Climate Change Advisory Council Secretariat

CB WG Meeting 3

31st May 2023

Agenda

Time	Agenda Item
10:30	1. Opening of Meeting
10:45	2. Vision for 2050 and Beyond
11:45	3. Carbon Budgets Work Plan
12:15	4. Scoping of Modelling Work
13:15	5. Next Steps and Agenda for next meeting
13:20	6. AOB
13:30	Meeting Close

1. Opening of Meeting

Action Number	Date Raised	Description	Owner	Due	Status
3	20/04/23	Expand discussion of macroeconomic inputs/ drivers	CCAC Secretariat and relevant CB WG Members	Q3 2023	Ongoing – Update to be provided at CB WG Meeting 4
4	20/04/23	Provide update on timelines for the Land Use Review	CCAC Secretariat	31/05/23	Update Provided at CB WG Meeting 3
5	20/04/23	Further develop the approach and preparation for topical discussions	CCAC Secretariat	Q3 2023	Ongoing – Secretariat to provide an update on the approach and preparation for upcoming topical discussions at each meeting.

1. Opening of Meeting

CB WG Action No. 4: Update on timelines for the Land Use Review

Theme: Land Use Review						
Measure: Implement the Land Use Review		**2025 KPI:**		**2025 Abatement Potential for Measure**		
Actions						
Action Number	Actions	Steps necessary for delivery	Output	Timeline	Lead	Stakeholders
LU/23/19	Publication of Phase 1 of the Land Use Review – Evidential Review	As per Headline Action	Phase 1 Report published	Q1 2023	DECC, DAFM, DHLGH	Relevant Agencies
LU/23/20	Commencement of Phase 2 of the Land Use Review - Policies, Measures and Actions	As per Headline Action	Commencement of Phase 2	Q1 2023	DECC, DAFM, DHLGH	Relevant Agencies
LU/23/20/A	-	Necessary: Interim Reporting to Government	Interim Report	Q4 2023	-	-
LU/25/1	Publication of Phase 2 of the Land Use Review – Polices, Measures and Actions	As per Headline Action	Phase 2 Report published	Q1 2025	DECC, DAFM, DHLGH	Relevant Agencies

- Action LU/23/19 is complete, and action LU/23/20 is underway

1. Opening of Meeting

ID	Date Raised	Risk Description	Likelihood of the risk occurring	Impact if the risk occurs	Severity (rating based on likelihood and impact)	Mitigating Action	Progress on Actions	Status
1	20/03/23	Revision of carbon budgets, as provided for under Section 6D of the Act	Medium	Medium	Medium	The Minister, at any stage, can request a revision of carbon budgets as provided for under Section 6D of the Act. The potential for the minister to request a revision of carbon budgets has been reflected in both the Carbon Budgets Methodology and the Terms of Reference for the Carbon Budgets Working Group. The role of the Carbon Budgets Working Group in responding to any request from the Minister to the Council for a review will be determined by Council if it arises.	Ongoing Monitoring	Open
2	20/04/23	Insufficient time to incorporate a potential step change in 2023 emissions from the Q2 2024 provisional emissions inventory publication	Medium	Low	Low	It is proposed that the 2030 start points for scenario modelling will account for both overperformance and underperformance of Carbon Budget 2. An activity related step change in 2023 provisional inventory in the Q2 2024 provisional emissions inventory publication is deemed a manageable risk mitigated by quarterly inventory reporting available from late 2023 and ongoing engagement with relevant CB WG members. No updates to the methodology are expected in the Q2 2024 provisional inventory publication. However, if there are major methodological changes of relevance there is the potential for the Minister to request a review under Section 6D of the Act – see Risk 1 above.	Ongoing Monitoring	Open

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Vision for 2050 - Introduction

3 initial aims;

1. Assess current literature
2. Review available pathways
3. Inform April Council Discussion on potential recommendations and present to May CB WG Meeting

Follow up objectives;

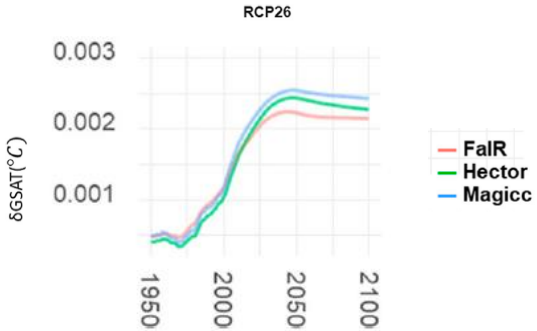
1. Clearly define the end goal of what we are trying to achieve.
2. Inform development of work package to consider pathways to 2050 in Q3/Q4 2023 and CB WG scenario analysis beginning in Q3 2023.

Vision for 2050

- Distinctions between climate neutrality, net zero based on GWP100, carbon neutrality and temperature neutrality.
- Challenge of downscaling global climate goals to national targets.
- Paris Agreement specifies global temperature ceiling.
- National policies specify a target year for climate neutrality or net zero but wording of climate goals can be vague.
- Recent paper by Wheatley (2023) attempts to look at temperature neutrality targets over specific timeframes.
- Scope of work to look at long term emissions pathways to 2050 to inform CB3 and CB4.
- Role of negative emissions.

	IE-C				
gas	2025	2030	2035	2050	2100
fossil-CO_2	85	49	35	0	−7
CH_4	95	90	85	60	50
N_2O	95	90	85	60	50
land-CO_2	95	85	80	−10	−20
SO_2	85	49	35	0	0
$MtCO_2eq$	60.1	44.3	37.4	13.6	8.0

Example of a scenario from Wheatley's 2023 paper, emissions expressed as percentages of 2018 values with MtCO2eq. totals based on AR5 GWP100



Example output from 3 SCMs on Irish contribution to global warming in scenario IE-C for global mitigation pathways RCP 2.6

Recommendations & areas for further research

- There are limited sector specific studies available which consider pathways to 2050 in Ireland. This will be an important consideration in developing the scope of work for a consultancy package in 2023 to inform the next carbon budgets process and also needs to be considered for future programmes of carbon budgets.
- Ireland's Long Term Climate Strategy should be an important information source to support this work.
- Further work is required to understand the potential for negative emissions in the Irish context.

Building blocks for scenarios for CB3 and CB4			
Start point in 2030	(1) staying within carbon budgets 1 and 2	(2) overperformance against carbon budgets 1 and 2 and	(3) underperformance against carbon budgets 1 and 2
Target for 2050		(1) based on an emissions trajectory consistent with specific temperature outcomes	(2) based on an emissions trajectory towards net zero greenhouse gas emissions in 2050.

Ireland's Long-Term Strategy for Greenhouse Gas Emissions Reductions

Consultation Questions

1) Following on from the 2019 consultation, is there anything new or incremental you think should be included in Ireland's Long-term Strategy?

2) Does the current long-term strategy identify realistic emission reduction pathways beyond 2030, or are there alternative or complementary pathways worthy of further consideration?

3) Noting that the transition to climate neutrality requires systemic change and that it is critical to consider the factors that may contribute to or hinder progress of such a transition, are there enabling conditions to support the transition that you think require greater focus, if so, what are they?

4) Are there any other comments or observations that you wish to make regarding Ireland's Long-term Strategy?

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3. Carbon Budgets Work Plan: Topics for Meetings

CB WG Meeting No.	Proposed Date and Time	Topic(s) for Consideration
1	Thursday 9th March 2023 10:00 – 13:00	Carbon Budgets Methodology
2	Thursday 20th April 2023 13:30 – 16:30	Carbon Budgets Methodology / Scoping of modelling work
3	Wednesday 31st May 2023 10:30 – 13:30	Vision for 2050 and Beyond/ Scoping of modelling work/
4	Thursday 29th June 2023 13:30 – 16:30	Climate Justice and 'Paris Test'/ Scoping of modelling work/ Macroeconomic Impacts of carbon budgets/ *International approaches to carbon budgets*
5	Thursday 27th July 2023 13:30 – 16:30	Focused discussion on methane/ Scoping of modelling work/ *Socioeconomic considerations*
6	Friday 8th September 2023 13:30 – 16:30	Biodiversity Considerations/ Populations Projections (CSO)
CB WG Workshop 1	Week 2 September 2023 (TBC)	Input model parameters for 2030 starting points, scenario development and assumptions
7	Thursday 19th October 2023 13:30 – 16:30	Landuse Review/ 2024 Projections Process (EPA, SEAI & ESRI)
8	Thursday 23rd November 2023 10:30 – 13:30	Role of Negative Emissions/ TBC
9	Friday 15th December 2023 13:30 – 16:30	TBC

3. Carbon Budgets Work Plan: Meeting No. 4: 29th June 13:30 – 16:30

Climate Justice and 'Paris Test'

- Overview of the 'Paris Test', developed by the Secretariat under the guidance of the Carbon Budget Committee for the first programme of carbon budgets.
- Carbon Budgets to Inform Climate Action: A society-wide, integrated GHG quota and accounting perspective, Paul R Price Research Summary Report for the Climate Change Advisory Council
- Presentation on the ethics of the Paris Test and what it means for Ireland.

➢ *Discussion of the approach to assessing compliance of Ireland's carbon budgets and performance in line with the Paris Agreement and methods to carry out this assessment for the second programme*

Scoping of Modelling Work

- Overview of the I3E, COSMO and NEMF models

Macroeconomic Impacts of carbon budgets

- Update from ESRI on D/Taoiseach's Research & Modelling Macroeconomic Subgroup

➢ *Discussion of the approach to assessing scenario modelling using macroeconomic analysis in relation to jobs, impacts on the economy, impacts on sectors and distributional effects along with the macroeconomic inputs/ drivers*

3. Carbon Budgets Work Plan: Meeting No. 5: 27th July 13:30 – 16:30

Focused discussion on methane

- Secretariat briefing paper
- Invited Speaker Joe Wheatley, Energy Institute UCD '*Temperature neutrality and Irish methane policy'*

➢ *Discussion of the Act requirement to take account of "relevant scientific advice, including with regard to the distinct characteristics of biogenic methane" and approach for the second programme*

Scoping of Modelling Work

- Overview of the NTA and FERS models

3. Carbon Budgets Work Plan

September Workshop (c.a. 13th – 14th September *Date TBC*)

Objective: Develop a shared understanding of model inputs and expected outputs

Proposed Agenda

1. Key questions to ask the models
2. 2030 starting points
3. Model Inputs (assumptions/variables/constraints)
4. Model Outputs
5. Sensitivities
6. Scenario development for 2nd Carbon Budget Programme
7. Scope for testing of results and post-hoc analysis

Next Steps

- Secretariat to prepare an outcome report
- CCAC meeting 28th September
- CB WG meeting No. 7 19th October
- Modelling/Analysis Iteration 1 Commences

3. Carbon Budgets Work Plan

MoU Requests RE Modelling Support for the 2nd Programme of Carbon Budgets

March 2023

Initial letters issued regarding the establishment of Carbon Budgets Working Group and commissioning of Modelling Services to support the development of the second programme of carbon budgets; DECC (cc-ing UCC), DECC (cc-ing NUIG), Teagasc, ESRI and SEAI.

June 2023

- The Council will follow up with a more detailed request based on the Carbon Budgets Work Plan.
- The Secretariat is engaging with experts under each Agency and Department prior to issuing these follow up letters to provide advance notice of these more detailed requests.
- Liaison officer contact point meeting scheduled for June (Date TBC)

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4. Scoping of Modelling Work

Item	Description	2023									2024												
		Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	**Modelling / Analysis Iteration 1**																						
1.1	Agree inputs, paramaters and assumptions																						
1.2	Core pathways development and modelling																						
1.3	Paris Test Assessment																						
1.4	Additional modelling and testing of results																						
1.5	Post-hoc analysis																						
2	**Modelling / Analysis Iteration 2**																						
2.1	Agree inputs, paramaters and assumptions																						
2.2	Core pathways development and modelling																						
2.3	Paris Test Assessment																						
2.4	Additional modelling and testing of results																						
2.5	Post-hoc analysis																						
3	**Modelling / Analysis Iteration 3**																						
3.1	Agree inputs, paramaters and assumptions																						
3.2	Core pathways development and modelling																						
3.3	Paris Test Assessment																						
3.4	Additional modelling and testing of results																						
3.5	Post-hoc analysis																						

D	**Key Deliverables**																						
D.1	Modelling / Analysis Iteration 1 Results																						
D.2	Modelling / Analysis Iteration 2 Results																						
D.3	Modelling / Analysis Iteration 3 Results																						
D.4	Carbon Budgets Technical Report																						
D.5	CCAC Carbon Budget Proposals																						

4. Scoping of Modelling Work

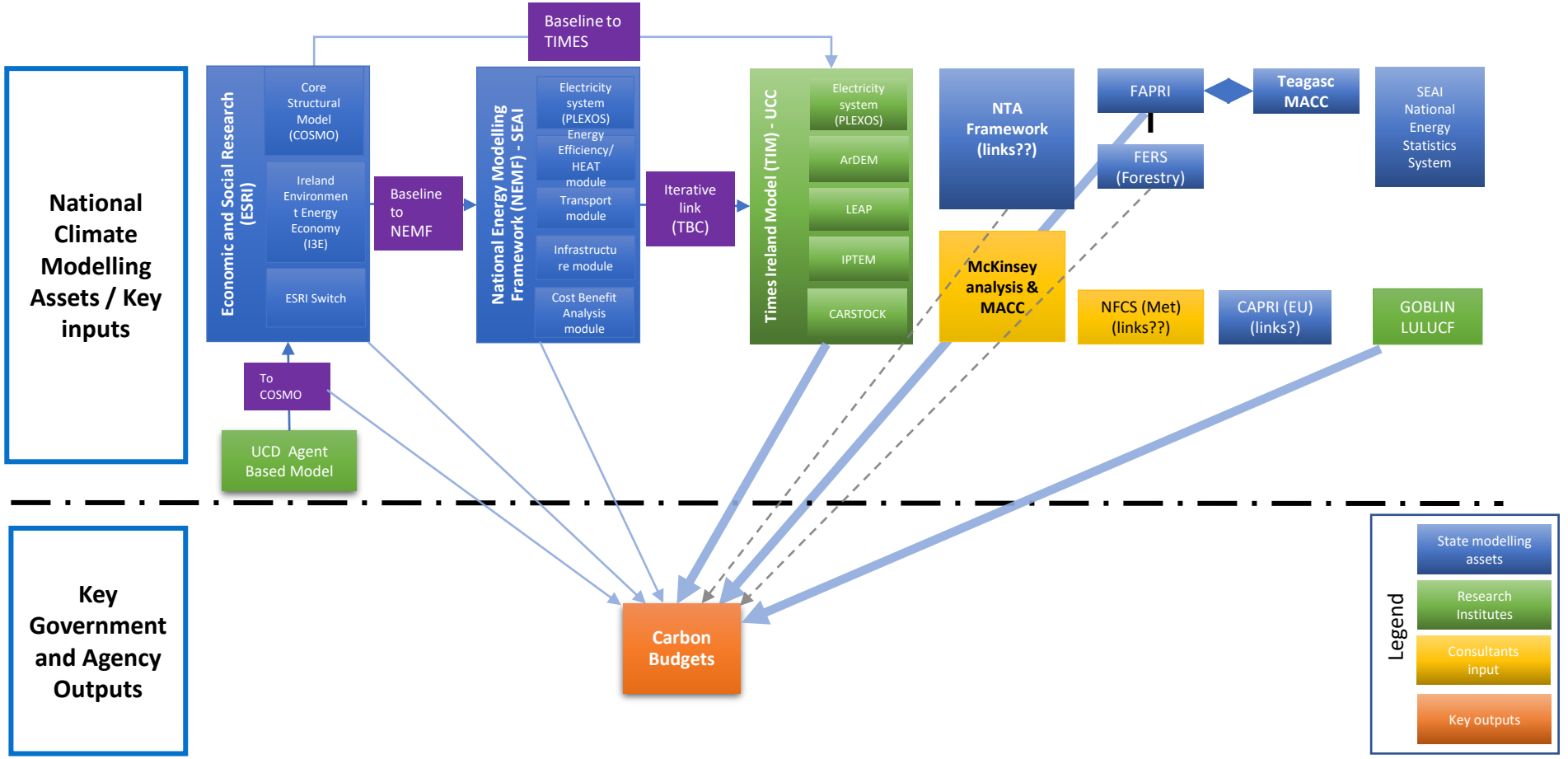
Core pathways development and modelling to be carried out by three groups;

1. **University College Cork TIMES Ireland Model (TIM)** focusing on the energy system,
2. **Teagasc Food and Agriculture Policy Research Institute (FAPRI) Ireland model** focusing on agriculture, and
3. **University of Limerick / University of Galway GOBLIN (General Overview for a Back-casting approach of Livestock Intensification) model** focusing on land use

- Model Overview
- Key questions to ask the model
- Model Inputs (assumptions / variables / constraints)
- Model Outputs
- Sensitivities

National Climate Modelling Assets – Links to Key Gov / Agency Outputs (High Level Map)

****draft to be updated / input from stakeholders required****



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6. AOB

Climate Change Advisory Council's Secretariat Events

Webinar: The future of the ETS with Dr Artur Runge-Metzger 31st of May from 2 - 3 pm

SharePoint Update

- Carbon Budgets Working Group Meeting 1 folder deleted from SharePoint
- Carbon Budgets Working Group Meeting 2 folder will be deleted from SharePoint when Meeting 4 materials are being shared

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Introduction to the TIMES-Ireland Model

Hannah Daly
University College Cork – May 31st 2023

HOST INSTITUTION

UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

PARTNER INSTITUTIONS

CIT Cork Institute of Technology · DIAS · Dundalk Institute of Technology · ESRI Economic & Social Research Institute · Maynooth University · NUI Galway · Trinity College Dublin · Dublin City University · Tyndall National Institute · UCD Dublin · University of Limerick

FUNDED BY:

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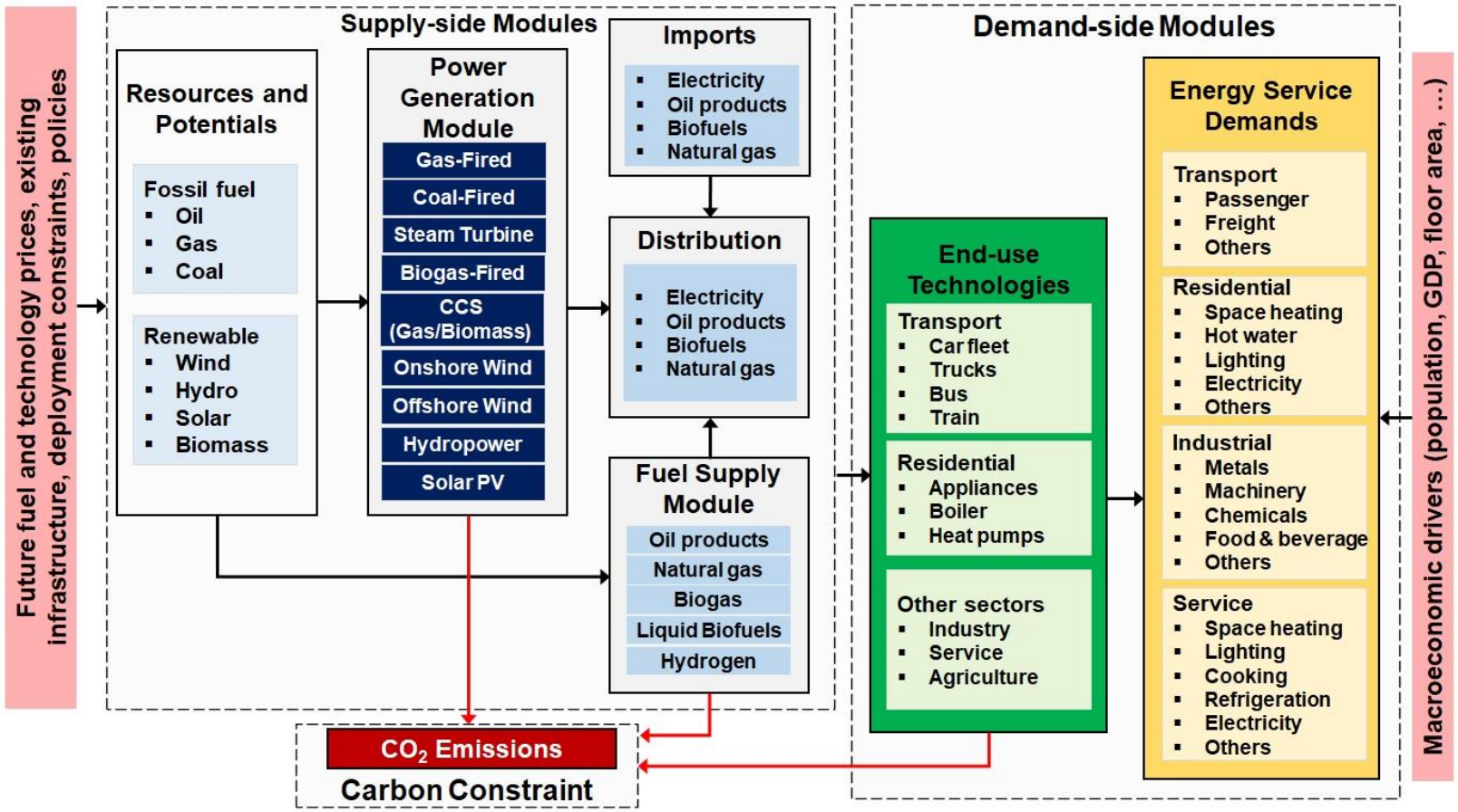
TIMES-Ireland Model (TIM)

TIM is an Energy Systems Optimisation Model (ESOM) which calculates the "least-cost" configuration of the energy system which meets future energy demands, respecting technical, environmental, social & policy constraints defined by the user.



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Given

- Final energy demands
  - e.g., passenger kms, home heating
- Climate policies
  - e.g., carbon budget, annual target
- Technology, fuel costs & efficiency
  - Existing & future cost and performance
- Resource availability
  - e.g., on/offshore wind, bioenergy
- User-defined constraints
  - e.g., speed of technology uptake, policies

TIM calculates

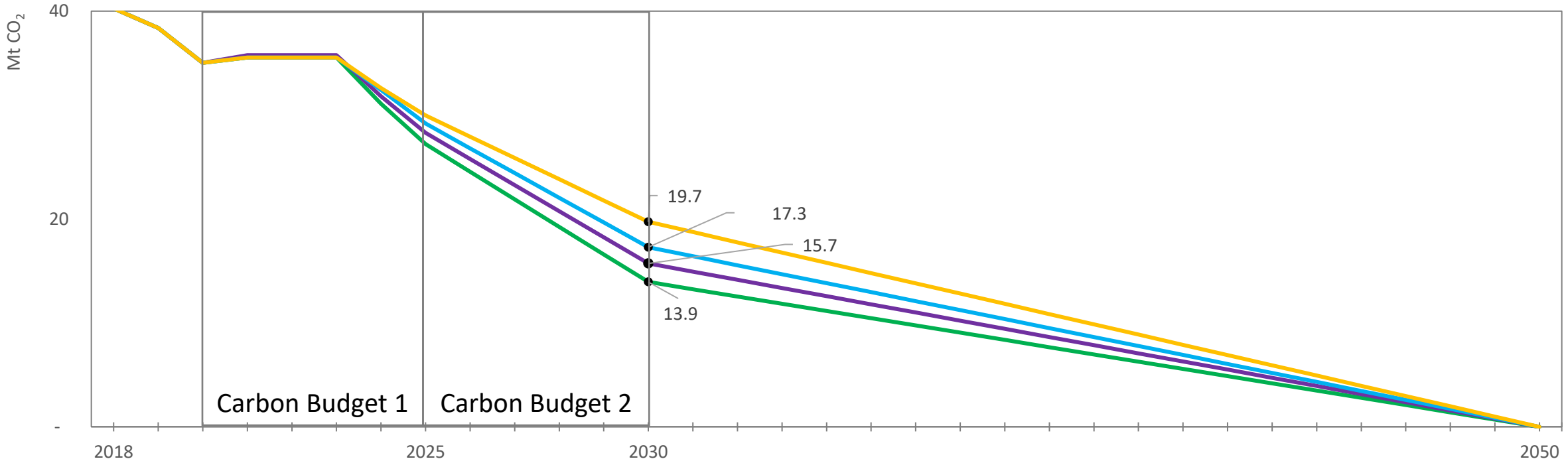
- "Least-cost" energy system meeting all constraints
- Investment and operation of energy technologies
- Emissions trajectories
- Total system cost
- Imports/exports
- Marginal energy prices

TIM development process

- Model fully **open-source** and **peer-reviewed**
- "Best-practice" **development approach** – Git used for version control and integration, open web app for results analysis & diagnostics
- Developers with **international expertise** and links with global TIMES community, allowing knowledge-sharing
- Using **TIMES framework** – well-proven, high quality, continuously developed/maintained, open source code
- **Flexible integration** – Simultaneously maintaining "stable, policy-ready" model and development of research variants, allowing innovations in ESOMs, pushing state-of-the-art – leveraging across projects
- Strength of **systems approach** – automatic "sector coupling" by design – where is the best use of resources? What are sectoral trade-offs?
- Extensive **stakeholder review**
- Training PhDs, interns etc. & wider engagement integral for national **capacity-building**
- A focus on **alternate scenarios**, sensitivities, "what if" analyses
- **Dynamic integration** with national data sources and other national models (where possible)

GHG trajectories inputs for TIM for CB1 & CB2

Carbon budget outcomes for different sectors depend on level of effort sharing between agriculture and the energy system



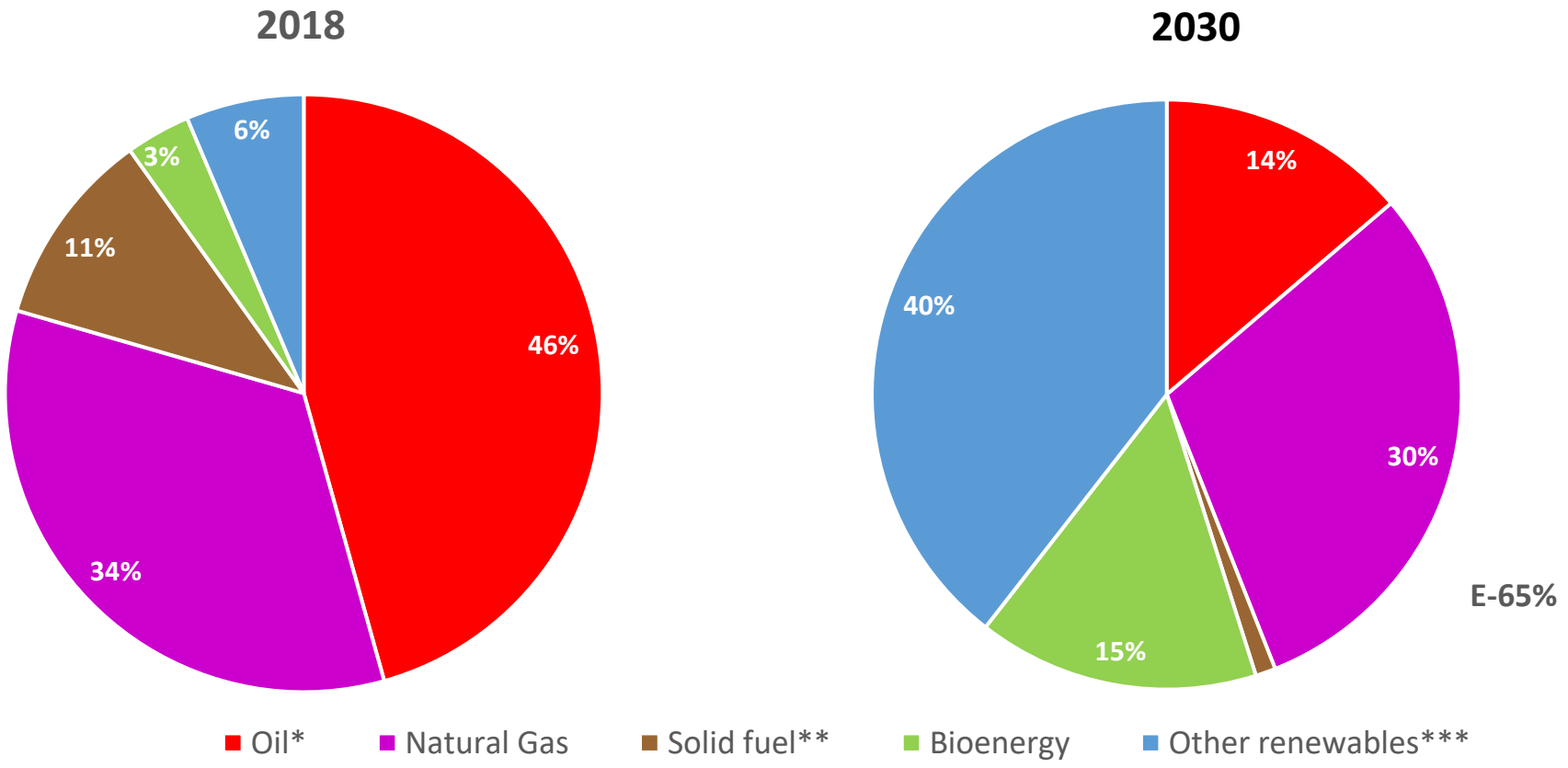
	Carbon budgets implied for energy & process ($MtCO_2$)	
1. Agri-25%, Energy-65%	165	96
2. Agri-33%, Energy-61%	167	104
3. Agri-40%, Energy-57%	168	110
4. Agri-51%, Energy-51%	169	119

All scenarios are consistent with a total Carbon Budget as follows:
CB1: 262 $MtCO_2e$
CB2: 181 $MtCO_2e$

Including agriculture, excluding LULUCF and International Aviation & shipping

Replacing fossil fuels with renewable energy

To meet carbon budgets, fossil fuels fall from 90% of primary energy demand in 2018 to ~47% in 2030, and overall energy demand falls, despite growing economy & population



* Oil excludes kerosene for international aviation
** Coal, peat and MSW
*** Primary wind, solar, ambient heat, hydro & ocean

Greater feasibility with lower demand & faster transition

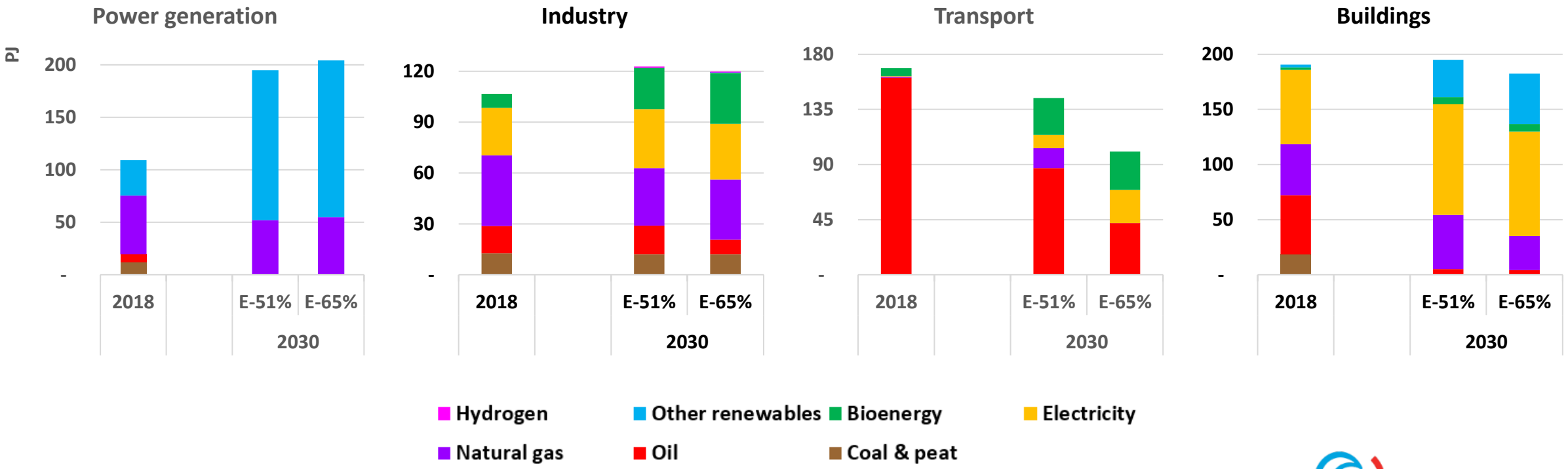
Scenarios with lower final energy demands and greater low-carbon technology availability reduces the marginal abatement cost - the cost of mitigating the most expensive tonne of CO_2 in 2030

Greater decarbonisation target for the energy system →

		E-51%	E-57%	E-61%	E-65%
Core	"BAU" demands, no bioenergy imports, 4-times 2018 indigenous bioenergy, no power-CCS available, no H2 import, 18 GW VAR-RE	**€674**	**€1,100**	**€1,292**	**€1,485**

Final energy consumption & power generation

Deep & rapid changes required in all sectors



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https://tim-carbon-budgets-2021.netlify.app/results/overview/emissions-and-cost 110%

EPMG ENERGY POLICY & MODELLING GROUP

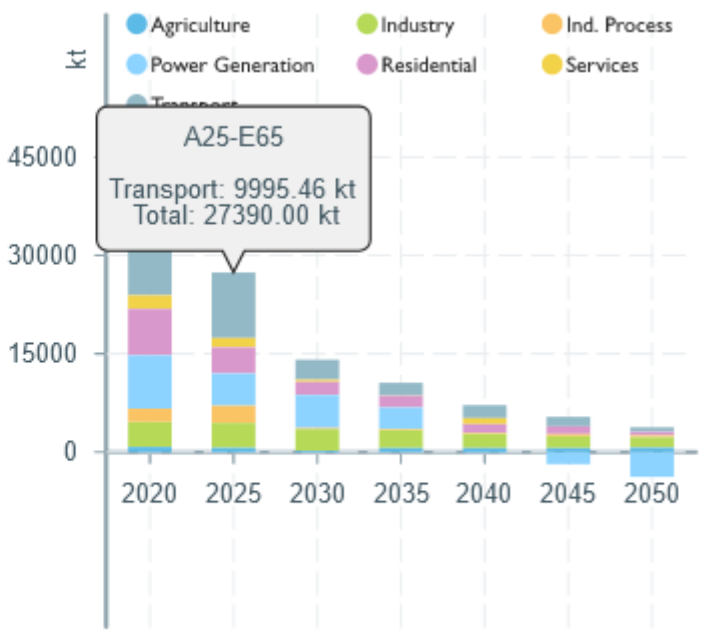
About Scenarios Documentation **Results** Archive

Scenarios

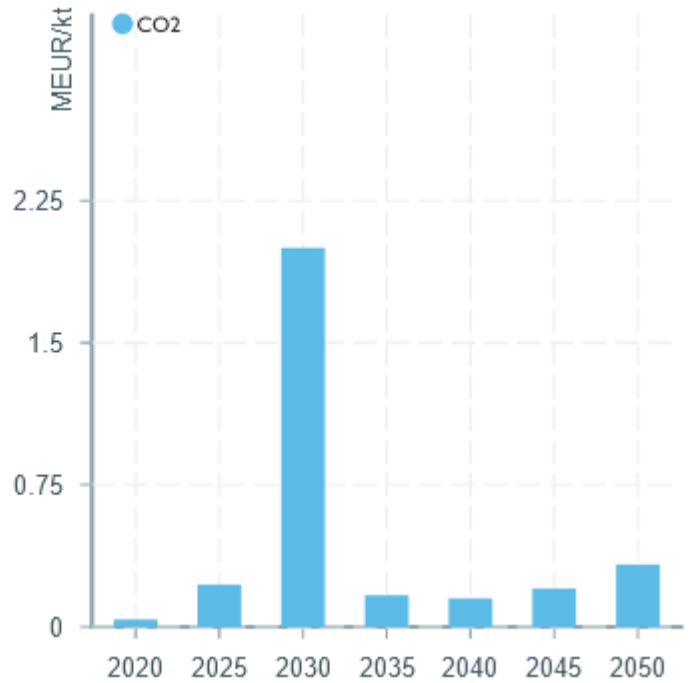
- **A25-E65**
- A25-E65 Early Action
- A25-E65 Late Action
- A25-E65 LED
- A25-E65 Tech-Optimism
- A33-E61
- A33-E61 Early Action
- A33-E61 Late Action
- A33-E61 LED
- A33-E61 Tech-Optimism
- A40-E57
- A40-E57 Early Action
- A40-E57 Late Action
- A40-E57 LED
- A40-E57 Tech-Optimism
- A51-E51

Emissions and cost | Final energy consumption | Primary energy

Domestic CO2 Emissions by Sector



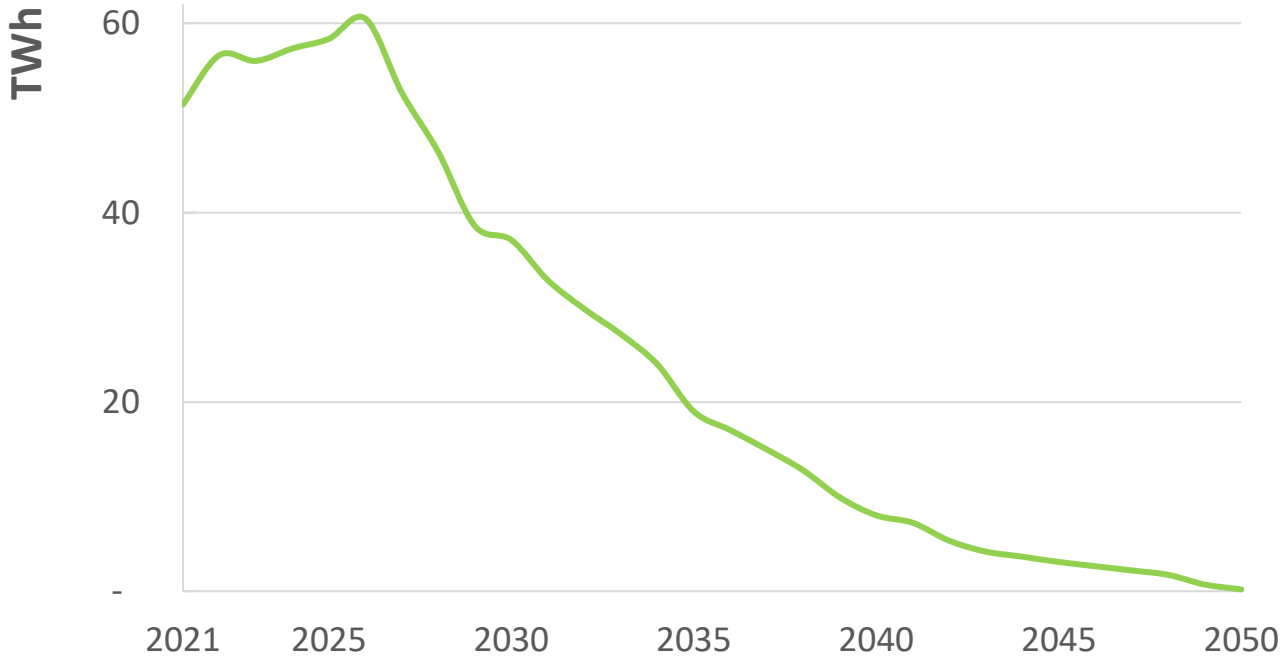
Marginal Emission Price



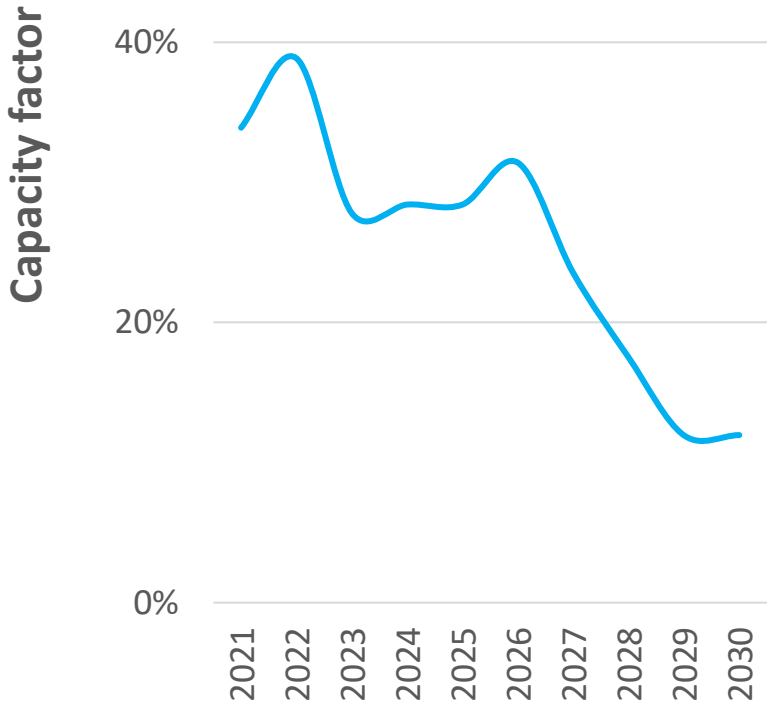
The future of natural gas

Carbon budgets require rapid reduction and phase-out of natural gas

Total natural gas demand in power, buildings and industry consistent with climate targets



Utilisation rate of natural gas power generation capacity

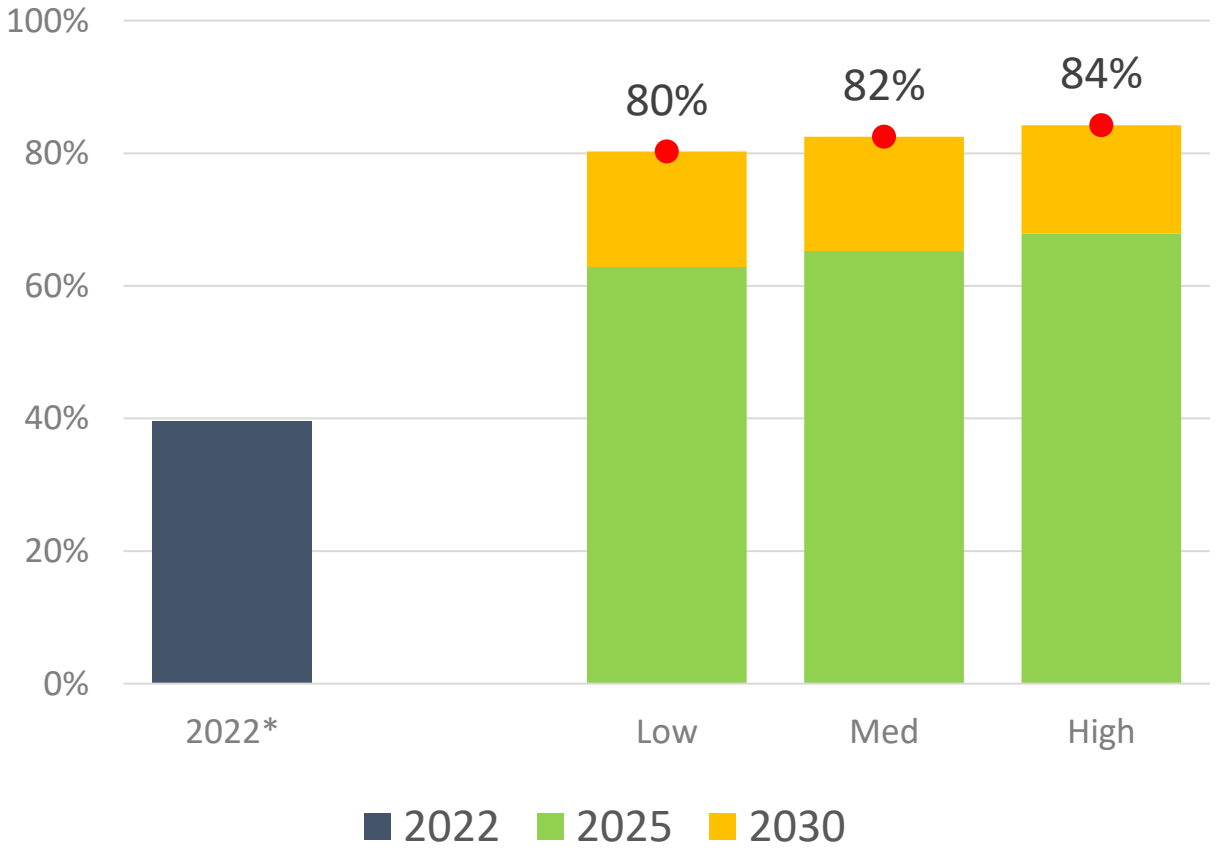


Any failure to rapidly deploy far greater renewable electricity capacity would lead to an increased utilisation rate of natural gas capacity, causing emissions to exceed sectoral carbon budgets

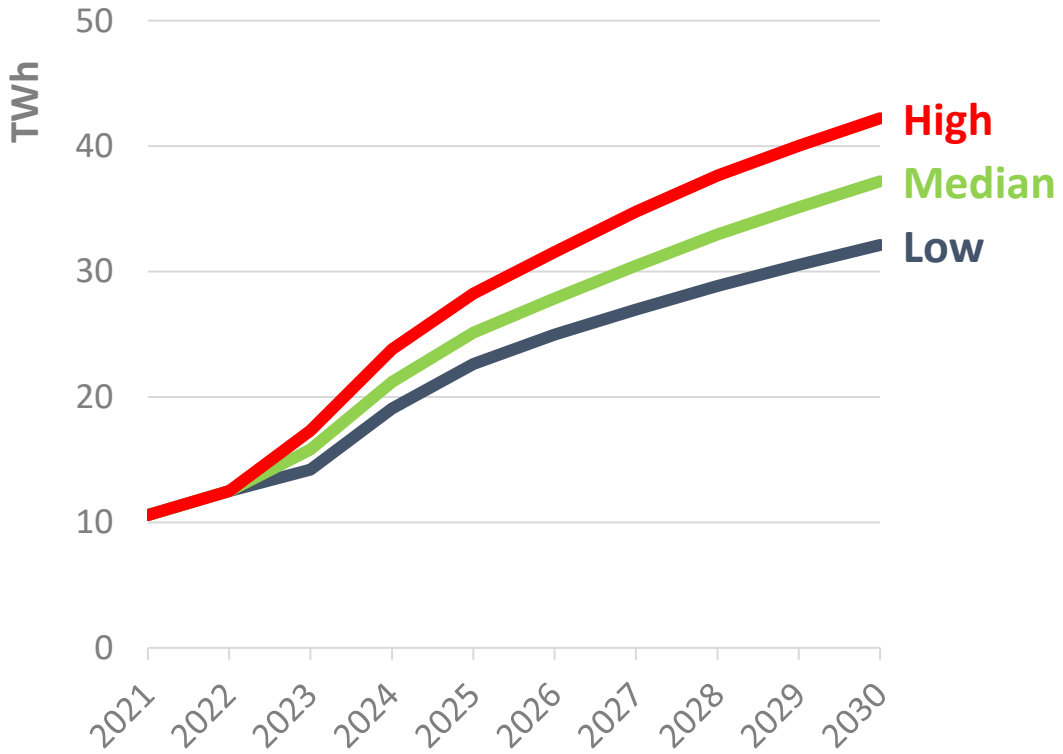
Data centres threaten carbon budget delivery

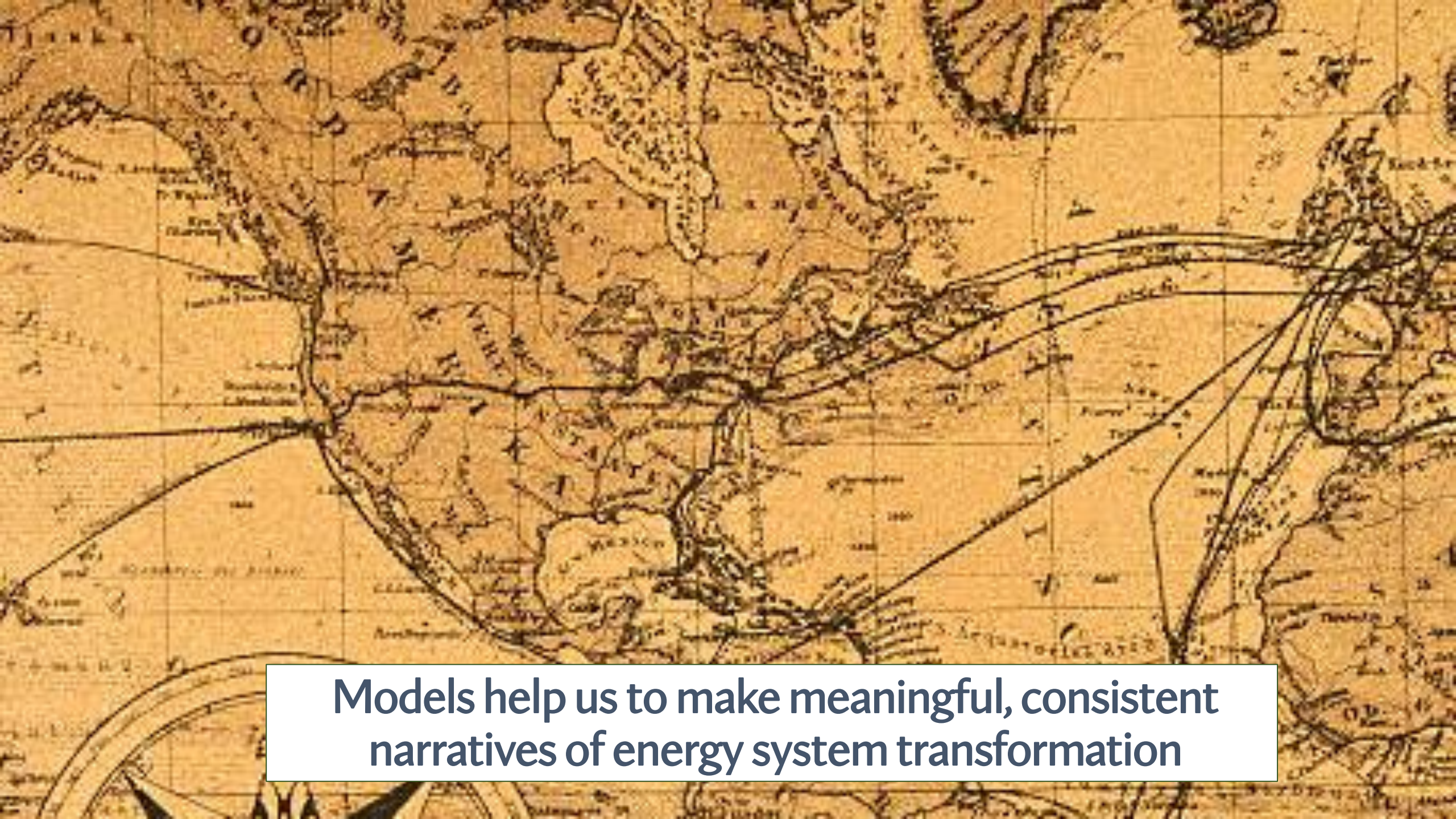
To remain within Sectoral Emissions Ceiling, electricity growth from data centres requires infeasibly strong renewables growth

Share of electricity from renewables required under alternate Data Centre demand growth scenarios



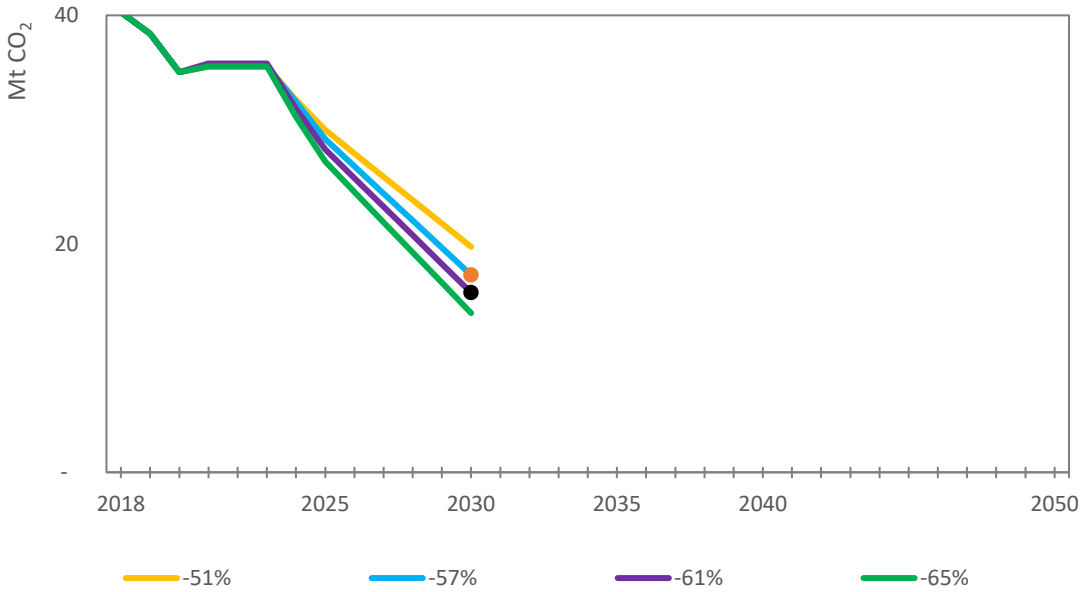
Total renewable electricity generation required under Alternate Data Centre growth scenarios

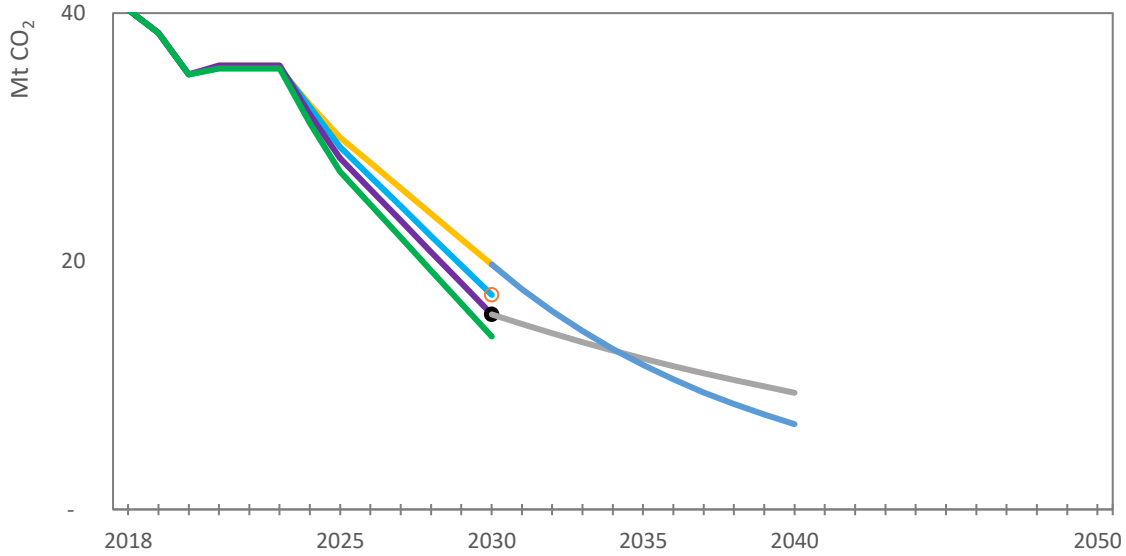




Models help us to make meaningful, consistent narratives of energy system transformation

Priority questions for CB3 & CB4 analysis





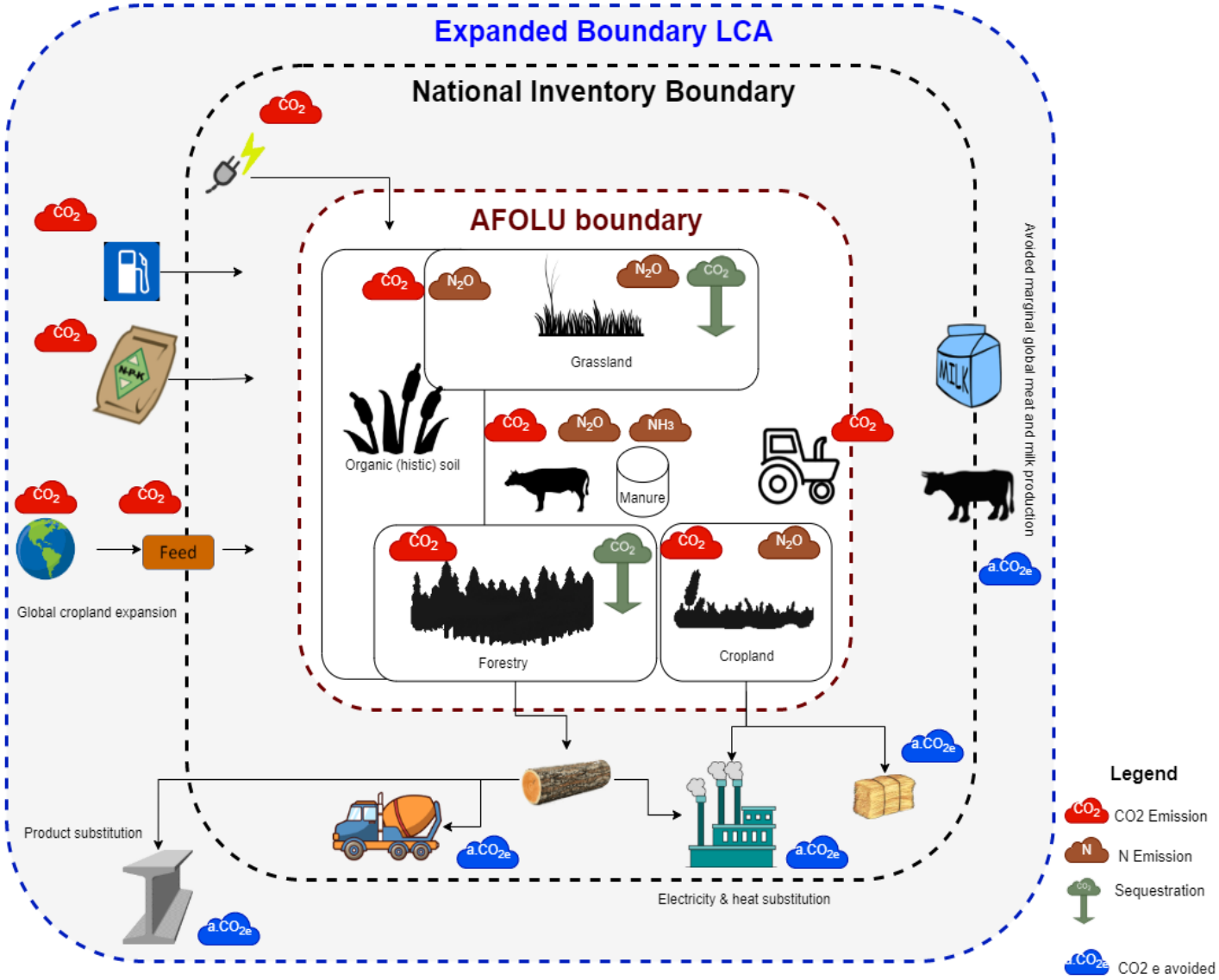
- What technology outlook?
- How to take 2050 pathway into account?

GOBLIN: A land-balance model to identify national land sector pathways to climate neutrality

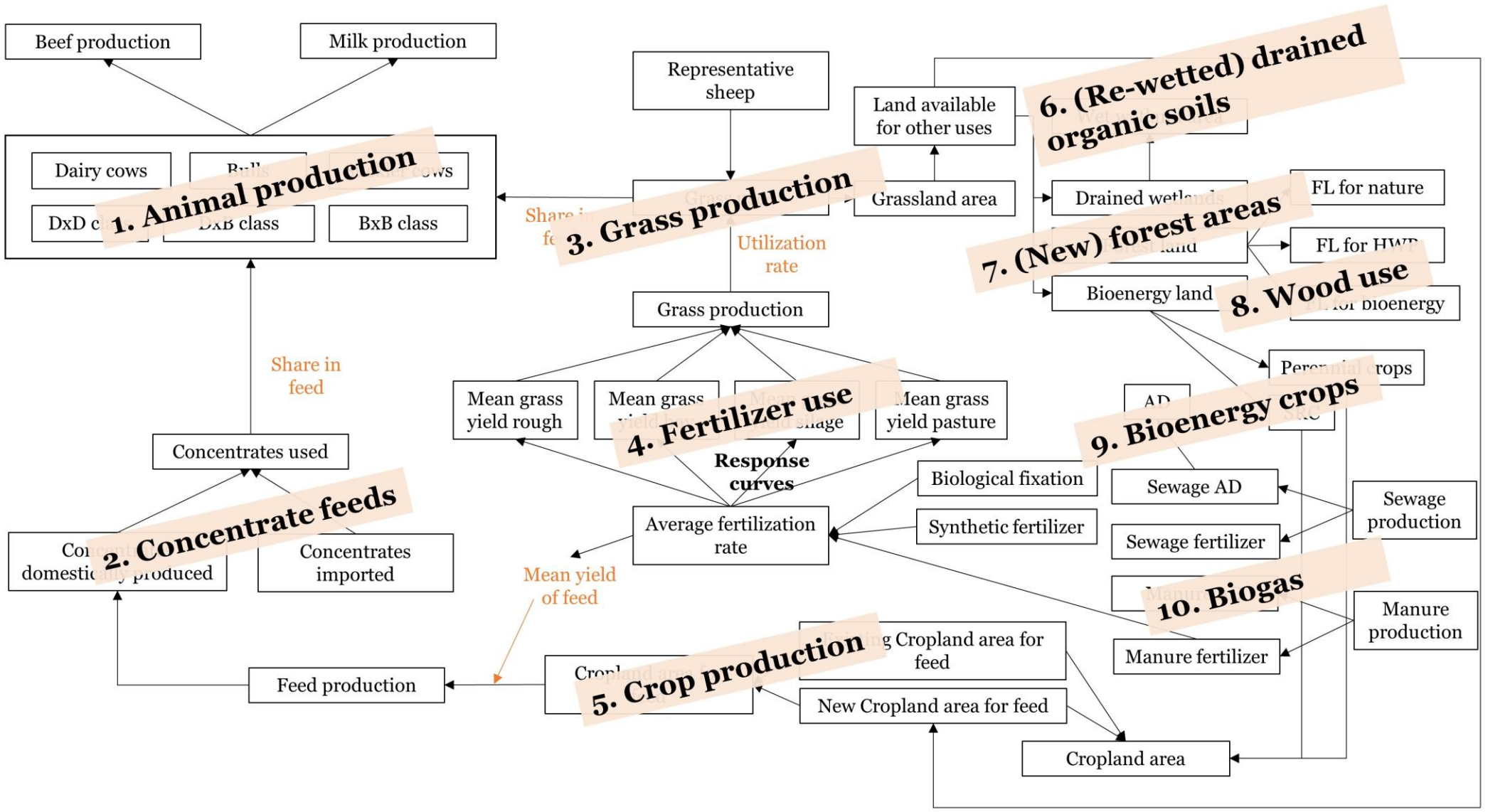
David Styles, Colm Duffy, Remi Prudhomme, George Bishop, Cathal O'Donoghue & Mary Ryan

Overview

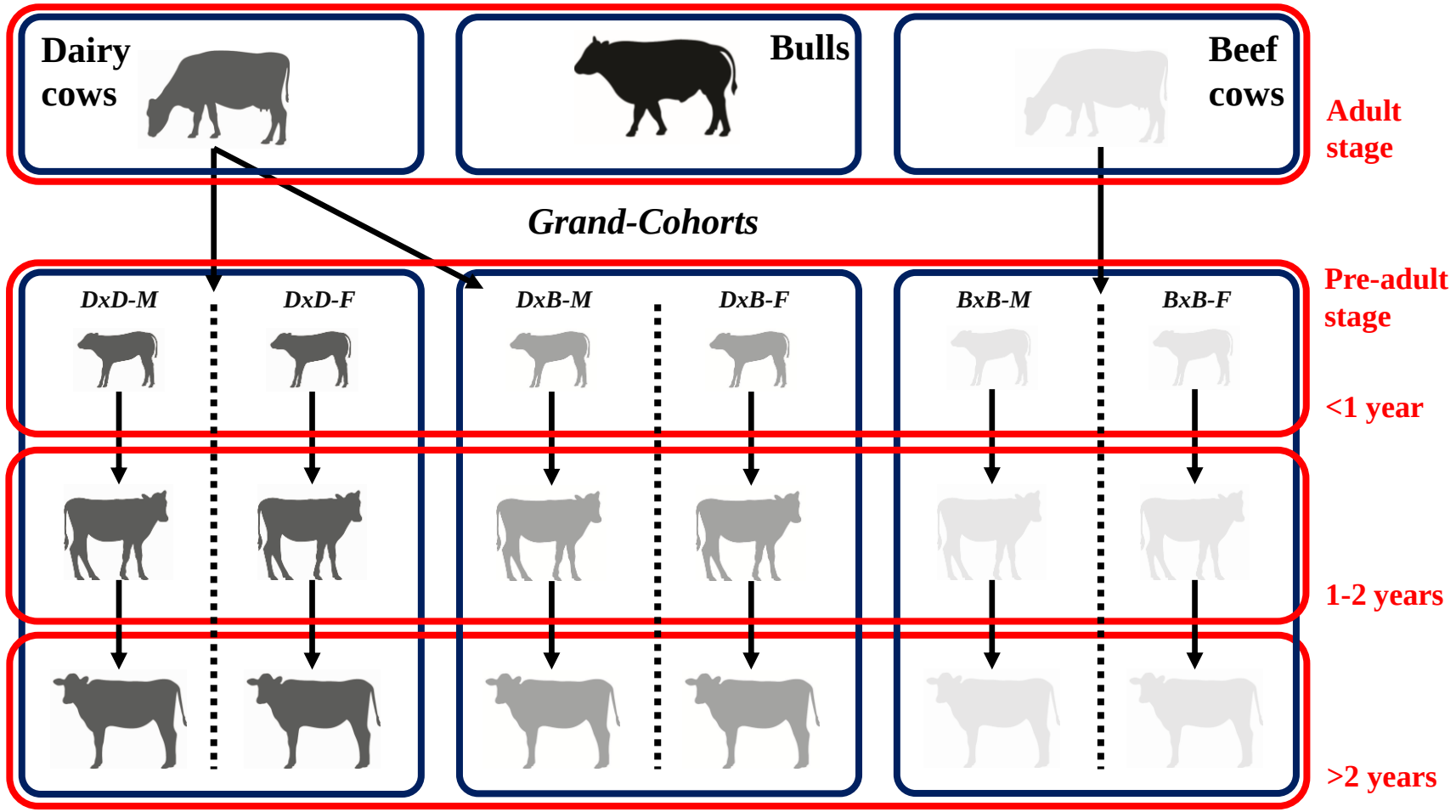
- General Overview for a Back-casting approach of Livestock INtensification & land use
- Comprises modules from previous livestock LCA and forestry research, with new functions
- Identify pathways to a climate neutral AFOLU sector 2050-2120
- Randomised, biophysically coherent scenarios
- Support a back-casting (Foresight) approach: what's *possible*?
- Duffy et al. (2022). Geoscientific Model Development: https://gmd.copernicus.org/preprints/gmd-2021-228/



Modular structure



Cattle herd dynamics



21 cohorts with individual liveweight and growth rates based on annual slaughter data

Henn et al (in review). *Improved representation of cattle herd dynamics for bio-physical modelling of pathways to a climate neutral land sector* (Agric Syst)

Key Questions

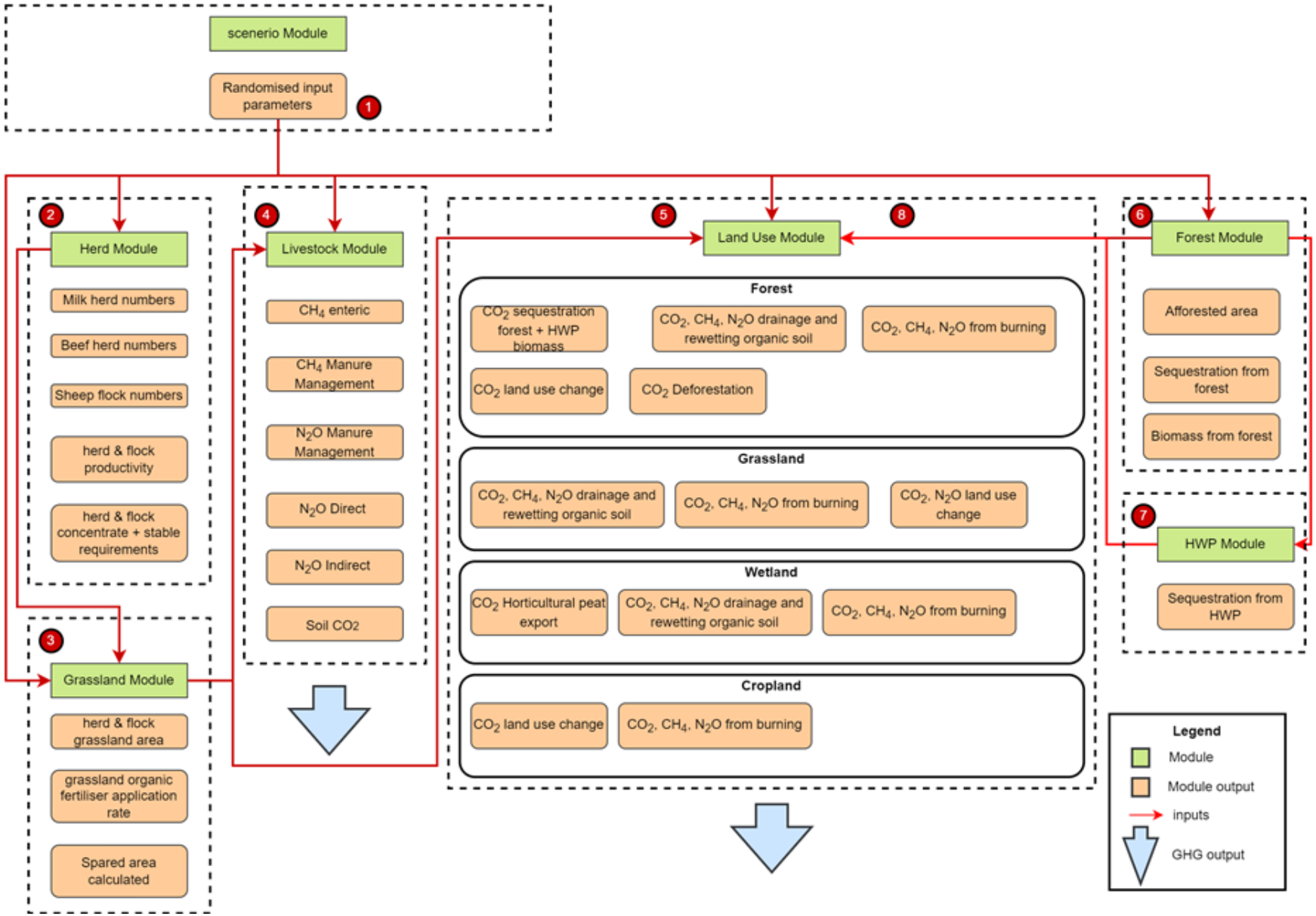
- What (many) combinations of Agriculture & LULUCF activities are compatible with different definitions of climate neutrality, 2050-2120

- Many derivatives thereof:
  - E.g. min afforestation needed to balance GHG from fixed milk production, under different animal productivities & abatement levels (post hoc)
  - Max milk and beef production that could be sustained under climate neutrality at given levels of afforestation and organic soil management
  - With and without constraints re. land requirements for e.g. biodiversity, bioenergy, biomaterials etc etc

Ollscoil na Gaillimhe
University of Galway

Overview, inputs, software

- 2015 baseline year - activity data from CSO, NFS etc plus NIR EFs)
- 2050-2120 target year(s) – randomised scenario activity data plus NIR EFs
- Randomised, biophysically coherent scenarios
- Assume activities vary within technical ranges - e.g. milk yields per cow, animal numbers, area drained organic soils rewetted
- Tier 1 & 2 NIR EFs applied through time
- Python code

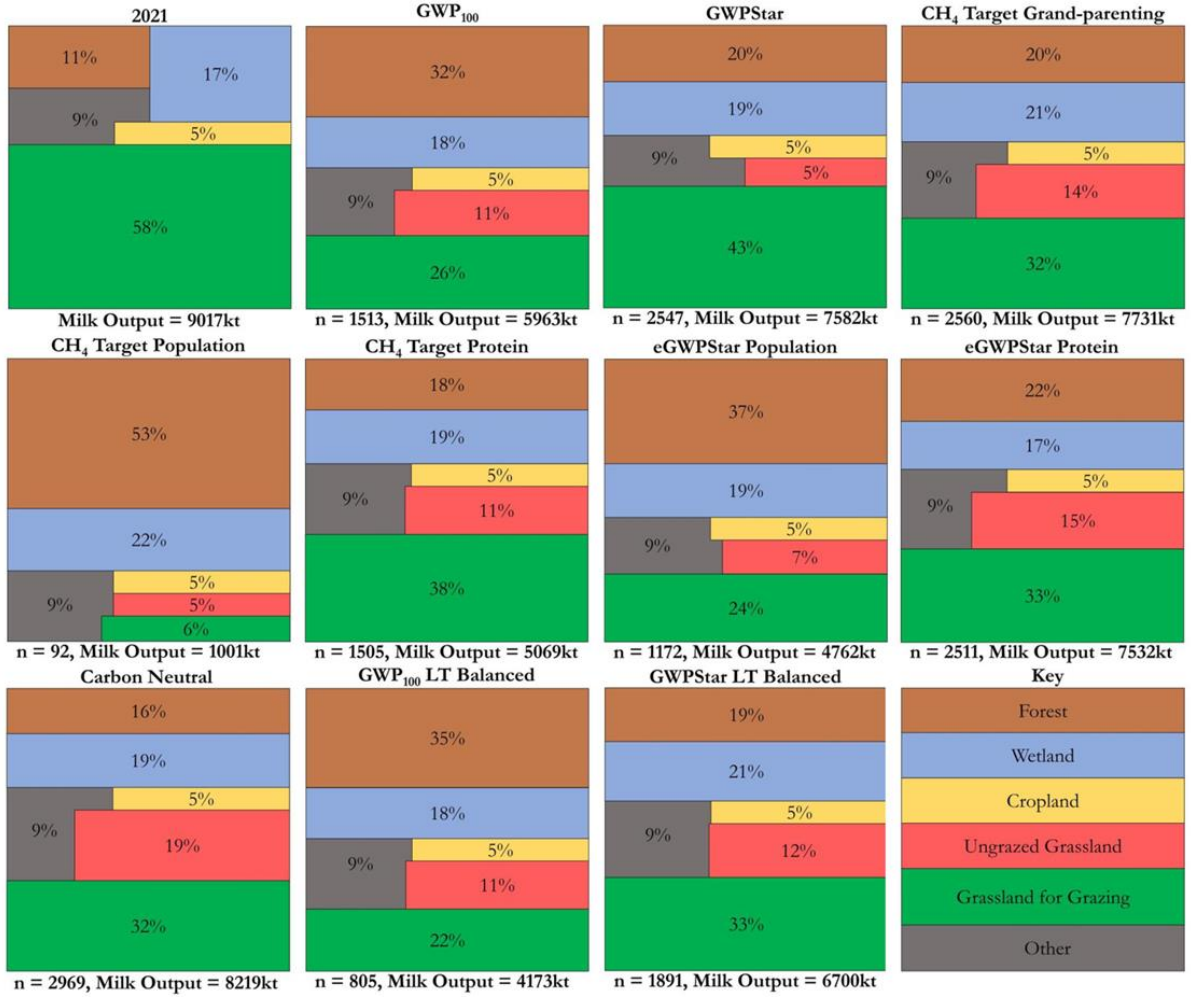


Assumptions & constraints

- Current emission factors for specific activities x management (Tier 2 ag) – post hoc reductions in source emissions to reflect future abatement
- Uncertain emissions for LULUCF: forestry updated with CBM-CFS3 model; organic soil emissions Tier 1 and assume close to zero balance upon rewetting
- Assume no new forest planting on organic soils – could be adapted
- Randomised future approach: Unconstrained by current "market"-subsidy-policy context, or biodiversity targets etc (biophysical constraints only) – but scenario inputs can be constrained and/or filtered
- Focus on 2050 and beyond (linear activity change trajectories out to 2050 – assume activities remain constant thereafter, though forestry dynamics represented to 2120)
- Currently simple (NIR) representation of HWP – cascading wood value chains being integrated
- National balance – GeoGOBLIN (Duffy et al., in prep.) includes spatial resolution down to Electoral District level (to be coupled with Land Cover map). Prototype for Blackwater catchment for GOBLIN v2.0 in *FORESIGHT*

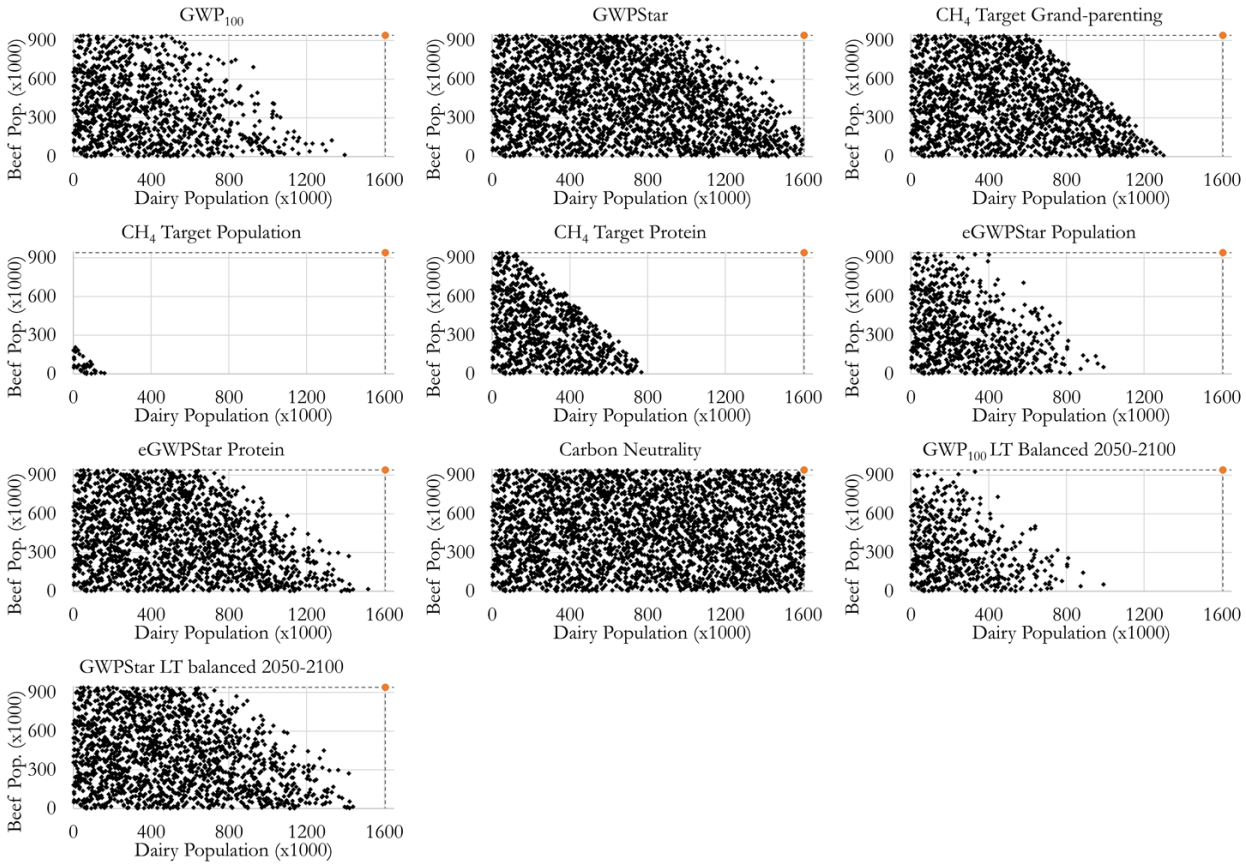
Outputs: disaggregation by gas

95%ile milk output by definition 2050-2100



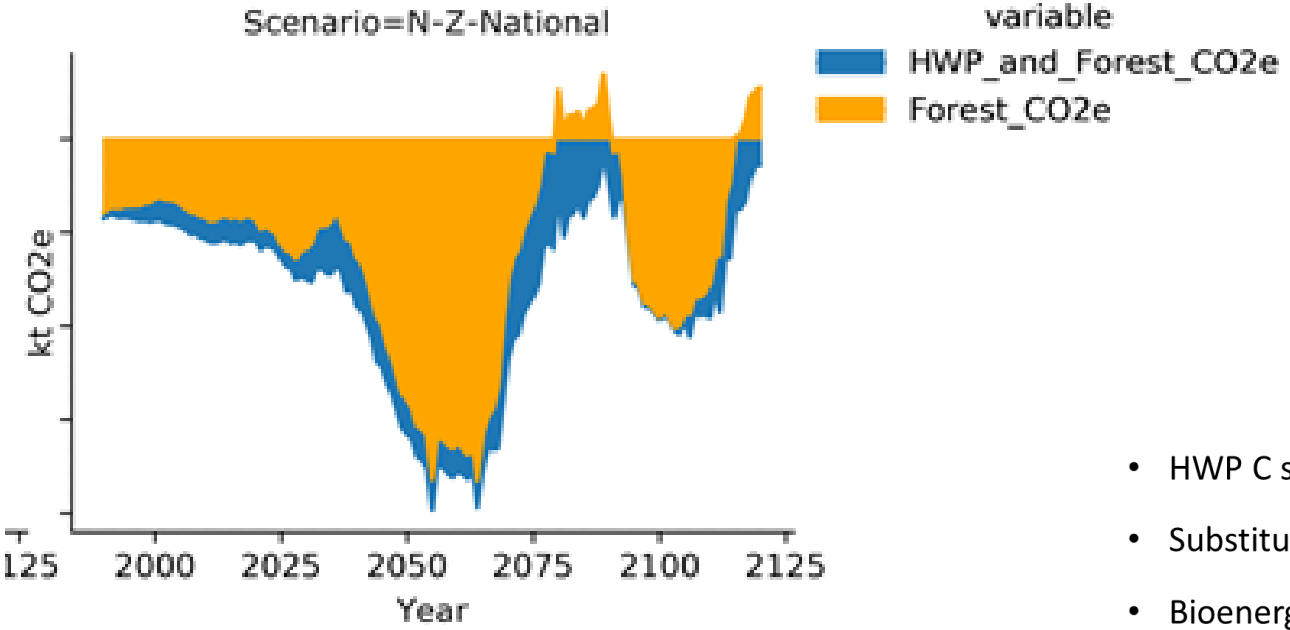
Bishop et al. (in review)

Associations & bounds across parameters (by definition)



With and without 30% technical abatement of CH_4 & N_2O

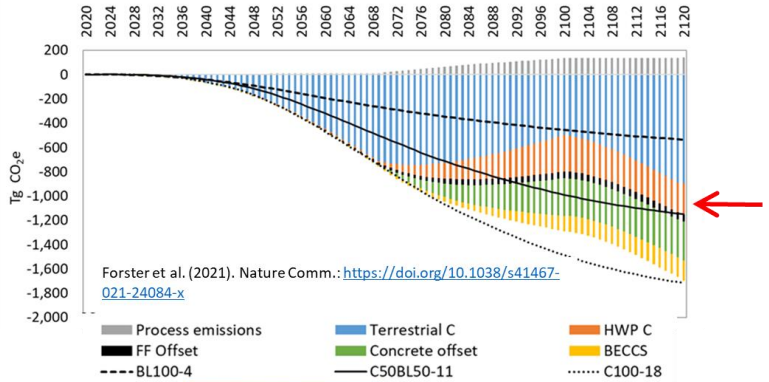
Output: time series



Duffy et al. (2022). Nature Sustainability https://rdcu.be/cUZ6w

Harvested Wood Products (40-100+ yrs)

- HWP C storage
- Substitution credits
- Bioenergy C capture & storage?
- Delayed emission to atmosphere plus bioeconomy mitigation

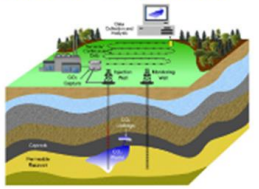


...3-10 yrs

...35-60 yrs

...45-70 yrs

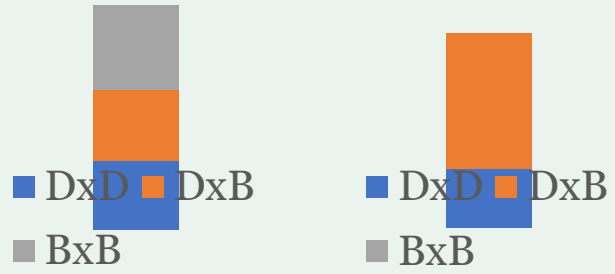
1000s of years?



Linkages with downstream models

Outputs: climate, water & air quality

6.76 million ↘ 5.69 million



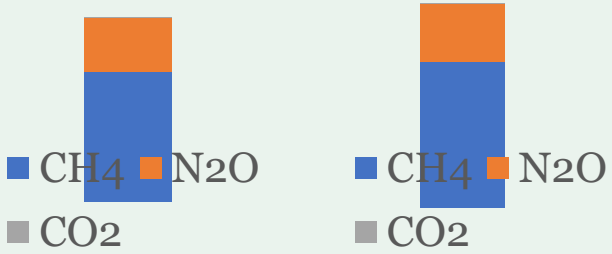
443 kt ↗ 543 kt

N – 362 kt ↘ N – 295 kt

P – 47 kt ↘ P – 39 kt

K – 122 kt ↘ K – 99 kt

20.3 Mt CO_2e ↘ 18.8 Mt CO_2e

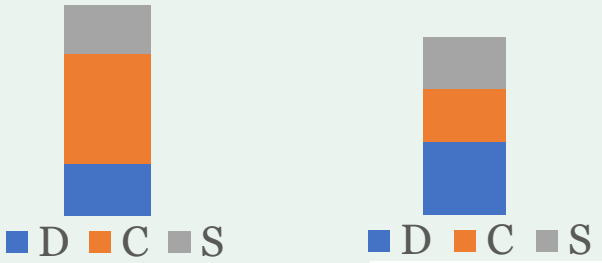


NH_3 – 131 kt ↘ NH_3 – 116 kt

N_{leach} – 87 kt ↘ N_{leach} – 76 kt

P_{leach} – 6.9 kt ↘ P_{leach} – 6.1 kt

4.01 million ha ↘ 3.26 million ha



Henn et al. (in prep.)

AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

The Irish Agriculture and Food Development Authority

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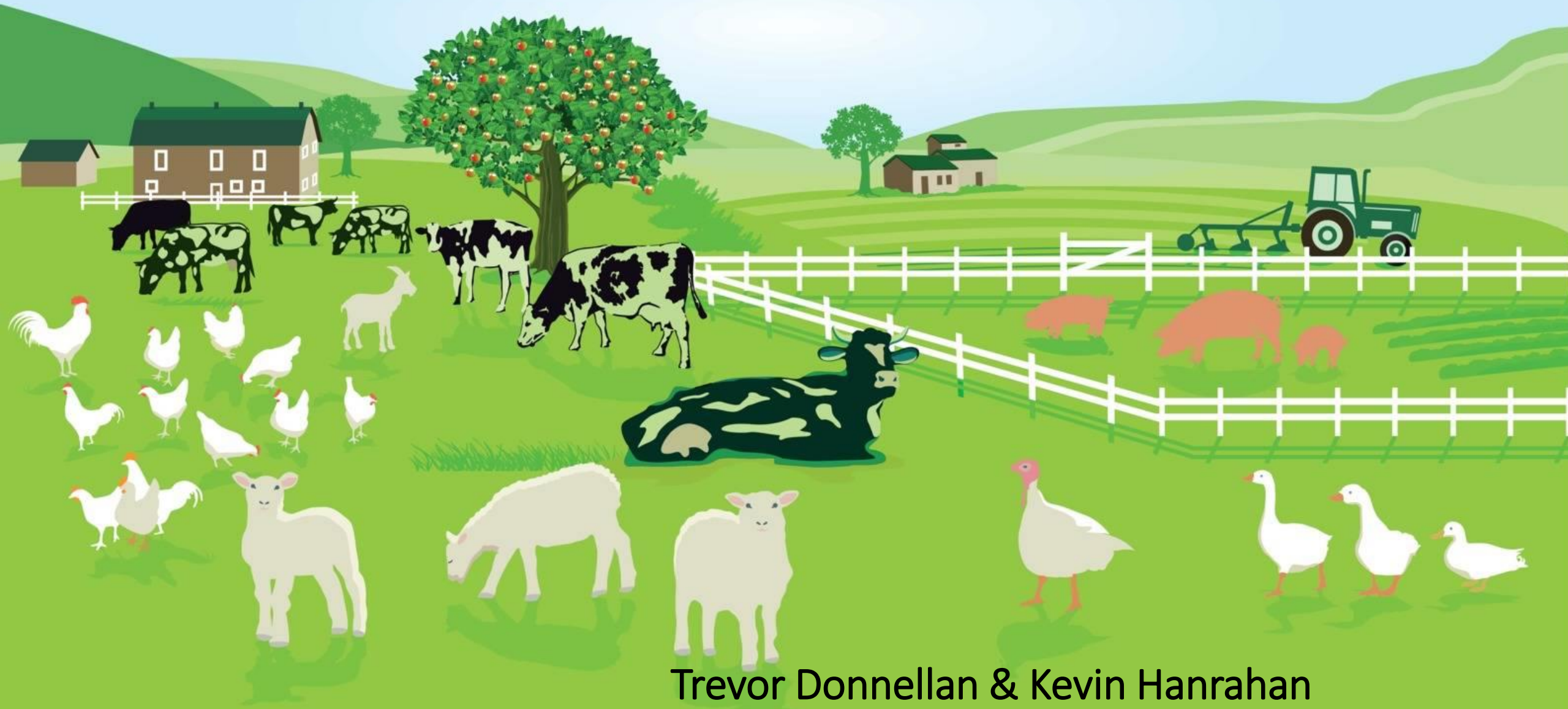
AGRICULTURE AND FOOD DEVELOPMENT AUTHORITY

FAPRI-Ireland Model of the Irish Agricultural Economy

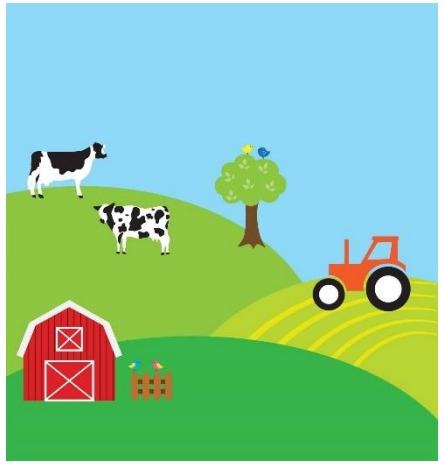


Trevor Donnellan & Kevin Hanrahan
Agricultural Economics and Farm Surveys Department Teagasc

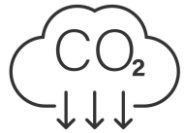
Overview of methodology employed

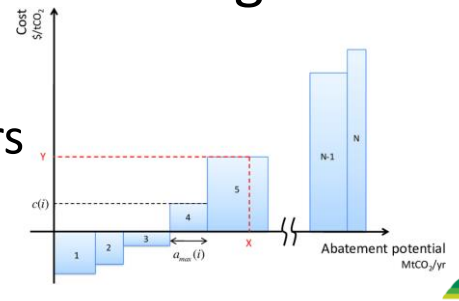
- **FAPRI-Ireland model is a Dynamic PE** model of the Irish agricultural economy
- **Global dimension:** International supply and demand critical for understanding medium term evolution of Irish agri-food economy
  - Like Irish pharma, electronics, traded services etc. most agri-food output is exported
  - Domestic (i.e. Irish) consumers are relatively unimportant – in marked contrast to many other EU MS
- Linked to the **FAPRI EU & FAPRI global agricultural market modelling** systems
- Uses **exogenous macroeconomic** projections from **domestic** and **international sources**
- Simulates commodity **market supply and use balances** and associated agricultural **activity levels** to a medium term horizon (**generally 10 years**)
- Model projections provides input data to
  - **farm level modelling of agricultural policy issues**
  - **modelling of GHG mitigation** within agriculture (Teagasc MACC)

Model extension to GHG and Climate Change



- To provide **GHG (& ammonia) emissions** projections
- **Highly detailed** Agricultural GHG component
  - GHG projection capacity aligned with **EPA GHG inventory** requirements
  - Model **modified overtime** to remain consistent with refinement of the inventory methodology (move towards Tier II)
- **Supply EPA with Agricultural activity projections**
  - to fulfil their EU and wider international GHG reporting requirements
- Use of FAPRI-Ireland model for assessment of climate related policies has grown
  - Initially projections **without GHG mitigation**
  - Projections **with mitigati**on (Teagasc MACC) included in more recent years





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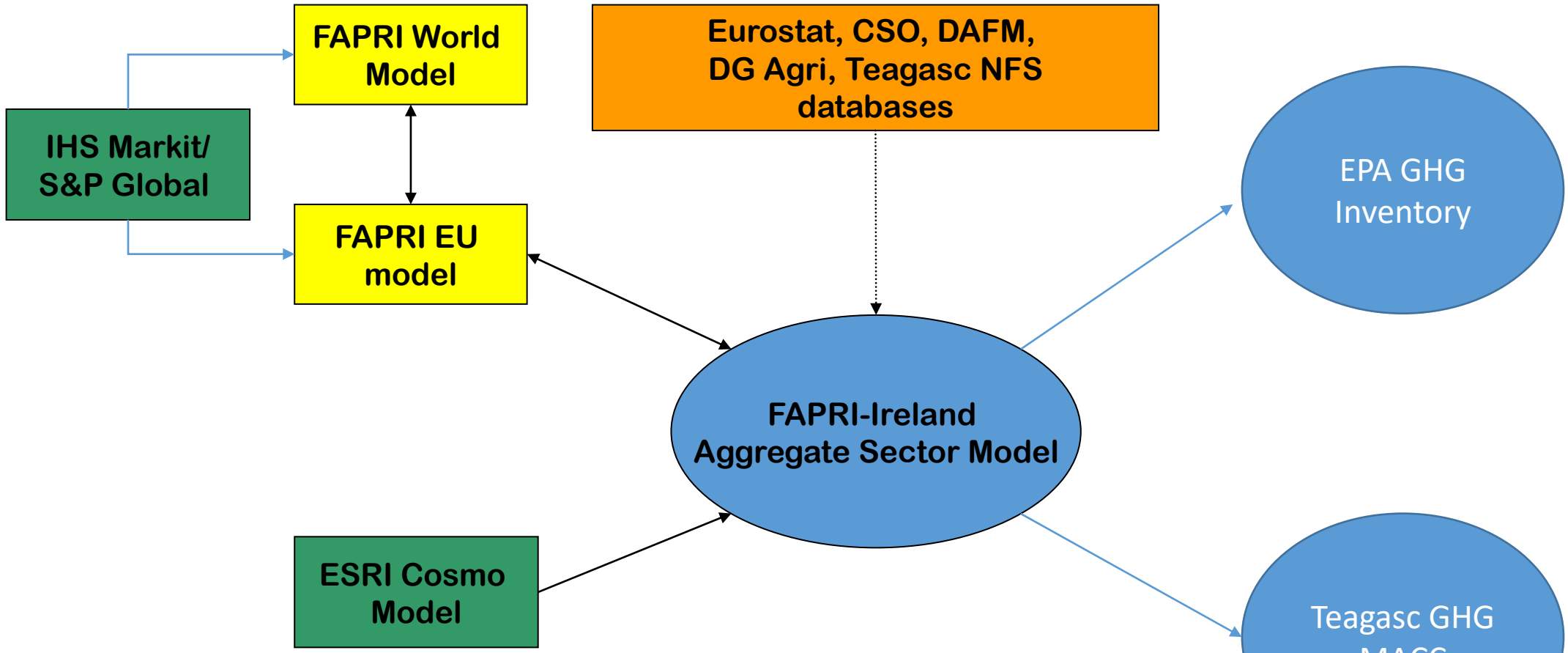
Model Interrelationships and Data sources



Central data sets and inputs

Exogenous to the model

- **Demographic and Macroeconomic variables**
  - GDP, Population, Exchange rates, Inflation
- Agricultural and trade **policy data**
  - Subsides, quota, tariffs, tariff rate quota
- **Technical relationships** for input use
- **Biological constraints**
  - **Pigs per sow, calves per cow per year**
- **Exogenous prices**
  - international agricultural commodities
  - energy prices

Endogenous to the model

- **Output** prices
- **Input** prices
- **Quantities** (Activity levels)
- Input demands
- Commodity **Supply & Use** balances
- Agricultural land use and animal balances
- **EAA** elements (Ag Accounts)
  - Output value, Intermediate consumption, GVA, Net Subsidies on Products, Net Subsidies on Production, Fixed Capital Consumption, Operating Surplus

Sources of data: CSO, Eurostat, EC, DAFM, ESRI, S&P Global

Model scope and complexity

Economic Modelling Outputs

- Ag sector and **Sub-sectors** modelling
  a) agricultural activity
  b) related commodity supply and use
  c) input demands
- **Market prices** for outputs and inputs
- Developments at sub-sectoral level
  - linked via competition for land, feed use, consumer demand and biology (e.g. milk and beef)
- Modelling trade is obviously critical in terms of Irish agriculture

Environmental Modelling and Output

- EPA Agriculture inventory
  - currently built on 75 agricultural activity levels and associated EF
  - GHG = $\sum_i$ GHG_i = Ag Activity_i*EF_i
- Model provides economically meaningful projections for most of these activity levels
- Model development has followed EPA GHG inventory developments
  - One of the reasons why high detail is vital

Key outputs: Key Questions to ask the model

- **Medium term projections (10 year horizon)**
  - Agricultural activity levels, Agricultural Output, Input and Income elements
  - Agricultural Output and Input prices
- **Agricultural activity drivers** of Ag GHGs
  - Animal Inventories (Cattle, Sheep, Pigs, Poultry)
  - Agricultural land use (Grassland, other Crops)
  - Crop production (Cereals, Potatoes, Oilseeds, Other)
  - Nitrogen fertiliser use

- **Projections of Agricultural GHG emissions** consistent with EPA inventory
  - Provide basis for EPA projections of Irish agricultural GHG emissions
  - Allow us to run different scenarios to explore possible future outcomes

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FAPRI Ireland Model Limitations/Sensitivities/Challenges

- **It's a model** – a necessary **abstraction from reality**
  - it is always going to be **"wrong"**
  - Simulation model not an optimisation model
- Maintaining model detail is (very) **time consuming**:
  - the **required level of detail** in the model **increases the burden of model maintenance**
  - from a **purely economic analysis standpoint** a **simpler model would be preferable**
  - but would **not satisfy inventory requirements**
  - Would not allow for assessment of mitigation via **MACC analysis**
- **Policy and political shocks** are **not easy to anticipate**
- Modelling economic activities that **currently do not occur** a challenge
  - E.g. growing grass for use in a Biomethane production (SEAI project ongoing)

FAPRI Ireland Model Limitations/Sensitivities/Challenges

- **Modelling over longer term horizons**
  - **Absence of exogenous projections of macroeconomic and energy market developments beyond 10 year horizon**
  - **Modelling to a ten year horizon is seen as long term in ag-food**
  - **Usual suspects are not producing 20/30 year conditional forecasts that we can "lean" on**
  - **FAPRI EU and Global models not run to 30 year horizons**
  - **Work by OECD on Long Term Agricultural Outlook Model (LAO) highlights important issues that arise over long term in modelling agricultural markets**