
How the History of Computers Predicts the Future of Energy

Computer Museum of America

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Author of Freeing Energy

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FreeingEnergy



Every form of technology has evolved and transformed the world... except the grid

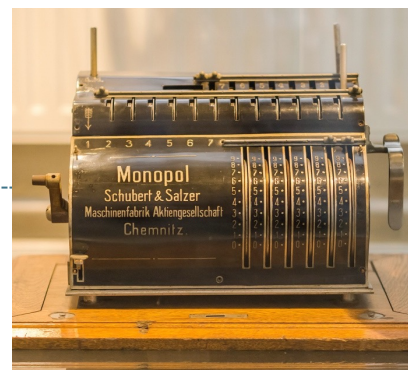
FLIGHT



COMMUNICATIONS



COMPUTING



ELECTRIC GRID



1920s

2020s

BILL & TED'S EXCELLENT ADVENTURE



One of the last operating UNIVAC computers (c. 1969)

UNIVAC

8 Tons

5,000 Vacuum Tubes

\$10M (2022\$)

1,900 ops/sec

Mac Laptop

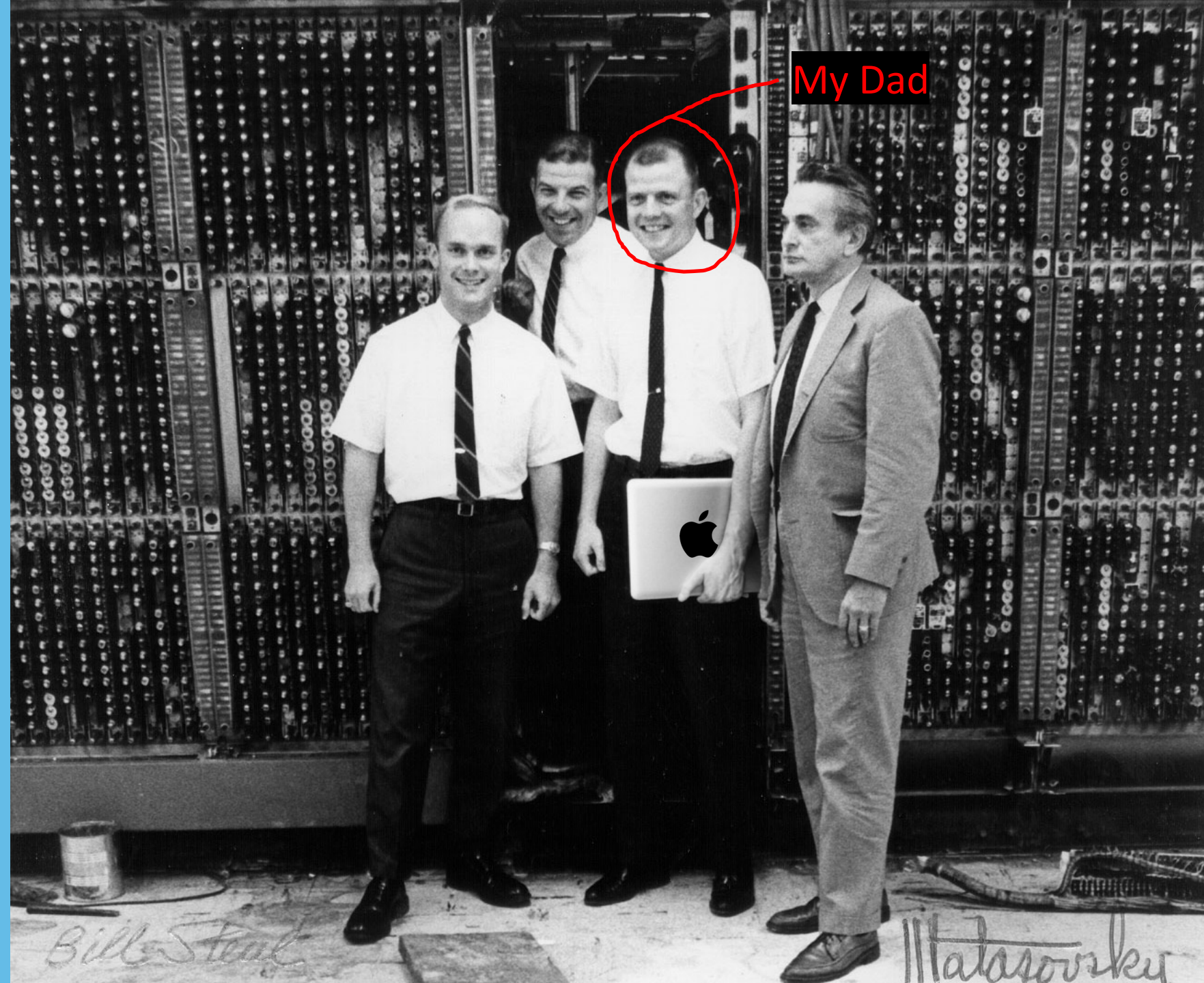
(Photoshopped in)

3 pounds

16 billion transistors

\$1000

36,000,000,000 ops/sec



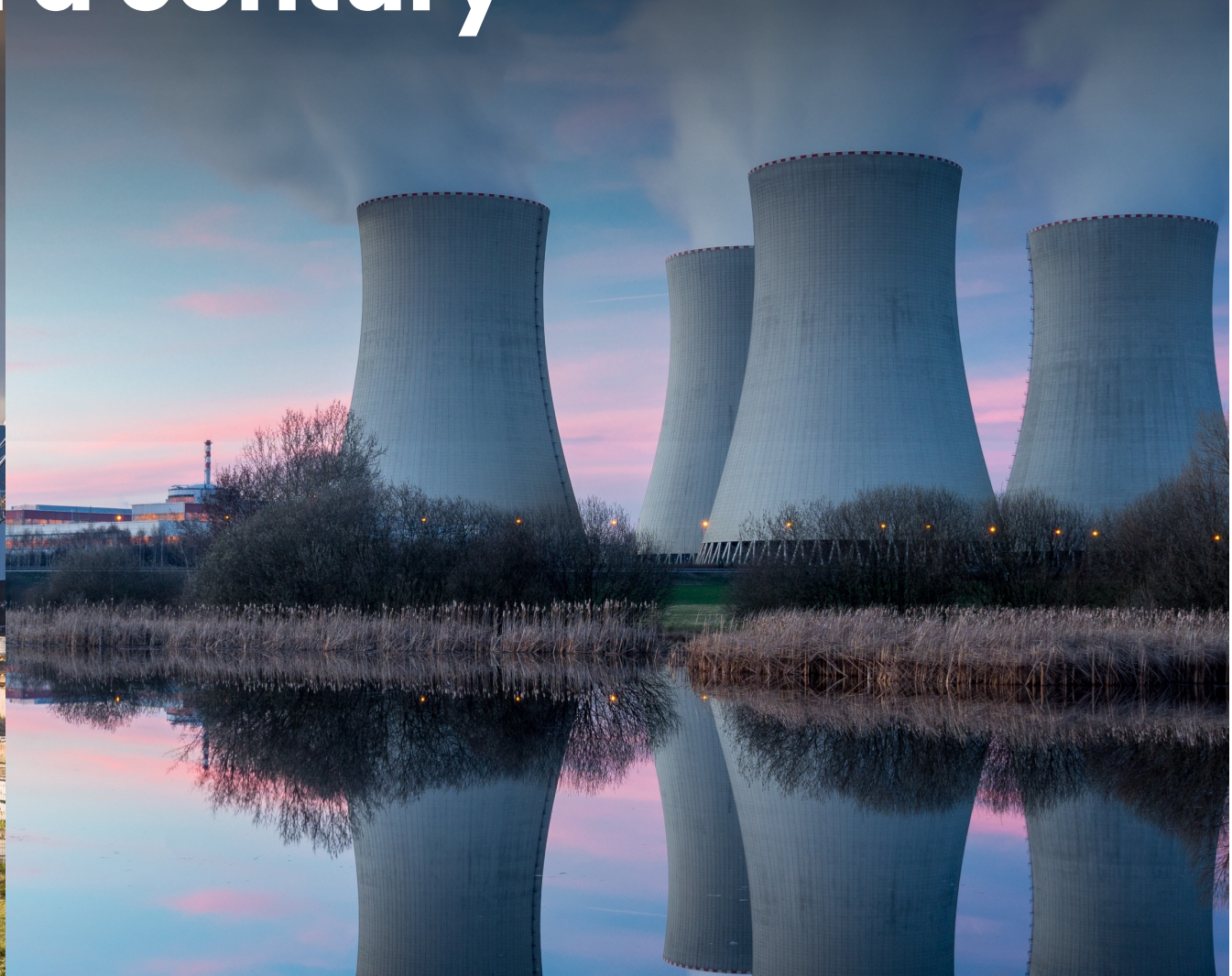
My Dad

Bill Steak

Matasovsky



Traditional energy has been purely fuels-based for more than a century



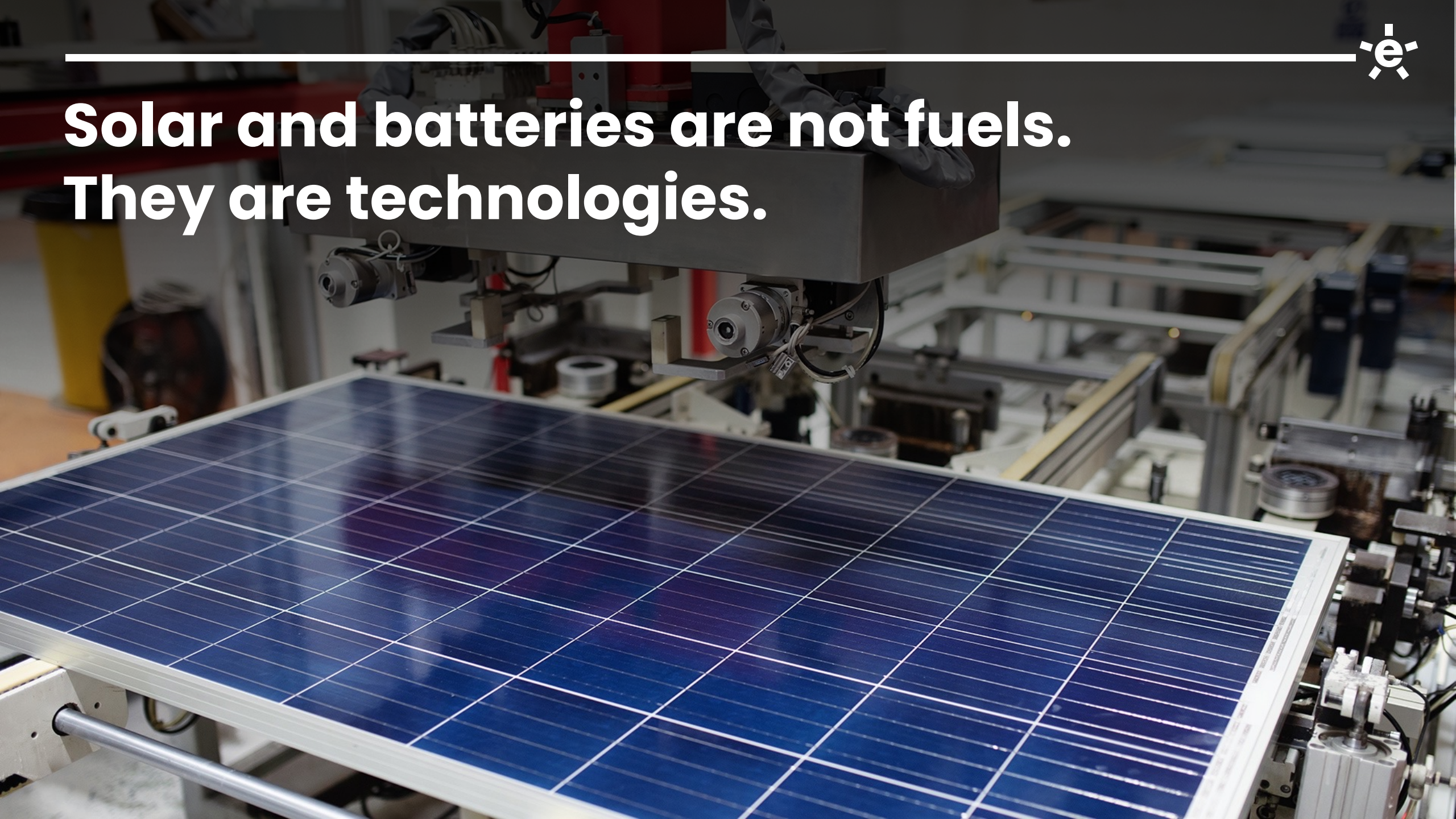


The shift to renewable energy is well underway but most people miss the most profound change taking place...





**Solar and batteries are not fuels.
They are technologies.**

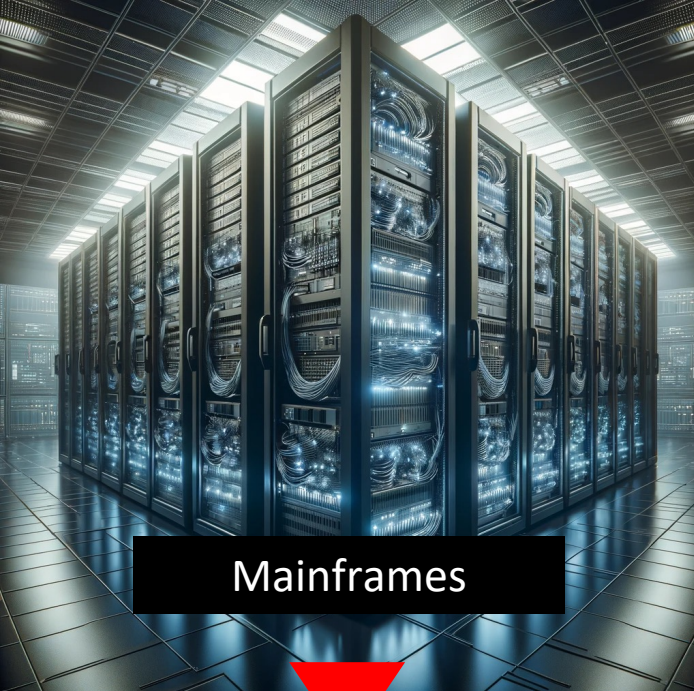


And unlike any previous energy generation system, only solar and batteries can be manufactured in massive quantities.

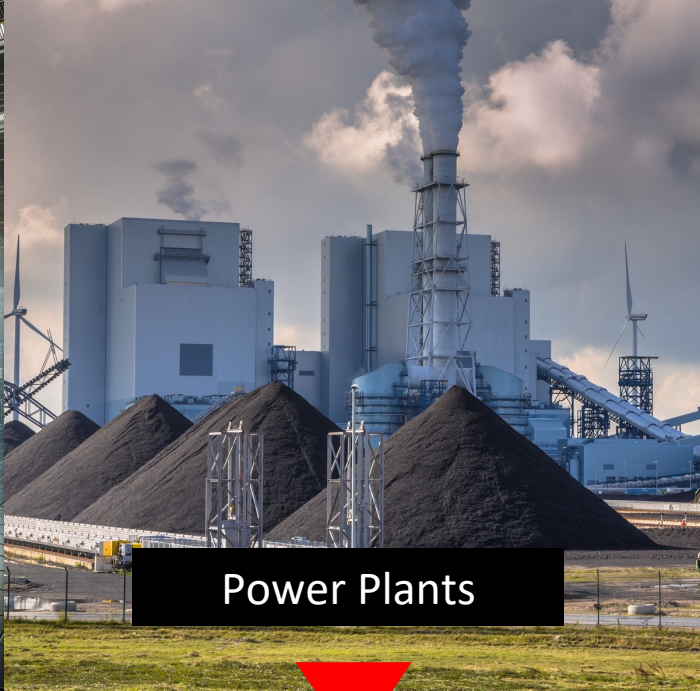
For the first time in history, energy has the same economic model as computers.



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Mainframes



Power Plants



Small-scale solar



Laptops and Phones

Like computers, energy is shifting from economies of scale to economies of volume

From a few very large things to millions of very small things



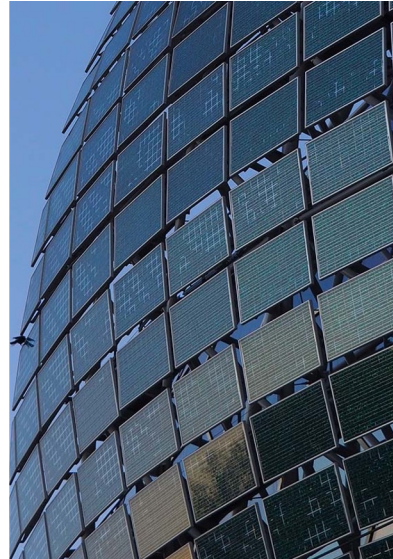
Local Energy



Community solar



Rooftop solar



Building
integrated



Microgrids &
batteries

Solar price drops

Ironically, it was computer tech, like silicon chip making and laptop batteries that shaved decades off the scaling of clean energy costs.

Changes in the cost of generating electricity over a decade
(levelized cost of energy (LCOE) in cents per kilowatt hour from 2010 to 2020)

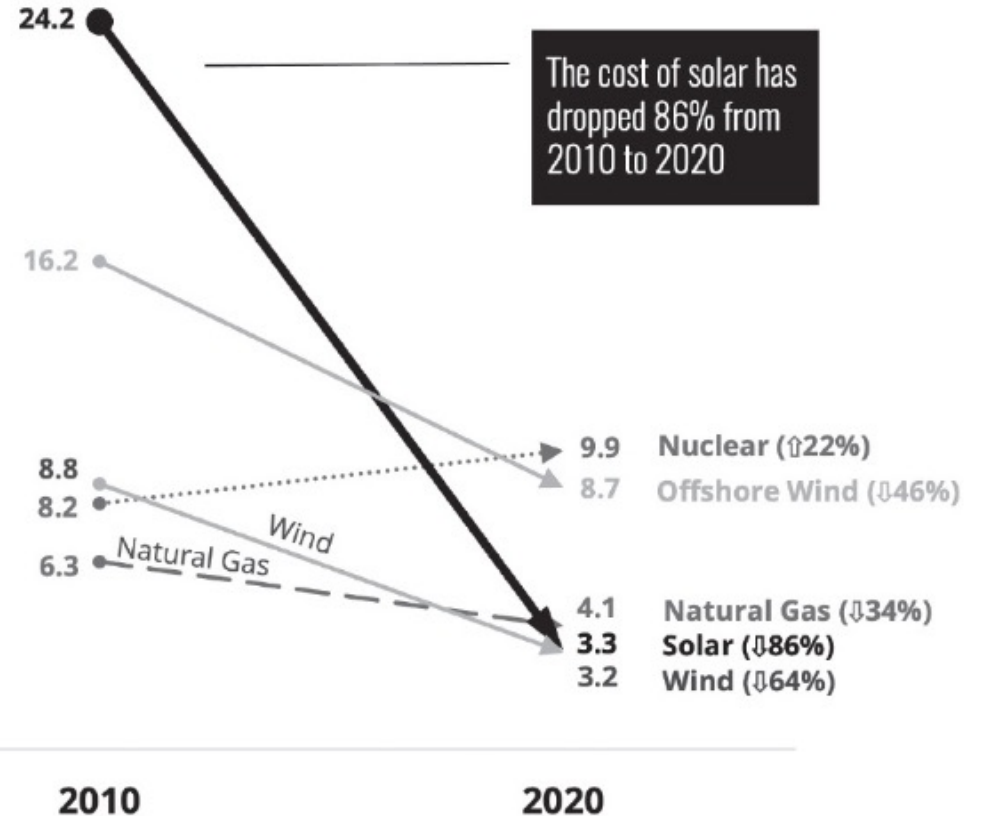


FIGURE 4.7 Between 2010 and 2020, the cost of generating electricity from solar has dropped further and faster than the costs declines of natural gas, solar, onshore wind or offshore wind. Sources: EIA, NREL, LBNL, Wood Mackenzie, BNEF, and Lazard (freeingenergy.com/g210).



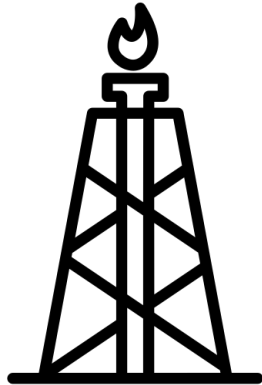
Methods of generating electricity by count



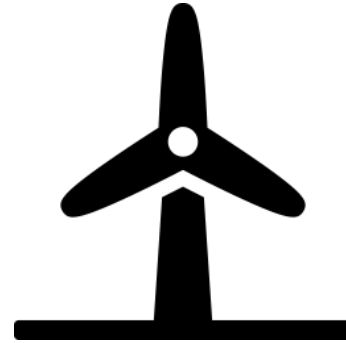
440
Nuclear
Plants



2,400
Coal
Plants



3,900
Gas
Plants



500,000
Wind
Turbines

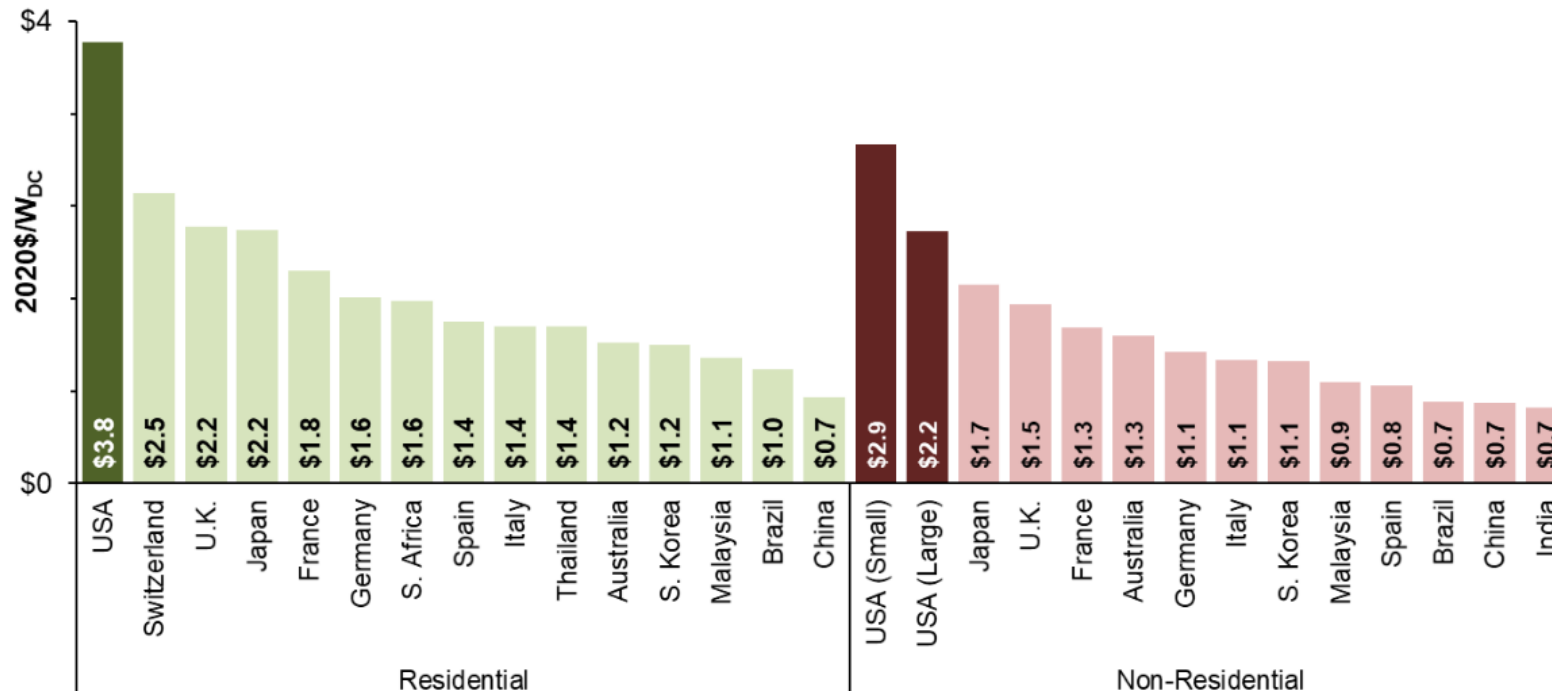


120,000,000,000
Solar
Cells



Local-scale solar is far cheaper in other countries; the US can catch up

Comparison of Installed Prices in 2020 across Countries



Notes: Installed prices for countries other than the USA are from the International Renewable Energy Agency (IRENA)'s "Renewable Power Generation Costs in 2020" report and are derived from IRENA's Renewable Cost Database. For the Non-Residential sector, data from IRENA generally refer to systems up to 500 kW in size, and thus encompass both the Small and some portion of the Large Non-Residential segment used within Tracking the Sun.

- The largest driver of expensive US local energy is soft-costs
- US drivers of soft-costs are being addressed and will almost certainly result in far lower costs of small-scale energy systems
- California just embraced a solution called SolarAPP+ that will greatly streamline permitting and interconnection



Local energy's future is being created by entrepreneurs.

Systems like microgrids are invented and sold outside electric monopolies, unleashing Silicon Valley-like innovation.



Laptops & Phones vs Mainframes

...Far cheaper

...Universally available

...Better and faster innovation

Just like local energy vs the Big
Grid



The Next Step:

The Energy Internet

The power of technology and rapidly declining costs are more powerful than politics, monopolies, and Big Tech.

Like Mainframes and laptops, local energy will disrupt the Big Grid from the outside in.



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What is the energy internet?

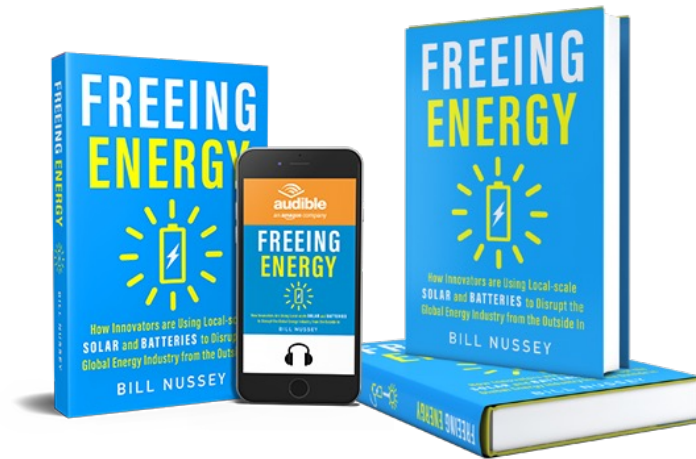
- Ironically, the grid is already reliant on computers and computer networks.
- This is creating a massive security risk we are seeing play out in the Ukraine war.
- Electrical vehicles are driving the cost of “power electronics”
- The “brains” of electricity production are moving from central systems to distributed systems.



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To learn more about local energy...



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amazon

#1 New Release

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