 4: Examples of small modular reactor designs (under construction or with near-term deployment potential)

Vendor	Country	Design	Type	Net capacity (MW)	In operation*	Under construction*
Babcock & Wilcox	United States	mPower	PWR	180	0	0
CNEA	Argentina	CAREM-25	PWR	25	0	1
CNEC	China	HTR-PM	HTR	210	0	Twin units
CNNC	China	ACP-100	PWR	100	0	0
KAERI	Korea	SMART	PWR	110	0	0
NuScale	United States	NuScale SMR	PWR	45	0	0
OKBM	Russia	KLT-40S	Floating PWR	2x35	0	Twin units (one barge)

*: As of 31 December 2014.

"However, the economics of SMRs have yet to be proven."

Source: IEA http://www.iea.org/publications/freepublications/publication/Nuclear_RM_2015_FINAL_WEB_Sept_2015_V3.pdf

Thank you