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Energy Policy and Modelling Group, UCC

Research Showcase Event 2025

15/12/2025

Engineers Ireland, Clyde Road, Dublin 4.



Introduction - Brian Ó Gallachóir



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Introduction - Brian Ó Gallachóir

Session 1: Climate Action

Session 2: Energy Security

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Funders



An Roinn Comhshaoil,
Aeráide agus Cumarsáide
Department of the Environment,
Climate and Communications



国家自然科学基金委员会
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Opening Keynote

Denis Naughton

**Former Minister of Department of
Climate, Energy and the Environment**

Session 1 Climate Action



Chaired by Dr Jeanne Moore

Policy Analyst at National Economic and Social Council

Including the following presentations

- 1. Will we remain within Ireland's 1st Carbon Budget? By Prof Brian Ó Gallachóir**
- 2. A Marginal Abatement Cost Curve for Ireland by Dr Tomás Mac Uidhir**
- 3. Beyond Net-Zero by Dr Róisín Moriarty**
- 4. Why we're still ignoring the physics of climate change by Professor Hannah Daly**

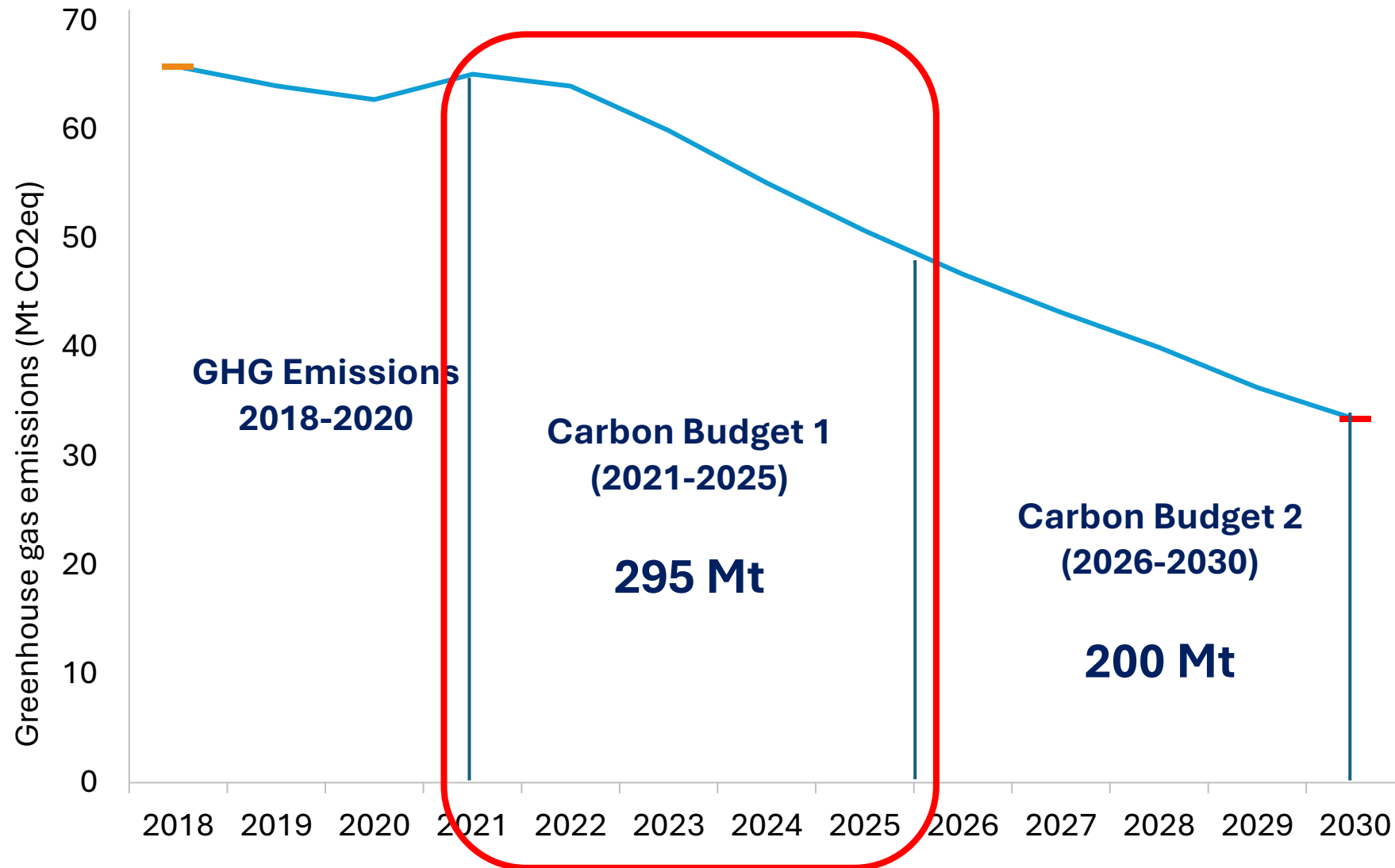
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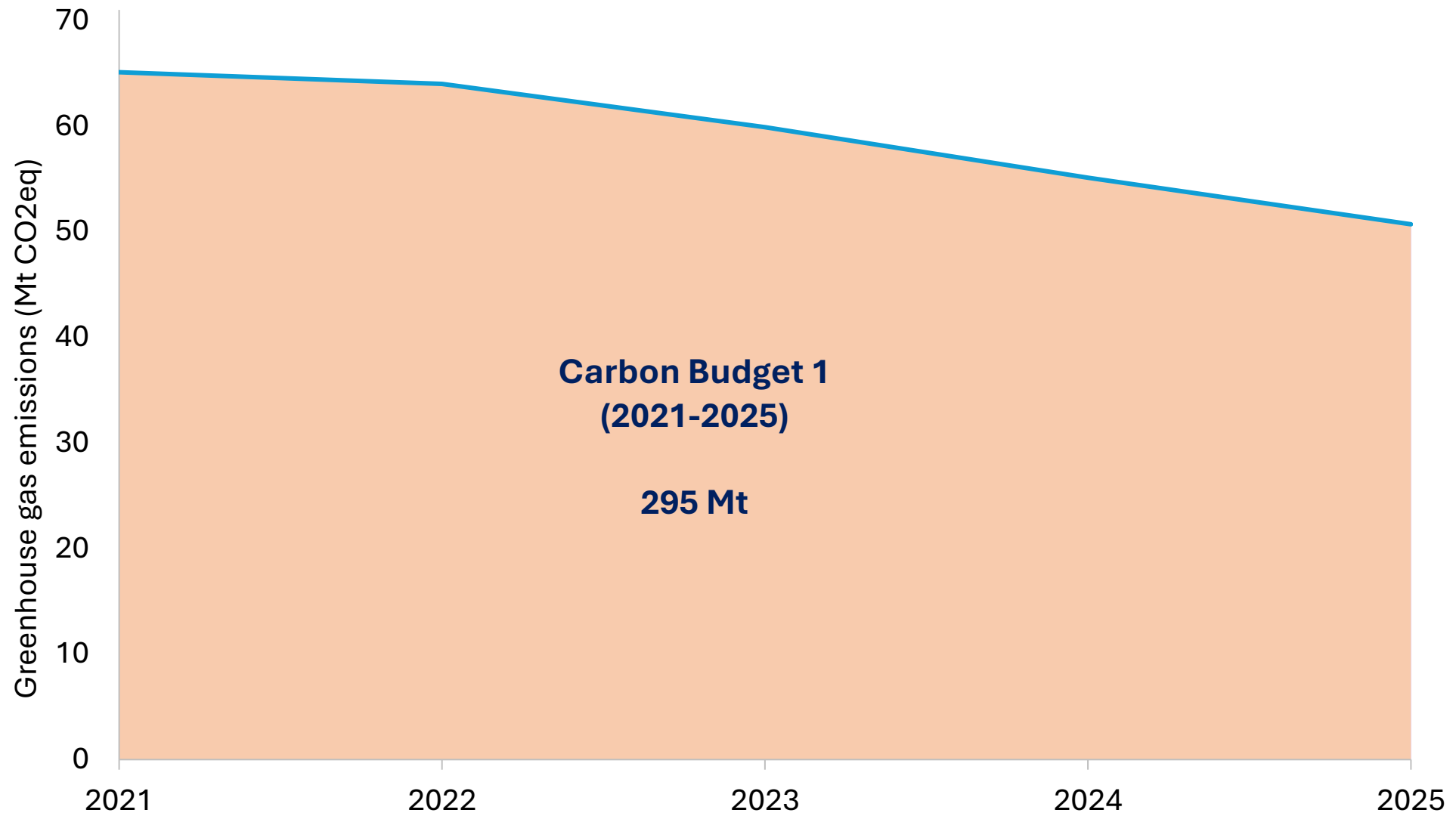
Will we remain within Ireland's 1st Carbon Budget?

Prof Brian Ó Gallachóir

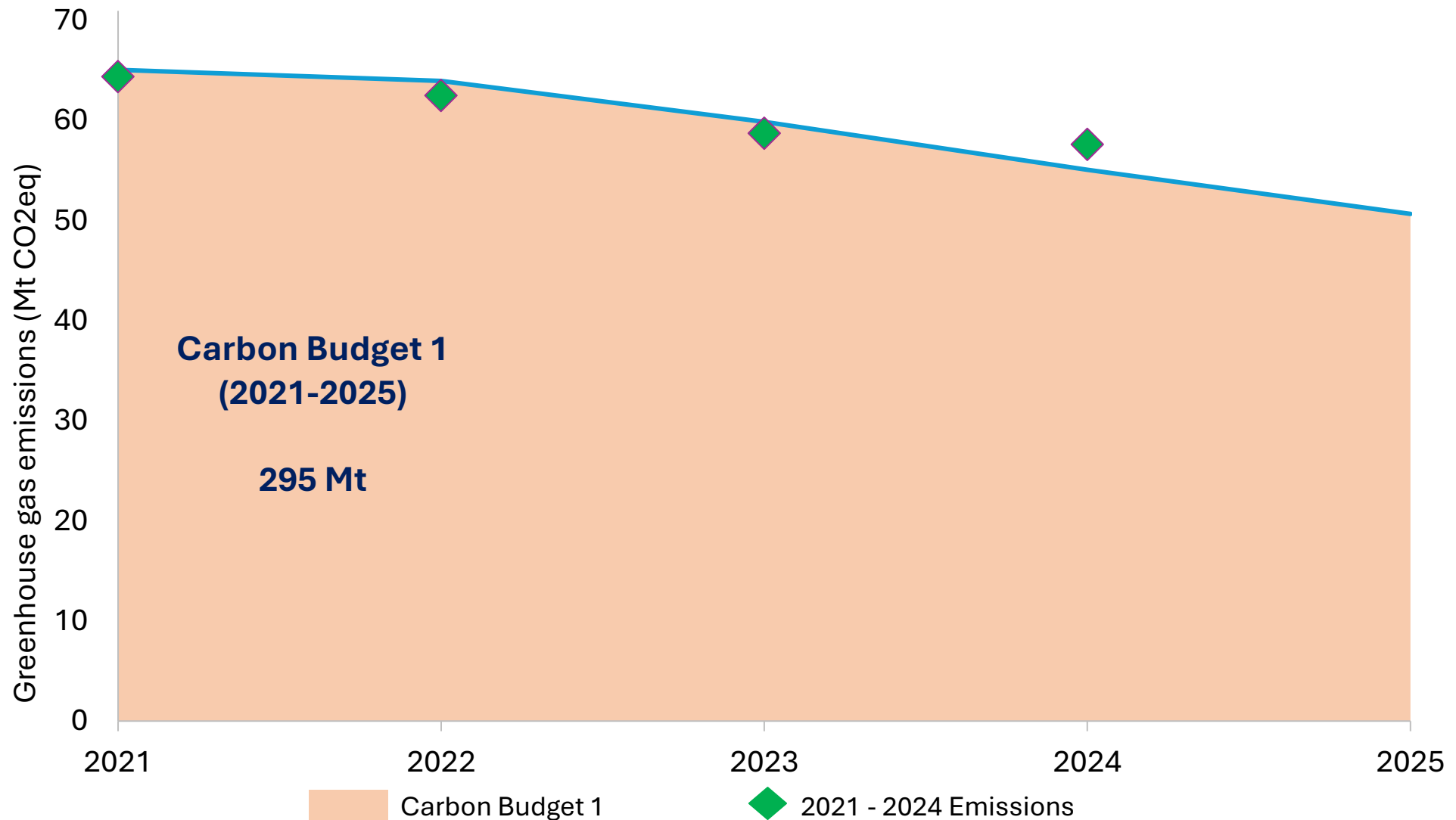
Indicative Pathway to Meet Ireland's Statutory Carbon Budgets (Fig 2 CCAC 2021 CB Report 2021)



... zooming in on Carbon Budget 1



... adding in EPA GHG emissions 2021-2024



... adding in estimates for GHG emissions 2025

Estimated Cumulative GHG Emissions 2021-2025

2021-2024	2025	Basis	Cumulative GHG (Mt CO _{2eq}) 2021-2025	Carbon Budget 1	Gap to CB1 (Mt CO _{2eq})	Gap to CB1
243 +	61	EPA WEM	304	295	9	3%
	58	EPA WAM	301		6	2%
	58	=2024	301		6	2%
	54	=2* H1 2025	297		2	1%

What about sectoral emissions ceilings?

Sectors	Sectoral Emissions Ceiling 2021-2025	Estimated Cumulative Emissions 2021-2025	Sectoral Emissions Ceiling Exceedance	Emissions Reduction 2018 - 2024
Electricity	40	40	0	32%
Transport	54	58	4	5%
Buildings (Residential)	29	29	0	20%
Buildings (Commercial and Public)	7	7	0	4%
Industry	30	32	2	14%
Agriculture	106	105	-1	5%
Other	9	9	0	20%

Ireland's total GHG emissions reduced by 12% in the period 2018-2024

Population grew by 10%, economy grew by 30%.

So where do we stand now?

- Ireland's carbon budgets and sectoral emissions ceilings **are achievable**
- **Political leadership, strong governance framework, supportive policies** and **societal mobilisation** have all played important roles
- There is a **delicate balance** between these four dimensions
- The most **significant progress** has been in **electricity** and **buildings**
- **System inertia** challenges in **transport** and **agriculture** are significant
- We **can achieve** the next carbon budget but that **does not mean we will.**

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A Marginal Abatement Cost Curve for Ireland

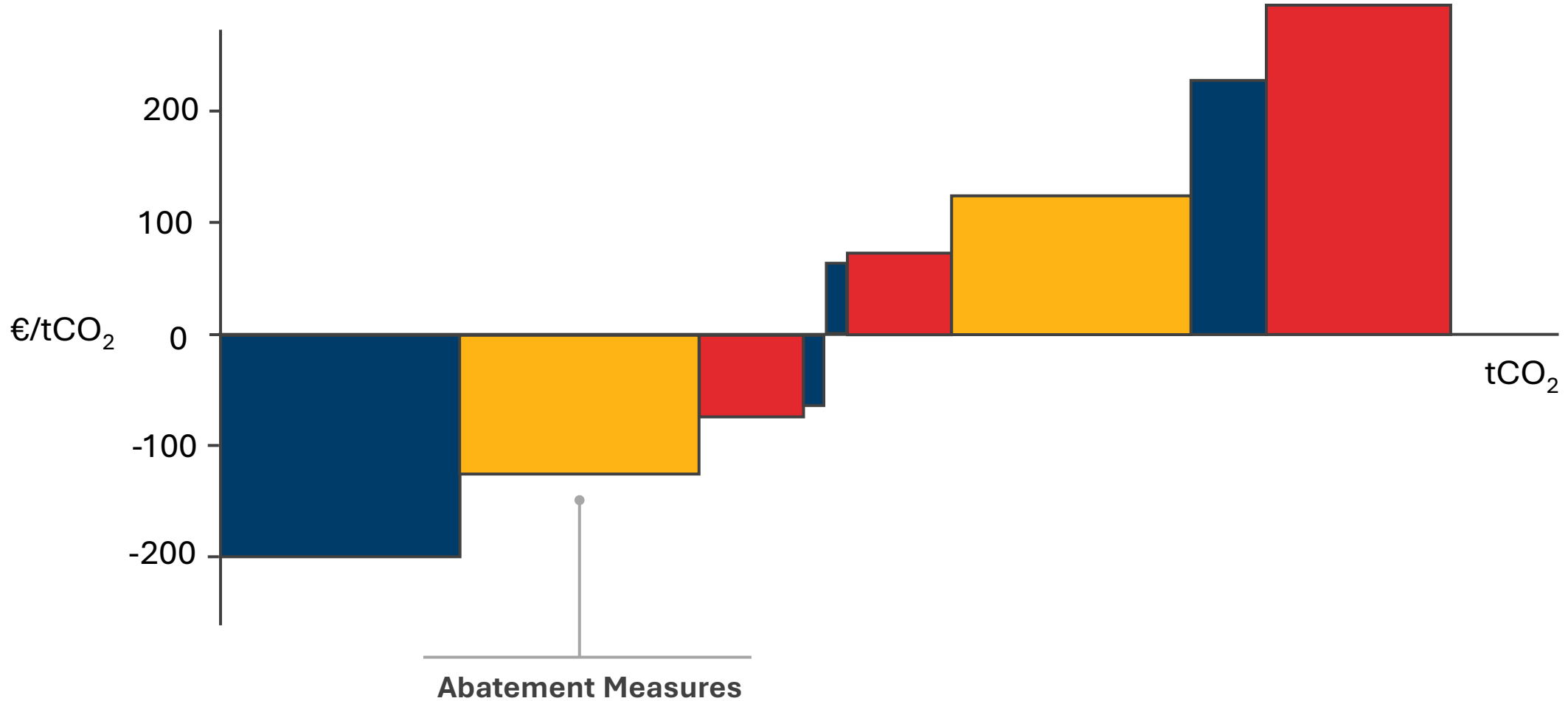
Dr Tomás Mac Uidhir

What about the next **25 years**?

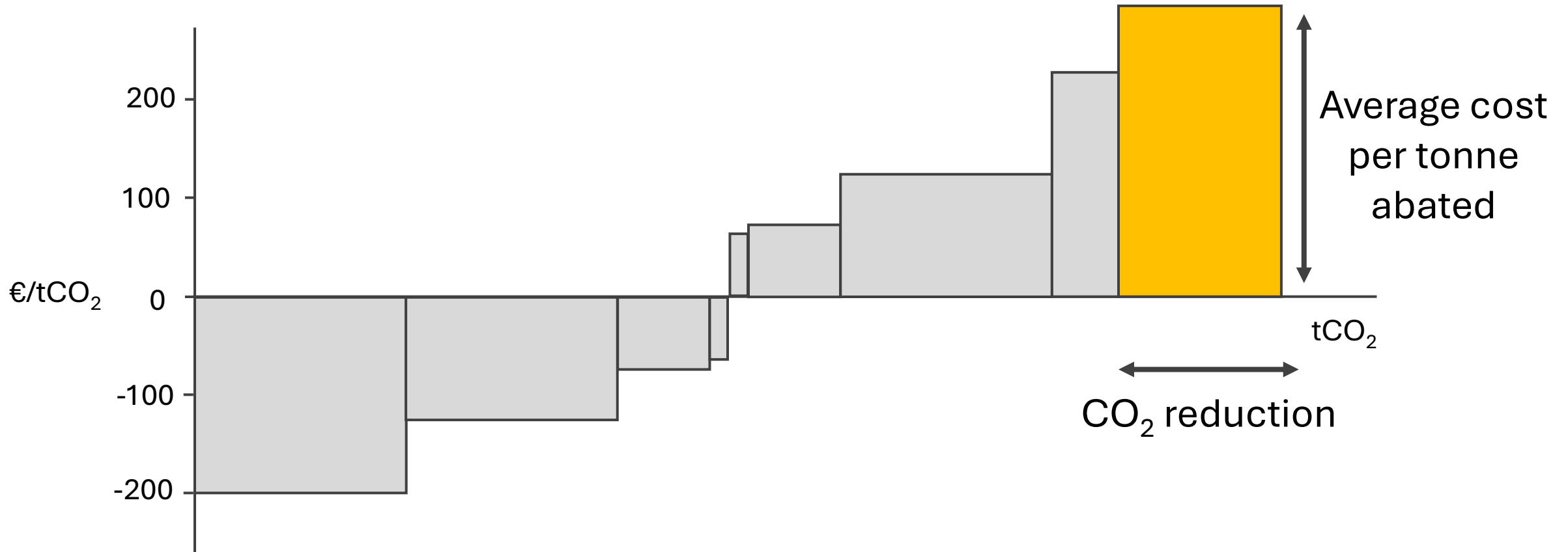
Ireland needs to make **informed choices** about how best to reduce emissions across the whole economy.

Decision confidence depends on clear **evidence** regarding the technologies and measures available, their **costs**, and their **mitigation potential**.

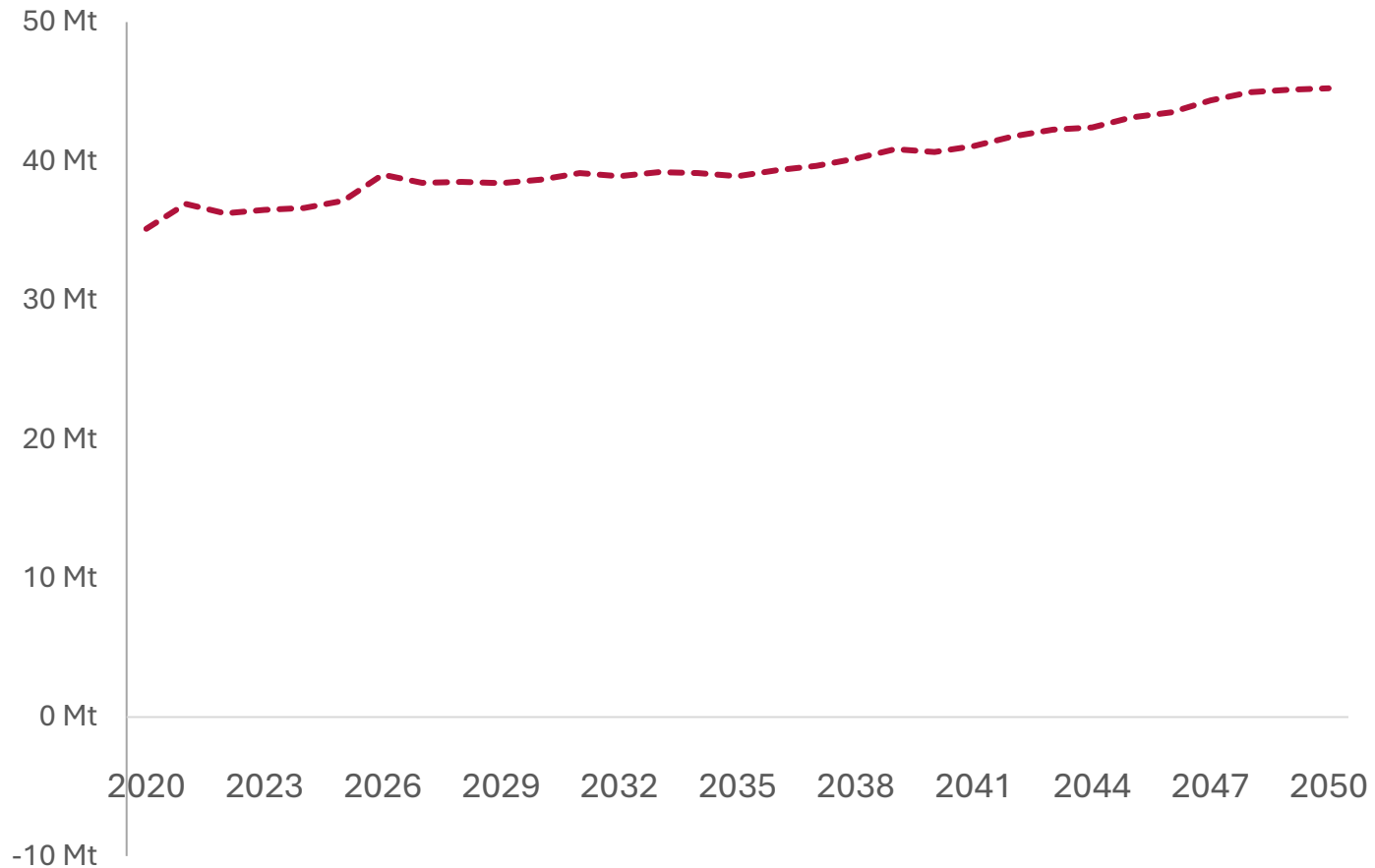
What is a Marginal Abatement Cost Curve (MACC)?



What is a Marginal Abatement Cost Curve (MACC)?

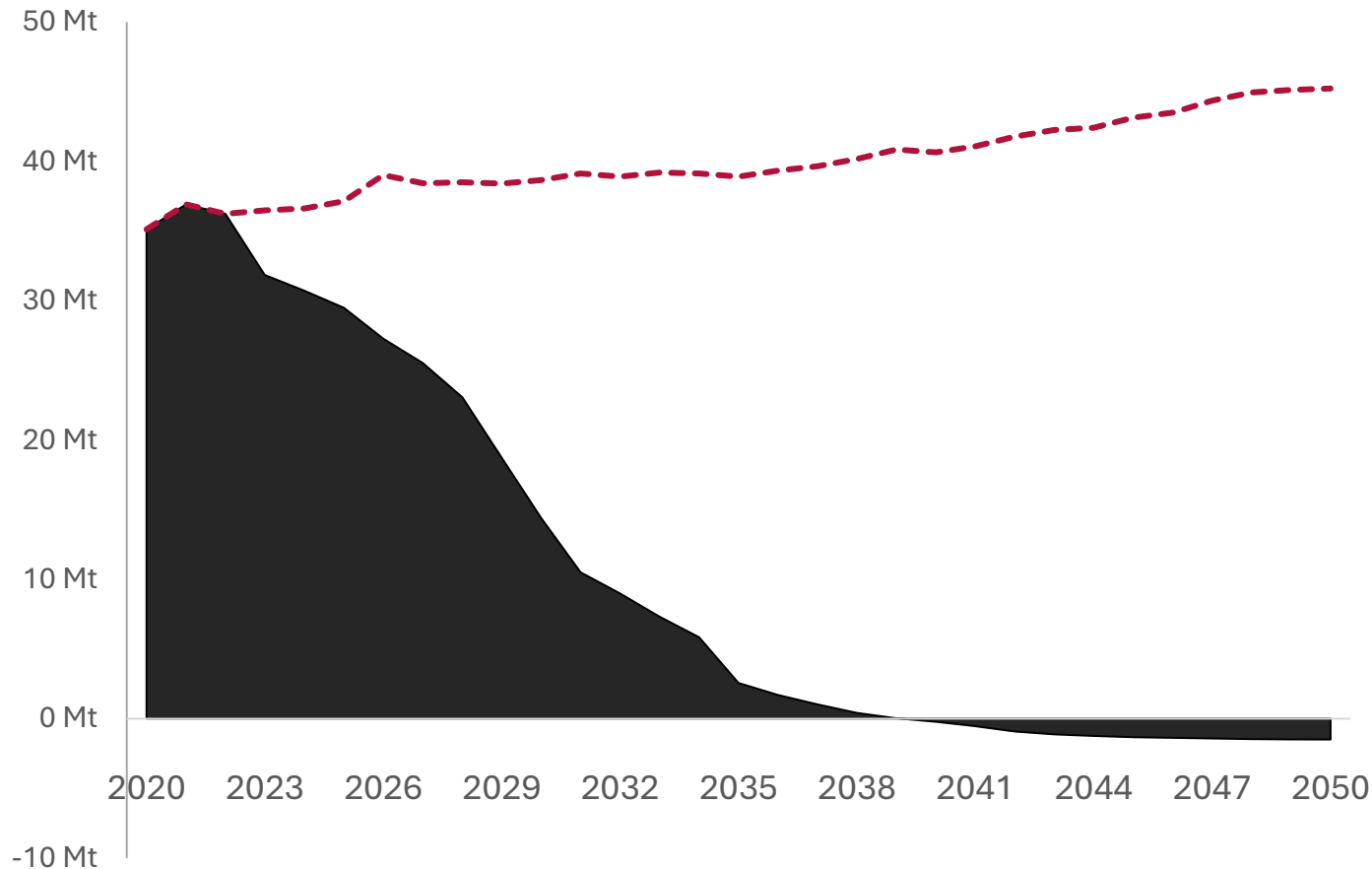


Scenario selection



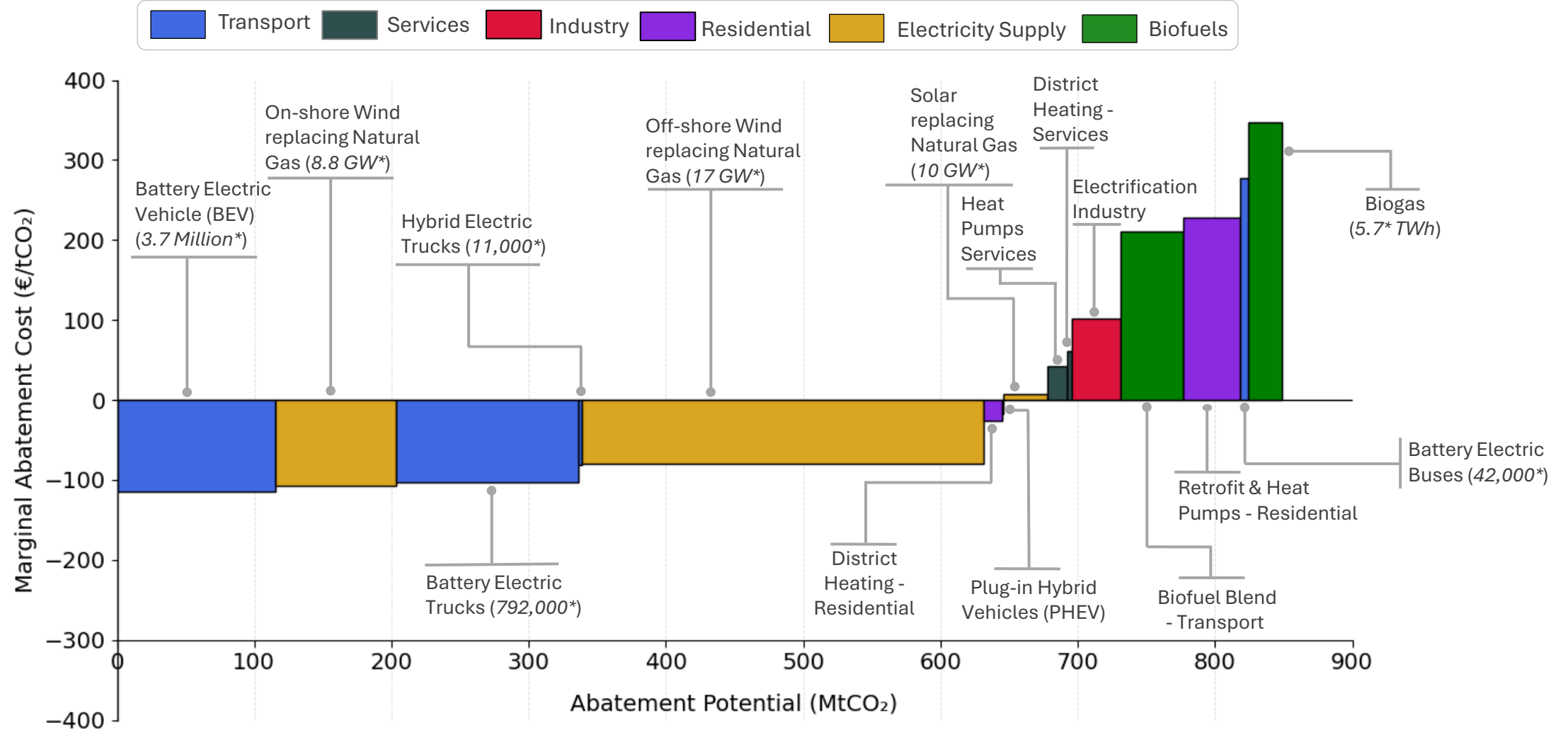
- Baseline: disable all technologies

Scenario selection

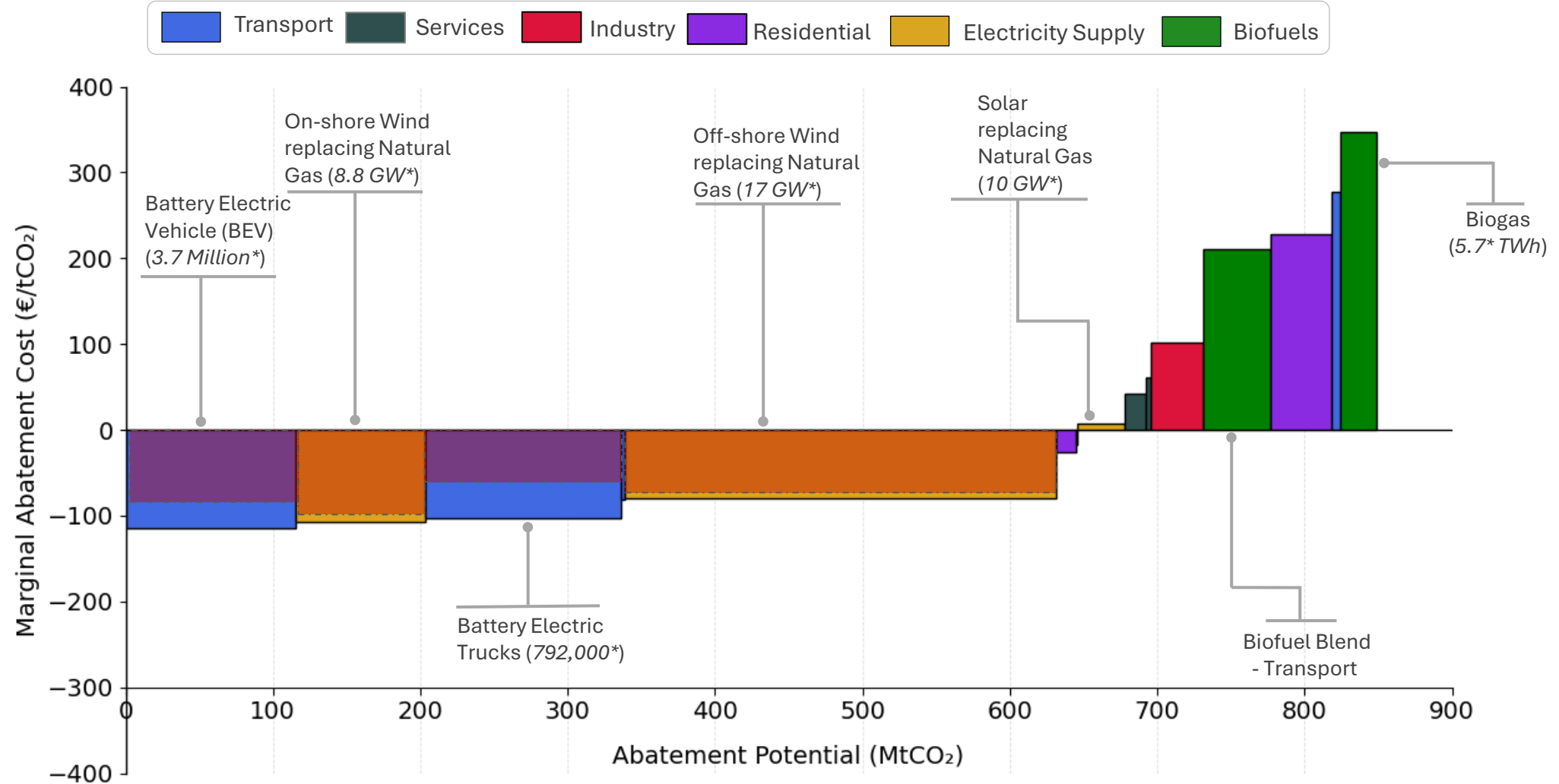


- Baseline: disable all technologies
- Mitigation: enable all technologies and set a carbon budget e.g. 300 MtCO₂eq
- Identify optimal deployment of individual technologies, consistent with Carbon Budget constraint.
- Re-enable technologies one-by-one
- Compare relative costs and emissions between baseline and mitigation scenario

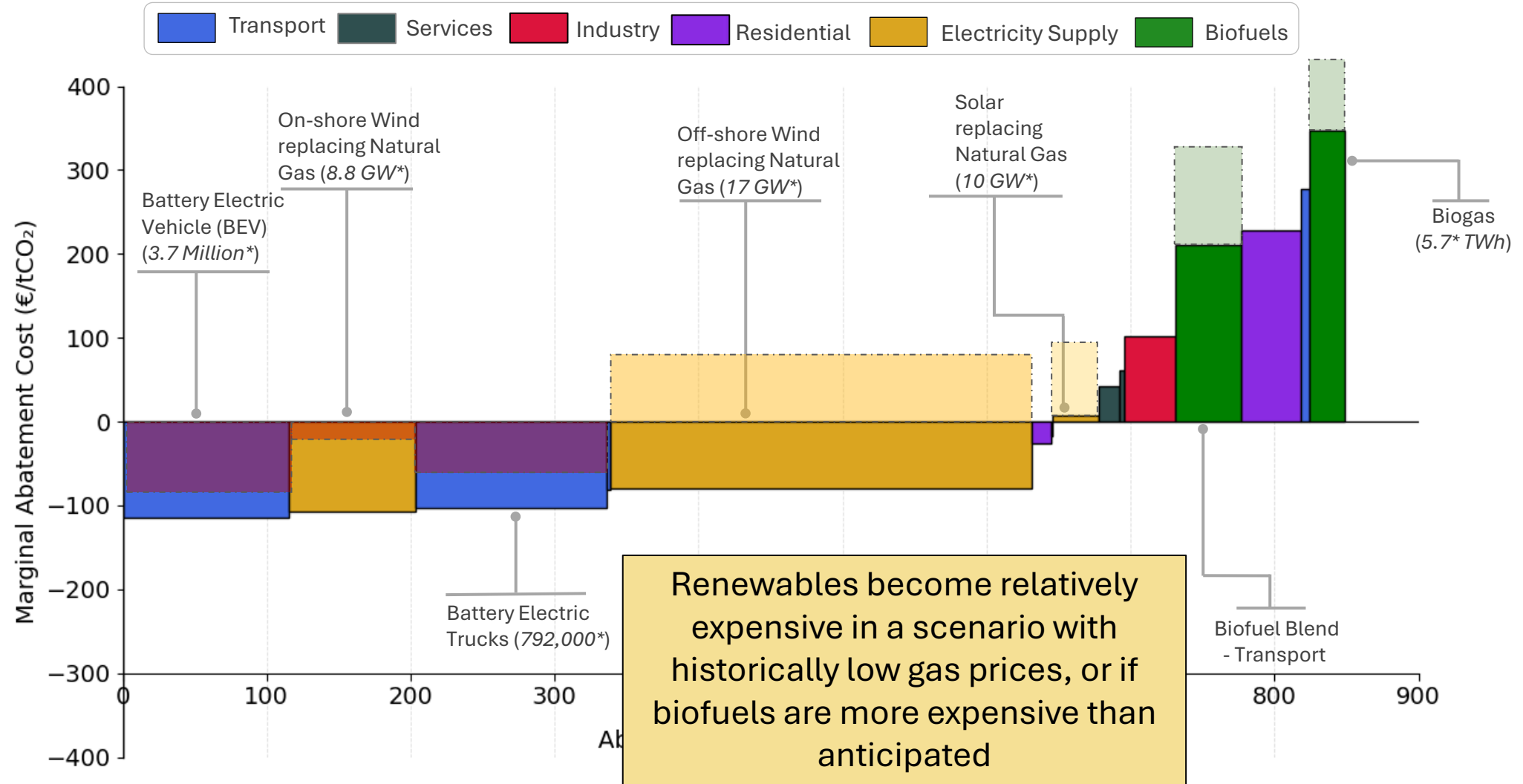
iMACC: Cumulative cost and abatement, €/tCO₂



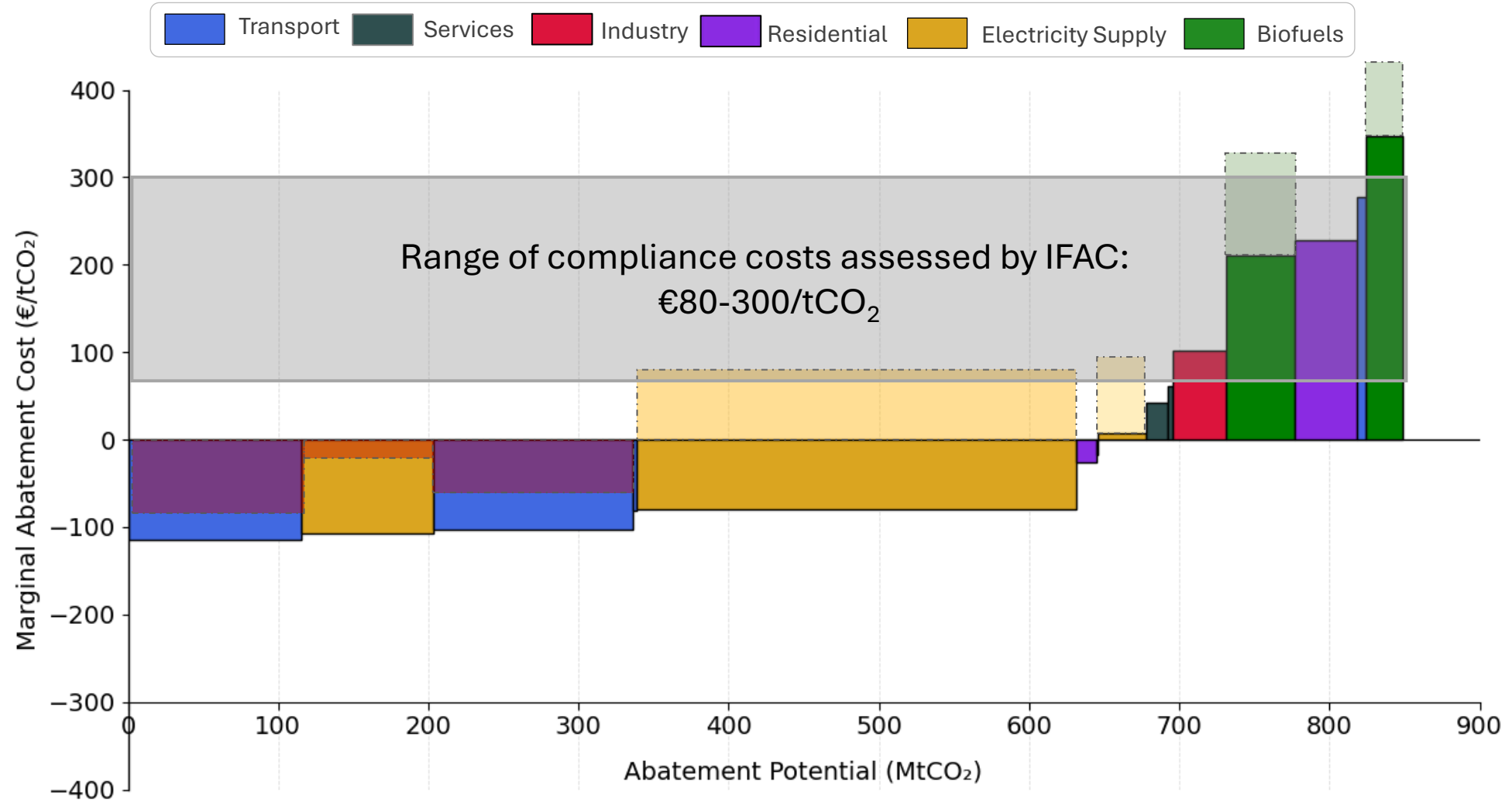
iMACC: Sensitivity (Grid & Charging)



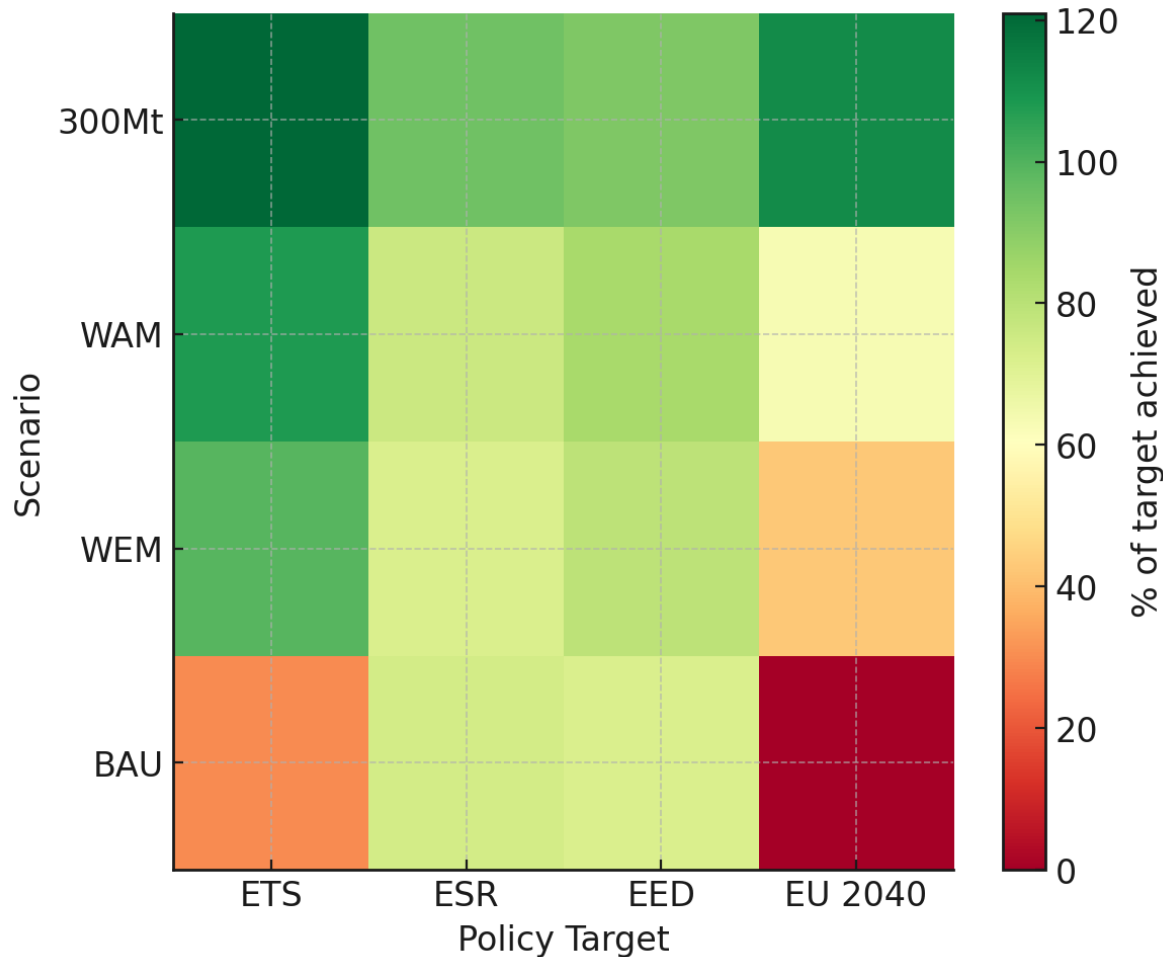
iMACC: Sensitivity (Low Gas & High Biofuel price)



iMACC: Sensitivity (Compliance)



iMACC: Sensitivity (Compliance)



Over-achievement of EU policy target

Under-achievement of EU policy target

ESR target assumes Agriculture sector meets WAM EPA trajectory
WEM and WAM scenarios are derived from EPA modelling

Conclusions and Key Takeaways

Conclusions

- Transparent, flexible, replicable
- Cost-effective mitigation is met through renewable electricity, and electrifying end uses. These are critical to remain within carbon budget shown.
- We are moving in the right direction but not fast enough, placing 2050 targets at risk.
- Realising full savings requires needs rapid scaling of all these measures e.g. All New car sales electric by 2029.
- The largest measures are already economical, but face barriers.
- Easy to model – hard to do!
- Simple communication tool but cannot inform:
 - What barriers & how to remove them?
 - Who pays? Who benefits?
 - Complexity within measures
 - Non-economic benefits & costs
- **-> not a policy design tool**
- MACC is typically used to inform incremental change, where there are a large range of choices and a long planning horizon
 - the challenge is no longer to identify low-cost opportunities, but to avoid all emissions at the lowest cost possible.
 - Risk that sensitivity is confused with uncertainty and delays action



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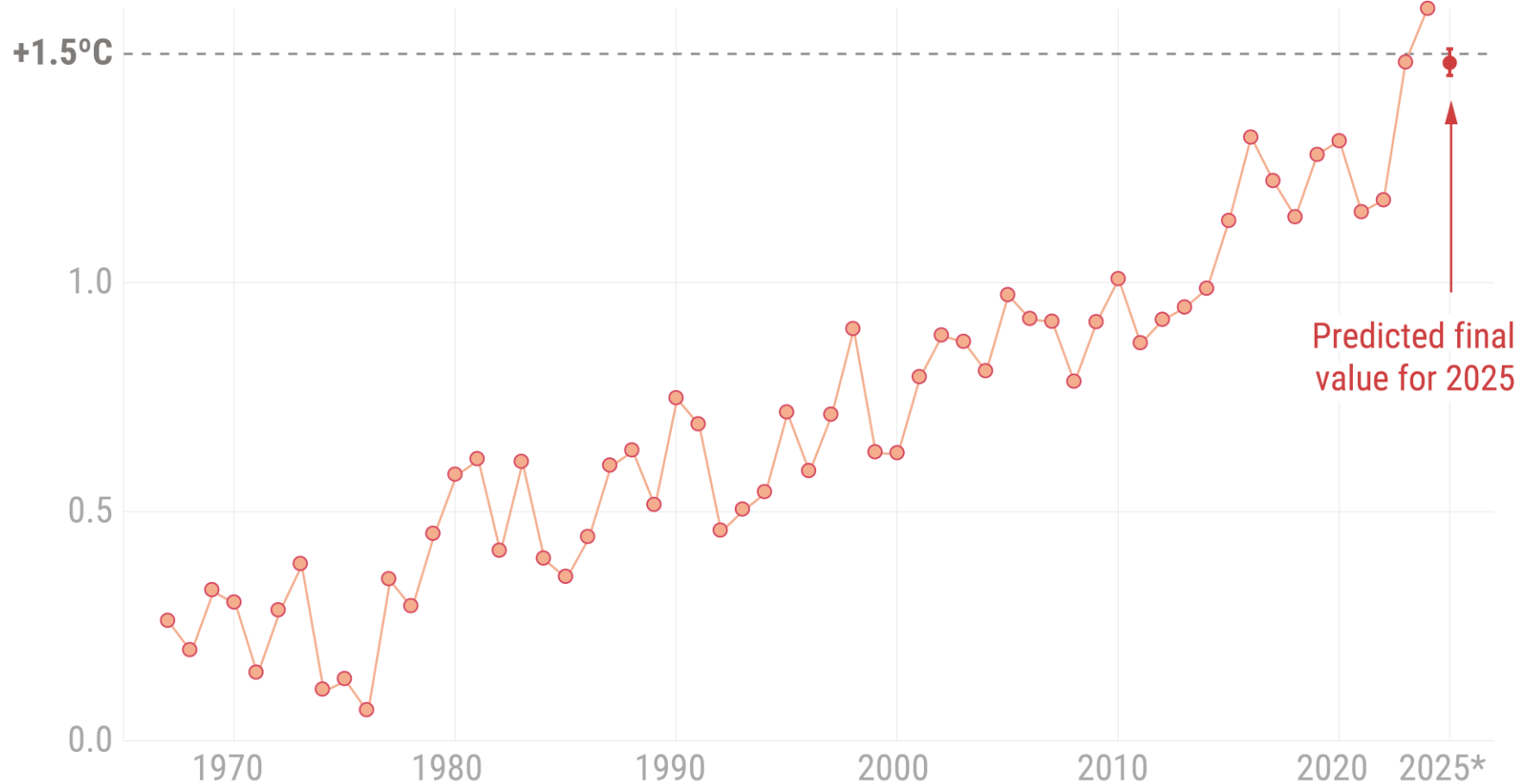


Beyond Net-Zero

Dr Róisín Moriarty

2025 projected to finish as 2nd or 3rd warmest year on record

Annual global surface air temperature increase above pre-industrial level



Predicted final value for 2025

Data: ERA5 • Credit: C3S/ECMWF

*Provisional estimate based on 10 months (Jan-Oct)



PROGRAMME OF THE EUROPEAN UNION



IMPLEMENTED BY



International impacts



World Weather Attribution

National impacts



Paris Agreement



Article 2.1(a) Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;

Article 4.3 Each Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

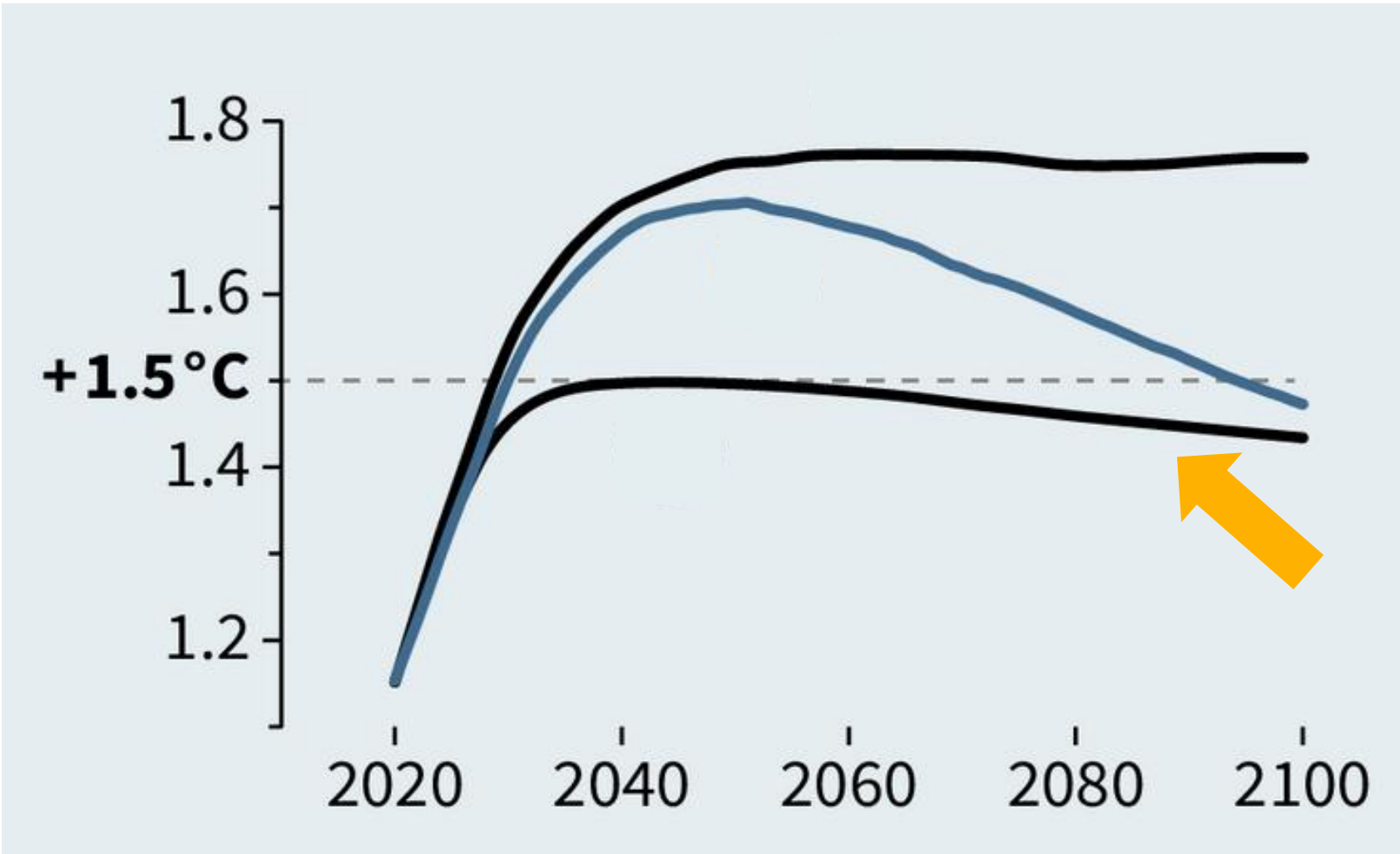
ICJ: Advisory Opinion



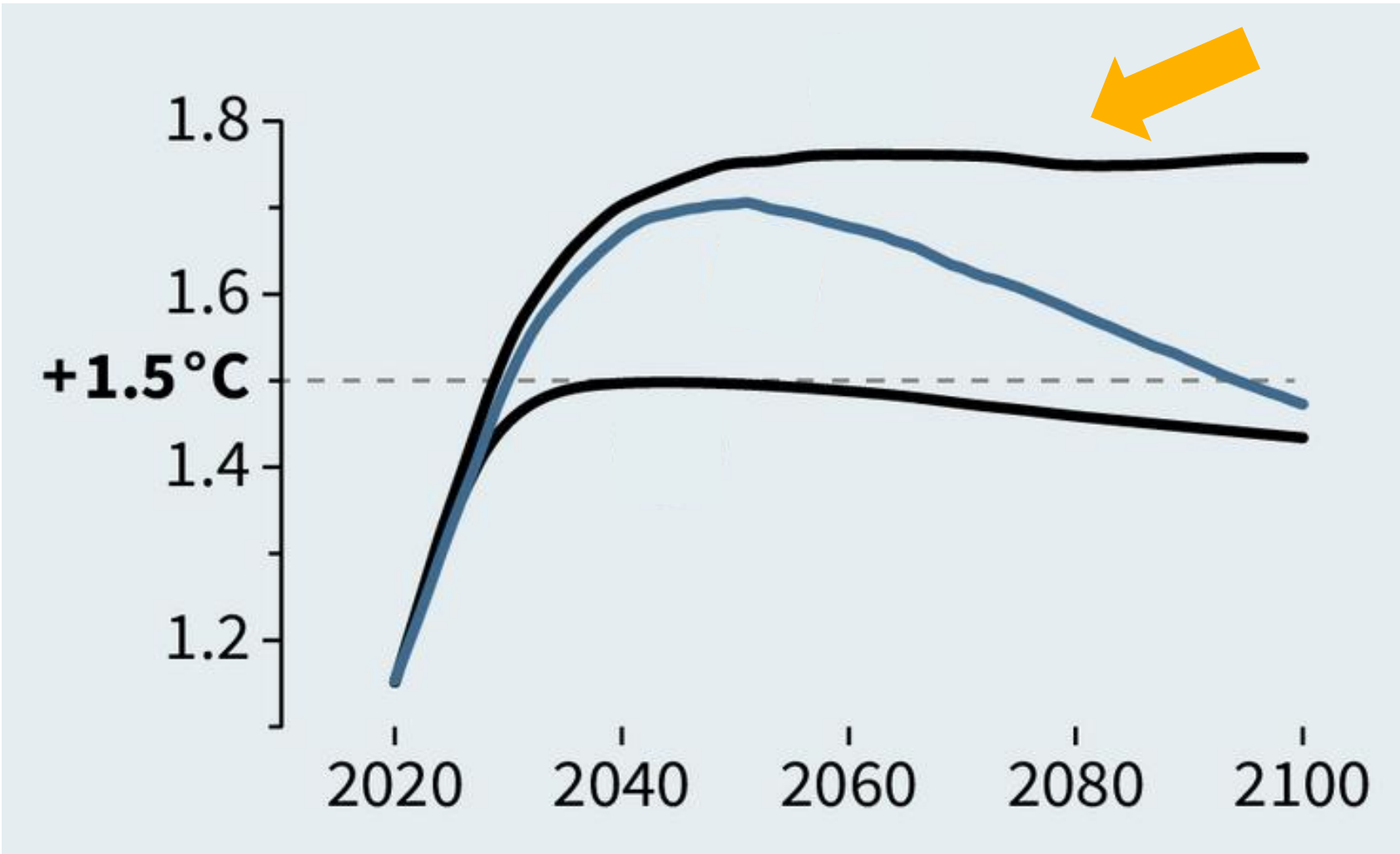
Paragraph 224. As a general matter, the Court notes that while the Paris Agreement provides for limiting the global average temperature increase to well below 2°C above pre-industrial levels as a goal and 1.5°C as an additional effort, 1.5°C has become the scientifically based consensus target under the Paris Agreement.

Paragraph 242. Second, a party's NDCs must reflect "its highest possible ambition". While this term is not defined in the Paris Agreement, the Court considers that the level of ambition to be reflected in a party's NDCs has not been left entirely to the discretion of the parties. The provision, when interpreted in its context and in light of its object and purpose and the customary obligation to prevent significant harm to the environment, reveals that the content of a party's NDCs must, in fulfilment of its obligations under the Paris Agreement, be capable of making an adequate contribution to the achievement of the temperature goal. ...

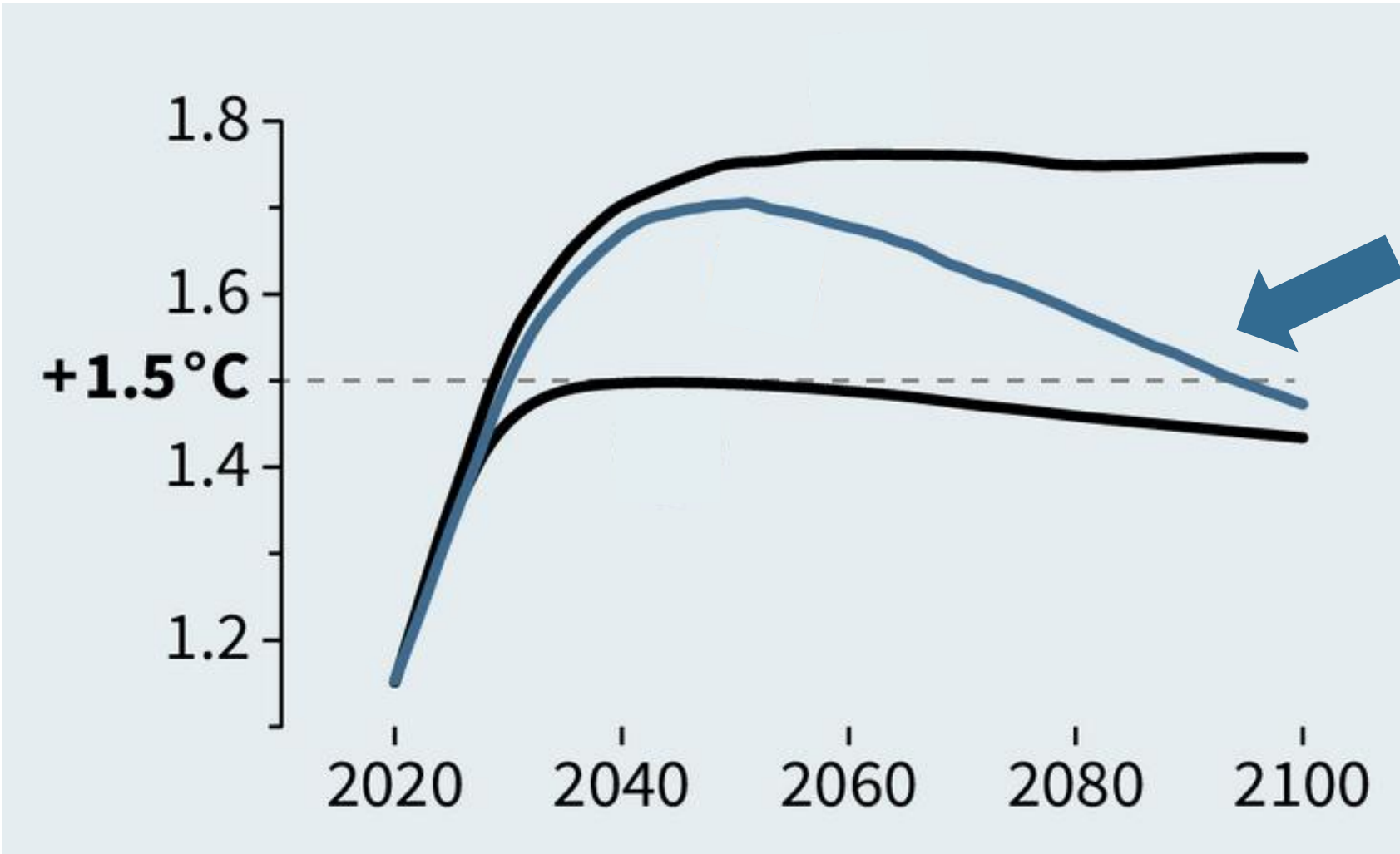
Keeping 1.5 °C in reach



Keeping 1.5 °C in reach



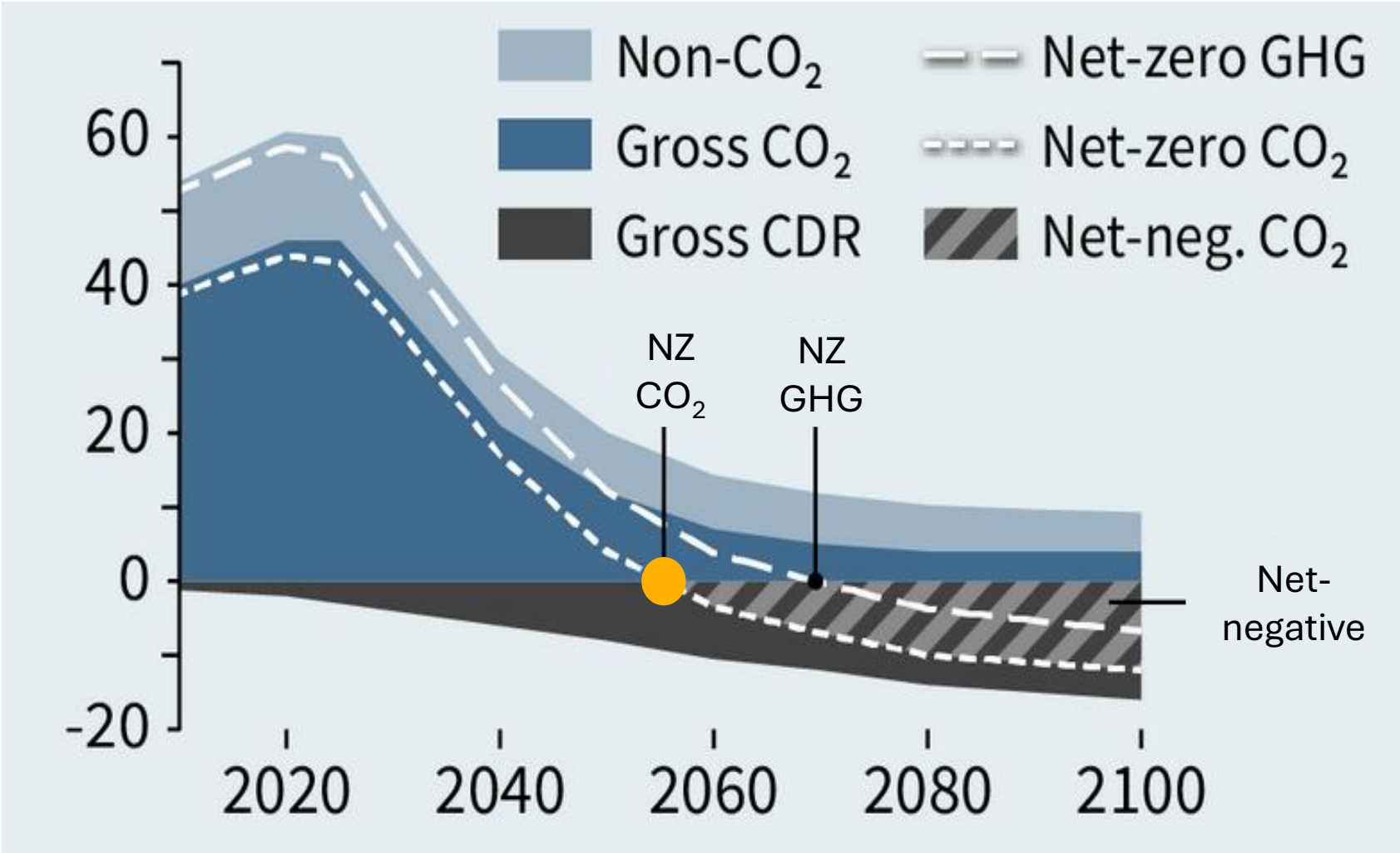
Keeping 1.5 °C in reach



Temperature overshoot

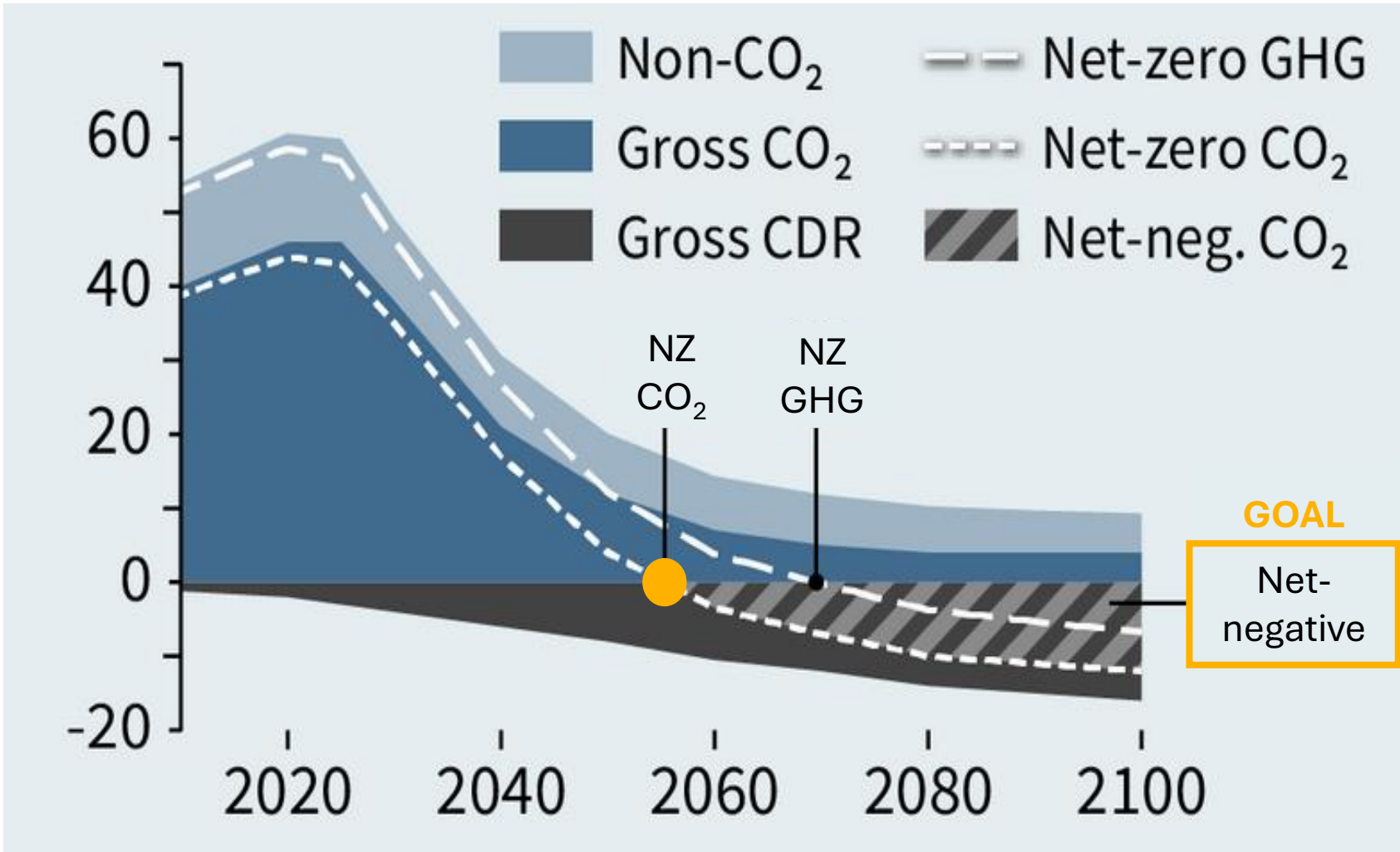
- > peak warming asap
- > limit amount of time above 1.5°C

Keeping 1.5 °C in reach



To halt global warming > global net CO₂ emissions reach zero

Keeping 1.5 °C in reach



- > To halt global warming
- > global net CO₂ emissions reach zero
- > Subsequent decline in global warming
- > net negative CO₂ emissions
- > total removals is greater than residual emissions of all long-lived GHGs
- > Reducing CH₄ would limit peak warming

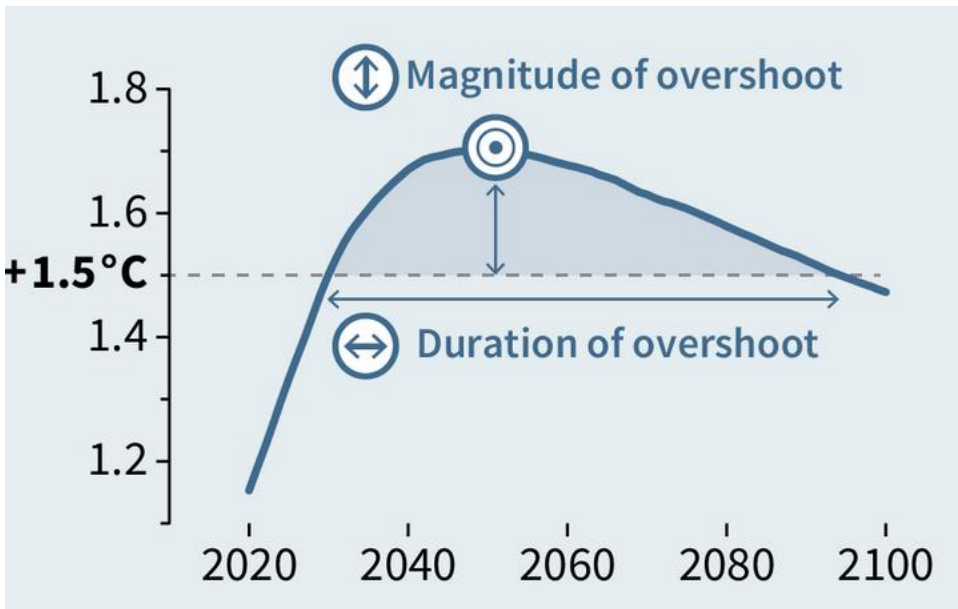
Overshoot of the 1.5 degree global temperature goal means that **net-zero** has become a **milestone**, on the way to **sustained net-negative emissions**, rather than the endpoint.

What we do now matters!



ICJ Advisory Opinion

- > far reaching legal and political consequences for at national level
- > states have legal obligations under the Paris Agreement
 - > in principle can be held liable if adequate action is not taken



Near-term GHG reductions

- > reducing CO₂ emissions to net-zero asap on the way to net-negative
- > substantial reductions in CH₄ emissions contribute to limiting peak warming

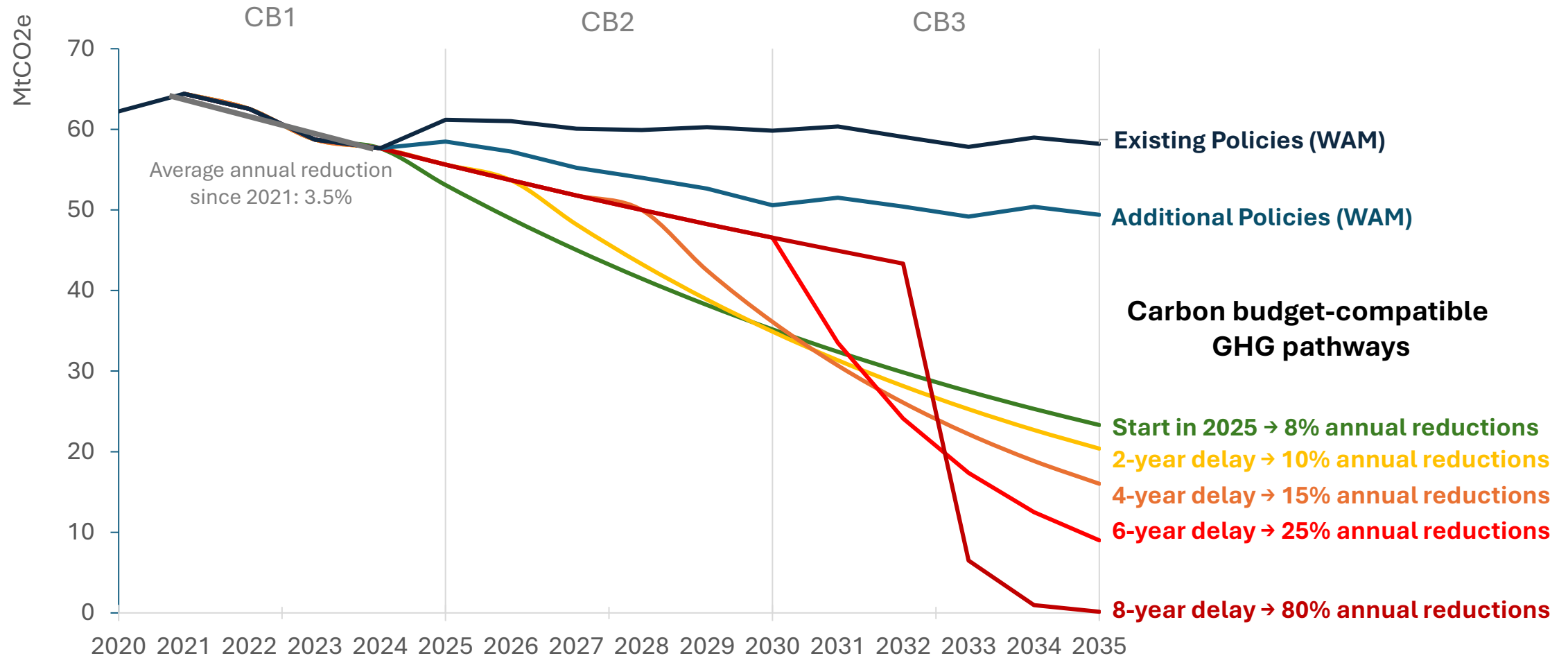
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Why we're still ignoring the physics of climate change

Professor Hannah Daly

Ireland's emissions: Planned path vs. legal and physical limits



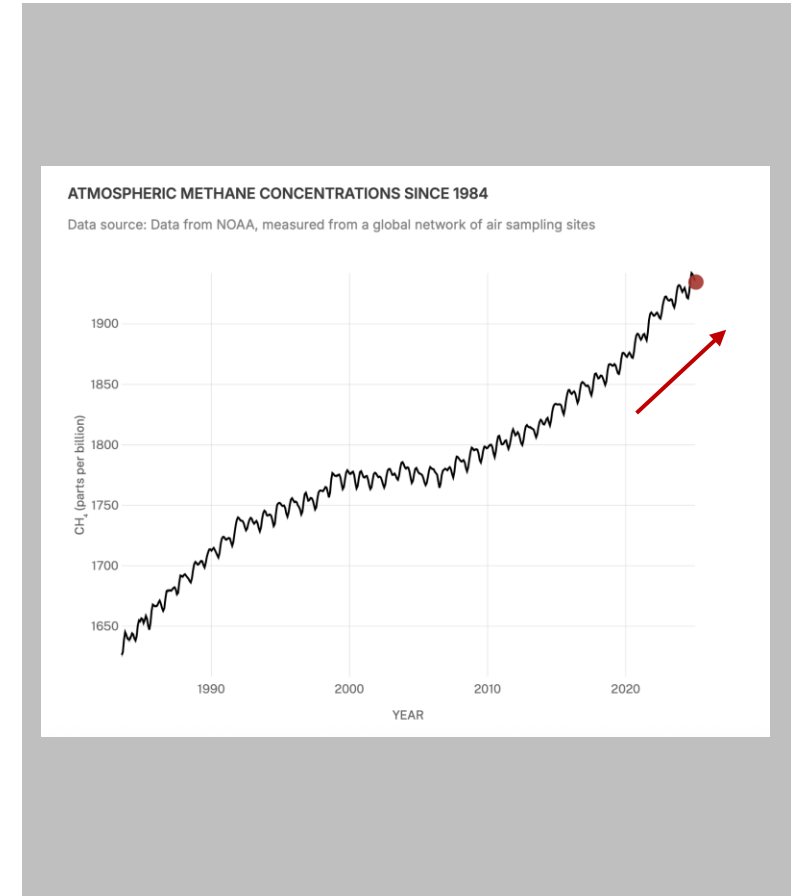
Where we are ignoring the physics



**Data centres &
gas lock-in**



**Airport expansion &
emissions**



**“No additional warming”
hiding warming**

*Every bit of warming
Every year
Every choice*

MATTERS.

ipcc

INTERGOVERNMENTAL PANEL ON climate change



WMO



UNEP

Panel Discussion

Session 1: Climate Action



Chair: Dr Jeanne Moore

Policy Analyst at National Economic and Social Council

Panel Members

- Prof Brian Ó Gallachóir
- Dr Tomas Mac Uidhir
- Dr Róisín Moriarty
- Prof Hannah Daly

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Short Break (20 mins)

Session 2 Energy Security



Chaired by Dr Ellen Diskin

Head of Net Zero Strategy & Sustainability at ESB Customer Solutions

Including the following presentations

- 1. Energy Transition system Readiness by Dr Fionn Rogan**
- 2. Electricity Pricing by Dr Paul Deane**
- 3. Exploring Energy Justice in Ireland by Jeanne Spillane**
- 4. Community Benefit Funding and Ireland's Energy Transition by Dr Evan Boyle**

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Energy Transition System Readiness

Dr Fionn Rogan



Is District Heating a cost-effective solution to decarbonise Irish buildings?

Jason Mc Guire ^{a b}  , Stefan N. Petrović ^c, Hannah Daly ^{a b}, Fionn Rogan ^{a b}, Andrew Smith ^{a b}, Olexandr Balyk ^{a b d}


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<https://doi.org/10.1016/j.energy.2024.131110>

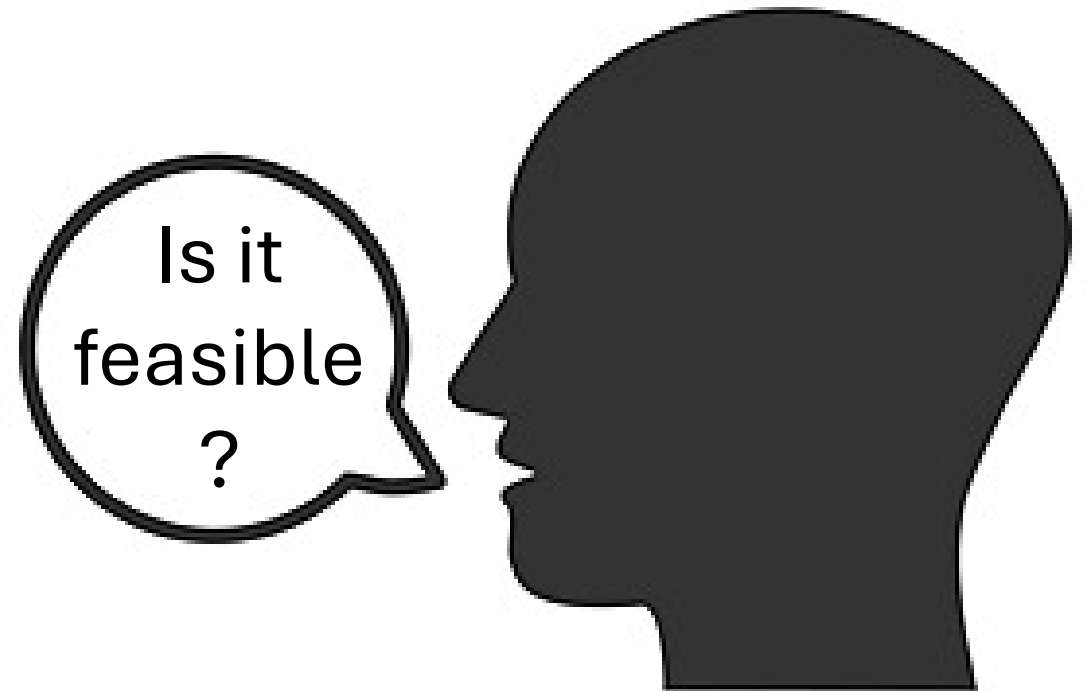
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Highlights

- District heating in Ireland can reduce marginal CO₂ emission prices by 13%–25%.
- District heating can cumulatively save €17.2 billion compared to no district heating.
- Regional energy policy is needed to align with cost-optimal pathways.
- Regional supply and demand quantified sensitivity analysis strengthens insights.



What are the non-technical factors impacting roll-out of District Heating?

The poster is a vertical document with a white background and blue and green accents. At the top left, it features the 'Interreg' logo and the European Union flag, with the text 'Co-funded by the European Union' and 'North-West Europe'. Below this is the project acronym 'RODEO'. A central green banner contains the title 'Rolling Out District Heating and Cooling (DHC) Extensively to home Owners' and an 'Energy transition' icon. A photograph of blue pipes in a trench is positioned below the banner. A blue box on the left contains a map of Europe with a red dot. To the right of the map, it lists '10 partners from BE, FR, IE, NL Cooperating from 2025 - 2029'. Below this, a table shows 'EU funding € 3,1 million' and 'Total project budget € 5,1 million'. The bottom section, titled 'Objectives', describes the project's goal to overcome economic barriers to DHC by using a participative business model in four pilot cities. The website 'rodeo.nweurope.eu' is at the bottom.

Interreg  Co-funded by the European Union
North-West Europe

RODEO

Rolling Out District Heating and Cooling (DHC) Extensively to home Owners

 Energy transition

 **10 partners from BE, FR, IE, NL**
Cooperating from 2025 - 2029

EU funding € 3,1 million	Total project budget € 5,1 million
------------------------------------	----------------------------------------------

Objectives
District Heating and Cooling (DHC) is a major tool for the energy transition of city neighbourhoods, featured in many local climate plans. However, there are economical barriers to developing grids. RODEO breaks down these barriers by introducing a more participative business model that rebalances the costs, benefits and risks of developing DHC. The project will validate this innovative co-creative model in 4 pilot cities.

rodeo.nweurope.eu

Rolling Out District Heating & Cooling (DHC) Extensively to home Owners [RODEO]

**Project Partner
Meeting, 25-27th Nov**



*Dublin,
Ireland*



*Oostende,
Belgium*

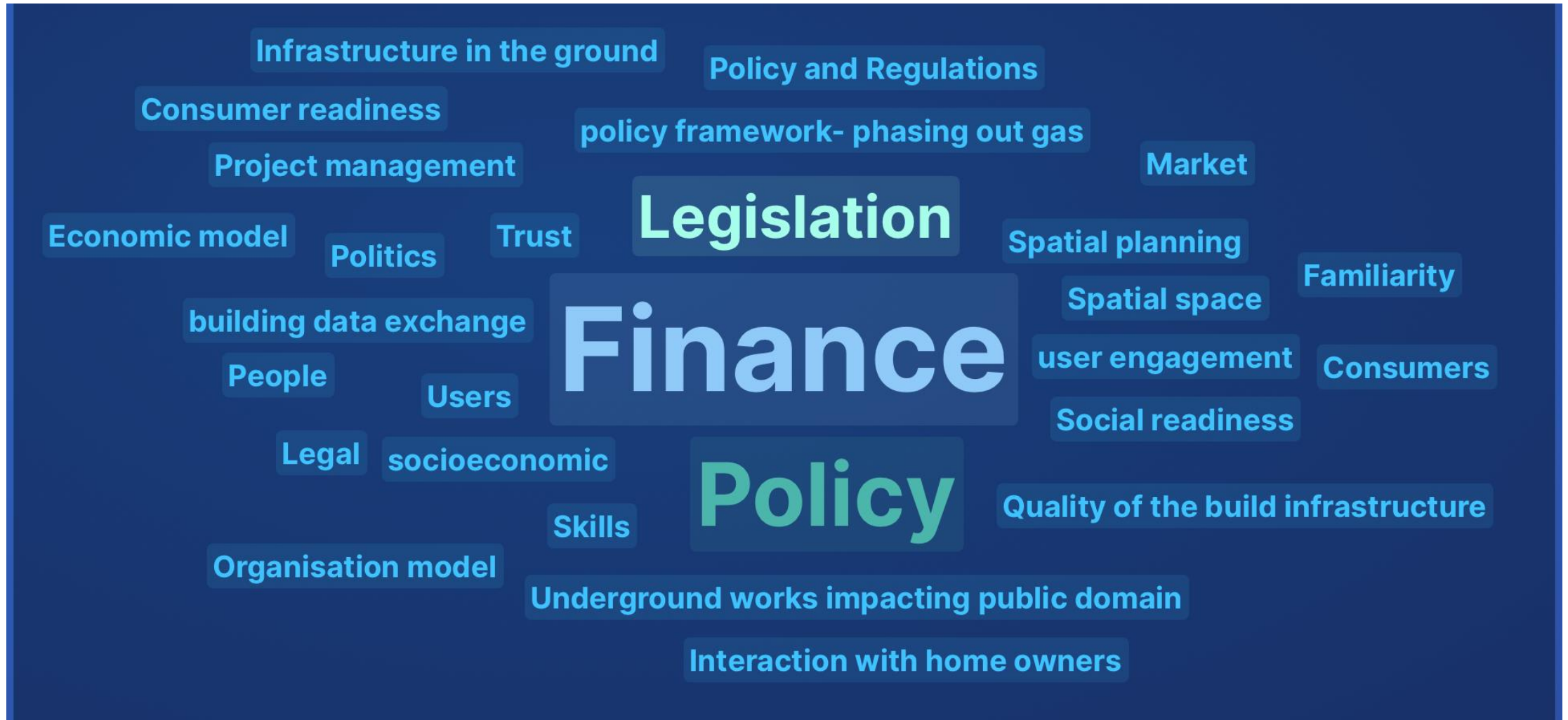


*Dunkerque,
France*

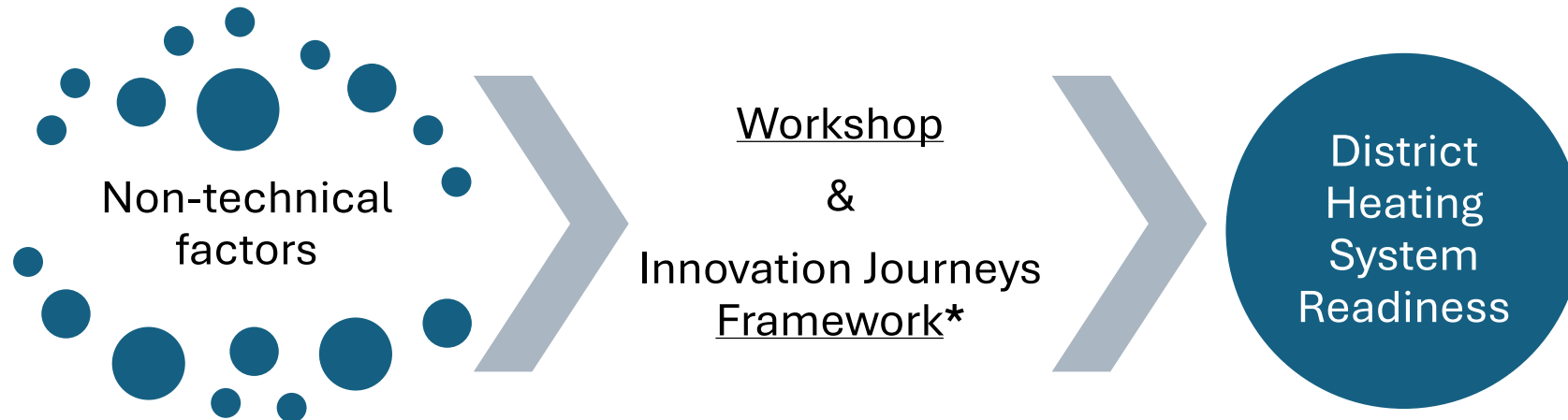


*Assen,
Netherlands*

What are the non-technical factors impacting roll-out of District Heating? [RODEO PROJECT]



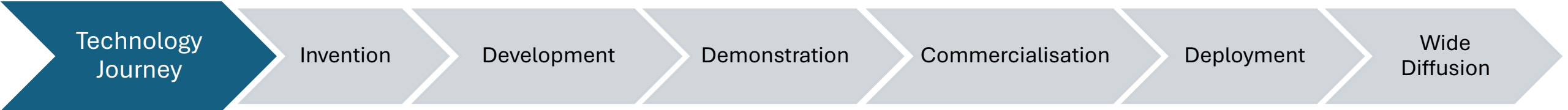
What are the non-technical factors impacting roll-out of District Heating? [DATA→INSIGHTS]



***Source:** (Grubb, McDowall & Drummond, 2017)

What are the non-technical factors impacting roll-out of District Heating? [WORKSHOP]





The diagram illustrates a six-stage technology journey process. It begins with a dark blue arrow labeled 'Technology Journey' pointing right. This is followed by five light grey chevron-shaped arrows, each containing a stage name: 'Invention', 'Development', 'Demonstration', 'Commercialisation', and 'Deployment'. The final stage is 'Wide Diffusion', which is contained within a light grey arrow that tapers to a point on the right. The entire process is represented as a continuous horizontal flow.

Technology
Journey

Invention

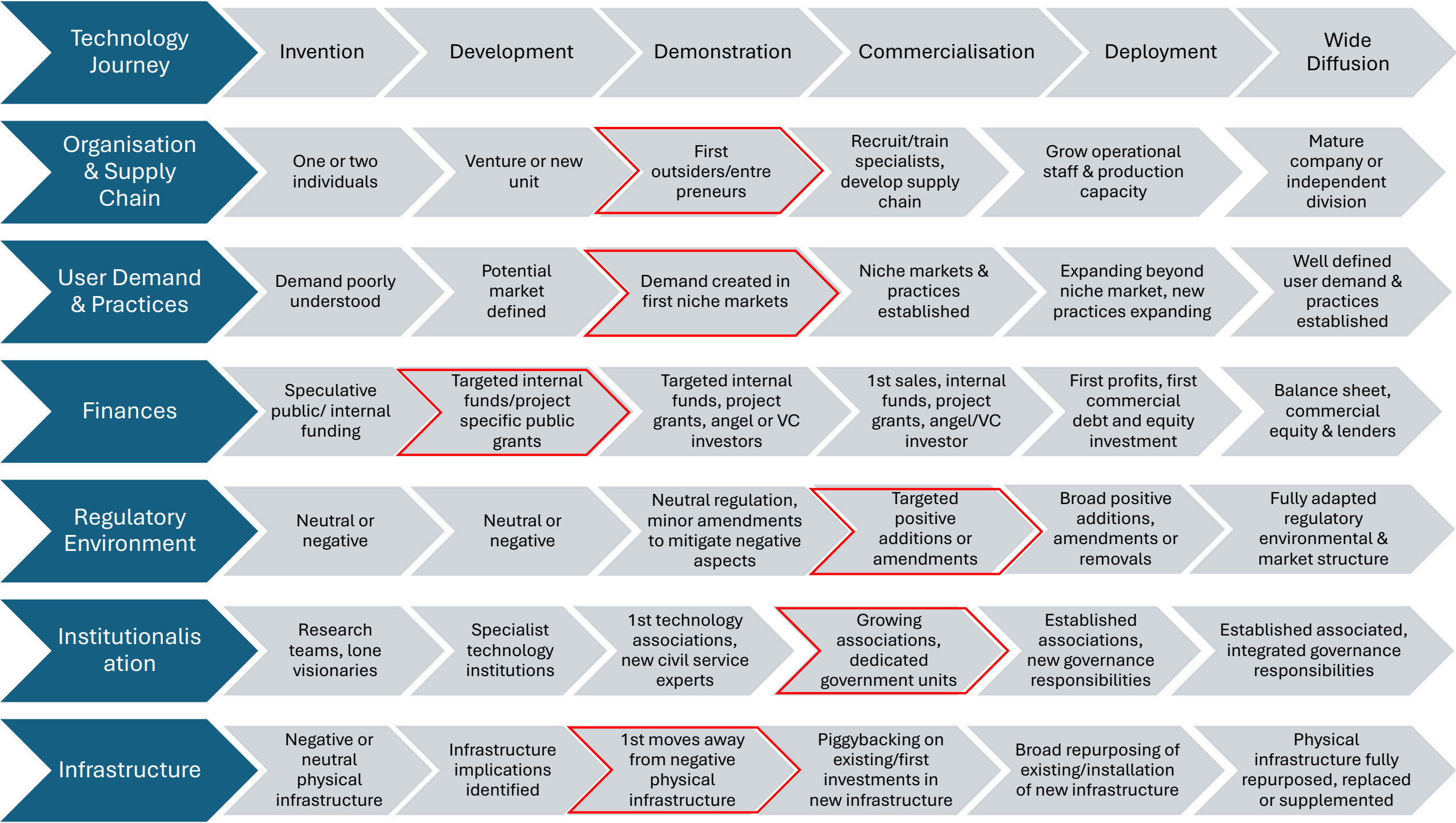
Development

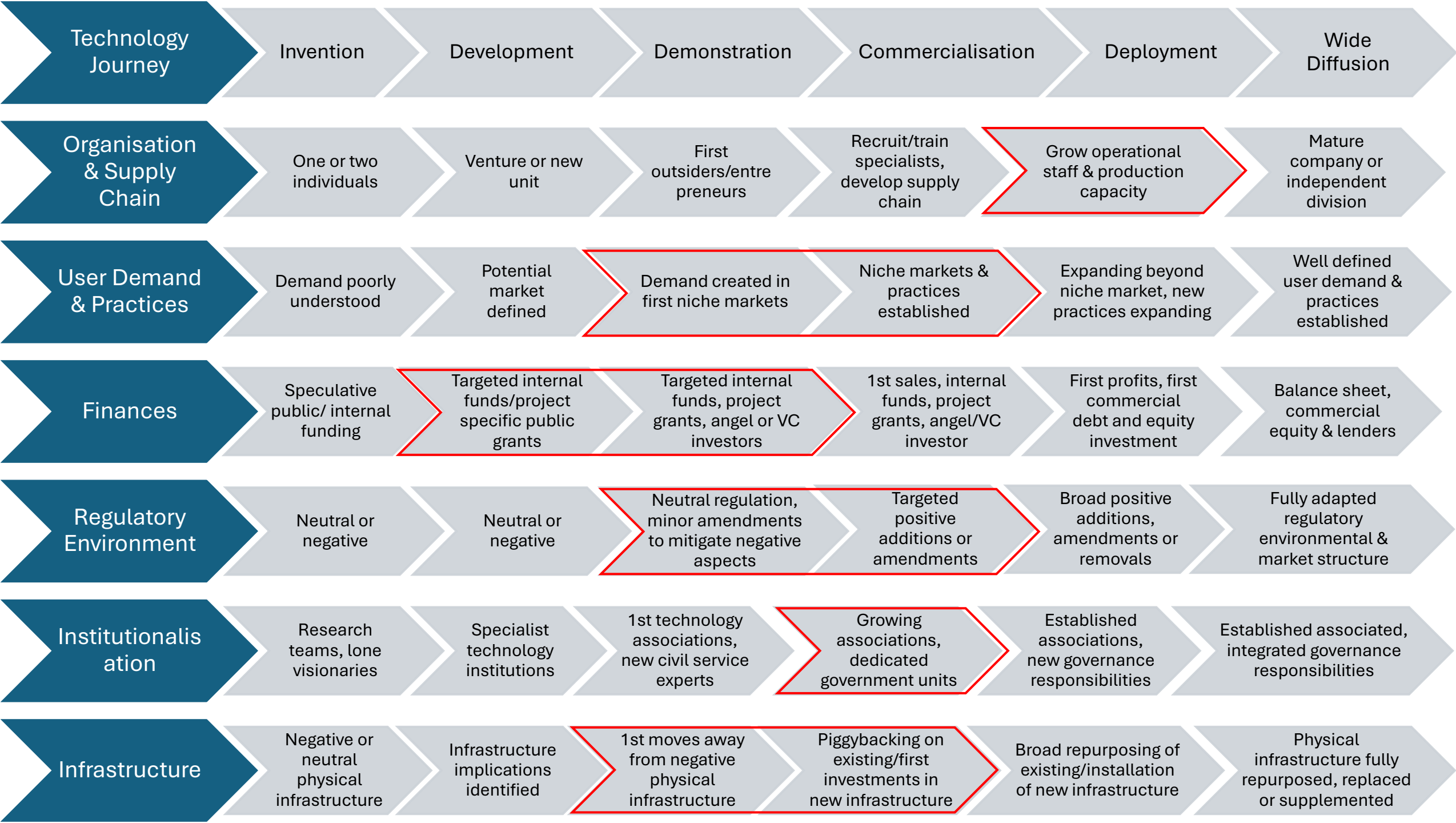
Demonstration

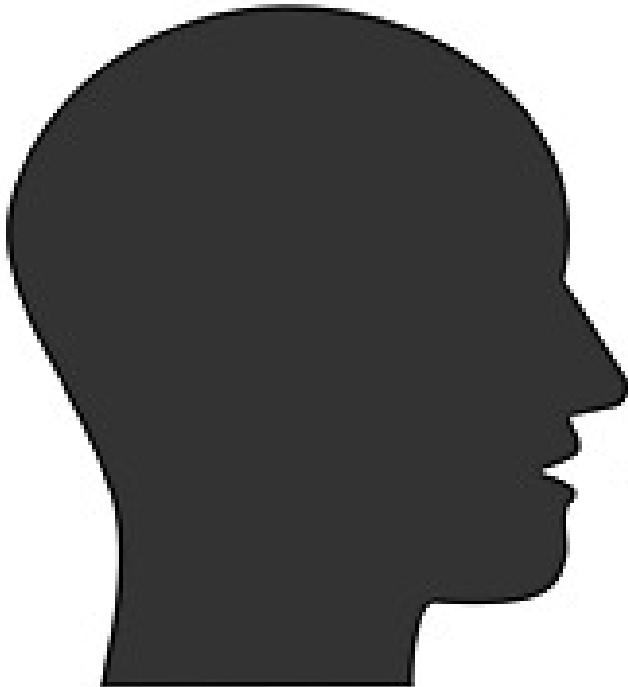
Commercialisation

Deployment

Wide
Diffusion

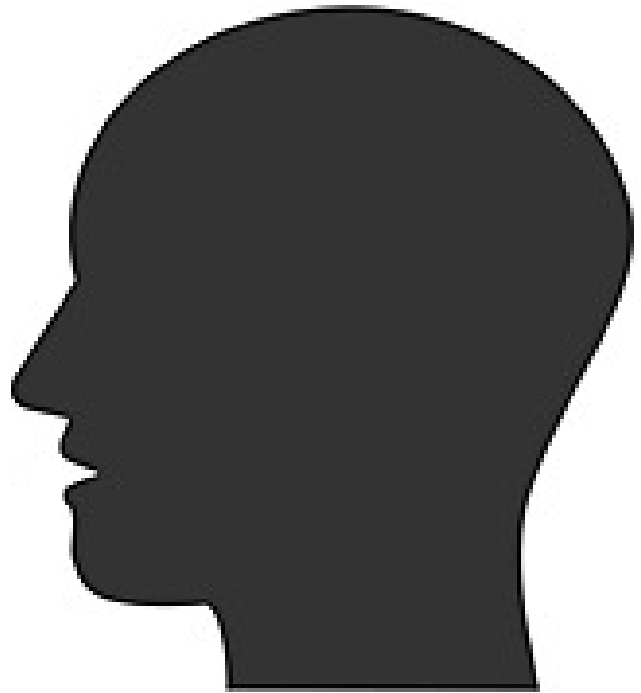






Is it
feasible
?

See you at Energy
Transition System
Readiness Workshop!




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Electricity pricing

Dr Paul Deane

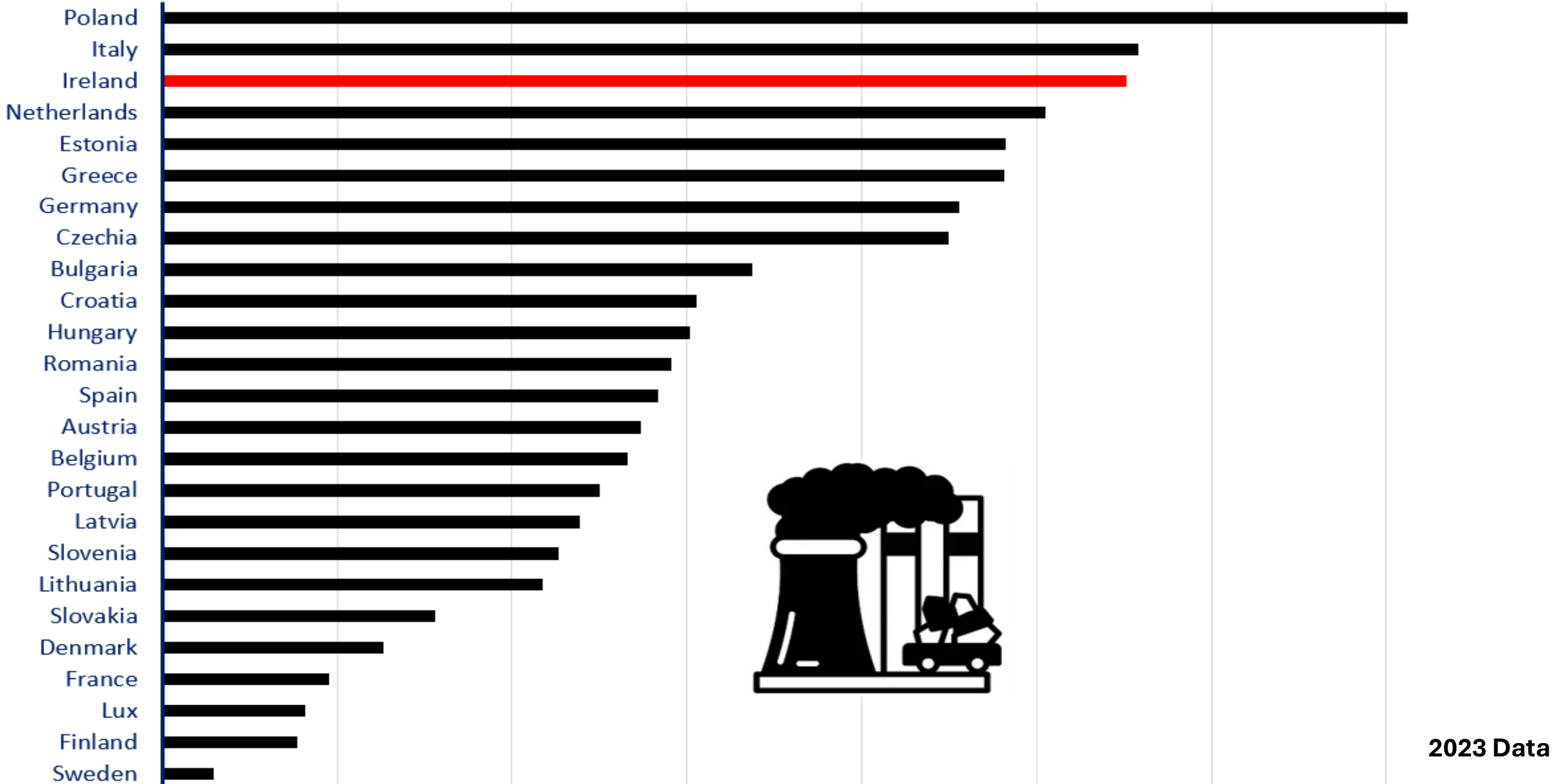


Electricity bills in Ireland are higher than other EU countries because:

- 1) it costs more to make electricity in Ireland and
- 2) it also costs more to move it around

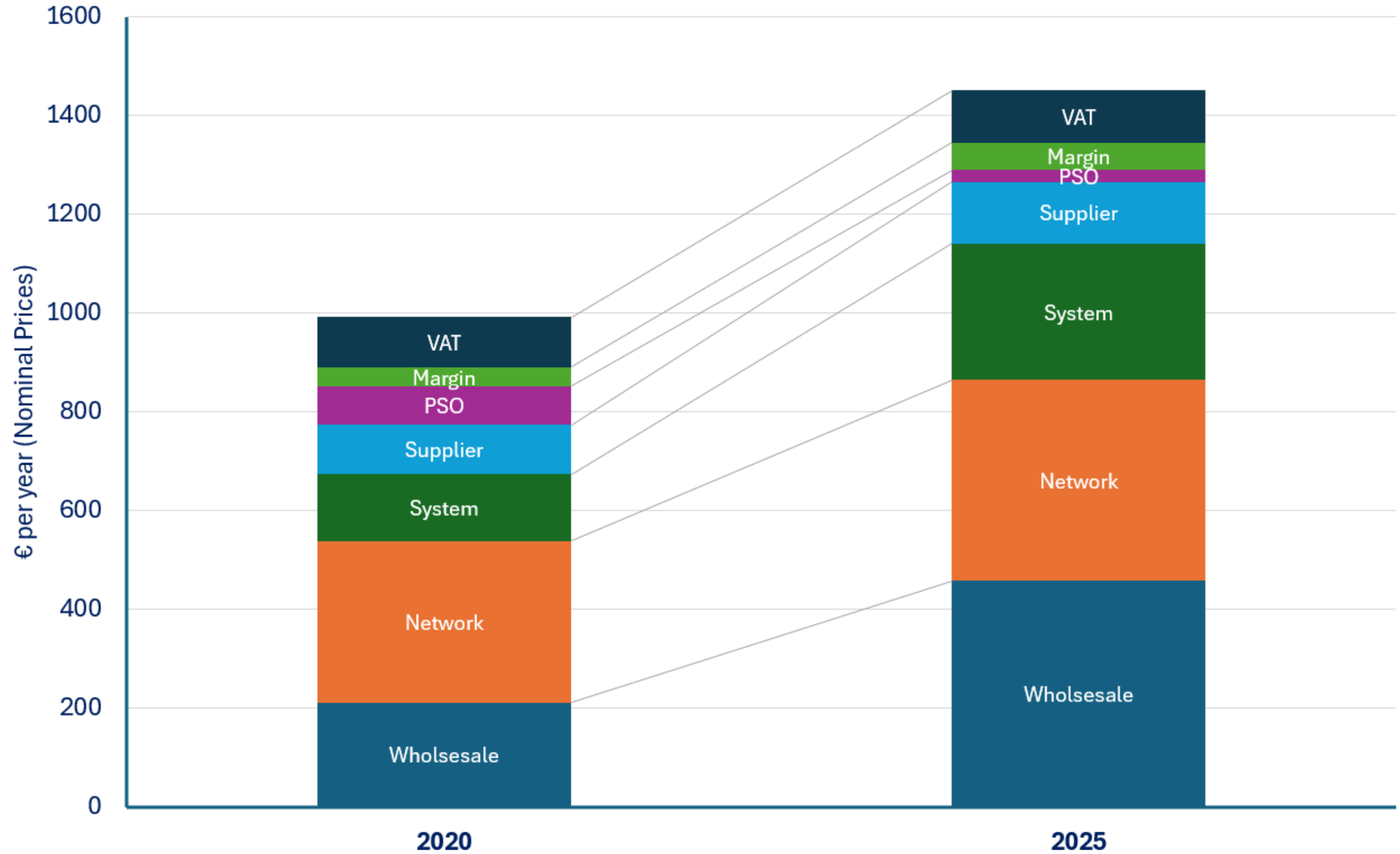
% of Fossil Fuels in Electricity Generation

0% 10% 20% 30% 40% 50% 60% 70% 80%



2023 Data

Sample Residential Annual Electricity Bill



Question we asked for 2030



“Will the cost of suppling electricity to the market increase or decrease if we have more renewables”

We looked at an 80% RES-E Scenario

We looked at an 68% RES-E Scenario

We looked at an 54% RES-E Scenario

2024 Commodity Prices are assumed for all scenarios

Electricity demand is the same for all scenarios

	2024 40% RES-E	54% RES-E	68% RES-E	80% RES-E
Annual Wholesale System Price (€/MWh) (A)	108	105	81	54
Estimated Top requirement (€/MWh) (B)	-	4	18	45
Resulting Energy Supply Price (€/MWh) (A+B)	108	109	99	99

Commentary on Future Electricity Prices



Looking to the future, there is little evidence to suggest that residential electricity prices will be significantly lower than today.

The narrative that electricity will be ‘cheap’ in the future as we move to a renewable system creates a false expectation because it overlooks the fact that as the cost of generating electricity reduces (likely to levels similar to today’s wholesale price), the costs of moving greater volumes of electricity will increase to finance extra network infrastructure.

Policymakers instead should focus on the natural characteristic of a well-planned renewable system which can deliver affordable, clean, and secure electricity in contrast to cheap, polluting, and volatile power prices.

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Exploring Energy Justice in Ireland

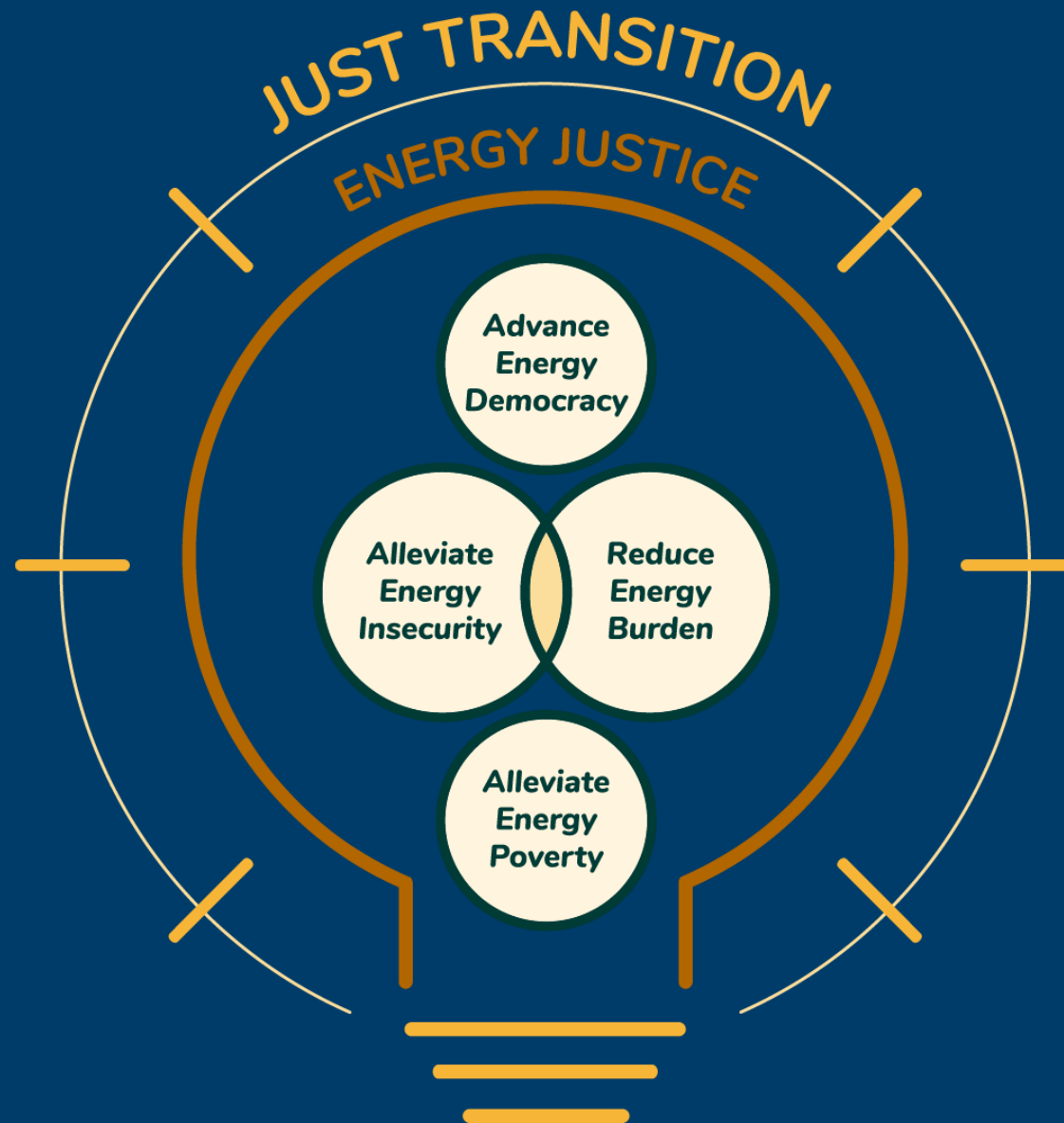
Jeanne Spillane

Exploring Energy Justice in Ireland

Background

- Extensive literature on energy poverty in Ireland, though definition and measurement are still contested
- Just Transition enjoys a growing focus in the Irish policy landscape
- Limited exploration of energy justice in an Irish context

“combines a social science perspective on energy (policy) with a natural science perspective (systems) and takes a whole systems approach to question how the positive and negative impacts of the energy transition are distributed, and those affected are recognised and included.”



Benefits of Solar

- Making lives better in tangible ways
- Reduced Energy Bills
- FIT payments
- When paired with battery – can improve flexibility and resilience
- Improved Air Quality
- Help Reduce Emissions

Energy Justice Implications

- National support schemes for those in energy poverty in Ireland don't include solar PV
- Grant for solar PV – must own home and high initial cost

Explore

- Socioeconomic implications
- Geographical implications

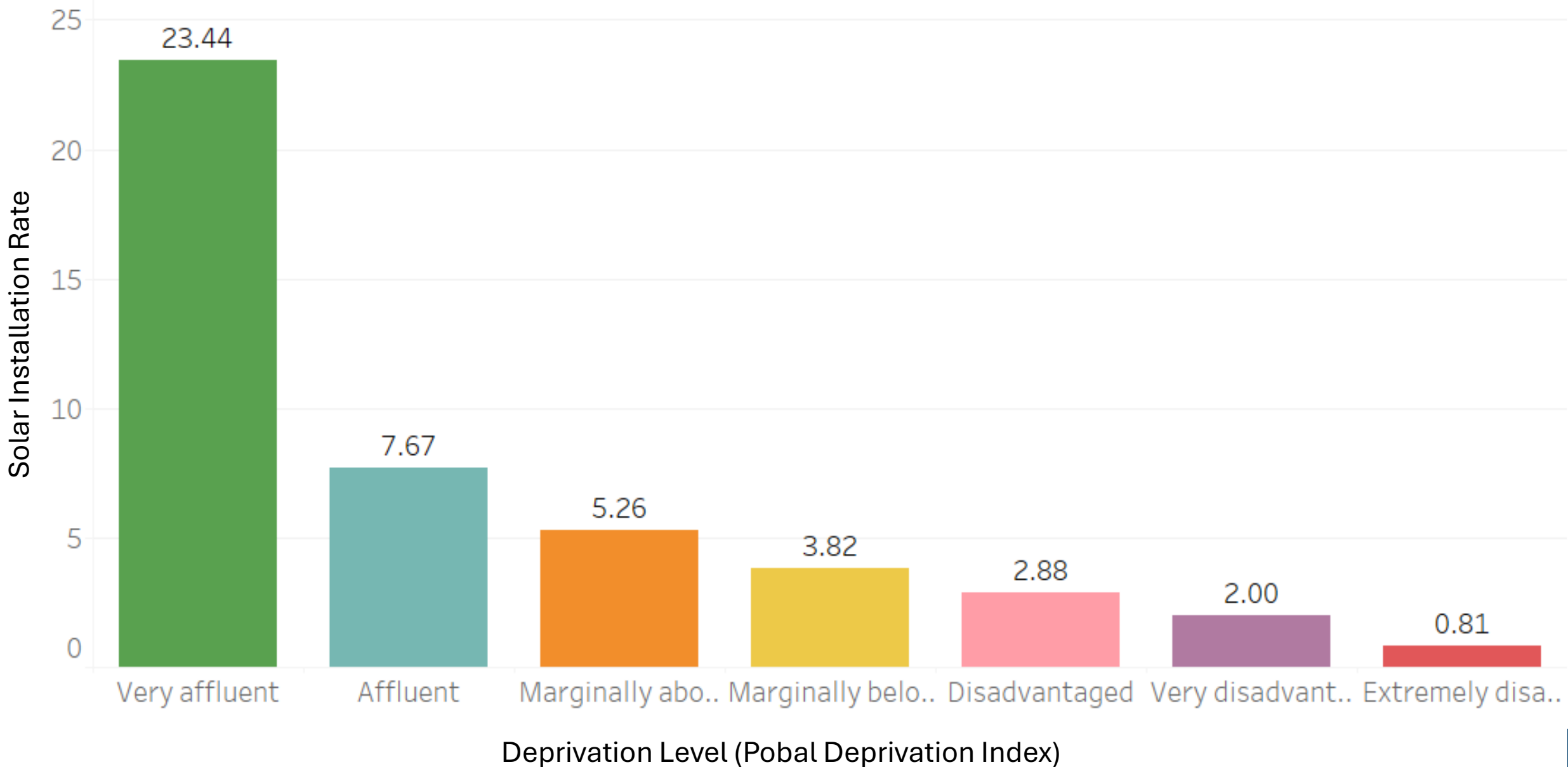
Methodology

Mixed methods research

Quantitative - merged three datasets

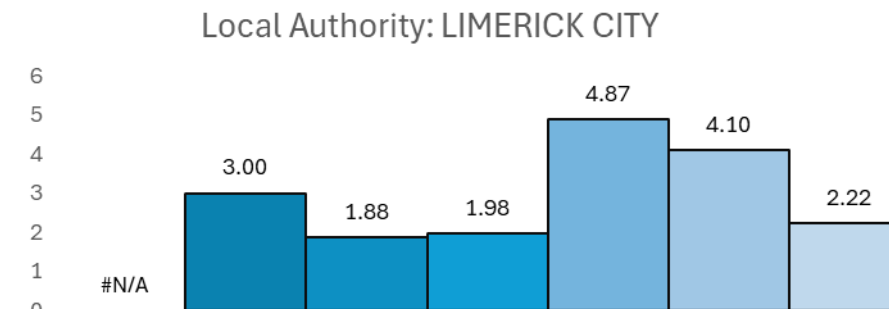
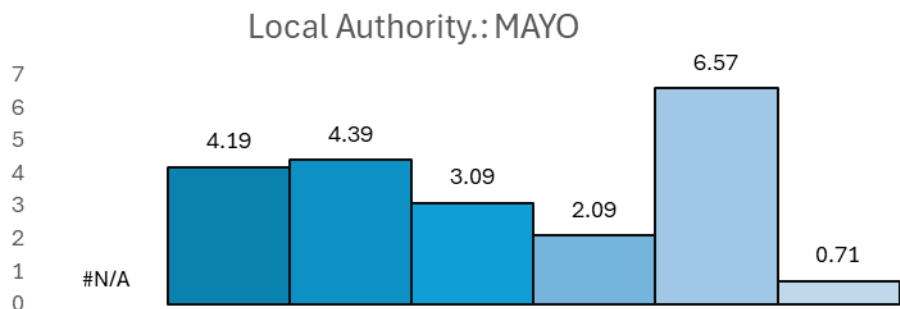
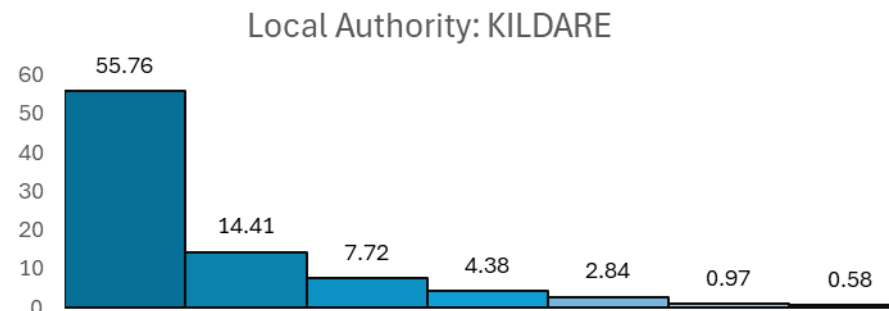
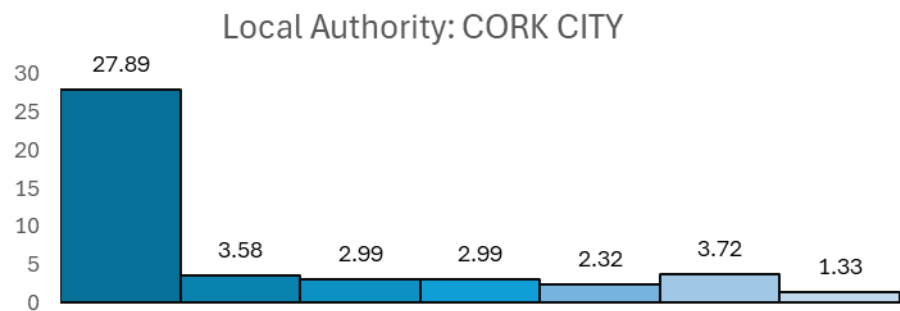
- CSO SAPS data
- Pobal Deprivation Index
- SEAI data on Solar Installations from LACAP database

Average Rate of Solar Installation by Household by Deprivation Level Nationally



Average Rate of Solar Installation by Household by Deprivation Level By County

Solar Installation Rate



Deprivation Level (Pobal Deprivation Index)

Main Findings

- National figures show a clear negative correlation between levels of deprivation and domestic solar installations
- More variation at a local level



Next Steps – explore this variation

- Qualitative Approach
- Interviewing key stakeholders working at county and regional levels
- Exploring perspectives on local and regional policies and processes that may help explain the discrepancies
- Are local level actions helping improve energy justice?



Questions or
Comments?

Please Get In
Touch!

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Community Benefit Funding and Ireland's Energy Transition

Dr Evan Boyle

The Opportunity Ahead

If Ireland is to address the delays in infrastructure development, it is crucial to ensure that the community benefits from renewable energy projects are both substantial and meaningful. This could lead to new engagement opportunities, such as fostering trust, equity, and community capacity to meet Ireland's energy and sustainability goals. The transfer of €1 billion to communities over the 15-year lifetime of projects within 2030 targets has transformative potential.

Projected RESS Community Benefit Funding from 2030 Targets

	Target by 2030 GW installed	GW currently installed	GW installed from 2025	MWh per annum	Total CBF over 15 years
Solar PV	8	1.8	6.2	5,974,320	€179,229,600
Onshore Wind	9	5	4	10,512,000	€315,360,000
Offshore Wind	5	0	5	17,520,000	€525,600,000
Total CBF over 15-year lifetime of projects					€1,020,189,600

The Research



Examined and enhanced how communities engage with electricity-grid development and community benefit funds to better align local participation with sustainability goals.

THE IRISH TIMES

Climate Crisis

How can communities benefit from €1bn fund transfer from renewable energy companies?

Community benefit funds are a useful way to enhance public engagement with energy and sustainability and address delays in developing infrastructure

Expand



All solar, onshore wind and offshore wind projects in Ireland must create a commun

Evan Boyle, Alexandra Revez, Aoife Deane and Brian Ó Gallachóir

Thu Nov 27 2025 - 12:04 • 6 MIN READ



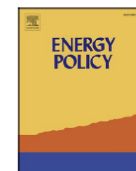
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Energy Policy

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Community benefit funds for energy infrastructure: Paving the way for public engagement and sustainable development?

Evan Boyle ^{a,b,*} , Alexandra Revez ^b , Daniel Carr ^b , Catriona Iulia Reid ^b , Aoife Deane ^b , Brian Ó Gallachóir ^{a,c}

^a Department of Sociology and Criminology, University College Cork, Ireland

^b MaREI Centre for Energy, Climate and Marine, Sustainability Institute, University College Cork, Ireland

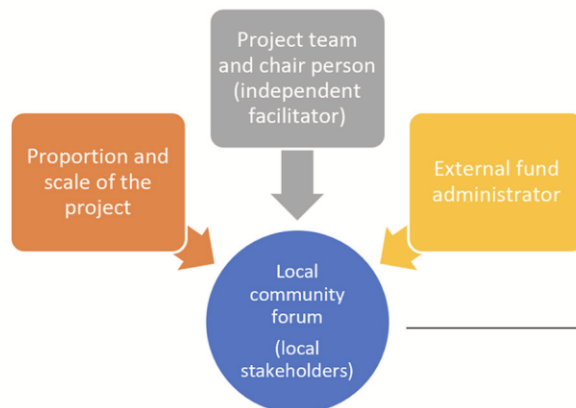
^c School of Engineering & Architecture, University College Cork, Ireland

Insights from EirGrid's Approach

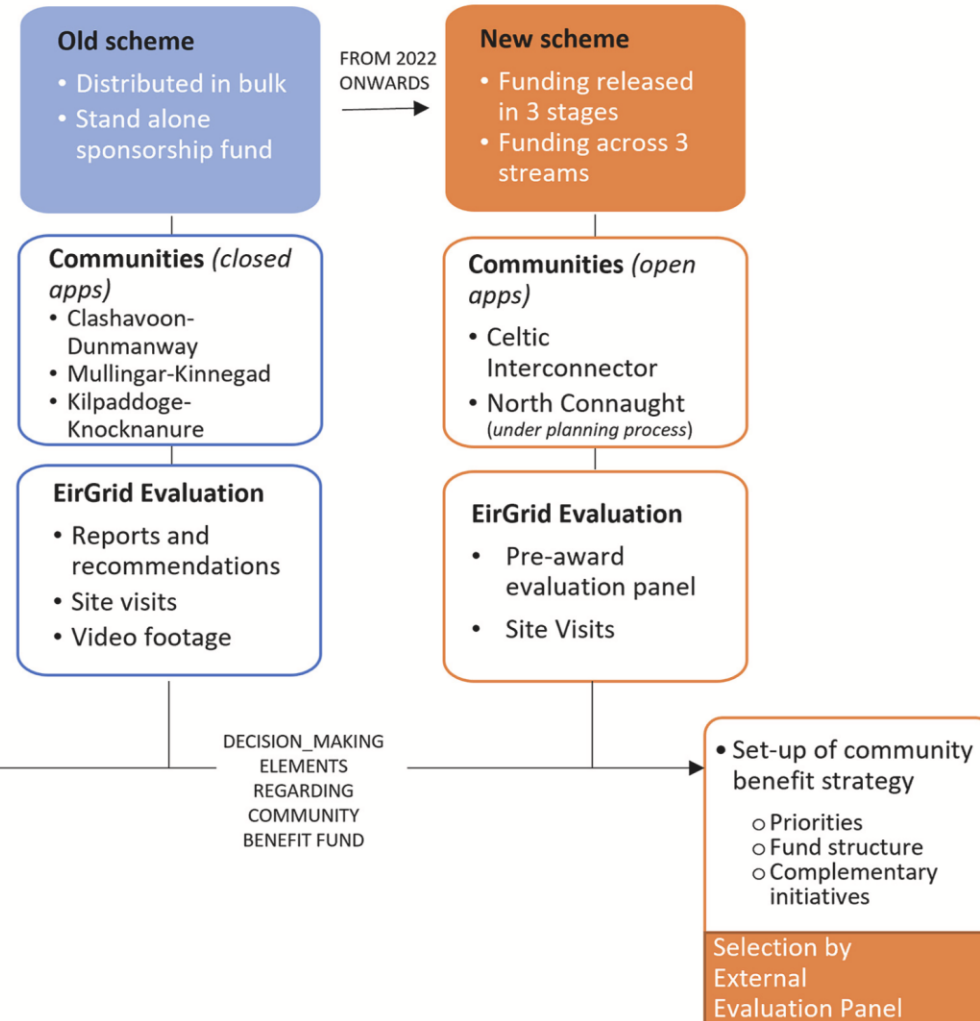
I. SIX STEP CONSULTATION PROCESS

- Step 1 Identifying future needs of the electricity grid
- Step 2 Technological solutions
- Step 3 Best options and areas affected
- Step 4 Identify build locations
- Step 5 The planning process
- Step 6 Construction, energization and benefit sharing

III. COMMUNITY FORUM



II. COMMUNITY BENEFIT FUND



FUND BECOMES LIVE UPON PLANNING PERMISSION

FORUM SET-UP FOR PROJECTS THAT QUALIFY FOR A COMMUNITY BENEFIT FUND

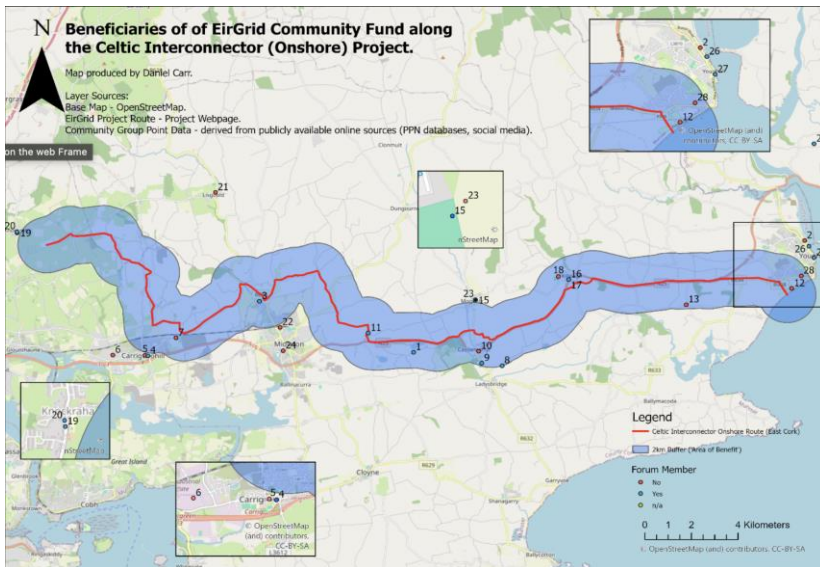
DECISION MAKING ELEMENTS REGARDING COMMUNITY BENEFIT FUND

Insights from EirGrid's Approach

	Case 1- CD	Case 2- LK	Case 3- CI
Technology	110kV electricity line	400/110kV substation. 110/38kV substation. New 110kV line. Further upgrades to lines and substations	700 MW high-voltage direct current (HVDC) submarine power cable to France
Geography	West Co. Cork	Co. Kilkenny and Co. Laois	East Co. Cork
Fund Approach	One round of funding, no thematic focus	Three rounds of funding, no thematic focus	Three rounds of funding, three thematic categories
Fund amount available during phase of study	€600,000	€204,600 (of €511,500)	€960,000 (of €2.4 million)
Projects funded during phase of study	36	12	29

- Connecting community benefit funding to **broader sustainability goals** can create shared advantages.
- More supports need for communities to **build their capacity**, including administrative, legal and financial advice alongside knowledge related to the energy transition under way.
- **Community forums** play an important role as a type of public participation approach that includes local stakeholders, such as sports organisations, volunteer groups, and community councils.
- Community sentiment highlighted the important role of expert **fund administration** in supporting groups through the process.
- An internationally recognised approach by EirGrid, with **early engagement and a flexible approach** to working with communities to support them in delivering local projects.

Doesn't readily copy and paste to RESS



- Defining what a “community” is for offshore wind not as clear cut as for grid upgrades
- Fishing is the most clearly impacted industry, but **the potential for opposition** from residents with a view of these new structures should not be underestimated.
- Potential for one “impacted” community to receive funding over another may raise **serious concerns around fairness and equity**, particularly in light of the coastal adaptation challenges which the country will face in the years to come
- Timely learnings are now available based on the approach adopted by EirGrid in terms of the role of community forums to distribute the funds, but **also in involving the communities in decision-making processes.**
- co-ordinated **tracking, monitoring and evaluation** of the impacts of community benefit funds to inform policy and practice over the next decade is needed.

Our Policy Recommendations

- Aligning community benefit funding with wider sustainability objectives represents an opportunity for co-benefits, however, capacity building is needed which should not be led by individual developers alone.
- The establishment of long-term needs analyses for communities located close to infrastructure may support alignment of CBF and wider objectives.
- The development of a network of communities at different stages of accessing and implementing funding can support capacity building.
- Developers should be supported through guidance in relation to best practice on community benefit funding and encouraged to work cross-organisationally to maximise the impact of funds.
- Fund administration has a major role to play in the administration of funds in developing infrastructure needed for the energy transition. Best practice informed approaches should be implemented and support provided to create more service providers.
- If capacity is not built in relation to sustainability and biodiversity at the community level, funding should not be ringfenced for such initiatives and instead remain open to community objectives.

Panel Discussion

Session 2: Energy Security

Chair: Dr Ellen Diskin

Head of Net Zero Strategy & Sustainability at ESB Customer Solutions

Panel Members

- Dr Fionn Rogan
- Dr Paul Deane
- Dr Evan Boyle
- Jeanne Spillane

**Engineers Ireland Wi-Fi
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Password: Engineersguest



Poster Pitches

Building a national integrated model to explore overshoot pathways

Doorgeshwaree Jaggeshar^{1,2}, Róisín Moriarty¹ & Hannah Daly^{1,2}



AIM

Develop a national integrated model (based on the TIMES energy model) that allows the exploration of overshoot pathways, particularly levers associated with reductions and removals across land, energy, agricultural and forest (LEAF) systems.

KEY FEATURES

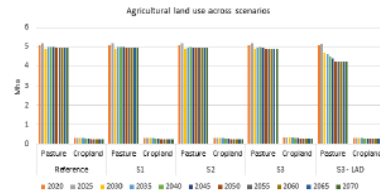
- Integration: energy, agriculture and forest systems linked through shared resources (land, biomass and carbon)
- Land representation & allocation
- Forestry: wood flow via forest area, biomass & harvest flows
- HWP: annual carbon inflows, decay & cumulative stock changes
- Complete CO₂ and non-CO₂ emissions and removals

OTHER FINDINGS

- Pasture remains the dominant land use across all scenarios, only under the most ambitious scenario does significant change in land use occur.
- CH₄ reductions under ambitious mitigation driven by lower ruminant numbers, improved manure management, and adoption of advanced technologies.

AGRI. SCENARIOS

- S1 > currently planned measures
- S2 > low-cost, technically mature & min. behavior change
- S3 > ambitious options requiring policy support or investment
- S3-LAD > S3 + low agricultural demand

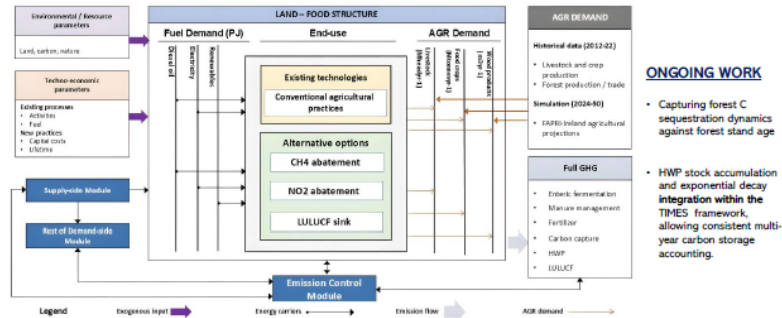


Building a national integrated model to explore overshoot pathways

Neha Jaggeshar



Ambitious mitigation in Irish agriculture (50-55% of GHG emissions) is feasible but requires a coordinated transformation across technological development and dietary change.



ONGOING WORK

- Capturing forest C sequestration dynamics against forest stand age
- HWP stock accumulation and exponential decay integration within the TIMES framework, allowing consistent multi-year carbon storage accounting.

¹Sustainability Institute & School of Engineering and Architecture ?Ma?RIE, the SFI Research Centre for Energy, Climate and Marine, University College Cork, Ireland

Ireland's Path to a Secure Clean Energy Future and the Challenges of Critical Materials



Stephanie Moura & Fatemeh Rostami

Introduction

The SHIELD project analyses how Ireland can safeguard its energy transition by assessing and mitigating emerging energy security risks from critical material supply disruptions and geopolitical dynamics, ensuring a resilient, affordable, and sustainable future energy system.

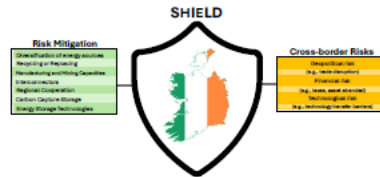
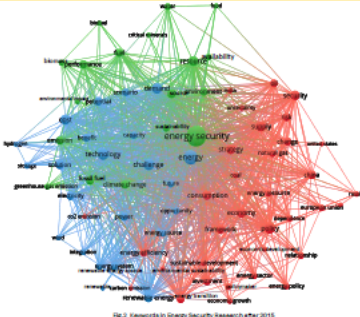
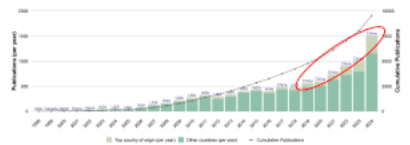


Fig.1 Framework of the project

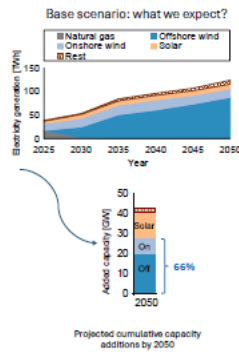
Qualitative study: Shift in Energy Security Research

Evidence suggests a post-2015 shift in energy security research, focused on the politics of renewables and critical materials and a decline in nuclear and coal studies, led predominantly by Chinese researchers.

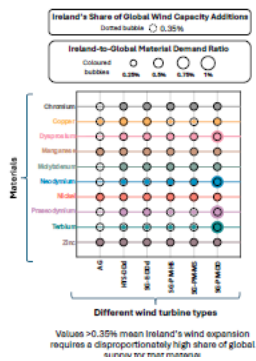


Quantitative study: Scenario Analysis with TIMES-Ireland Model (TIM)

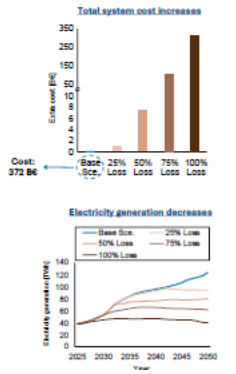
Carbon Budget: 300 Mton



Relative material consumption by wind turbines: Ireland vs. Global (IEA Net-Zero)



Consequences of wind capacity shortfalls



Ireland's Path to a Secure Clean Energy Future and the Challenges of Critical Materials

Dr. Stephanie Moura



Dr. Fatemeh Rostami



JOURNEYS TOWARD RURAL SUSTAINABILITY IN THE DINGLE PENINSULA
Engaged research for grassroots energy communities and local climate action

Alexandra Revez¹, Deirdre de Bhalis², Mario Couto³, Jonathan Sandham⁴, Evan Boyle¹, Aoife Deane⁵, Julia Blanke⁶, John Walsh⁶, Brian Ó'Gallachóir¹
¹University College Cork, ²Dingle Hub, ³EPRI Europe, ⁴DC St. Technology, ⁵ESB Networks



CONTEXT AND PREVIOUS RESEARCH

ENGAGED RESEARCH

The Dingle Hub's strategy for regional development is based on the belief that current project-based models of regional development are not realizing the full potential of engaged, place-based development.

INNOVATION & LIVING LABS

The Dingle Peninsula Living Lab is an innovative initiative that demonstrates a collaborative approach to localized climate action. It serves as a platform for innovation, scaling sustainable solutions, and enhancing impact.

SOCIETAL CAPACITY LEGACIES



ONGOING RESEARCH

Working with local energy communities to enhance energy data sharing services across Europe and improve energy systems by empowering citizens and fostering energy-secure communities.



FUTURE RESEARCH

INNO-TREC brings together energy industry and research partners to align with the EU's energy transition vision. It aims to develop next-generation tools and methodologies, which will be tested in six demonstration projects across six countries.



Fig. Above innovative concepts demonstrated in 6 pilot communities



Dr Alexandra Revez



Journeys Toward Rural Sustainability in the Dingle Peninsula

Who builds Climate Services in Belfast & Cork?

An exploration of the players that make climate services used at city level.

Sadhbh Gaston | sadhbh.gaston@ucc.ie, Dr. Niall Dunphy | n.dunphy@ucc.ie, Dr. Alexandra Revez | alexandra.revez@ucc.ie, CPPU Group, Sustainability Institute, University College Cork



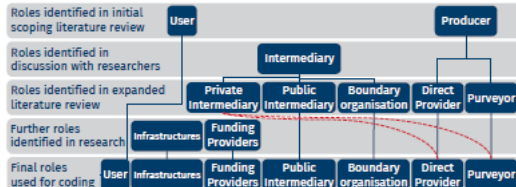
"Climate services are the provision and use of climate data, information and knowledge to assist decision-making."

(WMO, 2024, p16)

Who delivers climate services?

Early examples in literature from the 1970's conceptualised climate services as those provided by producers to users.

Since then co-creation has been acknowledged as essential to ensuring that climate services support decision-making in practice.



Users are organisations or individuals who act or make policy based on climate services.

Public intermediaries are public organisations that work in a large network to connect researchers and knowledge to users and the public.

Boundary organisations are organisations that work as a bridge between researchers and users to co-produce climate services.

Direct Providers produce their own data for a climate service they provide.

Purveyors apply knowledge and expertise to existing data and use this to provide a climate service.

Infrastructures are organisations or services that provide access to data either produced by the organisation or collected from other sources.

Funding Providers are organisations that provide funding to enable the creation of climate services or support the engagement of users, public intermediaries, boundary organisations, direct providers, purveyors or infrastructures in the creation and maintenance of climate services.

Why expand the terminology?

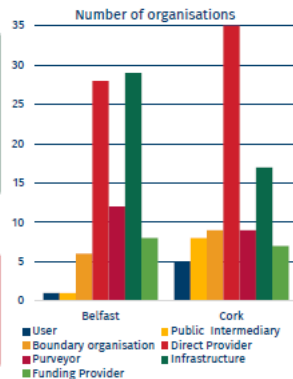
- The language of "users" and "producers" can guide actors to engage with the co-production process in limited ways.
- Public intermediaries and boundary organisations can support users in ways that are outside of the skillset of direct providers and purveyors.
- Infrastructure and funding providers have influence on climate service production and access, not describing this gives an incomplete picture.

A view of Belfast City and Cork City.

By examining climate policies that apply to the work of Belfast and Cork City Councils a range of organisations related to climate services were identified.

In Belfast a wider range of infrastructures was identified. Many of these were operated at UK level and a far larger proportion of these were third sector organisations with databases created by citizen scientists than were found in Cork.

In Cork policies, particularly those produced at local authority level, identified direct working relationships with other users, public intermediaries, and boundary organisations than were discovered in Belfast.



Next areas for study.

- What are the impacts of the terminology we use to describe actors within the process of creating climate services?
- Do the terms applied to actors in the process of climate service creation impact how they engage?
- May expanding the understanding of who is part of climate service creation assist in creating climate services that better support decision-making and action-taking?

JustCities Hub is an EPA-funded research project delivered by a multidisciplinary team in the Environmental Research Institute at University College Cork. Within JustCities Hub we are investigating how justice, resiliency and vibrancy can be embedded in cities work towards climate goals. At its core the project is about imagining city life in a way that embraces the challenges of climate action and promotes stable, just, and healthy urban environments. We are primarily working in two cities during this project, Cork and Belfast.



www.ucc.ie/cppu

Who builds Climate Services in Belfast & Cork?



Sadhbh Gaston



How Many Years before Ireland's Private Fleet is Fully Electrified?

Mannan Nazar

Quick Facts

- 2.4 million private cars on the road as of 2024.
- >137 thousand electric vehicles registered in Ireland as of 2024.
- Ev sales: 60% share for battery electric vehicles and 40% share for plug in hybrids.

Table: Fleet Electrification in Years

Share of Annual Car Sales That Are Electric	Level of Car Fleet Electrification							
	1%	5%	10%	20%	50%	80%	100%	
2%	10	50	100	200	499	798	998	
10%	2	10	20	40	100	160	200	
20%	1	5	10	20	50	80	100	
24.4%	1	4	8	16	41	65	82	
50%	0	2	4	8	20	32	40	
80%	0	1	3	5	13	20	25	
100%	0	1	2	4	10	16	20	

Source: SIMI MotorStats, Department of Transport, *European Alternative Fuels Observatory -Vehicles and Fleet

How Many Years before Ireland's Private Fleet is Fully Electrified?

Almost **1 out of 4** car sales in 2024 were electric vehicles (EVs). However only **~4%** of the car fleet is electric.

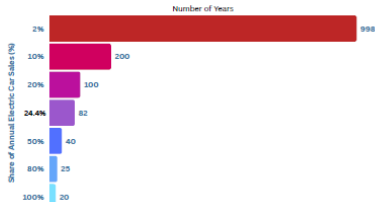
If annual electric vehicle sales remain at **24.4%** it would take **82 years** (all factors being equal) to electrify the entire car fleet.

If **100%** of sales were EVs, it would take **20 years** to electrify the entire car fleet.

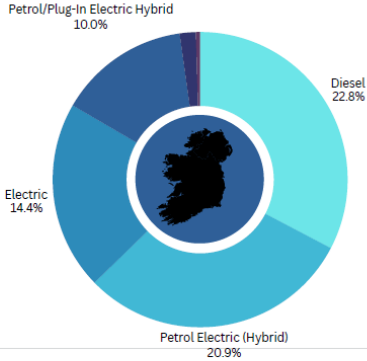
Current EU policies include a sales ban for all CO2 emitting new vehicles in 2035. The level of sales of EV's will be a key determinant for how long it takes to electrify the car fleet.

Sales in this poster refers to new car registered in 2024

Number of Years to Achieve 100% Fleet Car Electrification By Percentage Sales



Share of Vehicle Sales in 2024



INTEGRATING AVIATION INTO NATIONAL CARBON BUDGETS REVEALS CRITICAL RISKS TO PARIS-ALIGNED ENERGY TRANSITION

Vahid Aryanpur, Bakytzhan Suleimenov, Hannah Daly

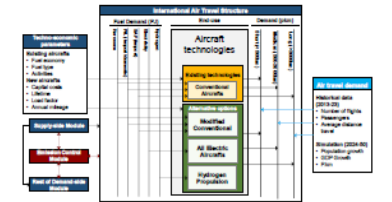


Introduction

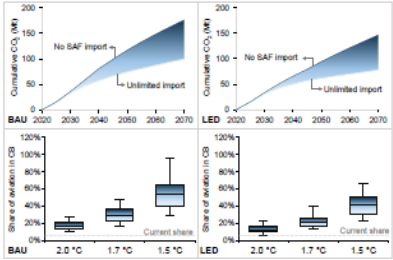
Ireland's Climate Action Plan sets sectoral emissions ceilings, but international aviation is excluded from national carbon budgets (CBs), creating a major blind spot in climate policy. We integrate aviation into a carbon-budget-constrained whole-energy-system model to assess: (1) how much aviation could deplete Ireland's Paris-aligned CBs, and (2) what cost-effective mitigation pathways exist, including impacts on land use and ticket prices.

Methods

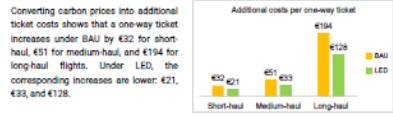
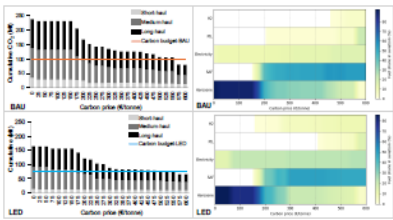
TIMES-Ireland Model (TIM) is a national optimisation model that identifies the cost-optimal fuel and technology mix required to meet Ireland's future energy demands under CB constraints. It includes over 370 commodities, 2,500 technologies and more than 250 constraints. By embedding a detailed representation of aviation sector, covering fuels, technologies and three distance segments, TIM quantifies aviation's cumulative contribution to national mitigation limits and explore the cost-effective pathways for reducing it.



Under LED, cumulative emissions increase from 78 Mt with full imports to 147 Mt with no imports, reaching nearly half of the 300 Mt CB. BAU is far more vulnerable: emissions rise from 100 Mt to 176 Mt under zero imports, nearly 60% of the CB. Aviation consumes 2-9 times its current share of a 2°C carbon budget



Carbon price-induced results indicate that prices below €150/t have little impact, while €200/t unlocks mid-cost abatement. To match budget-constrained outcomes, BAU requires -4500/t and LED -4825/t. Fuel switching accelerates above €175/t: BAU shifts from kerosene to SAF (up to 56%) with modest electricity use and late PtL adoption, while hydrogen remains <5%. LED diversifies earlier, with SAF and electricity rising steadily, hydrogen reaching 10% at high prices, and PtL limited to the very highest prices.



Conclusions

- **BAU overshoot:** Consumes 2-9x current carbon share, rivals domestic sectors, and drives overshoot by the early 2030s.
- **LED resilience:** Moderated demand avoids overshoot and tolerates up to 50% shortfall in fuel imports.
- **SAF production:** Domestic SAF production requires 6-11% of national farmland.
- **Carbon pricing:** €325-500/t needed, increasing one-way tickets by €21-194.
- **Policy needs:** Dedicated aviation sub-budgets and travel demand measures are essential to protect carbon budget integrity and achieve climate goals.

Results

In both scenarios, Zero-Emission Fuels (ZEFs) supply over 70% of aviation energy by 2050. LED demand is one-third lower than BAU. BAU depends heavily on imported SAF, while LED phases out kerosene faster and uses 50% more electricity by 2070 due to greater renewable availability. Electrification in BAU remains limited to short-haul routes. PtL acts as a transitional fuel and hydrogen remains marginal due to high costs. Import dependence stays high but is lower in LED (69% vs 80% in 2070).

Cumulative emissions exceed 510 Mt in BAU and overshoot the 300 Mt CB by 2031, requiring large-scale removals thereafter. LED stays within the budget, avoiding overshoot-related climate risks.

Aviation starts modestly but grows substantially, eventually reaching cumulative emissions comparable to domestic transport.

Removals diverge strongly. BAU depends heavily on negative emissions after 2040, with cumulative removals exceeding 210 Mt by 2070. LED uses roughly one-third less. BECCS deployment is similar in both, but LED avoids the need for large-scale carbon dioxide removal, while BAU requires extensive CDR to compensate for the overshoot. CCUS is also more than twice as high in BAU.

Detailed results from TIM



Contact: vahid.aryanpur@ucc.ie



Integrating Aviation into National Carbon Budgets Reveals Critical Risk to Paris-Aligned Energy Transition

Dr Vahid Aryanpur



Evaluating the consistency between Ireland's carbon budget-aligned energy system pathway and EU energy and climate targets



Ciara Doherty, Vahid Aryanpur & Hannah Daly

CONTEXT

- The alignment between national carbon budget (CB) frameworks and EU obligations is underexplored.
- Ireland's current policies are off track and risk major compliance costs.
- Core question:

Can a carbon budget aligned (CBaligned) energy pathway ensure compliance with EU obligations under the ETS, ESR, and EED, and position Ireland to meet the proposed 2040 emissions target?

METHODOLOGY

- CBaligned energy scenario created to align with CB 1&2 and proposed CB 3&4.
- Based on weighted average of TIMES-Ireland Model energy scenarios used to inform CCAC CB recommendation 2024.
- Energy pathways (CB-aligned, BAU, WEM & WAM) compared to policy targets:
 - EU-ETS: EU benchmark of -62% ETS emissions vs. 2005
 - EED: 2030 final energy consumption limited to 10.45 Mtoe
 - EU-2040: -90% in emissions vs. 1990
 - ESR: Annual Emissions Allocations assume agriculture meets EPA WEM trajectory

Delivering Ireland's carbon budgets in energy sectors (adopted to 2030 and proposed to 2040) can deliver strong alignment with EU climate and energy targets. **ESR compliance** remains the greatest challenge, achievable only with agricultural mitigation beyond planned policies.

RESULTS

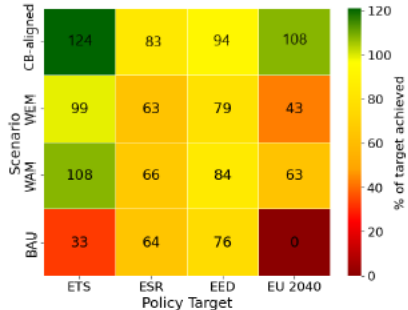


Fig. 1: Compliance of energy system scenarios with EU targets (percentage of the target achieved)

- EU Emissions Trading Scheme (ETS)**
 - CB-aligned pathways exceeds ambition in Power & Industry sectors by 24%.
- Energy Efficiency Directive (EED)**
 - CB-aligned pathway misses target by 1 Mtoe.
 - Low energy demand measures help close the gap.
- Effort Sharing Regulation (ESR)**
 - Poses the greatest compliance risk.
 - Even with strong energy sector mitigation, compliance falls unless agriculture also cuts emissions deeply.
- EU 2040 Emissions Target**
 - CB-aligned exceeds EU target in the energy sector
 - Achieves -90% target in 2036.

KEY INSIGHTS

- Meeting carbon budgets brings Ireland close to EU compliance, with only small gaps remaining for the EED and ESR.
- Efficiency and fuel switching alone won't deliver the EED target - deep demand reduction is essential for compliance.
- Energy sector ambition alone is insufficient: underperformance in non-energy sectors risk undermining ESR compliance and requires integrated, cross sectoral strategies.
- Early, sustained investment will likely be central in enabling compliance and avoiding long-term cost & feasibility risks.
- A carbon-budget-aligned energy pathway requires major upfront investment but is cost-effective in the long term.

For more info contact: cdoherty@ucc.ie

This poster is based on research commissioned by the Climate Change Advisory Council. Development of the TIMES-Ireland Model is supported by the Department of Climate, Energy and the Environment through the Climate and Energy Modelling Services to the Climate Action Modelling Group (CAMG) (grant No. R172022/S 164-466018), and supported by MaREI, the Research Ireland Centre for Energy, Climate and Marine (grant No. 12/RC/2302_P2).

Evaluating the consistency between Ireland's carbon budget-aligned energy system pathway and EU energy and climate targets



Ciara Doherty



A probabilistic energy system analysis of negative emissions technologies under an equity-based framework

technologies under an equity-based framework

Weipeng Xie^{1,2}, Paul Doonan^{1,2} & Hannah Daly^{1,2}

¹Sustainability Institute, University College Cork, Ireland

²School of Engineering and Architecture, University College Cork, Cork, Ireland



Introduction

Ireland's climate targets do not explicitly reflect equity principles consistent with common but differentiated responsibilities and respective capabilities under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement.

Previous studies on Ireland's energy-system decarbonisation have not systematically examined the role of carbon dioxide (CDR) removal technologies, like bioenergy with carbon capture and storage (BECCS) and direct air capture and storage (DACCS). Existing NET-modelling scenarios typically vary only one parameter at a time, without capturing the interactions among technological, economic, and policy uncertainties.

Our study integrates Latin Hypercube Sampling (LHS) with an equity-based carbon-budget framework to explore realistic and responsible carbon-removal pathways for Ireland's energy-system transition compatible with the 1.5°C target.

Methods

Scenario	Variable	Min	Max	Min	Max	Min	Max	Min	Max
Scenario 1	Variable 1	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Scenario 2	Variable 2	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Scenario 3	Variable 3	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Scenario 4	Variable 4	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Scenario 5	Variable 5	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Scenario 6	Variable 6	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Scenario 7	Variable 7	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Scenario 8	Variable 8	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Scenario 9	Variable 9	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00
Scenario 10	Variable 10	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00

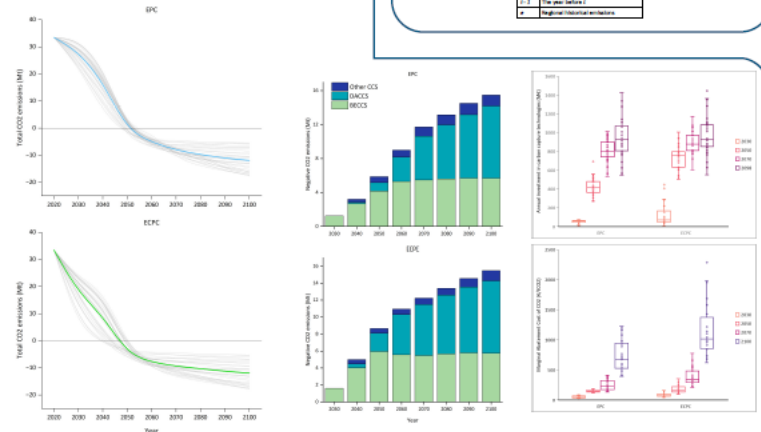
The TSM-ACA model implements coupling with Monte Carlo analysis (MCA) on the basis of the TSMC Ireland Model (TIM) to perform large-scale uncertainty analysis. We use the LHS method to replace the random sampling method used in the classical Monte Carlo simulation.



We apply the Equal Per Capita (EPC) and Equal Cumulative Per Capita (EPC-C) principles to derive the National Remaining Carbon Budgets (NRCB) from 2025 onward.

Scenario	Principle	Carbon Budget (GtCO ₂ e)
Scenario 1	Equal Per Capita (EPC)	100
Scenario 2	Equal Cumulative Per Capita (EPC-C)	100
Scenario 3	Equal Per Capita (EPC)	100
Scenario 4	Equal Cumulative Per Capita (EPC-C)	100

Preliminary Results



• Net-negative emissions are essential for Ireland to achieve 1.5°C, aligning with the Paris Agreement.

• To adhere to stricter carbon budget constraints, CDR deployment must be accelerated and scaled up.

Conclusions

- Saturation of CDR from BECCS reflects assumed resource limitations, DACCS is more scalable but has significant power needs.
- Although limited annual CO₂ storage injection rate, early GHG reduction and CDR deployment reduces the need for larger CDR capacity to meet a stricter carbon-budget constraint.
- To achieve the 1.5°C target, economic uncertainty has minimal impact on long-term CDR demand. The primary bottlenecks are physical constraints, specifically maximum build rates and carbon storage capacity.

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A probabilistic energy system analysis of negative emissions technologies in deep decarbonisation pathways

Weipeng Xie





Coláiste na hOllscoile Corcaigh
University College Cork, Ireland

Closing Keynote

Eamon Ryan

**Former Minister Department of
Climate, Energy and the Environment
and Department of Transport**

**Thank you all for attending, participating and
engaging with us.**



**Wishing you all a happy and restful holiday
season**



See you at next years event!