Lenovo

EAR

Energy optimization of data centers with Lenovo's Neptune strategy and Energy Aware Runtime (EAR) software

20e édition

Forum TERATEC 25

Speakers

Dr. Aurélien ORTIZ
HPC/AI Software Architect
aortiz11@lenovo.com

- *Architecting the HPC and AI Software Stack at Lenovo (Worldwide)*
- *Expertise: Architecture of HPC/AI solutions, installation & configuration, performance evaluation, auditing, system optimization, …*

Lenovo

Raphaël Brochard
Directeur Général EAR
raphael.brochard@eas4dc.com

- *Raphaël est un entrepreneur passionné par l'innovation et le développement durable*
- *Au fil des ans, il a cofondé plusieurs startups dans divers secteurs mais avec le même engagement.*

EAR

Lenovo Neptune® history

A Decade Of Innovation

2012

The journey began
iDataplex dx360 M4

2015

Transition to Lenovo
NextScale nx360 M4

2017

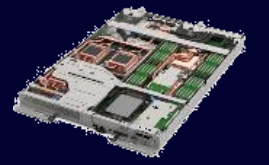
ThinkSystem is born
ThinkSystem SD650

2020

DWC Acceleration
ThinkSystem
SD650 V2
SD650-N V2

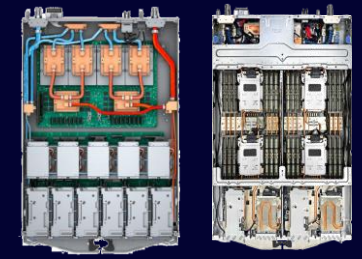
2022

The biggest launch ever
ThinkSystem
SD650 V3
SD665 V3



2023

ThinkSystem
SD650-I V3
SD650-N V3
SD665-N V3



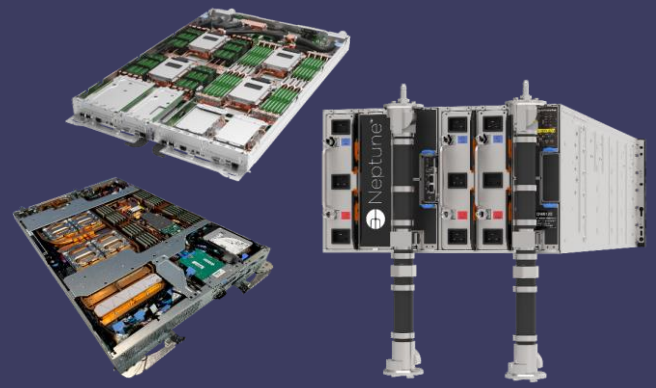
2025

ThinkSystem
N1380
SC750 V4
SC777 V4

Lenovo Neptune® technology family

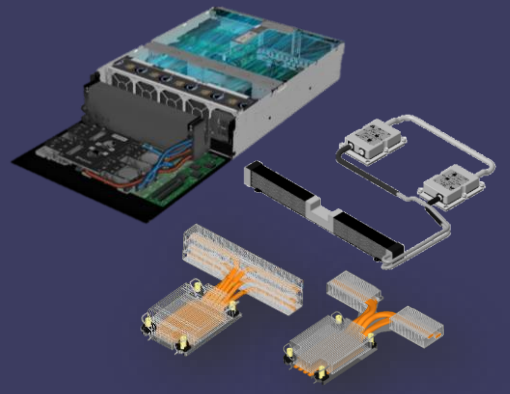
Neptune®

- The original, market-leading 100% direct water cooling
- Warm water up to 45°C inlet
- #1 performance density platform
- ExaScale to EveryScale™ design



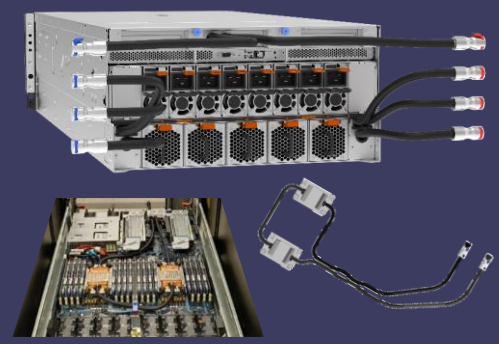
Neptune® Air

- Liquid Assisted Cooling to **Air**
- Close Loop with Radiator Resign
- Best air-cooling efficiency
- For broad configurability



Neptune® Core

- Targeted at the **Core** Components
- Open Loop Direct Water Cooling
- For datacenter PUE <1.2
- Maintain most configurability



Lenovo Neptune® offers the right choice for your datacenter at every scale.

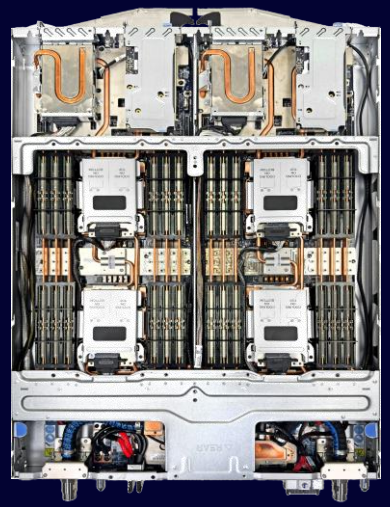
Neptune®

Warm Water Cooling	• >= 45*C inlet temperature at the system • 100% heat capture from the system • Advanced heat sink and waterloop designs
Most Reliable Materials	• Copper based water loops • Aluminum based cold plates • Thick EPDM or Stainless-Steel hoses
Safe for the Environment	• Pure Water – distilled or similar • Treated against corrosion/biosphere • No hazardous Glycol necessary
From Exascale to Everyscale™	• Build for the fastest Supercomputers • Scalable down to less than one 19” rack • Lenovo Manufacturing integrated, tested

Lenovo ThinkSystem N1380

Neptune®

- Zero airflow design, 100% direct water cooled
- Copper, Stainless Steel and EPDM quality



SC750 V4

- ✓ 2 Nodes per Tray
- ✓ Intel Granite Rapids

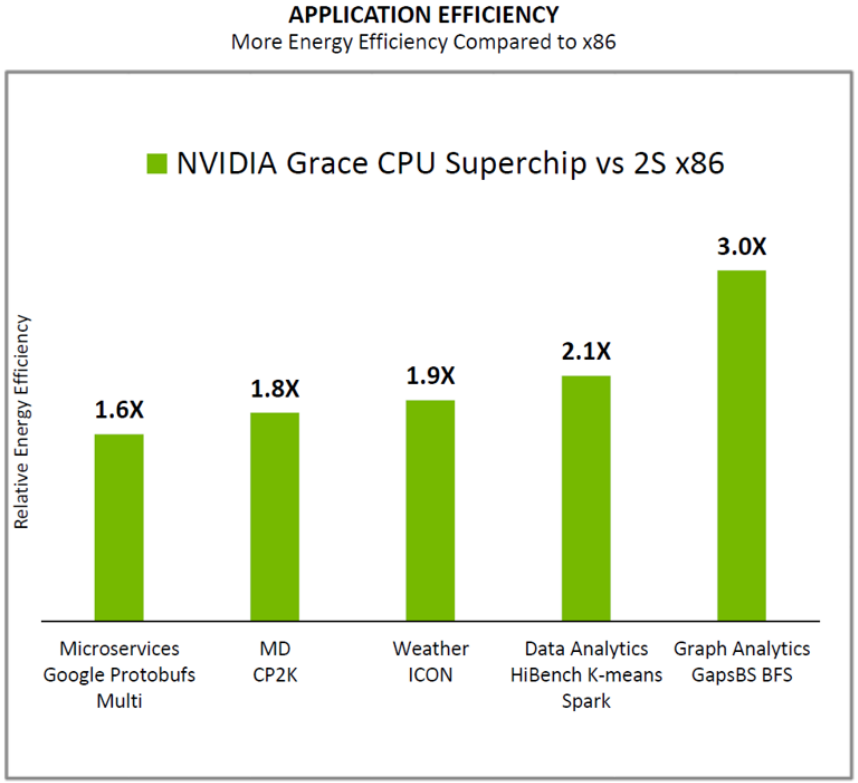
- Up to 45°C Inlet Water temperature
- Lenovo in-house designed coldplates

SC777 V4

- ✓ 2x CPU NVIDIA Grace
- ✓ 4x GPU NVIDIA Blackwell

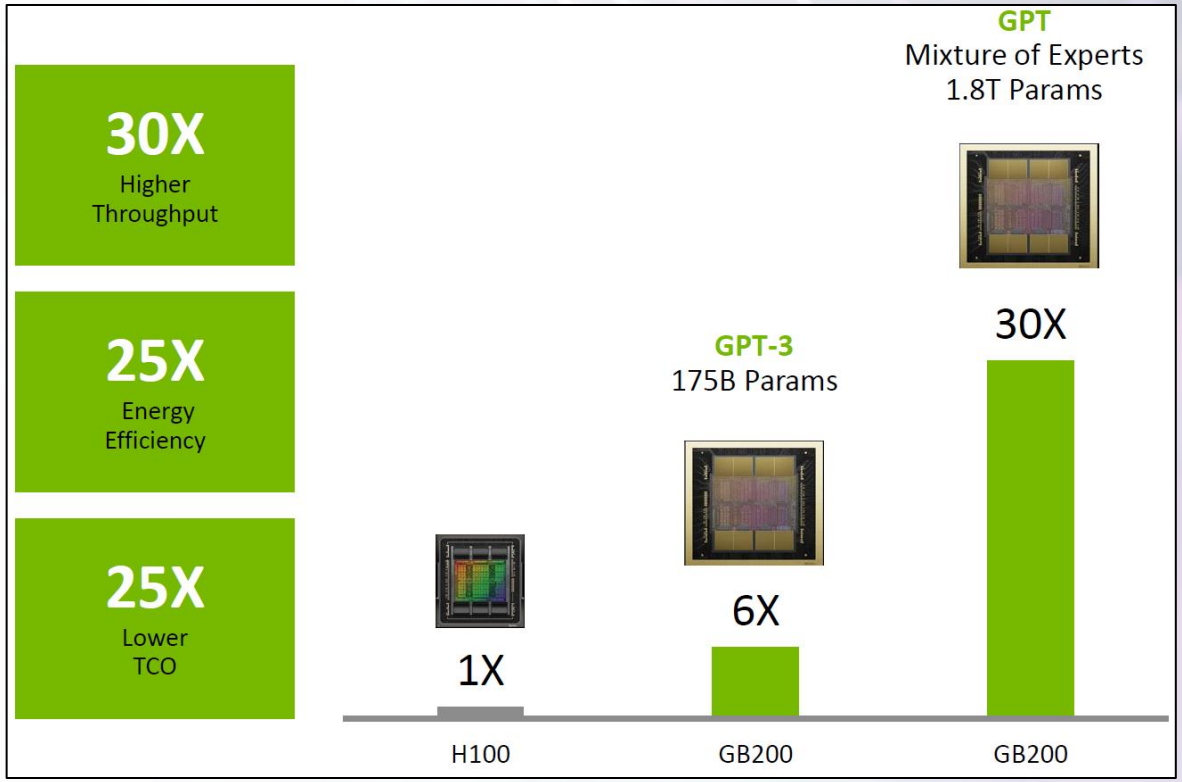
Maximum Efficiency for Unaccelerated Applications

Grace CPU delivers same performance, 3X better energy efficiency vs x86



Blackwell Drives Higher Performance and Efficiency on Largest Models

25X improved energy efficiency, 30X real-time inference trillion parameter Mixture of Experts inference



Lenovo ThinkSystem HPC & AI Compute Line Up 2025

SD535 V3

Neptune® Air
Neptune® Core

SR645 V3
SR665 V3

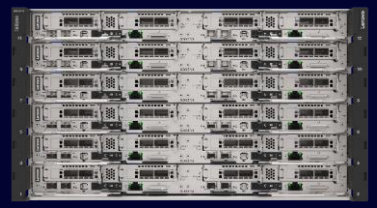
Neptune® Air
Neptune® Core

SR630 V4

Neptune® Air
Neptune® Core

SD665 V3

Neptune®



SC750 V4

Neptune®

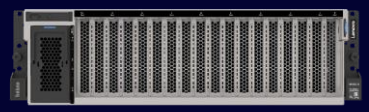
SC777 V4

Neptune®

SR675 V3

w/ 4x DW PCIe

w/ 8x DW PCIe

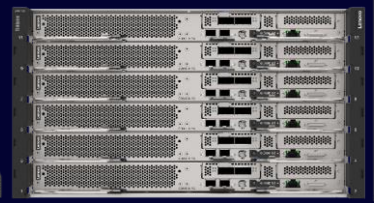


w/ 4x SXM

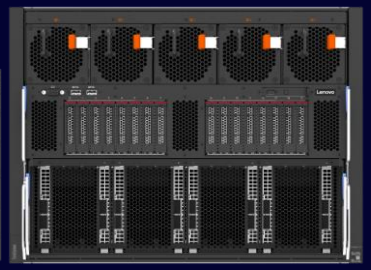
Neptune® Air

SD650-N V3
SD665-N V3

Neptune®

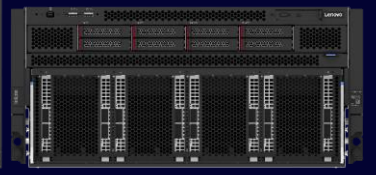


SR680a V3
SR685a V3



SR780a V3

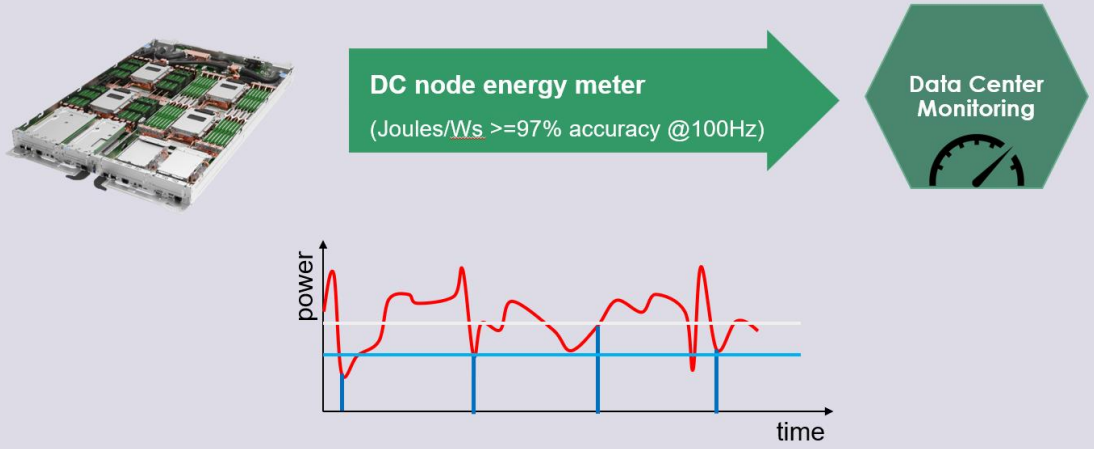
Neptune® Core



Energy Aware Runtime

- Energy Aware Runtime (EAR)
  - Mostly open-source management software
  - Developed by Barcelona Supercomputing Center (BSC)
  - Through a BSC-Lenovo collaboration since 2016
- Energy Aware Solution (EAS)
  - Spin-off of BSC, created by EAR authors in September 2020

- EAR integrates with Lenovo Neptune DWC server telemetry



Lenovo / EAR collaborations

- **LRZ Germany**
  - SuperMUC NG with 6480 Intel CPUs nodes
  - SuperMUC NG2 with 234 Intel Data Center GPU Max nodes
- **SURF Netherlands**
  - Snellius - Hybrid cluster with 576 AMD Rome CPU nodes + 36 Intel CPU / 4 NVIDIA A100 GPU
  - Snellius 2 – 720 AMD Genoa CPU nodes
- **BSC MN5 Spain**
  - General purpose partition – 7200 Intel Sapphire Rapids nodes
  - Accelerated partition – 1120 nodes with 4 NVIDIA H100 GPUs

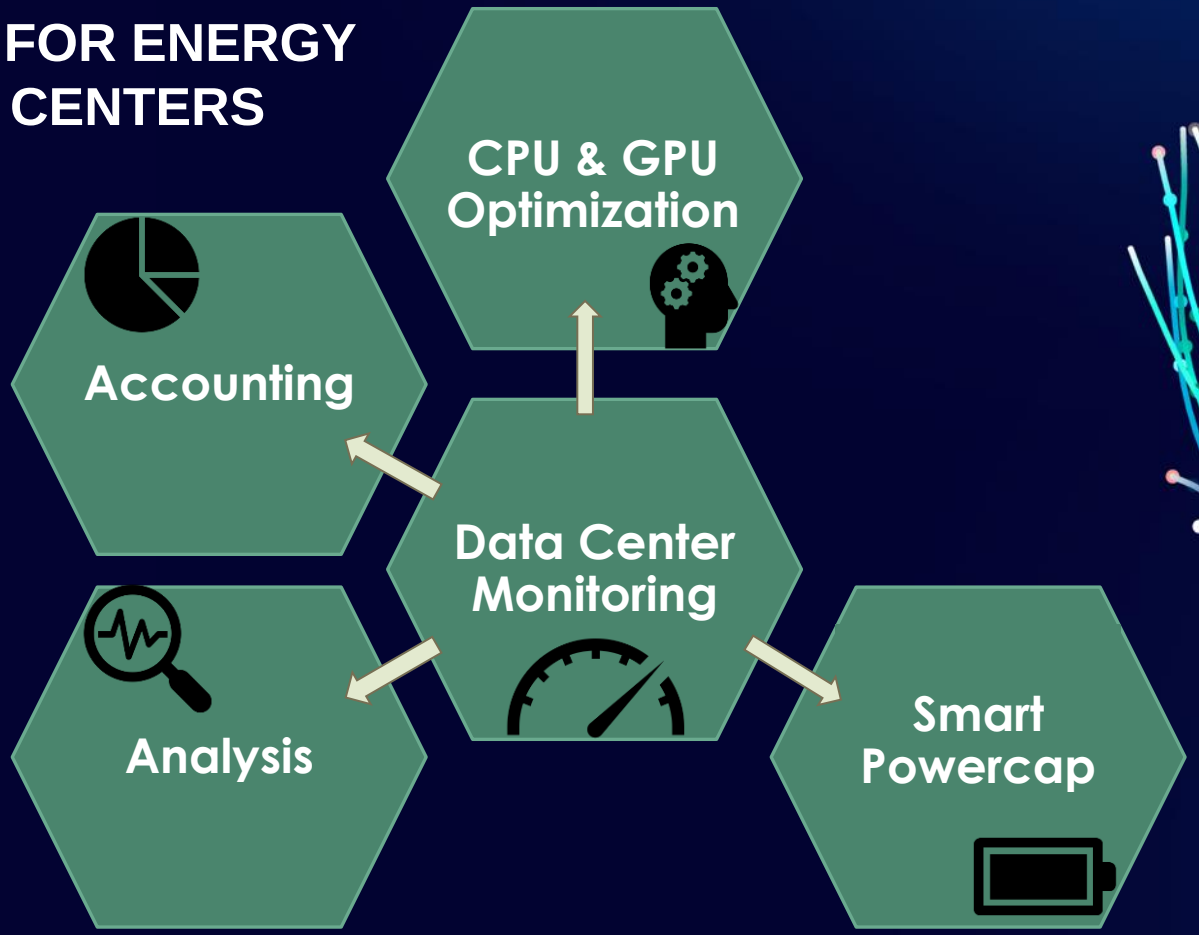
CHALLENGES:

- Power is a limited resource
- Performance limitation & TCO/OPEX
- ESG

WE BELIEVE IN:

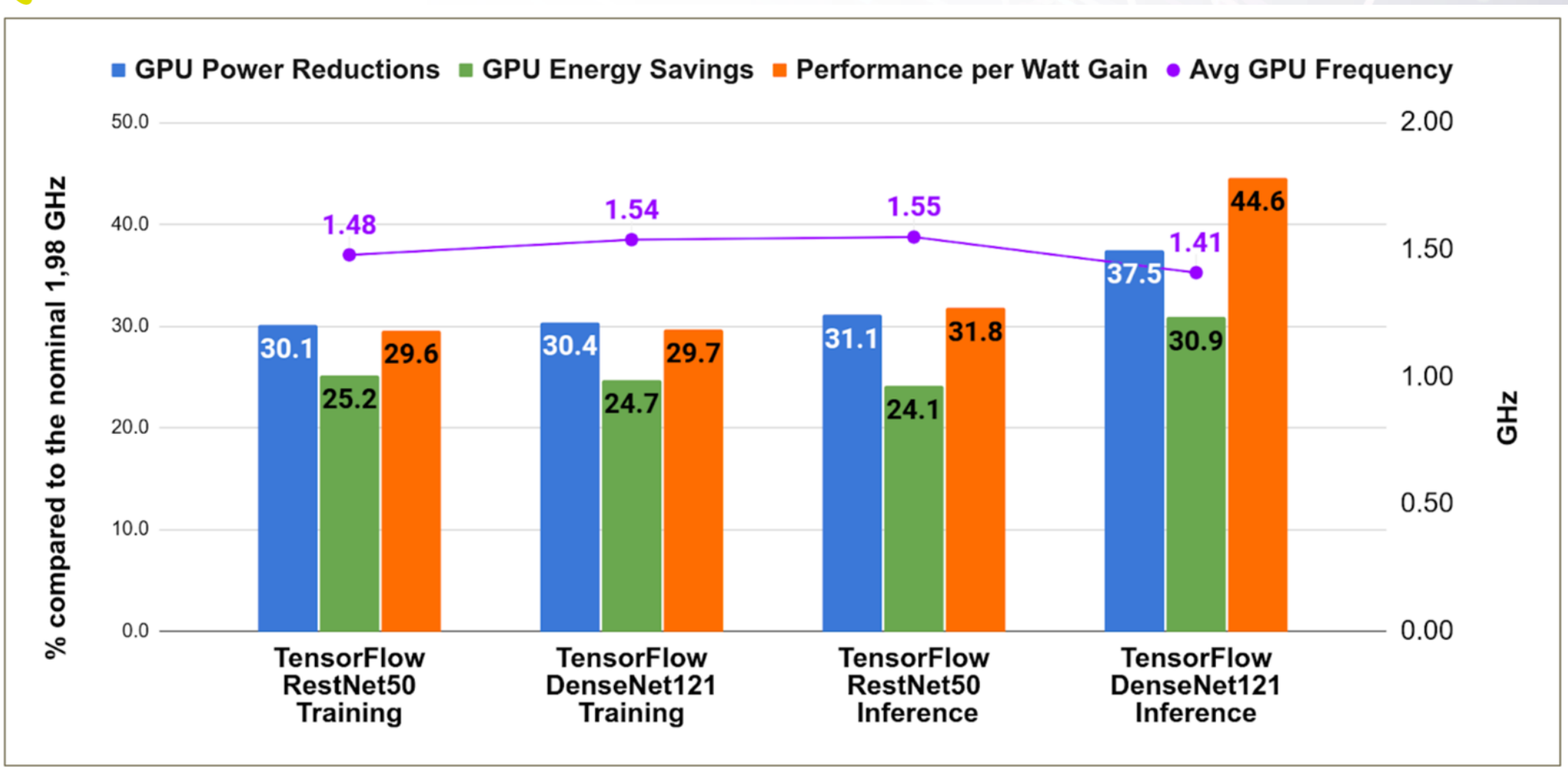
- Energy Awareness for HPC/AI
- Efficiency: More Performance Per Watt

EAR SOFTWARE FOR ENERGY EFFICIENT DATA CENTERS

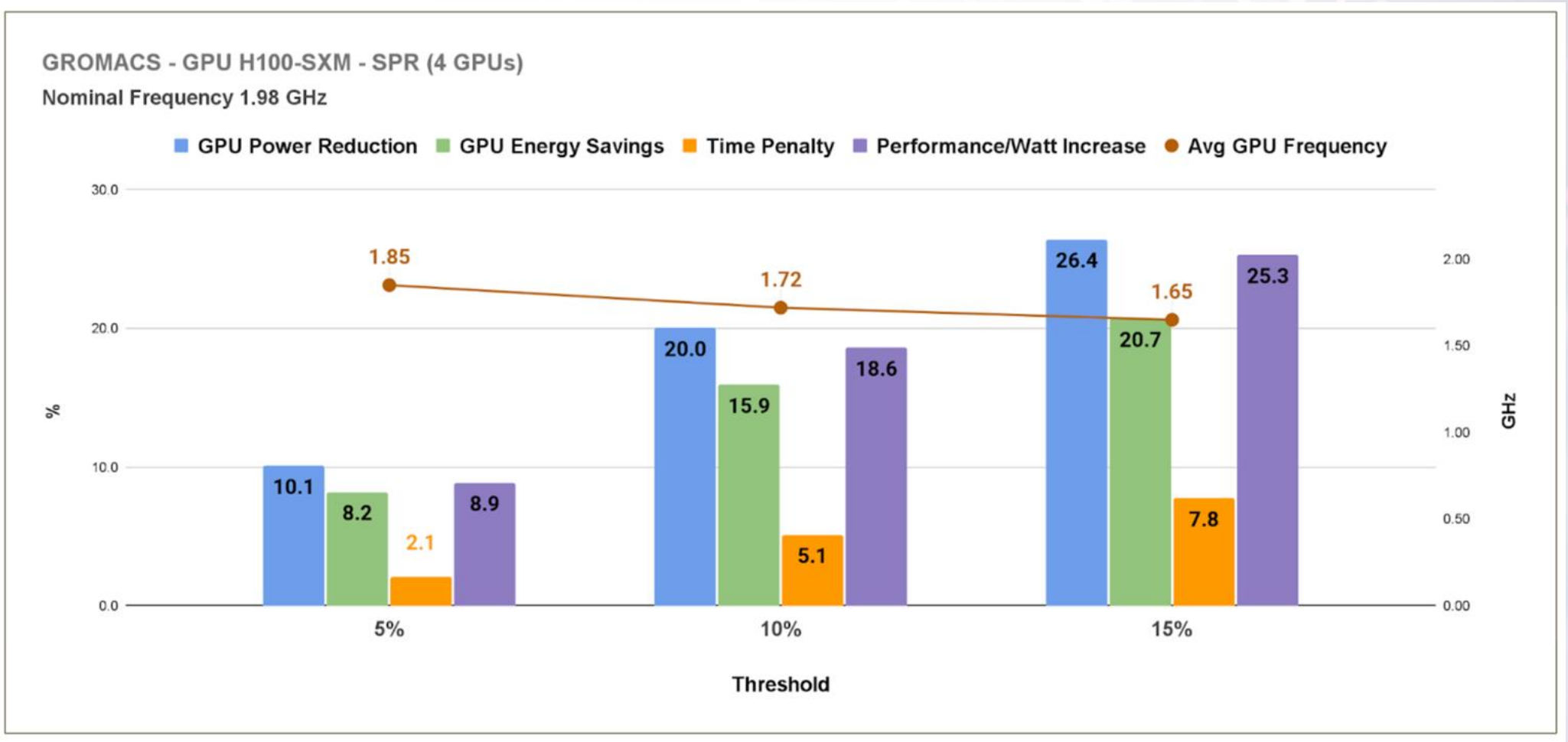


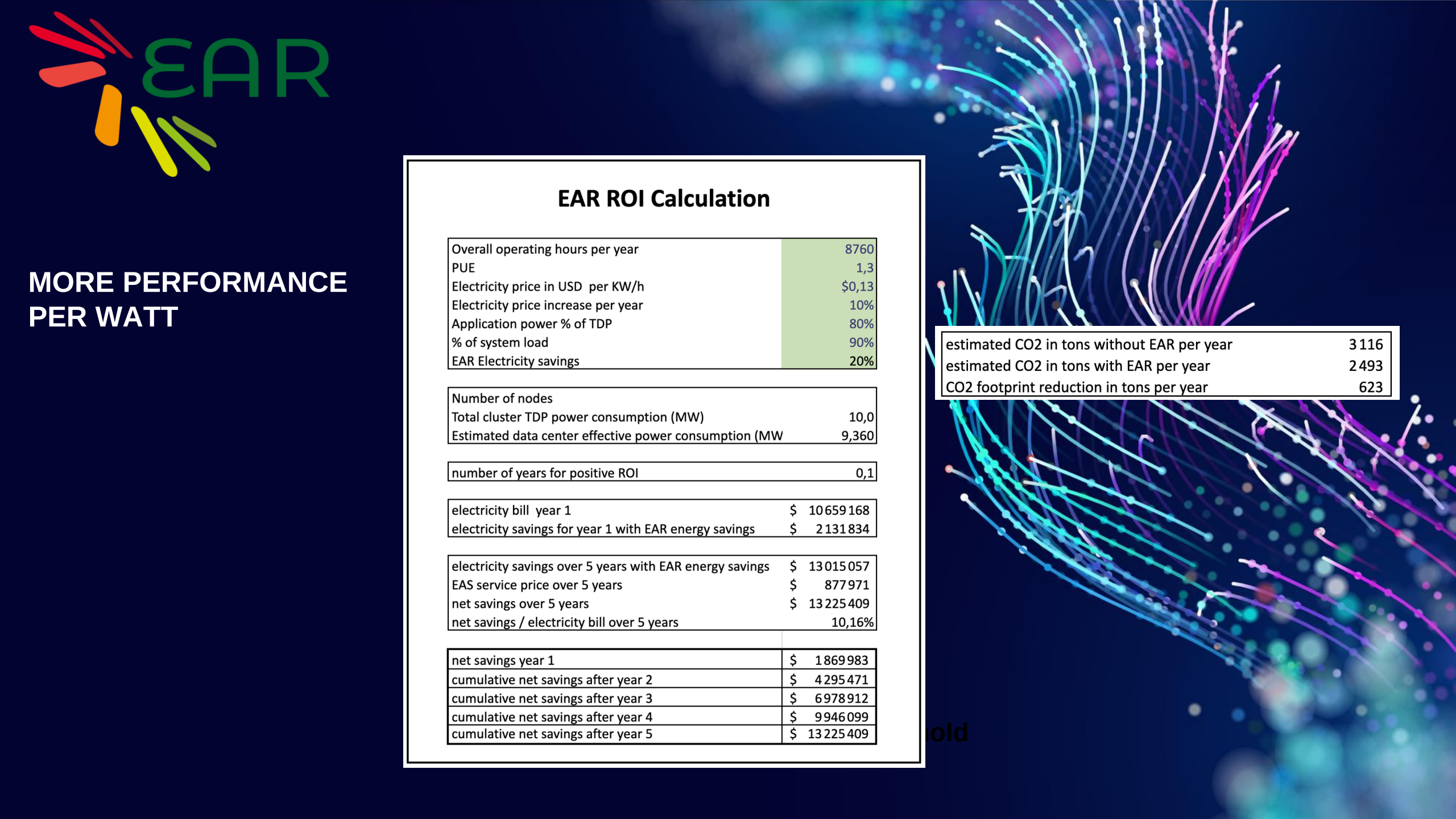
EAR SYSTEM SOFTWARE =

- Gain Up to 50% energy
- Live at runtime & Transparent
- Holistic et Agnostic



EAR Optimization with 10% threshold


GROMACS - GPU H100-SXM - SPR (4 GPUs)
Nominal Frequency 1.98 GHz
GPU Power Reduction
GPU Energy Savings
Time Penalty
Performance/Watt Increase
Avg GPU Frequency
30.0
20.0
10.0
0.0
%
2.00
1.50
1.00
0.50
0.00
GHz
1.85
1.72
1.65
10.1
8.2
2.1
8.9
20.0
15.9
5.1
18.6
26.4
20.7
7.8
25.3
5%
10%
15%
Threshold



MORE PERFORMANCE
PER WATT

EAR ROI Calculation

Overall operating hours per year	8760
PUE	1,3
Electricity price in USD per KW/h	$0,13
Electricity price increase per year	10%
Application power % of TDP	80%
% of system load	90%
EAR Electricity savings	20%

Number of nodes	
Total cluster TDP power consumption (MW)	10,0
Estimated data center effective power consumption (MW	9,360

number of years for positive ROI	0,1

electricity bill year 1	$ 10 659 168
electricity savings for year 1 with EAR energy savings	$ 2 131 834

electricity savings over 5 years with EAR energy savings	$ 13 015 057
EAS service price over 5 years	$ 877 971
net savings over 5 years	$ 13 225 409
net savings / electricity bill over 5 years	10,16%

net savings year 1	$ 1 869 983
cumulative net savings after year 2	$ 4 295 471
cumulative net savings after year 3	$ 6 978 912
cumulative net savings after year 4	$ 9 946 099
cumulative net savings after year 5	$ 13 225 409

estimated CO2 in tons without EAR per year	3 116
estimated CO2 in tons with EAR per year	2 493
CO2 footprint reduction in tons per year	623

CUSTOMERS USE CASES:

- EDF
- LRZ
- Toyota, Japan
- SURF
- BSC MN5
- European Space Agency
- Paderborn

Lenovo

STAND C08

Sponsored by:

NVIDIA

EAR

STAND Startup

MORE PERFORMANCE PER WATT

Let’s discuss:
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