Green-aware, Cooling-aware and Cost-Aware Scheduling of Cloud Workloads on Geo-Distributed data centers

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GEO-DISTRIBUTED DATACENTERS

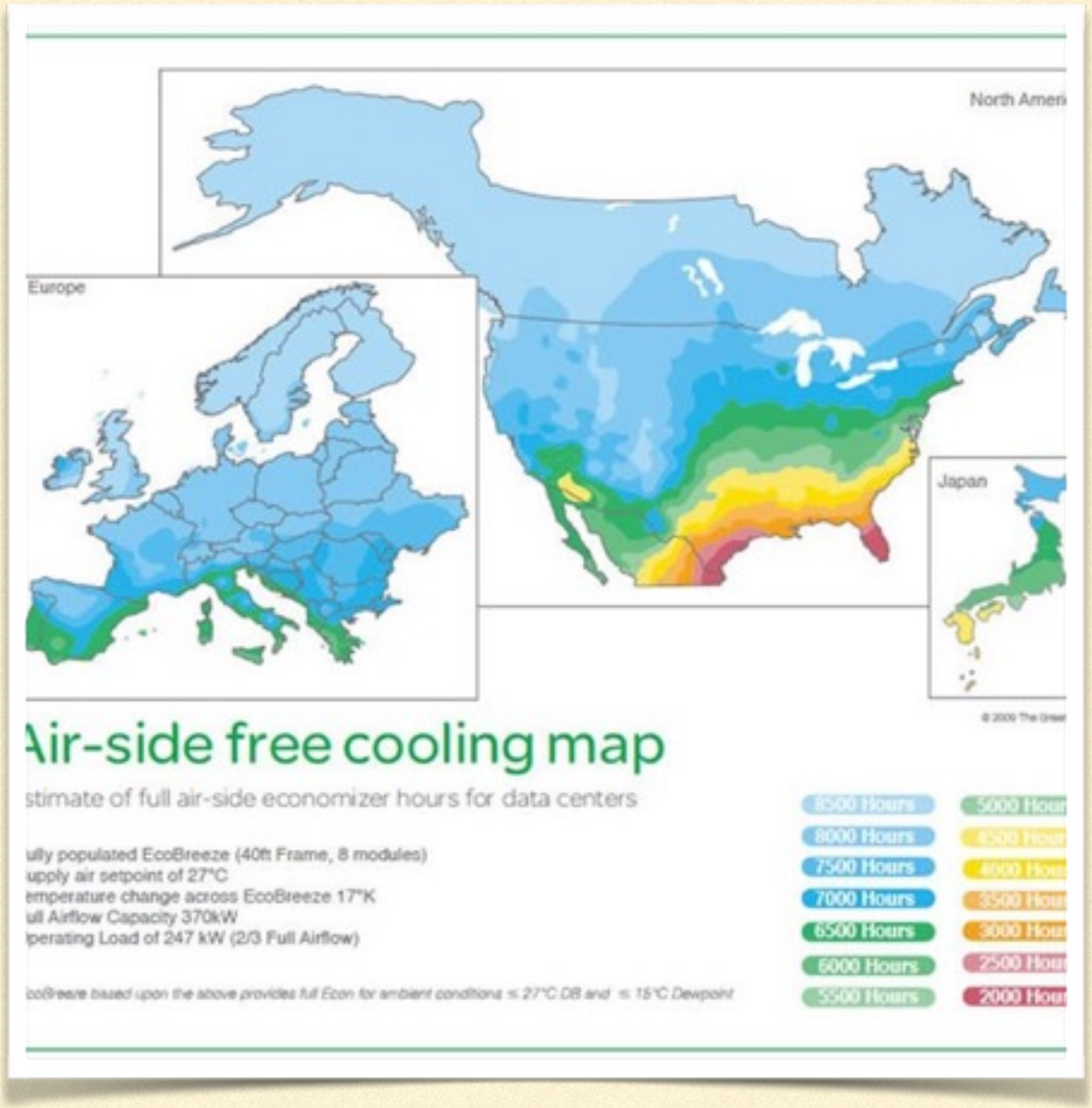
Google's data centers around the world

- All major cloud/internet companies have geo-dispersed data centers
- Facebook, Google, Microsoft etc
  - improved latency for geo-distributed customers
  - safe-guard against failures
- Example:
  - Google: 13 data centers over 8 countries in 4 continents

GREEN AWARE

- Renewable on-site energy supplies available in some data center
  - Solar and wind energy
    - Example: Apple's North Carolina data center (Solar panels)
- Maximize the use of these resources depending on their availability. (Solar energy may not be available during night time)
- Green resources might be costly, so the cost factor too needs consideration. (West US: Brown energy: 11.1 cents/KWh, Solar energy: 15.0 cents/KWh)

COOLING AWARE



- Cooling data centers can consume up to 50% of the total energy costs
- Some data centers use air economizers
- Cools data centers using outside air:
  - a) Use air directly
  - b) Use air to cool water which is then used in the air conditioner

COST AWARE

- Variable electricity prices across data centers
- Variable prices during the day (predict day-ahead electricity prices)
- Smart cooling also saves cost

NOVELTY

- The three factors have not been considered together and in some case individually in a geo-distributed datacenter context.

- All cloud workloads to be considered. Past research have focused on only a type of workloads (batch workloads (map-reduce,HPC), internet services etc)

- Look at data transfer across data-centers from green and cost perspectives

SUGGEST NEWER PRICING MODELS

- Allow users to choose if they want their jobs to be run with green energy. Might cost them extra.

- Cloud providers can pay 50% of the additional cost is the customer agrees to pay the other half.

- Optimizations should not violate the Service Level Agreements(SLAs)