

AI and the Environment : Impacts and Benefits

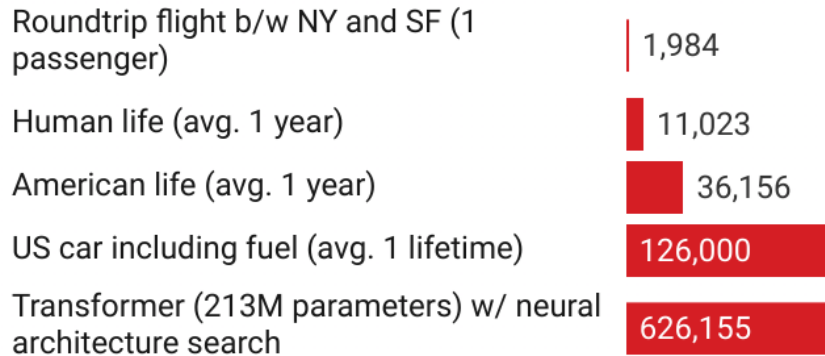
Sasha Luccioni

*ITU virtual workshop on AI & environmental efficiency
December 9th 2020*

Training a single AI model can emit as much carbon as five cars in their lifetimes

Common carbon footprint benchmarks

in lbs of CO2 equivalent



“OpenAI recently published GPT-3, the largest language model ever trained. GPT-3 has 175 billion parameters and would require **355 years and \$4,600,000** to train - even with the lowest priced GPU cloud on the market.”



Estimate and Track carbon emissions from the compute, quantify and analyze their impact.

[Official Documentation](#)

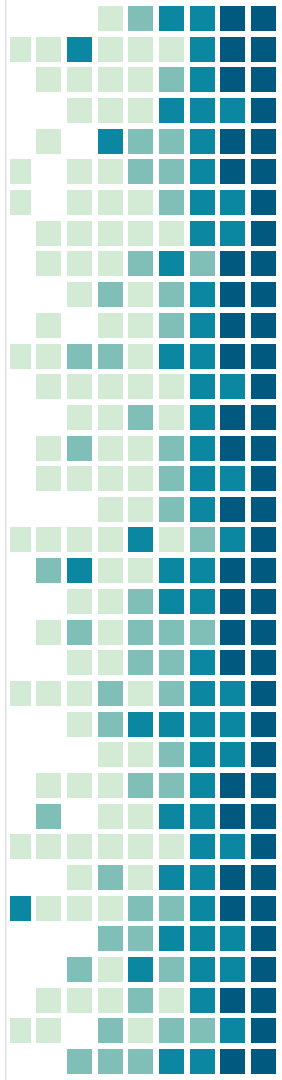
CONDA|CODECARBON

v0.1.0

PYPI

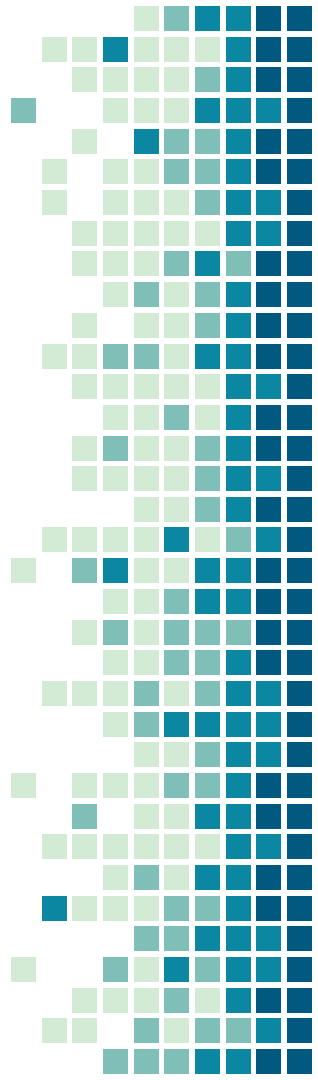
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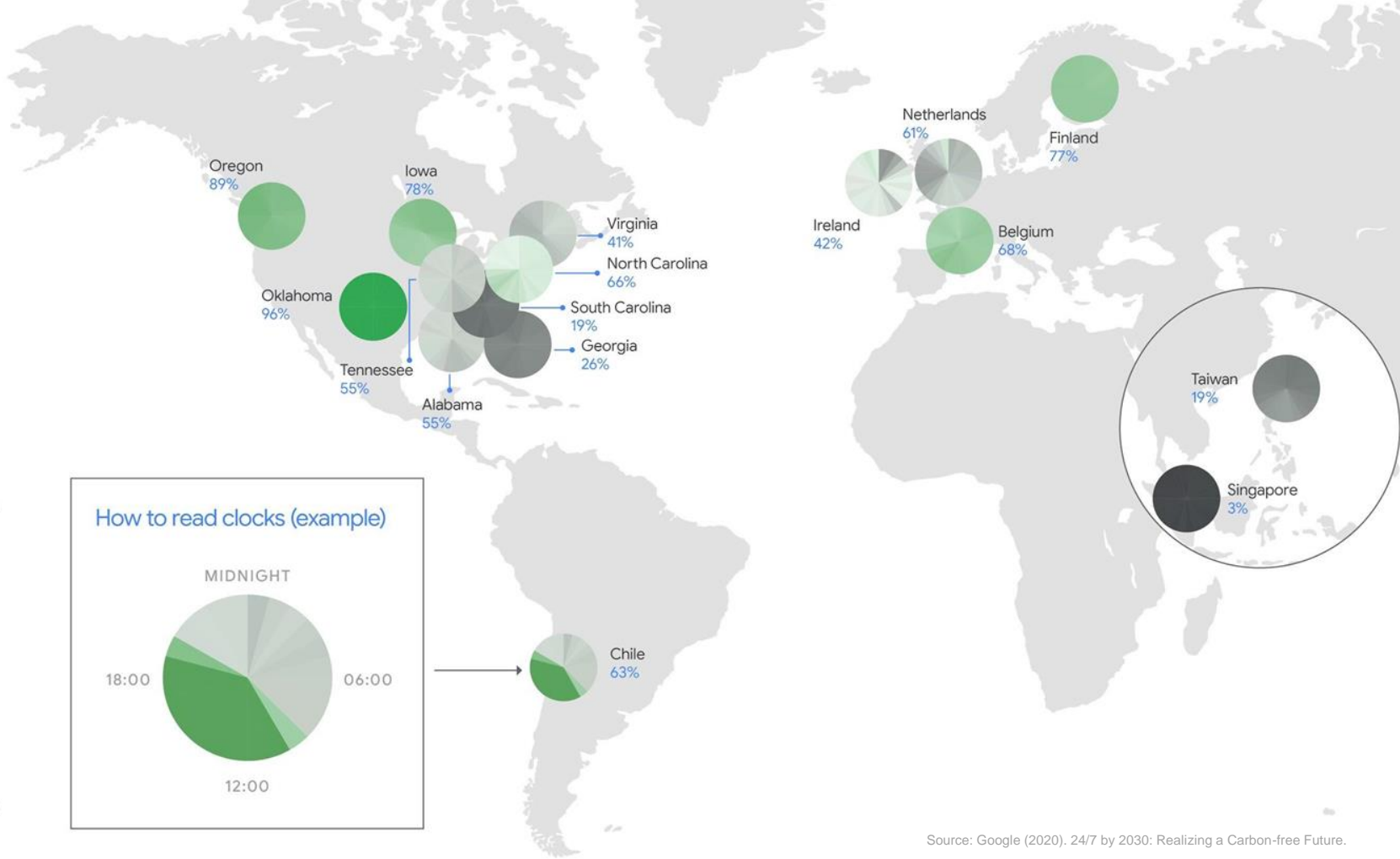
- [About CodeCarbon](#)
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Type of Energy Used

- AI's carbon emissions can vary up to a **factor of forty** depending on the grid's energy mix.
 - e.g. : Quebec, Canada: **20 grams of carbon per kWh,**
 - vs. Queensland, Australia: **800 grams of carbon.**
- This can really add up for a large neural network requiring a few GPUs for several weeks, resulting in almost a ton of carbon, or the equivalent of a transatlantic flight.





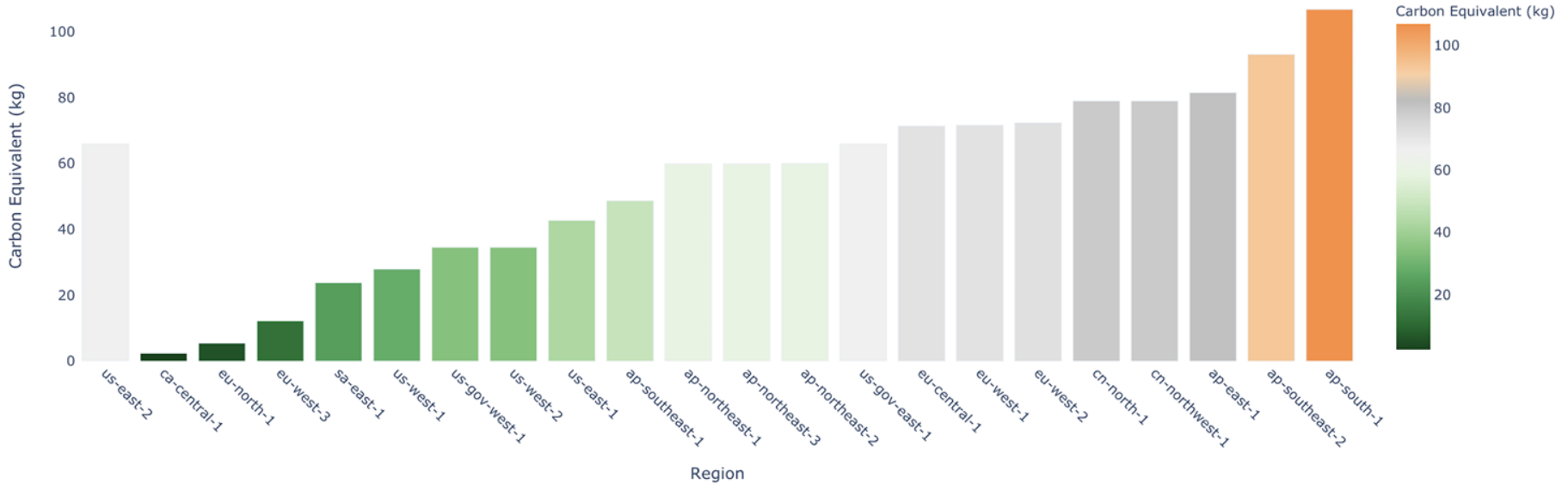
Source: Google (2020). 24/7 by 2030: Realizing a Carbon-free Future.

Choice of Cloud Provider

- Some large cloud providers are already **carbon neutral**, which means they have a *net zero* carbon footprint.
 - This is done through **carbon offsetting** and **renewable energy credits** (RECs)
- Google recently announced its goal of achieving 100% *carbon-free, 24/7 electricity* by 2030.
- Microsoft is aiming to be *carbon negative* by 2030



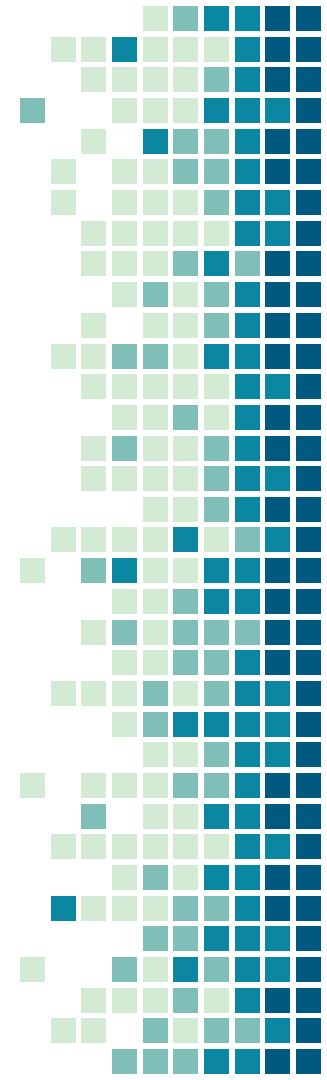
Emissions Across Amazon Web Services Regions



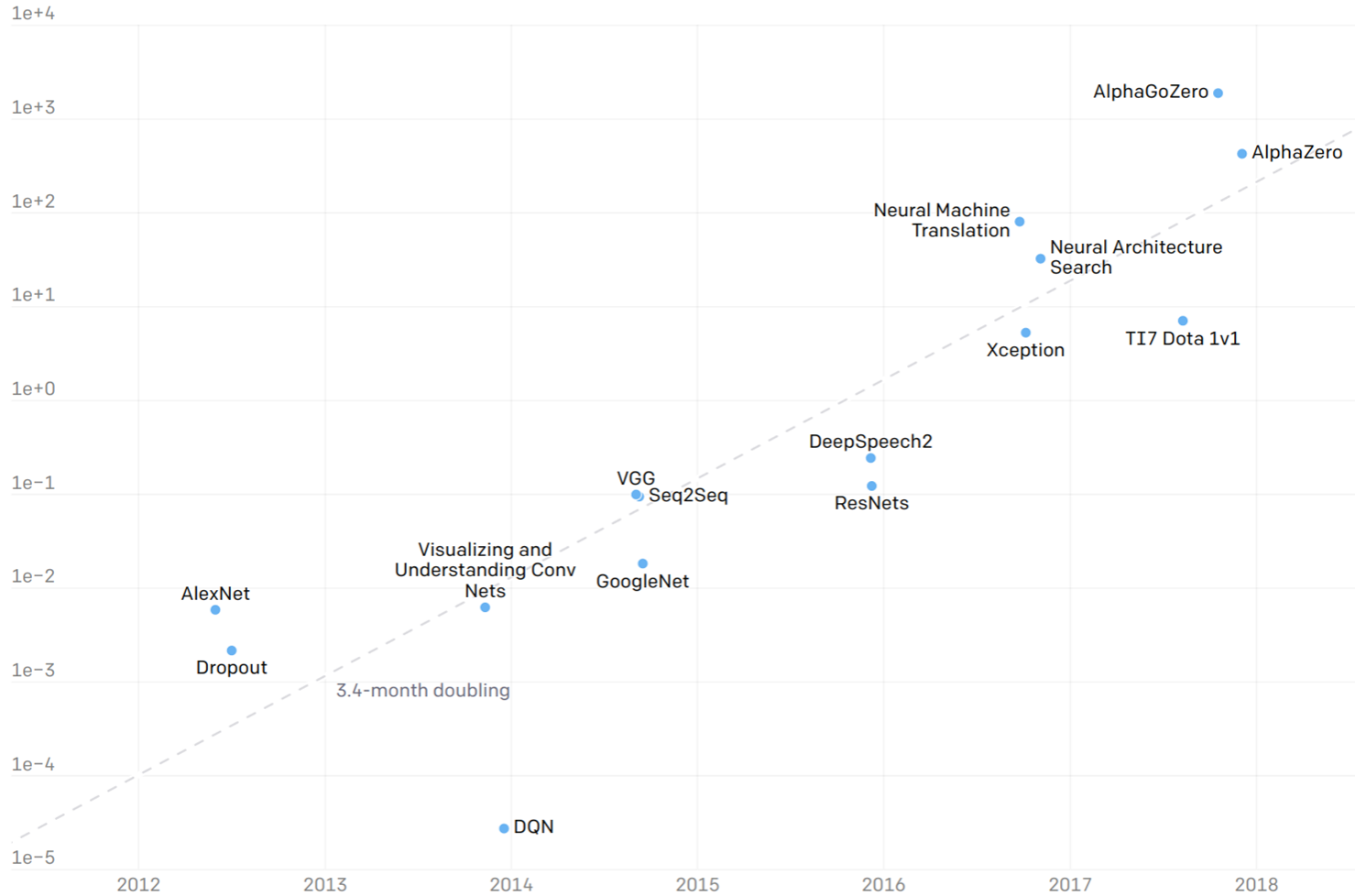
Had this been run in **ca-central-1** region,
then the emitted carbon would have been **2.3 kg**
Reducing the current emissions by **63.6 kg**

Training Time

- **Before 2012:** it was rare to use GPUs for Machine Learning, and the progress made was rather at the fundamental level
- **2012 to 2014:** The infrastructure to train on many GPUs was scarce, so most results used 1-8 GPUs rated at 1-2 TFLOPS
- **2014 to 2016:** Large-scale results used 10-100 GPUs rated at 5-10 TFLOPS,
- **2016 to 2017:** approaches that allow greater algorithmic parallelism, and we often use several hundred GPUs for weeks or months.

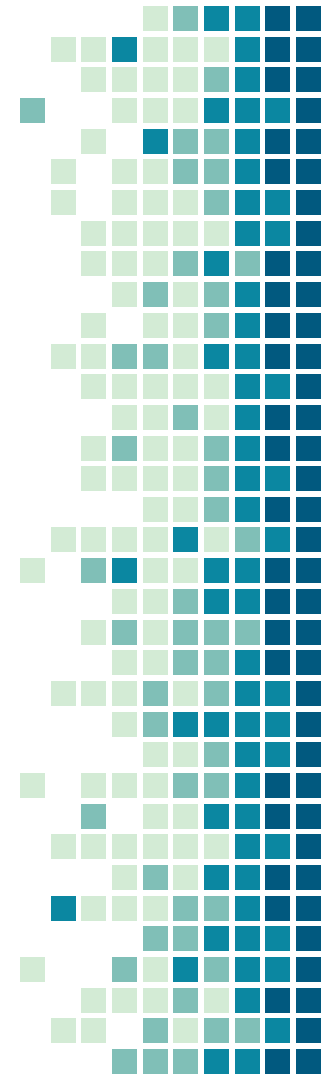


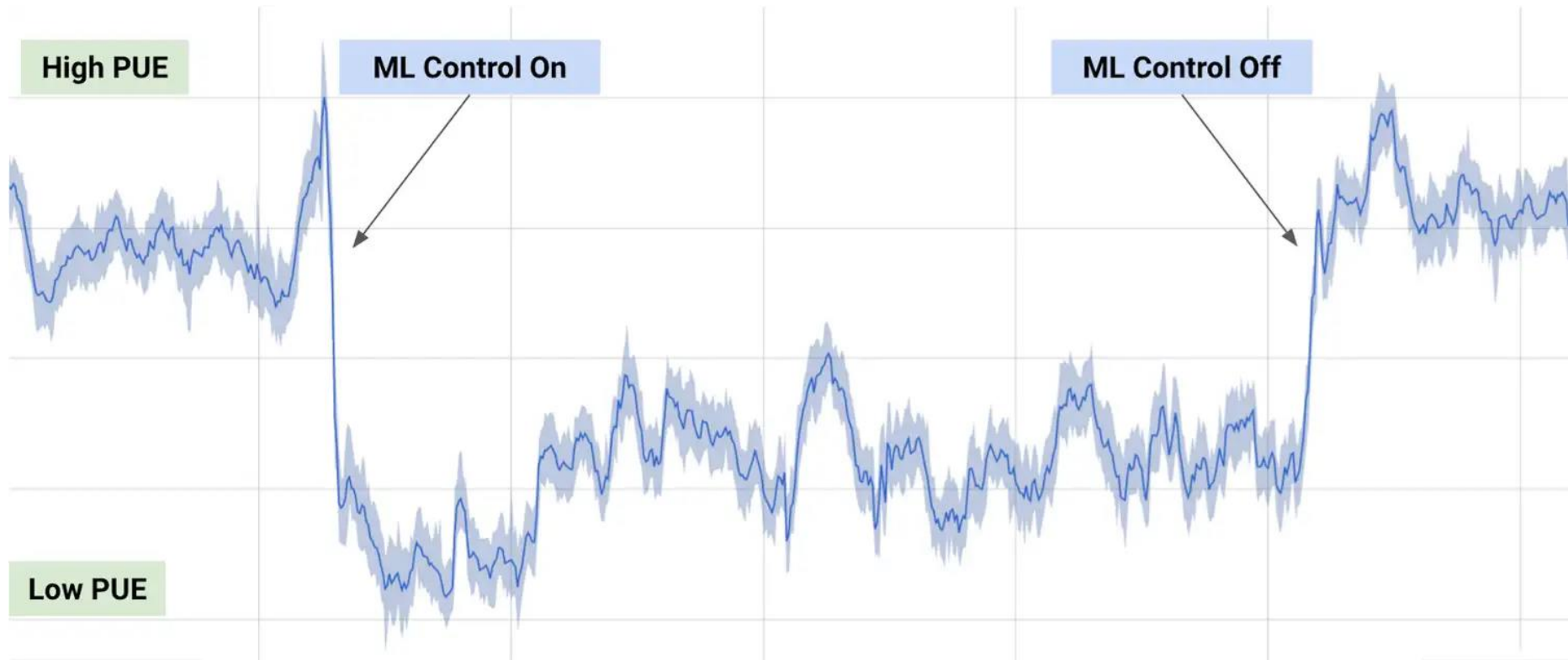
Petaflop/s-days



Source: Open AI (<https://openai.com/blog/ai-and-compute/>)

But there's hope! Thanks to AI



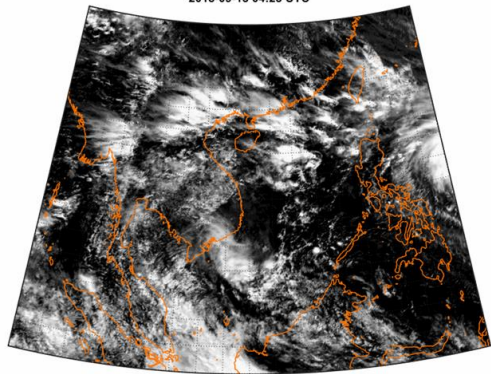


Source: <https://deepmind.com/blog/article/deepmind-ai-reduces-google-data-centre-cooling-bill-40>

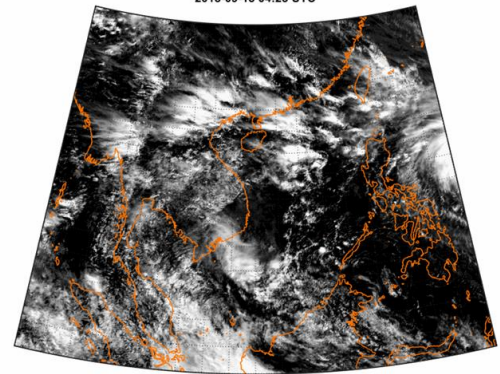


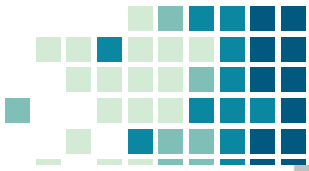
SOLCAST

estimated actual cloud opacity
2018-09-13 04:23 UTC



ensemble forecast, +00mins
2018-09-13 04:23 UTC





Rooftop solar potential

Google estimate

957,000

Total tCO₂e per year

Source:

Based on 97% data coverage over buildings in this geographic area. All estimates are based on buildings viable for solar panels.

Time period:

Annual value based on surveyed buildings in September 2014.

Key assumptions:

Included panels receive at least 75% of the maximum annual sun in the city. For Montreal, the average value of the threshold is 937.55 kWh/kW.

Potential emissions reductions equivalent to

Passenger cars

202,000

taken off the road for 1 year

Tree seedlings

24,500,000

grown for 10 years



