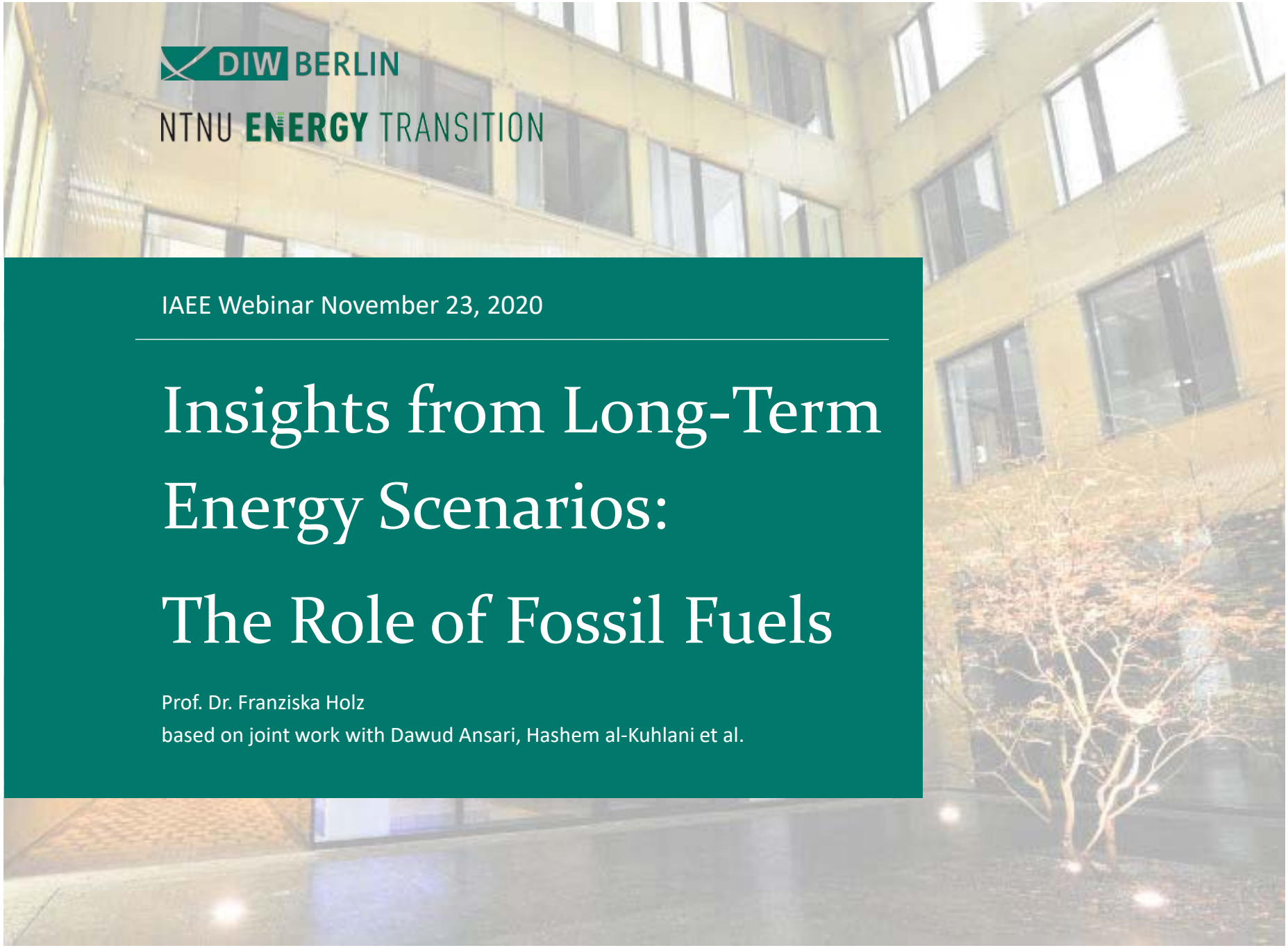

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IAEE Webinar November 23, 2020

Insights from Long-Term Energy Scenarios: The Role of Fossil Fuels

Prof. Dr. Franziska Holz

based on joint work with Dawud Ansari, Hashem al-Kuhlani et al.

Long-run scenarios: What for?

Scenarios structure the future into predetermined and uncertain elements… The foundation of decision scenarios lies in exploration and expansion of the predetermined elements: events already in the pipeline whose consequences have yet to unfold, interdependencies within the system (surprises often arise from interconnectedness), breaks in trends, or the 'impossible.'

(Pierre Wack, developer of Shell scenarios in the 1970s,

in *Harvard Business Review*, 1985)

Long-run scenarios: What for?

- Gain insight into possible transformation pathways, their drivers & long-term outcomes
- Deal with impact of uncertainties
- Identify impact of today‘s emerging trends
- Monitoring status of developments
- Rely on qualitative & quantitative information
- Outcomes:
  - „best case“
  - „worst case“
  - „base case“

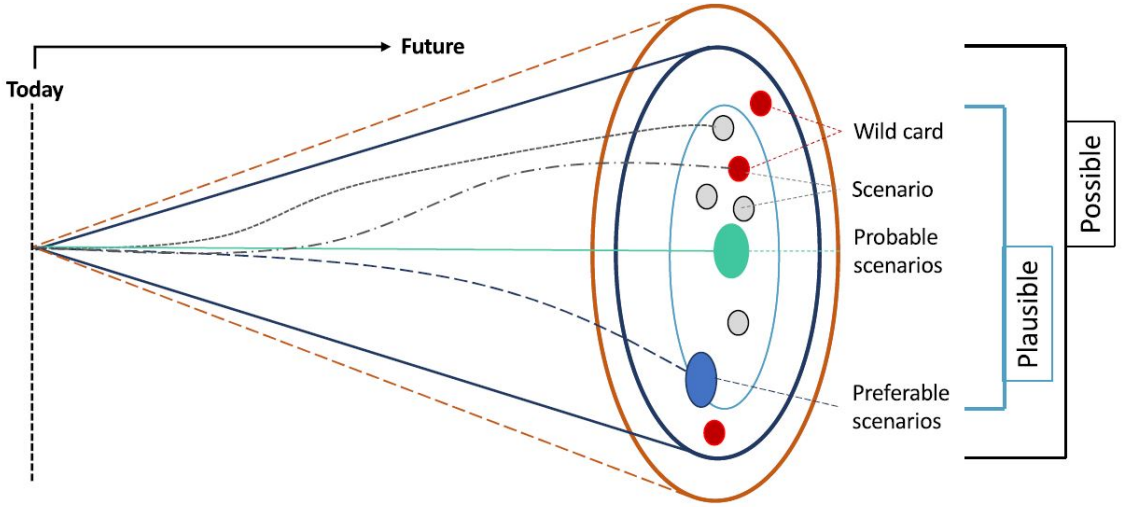


Figure 1: Illustration of the scenario cone

From: Ansari et al. (2019)

Many scenarios, different approaches

⁺ Paris Agreement compatibility reached in a later year

Sources	Storylines / driver analysis	Scenario and version	Scenario nature	Description	Paris Agreement met? ⁺	CO_2 emissions in 2050 (Gt)
IEA	Weak	New Polices (2018)	Positive	Policies adopted and announced until mid-2018	No	33.9 ◆
		Current Policies (2018)	Positive	Polici	No	42.5 ◆
		Sustainable Development (2018)	Normative (best case)	M	Yes	17.7 ◆
Shell	Strong	Sky (2018)	Normative (best case)	P	Yes	18.5
		Ocean (2013)	Positive	D	no⁺	40.0
		Mountain (2013)	Positive	Ir	no⁺	28.0
World Energy Council (WEC)	Strong	Unfinished Symphony (2016)	Positive (best case)	U su	no⁺	18.1
		Modern Jazz (2016)	Positive	Ir	No	29.7
		Hard Rock (2016)	Positive (worst case)	G	No	35.7
Equinor	Moderate	Renewal (2019)	Positive (best case)	G	Yes	10.6
		Reform (2019)	Positive	A	No	29.0
		Rivalry (2019)	positive (worst case)	E d	No	35.9
BP	Weak	Evolving Transition (2019)	Positive	C	No	35.9 ◆
		Rapid Transition (2019)	Positive (best case)	L	no⁺	18.0 ◆
		More Energy (2019)	Positive	S	No	N/A
		Less Globalisation (2019)	Positive	T	No	N/A
DIW-REM	Strong	Business as Usual (2019)	Positive	Co con	No	28.2 ▼
		Survival of the Fittest (2019)	Positive (worst case)	Apocal terminates gl	No	35.1 ▼
		Green Cooperation (2019)	Positive (best case)	Holistic transition enables leapfrogging, deep decarbonisation, and green growth.	Yes	8.5 ▼
		ClimateTech (2019)	Normative	Sudden breakthroughs in climate and energy engineering yield only mixed results and start a race against the clock.	Yes	14.0 ▼
MIT	Weak	Food, Water, Energy & Climate Outlook (2018)	Positive	Continuation of trends	No	40.4
Exxon Mobil	Weak	Outlook (2018)	Positive	Continuation of trends	No	36.3 ◆
EWG	Weak	100% renewables (2019)	Normative	World where all energy demand is satisfied by renewable energy	yes	0.0

- Most outlooks have a best case and a worst case
- Many „scenario worlds“ hardly described and consistent driver implementation / analysis unclear
- Many scenarios do not reach emissions reduction compatible with Paris Agreement
- Paris-compatible emissions can be reached in normative (target-driven) or positive (driver-induced) scenarios

Fuel shares in primary energy demand in 2050

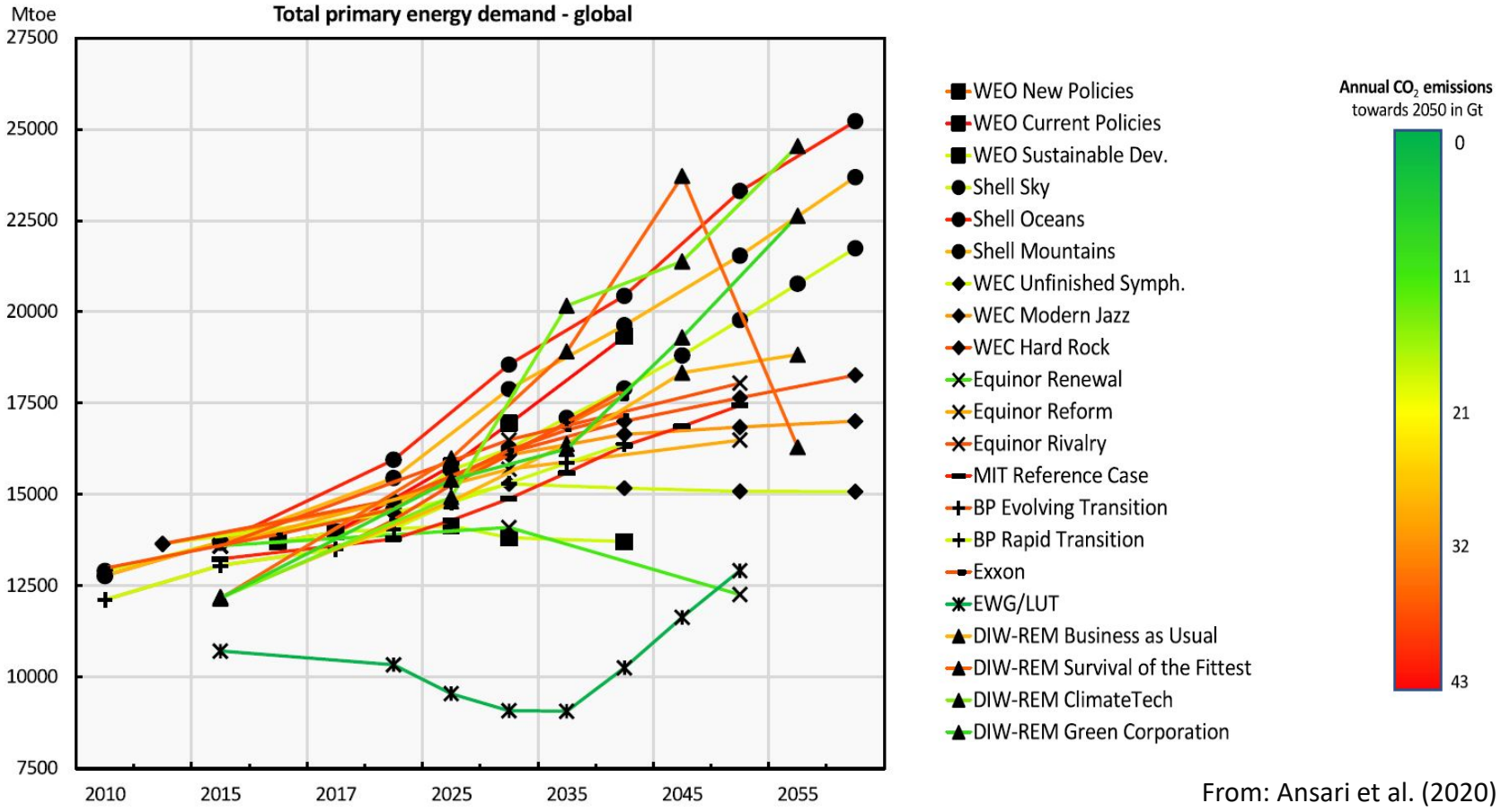
Source	Scenario	Coal (%)	Gas (%)	Oil (%)	Renewables (%)
IEA *	New Polices (2018)	22	25	28	20
	Current Policies (2018)	25	25	29	9
	Sustainable Development (2018)	12	23	25	31
Shell	Sky (2018)	12	14	19	46
	Ocean (2013)	22	19	23	31
	Mountain (2013)	24	26	18	22
WEC	Unfinished Symphony (2016)	7	25	26	31
	Modern Jazz (2016)	14	30	27	23
	Hard Rock (2016)	20	24	29	19
Equinor	Renewal (2019)	5	22	19	44
	Reform (2019)	17	24	26	27
	Rivalry (2019)	21	22	30	22
BP *▼	Evolving Transition (2019)	20	26	27	22
	Rapid Transition (2019)	6	24	22	34
DIW-REM +	Business as Usual (2019)	14	20	23	41
	Survival of the Fittest (2019)	19	39	19	21
	Green Cooperation (2019)	0	12	2	85
	ClimateTech (2019)	14	23	15	31
MIT	Food, Water, Energy & Climate Outlook (2018)	22	24	33	19
Exxon Mobil	Outlook (2018)	20	26	31	17
EWG	100% renewables (2019)	0	0	0	100

Natural gas = „natural bridge“?
Min share = 0% (2^{nd}: 12%)
Max share = 39%
Average share = 22%

Oil = indispensable transport fuel?
Min share = 0% (2^{nd}: 2%)
Max share = 33%
Average share = 22%

Carbon neutrality with renewables?
Max share = 100% (2^{nd}: 85%)
Min. share = 17%
Average share = 34%
Average share in Paris scens = 56%

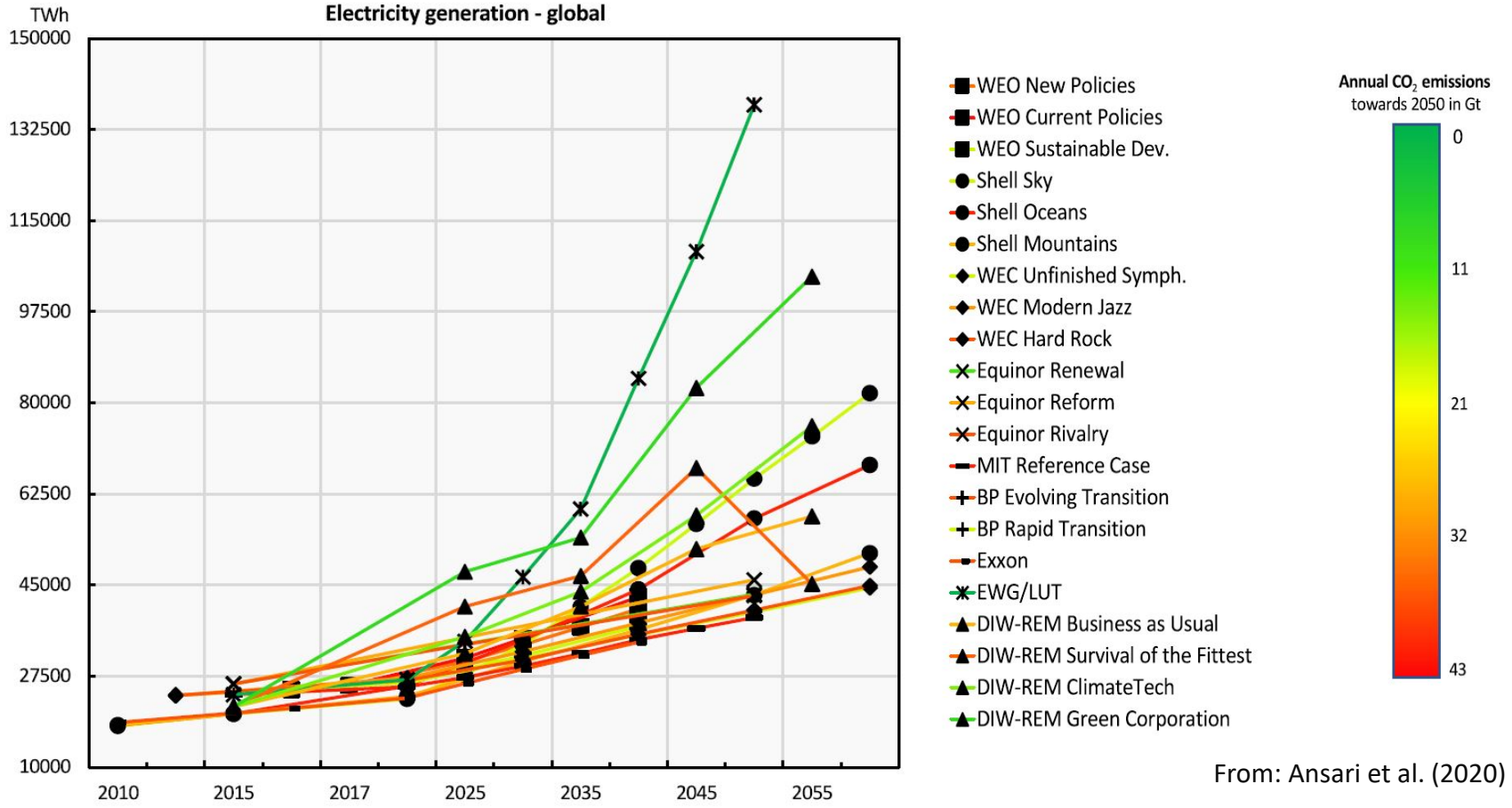
Energy futures: Global primary energy demand



From: Ansari et al. (2020)

- Almost all scenarios have increasing demand until the 2030s
- No common pattern towards 2050
- Large variety of possible developments, regardless type of scenario

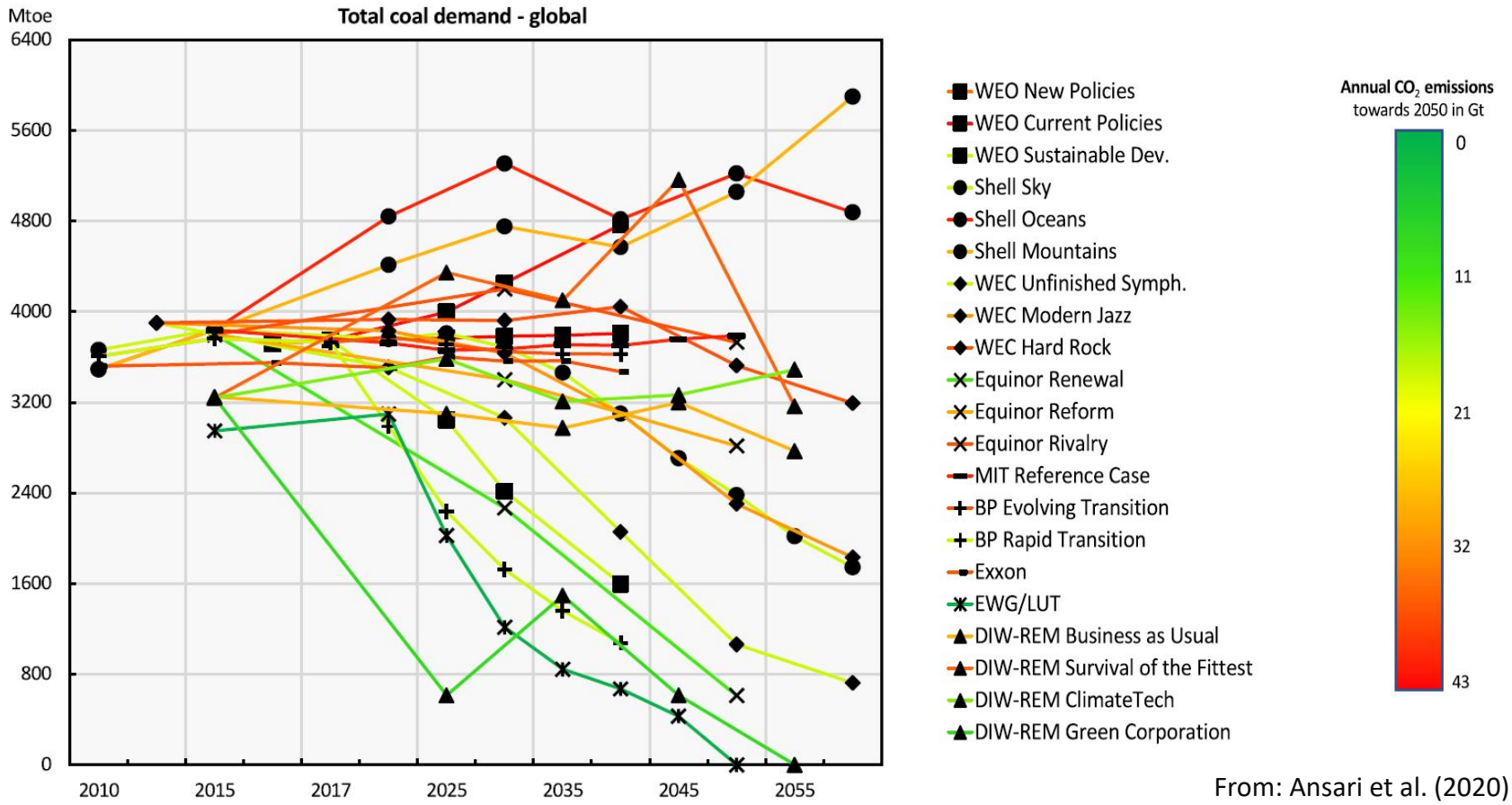
Energy futures: Global electricity generation



From: Ansari et al. (2020)

- Electricity growth towards 2030
- After 2040, diverging scenarios
- Trend in general: increasing electricity generation, except DIW-REM Survival of the Fittest

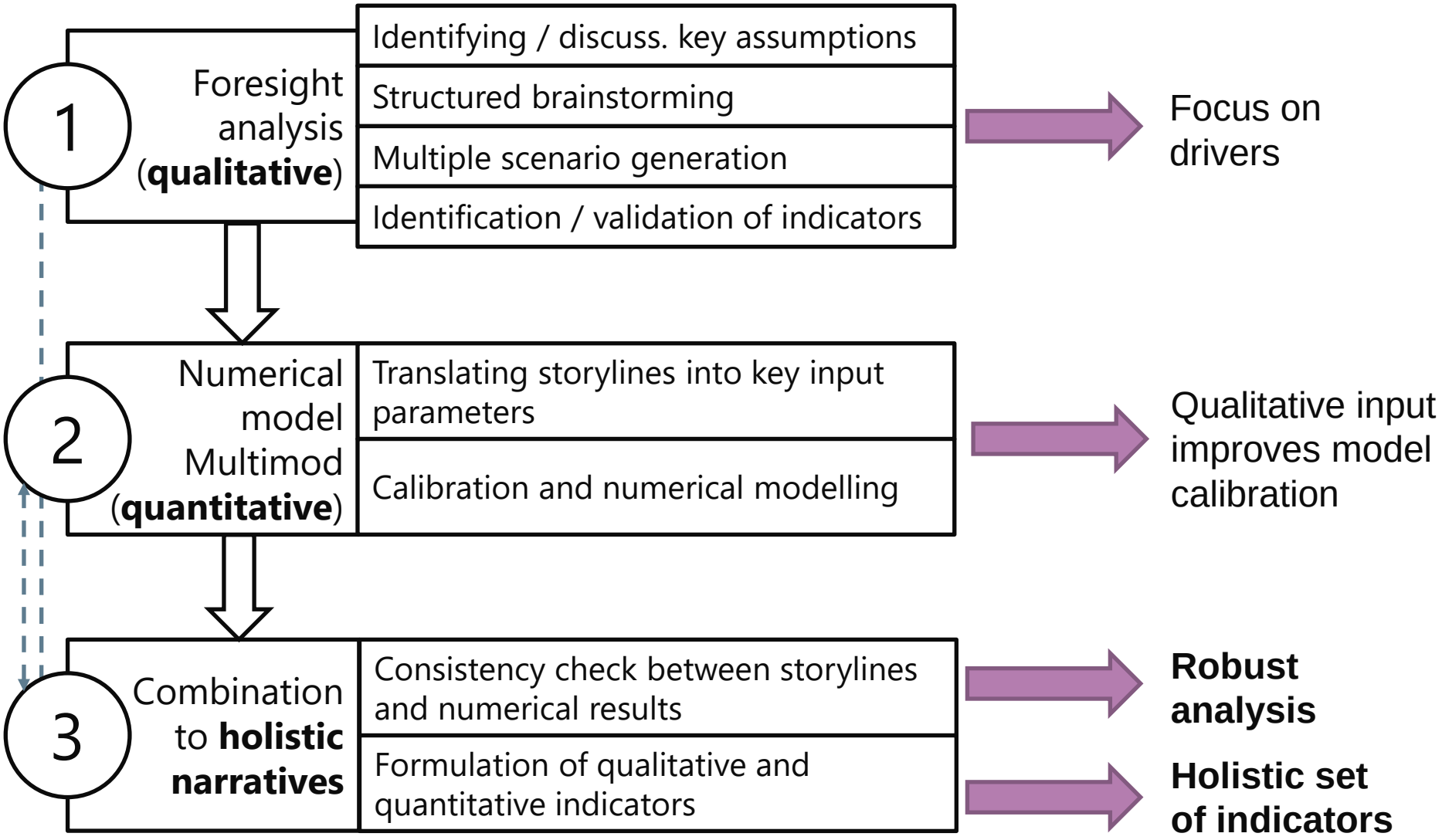
Energy futures: Global coal demand



From: Ansari et al. (2020)

- Demand projections diverge depending on scenario type → coal exit = uncertain
  - Best-case → decreasing demand
  - Base-case → slowly decreasing or stagnating demand
  - Worst-case → stagnating or increasing demand

DIW-REM Outlook: Three-step approach



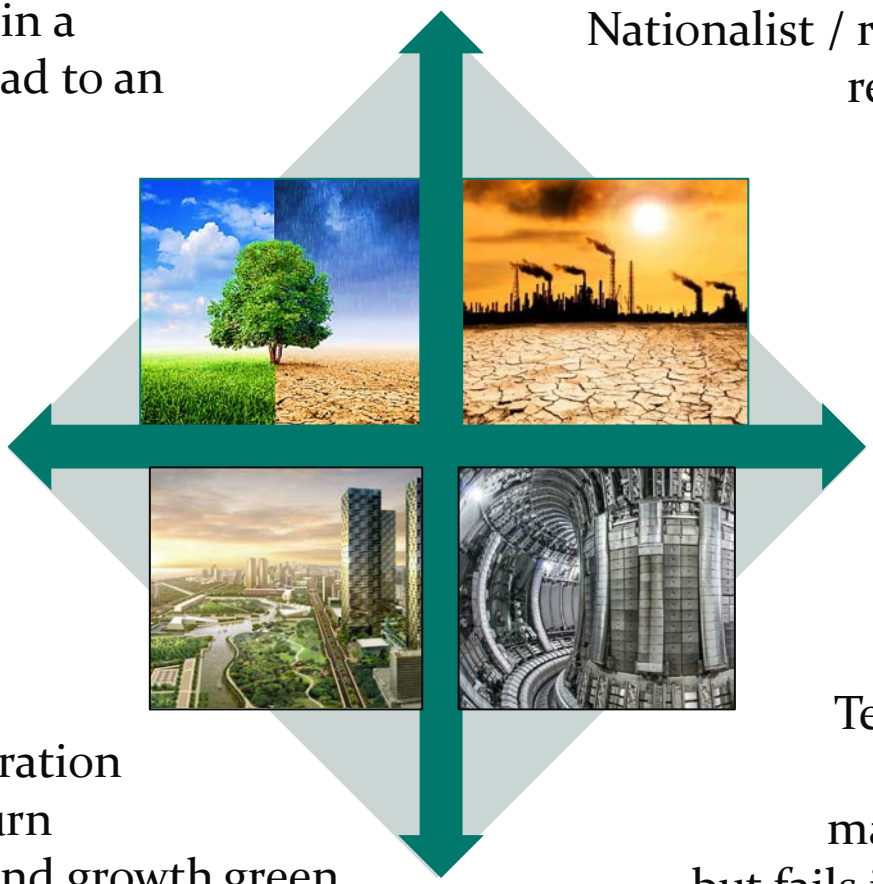
The DIW-REM outlook

Business as usual

Conflicting interests in a tense environment lead to an ambiguous future energy system.

Survival of the Fittest

Nationalist / regionalist world without regard to decarbonisation ends in large-scale climate catastrophes



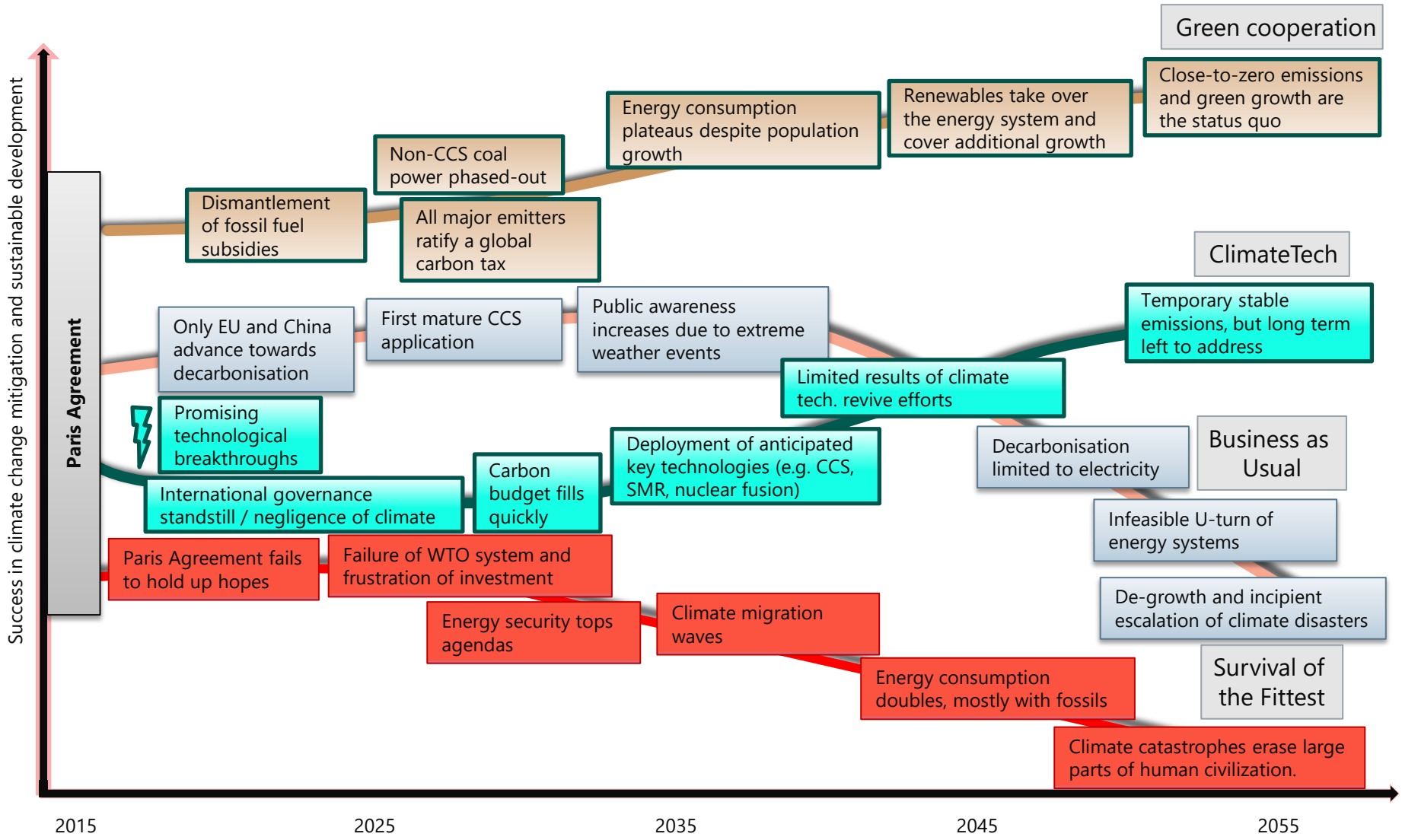
Green Cooperation

Revived global cooperation enables markets to turn civilisation, society, and growth green.

ClimateTech

Technology-centred world with sudden advances manages to curb emissions but fails in deep decarbonisation.

DIW-REM Outlook (2019)



From: Ansari et al. (2019)

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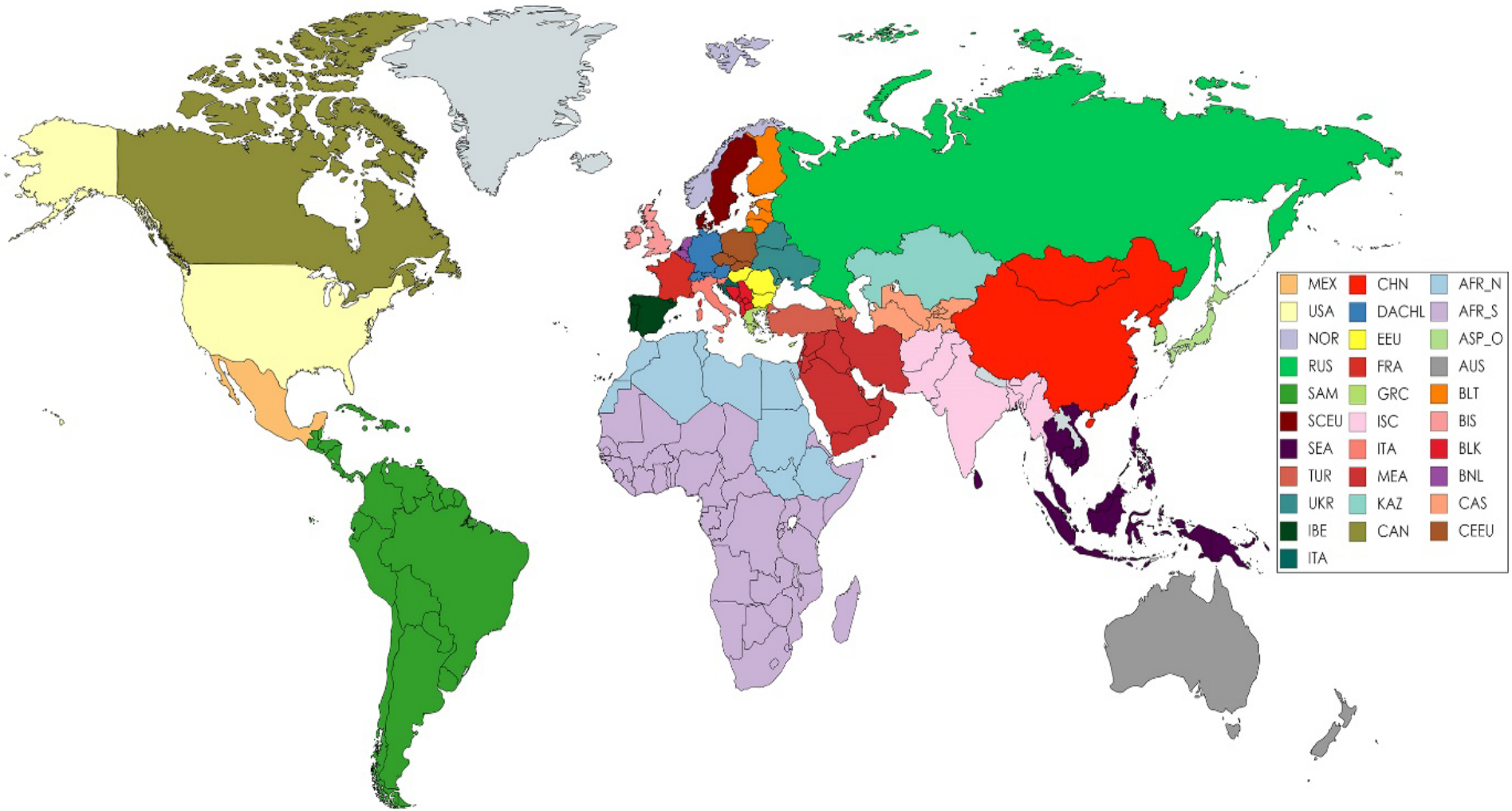
Global MultiMod model:
An energy system and resource market model



Stranded assets will be a problem in fossil fuel sectors

Index

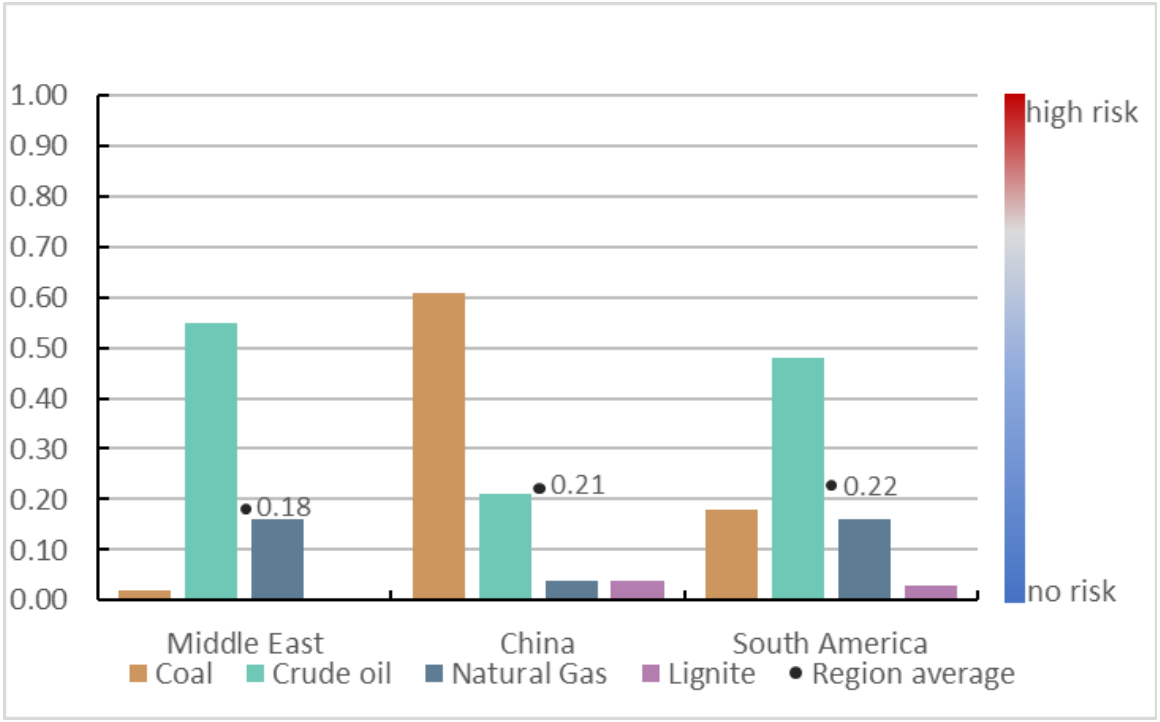
$$I_{s,f} = \sqrt{\Delta^{\max}_{\text{avg}}\text{util}_{s,f} * \text{share}_{s,f}}$$

- Fuel-production dependency
- Largest divergence between scenarios

"*Stranded assets*":

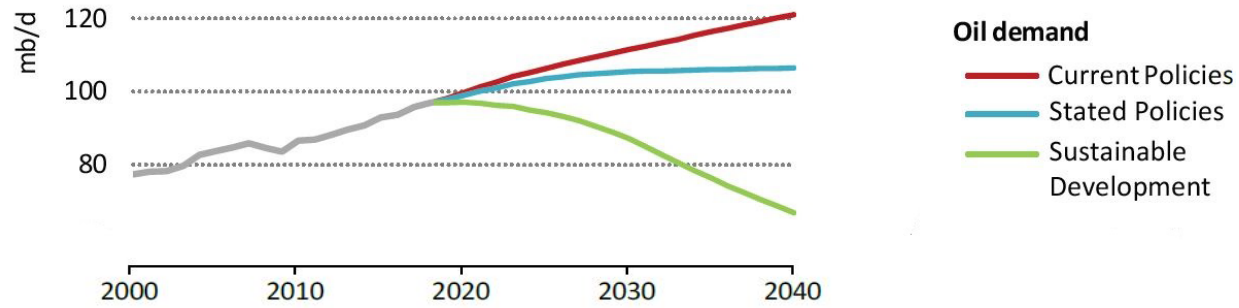
Assets that suffer from unanticipated or premature write-offs, downward revaluations or are converted to liabilities, as the result of a low-carbon transition or other environment-related risks.

(Based on Ansar, Caldecott, and Tilbury 2013)



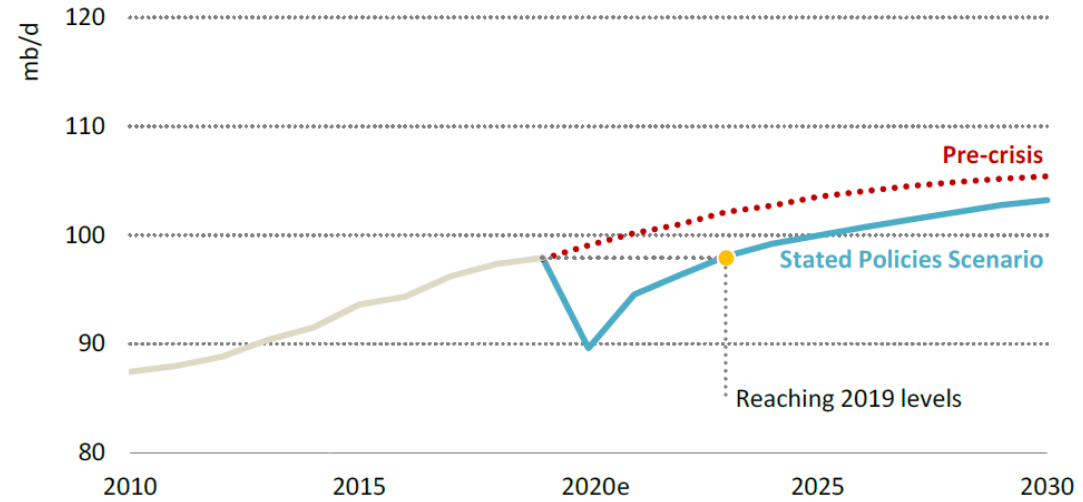
Influence of Covid-19 on oil markets - WEO

Figure 3.2 ▷ Global oil demand and crude oil price by scenario



From: WEO - 2019

Figure 5.7 ▷ Global oil demand in the Stated Policies Scenario, 2010-2030

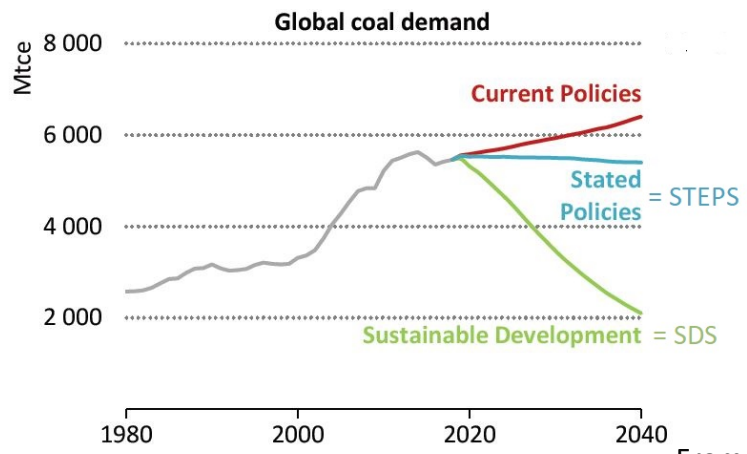


From: WEO - 2020

- Due to pandemic, demand & production decreased **~ 4%** than estimated in 2019 for year **2025** and **~ 2%** for year **2040**
- In the long run, oil demand will recover after drastic changes in consumption in 2020

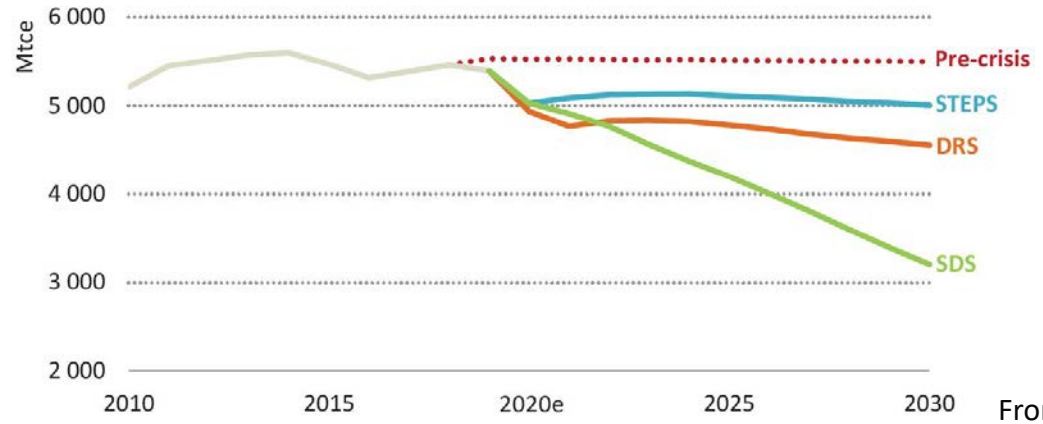
Influence of Covid-19 on coal markets - WEO

Figure 5.1 ▷ **Global coal demand by scenario**



From: WEO - 2019

Figure 8.12 ▷ **Global coal demand by scenario and sector to 2030**



From: WEO - 2020

- Due to pandemic, demand & production decreased **~ 7%** than estimated in 2019 for year **2025** and **~ 12%** for year **2040**
- Coal exit is sooner than before the crisis or demand will stagnate at a level lower than expected pre-crisis

Conclusions

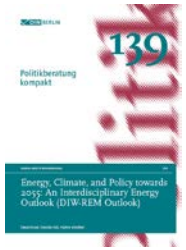
"After all, scenario making, i.e. the "science of the future", turns out to be an art rather than a hard science, calling for a critical review […]"

(Christian von Hirschhausen in „Long-Term Energy and Climate Scenarios – An Introduction" in *Economics of Energy and Environmental Policy*, Vol. 9 (1), pp. 1-5, Symposium on "Long-term Energy and Climate Scenarios".)

Thank you very much for your attention!

For more information, please refer to

- P. Crespo Del Granado, G. Resch, F. Holz et al. (2020): Energy Transition Pathways to a Low-carbon Europe in 2050: the Degree of Cooperation and the Level of Decentralization. *Economics of Energy and Environmental Policy*, Vol. 9 (1), pp. 121-135, *Symposium on "Long-term Energy and Climate Scenarios"*.
- D. Ansari & F. Holz (2020): Between Stranded Assets and Green Transformation: Fossil-Fuel-Producing Developing Countries Towards 2055. *World Development*, Vol. 130, pp. 104947.
- D. Ansari, F. Holz, H. al-Kuhlani (2020): Energy Outlooks Compared: Global and Regional Insights. *Economics of Energy and Environmental Policy*, Vol. 9 (1), pp. 21-42, *Symposium on "Long-term Energy and Climate Scenarios".*



- Ansari, D., Holz, F., & Al-Kuhlani, H. (2019). *Energy, climate, and policy towards 2055: An interdisciplinary energy outlook (DIW-REM outlook)* (No. 139). DIW Berlin: Politikberatung kompakt.

- D. Ansari & F. Holz (2019): Anticipating Global Energy, Climate and Policy in 2055: Constructing Qualitative and Quantitative Narratives. *Energy Research & Social Science*, Vol. 58, pp. 101250.
- IEA (2020): World Energy Outlook (WEO). OECD, Paris.

Thank you for your attention !

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