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Policy Simulation Modelling to Inform National Carbon Budget Pathways

Ms. Vera O'Riordan, Dr. Tomás Mac Uidhir, Dr. Fionn Rogan
Energy Policy and Modelling Group
MaREI, SFI Centre for Energy, Climate, and Marine, University College Cork, Ireland

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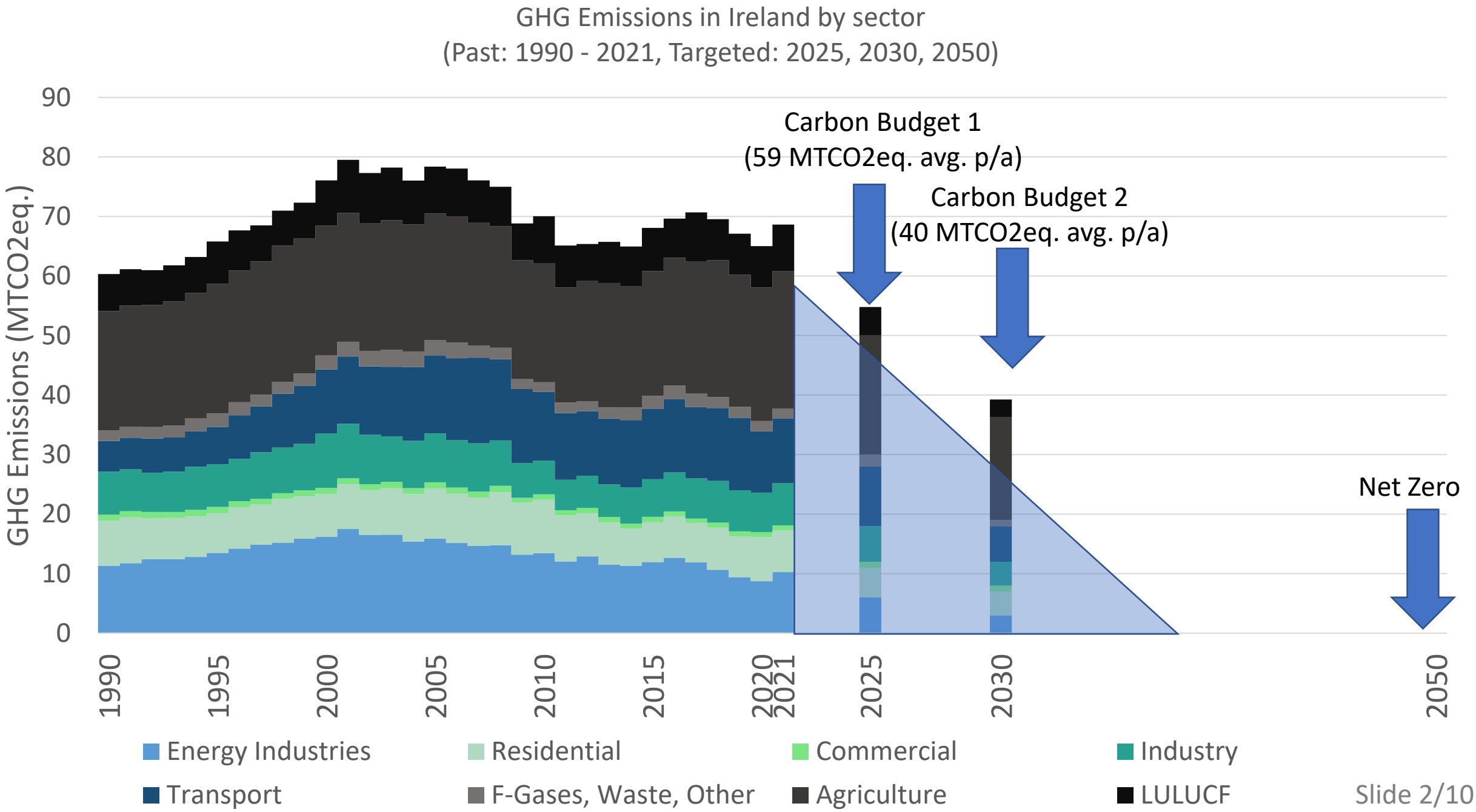
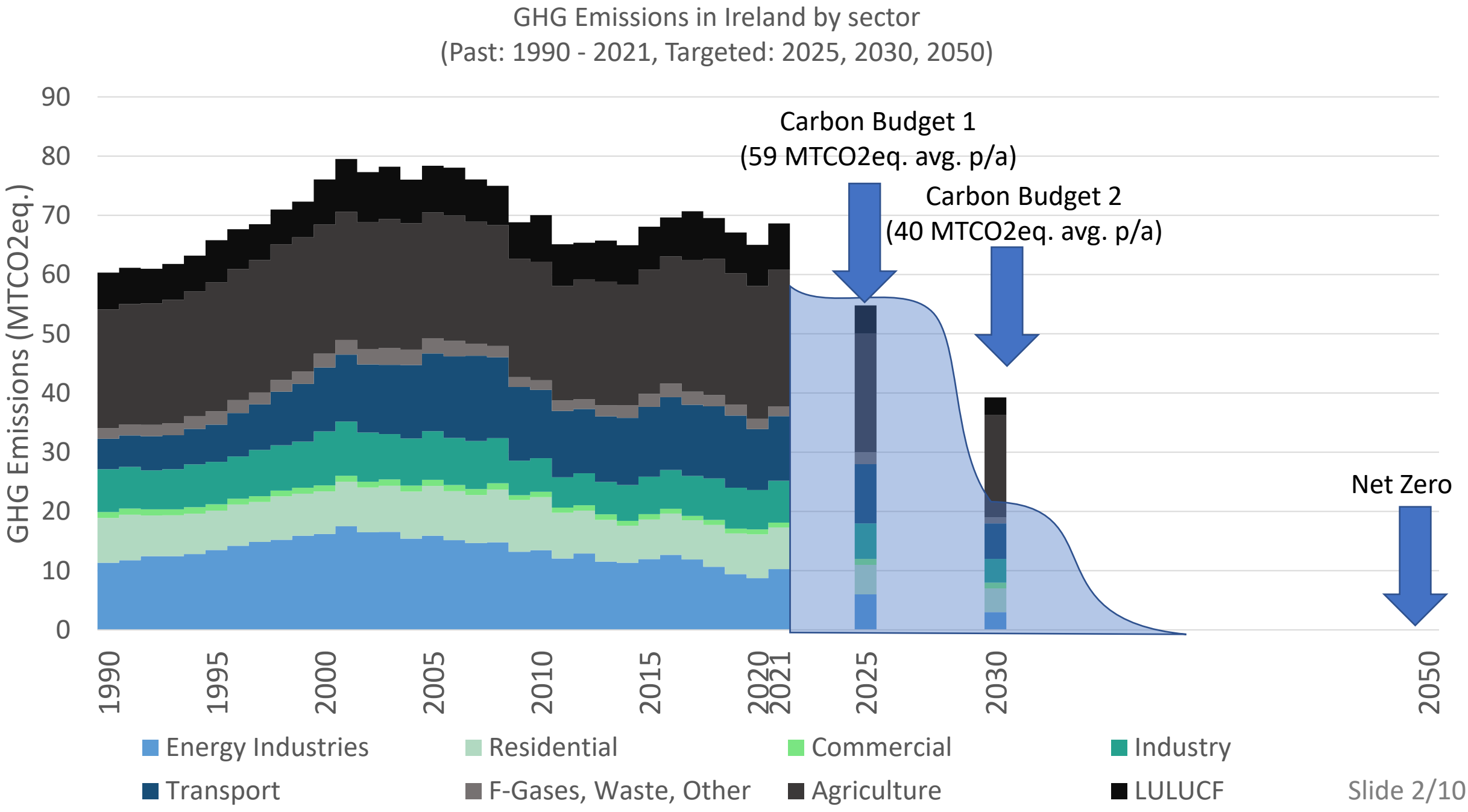
Ireland's Green House Gas Emissions

Where do they come from?

Source: Environmental Protection Agency, (Ireland) 2022 accessible at https://www.epa.ie/ghg


GHG Emissions in Ireland by sector
(Past: 1990 - 2021, Targeted: 2025, 2030, 2050)
GHG Emissions (MTCO2eq.)
90
80
70
60
50
40
30
20
10
0
Carbon Budget 1
(59 MTCO2eq. avg. p/a)
Carbon Budget 2
(40 MTCO2eq. avg. p/a)
Net Zero
1990
1995
2000
2005
2010
2015
2020
2021
2025
2030
2050
Energy Industries
Residential
Commercial
Industry
Transport
F-Gases, Waste, Other
Agriculture
LULUCF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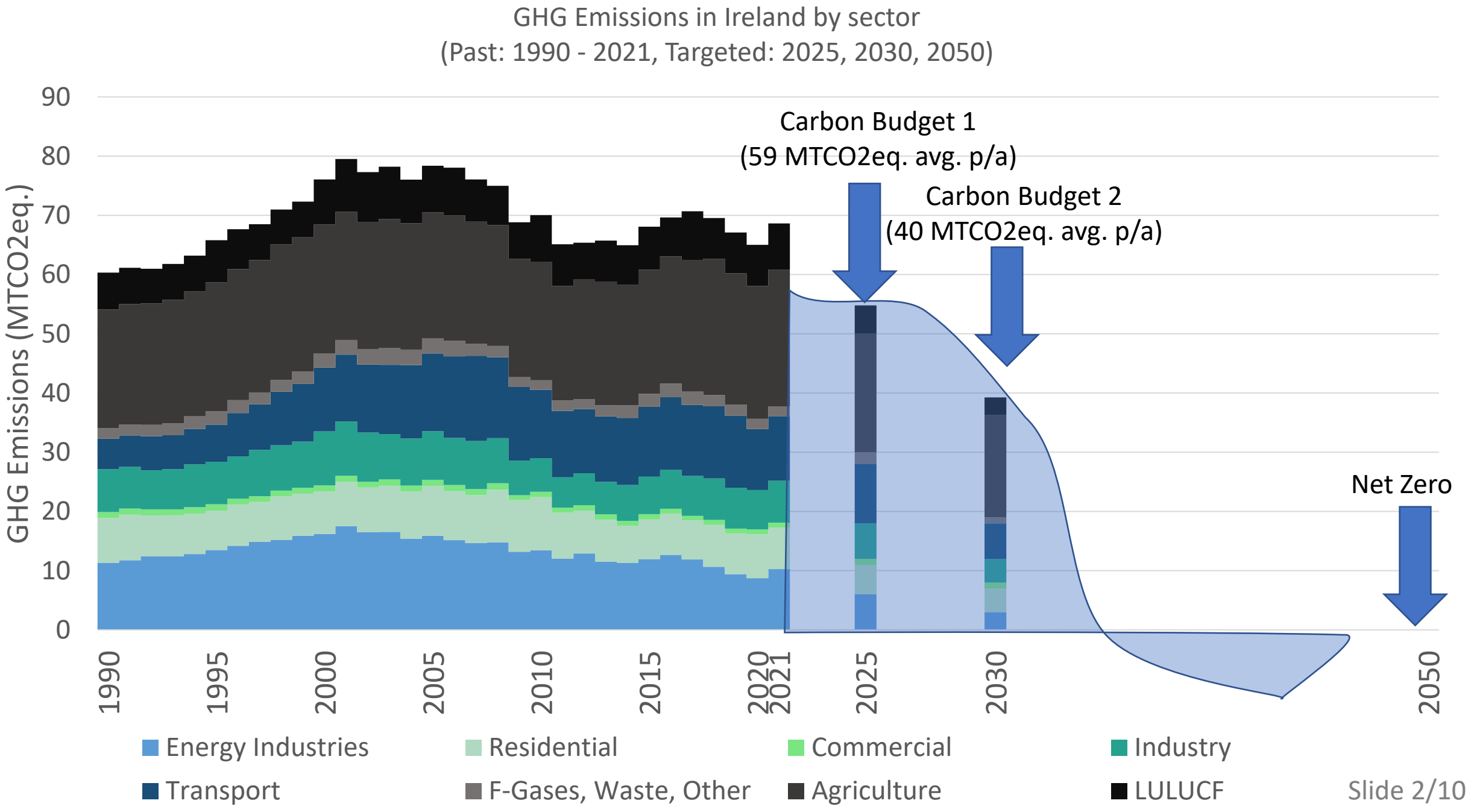
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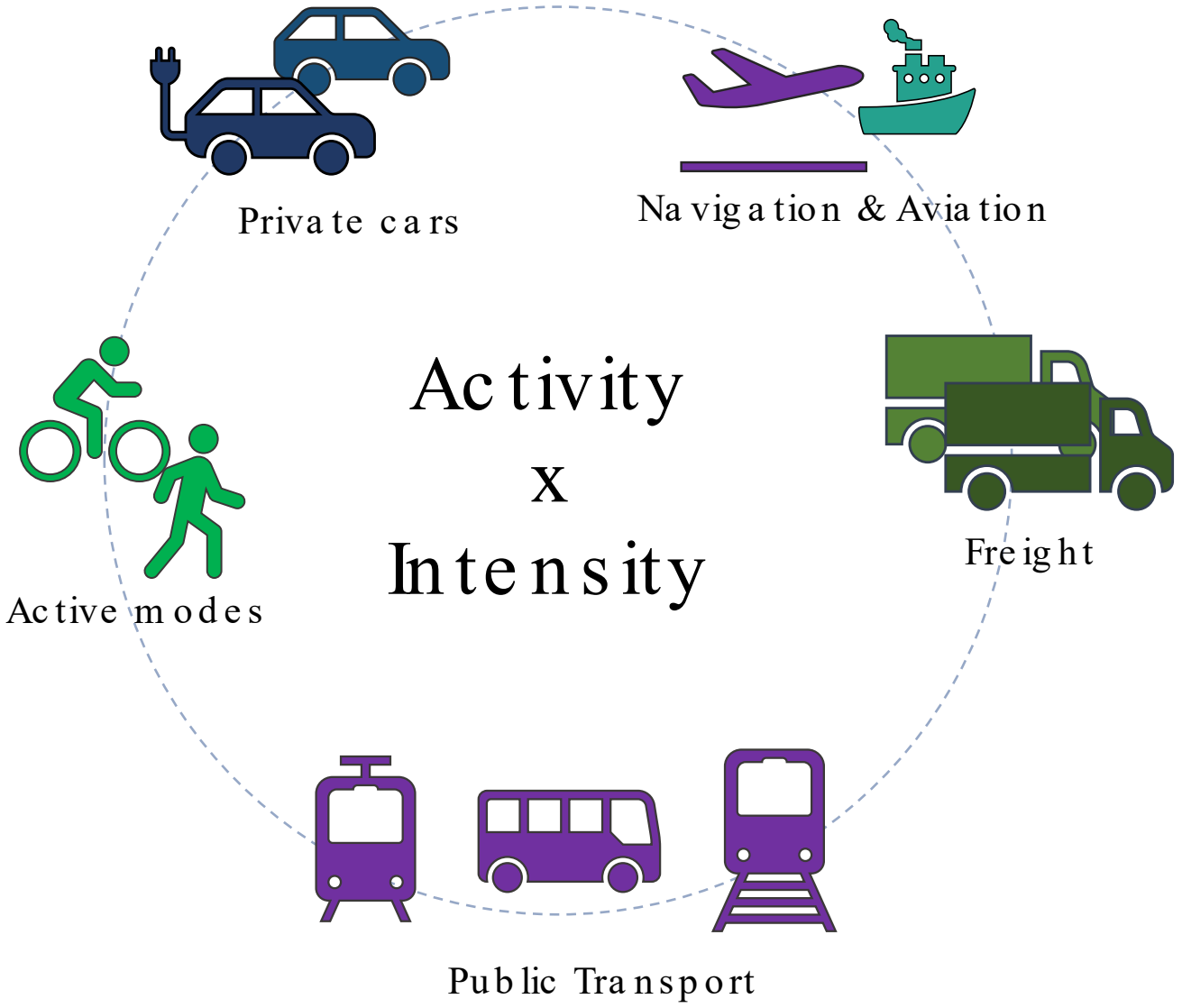
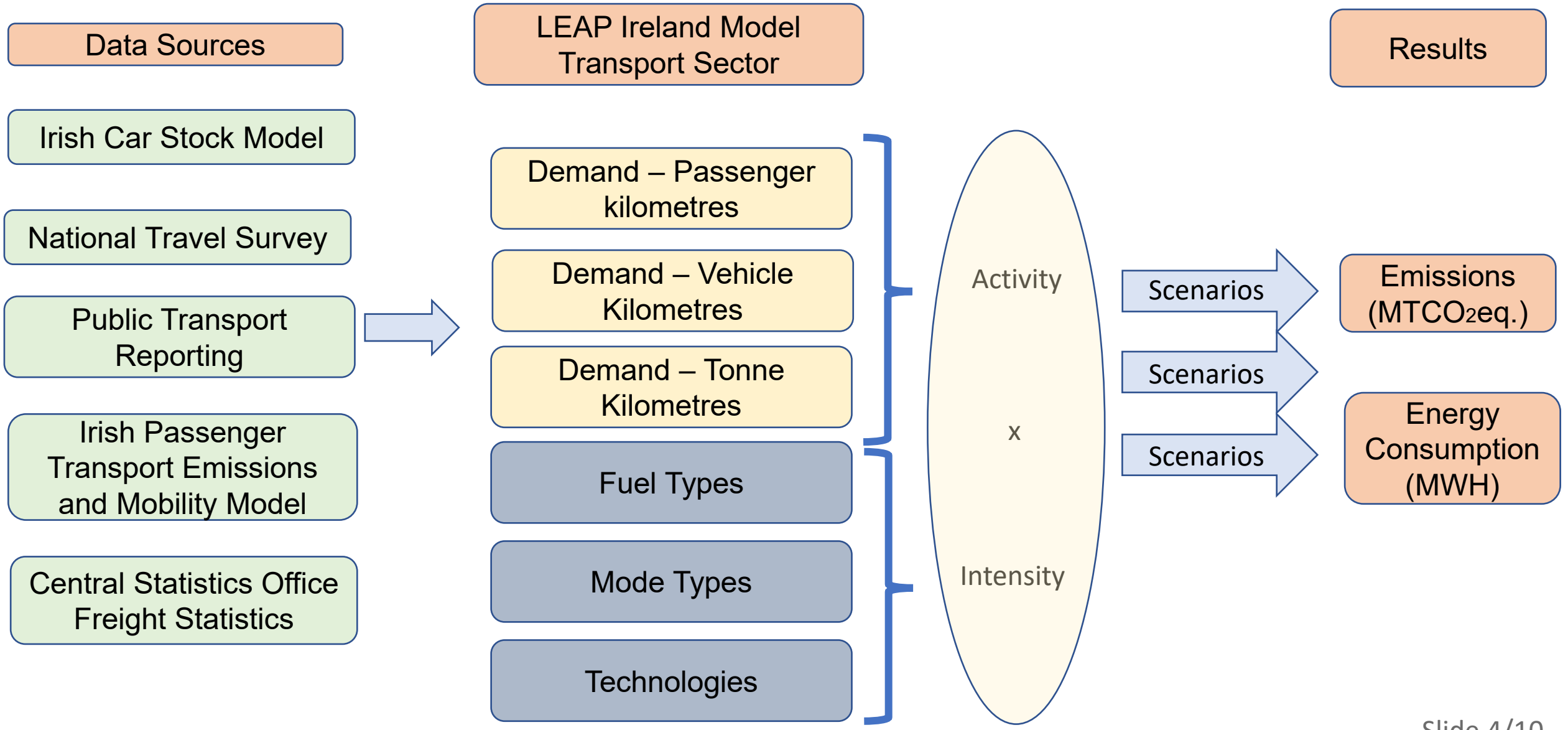
Simulation Modelling



Simulation Modelling



Simulation Modelling

Transport Policies

Biofuel Blending

Working from Home

845,000 EVs

Eco-driving with HGVs

95,000 Electric LGVs

3500 Electric HGVs

Rail electrification

Electric buses

Additional 500,000 public & active trips

Increased biofuel blending rates for ethanol (10%) and biodiesel (12%)

Simulation Modelling

Transport Policies

Biofuel Blending

Working from Home

845,000 EVs

Eco-driving with HGVs

95,000 Electric LGVs

3500 Electric HGVs

Rail electrification

Electric buses

Additional 500,000 public & active trips

Working from home 2 days per week, where possible

Simulation Modelling

Transport Policies

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95,000 Electric LGVs

3500 Electric HGVs

Rail electrification

Electric buses

Additional 500,000 public & active trips

Introduction of 854,000 Electric vehicles by 2030

Simulation Modelling

Transport Policies

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95,000 Electric LGVs

3500 Electric HGVs

Rail electrification

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Additional 500,000 public & active trips

10% improvement in fuel efficiency due to training/ improved practices

Simulation Modelling

Transport Policies

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3500 Electric HGVs

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Increased electrification of **Freight** transport (Heavy & Light Goods)

Simulation Modelling

Transport Policies

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845,000 EVs

Eco-driving with HGVs

95,000 Electric LGVs

3500 Electric HGVs

Rail electrification

Electric buses

Increased electrification of **Public** transport (Rail & Buses)

Additional 500,000 public & active trips

Simulation Modelling

Transport Policies

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Eco-driving with HGVs

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Rail electrification

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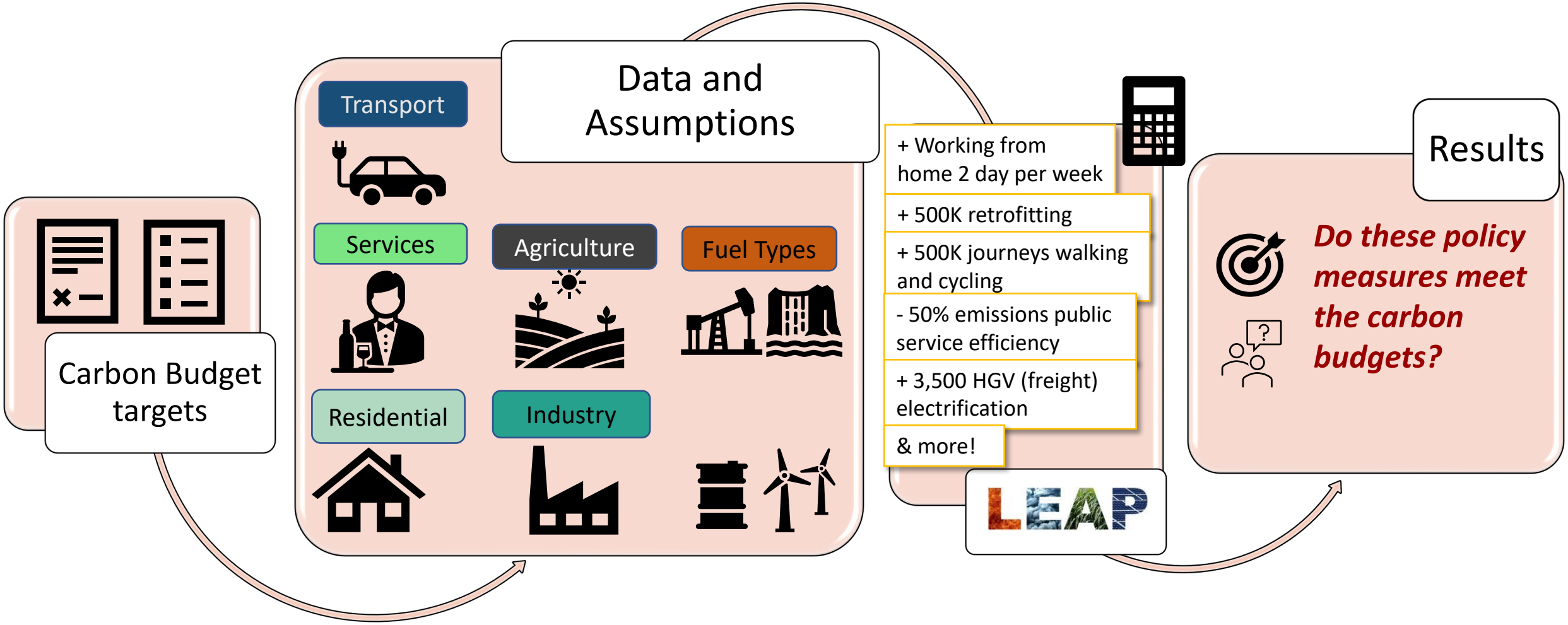
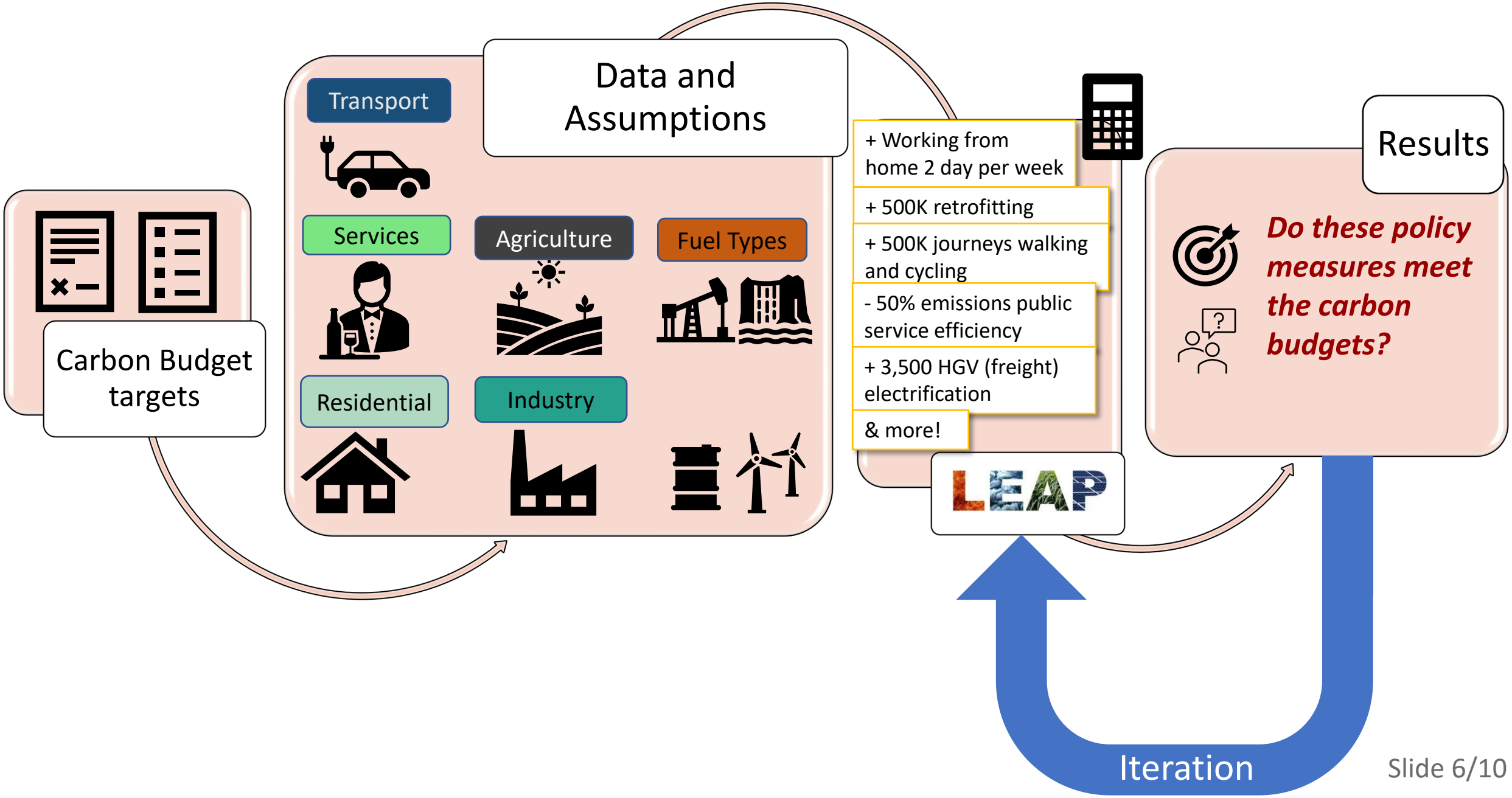
Additional 500,000 public & active trips

Rapid increase in use of public transport and active modes


Carbon Budget targets
Data and Assumptions
Transport
Services
Agriculture
Fuel Types
Residential
Industry
+ Working from home 2 day per week
+ 500K retrofitting
+ 500K journeys walking and cycling
- 50% emissions public service efficiency
+ 3,500 HGV (freight) electrification
& more!
LEAP
Results
Do these policy measures meet the carbon budgets?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LEAP
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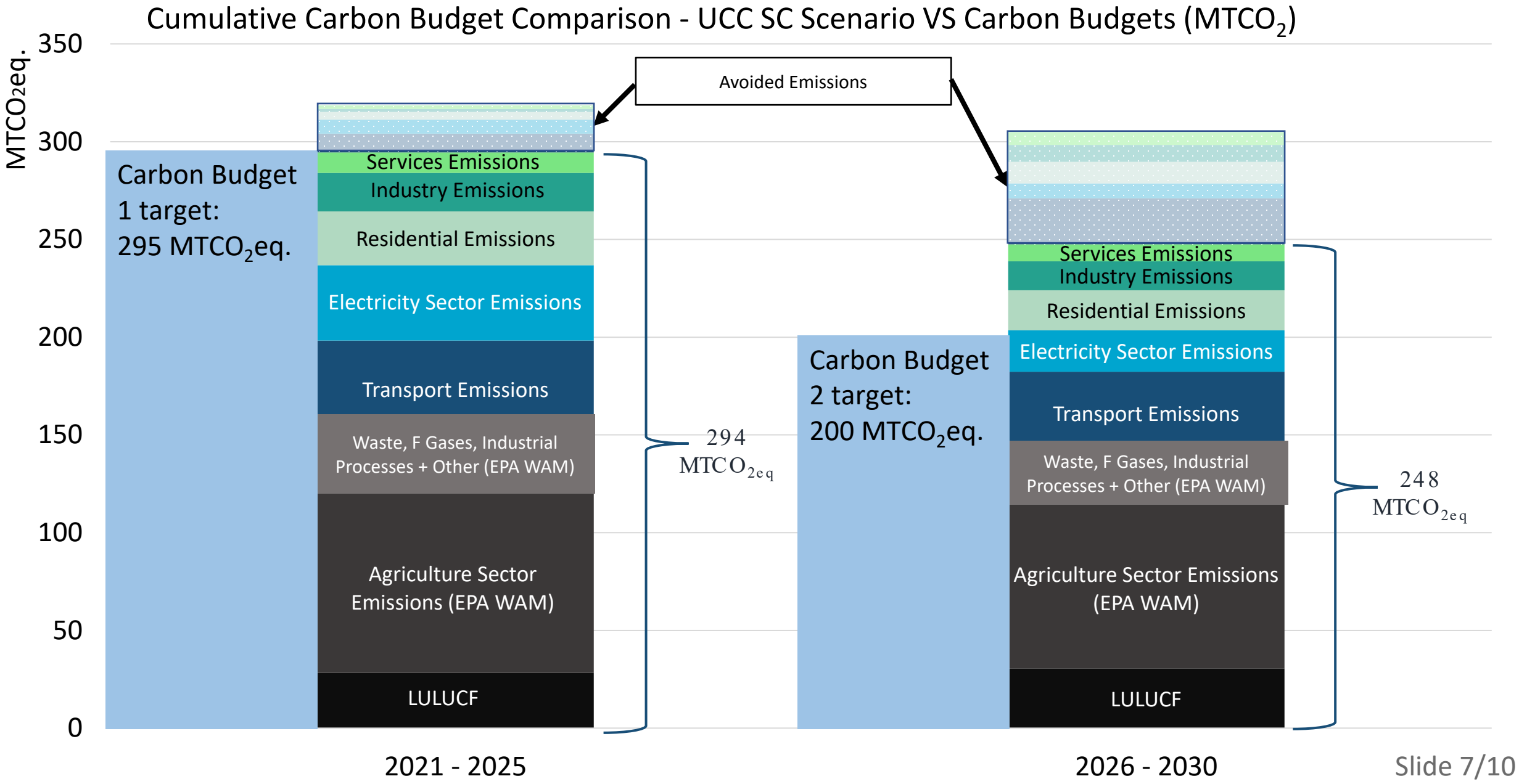
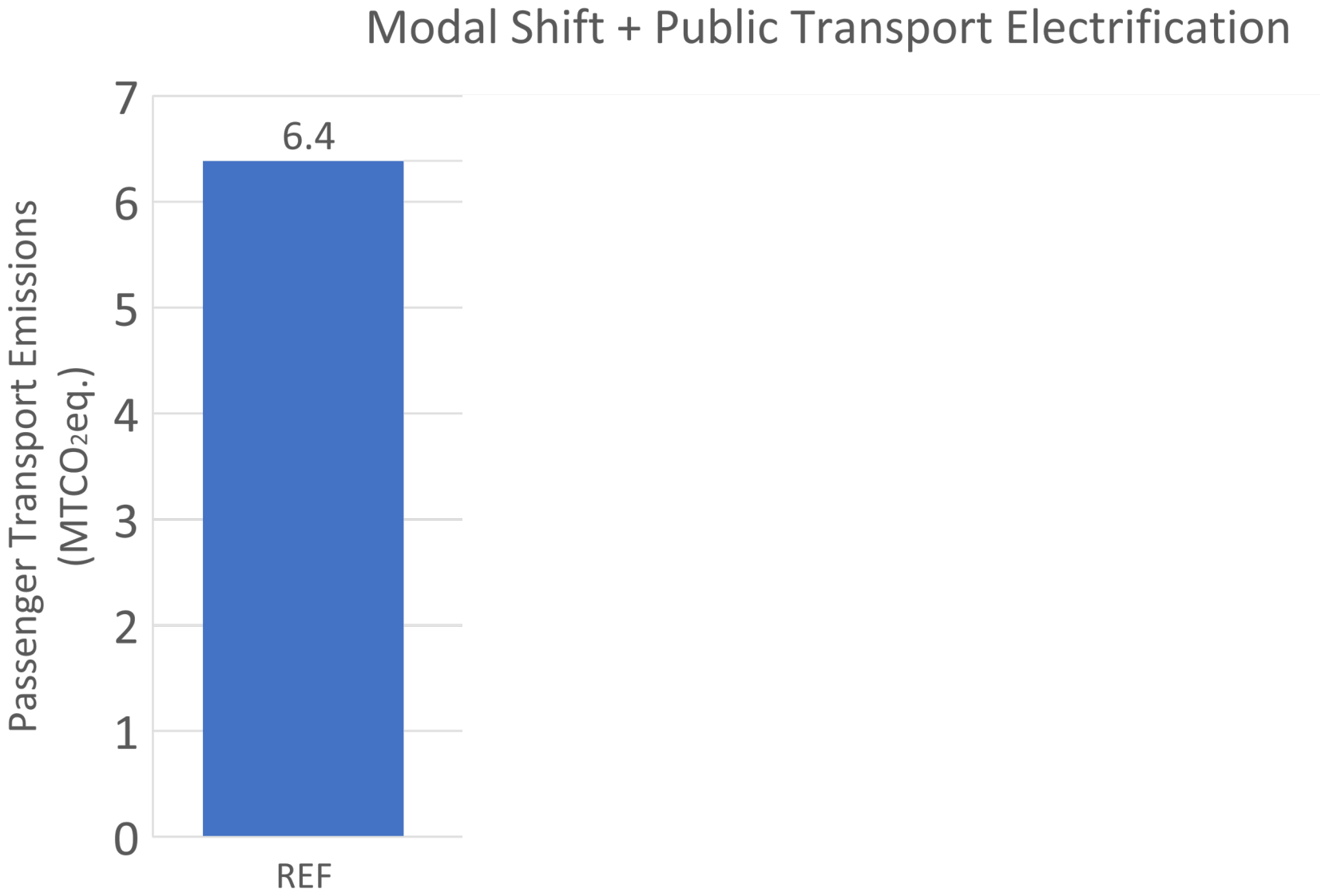
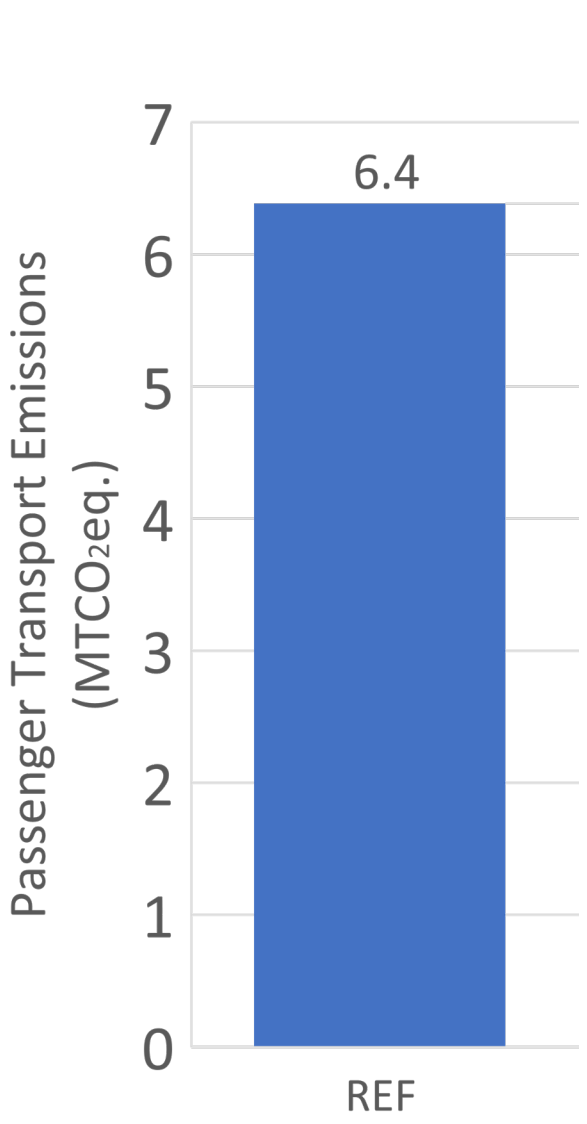
Iteration


Cumulative Carbon Budget Comparison - UCC SC Scenario VS Carbon Budgets (MTCO2)
MTCO2eq.
350
300
250
200
150
100
50
0
Avoided Emissions
Carbon Budget 1 target: 295 MTCO2eq.
Services Emissions
Industry Emissions
Residential Emissions
Electricity Sector Emissions
Transport Emissions
Waste, F Gases, Industrial Processes + Other (EPA WAM)
Agriculture Sector Emissions (EPA WAM)
LULUCF
294 MTCO2eq
Carbon Budget 2 target: 200 MTCO2eq.
Services Emissions
Industry Emissions
Residential Emissions
Electricity Sector Emissions
Transport Emissions
Waste, F Gases, Industrial Processes + Other (EPA WAM)
Agriculture Sector Emissions (EPA WAM)
LULUCF
248 MTCO2eq
2021 - 2025
2026 - 2030

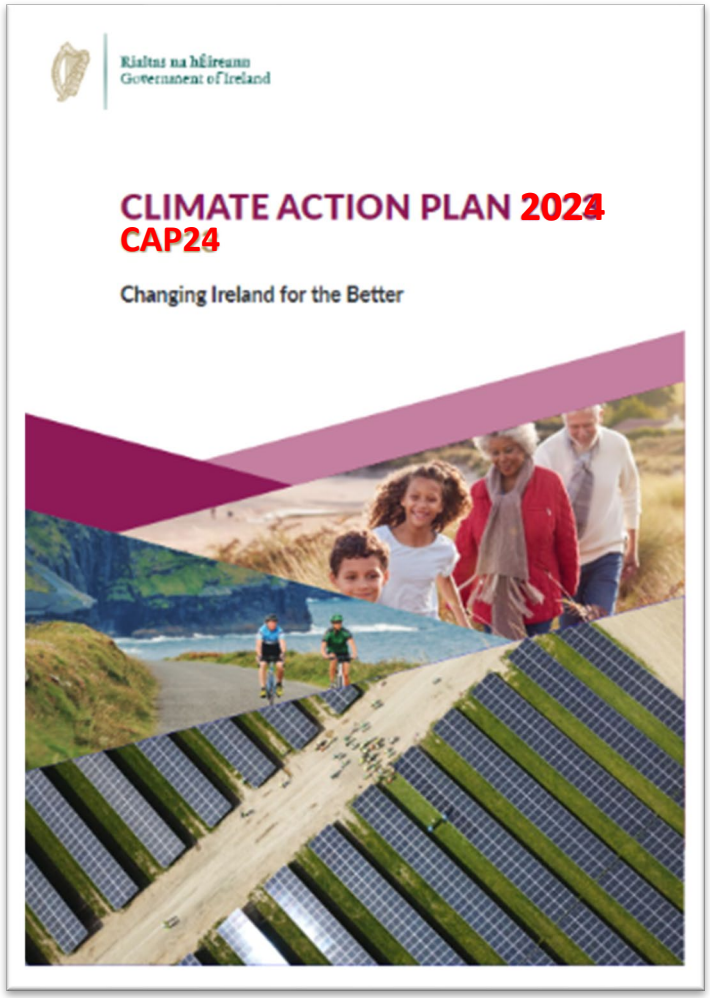
Policies Synergies – the bonus effect



Diminishing Returns – the double counting effect



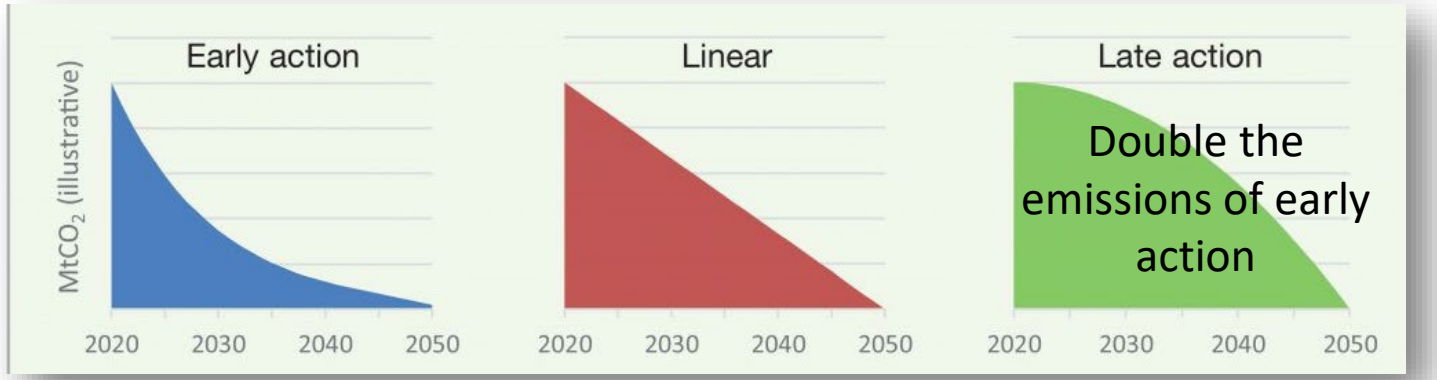
Reflections and Future Work



Climate Action Plan 2023 policies

Climate Action Plan 2024 policies

Impact of early action and delays on carbon budgets



Behavioural changes and new technologies beyond those targets in the Climate Action Plan 2023

CAPACITY

CLIMATE ACTION PATHWAYS & ABSORPTIVE CAPACITY

Questions & suggestions welcome, Thanks for listening!

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European Regional Development Fund
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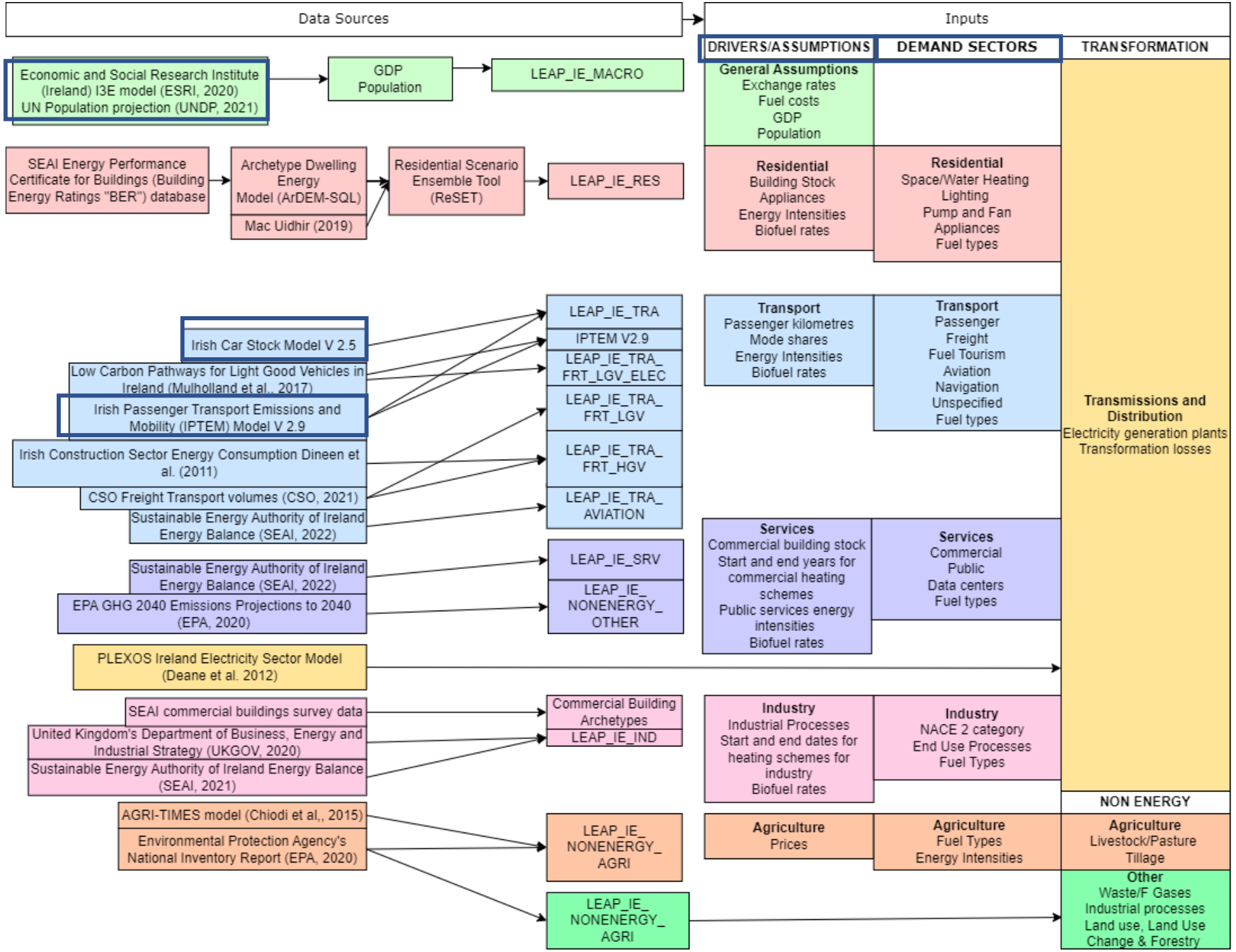
Data Sources
Inputs
DRIVERS/ASSUMPTIONS
DEMAND SECTORS
TRANSFORMATION
Economic and Social Research Institute (Ireland) I3E model (ESRI, 2020)
UN Population projection (UNDP, 2021)
GDP
Population
LEAP_IE_MACRO
General Assumptions
Exchange rates
Fuel costs
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LEAP_IE_RES
Residential
Building Stock
Appliances
Energy Intensities
Biofuel rates
Residential
Space/Water Heating
Lighting
Pump and Fan
Appliances
Fuel types
LEAP_IE_TRA
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Freight
Fuel Tourism
Aviation
Navigation
Unspecified
Fuel types
Transmissions and Distribution
Electricity generation plants
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LEAP_IE_SRV
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Commercial building stock
Start and end years for commercial heating schemes
Public services energy intensities
Biofuel rates
Services
Commercial
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Data centers
Fuel types
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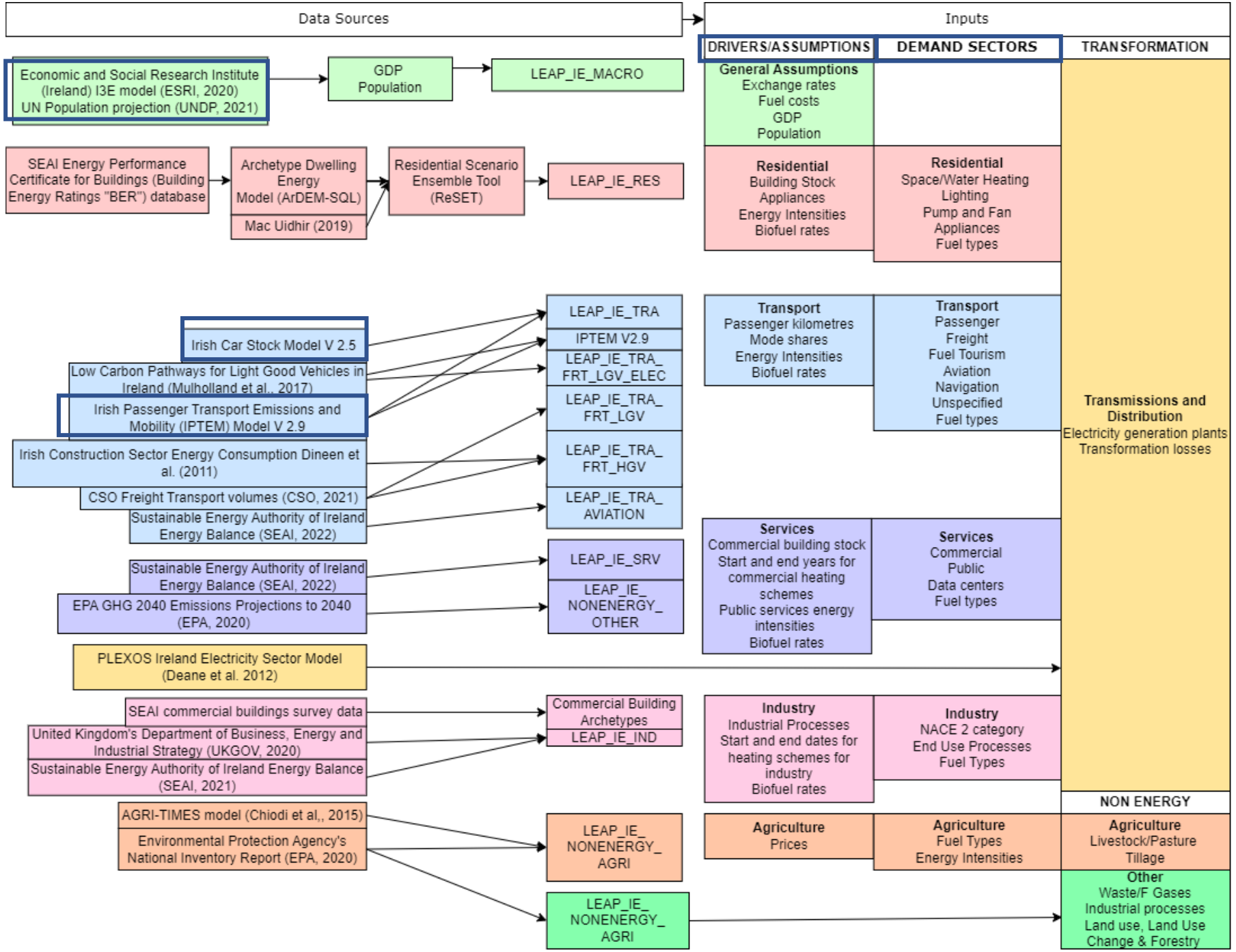
Fuel Types
Energy Intensities
Agriculture
Livestock/Pasture
Tillage
Other
Waste/F Gases
Industrial processes
Land use, Land Use Change & Forestry

	Carbon Budget 1			Carbon Budget 2		
	2021-2025			2026-2030		
	Sector Emission Ceiling	Reference Scenario	UCC SC Scenario	Sector Emission Ceiling	Reference Scenario	UCC SC Scenario
	$MTCO_2eq.$					
Electricity	40	46	39	20	29	21
Transport	54	59	50	37	66	42
Residential	29	32	28	23	31	20
Services	7	12	11	5	15	9
Industry	30	21	20	24	24	15
Other (F gases & Petroleum refining)	9	19	19	8	19	17
Agriculture	106	124	121	96	123	123

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
	$MTCO_2eq.$												
Reference	65.7	65.1	62.2	62.7	65.2	68.4	67.9	65.6	64.7	65.1	65.6	66.2	67.2
Energy	35.6	35.3	32.5	32.5	34.7	35.9	36.1	33.4	33.3	33.1	33.5	33.7	33.9
Non-Energy	30.1	29.8	29.7	30.2	30.5	32.5	31.8	32.2	31.5	32.0	32.1	32.4	33.3
Energy (%)	54%	54%	52%	52%	53%	52%	53%	51%	51%	51%	51%	51%	50%
Non-Energy (%)	46%	46%	48%	48%	47%	48%	47%	49%	49%	49%	49%	49%	50%
UCC Sectoral Ceilings	65.7	64.8	61.7	59.5	61.3	63.7	61.9	58.4	56.0	54.9	53.6	52.5	52.1
Energy	35.6	34.7	31.7	29.4	30.9	31.4	30.3	26.4	24.8	23.3	21.8	20.5	19.2
Non-Energy	30.1	29.8	29.7	30.2	30.4	32.4	31.6	32.0	31.2	31.6	31.7	32.0	32.9
Energy (%)	54%	54%	51%	49%	50%	49%	49%	45%	44%	42%	41%	39%	37%
Non-Energy (%)	46%	46%	48%	51%	50%	51%	51%	55%	56%	58%	59%	61%	63%

- Multi-sector energy and emissions simulation model methodology with carbon budget analysis is presented
- Interaction effect between public transport and modal shift showing additional savings of 0.1 MTCO2passenger transport decarbonisation policies is examined
- Interaction effect showing emissions savings overlap and ‘double counting’ effect between EVs uptake and biofuel blending of 0.3MTCO2, and EVs and modal shift 0.2MTCO2
- Transport, Residential, Industry and Electricity sectors meet Carbon Budget 1 (2021 – 2025) in the scenario presented
- Residential and Services sector meets Carbon Budget 2 (2026-2030) sectoral ceilings in scenario presented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