

GREAT DECISIONS

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2/Global Trade and Green Energy

Acronyms and abbreviations

CCS: Carbon Capture and Sequestration

EIA: Energy Information Administration

EV: Electric vehicle

IEA: International Energy Agency

GW: Gigawatt

OPEC: Organization of Petroleum Exporting Countries

PV: Photovoltaic

SRM: Solar Radiation Modification

Earth's climate processes to mitigate global warming by reflecting solar radiation back into space (solar radiation modification) or removing carbon dioxide from the atmosphere (carbon capture and sequestration)

Green energy: Energy produced from natural, renewable sources that do not pollute or cause harm to the environment

International Energy Agency (IEA): A forum of 29 industrialized nations that provides data and policy recommendations and facilitates international cooperation to help the world transition to clean energy

Net zero: A target that will be reached when the amount of greenhouse gases produced by human activity is balanced by the amount removed from the atmosphere; achieved through reductions in carbon emissions and removal of emissions from the atmosphere

Rare earth metals: 17 metallic elements with unusual properties; necessary to produce many high-tech products

Renewable energy (“renewables”): Natural sources of energy that are constantly replenished, such as wind, sunlight, and the movement of water

Semiconductor: A material that can conduct electricity; a key component of electronic devices

Glossary

Bauxite: A rock containing high amounts of aluminum that is mined to produce aluminum; larger deposits are found in tropical regions

Climate crisis: The threat of global warming and climate change

Fossil fuels: Non-renewable energy resources such as coal, gas, and oil that cause harmful greenhouse gas emissions when burned

Geoengineering: Large-scale manipulation of the

Please see the following pages for some additional readings and notes on the topic from the author.

Periodical articles and books

Falling Long-Term Growth Prospects: Trends, Expectations, and Policies, *The World Bank, April 2023. The World Bank offers what it says is “the first comprehensive assessment of long-term potential output growth rates in the aftermath of the COVID-19 pandemic and the Russian invasion of Ukraine.” The report characterizes these rates as the global economy’s “speed limit,” which would have significant implications for international commerce on renewable energy and other subjects.

The Bank report says “nearly all the economic forces that empowered progress and prosperity over the last three decades are fading.” It anticipates that between now and 2030 average global GDP growth likely will shrink by approximately one-third from the 2.2% annual growth rate during the first decade of the current century, even in the absence of a worldwide financial crisis or a recession.

“A lost decade could be in the making for the global economy,” said Indermit Gill, the World Bank’s Chief Economist and Senior Vice President for Development Economics. He pointed to serious implications for the world’s ability to tackle the expanding array of challenges unique to our times—stubborn poverty, diverging incomes, and climate change.” But he said such a decline “is reversible” if “the global economy’s speed limit can be raised—through policies that incentivize work, increase productivity, and accelerate investment.” Reporting on the new World Bank report in The New York Times’ Climate Forward newsletter on March 31, Manuela Andreoni, of the newspaper’s Brazil bureau, wrote** that “Economists are worried that one factor slowing things down, now relatively small, may weigh more heavily in the future.

“You guessed it: climate change.”

Andreoni then wrote of what she called “a vicious cycle”: “Global warming is expected to affect economic growth, and how a slump could hinder efforts to fight warming.”

*https://www.worldbank.org/en/news/press-release/2023/03/27/global-economy-s-speed-limit-set-to-fall-to-three-decade-low?intcid=ecr_hp_sidekick3_en_exT

** https://www.nytimes.com/2023/03/31/climate/economic-growth-climate-change.html?unlocked_article_code=Q4qJKC8KCLEK8tK5G-Gy24O9Q58_X06VRvSgqBPeaTBgYCznp7kvG-z9QR5nzQpxbvwwu80ixH0oVOyjWbBqEzI-hc40mnX2proaH-jhy4ImN39FJYm0eulpXJI6b4M-PS2yn6W9KvmG4YnDOLkwEjQIOAt9DL-d74Umz-V0E3lLkbCJ0y3-a2mDoF1BAGW_XjT7_MRN-3M9PUfGdFa7sB8S6h-4jk2-Mp9H5RIIm0yuvD-QKDORCB3ym64r_pqVMzw3WBiy85qgHRFK-W7x6GOK-11NNqaeuBJUiJtF1PVNi-zMsqZZS-G0CpaqMhe9jFzETCvie6D7kmhz6IT0eU-jPv-htSZ1Ux2j1_ozIk&smid=url-share

Chip War by Chris Miller. *New York Times* reporter and podcast host Ezra Klein in April 2023 interviewed historian and book author Chris Miller at length* about the importance of computer semiconductor chips in a wide range of critical applications involving, among other things, energy use and consumption.

“We think of chips as being in smartphones or being in P.C.s, but today, they’re in almost any device with an on/off switch,” Miller said. “So a new car will have a thousand chips inside of it, your refrigerator, your microwave, your dishwasher. All of our devices are full of chips that do computing and do sensing, increasingly do communication. And so the modern economy just can’t function without lots and lots of chips.”

Later in the podcast, Miller points to a particularly concerning aspect of advanced chips manufacturing and production:

“Today, TSMC [in Taiwan] produces, as you said, 90 percent of the most advanced processors, the types of processors that go into smartphones, P.C.s, data centers. The other 10 percent are produced by Samsung of South Korea. And Intel [U.S.-based] right now is a generation or two behind what either of those firms are capable of producing.” This point is especially poignant in the context of the current and ongoing concerns over a potential takeover of Taiwan by an aggressive China over the next half-decade or so: U.S. intelligence finds that the Chinese Communist Party, led by Chinese President Xi Jinping, has indicated an intent to invade Taiwan at some point over the next five years, a wrenching example of the importance of geopolitics in consideration of international trade issues.

In a *Forbes* magazine review** of *Chip War*, Roslyn

Layton, the magazine's Senior Correspondent on international tech policy, wrote:

“What’s clear is that the semiconductor sector has always been seen ebbs and flows of competition, even when certain industry-leading countries or companies seem too entrenched for any upstarts to dare put a dent in their business. In our time, chip competition substantially means China’s frontal assault on American and South Korean producers, with China working harder than ever to seize the commanding heights of chip production.”

Layton quotes Miller as saying: “If only China wanted a bigger part in this ecosystem, its ambitions could have been accommodated. However, Beijing wasn’t looking for a better position in a system dominated by America and its friends.... It was about remaking the world’s semiconductor industry, not integrating with it.”

*<https://www.nytimes.com/2023/04/04/podcasts/transcript-ezra-klein-interviews-chris-miller.html>

** <https://www.forbes.com/sites/roslynlayton/2022/11/04/review-of-chip-war-the-fight-for-the-worlds-most-critical-technology/?sh=5c2ac60f1059>

Barry Eichengreen, Distinguished Professor of Economics and Political Science at the University of California, Berkeley, wrote in a Foreign Affairs magazine review *** that the Miller book “characterizes the U.S.-Chinese rivalry, with Beijing seeking to build up design and manufacturing capabilities and Washington hoping to slow China’s progress.”

*** <https://www.foreignaffairs.com/authors/barry-eichengreen>

While, as of April 14, 2023, I have not finished reading the full Chip War book, no comprehensive consideration of international commerce involving emerging “green” technologies can be complete without consideration of the role of semiconductor chips.

The Right Way to Fix the Energy Crisis,* *The Economist*, June 25-July 1, 2022, “How to fix the world’s energy emergency without wrecking the climate,” the magazine’s popular “Leaders” feature** headlines in this “Power struggle” commentary column. “One priority is finding a way to ramp up fossil-fuel projects, especially relatively clean natural gas, that have an artificially truncated lifespan of 15-20 years so as to align them with the goal of dramatically cutting emissions by 2050.... This does not mean easing up on the drive

towards renewables – the most successful part, to date, of the world’s generally poor response to the climate crisis.”

“Politicians need to tell voters that their desire for an energy transition that eschews both fossil fuels and nuclear power is a dangerous illusion.”

*Cover story, *The Economist*, June 25-July 1, 2022

***The Economist*, June 25-July 1, 2022, “Leader” column, “Power struggle,” page 11

“How to Survive a Superpower Split”, *The Economist*, April 11, 2023. “How crafty countries that don’t want to pick sides,” on the war in Ukraine and other foreign policy issues, address the U.S., China, and Russia.

<https://www.economist.com/international/2023/04/11/how-to-survive-a-superpower-split>

“Buy an electric vehicle now or wait? Here’s how to decide.” *Washington Post* Climate Advice columnist Michael Coren points to pros and cons of a contemporary auto-purchase issue. His column raises the prospect of Chinese-based automakers seeking to enter the U.S. domestic market much as Japanese automakers (Toyota, Honda, Nissan, etc.) did several decades ago. Coren’s “bottom line”: Best for many would-be purchasers to consider leasing and postpone for now purchasing a new EV. <https://www.washingtonpost.com/climate-environment/2023/04/11/electric-vehicle-buying-guide/>

Representative web sites used in research

www.ipcc.ch The Intergovernmental Panel on Climate Change, a project of the United Nation Environment Program and the World Meteorological Organization, for decades has been widely acknowledged as the world’s most authoritative voice on climate change science. Its studies are the work of a who’s who of the world’s leading climatologists, and their work products reflect a comprehensive aggregation of recent years’ peer-reviewed journal reports and research.

Given its virtually sole emphasis on the fundamental earth sciences, the IPCC report itself is unlikely to have a highly visible presence in this Great Decisions climate competition report. But that science itself will serve as the basis for many of the global actions taken by some 200 nations of the world: Any scientific inferences will

comport with the most recent findings of the IPCC, as reflected on its extensive web site, and any serious trade policy initiatives being undertaken will be measured for their efficacy in terms of how they measure up to the IPCC climate science.

www.Rff.org/geo -- Resources for the Future's annual Global Energy Outlook. This yearly report aggregates key relevant data from several highly respected national and international sources to provide sector-by-sector and energy source-by-energy data (wind, solar, nuclear, etc.) and projections into coming decades. March 28 Zoom webinar featured panelists reacting to overview presentations by key RFF authors Daniel Raimi and Yugi Zhu, including insights on geopolitical aspects by Megan O'Sullivan of Harvard and CSIS researcher Jane Nakano.

A particularly helpful aspect of this site is an interactive data base that provides visitors "a unique 'apples-to-apples' comparison of energy projections by top institutions around the world." The two principal RFF report authors – Raimi and Zhu, in a three-way telephone conversation with me after their Zoom presentation of the report, have been especially cooperative in helping me better understand both their report overall and the optimum use of this data tool.

<https://www.brookings.edu> "Climate change creates financial risks. Investors need to know what those are." March 29, 2022. A "Planet Policy" commentary for the Brookings Institution by scholars Michael Panfil and David G. Victor. They address U.S. SEC initiatives to require more disclosure of financial risks facing public traded companies as a result of climate change. "The consequences of climate change are creating new and growing forms of financial risk that investors need to consider when choosing how to prudently allocate capital," they write. They point to mounting severe weather-caused financial losses affecting homes and personal property, public infrastructure, and critical ecosystems. <https://www.brookings.edu/blog/planetpolicy/2022/03/29/climate-change-creates-financial-risks-investors-need-to-know-what-those-are/>

www.iea.gov The International Energy Agency's deep and comprehensive web site reflects the global credibility of this organization and helps explain why it is among the most-cited expert sources on global energy issues.

The site provides data visualizations and other interactive resources on a wide range of energy sources and applications for 31 different member countries. Those IEA member countries are the following:

- Australia
- Austria
- Belgium
- Canada
- Czech Republic
- Denmark
- Estonia
- Finland
- France
- Germany
- Greece
- Hungary
- Ireland
- Italy
- Japan
- Korea
- Lithuania
- Luxembourg
- Mexico
- New Zealand
- Norway
- Poland
- Portugal
- Slovak Republic
- Spain
- Sweden
- Switzerland
- The Netherlands
- Turkey
- United Kingdom
- United States

In addition, IEA "association countries" reflected in the data base are:

- Argentina
- Brazil
- China
- Egypt
- India
- Indonesia
- Morocco
- Singapore
- South Africa
- Thailand
- Ukraine

The fuels and technologies for which IEA provides timely data are:

Fuels

- Coal
- Electricity
- Gas
- Nuclear
- Oil
- Renewables

Technologies

- Aluminum
- Appliances & equipment
- Aviation
- Bioenergy
- Building envelopes
- Carbon capture, utilization and storage
- Cement
- Chemicals
- Cooling
- Data centers & networks
- Demand response
- Electric vehicles
- Energy storage
- Fuel economy
- Heat pumps
- Heating
- Hydrogen
- Hydropower
- International shipping
- Iron & steel
- Lighting
- Methane abatement
- Other renewables
- Pulp & paper
- Rail
- Smart grids
- Solar
- Trucks & buses
- Wind

If there were only one primary and authoritative source of data on energy, it likely would be the IEA. But there actually are numerous such sources, generally reaffirming the most credible data available.

www.oecd.org The Organization for Economic Cooperation and Development, OECD, is a consortium of 38 countries, including the U.S. Founded in 1961

to stimulate economic progress and world trade. The OECD Wikipedia entry explains OECD “is a forum whose member countries describe themselves as committed to democracy and the market economy, providing a platform to compare policy experiences, seek answers to common problems.” Its website provides a wealth of country-by-country data and policy analyses on its priority issues, including environment, climate change, competition, and “green growth and sustainability.” It provides in-depth policy options and considerations relative to the subject of this Great Decisions paper.

www.wbcsd.org The Switzerland-based World Business Council for Sustainable Development casts itself as “the premier global, CEO-led community of over 200 of the world’s leading sustainable businesses working collectively to accelerate the system transformations needed for a net zero, nature positive, and more equitable future.” It specifies “three major challenges” that it says confront the global community: “the climate emergency, nature loss and mounting inequality.”

It urges a “beyond business-as-usual approach” and says that “Only collaboration at unprecedented levels will create the impact and speed needed to achieve all people living well within planetary boundaries by 2050.”

Key elements of the organization’s activities address climate and energy, food and nature, and the circular economy, which it describes as involving “decoupling resource consumption and economic performance, through information sharing, new business models, supporting policies, science-based targets and value chain collaboration.” It points to the landmark 2015 Paris Climate Agreement as “a decisive and global signal that the start of the transition to a thriving, clean economy is inevitable, irreversible and irresistible.”

While not specifically mentioning international trade in this context, it says that its member companies’ activities illustrate how “business is moving beyond talk to implement real solutions by bringing different sectors and stakeholders together to scale up solutions globally.” It says that its companion energy initiatives emphasize work on low-carbon energy solutions “through cross-sectoral collaboration in renewables and in electrification of heating, cooling and transport.”

The WBCSD roster of member companies includes numerous “Fortune 500” internationally recognized household-name corporations.

<https://iccwbo.org/> The International Chamber of Commerce, founded in 1919 after the end of World War I, represents some 45 million companies and national and local chambers of commerce, across more than 170 different countries.

Emphasizing what it says is its “neutrality and independence,” the Paris-based organization points to its support for multilateralism as “the best way to address global challenges.” Its website contains numerous posts and articles and reports dealing specifically with climate change, environment, and sustainability, and also with policies addressing competition. It sees “an increasing recognition amongst the business community that climate change presents an existential crisis (and a growing commitment to the United Nations Sustainable Development Goals (UN SDGs)). Many businesses and entrepreneurs want to be part of the solution to this crisis.”

“The Geopolitical Implications of the Energy Transition.” Meghan O’Sullivan of Harvard University Spoke in December 2021, just prior to an international meeting of the IPCC Conference of the Parties COP, to the Institute of International & European Affairs in Paris. Along with a related piece with the same title that she co-authored with Columbia University’s Jason Bordoff, their analysis amounts to a veritable master’s class in renewable energy geopolitics.

One could easily exhaust a conventional yellow marker highlighter pen (but fortunately not a digital one) in flagging the numerous key points these scholars make in this in-depth analysis. It for sure will be among the “recommended readings” included in this paper.

The brief IIEE blog post describing O’Sullivan’s presentation is at

<https://www.iaea.com/blog/the-geopolitical-implications-of-the-energy-transition>

The even more valuable full text of the Bordoff-O’Sullivan Foreign Affairs magazine article is at <https://www.foreignaffairs.com/articles/world/2021-11-30/geopolitics-energy-green-upheaval>