

## How may climate change mitigation and adaptation impact on production of key commodities, and how may this influence trade?

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Whether society manages to mitigate climate change in line with the Paris Agreement or not, the shipping sector is likely to see significant changes over the coming decades. Over the next fifty years, climate change impacts and the need for both mitigation and adaptation will affect the production output of many commodities, including agricultural products, iron and steel and fossil fuels. This is not to mention other geopolitical and economic factors that will ebb and flow both out with and in response to this changing scene.

Understanding the implications for shipping and trade under different climate change scenarios has been a key focus of the Shipping in Changing Climates (SCC) project. The SCC trade scenarios are framed by cumulative emissions budgets associated with 2°C and 4°C, and articulate visions of world trade that are informed by the Shared Socio-economic Pathways (SSPs) also developed for the IPCC's Fifth Assessment Report (table 1).

			Adaptation challenge	Mitigation challenge
2°C	RCP 2.6	SSP1: Green Road	Low – policy orientated towards sustainability; rapid development; high human capital; reduced inequality	Low – environmental awareness; actual or potential low carbon technology change; effective institutions and international co-operation
		SSP2: Middle of the road	Moderate challenges to adaptation as a result of moderate development trends	Moderate challenges to mitigation as a result of moderate development trends
4°C	RCP 8.5	SSP2: Middle of the road	Moderate challenges to adaptation as a result of moderate development trends	Moderate challenges to mitigation as a result of moderate development trends
		SSP5: Highroad	Low as mitigation challenges dominate	High challenges to mitigation – high energy demand; fossil fuel dominated energy supply; lack of international co-operation

Table 1. Overview of shared Socio-economic Pathways (SSPs) and Representative Concentration Pathways (RCPs) chosen to frame the SCC scenarios

The scenarios are being developed using a mixed method approach, integrating elements of visioning, material flow analysis and econometrics (figure 1). With a focus on key commodities including agricultural products, cement, iron and steel, this

paper demonstrates how alternative framings of climate mitigation, impacts and technological progress can change patterns of production and consumption of these commodities and considers the implication of these changes for international shipping.

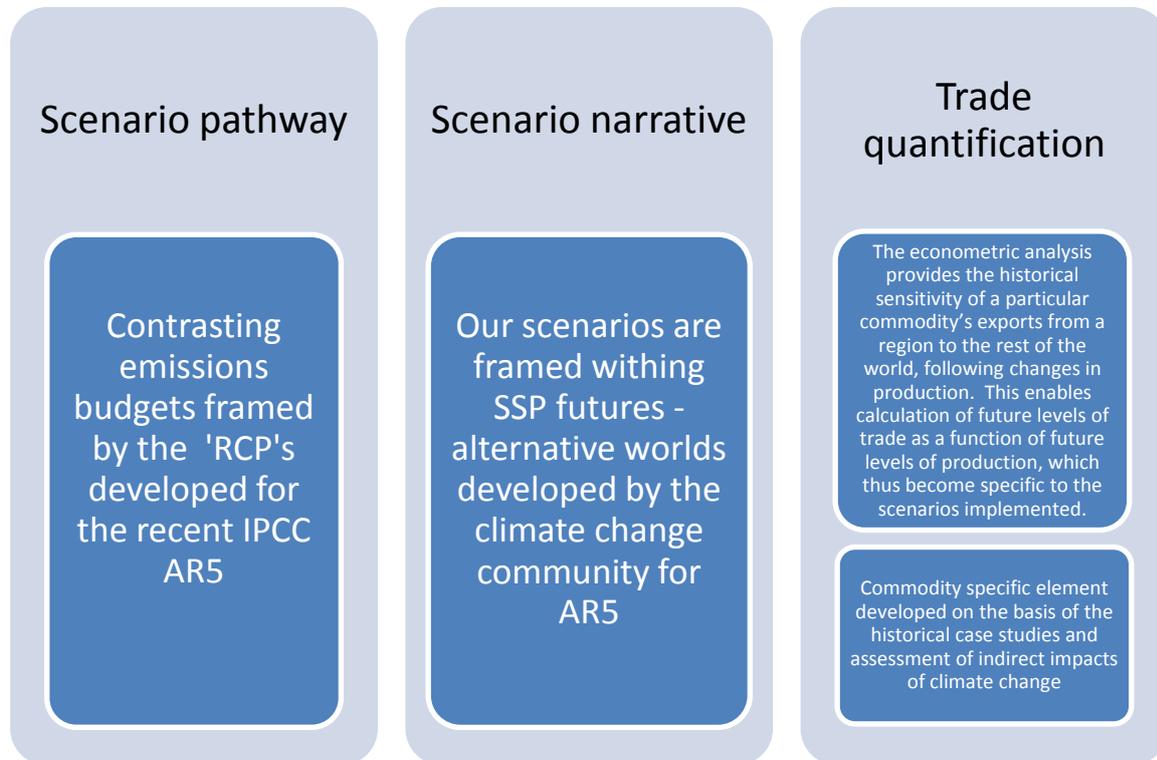


Figure 1. overview of method for the SCC trade scenarios

Reflecting assumptions concerning the nature of the economy, population, the extent of climate mitigation and technological progress, aggregate production for a given group of manufactured and non-manufactured commodities (agriculture, forestry, fisheries, manufactured food, metallic ore, non-metallic ore, paper, wood products, chemicals, non-metallic minerals, plastics and basic metals) is projected to grow by 33-90% by 2050 for a range of 2°C and 4°C scenarios. The lowest overall growth in trade occurs in the 2°C scenarios which explore a stronger sustainability with some efforts towards de-materialisation. Highest growth is experienced in the High Road scenario, a 4°C scenario where there is high adaptation to climate change impacts and a strongly performing economy. The production and trade of energy commodities is informed through use of the energy systems model, TIAM, in which energy futures are bounded by the broad scenario narrative. The results are contingent on assumptions about the availability of CCS, with a growth in bio-energy production and (albeit not to the same extent) trade associated with widespread deployment of CCS.

Although aggregate production levels continue to rise within the scenarios, these demonstrate different patterns of production than in 2010, with trade-offs between commodities. For example under the 2°C Green Road scenario, forestry output is

seen to double by 2050 as wood fuel production increases, while production of wood for non-fuel purposes declines. Within this scenario a technological transition from blast furnace to electric arc production, results in the output of iron ore decreasing significantly.

In terms of regional distribution of production, the scenarios do not envisage a significant change in terms of the important centres of production. Whilst no region grows in the same extent as has recently been observed for China, output in lower income regions including Africa, India and some parts of Latin America are envisioned to grow at a higher rate than in higher income regions such as the US or Western Europe.