Carbon Reduction Challenge 2023

Outsourcing GT local computing jobs to PACE data center

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Overview

- Recommendations:
  - Outsource local computing jobs to PACE data center
- Carbon Reduction Potential:
  - 62.20 [tonCO2e/year] or 137,000 [lbs/year]
- Cost Savings:
  - NPV: $324,037
  - IRR: 12.65%
  - Payback Period: 3 years

Background and Motivation

- Green Georgia and Atlanta
  - Georgia is preparing to reduce greenhouse gas emissions with fund by the Inflation Reduction Act
- GT Climate Action Plan 2023
  - Goal is to reaching carbon neutrality by 2050.
  - Led by Infrastructure and Sustainability, the process will include developing a greenhouse gas inventory, modeling potential mitigation strategies, and engaging with faculty, students, and staff from across campus.
- Focus on computing resources in GT campus
  - Calculate the embodied carbon from computing resources at GT
  - Recommendation to reduce carbon emission from computing resoures

Embodied Carbon from GT Computing Resources

Local Devices on GT campus

Device type	Quantities	Annual Electricity consumption [MWh/year]
Server	42	62.0
Storage	8	31.5
Tablet	390	4.6
Monitor	440	17.6
Laptop	178	4.5
Touchscreen PC	2	0.054
Desktop PC	233	11.5
Total		46.2

Escalate based on GT employee:

$46.2 * 14{,}000 / 600 = 1.08\ [ktonCO2e/year]$

PACE Data Center

PACE daily power consumption: 800 kWh on average.

The annual electricity consumption is

$$800[kWh] * 24[h] * 365[days] = 7008\ [MWh/year]$$

Thus, the annual carbon emissions is

$$7008\left[\frac{MWh}{year}\right] * 350\left[\frac{kgCO2e}{MWh}\right] = 2.45[ktonCO2e/year]$$

350 [kgCO2e/MWh] is the amount of carbon emissions produced per MWh in Georgia.

Total value $3.531\ [ktonCO2e/year]$

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Carbon Reductions

- Recommendations:
  - Outsource local computing jobs to PACE data center

- Case Study to evaluate carbon reduction and cost savings.
  - One new PACE server can replace 6 old servers on Georgia Tech campus
    - Reach equivalent CPU performance
    - CPU performance is based on SPEC CPU2017 floating point rate benchmarks

$$175 \ / 28 \ = 6.4$$

  - Energy consumption is reduced by 73%
    - Energy efficiency is measured by Thermal Design Power (TDP)

$$(6 * 95 - 165) \ /(6 * 95) = \ 73\%$$

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Carbon Reductions

Assumptions:

- Computing jobs that can be outsourced to the PACE clusters are limited to those concerning research activities.
- Only faculties and their students are engaged in research activities, among all the 14,000 GT employees
- Each faculty has 5 students
- 30 % of the local computing jobs run in local servers can be outsourced to the PACE clusters
- All the 30 % local computing jobs are referenced by old servers in case study
- All the outsourced local computing jobs are run by newly purchased PACE servers

- The number of GT employees using computing resources for their research activities is:

$$1309 * 6 = 7854$$

- 47% of the local electricity consumption is by servers. Thus the carbon emissions from local servers in the entire GT community is

$$1.08[ktonCO2e/year] * 0.47 = 506\ [tonCO2e/year]$$

- The reduced amount of carbon in Georgia Tech is

$$506\left[\frac{tonCO2e}{year}\right] * \left(\frac{7854}{14{,}000}\right) * 0.3 * 0.73 = 62.2\ [tonCO2e/year]$$

Carbon Reduction Potential:

- **62.2 [tonCO2e/year] or 137,000 [lbs/year]**

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Cost Savings

- Purchase and operating costs comparison

4 Years Product Life	6 Old Servers	PACE New Server
Purchase cost	9,000	40,000
Operating cost	51,744	6,040
Total cost	60,744	46,040

Cost savings escalated to GT:

- NPV: $324,037
- IRR: 12.65%
- Payback Period: 3 years

NPV and IRR Analysis

Initial investment	$ 31,000		Summary of Analysis	
Life of project (years)	4		NPV ($)	$ 6,613.86
Cost savings (pre-tax)	11,426		IRR (%)	12.54%
Growth	0.00%		Payback (Years)	3.00
Required return (WACC)	3.84%			
Tax rate	30.00%			

Year	0	1	2	3	4
Cost savings		11,426	11,426	11,426	11,426
(1) Cost savings x (1-T)		7,998	7,998	7,998	7,998
Depreciation expense		7,750	7,750	7,750	7,750
(2) Depreciation x T		2,325	2,325	2,325	2,325
(3) Initial Investment	$ (31,000)				
Total Cash Flows (1)+(2)+(3)	$ (31,000)	$ 10,323	$ 10,323	$ 10,323	$ 10,323

NPV	$ 6,613.86	Accept?	Accept
IRR	12.54%	Accept?	Accept

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Co-benefits

We can expect that by our recommendation, we can increase the awareness of faculties about the PACE clusters, and the benefits of using them from the carbon emission point of view. This would lead to more use of the PACE clusters, and less use of local machines, which may also result in saving monetary costs by not buying unnecessary local machines. This means the full utilization of existing GT computing resources.

Free tier MAM Account – Each PI will receive a MAM Account that contains the equivalent of 10,000 CPU-hours on a 192GB compute node.

More CPU GPU options - Researchers have more flexibility to leverage new hardware.
Rapid provisioning without the requirement to wait for a lengthy procurement period to complete.

Less down time - Insulation from failure of compute nodes.

Better Maintenance and Support - PACE staff will monitor the time jobs wait in the queue and procure additional equipment as needed to keep wait times reasonably low.

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Next steps

- We need to check the feasibility of our assumptions in the calculation.
  - We assumed each faculty has 5 students, but that actually varies for each faculty.
  - The percentage of local computing jobs that can be outsourced to PACE differs for each project type.
  - There is a funding limitation for faculties without enough funding.
  - The purchase and operating cost for different kinds of servers need to be estimated with more accuracy.
- We only considered the operational carbon emissions. But to evaluate the carbon emissions holistically, it’s desirable to evaluate the embodied carbon as well.
- In addition, we would like to compare PACE data center with commercial data center, for example, Google cloud and AWS.

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