Contribution ID: **15** Type: **not specified**

The 3 most important factors in datacenter planning: Location, location, location

Wednesday 11 December 2024 13:45 (15 minutes)

The single largest factor in determining the CO2 footprint of a compute resource is the CO2 intensity of the electricity used to power it. The carbon intensity ranges from 20 to 800gCO2/kWh, depending on the energy mix of the region. Due to the interconnectivity of the European electricity grid, it is not sufficient to look only at the regional electricity carbon intensity, but also at that of interconnected regions that could use that same energy. In a very real sense, a MW lower consumption in France can replace a MW of coal generated electricity in Germany.

On the other hand, there is very limited interconnectivity between the low carbon intensity Nordic grids and central Europe. An unused Nordic kWh cannot be transferred to reduce German generation from coal. It follows that locating our compute resource in Sweden, rather than central Europe, reduces its carbon footprint from around 1000gCO2/kWh to 20gCO2/kWh. One can question the assumptions in reaching the factor 50 improvement, but this will anyway make any O(10) percent improved efficiency of server, cpu, cooling, software, etc rather negligible.

We describe the power grids, interconnects and bottlenecks which lead to the objective conclusion that we should locate our computing where low carbon power is abundant and cheap but not transmittable. We also explore the artificial constraints which make minimizing CO2 emissions in this way a frustratingly futile endeavour.

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Session Classification: Infrastructure

Track Classification: All contributions