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A TRADITION OF INDEPENDENT THINKING

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Bridging the gap between INDCs and Paris ambition

James Glynn, et al

5th ESRI-UCC Energy Research Seminar 2016

Outline – 2015/16 collaborations

- COP21 – UCC Side Event
  - Equity and Effort Sharing
  - Nature Communications
- Local Air Pollution PSI, CRES
  - IEA-ETSAP Working Paper
  - International Energy workshop
- Developing a Hybrid Global computable General equilibrium CIRED
  - International Energy Workshop
- Cost of Delayed Action Globally
  - TIAM-UCL-MSA
- Reassessing Irish Energy targets for increased ambition
  - Irish-TIMES-MSA
- Energy security co-benefits of decarbonisation.
  - SEAI

PARIS2015 UN CLIMATE CHANGE CONFERENCE COP21·CMP11

PAUL SCHERRER INSTITUT PSI

ΚΑΠΕ CRES

Centre International de Recherche sur l'Environnement et le Développement CIRED

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seai SUSTAINABLE ENERGY AUTHORITY OF IRELAND

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Presentation Outline

- Research Question:
  - In the light of the Paris Agreement how should developed nations reassess their climate mitigation ambition?
  - How far below 2°C is feasible? (if at all?)
  - What would the macroeconomic impacts, demand response and sectoral dynamics be?

- Presentation in two sections
- TIAM-MACRO
  - How far below 2C towards 1.5C can we go?
  - Equitable Effort Sharing
- Irish TIMES-MACRO
  - What would the Irish energy system look like under equitable carbon budgets?
  - What would the macroeconomic impacts be?

Post Paris Policy Context –COP21
Highlight figures.

- CP21, 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 temperature increase to 1.5 ˚C would significantly reduce risks and impacts of climate change.
- Article 4 (2) Each party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions.
- Article 4 (3) Each Party's successive nationally determined contribution will represent a progression beyond the party's then current nationally determined contributions and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities in the light of different national circumstances.

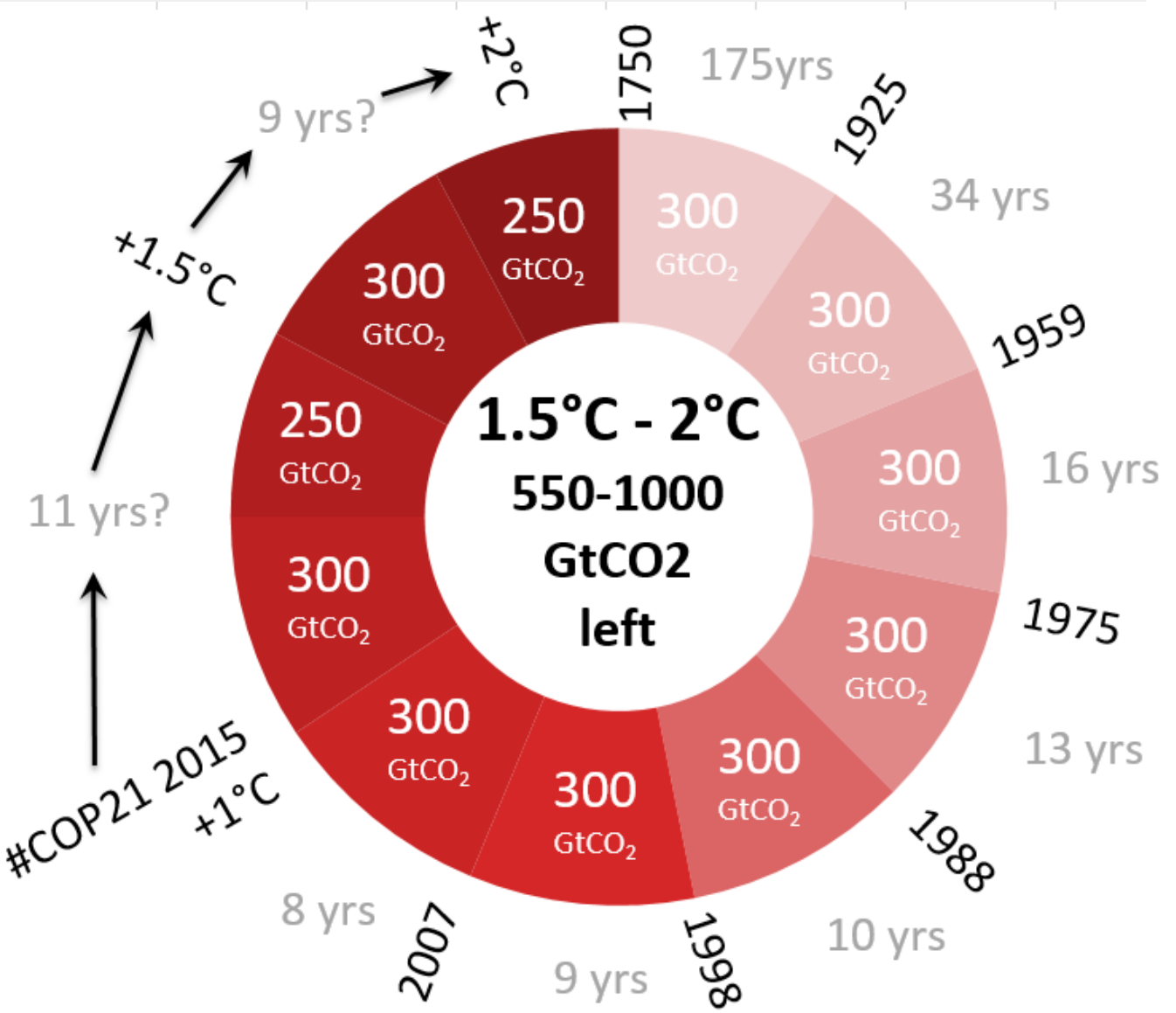
Post Paris Policy Context –COP21
Climate Finance

- Also decides that, in accordance with Article 9, paragraph 3, of the agreement developed countries intend to continue their existing collective mobilisation goal through 2025 in the context of meaningful mitigation actions and transparency on the implementation: prior to 2025 the conference of the parties serving as the meeting of the parties to the Paris agreement shall set a new collective quantified goal from a floor of USD 100billion per year, taking into account the needs and priorities of developing countries.

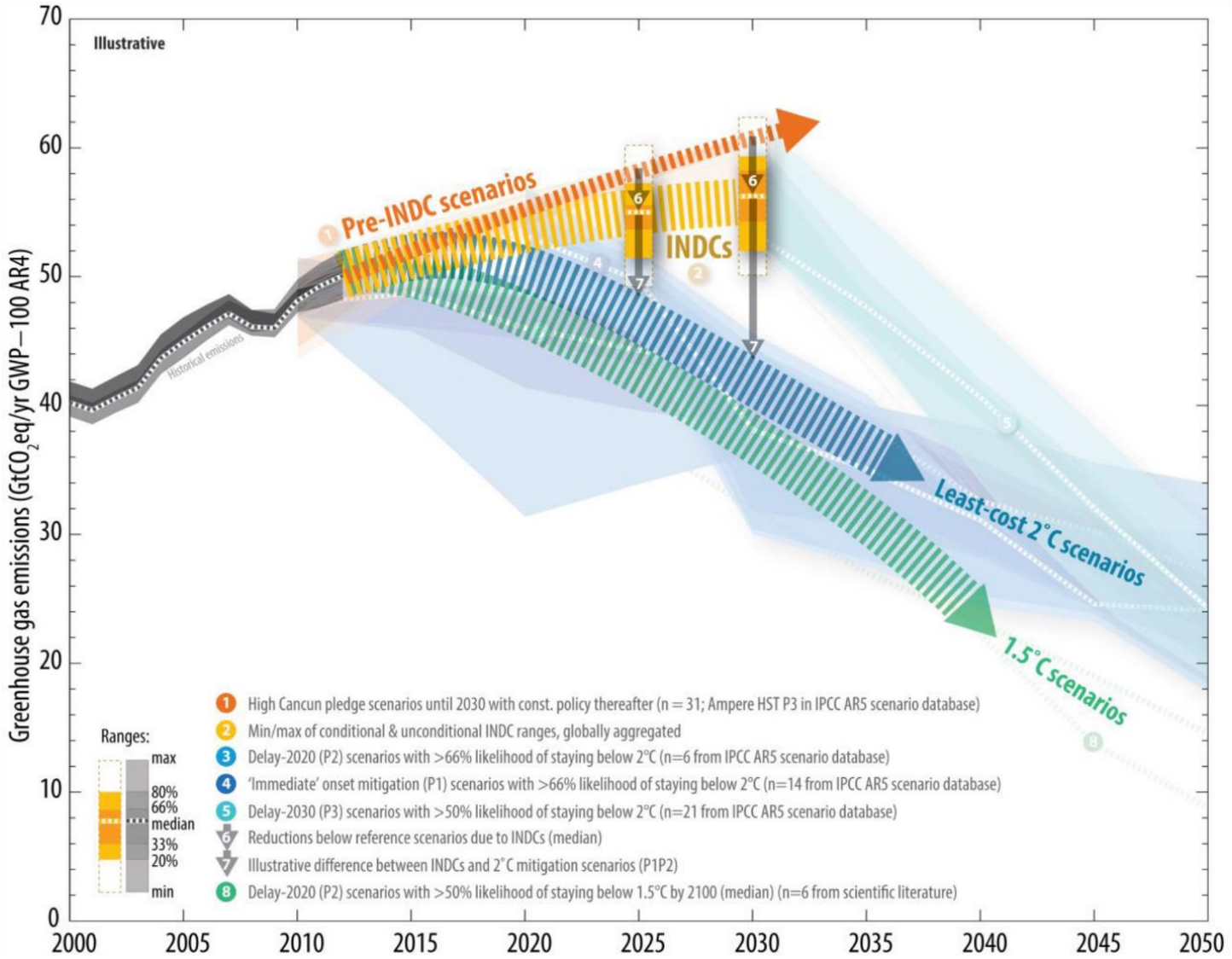
Post Paris Policy Context –COP21
Nationally Determined Contributions.

- AR5 carbon budget for the total global cumulative emissions since 2011 that are consistent with a global average temperature rise of 1.5C above pre industrial levels with 50% probability is 550GtCO_2.
- Considering the aggregate effect of INDCs, global cumulative CO_2 emissions are expected to equal 97% by 2025 and 134% by 2030 of the cumulative emissions consistent with achieving a temperature increase of less than 1.5˚C
- INDCs are estimated to result in global annual ~52GtCO_2e/yr in 2030
  - Not on a 2 ˚C least cost consistent path

Carbon Budgets, Past & Future

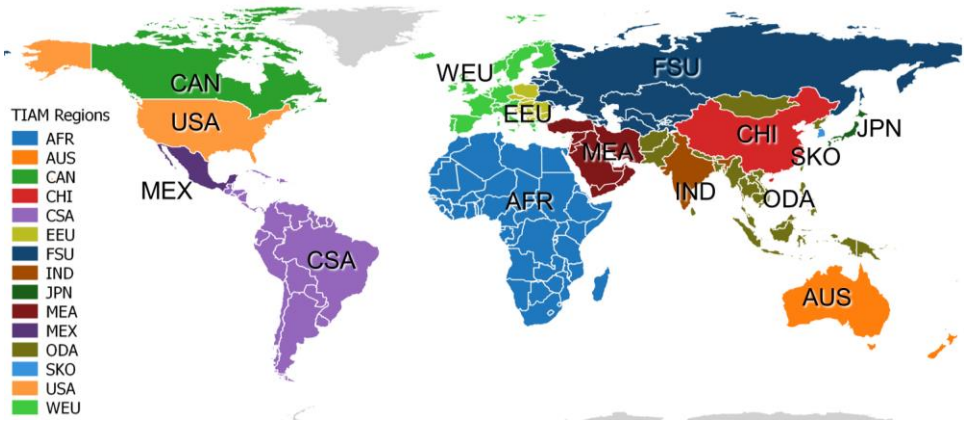


IPCC INDC Synthesis Report
April '16



GLOBAL ETSAP-TIAM model

- Linear programming bottom-up energy system model of IEA-ETSAP
- Integrated model of the entire energy system
- Prospective analysis on medium to long term horizon (2100)
  - Demand driven by exogenous energy service demands
- Partial and dynamic equilibrium (perfect market)
- Optimal technology selection
- Minimizes the total system cost
- Environmental constraints
  - Integrated Climate Model
- 15 Region Global Model
- Price-elastic demands
- Local Air Pollution externalities
- Macro Stand Alone
  - Single consumer-producer, multi-regional, inter-temporal general equilibrium model which maximises regional utility.
  - The utility is a logarithmic function of the consumption of a single generic consumer.
  - Production inputs are labour, capital and energy.
  - Energy demand and energy costs from ETSAP-TIAM model.
  - MSA Re-estimates Energy Service Demands based on energy cost



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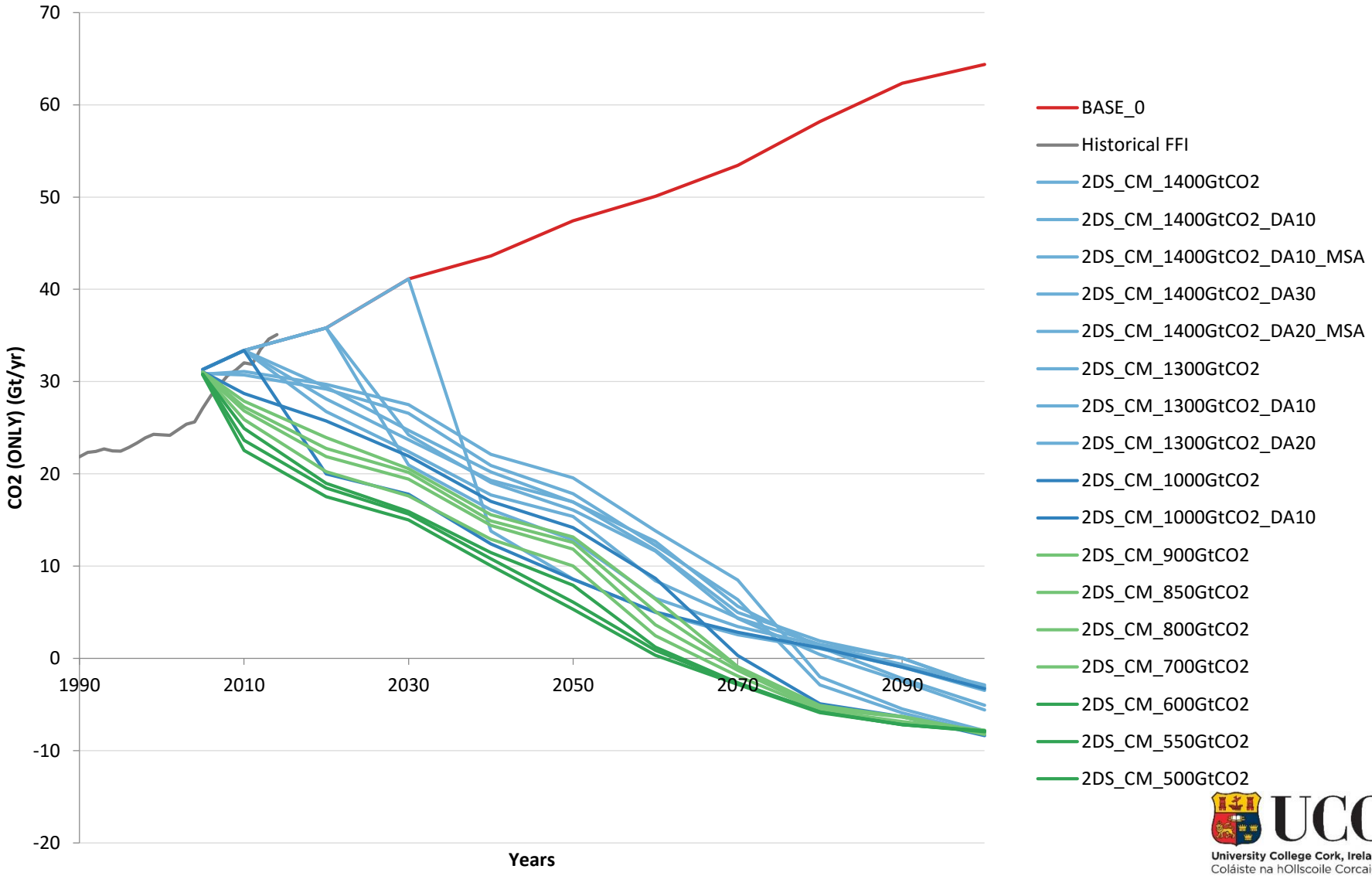
Scenario Definitions

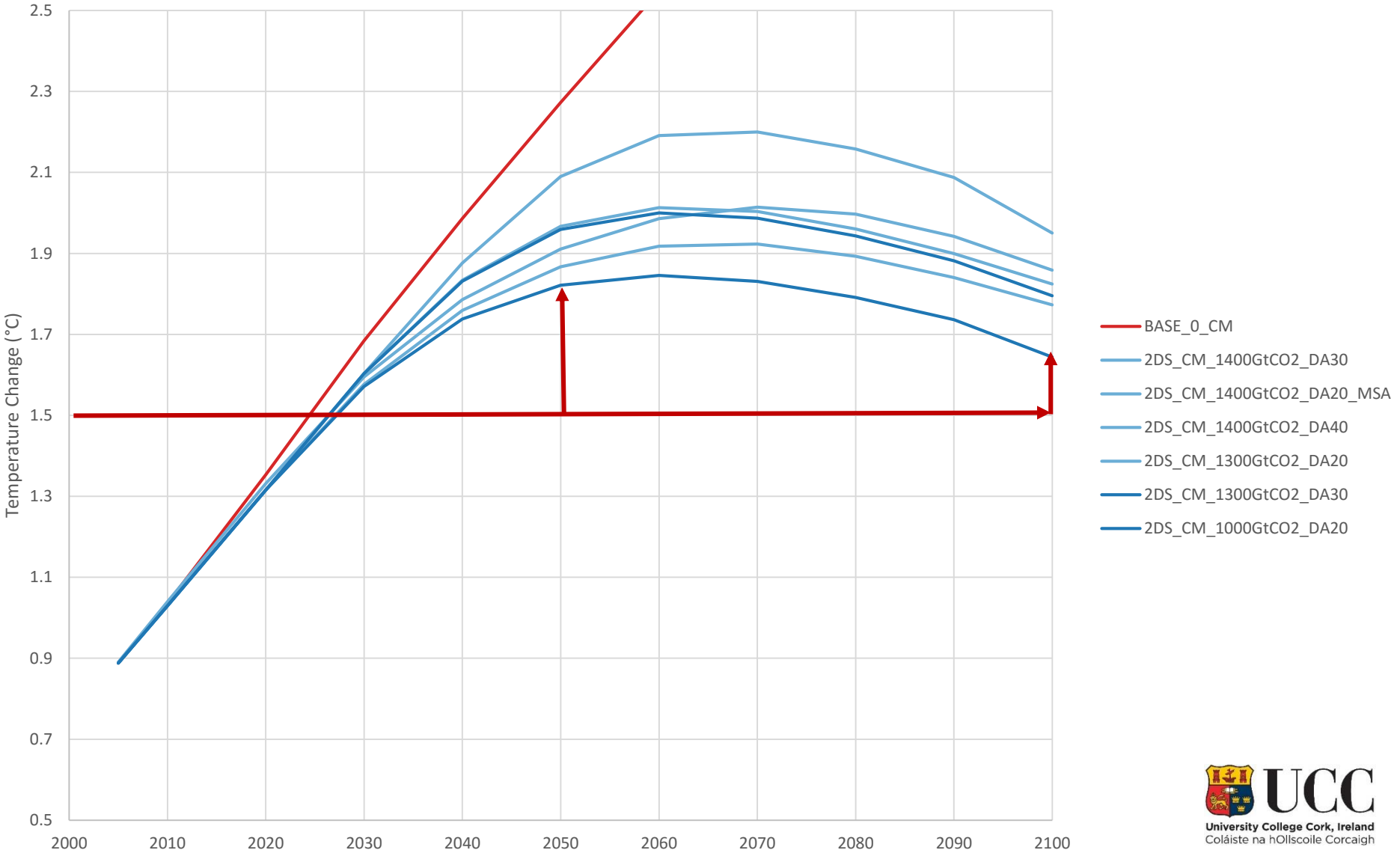
- Incremental Carbon Budgets from 1400GtCO_2-400GtCO_2 (55 Runs)
  - Climate model controlling concentrations of CH_4 and N_20 for 2 ˚C in 2100
- Delaying action where feasible 2010, 2020, 2030, *2040*
- Find the feasible solution space in AR5 carbon budgets between 2˚C and 1.5˚C
  - AR5 all working group Synthesis Report Table 2.2

	<1.5C								<2C			>3.5C
Carbon Budget GtCO2	66%	50%			33%				66%	50%		
Start Year/ Delayed Action	400	500	550	600	700	800	850	900	1000	1300	1400	Base
2005	<1.5C 66%	<1.5C 50%	<1.5C 50%	<1.5C 50%	<1.5C 33%	<1.5C 33%	<1.5C 33%	<1.5C 33%	<2C 66%	<2C 50%	<2C 50%	4DS
2010	<1.5C 66%	<1.5C50%	<1.5C50%	<1.5C50%	<1.5C 33%	<1.5C 33%	<1.5C 33%	<1.5C 33%	<2C 66%	<2C 50%	<2C 50%	
2020	<1.5C 66%	<1.5C50%	<1.5C50%	<1.5C50%	<1.5C 33%	<1.5C 33%	<1.5C 33%	<1.5C 33%	<2C 66%	<2C 50%	<2C 50%	
2030	<1.5C 66%	<1.5C50%	<1.5C50%	<1.5C50%	<1.5C 33%	<1.5C 33%	<1.5C 33%	<1.5C 33%	<2C 66%	<2C 66%	<2C 50%	
2040	<1.5C 66%	<1.5C50%	<1.5C50%	<1.5C50%	<1.5C 33%	<1.5C 33%	<1.5C 33%	<1.5C 33%	<2C 66%	<2C 66%	<2C 50%	

CO2 Trajectories

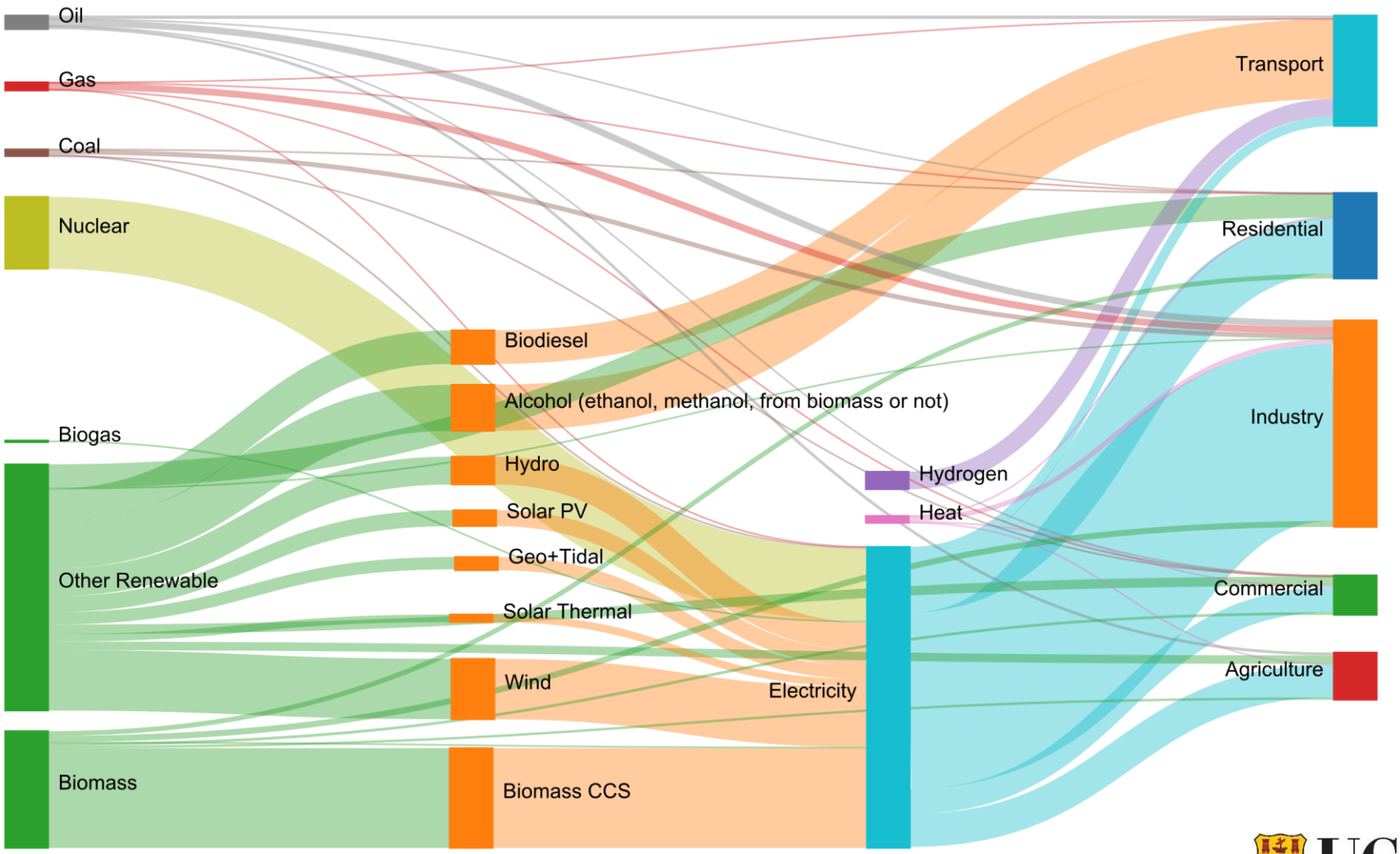


Temperature Change
1.5C – Threshold or 2100 Target



2DS 66% Energy System in 2100

1,000 $GtCO_2$ Budget 2020 – 2100



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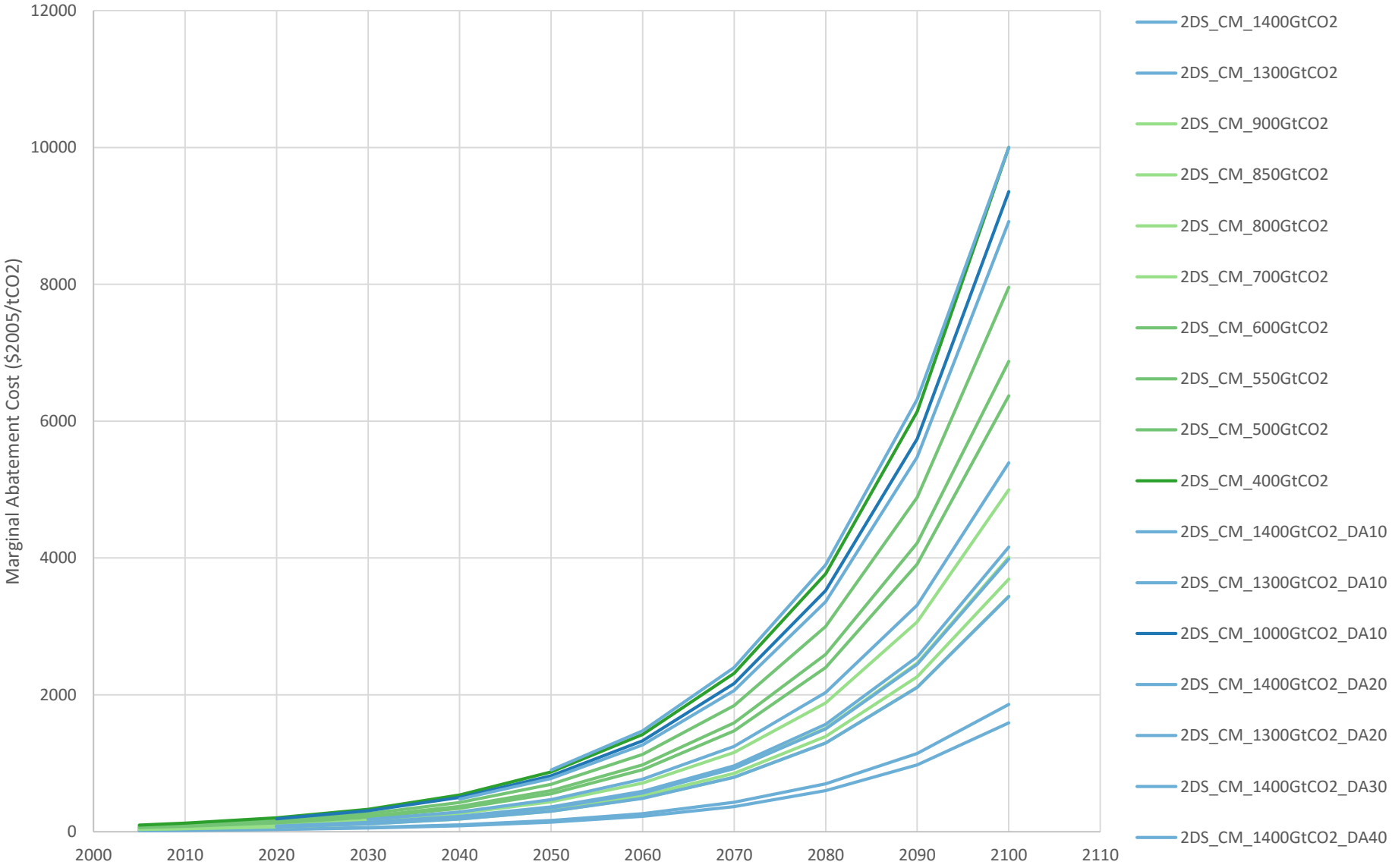
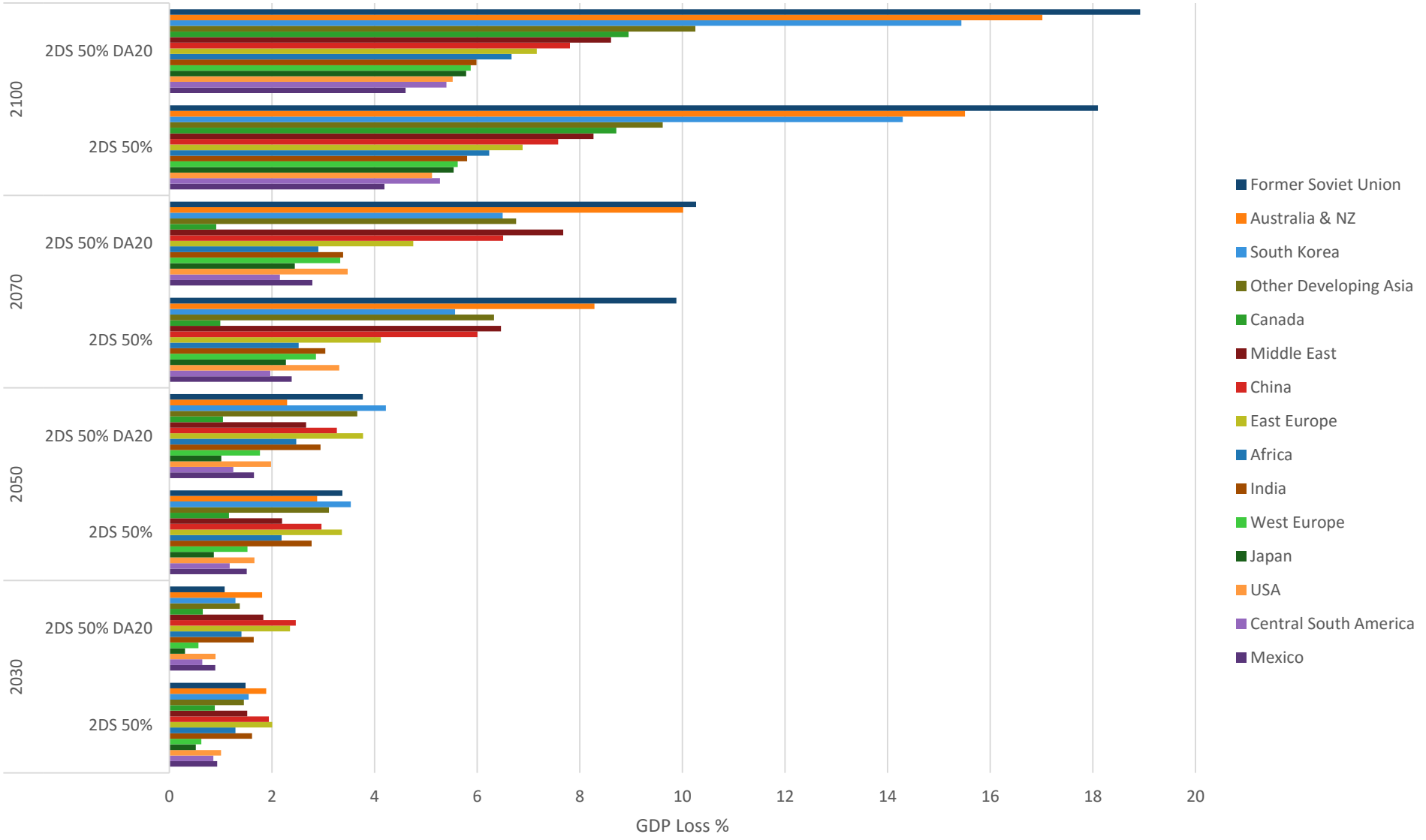
Marginal Abatement costs



GDP losses & Delayed Action



Finance for equitable effort sharing

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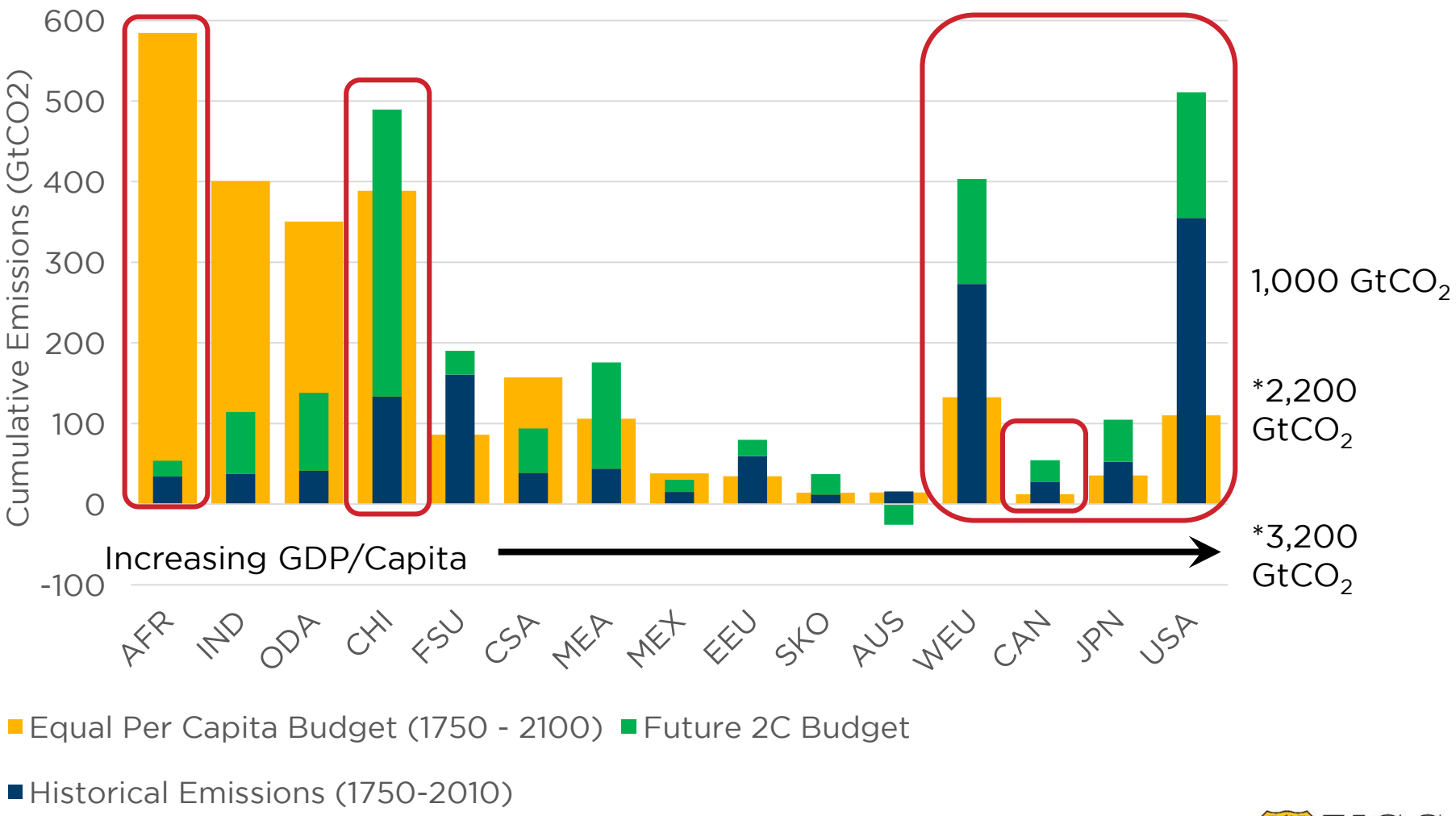
Carbon Budgets; Past and 2°C



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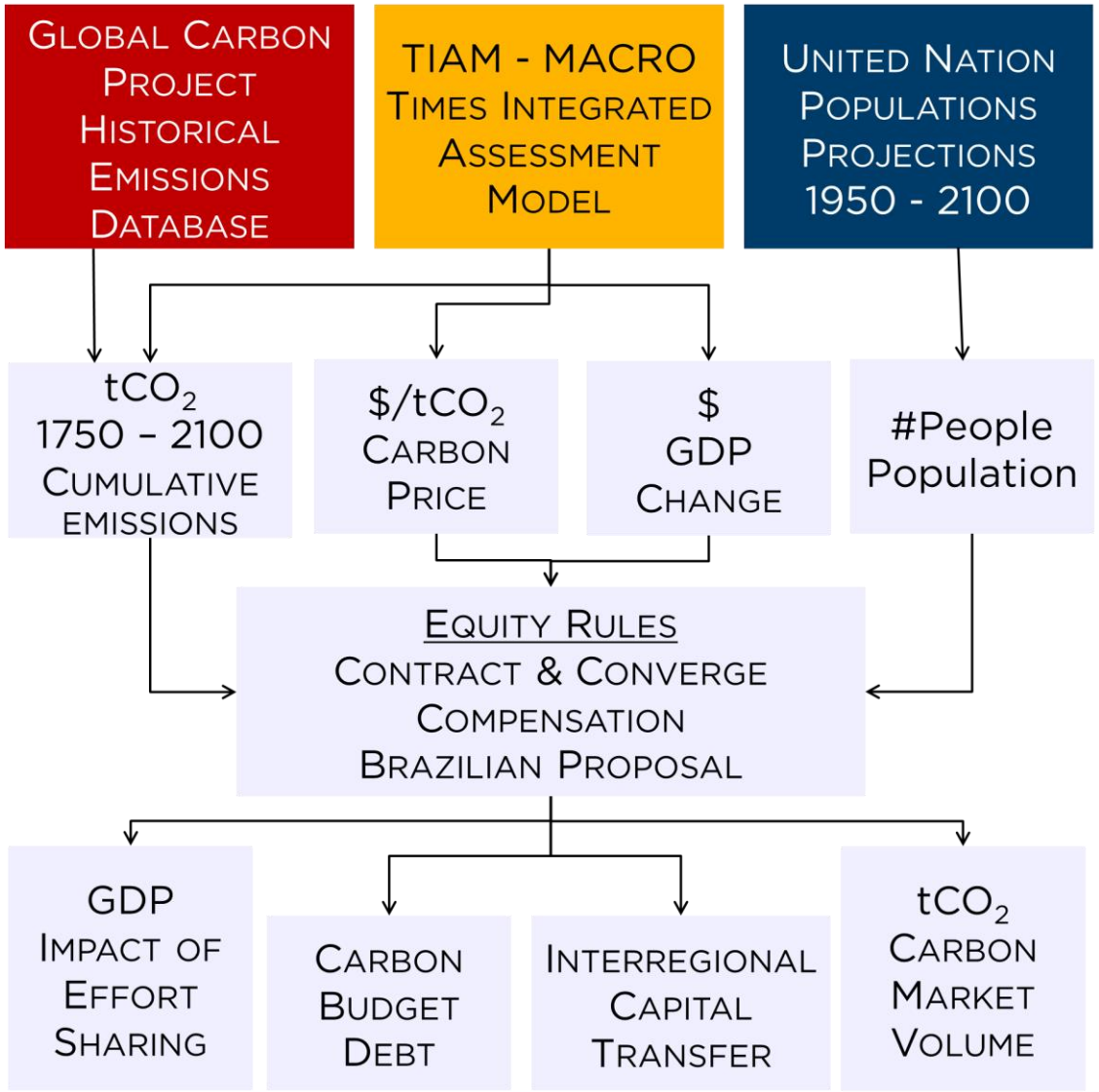
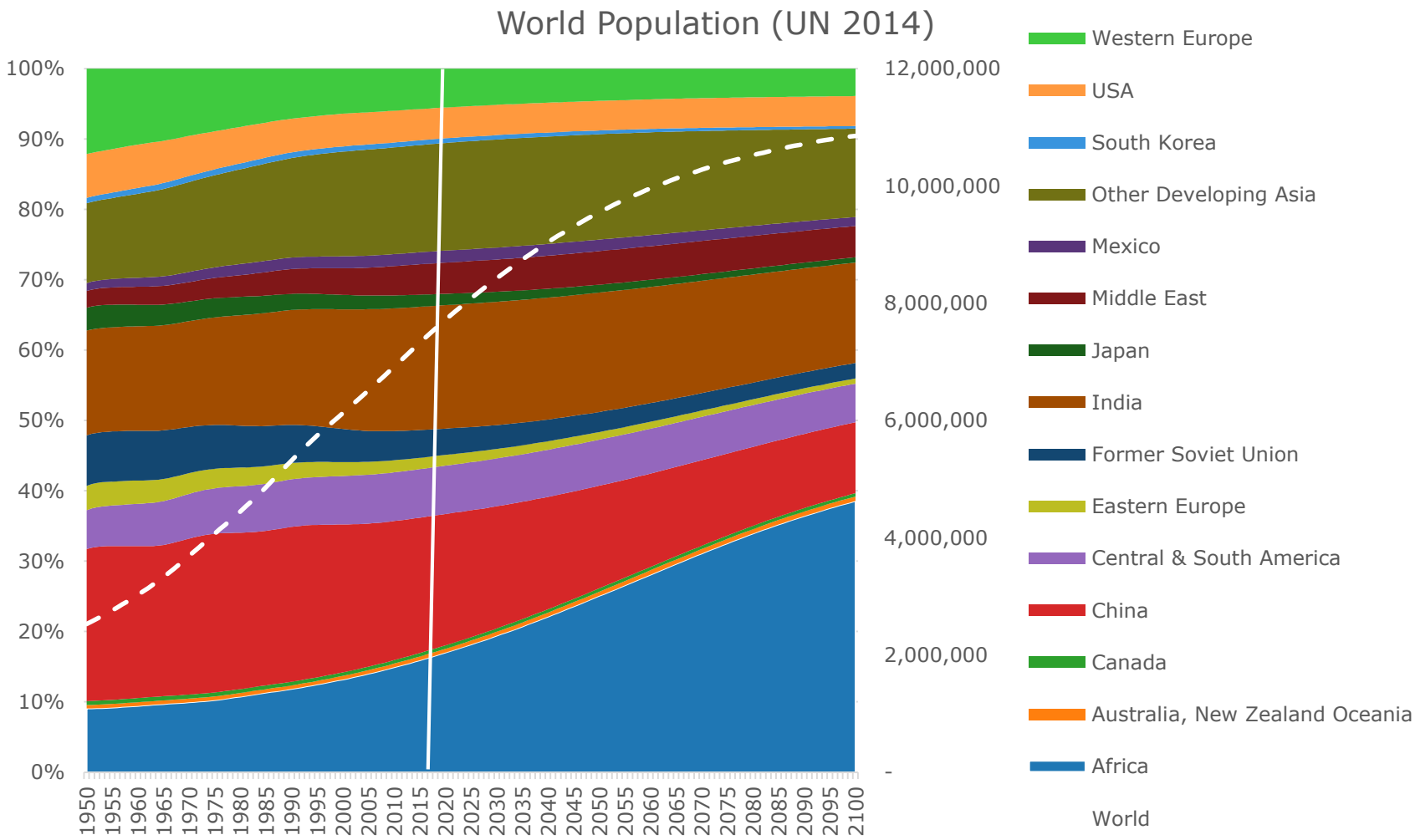
Effort Sharing Process



World Population Projection



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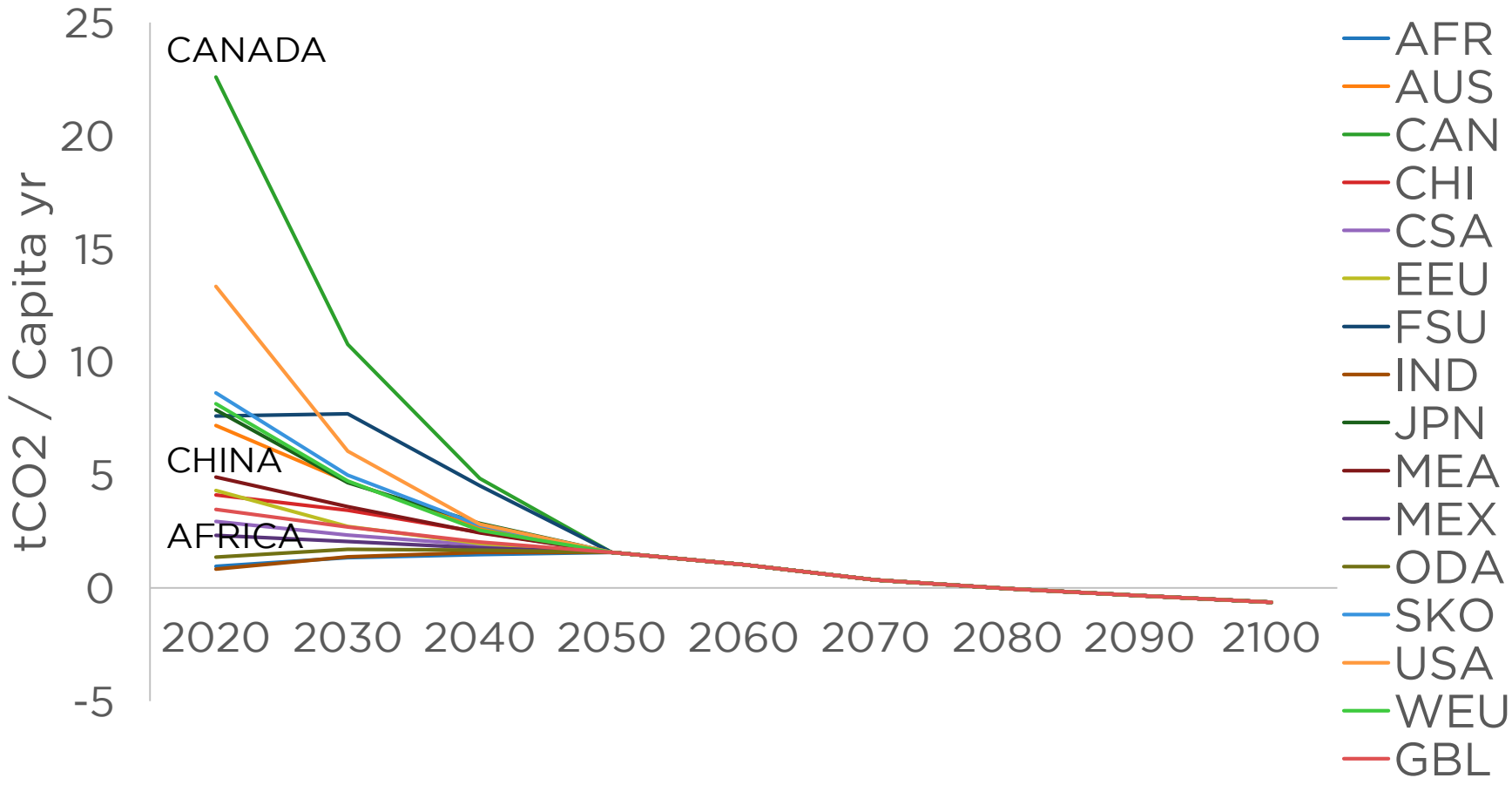
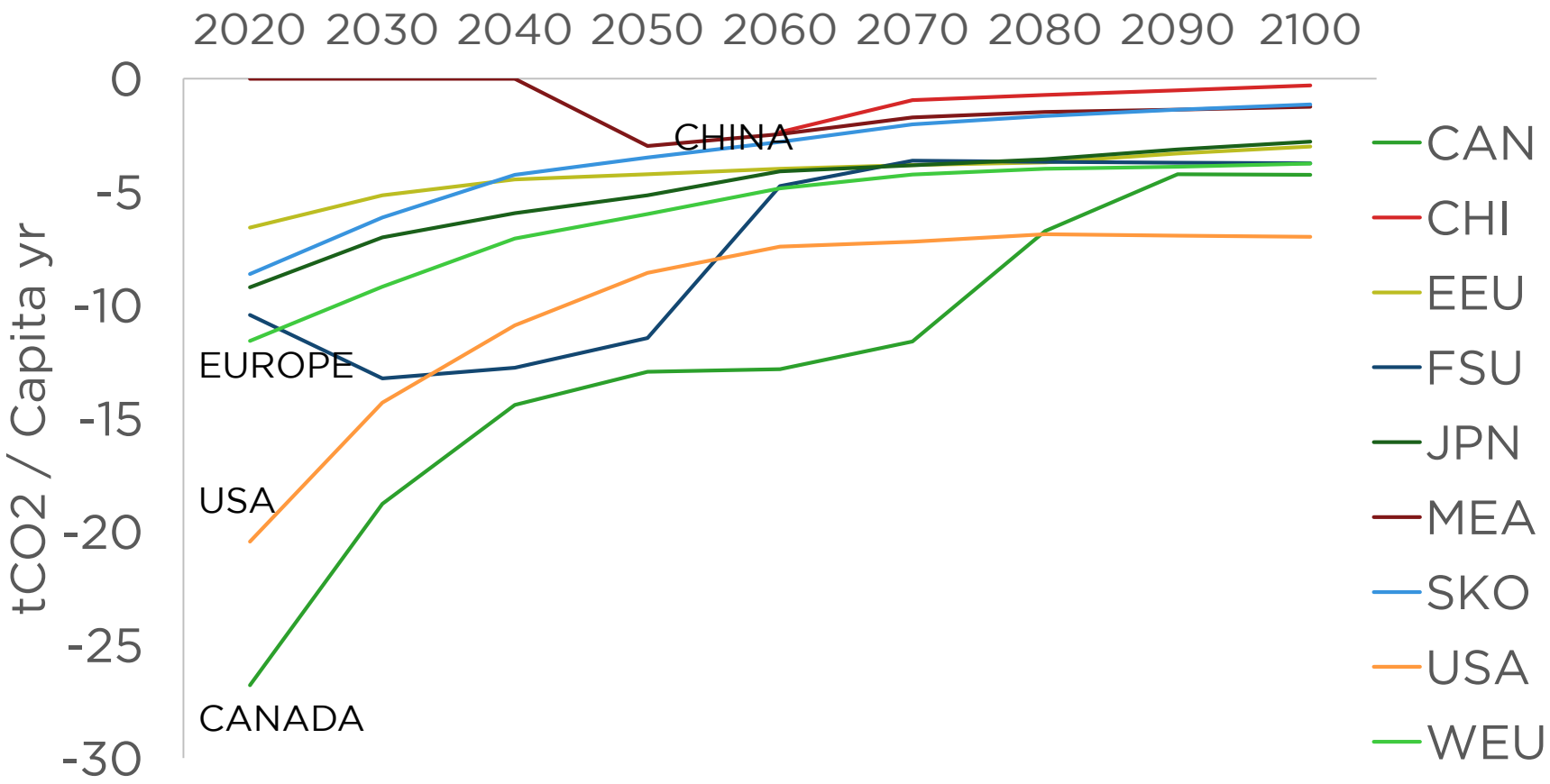
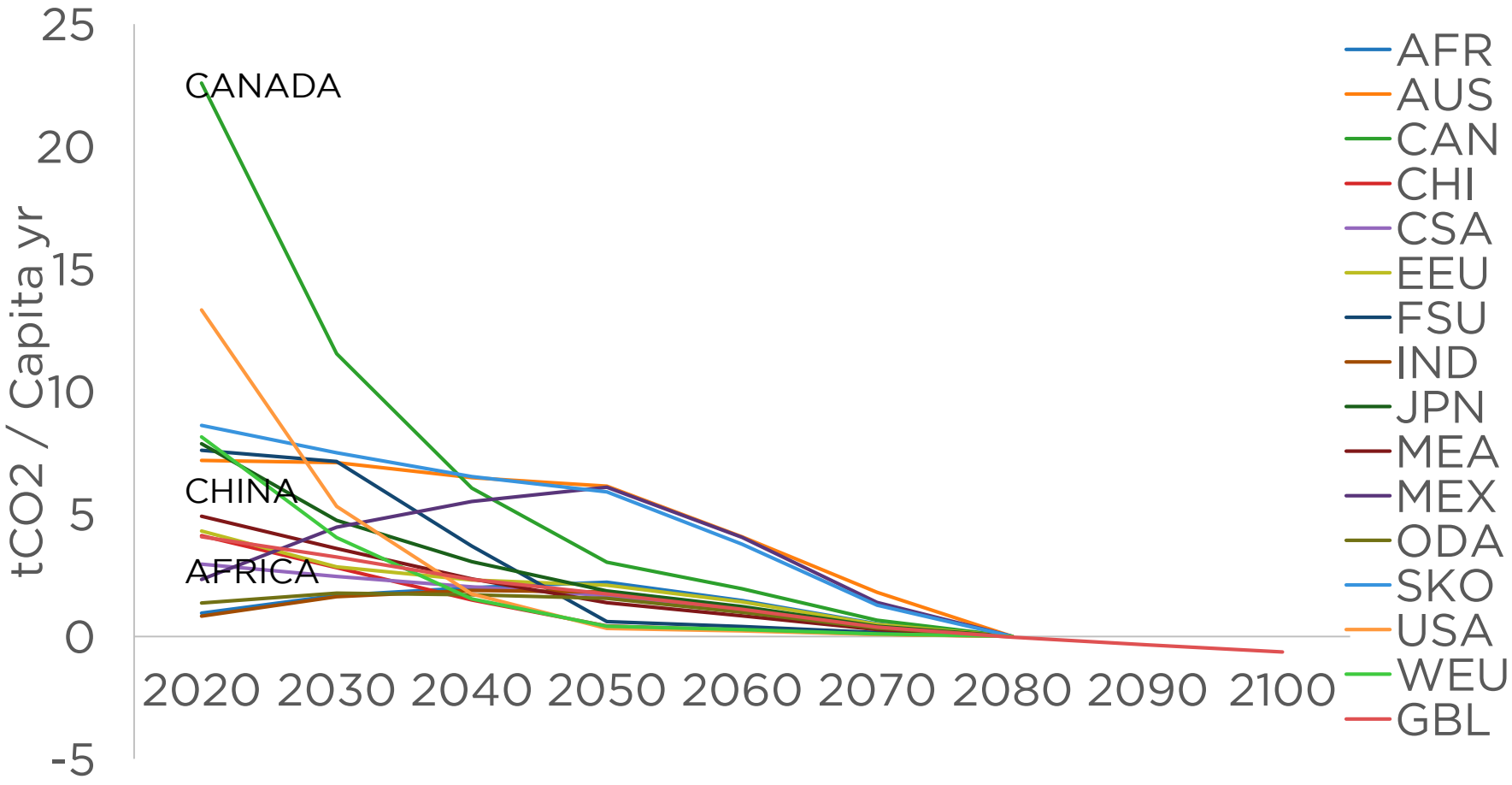
Effort Sharing Rules – (1) Contract & Converge



Effort Sharing Rules – (2) Past & Future Equity



Effort Sharing Rules – (3) Future Equity



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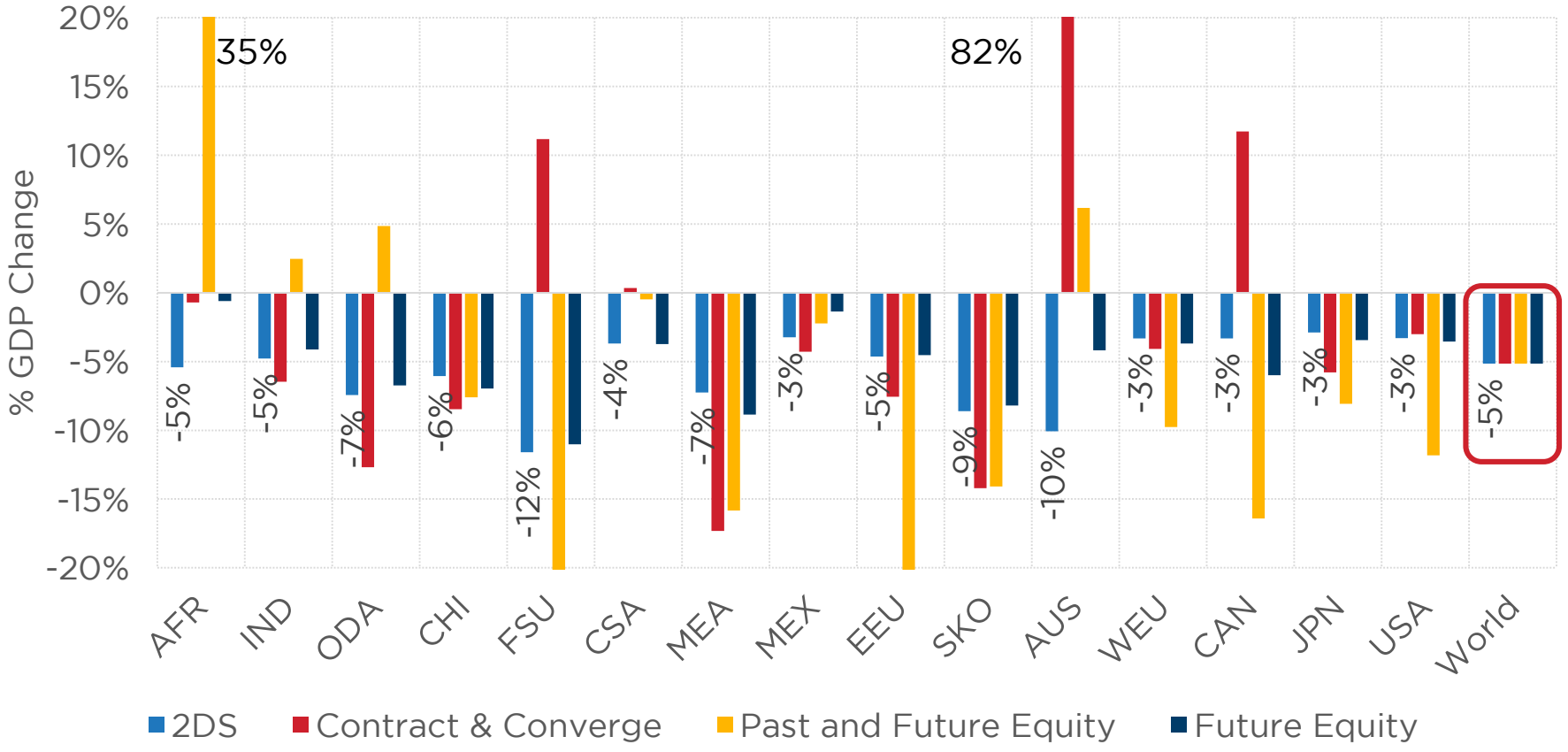
GDP Impacts



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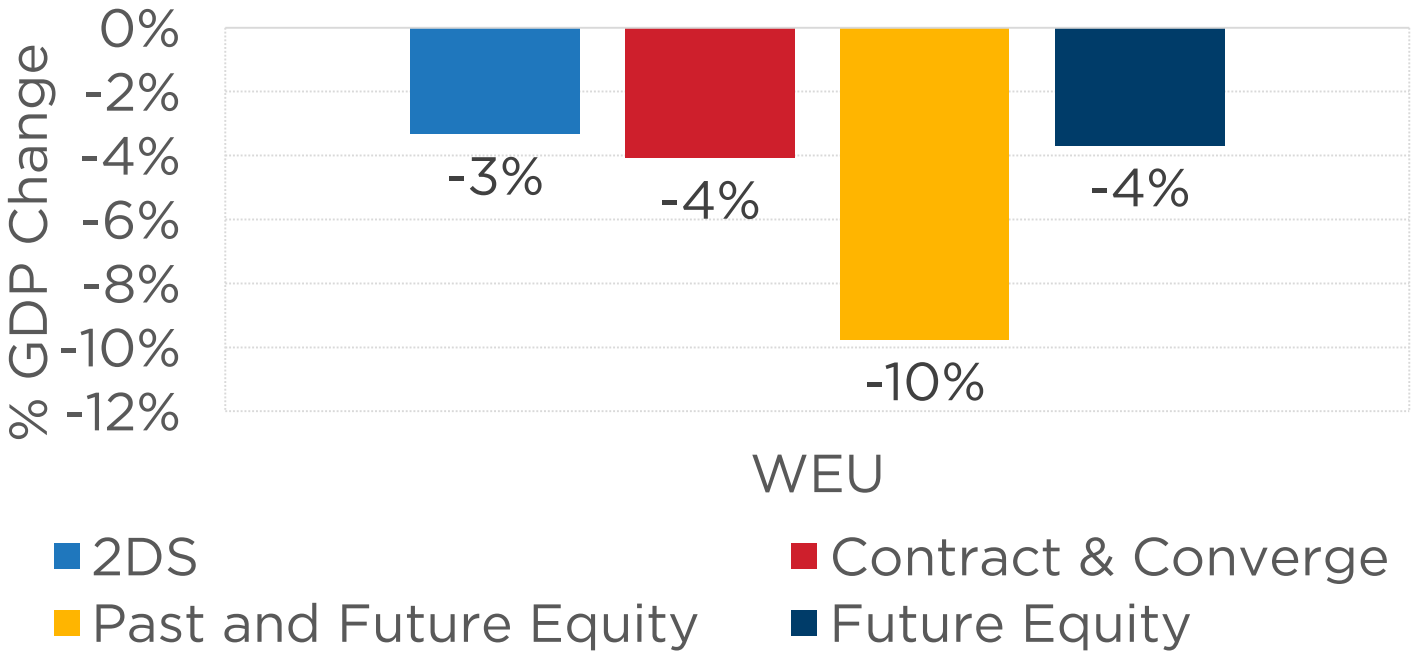
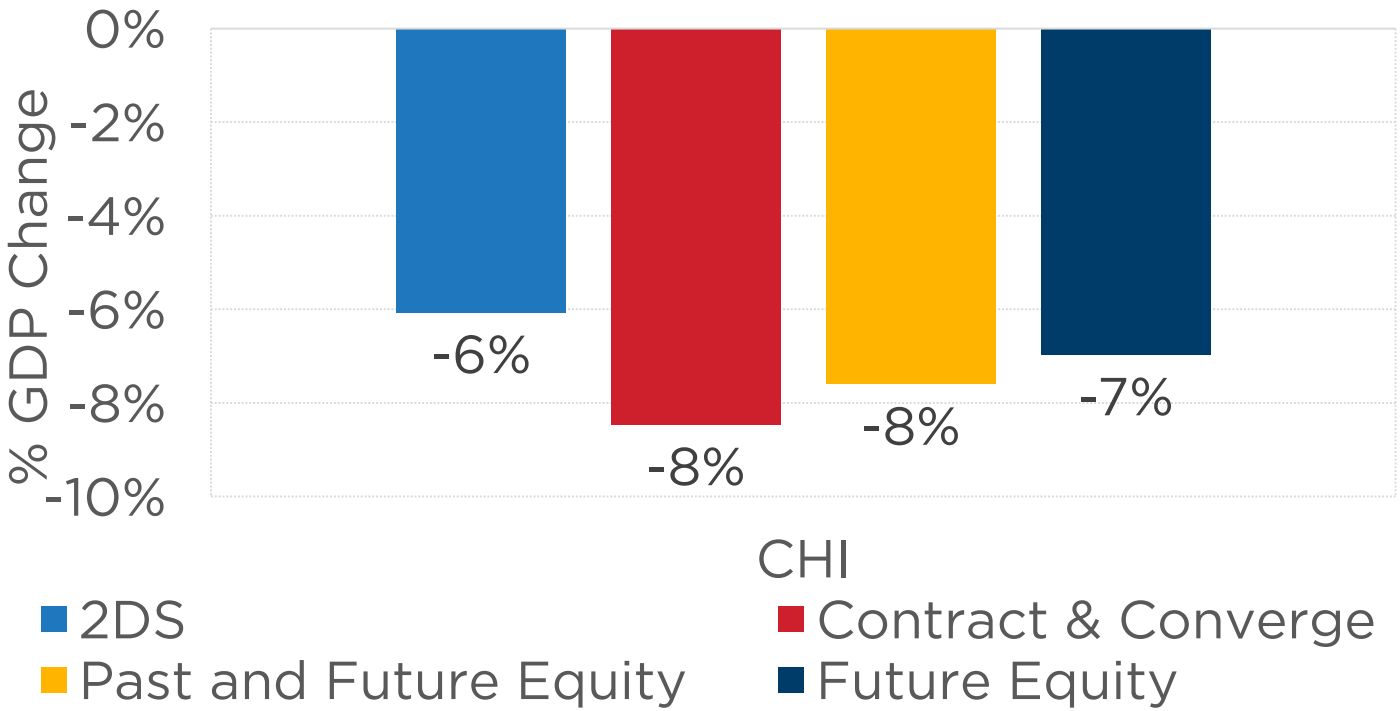
West Europe

- Europe's cumulative GDP loss in the least cost 2DS solution is 3.3%. Western Europe has already emitted it's equitable share of emissions and so trades accordingly causing GDP losses of 4% - 10% GDP depending upon the share of future emissions allowed to be emitted
- Capital Transfer range: -$1.2 Tn to -$14.2Tn (discounted at 5%)
  - -$7.6 Tn to -$134 Tn (undiscounted 2020 - 2100)



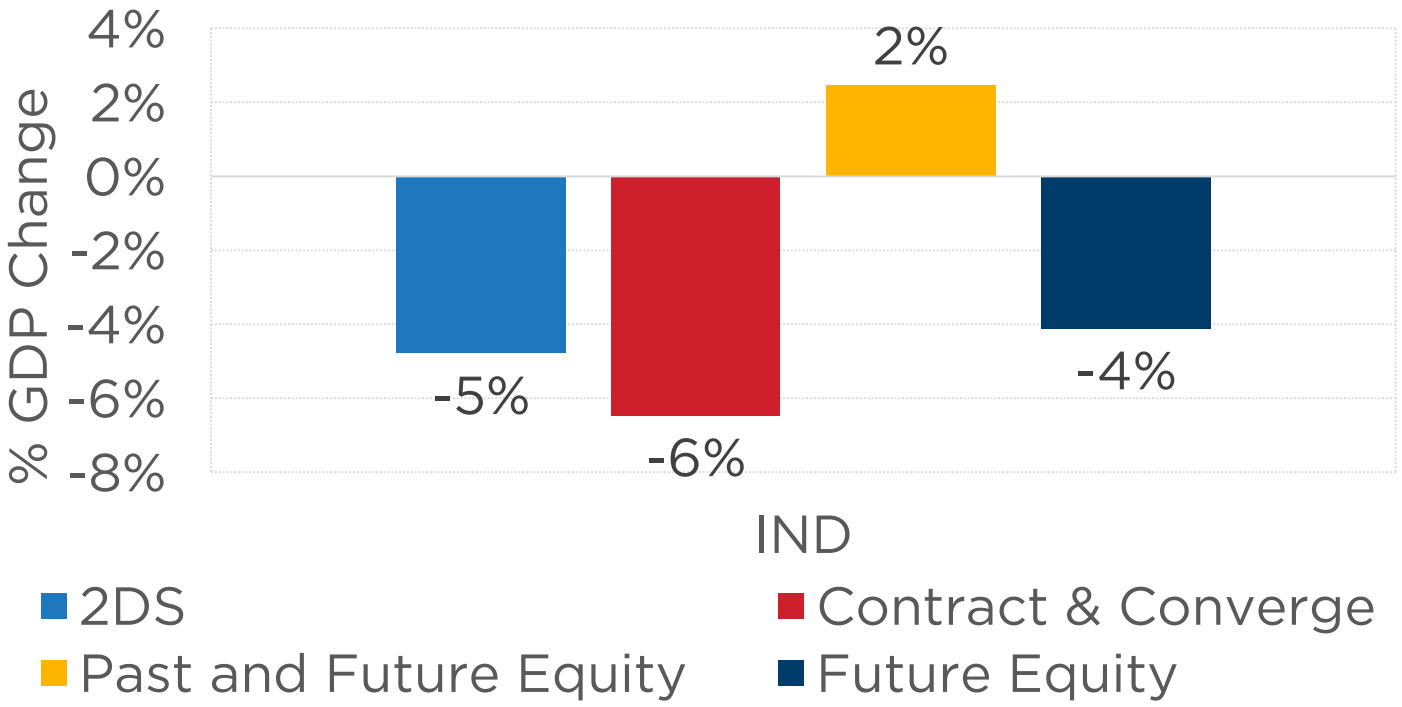
China

- China's cumulative GDP loss in the least cost 2DS solution is 6.1%. The "Future Equity" effort sharing rule (3) causes relative GDP losses of 7% but less than the other effort sharing rules presented
- Capital Transfer range: -$4.9 Tn to -$8.5Tn (discounted at 5%)
  - -$43 Tn to -$114 Tn (undiscounted 2020 - 2100)



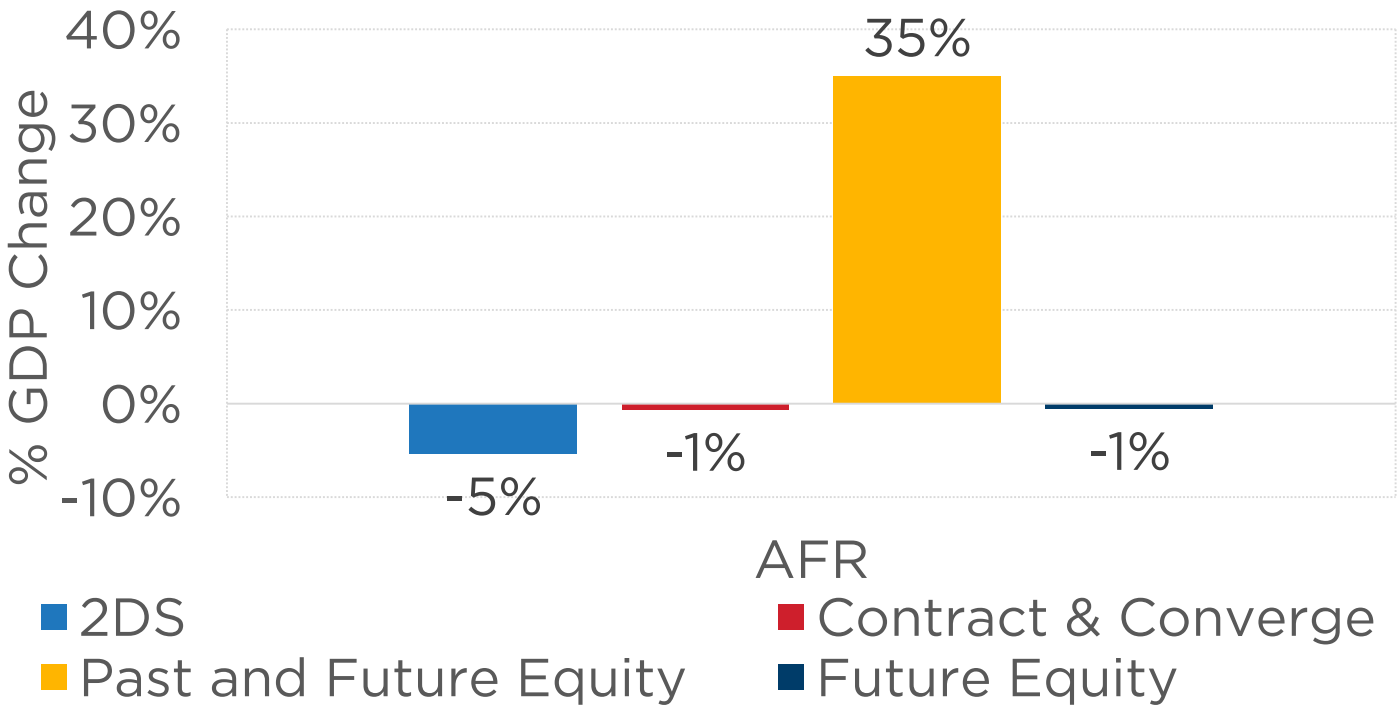
India

- India's cumulative GDP loss in in the least cost 2DS solution is 4.8%. Again the "Equity" effort sharing rule (2) causes relative GDP growth of 2.5%.
- Capital Transfer range: +$1.7 Tn to +$16.5Tn (discounted at 5%)
  - -$38.9 Tn to +$168 Tn (undiscounted 2020 - 2100)



Africa

- Africa's cumulative GDP loss in in the least cost 2DS solution is 5.4%. The "Equity" effort sharing rule (2) causes relative GDP growth of 34% given the continents lack of responsibility and population growth.
- Capital Transfer range: +$5.6 Tn to +$30.6Tn (discounted at 5%)
  - -$36 Tn to +$311 Tn (undiscounted 2020 - 2100)



Equitable Carbon Budgets for the Irish Energy System

Population weighted proportion of the remaining global Carbon Budget

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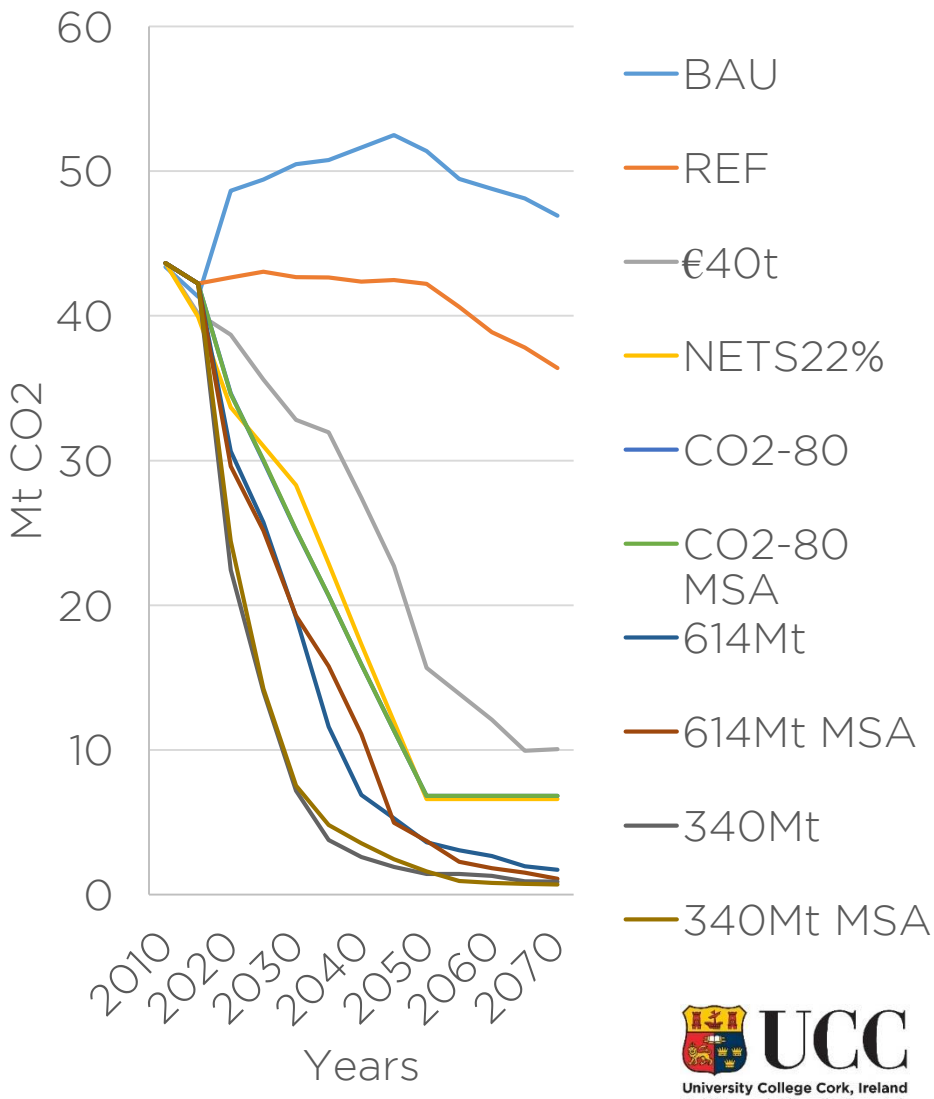
Equitable Carbon Budgets for the Irish Energy System

3200GtCO2 - The global Cumulate CO2 emissions budget to stay blow the 2C
1200GtCO2 – The remaining budget.
1000GtCO2 - The remaining budget between 2020 – 2100
10 billion people on planet by 2070
100 tCO2 per person lifetime
6.14million Irish people by 2070
614MtCO2 Irish emissions budget
1.624GtCO2 – past Irish Emissions
1.9GtCO2 – equal world per capita budget
340MtCO2 – Irish Cumulative equitable budget
18.7MtCO2/yr = Irish Agri Emissions
614/18.7 = 33 years
340/18.7 = 17 years



data sources:
http://www.globalcarbonproject.org/carbonbudget/14/data.htm
http://cdiac.ornl.gov/trends/emis/meth_reg.html
http://esa.un.org/unpd/wpp/

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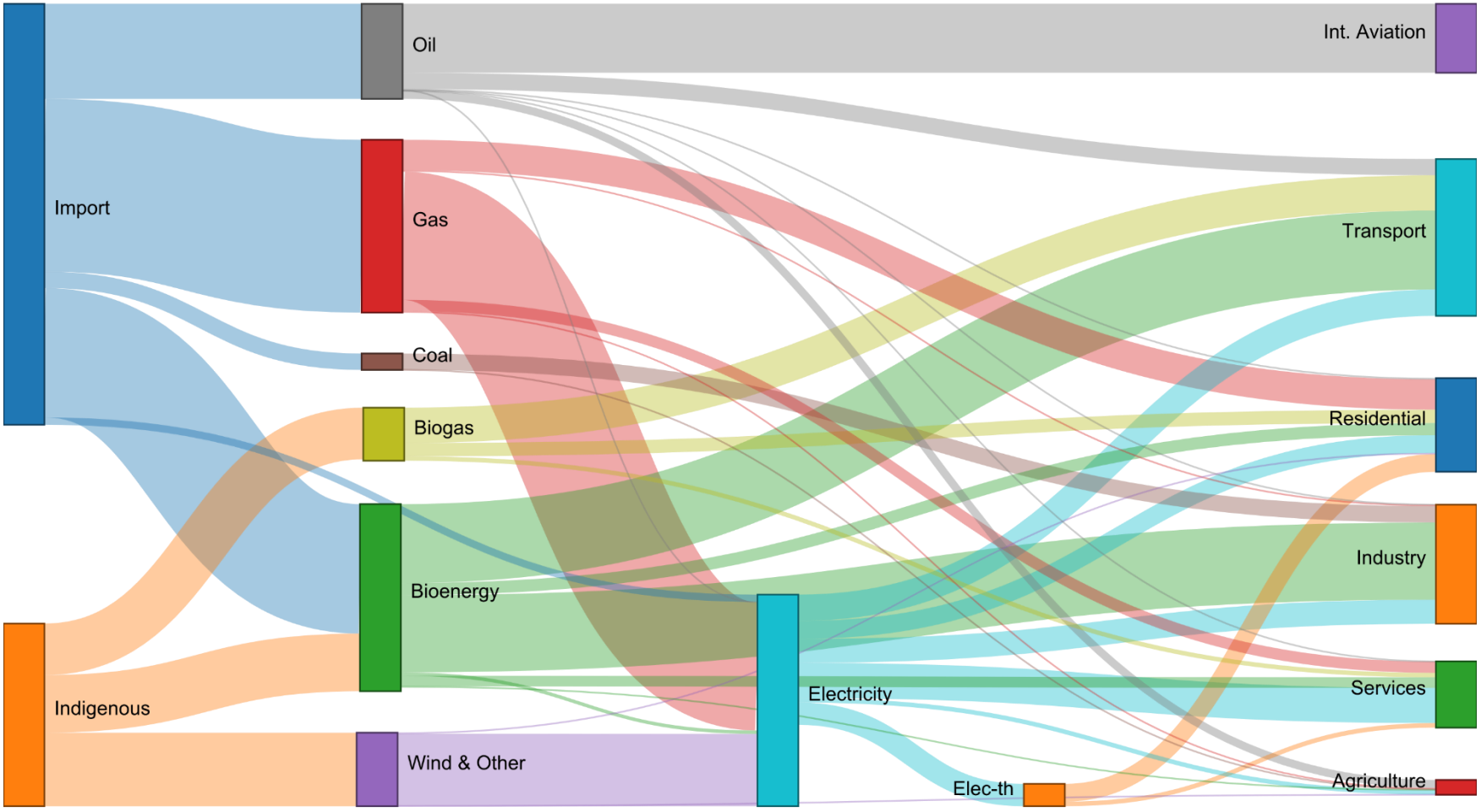
2050 -80% CO_2 relative to 1990



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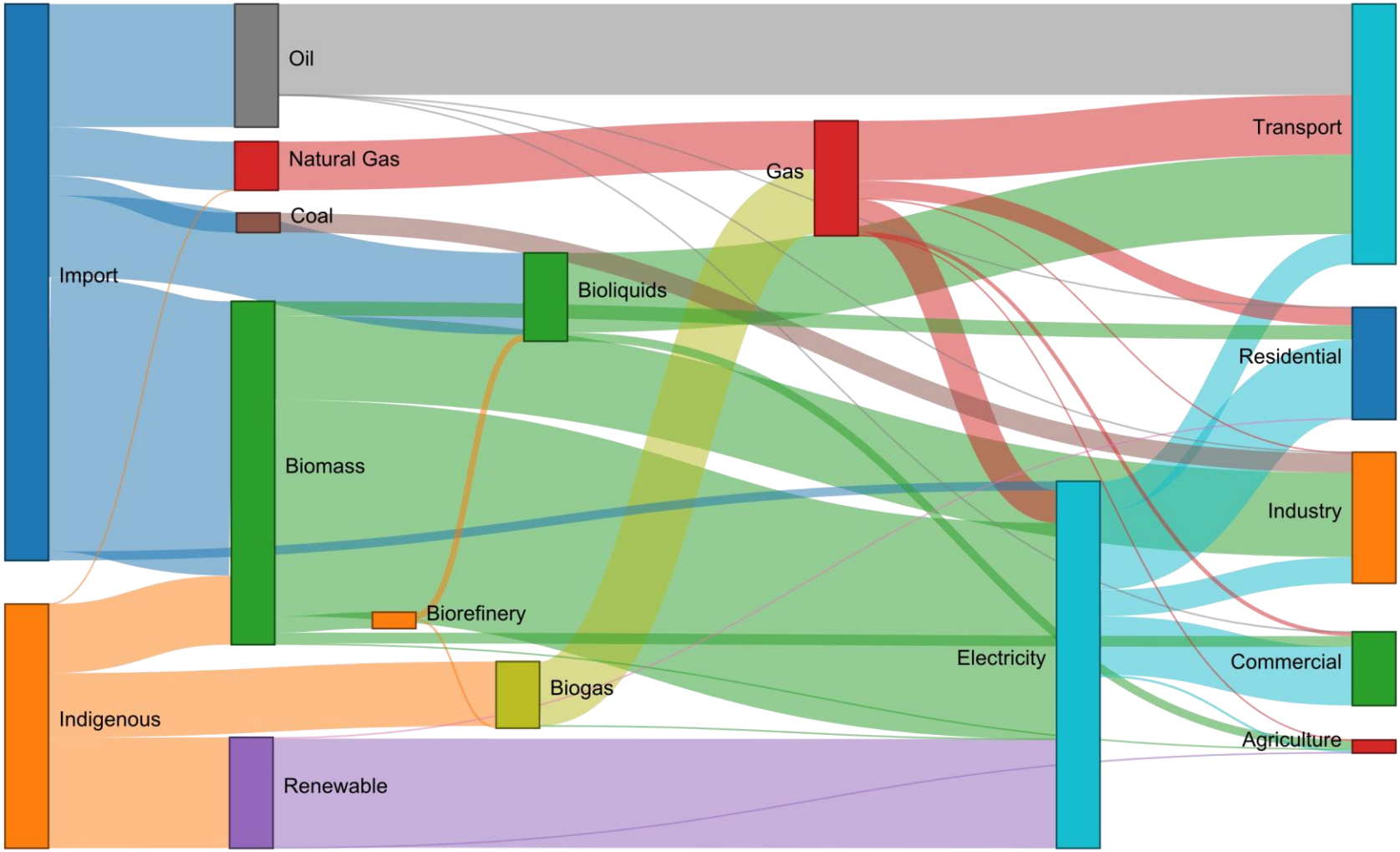
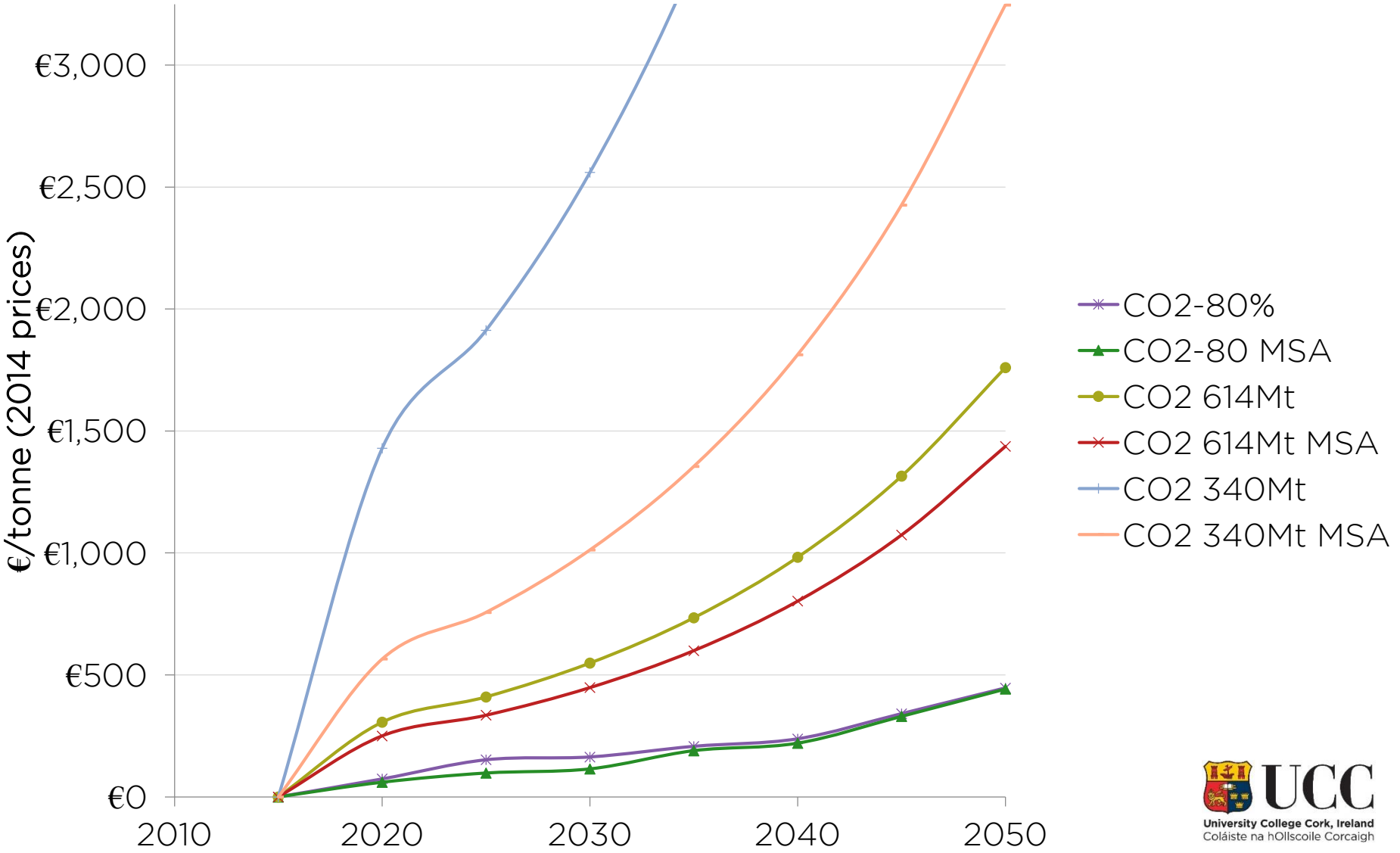
2050 - 340MtCO$_2$ budget



Abatement Costs & Demand Response



Sectoral Carbon Emissions

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Global Conclusions

- Achieving below 2C is highly improbable and near infeasible (given our current understanding of future trends and technology development).
  - 1.9°C – 1.8°C – simple climate model
- Equitable burden sharing rules require high capital transfers of trillions US $ between 2020 – 2100 (*Discounted at 5%/yr)
  - 1 – Contract & Convergence - **$Tn 15 ($Tn 342 - undiscounted)**
  - 2 – Past and Future Equity - **$Tn 65 ($Tn 660 - undiscounted)**
  - 3 – Future Equity - **$Tn 17 ($Tn 78.4 - undiscounted)**
- GDP losses in the utility maximising least cost scenario for delayed action to 2020 is regionally varied and inequitable.
- Hybrid Energy-Economy type of approach steps towards sectoral specific dynamics of decarbonising from a bottom up technology explicit perspective
  - Unemployment, structural changes, sectoral outputs
  - Inform targeted regional/sector specific transition policy

Irish Conclusions

- Under UN equity principles, of differentiated responsibility and capabilities, Irish decarbonisation ambition could increase, in terms of current emission rates of change and emissions targets.
  - UK reassessing their CO2-80% Target – is it ambitious enough?
- Significant demand reductions (15-30%) would be incurred compared to BAU
- GDP loss is estimated at ~3% by 2050
  - 0.2%/yr short term – 0.05% long term
- Carbon intensity per value added should be assessed across Irish economy sectors for targeted mitigation support and effort equalisation across sectors.
- Climate damages, local air pollution damages, and ecosystem services damages need to be assessed in macro-economy feedback methods

Acknowledgements

Centre International de Recherche
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