Public lecture:

Recent developments in US climate policy

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Melbourne Energy Institute

THE UNIVERSITY OF MELBOURNE

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WORLD RESOURCES INSTITUTE

RECENT DEVELOPMENTS IN U.S. CLIMATE POLICY

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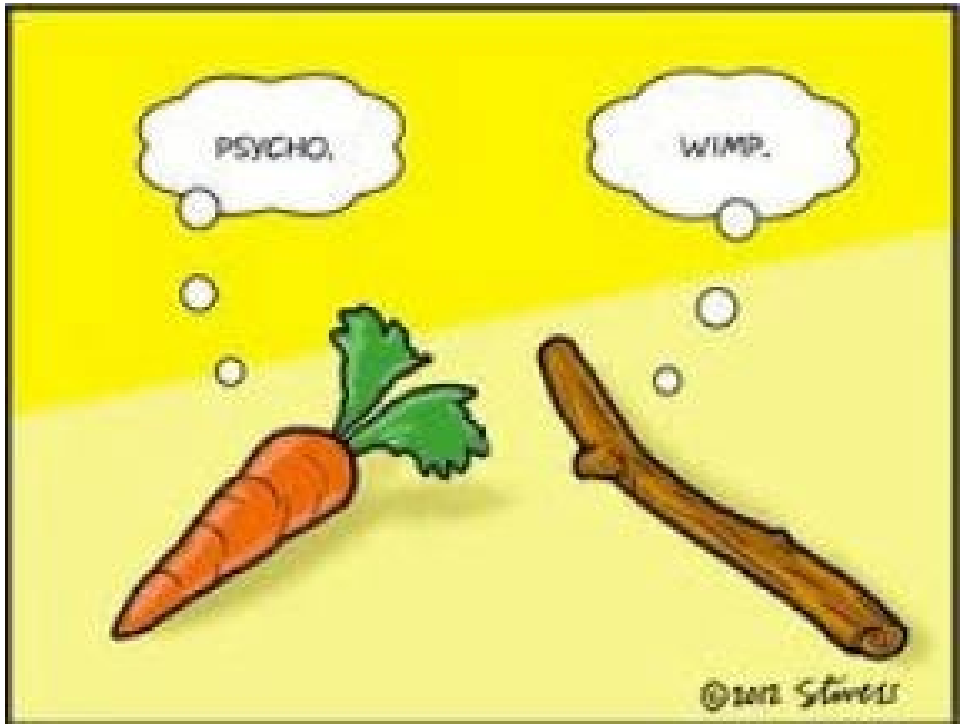
TOPICS

- A brief history of US climate policy
- How the Inflation Reduction Act (IRA) addresses the four key strategies to reach net-zero
- IRA impacts: investment, emissions
- Hot button issues:
  - Hydrogen
  - Permitting
  - LNG exports
  - Carbon capture
- Getting to net zero, globally: BNEF

View are my own.
See web links throughout

A BRIEF HISTORY OF MAJOR U.S. CLIMATE POLICY (ATTEMPTS)



"STICKS" vs. "CARROTS"

- 1993: BTU tax legislation
  - Passed House / Died in Senate
- 1997: Kyoto Protocol – envisioned international emissions trading
  - Never offered to Senate
- 2009: Waxman-Markey cap-and-trade
  - Passed House / Died in Senate
- 2022: Inflation Reduction Act (IRA) – 99% "carrots"
  - Tax incentives, loans, procurement, grants -- ~$370 billion
  - Couples with Infrastructure Investment and Jobs Act (IIJA, Nov. 2021) and CHIPS and Science Act (Aug. 2022) to form a comprehensive RDD&D program

www.thirdway.org/blog/adding-it-up-groundbreaking-federal-investments-into-clean-energy-innovation

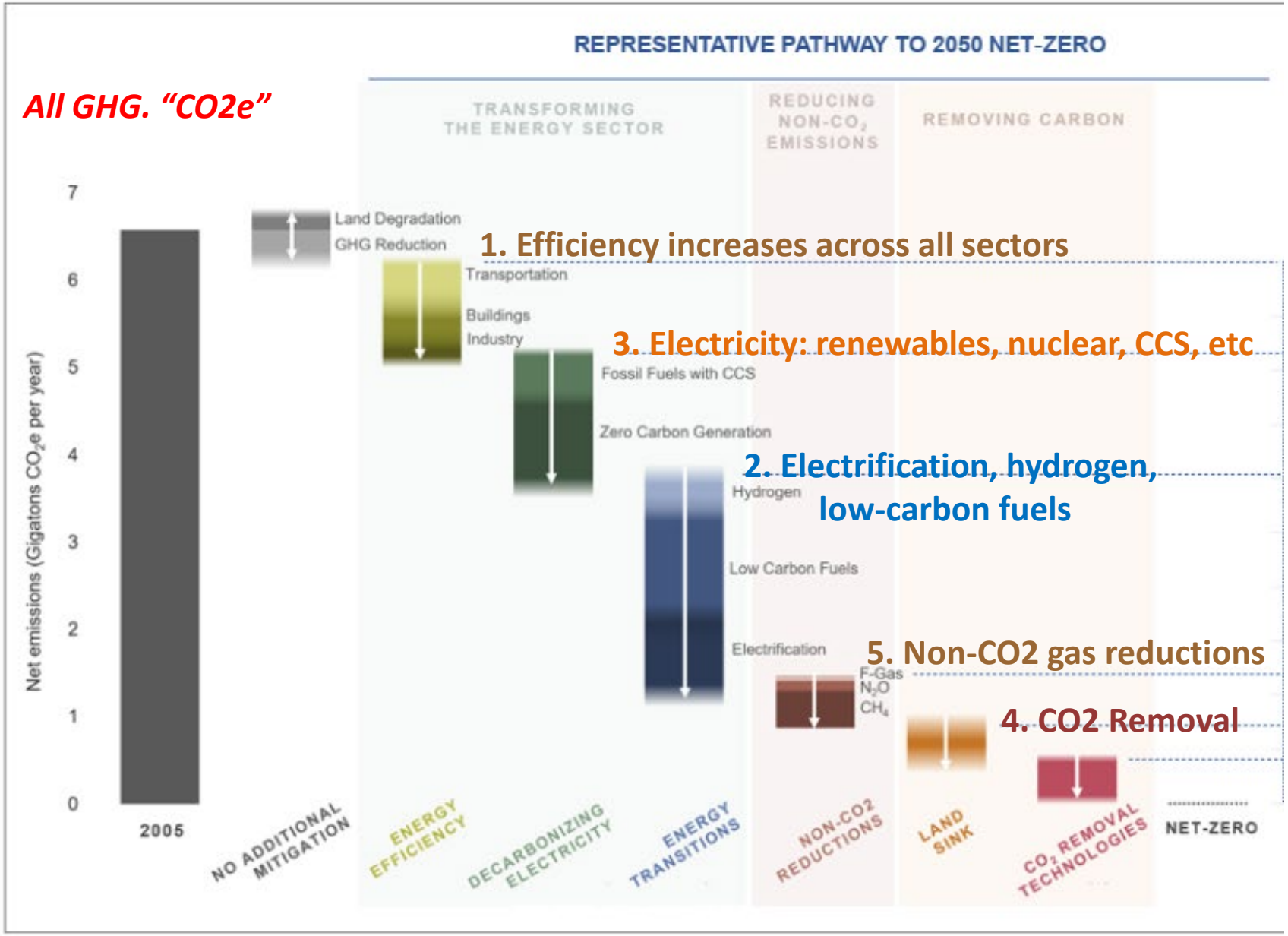
IIJA: https://www.whitehouse.gov/bipartisan-infrastructure-law/ Tax incentives: https://crsreports.congress.gov/product/pdf/R/R47202
CHIPS: https://bipartisanpolicy.org/press-release/congress-passes-the-chips-and-science-act-at-americas-bipartisan-party/

BUT THERE ARE EXISTING STICKS WORTH NOTING
U.S. HAS BEEN MAKING SOME PROGRESS IN RECENT YEARS…

- **Appliance efficiency standards *(long history, rarely weakened)***
- **CAFE and vehicle emission standards *(flip-flops: Obama, Trump, Biden)***
- **Power plant standards *(flip-flops: Obama, Trump, Biden)***
- **Phase down of HFCs *(important non-CO2 gas)***
  - **American Innovation and Manufacturing (AIM) Act of 2020**
  - **Ratification of the Kigali Amendment to Montreal Protocol (Sep. 2022)**
- **Cap-and-trade: *subnational***
  - **California – covering ~80% of GHG emissions**
  - **Regional Greenhouse Gas Initiative (RGGI) – CO2 from power sector in 12 NE states**
- **State Renewable Portfolio Standards *(sticks)***
  - **Combined with federal PTC/ITC for renewables *(carrots)***

Also: abundant, low-cost natural gas

U.S. LONG-TERM STRATEGY (NOV. 2021) – PATHWAYS TO NET-ZERO



Four Key Strategies to reach net-zero *(common across all credible studies)*:

1. **Efficiency**
2. **Electrification**
3. **Clean electricity**
4. **Carbon capture**
   (in multiple forms)

Plus non-CO2 gases

Biden LTS presents eight pathways and sensitivity analysis.

Source: ***https://www.whitehouse.gov/wp-content/uploads/2021/10/US-Long-Term-Strategy.pdf***

ADDRESSING THE FOUR KEY STRATEGIES TO GET TO NET-ZERO

1. **Energy efficiency**
    a. **Tax Credits for Energy Efficiency Improvements** *(insulation, windows, doors,)*
    b. **Investment in Low-Carbon Materials & Buildings**

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2. **Electrification of end-uses** *(including low-carbon fuels produced from electricity)*
   a. **Clean Vehicle Tax Credits** *(private & commercial)*
   b. **Grants for Clean Heavy-Duty Vehicles**
   c. **Tax Credits for heat pumps, electric stoves**
   d. **Clean Hydrogen Production Tax Credit**

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3. **Electricity decarbonization**
   a. **Clean Electricity Production Tax Credit *(moves to technology-neutral in 2025)***
   b. **Nuclear Power Production Tax Credit *(existing plants)***
   c. **Promotion off-shore wind via leasing**
   d. **Grants to facilitate new transmission lines**

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4. **Carbon capture** *(CCS, CCUS)* and **carbon dioxide removal** *(CDR)*
   a. **Enhanced Carbon Capture and Sequestration Tax Credits *(including technological CDR)***
   b. **Investments in Biomass, Carbon Removal, and Forest Management *(natural CDR)***
   c. **Funding for agriculture and forestry programs** *(EQIP, Conservation Stewardship Program, etc.)*

https://bipartisanpolicy.org/blog/inflation-reduction-act-summary-energy-climate-provisions/
https://crsreports.congress.gov/product/pdf/R/R47262

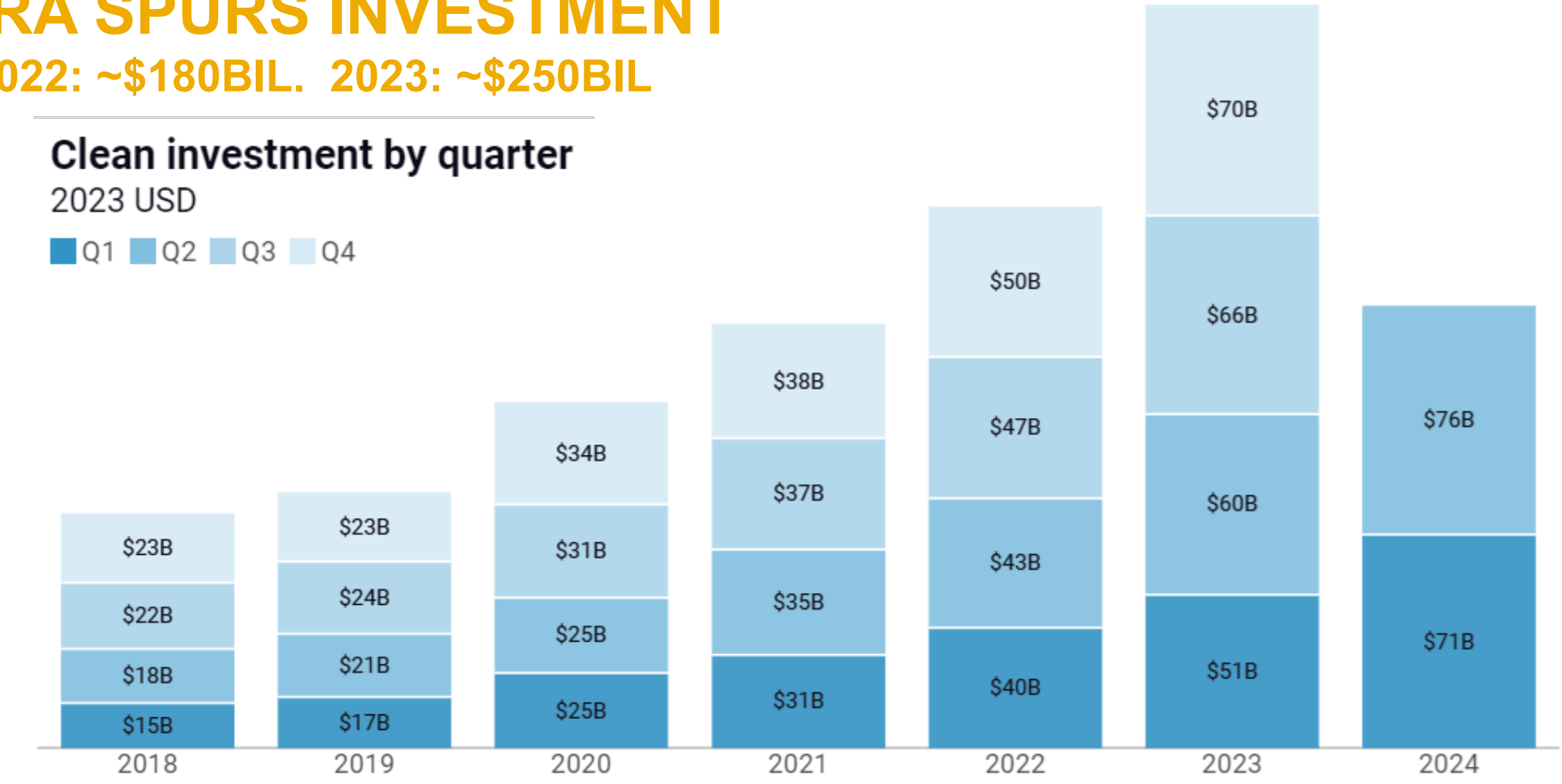
THERE IS SO MUCH MORE TO THE IRA…

- Aiming to enhance US jobs, wages, equity, environmental justice
- Cross-cutting provisions:
  - Bonuses for meeting prevailing wage, apprenticeship, domestic content requirements
  - Advanced manufacturing production credit, intended to spur U.S. manufacturing
  - Bonuses for projects in "energy" and low-income communities
  - Environmental justice grants ($60 billion)
  - "Direct pay" and "Transferability" of tax credits will expand entities that can take advantage of of tax credits
- See modeling of job impacts by WRI, Blue-Green Alliance
  - www.wri.org/insights/us-jobs-clean-energy-growth
  - www.bluegreenalliance.org/wp-content/uploads/2022/08/BGA-IRA-Jobs-Factsheet-8422_Final.pdf
- A "stick" for a non-CO2 gas: fee on methane emissions for facilities with excess of 25k tons CO2e

https://www.pillsburylaw.com/en/news-and-insights/ira-revives-hope-biden-climate-agenda.html
https://bipartisanpolicy.org/explainer/three-reasons-why-direct-pay-is-crucial-for-clean-energy-tax-policy/

IRA SPURS INVESTMENT

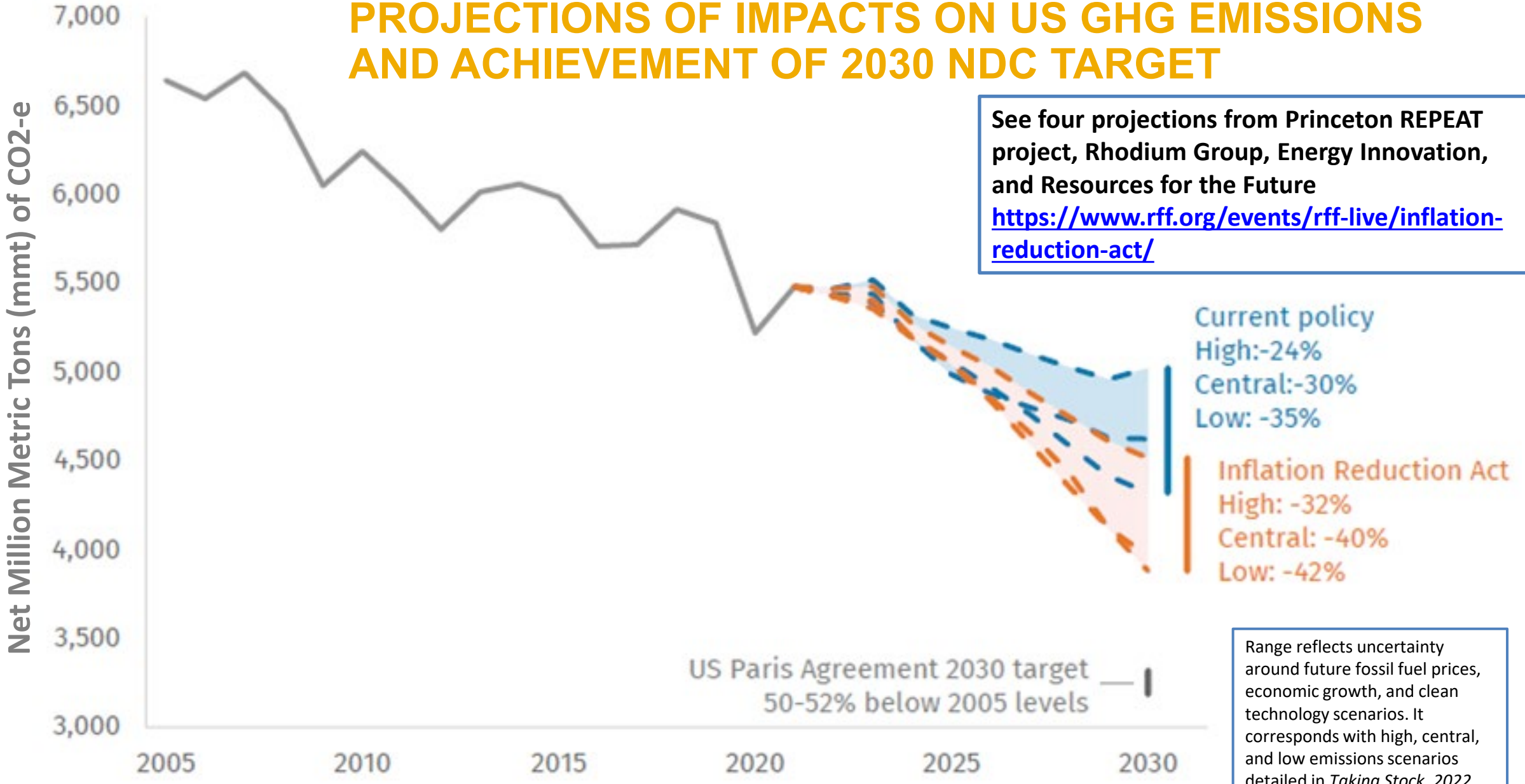
2022: ~$180BIL. 2023: ~$250BIL



Source: Rhodium Group-MIT/CEEPR Clean Investment Monitor

https://www.cleaninvestmentmonitor.org/

PROJECTIONS OF IMPACTS ON US GHG EMISSIONS AND ACHIEVEMENT OF 2030 NDC TARGET



See four projections from Princeton REPEAT project, Rhodium Group, Energy Innovation, and Resources for the Future https://www.rff.org/events/rff-live/inflation-reduction-act/

Range reflects uncertainty around future fossil fuel prices, economic growth, and clean technology scenarios. It corresponds with high, central, and low emissions scenarios detailed in *Taking Stock, 2022.*

Rhodium Group, *Assessing the Climate and Clean Energy Provisions in the Inflation Reduction Act*, https://rhg.com/research/climate-clean-energy-inflation-reduction-act/

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HOT BUTTON ISSUES: HYDROGEN ("45V")

- Example of: 'Regs can take a long time' (>30k comments, pending) and 'Pragmatists v. Purists'
- IRA provides production credit for each kg of qualified H produced at a qualified clean H production facility.
  - Amount of credit dependent on the emissions intensity of the H production process
- Unleashed battles over type, location and timing of the energy used to make H (electricity, natural gas)
- Pragmatists (including Dem. Senators): 'launch the industry'
- Purists: 'write the regs to strongly favor electrolysis and RE'

https://subscriber.politicopro.com/article/eenews/2024/07/30/greens-look-to-rebut-lawmaker-push-on-hydrogen-credits-1-00171613 https://www.eenews.net/articles/3-issues-to-watch-with-the-big-us-bet-on-clean-hydrogen/

HOT BUTTON ISSUES: PERMITTING

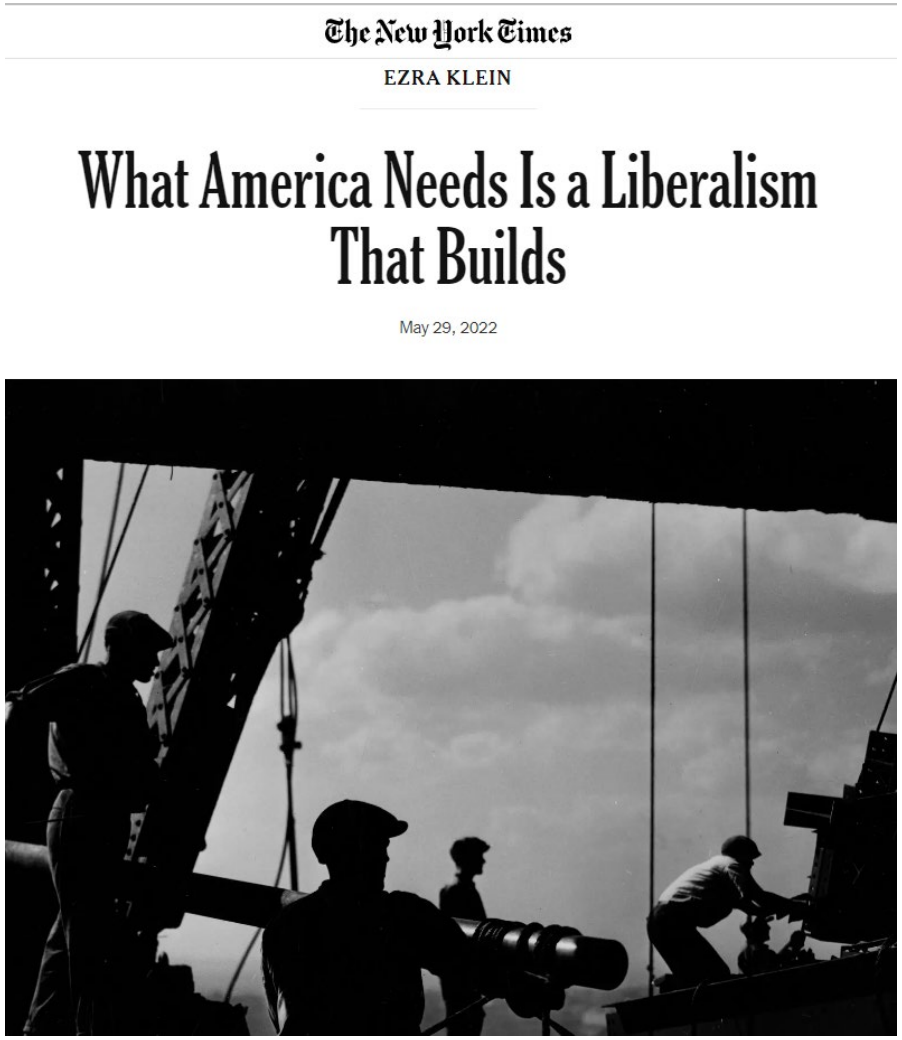
Brian Schatz
@brianschatz

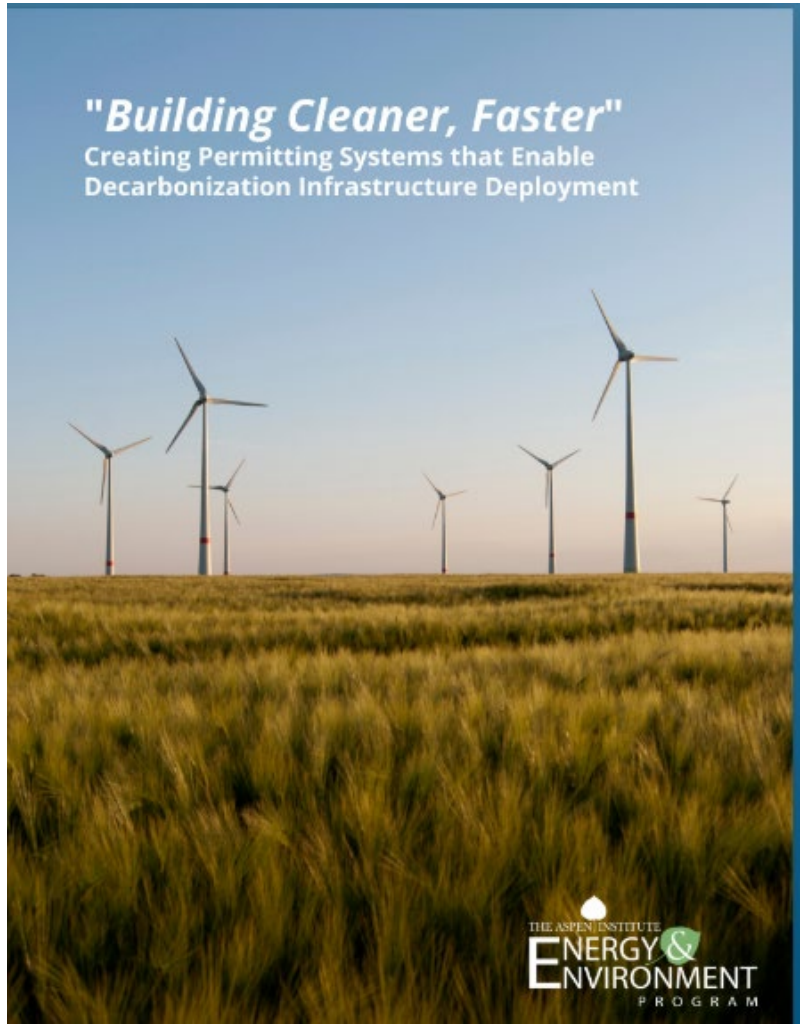
Sen. Schatz (D – Hawaii), climate hawk ···

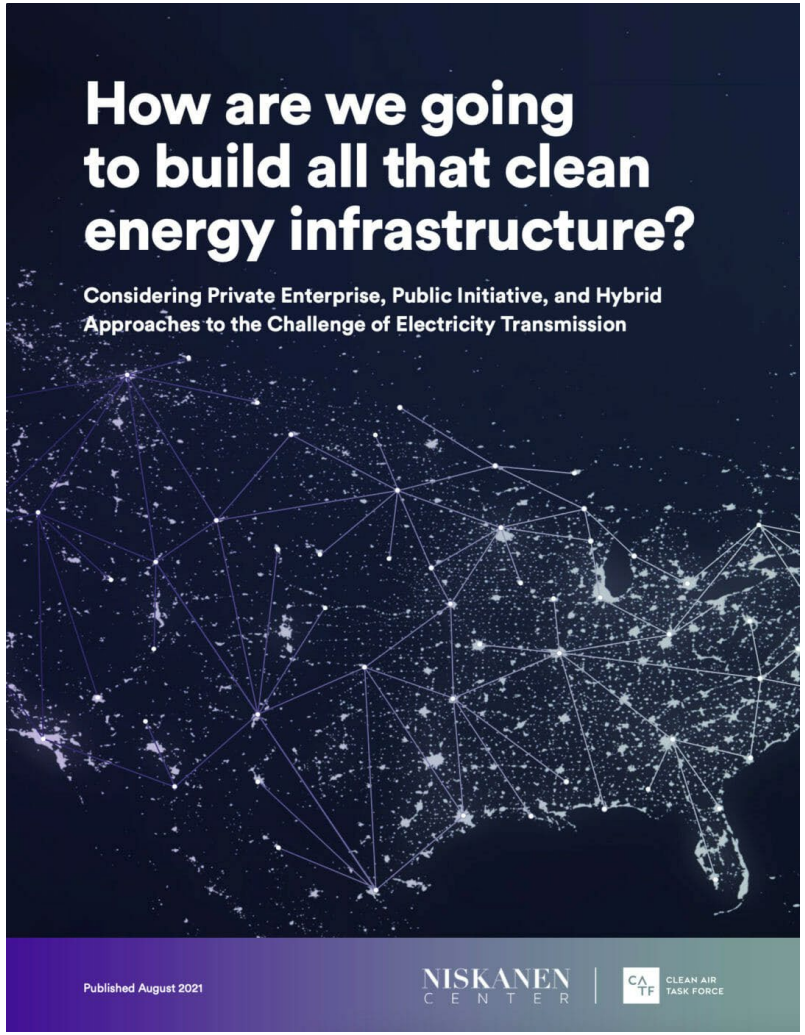
The environmental movement of the last generation was partly organized around stopping things. But to save the planet we are going to have to build things at an unprecedented speed and scale. We need to make it easier, not harder, to build big, planet saving projects.

https://twitter.com/brianschatz/status/1520468607293030400

CAN WE BUILD ALL THE NEEDED INFRASTRUCTURE? ONLY WITH PERMITTING AND SITING REFORM







www.catf.us/resource/clean-electricity-transmission/ www.aspeninstitute.org/publications/building-cleaner-faster-report/
www.nytimes.com/2022/05/29/opinion/biden-liberalism-infrastructure-building.html

"ALL-OF-THE-ABOVE" PERMITTING BILL

- Bipartisan: Sen. Manchin (I-WV) Sen. John Barrasso (R-WY)
  - Out of Committee 16-4
- Provisions on permitting and federal leases related to:
  - Solar and wind
  - Hydro
  - Geothermal
  - Transmission
  - Oil, gas, coal
  - LNG exports
- Pragmatists vs. Purists
  - Purists: 'Kill the bill"
  - Pragmatists: 'Pass it. Large net benefit to climate"
  - Q: What effect does US domestic fossil supply have on global emissions?

https://bipartisanpolicy.org/explainer/the-energy-permitting-reform-act-of-2024-whats-in-the-bill/
POLITICO Pro | Article | Analysis shows Manchin-Barrasso permitting bill yields emissions reductions

HOT BUTTON ISSUES -- U.S. LNG EXPORTS

- Rapid growth: 2016: ~0. 2023: >11 bil. ft3/day
  - Spurred upward by invasion of Ukraine
  - Could more than double by 2028
- Jan. 2024: Biden Admin. paused approval of new LNG export project.
  - Preparing report on climate, domestic market, and environmental justice issues
  - Last report: September 2019.
- Pragmatists vs. Purists
  - Purists: 'LNG is worse than coal. Stop all new fossil fuel infrastructure'
  - Pragmatisits: 'Take hard look at footprint. Don't ignore energy security.'
  - Q: What is the GHG footprint of LNG exports? What does LNG displace?
  - Q: What effect do US LNG exports have on global emissions?

Crabtree-Written-Testimony.pdf (house.gov) **https://doi.org/10.1002/ese3.1934**
A Major Paper on Liquified Natural Gas… | The Breakthrough Institute

IS NATURAL GAS STILL A BRIDGE FUEL TO NET-ZERO? IPCC: 'YES'

- **AR6, WGIII, Table TS.2 gives the percentage decrease in primary energy from coal, oil, and gas in 2030 and 2050 (relative to 2019) for all 1.5/2.0 scenarios**
- **Median value given** *(and interquartile range)*
- **Coal in 2050: -95%** *(-100%, -80%)* ***Gas in 2050:*** **-45%** *(-60%, -20%)*

Global indicators	1.5°C (>50%)	1.5°C (>50%) by 2100	2°C (>67%)		
	Immediate action, with no or limited overshoot	NDCs until 2030, with overshoot before 2100	Immediate action	NDCs until 2030	All
Change in primary energy from coal in 2030 (% rel to 2019)	–75 (–80,–65)	–10 (–20,–5)	–50 (–65,–35)	–15 (–20,–10)	–35 (–55,–20)
in 2050 (% rel to 2019)	–95 (–100,–80)	–90 (–100,–85)	–85 (–100,–65)	–80 (–90,–70)	–85 (–95,–65)
Change in primary energy from oil in 2030 (% rel to 2019)	–10 (–25,0)	5 (5,10)	0 (–10,10)	10 (5,10)	5 (0,10)
in 2050 (% rel to 2019)	–60 (–75,–40)	–50 (–65,–35)	–30 (–45,–15)	–40 (–55,–20)	–30 (–50,–15)
Change in primary energy from gas in 2030 (% rel to 2019)	–10 (–30,0)	15 (10,25)	10 (0,15)	15 (10,15)	10 (0,15)
in 2050 (% rel to 2019)	–45 (–60,–20)	–45 (–55,–30)	–10 (–35,15)	–30 (–45,–5)	–15 (–40,10)

HOT BUTTON ISSUES: CARBON CAPTURE

- 'Doesn't work'
- 'Too expensive'
- 'Too risky'
- 'Prolongs dependence on fossil fuels'

The "moral hazard" question….

It's Time to End Carbon Capture of Climate Policy

An Open Letter to US and Canadian Leaders

…half of our millions of members and supporters across the United States and Canada, we call on policymakers to recognize that … capture and storage (CCS) is not a climate solution. It is a dangerous distraction driven by the same big polluters who created the climate emergency.

https://www.technologyreview.com/2021/07/08/1027908/carbon-removal-hype-is-a-dangerous-distraction-climate-change/

https://www.ciel.org/wp-content/uploads/2021/07/Confronting-the-Myth-of-Carbon-Free-Fossil-Fuels.pdf

https://www.nytimes.com/2022/08/16/opinion/climate-inflation-reduction-act.html

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IRA PROVISIONS ON CARBON CAPTURE

Bumped up tax incentives for various forms of carbon capture:

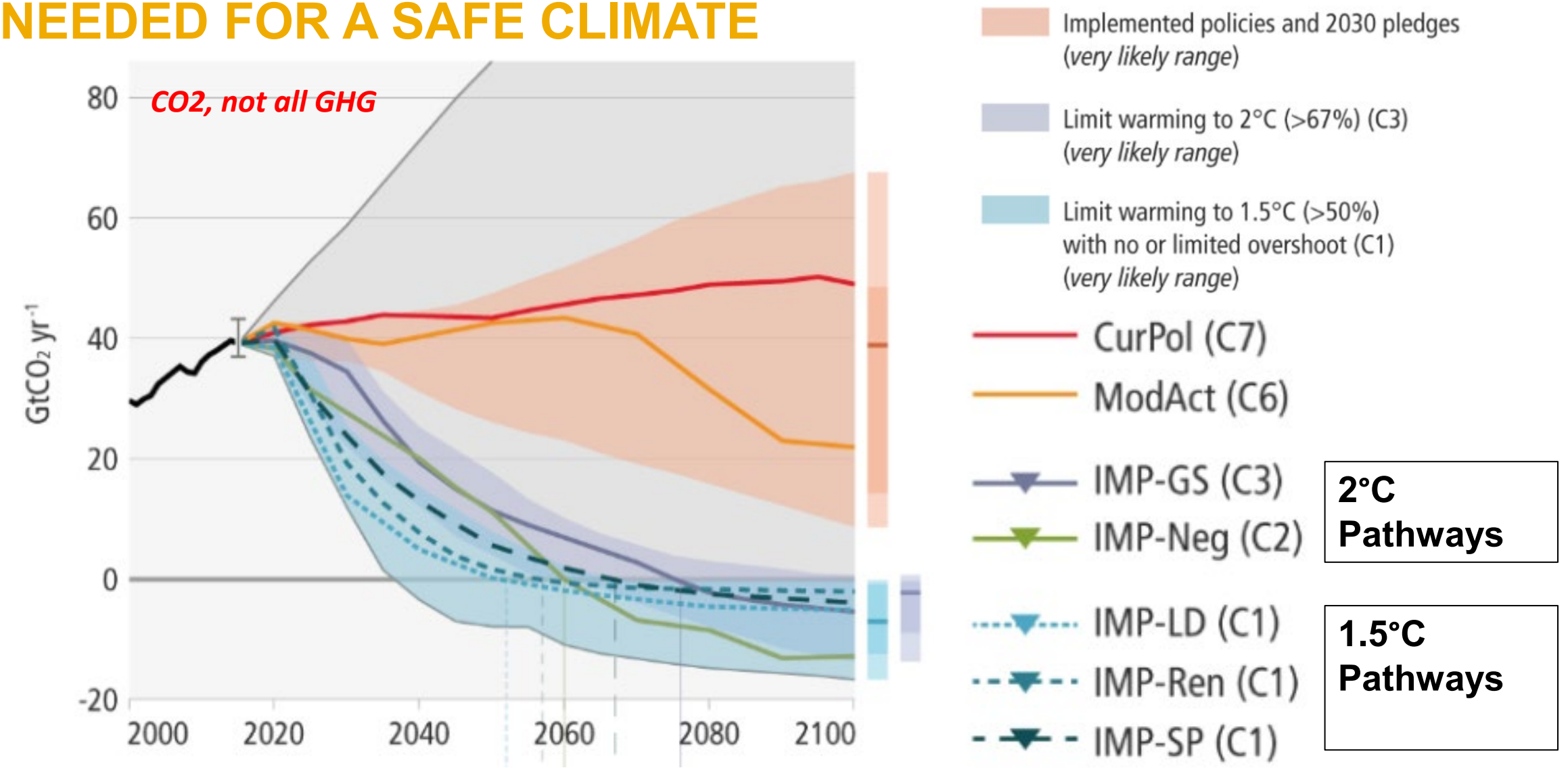
- **$60/ton for capture and utilization (CCU)**
- **$85/ton for capture and geologic storage (CCS)**
- **$180/ton for direct air capture & storage (DACS)**

Why? Context: IPCC Sixth Assessment Report (AR6)

- **Working Group III lays out global emission pathways that limit warming to to 1.5 or 2.0°C**

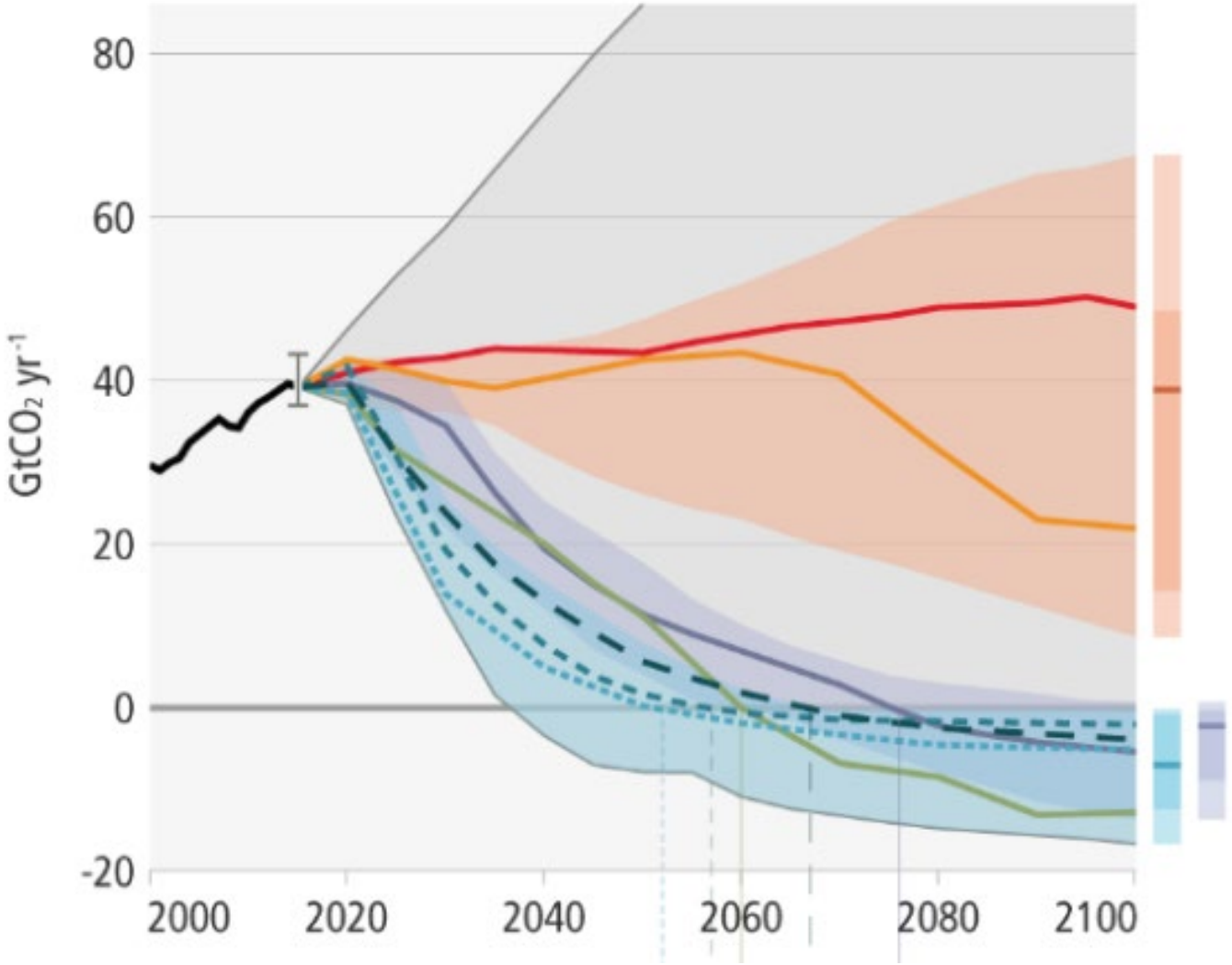
https://www.ipcc.ch/assessment-report/ar6/

IPCC: NET-ZERO EMISSIONS BY MID-CENTURY NEEDED FOR A SAFE CLIMATE



www.ipcc.ch/report/sixth-assessment-report-working-group-3/

THE CARBON CAPTURE IMPERATIVE



IPCC report indicates need for:

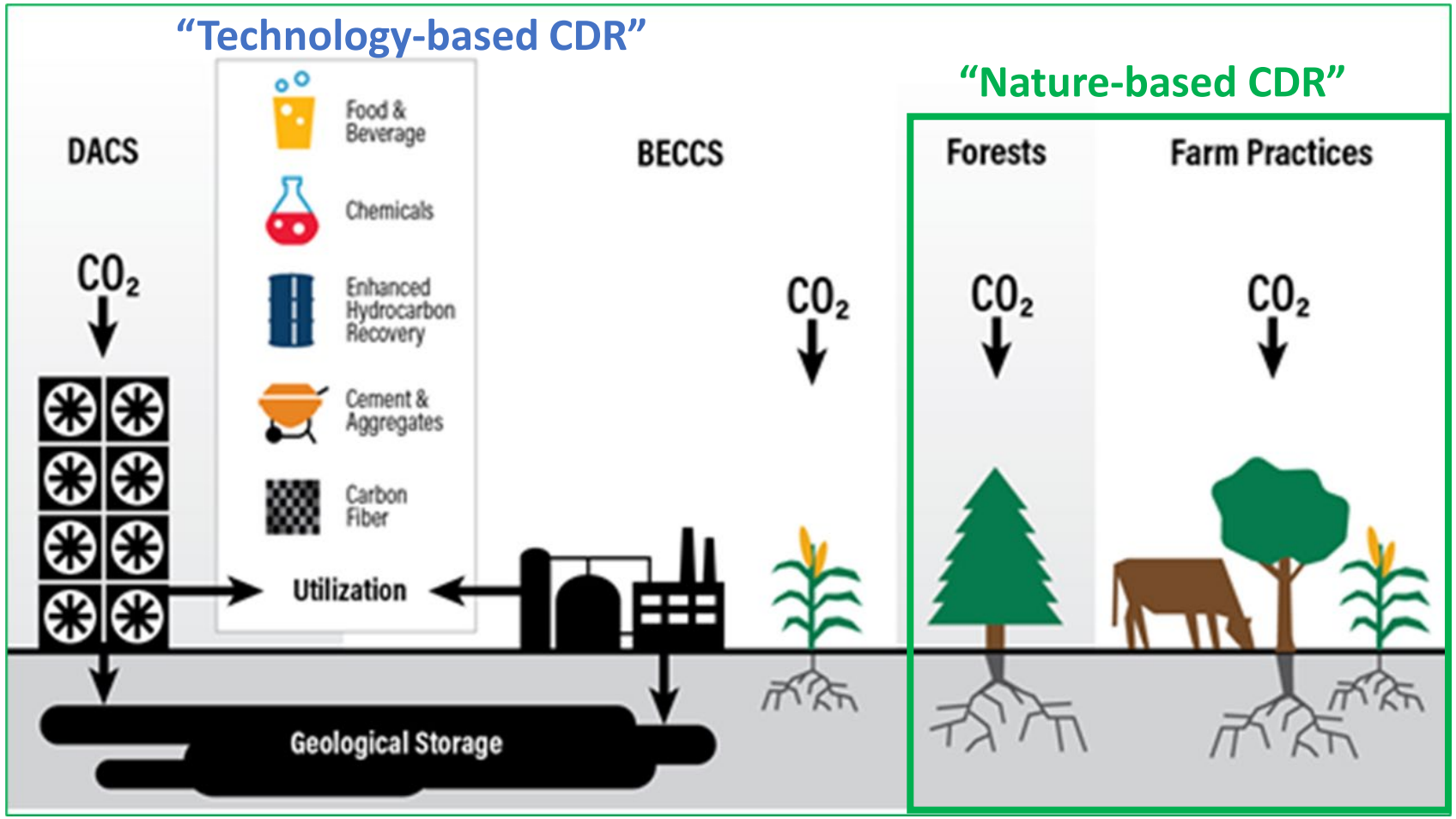
- **Carbon capture and storage (CCS) to reduce emissions in industry and potentially in power sector.**
- **Carbon dioxide removal from the atmosphere to:**
  - **Offset the effect of any residual CO2 emissions**
  - **Offset the effect of residual emissions of non-CO2 gases (CH4, N2O, F-gases)**
  - **Lower total GHG concentrations in case of overshoot of a 1.5 or 2.0 temperature goal**

Net Negative Emissions

Requires Carbon Dioxide Removal (CDR) by nature-based and/or technological means

https://www.ipcc.ch/assessment-report/ar6

CARBON DIOXIDE REMOVAL OPTIONS



- "Nature-based": use of forests and soil management
  - Ready now
  - Large co-benefits
  - Multiple land holders
  - Hard to measure
  - Risk of loss
- "Technology-based":
  - Under development
  - Costs & risks uncertain
  - "Utilization" could help
- Direct Air Capture & Storage (DACS)
- Bioenergy with Carbon Capture & Storage (BECCS)
- Research underway on other options

Some pathways might require only nature-based solutions (a few billion tons/year). However, total CDR could easily be 5, 10, 20 billion tons/year, exceeding the physical potential of nature-based solutions.

https://www.wri.org/publication-series/carbonshot-creating-options-carbon-removal-scale-united-states

GETTING TO NET ZERO, GLOBALLY: BNEF NET ZERO SCENARIO, 2024

"Nine technologies will make or break the low-carbon transition… There is no single solution that can transform the energy system from high- to low-carbon." **By 2050:**

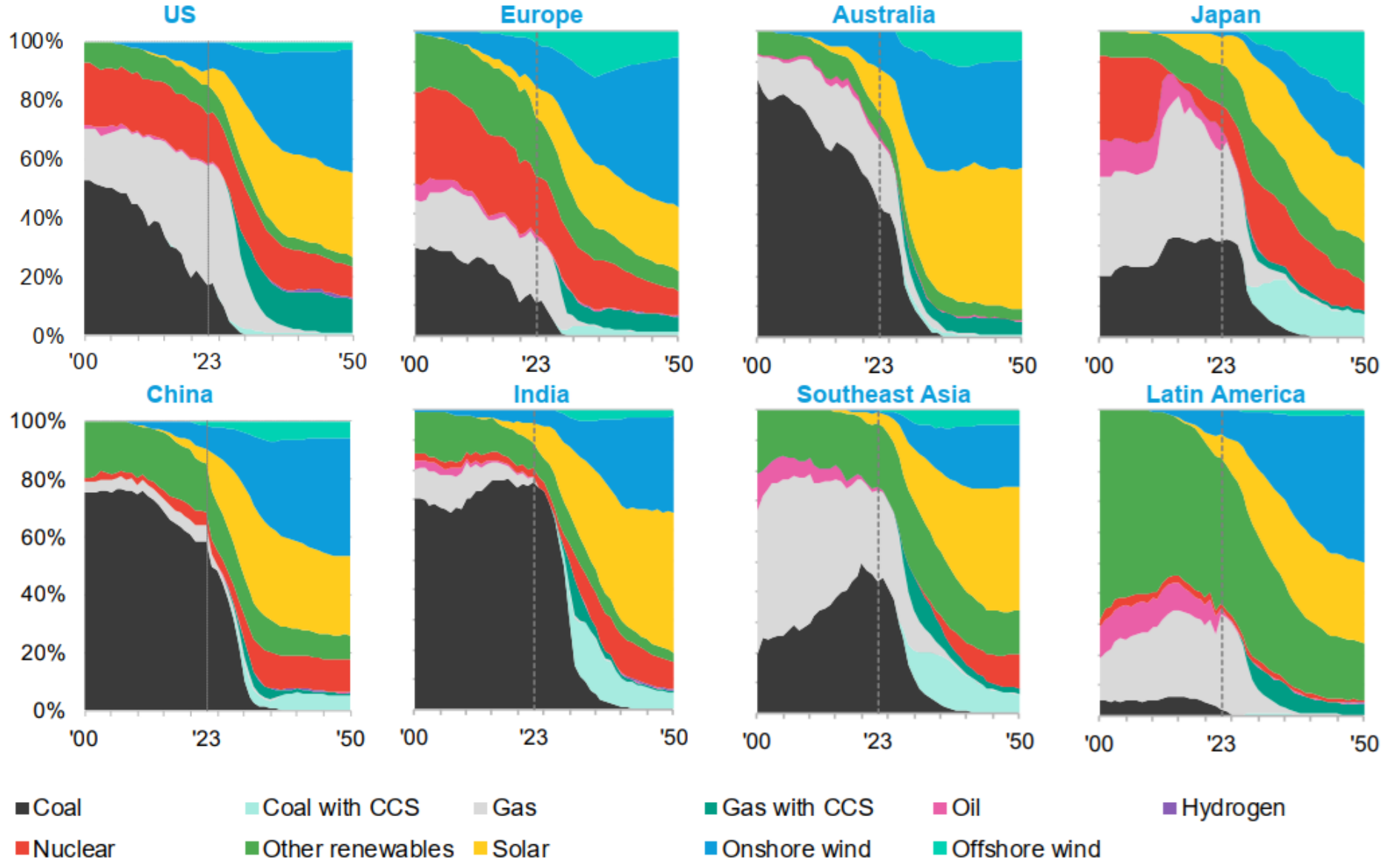
1. The **EV fleet** grows to 1.5 billion vehicles and no new ICE after 2034
2. **Wind and solar** capacity triples to 31 terawatts (TW) by 2030, and 3x again by 2050
3. **Battery storage** capacity hits 4TW – more than 50x current levels
4. **Nuclear power** capacity roughly triples to 1TW
5. **Carbon capture** capacity grows to 8GtCO2 sequestered per year
6. **Clean hydrogen** production is 390 million tons per year – 4x current levels
7. **Sustainable aviation fuel** consumption hits 88 billion gallons per year
8. The world's **power grid** grows to million kilometers in length – 2x current levels
9. **Heat pumps** reach over 500 million units – 10x current levels.

https://about.bnef.com/new-energy-outlook/

BNEF NET ZERO SECNARIO

- Clean firm power complements high VRE systems in most countries.
- Consistent with IPCC AR6, and global modeling by IEA, IRENA, etc

Figure 10: Electricity generation by source under the Net Zero Scenario, by country/region, 2000-2050



Source: BloombergNEF. Note: '00' is 2000, '23' is 2023, '50' is 2050. Includes electricity generation needed for hydrogen production via electrolysis. 'Other renewables' includes all other non-combustible renewable energy in electricity generation, such as hydro, geothermal and solar thermal. CCS is carbon capture and storage

BETTING ON CLIMATE SOLUTIONS: SHOULD WE…

Place all our "chips" on renewables and nature-based CDR?

Are the risks of nuclear power unacceptable?
Should we "Leave It in the Ground"? No CCS?
Should technological CO2 removal be off the table?

… Or spread our chips on a broader portfolio?

Also: consider varied country conditions and energy security concerns?

Fotossearch.com

Q & A

THANK YOU

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