Intel Sustainability: Data Center

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Arnold Verhoeven 13-12-2022

#1
2022 America's Most
Sustainable Company[1]
BARRON'S

Intel's Vision

Build a more sustainable computing industry from manufacturing to product to solutions

Reduce Intel's footprint through sustainable manufacturing and supply chain partnership

Continuous Innovation

Lead the industry by designing more sustainable products across silicon, platforms and software

Collaborate across the ecosystem to create standards and build scalable, sustainable solutions

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Sustainability Goals in Intel Operations

Climate & Energy

- Achieve net zero greenhouse gas (GHG) emissions across our global operations by 2040.
- By 2030, achieve 100% renewable electricity use across global operations; conserve 4 billion kWh of electricity; drive a 10% reduction in our absolute Scope 1 and 2 GHG emissions as we grow, informed by climate science.
- Build new factories and facilities to US Green Building Council LEED standards

In 2021: Achieved 80% renewable electricity use

Water

By 2030, achieve net positive water use by conserving 60 billion gallons of water and funding external water restoration projects.
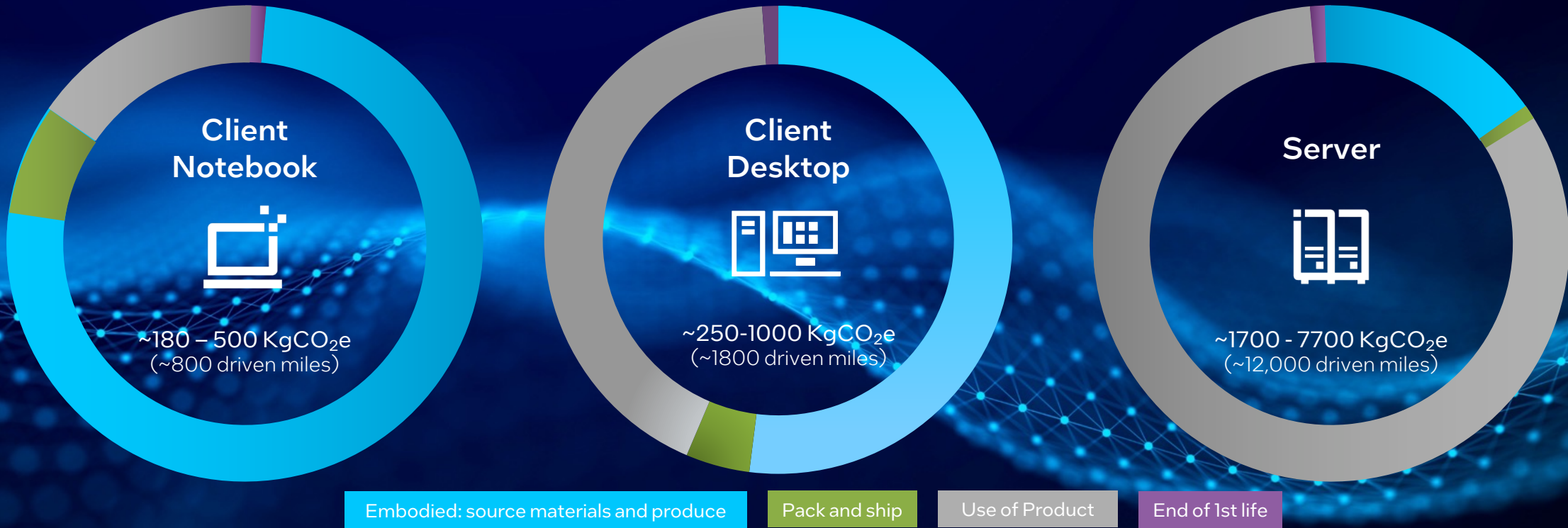
In 2021: 9.3 billion gallons conserved and net positive in US, Costa Rica and India

Waste

By 2030, achieve zero total waste to landfill and implement circular economy strategies for 60% of our manufacturing waste streams in partnership with suppliers.

In 2021: 5% total waste to landfill

Notebook, Desktop and Server Carbon Footprint: Embodied and Use of Product

Client Notebook

~180 – 500 $KgCO_2e$
(~800 driven miles)

Client Desktop

~250-1000 $KgCO_2e$
(~1800 driven miles)

Server

~1700 - 7700 $KgCO_2e$
(~12,000 driven miles)

Embodied: source materials and produce | Pack and ship | Use of Product | End of 1st life

Client Notebook Carbon footprint is mostly embodied, compared to Server that has majority in use of product. Client Desktop carbon footprint is split between use phase and embodied.
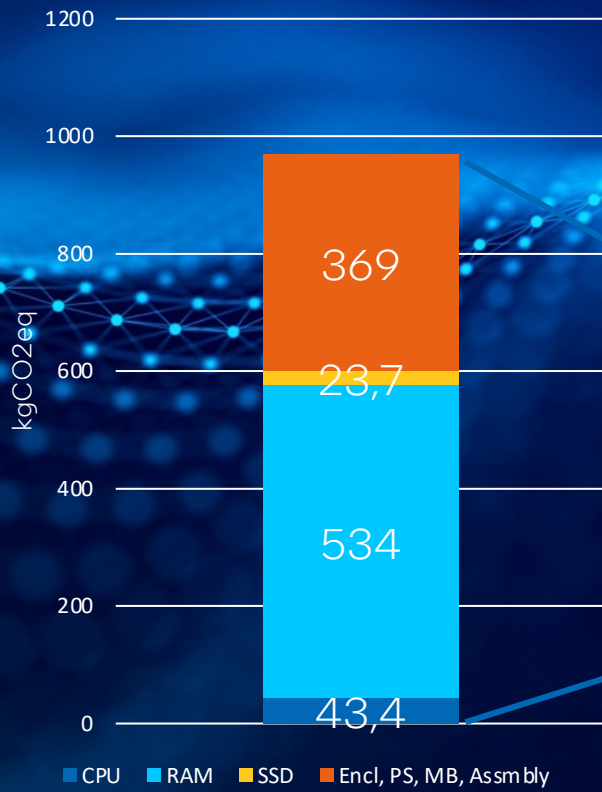
Assumes 4-year initial life
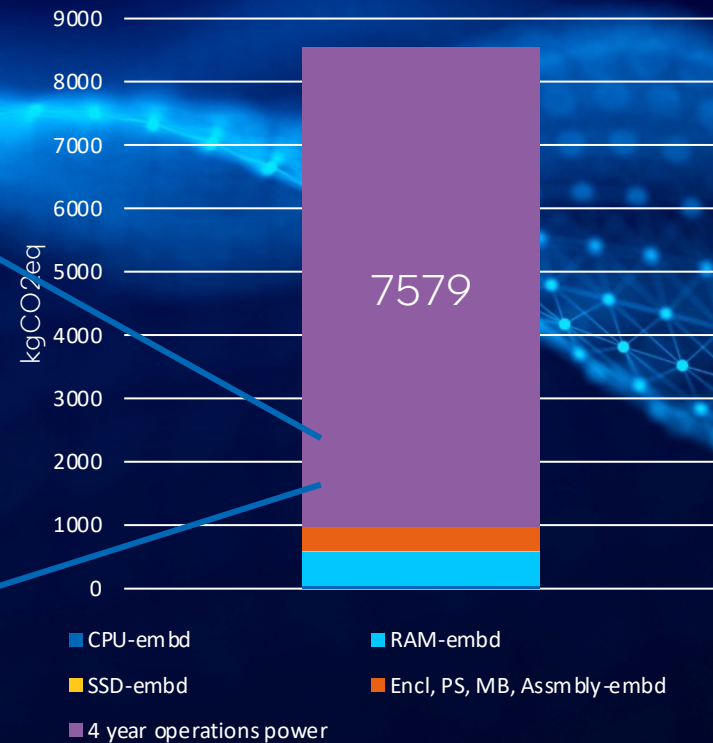
Assumes 100% carbon-based power during use phase

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Data Center System Use of Carbon Provides Great Opportunity for Reduction

Rack server, 2S, 12X32GB DDR, 1X 400GB SSD Server Embodied Carbon

kgCO2eq

Value	Category
369	Encl, PS, MB, Assmbly
23,7	SSD
534	RAM
43,4	CPU

Legend: ■ CPU ■ RAM ■ SSD ■ Encl, PS, MB, Assmbly

Rack server, @ 500W running 24/7/365 4 years Server embodied & operations CO2eq

kgCO2eq

7579 (4 year operations power)

Legend:
■ CPU-embd   ■ RAM-embd
■ SSD-embd   ■ Encl, PS, MB, Assmbly-embd
■ 4 year operations power

Embodied carbon is smallest portion of server footprint (~10%)

Intel is committed to reducing server embodied carbon through manufacturing goals and platform/solution enabling

Scope 3 use of product is largest portion of server carbon footprint (~90%)

Intel has holistic approach to reducing use of product carbon *from data center down to silicon level*

Assumes 100% carbon-based datacenter power

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Select the right hardware to lower carbon footprint

Lower Processor PCF

Lower Scope 3 Emissions

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semiconductor industry leading

80%

Renewable electricity overall

100%

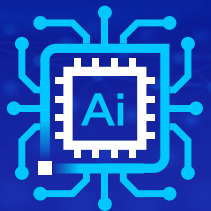renewable electricity in US, Europe and Asia

Intel® Xeon® platforms:
Advancing Performance & Sustainability

Made with 80% renewable electricity*
for lower carbon footprint

Integrated AI for 4x perf / watt boost[2]
for AI inference workloads - TensorFlow

Built-in telemetry and power management tools
Dynamically reduce frequency and power down cores with P-state and C-state controls

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XEON®

Architecture and built-in accelerators increase perf/watt on workloads that matter
Security, network, high-performance computing workloads, and more

10x increase in energy efficiency by 2030*
for client and server CPUs

Built with circular economy strategies for waste
5% total waste to landfill*

AI Software with CPU Frequency Tuning

Using an Intracom Telecom NFV-RI™ solution with:

AI based load prediction

Automatic CPU frequency tuning

KDDI

Japanese Telcom Provider
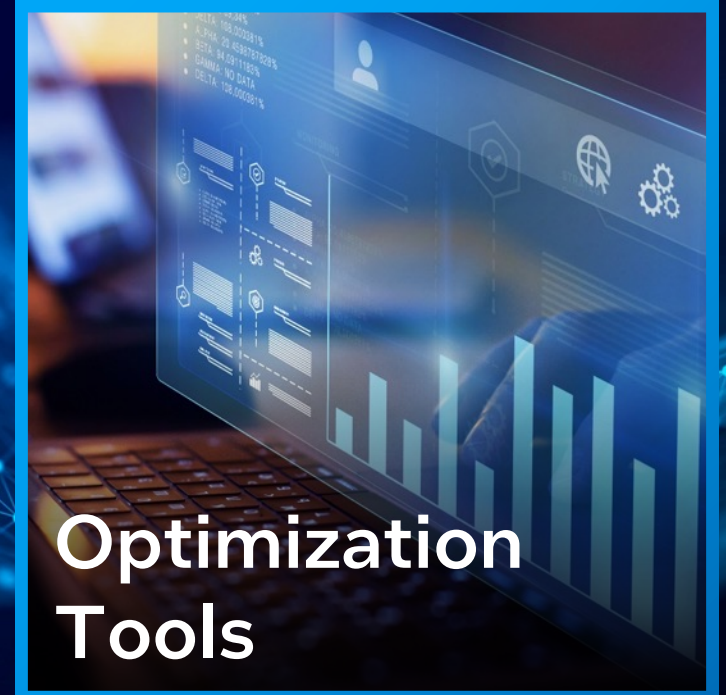
20%

Reduction in overall power consumption

Utilize AI –based telemetry and analytics for electricity saving opportunities

*In a trial using 3rd Generation Intel® Xeon® Scalable processors and Intel's power management and AI capabilities
For further information: https://builders.intel.com/docs/networkbuilders/intracom-telecom-machine-learning-boosts-nfv-energy-efficiency.pdf

Areas where you can help your customers

Maximizing hardware

Aware and Efficient Software

Optimization Tools

Carbon Optimized Compute: An Illustration

Unoptimized

gCO2eq emitted
per workload execution
634.01

Energy Optimized

Software optimized to consume **less energy** on Intel hardware

gCO2eq emitted
per workload execution
44.93

Carbon Optimized

Software optimized to take advantage of **clean energy**

gCO2eq emitted
per workload execution
000.43

**14x savings with energy optimization.
1500x savings with energy & carbon optimization**

Source: Intel Data, for illustrative purposes -not representative of any particular workload or code

Invest in green software

GREEN SOFTWARE FOUNDATION

kubernetes

1 oneAPI

Intel is a steering member of Green Software Foundation which promotes CO2 optimization though open source

Intel created power-aware scheduling developer capability on Kubernetes
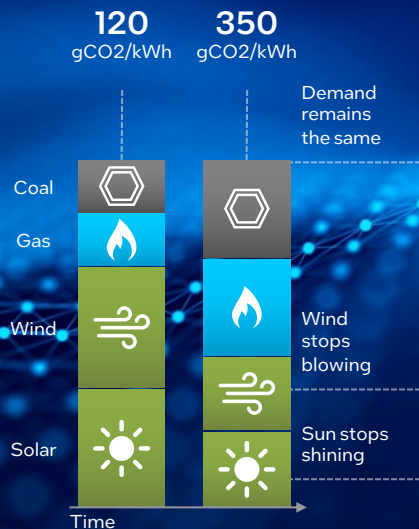
Users can measure, debug, and optimize system power consumption using tools such as Intel® SoC Watch and V-Tune™ Profiler
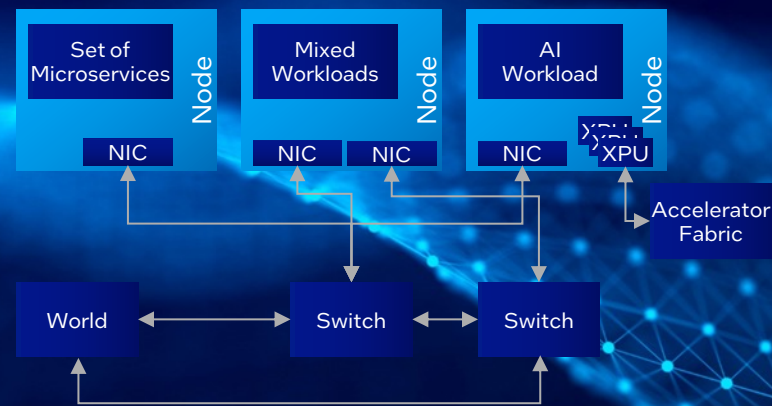
Use aware and efficient software

Carbon Intensity Awareness

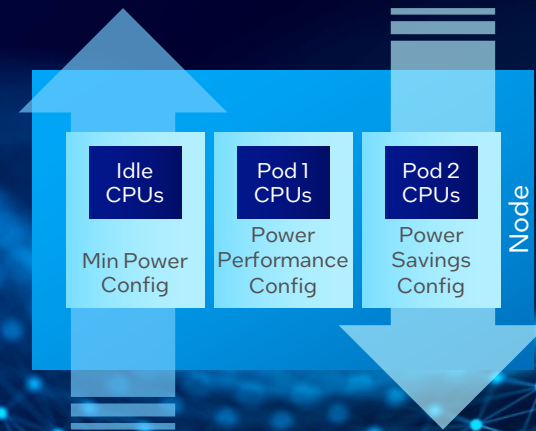Choose your region (and when) the energy used has the lowest carbon cost

120 gCO2/kWh   **350** gCO2/kWh

Demand remains the same

Coal
Gas
Wind

Wind stops blowing

Solar

Sun stops shining

Time

Workload efficiency:

Match workload needs to performance required

| Set of Microservices | Node | | Mixed Workloads | Node | | AI Workload | Node |
| NIC | | | NIC | NIC | | NIC | XPU XPU |

Accelerator Fabric

World ◄──► Switch ◄──► Switch

Ideal Workload Placement

Auto Workload Scaling:

Power up and down cores depending on need

| Idle CPUs | Pod 1 CPUs | Pod 2 CPUs | Node |
| Min Power Config | Power Performance Config | Power Savings Config | |

Optimization Tools/guides to use today:
Kubernetes Telemetry Aware Scheduling
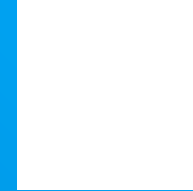Kubernetes Power Manager
Intel P and C State Tools

Monitor and Analyse Operational Use Electricity

Intel® Data Center Manager

Device and Data center Electricity and Carbon Emission Monitoring

Power and carbon Emission Control and Capping

Forecasting Carbon Emissions and Future Power and Space Needs

Identifying Underutilized Servers and Optimizing Density

Granular Thermal Mapping and cooling analysis

Optimize workloads with tooling: Granulate

Only capability that can autonomously and continuously deliver application efficiencies reducing infrastructure needs

40%
average cost saving due to less infrastructure

38%
processing time reduction

5X
throughput increase

0
code changes

Reduces infrastructure needs- enabling cost and sustainability benefits

Source: granulate.io

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14

Real Results

30-60%
Reduction in CPU utilization

40-60%
Reduction in compute costs

SALT SECURITY

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Develop Sustainability Best Practices

Data Center Operators (Edge to Cloud)

1. Choose processors manufactured with renewable electricity

Intel Xeon processors are manufactured using 80% renewable electricity

2. Choose server platform optimized for workload w/ power controls

Intel Xeon platforms have leading perf / watt for real world workloads that matter + power controls through P-States and C-States

3. Choose modular servers

Replacing compute, memory, and I/O separately can extend product life

4. Measure server energy consumption

Use tools to monitor electricity consumption in use like Intel Data Center Manager

5. Find underutilized servers and consolidate

Intel Granulate can help you find underutilized instances and take action

6. Run workloads when renewables available

Use software scheduling to run workloads when renewable electricity is available. Ask your utility company for renewable electricity options.

7. Use liquid cooling solutions to lower electricity use & reuse heat

Liquid cooling can save electricity, increase density, and enable heat reuse

8. Sell servers for 2nd life or retire responsibly

2nd life extends total service life before recycling responsibly

Public Cloud Users

1. Choose instances with processors manufactured with renewable electricity

Intel Xeon processors are manufactured using 80% renewable electricity

2. Choose instances optimized for perf / watt for workload

Intel Xeon processors have leading perf / watt for workloads that matter

3. Find underutilized instances and consolidate

Intel Granulate can help you find underutilized instances and take action

4. Run workloads when renewables available

Ask your cloud service provider for options

What else can be done?

Review Service Level Objectives: Latency

Reduce zombie services

Energy Efficient Coding Languages

Invest in performance and algorithm optimization

Storage

Get involved with Green software through organizations such as:

- Green Software Foundation (GSF)

- Environmental Sustainability TAG at Cloud Native Computing Foundation (cncf.io)

- Green Ops project at FinOps Foundation

Architect for serverless

Carbon accounting standards

Together we can make a difference

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Starting Now