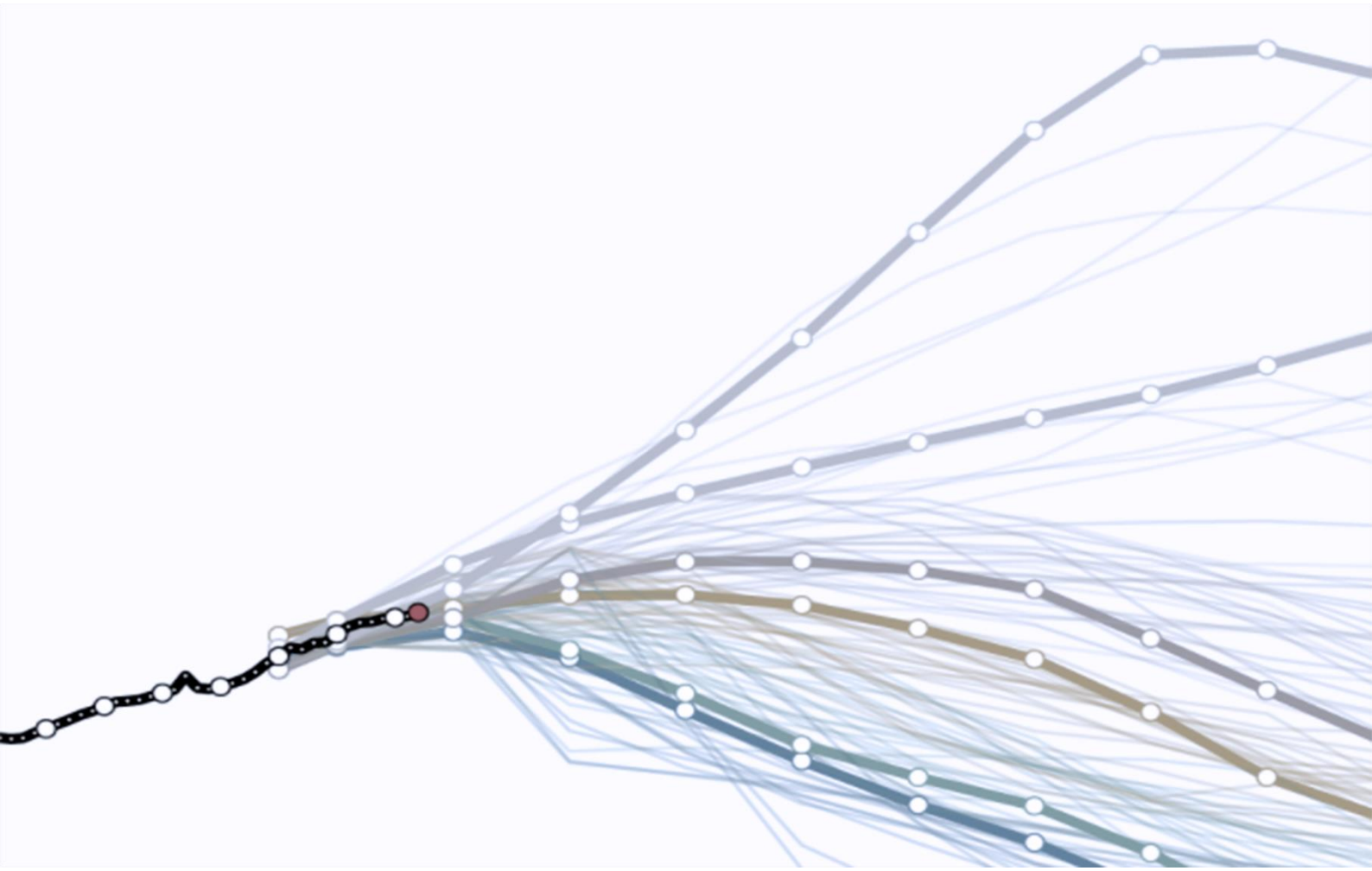
REPORT 2018:02

Climate scenarios demystified

A climate scenario guide for investors



CICERO
Climate Finance

Climate scenarios demystified

A climate scenario guide for investors

CICERO's *Climate scenario guide* helps investors understanding and implementing the recommendations on scenario stress testing by the Financial Stability Board's Task Force on Climate-Related Financial Disclosure (TCFD):

WHEN is scenario analysis useful?

WHICH scenarios should be used?

WHAT do scenarios imply?

Report outline:

Executive summary

Scenario stress testing is useful for some risks and periods, but not all. Stress testing against a range of scenarios can help prepare for *transition* risk, but does not capture *physical* risk in the near term.

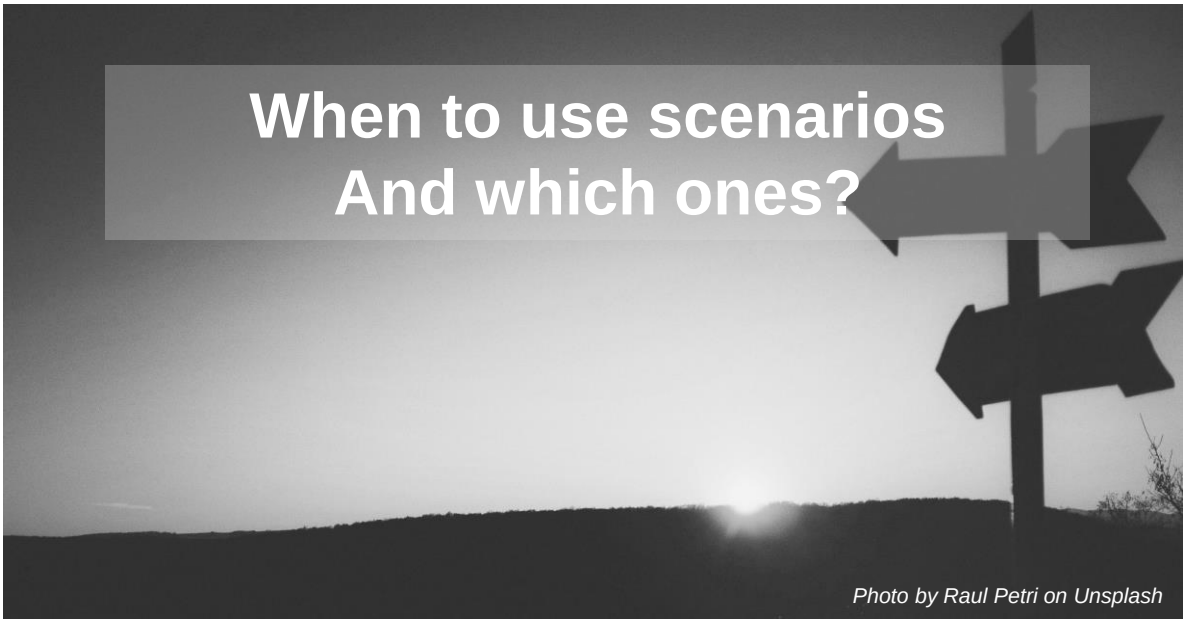
Plan for 2°C…but also 3°C and 4°C. We need to plan for a 2°C world, but at the same time recognize that it is not the most likely outcome given today's policy ambition:

- **Meeting 2°C requires having all the building blocks in place**: CO_2 pricing, renewable electricity generation, energy efficiency, electric vehicles, and carbon capture & storage (CCS). We are on track for electric vehicles, and made good progress in renewable electricity generation and energy efficiency, but are lagging behind on CO_2 pricing and CCS.
- **Currently, 3°C global warming seems more likely than 2°C** due to high uncertainty about the implementation and potential tightening of pledges under the Paris Agreement, and uncertainty about a rapid upscaling of low-carbon technologies like CCS.
- **Scenarios around 4°C can help examine extreme physical impacts in the longer term**.

Due to the profound changes needed for aggressive climate targets such as 2ºC, transition risk affects all sectors. In the short to medium term, industries that supply or use fossil fuels are most likely to be disrupted.

We do not need elaborate scenario testing to prepare for physical climate change in the short term. Changes such as extreme events and flooding are affecting all sectors and regions already. These impacts will become clearer over the next 10-20 years, because of historical emissions and independent of the scenario. By limiting future emissions, we can limit additional and worse impacts in the longer term.

Physical climate risks can affect all sectors. Extreme events, such as recent hurricanes and flooding, influence companies across all sectors via electricity, production and transportation outages.



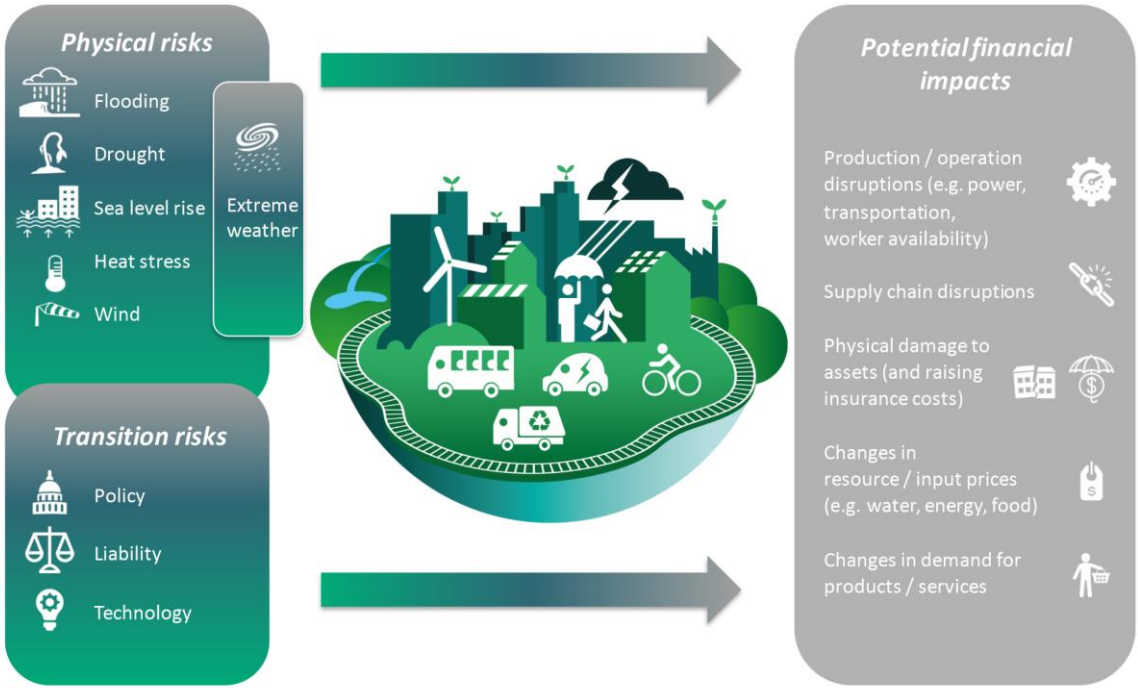
Scenario stress testing is useful for analyzing some risks and timeframes, but not all. To prepare for transition risk, investors should consider a range of scenarios from 2ºC to 4ºC. However, we do not need elaborate scenario testing to prepare for physical climate change in the next 10-20 years.

Achieving approximately 3ºC degrees in 2100 is more likely than 2ºC, given the policy ambitions today. This likelihood could shift in the future, if policies are tightened and technologies like CCS become more widespread.

The global average temperature is likely to be approximately 1.5°C higher pre-industrial levels in the next 10-20 years, regardless of the emissions scenario. Historical emissions accumulate in the atmosphere and there is a time lag before they result in temperature impacts.

Towards the end of the century, temperatures could span from approximately 2°C to 4°C, across a range of average emission scenarios.

Scope of climate risk



This report describes climate risk in line with the definition used by the Task Force on Climate-related Financial Disclosures:

- **Physical risk** is the risk of physical changes in the climate, such as extreme weather and/or sea level rise. Extreme events can cause significant damage in combination with all types of physical risk, which can also have chronic impacts. Physical risk can impact companies and businesses financially e.g. via infrastructure damage or electricity and transport disruptions.

- **Transition risk** is the risk that changes in policy, liability or technologies can impact markets and consumer behavior.

Physical climate impacts increasingly confront investors with unplanned and abrupt changes or disruptions to businesses or assets**.** While transition risks tend to have a built-in lead time for companies to plan and adjust, the abrupt shocks from physical climate change deserve immediate attention.

Not only physical facilities, but also production processes, markets and supply chains are at risk.

The risk of catastrophic social impacts are not fully captured in the currently available suite of models, however the Shared Socio-economic Pathways (SSP) being developed in collaboration with the IPCC are an attempt to capture more social impacts.

What are climate scenarios?

Energy system models
e.g. IEA's WEO

Model the energy system and estimate emissions

Possible to explore hundreds of alternative futures

Examine transition impacts

Climate models
e.g. IPCC

Model the climate system, translating emissions into climate variables e.g. temperature

Possible to explore a few representative scenarios

Examine physical and transition impacts

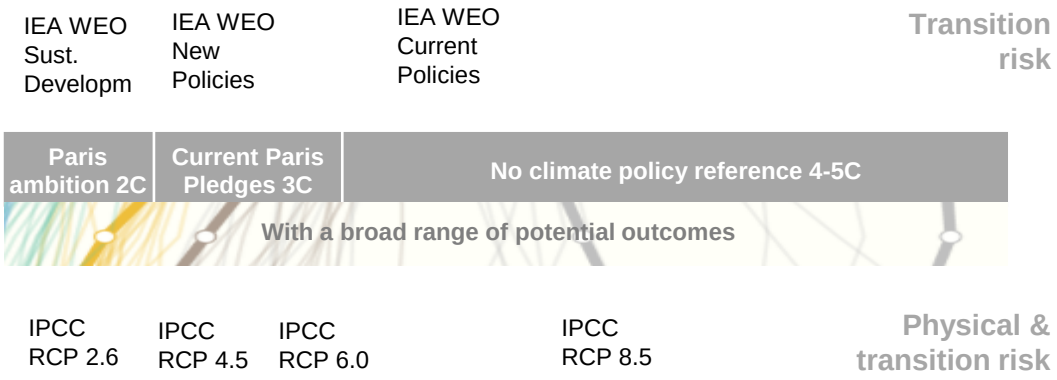
A climate scenario is a coherent narrative describing a future. Most scenarios also show the pathway to that future and the drivers of change along the way.

Scenarios allow investors and corporations to assess how their financial assets will be affected under a range of possible future developments, helping them to assess climate risk.

- **Transition impacts on the energy system** can be examined using scenarios in energy system models (e.g. the World Energy Outlook by the International Energy Agency - WEO). They can be used e.g. to estimate emissions and assess carbon prices.
- **Physical impacts and transition impacts on a global scale** can examined using scenarios from climate system models (e.g. IPCC). They translate emissions into climate variables, e.g. temperature. Specific regional impact, e.g. precipitation and wind, can be examined in greater detail using regional models and assessments.
- In combination, energy system and climate system models enable us to link models of the energy system to temperature increases in coherent scenarios.

There are many ways to get to 2°C, depending on socioeconomic and modelling assumptions. All 2°C scenarios require rapid decarbonisation, zero emissions between 2050 and 2100, and net-negative emissions thereafter – e.g. using bioenergy with CCS.

Common scenarios



Scenarios are coherent futures, each with advantages and disadvantages. They are used to explore key uncertainties, not to predict the future. There is no one 'correct' scenario.

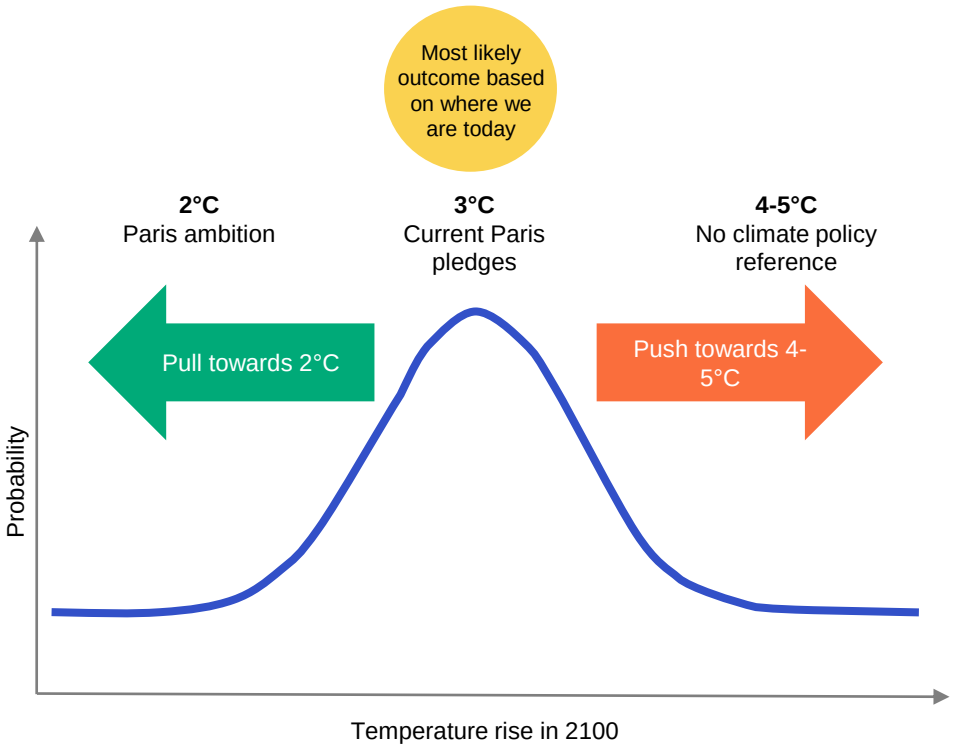
Many organisations develop scenarios, for a multitude of reasons. Scenarios from the International Energy Agency (IEA) and assessed by the Intergovernmental Panel on Climate Change (IPCC) are independently produced and well-known. In addition, business organisations (e.g. World Business Council for Sustainable Development) and companies (e.g. Statoil, BP) produce their own scenarios.

The figure aligns common scenarios with various temperature targets. The IPCC RCP2.6 targets approximately 2ºC at the end of the century, and the WEO Sustainable Development Scenario is roughly in alignment with a 2ºC pathway by it's end year in 2040. Scenarios vary in how often they are updated and the end year that they model.

Scenario	Purpose	Update frequency	Number scenarios	End year	Key focus
IPCC community: Marker Scenarios	Impact risk	5-7 years	4-6	2100	Focus on the climate system and impacts
IPCC community: Shared Socioeconomic Pathways (SSPs)	Transition risk	5-7 years	>130	2100	Comprehensive exploration of socioeconomic pathways using a range of models
IEA World Energy Outlook (WEO)	Transition risk	Annual	3	2040	Focus on markets
IEA Energy Technology Perspectives (ETP)	Transition risk	Annual	3	2060	Focus on energy technologies

The focus of this Guide is on scenarios in the range of 2-4°C, which are the most probable given current information.

Which scenarios are most likely?



The global average temperature is likely to be approximately 1.5°C higher pre-industrial levels in the next 10-20 years, regardless of the emissions scenario. Historical emissions accumulate in the atmosphere and there is a time lag before they result in temperature impacts.

Towards the end of the century, temperatures could span from approximately 2°C to 4°C, across a range of average emission scenarios.

Achieving approximately 3°C degrees in 2100 is more likely than 2°C, given today's policy ambition. Still, 2°C is considered to be somewhat more likely than 4-5°C, given the possibility of tightening ambition under the Paris Agreement design, and the possibility of deploying CCS on a large scale. No climate policy reaching approximately 4-5°C would mean that current climate policies would be rescinded or relaxed.

Political and/or technological events can influence the temperature increase, pushing it up to 4-5ºC or pulling it lower towards 2ºC.

Examples of push factors:

- Key countries (e.g. China, EU, India, US – jointly responsible for 60% of global emissions) fail to implement their climate targets (Nationally Determined Contributions).
- CCS deployment is delayed due to cost and public opposition

Examples of pull factors:

- CCS is deployed rapidly at large-scale. CCS plants are built at the historical pace of coal plants in China or nuclear plants in Europe.
- Key countries ambitiously tighten their climate targets every 5 years under the Paris agreement

The Paris Agreement also pursues efforts to limit to 1.5°C, but these scenarios are not included in this guide. The science community is still debating whether it is physically still possible or too late to limit warming to 1.5°C in 2100. 1.5ºC means no more net CO_2 emissions from mid-century[x] – likely requiring negative emissions technologies, which are untested at large scale; and global decarbonisation at an extreme rate, witnessed only regionally in short periods of recession or war.

When is scenario stress-testing useful?

	Next 10-20 years	Mid-century
Physical Risk 	**Climate impacts independent of scenario** because of historical GHG emissions Consider probabilities of physical events	**Scenario choice matters** Use alternative scenarios spanning 2-4°C to explore range of physical risks
Transition Risk 	**Scenario choice matters** Use alternative scenarios spanning 2-4°C to explore range of transition risks	

The Task Force on Climate-Related Financial Disclosure (TCFD) established by the Financial Stability Board recommends scenario stress-testing for all companies and financial organizations.

Scenario stress testing is useful for some risks and time frames, but not all.

Stress testing against a range of scenarios can help prepare for transition risk, across all periods. A range of scenarios should be examined to understand the range of transition risk, including 2°C, 3°C, and even 4ºC scenarios. **Given today's policy ambition, approximately 3°C global warming by 2100 is the most likely scenario**.

Physical climate impacts are independent of scenario in the near future. Changes such as extreme events and flooding are impacting all sectors and regions already. These impacts will become clearer over the next 10-20 years, as a result of historical emissions. By limiting current and future emissions we can limit additional and worse impacts. Regional assessments can be used to examine specific physical risks.

Using a higher temperature scenario e.g. 4°C can be useful for examining a possible worst-case scenario of potential physical impacts.

The period for stress testing should reflect the lifetime of the assets under consideration and how long it is exposed to climate risks.

For more details, see the next chapters on transition and physical risk.

Transition risk

Photo by Jason Blackeye on Unsplash

Transition risk is the risk that changes in policy, liability or technologies can impact markets and consumer behavior.

The World Energy Outlook (WEO) scenarios by the International Energy Agency are the most widedly used scenarios to assess transition risk across various industries. Many other organisations and corporations base themselves on the WEO to develop their own scenarios. The WEO is updated annually, but covers only the next 20 years.

The WEO includes three scenarios: *Current Policies scenario* (CPS); *New Policies scenario* (NPS); and *Sustainable Development scenario* (SDS).

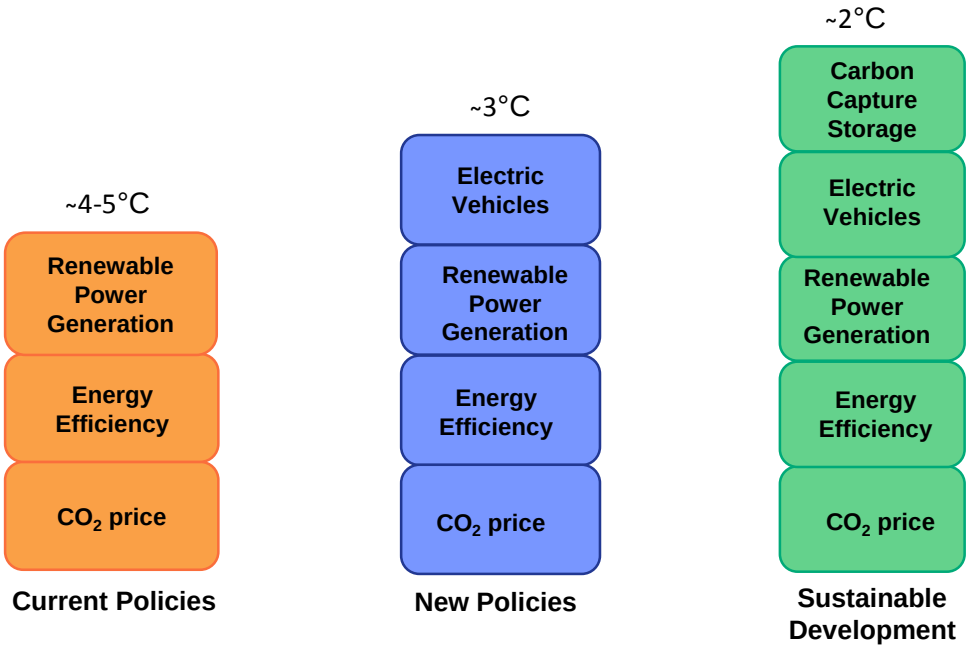
The WEO scenarios are coherent futures, consisting of various building blocks. Each building block is a necessary but insufficient condition to reach the 2ºC target. This guide examines the following building blocks: CO_2 pricing, energy efficiency, renewable energy, electric vehicles (EVs) and carbon capture and storage (CCS).

Due to the profound changes need for aggressive climate targets (e.g. 2ºC), transition risk affects all sectors. In the short to medium term, industries that supply or use fossil fuels are most likely to be disrupted.

Transition risk scoreboard for 2ºC:

- **CO_2 pricing**: *insufficient*
- **Energy efficiency**: *additional efforts needed*
- **Renewable energy**: *additional efforts needed*
- **Electric vehicles**: *continued efforts needed*
- **CCS**: *insufficient*

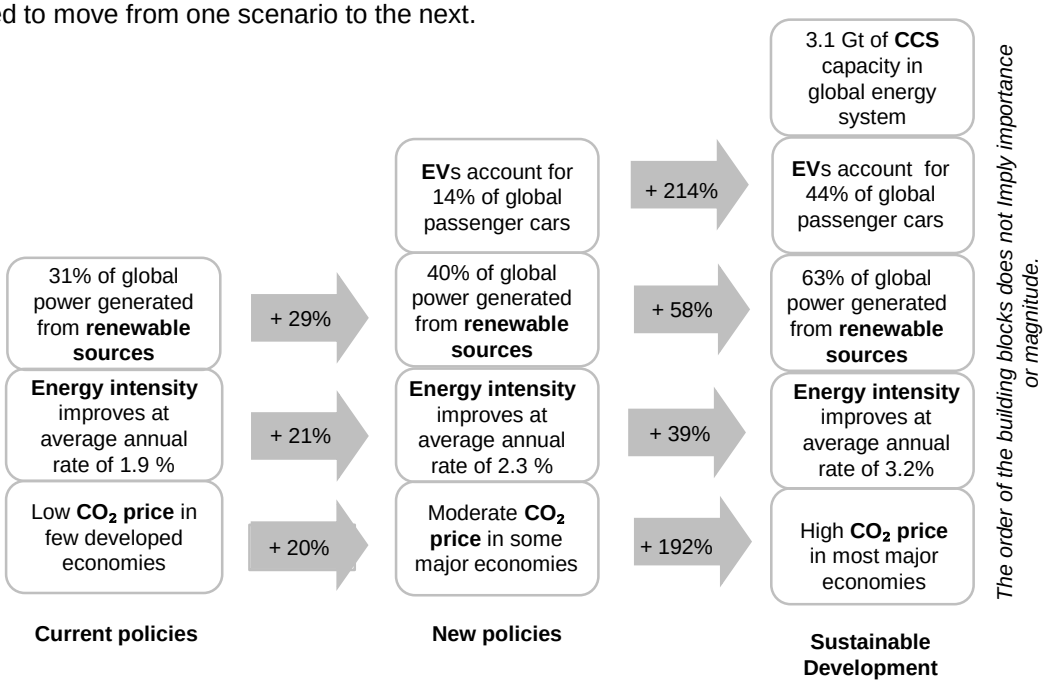
World Energy Outlook dissected into building blocks



The three WEO scenarios are coherent futures, comprised of various building blocks.

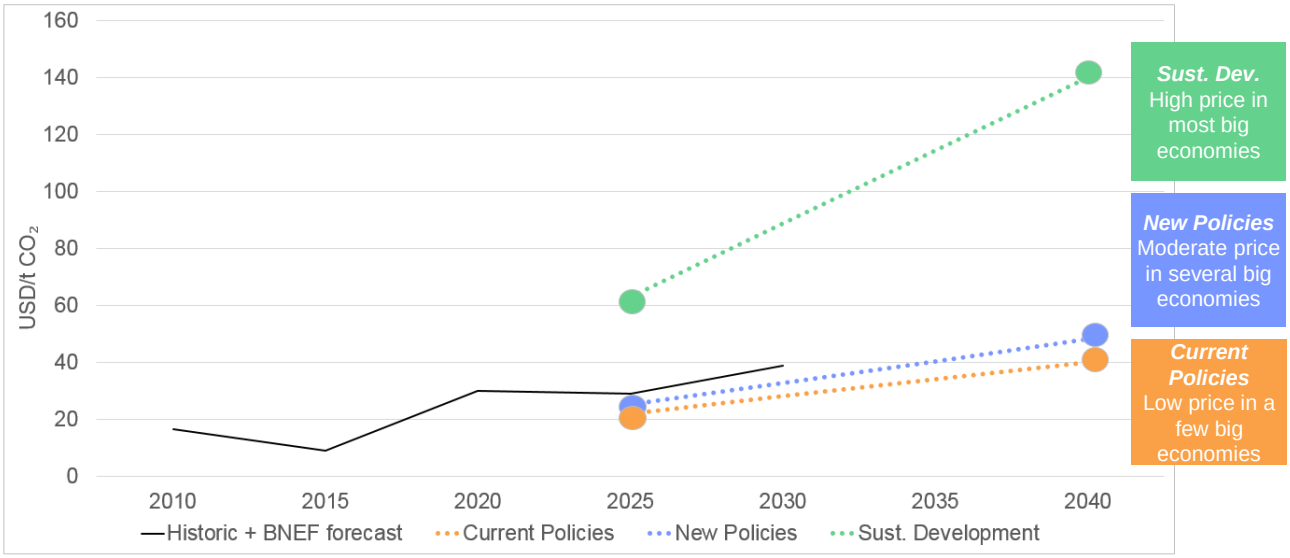
Every building block is a necessary but insufficient condition to be consistent with the temperature outcome. If one building block is removed, the coherence is gone and the target cannot be reached.

The figure below describes each building block in the year 2040, including the increase that is needed to move from one scenario to the next.



CO_2 price – insufficient progress

Example: EU Emissions Trading System - Price to emit one tonne of CO_2



- Carbon Capture & Storage
- Electric Vehicles
- Renewable Power Generation
- Energy Efficiency
- **CO_2 Price**

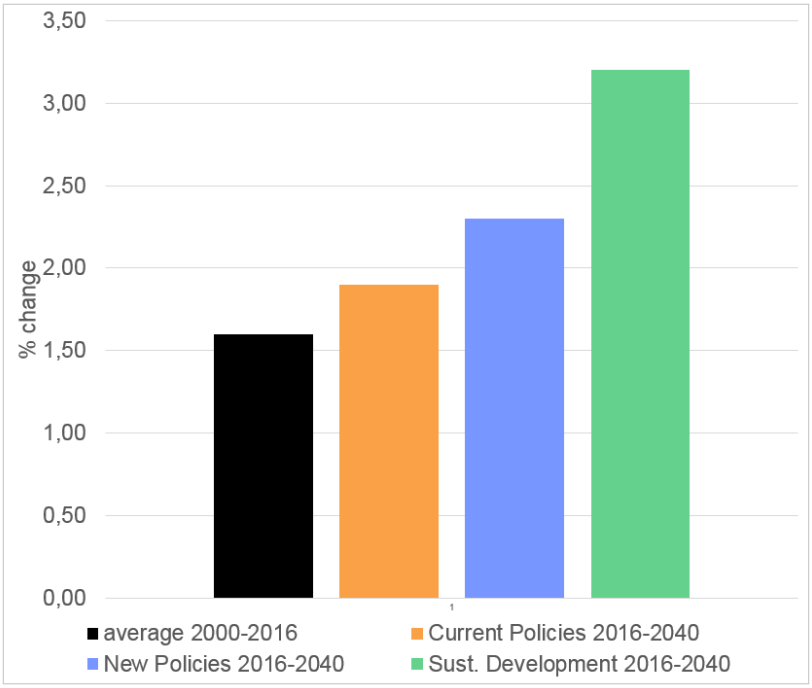
Progress on CO_2 pricing is insufficient for 2ºC. All climate scenarios require a much higher CO_2 price globally than today. This could be achieved e.g. via cap & trade systems or taxes.

Even in the most advanced cap and trade market, the EU ETS, the CO_2 price is not on track to reach the 2ºC target. According to the Sustainable Development Sceniario, the CO_2 price should be at USD 63 / tCO_2 in 2025 in advanced economies, while the EU ETS price forecast (BNEF) for 2025 is ca. USD 29 / tCO_2.

Source: 2010: Business Insider, ETS emission allowance price 4.1.2010; 2015: EEX ETS emission allowance price 2.1.2015; 2020-2030: Bloomberg forecast; Scenario prices: IEA WEO 2017 Bracket «Advanced Economies», 2030 and 2035 linearly extrapolated.
The EU ETS was chosen as an example because it is the only large market included in all three scenarios, and has established institutions to implement CO_2 pricing.

Energy efficiency – additional efforts needed

Energy Intensity Improvement – Average change per year



Current Policies 1.9% energy intensity improvement per year

New Policies 2.3% energy intensity improvement per year

Sust. Development 3.2% energy intensity improvement per year

- Carbon capture & Storage
- Electric Vehicles
- Renewable Power Generation
- **Energy Efficiency**
- CO_2 Price

Improvements in energy efficiency have been made but more efforts are needed to meet the 2°C target.

Energy efficiency measures affect a wide range of sectors and products.

Examples of how to improve energy efficiency:

- High CO_2 prices can reduce oil demand in transport;
- Enhanced standards for buildings and fuel economy in all end-use sectors;
- Energy savings in electric motors, from trains to pipeline compressors and household refrigerators; which account for over 50 % of global electricity demand;
- International agreements on energy savings in steel and cement industries.

Source: IEA WEO 2017. The assessment of progress towards the 2°C target is based on IEA ETP 2017. The analysis is based on energy demand developments in industry and transport and combined 13 sub-categories.
Energy intensity is understood as the amount of energy used per unit of GDP. Improvements in energy intensity are to a large extent driven by improvements in energy efficiency.

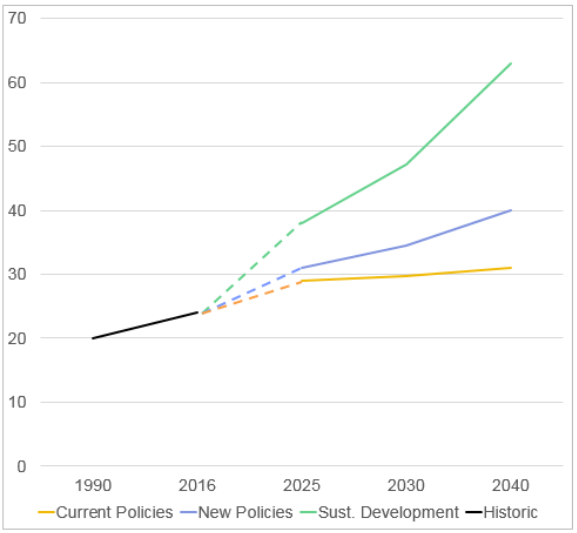
Renewable power generation – additional efforts needed

Sust. Development
RE reaches 63% of global electricity generation in 2040

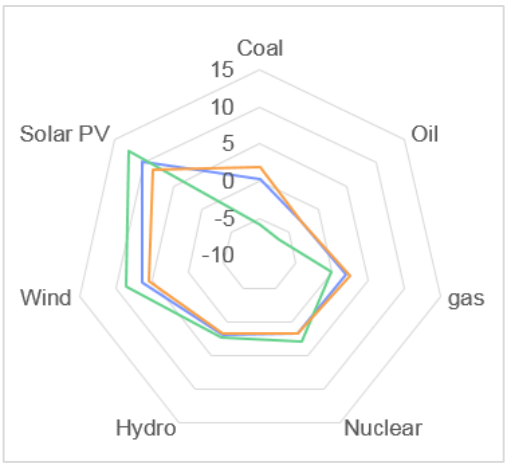
New Policies
RE reaches 40% of global electricity generation in 2040

Current Policies
RE reaches 31% of global electricity generation in 2040

RE Generation / Total Power Generation



Average Annual Growth Rate in Power Generation by Technology



- Carbon Capture & Storage
- Electric Vehicles
- **Renewable Power Generation**
- Energy Efficiency
- CO_2 Price

Renewable power generation is growing, but additional efforts are needed to be on track for the 2°C target.

Solar and wind power grow the most, under all scenarios.

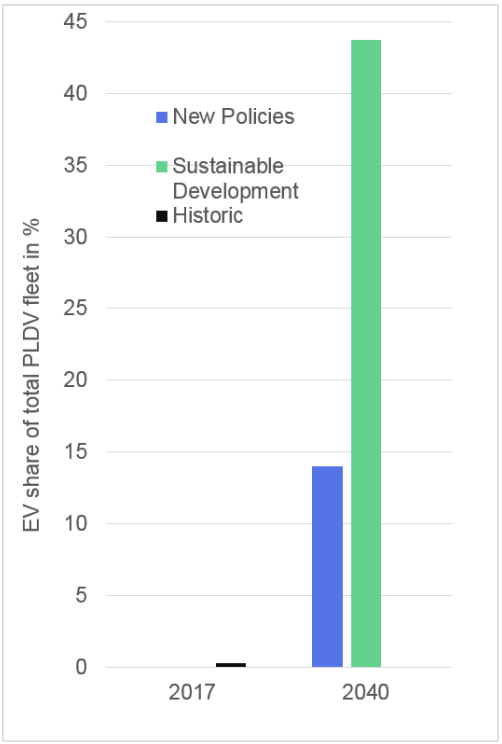
Solar and onshore wind power are on track, but additional efforts are needed in hydropower, offshore wind and biomass.

Under the Sustainable Development scenario, 63% of all power comes from renewable sources in 2040, up from 24 % in 2016.

Renewable Electricity technologies: Hydro, biomass, wind, geothermal, solar PV, concentrated solar power, marine.
The assessment of progress towards 2ºC is based on IEA ETP 2017.

Electric vehicles – continued efforts needed

EV share of global PLDV fleet



New Policies
EVs account for 14% of global PLDV fleet

Sust. Development
EVs account for 44% of global PLDV fleet

- Carbon Capture & Storage
- **Electric Vehicles**
- Renewable Power Generation
- Energy Efficiency
- CO_2 Price

Continued efforts are needed to meet the 2°C target: from 2 million EVs today, we need to reach 710 million in 2040.

In the last 5 years, the annual growth rate of EV fleet has been between 50 and 120%, reflecting significant growth in the EV fleet is already underway.

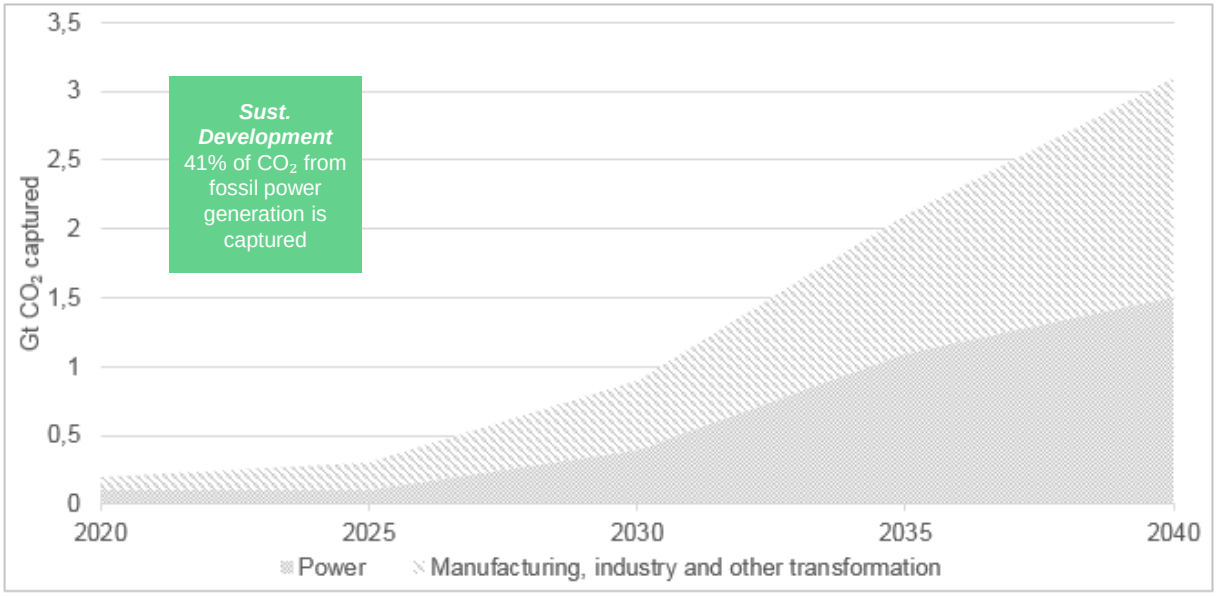
Several countries will ban the sale of fossil cars (Norway in 2025, India in 2030, France and UK 2040), while various mainstream car producers (e.g. Daimler, Nissan, GM) are soon introducing new EVs in their model range.

Additional efficiency efforts are needed in rest of transport sector: heavy road transport, aviation and especially shipping.

Source: 2017 EV share of PLDV fleet: BNEF 2017 forecast 3 million EVs, global PLDV stock 1.2 bn. The assessment of progress towards 2ºC is based on IEA ETP 2017.
PLDV = Personal Light Duty Vehicle
EVs are not included in the Current Policies scenario.

Carbon capture & storage – insufficient progress

CCS deployment in the Sustainable Development Scenario



Carbon Capture & Storage

Electric Vehicles

Renewable Power Generation

Energy Efficiency

CO_2 Price

CCS is a technology to capture, transport and store CO_2 from fuel combustion or industrial processes.

Reducing CO_2 by deploying CCS on a large scale is vital to reach the 2°C target, but development is not on track. The 2°C target requires construction of 3 CCS plants per week from now through 2040.

Different scenarios have very different levels of CCS, hence very different risks on fossil resources. WEO has relatively low CCS (3.1Gt CO_2 or about 3100 facilities in 2040), others can have high CCS (15Gt CO_2 or about 15000 facilities in 2040). This underscores the significant uncertainty facing the future of fossil resouces.

Source: IEA WEO 2017.
3.1 GtCO_2/yr accounts for approximately 150 Sleipner size facilities per year, or 3 facilities per week
Other transformation includes fuel production and refining

Which sectors are most likely to be hit by transition risk?

	WEO building blocks	Oil demand (barrels/day)	Electricity Generation	Transport	Buildings	Industry
Current Policies	CO_2 Price		!	!		!
	Energy Efficiency					
	Renewable Power Gen.	!	!			
	EVs					
	CCS					
New Policies	CO_2 Price		!	!		!
	Energy Efficiency	!	!	!	!	!
	Renewable Power Gen.	!	!			
	EVs	!	!	!		!
	CCS		!			
Sust. Develop-ment	CO_2 Price		!	!		!
	Energy Efficiency	!	!	!	!	!
	Renewable Power Gen.	!	!		!	
	EVs	!	!	!		!
	CCS		!			!

Due to the changes needed to meet the climate targets under the New Policies and Sustainable Development scenarios, transition risk affects all sectors.

In the short to medium term, industries that supply or use fossil fuels are most likely to be disrupted. Even in the Current Policy scenario the electricity generation sector is exposed to transition risk.

Energy efficiency measures have implications across all sectors.

Source: IEA WEO 2017.
Effects are interpreted from WEO scenario results in 2040, however post-2040 scenario effects can also impact infrastructure planning today. Blanks indicate no effect in the scenario. Effects can be either positive or negative. Oil demand affects both power and transportation sectors. Renewables include power decarbonisation. The impact of CO_2 pricing on retail fuel-prices is not direct or coherent. Efforts to reduce emissions from road, sea and air transport, like fuel-economy standards, are included under energy efficiency and EVs.

Damage after hurricane Irma. Photo by Florida Fish & Wildlife on Flickr

Physical impacts are observed in all regions today and can have abrupt consequences across all sectors. Physical impacts manifest themselves mainly by rare events becoming more variable, (sometimes much) more frequent and intense.

Observed today:

- ✓**Extreme weather** - stronger hurricanes, and significant damage in combination with other impacts e.g. flooding and sea level rise
- ✓**Flooding** - wet areas generally projected to become wetter
- ✓**Drought** is observed in all regions
- ✓**Sea level rise** is accelerating faster than expected

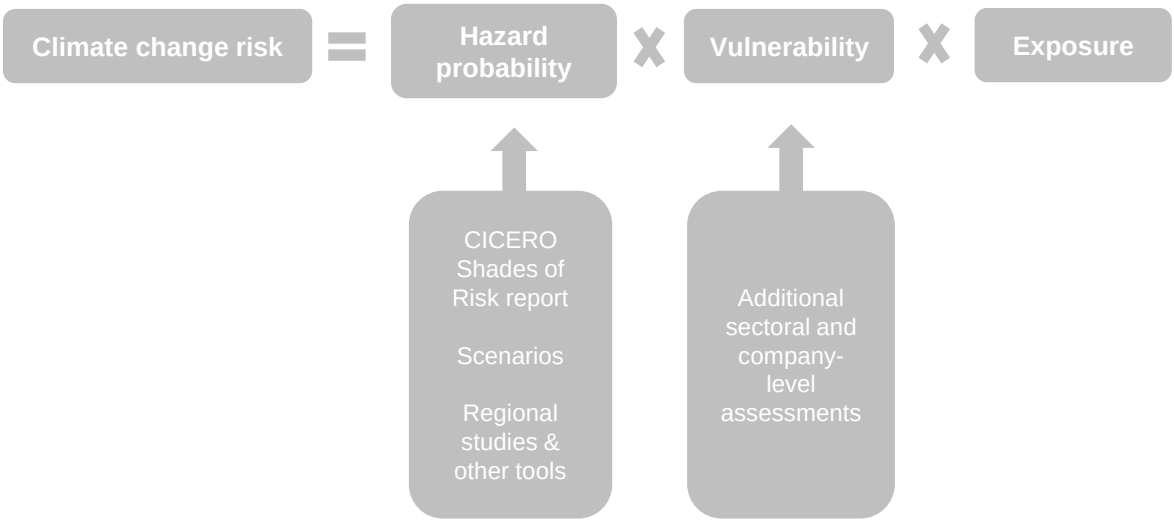
We do not need elaborate scenario testing to prepare for physical climate change for the next 10-20 years. We are already locked in for 1.5ºC global warming, because of historical emissions. Changes such as extreme events and flooding are impacting all sectors and regions already. These impacts will become clearer over the next 10-20 years. In the long term, policy decisions now impact physical risk in the future.

All sectors are exposed to physical climate risk, either by direct damage to infrastructure or via indirect transportation or electricity disruptions. Physical impacts can be chronic or abrupt, which may require different stress testing for companies.

CICERO's Shades of Climate Risk report (2017) analyses the probability of physical events or hazards by timeframe and region. The report was developed in collaboration with leading investors, using IPCC and the latest climate science as the starting point.
To read or download the report, go to: www.cicero.uio.no/en/climateriskreport.

In September 2017, CICERO launched the ClimINVEST research project with French and Dutch scientific partners, to improve indicators of physical impacts including extreme weather events.

Breaking down physical risk



The risk of physical climate change is a factor of the probability of the event occurring, the **vulnerability** of the asset or infrastructure to the event, and the **exposure** of a portfolio or company to the event.

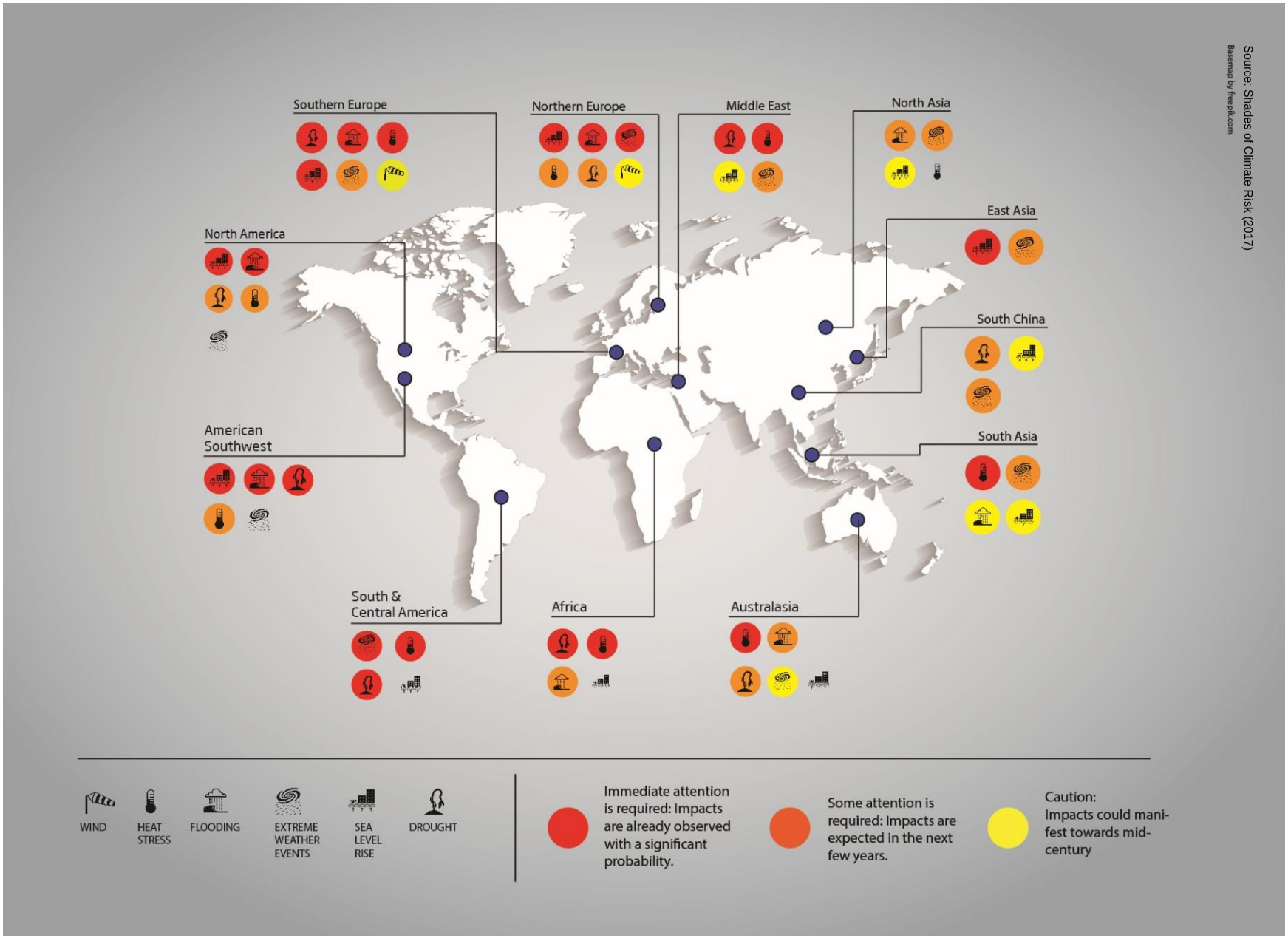
For the probability of an event occurring, **CICERO's Shades of Risk** provides probability categories of events by region, based on a meta-analysis of the IPCC.

At the global level, **new tools for investors** are also being developed specifically focusing on physical risk, for example:

- Equity Risk Scoring Tool (Four Twenty Seven): http://427mt.com/2017/11/08/physical-climate-risk-in-equity-portfolios-white-paper/
- Drought Stress Testing Tool (GIZ and Natural Capital Financial Alliance): http://globalcanopy.org/publications/drought-stress-testing-tool

For more **detailed regional information**, regional models and studies can be helpful. Some of the latest examples include:

- Fourth National Climate Assessment (US Global Change Research Program): http://science2017.globalchange.gov/
- Risky Business Reports (US Risky Business Project): http://riskybusiness.org/reports/
- Climate Change, Impacts and Vulnerability (European Environment Agency): www.eea.europa.eu/publications/climate-change-impacts-and-vulnerability-2016



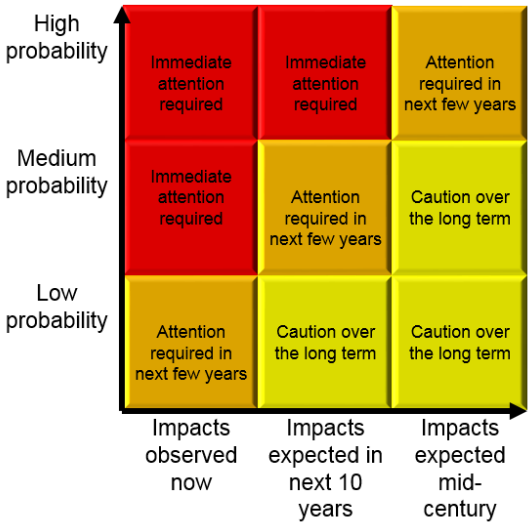
Source: Shades of Climate Risk (2017)

Basemap by freepik.com

Physical risk affects all regions today

Example: European physical impacts
More regions available in the Shades of Climate Risk report (2017).

Climate risks in Europe	Key message	Key impacted sectors	Shade of Risk
Extreme precipitation	High variability expected in precipitation, greater intensity in North. Precipitation could become more extreme in Mediterranean when it does occur after long dry spells (see also drought)	Infrastructure in high density urban areas	Northern and Central Europe Southern Europe
Flooding	Flooding from precipitation patterns and snow melt is observed and expected to increase	Infrastructure in high density urban areas	All
Drought	Reduced water availability in the South	Infrastructure (high density areas and along rivers), Energy (reduced hydropower generation in the South, increased in North), Agriculture (combined with ground water sinking from irrigation)	Northern Europe Southern Europe
Sea level rise	Sea level rise a concern low-lying coastal areas, especially in combination with extreme events such as hurricanes and spring floods	Infrastructure in coastal regions, nuclear energy	Coastal areas
Heat stress	Heat stress observed especially in South and expected to increase with high likelihood	Impacts on health, labour productivity, Agriculture (crop production, wildlife in South)	Northern Europe Southern Europe
Wind	No clear trend	Energy (changes in wind energy production uncertain, reductions most likely in South)	All



Which sectors are most likely to be hit by physical risk?

Sector	Extreme weather (incl. landslides, extreme precipitation, hurricanes)	Flooding	Drought	Sea level rise	Heat stress	Wind
Energy	!	!		!		!
Utilities (electric, gas, water)	!	!				
Materials	!					
Industrials (including transportation and infrastructure)	!	!	!	!	!	!
Consumer discretionary (including manufacturers)	!	!			!	
Consumer staples (including tourism and agriculture)	!	!	!	!	!	
Health	!				!	
Financials	!					
IT	!					
Telecommunications	!	!				

All sectors and regions are affected by **extreme weather events. Flood risk** is also wide-reaching. **Industrials and consumer staples** are especially exposed to all types of physical risk.

Physical climate change can be felt both **directly** (via infrastructure damage) **and indirectly** (via supply chain and transportation disruptions). Physical impacts can be **chronic or abrupt**, which may require different stress testing for companies. In the long term, policy decisions now impact physical risk in the future.

Source: Shades of Risk (2017), IPCC. This table reflects impacts that could occur by 2040 or earlier. Indicative sectoral impacts based on IPCC, and does not reflect comprehensive sectoral impact analysis for all risks. Blank boxes represent a lack of studies indicating impacts in that sector, which could also reflect an unknown effect. Consistent with MSCI Global Industry Classification Standard (GICS)

Implementing scenario stress testing requires information that is **tailored to sector and company** characteristics.

Sample questions can help investors engage with companies on scenario testing. These are presented in this section and could provide a foundation for future reporting requirements.

CICERO aims to establish a common understanding of climate scenarios. We can assist investors in doing **due diligence on companies or portfolios, or help facilitate targeted workshops** with companies.

Benchmarking WEO scenarios with IPCC scenarios for 2ºC can be used to illustrate scenario due diligence. This can also be done with company scenarios.

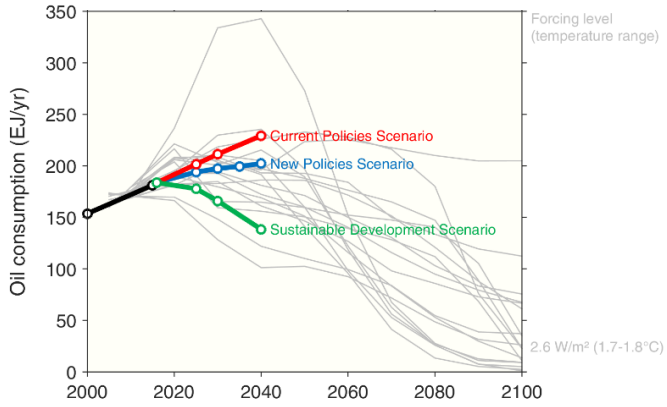
Sample questions to ask companies

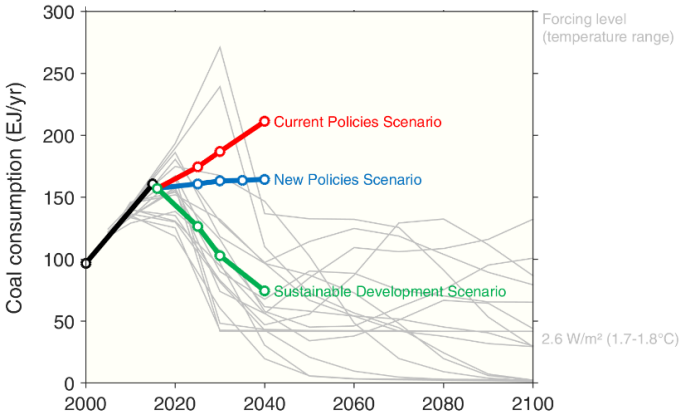
Physical risk 	**How are near-term physical risks assessed?**	• Are probabilities of physical risk assessed in current planning? • Are supply-chain disruptions considered? • Is insurance coverage or cost changing relative to physical risk such as flooding?
Transition Risk 	**Which scenarios are used to analyze the best- and worst-case for a company?**	• What is the base case, or reference scenario, considered? • Is a 2ºC scenario considered? • Are higher emitting scenarios of 3ºC and 4ºC also considered?

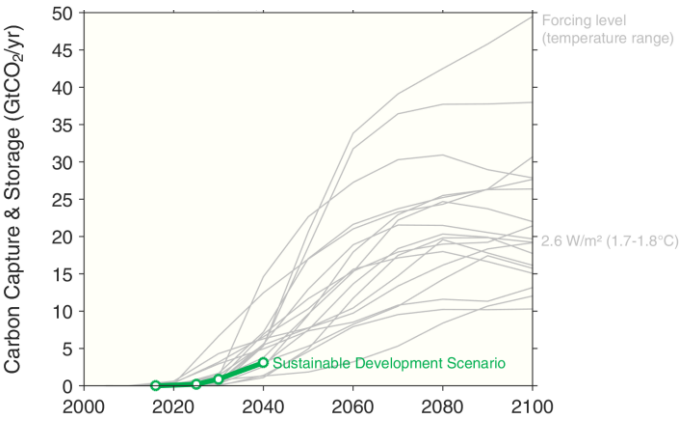
	Are the scenarios telling a coherent story?	• Are all necessary building blocks considered, and what are the key assumptions?
		  • CO_2 pricing
		  • renewable electricity generation
		  • energy efficiency
		  • electric vehicles
		  • CCS
		• Are total CO_2 emissions and total energy demand included and quantified?

	How does the scenario compare with other scenarios for the same target?	• Identify outlier assumptions by comparing to common scenarios e.g. WEO. Can the outliers be explained in a coherent story with other assumptions? • Recognize that many companies base their scenario assumptions in the commonly-used WEO scenarios, but many other scenarios exist. No scenario is 'correct', rather each tells a different story about reaching a target. • Oil consumption, e.g., can vary widely depending on the model and assumptions regarding energy demand, energy mix, and the availability of CCS.
	What happens after mid-century?	• For assets with a long lifetime, how the energy markets develop after mid-century are particularly important, e.g. with respect to CCS.

Example of Scenario Due Diligence







Benchmarking WEO with IPCC scenarios can be used to illustrate scenario due dilligence. This can also be done with companies' scenarios.

Explaining the figures:

Oil consumption levels out and drops steeply in most 2ºC scenarios, but oil supply declines more rapidly - which means there is a case for a limited amount of oil development as argued by the IEA and oil companies.

Yet if the other building blocks are not in place (e.g. energy efficiency, CCS, CO_2 pricing), then oil consumption must be considerably lower to remain coherent with 2ºC.

Sources: SSP database (IIASA), IEA WEO 2017. The light grey scenarios are from the Shared Socioeconomc Pathways to be assessed in the next IPCC Assessment Reports, and the coloured scenarios are from the IEA WEO 2017.

Summing Up

WHEN?	Use a range of climate scenarios to stress-test for transition impacts across all time periods, and physical impacts for longer time periods. For near term physical-impacts, use regional assessments and tools.
WHICH?	Given today's policy ambitions, recognize that 3ºC is the most likely outcome. We should also explore the risks of a transition to below 3ºC (e.g. the Paris target of 2ºC) and the risks of impacts higher than 3ºC (e.g. 4ºC).
WHAT IMPLICATIONS?	Physical risk can impact all sectors and regions, particularly via extreme weather events and flood risk. Impacts can be felt both directly (via infrastructure damage) and indirectly (via supply chain and transportation disruptions). Transition risk affects all sectors, due to the profound changes needed for aggressive climate targets (e.g. 2ºC and to a lesser degree 3ºC. In the short to medium term, industries that supply or use fossil fuels are most likely to be disrupted.
WHAT NEXT?	*Climate Scenarios Demystified* aims to establish a common understanding of climate scenarios. As companies begin to implement the TCFD recommendations for scenario stress-testing, the sample questions presented in this guide can help investors engage with companies and provide some considerations for future reporting requirements. CICERO can facilitate due diligence on company scenarios or portfolios, e.g. by comparing scenario assumptions, identifying any outliers, and considering coherence of the storyline.

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Concept and design by CICERO.

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Climate scenarios demystified

An climate scenario guide for investors

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CICERO is an independent, non-profit interdisciplinary climate research center. We count the IPCC's WGI Vice Chair and 16 former IPCC authors on our staff. CICERO is a leading global provider of green bond environmental assessments. CICERO also works with key institutional investors and companies on climate risk.

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