Nationally Determined Contributions under the Paris Agreement and the costs of delayed action

Dr Matthew Winning
UCL Institute for Sustainable Resources

17th October 2019

Focus

1. *A 2°C scenario compared against a baseline of current NDC commitments with emphasis on economic impacts using TIAM-UCL-MSA*
2. *How does the timing of action affect the economic impacts?*
3. *How do changes in renewable technology costs affect economic impacts?*

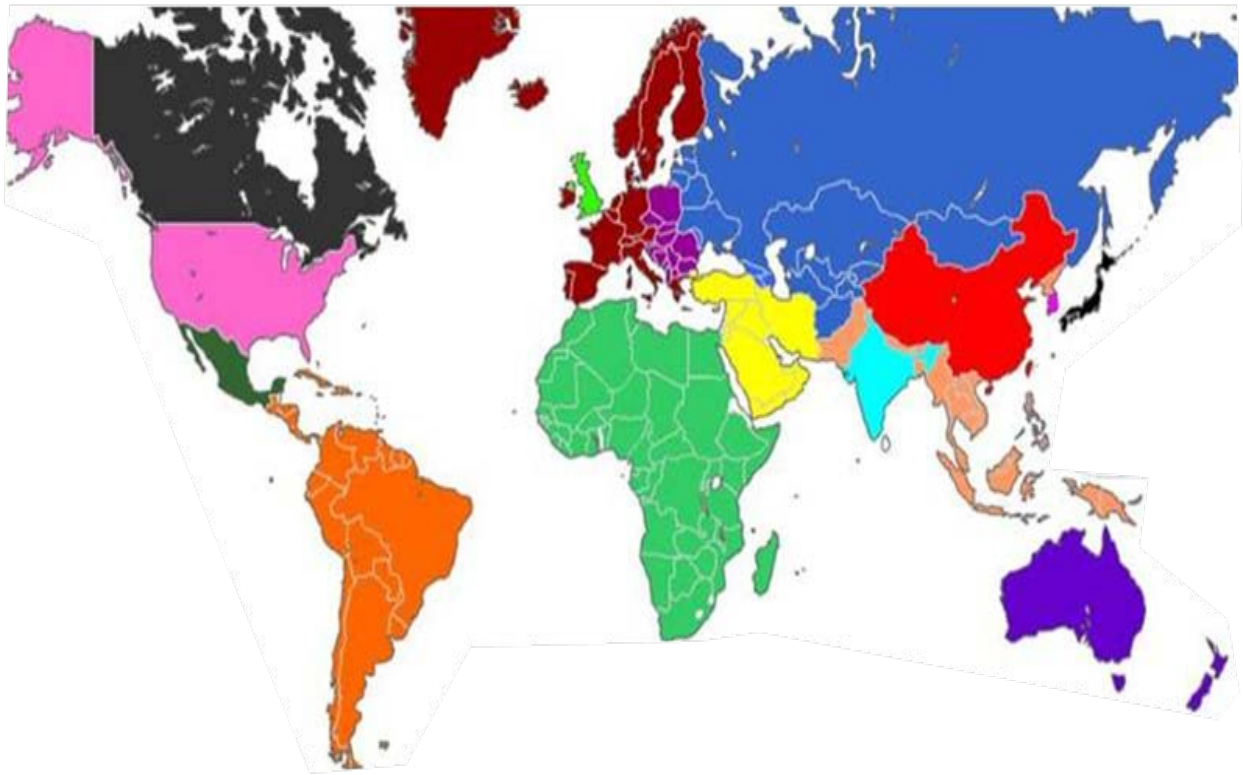
Nationally Determined Contribution (NDC) goals

Country	Share of global 2012 GHG emissions	GHG reduction	Target date	Base year	Other large-scale pledges	Max 2030 GHG emissions (Mt CO2-eq)	Change in 2030 from 2012 level
China	24%	60-65% reduction in CO_2/GDP intensity	2025	2005	20% share of non-fossil fuels in primary energy by 2030	13,500	+15%
United States	13%	26-28%	2025	2005	32% reduction in electricity CO_2 from 2005 levels by 2030	5,500	-8%
EU & Norway	9%	40%	2030	1990		3,200	-28%
Russia	5%	25-30%	2030	1990		2,500	+11%
Japan	3%	25%	2030	2005		1,000	-22%
Mexico	1.7%	22-36%	2030	BAU		690	-14%
India	6.7%	33-35% reduction in GHG/GDP intensity	2030	2005	40% share of low carbon in electricity capacity	6,752	+133%
Canada	1.5%	20%	2030	2005		520	-30%
South Korea	1.3%	37%	2030	BAU		540	-16%
Australia	1.2%	26-28%	2030	2005		450	-20%

NDC reports

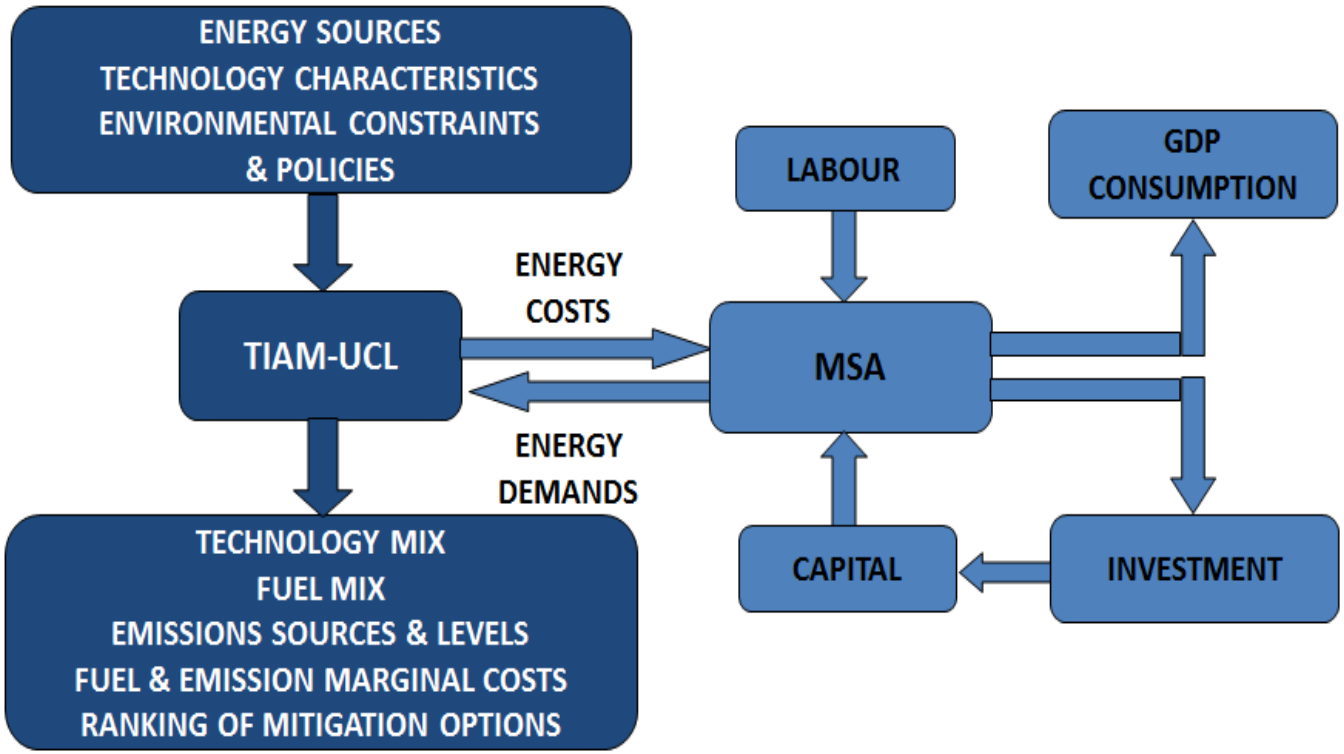
NDC Study	Approach / Model	Global GHG emissions in 2030 (Gt CO2 e)	Level relative to 2010	Level relative to ref / baseline in 2030
EC JRC (Kitous and Keramidas, 2015)	Emission reduction / POLES	54	+12%	
UNFCCC (2015b)	Emission reduction / Multi-study review	53.1 – 58.6	+11-20%	
Boyd et al (2015)	Analysis of NDCs submitted under different GDP projections	52.8 – 61.1		16.25%
Admirral et al (2015)	Emission reduction & IAM / IMAGE-TIMER	54 - 56		-14-17%
Ekholm and Lindroos (2015)	Emission reduction / REFUGE3	50 - 54		
Rogelj et al (2016)	Based on 10 global assessments including others in the table	52.6 - 55	+10-15%	
Vandyck et al (2016)	Emission reduction and macro effects / POLES & GEM-E3	55		-13%
Hof et al (2017)	Emission reduction & cost analysis / IMAGE	49.4 – 54.6	14.5 to 17%	- 14 to 16%
UNEP (2017)	Emissions reduction / multi-model	53 – 55.5		

16 regions in TIAM-UCL



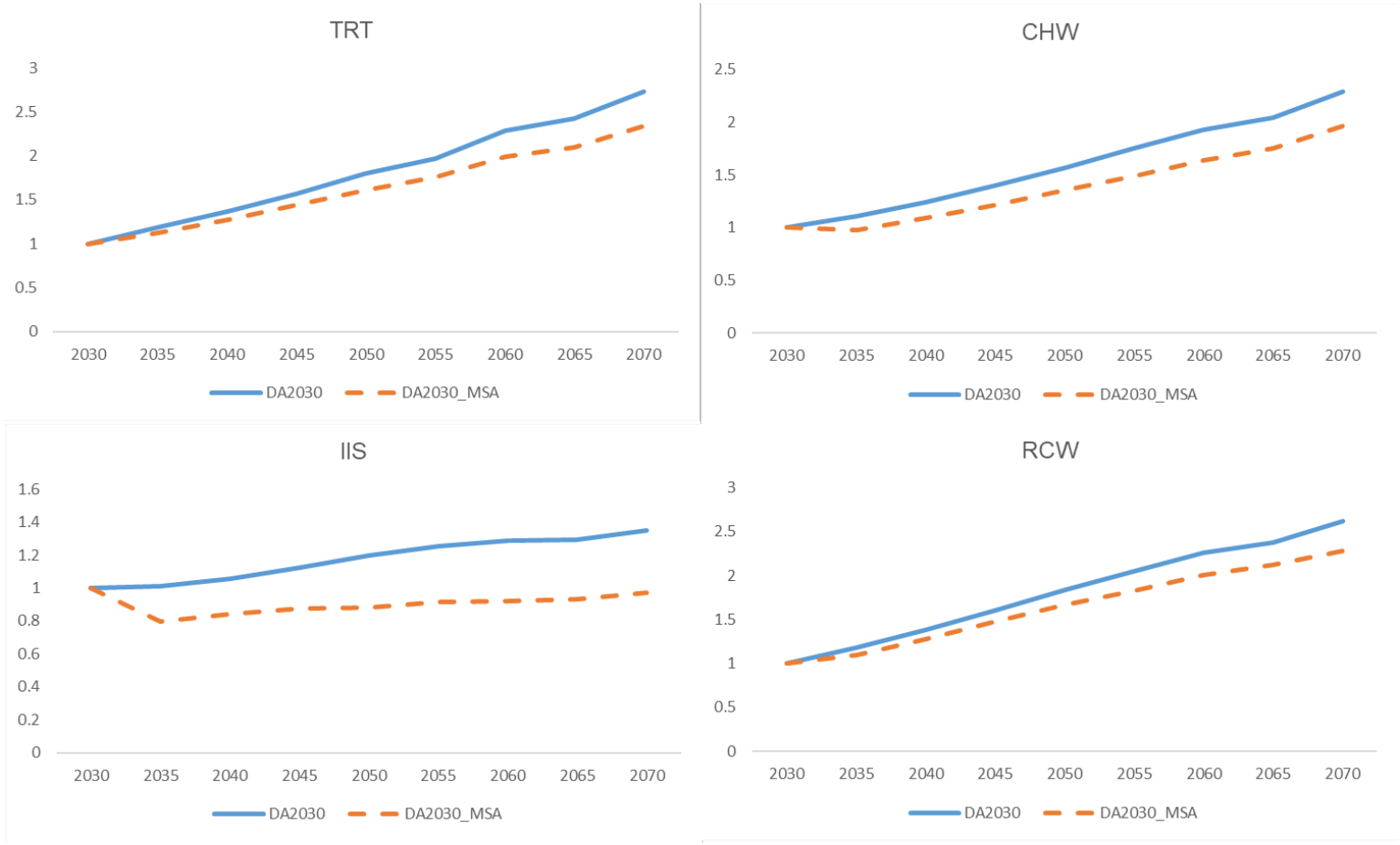
McGlade and Ekins (2015), The Geographical distribution of fossil fuels unused when limiting global warming to 2°C, *Nature*

TIAM-UCL-MSA (hard link)



Demand response

Figure A2: Comparison of demands (a) Car road (b) Commercial hot water (c) Iron and steel (d) Residential clothes washing, for the DA2030 scenario in linear and MSA versions of TIAM-UCL (indexed to 2030)



NDCs in TIAM-UCL-MSA

167 NDCs submitted. NDCs of 194 countries now comprehensively covered in TIAM-UCL covering 97% of global emissions

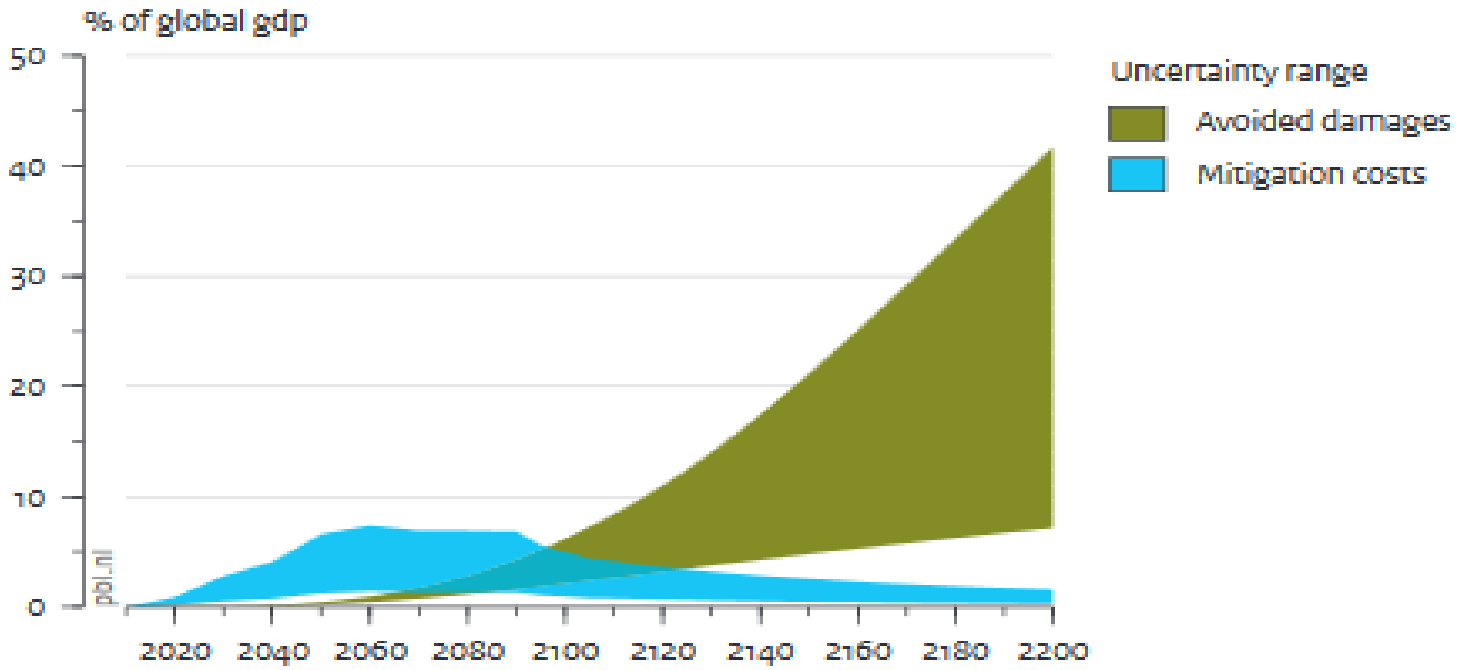
- Conditional vs. unconditional targets e.g. Algeria 7% or 22%; Nigeria 20% vs. 45%
- Emissions growth assumptions for Business-as-usual (BAU) to 2030 (high vs. low)
- 1.1 Gt CO2e difference between conditional and unconditional
- 2.9Gt difference between High Growth + unconditional vs. Low Growth + conditional
- TIAM-UCL range is 52 to 54.9 Gt CO2e

Scenarios

Scenario name	Description
NDC	Model Baseline. NDCs achieved to 2030 and then a constant regional level of emissions per GDP/capita beyond 2030.
2DS	2°C target is undertaken from 2020 onwards Upper limit of individual regions from NDC constraint.
2DS-TECH	As per 2DS but with lower solar PV, wind and transport costs
DA2030	2°C target is undertaken from 2030 onwards, with the pathways before 2030 fixed to NDC.
DA2030-TECH	As per 2DS-DA30 but with lower solar PV, wind and transport costs post-2030.

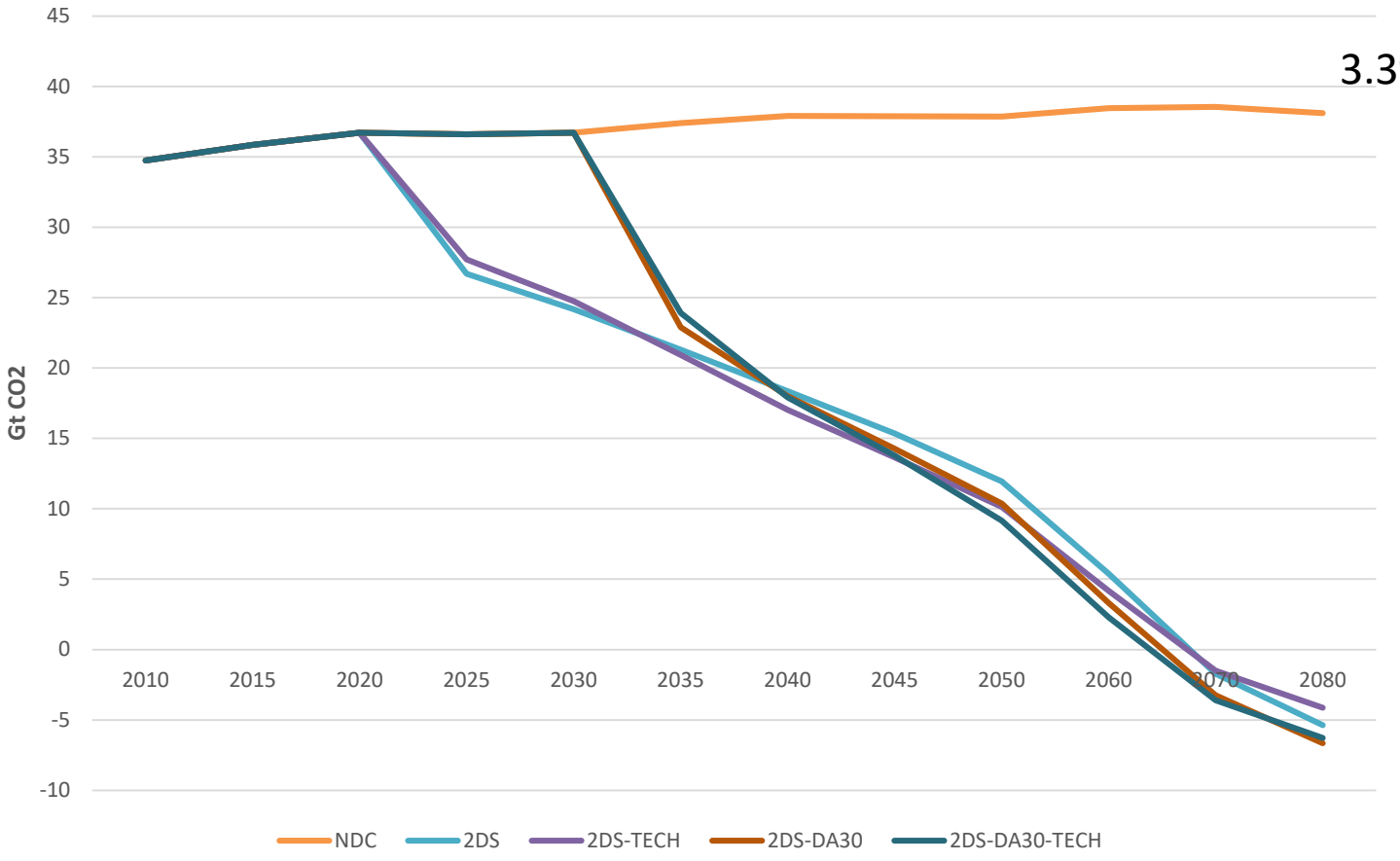
No damages

Figure 2.1
Annual mitigation costs and avoided damages of a 2 °C scenario



Source: Kriegler et al., 2013; Nordhaus and Sztorc, 2013; Weitzman, 2012; analysis PBL Netherlands Environmental Assessment Agency

Global emissions



3.3°C in 2100

Global emissions

Reduction rates in TIAM-UCL-MSA

GHGs:
2DS = 1.6% p.a.
DA2030 = 2.6% p.a.

CO2:
2DS = 3.5% p.a.
DA2030 = 6.1% p.a.

CO2 budget = 910-930 Gt

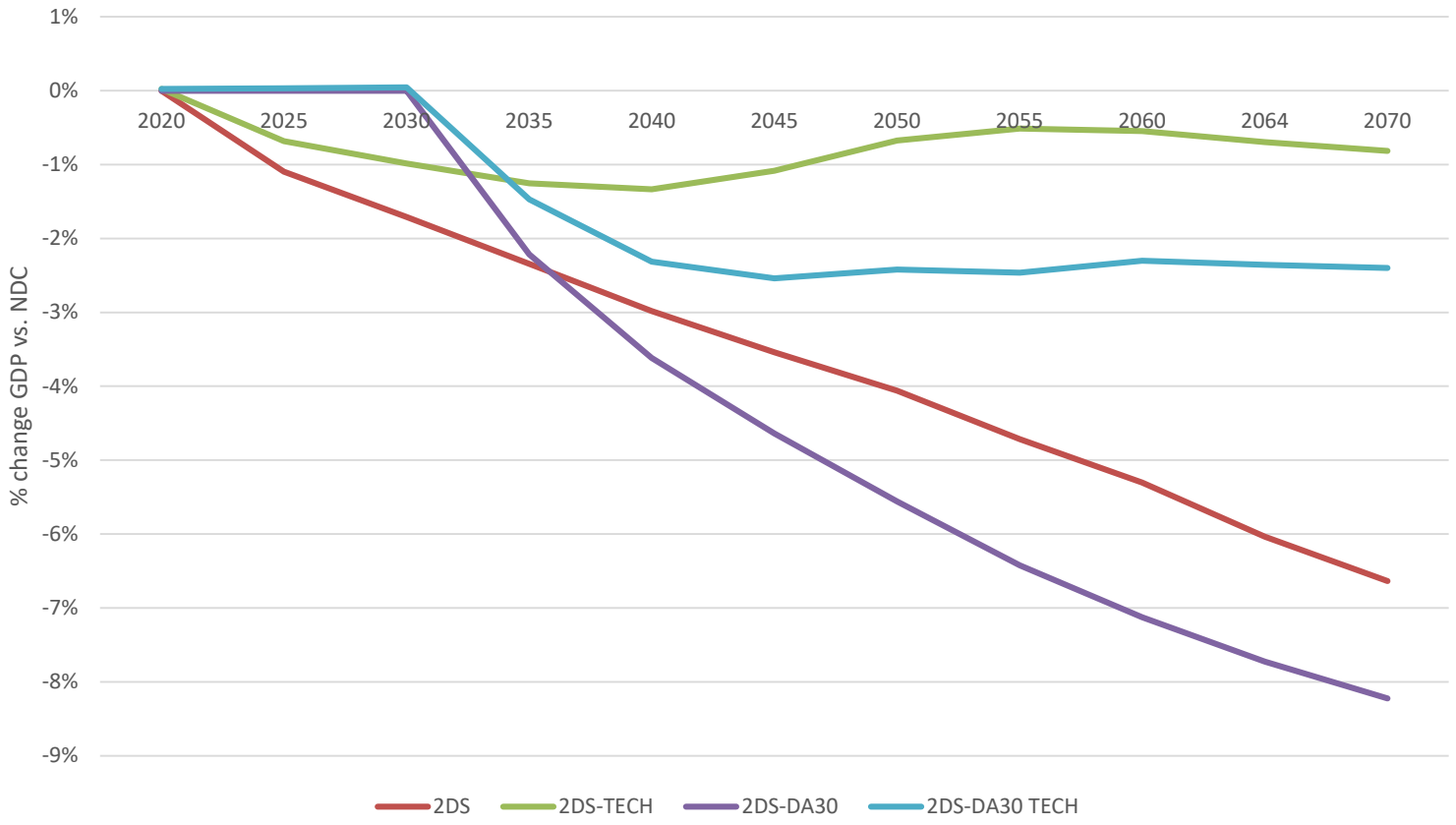
Other literature

GHGs (UNFCCC 2015):
2DS = 1.6% (0.6-2.2) p.a.
DA2030 = 3.3% (2.7-3.9) p.a.

Rogelj et al. (2016)
CO2 budget (66%) = 590-1,240 Gt

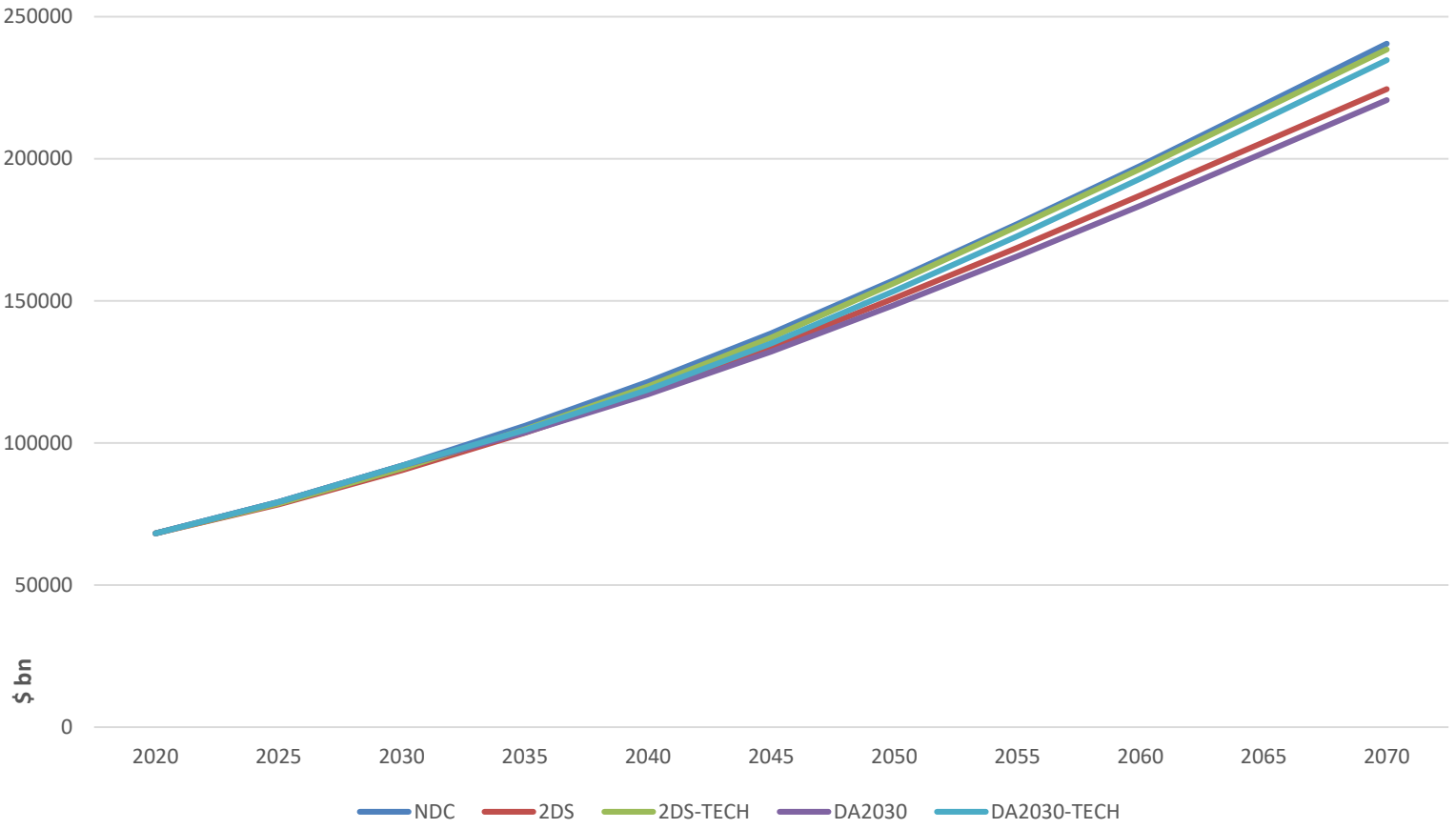
Results

Global GDP loss % for scenarios against NDCs



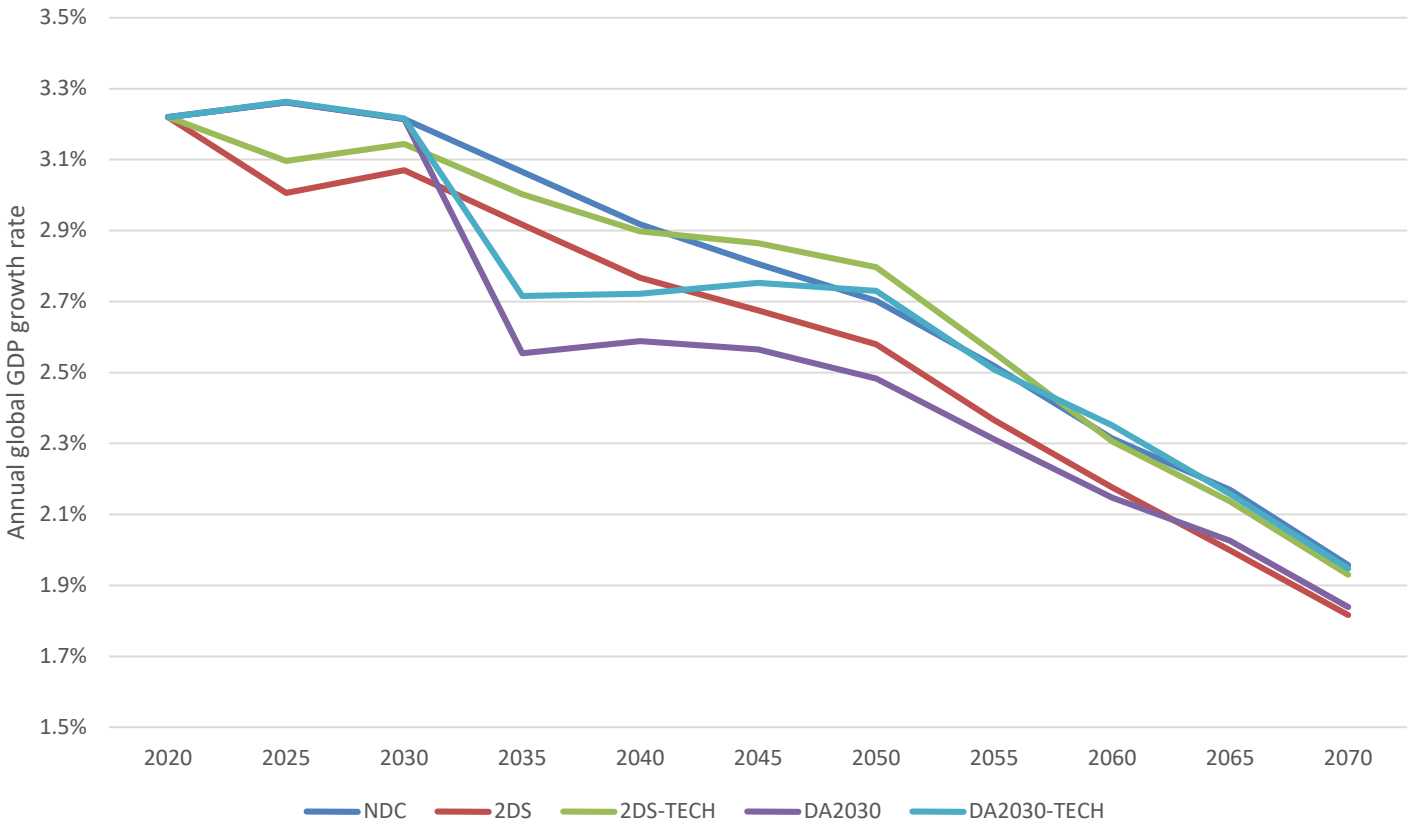
Results

Global GDP levels



Results

Annual global GDP growth rates

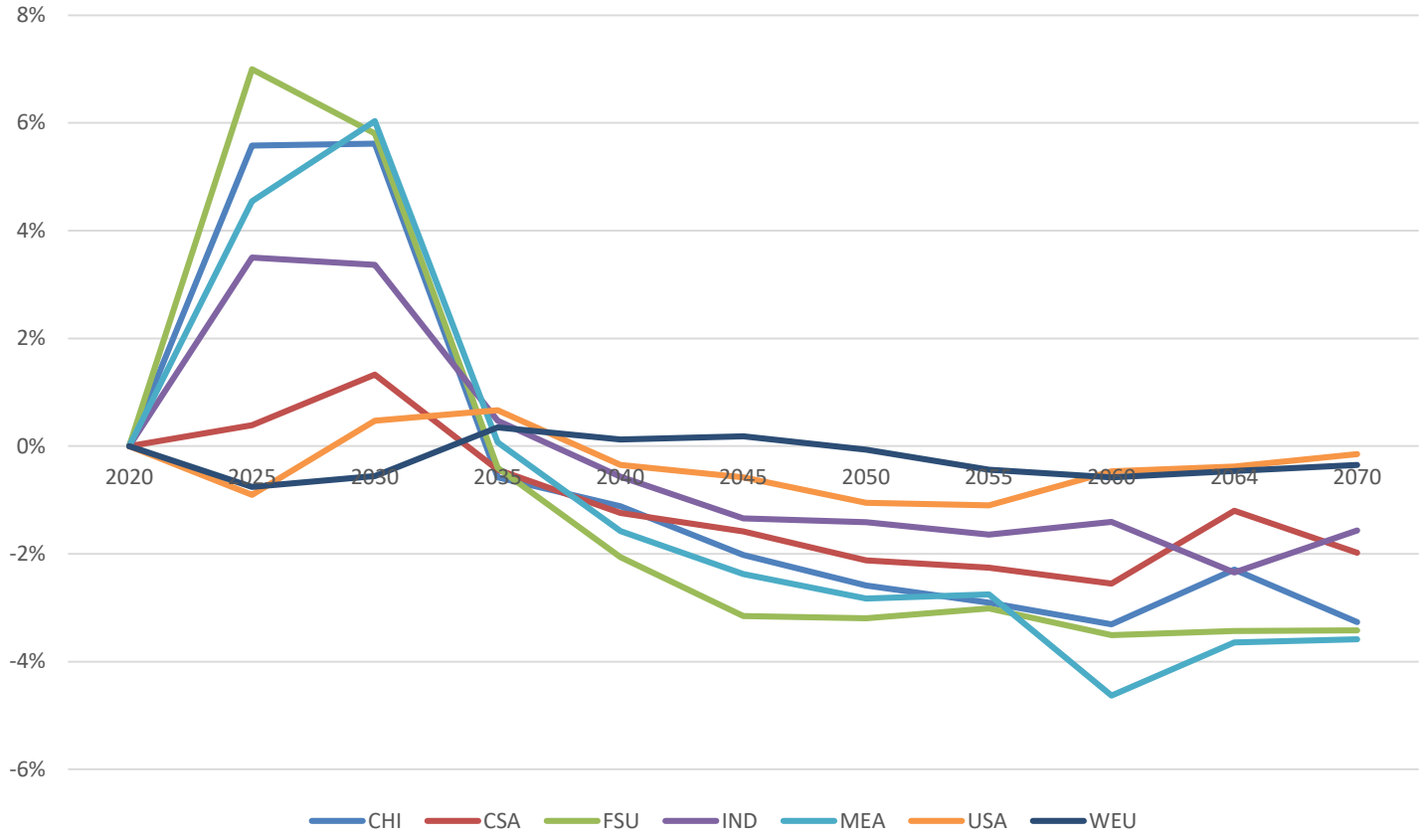


Global GDP growth % rates

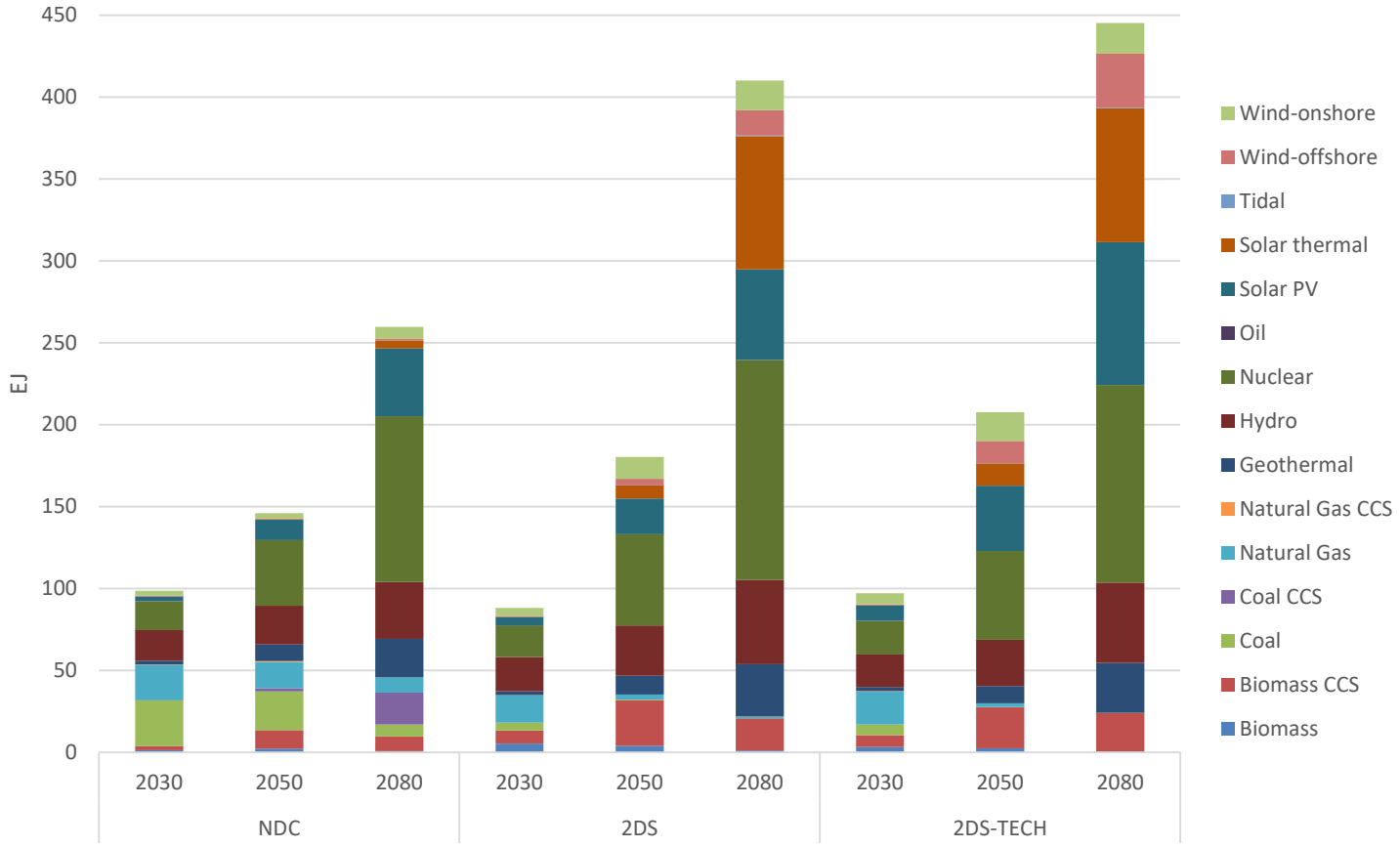
Scenario¥Period	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
NDC	3.22%	3.26%	3.21%	3.07%	2.92%	2.81%	2.70%	2.52%	2.31%	2.17%	1.96%
2DS	3.22%	3.01%	3.07%	2.92%	2.77%	2.67%	2.58%	2.37%	2.18%	2.00%	1.82%
2DS-TECH	3.22%	3.10%	3.14%	3.00%	2.90%	2.86%	2.80%	2.56%	2.31%	2.14%	1.93%
DA2030	3.22%	3.26%	3.21%	2.55%	2.59%	2.56%	2.48%	2.31%	2.15%	2.03%	1.84%
DA2030-TECH	3.22%	3.26%	3.22%	2.72%	2.72%	2.75%	2.73%	2.51%	2.35%	2.16%	1.95%

Results

Regional GDP loss % for DA2030 against 2DS



Global electricity production



Conclusions

- Current NDC ambition leads to a 3.1–3.3°C world in 2100
- Global rate of CO_2 emissions reduction is doubled between 2030 and 2050 if NDCs not ratcheted-up until 2030
- Total cumulative GDP over the century is lower when additional action is delayed to 2030 and therefore has an overall negative impact on the economy
- Early action combined with cost reductions in key renewable energy technologies can reduce GDP losses to minimal levels (<1%)
- A 2°C future with technological advancements is clearly possible for a similar cost as a 3.3°C world without these advances, but with lower damages and losses from climate change.

Reference:

Matthew Winning, James Price, Paul Ekins, Steve Pye, James Glynn, Jim Watson & Christophe McGlade (2019): Nationally Determined Contributions under the Paris Agreement and the costs of delayed action, *Climate Policy*, DOI: 10.1080/14693062.2019.1615858

This research formed part of the programme of the UK Energy Research Centre and was supported by the Research Councils UK under the Engineering and Physical Sciences Research Council award EP/L024756/1.

Also see:

Winning M., Pye S., Glynn J., Scamman D., Welsby D. (2018) *How Low Can We Go? The Implications of Delayed Ratcheting and Negative Emissions Technologies on Achieving Well Below 2°C.*
In: Giannakidis G., Karlsson K., Labriet M., Gallachóir B. (eds) *Limiting Global Warming to Well Below 2°C: Energy System Modelling and Policy Development*. Lecture Notes in Energy, vol 64. Springer, Cham

https://link.springer.com/chapter/10.1007/978-3-319-74424-7_4

Thank you

m.winning@ucl.ac.uk