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Center on Global Energy Policy
GLOBAL CCS INSTITUTE
Net-zero emissions & geospheric return:
Actions today for 2030 & beyond
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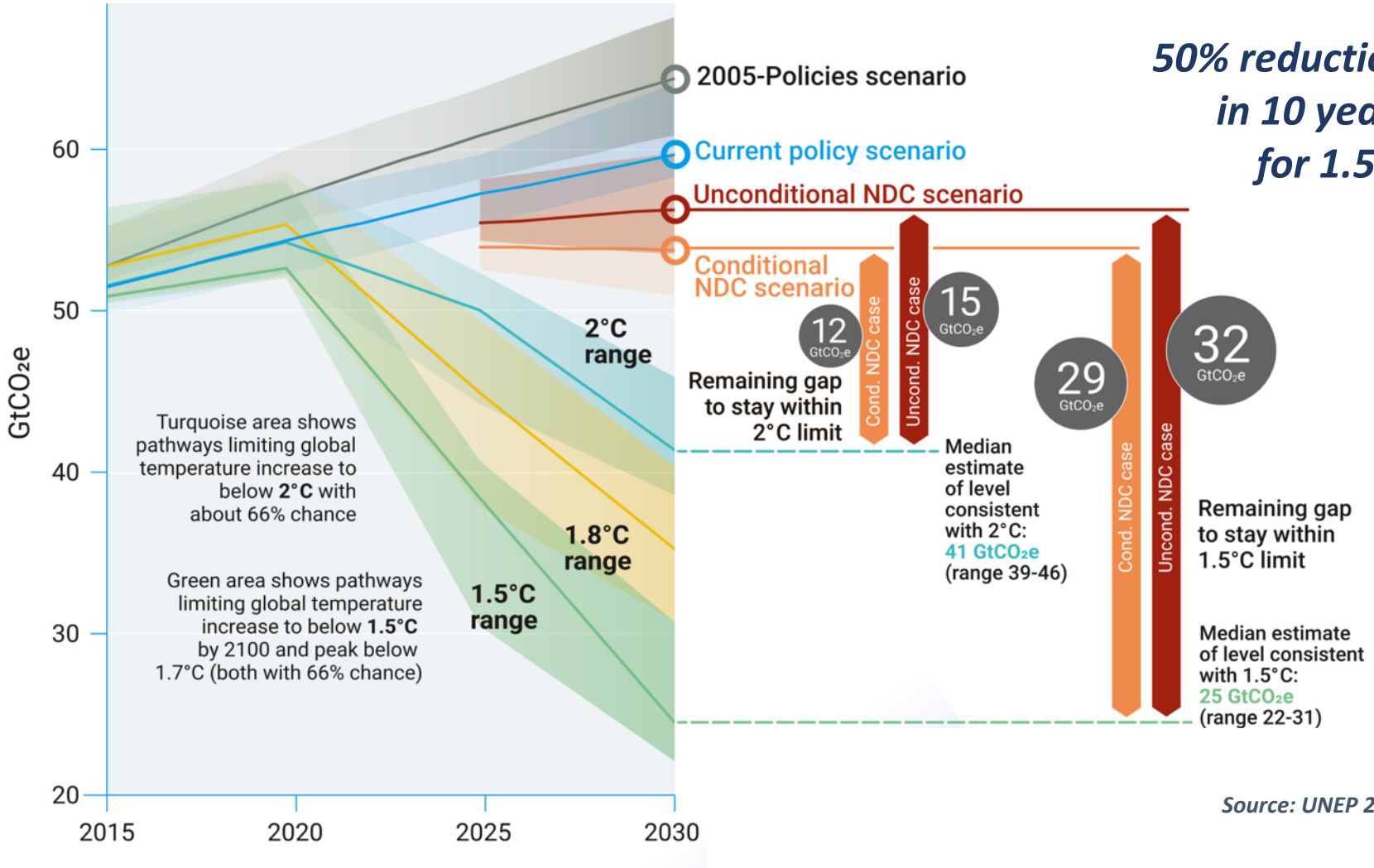
& 9 other authors
Climate Week NYC Sept 22nd, 2020

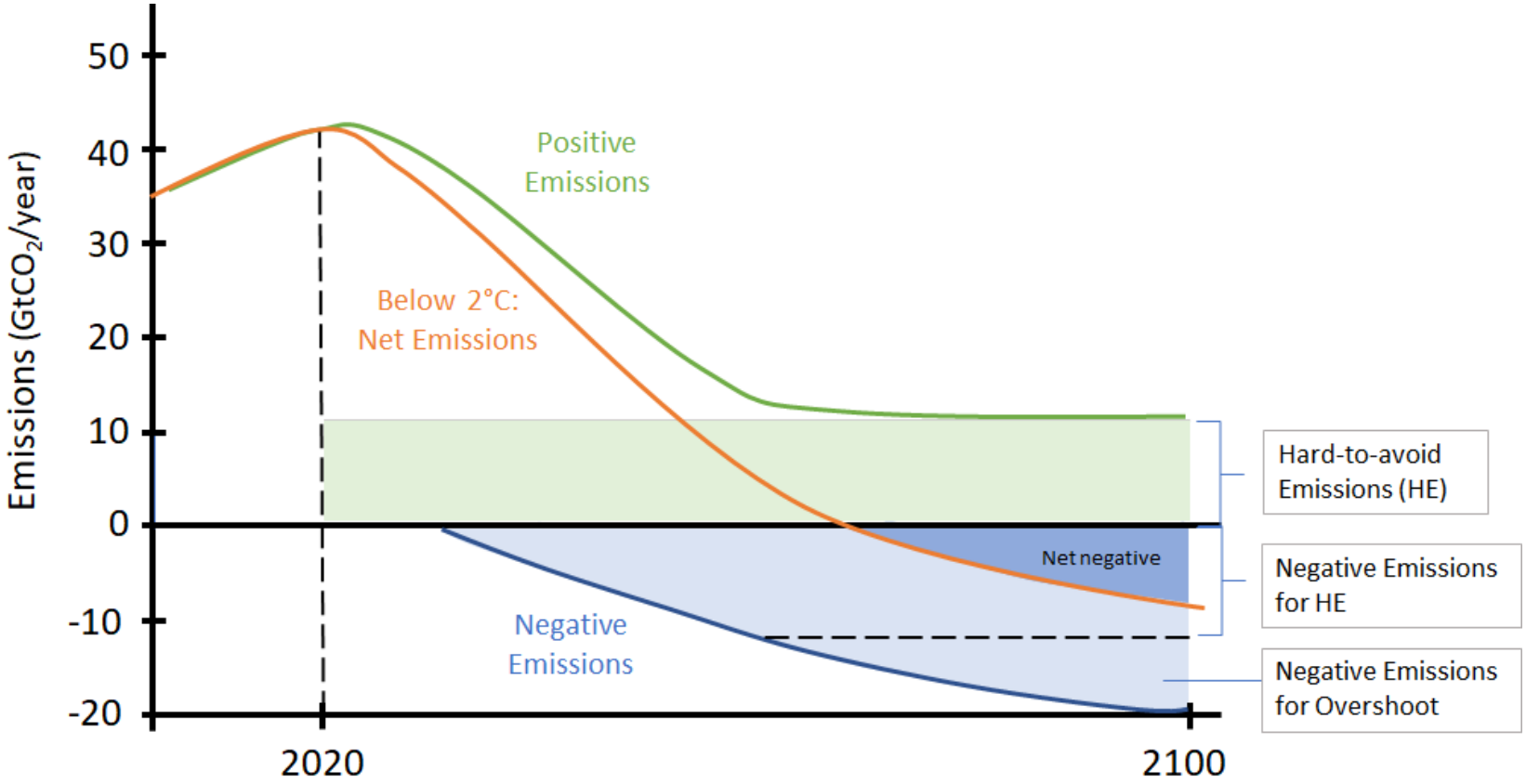
The core arithmetic of net-zero is harsh and unforgiving:

We are failing & We're out of time



50% reduction in 10 years for 1.5°C

Source: UNEP 2019


Emissions (GtCO2/year)
50
40
30
20
10
0
-10
-20
2020
2100
Positive Emissions
Below 2°C: Net Emissions
Net negative
Negative Emissions
Hard-to-avoid Emissions (HE)
Negative Emissions for HE
Negative Emissions for Overshoot

The core arithmetic of net-zero is clarifying:

All sectors
All approaches

Only one way to stabilize climate: net-zero everywhere

- Any emissions anywhere add to atmospheric CO_2 concentration
- Every year of delay makes problem worse
- We haven't yet fielded solutions for about 50% of the portfolio

For net zero: CO_2emissions - CO_2removals = 0

- Any residual emissions must be balanced by removal
- Likely need 10 Gt/y CO_2 removal by 2050
- Any delay or failure requires more CO_2 removal

Carbon from the earth must be returned to the earth

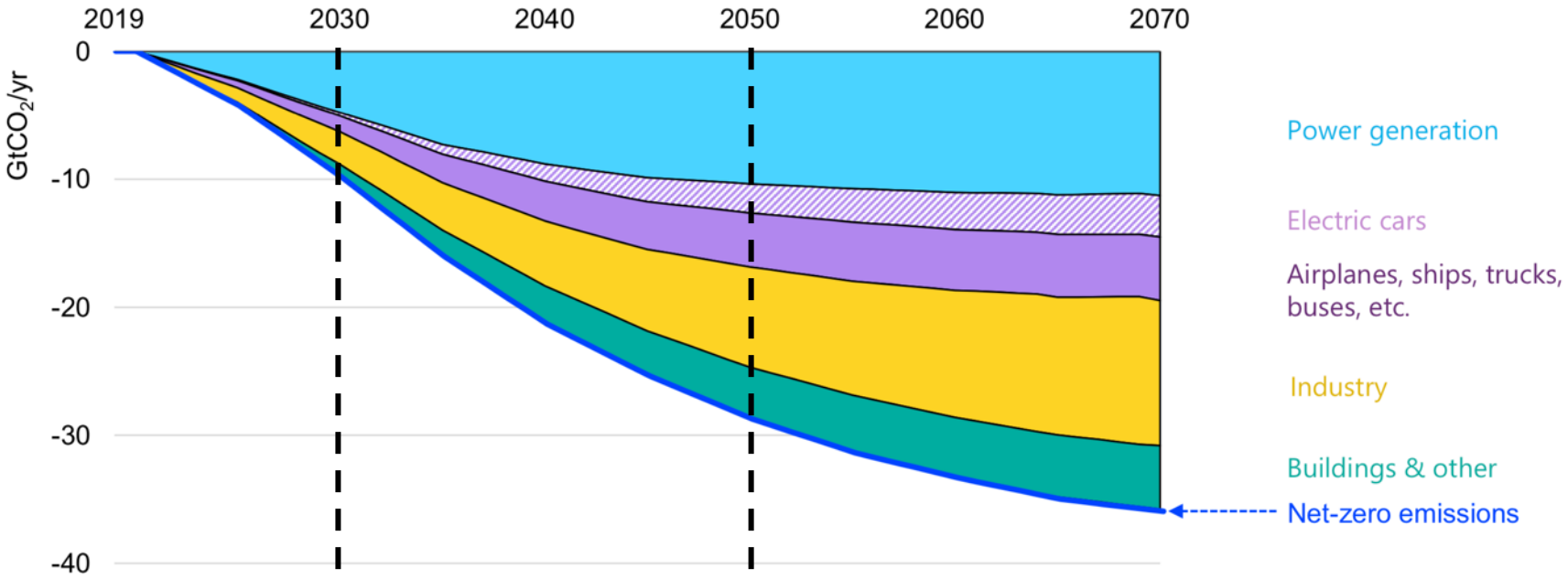
- Natural systems must return to balance
- Biosphere has limited capacity
- Risk of return is getting worse

CO_2 return to the geosphere anchors the net-zero global economy

Zero-C power is not enough for 2030 or 2050

Geospheric Return enables more sectors and more speed

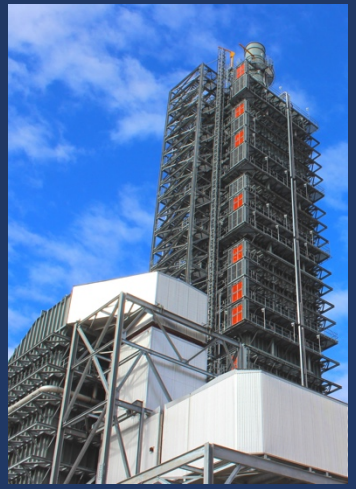
Global CO_2 emissions reductions in the IEA Sustainable Development Scenario (2 °C) relative to baseline



Source: IEA 2020

CCS: the “swiss army knife” of deep decarbonization

Power Sector



Coal (Bound. Dam)
Gas (Peterhead)
Biomass (Drax)

Industry

Steel (Al Reyadah)
Fuels (ADM, Qatar)
Chemicals (Enid)

Zero-C Hydrogen

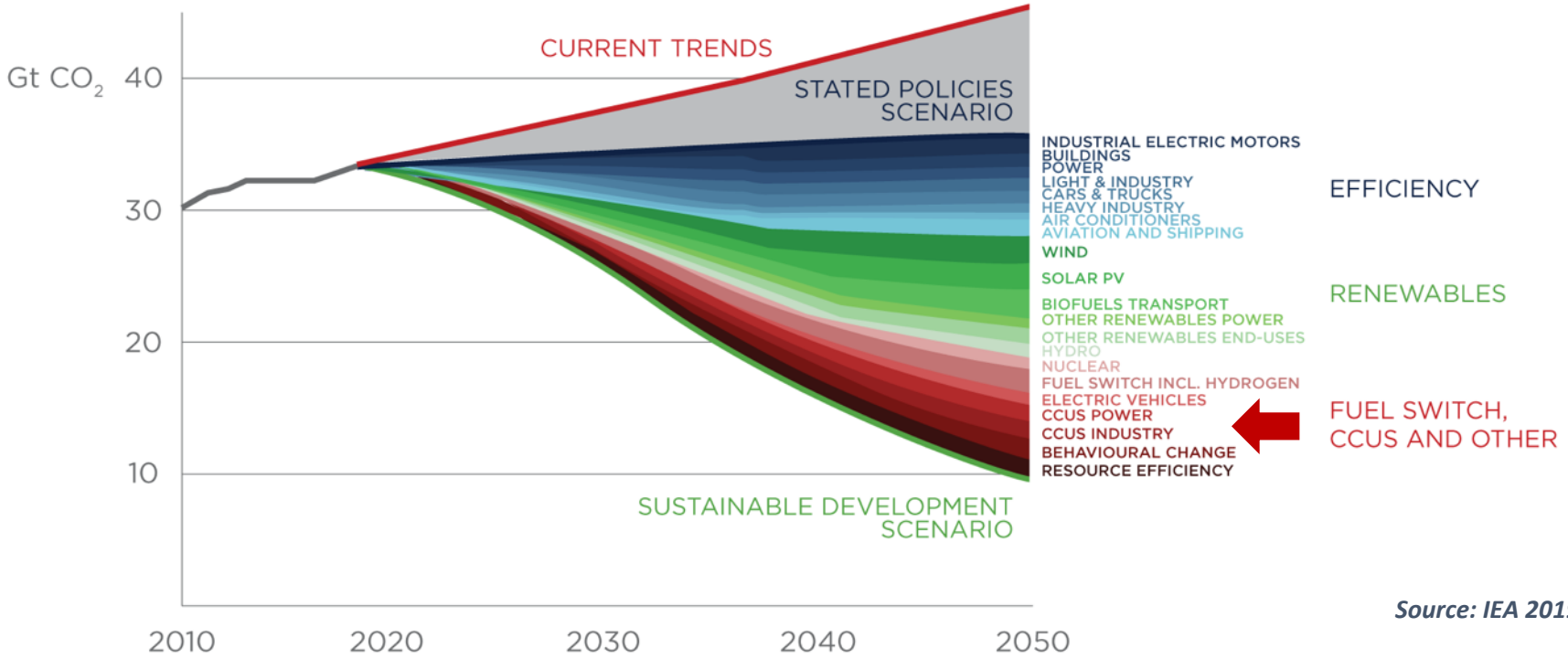
Port Arthur (USA)
Quest (Canada)
Sinopec Qilu (China)

CO_2 removal

Direct Air Capture
Bioenergy + CCS
C Mineralization

Geo-return: as big as all options required for deep decarb

IPCC (2014): Without CCUS, 50% of climate-energy models fail
IPCC (2014): Without CCUS, the models that solve cost ~140% more
IPCC (2018): All 2 °C models have ~4Gt CCS
IPCC (2018): All 1.5 °C models have ~4Gt CCS + 2-5 Gt CO_2 removal using CCS



Source: IEA 2019

By the numbers

10 nations have commercial CCS facilities

- U.S., Canada, Norway, Algeria, Australia, China, UAE, Saudi Arabia, Qatar, Brazil
- Countries in advanced development: Netherlands, Japan, U.K.
- 10 nations mention CCS in their NDCs

21 operating facilities world-wide

- ~40M tons/year anthropogenic CO_2
- ~260M tons cumulative
- Facilities: Power (2) hydrogen (5), steel (1), chemicals (2) ethanol (1), natural gas processing (many)
- Over 100 pilot and demo projects with >20 years of science
- Monitoring tools and regulatory framework well established

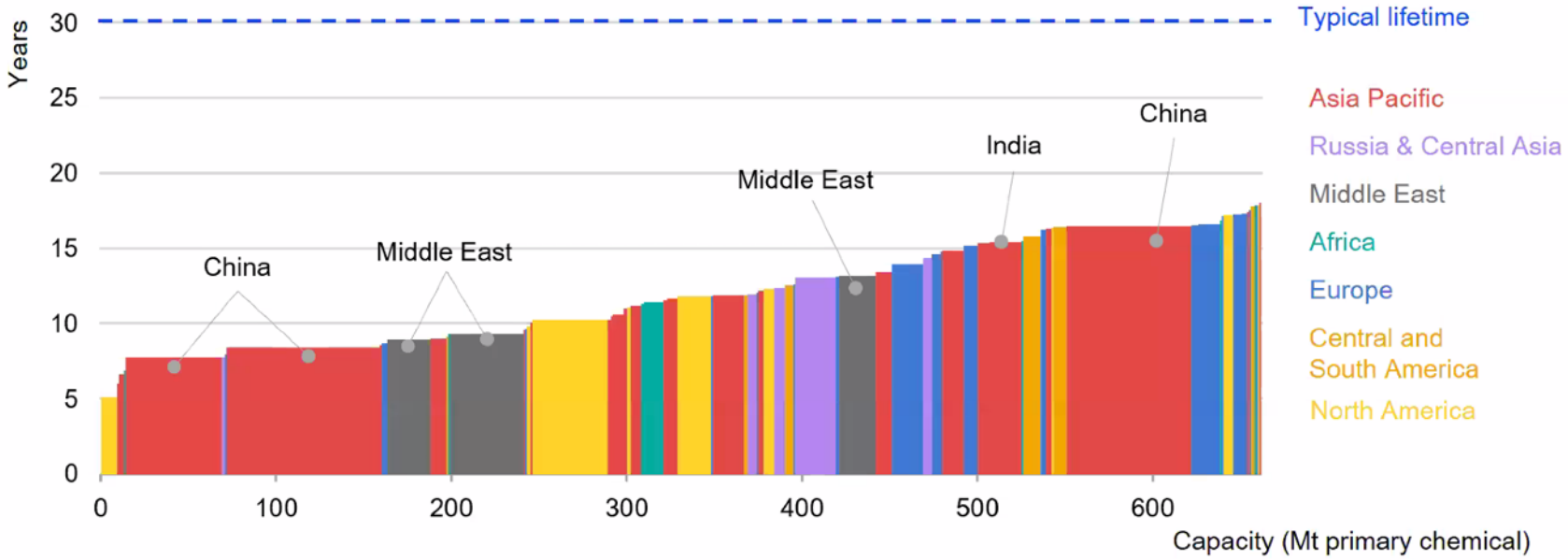
Science & technology well established

- First commercial carbon capture facility: 1938
- First large-scale CO2 injection: 1972
- First geospheric return project: 1996 (Sleipner, Norway)

Key benefits: saves time, saves money, reduces risk

Can decarbonize existing assets without waiting for retirement

Age profile of primary chemical production facilities

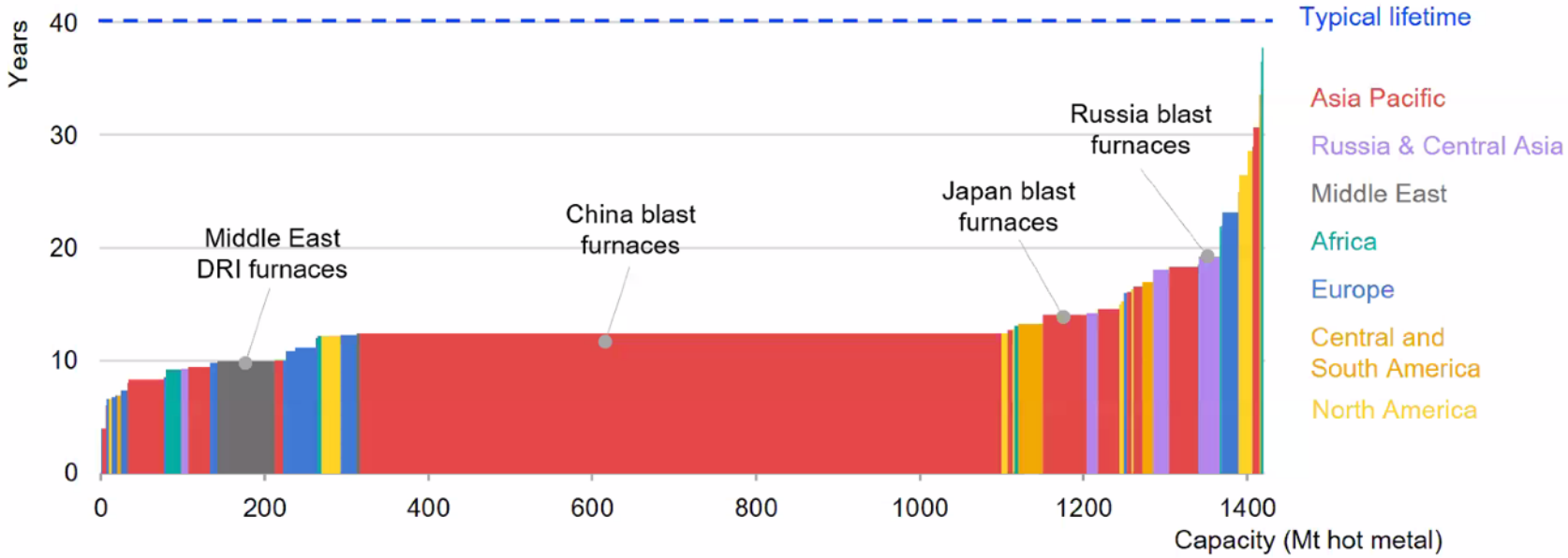


Source: IEA 2020

Key benefits: saves time, saves money, reduces risk

Can decarbonize existing assets without waiting for retirement

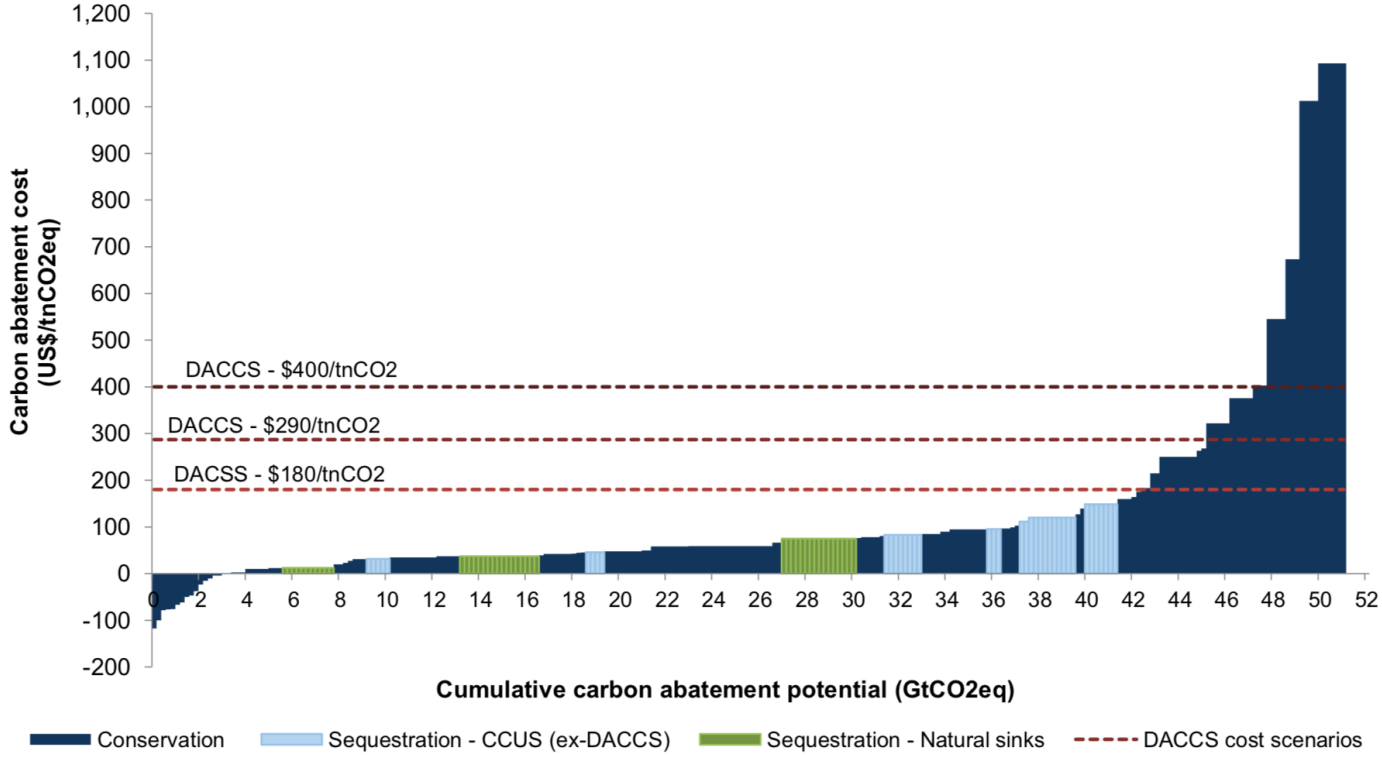
Age profile of primary steelmaking from iron ore (mostly blast furnaces)



Source: IEA 2020

Key benefits: saves time, saves money, reduces risk

Cheaper than many decarbonization and CO_2 removal options

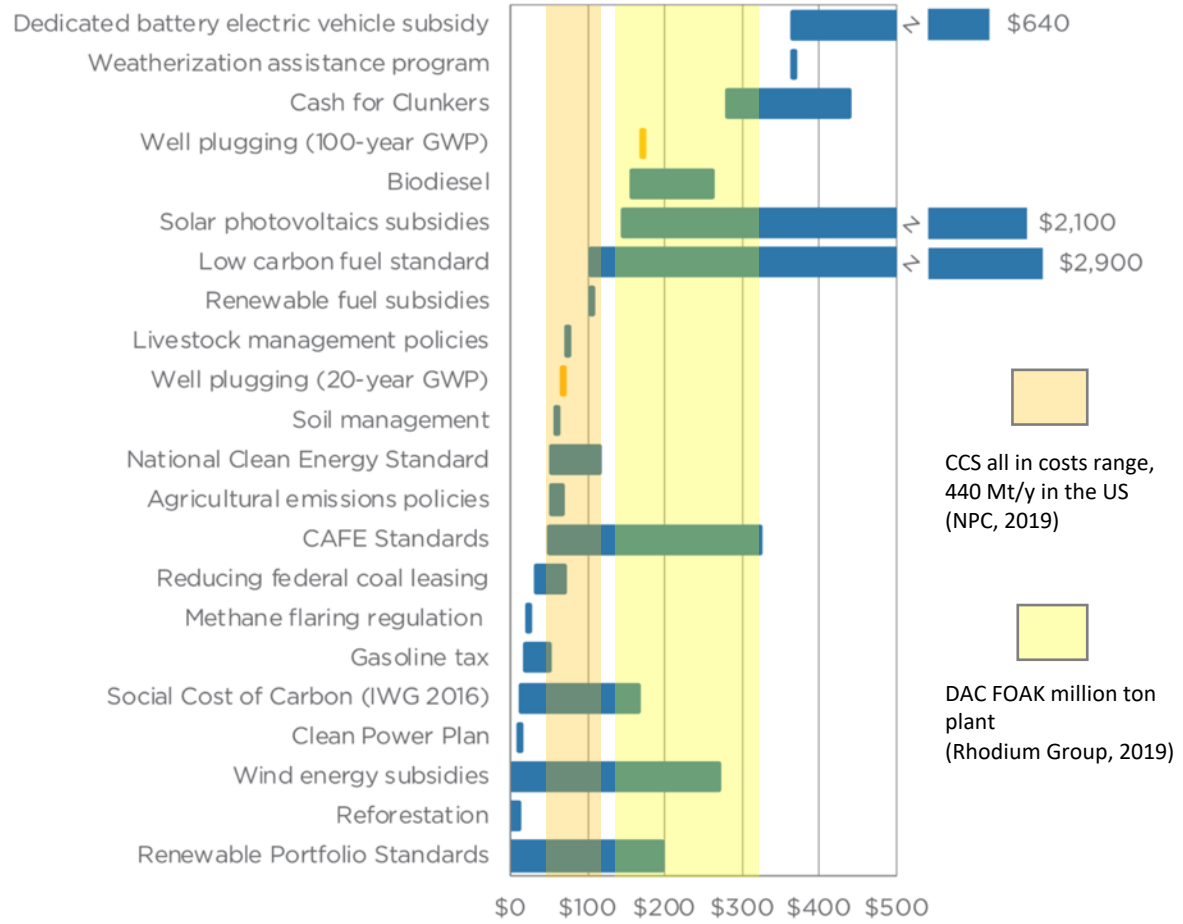


Source: GoldmanSachs 2020

CCS deployment is not about cost – it's about finance

CCS projects (power, H_2, & industry) are lower cost & more effective than many existing policies

Same is true for DACS & BECCS



Source: Bordoff et al. 2020
Data: Gillingham & Stock 2018

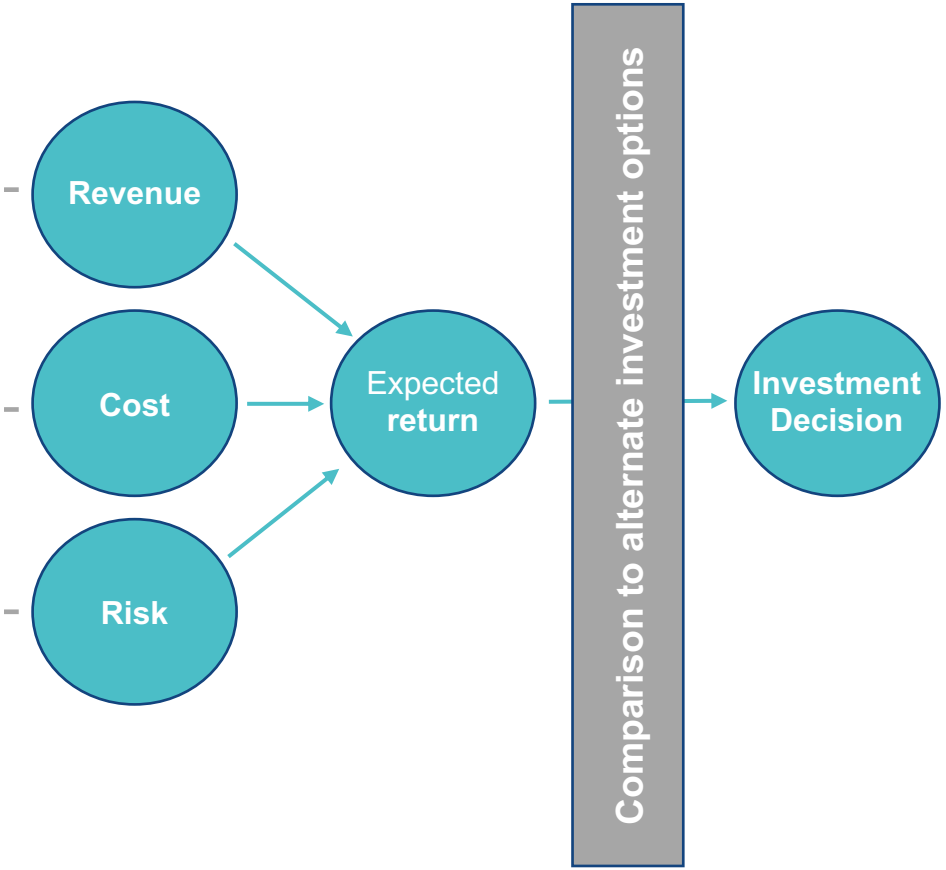
Key policies & investment enable CCS finance

Valorize, incentivize, de-risk

Bankable long-term value on CO_2
C price, CO_2 storage bounty, Tax Credit, Regulation, Govt. procurement policy

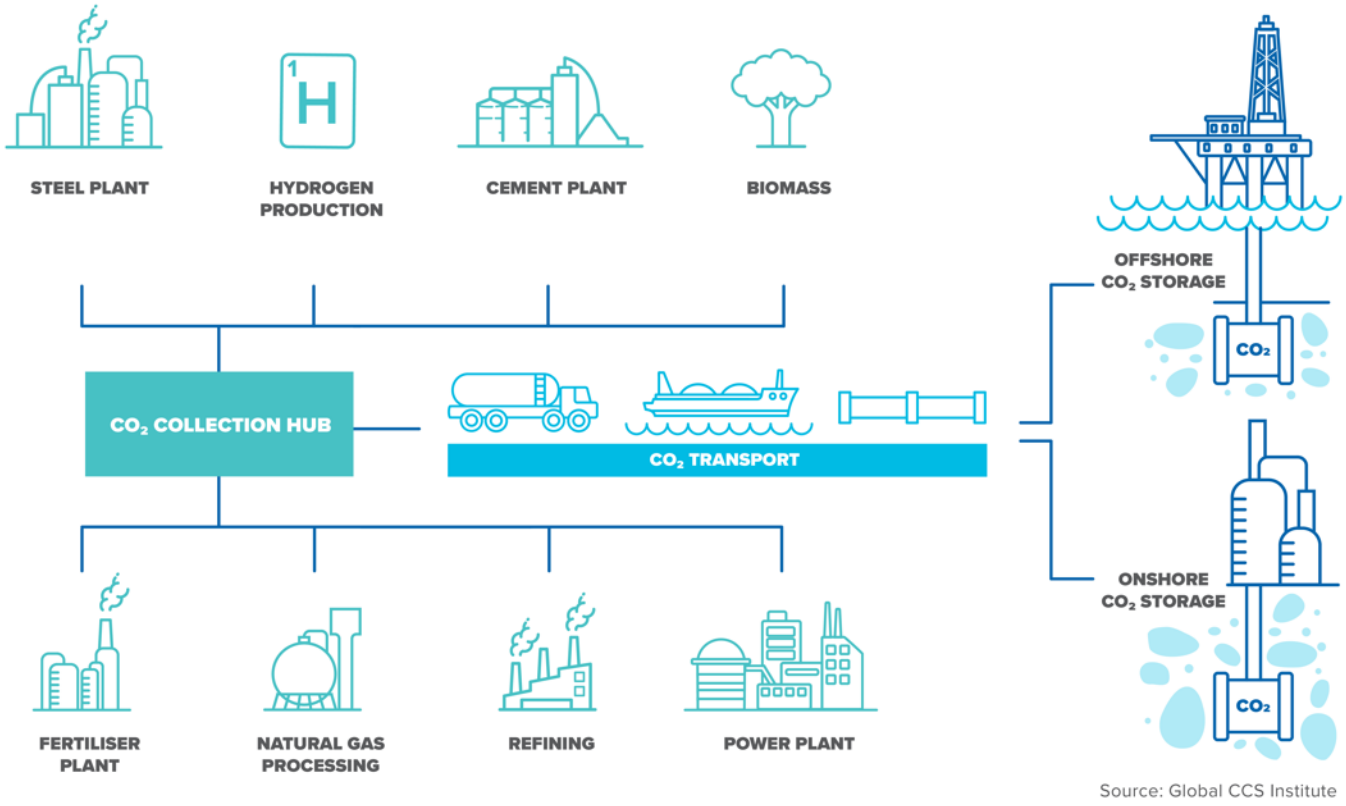
Reduce Cost to Investors
Material capital grants, Concessional finance/guarantees, Support geological storage resource appraisal

Reduce Risk to Investors
Support CCS hubs and CO_2 transport and storage infrastructure. Clear & predictable regulation. Long term liability management.



Hub infrastructure

Key to reducing risks and activating markets



Source: Global CCS Institute

Economies of scale in CO_2 transport and injection infrastructure

Multiple counterparties reduces cross-chain risk and delivers higher utilization of assets

Stabilization requires net-zero

Carbon taken from the geosphere requires return to the geosphere

IT'S ABOUT TIME

CCS is an anchor of the zero-carbon global economy

- Power sector, heavy industry, zero-C hydrogen
- CO_2 removal with direct air capture, BECCS, C mineralization

Policy support is essential

- Infrastructure first:
  - Hubs & Clusters
  - CO_2 pipelines
- Project finance support – ***many, many mechanisms***
- Ecosystem cultivation
  - Innovation policy
  - Pore volume access & long-term liability clarity
  - London Convention Amendment

IT'S ABOUT TIME

THANK YOU

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CCUS deployment is not about cost: it's about *finance*

Policy is essential for deployment

Market aligning policies close the finance gap

Infrastructure

- Pipelines; industrial hubs & clusters
- Pore-volume access & storage site characterization

Capital support

- Investment tax credits
- Grants (e.g., demonstrations, Projects of Common Interest)

Revenue enhancements

- Feed-in tariffs; Contract for Differences
- Production Tax Credits; government procurement

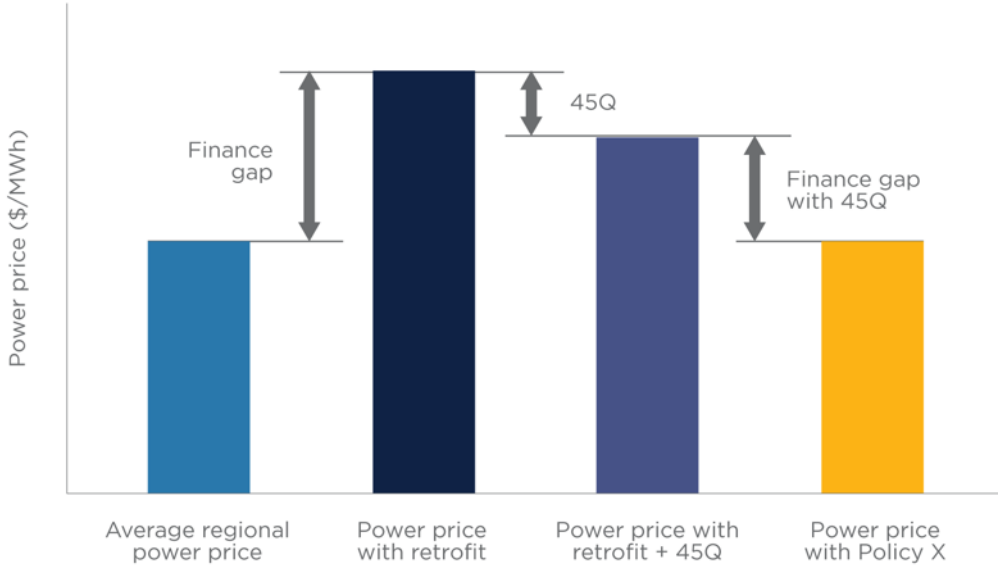
Other policies

- Mandates (e.g., zero-carbon power standards; retrofits)
- Innovation support (industrial policy; Mission Innovation)

Essential Policy 3: Ecosystem Support

Essential Policy 2: Support project finance

Market aligning policies must close the finance gap



Infrastructure

Capital support

- Investment tax credits
- Grants (e.g., demonstrations, PCI)
- Low-cost capital (esp. in developing nations)

Revenue enhancements

- Feed-in tariffs; Contract for Differences
- Production Tax Credits; government procurement

Other policies

- Mandates (e.g., zero-carbon power standards; retrofits)
- Innovation support (industrial policy; Mission Innovation)

Pipelines

US: 8000 km
Canada: Alberta Trunk

CCS Hubs

OGCI: 5 Hubs
UK: Humber

Detailed Site Assessments

US: CarbonSAFE