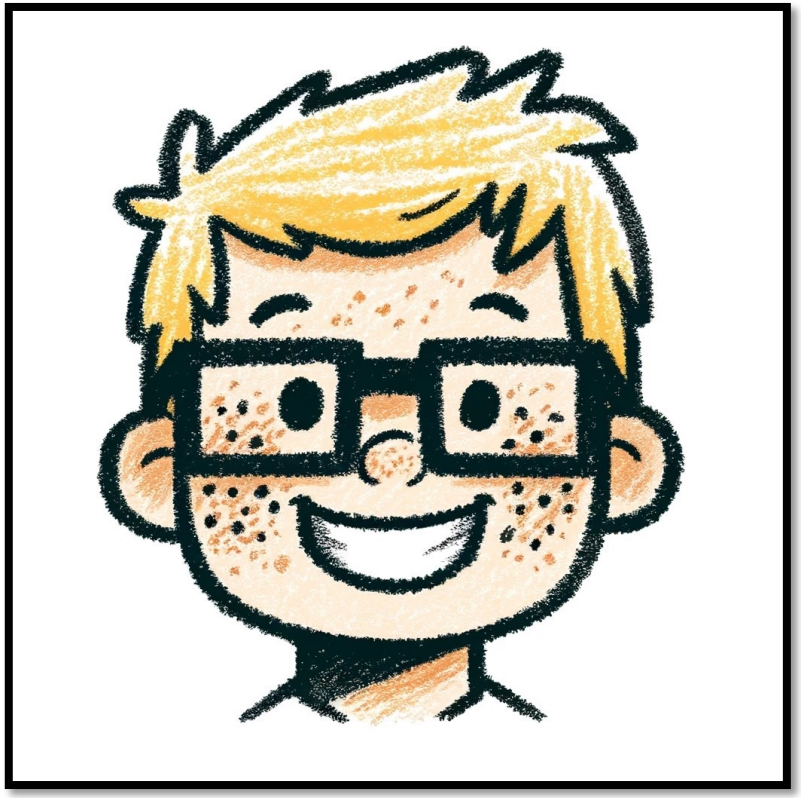
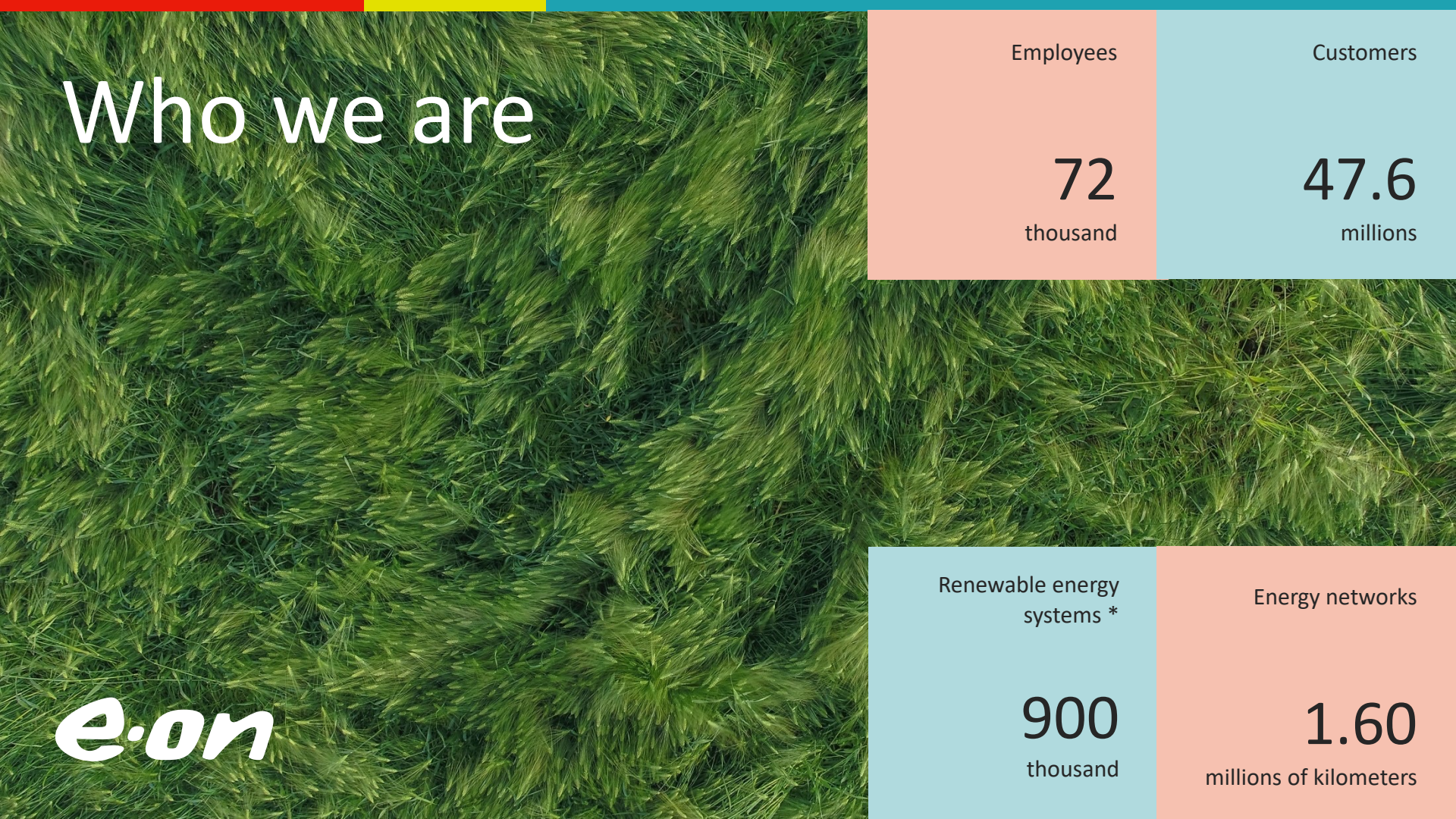
The Exponential Revolution: Unleashing a New Energy System

Me?



Who we are



Employees	Customers
72 thousand	47.6 millions

Renewable energy systems *	Energy networks
900 thousand	1.60 millions of kilometers

E.ON’s Swedish grid

1+ million
Customers

45 000
Nätstationer

145 000 km
Grid

145 m
per kund

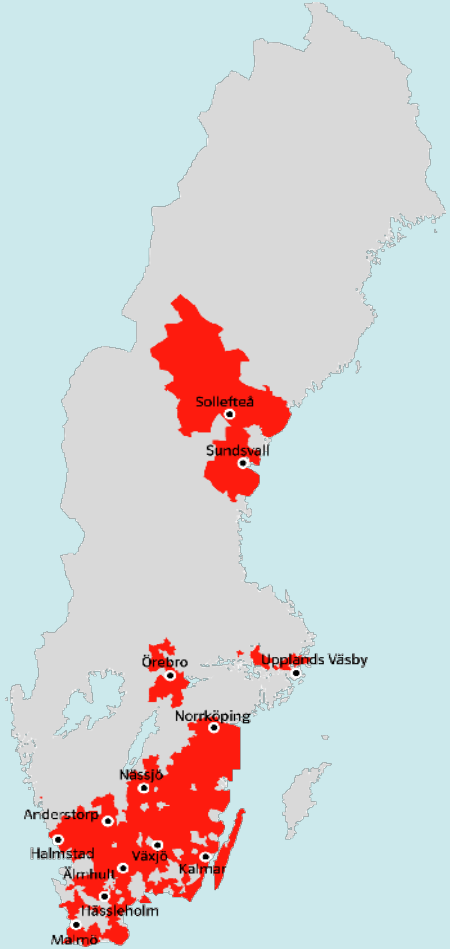
135 000 km
Distr. Grid

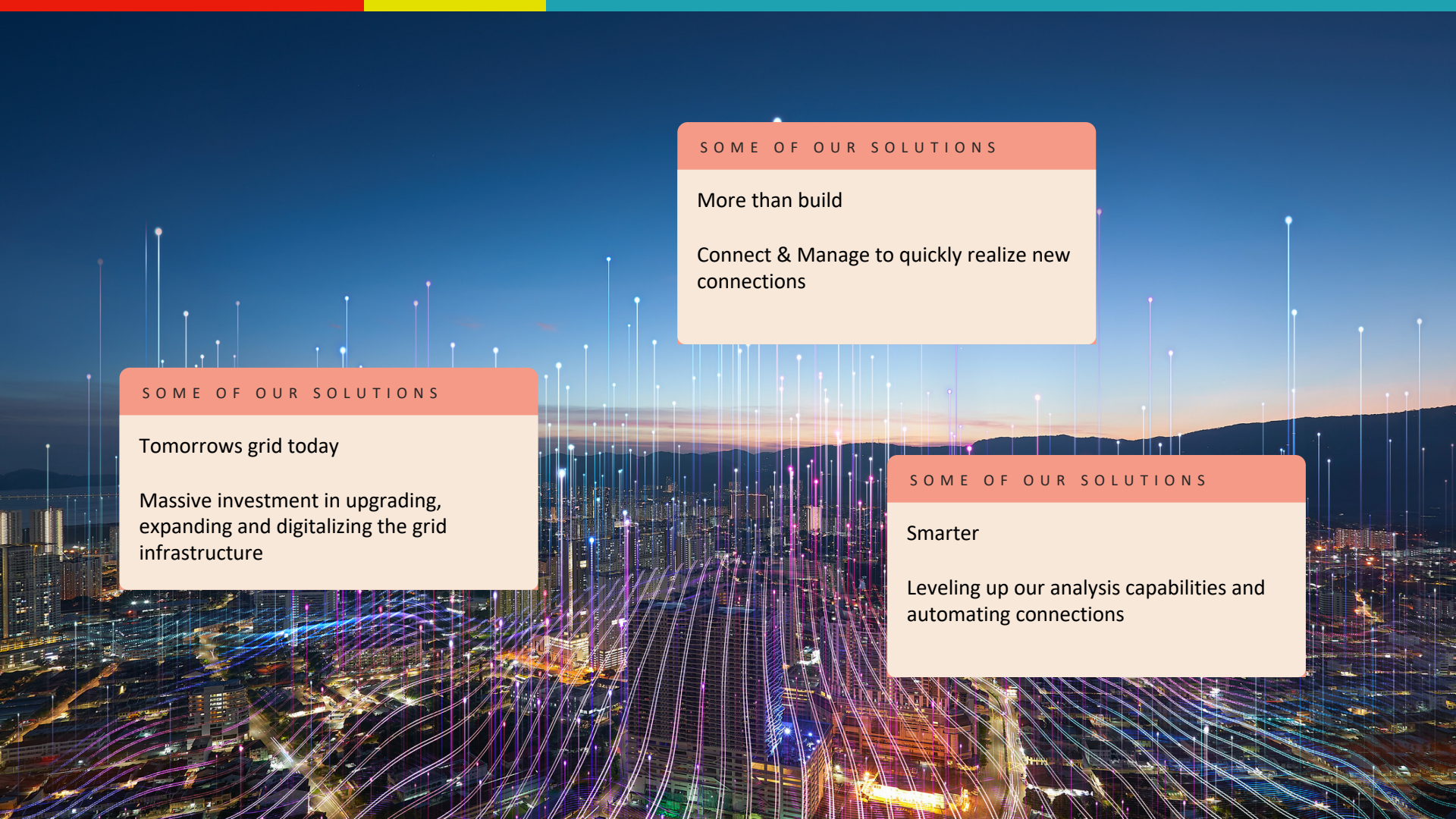
10 000 km
Regional Grid

40 Billion SEK
Investment
2024-2030

16 billion SEK
investment
2020-2023

900+
Employees





SOME OF OUR SOLUTIONS

More than build

Connect & Manage to quickly realize new connections

SOME OF OUR SOLUTIONS

Tomorrows grid today

Massive investment in upgrading, expanding and digitalizing the grid infrastructure

SOME OF OUR SOLUTIONS

Smarter

Leveling up our analysis capabilities and automating connections

Slides, data, graphs are from the sources below:

RMI is transforming the global energy system to secure a clean, prosperous, zero-carbon future for all.

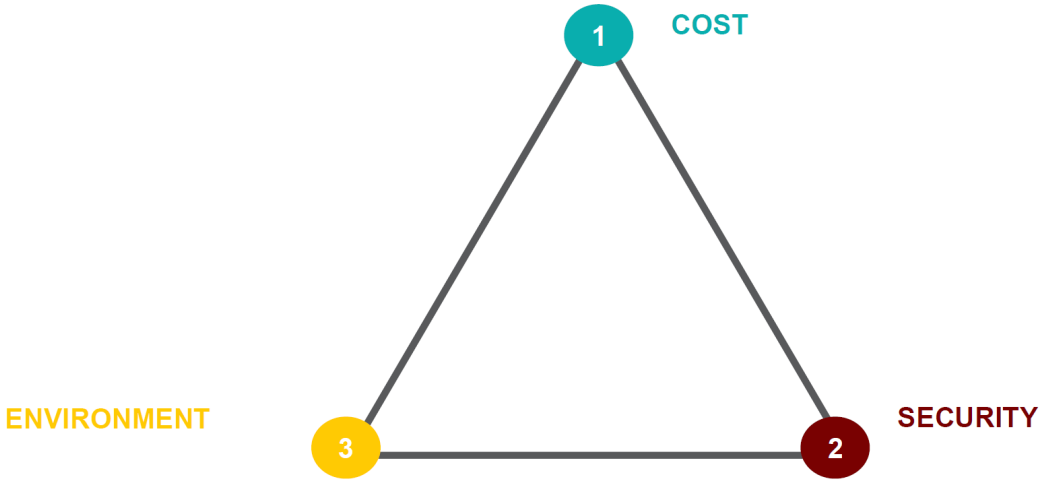
RMI

Nat Bullard (nathanielbullard.com)

Here we go

Renewable Energy

Solves the Energy Trilemma

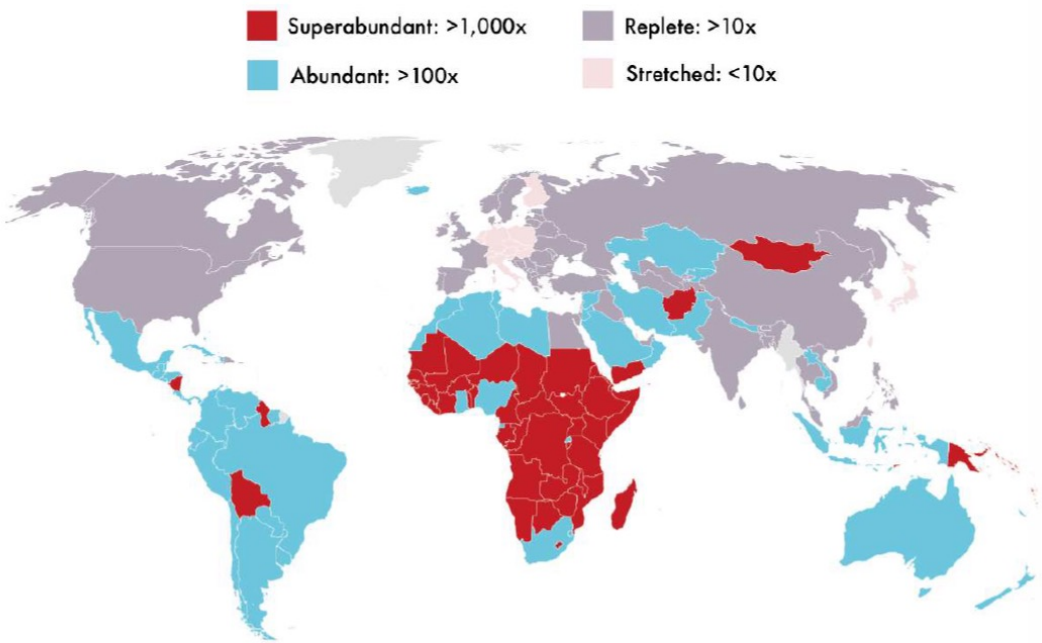


Source: [RMI renewable revolution; https://rmi.org]

National security: renewables are the answer

- Everyone has renewables. They are 100 times bigger than fossil fuels.
- But only 20% of people live in countries with ample fossil fuel supply.
- Fossil fuels are often used as a tool of power. You cannot do the same thing with renewables. If you cut off supply, then countries still have the renewable technologies they bought over the past 20 years.
- At present China does have a dominant in manufacturing, but that is changing fast as the United States and Europe build up their own supply chains.
- Solar and wind by definition are local. Nobody can cut off the sun.

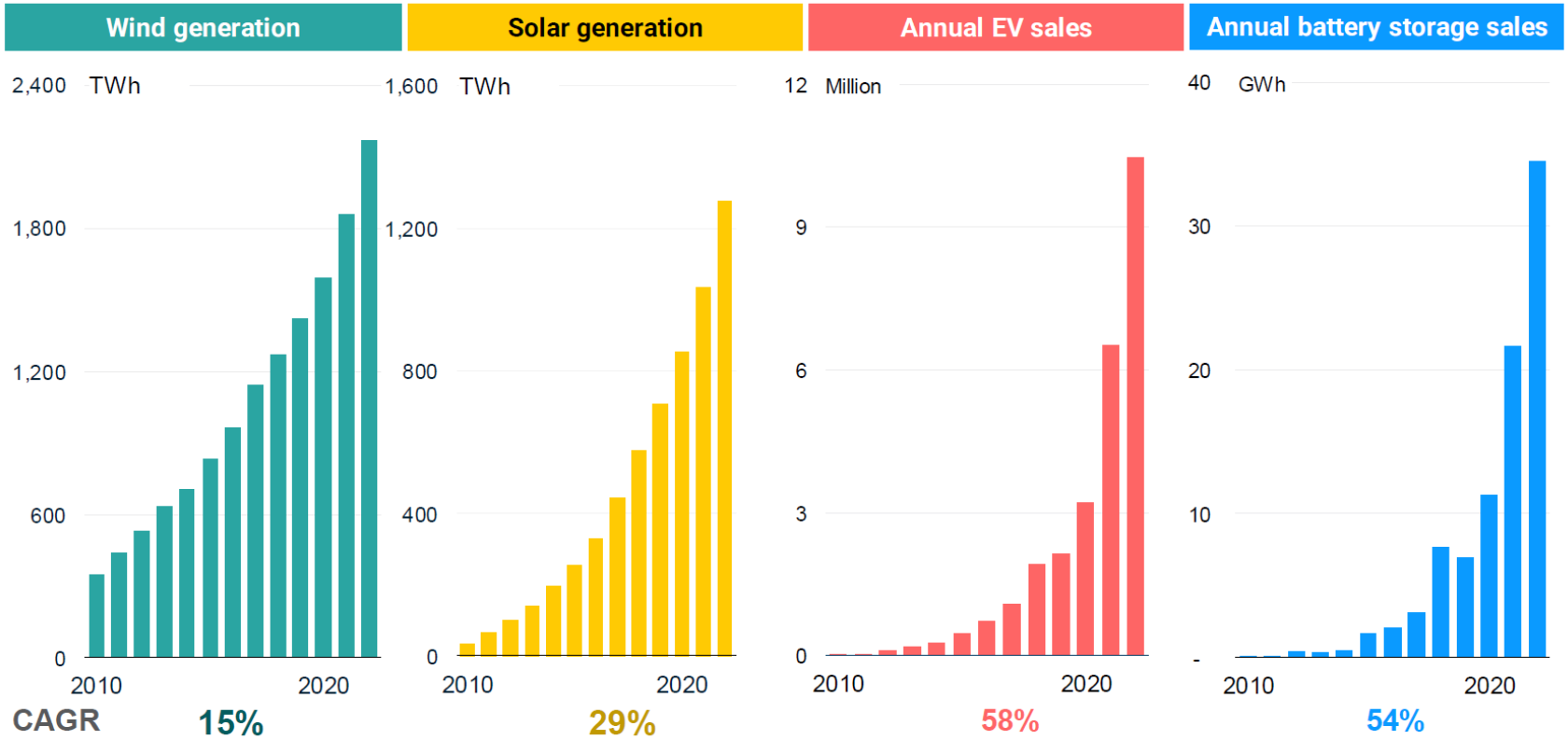
Solar and wind energy potential as a multiple of total energy demand



Source: Carbon Tracker

Source: RMI renewable revolution; https://rmi.org

Exponential energy change is all around us



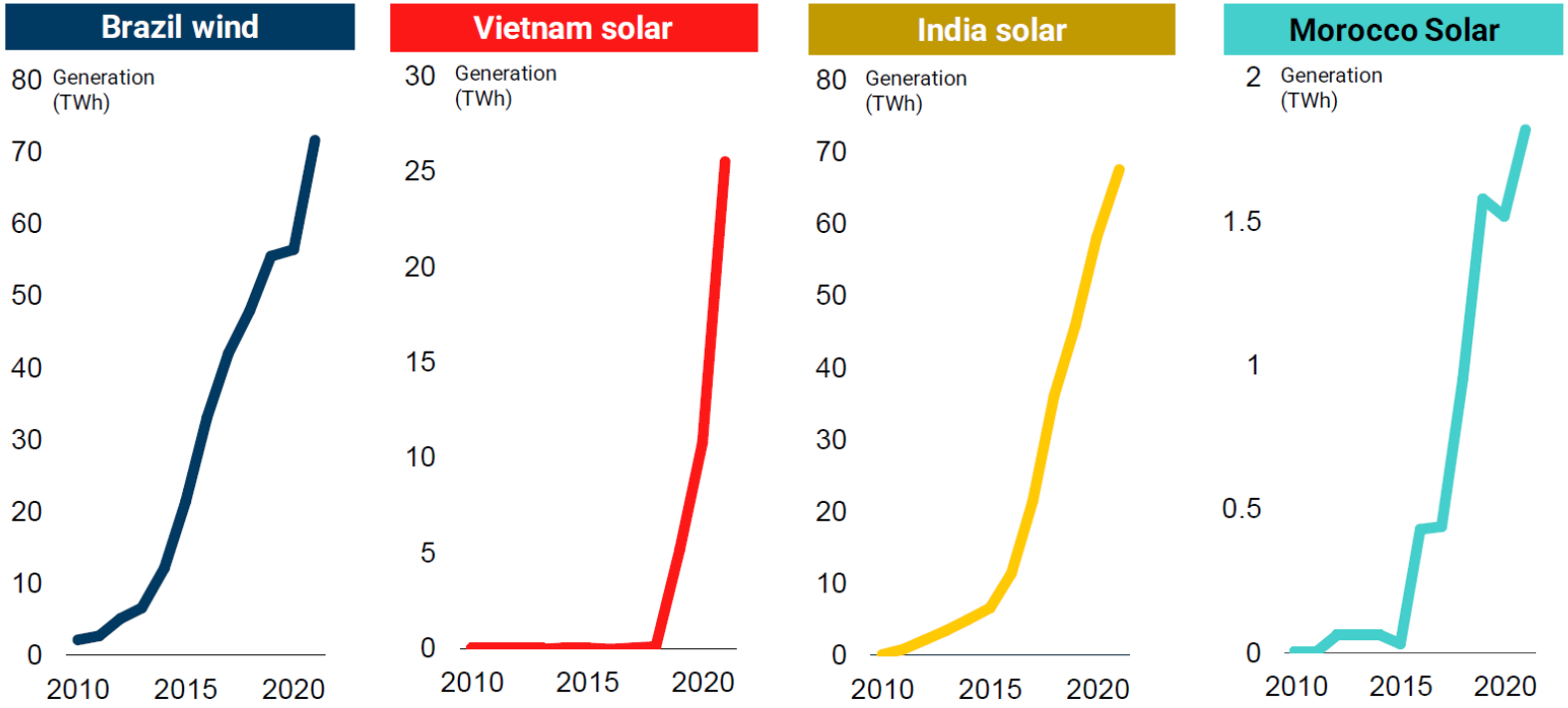
RMI – Energy. Transformed.

Source: BNEF, BP, Ember; Note: CAGR is the compound annual growth rate between 2012 and 2022. All data is global

Source: RMI renewable revolution; https://rmi.org

Change is happening across the world

Adoption of superior technology is not confined to the Global North

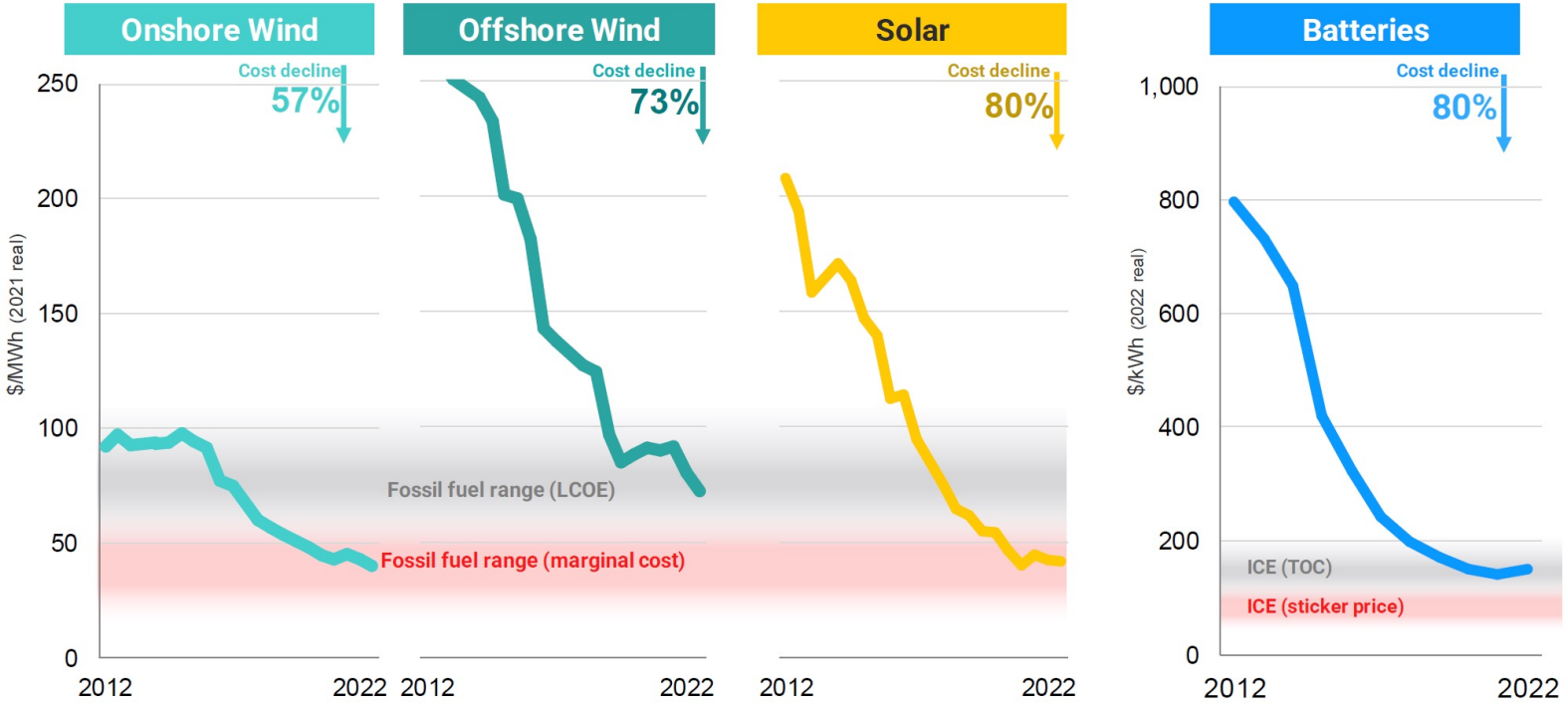


Source: BP, Ember

Source: RMI renewable revolution; https://rmi.org

We are in the middle of an energy technology cost revolution

The cost of new energy technologies has fallen by 60%–80% in the past 10 years

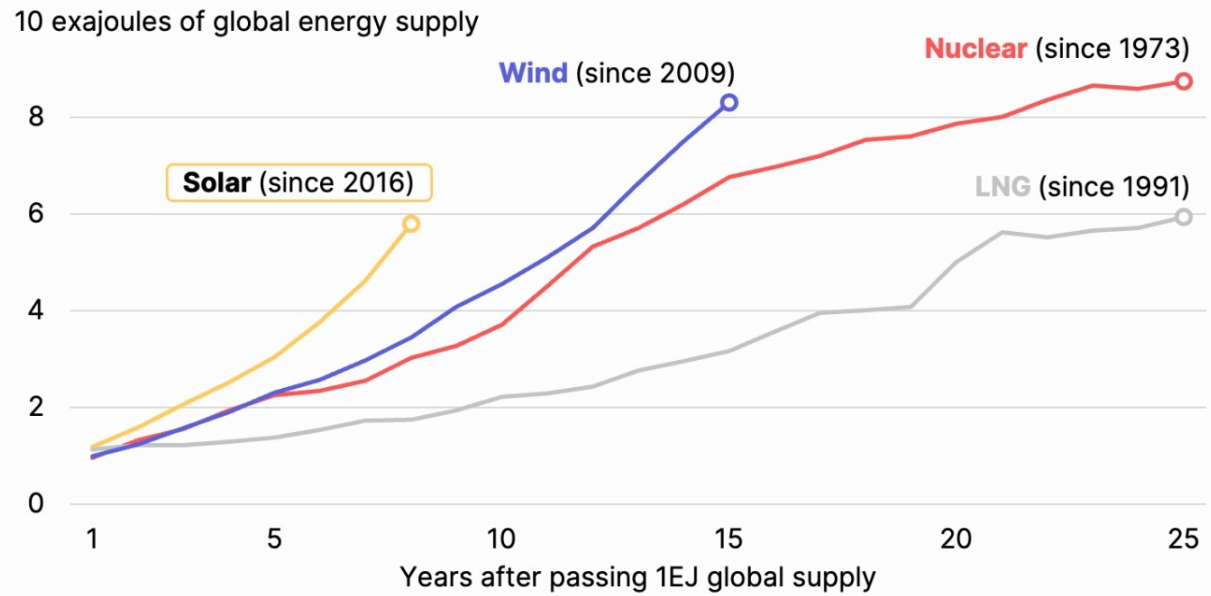


Source: BNEF

Source: [RMI renewable revolution; https://rmi.org](https://rmi.org)

The fastest new exajoules in decades

Solar and wind are adding new energy supply faster than LNG or nuclear ever have



Source: Ember, Shell, IEA

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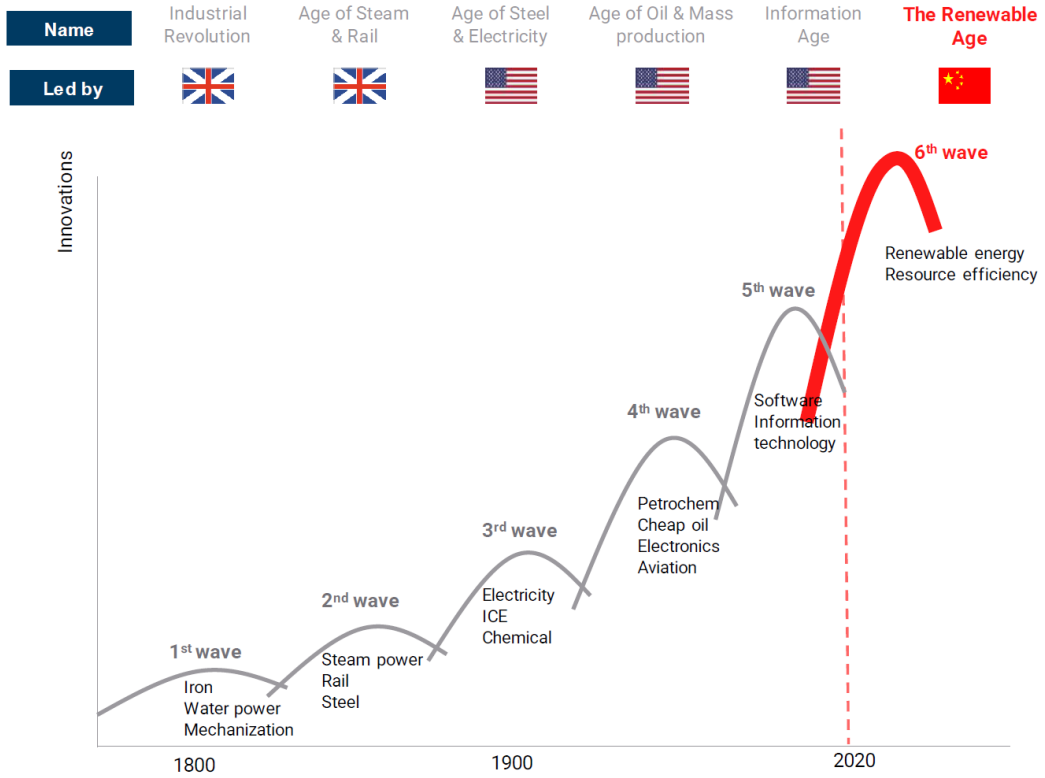
Source: [Presentations — Nat Bullard (nathanielbullard.com)]

Exponential is the new normal.

Do we go fast?
Or faster?

Another technology revolution — this time led by China

- Carlota Perez sets out five technology revolutions, taking place once every 40 years or so.
- The first two technology revolutions were led by the UK.
- The next three by the United States.
- The renewable revolution is led by China. That matters to the speed of change because China does not have the constraints faced by others.
- And as China surges ahead, so others race to catch up.

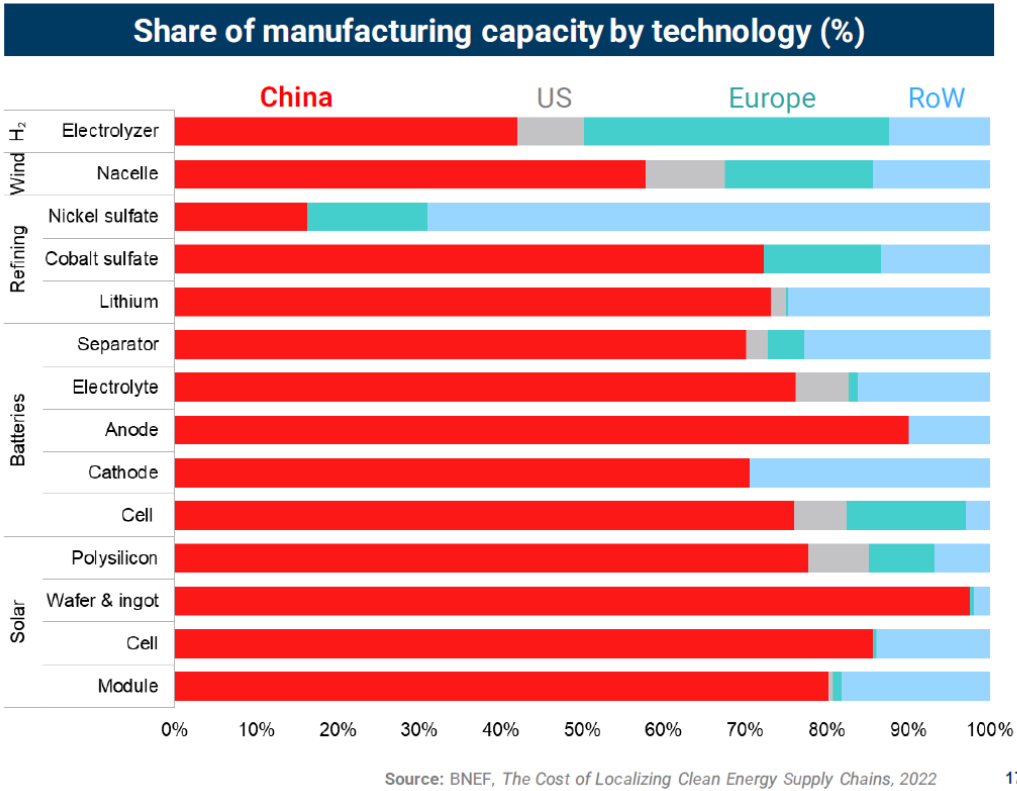


Source: Carlota Perez (first five), RMI (renewable age)

Source: [RMI renewable revolution; https://rmi.org](https://rmi.org)

China dominates production of renewables

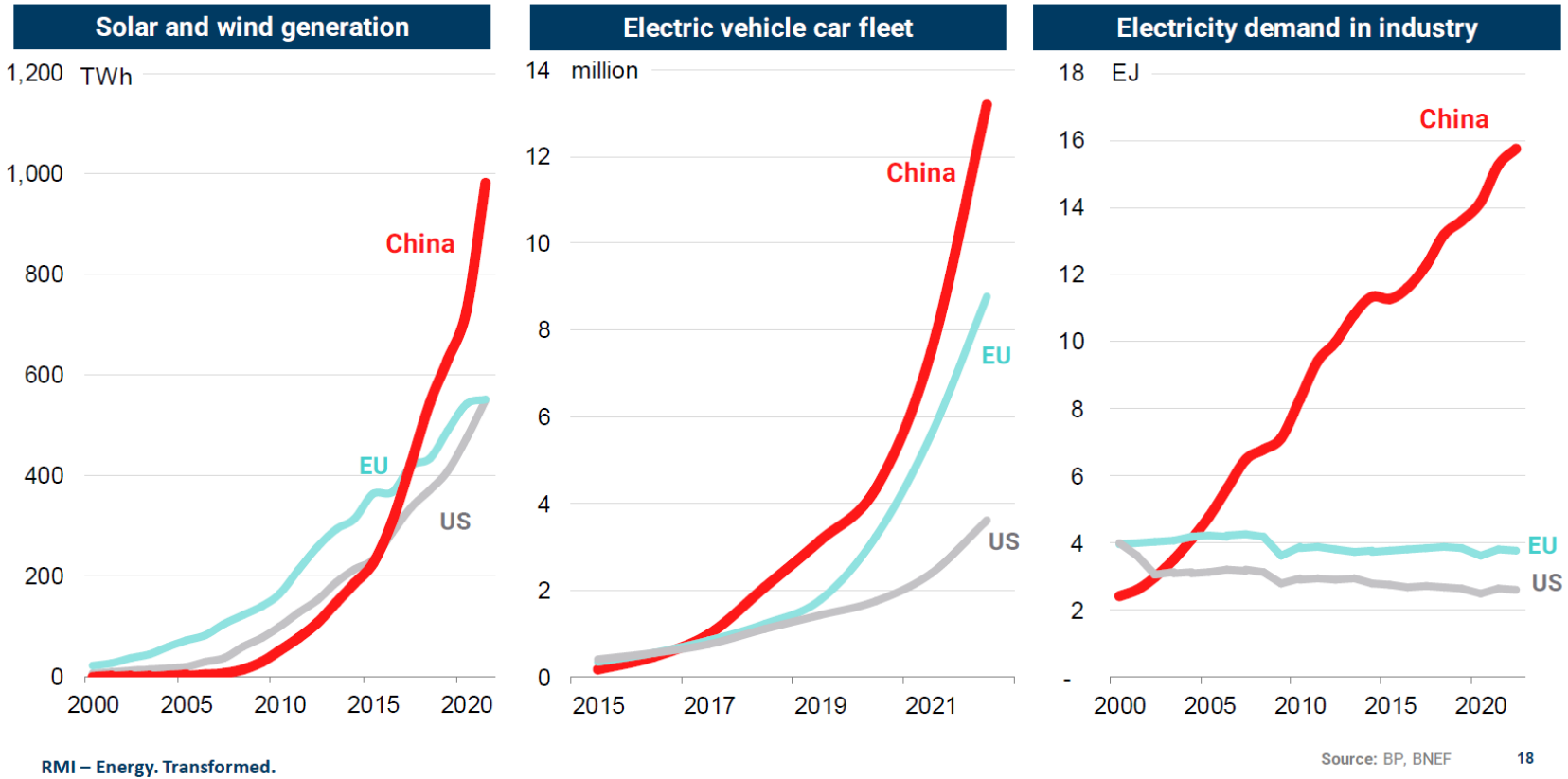
- China dominates production of all the key renewable energy technologies for many reasons:
  - It is the workshop of the world.
  - Manufacturing costs are considerably lower in China than elsewhere.
  - It is a major fossil fuel importer.
  - The government has had a strategic focus on renewables for a long time.
  - The West was not sufficiently focused on leadership.



Source: BNEF, *The Cost of Localizing Clean Energy Supply Chains, 2022*

Source: RMI renewable revolution; https://rmi.org

China leads the deployment of renewables

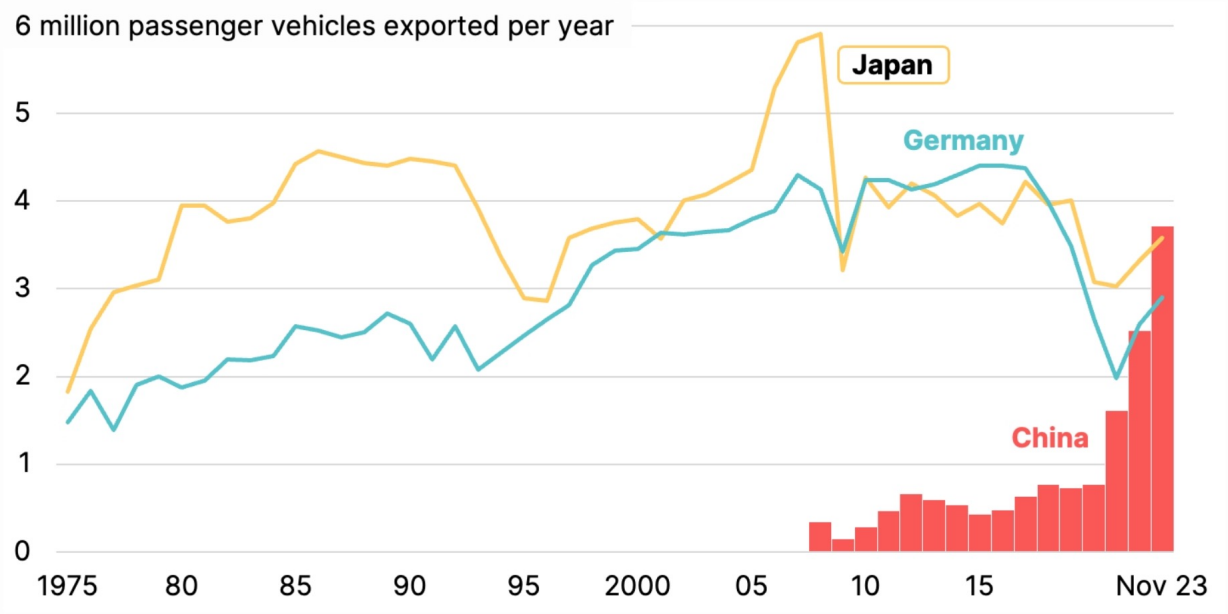


RMI – Energy. Transformed.

Source: [RMI renewable revolution; https://rmi.org](https://rmi.org)

The new global export leader

China almost certainly passed Japan as the world's biggest passenger car exporter in 2023



Source: VDA, JAMA, CAAM

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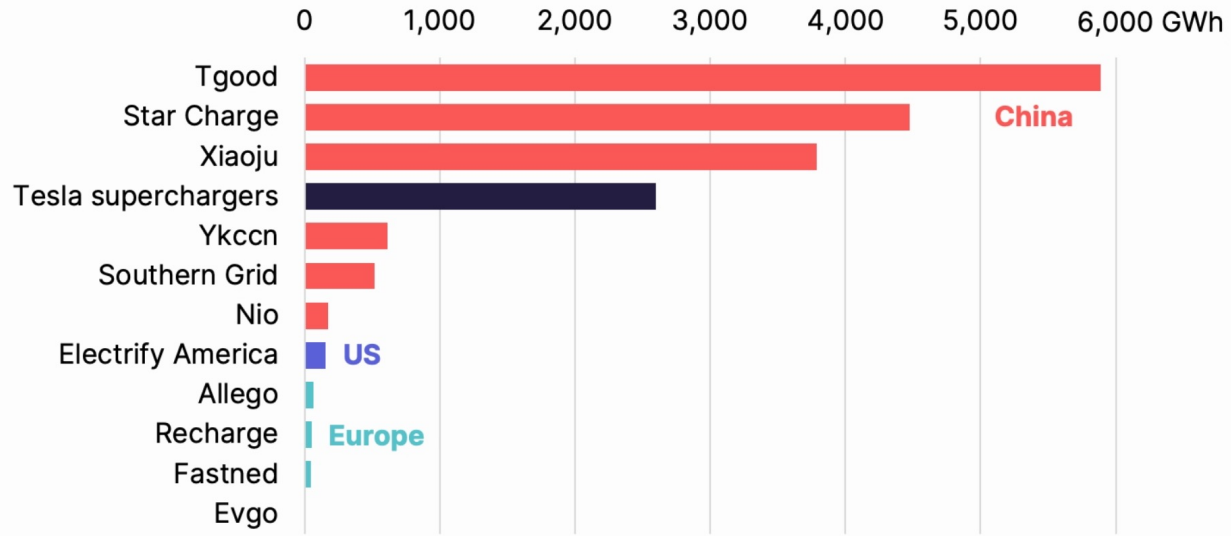
Source: [Presentations — Nat Bullard (nathanielbullard.com)]

EV charging at country scale

China's biggest EV charging networks already deliver as much power as Ethiopia generates

Energy delivered by select public EV charging networks, 2022



Source: BloombergNEF

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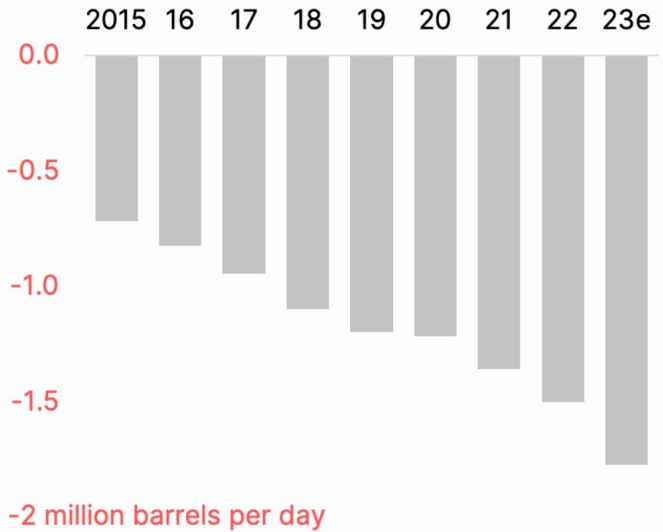
Source: [Presentations — Nat Bullard (nathanielbullard.com)]

Demand displacement

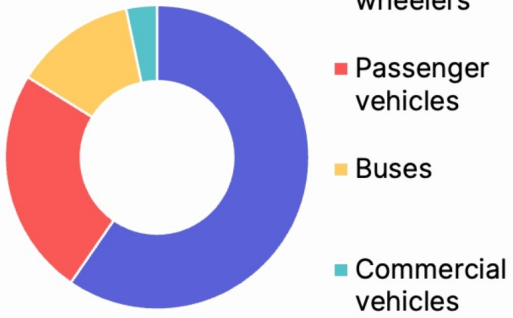
Electric vehicles displace almost 2 million barrels a day of oil demand, 60% from 2-3 wheelers

Source: BloombergNEF, IEA

Oil demand displacement by electric vehicles



Displacement by vehicle type



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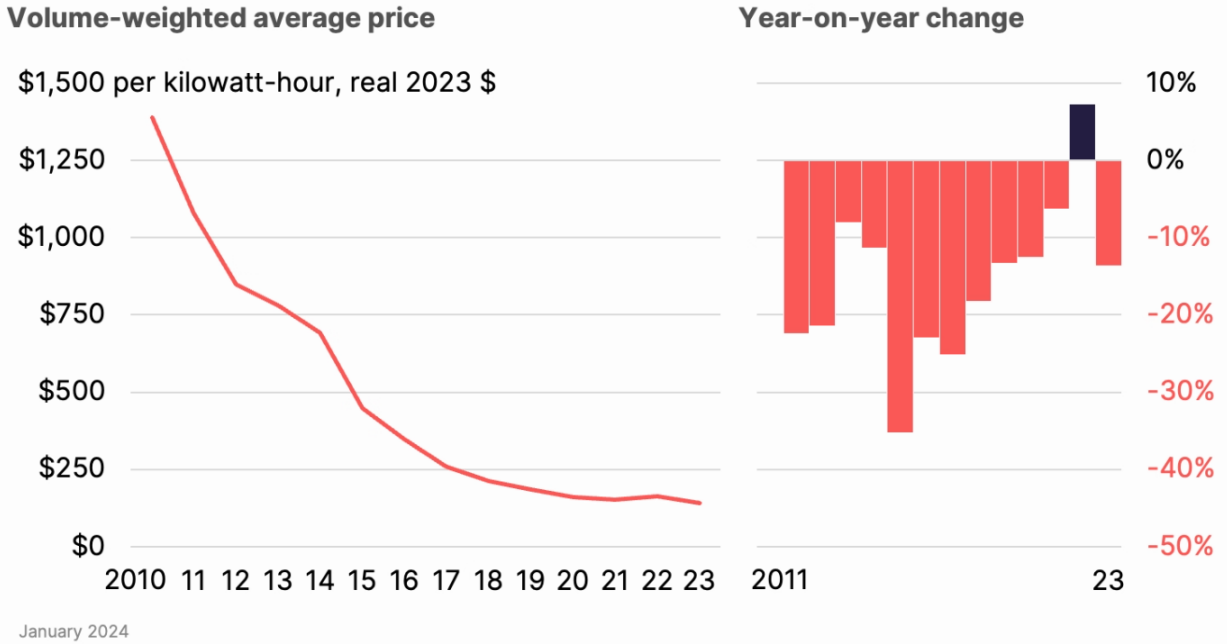
Source: [Presentations — Nat Bullard (nathanielbullard.com)]


BATTERIES. BATTERIES EVERYWHERE
LIGHTYEAR

Battery prices fell (again)

Lithium-ion battery prices continued their long-term decline, after increasing in 2022

Source: BloombergNEF



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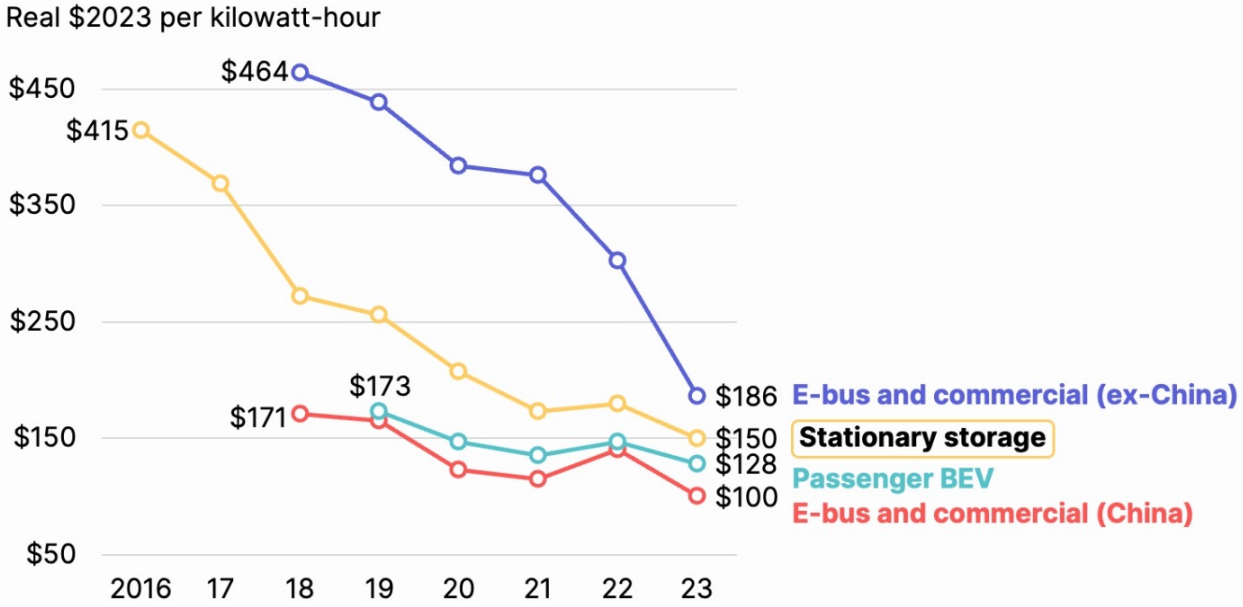
Source: [Presentations — Nat Bullard (nathanielbullard.com)]

Battery price convergence

As the battery sector matures, pack prices are converging between applications



Source: BloombergNEF

Note: weighted average prices per sector

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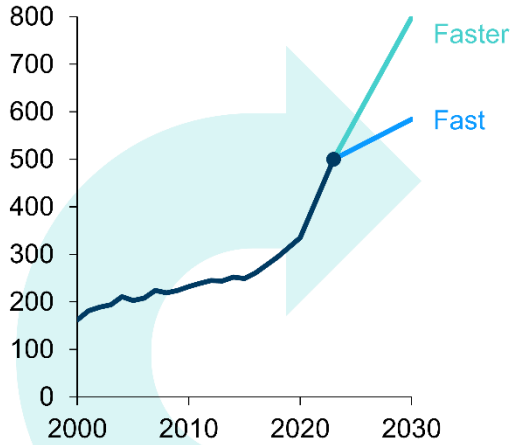
Source: [Presentations — Nat Bullard (nathanielbullard.com)]

The drivers of change will strengthen

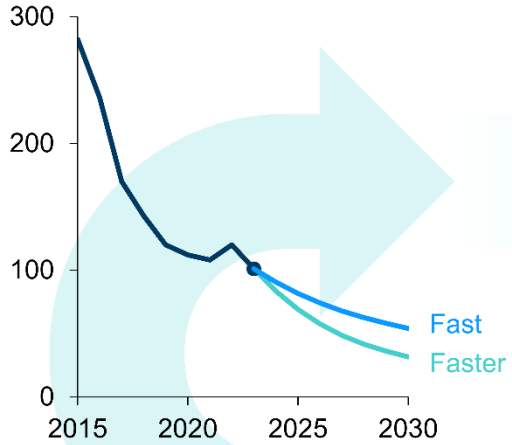
Battery energy density keeps rising…

Top-tier battery cell energy density outlook, Wh/kg



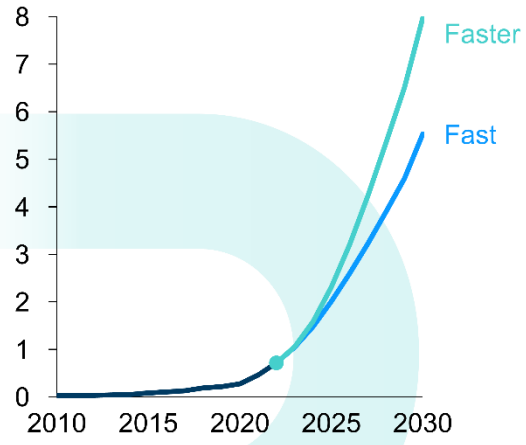
…while battery cost keeps falling…

Battery cell cost outlook, $/kWh



…driving exponential growth of battery demand…

Battery demand outlook, TWh/y

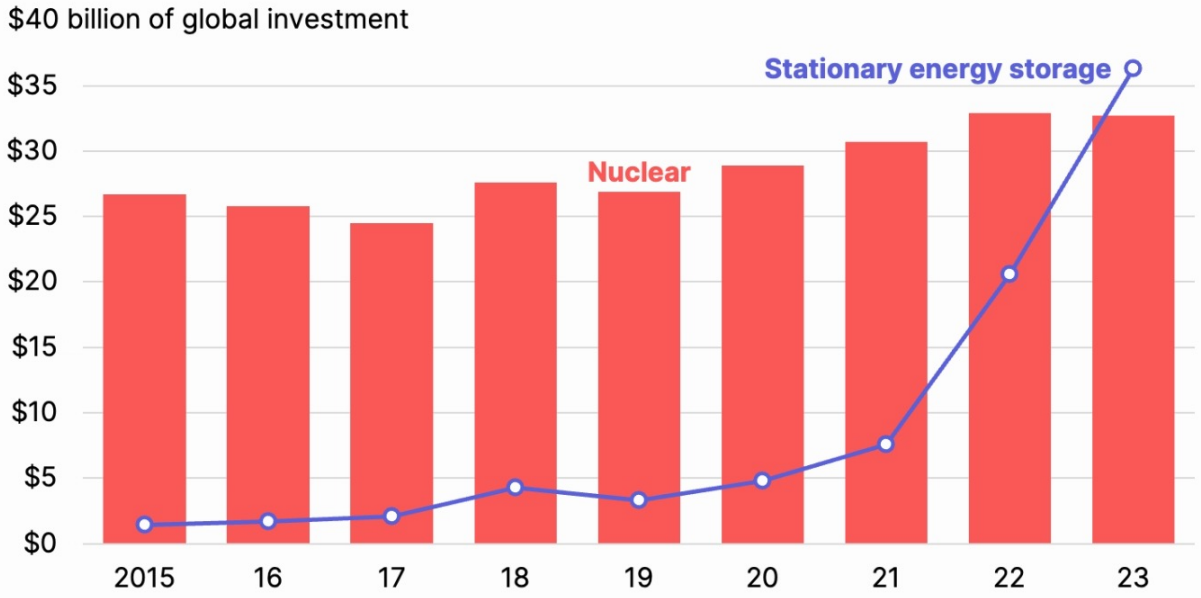


…which, in turn, further increases energy density and lowers cost through economies of scale and learning effects.

Source: [The Rise of Batteries in Six Charts and Not Too Many Numbers - RMI]

Storage passes nuclear

Investment in stationary energy storage exceeded nuclear power investment in 2023



Source: BloombergNEF

Note: excludes pumped hydro and hydrogen energy storage projects

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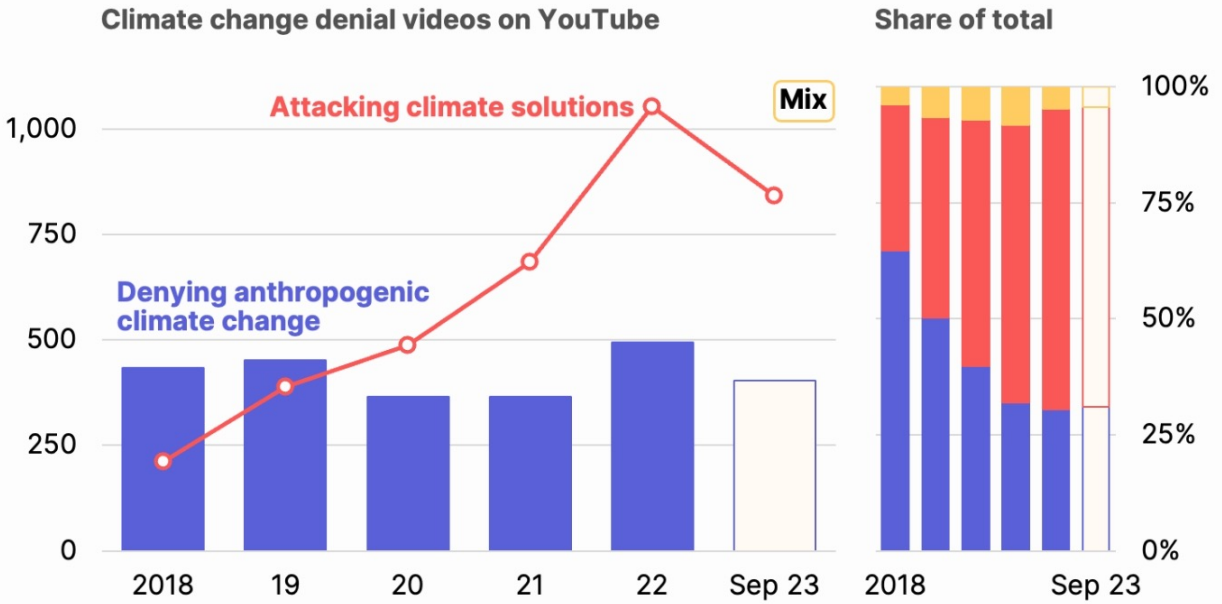
Source: [Presentations — Nat Bullard (nathanielbullard.com)]

From denying change to attacking solutions

YouTube climate denial videos are shifting away from outright denial, and to attacking solutions



Source: Center for Countering Hate, YouTube, Bloomberg

Note: 96 YouTube channels in study

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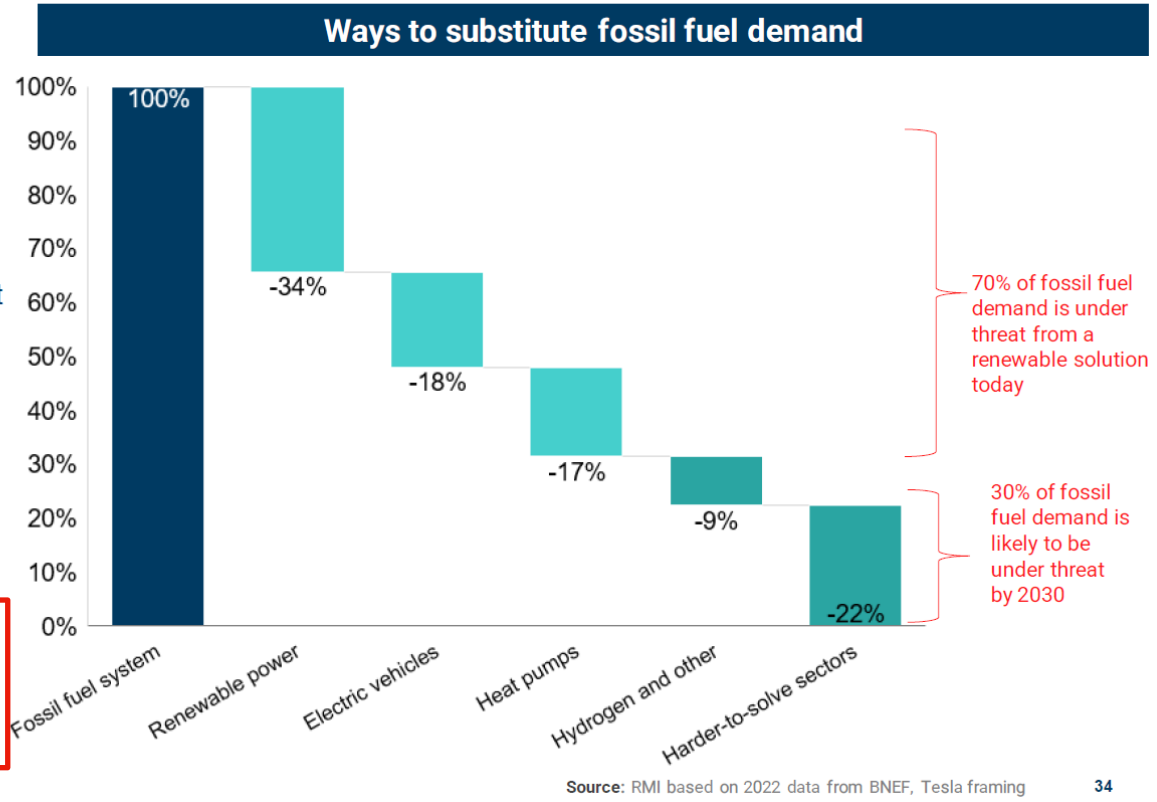
Source: [Presentations — Nat Bullard (nathanielbullard.com)]

Key technologies are enough to reshape the energy system

- Solar and wind decarbonize electricity, which is over a third of fossil fuel demand.
- EVs decarbonize road transport — first light then heavy.
- Heat pumps decarbonize home heat and light industry.
- Electrification and hydrogen solve most of the rest.
- Most attention focuses on the hard-to-solve areas which are the last 22% of fossil fuel demand, and solutions are already coming.
- But we already have today economically viable technology solutions eating into the first 70% of fossil fuel demand.



Source: [RMI renewable revolution; https://rmi.org]

Better roughly right than precisely wrong

Quote from The Eight Deadly Sins of Analyzing the Energy Transition - RMI

Pandora's box has been opened.
In every area of the energy system, people are hunting for solutions to improve efficiency, reduce carbon emissions, and lower costs.

Quote from [The Eight Deadly Sins of Analyzing the Energy Transition - RMI]

The error is to look only under the climate streetlight, thinking the sole driver of the energy transition is halting climate change.

The climate was the spark and remains a constant and powerful catalyst, ***but the forces of change are deeper and the motivations more diverse.***

Quote from The Eight Deadly Sins of Analyzing the Energy Transition - RMI

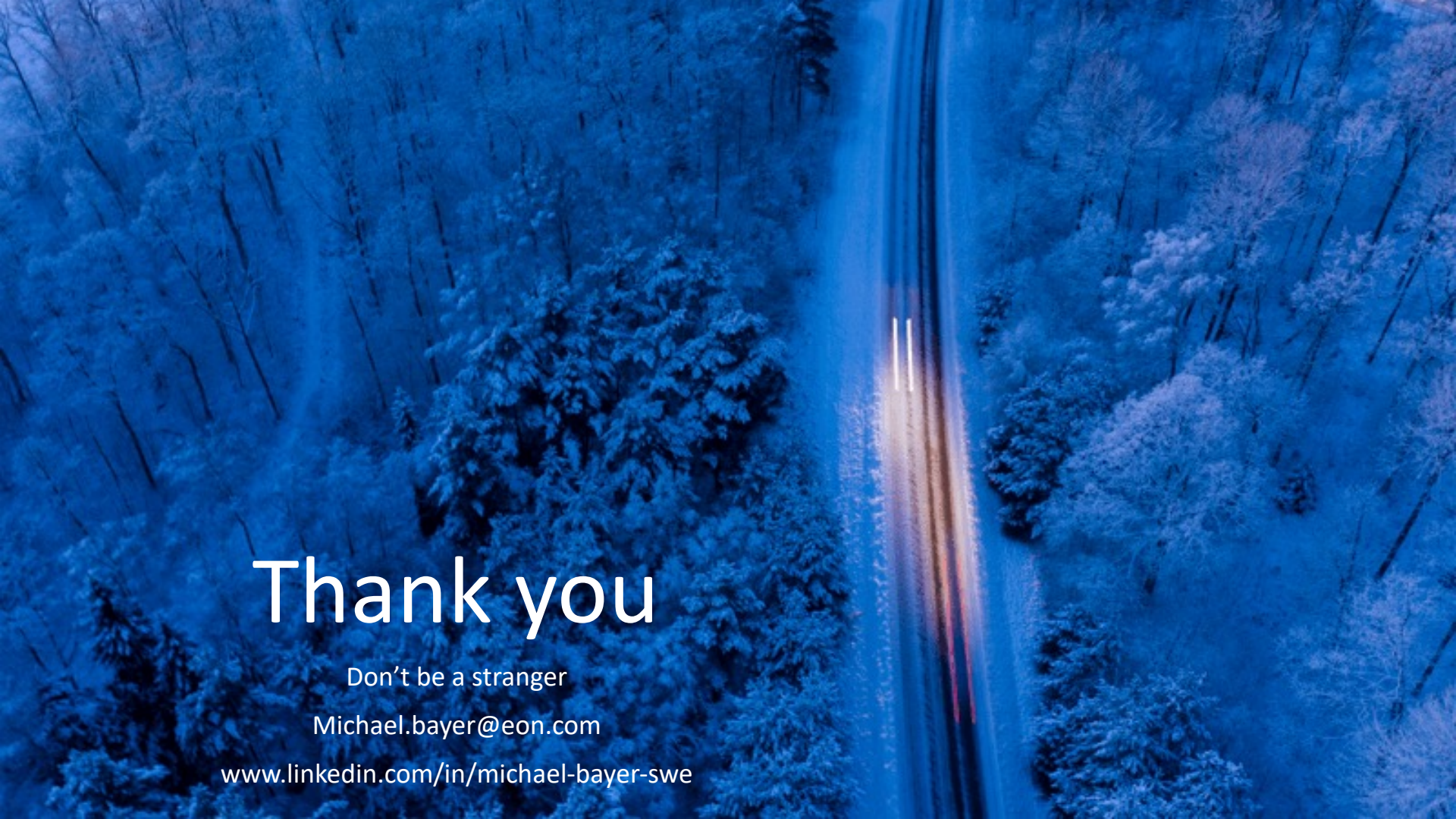
We have the solutions TODAY

Don't let tomorrow's problems stop us

Exponential is the new normal

Be the LEADER the world needs

We build the future we expect



Thank you

Don’t be a stranger

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