

ANNEX – RESULTS OF GEOPOLITICS OF HYDROGEN SURVEYS

To achieve a deeper understanding of the geopolitical consequences of the ongoing energy transition and a large-scale shift to renewable energy, IRENA established the Collaborative Framework on the Geopolitics of Energy Transformation in 2020. Under this Collaborative Framework, the Agency was tasked to analyse the potential geopolitical impacts of emerging developments in hydrogen.

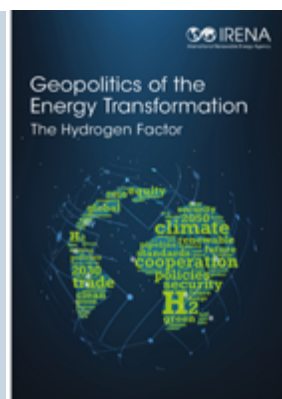
The Collaborative Framework builds on the pioneering work of the Global Commission on the Geopolitics of Energy Transformation and the resulting report "[A New World – The Geopolitics of the Energy Transformation](#)", released in 2019. In addition to drawing on past work, desk research, and IRENA expertise, two surveys were designed to garner feedback from industry experts. For an emerging and rapidly evolving topic that has gathered widespread interest, the surveys provided qualitative views and insight from a large population. Participation in both surveys was voluntary.

The first survey was focused at gathering input from countries to develop a high-level understanding of country plans and associated drivers and barriers of hydrogen's role in the energy transition. The survey was issued to IRENA's Membership, which stood at 164 countries and the European Union at the time.¹ Short, multiple choice questions were posed, with limited text entry to encourage participation. A total of 48 responses from 37 Members were received, a response rate of 22%.²

Building on the Agency's broad reach and network, a second survey was issued to target topical experts (purposive sampling). Questions in this second survey were more extensive to gather technical views and participants were able to provide additional explanation or thoughts. Respondents also had the option to suggest other experts well placed to participate in the survey (snowball sampling). Care was taken to maximise the diversity of respondents in terms of location, sector and background. Under this second survey, 162 experts were approached, and 78 responses received (48% response rate). The survey was completed anonymously. Those participants that provided consent to share their information have been acknowledged by name in the acknowledgement section of the report.

Input received was analysed and aggregated; a sampling of which is provided below. Respondents were not required to answer every question and the format of the questions (multiple answer, comment boxes) means that the values presented may not correspond to the total number of responses received. Unless otherwise indicated, the percentage value shown is calculated from the number of respondents answering the question. Partial responses, where participants did not reach the end of the survey, have not been included.

Survey data provides a baseline for observing sector developments and has informed the analysis summarised in the IRENA report: *Geopolitics of the Energy Transformation: The Hydrogen Factor*.



¹ July 2021

² Multiple responses from the same country were counted as one entry

A - RESULTS OF SURVEY OF COUNTRIES

Figure A.1 Regional breakdown of respondents

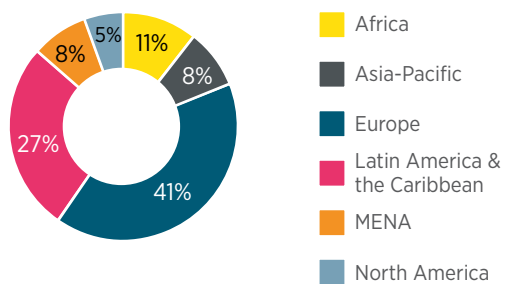
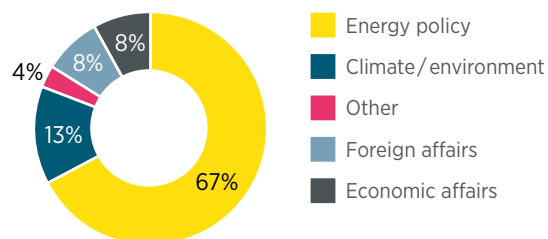


Figure A.2 What ministry or government department do you work for?



Note: Multiple selections permitted

Figure A.3 Does your country currently have a national hydrogen strategy or roadmap?

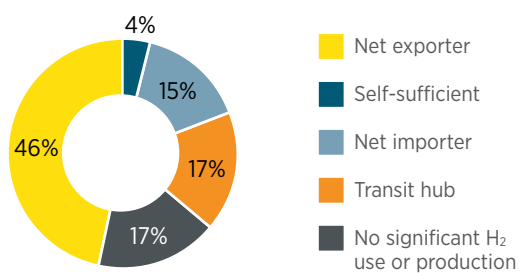


Figure A.4 If hydrogen develops into an internationally traded commodity, which trade position would best characterise your country's status by 2050?

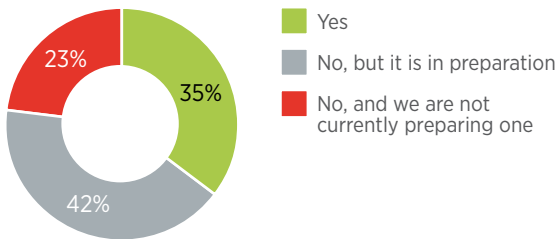


Figure A.5 Has your country already developed relationships with other countries for potential future trade in hydrogen (or derivatives)?

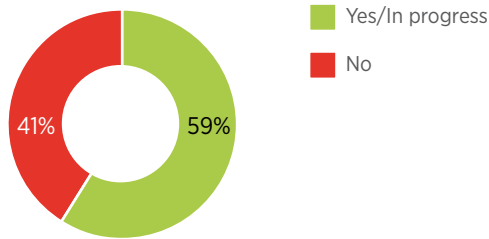


Figure A.6 Does your country prefer a particular hydrogen production route?

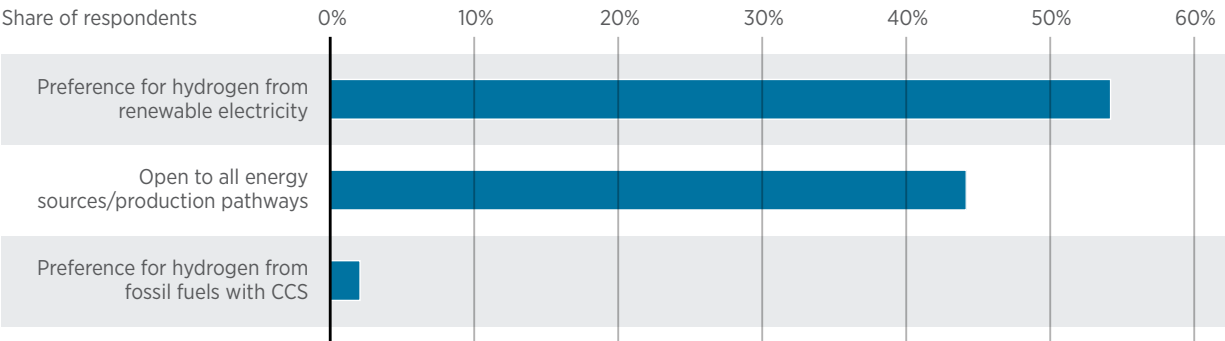
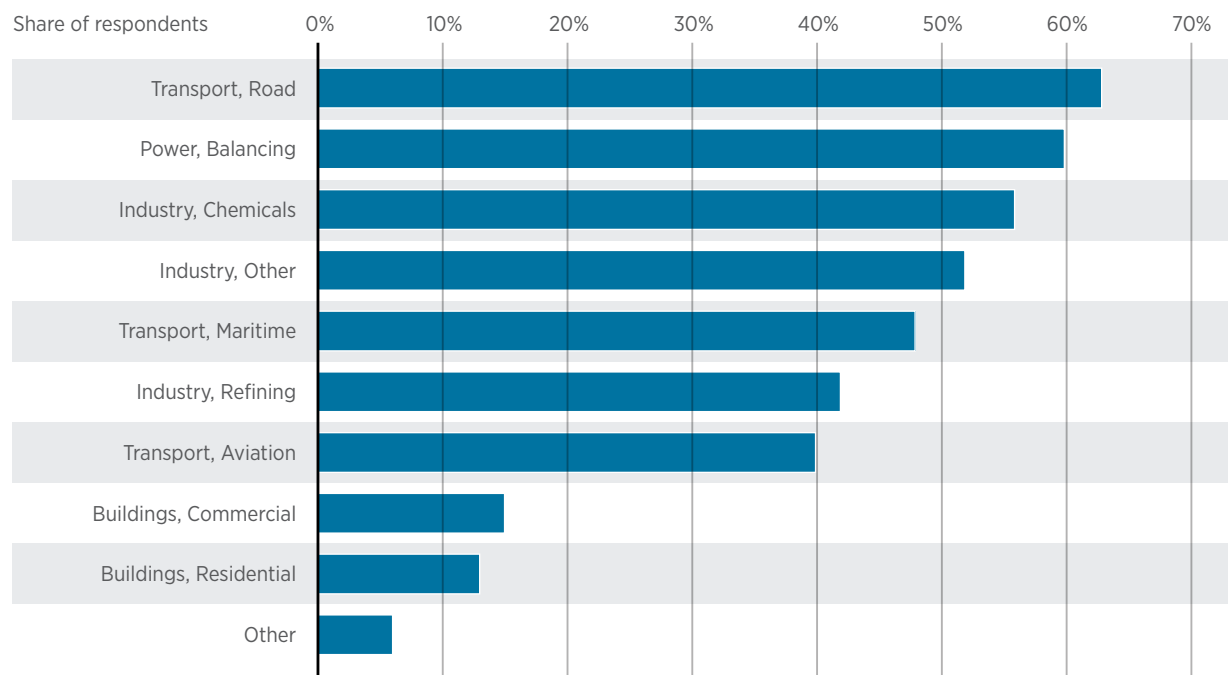
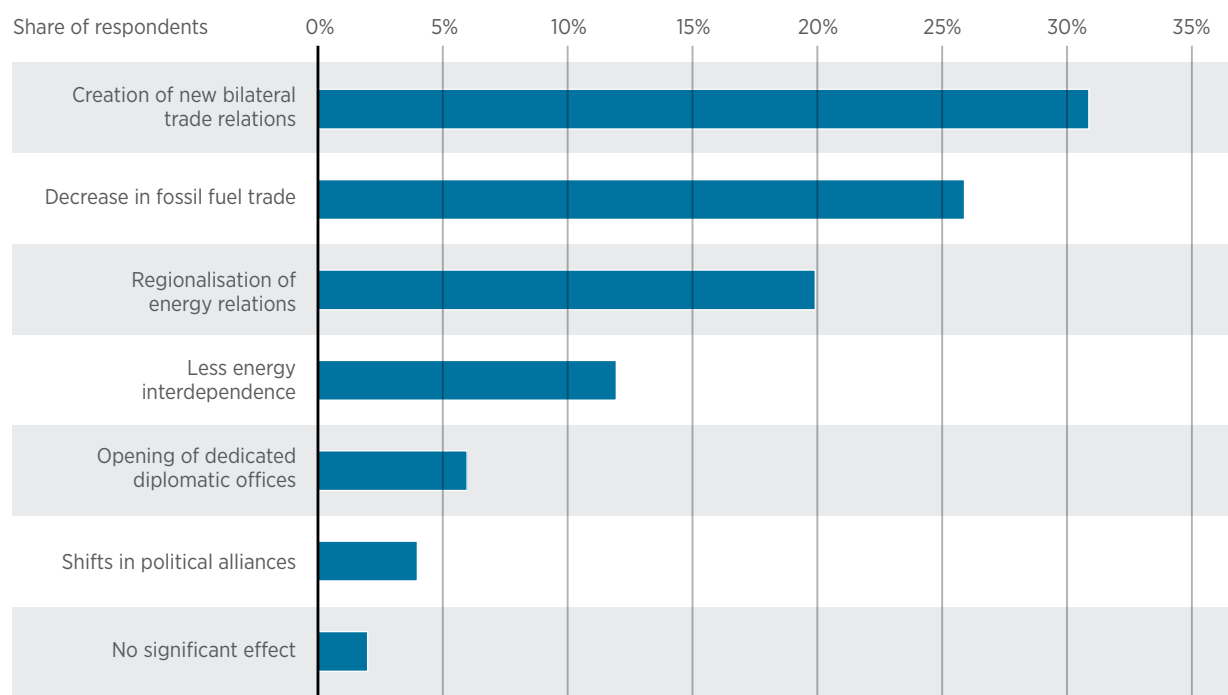
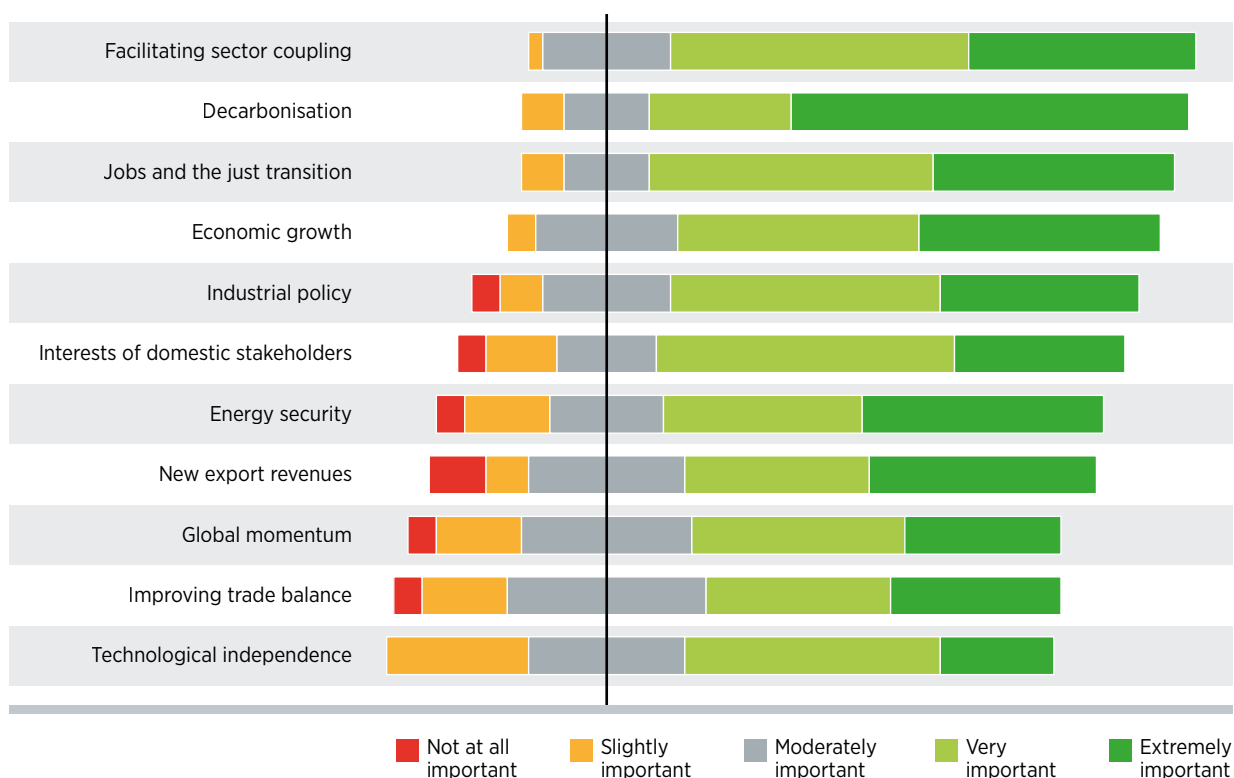
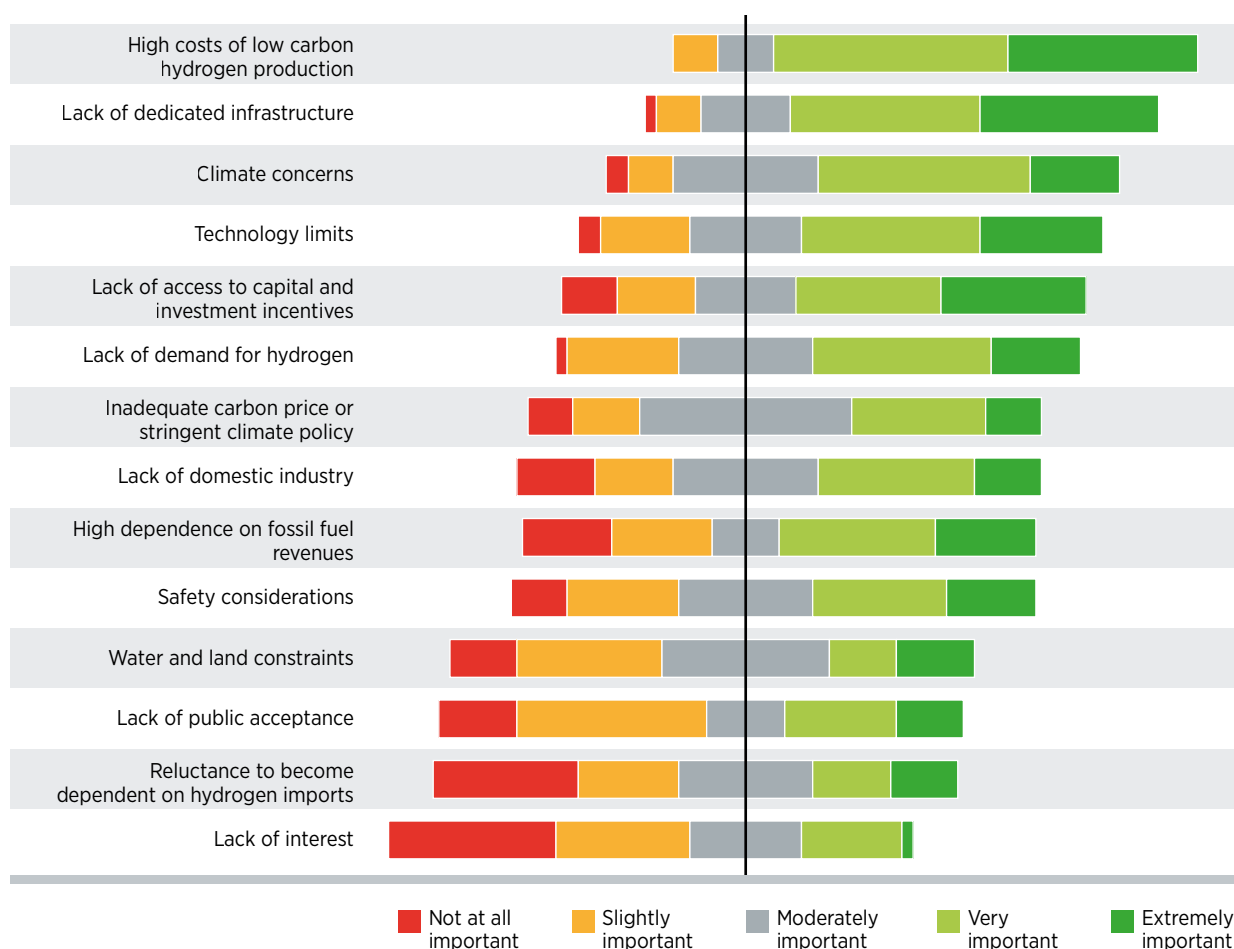


Figure A.7 In which sectors of the economy does your country see hydrogen playing a key role in 2050?

Note: Multiple selections permitted

Figure A.8 What will be the likely effects of hydrogen on your country's foreign policy by 2030?

Note: Multiple selections permitted

Figure A.9 How important are the following drivers for your national hydrogen policies and strategies?**Figure A.10** In your view, how important are the following barriers for your country to develop hydrogen policies and strategies?

B - RESULTS OF SURVEY OF EXPERTS

Figure B.1 In which sector are you currently employed?

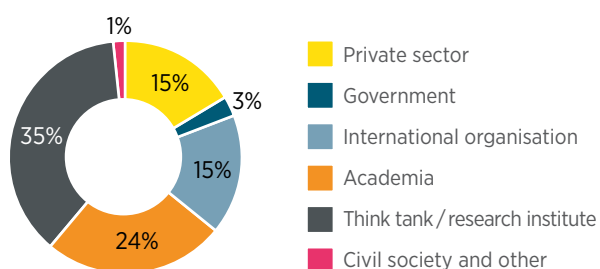
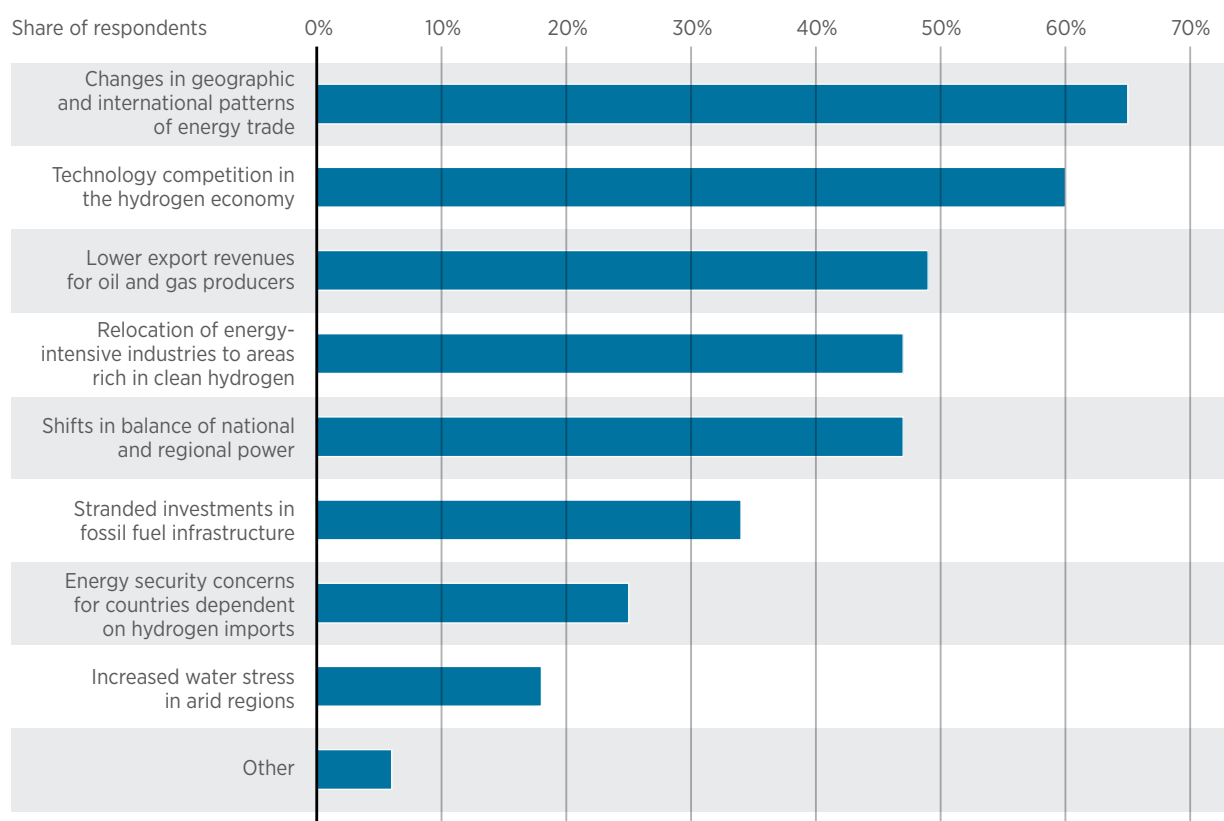
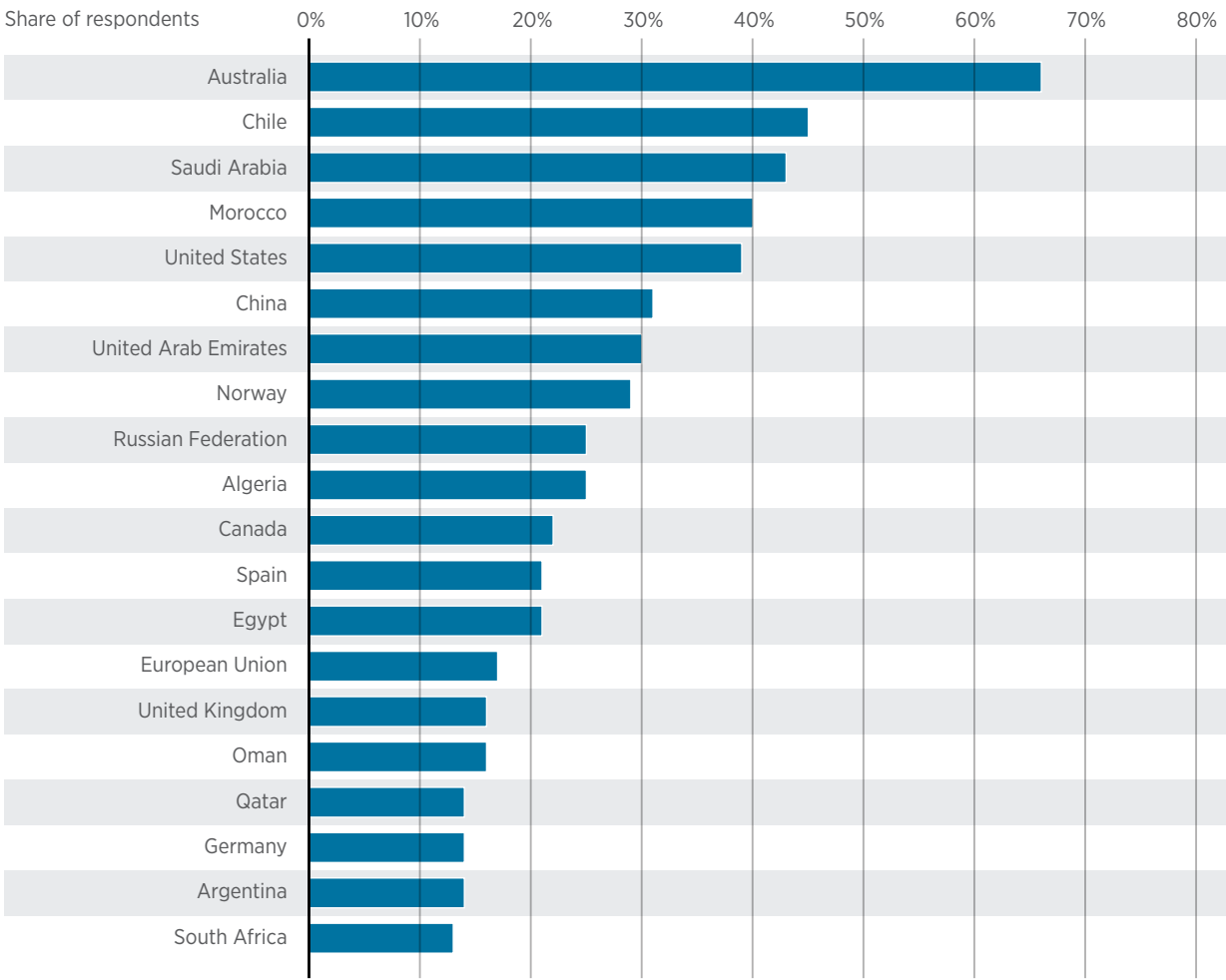


Figure B.2 What are the most likely geopolitical implications of a significant scaling up of hydrogen value chains across the globe by 2050?



Note: Multiple selections permitted

Figure B.3 In your opinion, which countries are best placed to become major producers of hydrogen?



Note: Showing the top 20 countries selected by respondents. Multiple selections permitted

Trade flows and interdependence

Figure B.4i How do you think international trade in hydrogen will develop by 2050 – Markets

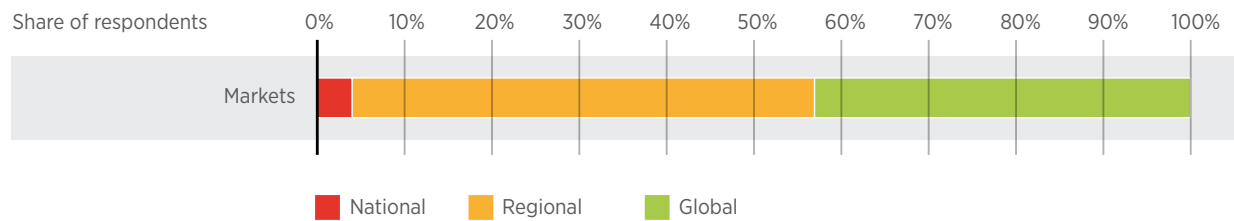


Figure B.4ii How do you think international trade in hydrogen will develop by 2050 – Means of transporting hydrogen across borders

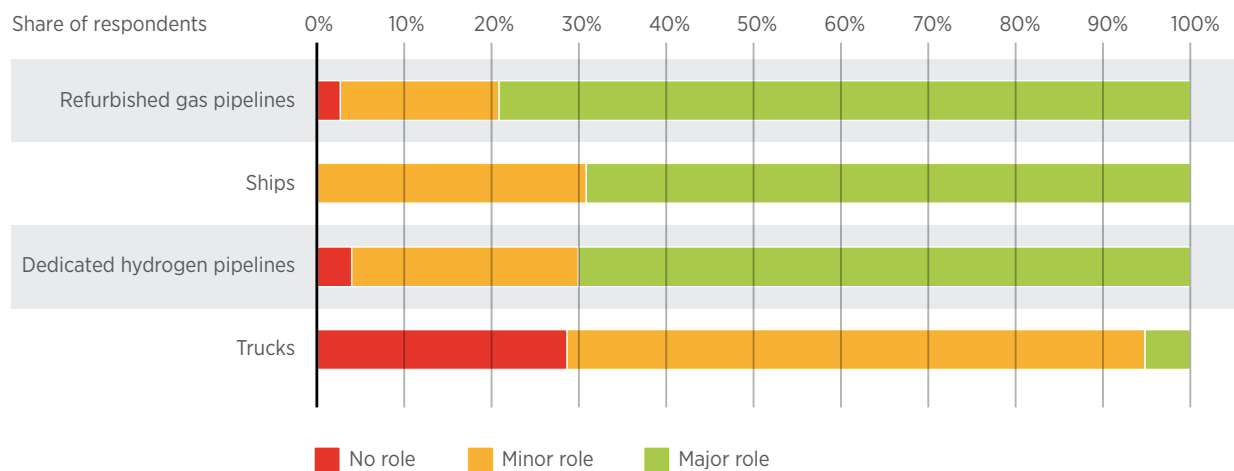
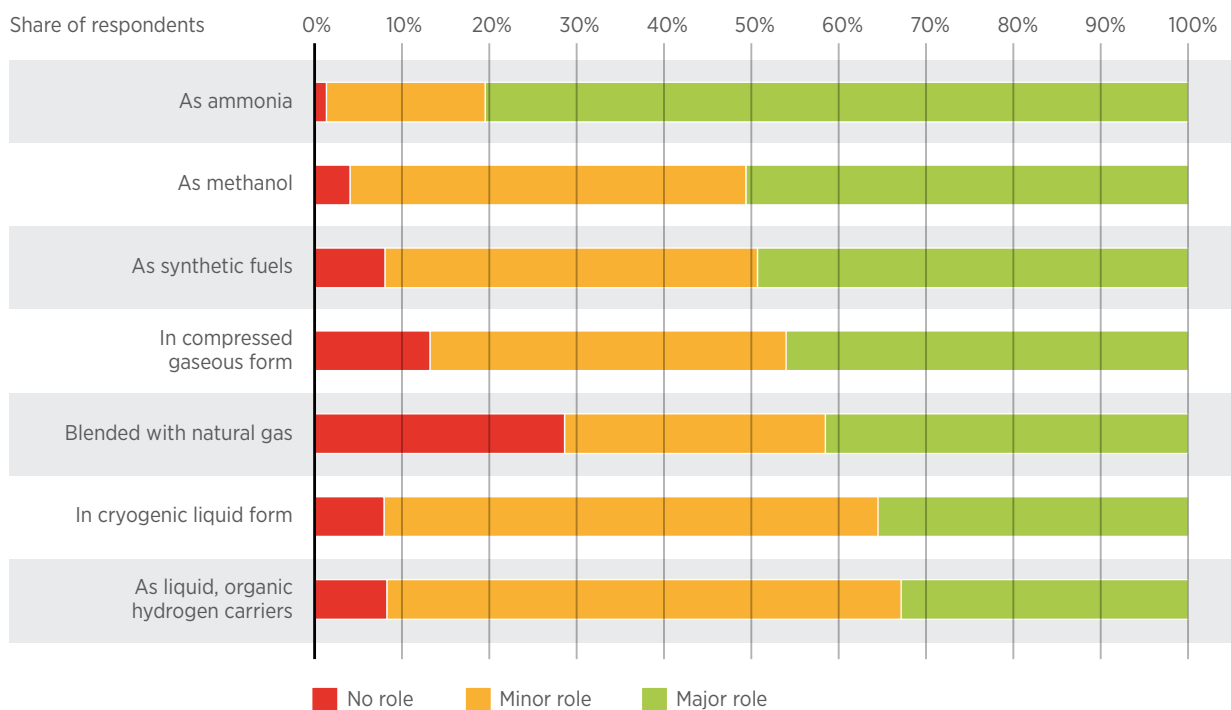
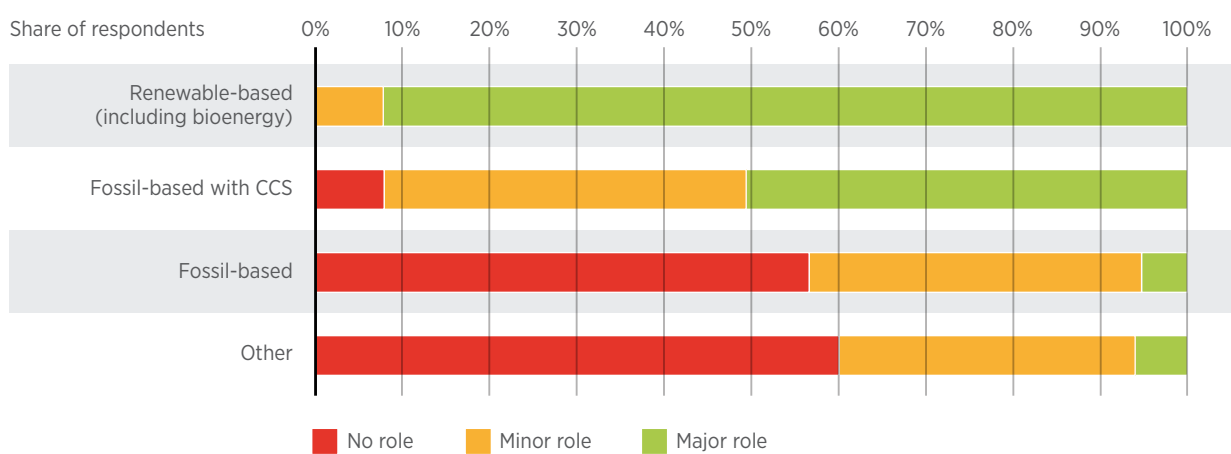


Figure B.4iii Development in international trade – Form of hydrogen trade**Figure B.4iv Development in international trade – Origin of hydrogen traded across borders**

Shifts in countries' positioning

Figure B.5i In your opinion, how important are the following factors in assessing how well countries are positioned to become major producers of hydrogen – Area-specific resource potential

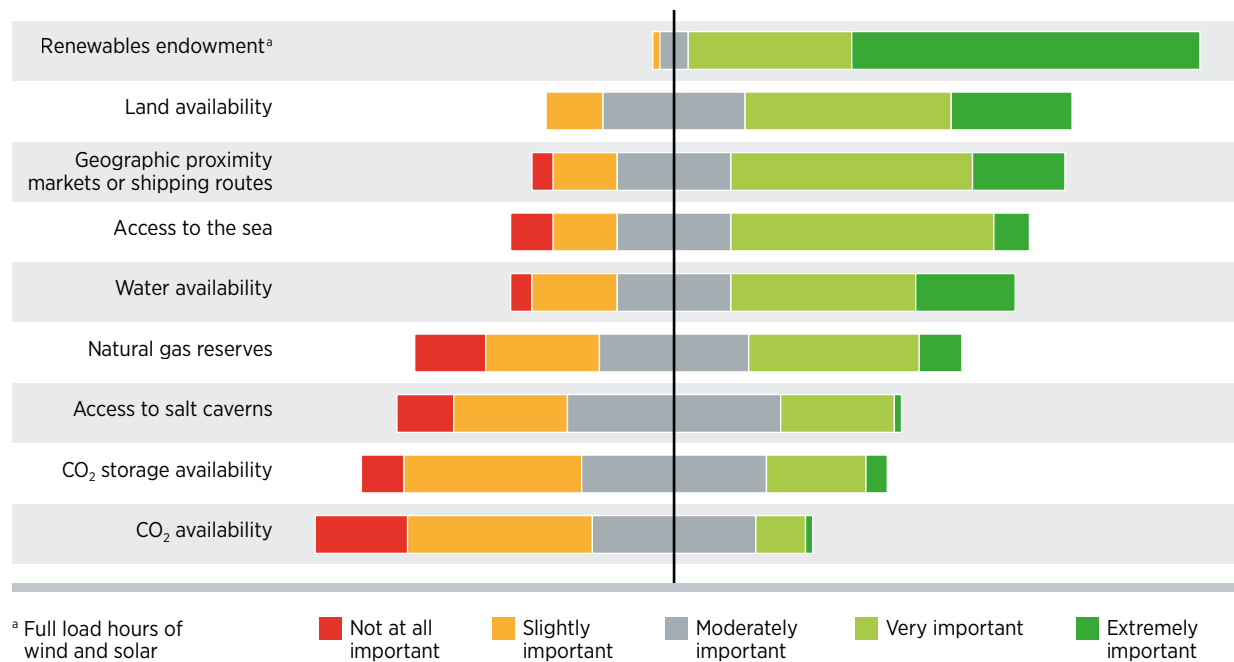


Figure B.5ii In your opinion, how important are the following factors in assessing how well countries are positioned to become major producers of hydrogen – Infrastructure and soft factors

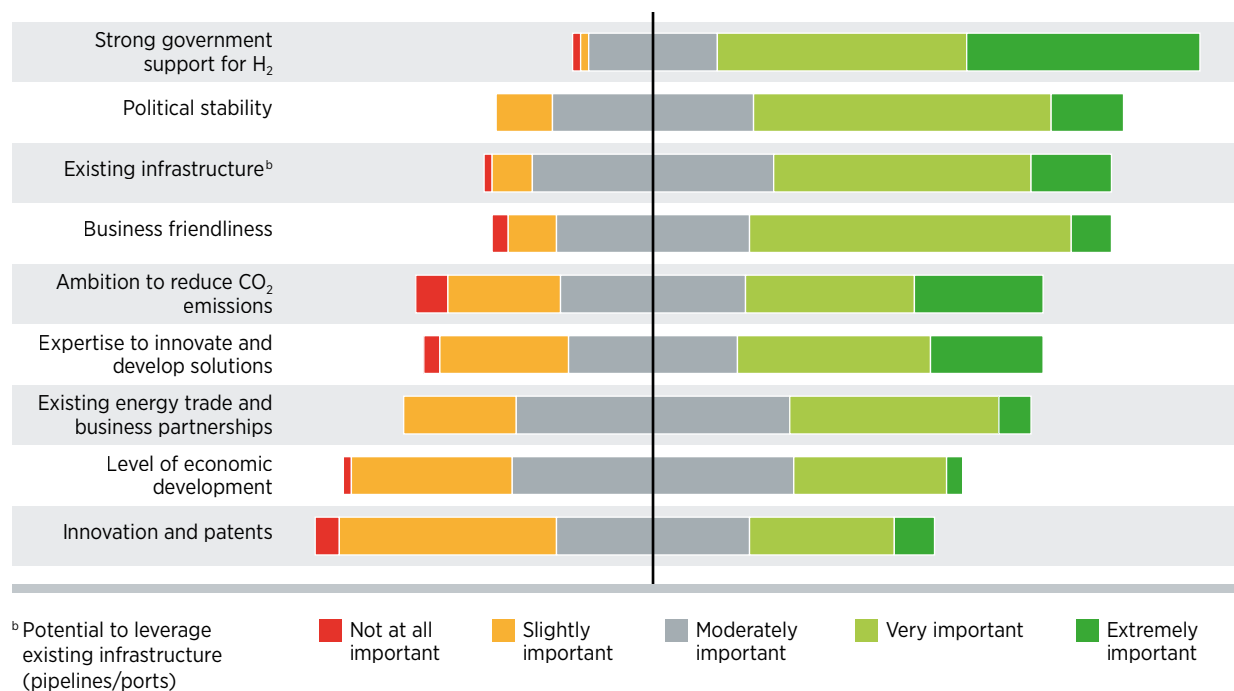


Figure B.5iii In your opinion, how important are the following factors in assessing how well countries are positioned to become major producers of hydrogen – Current energy mix and industry

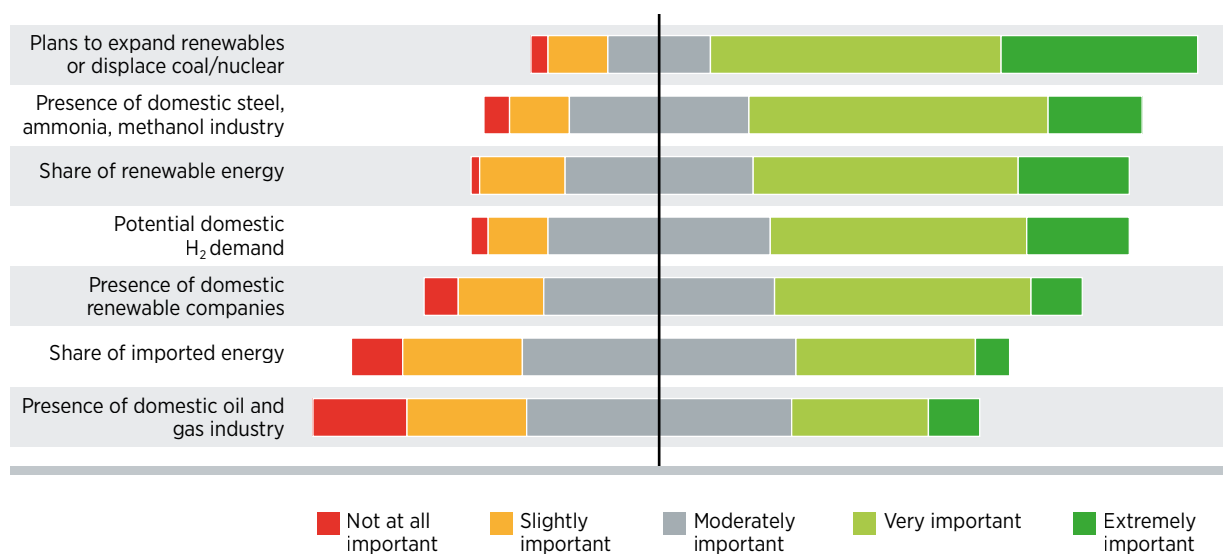
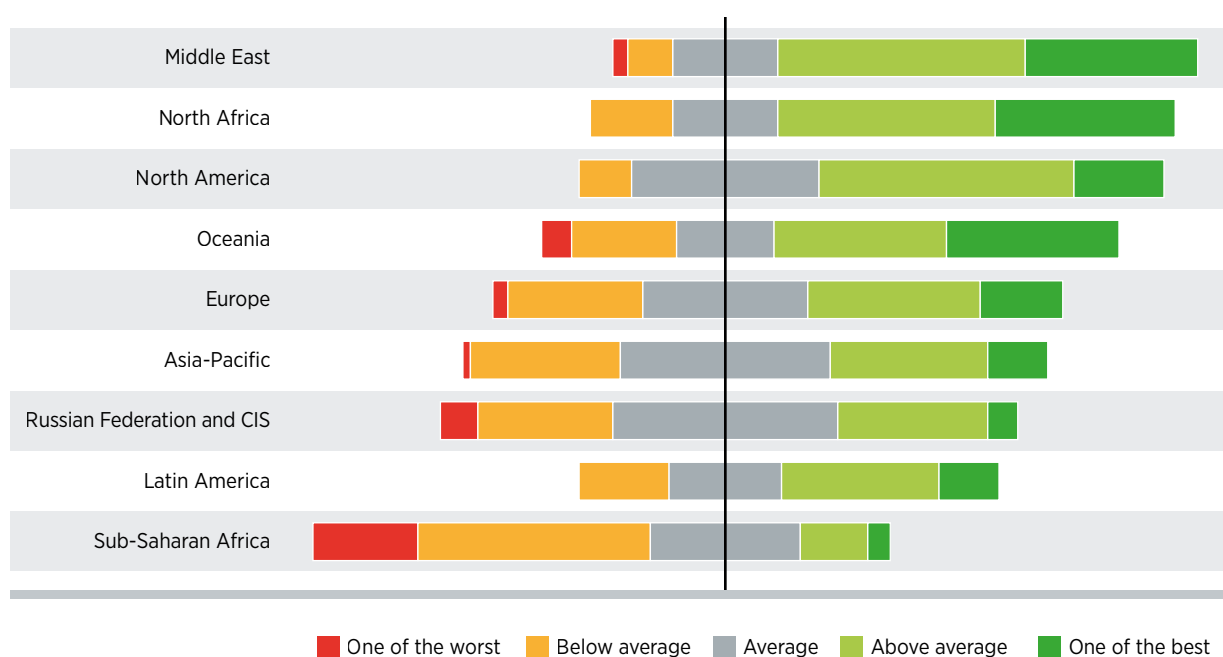


Figure B.6 In your opinion, how well are the following regions placed to become major producers of hydrogen?



Technology leadership

Figure B.7 What does it mean for a country to be a technology leader in hydrogen?

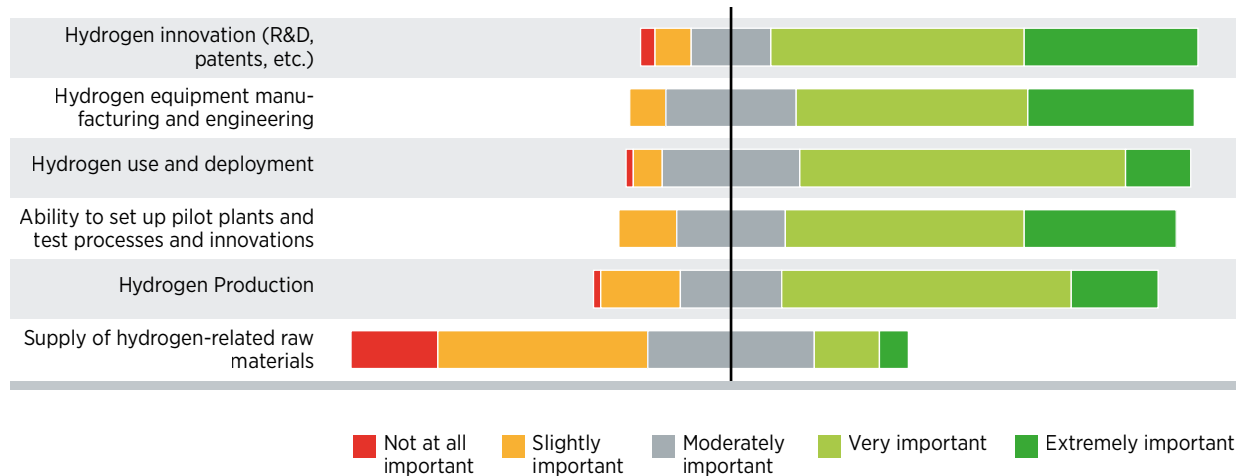
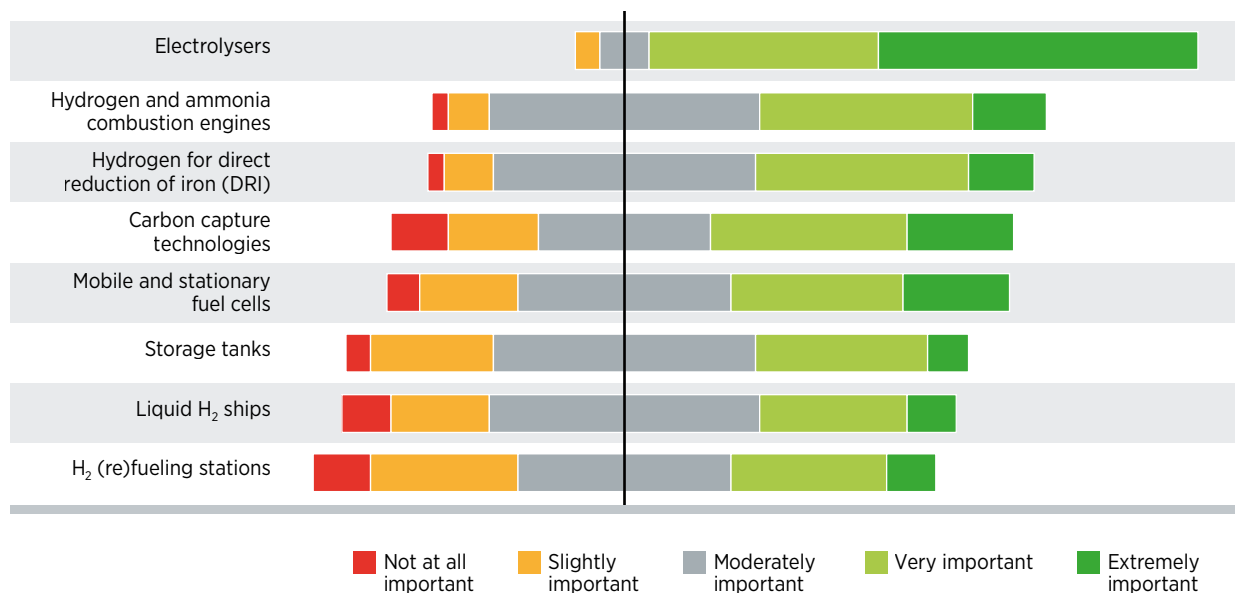


Figure B.8 In which aspects of the value chain should a hydrogen technology leader excel?



Changes in energy security

Figure B.9 How likely will the following risks to hydrogen trade flows have become by 2050?

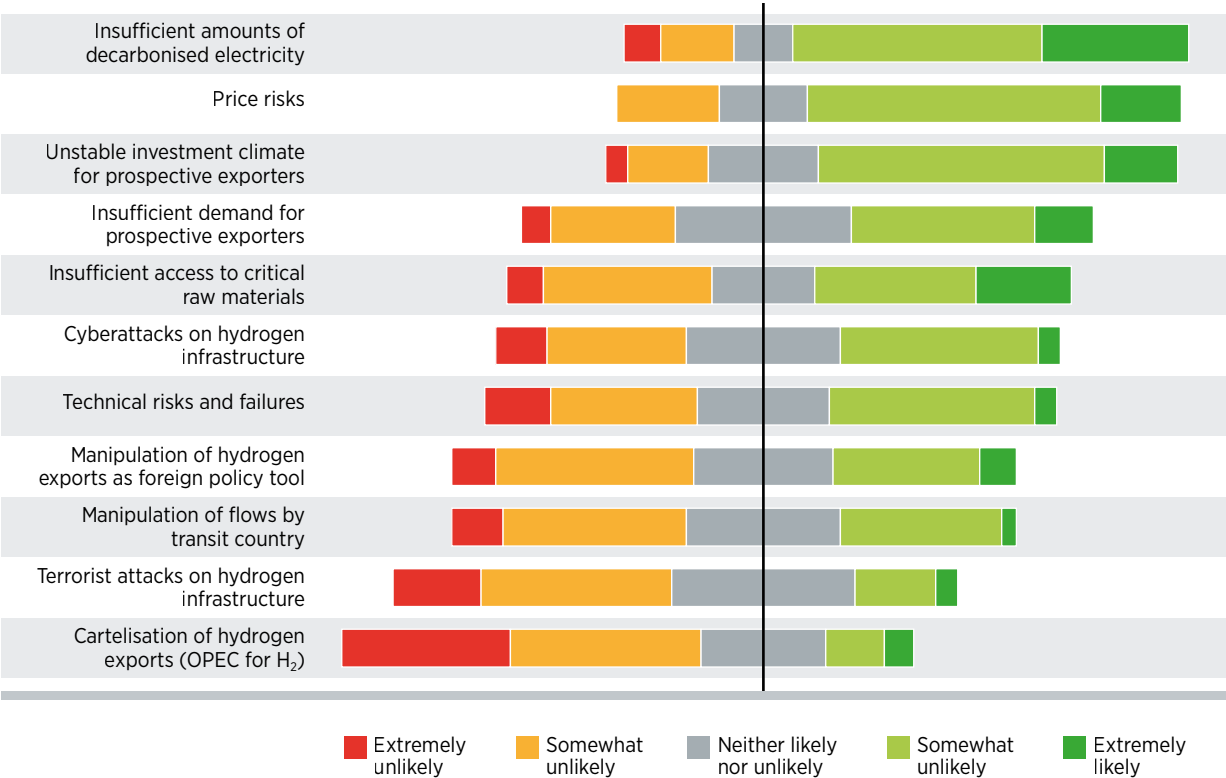
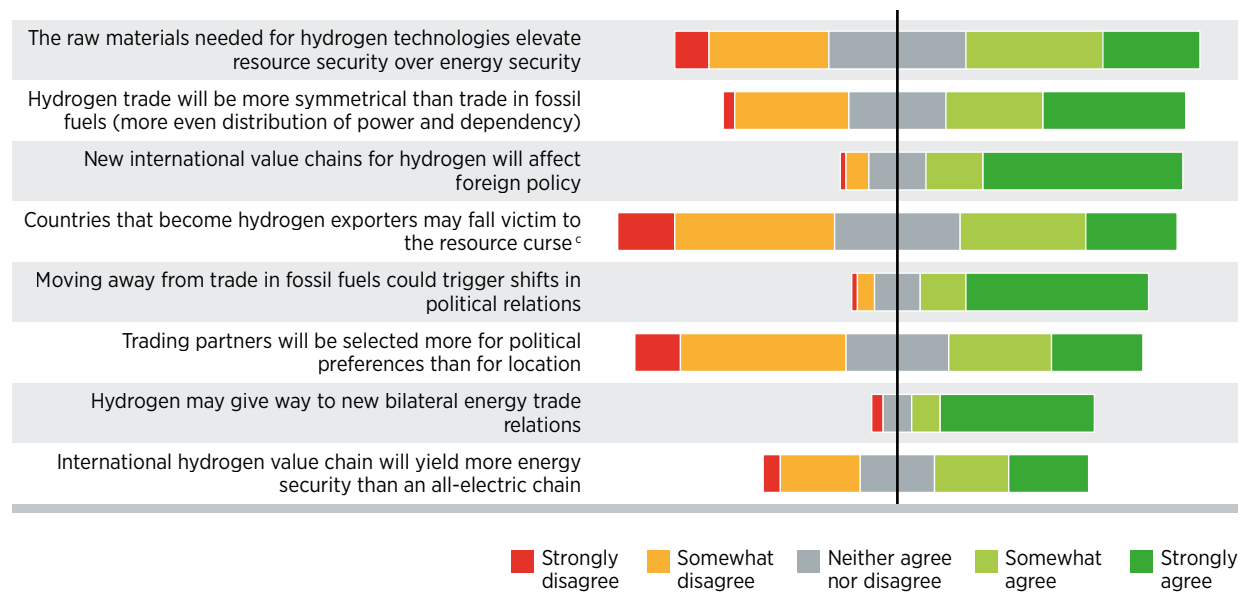


Figure B.10 Regarding energy security, how strongly do you agree with the following statements about the status of hydrogen in 2050?



^c The resource curse, also known as the paradox of plenty, is the phenomenon of countries with an abundance of natural resources having less economic growth, less democracy, or worse development outcomes than countries with fewer natural resources.

Transition pathway for incumbents

Figure B.11i Regarding current oil and gas producers, to what extent do you agree with the following outcomes by 2050 – Strategies and impacts

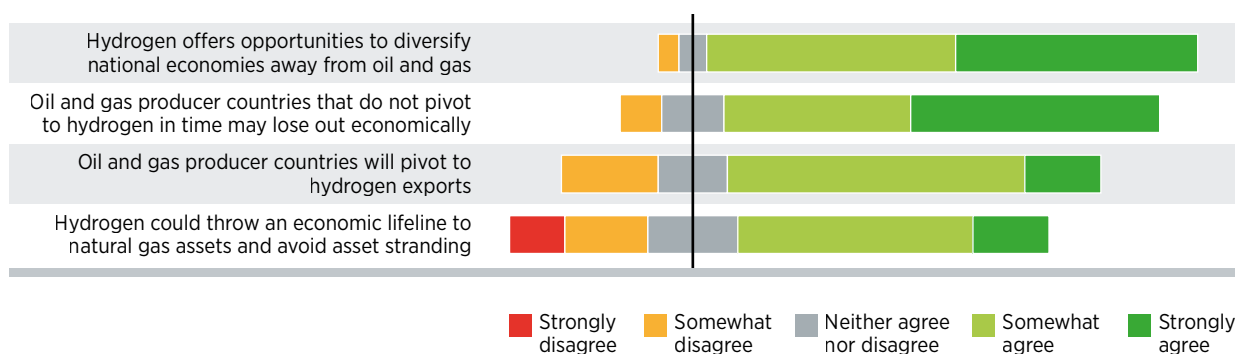


Figure B.11ii Regarding current oil and gas producers, to what extent do you agree with the following outcomes by 2050 – Revenues and market structure

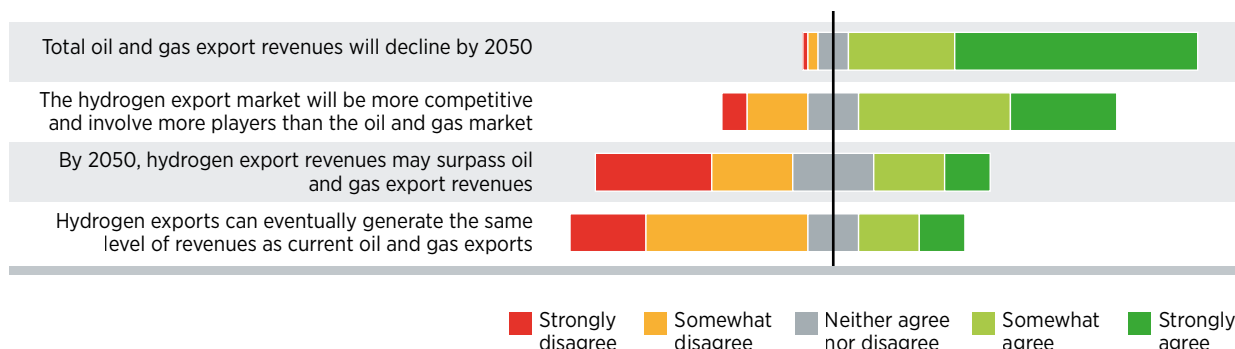
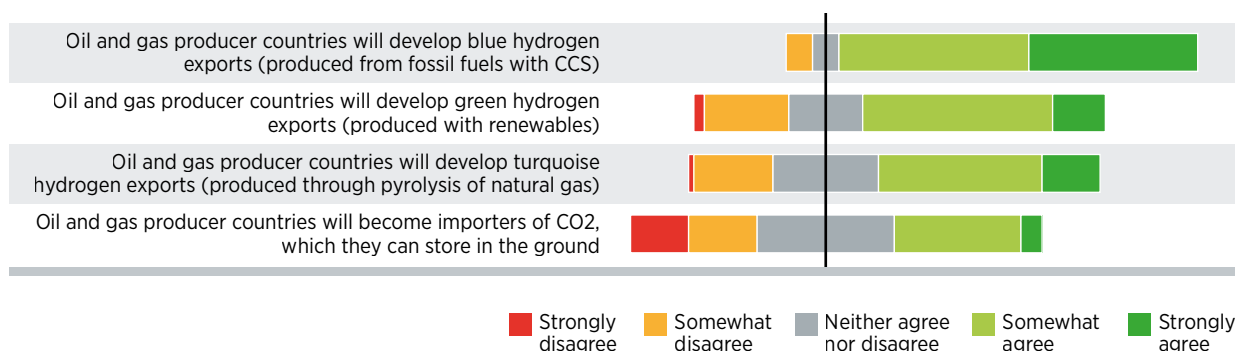
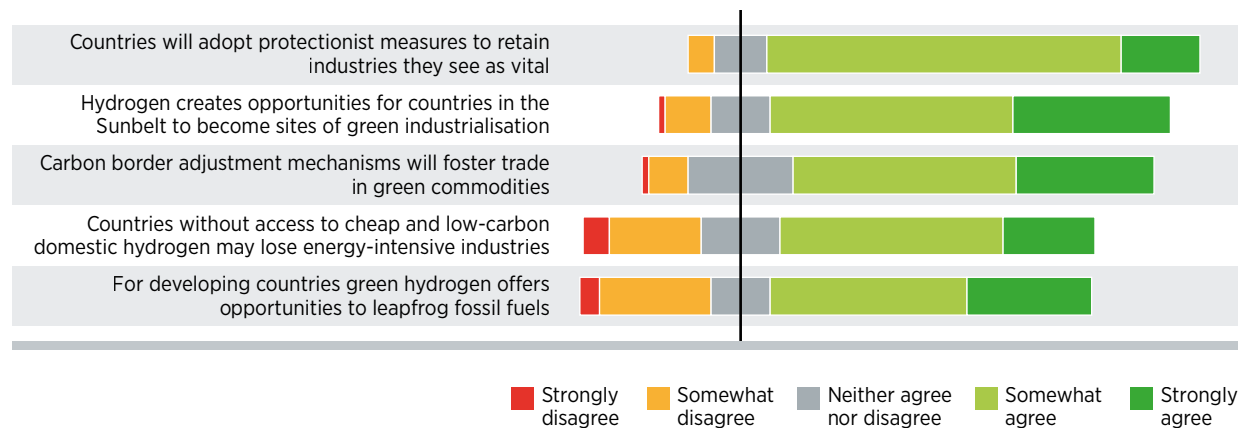


Figure B.11iii Regarding current oil and gas producers, to what extent do you agree with the following outcomes by 2050 – Production pathways



Green industrial development

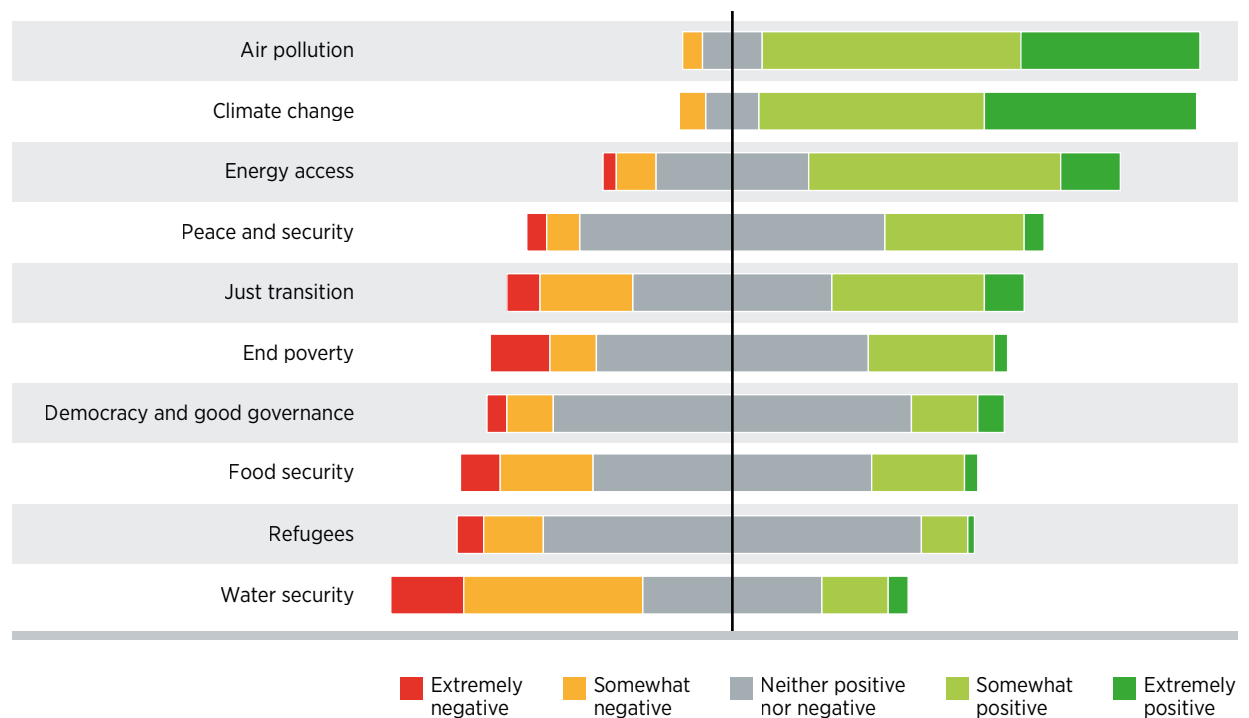
Figure B.12 Regarding industrial development, to what extent do you agree with the following outcomes by 2050?



Note: Countries in the Sunbelt are those within 40 degrees of the equator that have the highest level of solar radiation

Sustainable development

Figure B.13 Regarding sustainable development, how will hydrogen affect the following goals by 2050?



Effects on human and climate security

Figure B.14 Regarding international governance, how strongly do you agree with the following statements?

