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Hardware Utilization Effectiveness (HUE)



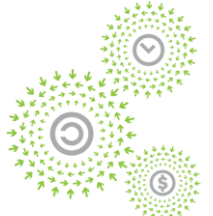
OCP
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Hardware Utilization Effectiveness (HUE)

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What is HUE?



PUE

Power **U**talization **E**ffectiveness

$$PUE = \frac{\text{Total DC Power}}{\text{Total IT Power}}$$

- Introduced by Green Grid in 2007 and widely adopted in following years
- Meta started with PUE ~ 2.0
- Meta now achieves PUE ~ 1.10*

Useful for characterizing **power efficiency** of the building

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SUSTAINABILITY



HUE

Hardware **U**talization **E**ffectiveness

$$HUE = \frac{\text{Total IT Power}}{\text{Information Processing Power}}$$

- Can be calculated at multiple scales
 - Component Level
 - System/Server Level
 - Rack Level
 - Data Hall Level

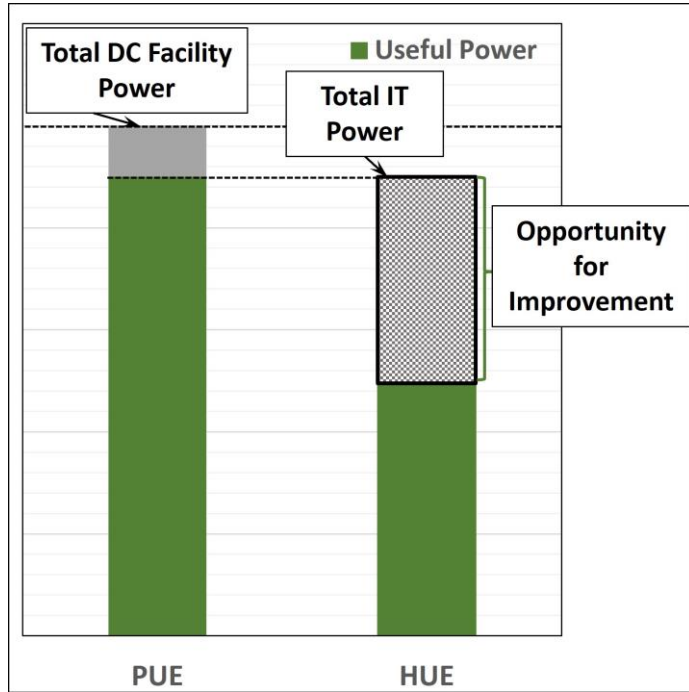
Useful for characterizing **power efficiency** of the IT gear



* Based on 2020 FB Sustainability report: <https://sustainability.fb.com/report-page/data-centers/>

Opportunity of HUE

Characterizing HW Efficiency*



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*PUE & HUE illustration represents air-cooled facility



SUSTAINABILITY

- HUE reveals large opportunity for improvement
- Opportunity for improvement composed of various sources of non-useful power:
 1. Hardware (HW) Tax
 2. Thermal Kit
 3. Leakage Power
 4. ... & more

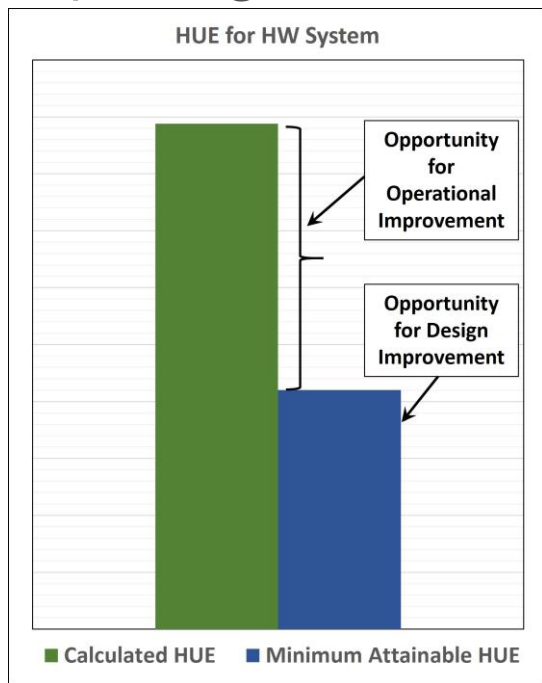


Opportunity of HUE

Improving HW Efficiency (Reducing HUE)



SUSTAINABILITY



Minimum Attainable HUE

*The minimum possible HUE for a given hardware platform
→ HUE at highest efficiency operation*

Design Improvements

- Reduce Minimum Attainable HUE for a given HW system type
- Minimum Attainable HUE driven by underlying technologies
 - Reduce idle power of components
 - Measure changes in HUE over generations of designs

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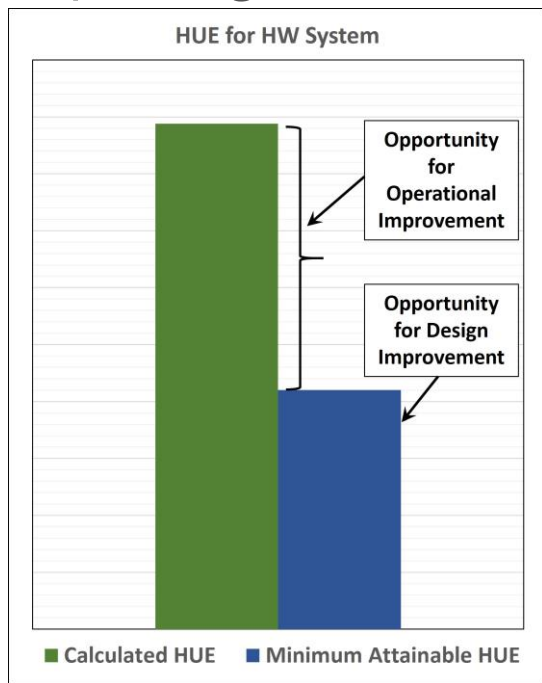


Opportunity of HUE

Improving HW Efficiency (Reducing HUE)



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Operational Improvement

- Reduce gap between current HUE & Minimum Attainable HUE
 - Optimize service placement (improve utilization)
 - Enable lower power state(s)

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HUE Strategy



SUSTAINABILITY



Generalizable



Universal



Scalable



Standardize

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HUE Calculation Methodology

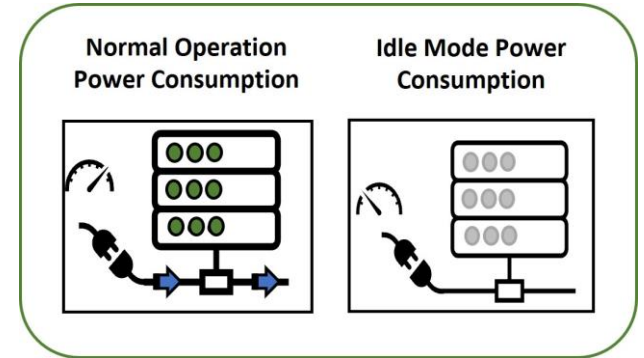


SUSTAINABILITY

$$HUE = \frac{\text{Total IT Power}}{\text{Information Processing Power}} = \frac{\text{Total IT Power}}{\text{Total IT Power} - \text{Parasitic Power}}$$

Parasitic Power = HW Tax + Thermal Kit + Thermal Leakage

1. Total IT Power: Total power delivered to IT device
2. HW Tax: Total power measured on test bench with minimum software to become operational at idle
3. Thermal Kit: Total power measured from cooling solutions such as fan(s) and pump(s)
4. Thermal Leakage: Modeled thermally dependent leakage power



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HUE in Industry



SUSTAINABILITY

- Encourage partners to study HUE of existing hardware & identify opportunities of improvement
- Promote transparency within industry by sharing HUE metrics
- Leverage HUE as industry wide metric to influence IT ecosystem
- Accelerate net carbon zero and water conservation milestones by incorporating HUE goals into next generation IT equipment

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Call to Action

Get involved with HUE through:

OCP Strategic Initiatives Sustainability Workstream:

<https://www.opencompute.org/projects/sustainability-initiative>

OCP Strategic Initiatives Sustainability Workstream Mailing List:

<https://ocp-all.groups.io/g/Sustainability>

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Thank you!



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