From the NDCs to 2°C: A new baseline and delayed ratcheting

Dr Matthew Winning & Prof. Paul Ekins
UCL Institute for Sustainable Resources

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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	Global GHG emissions in 2030 (Gt CO2 e)
EU JRC (2015)	54
IPCC (2015)	53.1 – 58.6
Boyd et al (2015)	52.8 – 61.1
Admirral et al (2015)	54 - 56
Ekholm and Lindroos (2015)	50 - 54
Rogelj et al (2016)	52.6 - 55
Vandyck et al (2016)	55
Hof et al (2017)	49.4 – 54.6

NDC reports

- IPCC (2015) – 2030 emissions are 35% higher than 2°C least-cost scenario
- Fawcett *et al* (2015) – probabilistic method shows NDC continued ambition leads to 2-3°C with a 50% probability
- Spencer *et al* (2015) – average carbon intensity of electricity reduces by 40% in 2030 from 2010 across Brazil, China, India, EU, Japan and USA

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Global and regional abatement costs of Nationally Determined Contributions (NDCs) and of enhanced action to levels well below 2 °C and 1.5 °C

Andries F. Hof[a,b,*], Michel G.J. den Elzen[a], Annemiek Admiraal[a], Mark Roelfsema[a], David E.H.J. Gernaat[a,b], Detlef P. van Vuuren[a,b]

[a] PBL Netherlands Environmental Assessment Agency, P.O. Box 30314, 2500 GH The Hague, The Netherlands
[b] Copernicus Institute of Sustainable Development, Faculty of Geosciences, Utrecht University, P.O. Box 80.115, 3508 TC Utrecht, The Netherlands

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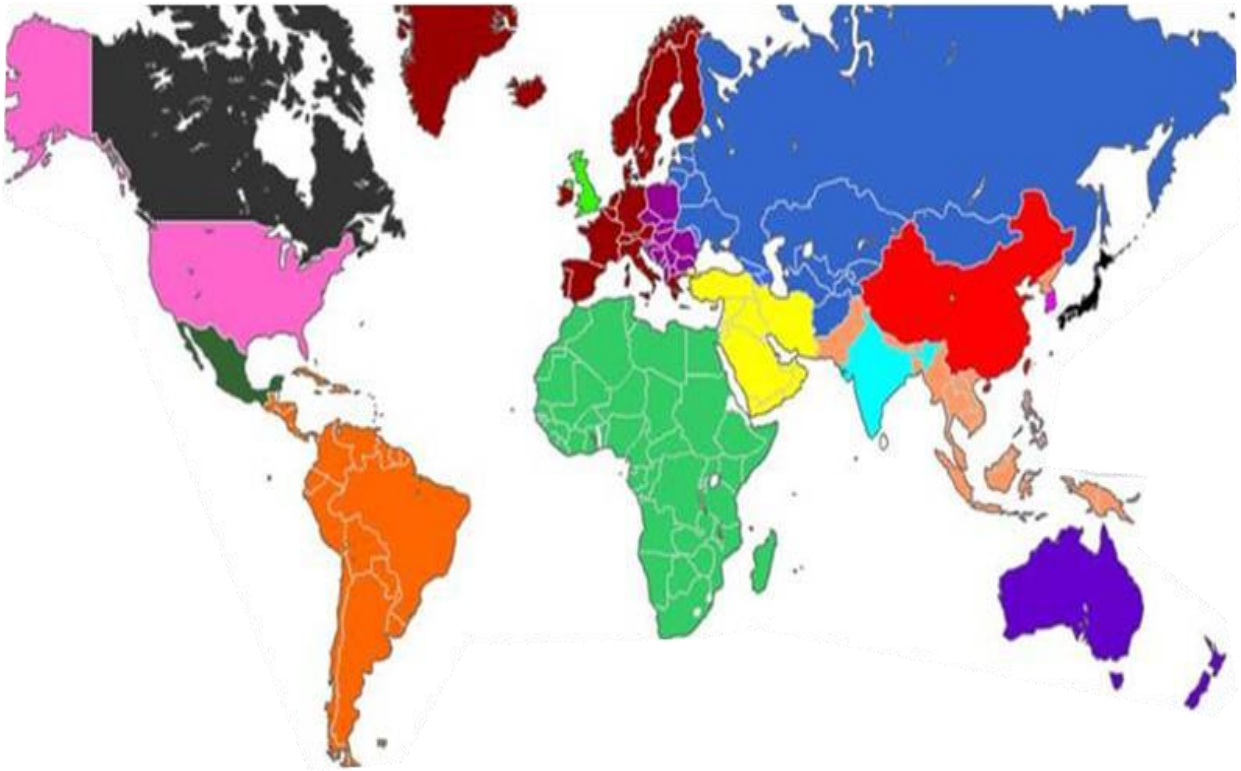
ABSTRACT

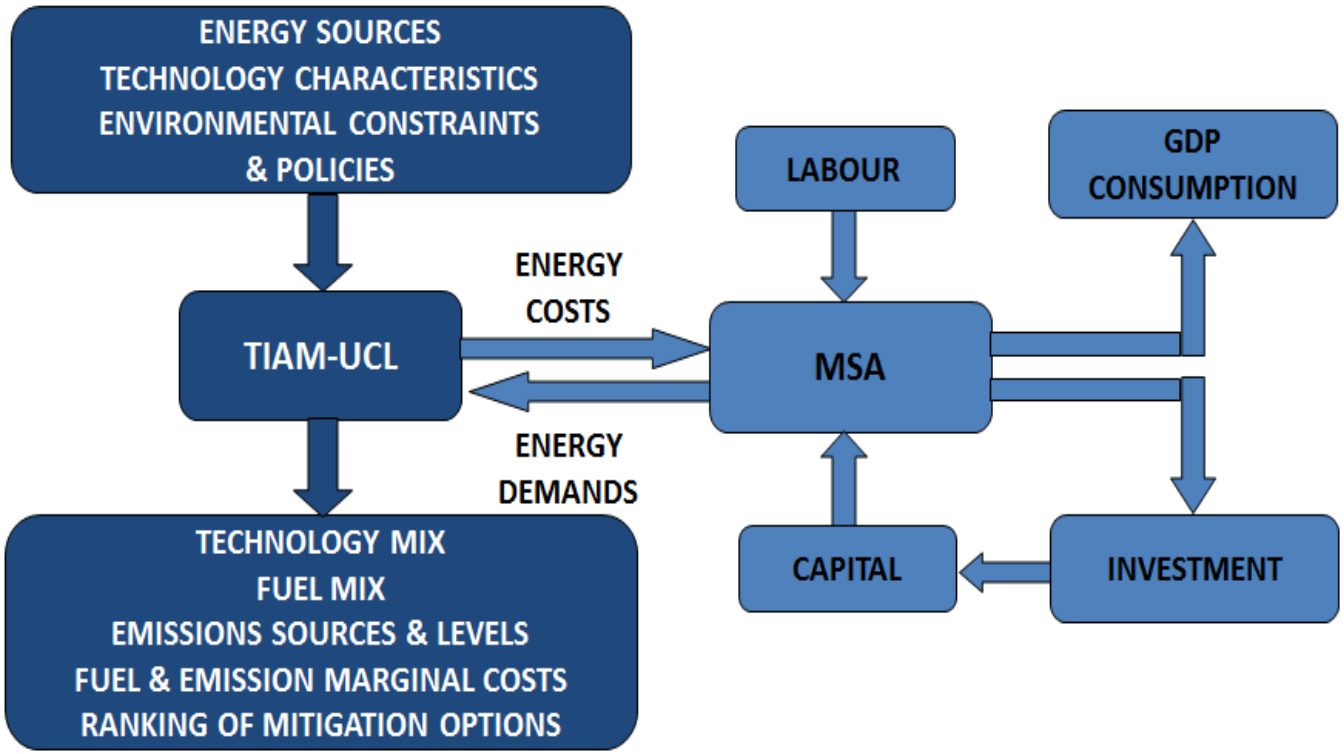
As part of the Paris climate agreement, countries have submitted (Intended) Nationally Determined Contributions (NDCs), which includes greenhouse gas reduction proposals beyond 2020. In this paper, we apply the IMAGE integrated assessment model to estimate the annual abatement costs of achieving the NDC reduction targets, and the additional costs if countries would take targets in line with keeping global warming well below 2 °C and "pursue efforts" towards 1.5 °C. We have found that abatement costs are very sensitive to socio-economic assumptions: under Shared Socioeconomic Pathway 3 (SSP3) assumptions of slow economic growth, rapidly growing population, and high inequality, global abatement costs of achieving the unconditional NDCs are estimated at USD135 billion by 2030, which is more than twice the level as under the more sustainable socio-economic assumptions of SSP1. Furthermore, we project that the additional costs of full implementation of the conditional NDCs are substantial, ranging from 40 to 55 billion USD, depending on socio-economic assumptions. Of the ten major emitting economies, Brazil, Canada and the USA are projected to have the highest cots as share of GDP to implement the conditional NDCs, while the costs for Japan, China, Russia, and India are relatively low. Allowing for emission trading could decrease global costs substantially, by more than half for the unconditional NDCs and almost by half for the conditional NDCs. Finally, the required effort in terms of abatement costs of achieving 2030 emission levels consistent with 2 °C pathways would be at least three times higher than the costs of achieving the conditional NDCs – even though reductions need to be twice as much. For 1.5 °C, the costs would be 5–6 times as high.

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)



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

NDCs in TIAM-UCL-MSA

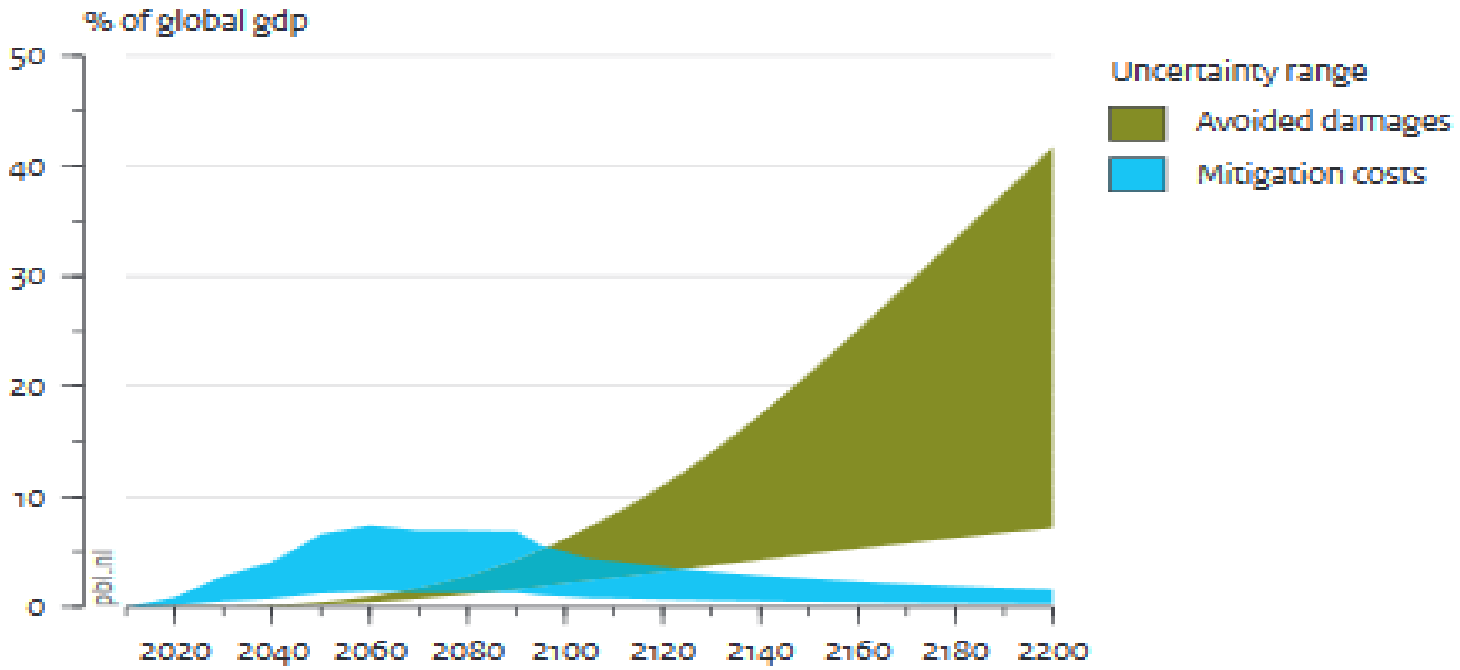
Emissions cap

Explicit target
Interpolated
Based on continuation of emissions per capita

	2020	2025	2030	2035	2040	2045	2050
AFR	-	-	3,600,000	3,990,478	4,402,780	4,831,771	5,271,419
AUS	638,400	563,580	488,760	511,035	532,789	554,394	575,739
CAN	614,200	566,100	518,000	534,170	548,923	562,975	576,800
CHI	13,247,981	13,602,427	13,644,341	13,601,457	13,479,828	13,280,276	13,008,678
CSA	4,142,399	4,321,193	4,480,460	4,617,631	4,731,947	4,823,045	4,890,556
EEU	1,018,047	890,791	763,535	636,279	509,024	381,768	254,512
FSU	4,319,749	4,117,261	3,914,773	3,931,197	3,944,945	3,952,395	3,947,991
IND	4,619,000	5,685,890	6,752,781	6,976,861	7,160,456	7,303,928	7,409,924
JPN	1,213,101	1,127,550	1,042,000	1,016,412	989,241	961,957	935,788
MEA	-	-	3,600,000	3,785,138	3,957,647	4,114,439	4,250,197
MEX	709,766	700,298	690,830	595,623	500,415	405,208	310,000
ODA	-	-	5,900,000	6,103,069	6,270,402	6,400,882	6,494,843
SKO	547,400	541,765	536,130	538,549	536,946	531,921	524,256
UK	507,000	390,000	358,800	308,100	257,400	206,700	156,000
USA	6,100,500	5,365,500	5,549,175	5,715,047	5,863,432	6,000,319	6,134,096
WEU	2,766,453	2,420,646	2,074,840	1,729,033	1,383,226	1,037,420	691,613

No damages

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

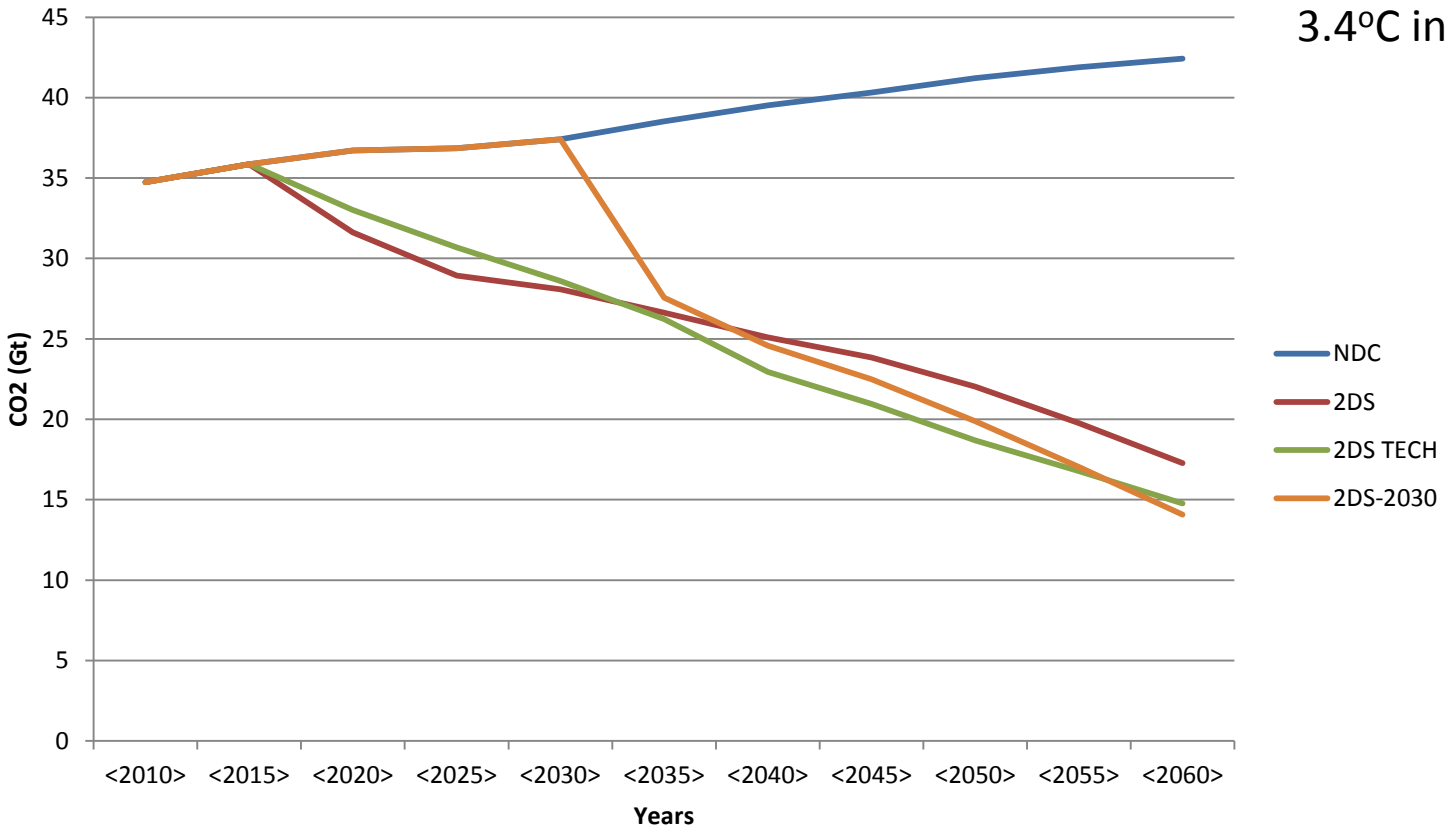


Source: Kriegler et al., 2013; Nordhaus and Sztorc, 2013; Weitzman, 2012; analysis PBL Netherlands Environmental Assessment Agency

Scenarios

Name	Description
NDC (Baseline)	NDC commitments in GHGs until 2030. No policy increase beyond 2030. Constant GHGs per (GDP/Cap)
2DS	2°C target is undertaken from 2015 onwards
2DS-2030	Results fixed to NDC run until 2030 then 2DS
2DS-TECH	2°C target is undertaken with lower solar PV, wind and transport costs

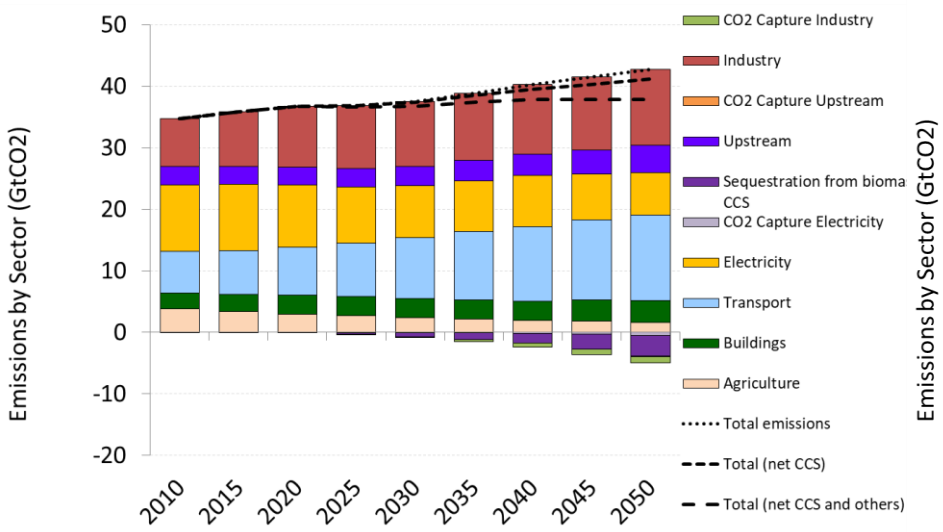
Global emissions



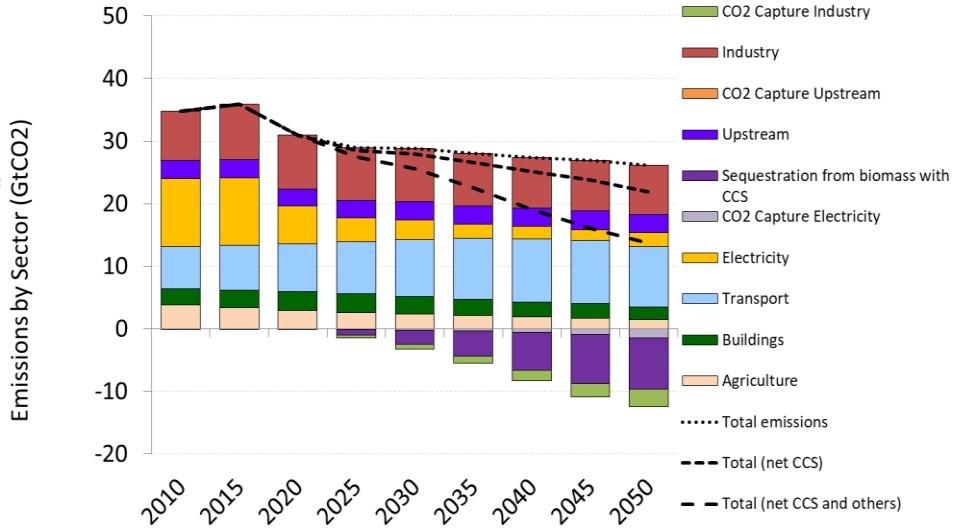
3.4°C in 2100

CO2 emissions by sector

***Scenario**: NDCs*

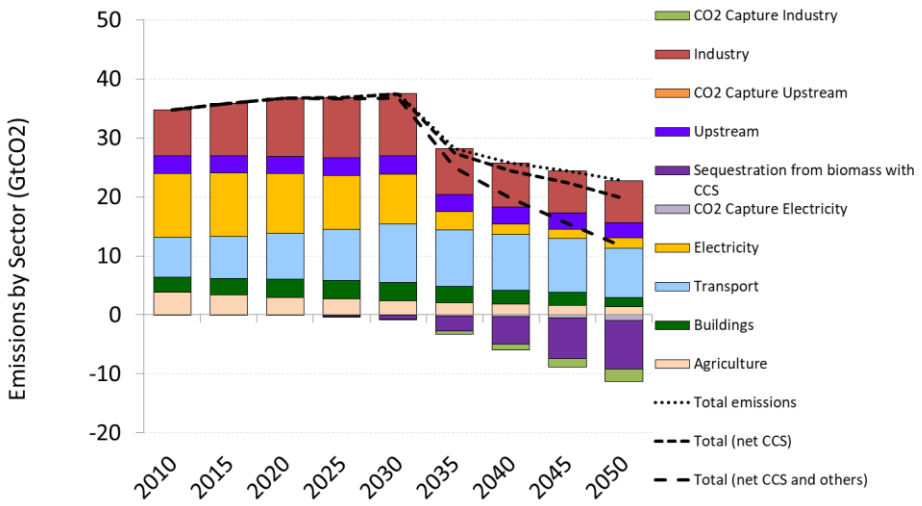


***Scenario**: 2DS*

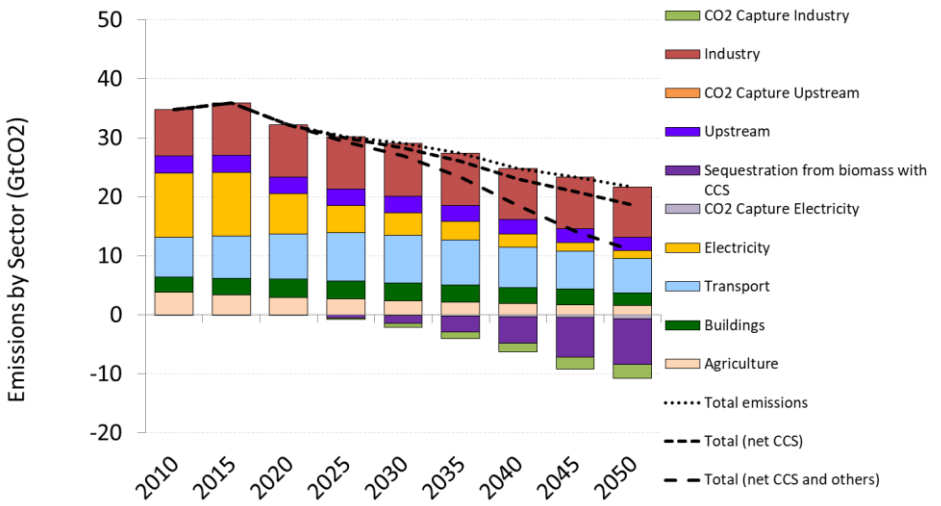


CO2 emissions by sector

***Scenario**: 2DS-2030*

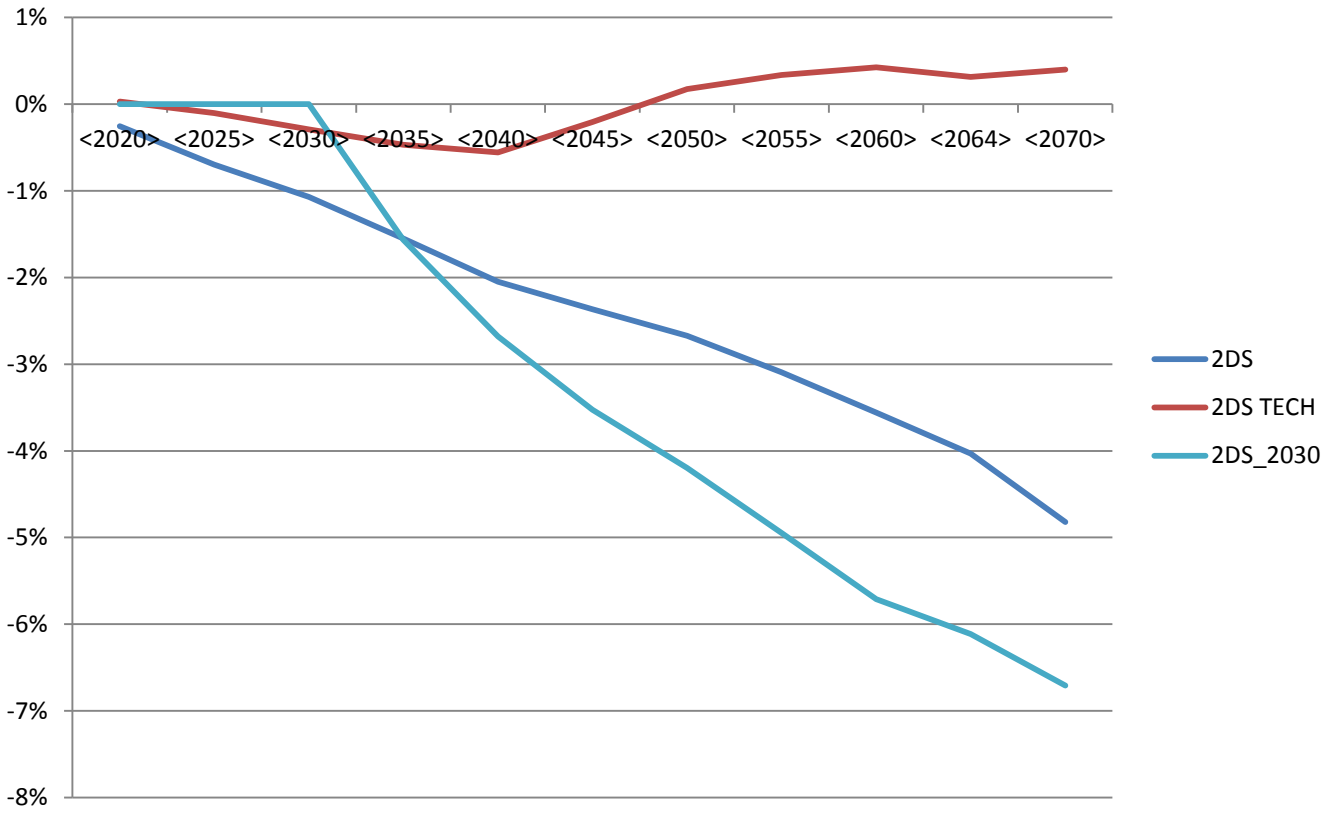


***Scenario**: 2DS-TECH*



Results

Global GDP loss % for scenarios against NDCs

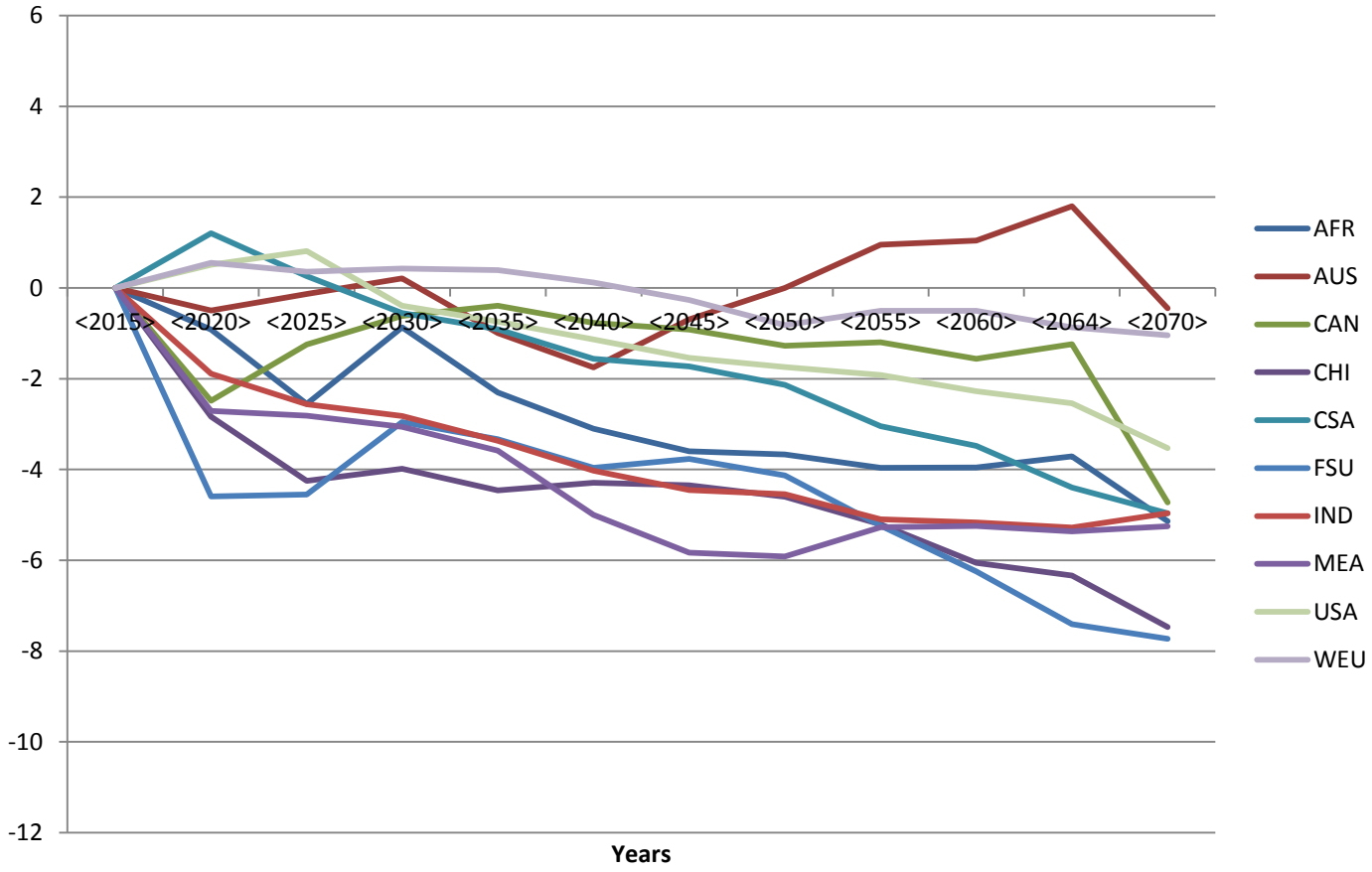


Global GDP growth % rates

Scenario\Period	2015-20	2020-25	2025-30	2030-35	2035-40	2040-45	2045-50	2050-55	2055-60	2060-70
NDC	3.22%	3.26%	3.21%	3.07%	2.92%	2.81%	2.70%	2.52%	2.31%	2.17%
2DS	3.16%	3.16%	3.13%	2.95%	2.80%	2.73%	2.63%	2.42%	2.21%	2.01%
2DS-2030	3.22%	3.26%	3.21%	2.70%	2.66%	2.61%	2.54%	2.34%	2.13%	2.04%
2DS TECH	3.22%	3.23%	3.17%	3.02%	2.90%	2.89%	2.79%	2.55%	2.33%	2.17%

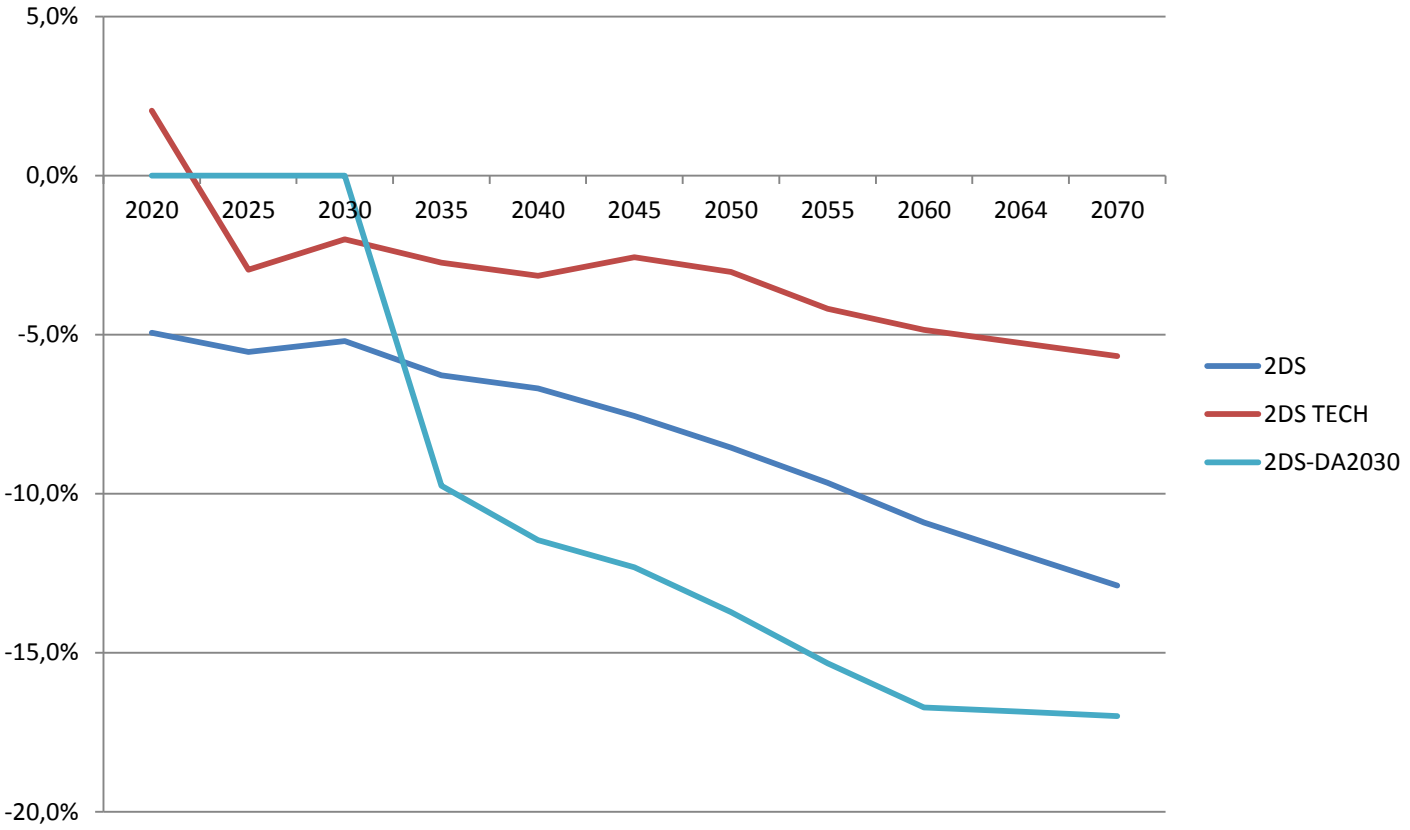
Results

Regional GDP loss % for 2DS against NDCs

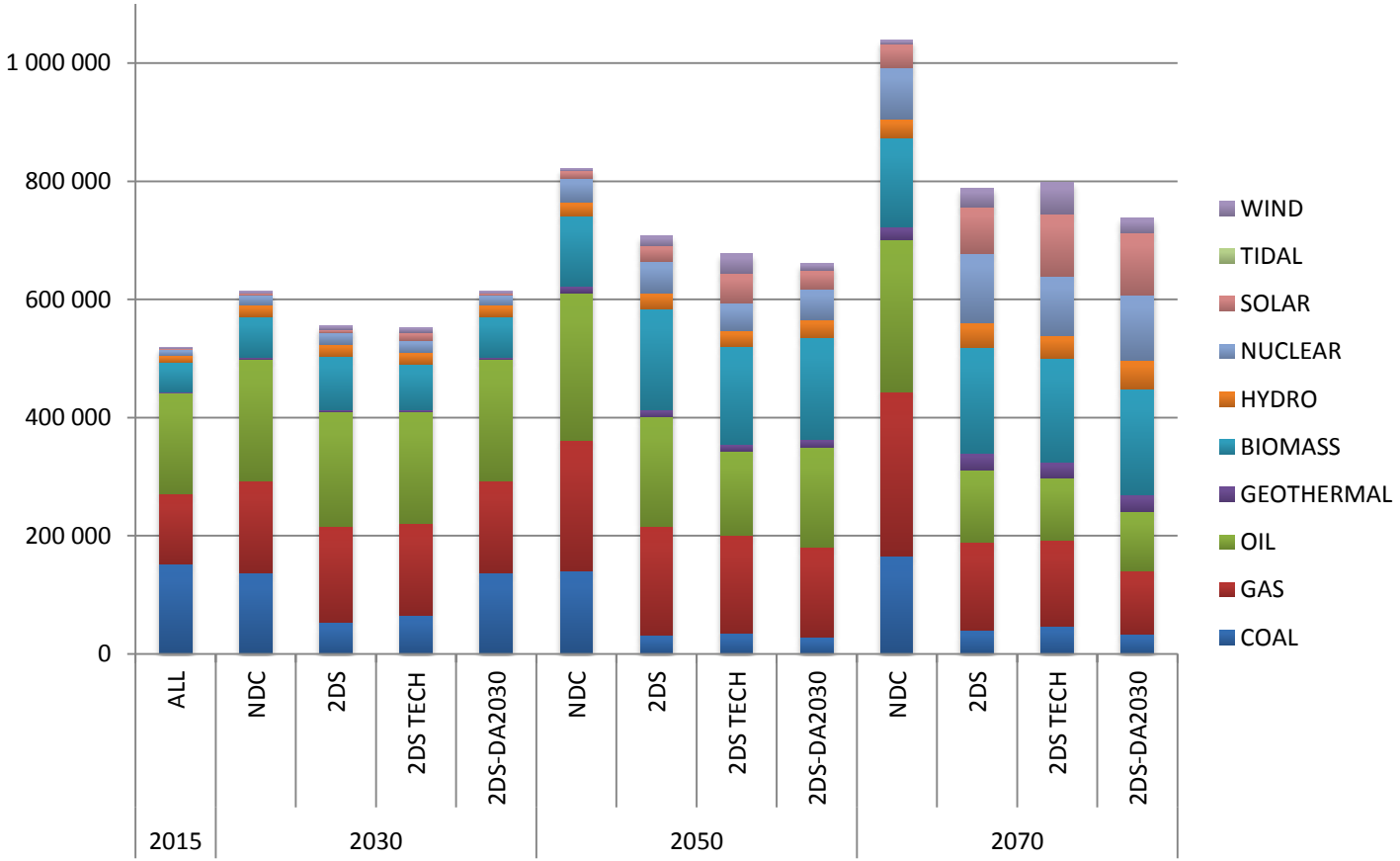


Results

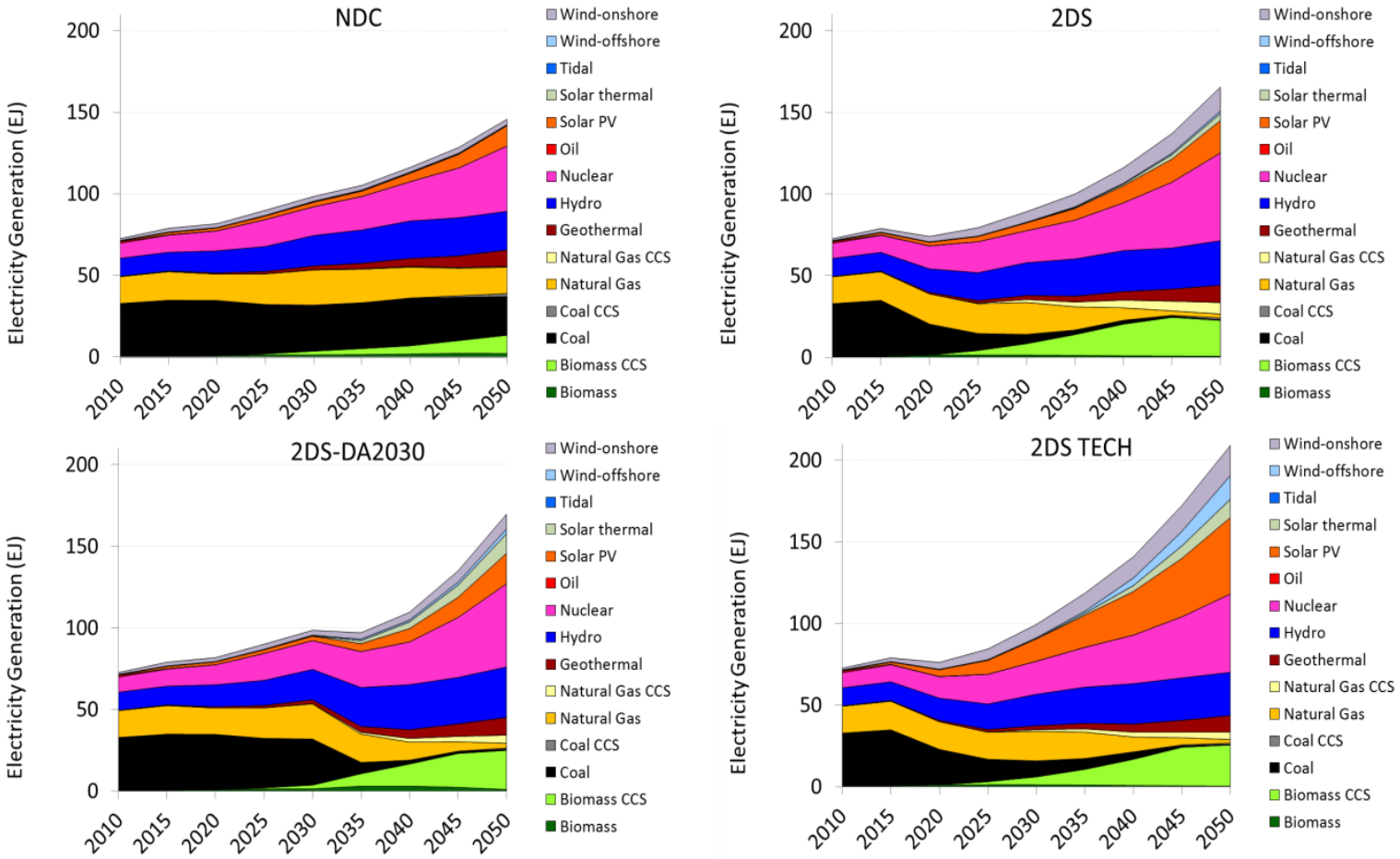
Energy demand reduction by scenario against NDCs



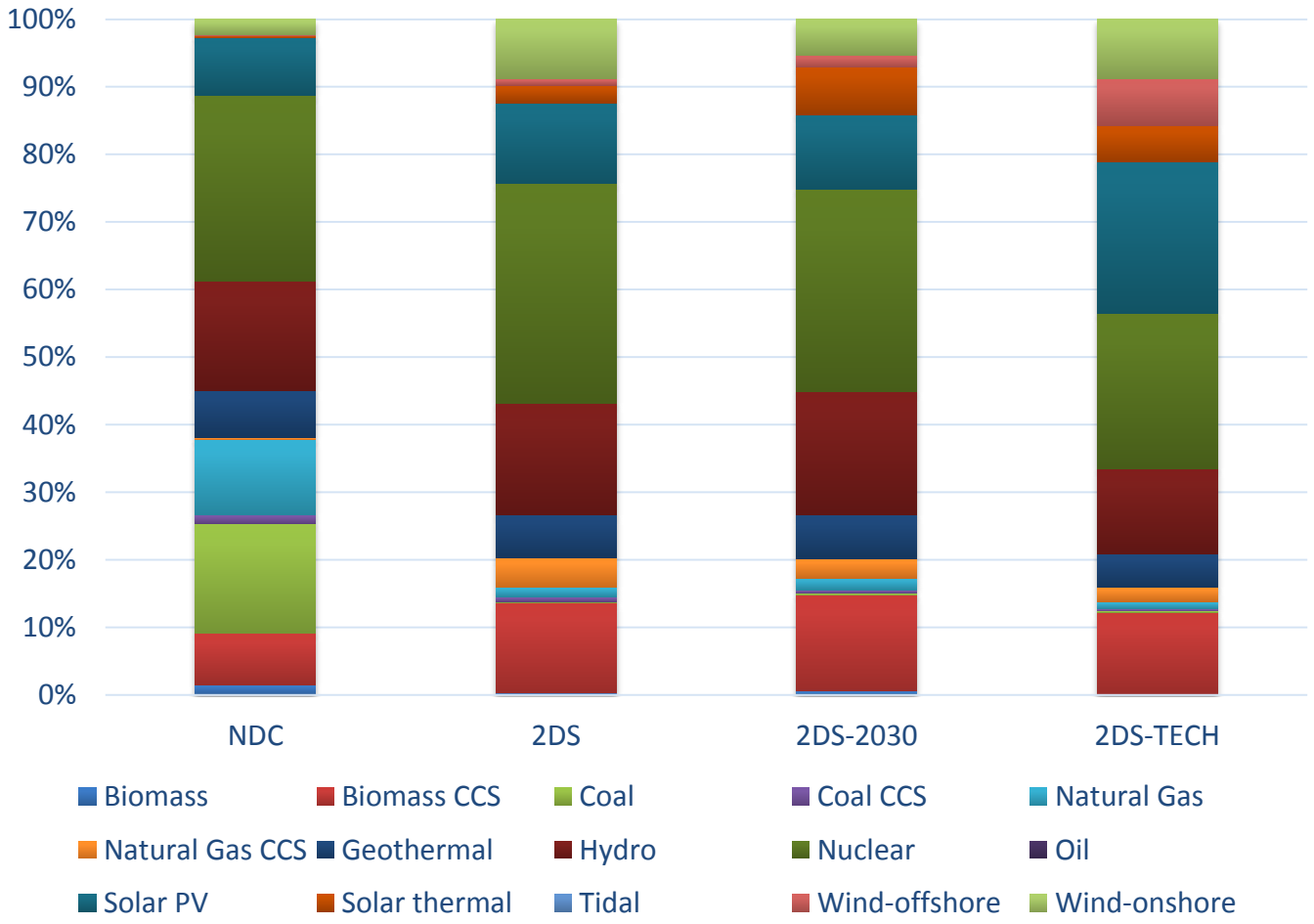
Global energy production



Power sector generation



% generation in 2050



Conclusions

- *Global rate of GHG reduction between 2030 and 2050 needs to be 3.9% a year if NDCs not ratcheted-up until 2030, compared to only 1.9% if 2DS from 2015 onwards i.e. double*
- *With reduced wind and solar costs then 2DS-TECH can improve economy against the NDC baseline (although assumed costless in model)*