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Energy at Hopkins

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RENEWABLE ENERGY AND EQUITY WORLDWIDE

Science and Policy Innovation for the Just Energy Transition

Daniel Kammen

Bloomberg Distinguished Professor of Energy and Climate Justice
Department of Civil and Systems Engineering (CASE)
Paul Nitze School of Advanced International Studies (SAIS)
The Ralph O'Connor Sustainable Energy Institute (ROSEI)
Johns Hopkins University

Former Science Envoy, United States Department of State
US National Academy of Science | American Academy of Arts & Sciences

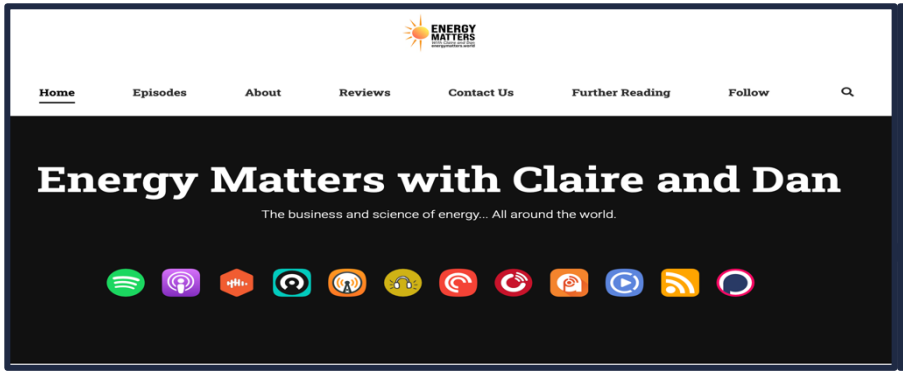
Tohoku U, Sendai, Japan - February 18, 2026

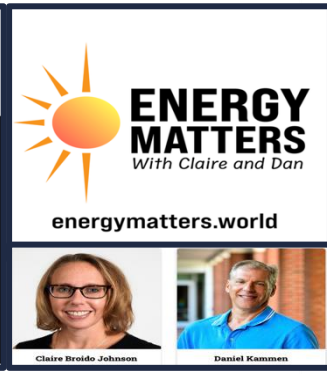
Avenues to interact:

1. The Ralph O'Connor Sustainable Energy Institute http://energyinstitute.jhu.edu
   Bluesky: @dankammen.bsky.social
   Twitter: @dan_kammen

2. *Energy Matters* podcast

   http://energymatters.world





3. The Renewable Energy & Equity Worldwide Lab: https://kammen.wse.jhu.edu

Overview:

The landscape of sustainable and reliable clean energy

Leveraging clean energy for Justice on a fragile, hot, and crowded planet

- Energy markets in the US west
- Energy Systems models in Japan, China & Africa
- Energy for the UN SDG goals in Africa

An to a Just Energy collaboration in Africa

My personal experience at:
RAEL (@UC Berkeley), now RENEW (@JHU) is an an innovation engine

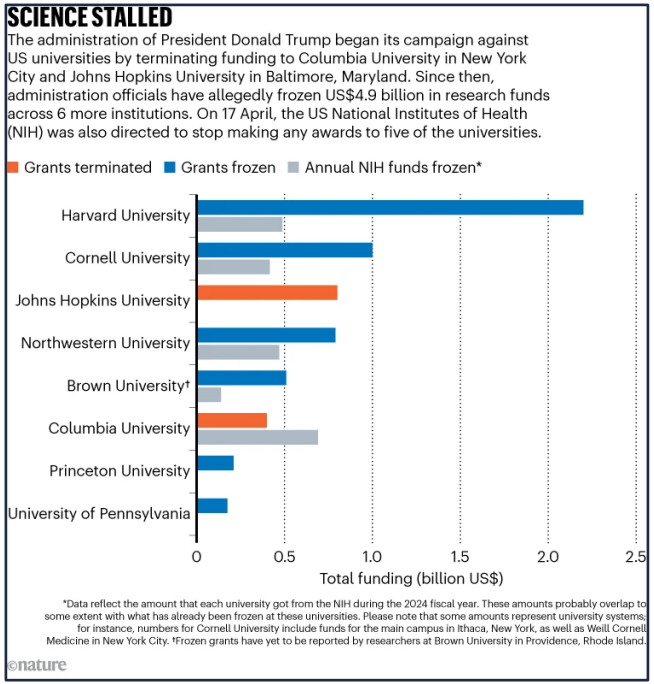
Businesses

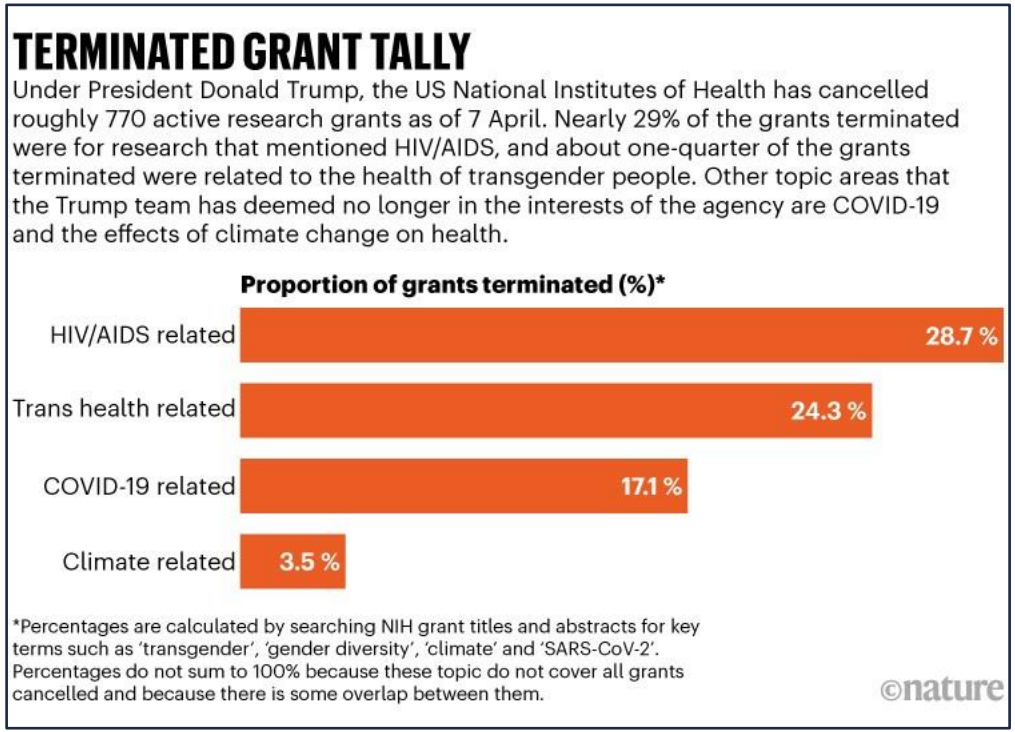
Community Groups

Institutions

The sad turn away from sanity and civility:

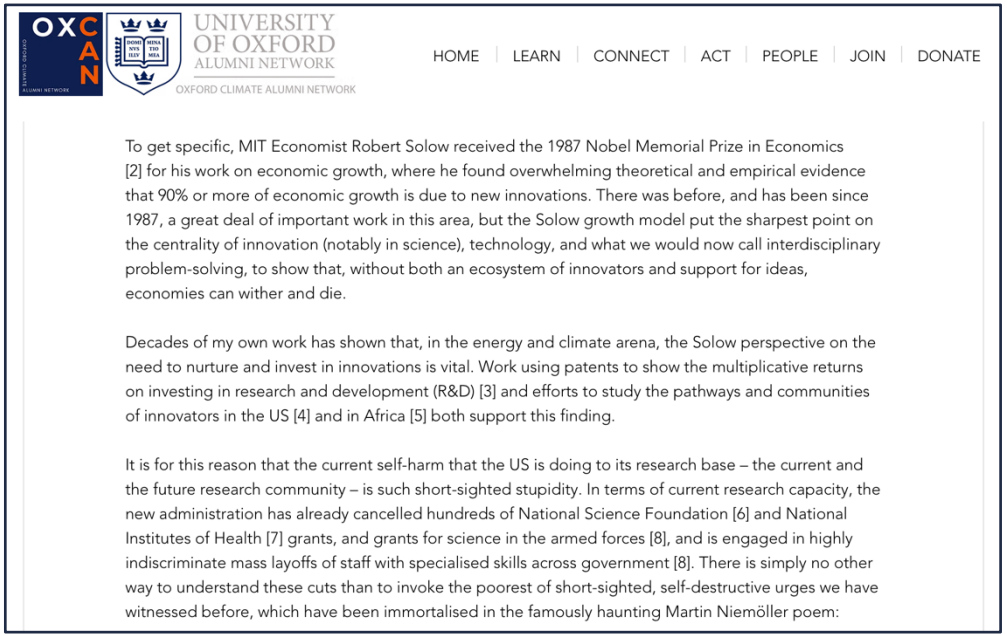
"Like going on a diet by removing brain tissue"





https://www.nature.com/articles/d41586-025-01289-4

The global damage that the current US administration is doing may be long-lasting



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To get specific, MIT Economist Robert Solow received the 1987 Nobel Memorial Prize in Economics [2] for his work on economic growth, where he found overwhelming theoretical and empirical evidence that 90% or more of economic growth is due to new innovations. There was before, and has been since 1987, a great deal of important work in this area, but the Solow growth model put the sharpest point on the centrality of innovation (notably in science), technology, and what we would now call interdisciplinary problem-solving, to show that, without both an ecosystem of innovators and support for ideas, economies can wither and die.

Decades of my own work has shown that, in the energy and climate arena, the Solow perspective on the need to nurture and invest in innovations is vital. Work using patents to show the multiplicative returns on investing in research and development (R&D) [3] and efforts to study the pathways and communities of innovators in the US [4] and in Africa [5] both support this finding.

It is for this reason that the current self-harm that the US is doing to its research base – the current and the future research community – is such short-sighted stupidity. In terms of current research capacity, the new administration has already cancelled hundreds of National Science Foundation [6] and National Institutes of Health [7] grants, and grants for science in the armed forces [8], and is engaged in highly indiscriminate mass layoffs of staff with specialised skills across government [8]. There is simply no other way to understand these cuts than to invoke the poorest of short-sighted, self-destructive urges we have witnessed before, which have been immortalised in the famously haunting Martin Niemöller poem:

First they came for the Communists
And I did not speak out
Because I was not a Communist
Then they came for the Socialists
And I did not speak out
Because I was not a Socialist
Then they came for the trade unionists
And I did not speak out
Because I was not a trade unionist
Then they came for the Jews
And I did not speak out
Because I was not a Jew
Then they came for me
And there was no one left
To speak out for me

https://www.oxfordclimatealumni.org/post/an-antidote-to-the-ongoing-suicide-of-a-superpower

Secretary of State John Kerry
Energy Access Summit

President Barack Obama
Blue Ocean Initiative

US Ambassador to Morocco Dwight Bush
US-Africa Clean Energy Partnership Summit

Science Envoy, US State Department

THE WHITE HOUSE

WASHINGTON

January 12, 2017

Daniel Kammen, Ph.D.
Berkeley, California

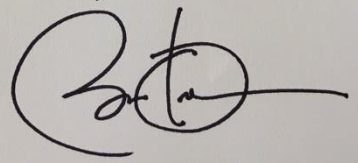
Dear Dr. Kammen:

Please accept my deepest gratitude for the distinction with which you have represented our country and my Administration as a Science Envoy.

Embodying the spirit of service and the search for shared values that speak to our common interests and humanity, you've helped promote the advancement of science, diplomacy, and partnership between nations and strengthen our country's standing in the world. I want you to know how much I have appreciated your work and the role it has played in our efforts to bring about a future of greater possibility, both here at home and across the globe.

Again, thank you for endeavoring alongside me to demonstrate that there is far more that binds us than that divides us and to bring us closer to a tomorrow that reflects this essential truth. You have my very best wishes for all that lies ahead.

Sincerely,



Letter on Twitter

DIRECTOR, RENEWABLE AND APPROPRIATE ENERGY LAB (RAEL)
BERKELEY, CA 94720-3050
URL: *http://rael.berkeley.edu*
TWITTER: @DAN_KAMMEN

DANIEL M. KAMMEN
PROFESSOR AND CHAIR, ENERGY AND RESOURCES GROUP
PROFESSOR OF PUBLIC POLICY IN THE GOLDMAN SCHOOL
PROFESSOR OF NUCLEAR ENGINEERING

August 23, 2017

Mr. President,

I am resigning from my position as Science Envoy for the Department of State of the United States. Since 1996, I have served the Departments of Energy, the US Environmental Protection Agency, and the State Department in a number of roles. Working closely with the talented teams at State Department Headquarters and at U. S. embassies abroad, we have built significant partnerships in North and East Africa, and in the Middle East, around shared visions of national security, job creation in the U. S. and sustainable energy.

My decision to resign is in response to your attacks on core values of the United States. Your failure to condemn white supremacists and neo-Nazis has domestic and international ramifications. On this issue, I stand with the unequivocal and authoritative statements of Charlottesville Mayor Mike Signer, Virginia Governor Terry McAuliffe, Ohio Governor John Kasich, Senator John McCain, Congresswoman Ileana Ros-Lehtinen, Governor Arnold Schwarzenegger, Presidents George H. W. Bush and George W. Bush, Dr. Cornel West, Linda Sarsour, the Palestinian-American activist and one of the organizers of the Women's March, and many others.

Particularly troubling to me is how your response to Charlottesville is consistent with a broader pattern of behavior that enables sexism and racism, and disregards the welfare of all Americans, the global community and the planet.

Examples of this destructive pattern have consequences on my duties as Science Envoy. Your decision to abdicate the leadership opportunities and the job creation benefits of the Paris Climate Accord, and to undermine energy and environmental research are not acceptable to me.

Acts and words matter. To continue in my role under your administration would be inconsistent with the principles of the United States Oath of Allegiance to which I adhere.

Character is vital in leadership. I find particularly wise the admonition of President Dwight D. Eisenhower, who cautioned that, "A people [or person] that values its privileges above principles soon loses both."

Herein, with regret, I resign. I deeply respect and value the work of the many fine people I have encountered in our federal agencies and will miss the opportunity to work with and support them. Your actions to date have, sadly, harmed the quality of life in the United States, our standing abroad, and the sustainability of the planet.

Sincerely,

Professor Daniel M. Kammen
Science Envoy, U. S. State Department (former)

J.K. Rowling @jk_rowling Aug 23

I wonder whether there's anyone left in America who doesn't know what an acrostic is.

> **Daniel M Kammen** @dan_kammen
>
> Mr. President, I am resigning as Science Envoy. Your response to Charlottesville enables racism, sexism, & harms our country and planet. pic.twitter.com/eWzDc5Yw6t

4,271 20K

Daniel M Kammen @dan_kammen Aug 23

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45K 125K

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POLITICS NEWS

State Dept. Science Envoy Spells Out 'IMPEACH' In Resignation Letter

Daniel Kammen, a State Department science envoy, quit Wednesday with a blistering letter, writing that Trump's response to Charlottesville was the last straw.

A former Trump science adviser on his "impeach" message, getting rid of coal, and embracing renewable energy

Energy expert Dan Kammen weighs in on recent controversies.

By David Roberts | @drvolts | Sep 6, 2017, 9:30am EDT

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Los Angeles Times

CALIFORNIA

I-M-P-E-A-C-H: UC Berkeley professor who broke from Trump administration over Charlottesville speaks out

BY JAMES QUEALLY, ALENE TCHEKMEDYIAN

AUG. 24, 2017 9:50 AM PT

For the last two decades, UC Berkeley professor Daniel Kammen has served as a climate change advisor under Republican and Democratic presidents.

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HOUSE - 4H 4M AGO

Graham: 'It is time to mobilize our retired and former service members' to secure schools
SENATE - 5H 21M AGO

California court says some bees are fish
NEWS - 7H 11M AGO

ENERGY & ENVIRONMENT

State Dept. science envoy resigns with letter that spells out 'Impeach'

BY REBECCA SAVRANSKY - 08/23/17 12:09 PM ET

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Donald Trump

Science envoy resigns over Trump – with a letter spelling out 'impeach'

State department's Daniel Kammen quits with note calling out Charlottesville and Paris accord – and a hidden message in the first letters of each paragraph

Associated Press

Wed 23 Aug 2017 18.39 EDT

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The Guardian

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SCIENCE

Trump's science envoy quits in scathing letter with an embedded message: I-M-P-E-A-C-H

By Amy B Wang

August 23, 2017 at 2:55 p.m. EDT

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Science

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HOME > NEWS > SIFTER > SCIENCE ENVOY RESIGNS FROM TRUMP ADMINISTRATION WITH A HIDDEN MESSAGE: 'IMPEACH'

SIFTER

Science envoy resigns from Trump administration with a hidden message: 'impeach'

Daniel Kammen quit in response to President Trump's "attacks on the core values" of the coun

23 AUG 2017 · BY GIORGIA GUGLIELMI

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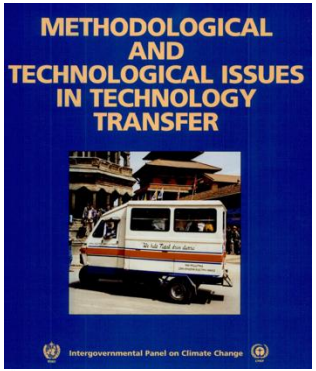
Meet the State Dept. Science Envoy Who Spelled Out "Impeach" in His Resignation Letter to Trump

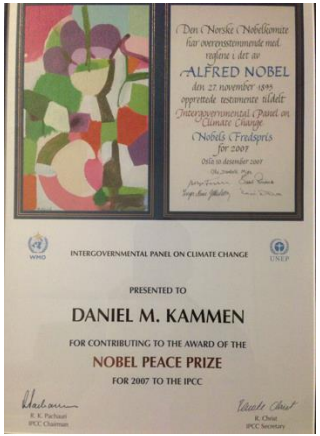
STORY AUGUST 25, 2017 Watch Full Show

More from this Interview

Part 1: Meet the State Dept. Science Envoy Who Spelled Out "Impeach" in His Resignation Letter to Trump

Part 2: Science Envoy Who Resigned in Protest of Trump Climate Change Makes Storms Like Harvey More Severe





IPCC Estimates of Climate Damages

IMPACTS AT 1.5°C AND 2°C OF WARMING

DIRECT IMPACTS	1.5°C	2°C	2°C IMPACTS
EXTREME HEAT — Global population exposed to severe heat at least once every five years	14%	37%	2.6X WORSE
SEA-ICE-FREE ARCTIC — Number of ice-free summers	AT LEAST 1 EVERY 100 YEARS	AT LEAST 1 EVERY 10 YEARS	10X WORSE
SEA LEVEL RISE — Amount of sea level rise by 2100	0.40 METERS	0.46 METERS	0.06m MORE
SPECIES	**1.5°C**	**2°C**	**2°C IMPACTS**
SPECIES LOSS: VERTEBRATES — Vertebrates that lose at least half of their range	4%	8%	2X WORSE
SPECIES LOSS: PLANTS — Plants that lose at least half of their range	8%	16%	2X WORSE
SPECIES LOSS: INSECTS — Insects that lose at least half of their range	6%	18%	3X WORSE
LAND	**1.5°C**	**2°C**	**2°C IMPACTS**
ECOSYSTEMS — Amount of Earth's land area where ecosystems will shift to a new biome	7%	13%	1.86X WORSE
PERMAFROST — Amount of Arctic permafrost that will thaw	4.8 MILLION KM²	6.6 MILLION KM²	38% WORSE
CROP YIELDS — Reduction in maize harvests in tropics	3%	7%	2.3X WORSE
OCEANS	**1.5°C**	**2°C**	**2°C IMPACTS**
CORAL REEFS — Further decline in coral reefs	70–90%	99%	UP TO 29% WORSE
FISHERIES — Decline in marine fisheries	↓ 1.5 MILLION TONNES	↓ 3 MILLION TONNES	2X WORSE

Figure 16: The difference in projected climate impacts between 1.5°C and 2°C of warming. **Source:** IPCC 2018.

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Renewable & Appropriate Energy Laboratory
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The world is not on pace to meet the SDGs

This is where the Johns Hopkins innovation ecosystem must fo

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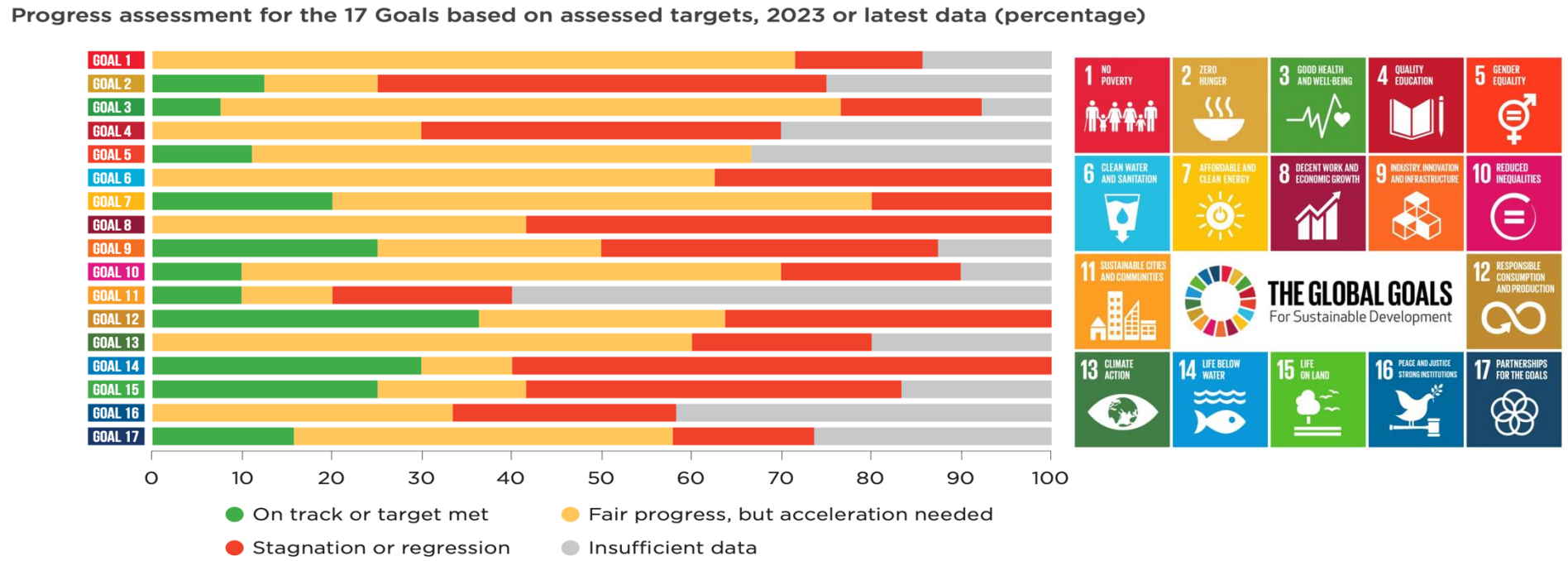
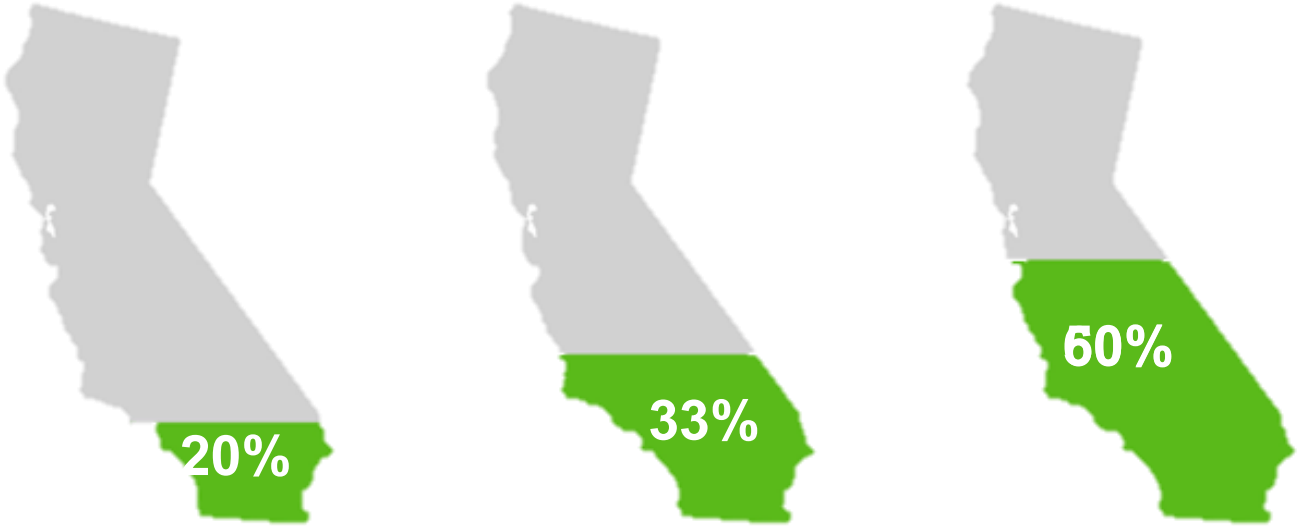


https://unstats.un.org/sdgs/report/2023/progress-chart/Progress-Chart-2023.pdf

California Energy & Environmental Justice Path

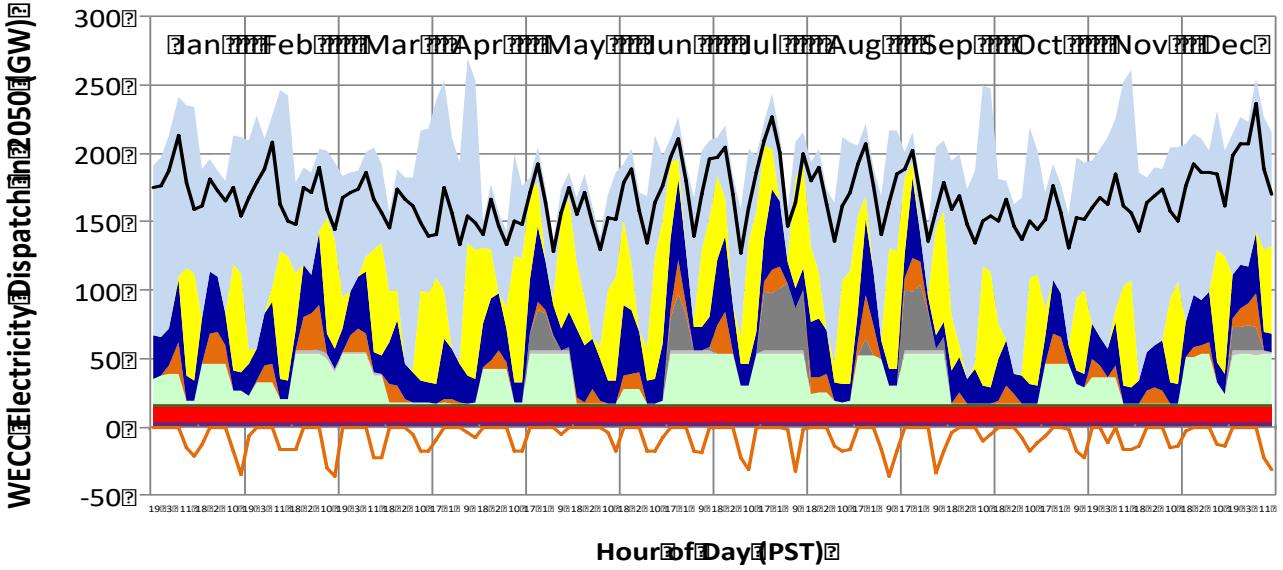
35%+ of Carbon Cap & Trade Funds for Under-Served Communities



California Senate Bill 100: 100% clean energy by 2045 and 2030 standard now 60% (without nuclear or large hydro)

Dispatch in 2050 (SWITCH-WECC, Western North America): Flexibility and variable renewables dominate

Storage almost exclusively moves solar to the night
Geothermal only remaining substantial baseload

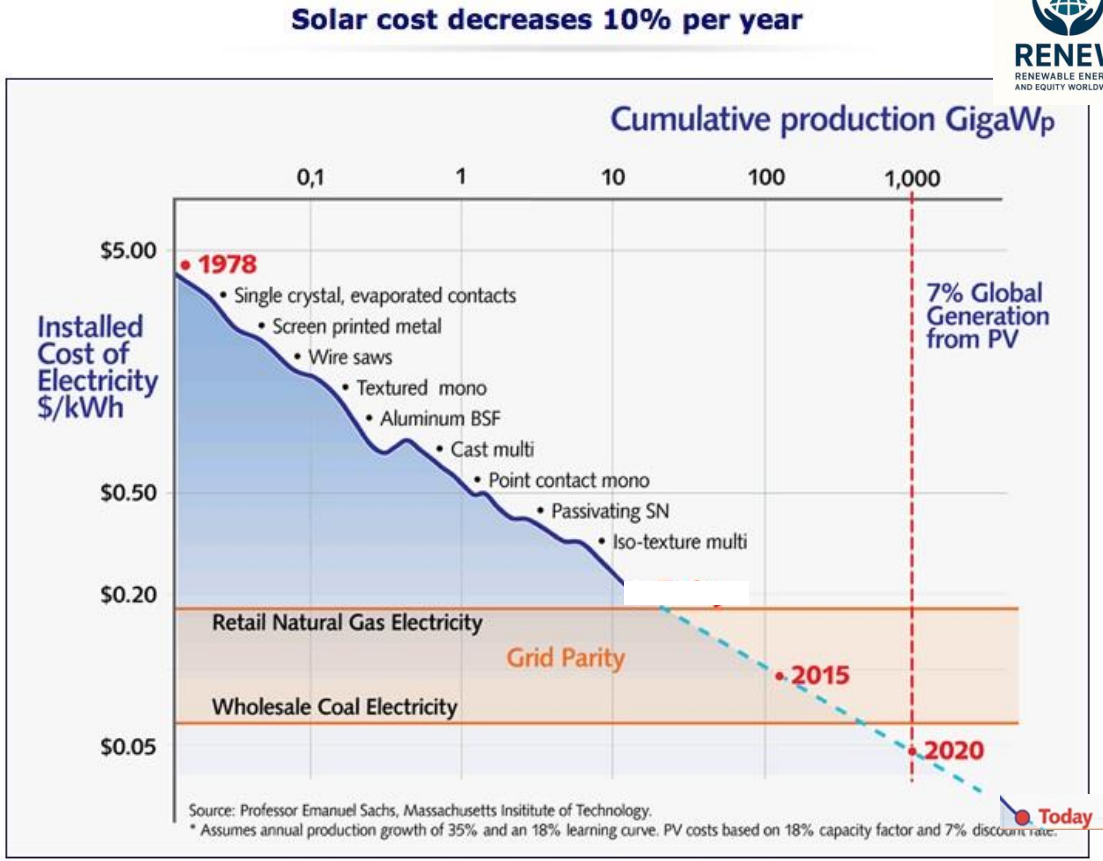


The Learning Curve
Swanson's Law

"Moore's Law"

Cost (C) & Sales(V)
at times t_1 and t_2

$$\frac{C_{t2}}{C_{t1}} = \left(\frac{V_{t2}}{V_{t1}}\right)^{-b}$$



Source: Professor Emanuel Sachs, Massachusetts Insititute of Technology.
*Assumes annual production growth of 35% and an 18% learning curve. PV costs based on 18% capacity factor and 7% discount rate.

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Setting the agenda in research

Comment

The Taipingling nuclear power plant in Huizhou, China, has been under construction since 2019.

Can China break the 'cost curse' of nuclear power?

Shangwei Liu, Gang He, Minghao Qiu & Daniel M. Kammen

Escalating construction expenses threaten to derail global progress on atomic energy. China offers lessons on how to rein in costs.

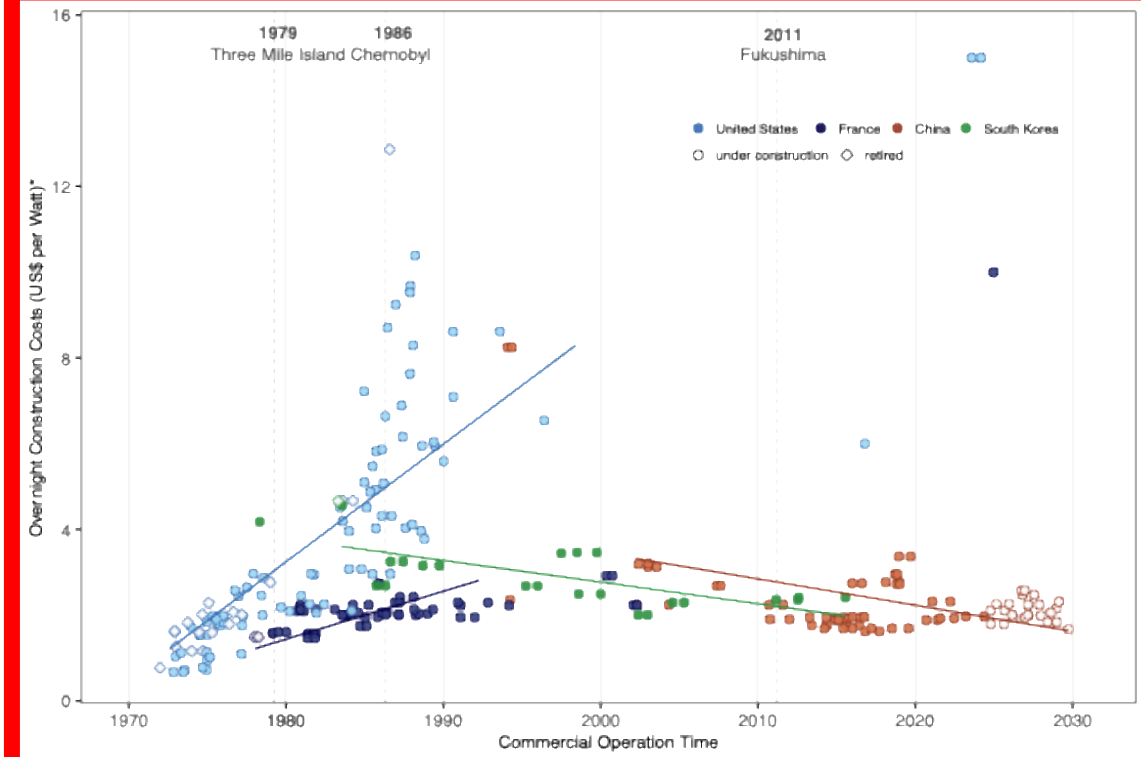
Once again, the world is betting on nuclear power. The United States aims to quadruple its nuclear capacity by 2050, and more than 30 countries have pledged to triple global capacity by mid-century. China has more than 30 reactors under construction and in planning, and France has announced plans to build 14 reactors. Technology giants, including Amazon, Google and Microsoft, are also investing in nuclear to power their energy-hungry data centres and lower their carbon emissions.

A central challenge remains: can development be done at a manageable cost? Historically, the industry has faced a 'cost escalation curse'[1]. Building more nuclear reactors has led to higher, not lower, costs per watt (see 'Costly construction'), hampering their economic viability. By contrast, for solar and wind energy, mass production and steady technological improvements have driven costs down[2].

The cost of building nuclear power plants can soar because of a lack of standardized designs, rising material and labour costs, evolving regulations and technical complexities[3]. But is this cost escalation inevitable? Here, we show that tailored regulations and policies can reverse the trend. Decades of nuclear-energy development in China demonstrate that construction costs can be brought down through a combination of stable regulations and efforts to strengthen domestic supply chains.

China's success in curbing costs

Over the past two decades, China has been the main country to substantially and consistently expand its nuclear fleet, to 58 operating reactors in 2024. Since 2022, the government has been approving around ten new reactors each year, putting China on track to surpass the United States and become the world's largest holder of nuclear power capacity by 2030. State-affiliated research centres have outlined a goal of quintupling China's current nuclear capacity by 2050.



*Overnight construction costs are the cost of building a project as if it were completed overnight, without taking financing costs (interest during construction) into account. All costs are converted to their equivalent 2020 value. Direct cross-country cost comparisons should be interpreted with caution because of differences in exchange rates and inflation. Cost data for the US, France, and South Korea are from Lovering et al. (2016). Cost data for China are from Liu et al. (2025). No data are available for South Korea after 2016.

Shangwei Liu, Gang He, Minghao Qiu & Daniel M. Kammen (2025) "Can China break the 'cost curse' of nuclear power," *Nature*, 643, 1186 – 1188. *doi: https://doi.org/10.1038/d41586-025-02341-z*

Setting the agenda in research

Comment

Can China break the 'cost curse' of nuclear power?

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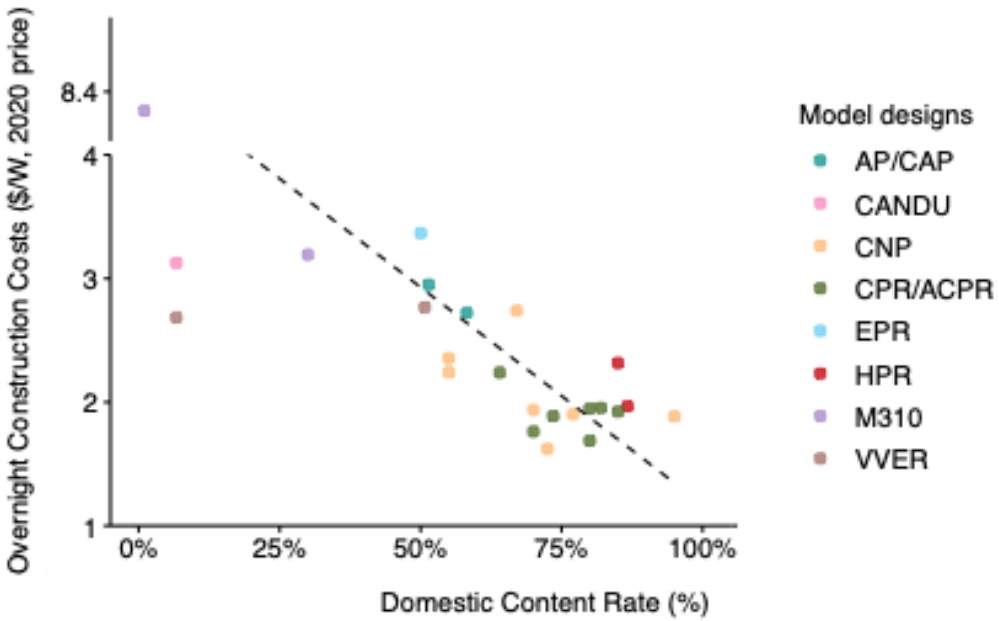
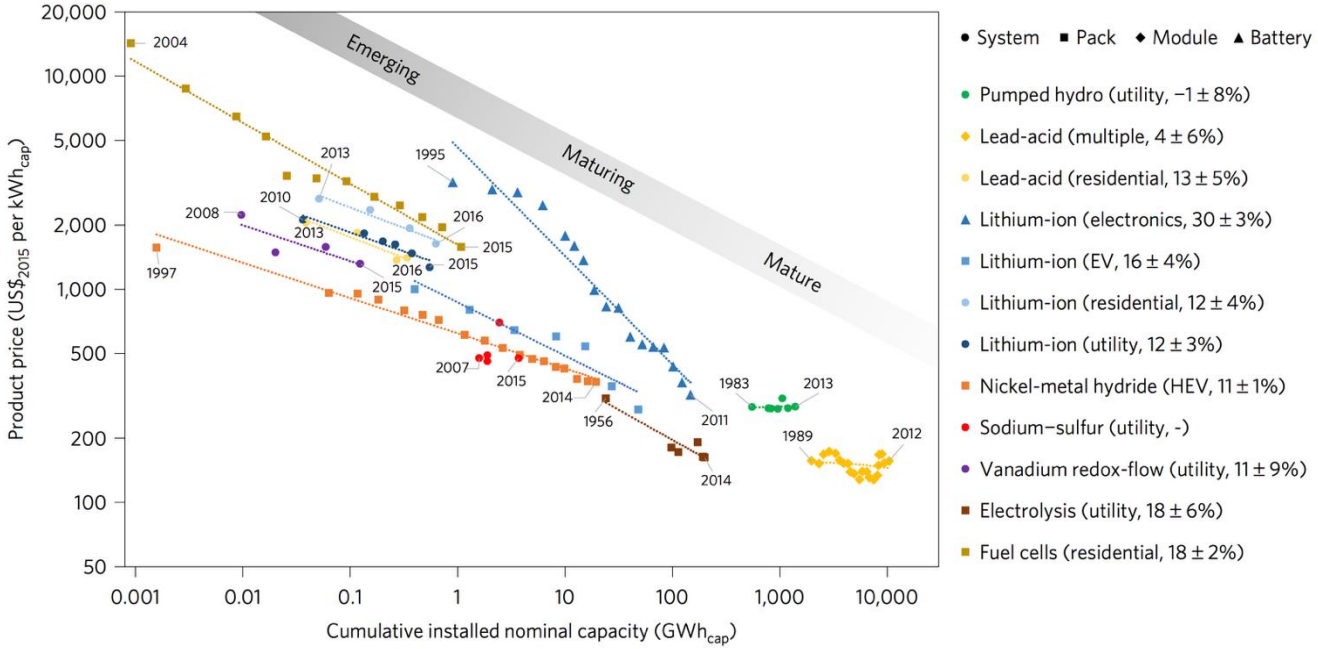


Figure 3 The effect of indigenization (domestic content rate) on unit overnight construction costs of Chinese operating nuclear power plants. Each dot represents a nuclear power plant (including multiple units), as costs and domestic content rates are typically reported at this level. The dashed line represents the fitted linear regression of domestic content rate against unit overnight construction costs.

Shangwei Liu, Gang He, Minghao Qiu & Daniel M. Kammen (2025) "Can China break the 'cost curse' of nuclear power," *Nature*, 643, 1186 – 1188. *doi: https://doi.org/10.1038/d41586-025-02341-z*

Materials Science & Engineering for Storage Innovation



Kittner, Lil & Kammen (2017) Energy storage innovation. *Nature Energy*, ***2,*** 17125

The SWITCH Modeling Framework

http://rael.Berkeley.edu/project/SWITCH

$$\min_{(c_i)}.NPV \sum_{i,k=1}^{n,m} TC_k\ (c_i)$$

$$Total\ Cost\ TC_k = Capital\ Cost_i * Capacity\ (c_i) + [Variable\ Cost_i * Capacity\ (c_i) *\ CF_i *\ 8760]$$

$$\sum_{i=1}^{n} Capacity\ (c_i) * Peak\ Contribution_i \quad \geq Annual\ Peak\ Demand * [1 + Reserve\ Margin]$$

$$\sum_{i=1}^{n} [Capacity\ (c_i) *\ CF_i *\ 8760]\ \geq\ Annual\ Load$$

$$Annual\ Load *\ Spill\ Factor\ \geq \sum_{i=1}^{n} [Capacity\ (c_i) *\ \ CF_i *\ 8760]$$

$$Total\ Resource\ Potental_i\ \geq \sum_{k=1}^{m} Capacity\ (c_i)$$

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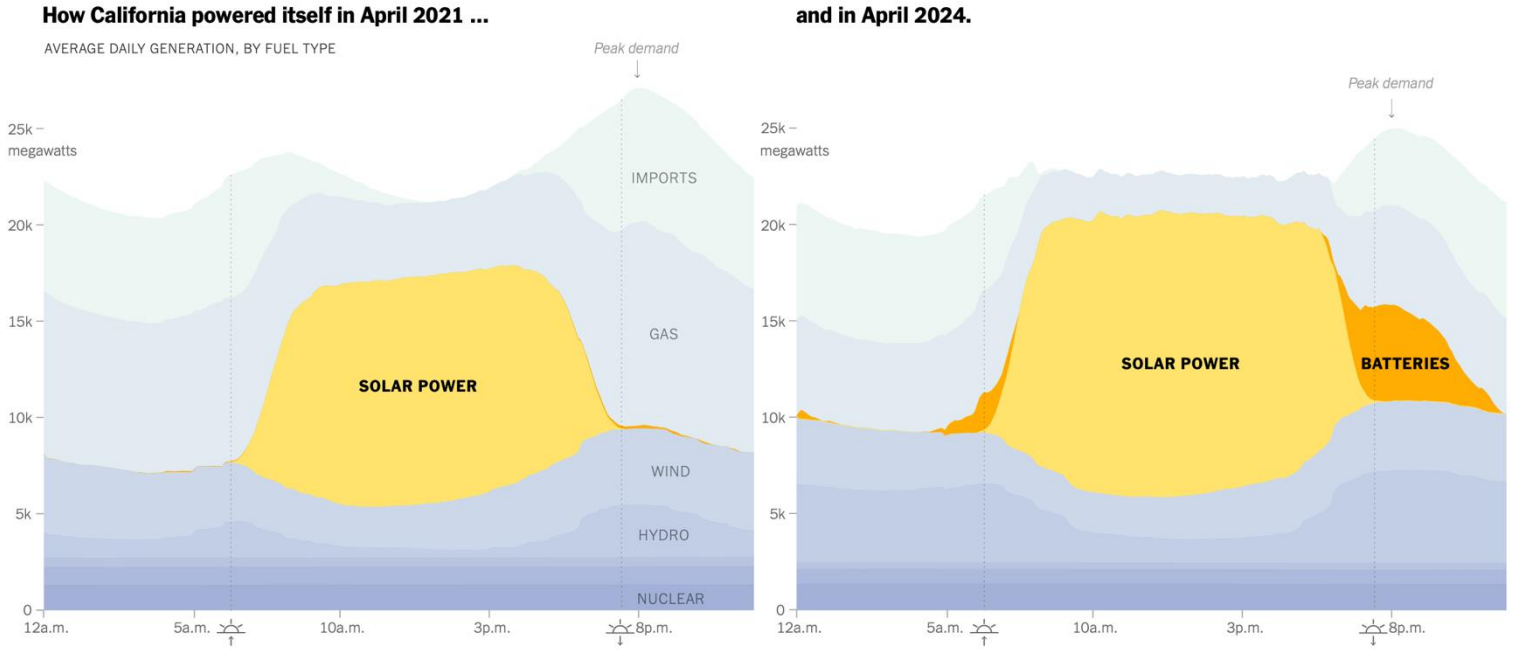
A UC Berkeley-RAEL proposal became the California 2013 Energy Storage Legislation: 1.2 Gw_{peak} of new storage online by 2020

Giant Batteries Are Transforming the Way the U.S. Uses Electricity

They're delivering solar power after dark in California and helping to stabilize grids in other states. And the technology is expanding rapidly.

By Brad Plumer and Nadja Popovich May 7, 2024



https://www.nytimes.com/interactive/2024/05/07/climate/battery-electricity-solar-california-texas.html

RENEW
RENEWABLE ENERGY AND EQUITY WORLDWIDE

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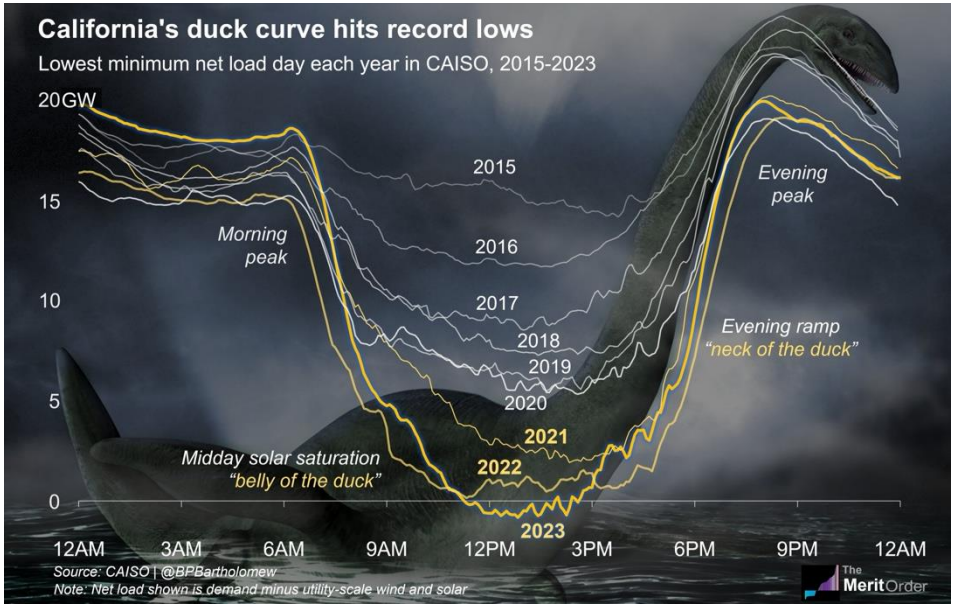
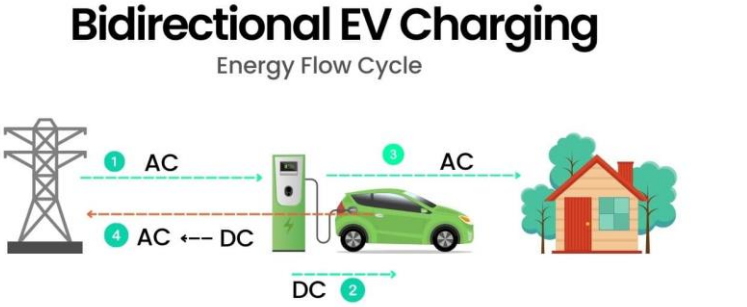
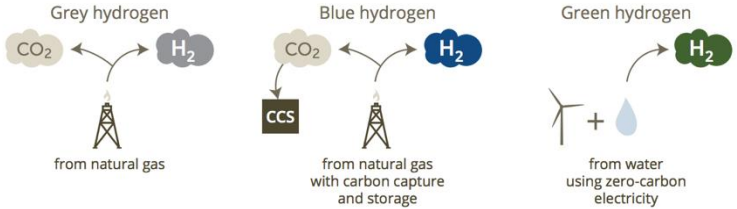
From (perceived) utility crisis to energy innovation opportunity







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IOP Publishing Environ. Res. Lett. 19 (2024) 084011 https://doi.org/10.1088/1748-9326/ad5856

ENVIRONMENTAL RESEARCH
LETTERS

LETTER

The role of hydrogen as long-duration energy storage and as an international energy carrier for electricity sector decarbonization

Kenji Shiraishi[1,2,3], Won Young Park[3] and Daniel M Kammen[1,2,4,*]

[1] Renewable and Appropriate Energy Laboratory, University of California, Berkeley, CA 94720, United States of America
[2] Goldman School of Public Policy, University of California, Berkeley, CA 94720, United States of America
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Keywords: hydrogen energy, decarbonization, zero-emission, long-duration energy storage, international energy carrier

Supplementary material for this article is available online

Abstract

With countries and economies around the globe increasingly relying on non-dispatchable variable renewable energy (VRE), the need for effective energy storage and international carriers of low-carbon energy has intensified. This study delves into hydrogen's prospective, multifaceted contribution to decarbonizing the electricity sector, with emphasis on its utilization as a scalable technology for long-duration energy storage and as an international energy carrier. Using Japan as a case study, based on its ambitious national hydrogen strategy and plans to import liquefied hydrogen as a low-carbon fuel source, we employ advanced models encompassing capacity expansion and hourly dispatch. We explore diverse policy scenarios to unravel the timing, quantity, and operational intricacies of hydrogen deployment within a power system. Our findings highlight the essential role of hydrogen in providing a reliable power supply by balancing mismatches in VRE generation and load over several weeks and months and reducing the costs of achieving a zero-emission power system. The study recommends prioritizing domestically produced hydrogen, leveraging renewables for cost reduction, and strategically employing imported hydrogen as a risk hedge against potential spikes in battery storage and renewable energy costs. Furthermore, the strategic incorporation of hydrogen mitigates system costs and enhances energy self-sufficiency, informing policy design and investment strategies aligned with the dynamic global energy landscape.

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ENVIRONMENTAL RESEARCH
LETTERS

LETTER

Exploring offshore wind's potential to enhance energy security in nations with limited land and fuel resources

Kenji Shiraishi[1,*], Umed Paliwal[2], Nikit Abhyankar[3], Daniel M Kammen[3,4,5], Amol Phadke[2] and Won Young Park[1,*]

[1] Sustainable Energy and Environmental Systems Department, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, United States of America
[2] Energy Markets and Policy Department, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, United States of America
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[5] Goldman School of Public Policy, University of California, Berkeley, Berkeley, CA 94720, Unites States of America
[*] Authors to whom any correspondence should be addressed.

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Keywords: offshore wind energy, zero-carbon grid, energy security

Supplementary material for this article is available online

Abstract

Offshore wind (OSW) power is critical to addressing energy security issues in nations with limited land and fuel resources. This study aims to assess the quality of OSW resources with high temporal and spatial resolution and to elucidate the economically feasible deployment of OSW using advanced power system models with Japan as a case study. First, comprehensive evaluations of OSW resources were performed by integrating a geographic information system (GIS)-based resource assessment with simulated data for hourly resource availability and renewable power plant operation. Then, using the 'SWITCH-Japan' model developed in our previous study, four key policy scenarios ('pathways') were analyzed. Each scenario incorporated three technology cost sensitivities and was assessed on multiple criteria including affordability, energy security, and land-use change. Finally, the potential for hydrogen production in other sectors was explored. We found that the Least-Cost scenario, which accelerates renewable energy growth, reduces average system costs by 43% and increases energy self-sufficiency by 31 percentage point compared to the business-as-usual scenario. While it is a highly valuable resource, OSW nonetheless necessitates significant infrastructure development and potentially faces both stricter regulations and local opposition. In recognition of this, the Limited Onshore Resources scenario reduces direct land use by half but finds only a slight increase in overall costs. While the balance of OSW potential is utilized for power systems, the remainder can materially enhance energy security for entire economies. Ultimately, OSW energy presents a strategic opportunity for nations to achieve energy self-reliance and reduce import dependence, emphasizing the need for timely infrastructure development.

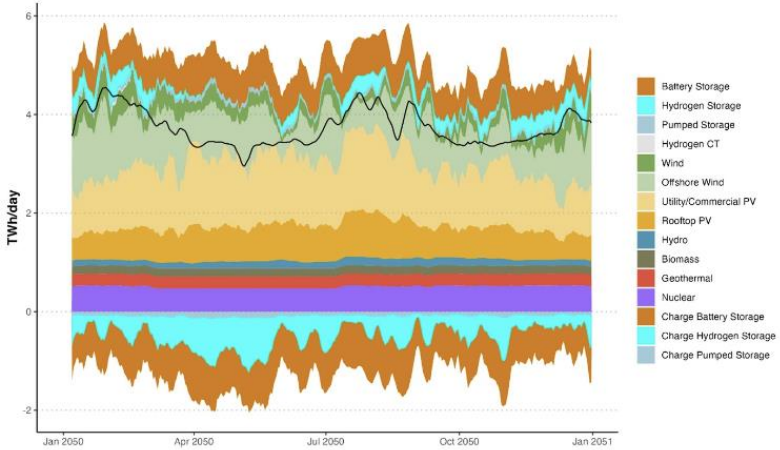


Figure 3. Annual national dispatch results with seven-day averaging under the Base scenario. The black solid line represents Japan's national load.

Clean Energy Japan scenario details:

Published today in *Env. Research Letters*
July 10, 2024:
The role of Hydrogen in the low-cost, high-reliability decarbonization of the Japanese power sector.

IOP Publishing Environ. Res. Lett. 19 (2024) 084011 K Shiraishi et al

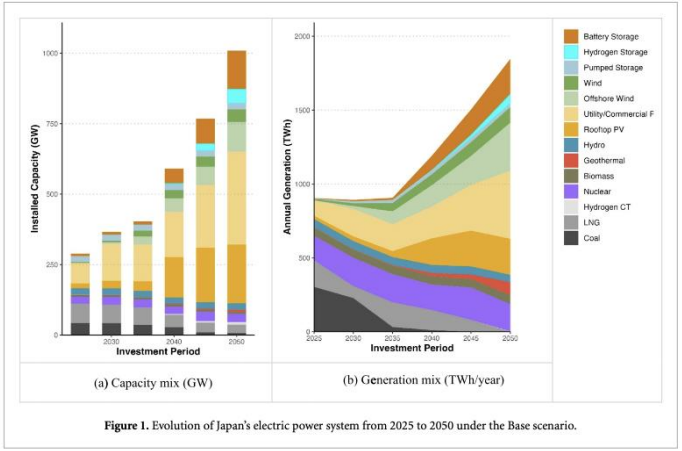


Figure 1. Evolution of Japan's electric power system from 2025 to 2050 under the Base scenario.

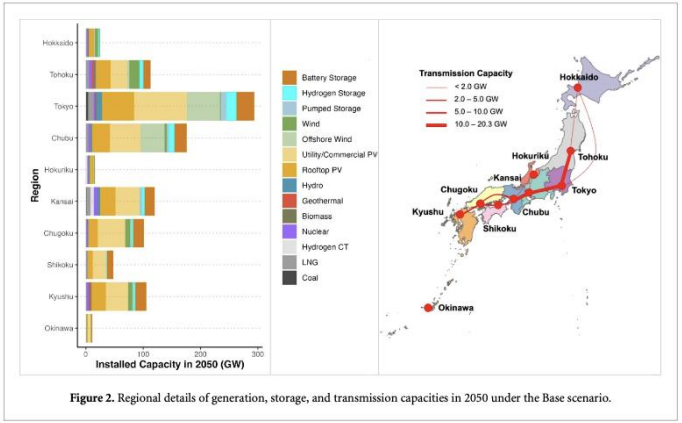
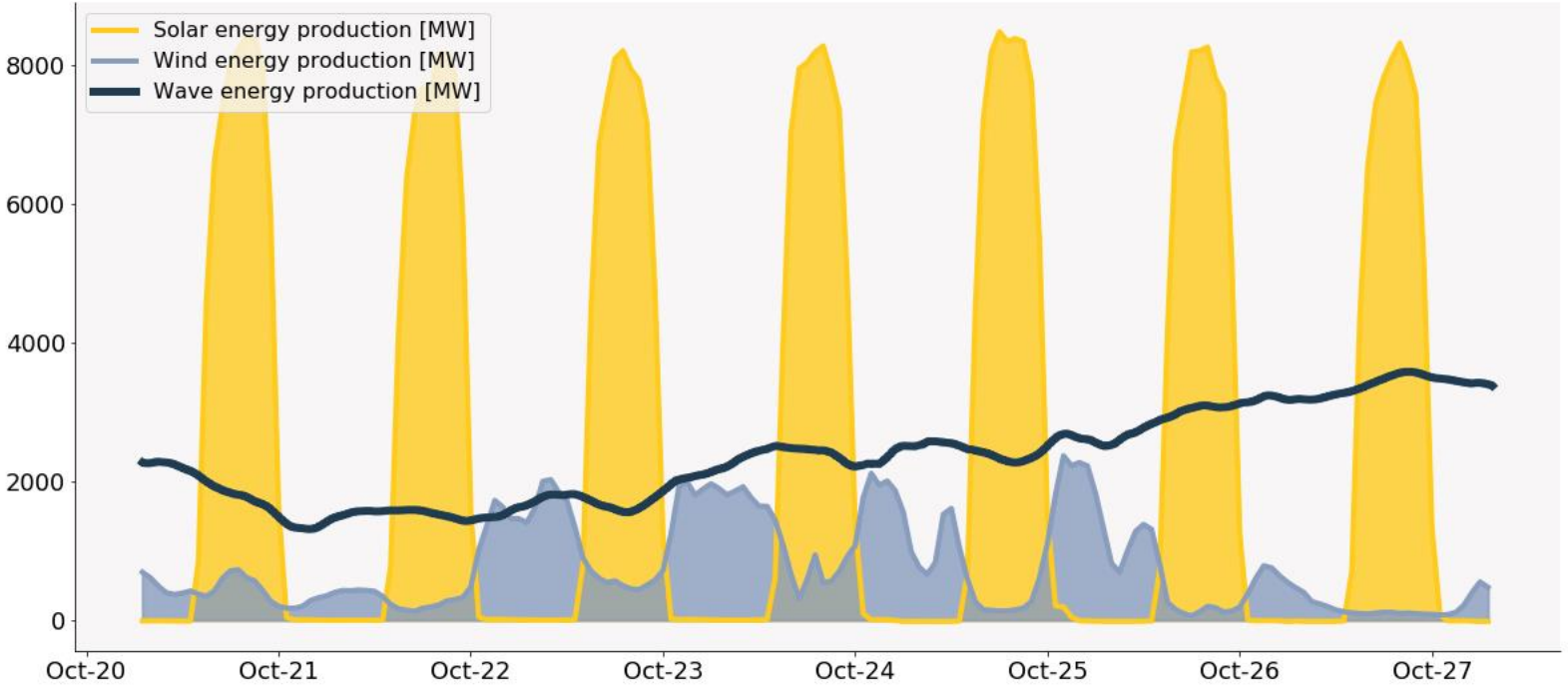


Figure 2. Regional details of generation, storage, and transmission capacities in 2050 under the Base scenario.

Consistent and complementary production profile

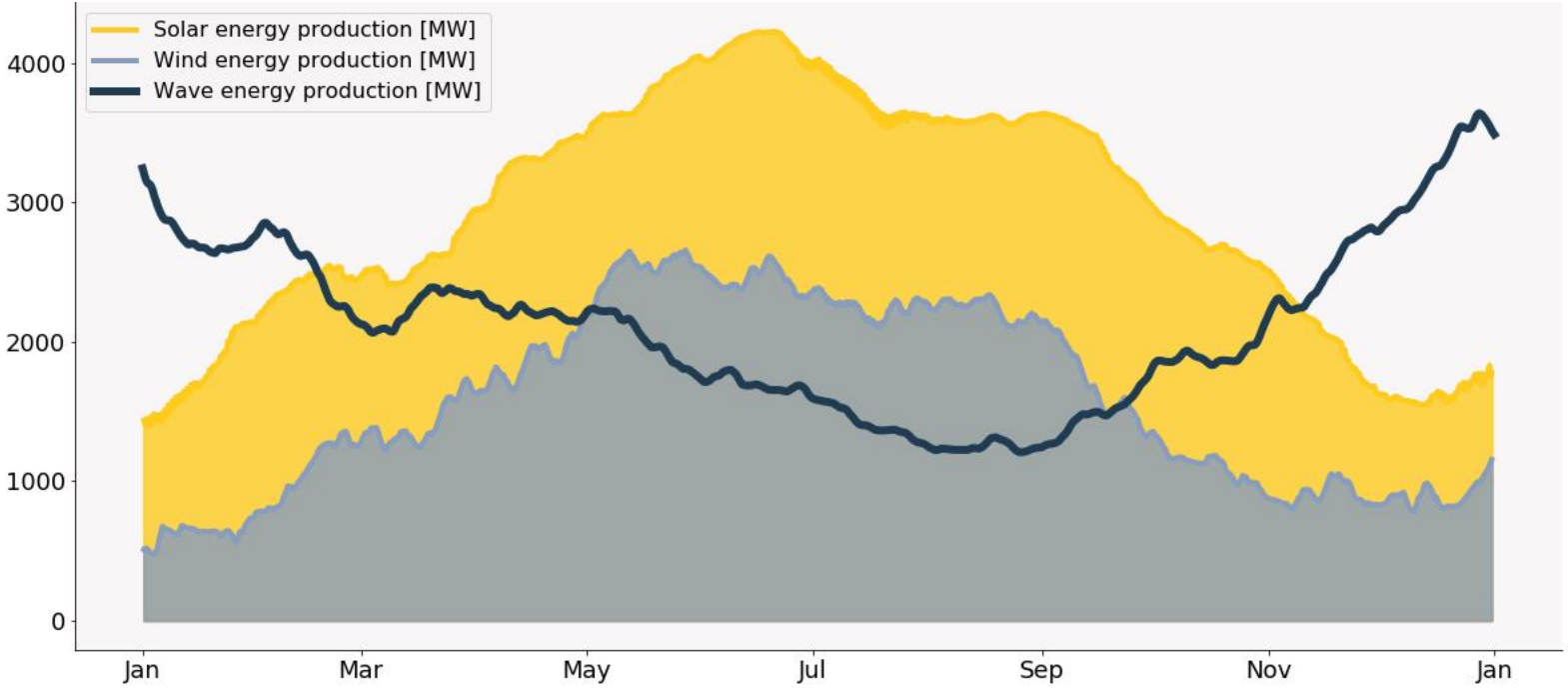


Wind (6.5 GW) and solar (13.5GW) production: Actual time series of the period
Wave production (6.0 GW): Estimate based on measured wave data and CorPower power matrix
6 GW wave energy devices evenly distributed over four sites along the coast of California

ANNUAL PROFILE

Annual profile is complementary to solar and wind on US west coast.

Attractive for seasonal balancing.



Wind (6.5 GW) and solar (13.5GW) production: Actual time series of the period
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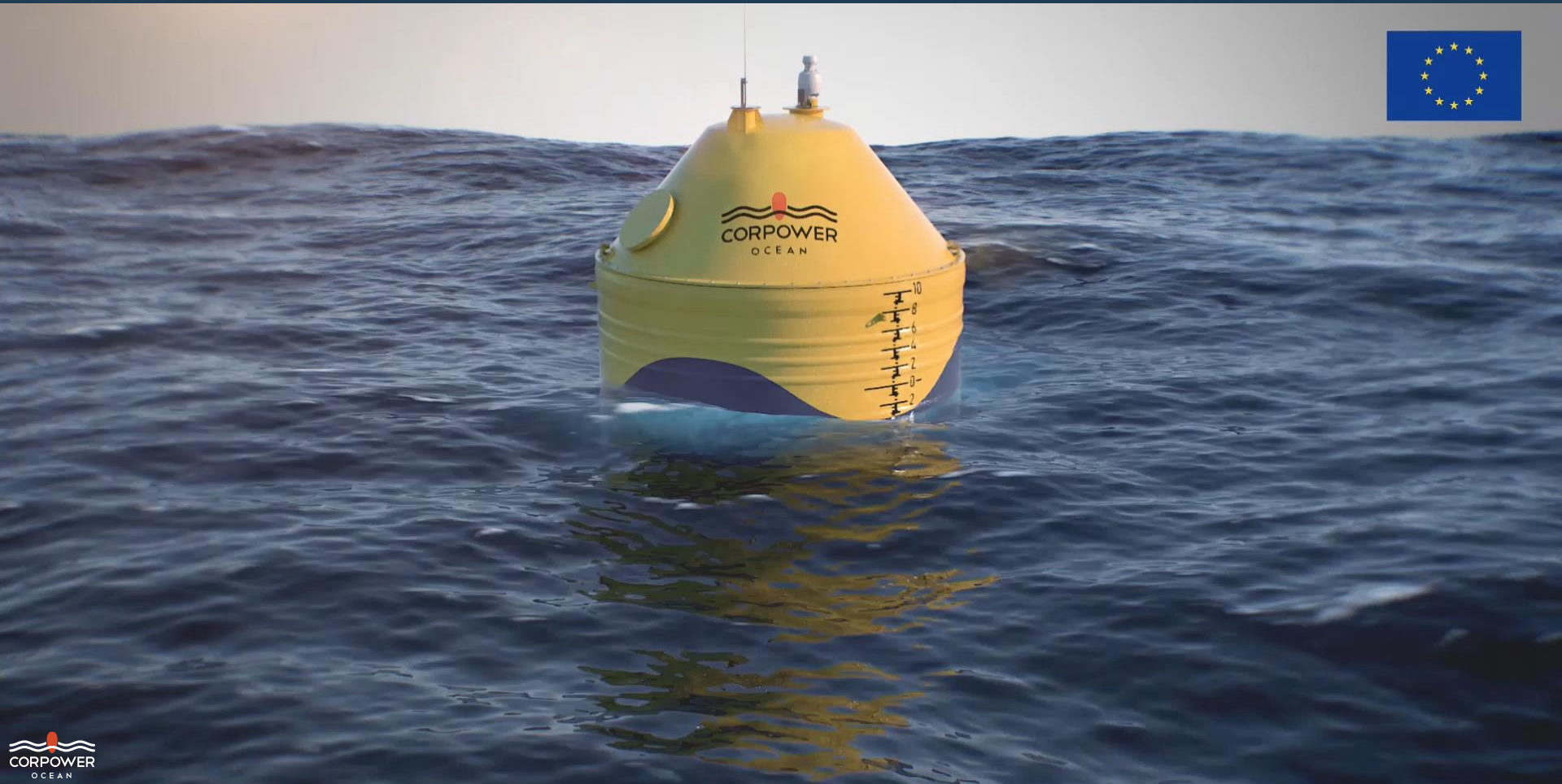
6 GW wave energy devices evenly distributed over four sites along the coast of California

TRANSPARENT IN STORMS – AMPLIFIED IN NORMAL OPERATION

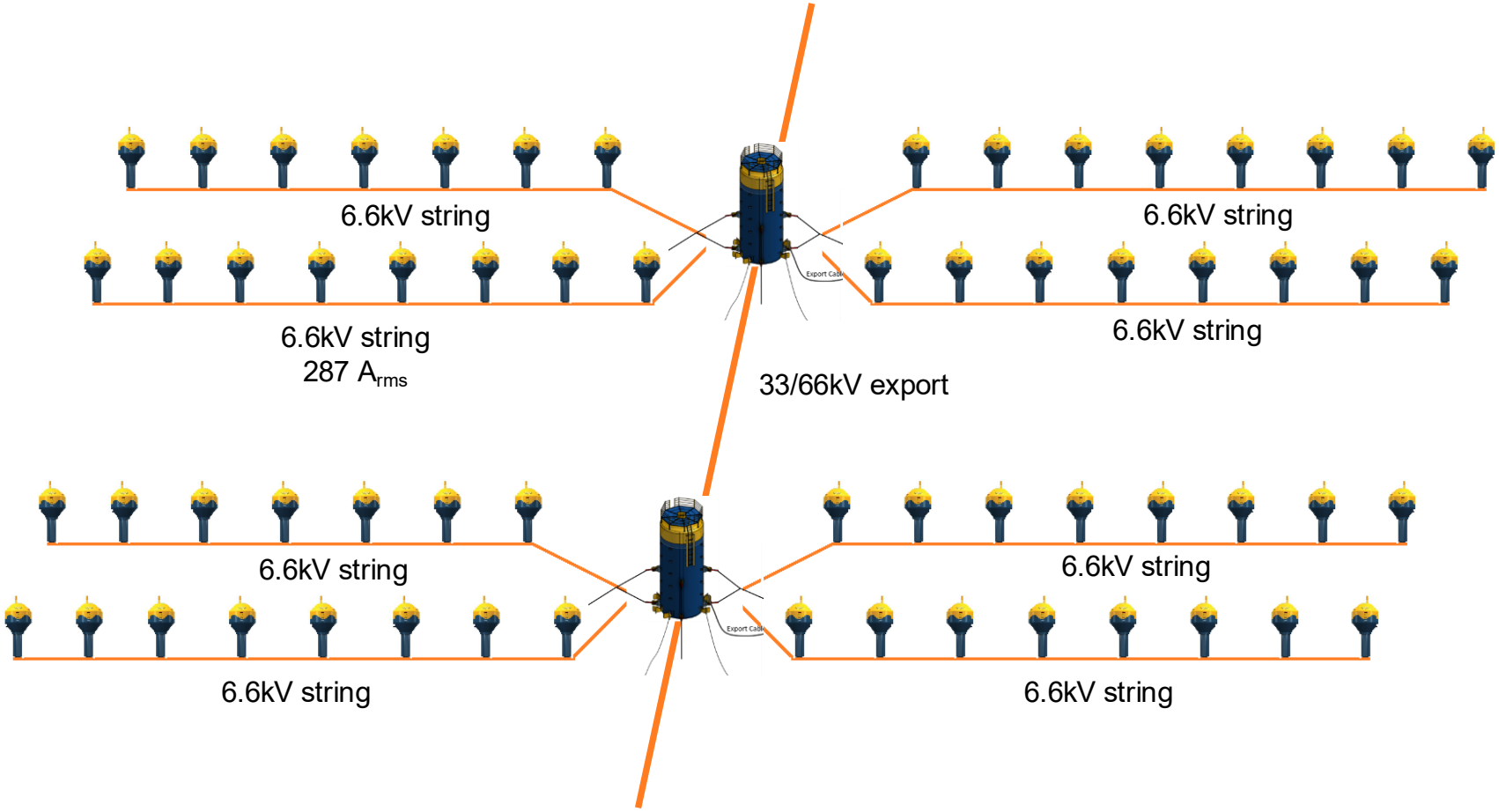
CORPOWER OCEAN

TRANSPARENT IN STORMS – AMPLIFIED IN NORMAL OPERATION



PRODUCT: 5-30MW+ CLUSTERS

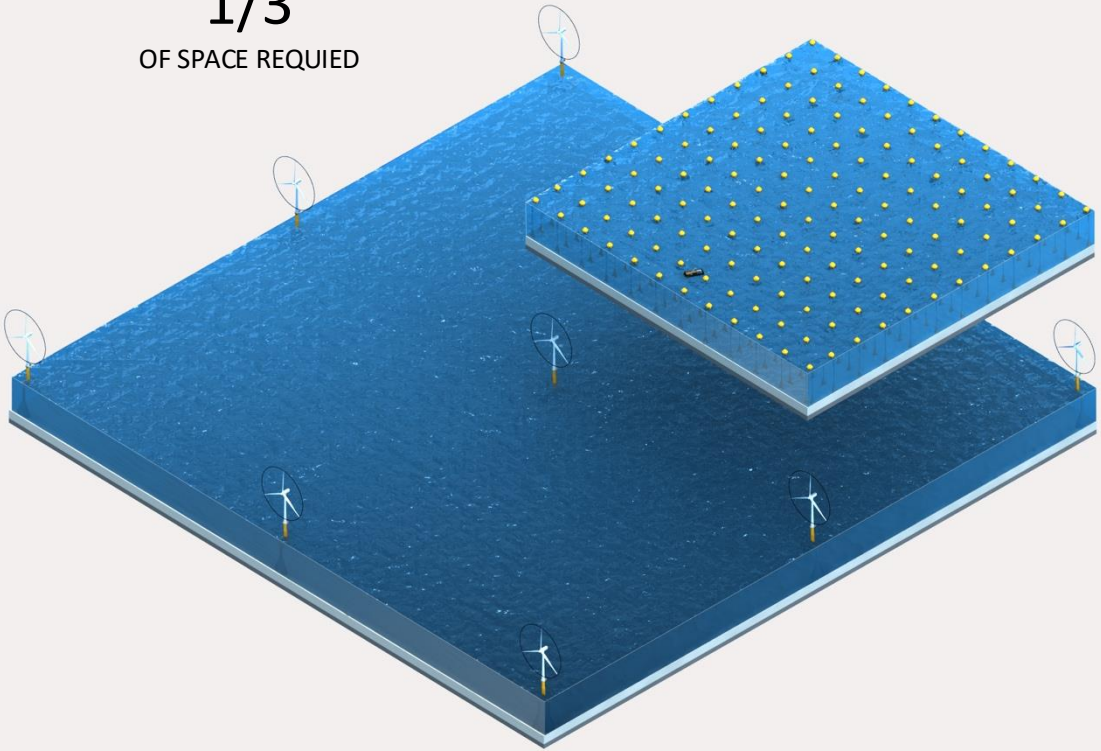
ELECTRICAL CONNECTION ARCHITECTURE: 5-30MW CLUSTERS

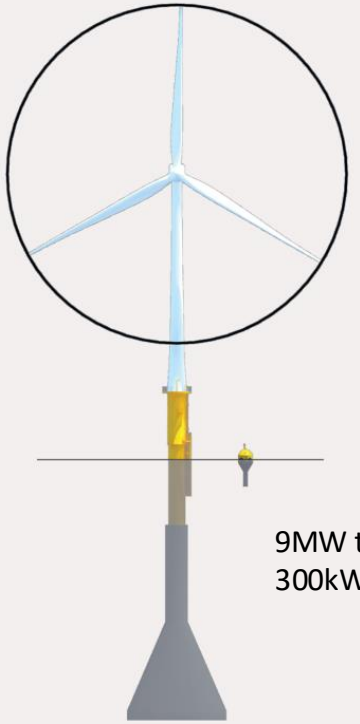


OCEAN FOOTPRINT & DEVICE SIZE

1/3

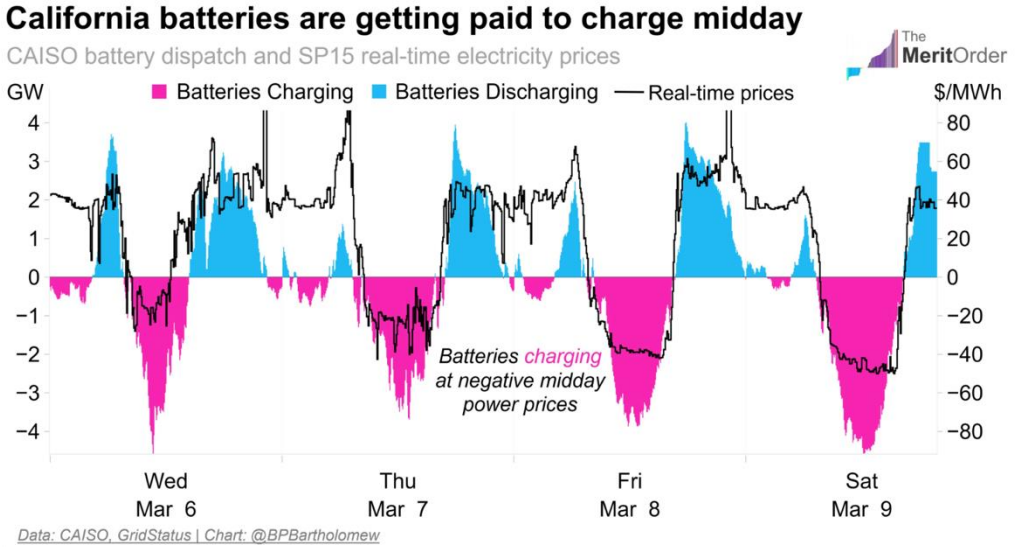
OF SPACE REQUIED

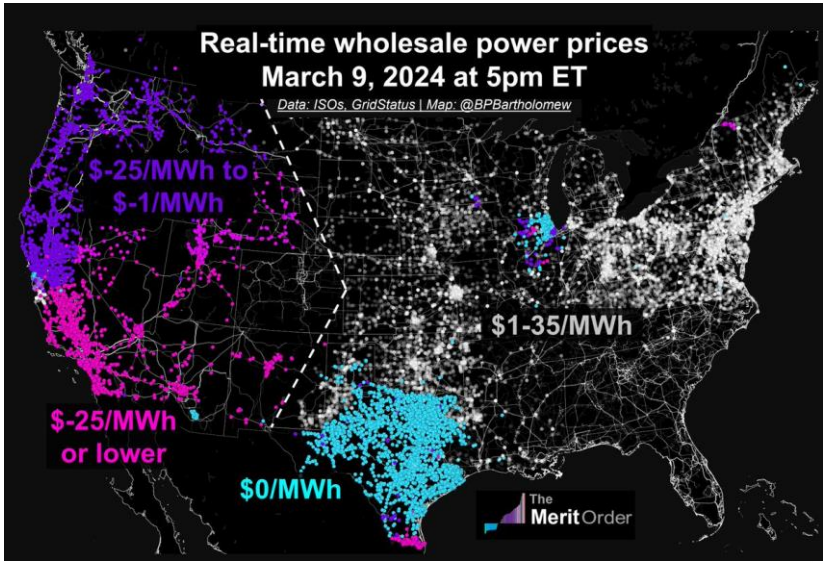




9MW turbine
300kW WEC

From laboratory to green market innovation and transformation





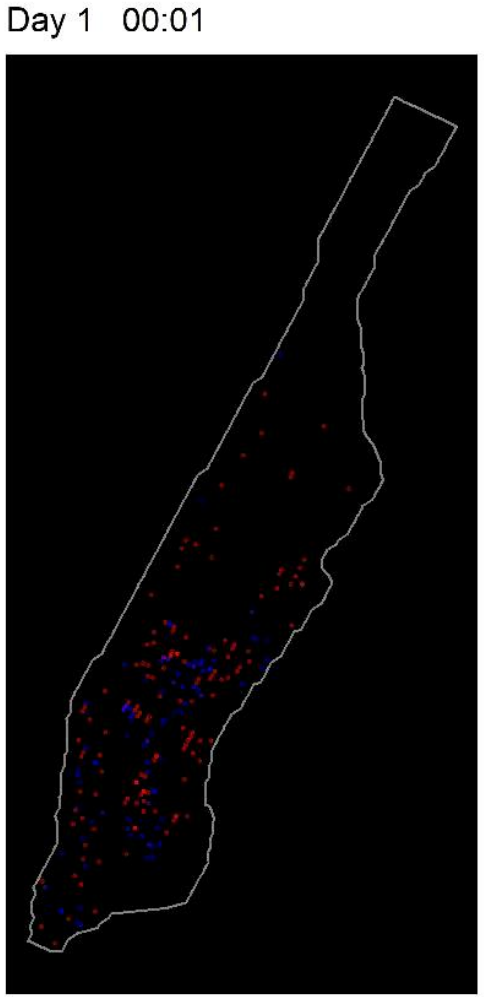
Electric Vehicle Data Science: China and New York City

Midnight (0:00) to 3 pm (15:00)

Red dot: taxi with passengers

Blue dot: taxi w/o passengers

Green: optimal charging



派尔城市
PAIR CITY

Example: Shenzhen Taxi Fleet Transformed in partnership with RAEL: 0 to 95% EV in 1 year

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As of 2021: 95% of the taxi fleet is EV in Shenzhen, China (21,000+ vehicles)

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Big Data Application | Solving long wait time outside EV taxi charging stations

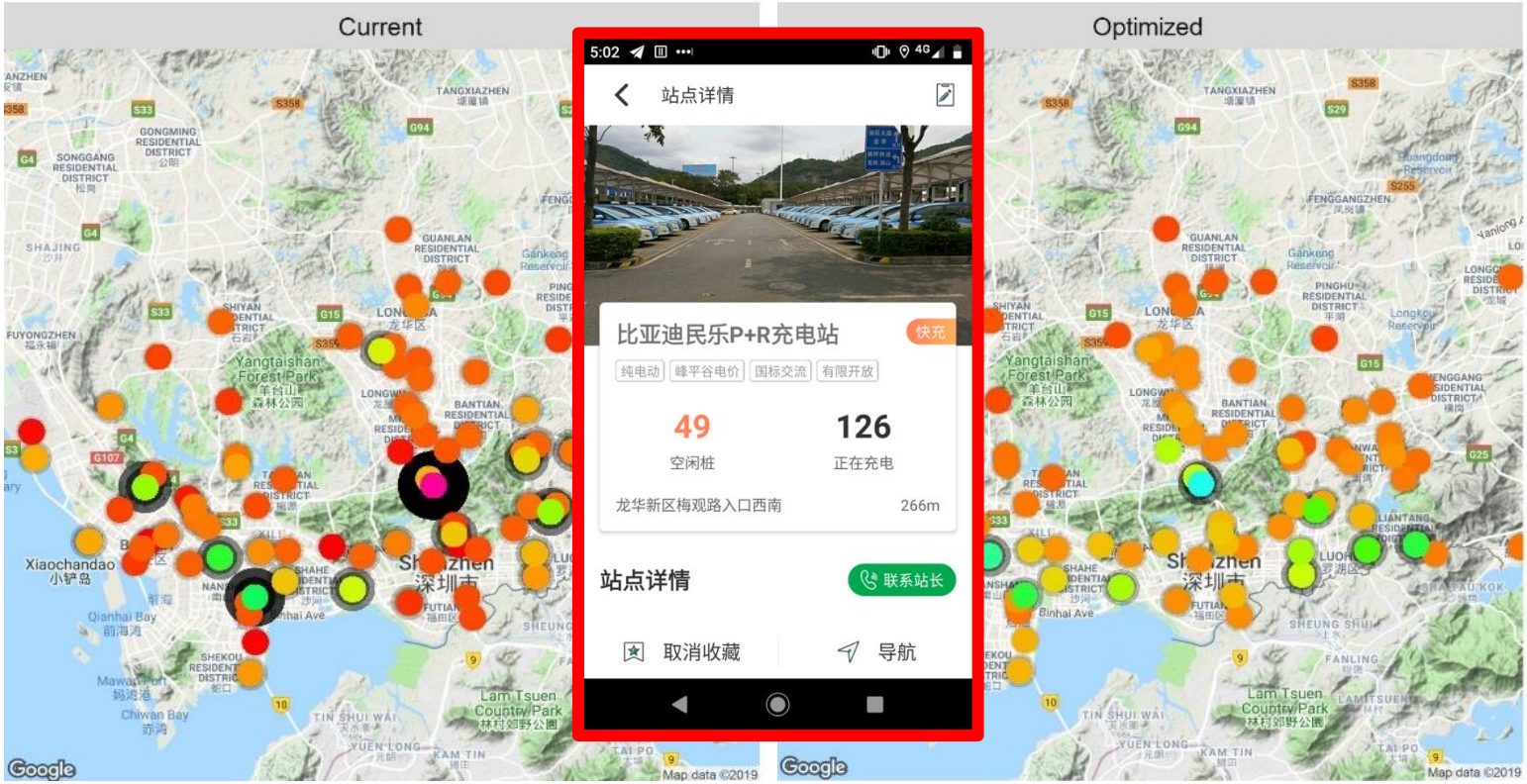
Lines of EV taxis waiting
to enter the charging station

Rows of faster chargers (total 637)
inside China's largest EV charging station

Data Science for Optimized dispatch: 20% reduced delay time; increased revenue

RENEW
RENEWABLE ENERGY AND EQUITY WORLDWIDE

派尔城市
PAIR CITY



Integrated Energy-IT Systems for Equitable Access

Integrated green mobility of subway, bus, bike & EV in Chengdu

So many business opportunities while ‘doing good’
E-bikes and battery swapping in Kenyan cities

Light-duty e-bikes now #1 delivery option in Kenyan cities

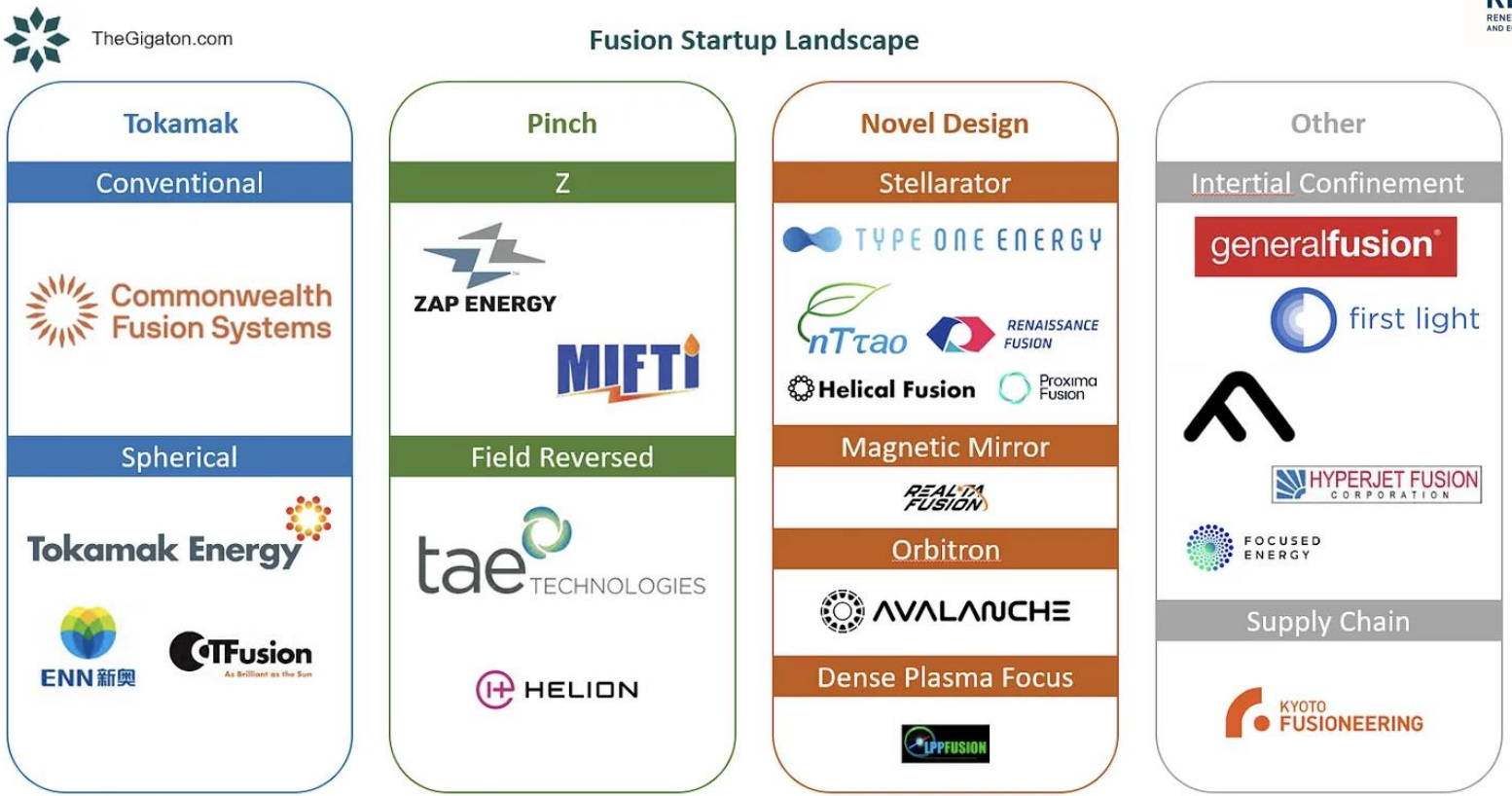
So many business opportunities while ‘doing good’

Integrated EV truck and eHelicopter: delivery of supplies, patients, supplies

So many business opportunities while ‘doing good’

Integrated EV truck and eHelicopter: delivery of supplies, patients, supplies

Over 50 fusion startups:



Note: Includes companies with >5M USD raised as of July 2023

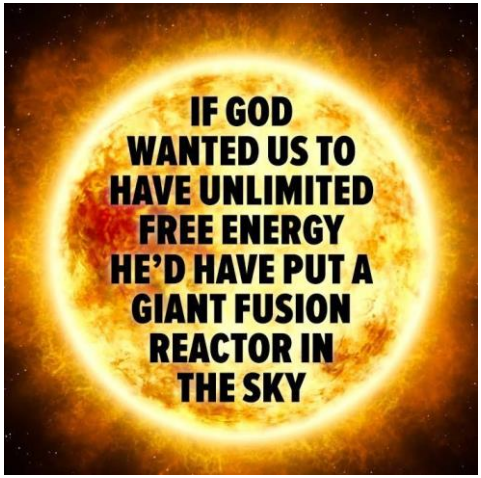
Source: https://www.fusionindustryassociation.org/news/from-the-fia/#industry-reports

Forecast:

In 2070 we will be ~70%
powered by fusion energy,

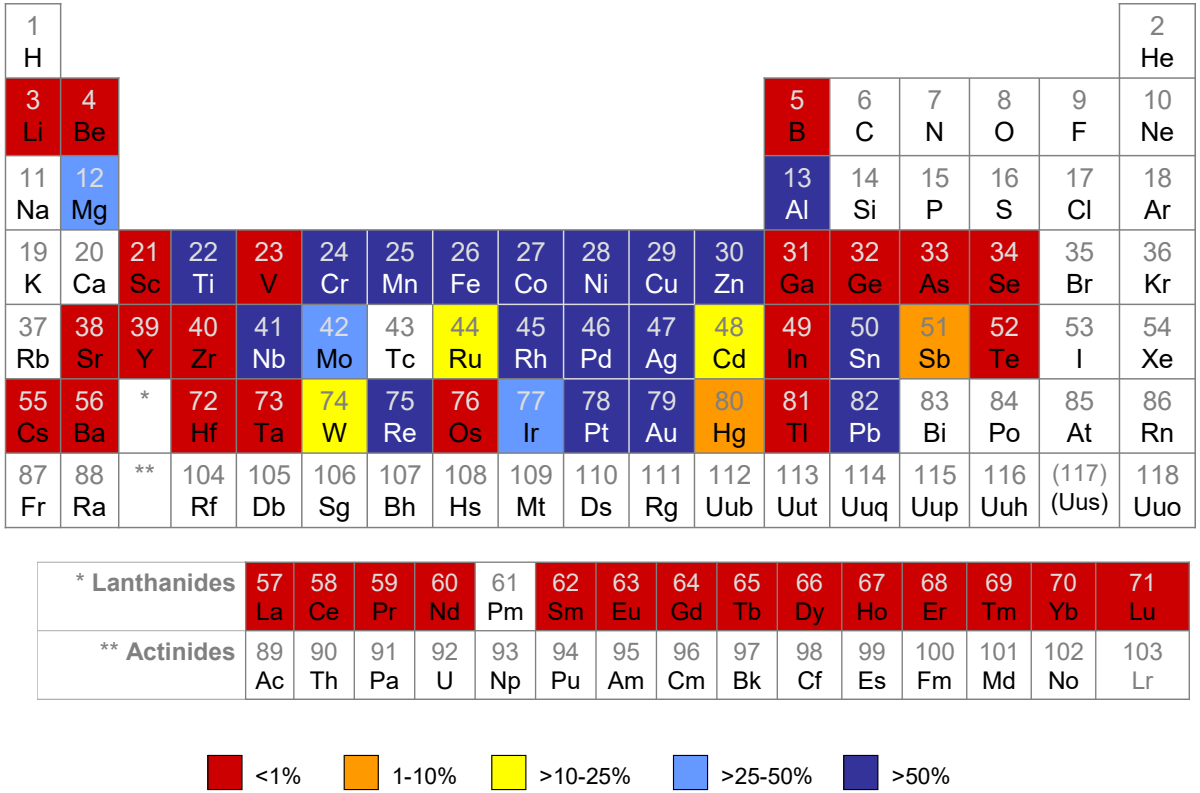
with half of it
150 million kilometers away

1/3 solar
1/3 terrestrial fusion
1/3 other



End-of-life (EOL) recycling rates for 62 metals in your phone
A new innovation agenda is needed.

RENEW
RENEWABLE ENERGY AND EQUITY WORLDWIDE

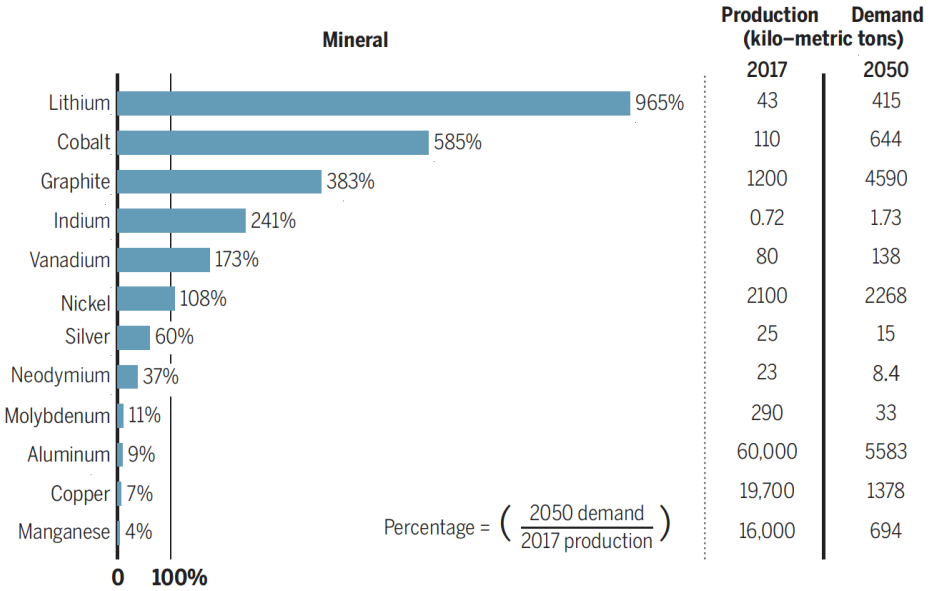


Graedel, Reck et al. (2011), *J. Ind. Ecol.*, 15(3): 355-366.

We must center 'Directed Innovation' to Make Wise Choices

A creuseur, or digger, descends into a Congolese copper and cobalt mine in Kawama. Wages are low, and working conditions are dangerous, often with no safety equipment or structural support for the tunnels.

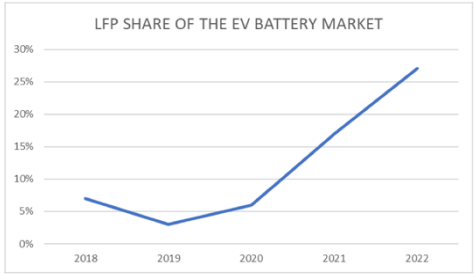
Growth in mineral needs for low-carbon energy technology



All production and demand data reflect annual values. 2017 data reflect annual production for all uses. 2050 data reflect estimated demand for only low-carbon energy technology uses. Data from (*7*).

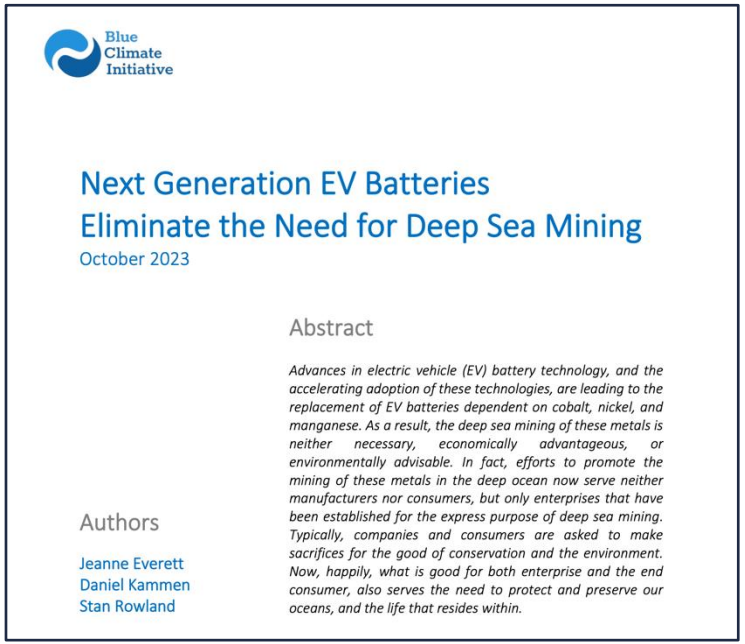
"Sustainable minerals and metals for a low-carbon future"
Benjamin K. Sovacool, Saleem H. Ali, Morgan Bazilian, Ben Radley, Benoit Nemery, Julia Okatz and Dustin Mulvaney
DOI: 10.1126/science.aaz6003
Science **367** (6473), 30-33.

Centering Ecosystem Protection



Source: International Energy Agency, Paris[3]

The Lithium Phosphate (LFP) market has grown from 7% to over 30% in 2023. In China the LFP battery share is over 20%



Blue Climate Initiative

Next Generation EV Batteries Eliminate the Need for Deep Sea Mining

October 2023

Abstract

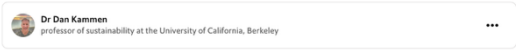
Advances in electric vehicle (EV) battery technology, and the accelerating adoption of these technologies, are leading to the replacement of EV batteries dependent on cobalt, nickel, and manganese. As a result, the deep sea mining of these metals is neither necessary, economically advantageous, or environmentally advisable. In fact, efforts to promote the mining of these metals in the deep ocean now serve neither manufacturers nor consumers, but only enterprises that have been established for the express purpose of deep sea mining. Typically, companies and consumers are asked to make sacrifices for the good of conservation and the environment. Now, happily, what is good for both enterprise and the end consumer, also serves the need to protect and preserve our oceans, and the life that resides within.

Authors

Jeanne Everett
Daniel Kammen
Stan Rowland

https://www.blueclimateinitiative.org/next-gen-batteries-eliminate-need-for-dsm

ECONOMIST IMPACT



Dr Dan Kammen
professor of sustainability at the University of California, Berkeley

PUBLISHED 5 FEBRUARY, 2024 • 4 MIN READ

It is a good day indeed when science, US job creation, bipartisan politics, economics, technological advances, Indigenous wisdom, social justice and ocean protection *all* align.

https://impact.economist.com/ocean/sustainable-ocean-economy/dont-buy-the-greenwashing-we-dont-need-deep-sea-mining

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RENEWABLE ENERGY AND EQUITY WORLDWIDE

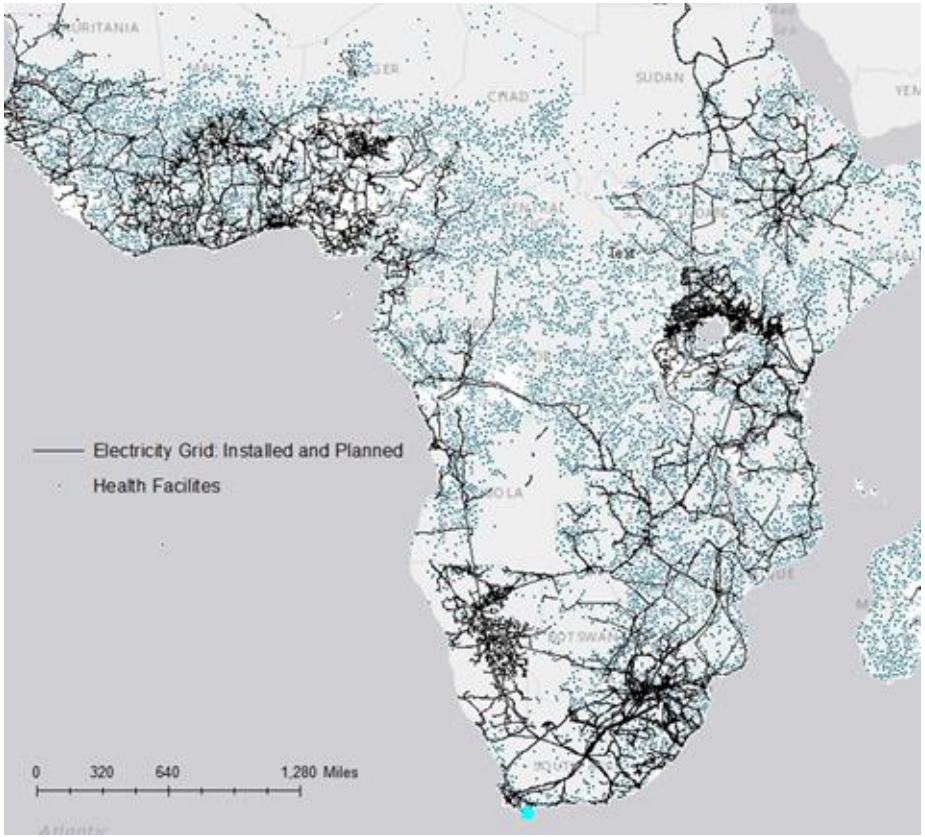
The Need: HETA
Health, Electrification & Telecommunications Alliance

100,000 facilities (public) lack access to reliable or no power in SSA

Nearly **1 billion** globally served by health facilities without reliable electricity

$5 billion is needed to achieve universal health electricity

Source: Recent Energizing Health report



Source: Kakoulaki, Georgia; Moner-Girona, Magda (2021)

A partnership to transform health and invest in the SDGs

No longer ON-PACE: Electrify 10,000 health facilities by 2025; ultimately 100,000

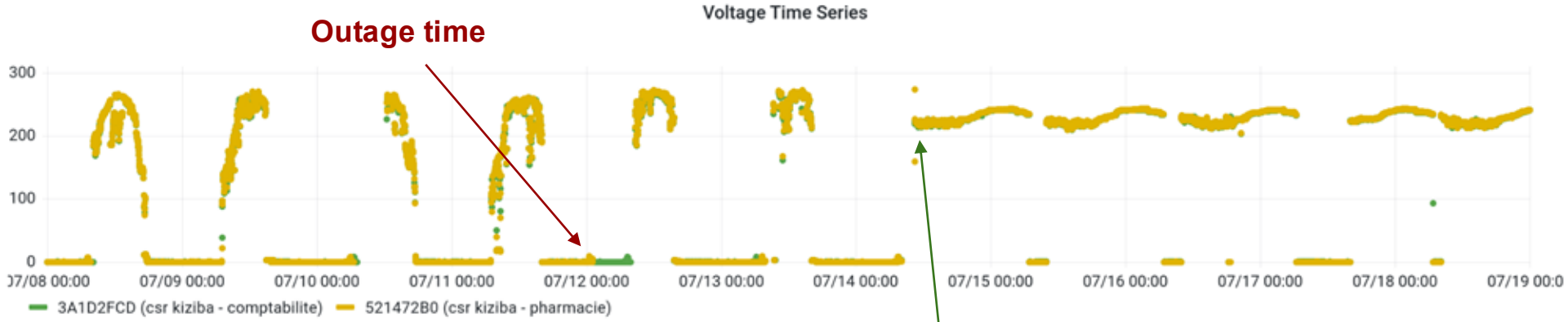
MINISTRY OF FOREIGN AFFAIRS OF DENMARK

A social/technical strategy is needed for HETA

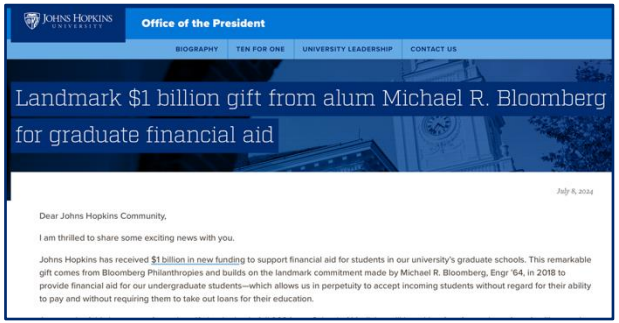
Photo: Power Africa/Justice Kalebe

Photo: Jeremy Weate

The largest mini-grid in Africa: Goma, DRC
Design and monitoring with UC Berkeley spin-out technolog




10:16
LTE
Reels
Billionaires who donated their wealth to charity:
Jamsetji Tata: $102.4 Billion donated
Bill Gates: $75.8 Billion
Warren Buffett: $32.1 Billion
George Soros: $32 Billion
Azim Premji: $21 Billion
MacKenzie Scott: $14 Billion
Michael Bloomberg: $12.7 Billion
Li Ka-Shing: $10.7 Billion
Andrew Carnegie: $9.5 Billion
Elon Musk: $7.6 Billion
128
4
22
Show your appreciation
Send
According to Edelgive Hurun Top 50... more
Lady Gaga · Judas
Add a comment


Office of the President
BIOGRAPHY
TEN FOR ONE
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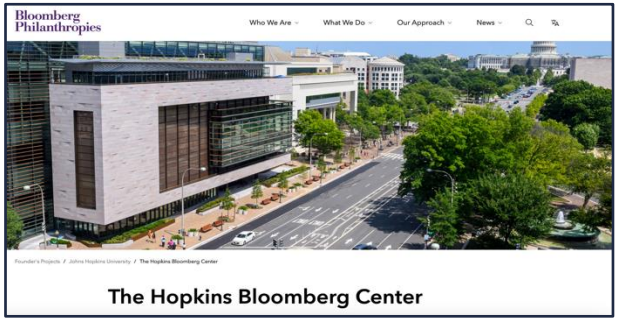
Landmark $1 billion gift from alum Michael R. Bloomberg for graduate financial aid
July 8, 2024
Dear Johns Hopkins Community,
I am thrilled to share some exciting news with you.
Johns Hopkins has received $1 billion in new funding to support financial aid for students in our university's graduate schools. This remarkable gift comes from Bloomberg Philanthropies and builds on the landmark commitment made by Michael R. Bloomberg, Engr '64, in 2018 to provide financial aid for our undergraduate students—which allows us in perpetuity to accept incoming students without regard for their ability to pay and without requiring them to take out loans for their education.


BLOOMBERG DISTINGUISHED PROFESSORS
Home > Research & Faculty > Bloomberg Distinguished Professors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What We Do
Our Approach
News
The Hopkins Bloomberg Center


Mike Bloomberg will donate $600m to historically Black medical schools
Gifts to 'diversify the medical field' will give millions to schools like Howard University College of Medicine
National Medical Association
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Press Releases
Bloomberg Philanthropies Makes Medical School Free at Johns Hopkins University for Majority of Students
July 8, 2024
Public Health
Bloomberg Philanthropies
New $1 Billion Gift Addresses Decline in U.S. Life Expectancy by Covering Costs for All Medical School Students with Limited Means and Increasing Financial Aid at Schools of Nursing, Public Health, and Other Graduate Schools
100 Percent of Tuition Will be Covered for Medical Students from Families Earning Under $300,000 - Representing 95 Percent of All Americans - With Living Expenses

JOHNS HOPKINS
UNIVERSITY

For seven decades, Johns Hopkins students have distinguished themselves by pursuing academic excellence in international relations. The school was established in Washington, D.C., in 1943, opened its campus in Bologna, Italy, in 1955 and in 1986 initiated one of the first Western university programs in the People's Republic of China in Nanjing.

Plan: open programs in Africa in 2026

Plan: open campus in Africa in 2027

Johns Hopkins University Africa - *Phase I* proposal

- An R1 research and teaching university in Africa, with a deep foundation in data science, smart systems & AI, sustainability and social justice.
- Phase 1: Excellence in three mission-driven areas:

Energy Systems

Sustainable energy is critical to inclusive growth

The Blue Economy

Marine conservation and ocean health is our health

Land use, gender & biodiversity

Sustainable lives, sustainable ecosystems & vibrant culturally rich and diverse societies

We seek partners in this vision where African and other needy students attend *on scholarship*

Launching the Blue New Deal

Marine Energy and Transport

Food and Nutrition

Health and Well-being

Biodiversity and Nature-based Solutions

Mineral and Genetic Resources

Sustainable Tourism

https://www.blueclimateinitiative.org

Launching the Blue New Deal

Marine Energy and Transport

Food and Nutrition

Health and Well-being

Biodiversity and Nature-based Solutions

Mineral and Genetic Resources

Sustainable Tourism

https://www.blueclimateinitiative.org

Personal / scientific eSubmarines now under development

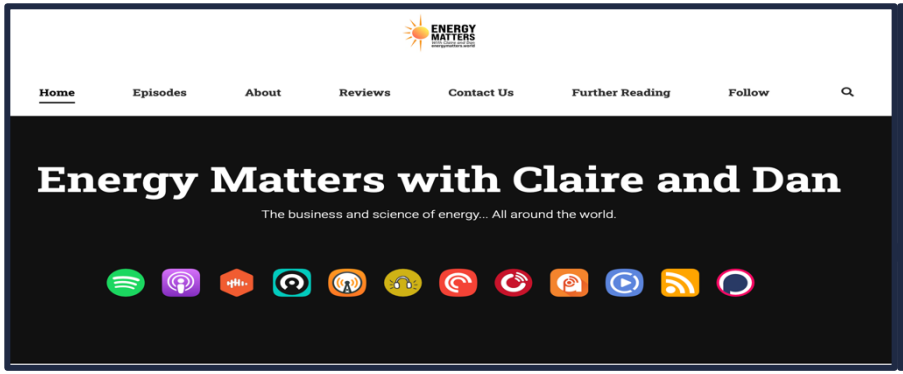
Precision **Ecotourism and science**

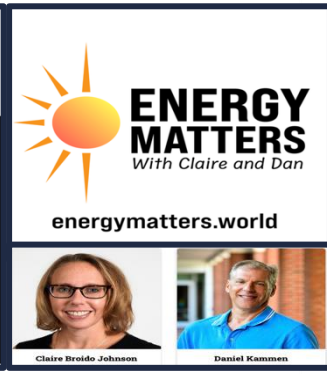
Avenues to interact:

1. The Ralph O'Connor Sustainable Energy Institute http://energyinstitute.jhu.edu
   Bluesky: @dankammen.bsky.social
   Twitter: @dan_kammen

2. *Energy Matters* podcast

   http://energymatters.world





3. The Renewable Energy & Equity Worldwide Lab: https://kammen.wse.jhu.edu


10:16
LTE
Reels
Billionaires who donated their wealth to charity:
Jamsetji Tata: $102.4 Billion donated
Bill Gates: $75.8 Billion
Warren Buffett: $32.1 Billion
George Soros: $32 Billion
Azim Premji: $21 Billion
MacKenzie Scott: $14 Billion
Michael Bloomberg: $12.7 Billion
Li Ka-Shing: $10.7 Billion
Andrew Carnegie: $9.5 Billion
Elon Musk: $7.6 Billion
128
4
22
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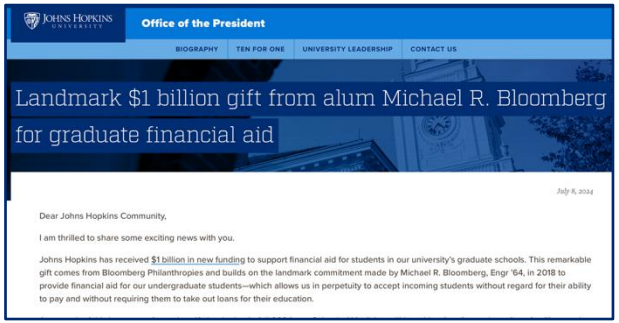
Office of the President
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Landmark $1 billion gift from alum Michael R. Bloomberg for graduate financial aid
July 8, 2024
Dear Johns Hopkins Community,
I am thrilled to share some exciting news with you.
Johns Hopkins has received $1 billion in new funding to support financial aid for students in our university's graduate schools. This remarkable gift comes from Bloomberg Philanthropies and builds on the landmark commitment made by Michael R. Bloomberg, Engr '64, in 2018 to provide financial aid for our undergraduate students—which allows us in perpetuity to accept incoming students without regard for their ability to pay and without requiring them to take out loans for their education.


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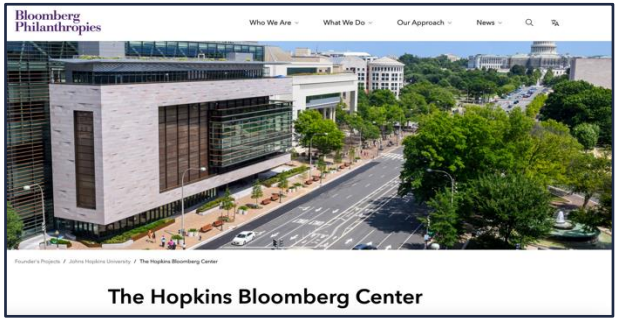
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Our Approach
News
The Hopkins Bloomberg Center


Mike Bloomberg will donate $600m to historically Black medical schools
Gifts to 'diversify the medical field' will give millions to schools like Howard University College of Medicine
National Medical Association
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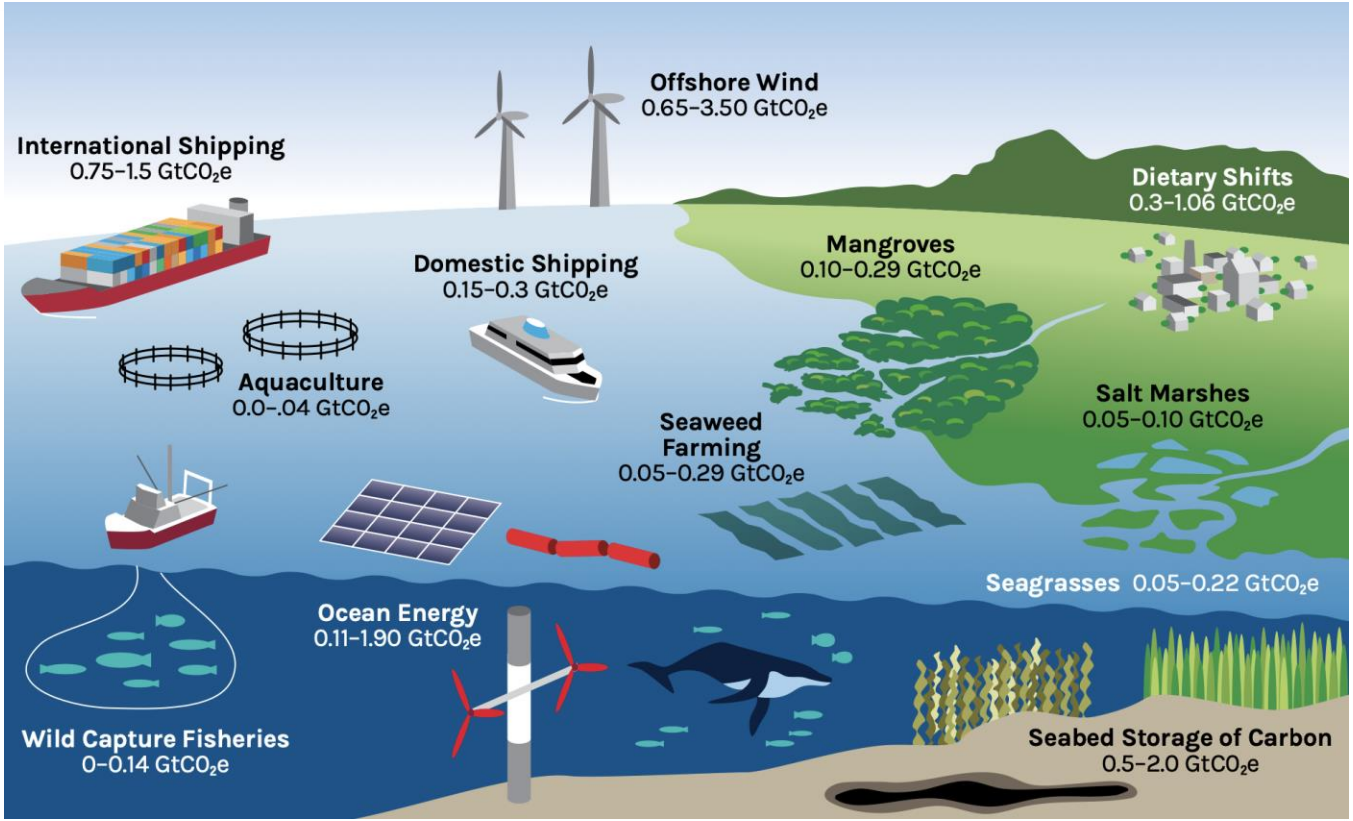
Our Approach
Press Releases
Bloomberg Philanthropies Makes Medical School Free at Johns Hopkins University for Majority of Students
July 8, 2024
Public Health
Bloomberg Philanthropies
New $1 Billion Gift Addresses Decline in U.S. Life Expectancy by Covering Costs for All Medical School Students with Limited Means and Increasing Financial Aid at Schools of Nursing, Public Health, and Other Graduate Schools
100 Percent of Tuition Will be Covered for Medical Students from Families Earning Under $300,000 - Representing 95 Percent of All Americans - With Living Expenses

Ocean solutions:

We need to reduce emissions by 30 – 40 Gt CO_2



Hoegh-Guldberg. O., *et al.* (2019). "The Ocean as a Solution to Climate Change: Five Opportunities for Action." Washington, DC: World Resources Institute. http://www.oceanpanel.org/climate