

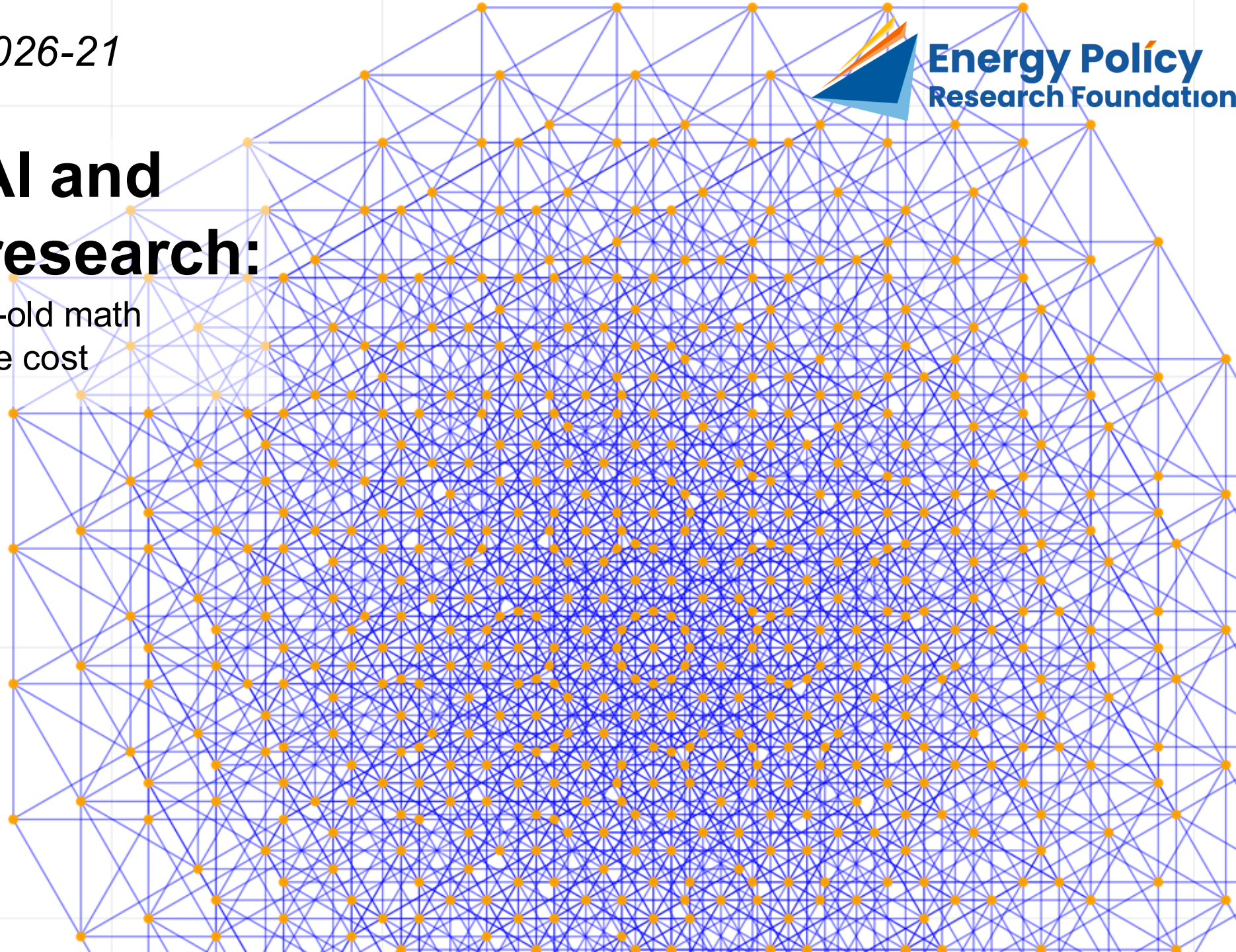
Chart of the Week #2026-21
June 4, 2026

The value of AI and fundamental research:

An LLM cracks an 80-year-old math
problem for a fraction of the cost

The **Erdős unit-distance
conjecture** long believed
unbreakable was resolved by a
general reasoning model in
about **32 hours of compute,**
for roughly \$1,000.

*Right: The AI's winning construction:
a new family of point arrangements
with more unit-distance pairs than
the 80-year-old bound allowed.*



A Fully Automated Solution

- No research directions were given to the model. The statement was simply stated precisely, then the model was told to solve it completely, no partial credit allowed.

Prompt.

Let $P \subset \mathbb{R}^2$ be a finite set of distinct points. Define

$$\nu(P) = \left| \left\{ \{p, q\} \in \binom{P}{2} : \|p - q\|_2 = 1 \right\} \right|$$

and, for each integer $n \geq 1$, $\nu(n) = \max_{\substack{P \subset \mathbb{R}^2 \\ |P|=n}} \nu(P)$.

Resolve Erdős's planar unit-distance problem completely: $\nu(n) \leq n^{1+O(1/\log \log n)}$ as $n \rightarrow \infty$? Equivalently, determine whether there exist absolute constants $C > 0$ and $N \in \mathbb{N}$ such that $\nu(n) \leq n^{1+C/\log \log n}$ for every integer $n \geq N$. Here \log denotes the natural logarithm, and N may be taken large enough that $\log \log n > 0$. The hidden constant in $O(1/\log \log n)$ is absolute and independent of P and n .

A complete solution must prove exactly one of the following.

Affirmative resolution. Prove that there exist absolute constants $C > 0$ and $N \in \mathbb{N}$ such that every set $P \subset \mathbb{R}^2$ of $n \geq N$ distinct points satisfies $\nu(P) \leq n^{1+C/\log \log n}$.

Negative resolution. Prove that no such constants exist. Equivalently, prove that for every $C > 0$ and every $N \in \mathbb{N}$, there are an integer $n \geq N$ and a set $P \subset \mathbb{R}^2$ of n distinct points such that $\nu(P) > n^{1+C/\log \log n}$.

Pairs are unordered, the distance is the usual Euclidean distance in \mathbb{R}^2 , and the asymptotic assertion is for all sufficiently large integers n , not merely infinitely many n .

Partial progress does not count unless it implies one of the two resolutions above. In particular, improved bounds such as $O(n^{4/3-\epsilon})$, better constants in the $n^{4/3}$ bound, finite verification, special cases, structural reductions, or heuristic evidence are insufficient unless they prove the full Erdős bound or disprove it.

— **Statement of Problem**

— **Restatement of Problem**

— Notational clarification

— Restatement of problem 3rd time; explicitly what a proof or disproof would need to show

— More notational clarification

— **No Partial Credit Allowed;** do not stop until you have proved or disproved it

The exact prompt fed to the model.

“There is no doubt that the solution to the unit-distance problem is a milestone in AI mathematics: if a human had written the paper and submitted it to the Annals of Mathematics and I had been asked for a quick opinion, I would have recommended acceptance without any hesitation”

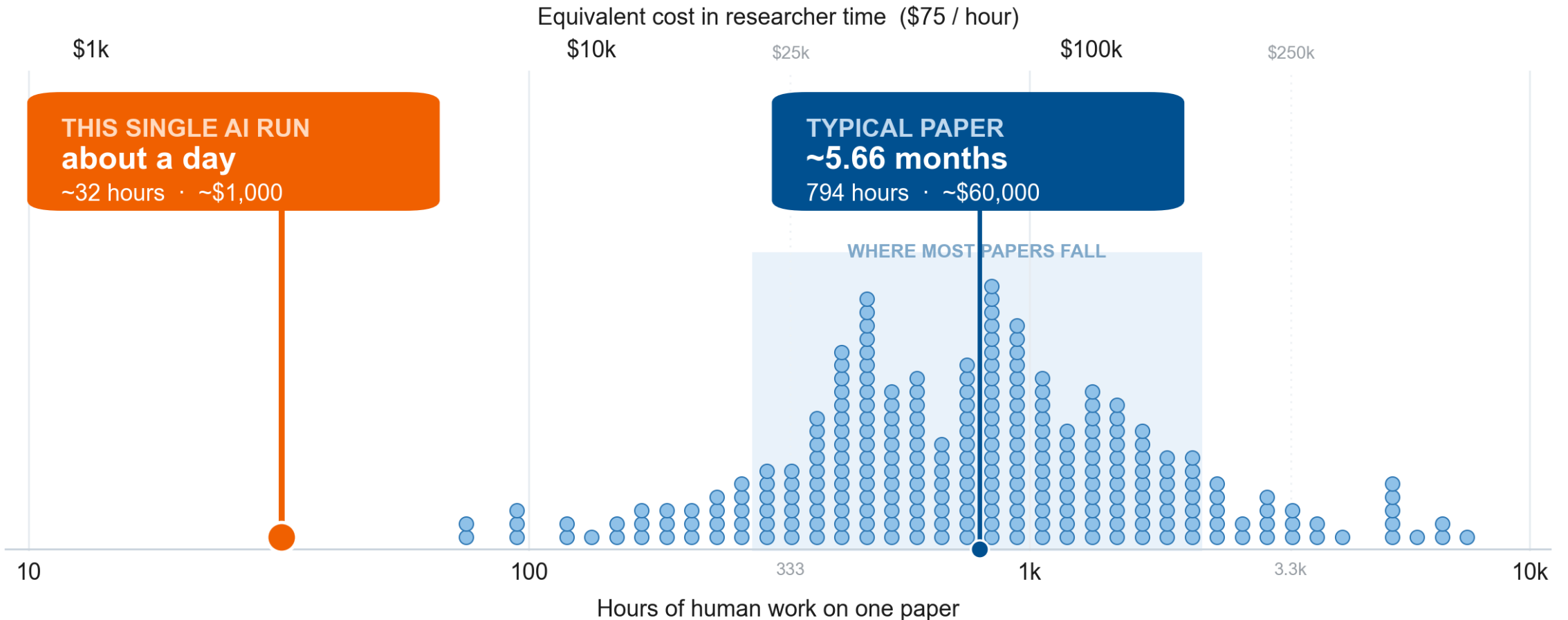
— Timothy Gowers, Fields Medalist

SO, WHAT'S “ANNALS-WORTHY” ACTUALLY WORTH?



Estimated effort per Annals of Mathematics paper, in work-hours and salary-equivalent cost

Each dot is one of 262 papers (2018–2025); a single AI-generated proof is shown for comparison.



Source: EPRINC analysis of 262 Annals of Mathematics papers (2018–2025), cross-referenced with author preprint records.
Dollar axis shows hours × \$75/hour of researcher time. AI cost is the reported compute amount, not hours × rate.

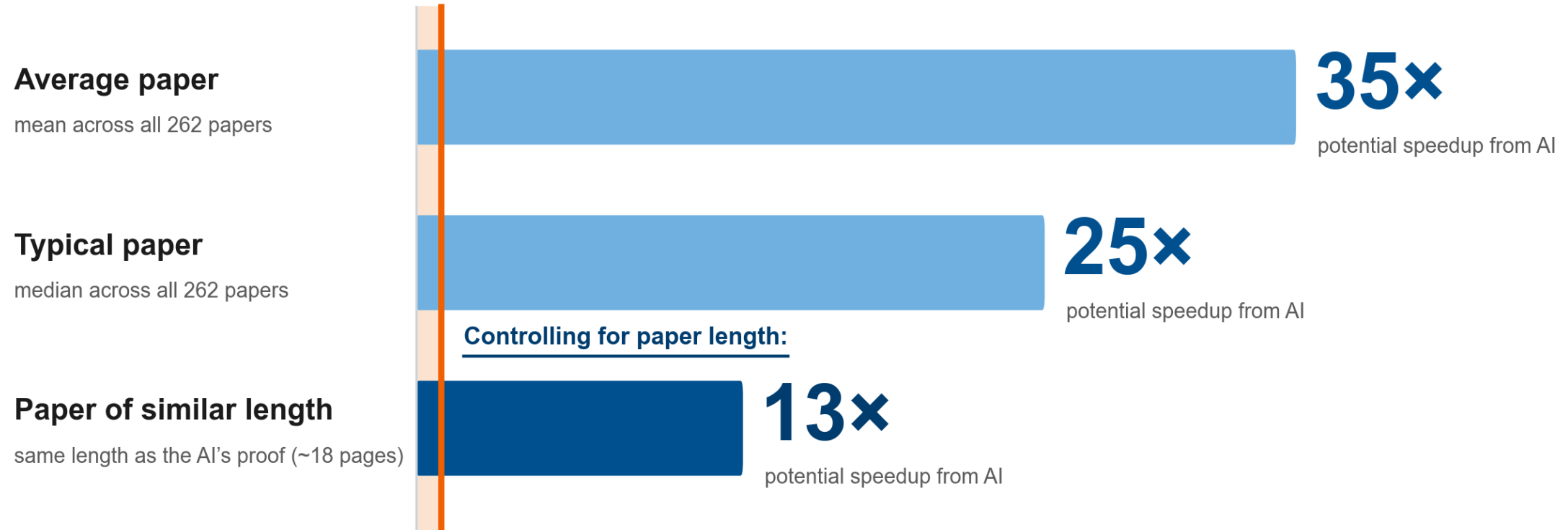


Ratio of estimated human to AI work-hours per Annals of Mathematics paper

Human effort for an average, typical, and length-matched paper, each compared with a single AI run (~32 hours, 2026).

Baseline from this AI run = 1×

about a day · ~32 hours



Source: EPRINC analysis of 262 Annals of Mathematics papers (2018–2025). The bottom bar (length-matched) is the most defensible comparison because it controls for paper length.

The Value of AI and the need for Reliable Electricity at Scale

- There are limited practical applications to this specific problem, however the result shows that ***AI can potentially solve certain open problems more efficiently than mathematicians***. The proof the computer found was highly ingenious, involving connecting algebraic number theory to a seemingly unrelated field, a link previously unexplored
- ***At present, AI's application in research mathematics remains limited***. This problem was in many ways ideally suited for LLM attack with many optimization decisions needing to be made in the specific choice of number field.
- A year ago AI struggled to do basic high school math. The trajectory has been improving astronomically
- This proof was checked and improved upon by mathematicians. ***The key bottleneck remains verification***; while when properly prompted AI can quickly confidently claim many solutions, verifying that these claims are correct takes human labor. Some mathematicians are currently working on this.
- Even if AI is used in a small subset of fundamental research tasks, it could lead to ***exponential speedups in research times across fields***, leading to breakthroughs at rates previously unimaginable. What's currently achievable previously in months to years may be achievable in weeks to days.
- This point means policymakers should adopt ***an increased likelihood that far-out technologies may be much closer than we imagined***, thus have higher expected returns. Two examples might be nuclear fusion or cancer
- AI has the potential to be immeasurably valuable to the U.S. economy, and its development should be prioritized
- ***These breakthroughs are only possible with a reliable and robust electricity grid, deployed quickly at scale***. We are entering an era where there is a direct conversion between electricity and technological breakthroughs

Further Reading and Research

- This slide deck is available at: <https://eprinc.org/chart-of-the-week/>
- For more information on this chart, please contact Matthew Sawoski (matthews@eprinc.org)
- The Energy Policy Research Foundation is committed to further research on this topic, and is considering launching a “Value of AI” research program focusing on mapping the potential policy implications of research speedups to the American economy, and what that means for energy demand. Contact us for more.

