



Energy
Transitions
Commission

ETC impact: Highlights from 2024, and future areas of focus into 2025

*ETC Commissioners Meeting
27th June 2024*

ETC impact Highlights so far this year



ETC 2024 work programme

Extending our influence in the global climate debate

Disseminating ETC insights & recommendations



Leveraging existing knowledge



Informing the influencers



Delivering action through future COPs

Ambition and format of NDCs



COP 29, 30, 31



Building the clean energy system faster

Main reports

Power system transformation – barriers to clean electrification

Grids



Energy storage & flexibility



Shorts

Offshore wind



Power demand growth



Energy productivity

Buildings decarbonisation



Road transport



HTA sectors (MPP)



Energy Productivity across the economy



Building the ETC regional network



Supporting the MPP



Supporting the ETC members

Highlights from 2024 so far...

Media

1.6k stories this year. Highlights include:

Leaders | Let them dig

The world needs more critical minerals. Governments are not helping

Just obtaining a permit takes a remarkably long time



Commodity markets are in a 'super squeeze' — and higher prices could be here to stay



Lex in depth: how the hydrogen hype fizzled out

FINANCIAL TIMES

Videos

9 new videos on YouTube channel



How to reach net-zero: Infrastructure and Skills

Newsletters

24,000 subscribers and over **5,000 subscribers on LinkedIn**,

Social Media



X: **26K impressions**



LinkedIn: **78.2K impressions**, 5% avg. engagement rate.

Website refresh

~40k visits, **~9k report downloads**.



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Sign up to our mailing list to receive regular updates

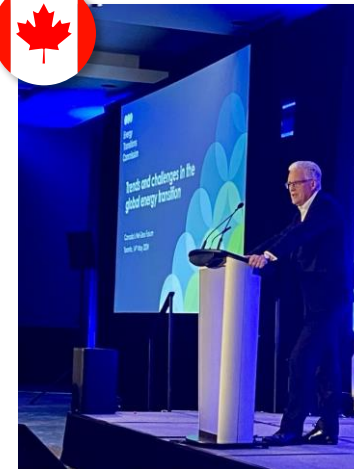
Email address

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Events

ETC has spoken at 40 events around the world:



ETC member engagement highlights in 2024 so far

4 Key meetings

- 2x Representatives' Meetings
- 1x EU strategy meeting
- 1x Comms Club

9 Expert workshops

- 1x Ambition and format of NDCs
- 4x Buildings decarbonisation
- 2x Grids
- 1x Energy storage & flexibility
- 1x Road transport

2 Reports produced

- Overcoming Turbulence in the Offshore Wind Sector
- Credible Contributions: Bolder Plans for Higher Climate Ambition in the Next Round of NDCs

2 Webinars

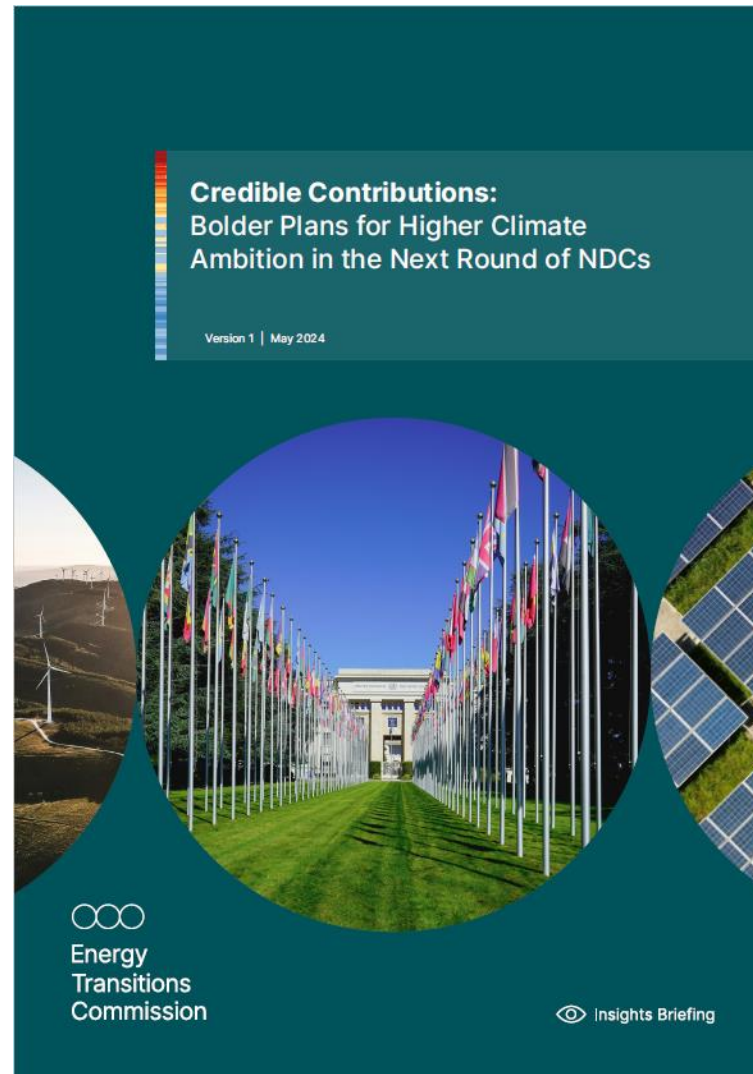
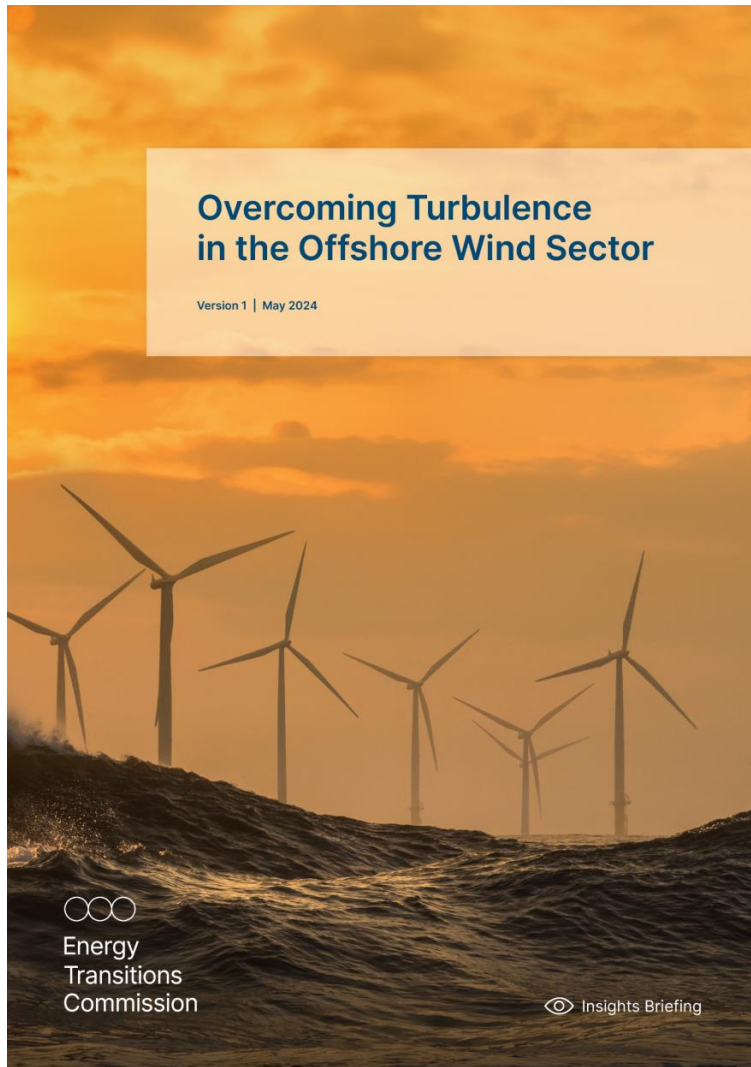
- Material and Resource Requirements for the Energy Transition
- Financing the Transition: How to Make the Money Flow for a Net-Zero Economy

3 Regional trips

- India-Indonesia
- Brazil
- Canada



We have launched two 'insights briefings' this year...



ETC Insights Briefings are shorter reports developed to respond to the key debates by re-packaging, updating and expanding our point of view to:

- Repeat & reinforce key messages
- Provide a point of view on live debates
- Deliver impact over an extended period

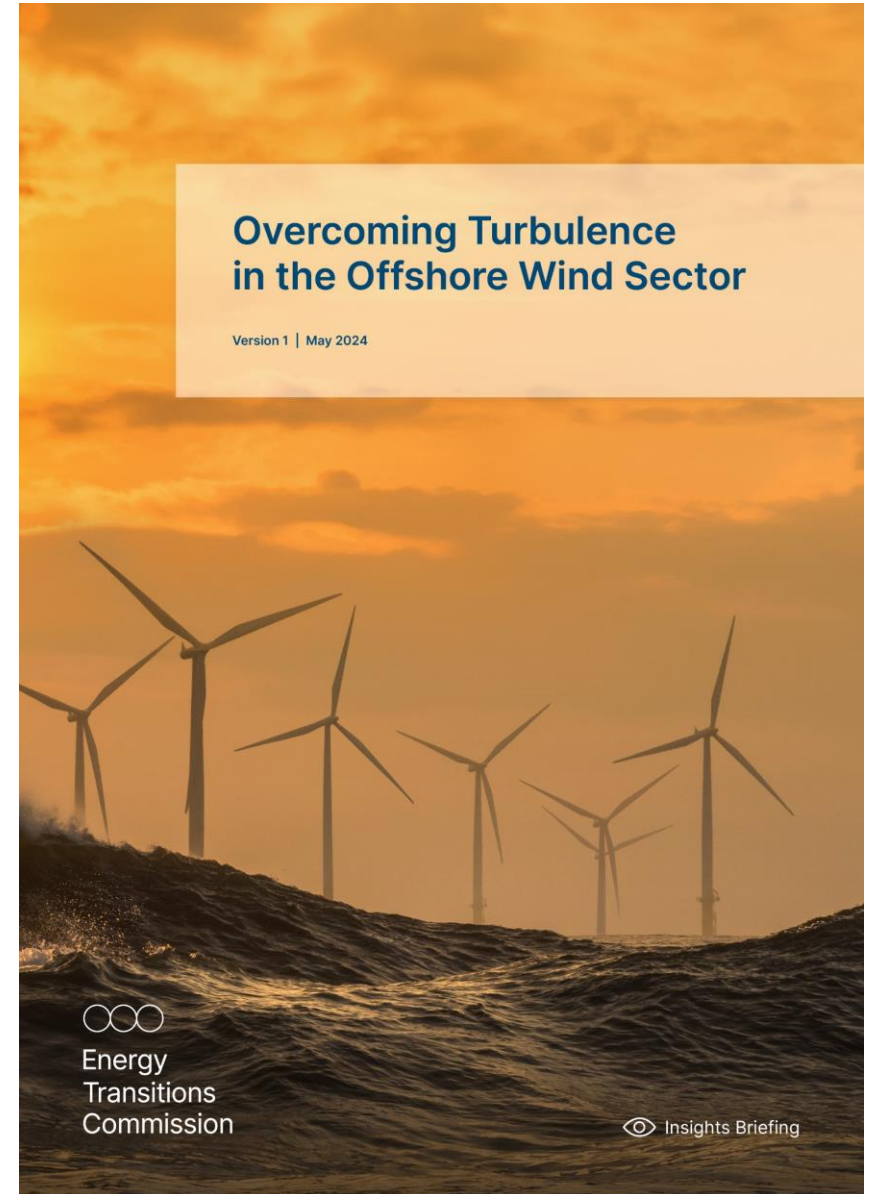


Offshore Wind Insights Briefing Key Messages

Governments and the offshore wind industry must join forces to restore confidence in the market, drive down costs and accelerate the clean energy transition.

Key messages:

- Offshore wind is **already delivering large-scale clean electricity** at a competitive cost around the world
- But in 2022-2023, inflation, supply chain bottlenecks and higher interest rates led to **rising offshore wind costs** in some markets.
- While increases were significant, they're mostly expected to be **short-term**.
- **Governments and industry must closely collaborate** to relaunch confidence in offshore wind markets and bring down costs.
- Setting ambitious targets, reducing risks of non-delivery, streamlining planning and permitting, achieving economies of scale and addressing supply chain bottlenecks will help to achieve this.



Since launch, ETC has targeted engagement with industry and trade media

Targeting international trade media in regions where the offshore wind industry is maturing

What crisis? | Governments must show world they have faith in offshore wind, says ETC

RECHARGE

Recommendations are intended to provide sector with new impetus after ramp-up lost momentum last year



BusinessGreen™

Is the offshore wind sector in crisis, or is it doing better than ever?

ETC: Boosting Offshore Wind to Energize Clean Energy Transitions

Environment + Energy LEADER

STRATEGY
Offshore Wind Problem-Solving Within Reach
Copyright © 2024 Enerveer Intelligence Group
Energy Intelligence

Informing new international audiences through briefings

POLITICO



The Washington Post



WSJ

Collaborating with ETC members to engage with the offshore wind industry



Digital storytelling with support from ETC membership

ETC members provide voices from industry

SSE plc
141,888 followers
5m · 🌐

+ Follow

The **Energy Transitions Commission** have published their new briefing on **#OffshoreWind**.

Setting ambitious targets, streamlining planning and permitting and addressing supply chain bottlenecks, amongst other actions, will help overcome turbulence in the sector.

Read the **#OffshoreTurbulence** report via the link in the comments 🗨️ 1

WRI Energy
@WRIEnergy

Follow

New **@ETC_Energy** Offshore Wind paper calls on gov'ts and offshore wind industry to join forces and restore confidence in the market, drive down costs and accelerate the clean energy transition.

Read it here: bit.ly/4dgDOLZ
#OffshoreTurbulence

Energy Transitions Commission @ETC.energy · 3 May

#OffshoreWind is already delivering clean electricity at a competitive cost worldwide. But inflation, supply chain bottlenecks & higher interest rates led to rising costs in 2022-23.

Our latest analysis looks to shed some light on the question - is the sector in crisis?

Adair Turner
Chair, Energy Transitions Commission

0:12 / 2:02

🗨️ 4 ❤️ 4 📺 368 📌 🔄

ARUP Arup
919K followers
38m · 🌐

+ Follow

We're proud to have contributed to the latest insight briefing from the Energy Transitions Commission, "Overcoming Turbulence in the Offshore Wind Sector", that highlights the need for governments and the offshore wind industry to join forces to restore confidence in the vast potential of offshore wind.

One of the five recommendations calls for ensuring that wind turbine and component production can achieve economies of scale based cost reductions by encouraging harmonisation of turbine components and sizes.

Read the full insight briefing here: <https://lnkd.in/gBmHvpxE>

#WeAreArup #OffshoreWind #OffshoreTurbulence #Energy

Graeme McCann
Technical Director - Renewables

ARUP

"Technological progress must be combined with systems thinking to realise the supply-chain efficiencies necessary to scale offshore wind around the world"

ETC engaged in the debate by capturing key messages from the report in short, sharable videos

1

Adair Turner
Chair, Energy Transitions Commission

1:55 1x

Is the Offshore Wind Sector in Crisis?

2

Steve Wilson
Director of Capital Projects - Offshore, SSE Renewables

0:17 1x

Outlook on Offshore Wind Sector from SSE Renewables

3

Overcoming Turbulence in the Offshore Wind Sector

The Role of Offshore Wind in the Energy Transition

Energy Transitions Commission

The Role of Offshore Wind in the Energy Transition

4

Adair Turner
Chair, Energy Transitions Commission

0:17 1x

Are Recent Cost Increases in Offshore Wind Temporary or Permanent?

5

Overcoming Turbulence in the Offshore Wind Sector

Five key recommendations

Energy Transitions Commission

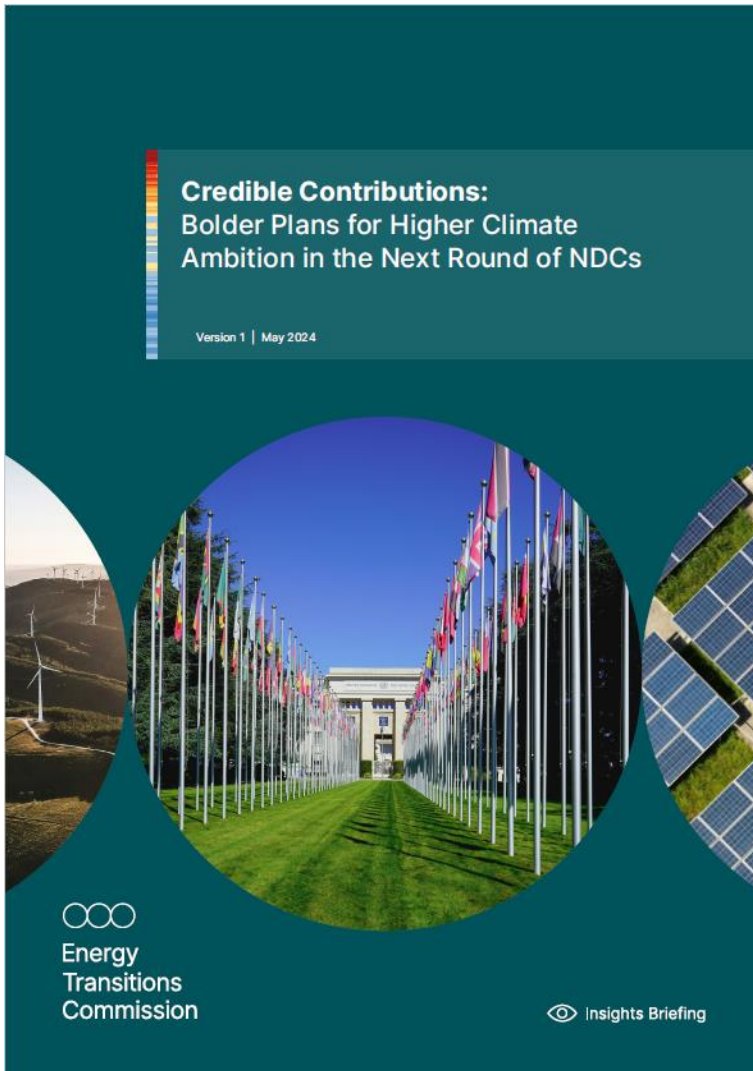
How to Return Confidence in Offshore Wind Sector

Reach (6.1% engagement rate)

- Video 1 - 2.1k views
- Video 2 - 5.2k views
- Video 3 - 3k views
- Video 4 - 1.2k views
- Video 5 - 7.5k views



NDC Insights Briefing Key Messages



The ETC calls for industry and government collaboration to raise the ambition of the next round of NDCs due by COP30 to limit the impact of climate change.

Key messages

- Success in the transition to date has been driven by **industry's response to ambitious government targets – accelerating deployment and driving down costs.**
- If governments **reflect existing policy commitments and the latest technological progress** in the next round of NDCs, overall ambition could triple.
- Industry recognises the opportunity and calls on governments to prioritise delivering **high-ambition NDCs which will provide certainty, unlock investment and accelerate technology deployment.**
- Ambition alone will not translate into progress. NDCs 3.0 must help turn ambition into action with **clear and detailed roadmaps for implementation, measurable, comprehensive and granular targets and investable plans, especially in emerging markets.**



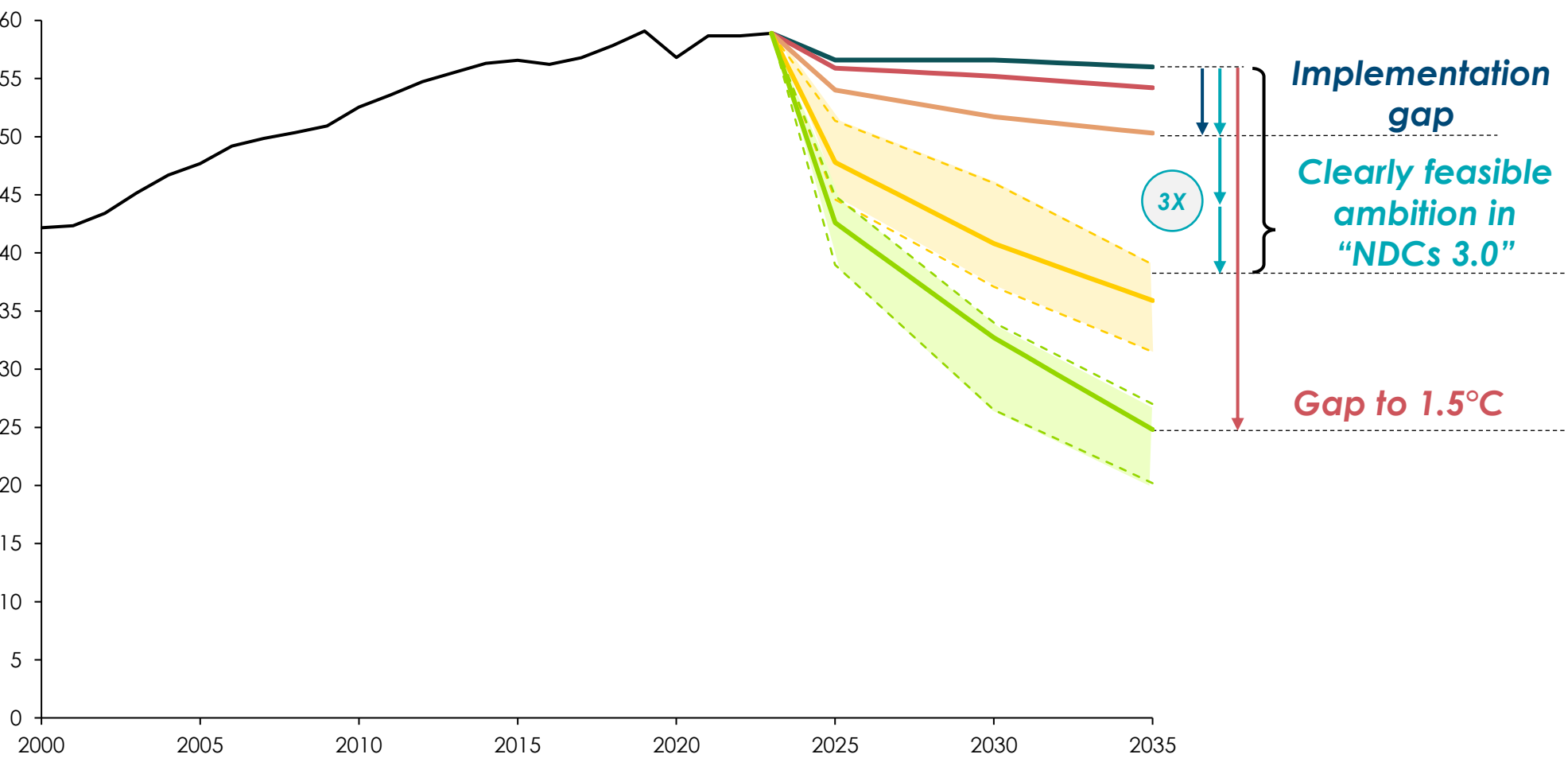
The next round of NDCs can credibly triple in ambition and put the world on track for 2°C



Pre-read only

Global GHG emissions
GtCO₂e p.a.

— Historical¹ — "NDCs 2.0" all targets
 — Current policies² — 2°C Pathway^{2,i,iii}
 — "NDCs 2.0" unconditional targets² — 1.5°C Pathway^{2,i,iii}



PRIORITIES OF UPCOMING NDCs

Make clear how implementation gap between policies and 2030 targets will be closed.

Triple ambition compared to current NDC targets, reflecting:

- Globally accelerating technology deployment & policies
- Industry commitments
- National commitments already made, in particular those made at COP28

... but further action is still required to reach 1.5°C

1.5°C GAP

Notes: [i] Based on IPCC Working Group III Sixth Assessment Report scenario class c1 (limit warming to 1.5°C (>50%) with no or limited overshoot). [ii] Based on IPCC Working Group III Sixth Assessment Report scenario class c3 (limit warming to 2°C (>67%)). [iii] Range corresponds to range between tenth and ninetieth percentile, central line corresponds to median. Sources: Systemiq analysis for the ETC based on [1] IPCC (2022), Metadata Browser: Data for Figure SPM.5 - Summary for Policymakers of the WGIII Contribution to the IPCC AR6, [2] UNEP (2023), Emissions Gap Report: Broken Record.

From Bonn to Belem Comms Campaign

The objective is to reach target audiences including

- Government officials and senior policymakers, directly involved in the NDC-setting process.
- Non-state actors (NSAs) and advisers to NDC-setting policymakers.
- Industry (core ETC members and audience)



Collaborate with comms partners to maximise opportunities at key events

- Tap into engagement opportunities at key climate calendar events (Bonn, LCAW, NYCW, COP29) with the NDCs Partnership, UNFCCC, WBCSD.
- Partner with Global Optimism to convene a workshop at Bonn and LCAW.
- Follow up events (LCAW, NYCW and COP29) with member support



Amplify and build momentum at international climate events

- pre-brief business stakeholders, non-state actors, and policymakers.
- media launch June 2024 at the end of Bonn Climate Change Conference. Targeting international broadcast media.
- Keep beating the drum at London Climate Action Week, New York Climate Week, COP29 and all the way through to COP30.



Launched with endorsement from leading voices

“The next round of national climate plans – NDCs 3.0 - are due from early next year and will be among some of the most important policy documents produced so far this century. Each country’s NDC is for it to decide – they are after all nationally determined, so it’s not one-size-fits-all. As the Energy Transitions Commission report underscores, these new plans can serve as powerful blueprints, to propel countries’ economies and societies forward.” **Simon Stiell, Executive Secretary of the United Nations Framework Convention on Climate Change (UNFCCC).**



“This analysis provides further evidence of just how much political ambition in NDCs is lagging behind the rapid technological progress we have witnessed in recent years. It shows that tripling ambition in updated climate plans now merely means catching up with the exponential growth of clean technologies that is already underway and the climate commitments that have already been made. However, what is truly required in this moment – in which climate impacts are hitting harder every month – is the courageous leadership that takes us beyond what’s already possible and into what’s truly needed to protect people and planet.” **Christiana Figueres, Founding Partner of Global Optimism.**

International engagements starting at Bonn Climate Change Conference

Engagement with climate network



Participation at international events:

UN Climate Change Conference in Bonn and LCAW



ETC hosted a full-house workshop at the UN office in Bonn convened reps from EU, Canada, Chad, Zimbabwe, Germany and UK, and organisations including WBCSD, WMBC, NDC Partnership and Climate Champions and corporates (Google, IKEA)

And plan to use **LCAW**, **New York Climate Week**, **COP29** to engage with climate network and as international media "hooks" to keep the conversation going



International media targeted

Global newswire distribution to 144 countries, supported by translations into Chinese, French, Spanish, and Portuguese helped to land over 800 news stories in the week of launch

Possiamo triplicare gli obiettivi di riduzione delle emissioni entro il 2035

Rinnovabili
Inform · Act · Share

'NDCs 3.0': Countries have headroom to triple climate ambition, Energy Transitions Commission claims
BusinessGreen

Så långt efter ligger ländernas klimatplaner Parisavtalet

Miljö&Utveckling

Nations urged to revamp Paris Agreement commitments to bridge global emissions gap

edie
driving sustainable business.

And conducted briefings with broadcast and print media...

The Guardian

FT FINANCIAL TIMES



The Telegraph

Further work to be done to engage with international media, especially targeting India, China, Brazil, EU and US.



euronews.



Caixin

CGTN

Bloomberg

THE WALL STREET JOURNAL.

TOI



The Economist



Key message supported by influencers and synthesized in digital content

Support from key influencers to expand outreach

Christiana Figueres @CFigueres

Political ambition in NDCs is lagging behind the rapid technological progress of recent years. Yesterday's new insights briefing from @ETC.energy shows that ambition in the next round of NDCs due at #COP30 could be at least 3x higher than present. [1/3]

9:37 AM · Jun 11, 2024 · 6,413 Views

Post your reply

Christiana Figueres @CFigueres · Jun 11

It shows that tripling ambition in updated climate plans now merely means catching up with the exponential growth of clean technologies that is already underway, and the climate commitments that have already been made. [2/3]

Christiana Figueres @CFigueres · Jun 11

However, what is truly required in this moment - in which climate impacts are hitting harder every month - is the courageous leadership that takes us beyond what's already possible and into what's truly needed to protect people and planet. energy-transitions.org/publications/c... [3/3] [Show more](#)

Credible Contributions:
Bolder Plans for Higher Climate Ambition in the Next Round of NDCs

Energy Transitions Commission

New ETC Paper - Credible Contributions: Bolder Plans for Higher Climate Ambiti...

Dave Jones • 2nd Global Insights Programme Director

If you're involved with #NDCs, you need to read this

Energy Transitions Commission
13,998 followers

Today we published our latest Insights Briefing on #CredibleContributions: Bolder Plans for Higher Climate Ambition in the Next Round of NDCs.

We Don't Have Time @WeDontHaveTime · 10 Jun

"The existing #NDCs are one of those areas where we are far below the level of ambition needed."

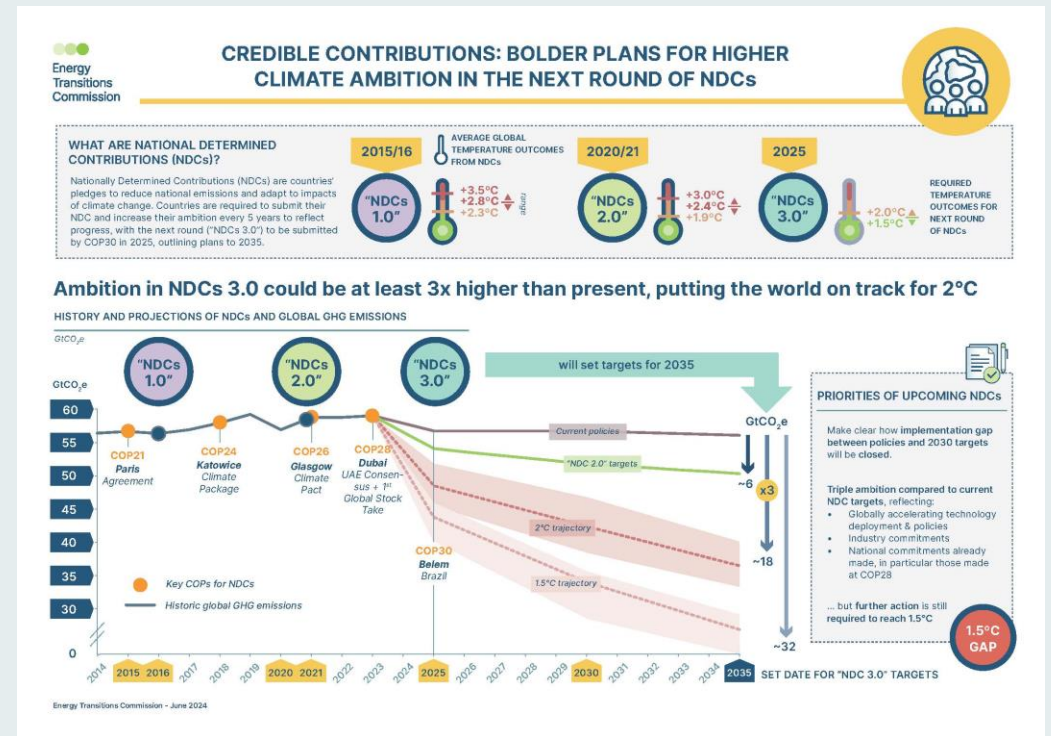
Listen to Ita Kettleborough, Director @ETC.energy about how we can use the NDCs to tackle climate change at the #JuneClimateMeetings #SB60 app.wedonthavetime.org/posts/dd7a1a2a...

Ita Kettleborough
1:30 cto, Energy Transitions Commission

UN Environment Programme New York @UNEPNYO

For the potential to triple global climate ambitions & strategies, @ETC.energy is calling on nations to utilize the #NDCNavigator launched by @UNFCCC & partners to bridge the decarbonization action gap & help countries deliver on the #ParisAgreement

Sharable content available to distill the briefing's key messages



Informing the influencers and reaching new audiences so far in 2024

Expanding digital storytelling beyond news programmes, via explainer series and developing talking head videos




Adair Turner
Chair, Energy Transitions Commission



6 Critical Actions to Enable Electrification
Energy Transitions Commission
Public
4 videos Last updated on May 12, 2024
Play all Shuffle

Leveraging social networks and collaborating with communications partners




COAL TO CLEAN ENERGY POLICY




Dave Jones • 2nd
Global Insights Programme Director
1w • 1

If you're involved with #NDCs, you need to read this

Energy Transitions Commission
14,016 followers
1w • 1

Today we published our latest Insights Briefing on #CredibleContributions: Bolder Plans for Higher Climate Ambition in the Next Round of NDCs.
Accelerating the energy transition is underpinned by increasingly strong national




Broadening our media reach - outside climate & internationally



'Faster and cheaper than we dared think possible': Why a global leader in the energy transition is still feeling optimistic

The Telegraph

CHINA DAILY

New Delhi Times
New Delhi Times



The night that James Norton told me to turn off the lights


CORRIERE DELLA SERA

Expanding our reach to new audiences and interest groups




FairCharge
The Little Book of EV Myths





Global Infrastructure Investor Association

ETC 2025 work-programme – initial discussion



In our 2024 work-programme we proposed a two year work-programme across the following areas

1

Building the clean energy system faster

Analytical programme

2

Extending our influence in the global climate debate

Communications programme

3

Building the ETC regional network

Regional programme

4

Delivering action through future COPs

5

Supporting the MPP

MISSION
POSSIBLE
PARTNERSHIP

6

Supporting the ETC members

We are now 1/4 quarter of the way through this work and we want to:

- Share overview of where we plan to focus over next 18 months, in particular: Analytical programme, Communications & outreach, COPs engagement
- Discuss prioritisation, any additional areas.

Last year we proposed a two year work-programme

1

Extending our influence in the global climate debate

Analytical programme

2

Extending our influence in the global climate debate

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Supporting the ETC members



2024 – major focus on everything to do with electricity

2025 – 3 areas: carbon molecules, economic impacts & further power

2024

2025 →

Power system transformation – an interconnected set of issues

Transmission & distribution grids

Building decarbonization

Energy storage & flexibility

Shorts, e.g.

Offshore wind

Power demand growth

The role of nuclear in net-zero power systems

Power Market design 2.0 – consumer pricing

Electrifying industrial heat

Economic impact of the ET

Investment, costs & affordability

Implications for growth, externalities & industrial policy

Regional Programmes, e.g.

Indonesia – solar + grids

Power in China, India, Europe, Canada...

Energy productivity

Shorts, e.g.

Transport

Role of energy productivity

Beyond power and H₂ – the role of emission-free molecules and 'defossilizing' carbon

The role of low-carbon molecules across sectors

Sourcing fossil-free carbon (recycling carbon, DAC, bioresources)

Shift forward into 2024 if resources allow

'Beating the drum' – ongoing

Shorts, e.g.

Ambition and format of NDCs

Short form & tailored content

Taking the messages out – media, events

Partnership building

2025 analytical work-programme

1. Publishing 2024 insights (Q1 focus)

1. Managing the system balancing challenge
2. Building and optimising grids
3. The role of energy productivity across the economy

2. Carbon molecules - role of emission-free molecules and 'defossilizing' carbon

- The role of low-carbon molecules across sectors (how far power + H2 derivatives can go)
- Sourcing fossil-free carbon (recycling, DAC, bioresources)

3. Economic impacts of the Transition

- Investment, costs & affordability
- Implications for growth, externalities & industrial policy

4. Power system transformation – further deep dives

- The role of nuclear in net-zero power systems
- Power Market design 2.0 – consumer pricing
- Electrifying industrial heat

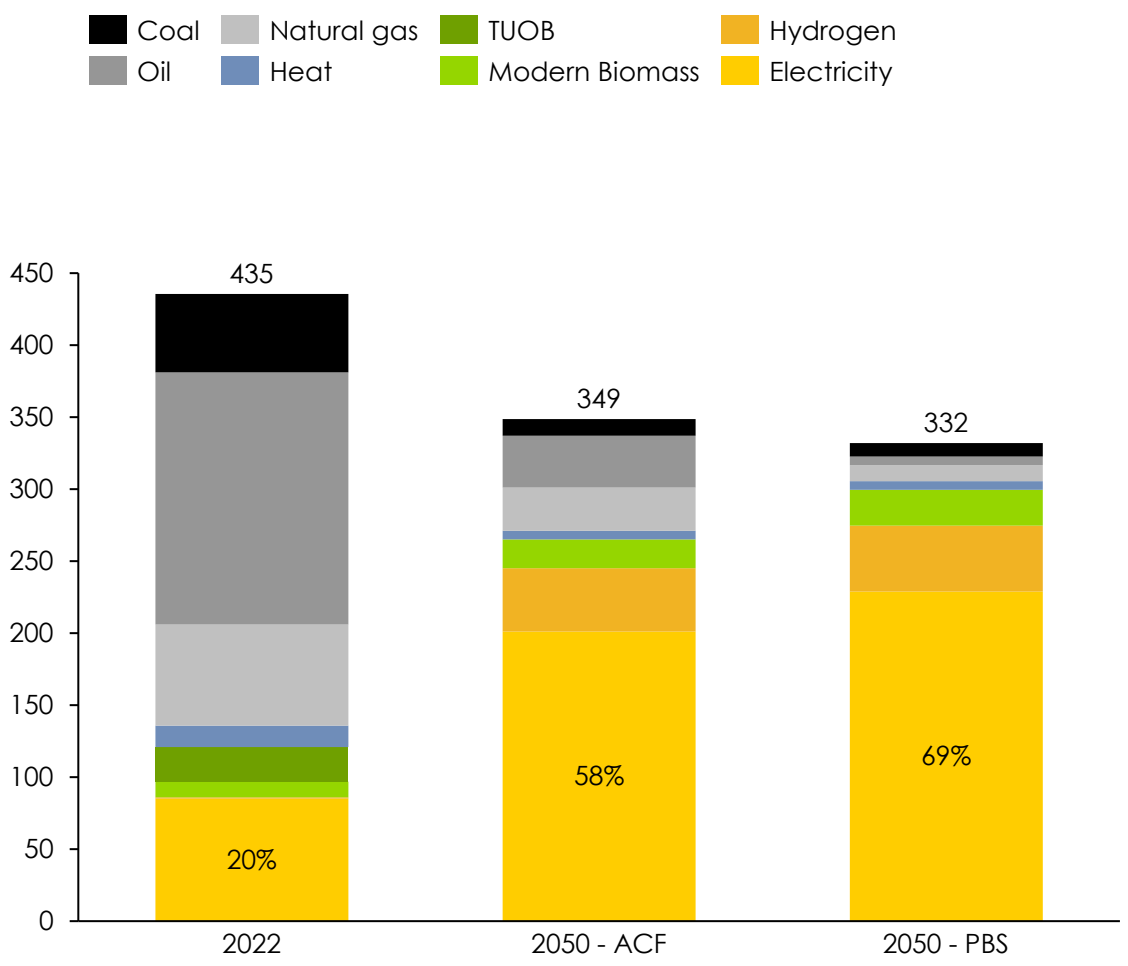
Aiming to start in 2024 with additional philanthropic funding



Clean electrification will be the most important driver of decarbonisation...

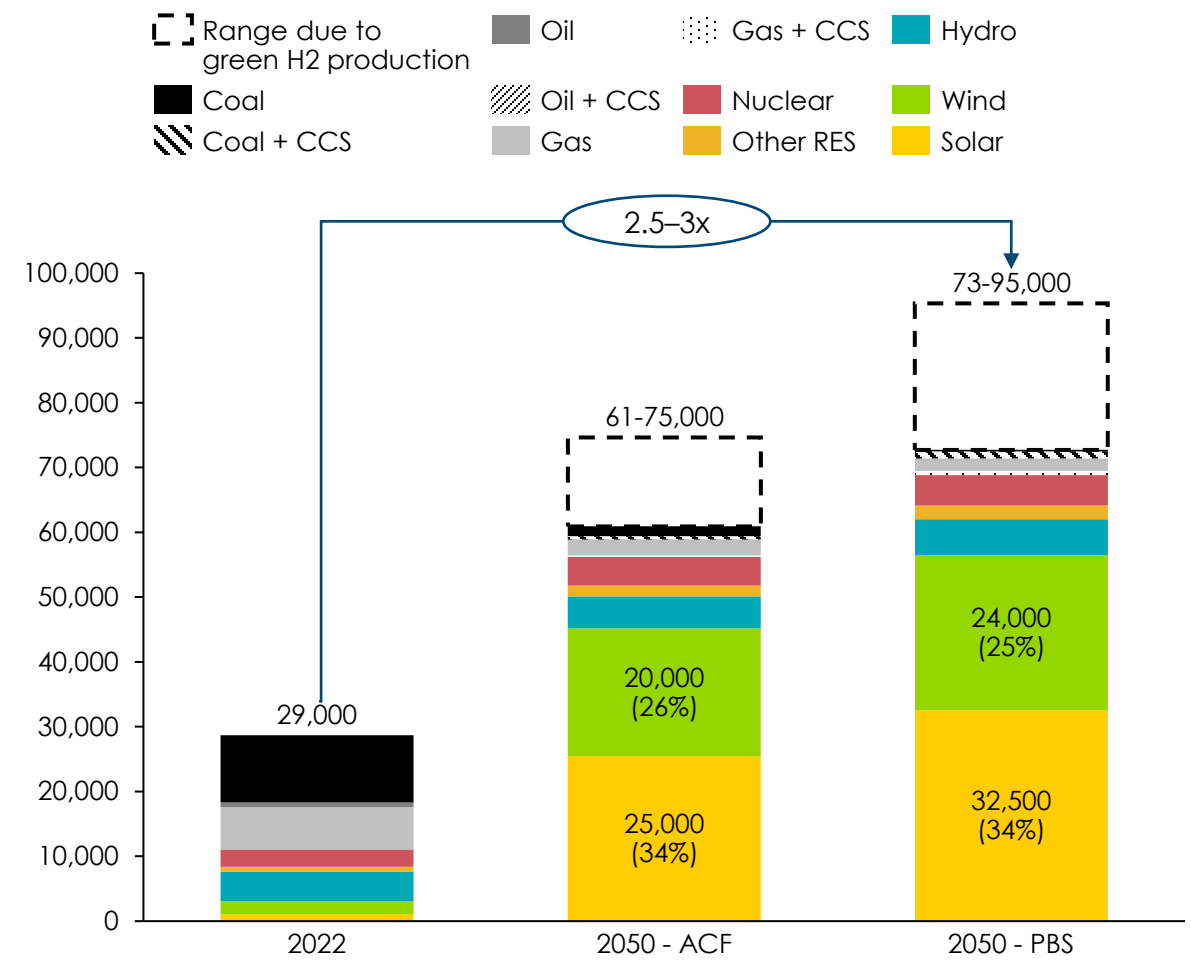
Electricity will need to go from 20% → 55-70% by 2050

Final Energy Consumption, EJ



Power generation will be dominated by wind and solar

TWh

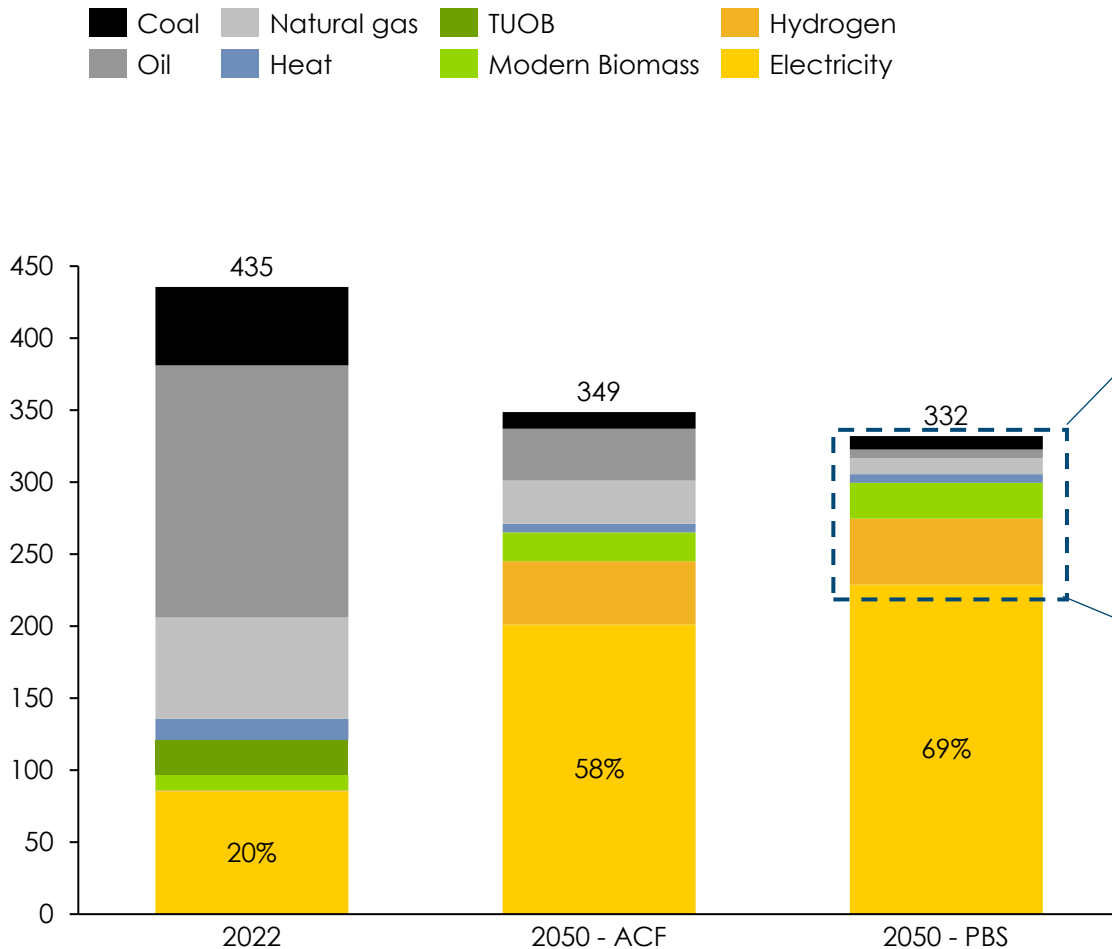


Note: ACF = Accelerated but Clearly Feasible; PBS = Possible but Stretching. Wood products and pulp and paper excluded from modern biomass
 Source: ETC (2023), *Fossil fuels in transition*.

...but there will still be a significant role for molecules as energy vectors

Electricity will need to go from 20% → 55-70% by 2050

Final Energy Consumption, EJ



Role of Molecules:














- **30-45% of overall Final Energy Demand, of which:**
 - 10-15% is **hydrogen or derivatives**
 - 5-10% is **biomass-derived carbon**
 - 10-25% is **fossil carbon**



Note: ACF = Accelerated but Clearly Feasible; PBS = Possible but Stretching. Wood products and pulp and paper excluded from modern biomass
Source: ETC (2023), *Fossil fuels in transition*.

Molecules will likely be essential in aviation, chemicals, fertilisers, shipping; for other sectors electrification will likely dominate

Carbon molecules

Likelihood of role	Potential Application	Current Fossil Fuel Demand ¹			Sector power demand in 2050 Final and Intermediate	Share of electricity in FED in 2050
		Coal	Gas	Oil		
Most likely role for molecules	Aviation 			5.5 mb/d	5,000 TWh	
	Shipping 			5 mb/d	1,000 TWh	
Some role, depending on costs vs. electrification	Plastics and Petrochemicals 	230 Mtce	500 bcm	17 mb/d	2-10,000 TWh	
	Fertilisers/Ammonia 					
	Iron / Steel-making 	900 Mtce	100 bcm		9,000 TWh	
Minimal role – electrification wins	Other industry 	750 Mtce	600 bcm	4 mb/d	7,000 TWh	
	Power, Road Transport, Buildings 	4,000 Mtce	3,000 bcm	67 mb/d	35-40,000 TWh	

Most likely role for molecules

Some role, depending on costs vs. electrification

Minimal role – electrification wins

¹ Demand is for direct use of fossil fuels.
Source: Systemiq analysis for the ETC; ETC (2023), *Fossil Fuels in Transition*.



What kind of molecules, from where, is still an open question

Likelihood of role

Potential Application

Options for low-carbon molecules

Most likely
role for
molecules

Aviation



- Biofuels (HEFA-based or other e.g., from gasification)
- Synthetic fuels enabled by carbon streams (likely from point-source or direct-air capture) and low-carbon hydrogen
- Potential for continued use of fossil-based jet fuel together with carbon removals

Shipping



- Low-carbon hydrogen to make ammonia
- Methanol – requires both low-carbon hydrogen and additional carbon atoms

Plastics and Petrochemicals Fertilisers/Ammonia



- Low-carbon hydrogen in combination with...
- ... carbon atoms from multiple potential sources: bio-based and recycled feedstocks, from fossil fuels, or captured carbon

Iron -making



- Low-carbon hydrogen for use in direct reduction of iron
- ... but also multiple options for recycling of carbon and hydrogen rich off-gases
- ...and carbon capture may make iron making a source of carbon for other sectors

Other industry



- Some role for bioenergy or hydrogen in combustion for provision of mid/high-temperature heat

Power, Road Transport, Buildings



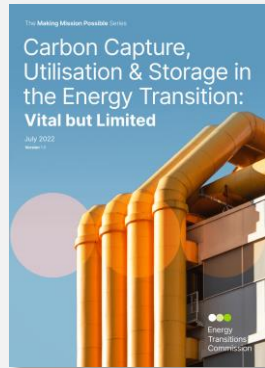
- Small role for molecules in:
 - Storage (low-carbon hydrogen)
 - Balancing (low-carbon hydrogen or bioenergy)
 - Heavy-duty trucking (low-carbon hydrogen >> bioenergy)

Some role,
depending on
costs vs.
electrification

Minimal role –
electrification
wins

¹ Demand is for direct use of fossil fuels.
Source: Systemiq analysis for the ETC; ETC (2023), *Fossil Fuels in Transition*.

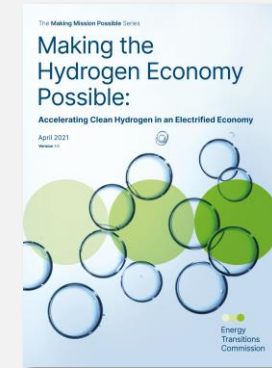
Previous ETC reports have assessed the relative role of role of CCUS, bioresources and hydrogen



- CCUS is vital but limited:
 - Where **alternatives are technically limited** (e.g., Cement process emissions)
 - To provide **least-cost decarbonisation** in key sectors and geographies where CCUS is competitive
 - To provide some **carbon removals**
- Enabling **transport & storage infrastructure** will be crucial – CCUS clusters could be important
- Most recent ETC analysis estimates **7-9 GtCO₂ of CCUS**, of which 4-5 GtCO₂ is point-source applied to fossil fuels and 3-4GT CO₂ is DAC



- Use of Bioresources faces **strong land use competition** and **sustainability constraints**
- A “prudent” estimate of sustainable biomass supply would be **40-60 EJ in 2050** – could rise up to 120 EJ in a “max. potential” scenario
 - Producing 50 EJ/yr could need **~2.8 million km² of land** (~8% of agr. land)
- Use of biomass should be **prioritized for sectors where alternatives are limited**:
 - Pulp and paper, timber
 - Plastic feedstocks
 - Aviation
 - Some high/mid-temperature heat



- **Green hydrogen** could be competitive with grey by 2030s (though latest progress slow)
- **Blue hydrogen** will also have a role – competitiveness depends strongly on cost of gas and availability of CCS
- Priority should be to **displace existing ~95 Mth₂ of grey hydrogen demand first**, then expand into wider sectors
- Enabling **transport & storage infrastructure** will be crucial
- Most recent ETC analysis estimates **350-600 Mth₂ of demand in 2050**, with greatest role in chemicals, steel, aviation and shipping

Source: ETC (2021), *Bioresources within a net-zero emissions economy*; ETC (2021), *Making the hydrogen economy possible*; ETC (2022), *Carbon capture, utilisation and storage in the energy transition*; ETC (2023), *Fossil fuels in transition*.

Carbon molecules in the zero-emission economy: proposed work programme

1. How large a role can and should direct electrification play in a zero emission economy?

- Develop an **extreme scenario** which identifies how much of the economy could **in principle be electrified** if zero carbon electricity were available at a very low cost and on the required scale
- A revised version of our **Possible but Stretching scenario** which describes the optimal role of electricity

2. The role of hydrogen and non-carbon H₂ derivatives

- Develop an **updated set of scenarios for the role of hydrogen**, exploring in particular the balance between hydrogen and non-carbon H₂ derivatives relative to carbon and hydrocarbon molecules in different sectors

3. The potential to recycle and reuse carbon molecules

- Developing another **extreme scenario to explore how close to total recycling** of all carbon molecules it would be possible to get, and with what implications for the primary supply of new carbon still required to support a prosperous global economy
- Produce **a range of less extreme plausible scenarios** for carbon source demands in a zero emission economy

4. Sources of primary carbon: costs and sustainability

- Assess whether there is a case for **increasing or decreasing our past estimates** of potentially sustainable bioresource supply
- **Engage with Brazil's distinctive view point** by establishing an ETI Brazil effort to assess the optimal decarbonisation path within Brazil's specific conditions

2025 analytical work-programme

1. Publishing 2024 insights (Q1 focus)

1. Managing the system balancing challenge
2. Building and optimising grids
3. The role of energy productivity across the economy

2. Carbon molecules - role of emission-free molecules and 'defossilizing' carbon

- The role of low-carbon molecules across sectors (how far power + H2 derivatives can go)
- Sourcing fossil-free carbon (recycling, DACC, bioresources)

3. Economic impacts of the Transition

- Investment, costs & affordability
- Implications for growth, externalities & industrial policy

4. Power system transformation – further deep dives

- The role of nuclear in net-zero power systems
- Power Market design 2.0 – consumer pricing
- Electrifying industrial heat

Aiming to start in 2024 with additional philanthropic funding



In Mission Possible and Making Mission Possible we considered the impact of the transition on consumers by sector

Economic impacts of
the transition

Incremental decarbonisation costs will reduce conventionally measured living standards attainable in 2050 by less than 1%.






But important specific distributional effects need to be recognised:

- **Residential cooling:** negligible incremental cost, given the potential to deliver zero-carbon electricity at costs equal to or below the cost of fossil fuel-based systems and potential for further efficiency improvements.
- **Road transport:** In the long term, consumers will buy surface passenger transport services at lower cost than under a fossil fuel-based system, while road freight costs will be broadly unchanged. But the cost and feasibility of initial EV adoption will vary significantly by specific location and use patterns (e.g., urban and rural locations).
- **Residential heat:** Decarbonising residential heat could have a significant impact on living standards for specific households, unless careful redistribution policies are put in place. Poorer households in insufficiently insulated buildings will bear larger energy bill increases than richer households with better-insulated homes.
- **Multiple sectors with negligible impact:** healthcare and education, consumer electronics and mobile phones, telecom services, entertainment and other Internet services, clothing, restaurant meals and hotel stays will be immaterial.
- **Industrial sectors:** For heavy industry sectors, consumer incremental costs will be very small. This is because intermediate products account for only a small proportion of the cost of the final goods or services.
- **Long-distance aviation:** Decarbonising long-distance aviation will probably require a significant increase in ticket prices versus business as usual. The size of this impact will depend on future trends in the cost of producing sustainable aviation fuels from bio or synthetic feedstocks, which are inherently uncertain.



... Including in industrial sectors, international shipping and long distance aviation

Economic impacts of the transition

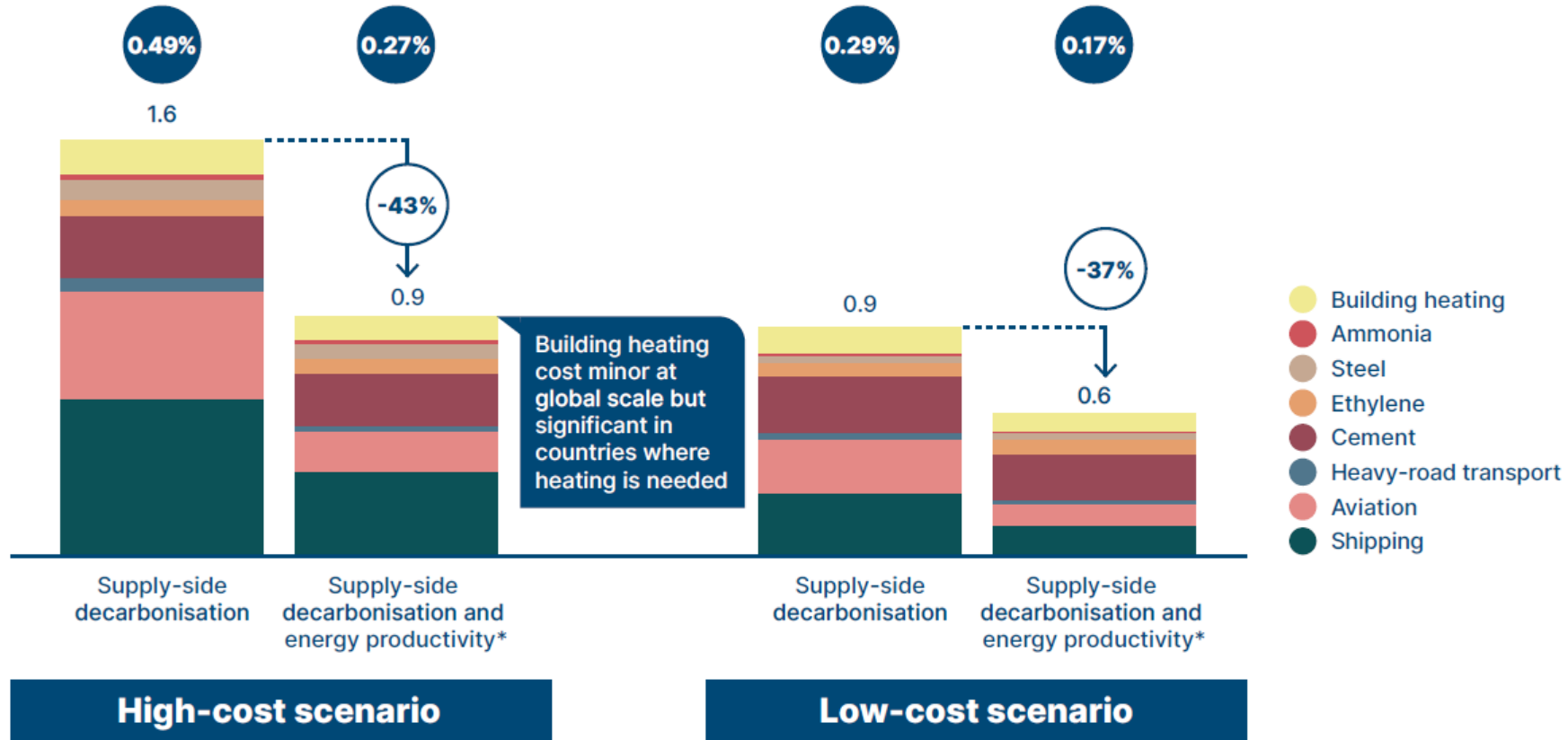
	Impact on intermediate product cost US\$ / % price increase		Impact on final product cost US\$ / % price increase	
 Plastics	+\$500 per tonne of ethylene	+50%*	+\$0.01 on a bottle of soda	<1%
 Steel	+\$120 per tonne of steel	+20%	+\$180 on the price of a car	+1%
 Cement	+\$100 per tonne of cement (+\$30 per tonne of concrete)	+100% (+30%)	+\$15,000 on a \$500,000 house	+3%
 Shipping	+\$4 million on typical bulk carrier voyage call per annum	+110%	+\$0.03 per kilogram of imported sugar	<1%
 Aviation	+\$0.3-0.6 per litre of jet fuel equivalent	+50-100%	+\$40-80 on a 6,500-km economy class flight	+10-20%



And consider total impact of the transition on overall consumer living standards in 2050...

Total cost of decarbonisation
Trillion US\$ per year, 2050

X% Share of global projected GDP, 2050



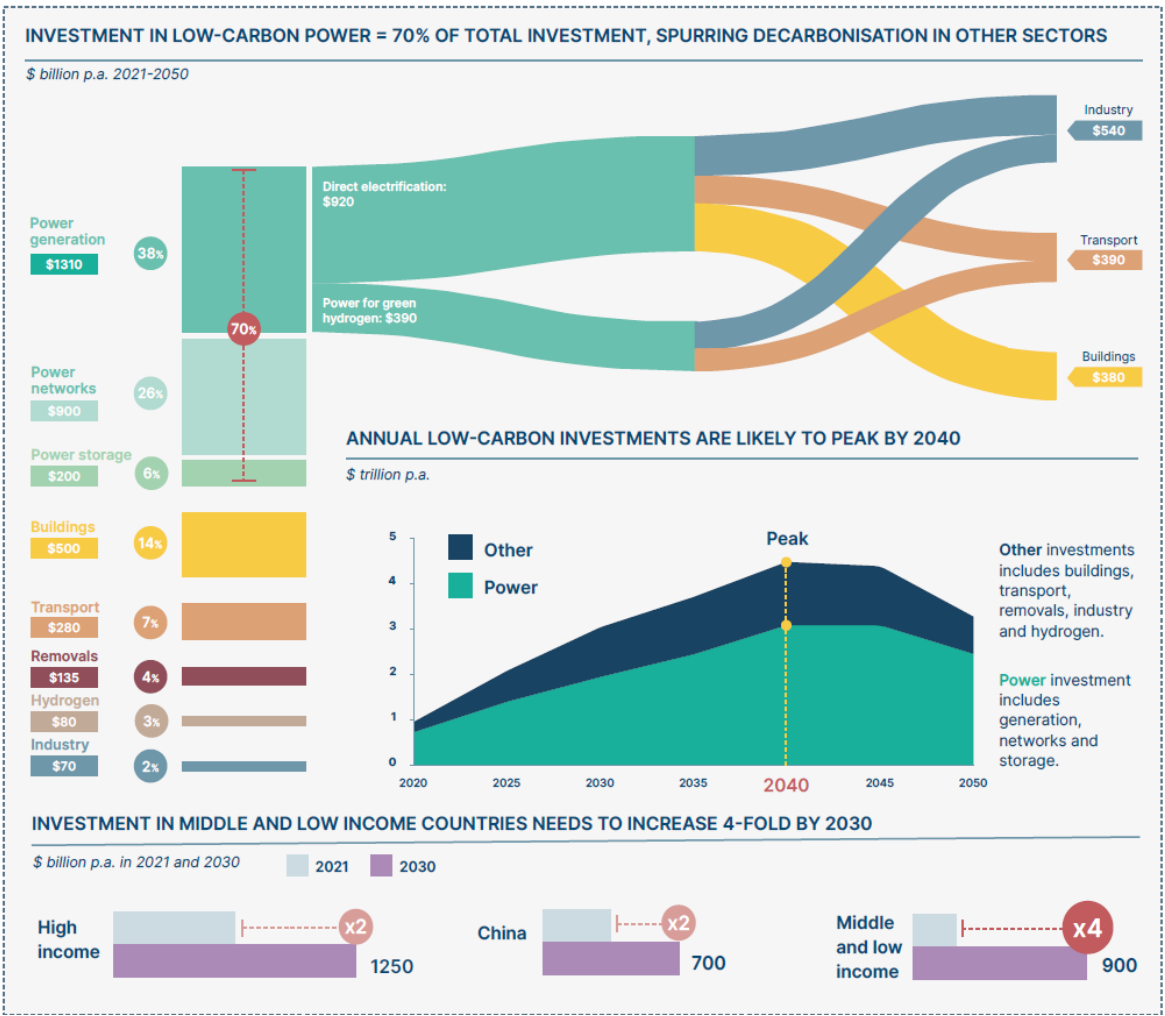
NOTE: The term "energy productivity" covers energy efficiency, material efficiency and service efficiency.

SOURCE: SYSTEMIQ analysis for the Energy Transitions Commission (2020) based on McKinsey & Company (2018), *Decarbonization of industrial sectors: the next frontier* and Material Economics analysis for the Energy Transitions Commission (2018)

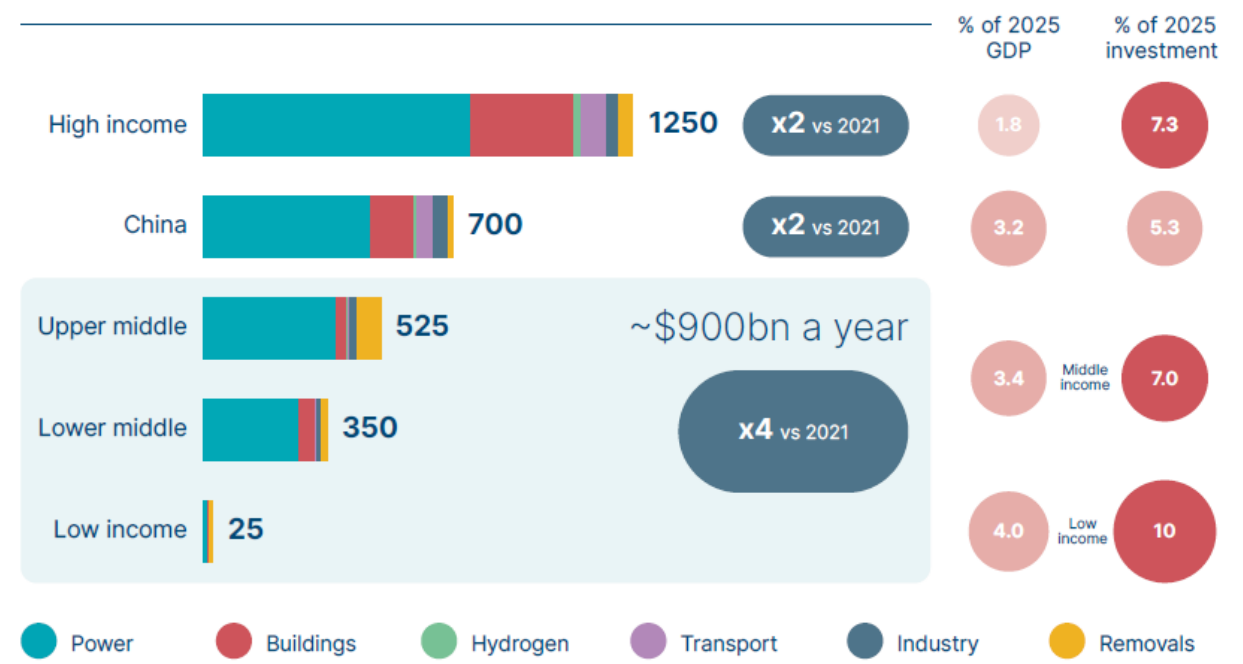


Last year we published our *Financing the Transition* report which focused on total investment needs...

Economic impacts of the transition



Estimated annual investment by region and sector, 2026–2030
 \$ billion p.a.



SOURCE: Systemiq analysis for the ETC (2023); SYSTEMIQ (2021), *Investments for green recovery and transformational growth 2020–30: Technical Note*; IMF (2022), *World Economic Outlook October 2022*.
NOTE: 2025 GDP projections based on GDP in market exchange rate terms. Total investment is assumed to grow in line with GDP.



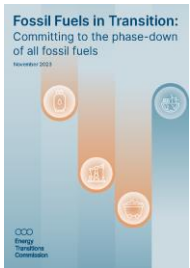
Given increasing politization of net-zero, focus on the economic impacts of the transition (both costs & benefits) – on individuals, sectors & nations

Economic impacts of the transition

Leveraging our previous insights...



Presents an **assessment of the impact of the energy transition on consumer living standards**, drawing on our then-current assessment of technology costs and investment needs



Describes technically feasible pathways to a zero-carbon economy by mid-century and has considered the **relative economics of different technology options**



Estimates **the total investment needs** for the energy transition, by region and sector

... we propose to conduct an **integrated assessment of the impact of the energy transition** on economic growth, investment requirements and the implications for consumer living standards, including

- **An assessment of how the impact might vary by countries/regions at different stages of economic growth**
- **How it might vary by different income levels within countries**
- **Essential to engage effectively in increasingly polarised debates about the economic costs of the energy transition and the need for a “just transition”**

Current hypothesis:

- **We previously thought an ~80% reduction in emissions might have a ~1% impact on GDP. Now we think 100% might have low - or possibly no - impact.**
- **But that does not mean transition is costless – cost is need to invest, which likely means less consumption or investment in other sectors of economy.**



2025 analytical work-programme

1. Publishing 2024 insights (Q1 focus)

1. Managing the system balancing challenge
2. Building and optimising grids
3. The role of energy productivity across the economy

2. Carbon molecules - role of emission-free molecules and 'defossilizing' carbon

- The role of low-carbon molecules across sectors (how far power + H2 derivatives can go)
- Sourcing fossil-free carbon (recycling, DAC, bioresources)

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Aiming to start in 2024 with additional philanthropic funding



Power system transformation – rounding out critical issues & barriers to clean electrification

Economic impacts of the transition



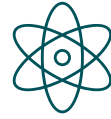
Consumer power market design

Residential and commercial consumers should benefit from the high price certainty and low costs of renewable generation in a renewable-dominated power system

- Increase transition fairness and consumer buy-in
- Move away from gas setting the price for the whole market

Key outputs

- A summary of current power market design across countries
- **Assessment of options** for to adapt power market design



Role of nuclear

Nuclear energy will continue to be an important technology during the energy transition, potentially making up ~c.5-10% of electricity supply in 2050

- Revisit question of nuclear generation in a variable renewable dominated system – including costs, ability to run flexibly, and latest view on innovation
- Consider embodied carbon, water usage and waste disposal

- Latest **technology perspectives**
- **Resource needs** (i.e. materials, fuels, water impact, etc.)
- **Risks and local environmental impacts**



Electrifying industrial heat

There is a growing consensus that much more industrial heat can be electrified than previously thought

- Both the 45% of industrial heat demand that is below 200°C but also potentially very high-temperature heat
- This reflects the falling cost of renewables, developments in heat pump and other technologies to reach higher temperatures

- Outlining the **options** for decarbonising industrial heat
- The **interventions required** to address barriers to implementation



ETC analytical programme

Are these still the right areas?

Are there others we should be considering?



Last year we proposed a two year work-programme

1

Extending our influence in the global climate debate

Analytical programme

2

Extending our influence in the global climate debate

Communications programme

3

Building the ETC regional network

Regional programme

4

Delivering action through future COPs

5

Supporting the MPP


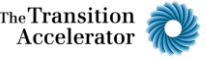



MISSION
POSSIBLE
PARTNERSHIP

6

Supporting the ETC members



Consolidating the ETC's growing regional network

	2017	2018	2018	2019	2020	2021	2021	2022	2023	2024	
Est.	2017	2018	2018	2019	2020	2021	2021	2022	2023	2024	
Knowledge Partner(s)	 	 	 	 	  		 		 		
Initiative	Energy Transitions India		Energy Transitions Commission	Australian Industry Energy Transitions Initiative	Energy Pathways USA	ELECTRIFYING CANADA AN INITIATIVE OF THE TRANSITION ACCELERATOR	CENTER FOR GLOBAL COMMONS	African Energy Dialogues	Potential for larger ASEAN initiative in 2025		
Insights	 	 	 	 		 					
									In-progress	In-progress	



Our engagement with the COP process has grown over the past 5 years

2021

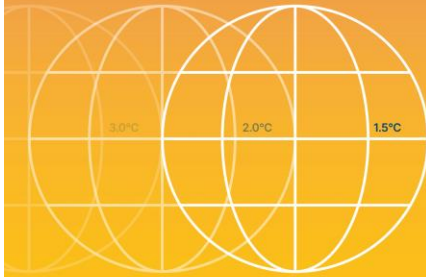


**UN CLIMATE
CHANGE
CONFERENCE
UK 2021**

IN PARTNERSHIP WITH ITALY

**Keeping 1.5°C Alive:
Closing the Gap in
the 2020s**

September 2021



Energy
Transitions
Commission



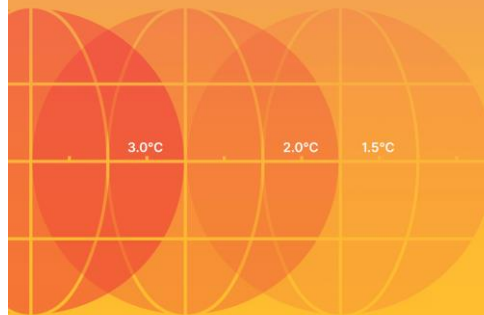
2022



The Keeping 1.5°C Alive Series

**Degree of Urgency:
Accelerating Action to
Keep 1.5°C on the Table**

November 2022



Energy
Transitions
Commission

Version 1.0

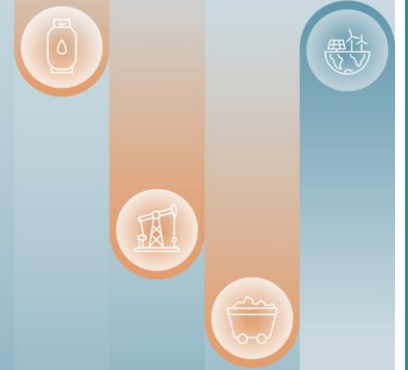
2023



**COP28
UAE**

**Fossil Fuels in Transition:
Committing to the phase
down in all fossil fuels**

November 2023



Energy

**COP28 Action Agenda:
Potential Impact to 2030**

Lord Adair Turner
Chair, Energy Transition Commission



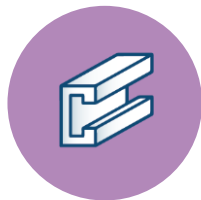
COP29, 30 & 31: 4 priorities to deliver action through future COPs



Delivering and increasing the COP28 commitments to triple RE capacity by 2030 informed by work on barriers to clean electrification



Further progressing the global debate about moving beyond fossil fuels, seeking to gain increasingly strong and specific commitments to the rapid phase-down



Supporting the work of the ITA, which is envisaged as a multi-COP initiative. Driven by MPP but with the ETC focused on identifying, and driving action on, implications for the wider energy transition (e.g., the scale of clean electricity or H₂)



Developing more ambitious and comparable NDCs in the next NDC ratchet – ensuring they reflect commitments made at COP26 and COP28, real economy action, and latest technological progress.



From Bonn to Belem NDC Insights Brief Comms Campaign



Credible Contributions:
Bolder Plans for Higher Climate
Ambition in the Next Round of NDCs

June 2024

The objective is to reach target audiences including:

- Government officials and senior policymakers, directly involved in the NDC-setting process.
- Non-state actors (NSAs) and advisers to NDC-setting policymakers.
- Industry (core ETC members and audience)

Collaborating with comms partners to maximise opportunities at key events

- Tap into engagement opportunities at key climate events (Bonn, LCAW, NYCW, COP29) with the NDCs Partnership, UNFCCC, WBCSD.
- Partner with Global Optimism to convene a workshop at Bonn and LCAW
- Follow up events (LCAW, NYCW and COP29) with member support

Amplifying and building momentum

- Pre-brief business stakeholders, non-state actors, and policymakers.
- Media launch June 2024 at the end of Bonn Climate Change Conference. Targeting international broadcast media.
- Keep beating the drum at New York Climate Week, COP29 and all the way through to COP30.

Proposed focus for COPs 29, 30 & 31



Partners:



Main area of focus:



- Accelerating **rapid phase-down of fossil fuel** production and use, extending work at COP26 & COP28
- **Financing the transition** & placing the New Collective Quantified Goal ("NCQG") in context
- Exploring the opportunity of **interconnectors**

- Establish "ETI Brazil" programme to build partnerships and potentially impact the **system-wide vision for a Net-Zero Brazil**
- **Convene cross-sectoral working group** of stakeholders within Brazil to debate decarbonization pathway options and the impact on land use and resulting energy supply
- Position Brazil with the **global context** to understand the **opportunity to become a green supply chain leader**

- To accelerate successful delivery of **low-carbon industrial hubs** to provide a template for climate leadership to be replicated globally
- Major focus on **low-carbon power systems** in SEA, and **accelerating coal phase out**

Last year we proposed a two year work-programme

1

Extending our influence in the global climate debate

Analytical programme

2

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MISSION
POSSIBLE
PARTNERSHIP

6

Supporting the ETC members



ETC Communications 2-year Programme:

Pillar 1

Disseminating ETC reports

- **Broaden media presence:** focus on Tier 1 media and non-English international media.
- **Explainer content:** concise, informative, digital friendly.
- **Social media campaigns.**
- **Events:** increased presence in key sectoral and regional events.
- **Direct engagements:** structured and targeted outreach.
- **ETC Matters Newsletter:** valuable mailing list incl. journalists, climate activists, policymakers.

Pillar 2

Repackaging existing insights

- **To inform and explain:** dispelling myths, correcting misinformation, and explaining and re-explaining complex ideas.
- **Shorter, more digestible forms** (e.g., videos, social media posts, blogs)
- **Informing the debate** via timely op-eds and articles on international media platforms.
- **Spreading the word** at key climate events (e.g. New York Climate Week, Clean Energy Ministerial, COP).

Pillar 3

Informing the influencers and reaching new audiences

- Developing **broadcast opportunities.**
- Expanding **digital storytelling** (TED Talks, Talking heads videos)
- Leveraging **social media network.**
- **Audience specific** tailored content.
- Collaboration with **other communications partners** (e.g, Global Optimism, GSCC).
- Test **direct outreach** with high impact interest groups (NGO groups, University programmes).

Towards COP29 & COP30



Pillar 1: Integrated, multi-channel approach

Media

Broaden media presence, focus on Tier 1 media and non-English international media.



Social campaigns

Driving engagement on ETC's existing social media channels.

Connecting with target influencers on LinkedIn and X.

Continuing development of explainer **video series**.



Events

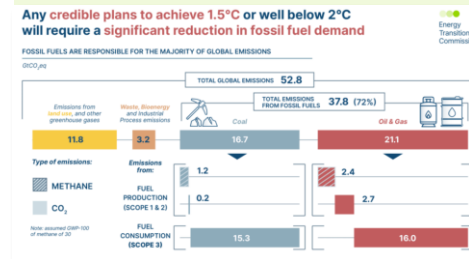
Events: increased presence in key sectoral and regional events.



Climate Action

Explainer Content

Developing concise, informative, digital-friendly content for cross-channel use.



Direct engagement

Direct engagements: structured and targeted outreach.



Offshore wind and NDCs campaign continue – member support to amplify



Engage with local events and media

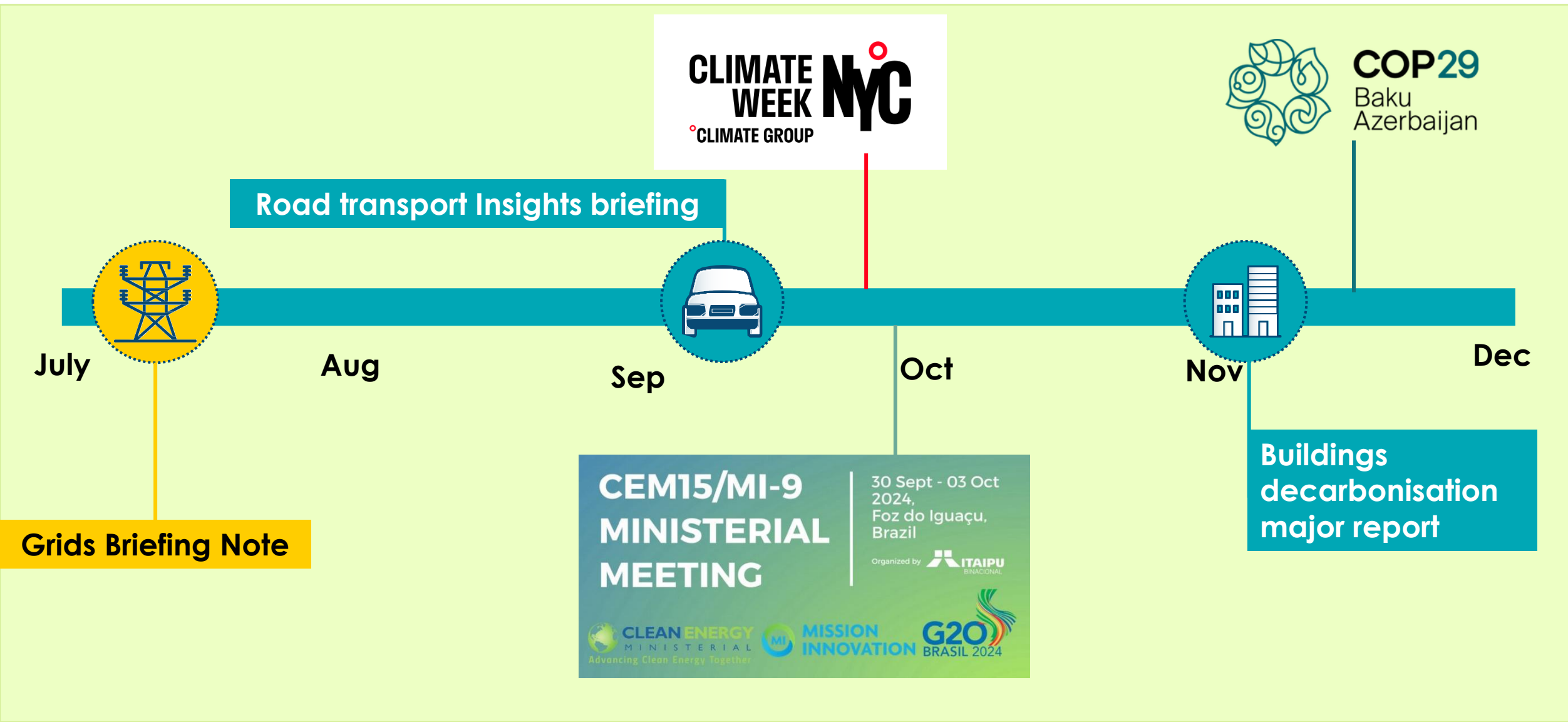
- **Use ETC speaking-notes** at industry events.
- Take key messages to **national broadcast and print media** in local languages.

Connect ETC with policymakers and industry groups

- **ETC spokespersons can support members** at industry events.
- Connect ETC analytical team **with relevant national policymakers or industry groups**.
- The ETC team is available to **conduct policy roundtables & briefings** based on member interest.



What is coming up later this year



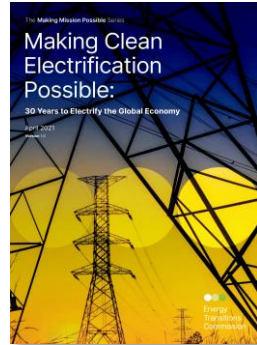
Pillar 2: Rich back catalogue of content to re-package



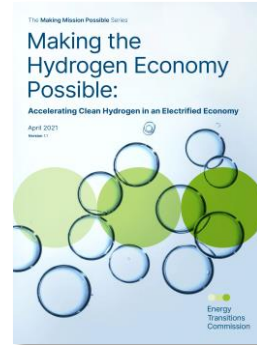
172 pages
+ 38-page executive summary



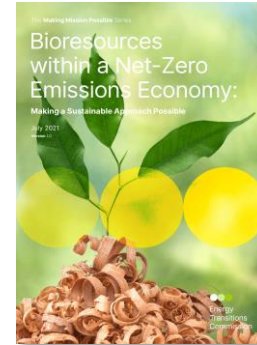
89 pages
+ 31-page executive summary



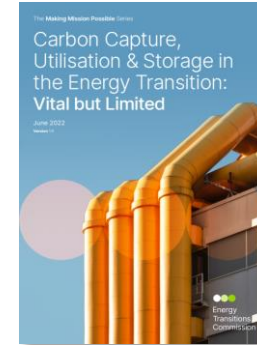
108 pages
+ 36-page executive summary



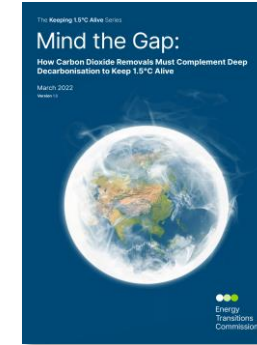
92 pages
+ 30-page executive summary



116 pages
+ 30-page executive summary



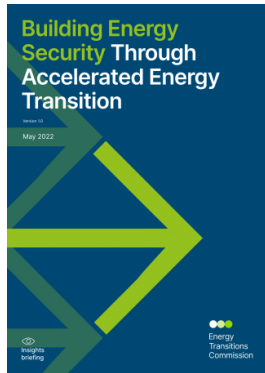
120 pages
+ 40-page executive summary



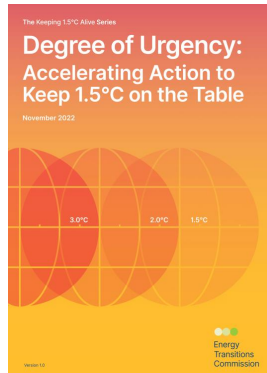
100 pages
+ 36-page executive summary



64 pages
+ 14-page executive summary



32 pages



43 pages



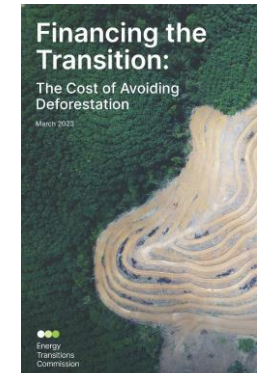
35 pages
+ 3 toolkits (5-20 pages each)



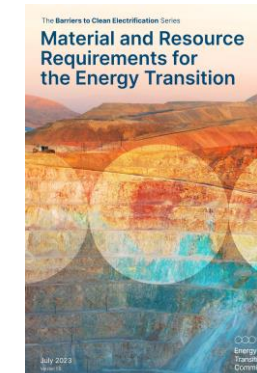
51 pages
+ 22-page toolkit



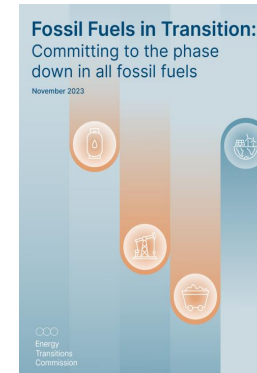
101 pages
+ 29-page executive summary



26 pages



130 pages
+ 24-page executive summary



160 pages
+ 28-page executive summary



Pillar 2: We are already doing this ... and have started to go further



The Energy Transitions Commission has launched a new Insights Briefing *Streamlining Planning and Permitting to Accelerate Wind and Solar Deployment*

Along with 3 Solution Toolkits recommending crucial action to be taken by:

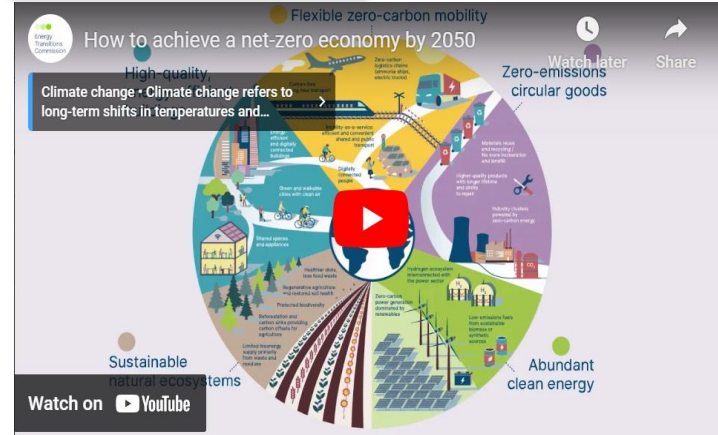
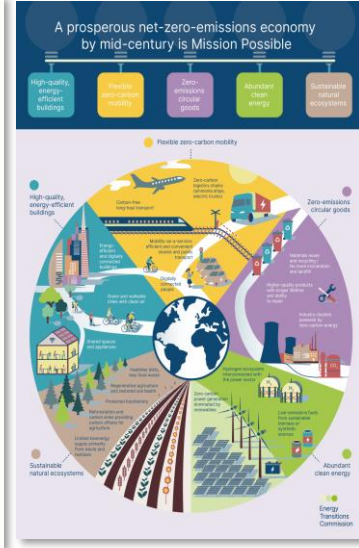
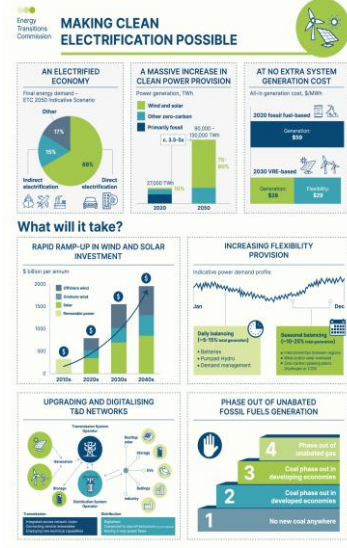
1. Governments and policymakers
2. Wind and solar developers
3. Local authorities and civil society

Our analysis finds that **wind and solar project times can be more than halved** if targeted action is taken to reduce delays during the planning and permitting stages while maintaining strong environmental, biodiversity and social safeguards.

[Click here](#) to access the Insights Briefing and Solution Toolkits.

Global clean electricity capacity must grow rapidly

Clean electrification is the backbone of the transition to net zero. The ETC estimates that 60% of all energy consumed in 2050 will come from clean electricity sources, up from 20% today. A global energy system based on clean electrification will require dramatic growth of wind and solar capacity – an increase of 5-7 times by 2030.



- Fill the need for strong evidence-based storytelling in current political and social climate
- Utilise ETC's position to inform, explain, and dispel myths and misinformation
- Share analysis in shorter, more digestible formats to extend its reach
- Answer pertinent questions in the ongoing climate debate



Priority topics for second half of 2024

Post- EU election campaign, further emphasis Energy Security



Post-EU elections, the EU factsheets will remain **available to members, support ETC's expanding network of ambassadors, used in a social media campaign, and for EU media briefings.**

euronews. **EURACTIV**
POLITICO

Financing the Transition, a key topic in the global debate through to COP29



- New Collective Quantified Goal (NCQG) deliberations will conclude at COP29, but negotiations are fraught – high risk of perceptions of 'failure' at COP29
- Key messages from the ETC's Financing the Transition report and NDCs briefing can support the ongoing work to develop the NCQG
- Aim to repackage the finance story
 - Push out via **media briefings, social media engagement, partner briefings and amplification, events (e.g., NYCW and COP29)**
 - Exploring developing **a short 4-6 page briefing to put out in the autumn, to use as a comms vehicle for the above and get it into the hands of comms partners (e.g., GSCC and ECIU)**

Pillar 3: Tailoring the message to the audience

	Traditional	Unaware	Unconvinced
Who?	<p>Key players in the transition journey. The ‘movers and shiffters’ of energy and economic decisions needed to unlock the transition.</p>	<p>Those who have not engaged with the transition debate or lack the understanding of solutions and impact on their work, lives, and environment.</p>	<p>Individuals who have not bought in to the transition potential. But can be convinced</p>
How?	<ul style="list-style-type: none"> • Providing the evidence-backed analysis to show the transition is possible. • This is what needs to happen in the 2030s and 2040s to achieve it. 	<ul style="list-style-type: none"> • Simplifying arguments with practical/tangible solutions to show the transition is possible. • Painting a picture to boil down the complex arguments & analysis into stories that resonate. 	<ul style="list-style-type: none"> • Focusing on the economic story: growth potential of and affordability of the transition. • Still presenting the evidence that the transition is possible.

Heat pumps too expensive to meet net zero target

● Steel workers facing job losses under net zero plan



“How much money and energy can heat pumps save you in winter”

“Green steel means growth and opportunity for the future of the industry”

Pillar 3: In-direct engagement – ‘Informing the influencers’

Traditional

Unaware

Unconvinced

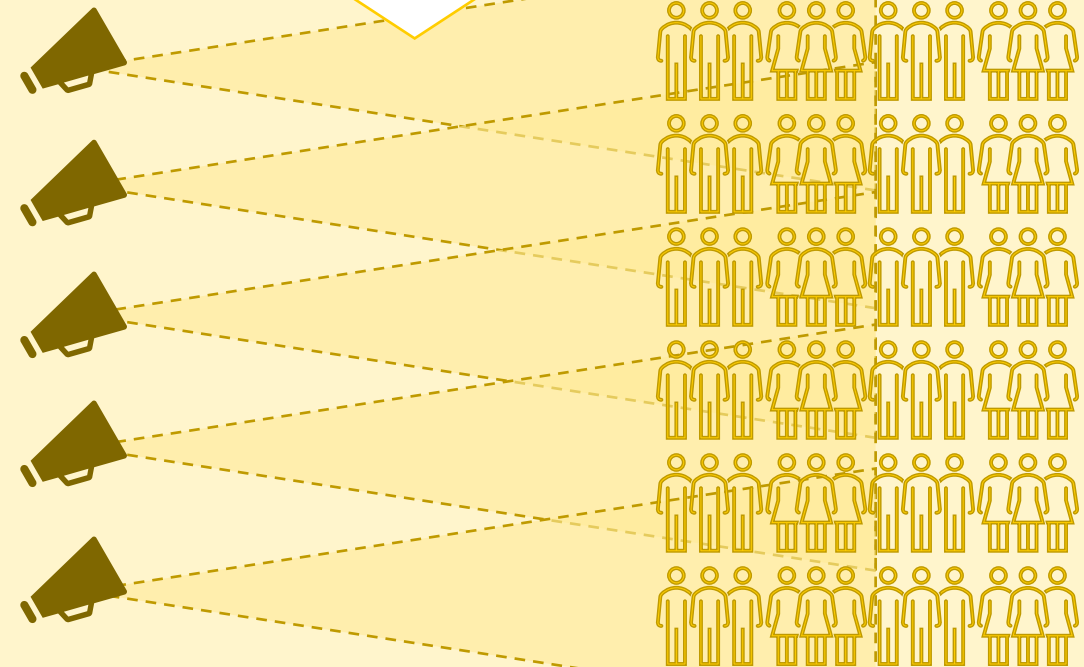
Direct - informing the debate

In-direct – via partners and interest groups to reach a broader audience

Targeting those who speak directly to the unaware & unconvinced... five channels



- A Traditional media
- B Broadcast and video storytelling
- C Social media
- D Communications partners
- E via interest groups

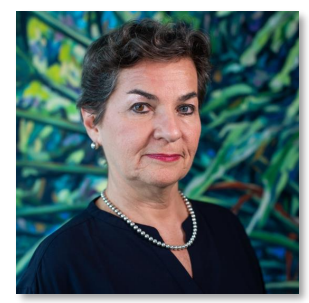


Expanding our Audience & Targeting Beyond the Climate Bubble

Informing those who speak directly to the unaware & unconvinced...

	Traditional Media	Broadcast & video storytelling	Social media	Communications Partners	Special Interest groups
Who we will target	<ul style="list-style-type: none"> International outlets, beyond climate & energy correspondents 	<ul style="list-style-type: none"> Climate focused production companies Podcast producers 	<ul style="list-style-type: none"> Energy influencers Non-expert influencers who can have impact 	<ul style="list-style-type: none"> Climate partners with a broader audience 	<ul style="list-style-type: none"> Professional, Academic and NGO groups.
How will we target them	<ul style="list-style-type: none"> Background briefings Answer questions. Explainer content (guides) 	<ul style="list-style-type: none"> Data storytelling – e.g., media briefing pack and videos Spokespeople Direct outreach Partner relationships 	<ul style="list-style-type: none"> Short-form content Data stories Partner with influencer agencies/experts Social listening 	<ul style="list-style-type: none"> Early engagement with content & message testing Collaboration at key events and with their campaigns. 	<ul style="list-style-type: none"> Identify & test proposition with 3 groups (2024) Tailored content – guides to energy transition

Already achieved



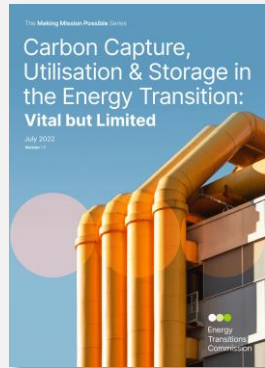
Next 6 months: Broadening our reach via amplifiers and multipliers

Traditional Media	Storytelling through broadcast & podcasts	Social media	Communications Partners	Special "Interest groups"
<ul style="list-style-type: none"> • Re-package & re-use content to tell energy transition story • Background briefings beyond energy & climate • Target international media for report amplification • Target priorities: 	<ul style="list-style-type: none"> • International broadcast campaign NDCs/COP29 • Podcast and data/video storytelling focus 	<ul style="list-style-type: none"> • Summer campaign to key influencers, including Matt Levine, Robert Colville, Marina Silva, Andhyta F. Utami, Chandra Bhushan 	<ul style="list-style-type: none"> • Mission 2025 NDC campaign • Work with GSCC network on finance repackaging 	<ul style="list-style-type: none"> • Executive education: Pilot project with Sustainability Unlocked • Engagement with faith groups on NDCs 

Backup Carbon molecules deepdive



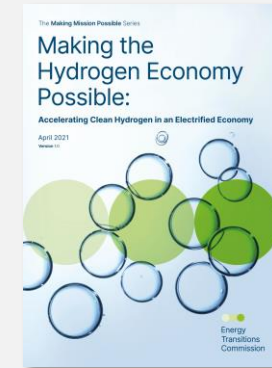
Previous ETC reports have assessed the relative role of role of CCUS, bioresources and hydrogen



- CCUS is vital:
 - Where **alternatives are technically limited** (e.g., Cement process emissions)
 - To provide **least-cost decarbonisation** in key sectors and geographies where CCUS is competitive
 - To provide some **carbon removals**
- Enabling **transport & storage infrastructure** will be crucial – CCUS clusters could be important
- Most recent ETC analysis estimates **7-9 GtCO₂ of CCUS**, of which 4-5 GtCO₂ is point-source applied to fossil fuels and 3-4GT CO₂ is DAC



- Use of Bioresources faces **strong land use competition** and **sustainability constraints**
- A “prudent” estimate of sustainable biomass supply would be **40-60 EJ in 2050** – could rise up to 120 EJ in a “max. potential” scenario
 - Producing 50 EJ/yr could need **~2.8 million km² of land** (~8% of agr. land)
- Use of biomass should be **prioritized for sectors where alternatives are limited:**
 - Pulp and paper, timber
 - Plastic feedstocks
 - Aviation
 - Some high/mid-temperature heat



- **Green hydrogen** could be competitive with grey by 2030s (though latest progress slow)
- **Blue hydrogen** will also have a role – competitiveness depends strongly on cost of gas and availability of CCS
- Priority should be to **displace existing ~95 Mth₂ of grey hydrogen demand first**, then expand into wider sectors
- Enabling **transport & storage infrastructure** will be crucial
- Most recent ETC analysis estimates **350-600 Mth₂ of demand in 2050**, with greatest role in chemicals, steel, aviation and shipping

Source: ETC (2021), *Bioresources within a net-zero emissions economy*; ETC (2021), *Making the hydrogen economy possible*; ETC (2022), *Carbon capture, utilisation and storage in the energy transition*; ETC (2023), *Fossil fuels in transition*.

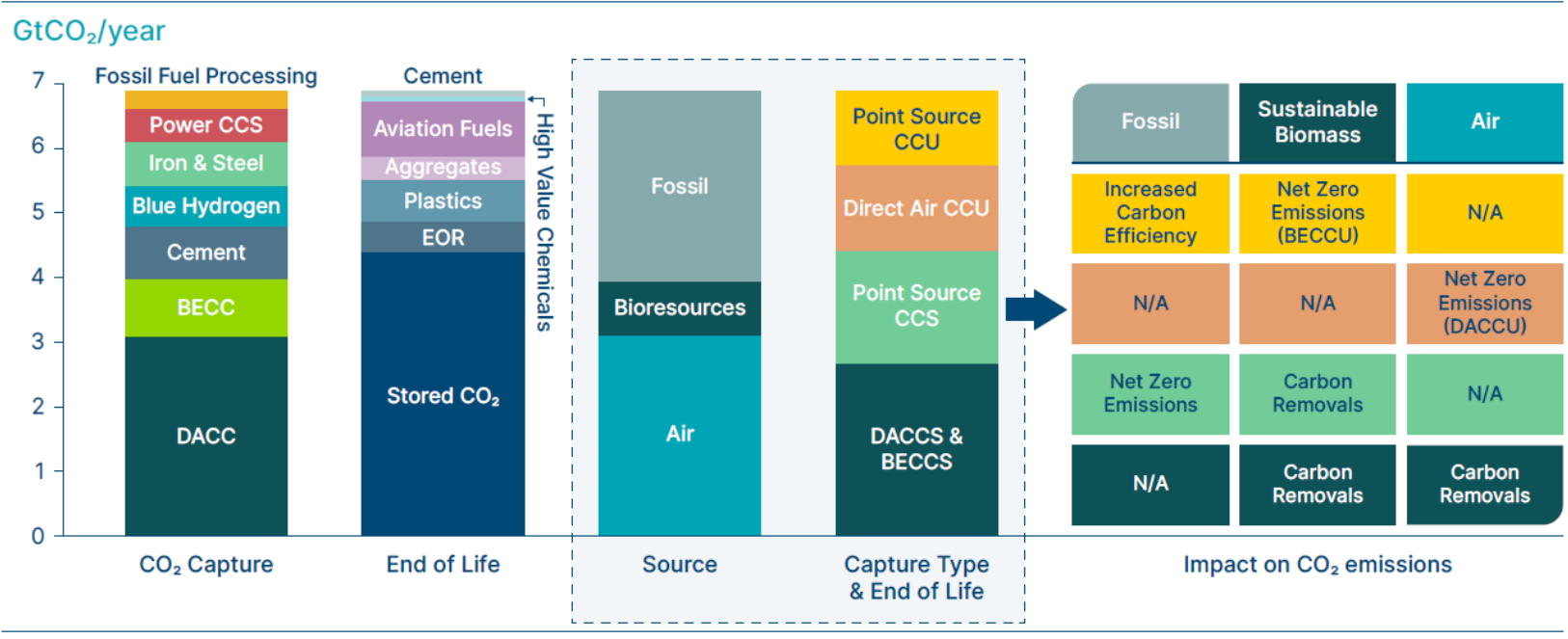
CCUS will likely entail a complex combination of sources, storage and uses

Carbon molecules

Future CO₂ demand: 2-3 GtCO₂ of utilization, 4-5 GtCO₂ of storage

Varying combinations of CO₂ capture and end of life imply different impacts on CO₂ emissions

CCUS volumes in 2050 under Base scenario

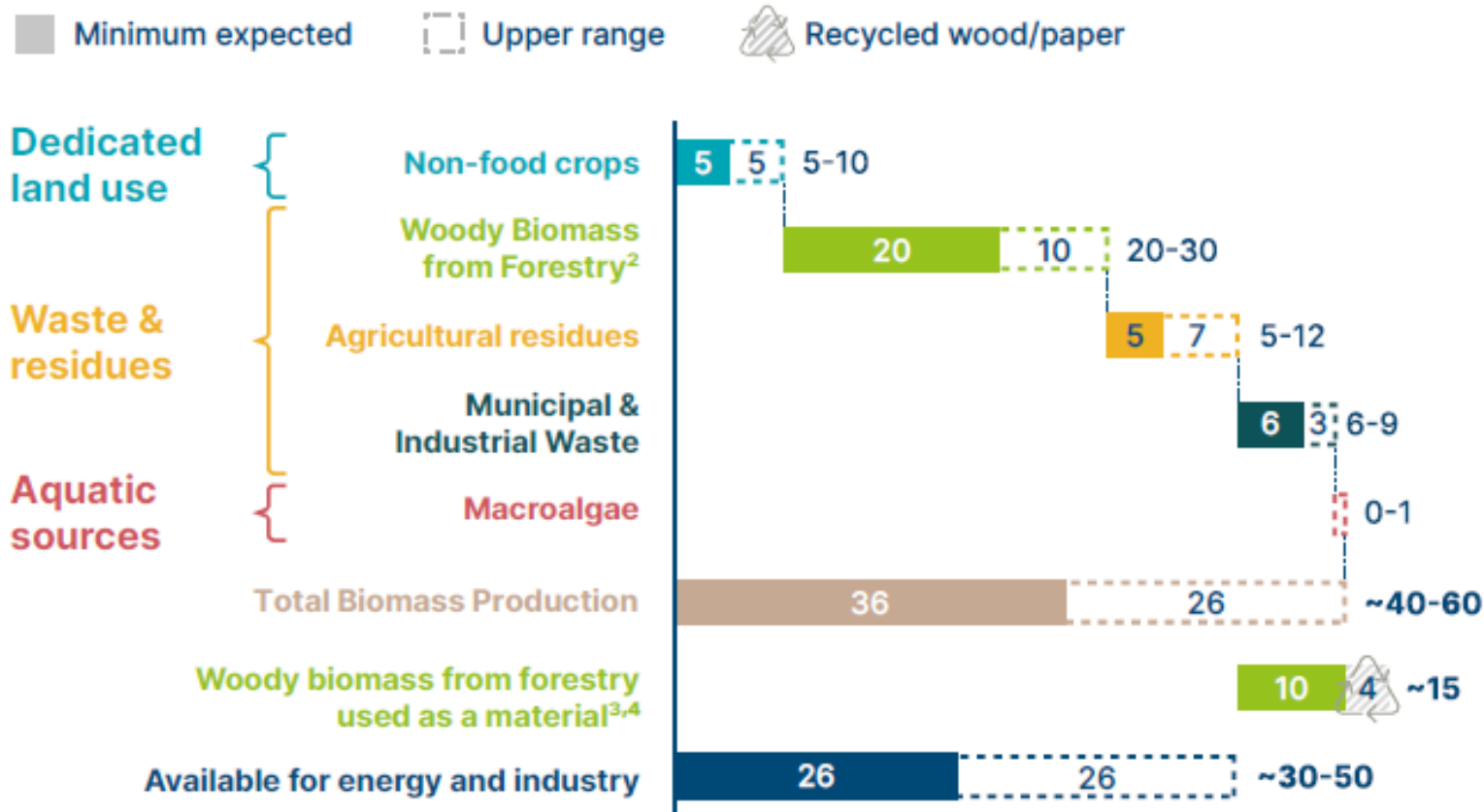


Source: ETC (2022), Carbon capture, utilisation and storage in the energy transition.

Sustainable bioresource supply must come from waste and residues, with limited use of dedicated bioresource crops

Global sustainable biomass¹ supply (2050) – illustrative scenario
EJ/year (primary energy)

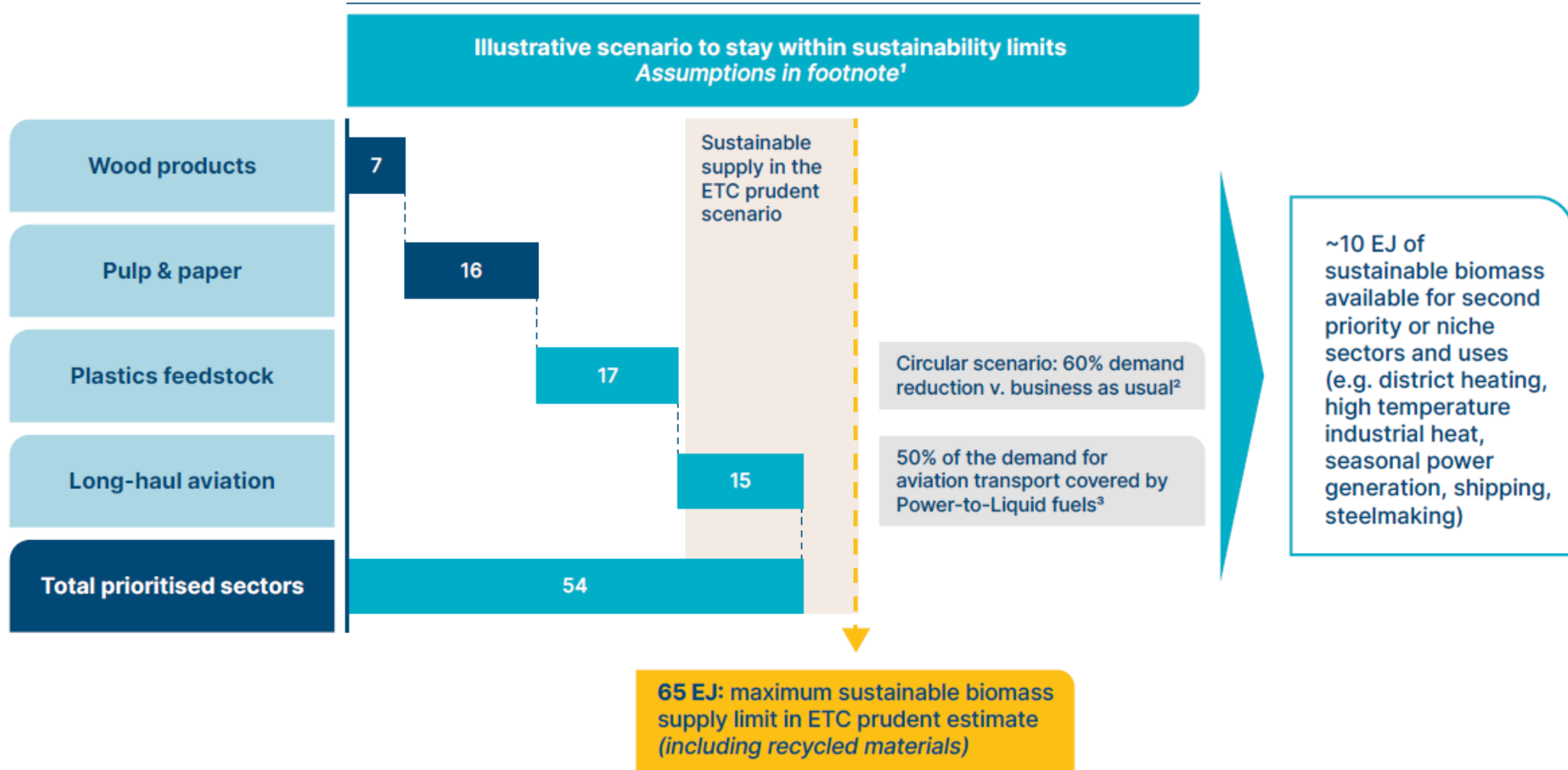
Illustrative



Note: [1] The term 'sustainable biomass' is used to describe organic material that is renewable, has a life-cycle carbon footprint equal or close to zero (including considerations for the opportunity cost of land), and for which the cultivation and harvesting practices used are mindful of ecological considerations such as biodiversity and health of the land and soil. [2] Includes high-quality stemwood from forestry suitable for the timber and pulp & paper sectors (~10 EJ/year today, FAO Industrial Roundwood production less by-products used for energy). This category also includes residues from forestry but excludes traditional fuelwood (~25 EJ/year today, assumed to reduce with modernisation) due to collection and sustainability assurance challenges. [3] E.g., timber, pulp & paper. Based on current harvests from commercial forestry; may increase if forestry additional high-quality stemwood could be made available if freed up land were dedicated to forestry. [4] Additional supply from recycled materials (~4 EJ/year today).

Priorities for use of bioresources

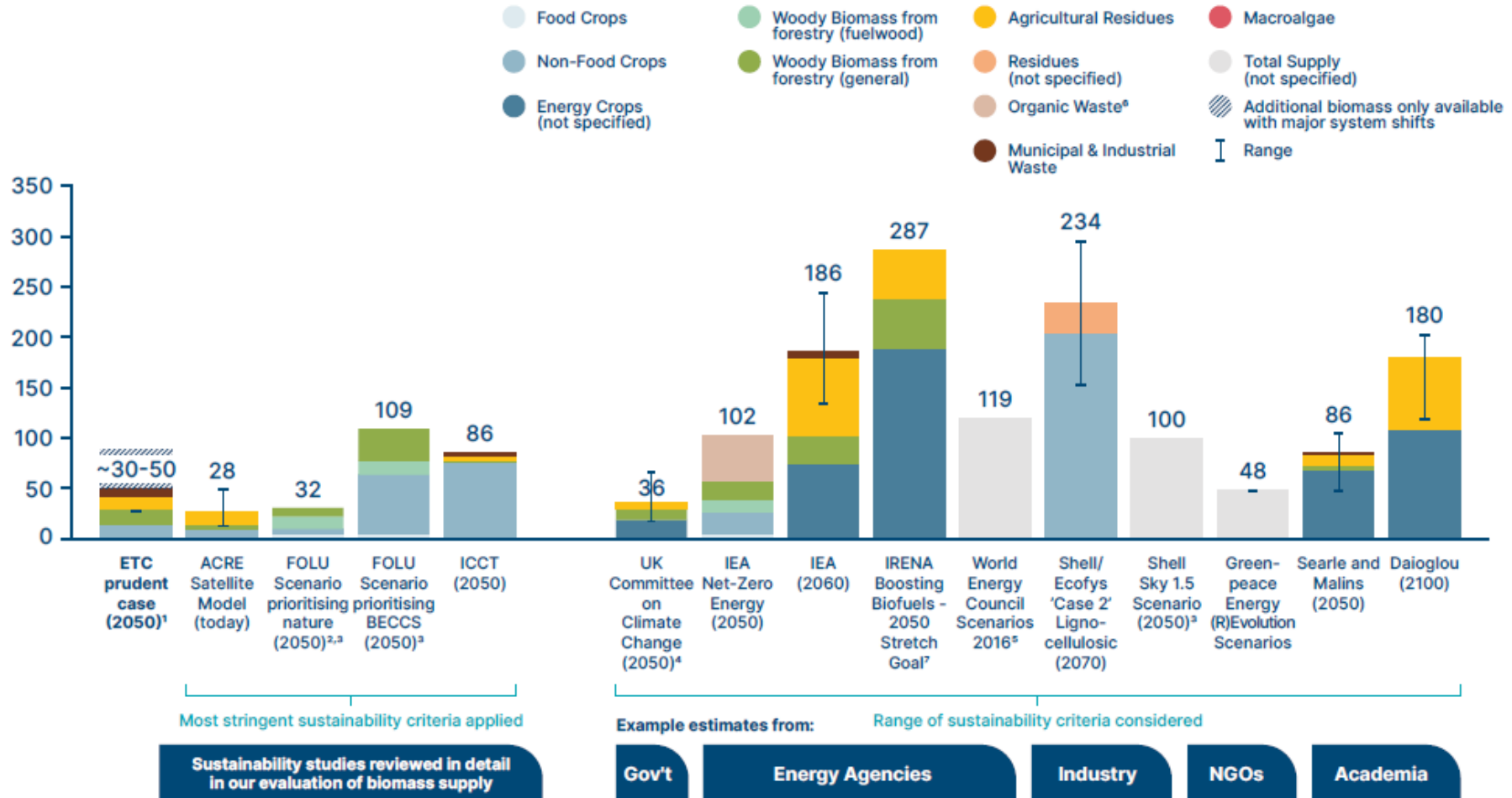
Total biomass required to decarbonize EBIT sectors,
EJ / year in 2050



Other organisations see a much larger potential role for bioenergy

Carbon molecules

Total global biomass supply (primary energy)
EJ/year

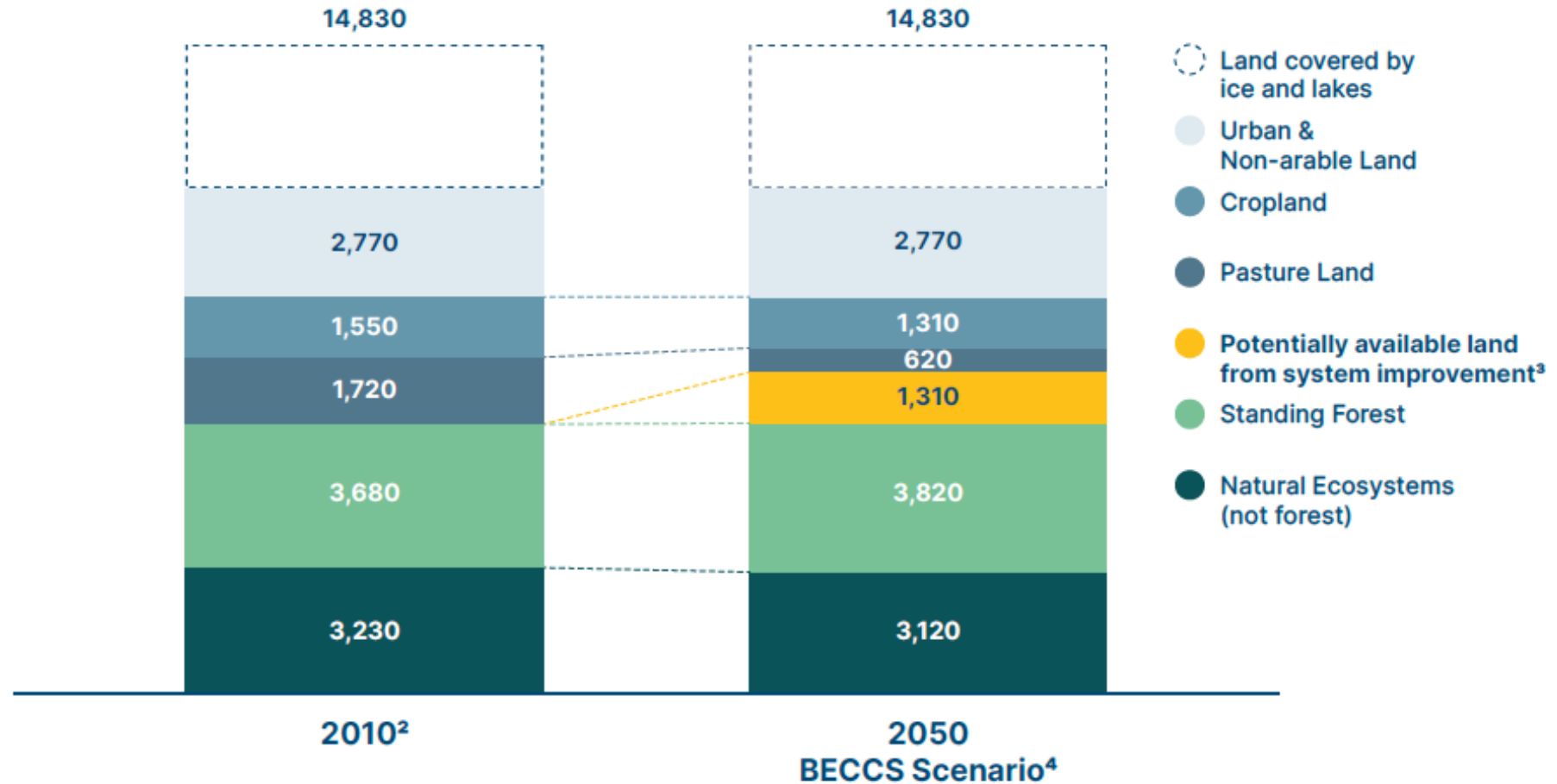


Source: ETC (2021), *Bioresources in a Net-Zero Economy*.



Radical changes to the food and agricultural system might allow 1 billion hectares to be freed up for alternative use...

Total Global Surface Land Use (million hectares)¹



Note: [1] Global surface area excludes oceans. Land covered by lakes and ice (e.g., Antarctica) also unavailable. [2] Baseline data forecast from 2000. [3] Of which a maximum of 1,050 Mha is likely to be suitable for managed forests and/or energy crops, though only a fraction of this potential might be used as such. [4] Unpublished scenario from FOLU/IIASA (2019), Growing Better.

Source: ETC (2021), *Bioresources in a Net-Zero Economy*



... but if available, this land might be better used to achieve other objectives

Carbon molecules

Alternative uses of surplus land

1. **Carbon removal** via forest growth and soil carbon sequestration - in some circumstances more carbon efficient than bioenergy extraction
2. **Solar PV** over a fraction of the land needed for equivalent bioenergy extraction
...potentially combined with agriculture - “agriPV”
3. **Biodiversity** via rewilding.



Photosynthesis is a land inefficient way to extract solar energy

How much electricity could you produce by using the US's biofuel land with solar PV?

The US uses 25 million hectares of land for biofuel product. If used for solar PV production, this land would produce 12,500 TWh; three times the US's current electricity use.



Data Source: UNECE Lifecycle of Electricity Generation; Ember Climate • Note: Assumes a land use of 20 m² per MWh of electricity from solar PV.

Existing land use in key countries (US, Brasil) is significant – and could be more effectively used by e.g. solar power

Kilometres driven per hectare: US biofuels vs. electric cars and solar

The number of kilometres that could be driven from one hectare of US biofuels (mostly corn), compared to an electric car powered by solar.



Data Sources: Based on UNECE; EV Database; and USDA • Note: Assumes 20 m² of land needed to produce one MWh of solar; and an EV efficiency of 144 and 171 Wh per kilometre.

Driving using biofuels is over 100x less efficient than using an EV powered by solar PV

Innovation could free up land, increase the potential for recycling and reduce the energy inputs needed for molecular transformations

Synthetic biology / precision fermentation > synthetic meat

- Huge theoretical potential to reduce food land use, given inherent inefficiency of both photosynthesis and cattle based conversion of vegetable to meat protein
- Challenges of cost-competitiveness and consumer acceptance

Bioreactors/ microbial biocatalysts (e.g. Lanzatech)

- Reducing energy demands for multiple variants of molecular transformation
- Enabling lower cost conversion of waste, residues and CO₂ streams into ethanol, other fuels, chemicals

Chemical recycling

- Depolymerization (via e.g. catalytic cracking – breaking down long hydrocarbons)
- Feedstock recycling (via e.g. pyrolysis or gasification)
- New catalysts significantly reducing required energy inputs

Electrochemical technologies

- e.g CO₂ electrolysis (“Twelve”) reducing cost of CO₂+H₂ synthesis into jetfuel

How fast can these technologies develop and cost-reduce?

What implications for balance between:

- **Continued fossil fuel use + CCS**
- **Sustainable bioenergy supply and bioenergy applications**
- **Continuous recycling of carbon atoms**

