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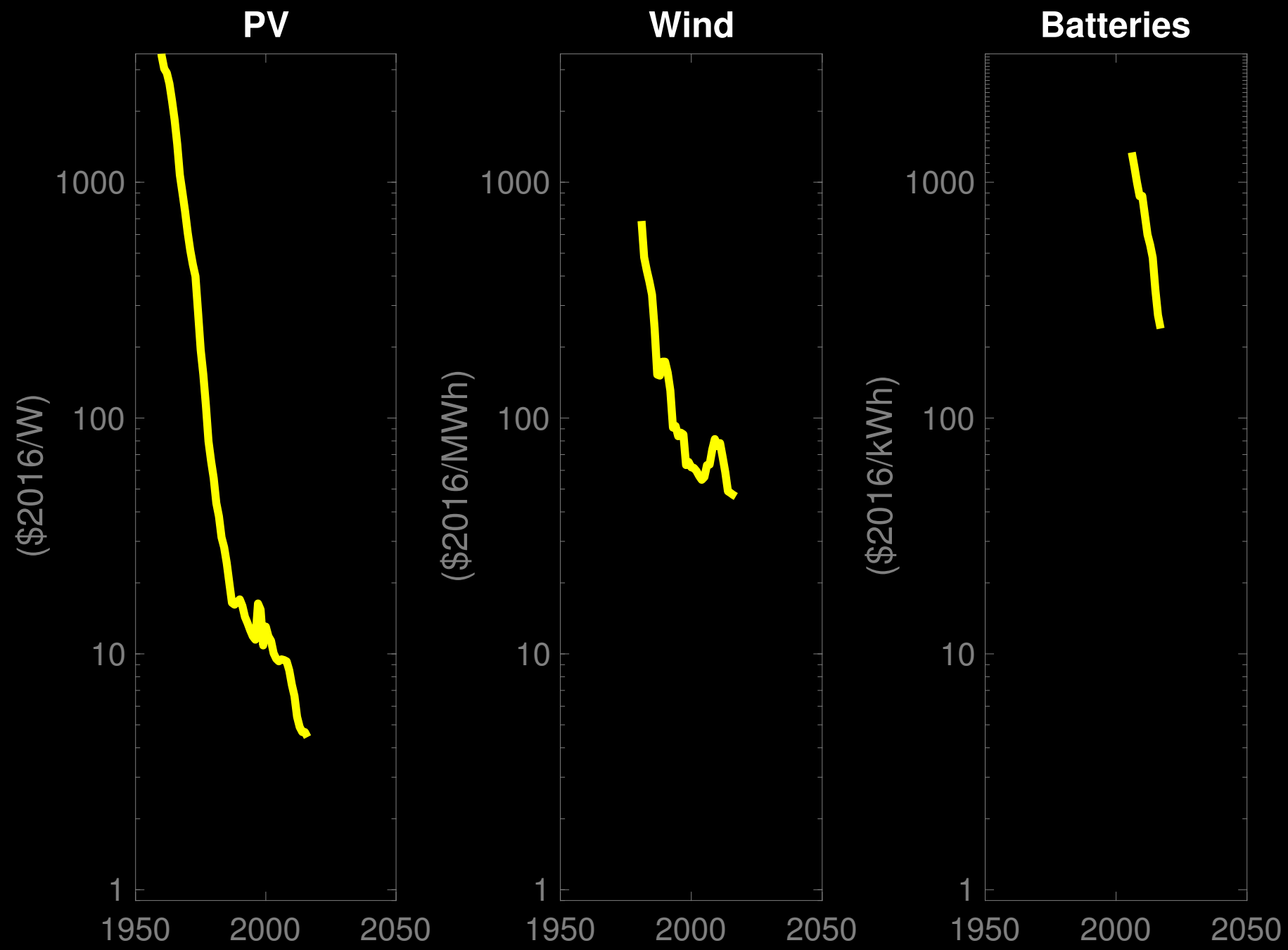
HOW SOLAR ENERGY BECAME CHEAP

A MODEL FOR LOW-CARBON INNOVATION

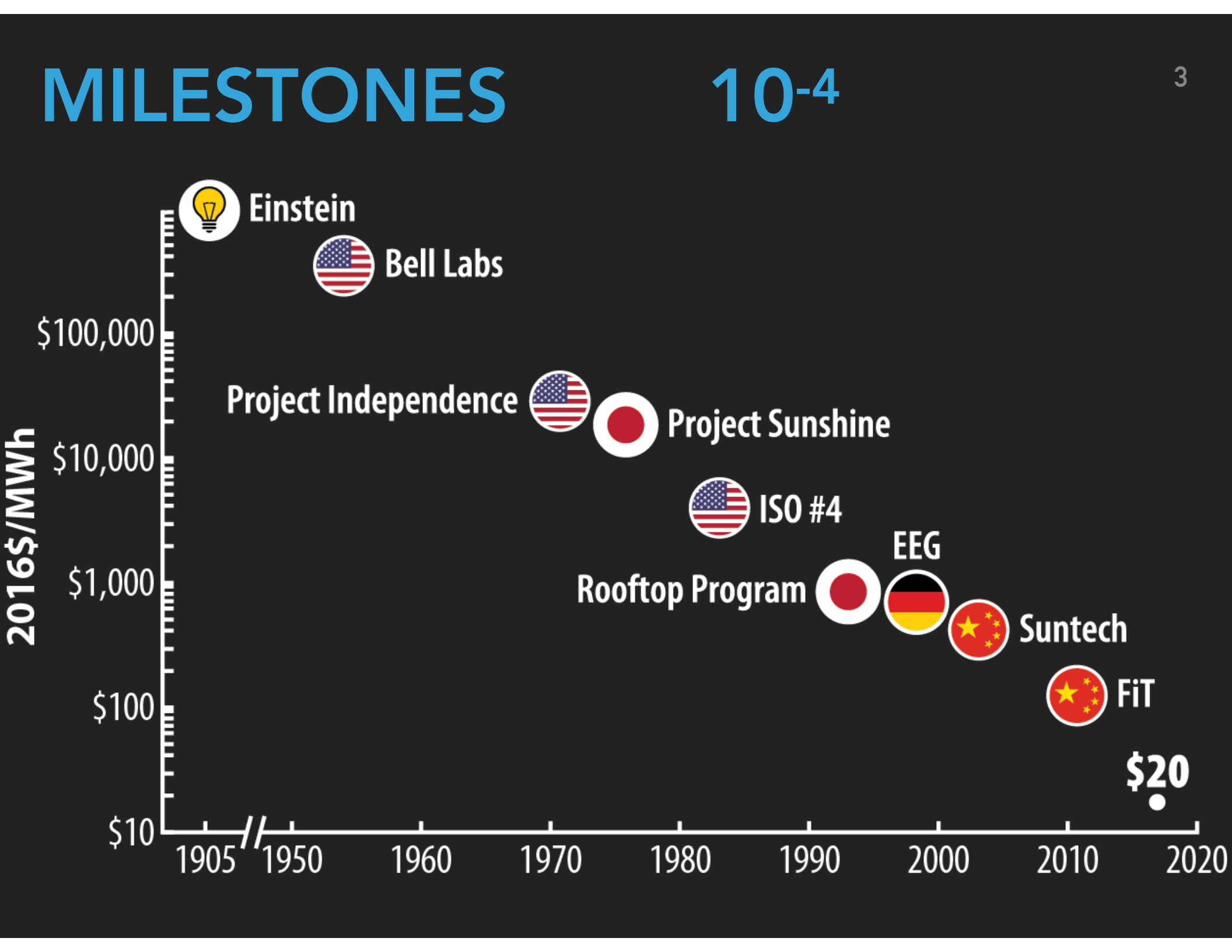
Gregory F. Nemet

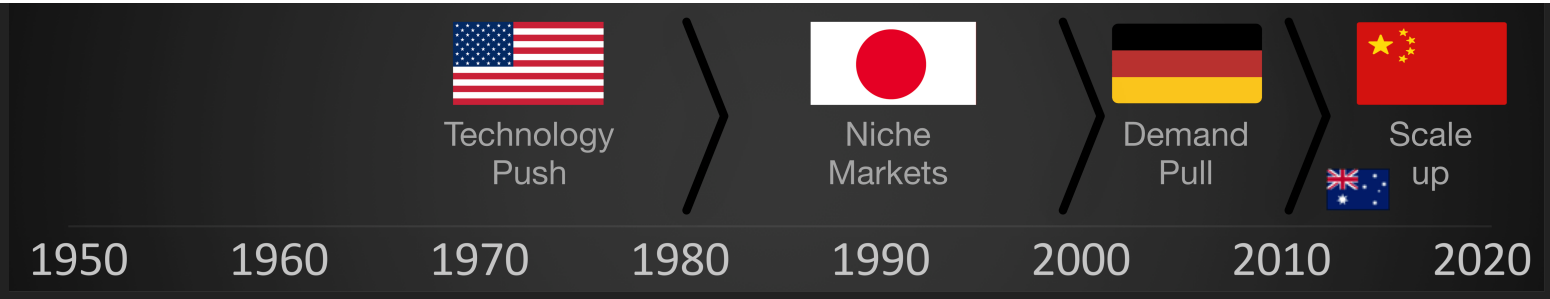
earthscan from Routledge

LONG TERM COST REDUCTIONS

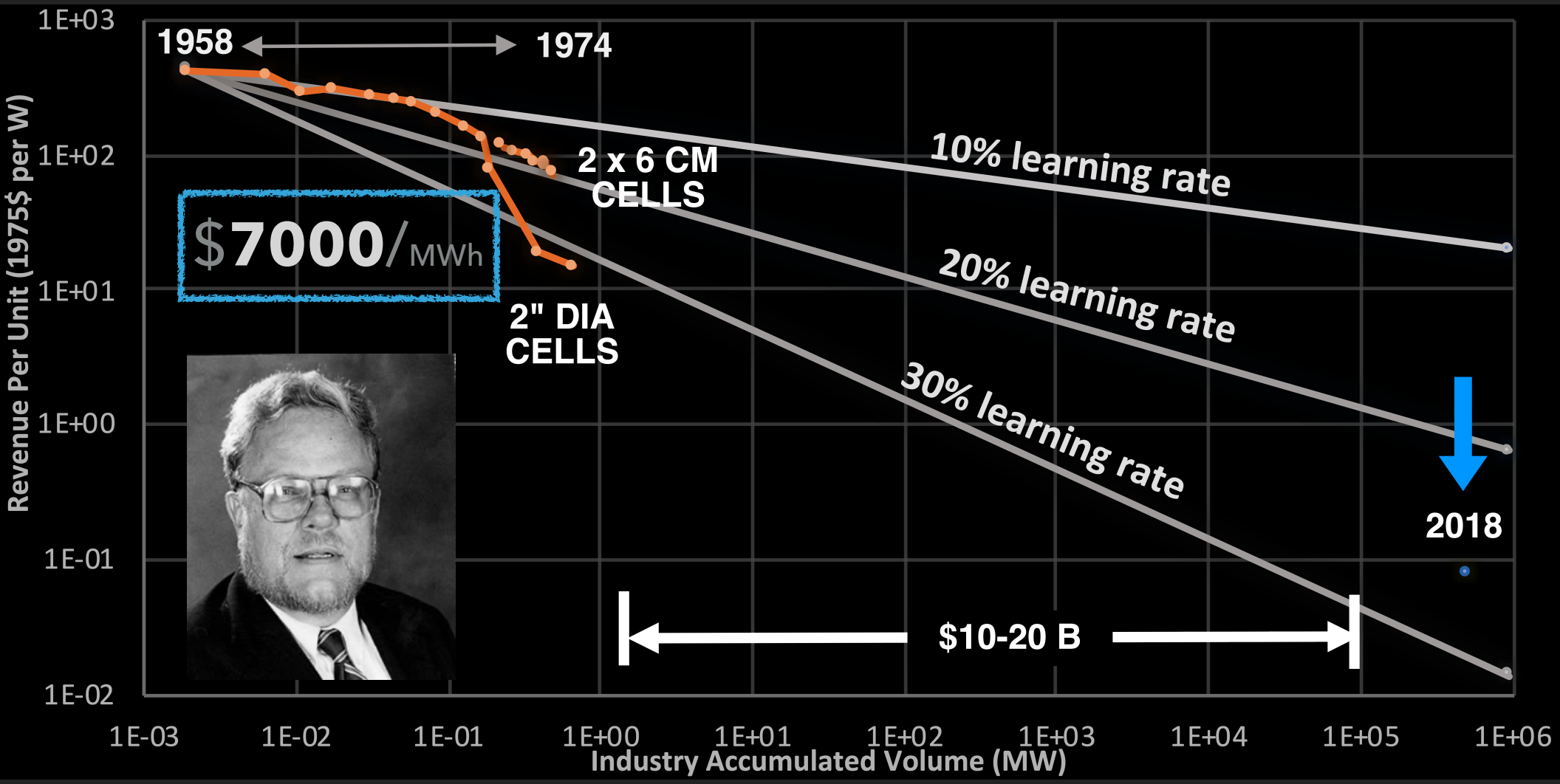


MILESTONES


10-4
Einstein
Bell Labs
Project Independence
Project Sunshine
ISO #4
EEG
Rooftop Program
Suntech
FiT
$20
2016$/MWh
$100,000
$10,000
$1,000
$100
$10
1905
1950
1960
1970
1980
1990
2000
2010
2020

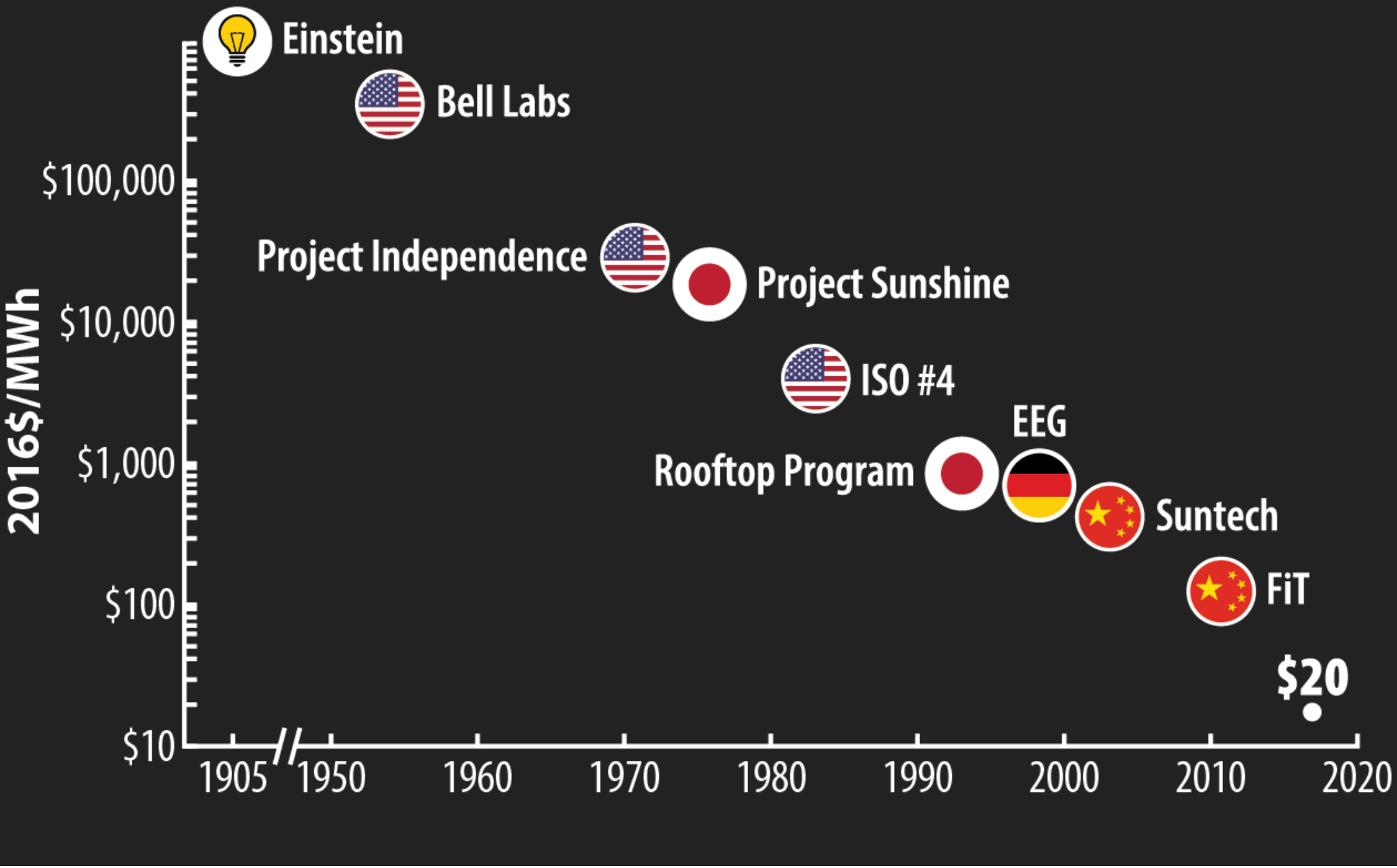


PROJECT INDEPENDENCE 1ST PV LEARNING CURVE

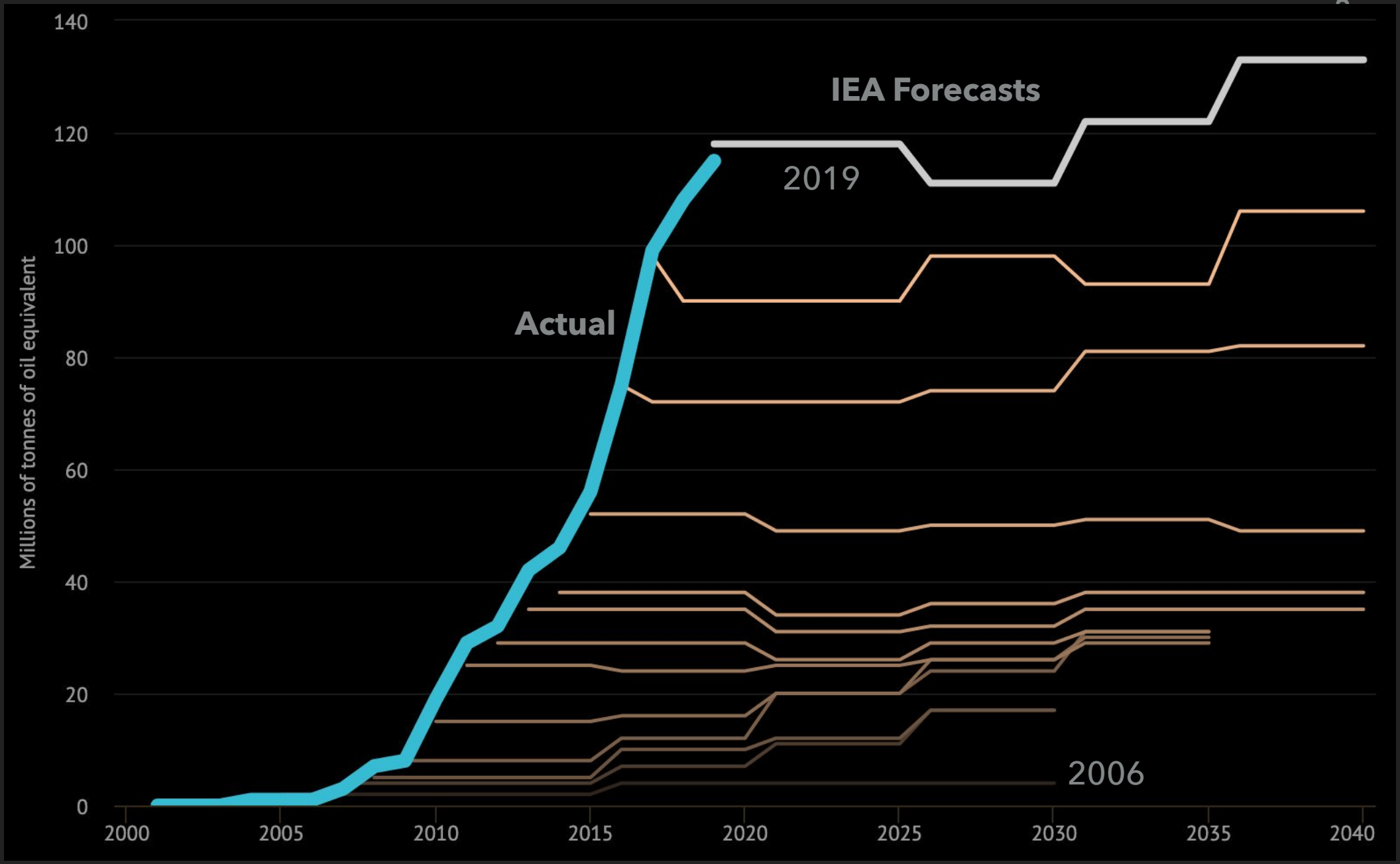


MILESTONES

10^{-4}

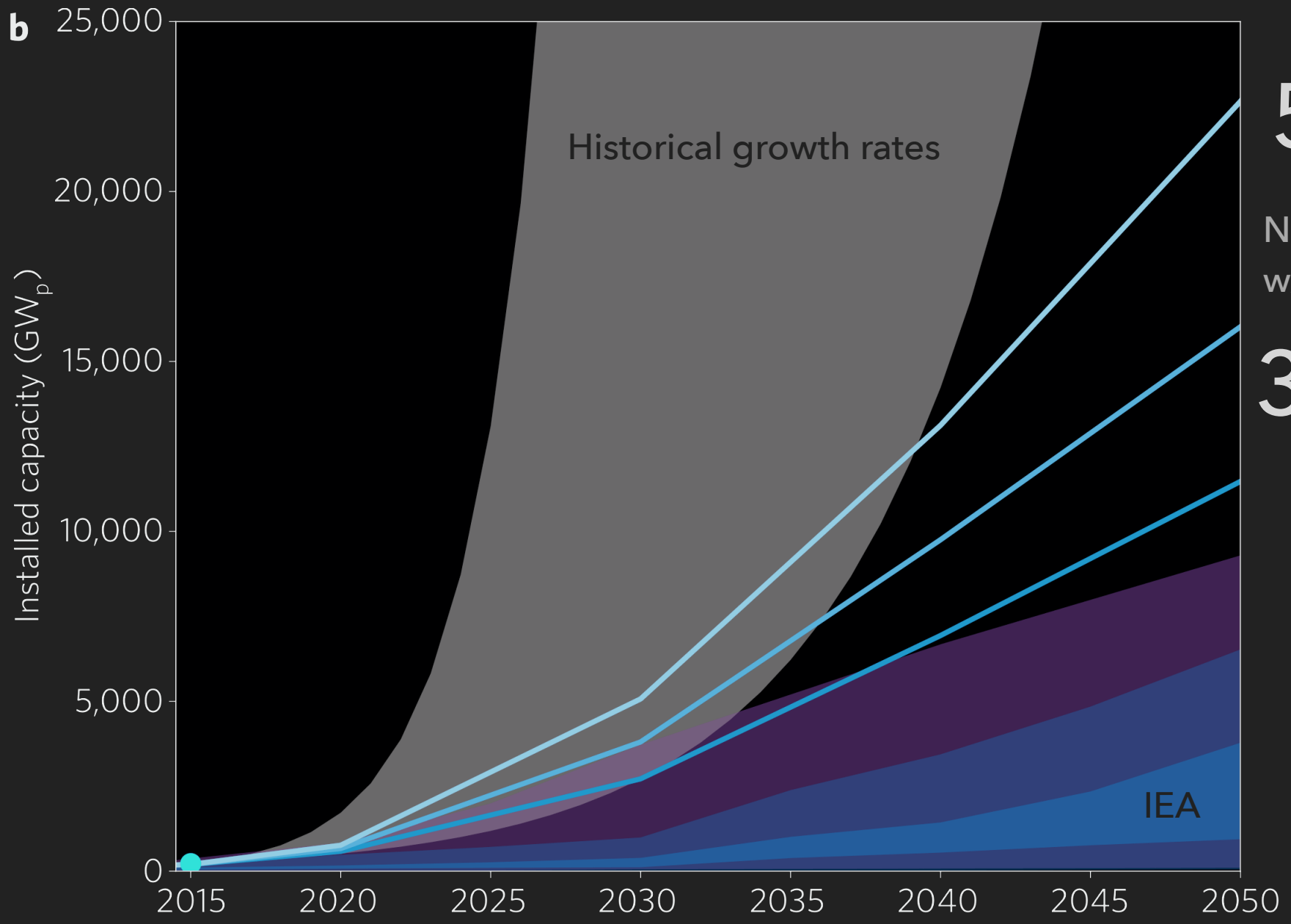


POTENTIAL FOR SOLAR HAS BEEN UNDERESTIMATED



Simon Evans, Carbon Brief

POTENTIAL FOR SOLAR HAS BEEN UNDERESTIMATED

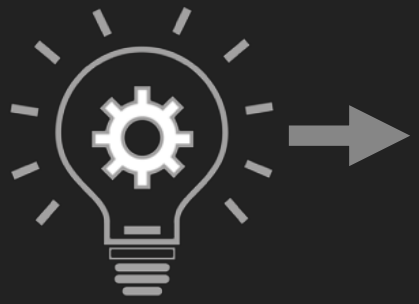


Creutzig, F., P. Agoston, J. C. Goldschmidt, G. Luderer, G. Nemet and R. C. Pietzcker (2017). "The underestimated potential of solar energy to mitigate climate change." Nature Energy **2**: nenergy2017140.

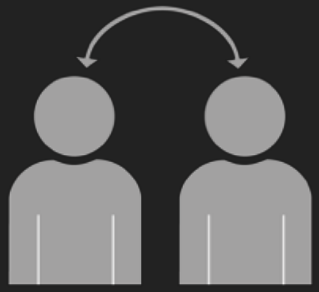
HOW DID SOLAR GET CHEAP?

CREATING TECHNOLOGY

SCIENTIFIC UNDERSTANDING

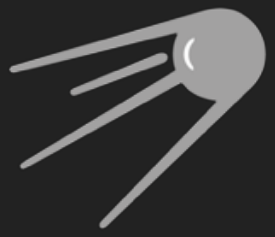


EVOLVING R&D FOCI



KNOWLEDGE SPILLOVERS

BUILDING A MARKET



NICHE MARKETS

MODULAR SCALE

ROBUST POLICY SUPPORT

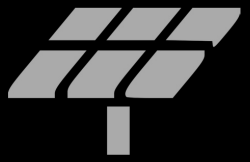
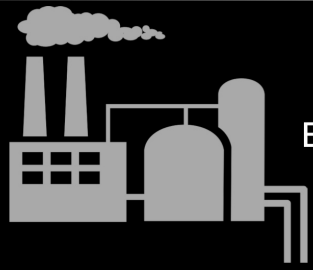
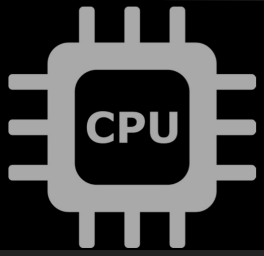
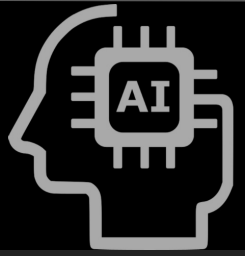
MAKING IT CHEAP

LEARNING BY DOING

ITERATIVE UPSCALING

DELAYED SYSTEM INTEGRATION

WE NEED MULTIPLE MODELS

Technology type	Innovation model	Low-carbon target
1. High-tech, iterative, disruptive	 Solar PV	 Direct air capture
2. Low-tech, small, distributed	 Green revolution	 Soils
3. Large, system integration intensive	 Chemical plants	 BECCS
4. General purpose	 Micro-processors	 Artificial intelligence

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