The Global Energy Transition:
How to get rich and save the planet

Presentation to I-SEE, University of Bath

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Summary

- This presentation sets out an alternative view of the energy transition.
- Rapid energy technology change is inevitable and beneficial, not forced and costly.
- The speed of change is set by challengers, not incumbents; by fossil fuel importers, not exporters; and by markets more than policymakers.
- Ever-falling costs open up new markets and opportunities.
- Financial markets, policy, and social norms are responsive, not static.
- This is a just transition, as we move from a commodity that favors the few to technology for the many.
- History shows that rapid technology shifts at the margin are the norm, not the exception.
- Peaks come early, and with peaks comes disruption.
- Change happens far faster than most incumbent experts predict.
- This decade will see enormous opportunity for those that embrace change, and catastrophic risk for those that fail to see what is going on.
- The energy transition is not primarily a debate about ideology or values. It is simply a technology shift.
- This will not be easy as incumbents resist change. So we need to make it happen. The renewable economy needs to be built.

Two Competing Views on the Energy Transition

Slow, hard, & forced vs. fast, beneficial, & inevitable

New Energy Technologies: Superior or Inferior

Growth of New: S-curves or Linear

Cost: Learning Curves or No Change

Challenges: Temporary or Insoluble

Financial Markets: Responsive or Static

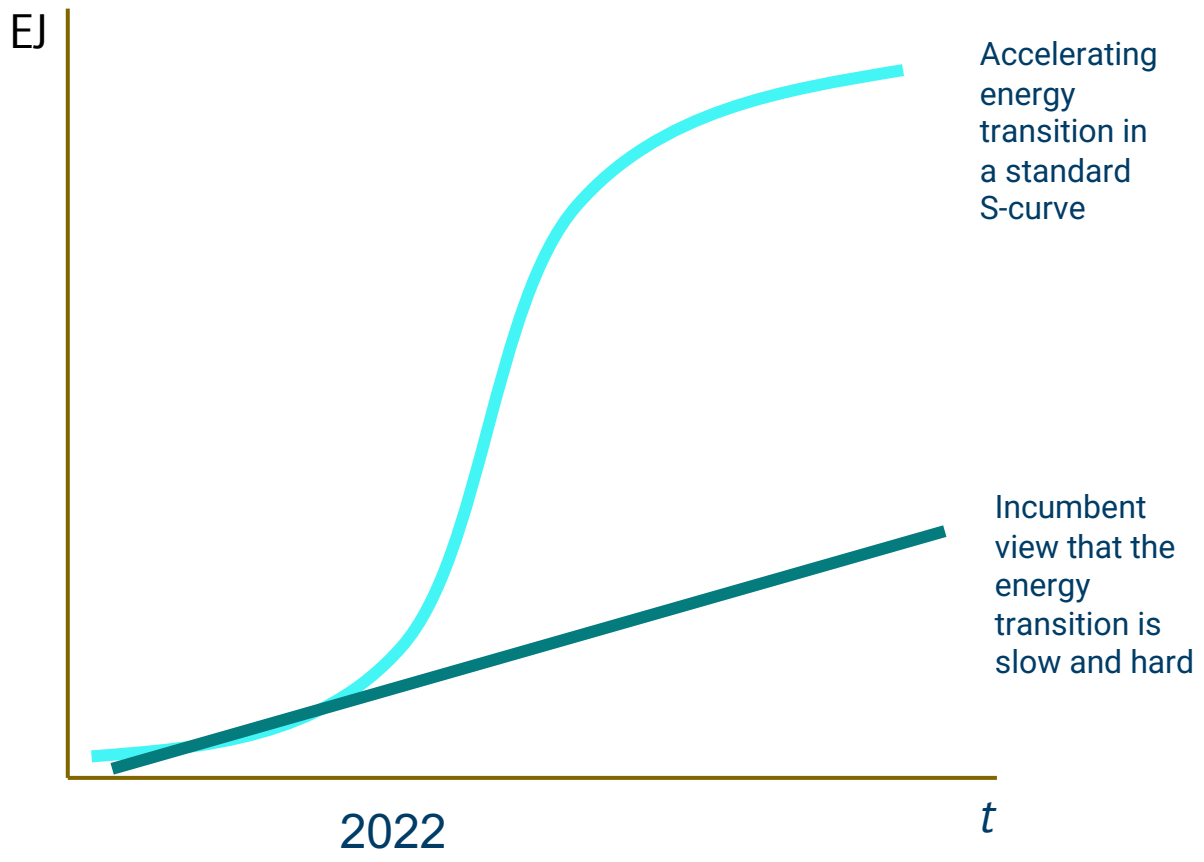
Policy & Societal Pressure: Rising or Static

Who Sets the Tempo: Insurgents or Incumbents; Fossil Importers or Exporters

Disruption Comes: Early or Late

Narrative: Gain or Pain

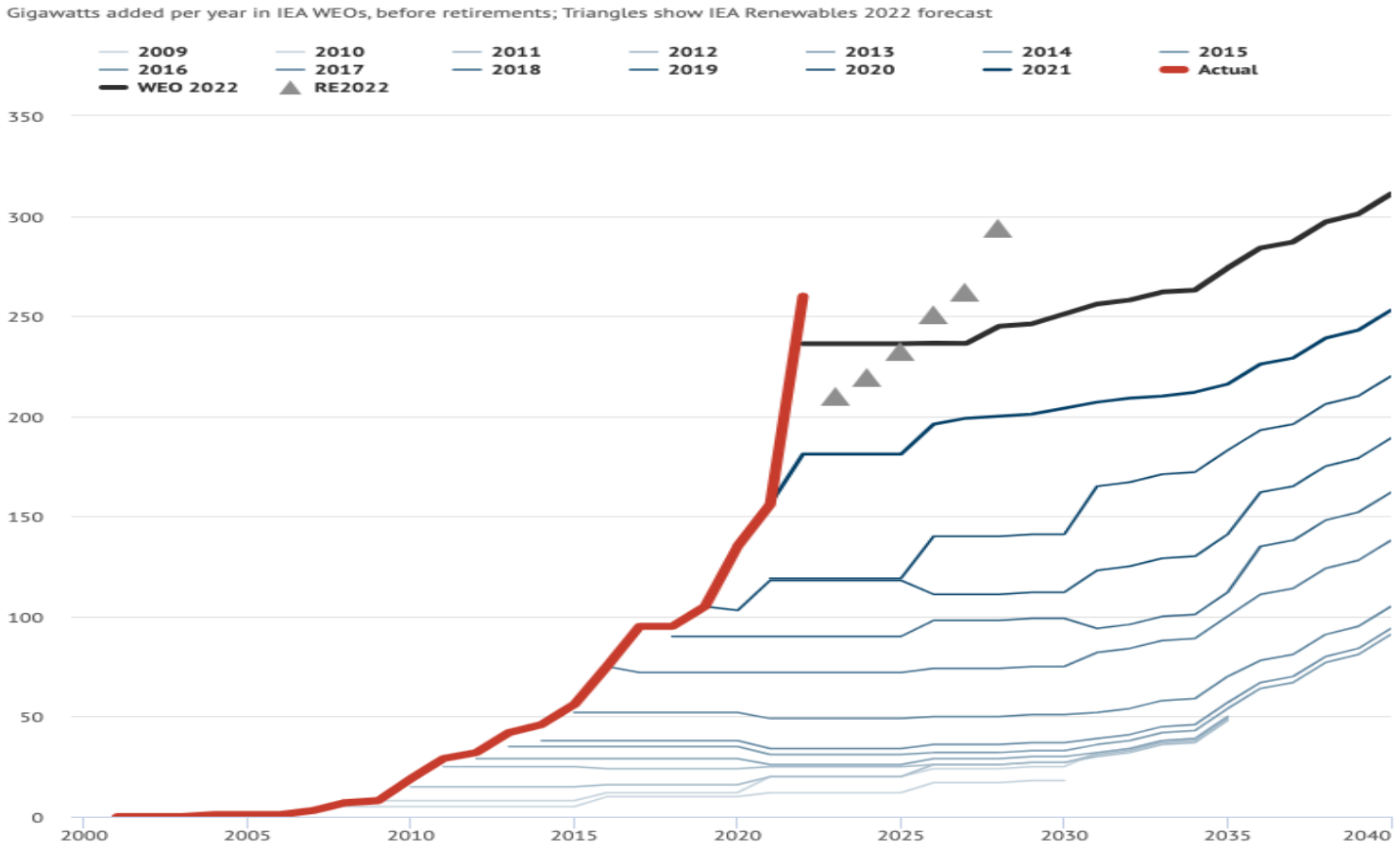
Indicative Energy Transition Pathways



Source: RMI

The incumbents are lying to you. The world is changing fast

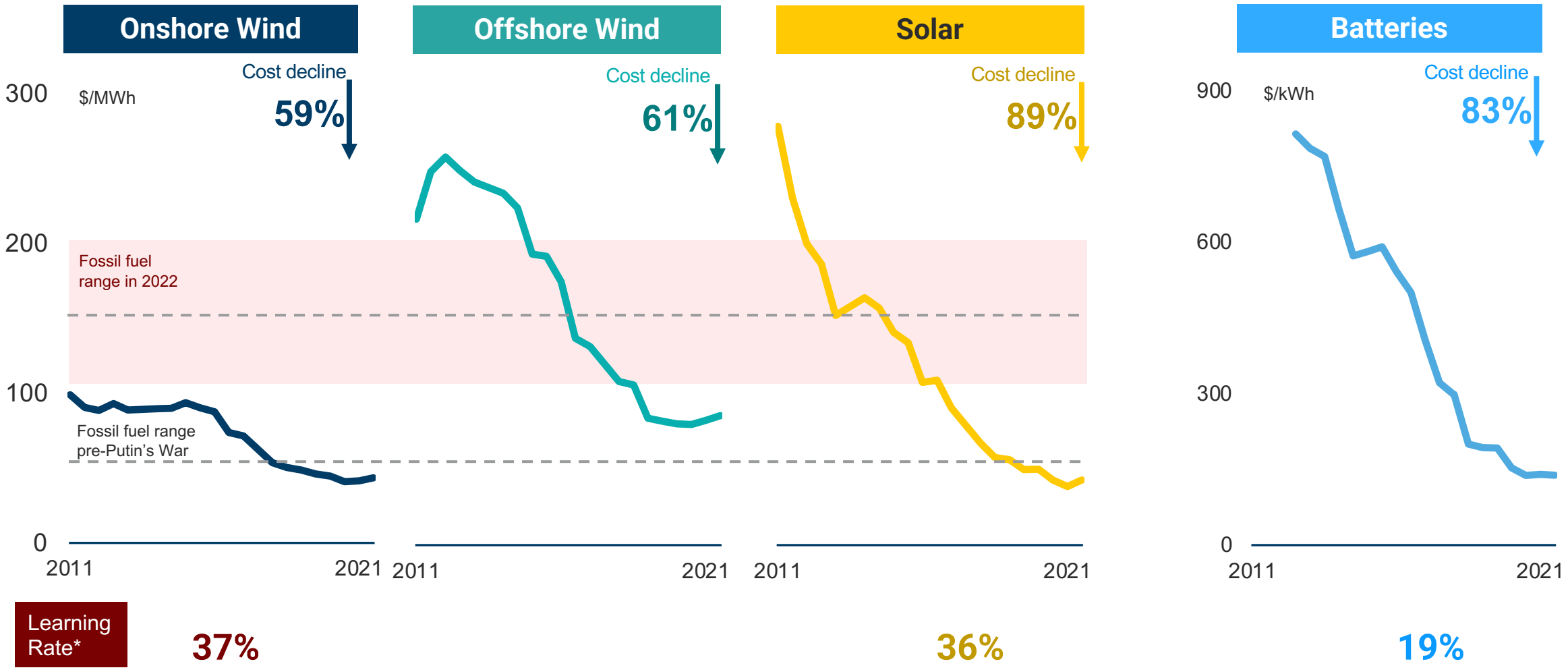
New solar capacity GW



Source: Carbon Brief via Auke Hoekstra

We Are in the Middle of an Energy Technology Cost Revolution

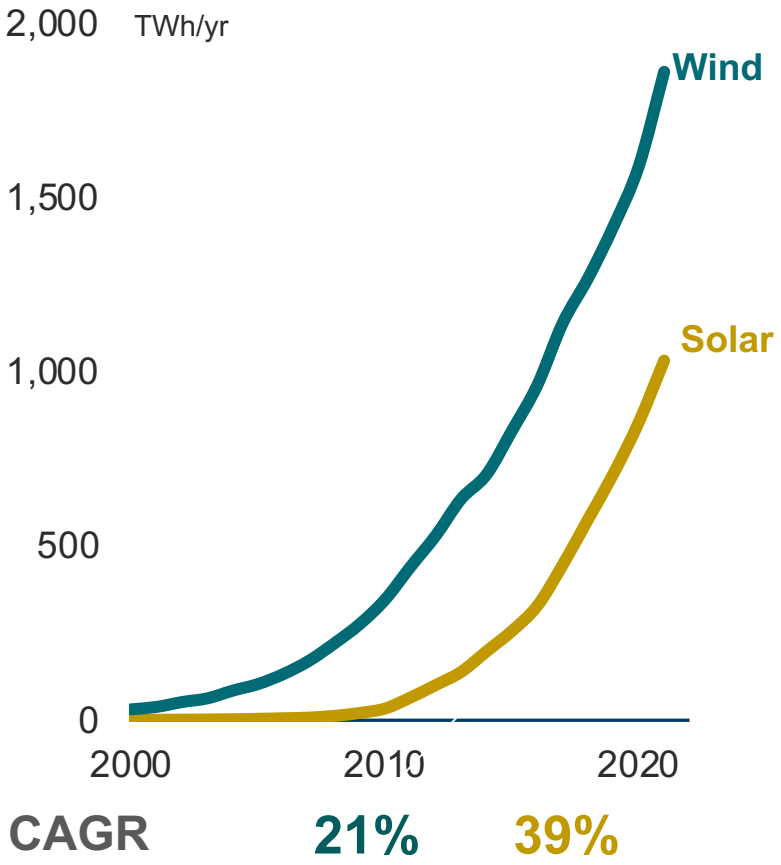
The cost of new energy technologies has fallen by 60%–90% in 10 years



Source: BNEF; Note: * in sample time period; Definition: the learning rate is the observed cost reduction for each doubling of deployment

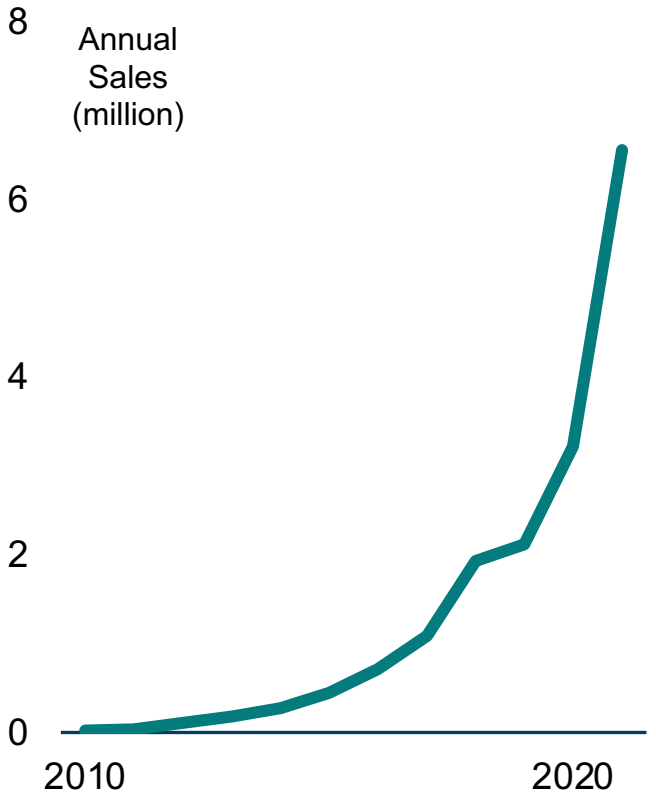
Exponential Energy Change Is All around Us

Annual solar & wind generation



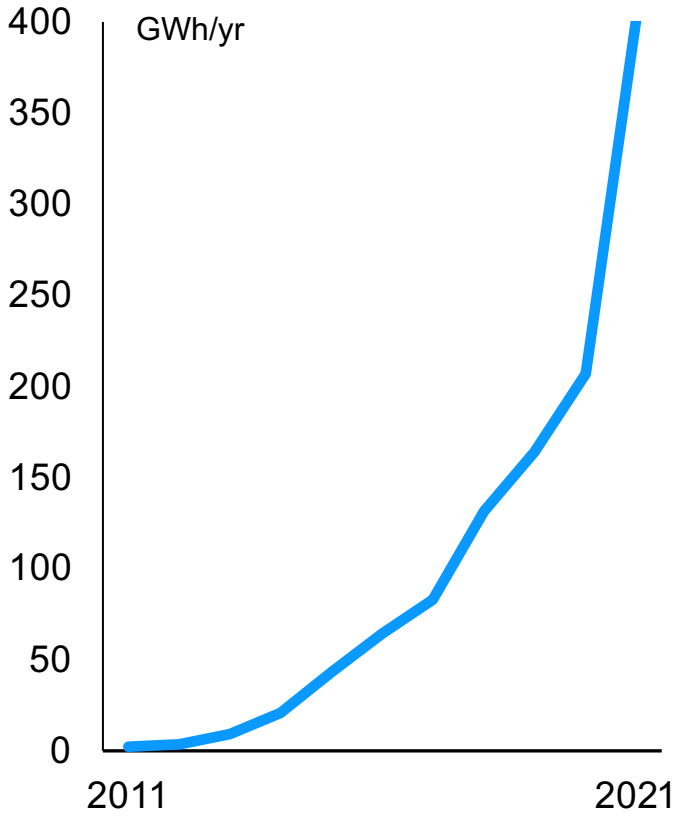
CAGR 21% 39%

Annual EV sales



68%

Annual battery sales

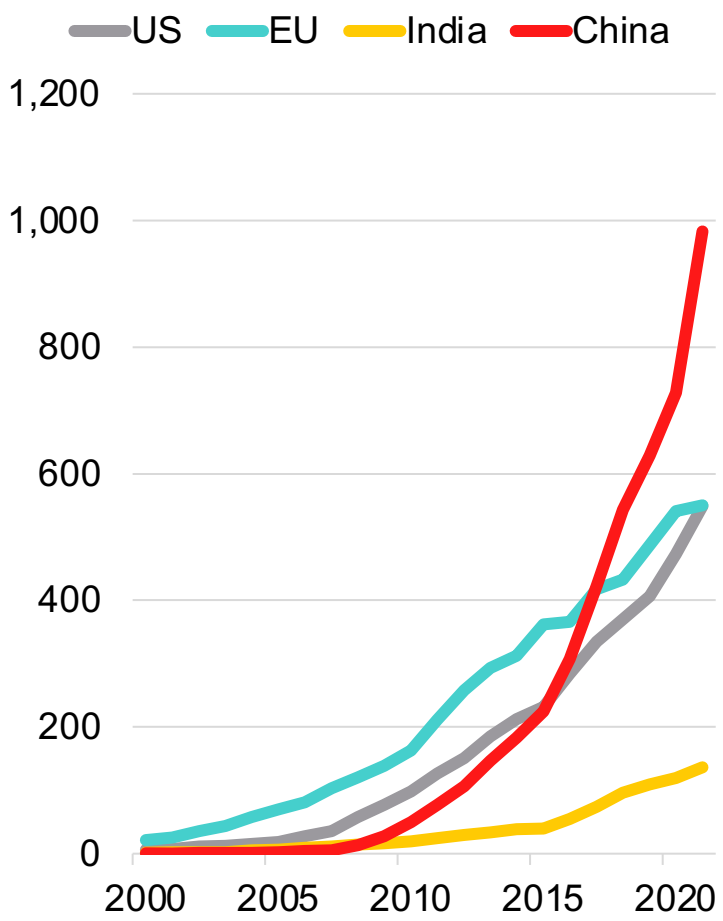


68%

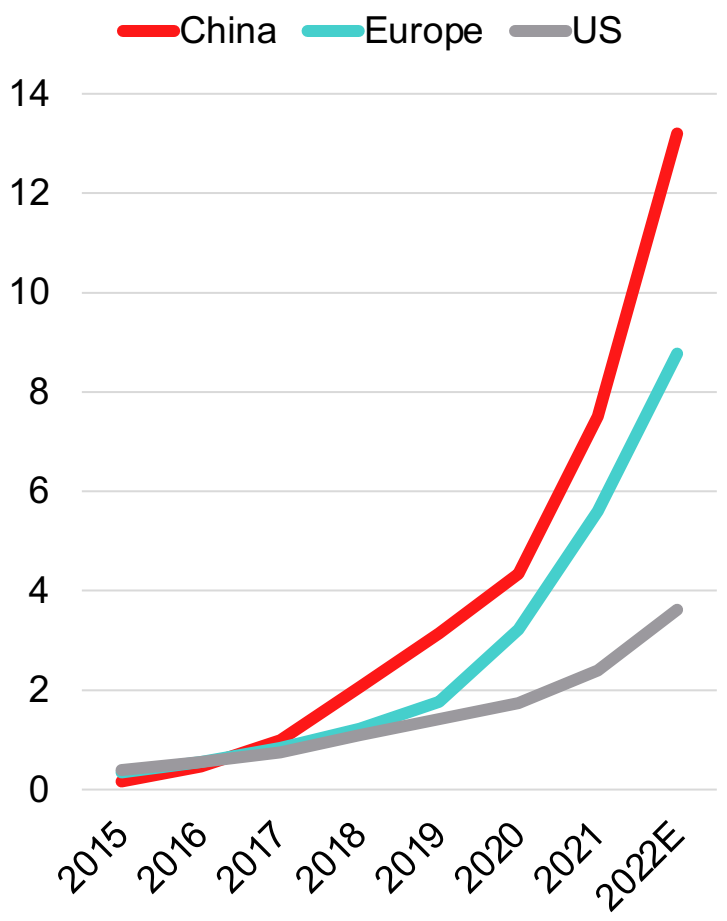
Source: BNEF, BP; Note: CAGR is the compound annual growth rate over the sample time period

China is the leader

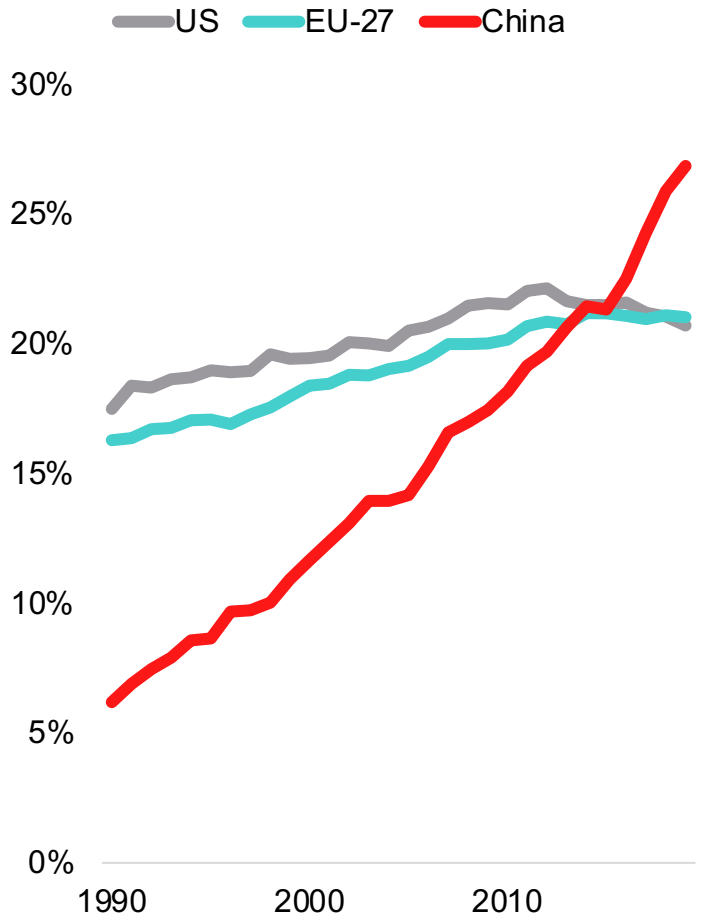
Solar and wind generation TWh



Electric vehicle fleet (m)



Electricity's share of final consumption

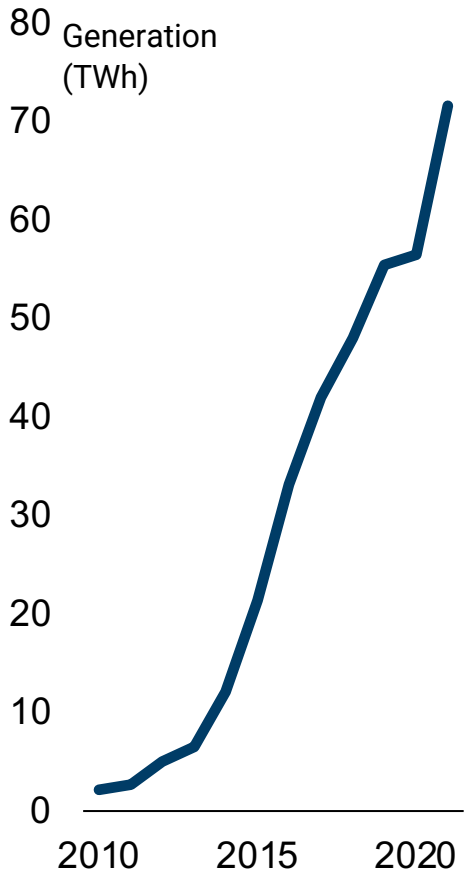


Source: BP, BNEF

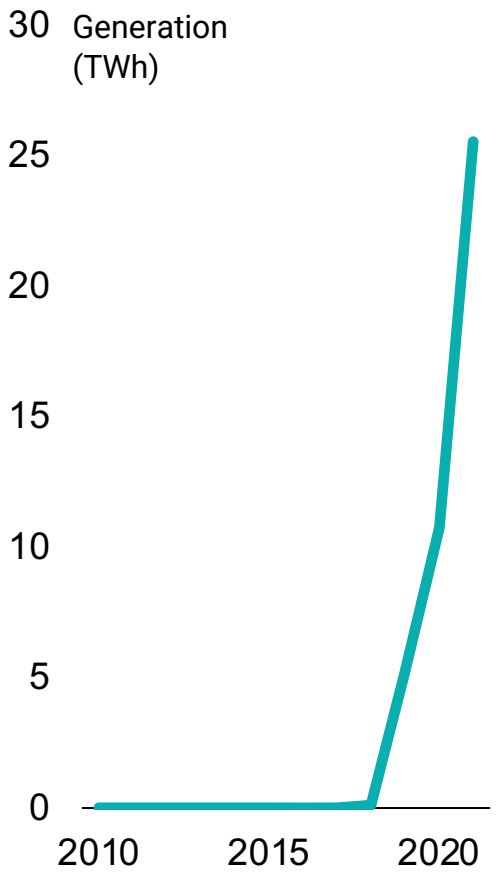
Change Is Happening across the World

Adoption of superior technology is not confined to the Global North

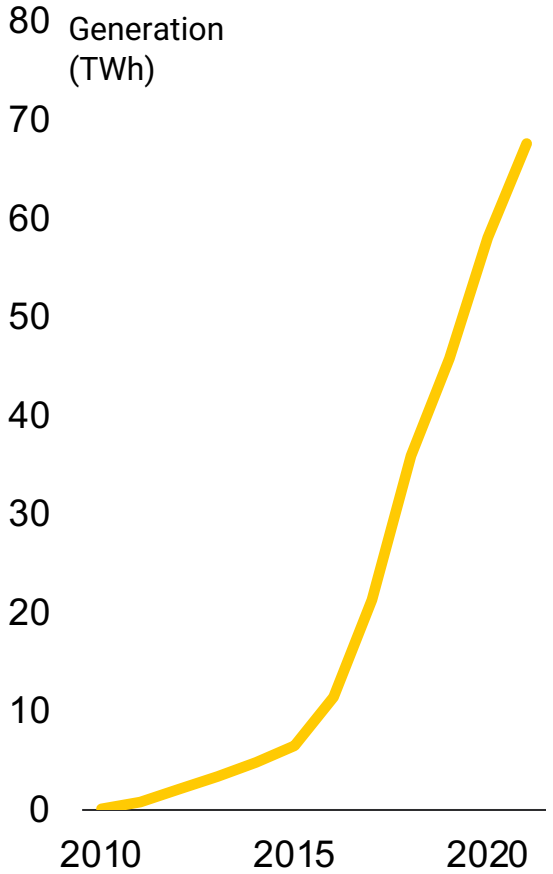
Brazil wind



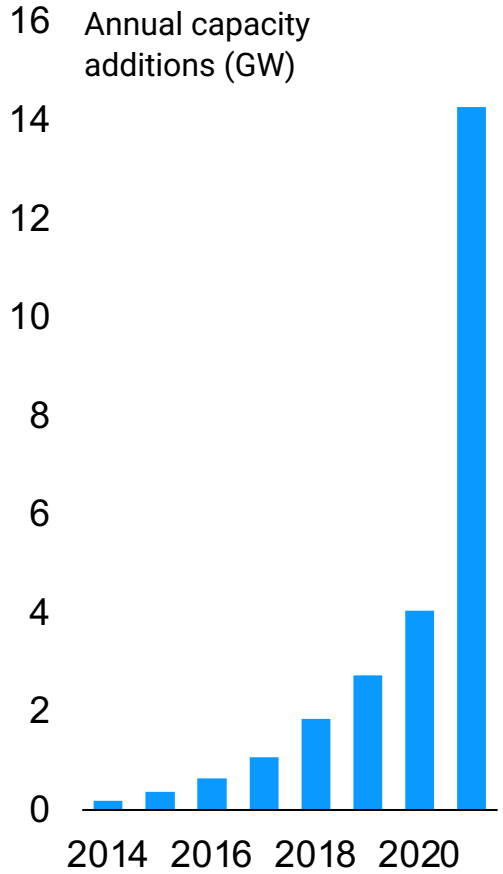
Vietnam solar



India solar



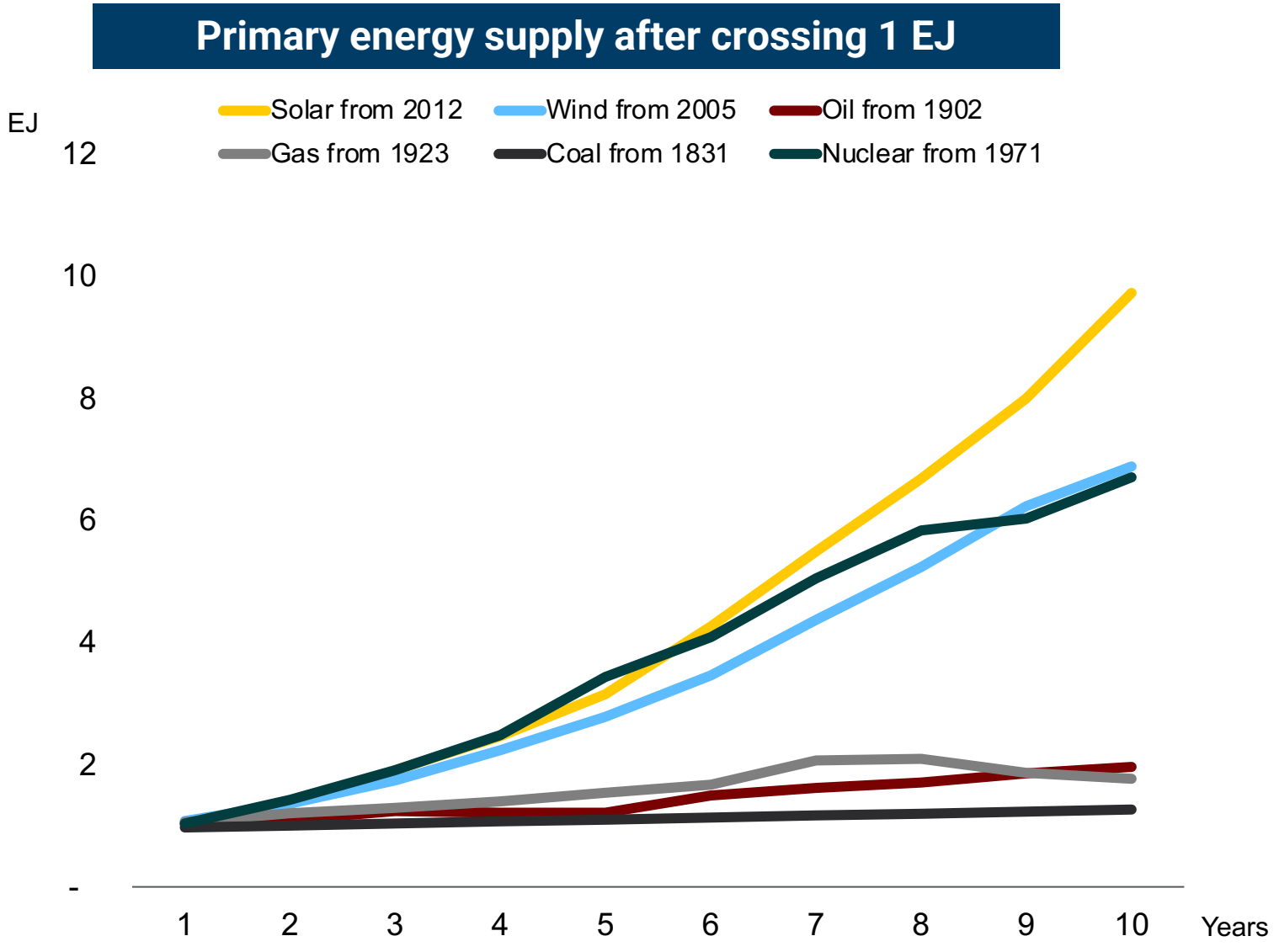
China offshore wind



Source: BNEF, BP

The speed of this growth is unprecedented

- In 1831, global energy supply from coal crossed 1 EJ. It took 51 years to reach 10 EJ, but still transformed the global balance of power.
- In 1902, oil reached 1 EJ. It took 34 years to reach 10 EJ. Gas took 32 years.
- Nuclear was fast initially but turned out not to enjoy a learning curve, and growth stopped about 30 years ago.
- Wind crossed 1 EJ in 2005 and reached 10 EJ only 13 years later.
- Solar crossed 1 EJ in 2012, and within a decade reached 10 EJ.
- These unprecedented growth rates have surprised incumbent forecasters for years.



Source: BP Statistical Review.
Note that 1 EJ of energy is the amount of primary energy Greece uses in a year

Renewable Costs Will Continue Falling on Learning Curves

Decreasing costs of solar, wind, batteries, and hydrogen — past and future

Key renewable energy technologies enjoy learning curves. Fossil fuels do not because technology improvements are offset by reserve depletion.

So the bigger renewables grow, the cheaper they get.

Learning curves are extremely persistent.

Learning curves have proven the most accurate way to forecast future costs.

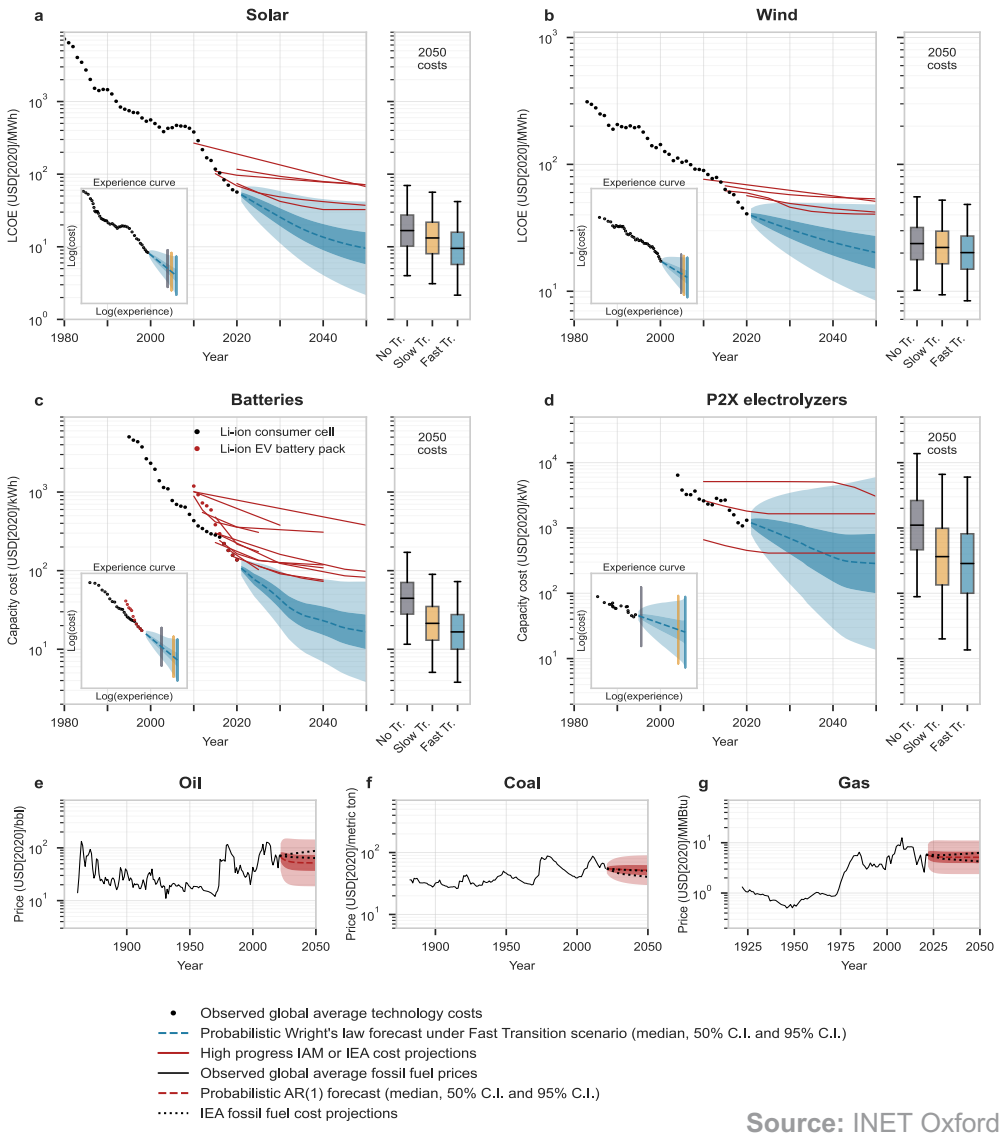
Mathematicians at Oxford University use this framing to forecast future costs.

Their central scenario implies $10 per MWh for solar LCOE by 2050 as a global average. The Al Shuaiba project is Saudi Arabia reached that level in 2021.

Primary

Carrier

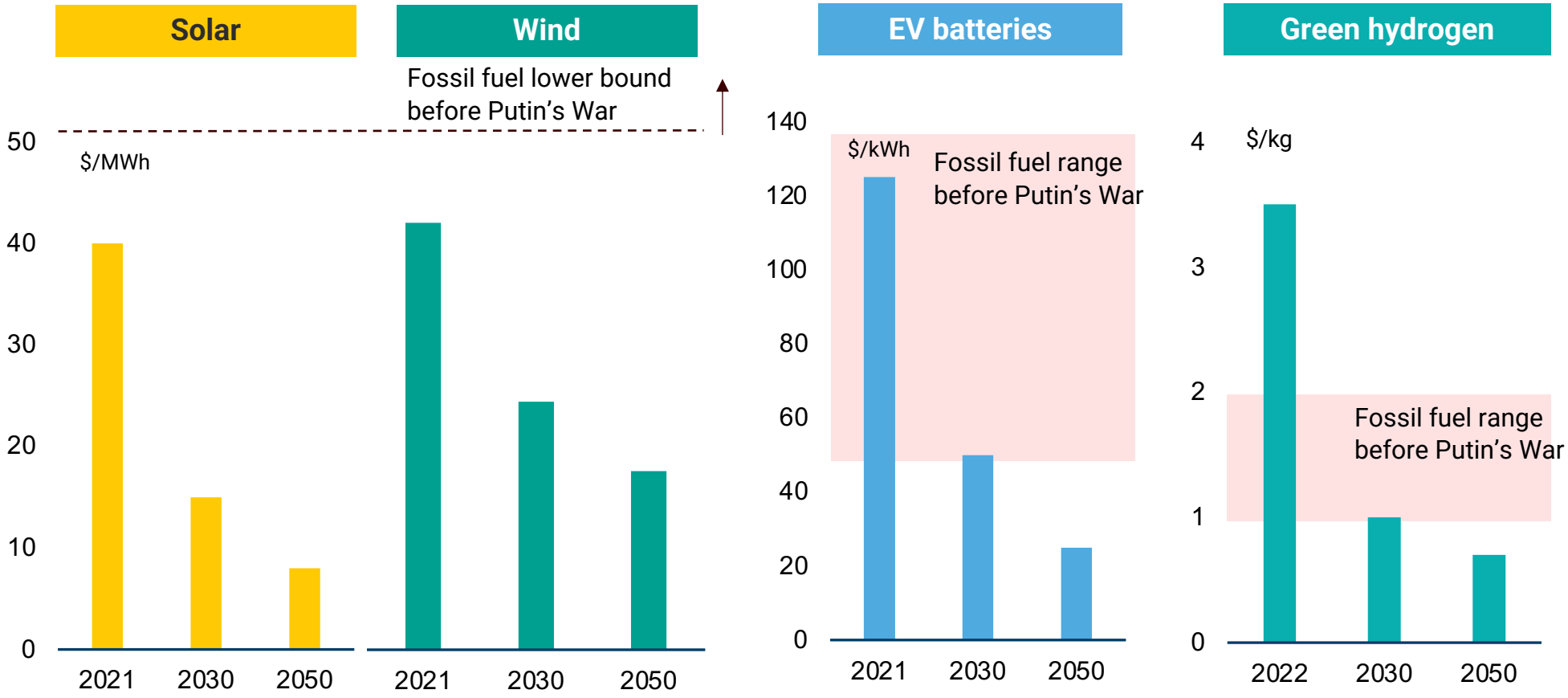
Fossil fuels



Source: INET Oxford

And Cheap Renewables Create an Entirely New Paradigm

The faster change happens, the cheaper renewables become



If we continue on existing learning and growth rates, then by 2030 the world will enjoy $15 per MWh solar, $25 per MWh wind, $50 per kWh Li-ion batteries, and $1/kg green hydrogen.

Source: RMI; cost forecasts use Rystad's growth rates and observed learning rates. Hydrogen is competitive locations

Renewables Are 100 Times Bigger Than Fossil Fuels

Humanity has unlocked a giant new energy source

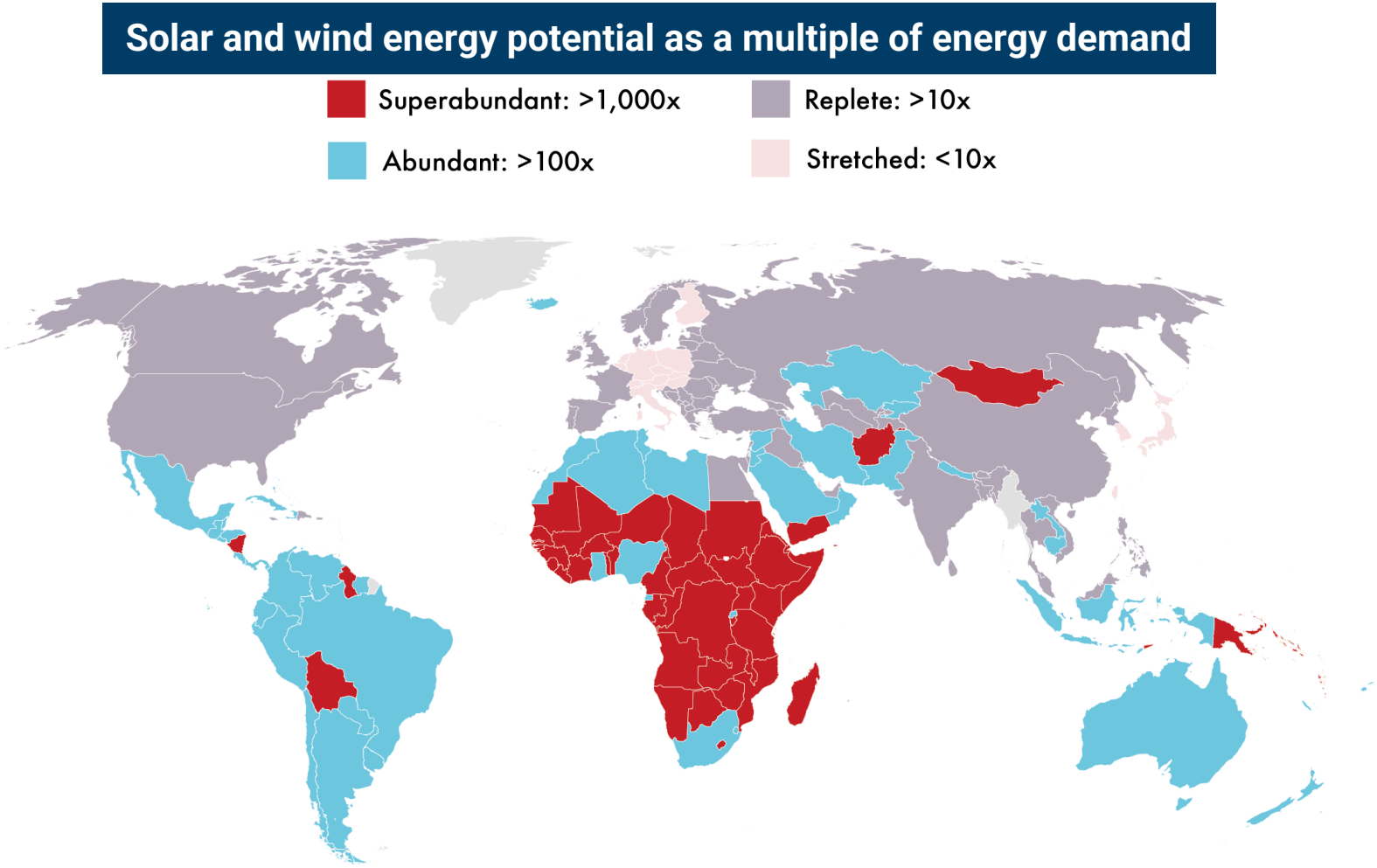
Renewables are, obviously, available everywhere.

Even if you massively constrain deployment, the world has annual renewable flows of over 100 times fossil fuel supply.

Solar rooftops alone could supply us with all our electricity needs.

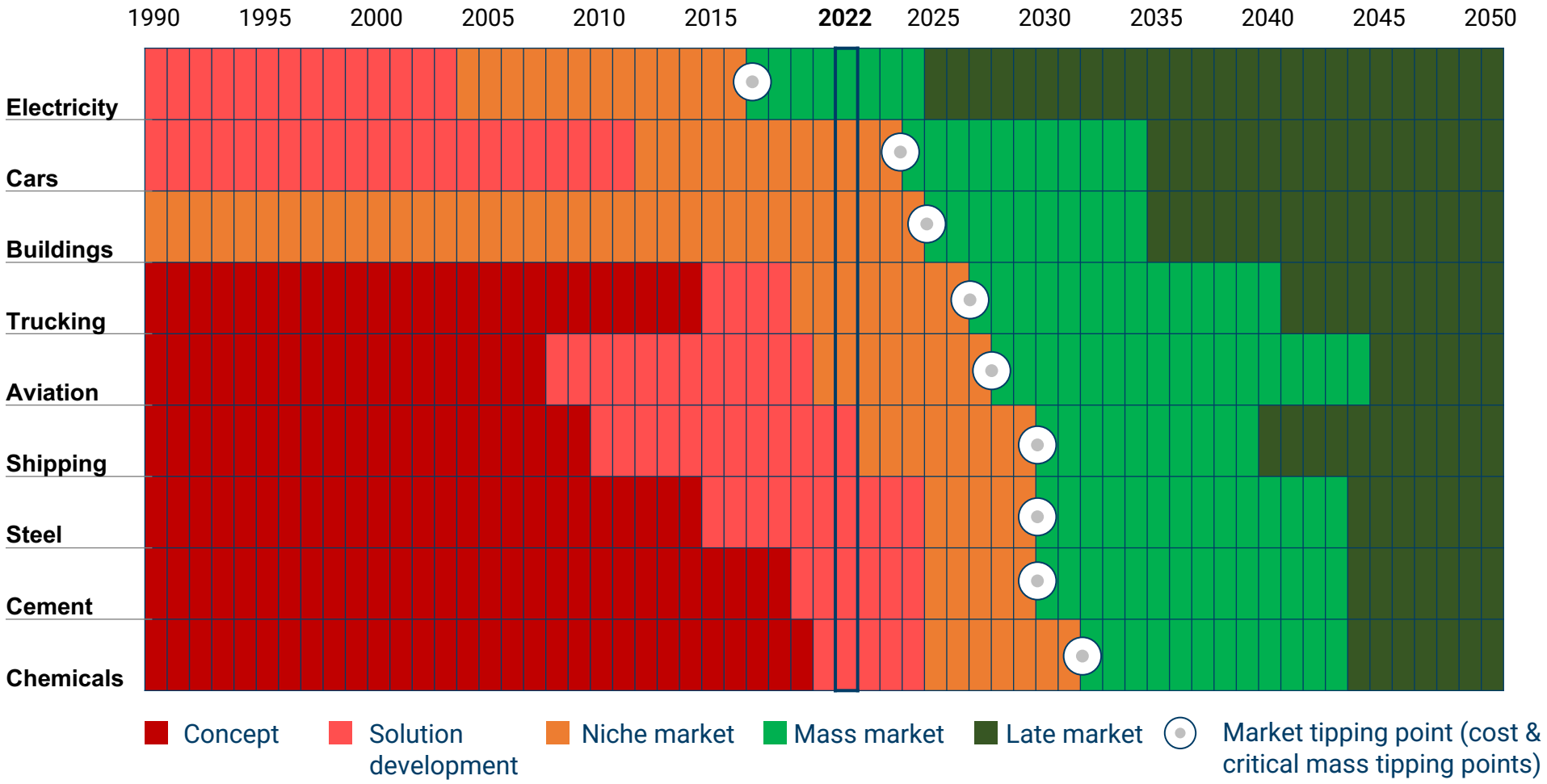
The Global South is especially abundant in renewable energy resources.

Only 10% of demand comes from places like Germany or Japan that may struggle to find enough space.



Source: Carbon Tracker based on data from Solargis and NREL

Key Sectors Hit Their Tipping Point This Decade



Each of the key sectors will hit a price tipping point this decade.

That moment has already come for electricity, which is 35% of fossil fuel usage.

And for light vehicles.

These tipping points are spreading to the rest of the system.

Source: SYSTEMIQ

There Are No Insoluble Barriers to Change

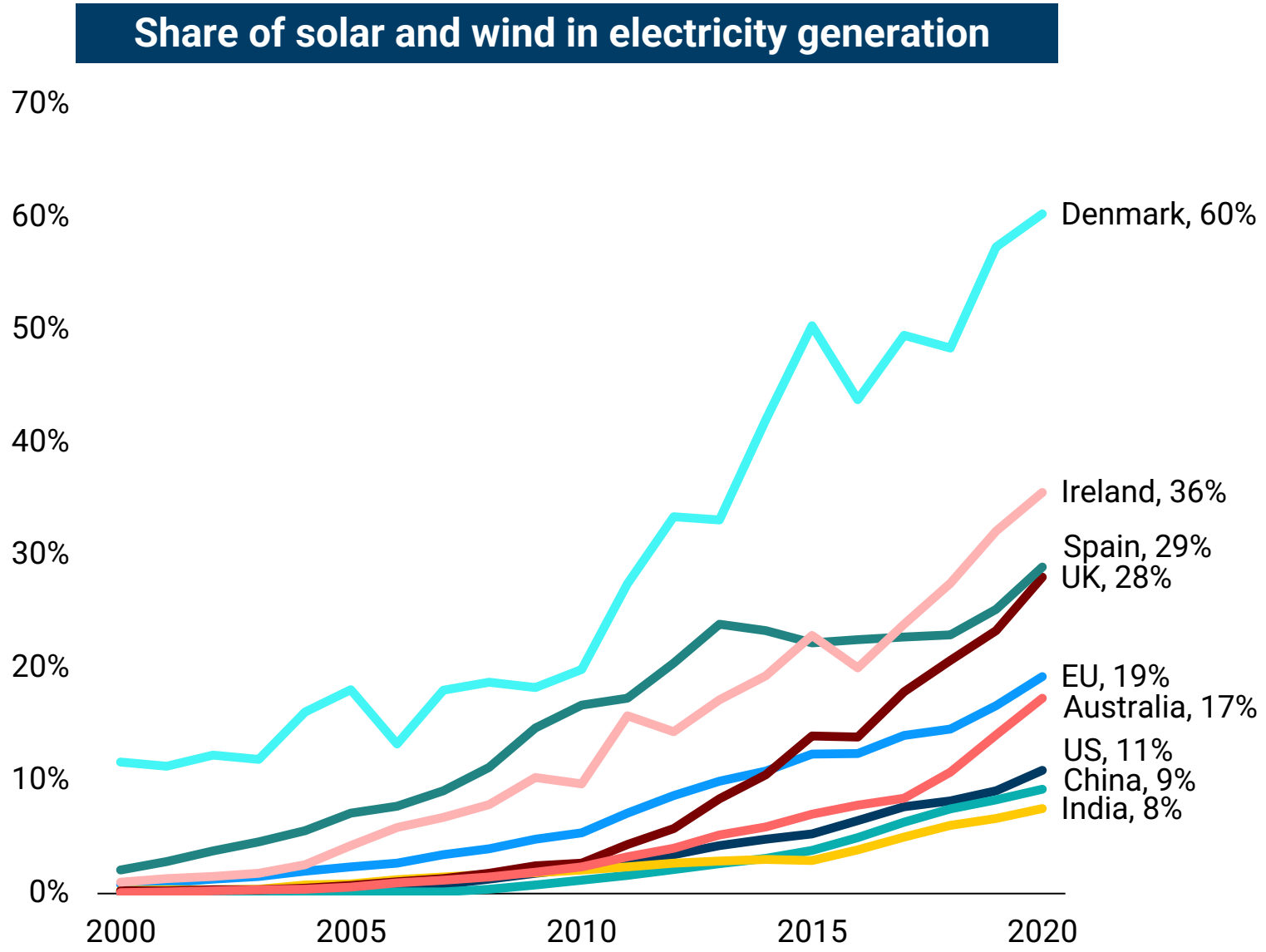
Skeptics have been hoping for years that something would stop the deployment of renewable electricity.

Grid codes, intermittency, lack of minerals, and so on were meant to act as a ceiling on growth.

But we have found solutions for all of these. This has required constant innovation and hard work.

The ceiling of the possible is therefore constantly rising.

Meanwhile, most countries are far below the ceiling of the possible.

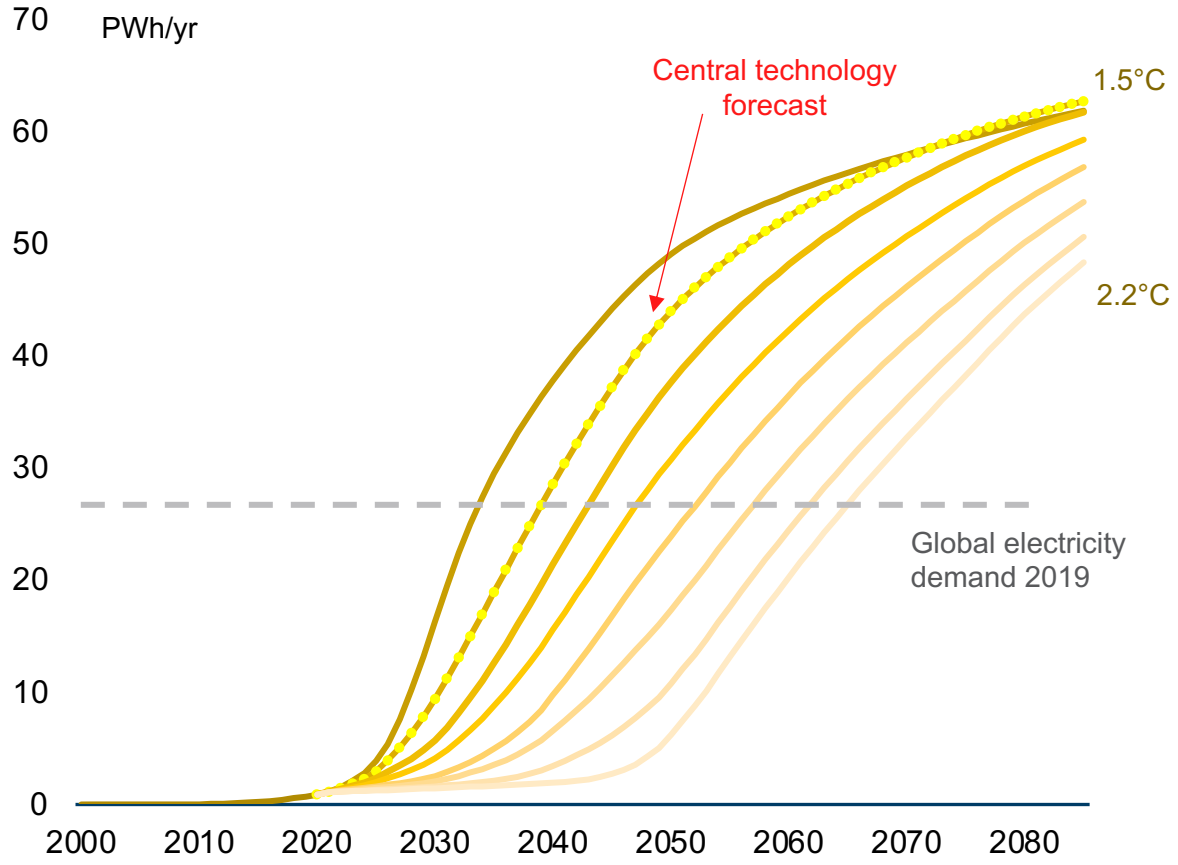


Source: BP

So Exponential Growth of Renewables Will Continue

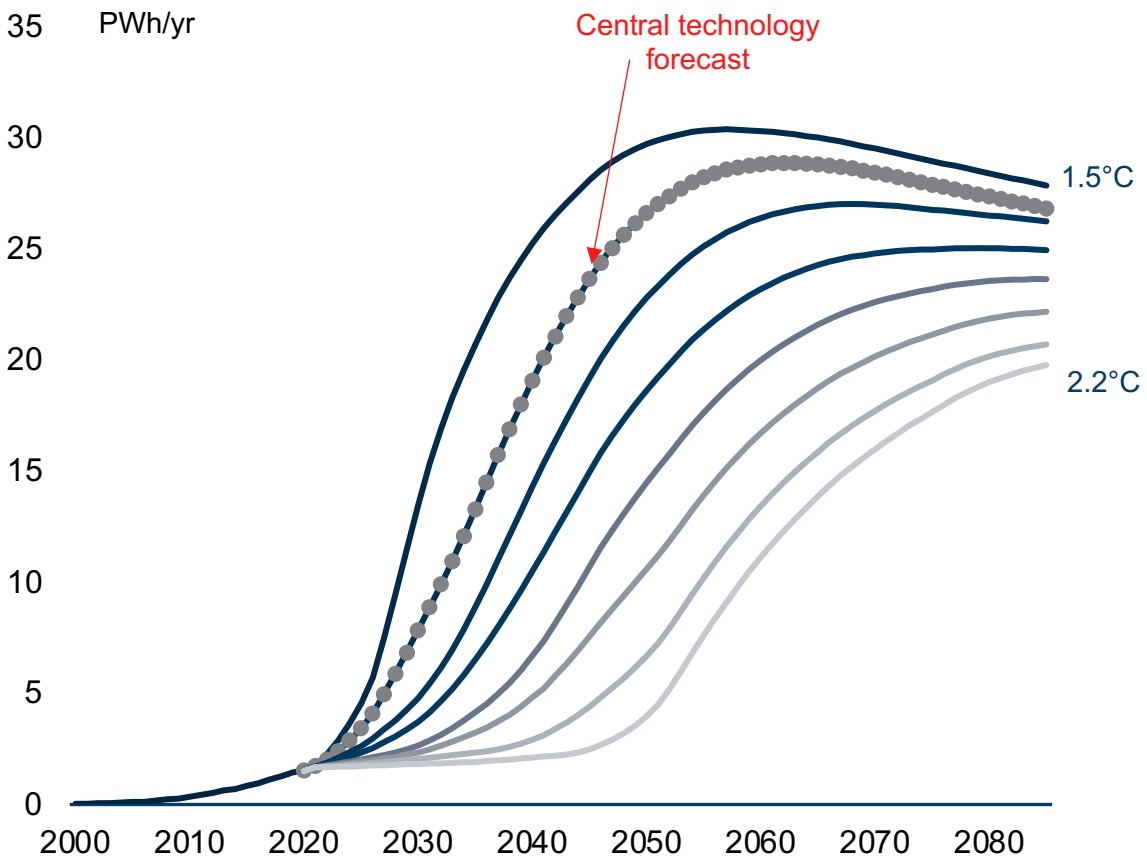
Powered by and powering falling costs

Solar generation



Solar generation will increase from over 1 PWh today to around 40 PWh in 2050, a growth rate of around 14% a year versus 25% today.

Wind generation



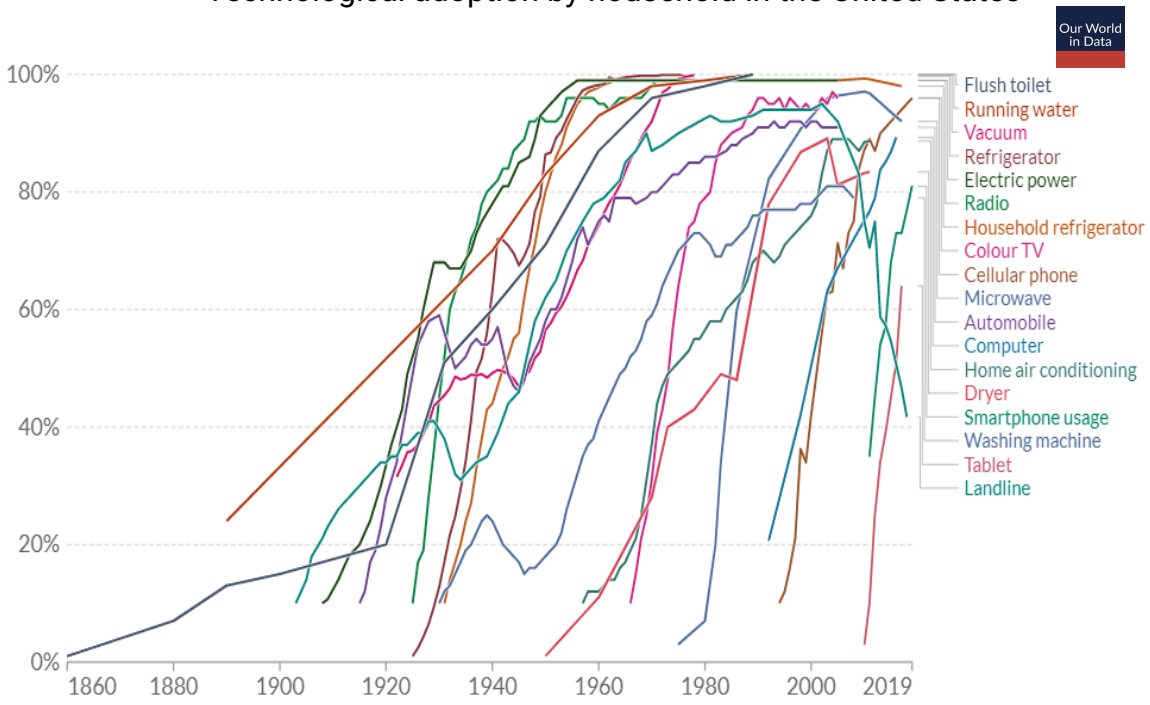
Wind generation will increase from 2 PWh today to over 20 PWh in 2050, a growth rate of 7% versus 15% today.

Source: Rystad; light to dark: 1.5°C to 2.2°C; 1.6°C (Rystad's central scenario) is based on technology change

And This Pattern of Growth Has Been Seen Many Times

Individual products

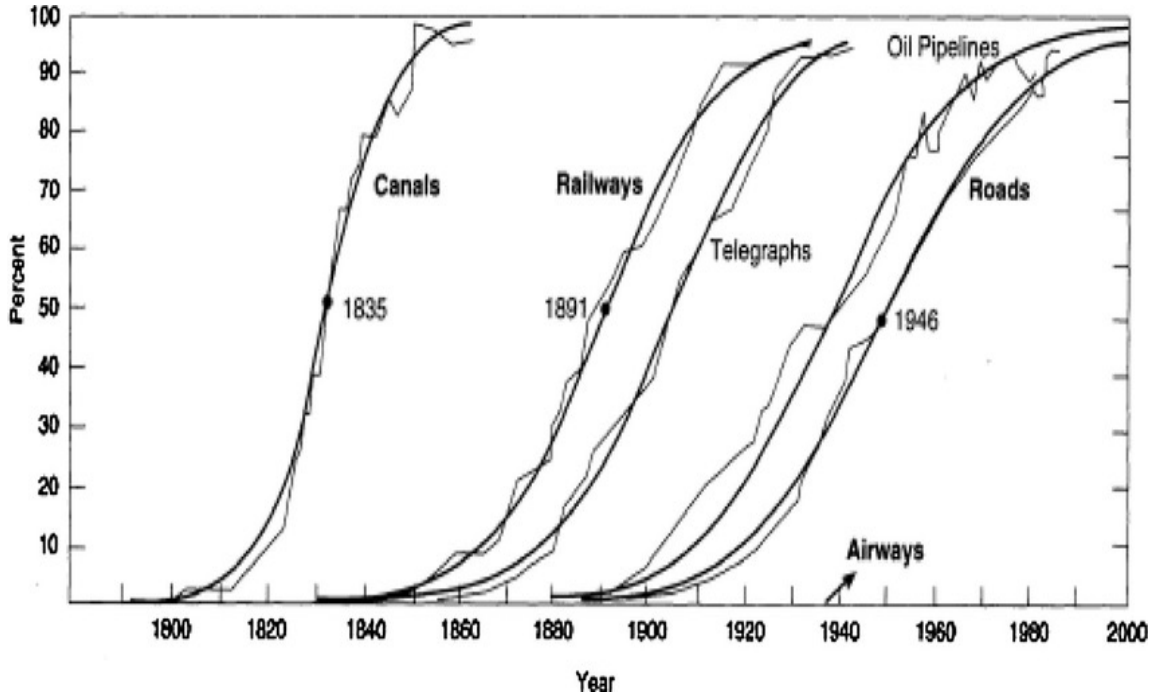
Technological adoption by household in the United States



Rapid exponential growth along S-curves is a standard characteristic of successful new technologies.

Infrastructure systems

Share of maximum size in the United States



S-curve-type growth even applies to infrastructure.

Source: Comin & Hobijn via OWID (L); Grubler (R)

Energy will be cheaper, more efficient, local, and fairer

The age of renewables is coming

The Age of Carbon

- Commodity-based system
- No learning curve (or decreasing returns)
- Geographically concentrated
- Finite
- Continuous material flow required
- EROI falling
- Heavy
- Fiery molecules
- Low efficiency
- Pervasive negative externalities
- Trillions of dollars of rent for oligarchs
- Concentrates power

The Age of Renewables

- Technology-based system
- Learning curve (increasing returns)
- Everywhere
- Abundant
- Zero marginal cost
- EROI rising
- Light
- Obedient electrons
- High efficiency
- Much lower impact on nature
- No superprofits
- Distributes power

Source: RMI

The Rise of the New (Renewables) Pushes Out the Old (Fossil Fuels)

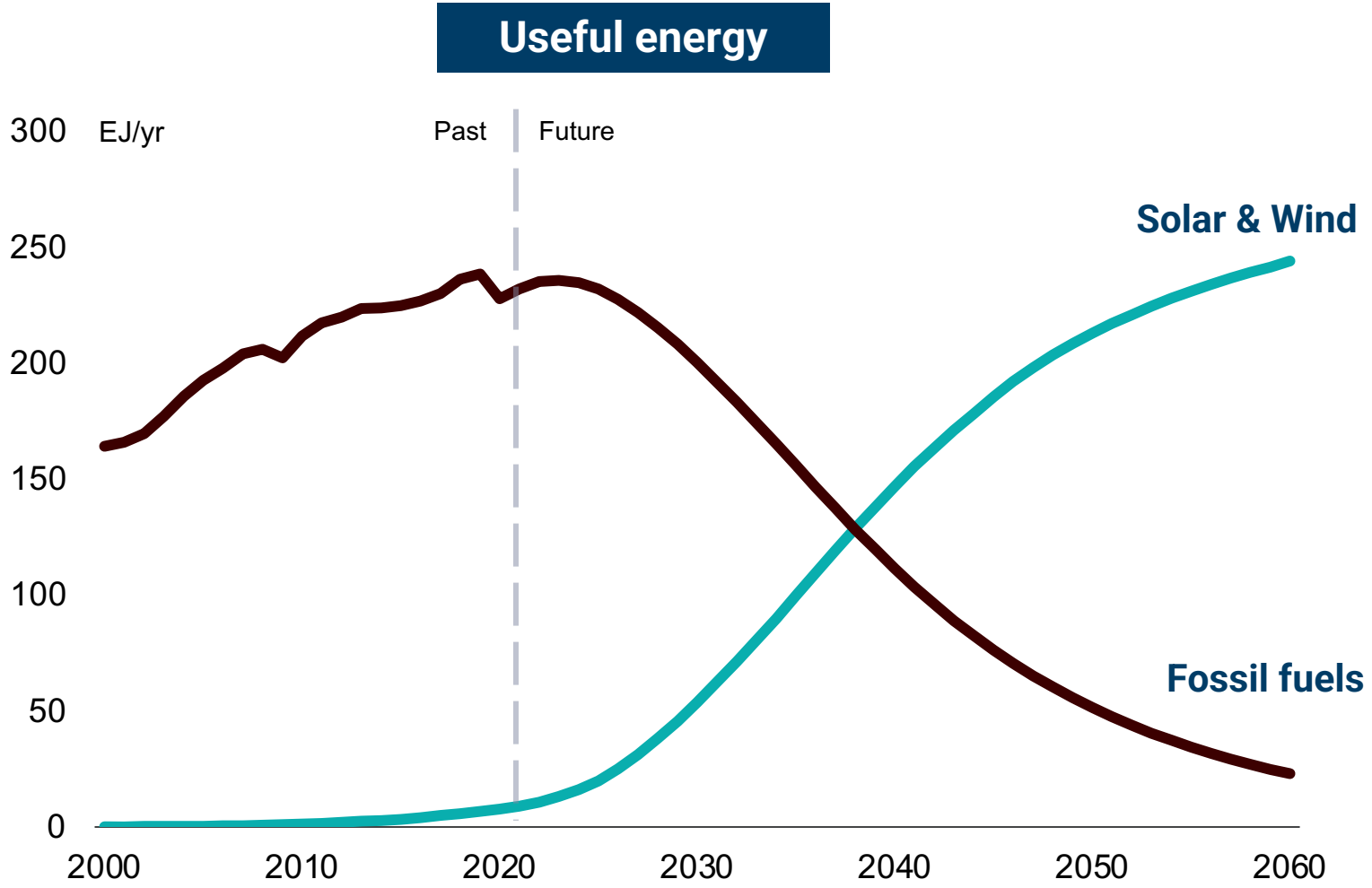
The new, not the old, sets the speed of change

The growth of renewables inevitably means a decline in demand for fossil fuels.

It is the new technology that sets the speed of change, not the old.

The very size of the fossil fuel system makes it extremely vulnerable to this type of disruptive change.

There is no debate that we will still need a lot of fossil fuels in 20 years' time. But the point is we will need much less than today.

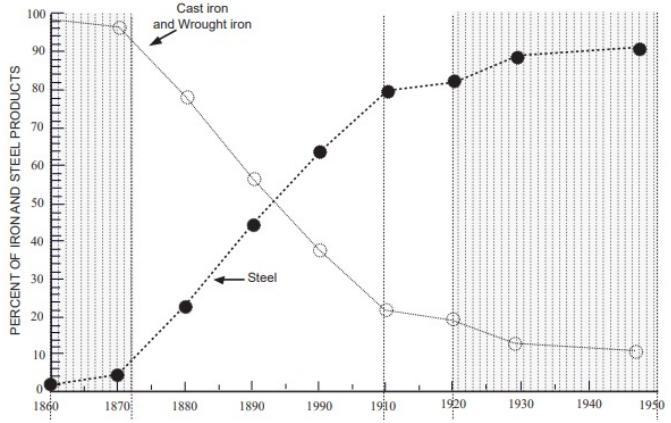


Source: Rystad Central Scenario (1.6 degrees)

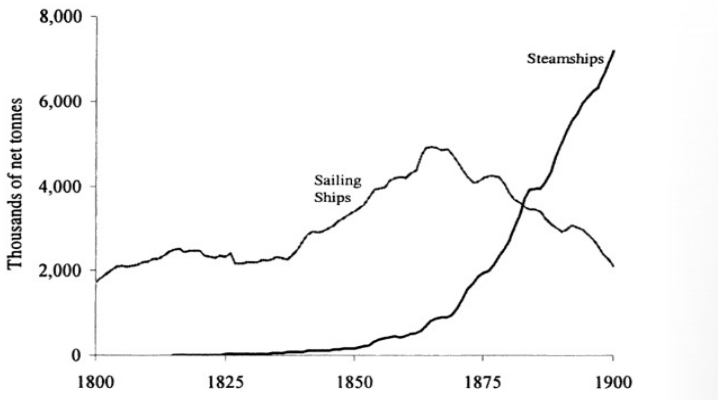
This X Pattern Is Common to Most Technology Shifts

As superior new technologies grow, demand for old technologies peaks early and falls fast

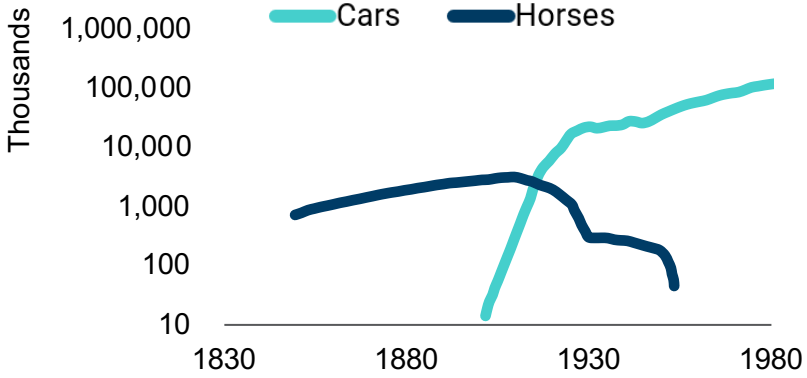
Cast iron to steel



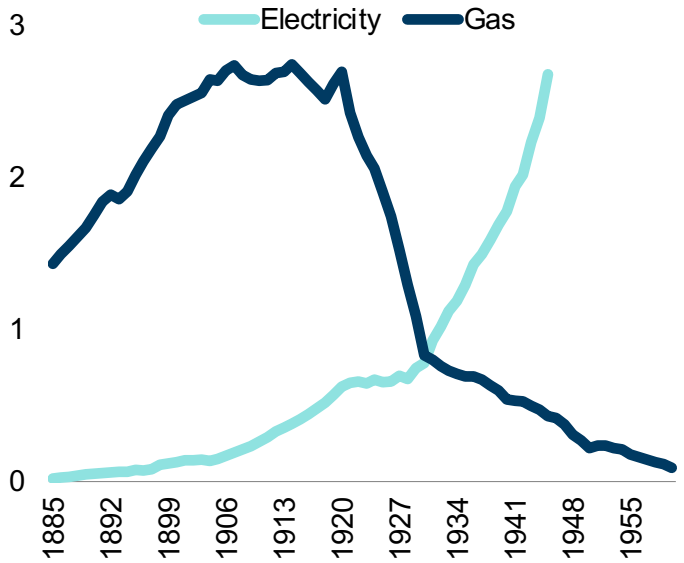
Transport: Sailing ships to steamships



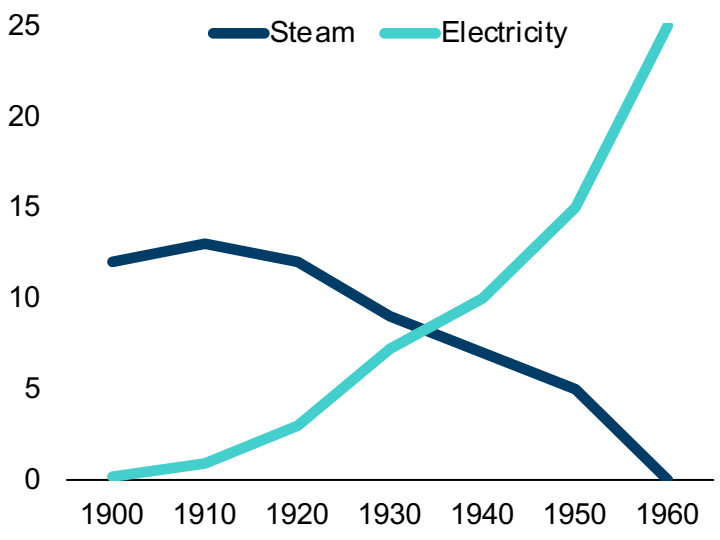
Transport: Horses to cars



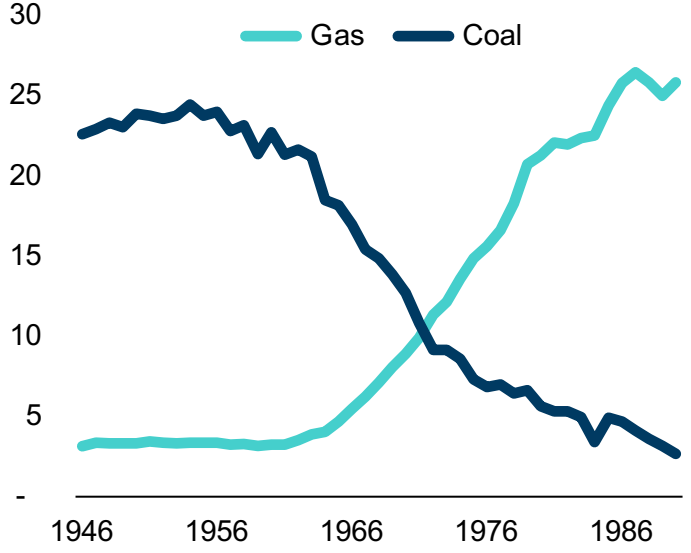
Lighting: Gas to electricity



Power: Steam to electricity



Heat: Coal to gas



Source: Perez, Fouquet, Nakicenovic, Mitchell; Note: all UK charts except horses to cars (US)

Incumbents Rarely Forecast Disruptive Change

We should not be surprised by the failure of incumbents to forecast a future without them

New area	Quote	Source
Trains	Rail travel at high speed is not possible because the passengers, unable to breathe, would die of asphyxia.	Lardner, professor of natural philosophy, UCL, c. 1830
Telephones	What use could this company make of an electrical toy?	Western Union to Bell when turning down his patents, 1876
Electricity	Edison's ideas are unworthy of the attention of practical or scientific men.	Committee of the British parliament on Edison's work, 1878
Oil	Drill for oil? You mean drill into the ground and try to find oil? You're crazy.	Prospective drillers to Drake, 1859
Cars	The horse is here to stay, but the automobile is only a novelty — a fad.	Advice to Henry Ford's lawyer, c. 1910
Computing	I think there is a market for about five computers.	Watson, Chairman of IBM, 1943
Renewables	The fundamentals of our (energy) lives will not change drastically in the coming 20-30 years	Vaclav Smil, 2022

Source: Nairn, Engines that move markets, Recharge News

The maths of peaking demand is not complex

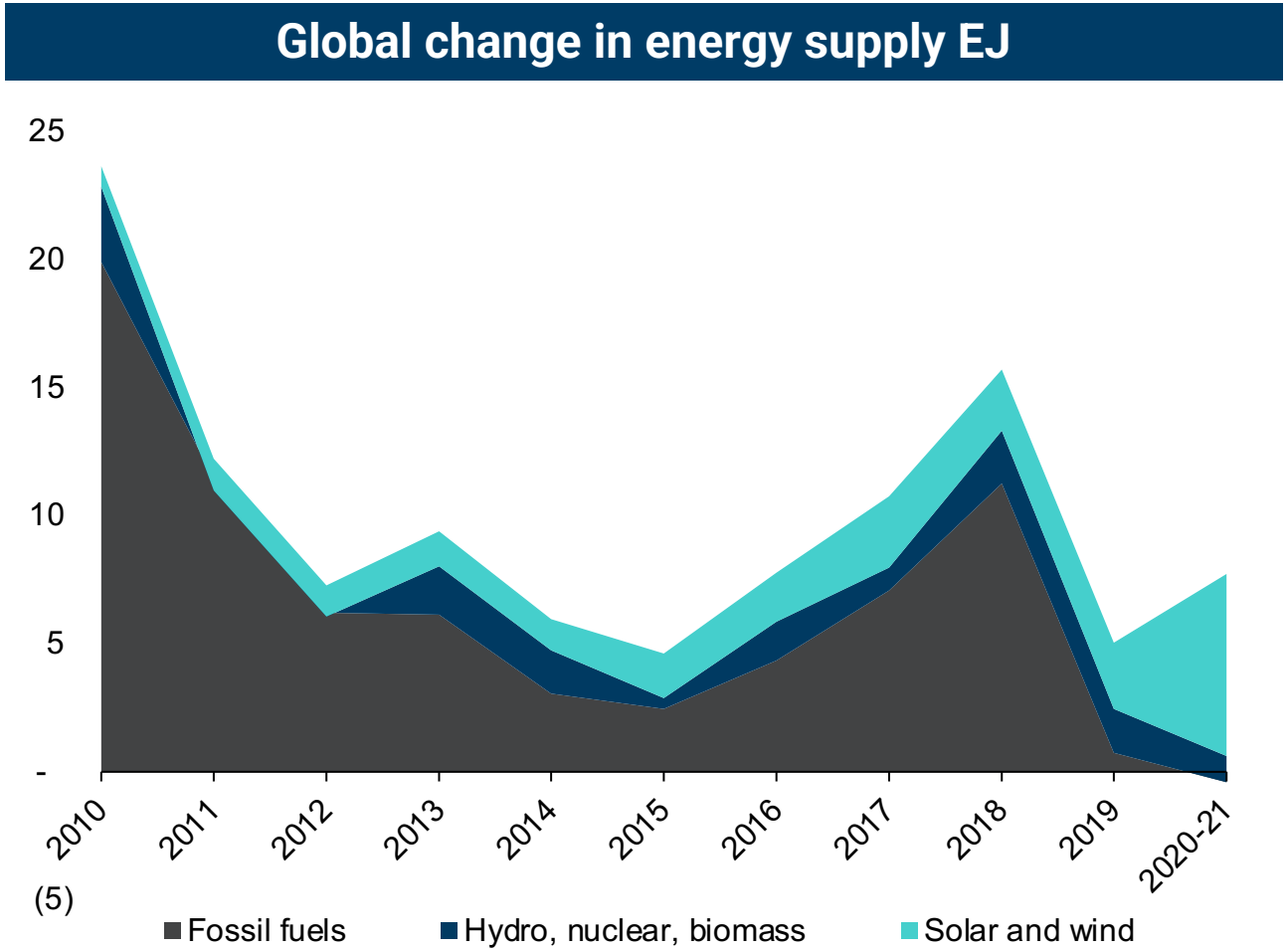
In 2019, fossil fuels were only 15% of the increase in energy supply

In the crash and recovery of 2020-21, solar and wind supply increased by 7 EJ, and other renewables by 1 EJ. Fossil fuel supply fell by 0.4 EJ.

Solar and wind are now 5% of primary energy supply and growing at around 20% a year.

Therefore, energy demand growth needs to be more than 1% for fossil fuel demand to grow at all.

Putin's War reinforces security concerns and drives up fossil fuel prices. This brings forward the peak by supercharging renewable supply and slowing global growth.



Source: BP Statistical Review

Renewables supply all energy demand growth

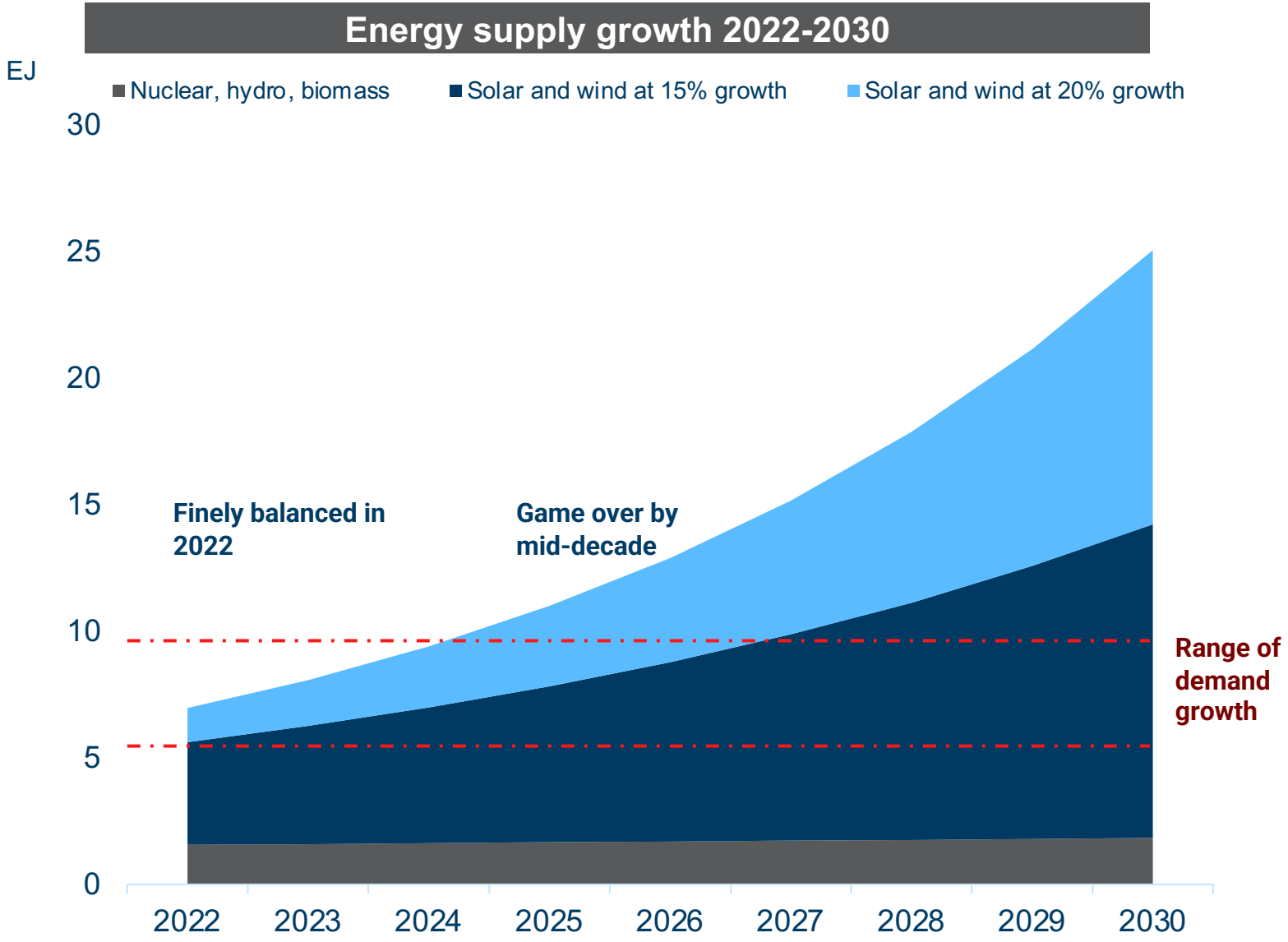
If global energy demand growth is 1% (our core assumption), then it will be 6 EJ. Even at 1.5% growth, global energy demand growth would be only 9 EJ.

The slow growth of nuclear, biomass, and hydro provides a foundation of just under 2 EJ of clean supply growth.

We then show how solar and wind add to the total at either 15% or 20% growth rates.

The picture is finely balanced in 2022 and 2024, but the rise of solar and wind is inexorable.

And by the middle of the decade, under any reasonable assumptions, renewables will be providing all the growth in supply.



Source: RMI using BP

The Future for Fossil Fuels Is One of Peak, Plateau, and Decline

Peak demand for incumbents is reached relatively early in all transitions.

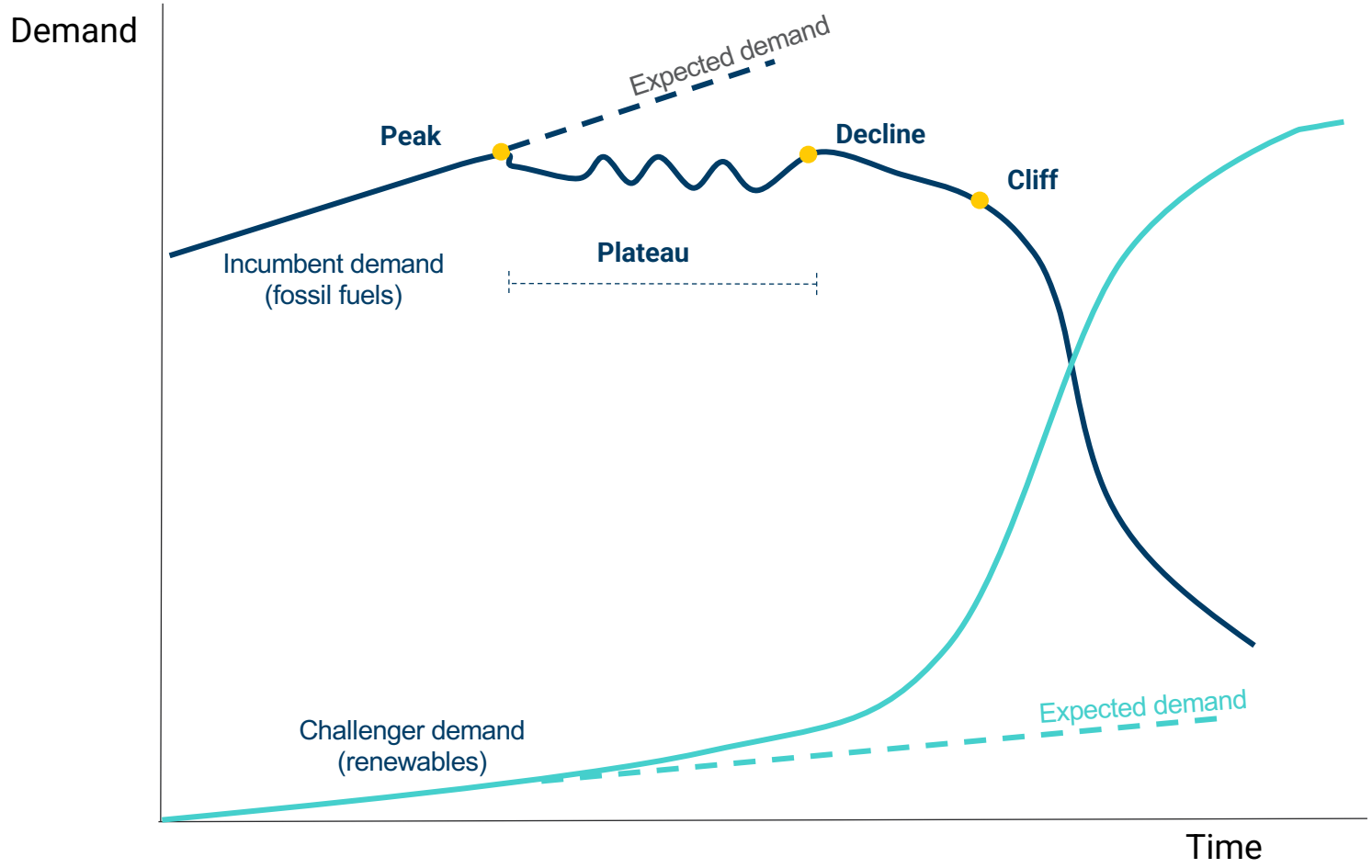
Because of inertia and large amounts of incumbent machinery, there is then a plateau.

External shocks (like COVID or Putin's war) make that plateau bumpy.

But decline sets in after 5–10 years, as new technologies move up the S-curve.

Investors should not mistake a bump on the plateau for a new mountain.

The pattern of peak, plateau and decline (illustrative)



Source: RMI

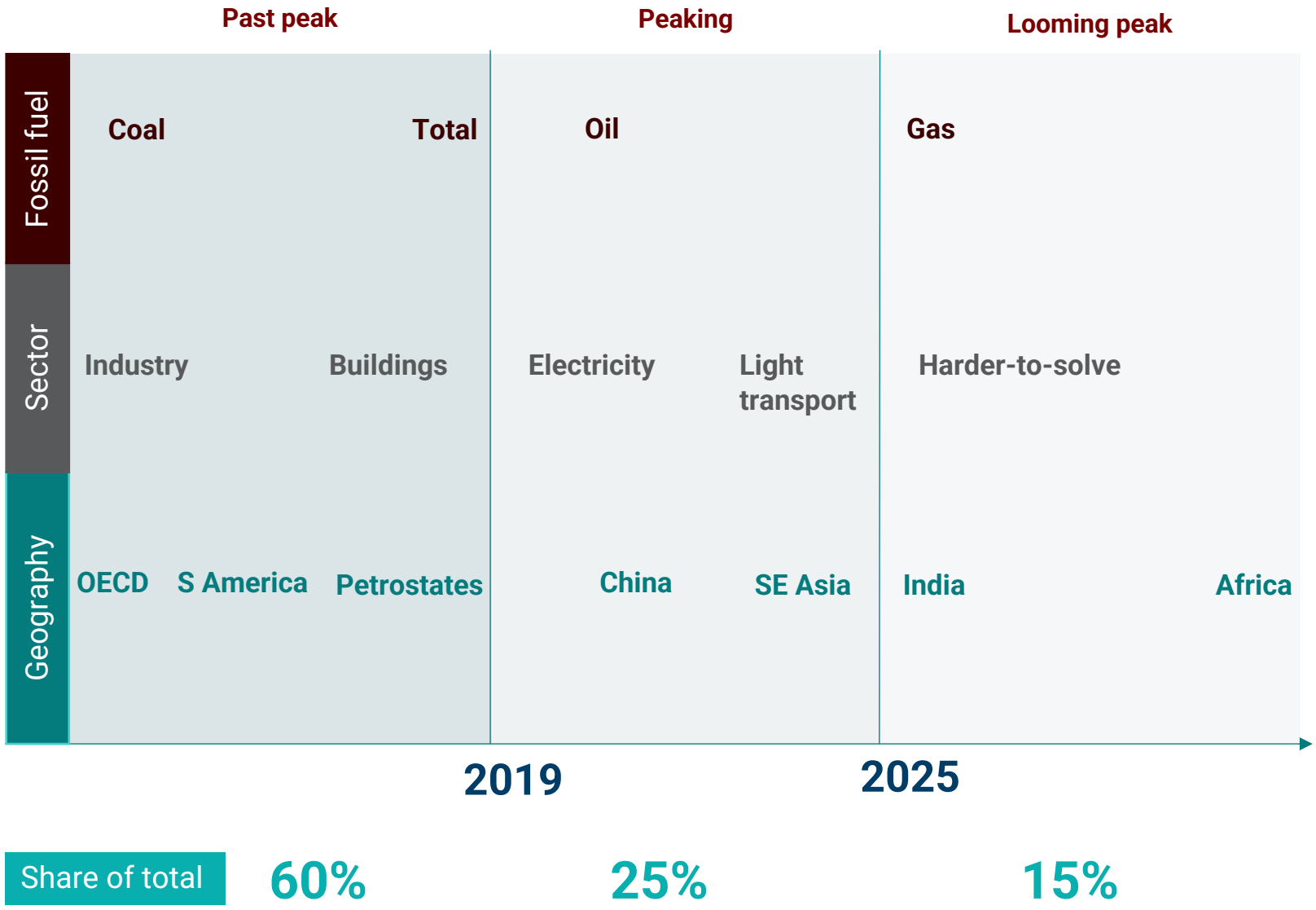
We Can Set Out the Timing of Peaks in Fossil Fuel Demand by Area

We can identify fossil fuel demand peaks by fossil fuel, sector, and region.

The past: We have seen peak demand for coal, for industry, for the OECD — and for fossil fuels as a whole.

The present: Demand is about to peak for oil, for electricity, and for China.

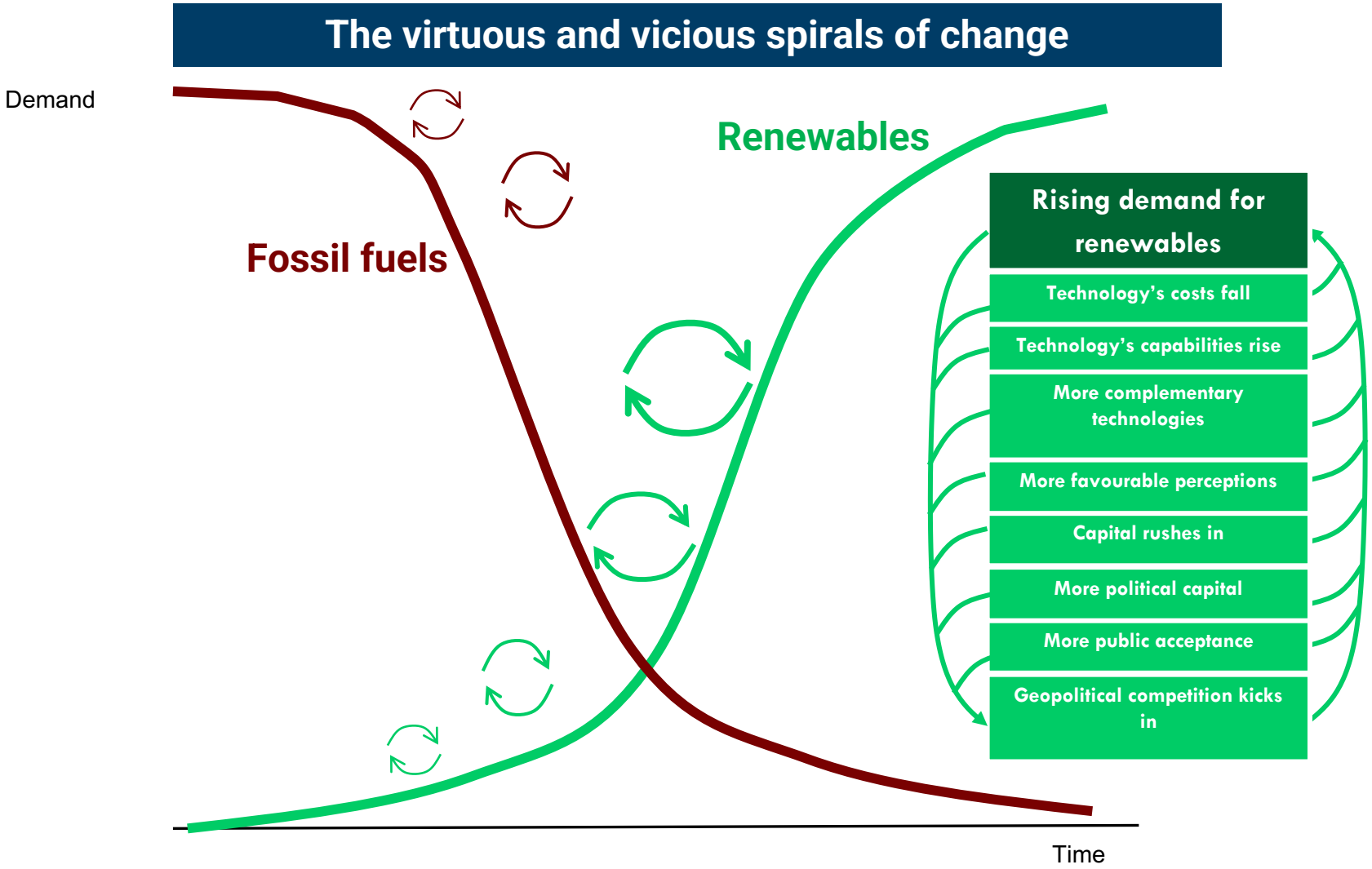
The future: Demand will peak by the end of the decade for gas, for India, and for harder-to-solve sectors.



Source: RMI

Feedback loops speed up change

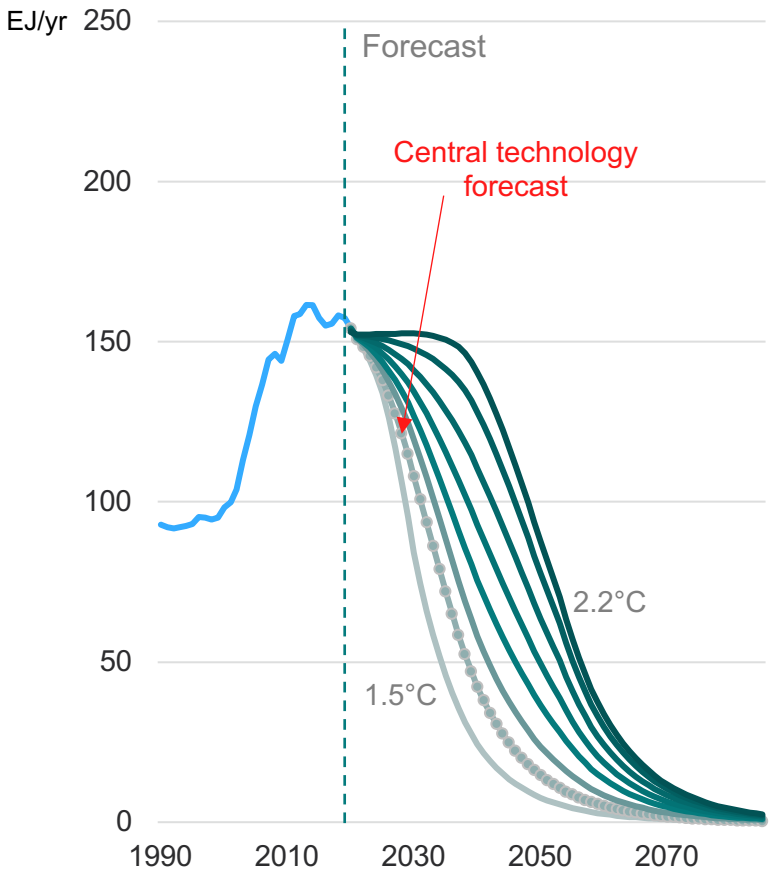
The faster it goes, the faster it gets



Source: RMI

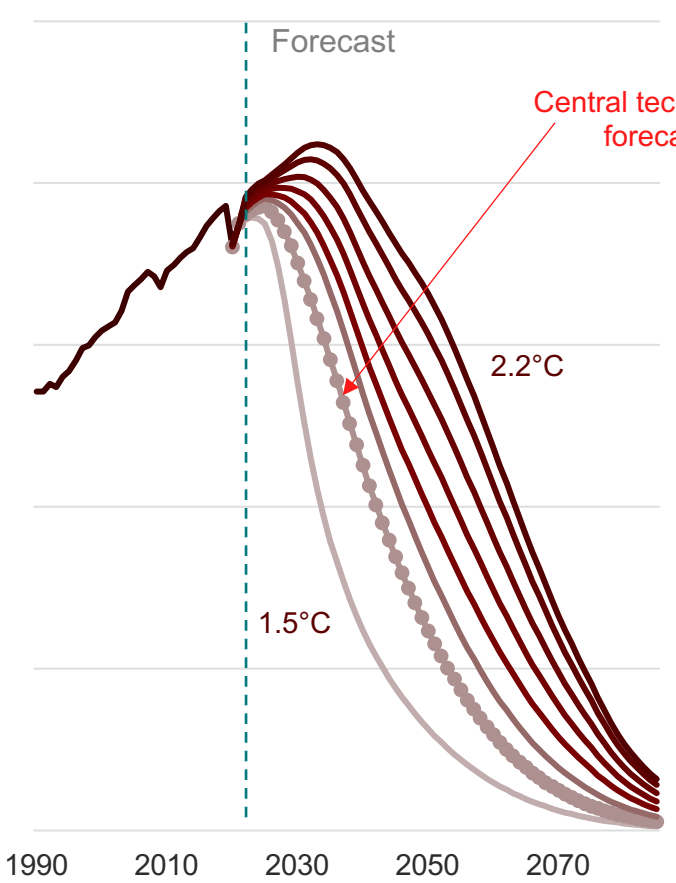
And then comes the decline for fossil fuels

Global coal demand



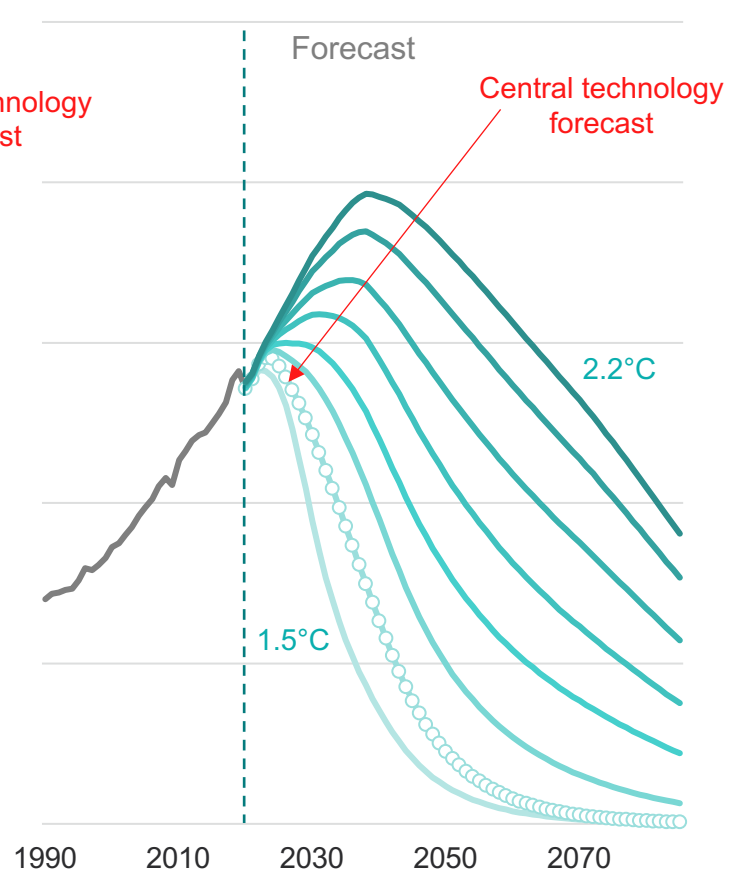
Coal demand is reaching the end of its plateau and is about to decline steeply.

Global oil demand



Oil demand reached its peak in 2019 and is bouncing along the plateau.

Global gas demand

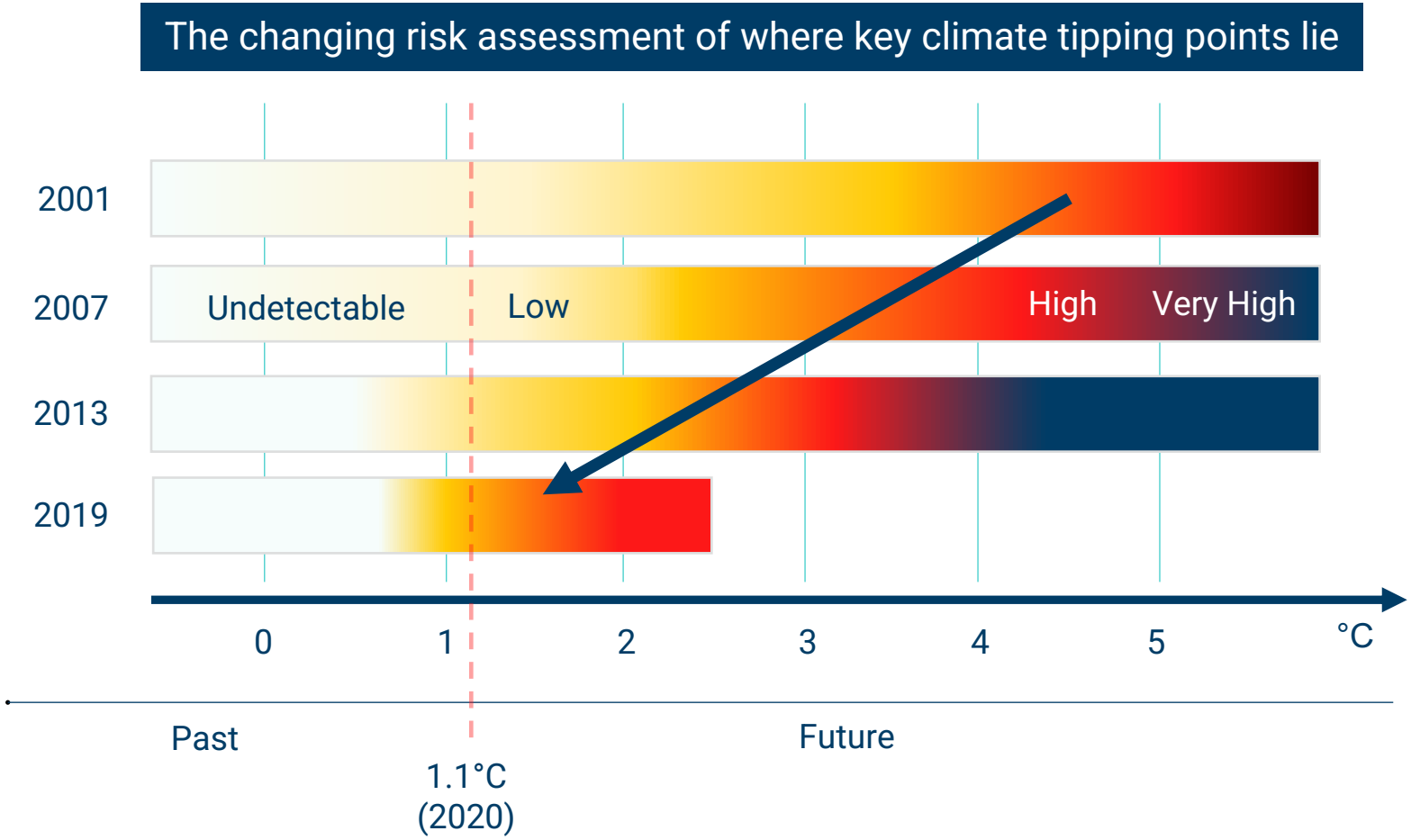


Gas demand is still rising, but the peak is near.

Source: Rystad; Note: Light to dark: 1.5°C to 2.2°C

But…the climate is also changing faster than we thought

IPCC Assessment Reports and Special Reports



In 2001, the IPCC thought that climate risks would be "high" at over 4°C of warming

Better modeling means that the IPCC now believes that climate risks are high at over 1.5°C

The latest paper published this year in Science suggests that we are already at risk of crossing tipping points in several areas including the Greenland and West Antarctica ice sheets and the Northern permafrost

Source: Lenton et al 2019

We still face a wide range of barriers to change

- This table shows the seven key barriers to change.
- Every day we expand the realm of the possible. And as we find solutions in one country, those lessons can be put to work in others.
- In broad terms, we have solved the main technology and economics issues.
- The main barriers to change now are linked to policy decisions.

The key barriers to change		
Challenge	**Short-term solution**	**Long-term solution**
Variability	Regulation; batteries; digitization	Efficient/timely use; Grids and storage
Land	Permitting; roofs	Deployment
Minerals	More mines; new chemistries	Efficiency; substitution; recycle; find resources
Supply chains	Build out	Diversify
Chinese dominance	Alternative supply chain build	Different global nodes
Low-income countries	Development banks; policy	Capital and technology transfer
Petrostates	No barrier to global change	Change to survive

Source: RMI. A separate presentation looks in more detail at each of these barriers. We summarise some generic solutions below

You need to make change happen

Conditional optimism, not complacent optimism

“**Complacent optimism** is the feeling of a child waiting for presents.

Conditional optimism is the feeling of a child who is thinking about building a treehouse.
If I get some wood and nails and persuade some other kids to help do the work, we can end up with something really cool.

What the theory of **endogenous technological progress** supports is conditional optimism, not complacent optimism. Instead of suggesting that we can relax because policy choices don’t matter, it suggests to the contrary that policy choices are even more important than traditional theory suggests.”

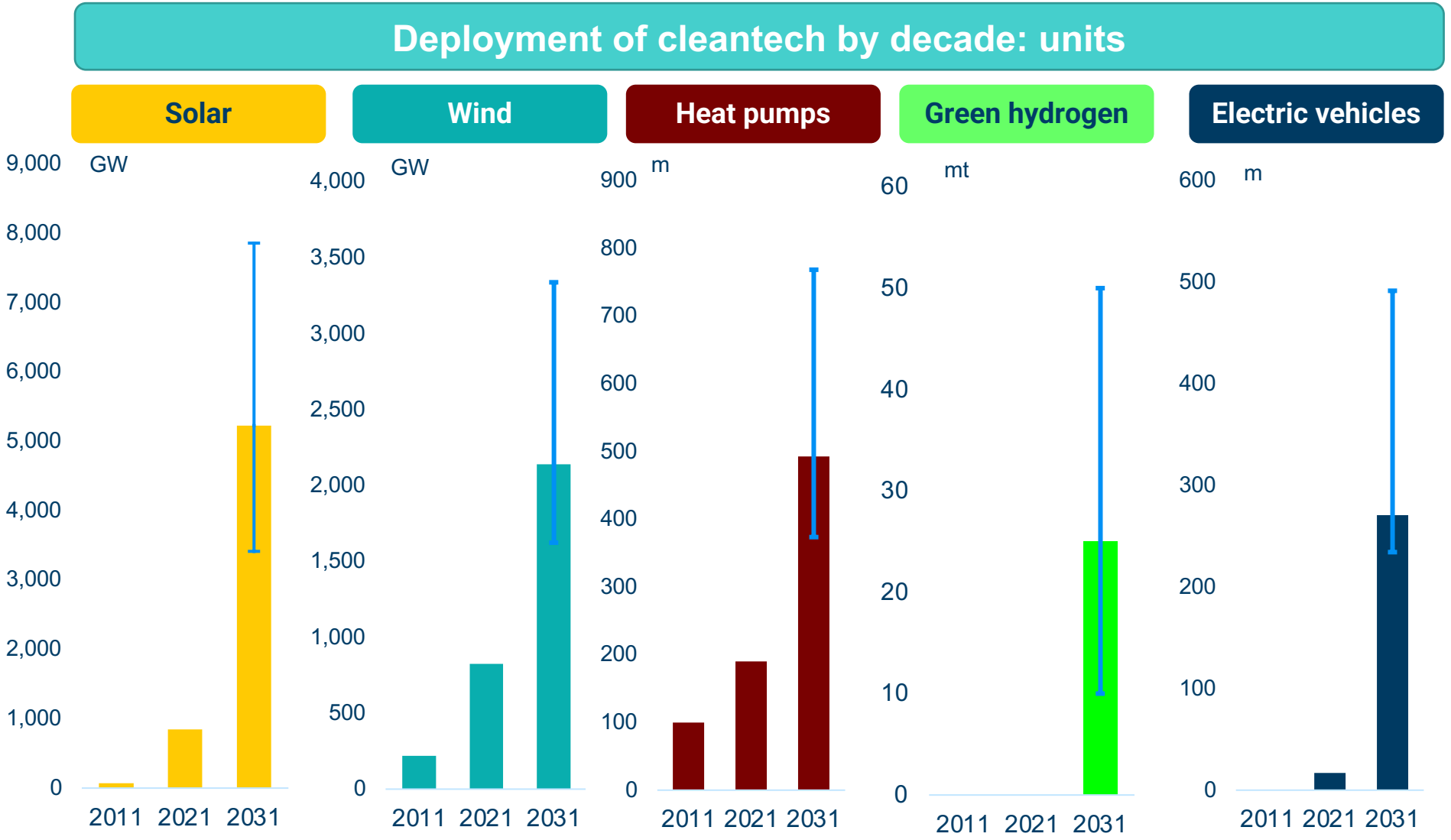
—Paul Romer, Nobel Prize in Economics, 2018

“Now is the time to be practitioners, not theorists; to be synthesists, not specialists; to do solutions, not problems; to do transformation, not incrementalism.”

— Amory Lovins, RMI, **Applied Hope**

Renewables have all the growth

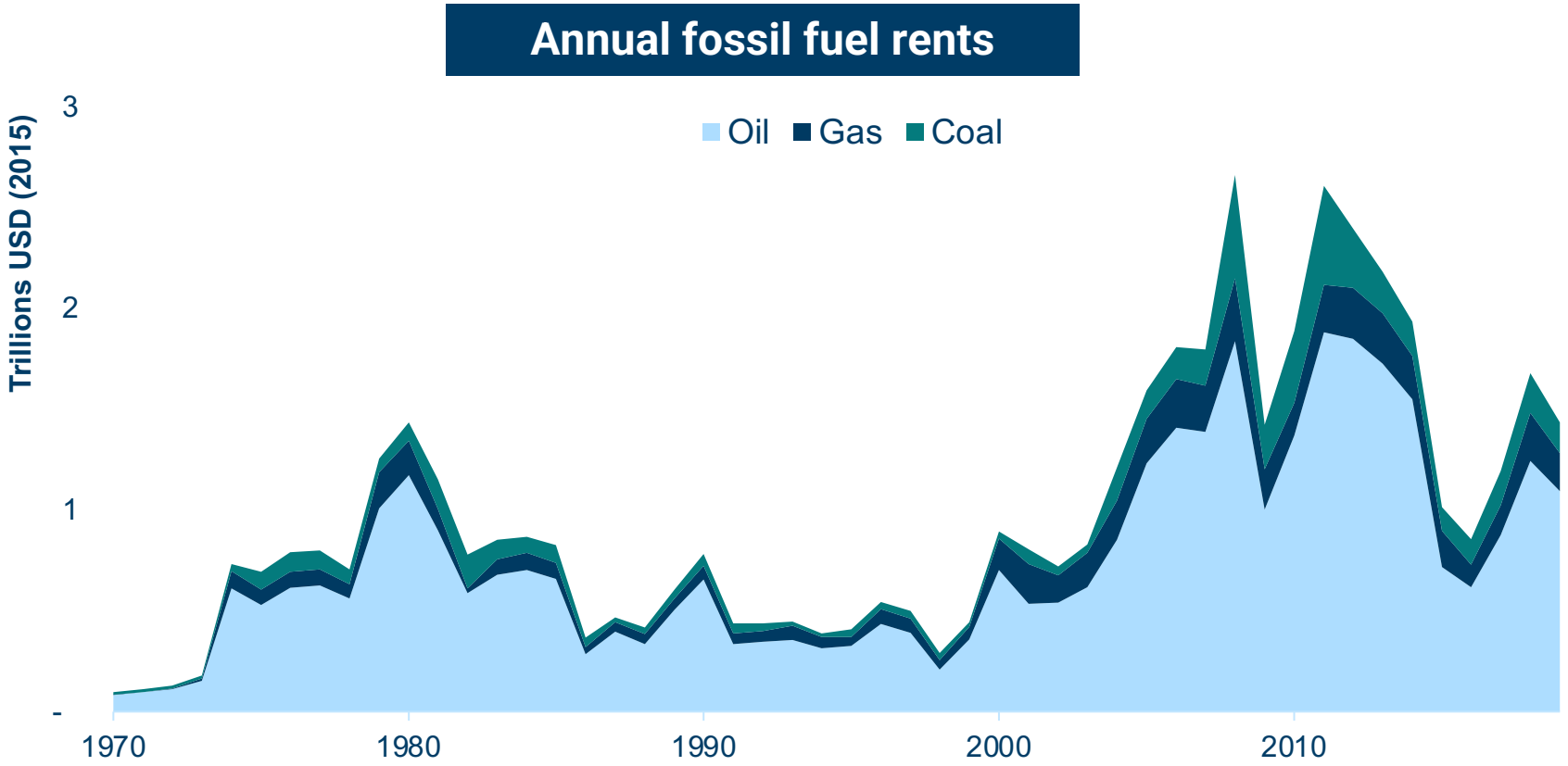
- There is much debate about the level of deployment of new energy technologies in 2030.
- However, what is not in debate is that the change over the course of this decade to come will be far higher than the change in the decade past.
- For example, the past decade saw EVs grow from zero to 17 million. By 2030 they will be between 230 and 500 million, depending on your preferred growth rate.
- From 2011–21, solar grew from 72 to 854 GW. By the end of this decade, it will be between 3,000 and 8,000 GW, depending on your preferred growth rate.



Source: BP, BNEF, Ember, Rystad, RMI estimates

FAQ

Incumbents Resist Change because they make money from the status quo

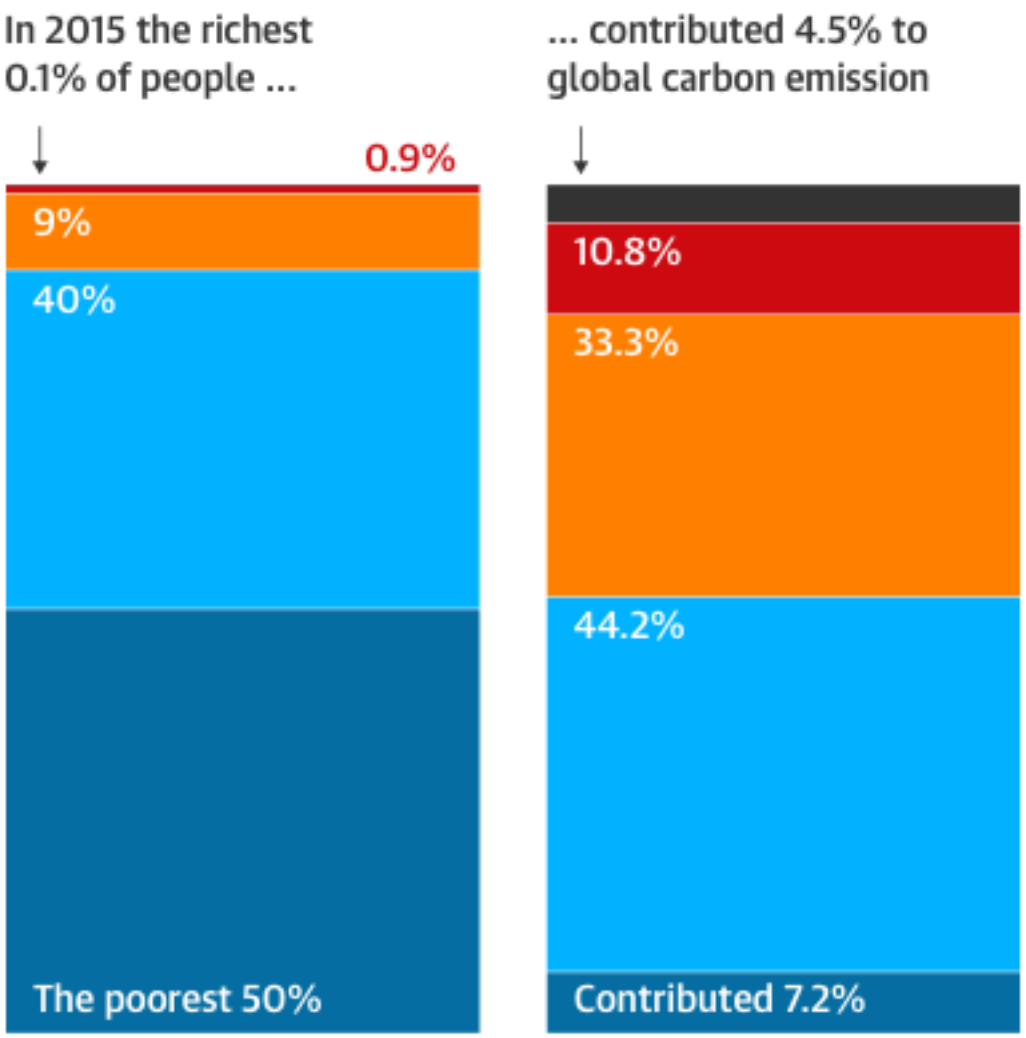


Rents are the lovely free money you get for extracting oil for $20/barrel and selling it for $100. Rents can be spent on important things like gold bathtubs, pointy missiles, misinformation, and lobbying.

Incumbent fossil fuel companies are fighting to protect their rents and their assets for just a few more years.

Source: World Bank

Justice calls out for change



Guardian graphic. Source: Emissions-inequality.org

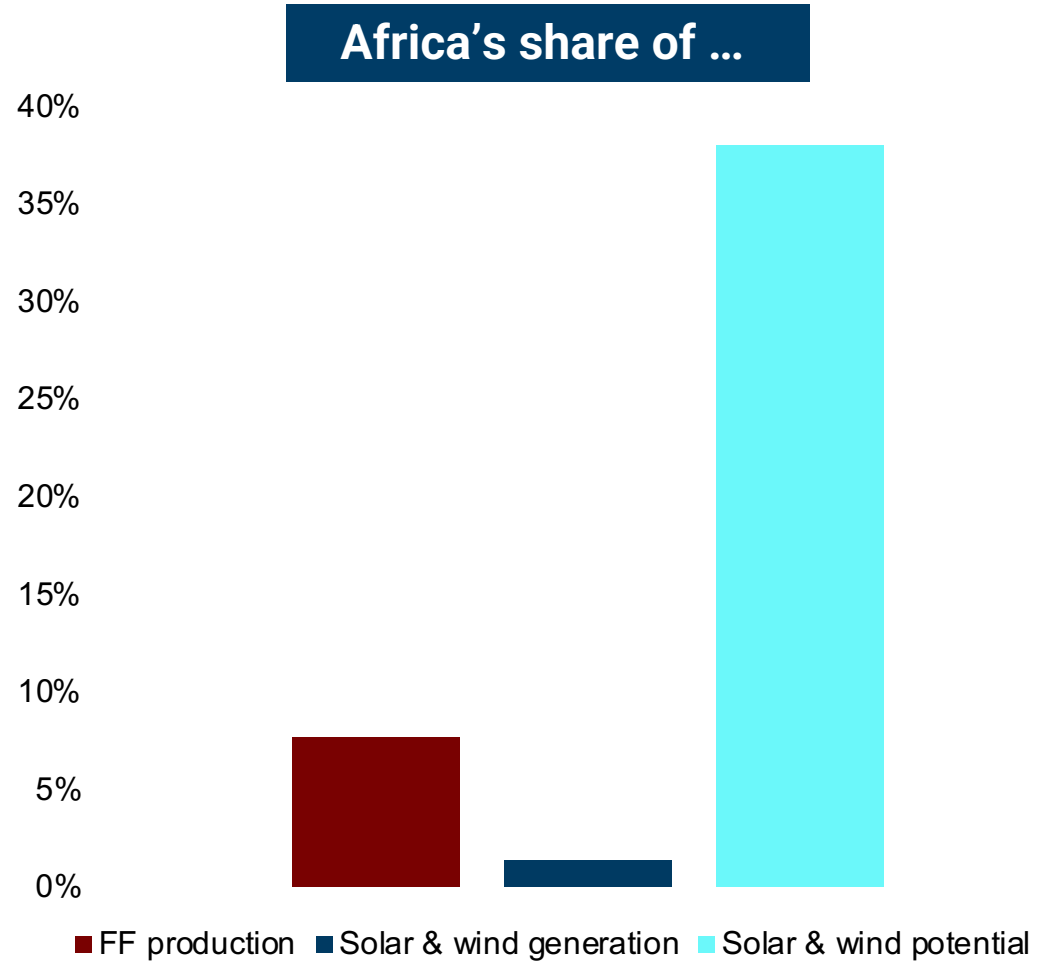
It is the rich who use fossil fuels. The top 10% use half of the fossil fuels.

While the poorest 50% use only 7% of the total.

Analysis of change indicates that it is also the rich who make up most of the growth in demand for fossil fuels.

Source: Emissions-inequality.org

Africa has far more Renewables than Fossil Fuels



Africa produces only 7% of global fossil fuels but has access to 38% of global renewable potential.

Fossil fuels have failed to deliver electricity to nearly 800M people in Africa, but renewables can do this.

Embracing fossil fuels at the end of the fossil fuel era is thus like embracing canals or landline phones. It is too late.

Africa has the opportunity to bypass fossil fuels and move directly to the superior renewable solution.

Support will be necessary to ensure that this happens.

Source: BP, RMI

Three key questions to ask of every barrier to change

- For a barrier to hold back the inexorable growth of renewables, it needs to be insoluble, immediate, and universal.
- Our contention is that today, and for the foreseeable future, none of the barriers fit all these criteria.
- While it is hard to build out supply chains and source the necessary minerals, this is something that has been solved before and is being addressed; thus it is not an insoluble barrier.
- Variability of solar and wind can now be handled at reasonable cost at variable renewable penetration levels of up to 70% or more. The world as a whole is at 12%, so this threshold is not an immediate problem.
- And while high penetration raises issues to be solved for a number of jurisdictions like Denmark or California, it is not a universal problem because most are far below this level.
- While some countries (the fragile states) struggle to implement renewable technologies, they are a small part of the entire system (under 5%). This is then a specific not a universal barrier.

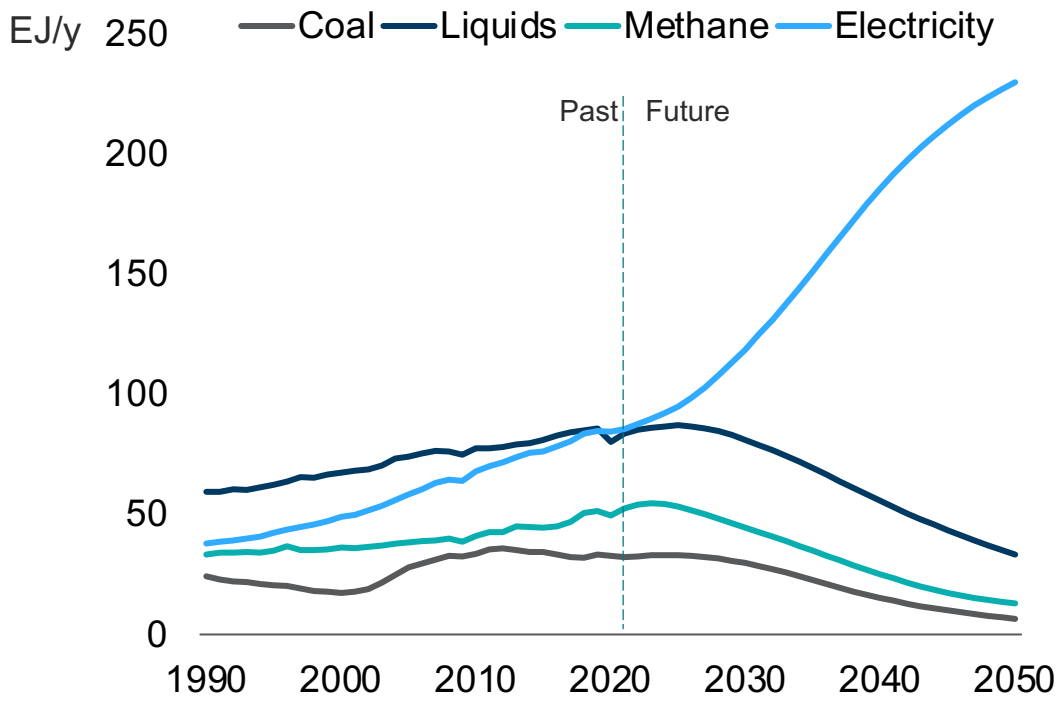
Soluble or hard to solve

Immediate or later

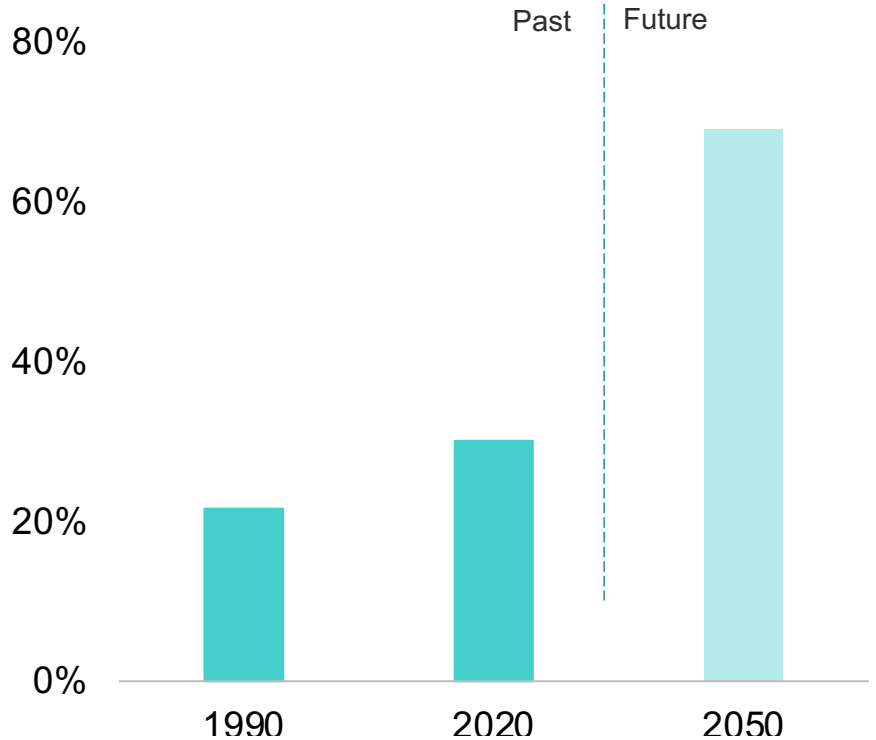
Specific or universal

Electricity is all the Growth in Useful Energy

Useful energy supply



Share of electricity in useful energy supply



It is often argued that electricity is only 20% or less of final energy demand and therefore can be largely dismissed as a driver of change.

This interpretation relies on outdated thinking, which compares the energy in a lump of coal with that available at the light switch.

If we look at useful energy, electricity is a third of the total and all of the growth.

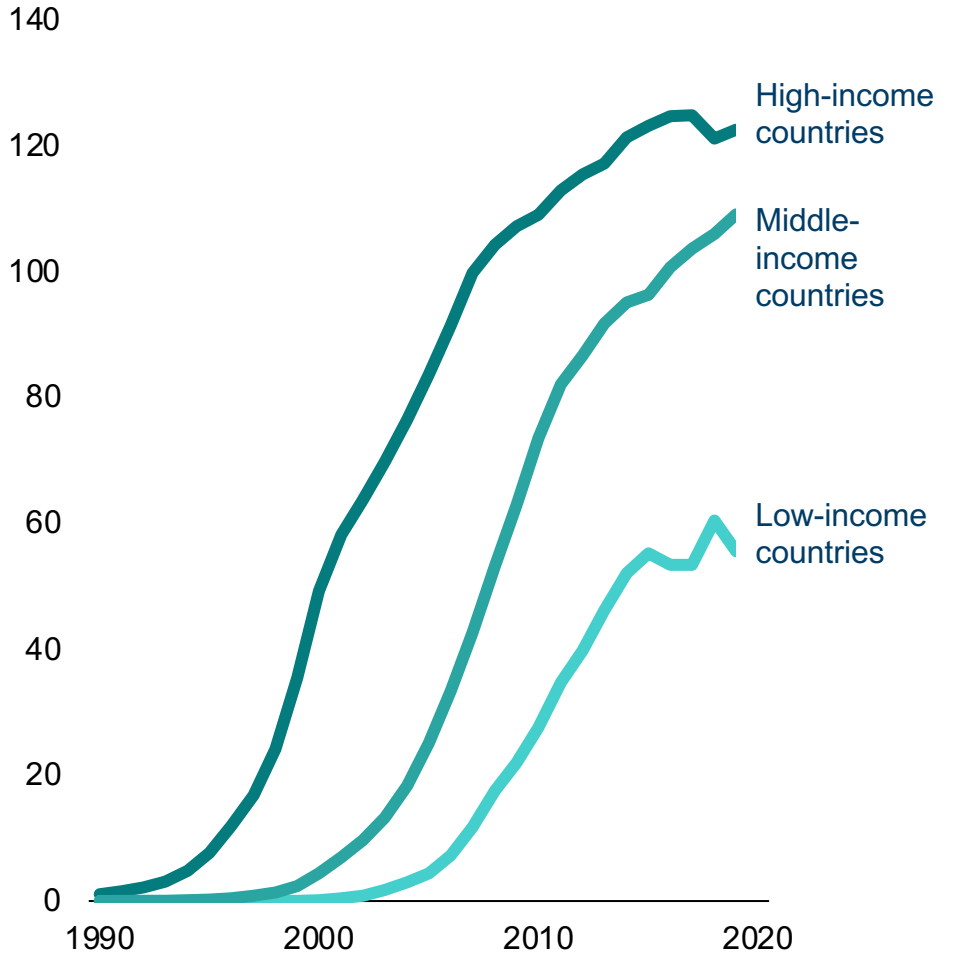
Source: Rystad central scenario (1.6°C); Useful energy is the energy that is converted to useful services, such as moving a car or lighting a building

High-income countries normally adopt new technology faster

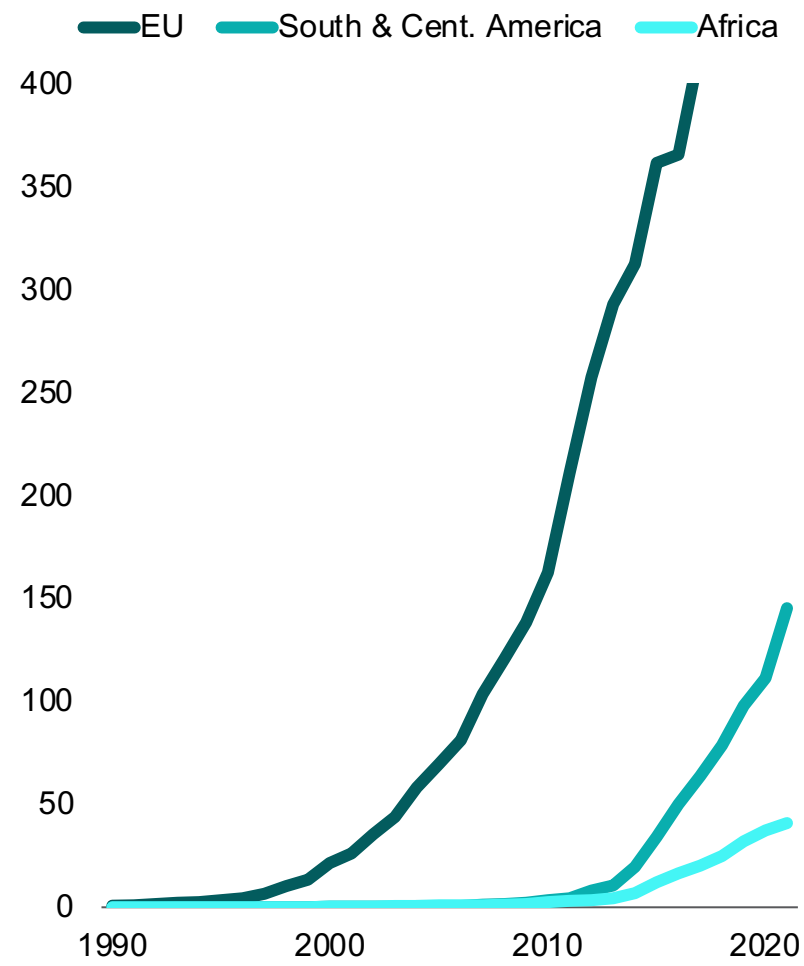
The key question is how to reduce this gap so that everyone has access to cheap, secure, and clean energy as fast as possible

- It is normal for wealthy countries to deploy new technologies first. This is what happened with the internet, mobile phones, and many other technologies.
- It is also normal for lower-income countries to adopt the technologies when they are cheaper and the initial teething problems have been solved.
- The key question is how to make this happen faster and more equitably.
- And it is here we need to focus on the solutions most capable of delivering the desired development goals: cheap, fast, secure, local, clean energy.

Mobile cellular subscriptions (per 100 people)



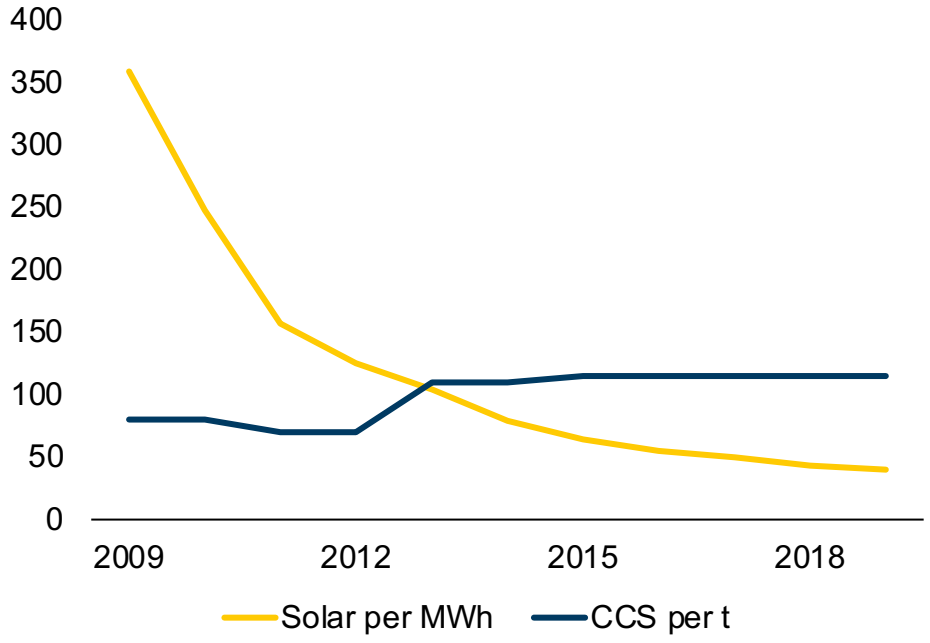
Solar & wind generation (TWh)



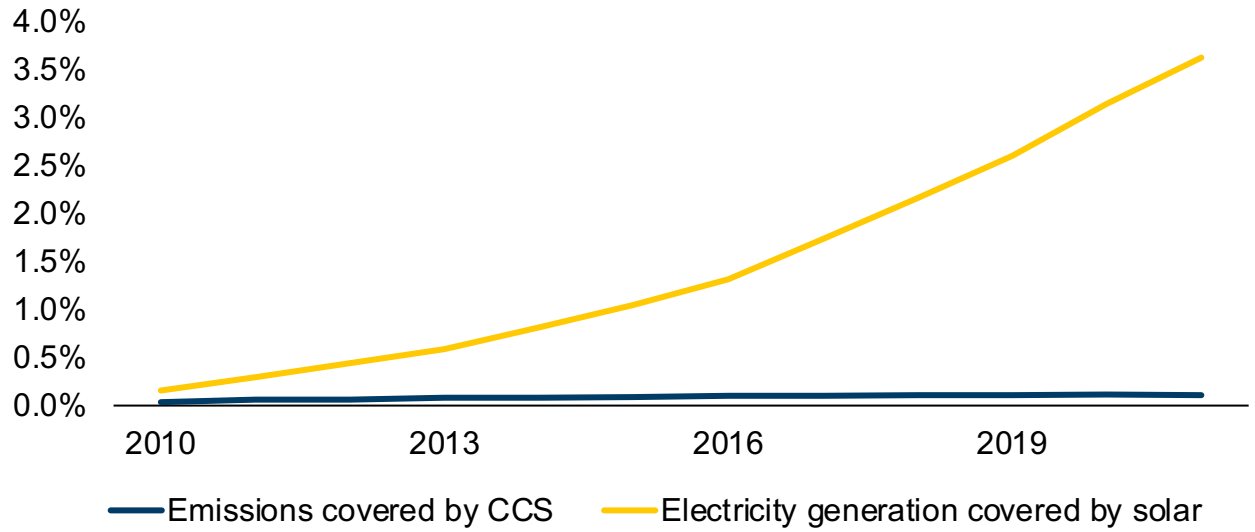
Source: World Bank via Our World in Data (L), BP (R)

CCS is theory. Solar is practice.

Cost of solar and CCS



Share of global total

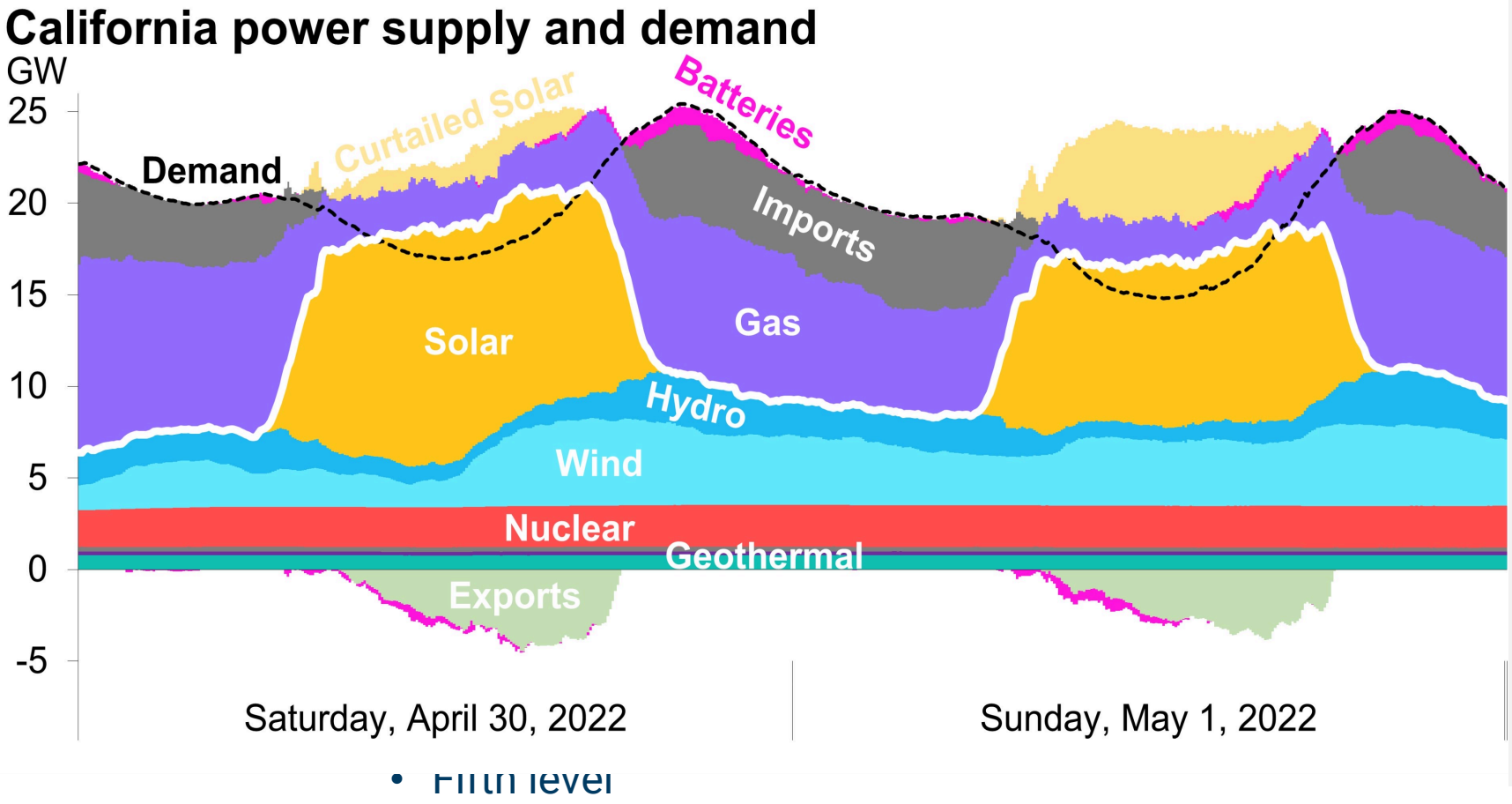


So far CCS has not shown any learning curve. Its growth has been modest and driven by subsidy.

A comparison with solar since 2009 reveals the gap. Solar has shown a learning curve, and its share of global electricity generation has exploded, while the share of CCS in emissions has been stuck at low levels.

Source: IRENA, BNEF

Gas Shifts from Baseload to Backup



- Fifth level

Gas will shift over time from baseload to backup.

As baseload it accounts for 30%–40% of electricity generation.

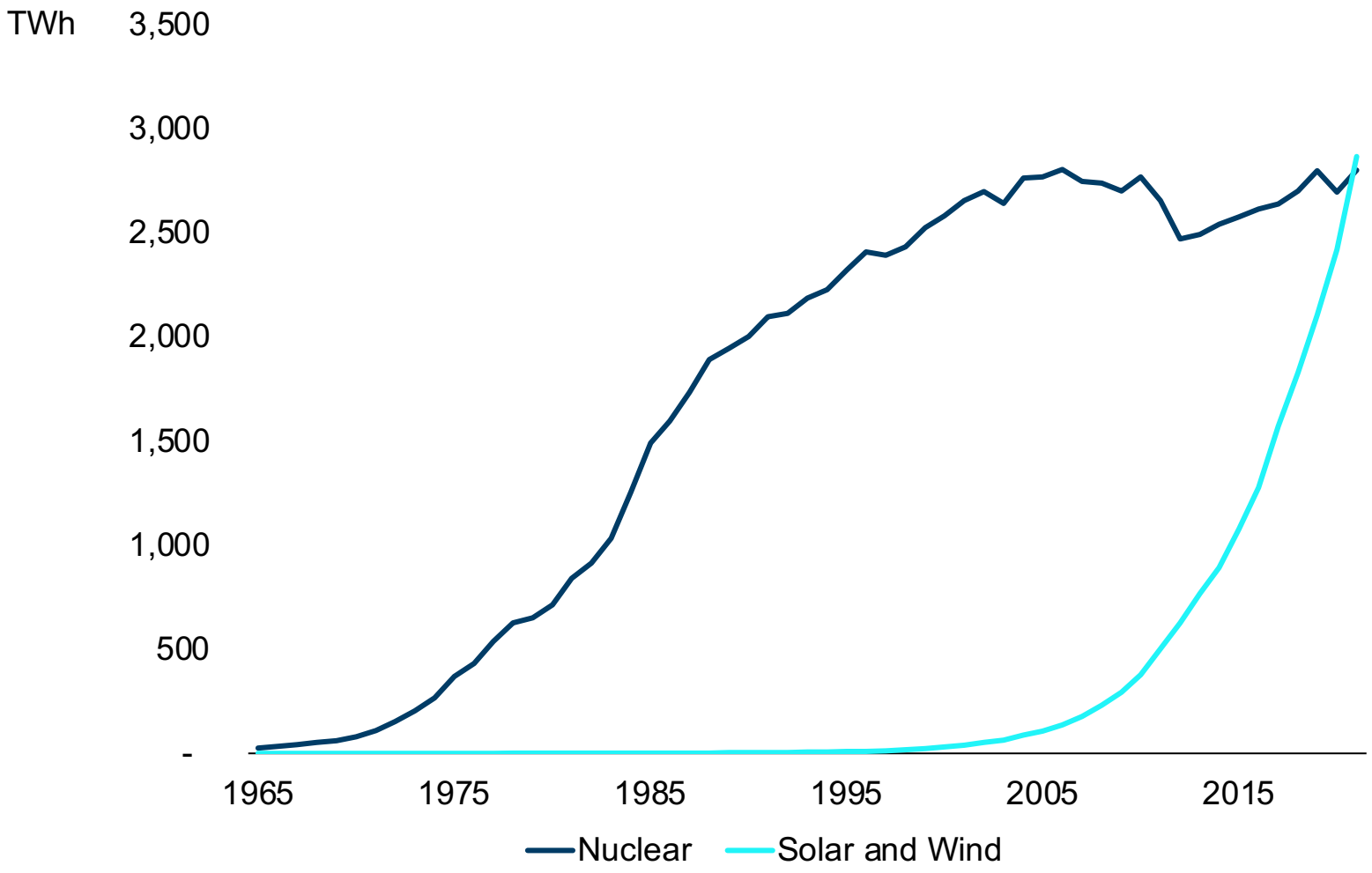
As backup it will account for 5%–10% of electricity generation, falling over time.

Gas is there precisely for those cold, calm winter nights that people worry about.

But that still means a lot less gas demand than today.

Nuclear is Stagnant and Expensive

Global power generation from nuclear vs. wind and solar



Nuclear energy has no learning curve, and supply has been stagnant for two decades.

That contrasts with the S shape of supply growth of solar and wind.

Nuclear costs are now much higher than the costs of solar and wind, even when intermittency is factored in.

Even advocates of nuclear energy do not see rapid growth over the next few decades.

Nuclear supply might increase to 3–4 PWh at a time when solar and wind are likely to grow to 30–40 PWh.

Source: BP Statistical Review

The Vaclav Smil Approach to the Energy Transition

How to deny energy system change

- Focus on the hard-to-solve sectors
- Focus on the hard-to-solve countries
- Focus on total transition
- Set up and demolish straw man arguments
- Ignore all the solutions that are driving change
- Ignore evidence of peaking demand
- Ivory towers versus real-world change

The Canadian academic Vaclav Smil argues that the energy transition will take decades. Nobody really disagrees with that point.

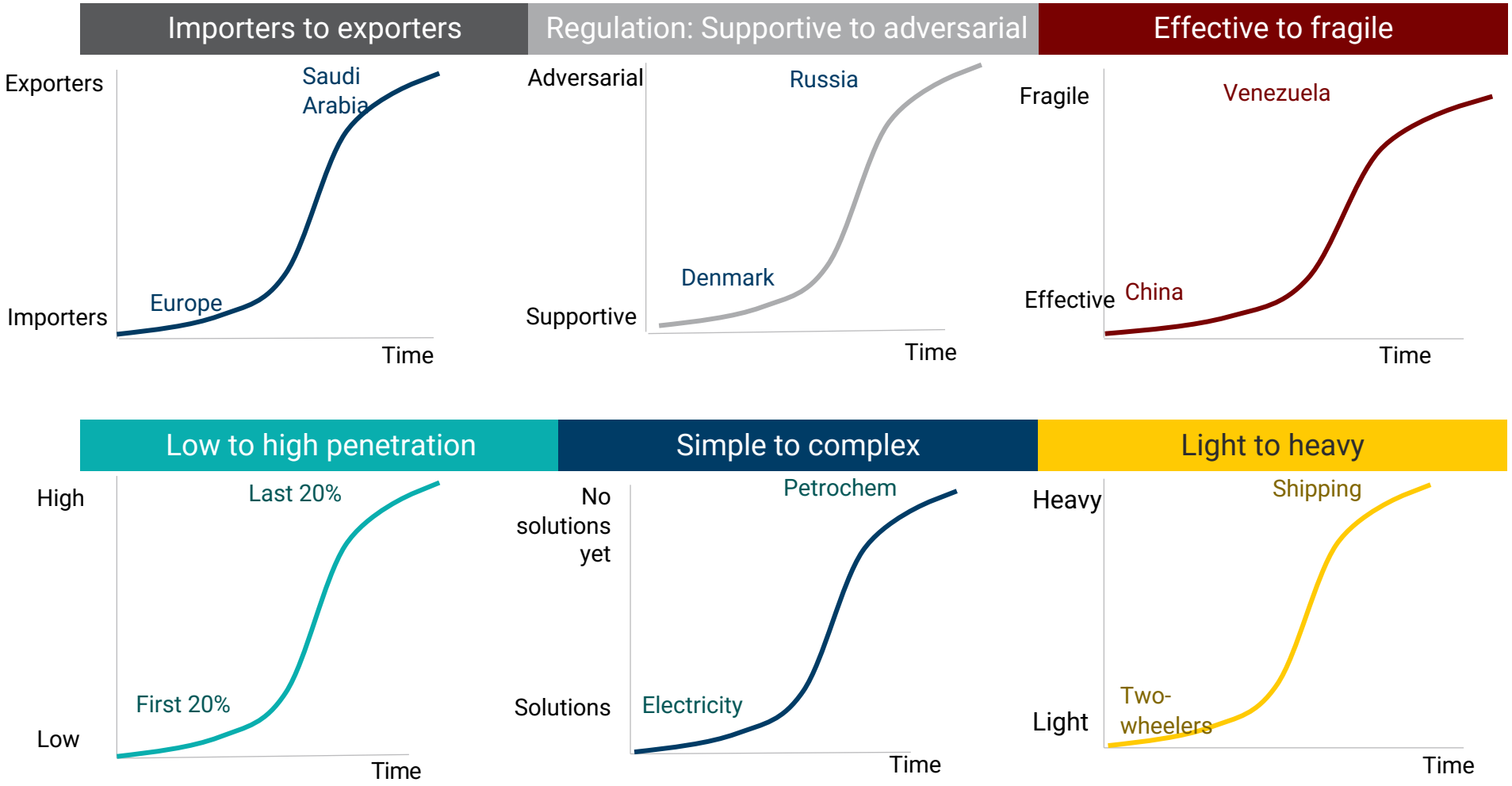
The point of disagreement is that markets react at the start of transitions, not the end.

Smil has also assembled a series of arguments about why the energy transition will not happen.

These are a master class in focusing on the hardest problems (the endgame one day in the future) and ignoring the many areas of success (today and right now).

In every area, change moves from easy to hard

- In every area and sector, change progresses from easy to hard.
- For example, areas of low penetration are easier to address than those with high penetration. Countries with supportive regulatory regimes change before those with opposed regimes. Effective governments drive change faster than weaker ones.
- This framing is quite normal and is seen in many areas of life.



Source: RMI

We Have All the Technologies We Need

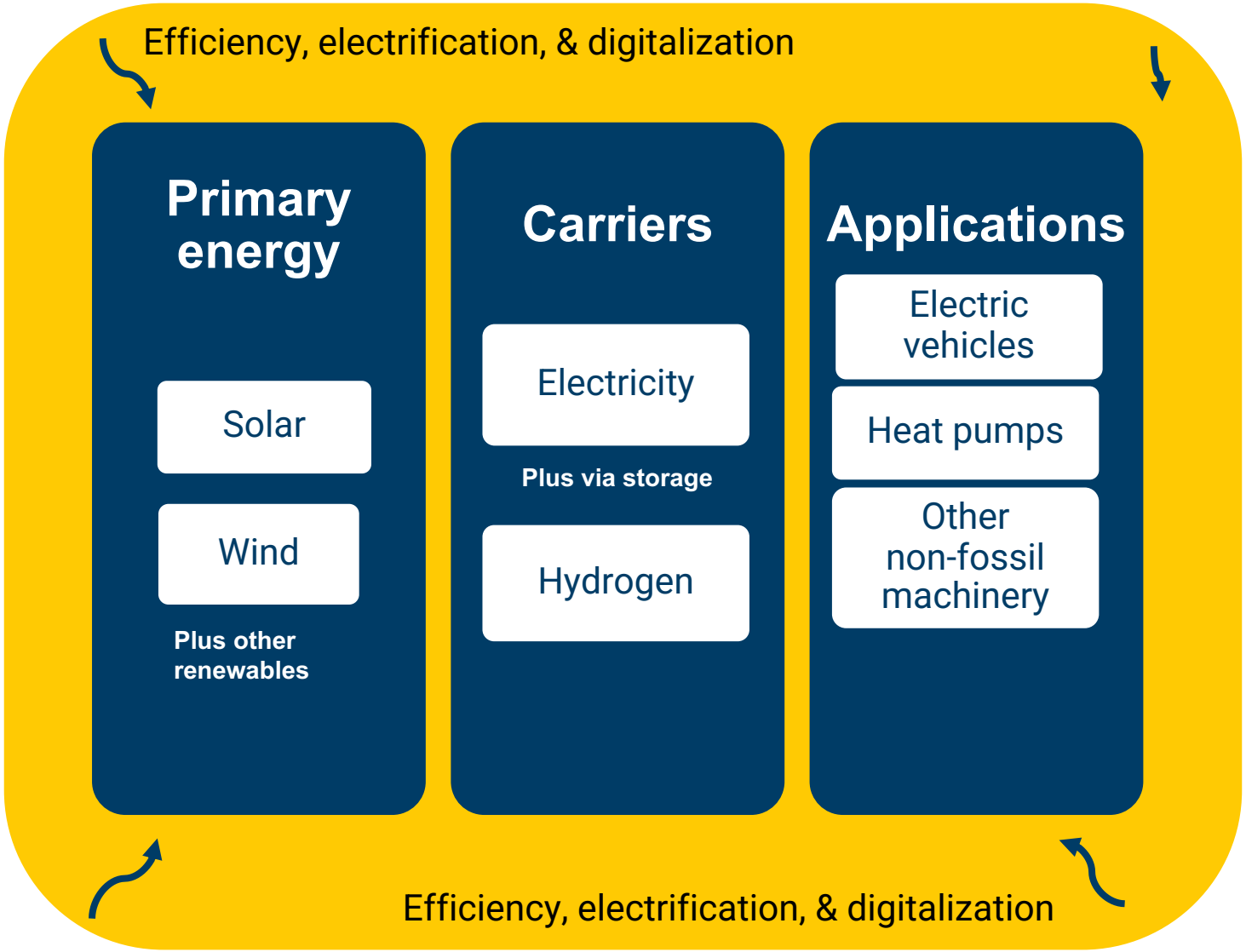
A new cluster of technologies can replace the entire fossil fuel system

Energy efficiency is improving all the time thanks to better design, machines, electrification and digitization

The two core primary renewable energy sources are solar and wind

The key carriers are electricity, batteries and hydrogen

The new prime movers include EV, heat pumps, ammonia powered ships and other non-fossil machinery



Source: RMI

We Know Roughly What to Do

What we need to do	Where we stand	What we need to do	Is this feasible?	Grounds for hope
Increase efficiency	Efficiency gains of 1.8% p.a. for the past decade	Increase efficiency to over 3% p.a.	Efficiency gains of 3% p.a. follow inevitably from the deployment of renewable technologies	On track
Decarbonize electricity	38% of electricity already from non-fossil sources. Renewables are cheaper than fossils in 90% of the world and growing on S-curves	Increase renewables to 100% of supply. Leaders first, then laggards	We need to maintain solar and wind growth up the S-curve	On track
Electrify whatever we can	Non-fossil energy is already the energy source for two-thirds of buildings and a third of industry. EVs are comparable in lifecycle price with ICE vehicles	Electrify transport. Deploy heat pumps at scale. Electrify industry and buildings	The transport revolution has started. Industry and building electrification needs to happen faster	China is doing this
Hydrogen, biomass, or CCS for the rest	Massive ramp in green hydrogen planned	Get green hydrogen costs down to $1/kg, which is price parity	The past 12 months have seen a massive increase in hydrogen plans	Hydrogen ramp has started, led by China

Source: RMI

Efficiency Is Moving from Incremental to Systemic

As new energy technology penetration increases, efficiency gains will rise

Efficiency gain

Solar as a primary energy source is

250%

more efficient than coal

A heat pump is

300%

more efficient than a gas boiler

An electric vehicle is

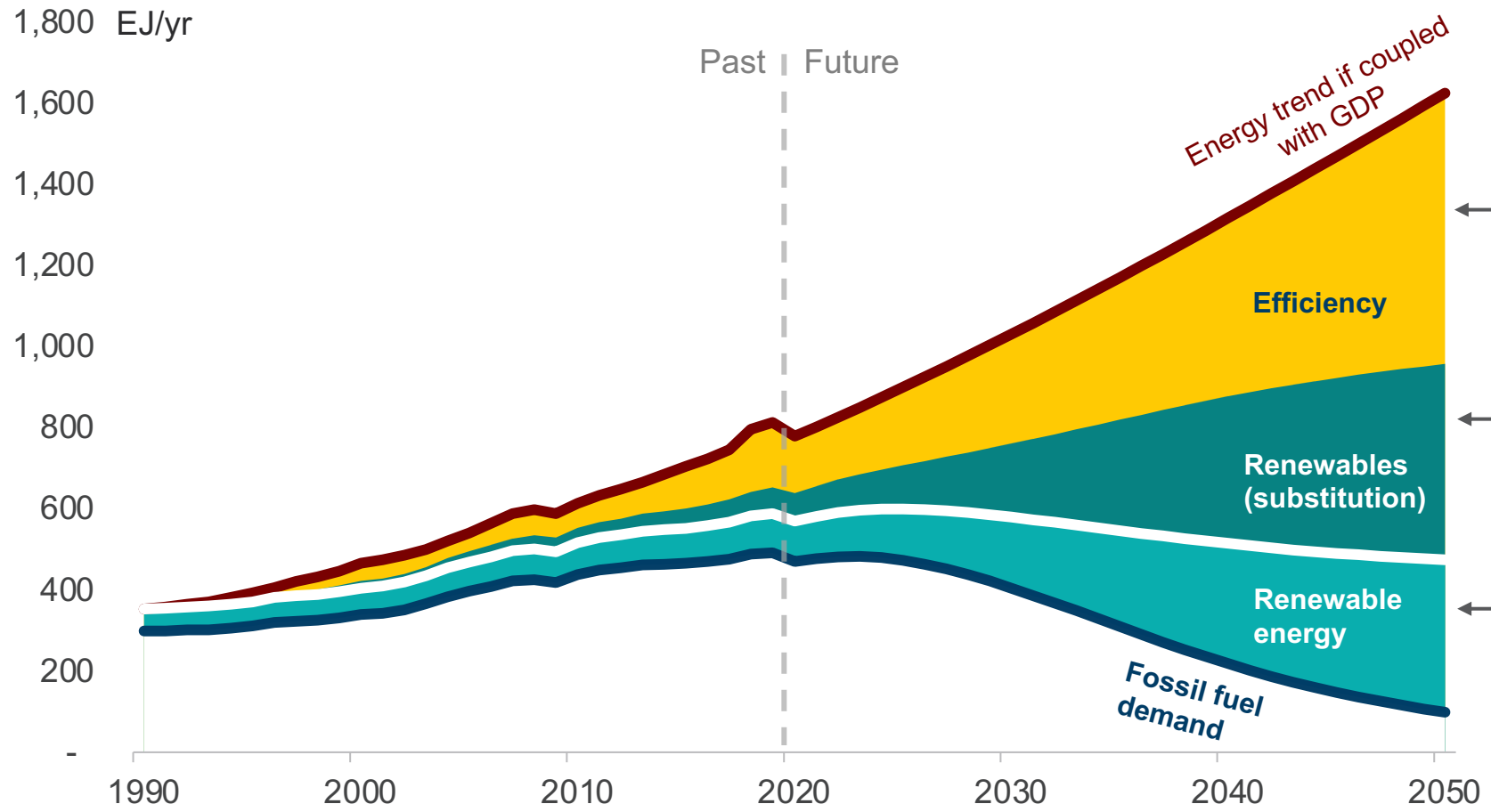
400%

more efficient than an ICE

Change Happens When You Combine Efficiency and Renewables

Efficiency slows growth; renewables push fossil fuels off the plateau

Global energy demand (EJ/year) since 1990



Description

More efficient technologies & systems

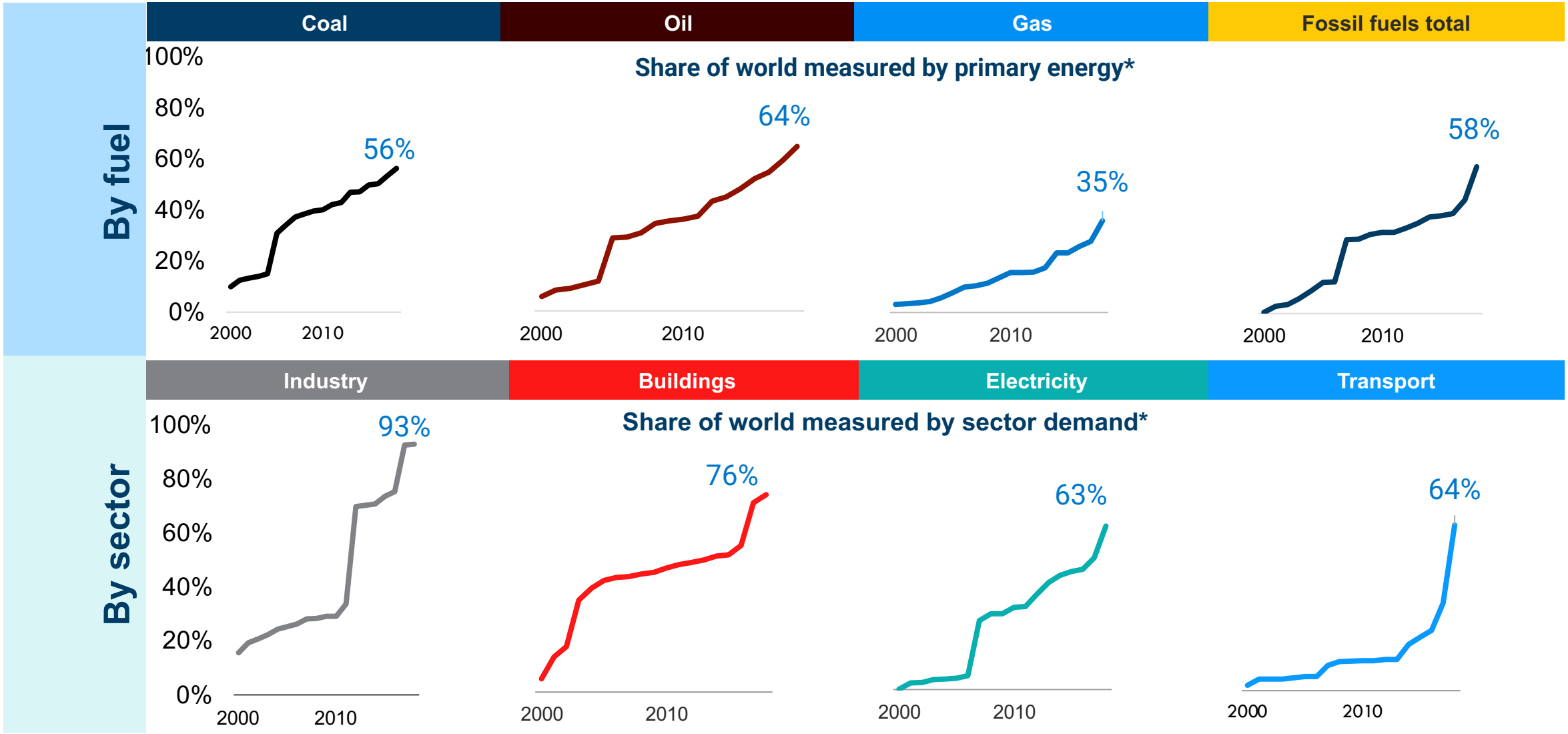
Goodbye to the huge thermal losses of fossil fuels

Renewables push out fossil fuels from the energy system

Source: Rystad central scenario (1.6°C) for energy data; IMF for GDP; RMI calculations

Share of Demand Past the Fossil Fuel Peaks by Fuel Type & Sector

Peaking demand is happening in every sector and every fuel. This shows what share of the world is past the peak

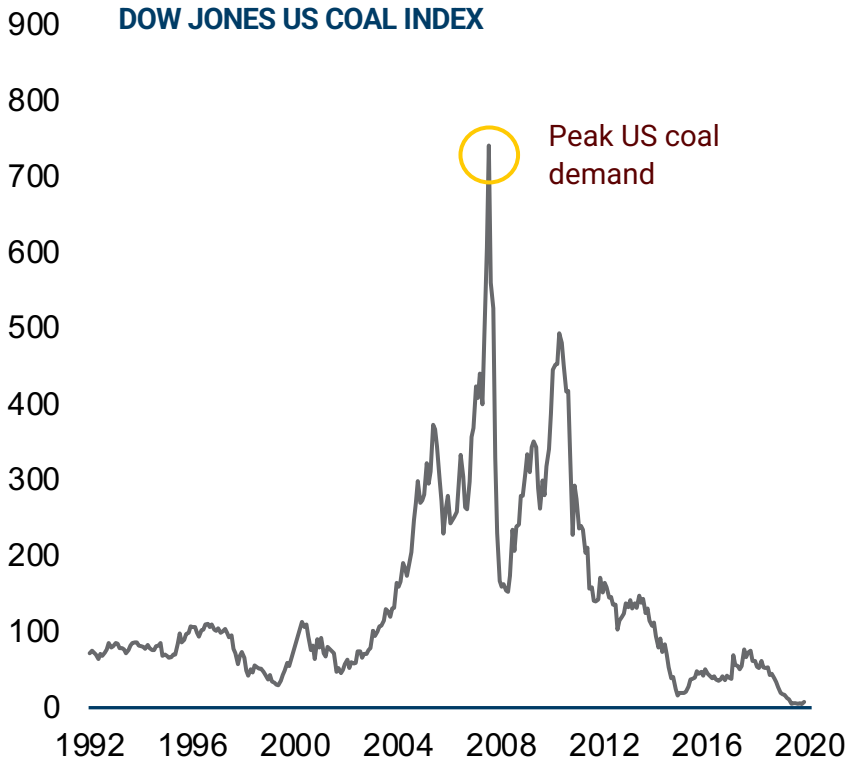


Source: IEA WEB; RMI. For example, countries using 56% of primary energy have seen peak coal, and countries with 76% of buildings demand have seen peak fossil fuels in buildings

Investors Sell Shares in Incumbents at the Peak

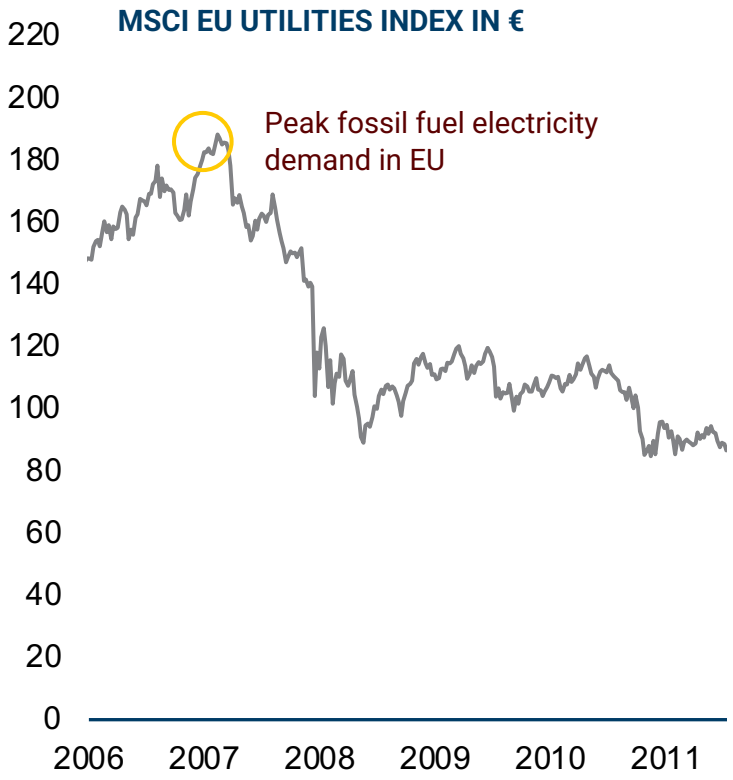
Investors hunt out peaks and sell just before

US coal



US coal stocks peaked in 2008, just as US coal demand was peaking.

EU fossil fuel electricity



EU electricity stocks peaked in 2007, just before demand for fossil fuel electricity peaked.

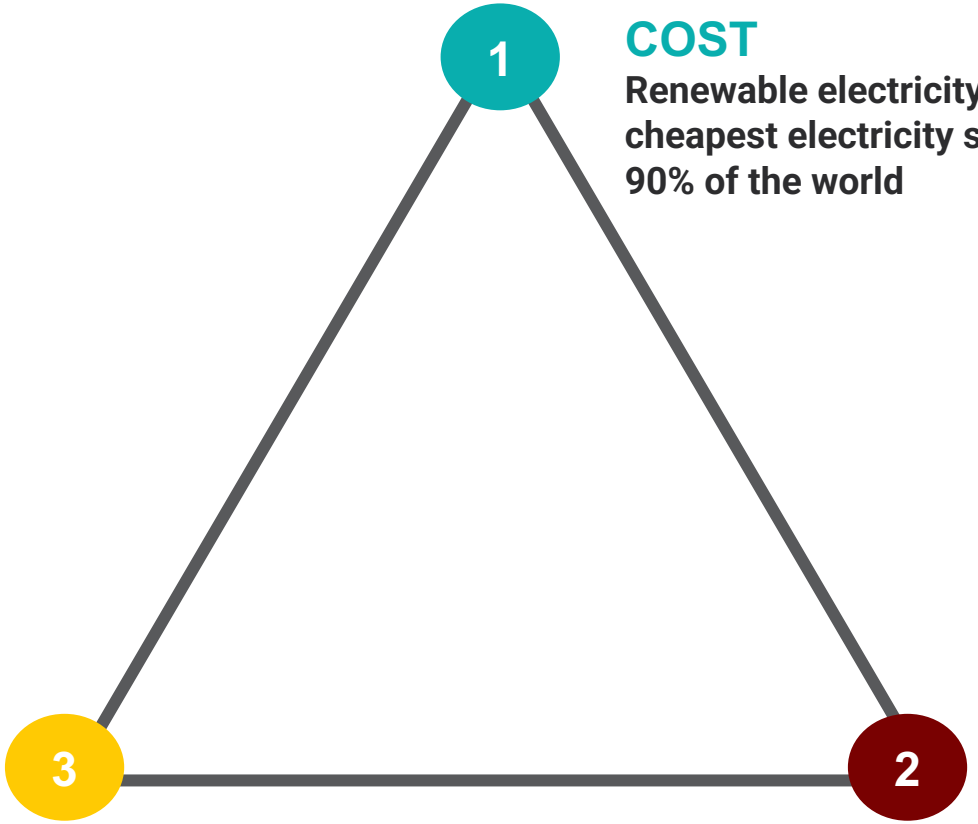
Oil services

The oil services index peaked in 2014, just as E&P capex peaked.

Source: Bloomberg

Putin Solved the Energy Trilemma

Cost, security, and climate: once at odds, now fully aligned



COST

Renewable electricity is the cheapest electricity source in 90% of the world

SECURITY

90% of people live in countries with abundant renewable energy

ENVIRONMENT

Renewables have an ecological footprint c.100 times lower than fossil fuels

Source: RMI summary based on data from BNEF, Solargis, NREL, World Bank, Carbon Brief, Nature Energy, IEA

A New Energy System Will Mean More Jobs

The impact of the energy transition on jobs

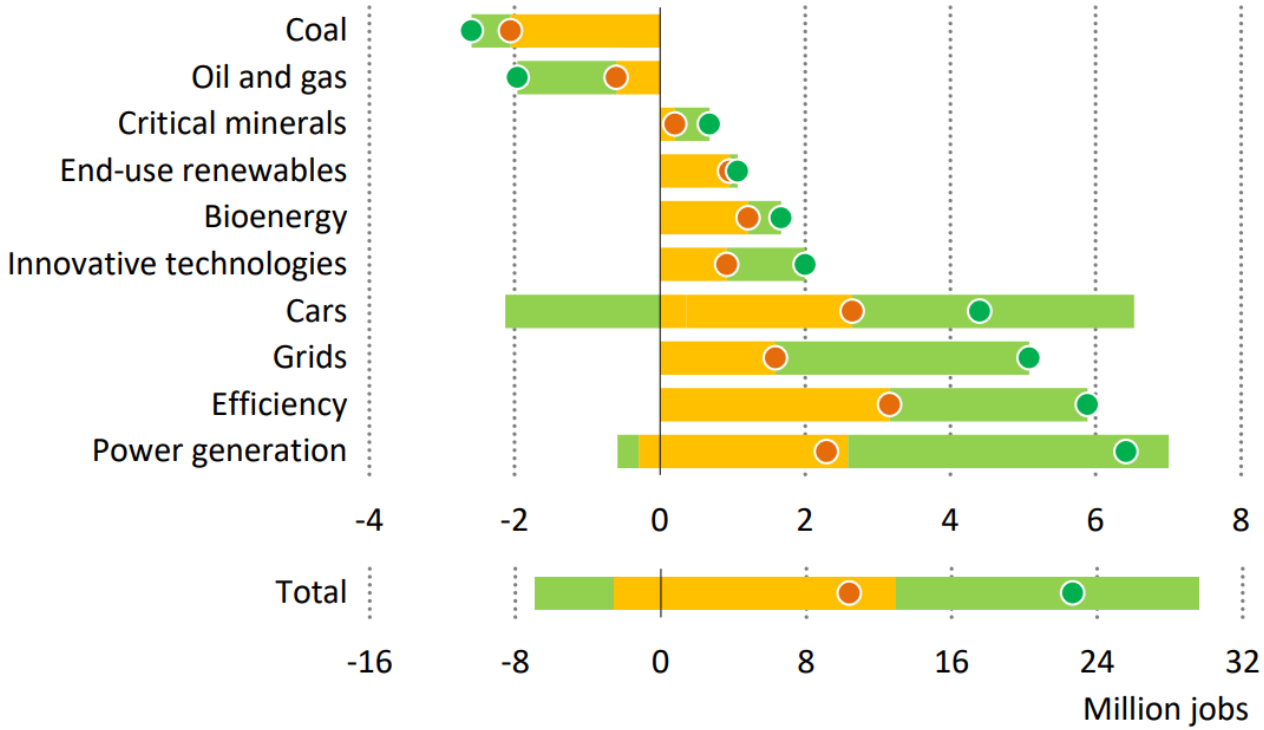
The IEA calculates that there are already more jobs in clean energy than in fossil fuels.

And an energy transition would mean a net gain of 22 million jobs. Although they need to be trained.

For fossil fuel importers (80% of the world), you exchange rent paid to petrostates for jobs paying local employees.

Renewable energy jobs are more local, and more diverse by gender and education.

Employment Growth in Clean Energy and Related Areas to 2030



Source: IEA. APS is the announced pledges scenario. NZE is the net zero emissions scenario

The Drive to Change Is Greatest in Fossil Fuel Importers

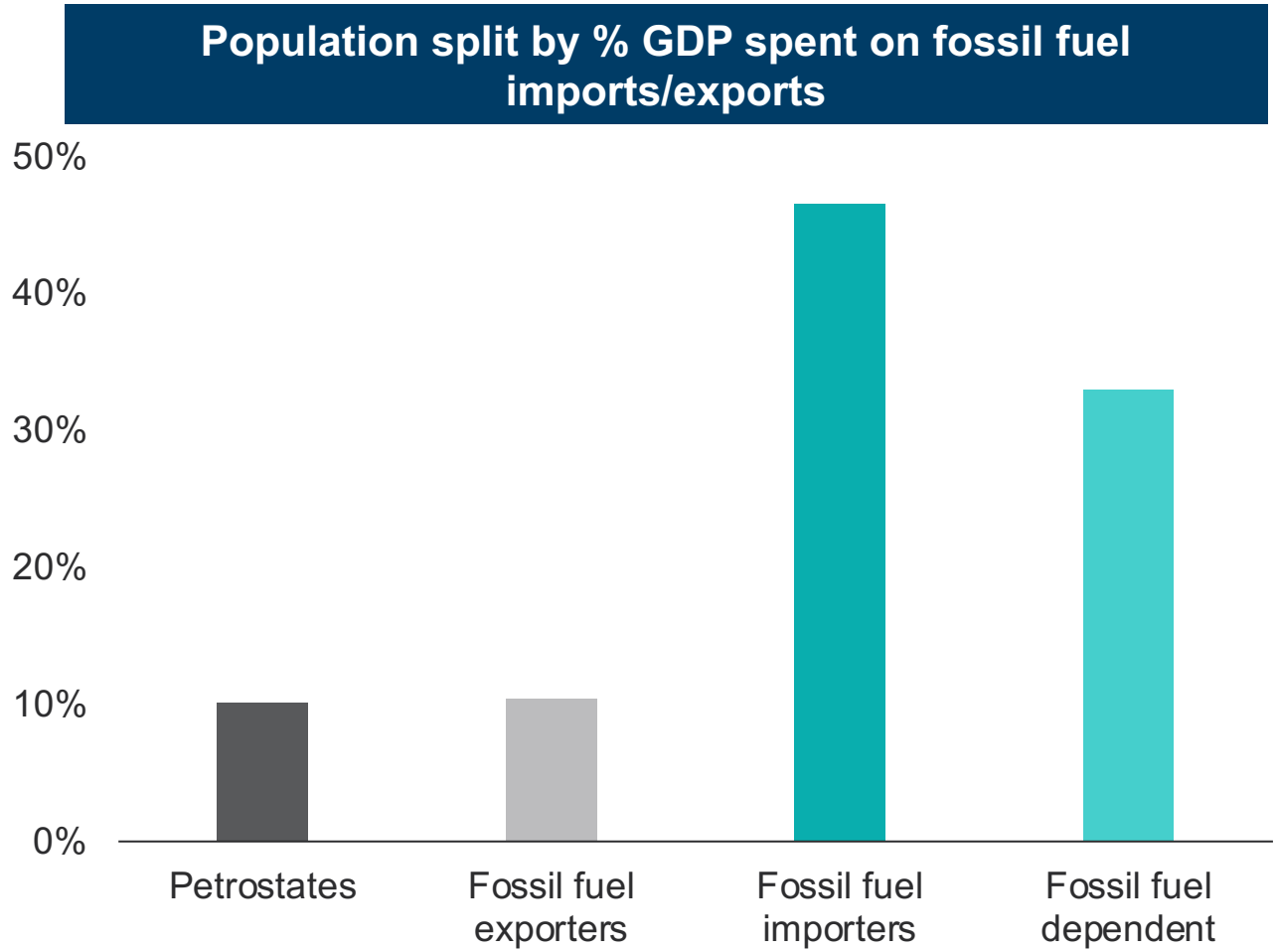
80% of the world lives in fossil fuel importers

The balance of forces in favor of change is especially strong in countries that import fossil fuels.

80% of people live in fossil fuel importers. It is importers, not exporters, who determine future fossil fuel demand.

Only 10% of people live in petrostates.

Most of the sources of energy demand growth are in fossil fuel importers, notably China and India, both of which face rising dependency on oil and gas imports under BAU.



Definitions: Petrostate >10% GDP in fossil fuel exports, Exporter 0%–10%, GDP in exports
Importer 0%-5% of GDP in fossil fuel imports;, dependent <5% of GDP in imports

Source: COMTRADE 2016, RMI assumptions

About RMI

RMI is an independent nonprofit founded in 1982 that transforms global energy systems through market-driven solutions to align with a 1.5°C future and secure a clean, prosperous, zero-carbon future for all. We work in the world's most critical geographies and engage businesses, policymakers, communities, and NGOs to identify and scale energy system interventions that will cut greenhouse gas emissions at least 50 percent by 2030. RMI has offices in Basalt and Boulder, Colorado; New York City; Oakland, California; Washington, D.C.; and Beijing.

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Related

Peaking: Why Fossil Fuel Demand Peaked in 2019

Peaking: Why Peaks Matter

The Energy Transition Narrative