Artificial intelligence drives divergent emission futures
Supplementary Information

Supplementary Methods 1 – Expert Elicitation

Supplementary Table 1 | Experts involved throughout the expert elicitation process and their involvement at different stages in the project

Number	Profession/Organisation Type	Involvement	
Expert 1	Academic & NGO researcher	All stages	
Expert 2	Academic researcher	All stages	
Expert 3	Research organisation employee/academic	All stages	
Expert 4	Researcher in tech sector	All stages	
Expert 5	Academic researcher	All stages	
Expert 6	Researcher in tech sector	All stages	
Expert 7	NGO researcher	All stages	
Expert 8	Tech expert in private sector	Workshops, surveys	
Expert 9	Academic researcher	All stages	
Expert 10	Researcher at international organisation	All stages	
Expert 11	Academic researcher	All stages	
Expert 12	Academic researcher	Workshops, surveys	
Expert 13	Research organisation employee/academic	Interview	
Expert 14	Tech expert in private sector	Interview	
Expert 15	Academic researcher	Interview	
Expert 16	Academic researcher/consultant	Interview	
Expert 17	Researcher in private sector	Interview*	

*Conducted following initial interview stage, insights informed scenario framework.

Interview Questions

The interviews were semi-structured, following a set structure based around three main questions. However, each interview varied and contained a range of participant-specific follow-up questions. These questions were to obtain clarifications or further detail on specific factors being discussed.

Supplementary Table 2 | Main questions asked in the interview stage

Number	Question	Purpose
1	Please outline the keys ways in which you think AI may impact climate change mitigation	To understand their perspective on the range of different ways in which AI might impact climate.
2	Please now go further regarding the timeframe for different impacts, and what you think their relative importance will be.	To understand where participants place most importance, and to understand the timeframes, whether relevant for our process.
3	Please now describe your vision for both the extreme best and worst case for AI and climate in the year 2050.	Used as a bounding exercise for different impacts and their magnitudes. Used for scenario framework, narrative scenarios

Supplementary Table 3 | High, medium and low values for model inputs, with narrative scenario annotations. Scenarios and relevant symbols: AI Race ○, AI Flop ●, Climate-misaligned AI ■, Climate-aligned AI ★.

Variable	Units	20th (low)	50.0th (medium)	80th (high)
Electricity Consumption from AI 2030	% of 2024 total electricity	1.7 • ★	4.5	7.5 ○ ■
Electricity Consumption from AI 2040	% of 2024 total electricity	3.2 • ★	10.4	26.9 ○ ■
Fossil fuel efficiency extraction change 2040	%	+5.2 •★	+11.0 ■	+55.3 ○
Passenger transport cost change 2040	%	-7.1 • ■	-27.1	-52.1 ○★
Carbon capture and storage price change 2040	%	0 • ■	-12.6	-38.1 ○★
Cost change for renewables 2040	%	-1.7 • ■	-16.3	-40.2 ○★
Cost change for nuclear 2040	%	-0.65 • ■	-7	-18.5 ○★
Material goods demand change in 2040	%	-16.1	+27.5	+86.5
Passenger transport demand change in 2040*	%	-16.3 ★	+21.8	+80.7 ○ ■
Grid electricity efficiency change 2040	%	+3.2	+23.9	+60.6

**AI flop assumes no change in transport demand due to low AI effects*

Supplementary Table 4 | Electricity Supply Proportions for narrative scenarios.

Scenario	Cost Optimal Grid	Direct Supply Fossil	Direct Supply Renewables	Direct Supply Nuclear
AI Race	55%	10%	25%	10%
AI Flop	100%			
Climate Misaligned AI	55%	45%		
Climate-aligned AI			100%	

Supplementary Table 5 | R15 Regions used in TIAM Model and their respective countries

Region	Countries
Africa (AFR)	Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Swaziland, Togo, Tunisia, Uganda, United Republic of Tanzania, Zambia, Zimbabwe
Australia (AUS)	Australia, New Zealand

Canada (CAN)	Canada
Central and South America (CSA)	Anguilla, Antigua and Barbuda, Argentina, Aruba, Bahamas, Barbados, Belize, Bermuda, Bolivia, Brazil, Cayman Islands, Chile, Colombia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Salvador, Falkland Islands, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Martinique, Netherlands Antilles, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela (Bolivarian Republic of)
China (CHI)	China, Taiwan, Tibet
Eastern Europe (EEU)	Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Hungary, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia, The former Yugoslav Republic of Macedonia
Former Soviet Union (FSU)	Armenia, Azerbaijan, Belarus, Estonia, Georgia, Kazakhstan, Kyrgyzstan, Latvia, Lithuania, Republic of Moldova, Russian Federation, Tajikistan, Turkmenistan, Ukraine, Uzbekistan
India (IND)	India
Japan (JAP)	Japan
Middle-east (MEA)	Bahrain, Brunei Darussalam, Cyprus, Iran (Islamic Republic of), Israel, Jordan, Kuwait, Lebanon, Occupied Palestinian Territory, Oman, Qatar, Saudi Arabia, Syrian Arab Republic, Turkey, United Arab Emirates, Yemen
Mexico (MEX)	Mexico
Other Developing Asia (ODA)	Afghanistan, American Samoa, Bangladesh, Bhutan, Cambodia, Democratic People's Republic of Korea, Fiji, French Polynesia, Indonesia, Kiribati, Lao People's Democratic Republic, Malaysia, Maldives, Mauritius, Mongolia, Myanmar, Nepal, New Caledonia, Pakistan, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Islands, Sri Lanka, Thailand, Timor-Leste, Tonga, Vanuatu, Vietnam
South Korea (SKO)	Republic of Korea
USA (USA)	United States of America
Western Europe (WEU)	Albania, Andorra, Austria, Belgium, Denmark, Faroe Islands, Finland, France, Germany, Gibraltar, Greece, Greenland, Iceland, Ireland, Italy, Luxembourg, Malta, Monaco, Netherlands, Norway, Portugal, San Marino, Spain, Sweden, Switzerland, Vatican, United Kingdom

Supplementary Results

We perform some simple calculations to estimate the resulting IT compute power that our expert elicited AI energy demand numbers would equate to, assuming different power usage effectiveness (PUE) numbers. The PUE value represents the total facility energy divided by the IT equipment electricity and indicates how much energy is required for additional facility needs such as cooling. A PUE of 1 would represent all energy being used for IT equipment[1].

We calculate PUEs of 1.1., 1.3 and 1.6, as illustrative best in-class, reasonable efficient and lower efficiency scenarios, respectively (Supplementary Table 6). For median 2030 electricity estimates, the IT power (compute load) ranges from 144.7GW to 99.5GW, depending on the PUE estimates. For 2040, the median values range from 335-230 GW. Here it important to note that these values would represent compute load *only* for AI applications, given our experts were asked about AI energy demands.

Supplementary Table 6 | Equivalent IT Power at different power usage effectiveness values for our expert elicited electricity demand estimates.

Year	Estimate	Total AI electricity Demand TWh/year	Avg. facility power (GW)	IT Power PUE 1.1 (GW)	IT Power PUE 1.3 (GW)	IT Power PUE 1.6 (GW)
2030	Lower (20th)	530	60.5	55.0	46.5	37.8
2030	median	1395	159.2	144.7	122.4	99.5
2030	Upper (80th)	2309	263.7	239.7	202.8	164.8
2040	Lower (20th)	995	113.6	103.3	87.4	71.0
2040	Median	3224	368.0	334.6	283.1	230.0
2040	Upper (80th)	8311.1	948.3	862.1	729.5	592.7

References

1. Avelar, V., Azevedo, D. & French, A. PUE: A COMPREHENSIVE EXAMINATION OF THE METRIC EDITORS. https://datacenters.lbl.gov/sites/default/files/WP49-PUE%20A%20Comprehensive%20Examination%20of%20the%20Metric_v6.pdf (2012).