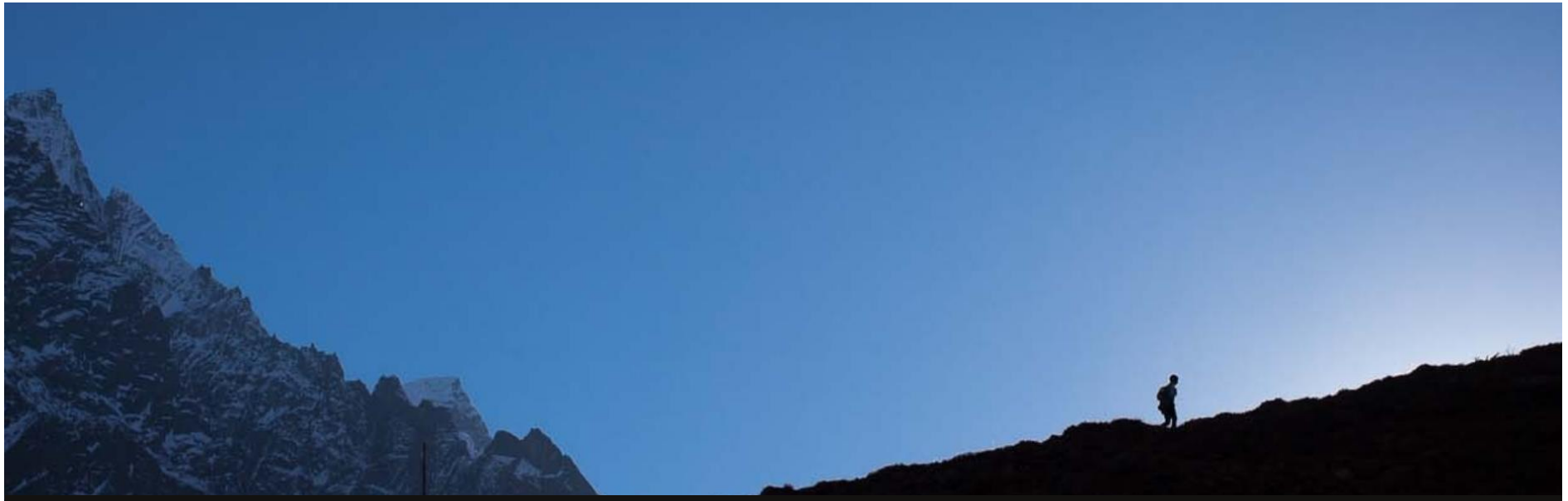
Doutoramento em Alterações Climáticas e Políticas de Desenvolvimento Sustentável



Class 10 | 13th May 2022 | Global energy and climate

Sofia G. Simoes

SEMINAR ENERGY & CLIMATE CHANGE

Climate Change and Sustainable Development Policies

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1	04/03 6ª Feira	16h-18h	Session reserved for students meeting with the Scientific Committee on practical aspects of the PhD Program, and choice of tutors.	Comissão Científica
2	11/03 6ª Feira	16h-18h	ENERGY & CLIMATE CHANGE: A COMPLEX RELATION, PERENE AND INTERDISCIPLINARY. Framework and purpose of the course in the PDACPDS. Practicalities and seminar program. Basic concepts of the energy systems.	J. Seixas, FCT NOVA
3	18/03 6ª Feira	16h-18h	**Current state of the global energy system :** main energy carriers, energy production and consumption regions; energy access; concepts of energy and carbon intensity.	S. Simões
4	25/03 6ª Feira	14h-16h	**Global balance of CO_2 emissions** associated with energy and industrial processes. Estimates of the Global Carbon Budget (http://www.globalcarbonproject.org/) and its relationship to the global energy system and changes in land use. Future scenarios for greenhouse gas emissions: RCPs (Representative Concentration Pathways). Global emissions based on consumption vs. production.	S. Simões
5	02/04 Sábado	09h-11h	**Renewables:** Economic, environmental and energy security of endogenous vs. imported resources. Renewable technologies. Sustainability issues related with renewables. Land & water use, critical raw materials. Discussion: Where to place 7GW of solar PV in Portugal till 2030?	S. Simões
6	08/04 6ª Feira	16h-18h	**Energy concepts:** Primary/final energy; Sankey diagrams; energy efficiency; Energy services; Energy carriers; Final energy supply cost curves; learning curves of energy technologies. Definition and usefulness of LCOE. System value of Renewables. Global renewables' market.	S. Simões
7	22/04 6ª Feira	16h-18h	**Drawdown** - Climate Solutions for a New Decade	João P. Gouveia, FCT NOVA
8	30/04 Sábado	09h-11h	**Green hydrogen:** technological options, costs and the role for a carbon neutral energy system	P. Fortes, FCT NOVA
9	06/05 6ª Feira	18h-20h	**CARBON PRICING.** Regulatory framework in the European Union: 2020 - 2030 targets. Fit for 55. European low-carbon Roadmap 2050. Paris Agreement, and its implications.	S. Simões
10	13/05 6ª Feira	16h-18h	**Debate Como perspetivar o futuro da energia e alterações climáticas?** Baseado no artigo *An energy vision: the transformation towards sustainability — interconnected challenges and solution s*	students / S. Simões
11	21/05 Sábado	11h-13h	**Hands-on energy data:** access to energy databases, Portuguese and European (PORDATA, DGEG, EUROSTAT). i) How to find and explore energy statistics and emissions of greenhouse gas (GHG) emissions for Europe and Portugal; ii) How to make energy conversions; iii) How to build indicators and charts with added value; iii) How to analyze economic sectors, and interpret their performance in terms of energy consumption and greenhouse gas emissions.	S. Simões
12	27/05 6ª Feira	16h-18h	**Integrated assessment of energy systems:** The energy system addressed by the systems analysis approach. How to envisage the future energy system? Implications for the decision making in the medium and long term. Concept and formulation of cost-effectiveness within the integrated energy systems. Hands on Climate Mitigation Simulation	S. Simões
13	03/06 6ª Feira	16h-18h	Mentoring with each students' group : discussion on the approach and methods adopted by the students, expected results to be obtained with the final work; assessing preliminary results, if any.	S. Simões
14	17/06 6ª feira	18h-20h	**Smart and Sustainable cities:** concept, components and implications for the energy systems. The concept of Postive Energy Districts, and implications for future planning at the city level.	João P. Gouveia, FCT NOVA
	2 julho, 14h	14h-16h	Avaliações: apresentação dos trabalhos pelos alunos.	S. Simões / J. Seixas

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Júlia Seixas
mjs@fct.unl.pt

Sofia Simões
sofia.simoes@lneg.pt

João Gouveia
jplg@fct.unl.pt

Patrícia Fortes
p.fs@fct.unl.pt.pt

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GROUPS

Francisco Mahús joining group 9

Domingos could you join Gideon in group 8???

1		Beatriz Costa Oliveira	Agriculture in Portugal
2	Group 1	Miguel Silva Rodrigues	
3		Vanessa Azevedo Domingos	
4		Johanna Jeukendrup Rothman Hanneke	Beekeeping
5	Group 2	Maria Marise Simões de Almeida	
6		Yvette Ramos	
7		Flavia Queiroz Lima	Banking
8	Group 3	Francesco Ferrario	
9		Vanessa Soares Tavira	
10		Adekunle Joseph Adeogun	Energy supply in megacities
11	Group 4	Aura Maria Bustillo Mendoza	
12		Tambe Honourine Enow	
13		Carla Castelo	Energy decentralization – local authority
14	Group 5	Luiz Eduardo Rielli	
15		Maria Sofia Mourão de Carvalho Cordeiro	
16		Isabella Pereira de Melo Wanderley Costa	Solid Waste (BR)
17	Group 6	Joao Pedro Maciente Rocha	
18		Yasmin Hurtado Sarmiento	
19		Mariana Campista Chagas	Municipal waste management in Portugal
20	Group 7	Nélia Maria Sequeira de Sousa	
21		Raul Emilio Fretes	
22	Group 8	Gideon Osabutey Ofori	Banking Industry
23	Group 9	Antonio Ngovene Junior	Shade growing coffee and Biodiversity
24		Artur Marulo	
25		Bilardo António da Silva Nharreluga	Not here anymore?
26		**Domingos Malú Quadé**	**will join group 8?**
27		Euclides Siquile	Not here anymore?
28		Filipa Fontes Heitor	Sofia will ask
29		Lorene Martins Brito	never showed up
30		Mahugnon Djohy	never showed up
31		**Francisco Mahú**	**joining group 9**

Outline

- European low-carbon Roadmap 2050
- Fit for 55 (FF55) and REPOWEREU
- Discussion

Climate Change and Sustainable Development Policies

1990-2019

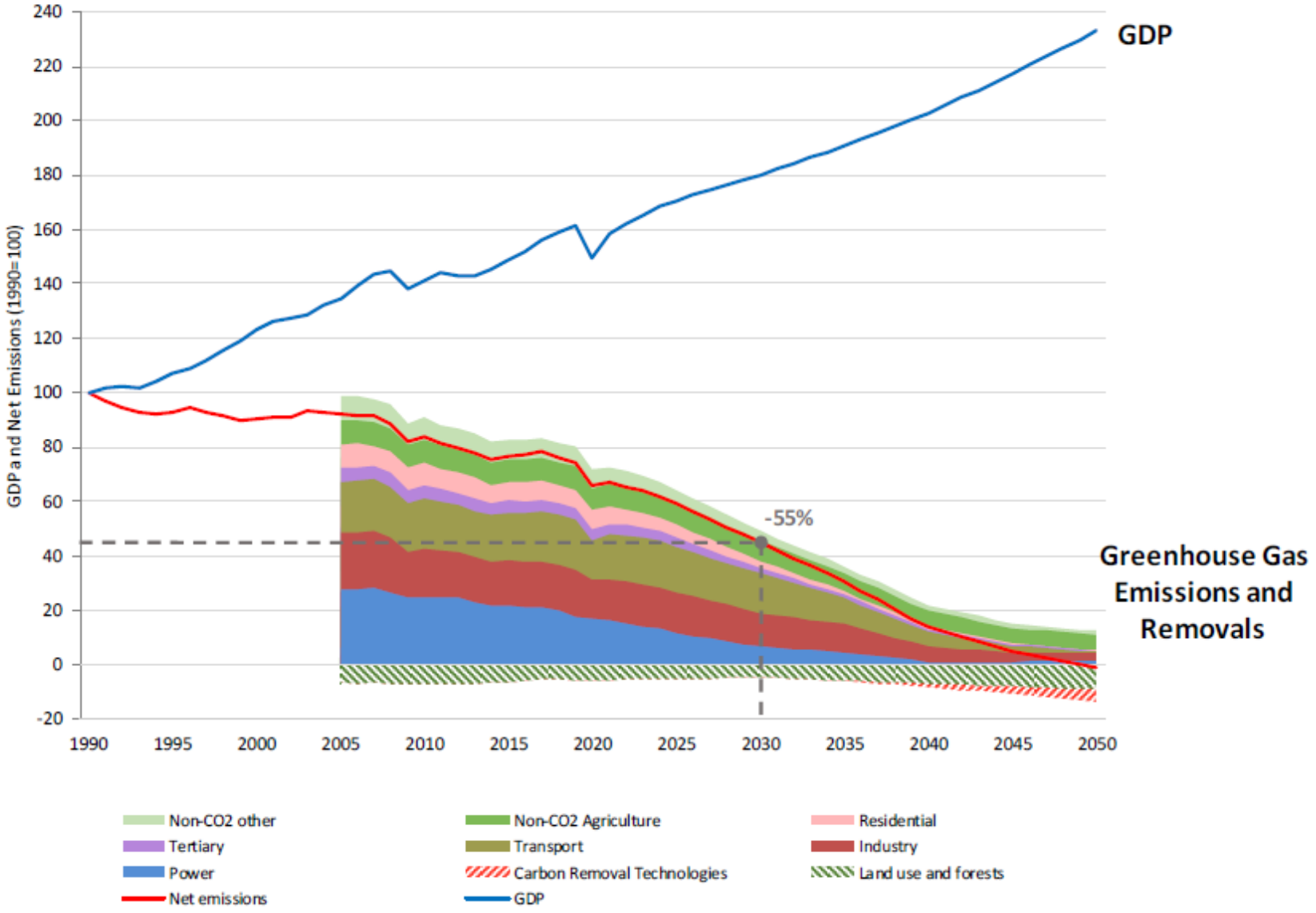
EU GHG (with removals) -25%

EU economy +62%

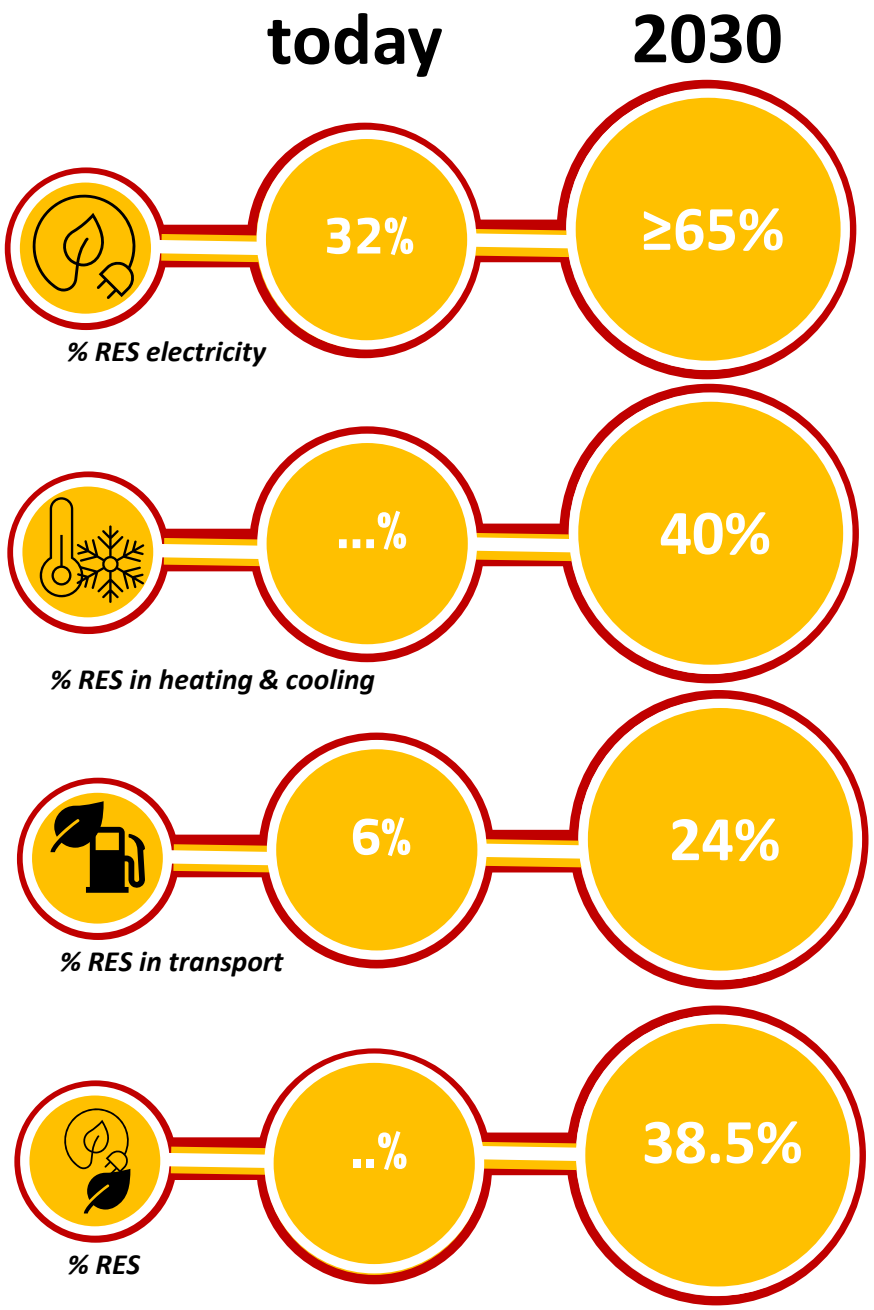
Current EU GHG emission pathway leads -60% GHG_{1990} by 2050

2030

-55% GHG_{1990}



Climate Change and Sustainable Development Policies



regulate at least intra-EU aviation emissions in the EU ETS and include at least intra-EU maritime transport in the EU ETS

Fossil fuels consumption

coal -70% $_{2015}$

oil -30% $_{2015}$

gas -25% $_{2015}$

savings of 36-37% for final energy consumption and 39-41% for primary energy

2030 GHG emissions reduction

-20% $_{2015}$

-25% $_{2015}$

CH_4, N_2O, F-gases -35% $_{2015}$

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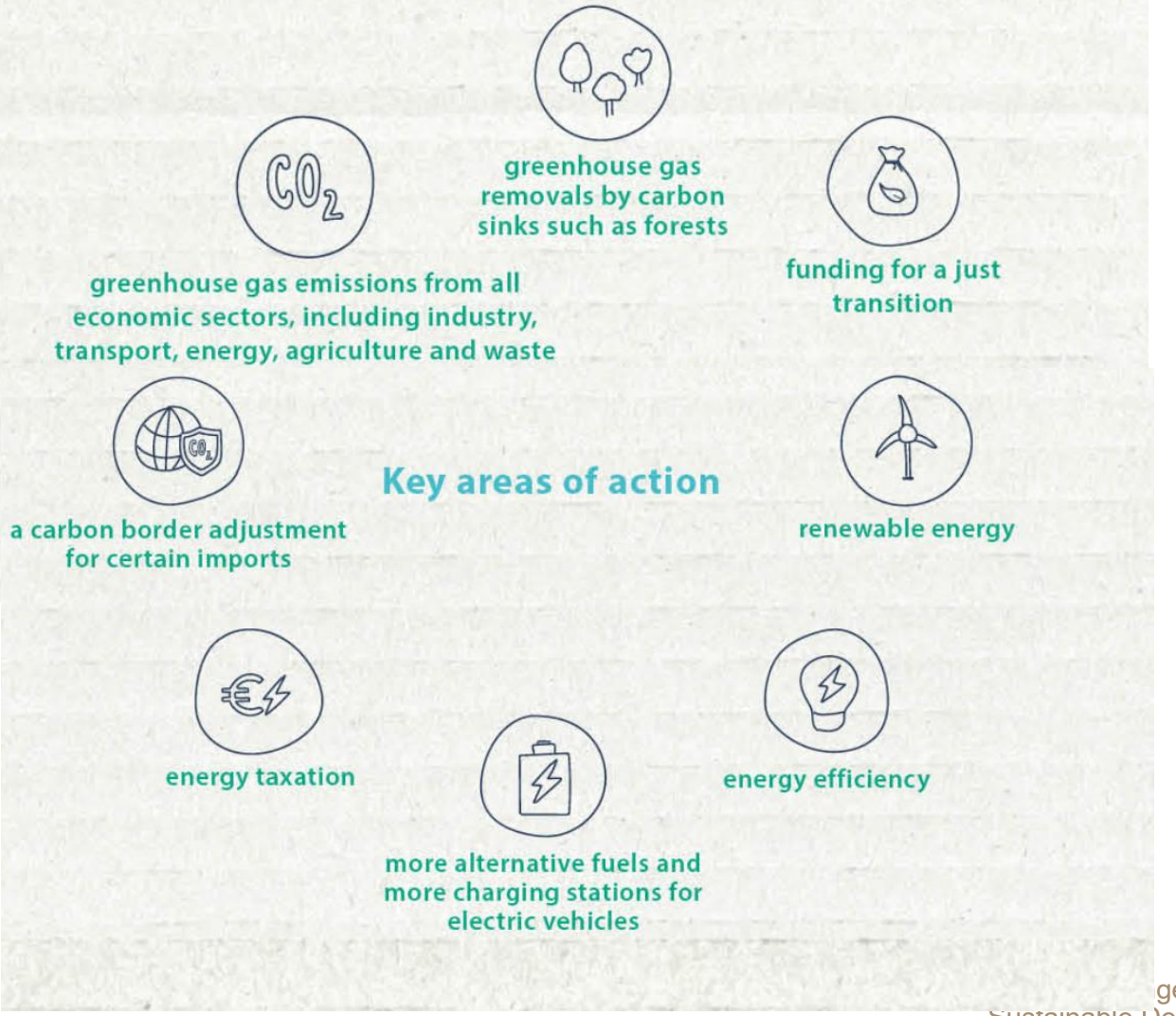
The European Council has set the goal for the EU to become climate neutral by 205
EU legislation needs to be adapted to make the green transition a reality.

The **Fit for 55 package** is a set of new legislative proposals and amendments to existing EU legislation that will help the EU cut its net greenhouse gas emissions by at least 55% by 2030 compared to 1990.



ge and
Sustainable Development
Policies

Press release | 8 March 2022 | Strasbourg

REPowerEU: Joint European action for more affordable, secure and sustainable energy

"Full implementation of the Commission's 'Fit for 55' proposals would already reduce our annual fossil gas consumption by 30%, equivalent to 100 billion cubic metres (bcm), by 2030. With the measures in the REPowerEU plan, we could gradually ***remove at least 155 bcm of fossil gas use, which is equivalent to the volume imported from Russia*** *in 2021.* ***Nearly two thirds of that reduction can be achieved within a year****, ending the EU's overdependence on a single supplier. The Commission proposes to work with Member States to identify the most suitable projects to meet these objectives, building on the extensive work done already on national Recovery and Resilience Plans."* https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1511

"Diversifying gas supplies, via higher LNG imports and pipeline imports from non-Russian suppliers, and higher levels of biomethane and hydrogen."

- If new gas infrastructure is needed, it should be hydrogen compatible

REPowerEU measures

REPowerEU	Focus	FF55 Ambition by 2030	REPowerEU Measure	Replaced by end of 2022 (BCM equivalent) estimate	Additional to FF55 by 2030 (BCM equivalent) estimate
Gas diversification	**Non-RU Natural Gas**	-	LNG diversification	50*	50
		-	Pipeline import diversification	10	10
	More Renewable Gas	17 bcm of **biomethane** production, saving 17 bcm	**Boost biomethane** production to 35bcm by 2030	3.5	18
		5.6 million tonnes of renewable **hydrogen**, saving 9-18.5 bcm	**Boost hydrogen** production and imports to 20mt by 2030	-	25-50
Electrify Europe	**Homes**	**Energy efficiency** measures, saving 38 bcm	EU-wide energy saving, e.g. by **turning down the thermostat** for buildings' heating by 1°C, saving 10bcm	14	10
		Counted under overall RES figures below	**Solar rooftops** front loading – up to 15 TWh within a year	2.5	frontloaded
		30 million newly installed **heat pumps** installed in 2030, saving 35 bcm in 2030	Heat pump roll out front loading by doubling deployment resulting in a **cumulative 10 million units** over the next 5 years	1.5	frontloaded
	Power sector	Deploy **480 GW of wind** capacities and **420 GW of solar** capacities, saving 170bcm (and producing 5.6 Mt of Green Hydrogen)	Wind and solar front loading, **increasing average deployment rate by 20%,** saving 3bcm of gas, and additional capacities of **80GW by 2030** to accommodate for higher production of renewable hydrogen.	20	Gas savings from higher ambition counted under green hydrogen, the rest is frontloaded
Transform Industry	**Energy intensive Industries**	Front load **electrification** and renewable **hydrogen** uptake	Front load **Innovation Fund** and extend the scope to **carbon contracts** for difference	Gas savings counted under the renewable hydrogen and renewables targets	

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM%3A2022%3A108%3AFIN

Outline

- Discussion

How to envision the future of energy and climate change?

Based on “An energy vision: the transformation towards sustainability — interconnected challenges and solutions”

and

https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change

Climate Change and Sustainable Development Policies

https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change

RCP *vs* SSP

Representative Concentration Pathway (RCP): **descriptions of how the climate may evolve in the future** over the rest of the century – trajectories adopted by many scientific communities and IPCC (for its 5th Assessment Report (AR5)) **representing radiative forcing* from greenhouse gas concentration (not emissions).**

Originally there were **4 RCP** (IPCC 5th Assessment Report 2013/2014)
> After the adoption of the Paris Agreement **RCP 1.9** developed to represent mitigation pathways compatible with the 1.5 °C warming
> New **RCP7** – baseline outcome (IPCC 6th Assessment Report 2021/2022)

"Representative": each one of the RCPs represents a larger set of scenarios in the literature.

RCP	Forcing	Temperature	Emission Trend	Paris Agreement
1.9	1.9 W/m2	~1.5 °C	Very Strongly Declining Emissions	
2.6	2.6 W/m2	~2.0 °C	Strongly Declining Emissions	
4.5	4.5 W/m2	~2.4 °C	Slowly Declining Emissions	
6.0	6.0 W/m2	~2.8 °C	Stabilising Emissions	
8.5	8.5 W/m2	~4.3 °C	Rising Emissions	

Approximate radiative forcing levels were defined as ±5% of the stated level in W/m2 relative to preindustrial levels. Radiative forcing values include the net effect of all anthropogenic GHGs and other forcing agents

Shared Socio-economic Pathways (SSPs) define **5 narratives of world development characterized by different drivers** (e.g. population, economic activity, urbanization, technological development, etc.)
> SSPs consider the **absence of climate change and climate policy**
> They show that it would be much easier to mitigate and adapt to climate change in some versions of the future than in others

Source: O'Neill, et al. (2017). The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century. Global Environmental Change, 42, 169-180, https://doi.org/10.1016/j.gloenvcha.2015.01.004

**Radiative forcing is the change in energy flux in the atmosphere caused by natural or anthropogenic factors of climate change as measured by watts / meter*

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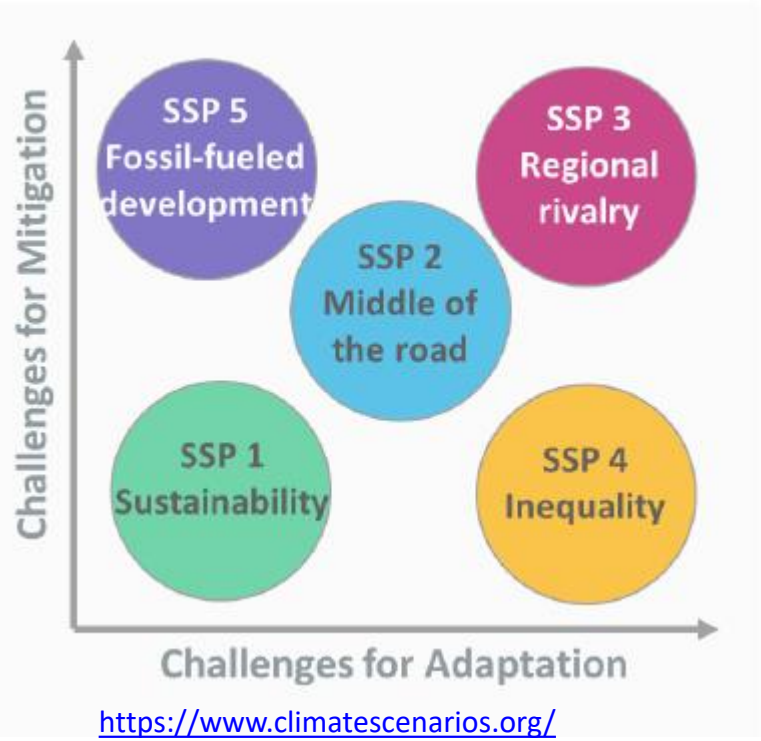
SSP



https://www.climatescenarios.org/

Source: O'Neill, et al. (2017). The roads ahead: Narratives for shared socioeconomic pathways describing world futures in the 21st century. Global Environmental Change, 42, 169-180, https://doi.org/10.1016/j.gloenvcha.2015.01.004

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SSP

SSP5

SSP 3: Regional rivalry - A rocky road

- This future poses **high challenges to mitigation** and **high challenges to adaptation**
- Population growth continues with high growth in developing countries
- Emphasis on national issues due to regional conflicts and nationalism
- Economical development is slow and fossil fuel dependent
- Weak global institutions and little international trade

SSP2

SSP 1: Sustainability - Taking the green road

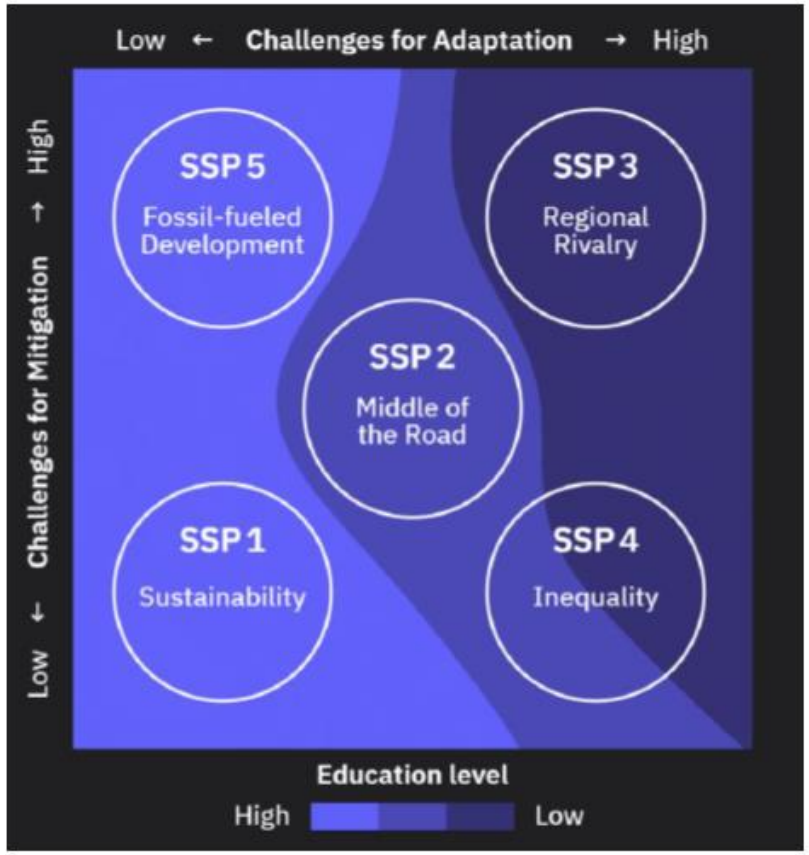
- This future poses **low challenges to mitigation** and **low challenges to adaptation**
- Global population peaks mid-century
- Emphasis on human well-being
- Environmentally friendly technologies and renewable energy
- Strong and flexible institutions on global, regional, and national level

SSP4

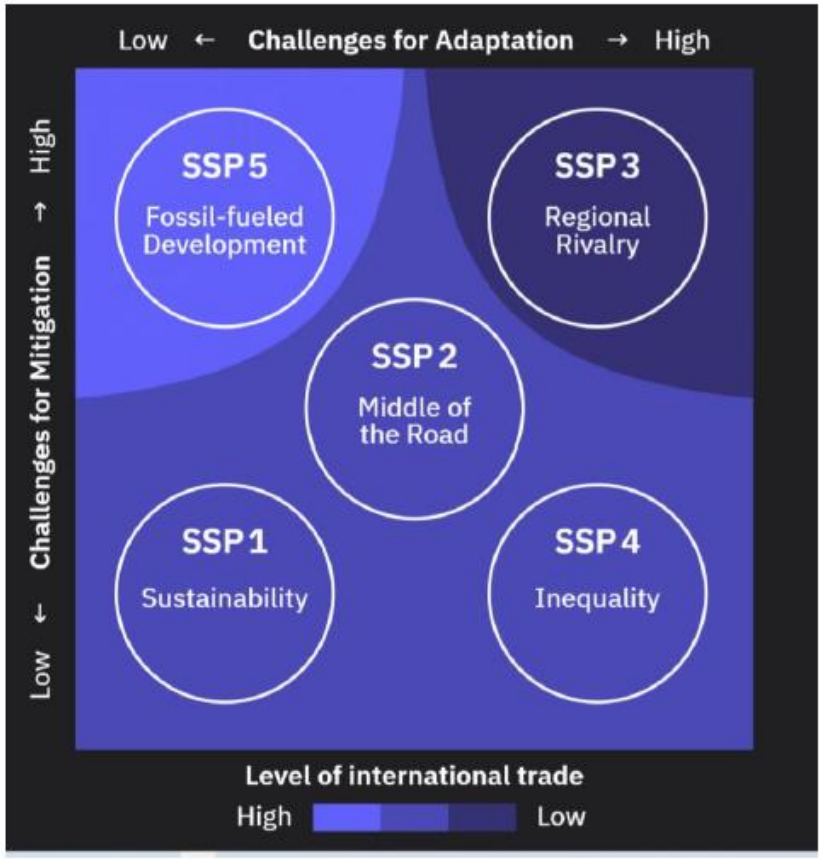
Source: https://climatescenarios.org/

SSP

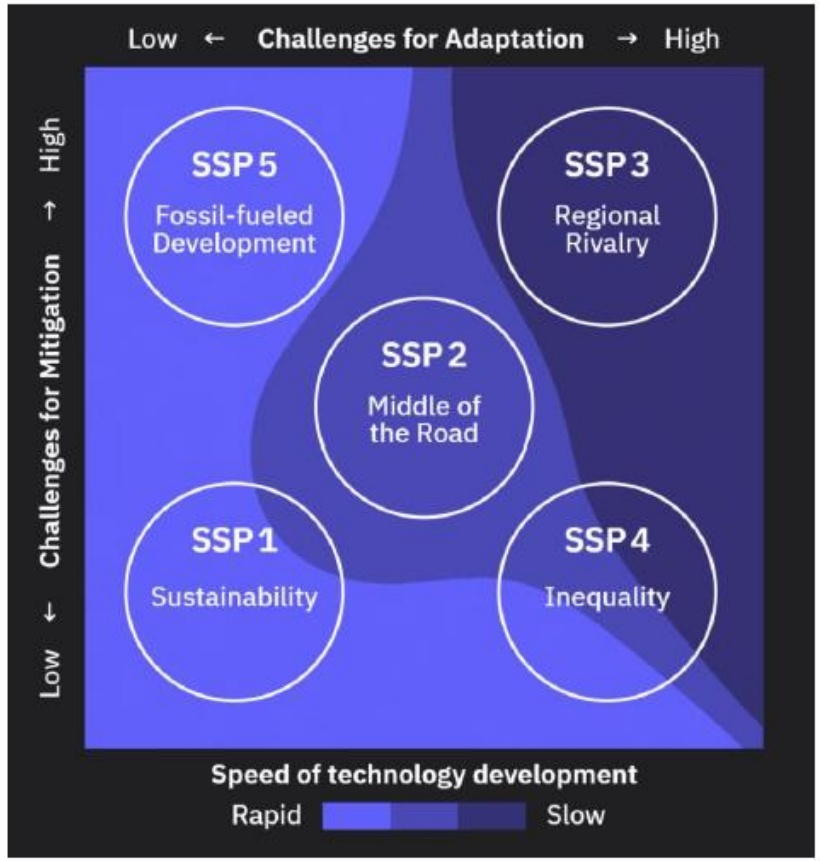
Education → Population



International Trade



Technology Development



Source: https://climatescenarios.org/

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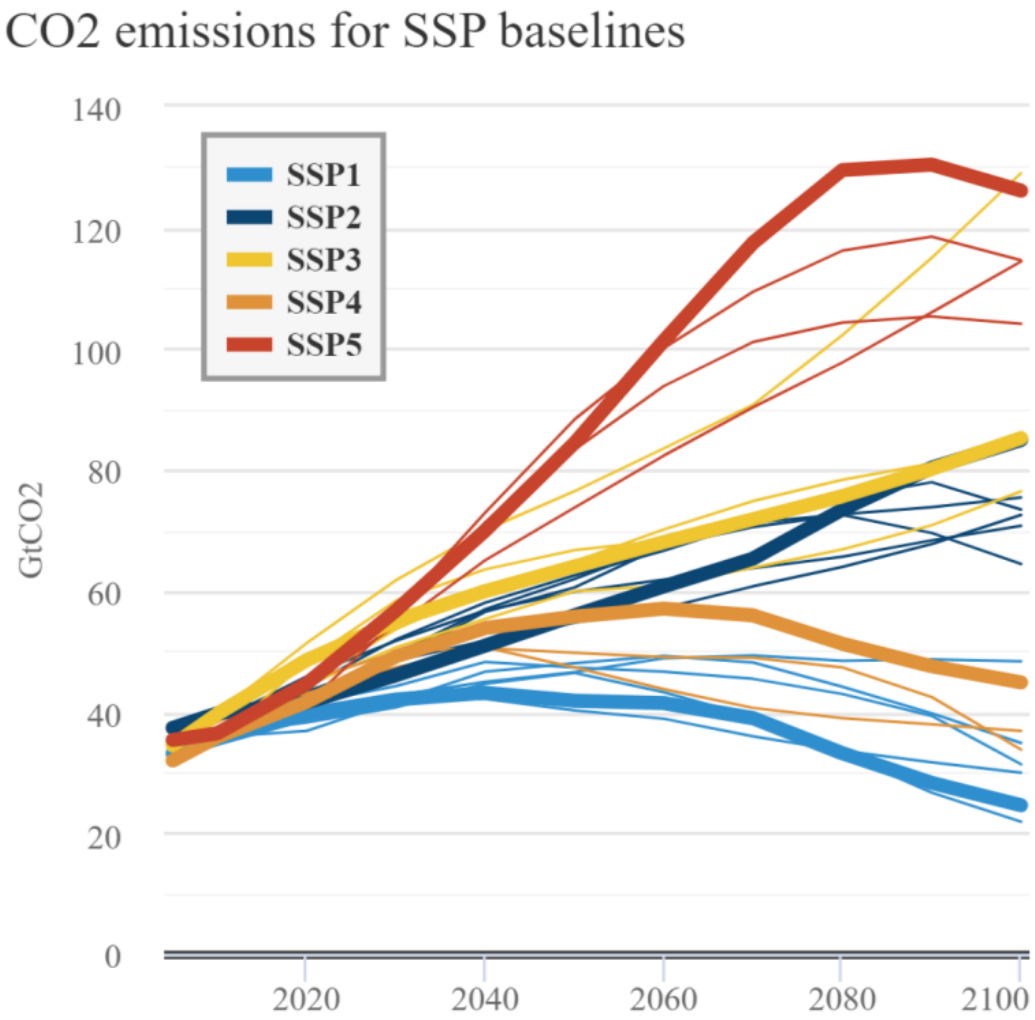
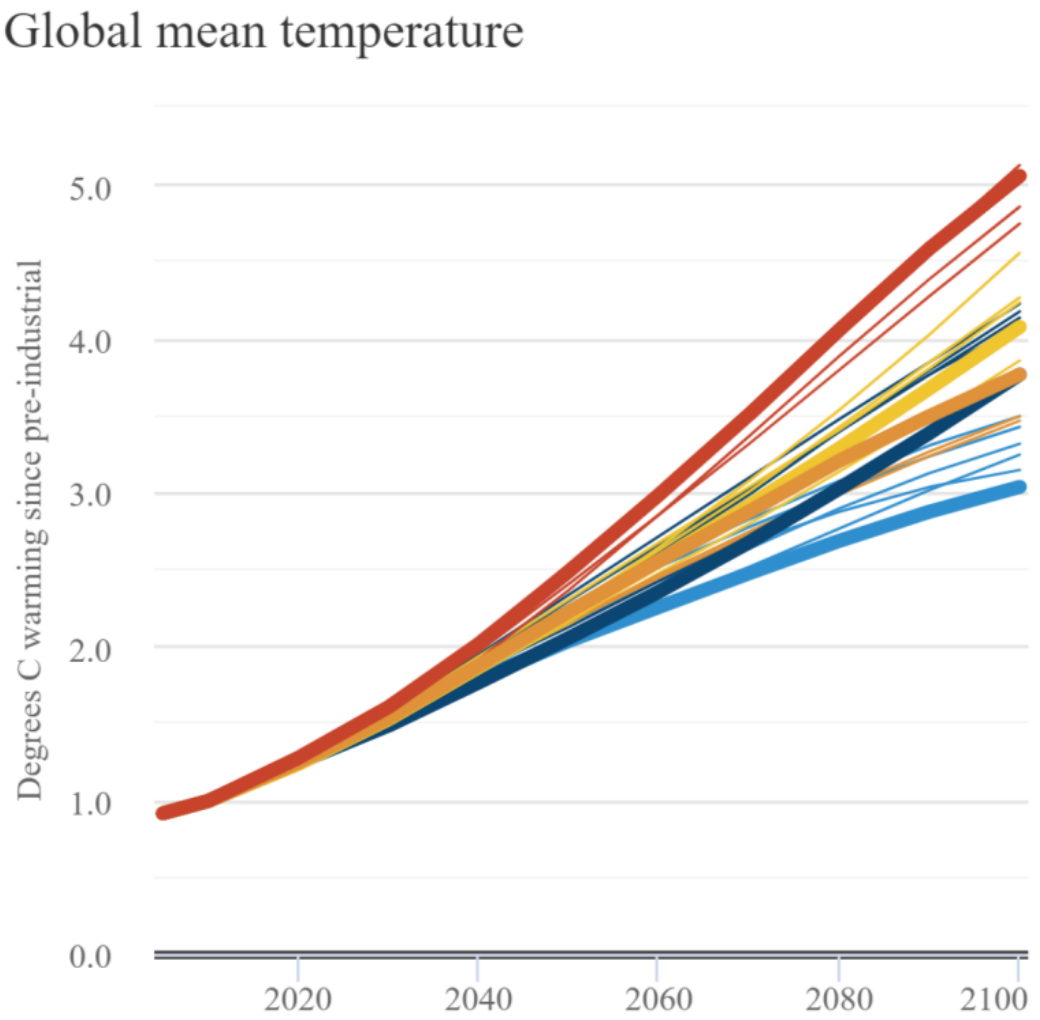
SSPs and emissions: how the world will warm with no climate policy (baseline)





https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change

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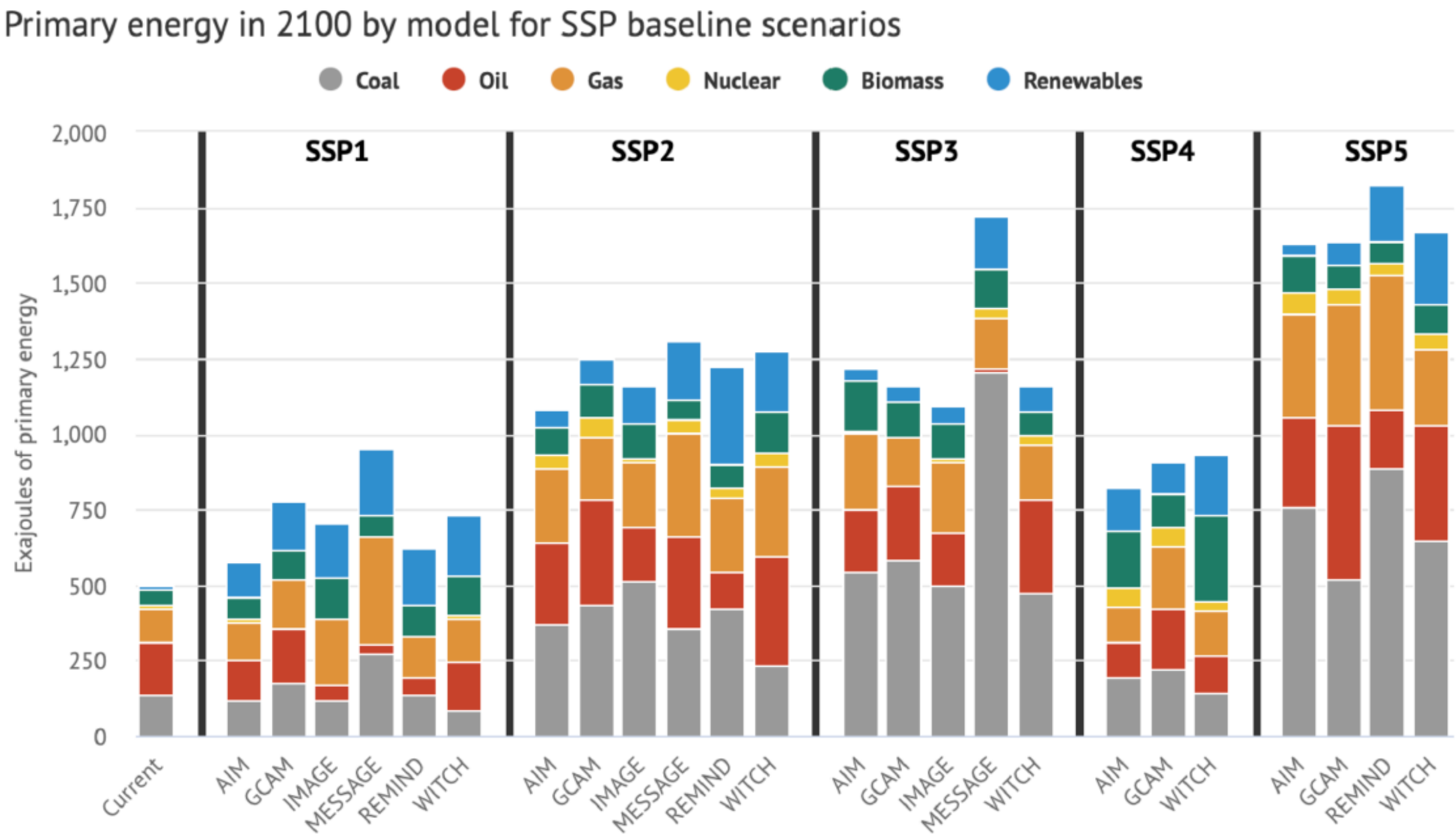
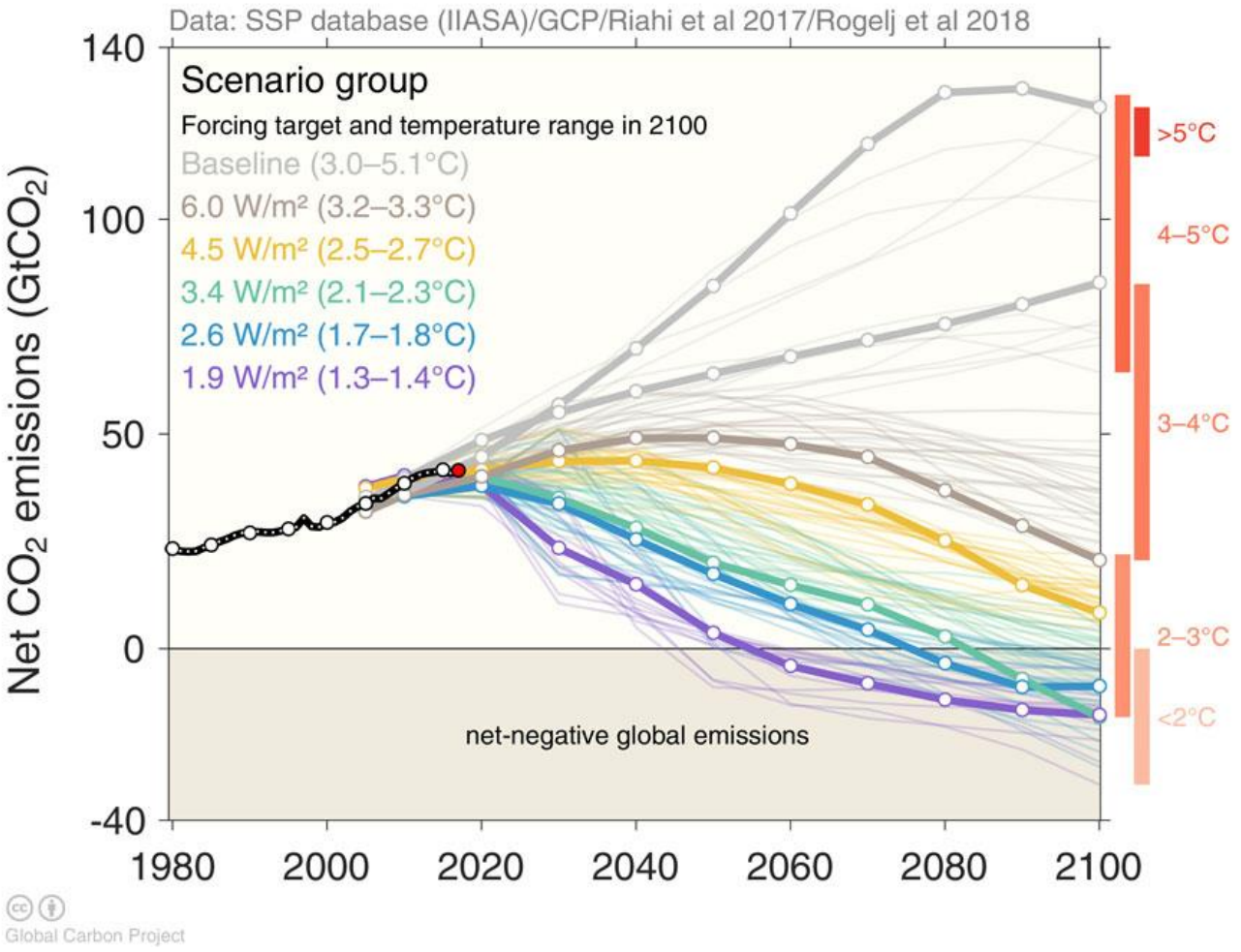


Combining SSPs and mitigation targets

baseline SSP scenarios outcomes in the absence of additional climate policy - > how different levels of climate mitigation/ adaptation would fit into the future described by each SSP?

1. **shared policy assumptions*** on international collaboration on climate policy
2. respecting limitations as in the **underlying assumptions** (population growth, economic activity and technological development)
3. **mitigation targets** as in the RCPs for 2100



In the chart SSPs baseline are the grey lines and the color lines follow the RCPs

https://www.carbonbrief.org/explainer-how-shared-socioeconomic-pathways-explore-future-climate-change

* https://link.springer.com/article/10.1007/s10584-013-0971-5

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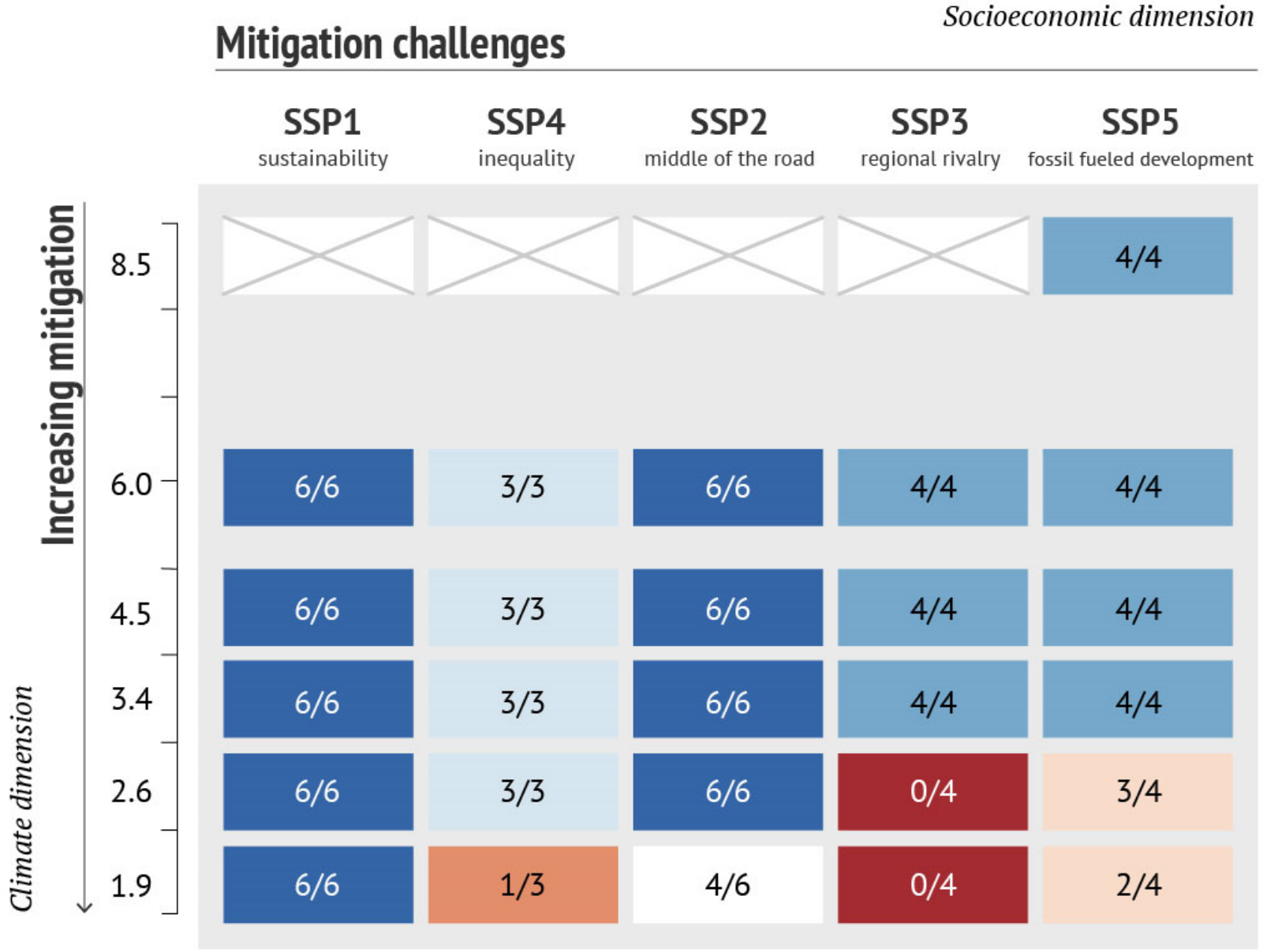
Combining SSPs RCPs

Each box in the figure shows the number of models that were able to successfully reach the RCP target, out of the total number of models available for a given SSP.



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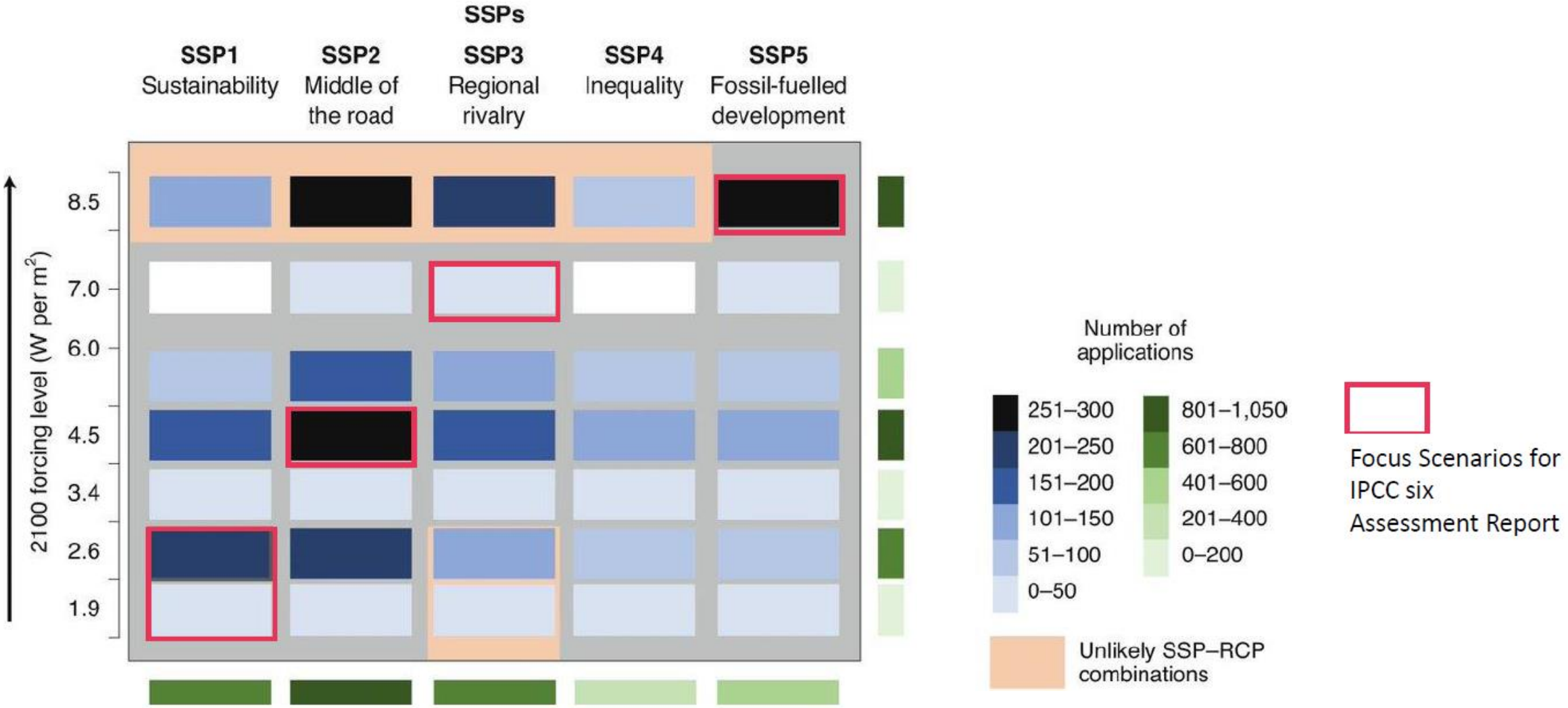
Combining SSPs and mitigation targets



O'Neill, et al. (2020). Achievements and needs for the climate change scenario framework. Nat. Clim. Chang. 10, 1074–1084 https://doi.org/10.1038/s41558-020-00952-0

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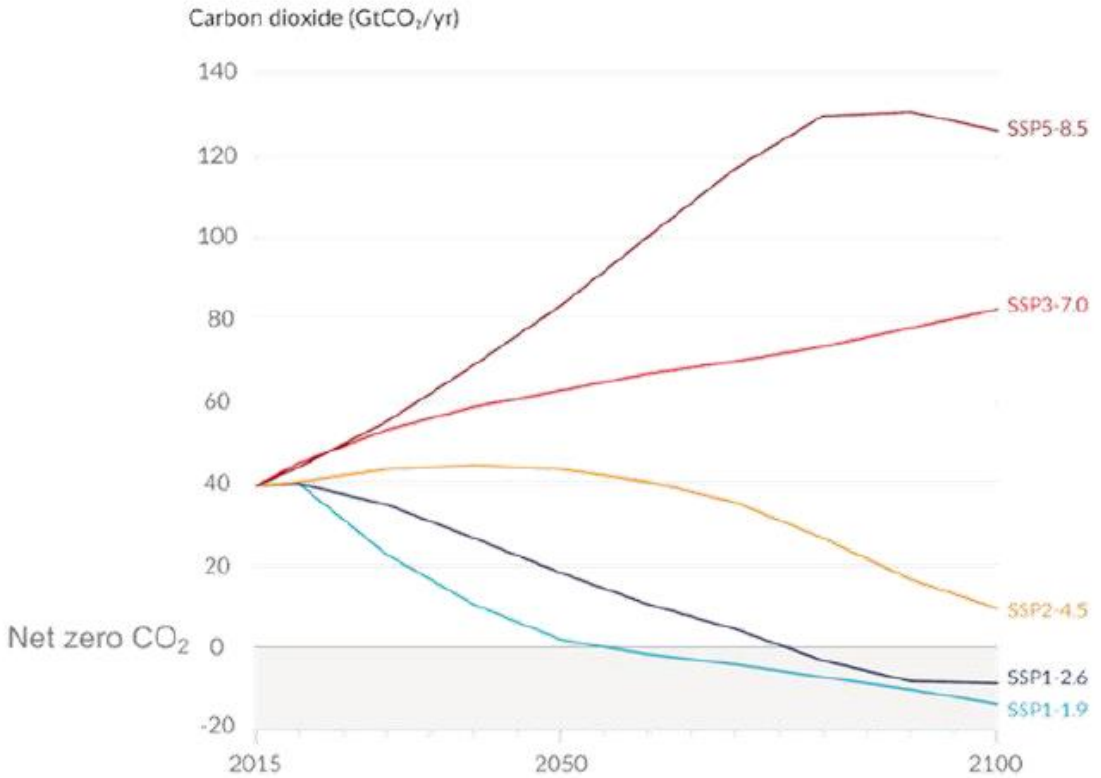
The illustrative set of five SSP scenarios span a broader range of greenhouse gas and air pollutant futures than assessed in earlier WGI reports.

COMBINATION BETWEEN SSP AND RCP

Shared Socioeconomic Pathway (SSP) Scenarios



Very high

High

CO_2 emission pathways without any climate change mitigation

Intermediate CO_2 emission pathway

Low ~2.0°C

Very low ~1.5°C

CO_2 emission pathways in which CO_2 emissions decline to net zero around or after 2050

Slide kindly provided by P. Fortes (CENSE - NOVA/FCT)

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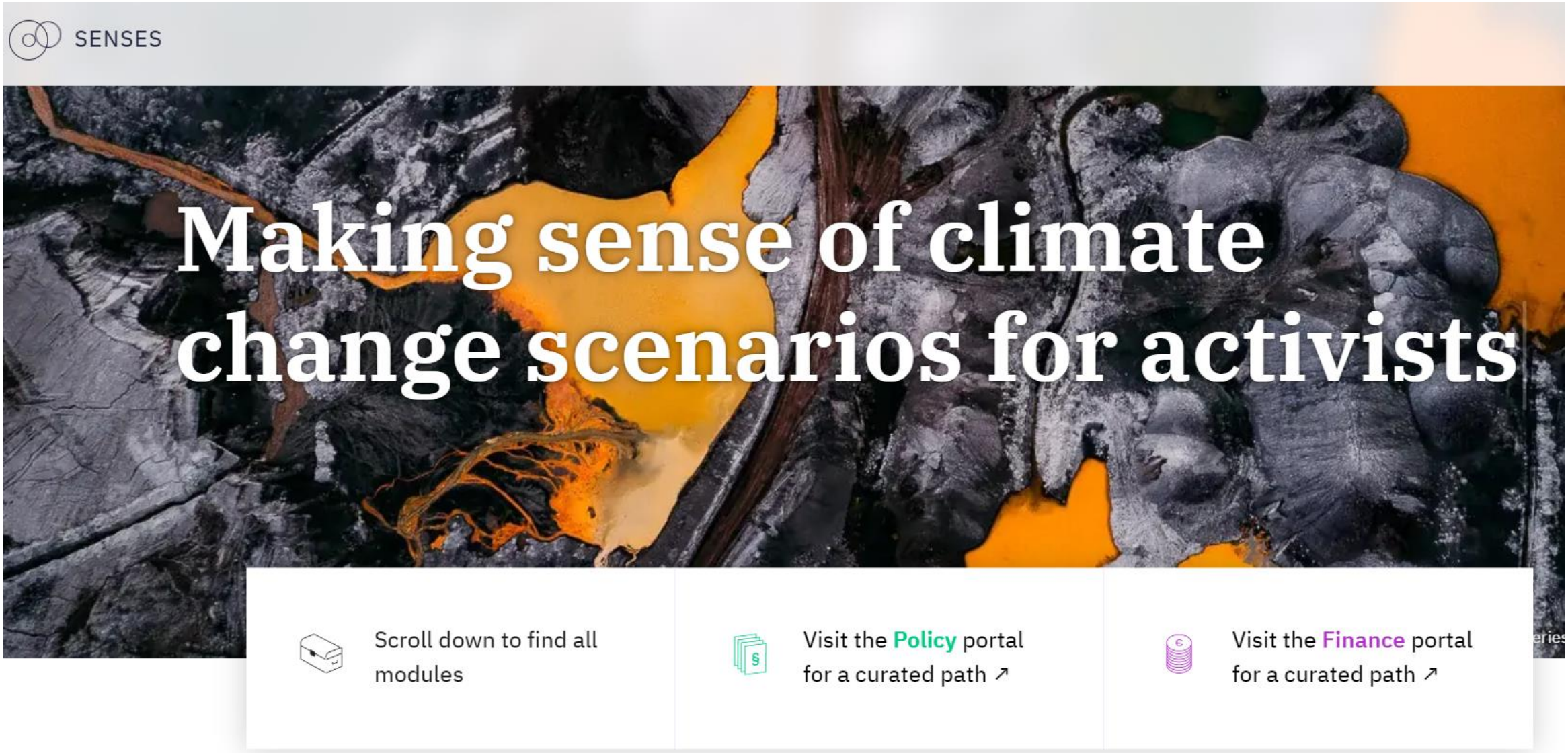
SENSES TOOLKIT



https://climatescenarios.org/toolkit/

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The climate game

https://ig.ft.com/climate-game/

The climate game

https://ig.ft.com/climate-game/

FINANCIAL TIMES

Choose your adviser

Your adviser will use their specialist knowledge to help you cut emissions. Who do you pick?

Gina Green

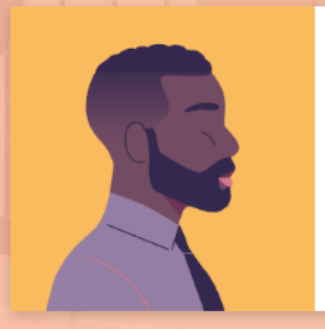
Specialist skill

Teen activist sparking behavioural change

Waldo Watts

Specialist skill

Entrepreneur developing new technologies



David Deals

Specialist skill

Businessman influencing global leaders

Catalina Congress

Specialist skill

Politician driving policy change

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Outline

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- **Developing countries:**
  - Francisco, António, Artur - **Mozambique** "*not in the time frame we have!!!*"
  - Miguel, Vanessa D, Beatriz - **country X** "*traditional biomass, finance needed via international cooperation*"
  - Raul, Nélia and Mariana – **Paraguay** "*50% RES – but most hydropower and we need to safeguard conservation of our river basins*"
  - Johanna, Marise, Yvette – **Jordan** "*7% of RES, but we have a refugee problem at the moment!*"
  - Joseph, Aura Maria, Honourine – **Namibia** "*we have a big problem with energy access*"
- **City in a developed country** "*cities consume a lot of resources*"
- **UK** "*we are willing to do this with R&D and changing the demand*"
- **Brazilian automotive industry** "*a very big market but we need support of rich countries and cities* "

1) **what are the (different and diverse) opportunities to achieve a sustainable and neutral carbon energy system to provide the energy services for the economy and consumers?**
2) **what barriers exist for such transformation?**
3) **what are the key factors to invest in?**
4) **what aspects should be avoided? [you may cover all aspects, from technology to financing, education or policy instruments, among others]. Each group's member need to raise hand to call for intervention!**

Energy access! People live in rural areas in a disperse setting and very set in their traditional ways (MZ)

Looking into green H_2 in south but only in a sustainable way – desalination – it will take 40 yrs! (Namibia)

People always say they need more money but there are a lot fossil fuels, that need to shifted in order to be able to buy the cool UK tech (UK)

We have wind and solar resources, but no tech know-how and 13% population are refugees from Syria. We have 45% youngsters that are unemployed and could work on solar (Jordan)

Cities can collaborate and decarbonization can be a growth strategy, with efforts on construction of buildings & energy decentralization. Cities can move faster than countries and be bolder! Innovate on financial mechanisms and avoid emissions. Govt should help us! (rich city Y)

Barriers: energy demand is rapidly increasing, and we need fast and mature solutions! We lack capital (upfront costs are a problem). Also lack data on energy access/end-use & tech know-how. Biofuels and food competition (lack of policy integration)!!! Do not forget that people want to improve their lifestyles (X)

Booming population stressing energy system, creating efficiency losses in the energy system. Need to diversify economy from soy crops. We require finance but also know-how. Carbon neutrality is important, but other problems as housing are more important (Paraguay)

Brazil energy demand will increase a lot. Biofuels vs food! BR can supply lots of raw materials for batteries, but we need to preserve Amazon. 1.3 Mjobs in auto industry – how to upskill/reskill these people? Very expensive! Policies needed for auto inspection (auto)

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Final statements

Green H_2 is quite expensive, and we citizens might not be able to afford it – we are looking into climate finance, also to increase living standards (Namibia)

We need to avoid regional divisions amongst countries. We are past this allocation of responsibilities; climate change is our common shared problem! People, planet and prosperity are all equally important! (UK)

We want to be adopted by an EU country with knowledge - it can be a loan not a subsidy (Jordan)

Local level govts have an active role to play – we can be a lab for large scale solutions – we need to overcome inertia and are willing to learn and collaborate (rich city Y)

We are not asking for loans - we just want what is rightfully ours - the opportunity to develop our nation into a prosperous one - developed nations have the duty to help us and they should fulfill their promises (Paraguay)

Automotive industry also cannot due it alone – we need different cities more connected and diverse – we will change technology (auto)

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CENSE center for environmental and sustainability research

Discussion was very good, but what about if a rich oil company comes to your country wanting to invest billions in oil and gas???

What will you say?

https://www.theguardian.com/environment/ng-interactive/2022/may/11/fossil-fuel-carbon-bombs-climate-breakdown-oil-gas

Climate Change and Sustainable Development Policies