



BUILDING FOR THE ROAD AHEAD

DETROIT 2022

TAG Environmental Sustainability: How to Get Involved?

Marlow Weston & Huamin Chen



KubeCon



CloudNativeCon

— North America 2022 —

BUILDING FOR THE ROAD AHEAD

DETROIT 2022

October 24-28, 2021

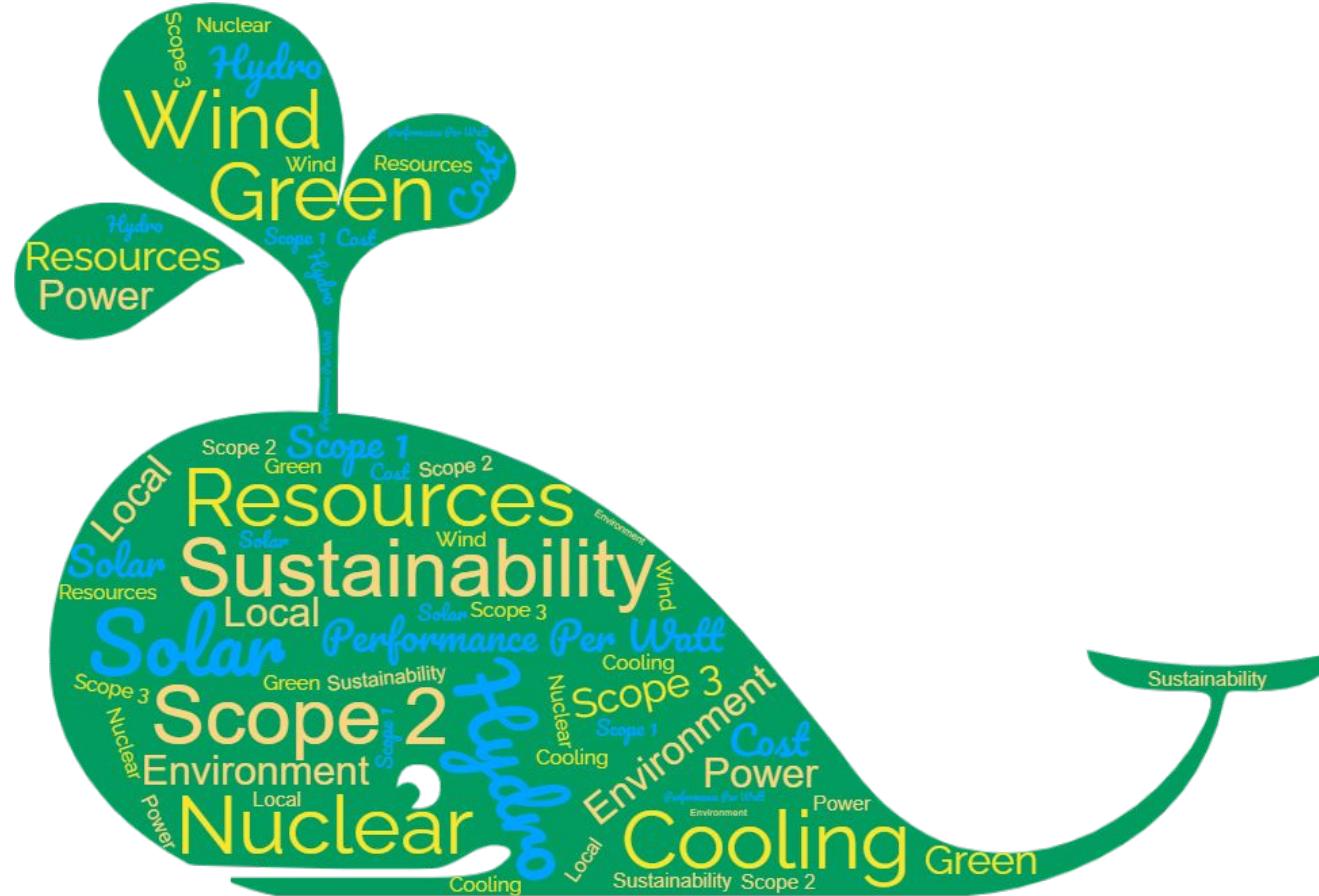


Marlow Weston
Cloud Software Architect
Intel



Huamin Chen
Sr. Principal SW Engineer
Red Hat

TAG Intro



Environmental Sustainability TAG Chairs

Role of Chairs:

Facilitate and enable community based work and projects

Make sure we contribute agreed-upon deliverables to the TOC and community



Marlow Weston
Cloud Software Architect
Intel



Max Körbächer
Co-Founder & Associate
Partner
Liquid Reply



Leonard Vincent Simon Pahlke
Consultant
Liquid Reply

Environmental Sustainability TAG Contributors

Role of Contributors:

Contribute to Projects

Contribute Projects

Contribute Direction and Vision

Provide Technical Knowledge



Tony
Mongkolsmai



Ariel
Jatib



Cara Delia



Jochen
Joswig



William Caban



Niki
Manoledaki



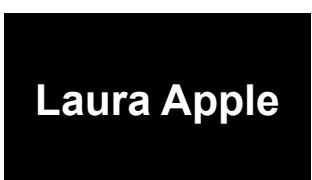
Scott Rigby



Chen Wang



Parul Singh



Laura Apple

Some Definitions

- The **Greenhouse Gas protocol (GHG Protocol)** sets the standards to measure and manage emissions.
- The GHG Protocol defines **three emissions scopes**, each extending the dependencies beyond the direct organization.

Scope 1



Sources controlled or owned by the organization

Scope 2



Caused by production of energy purchased & used by the organization

Scope 3

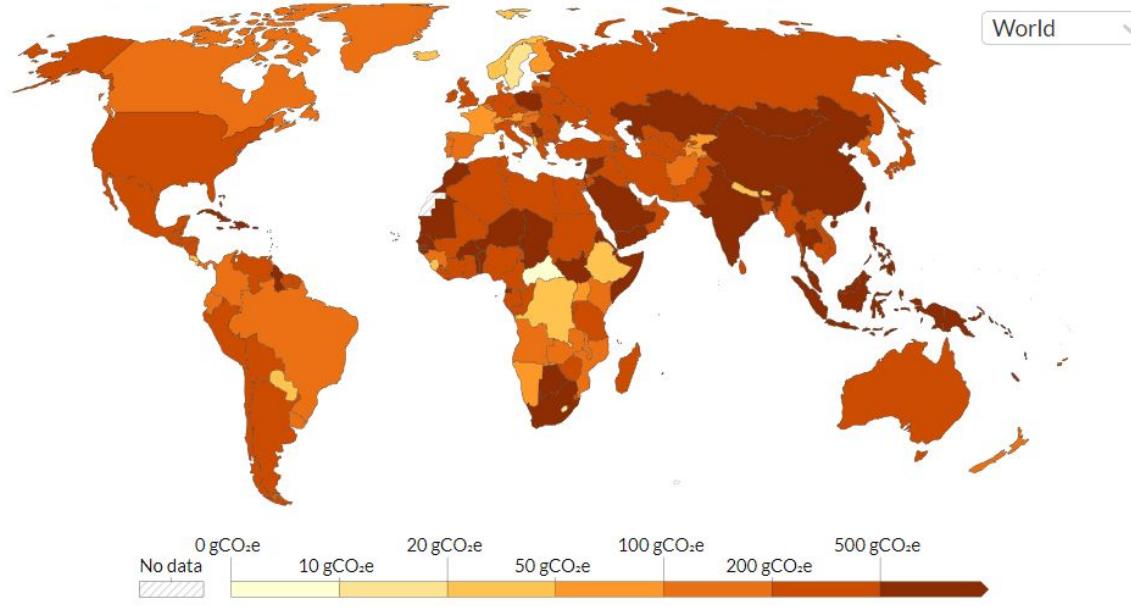


Caused by providers of services or products consumed by the organization

Cloud Native Sustainability: Region and Timezone

Carbon intensity of electricity, 2021

Carbon intensity measures the amount of greenhouse gases emitted per unit of electricity produced. Here it is measured in grams of CO₂-equivalents per kilowatt-hour of electricity.



Source: Ember Climate (from various sources including the European Environment Agency and EIA)

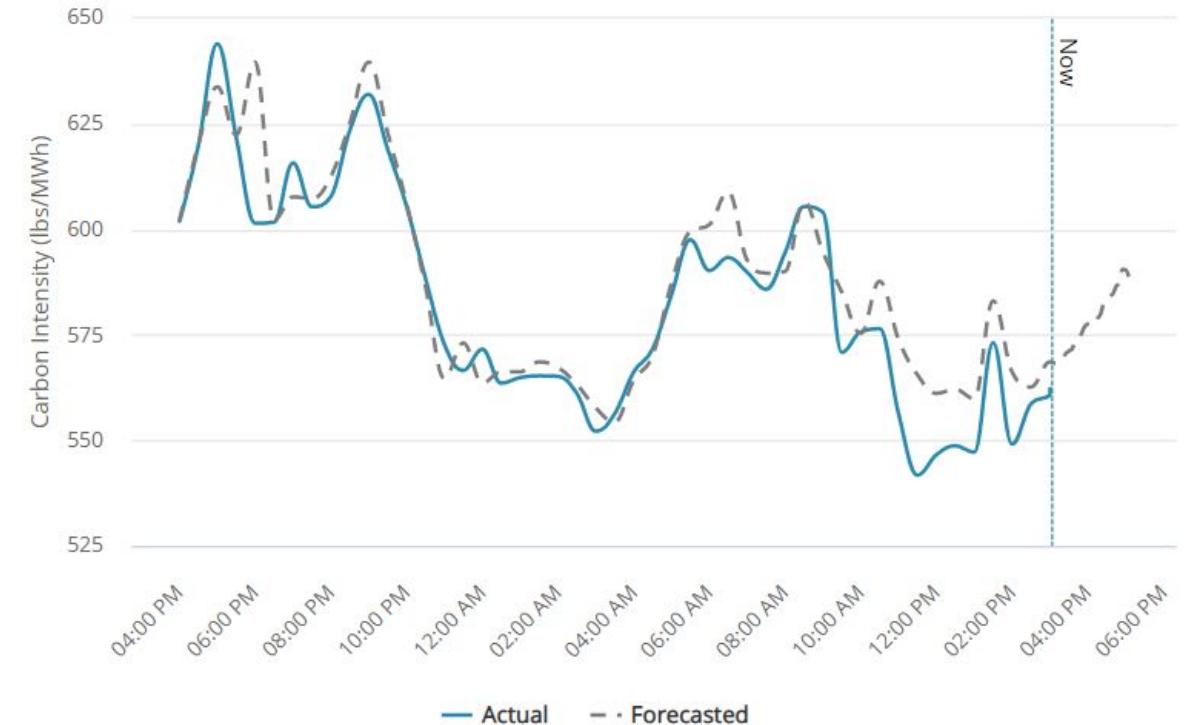
OurWorldInData.org/energy • CC BY

Carbon Intensity varies across regions.

Source:

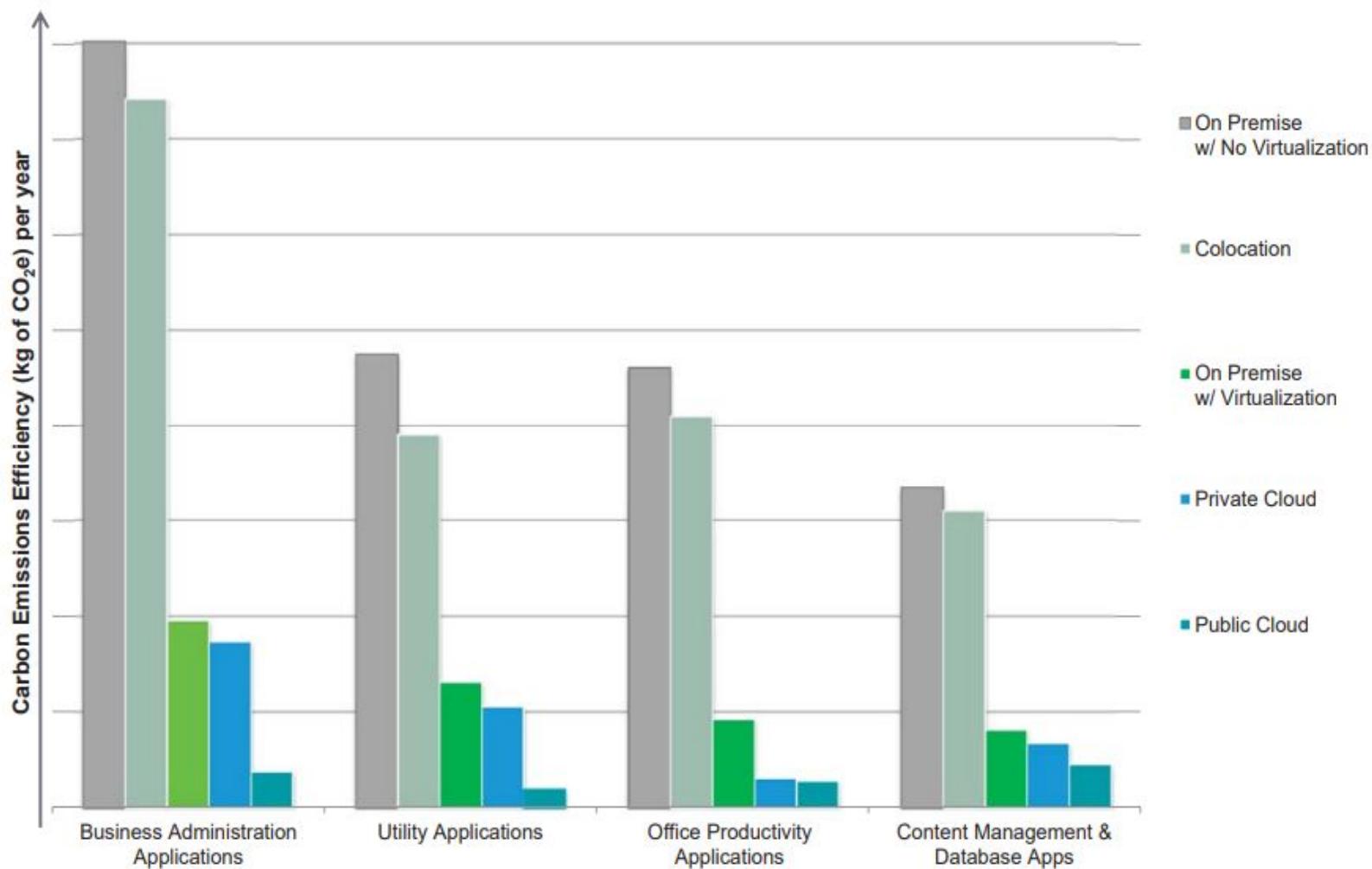
- [Carbon intensity of electricity, 2021](#)
- [Carbonara](#)

Carbon Intensity Trend



Carbon Intensity varies by hour in the same region

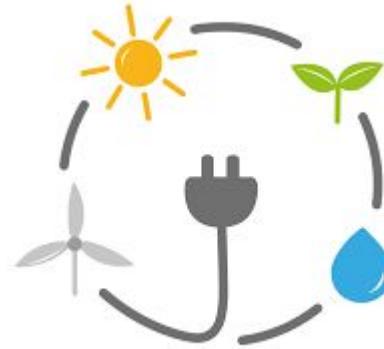
Cloud Native Sustainability: Infrastructure



Carbon Footprint Varies among:

- Types of Workloads
- Bare metal vs Virtualization
- Container vs VM
- Public vs Private Cloud

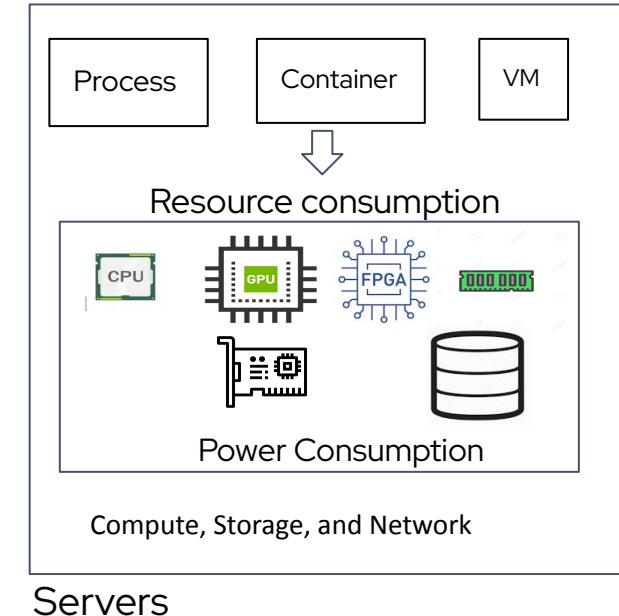
Cloud Native Sustainability: Telemetry



Carbon Intensity



Data center power usage effectiveness
(PUE)



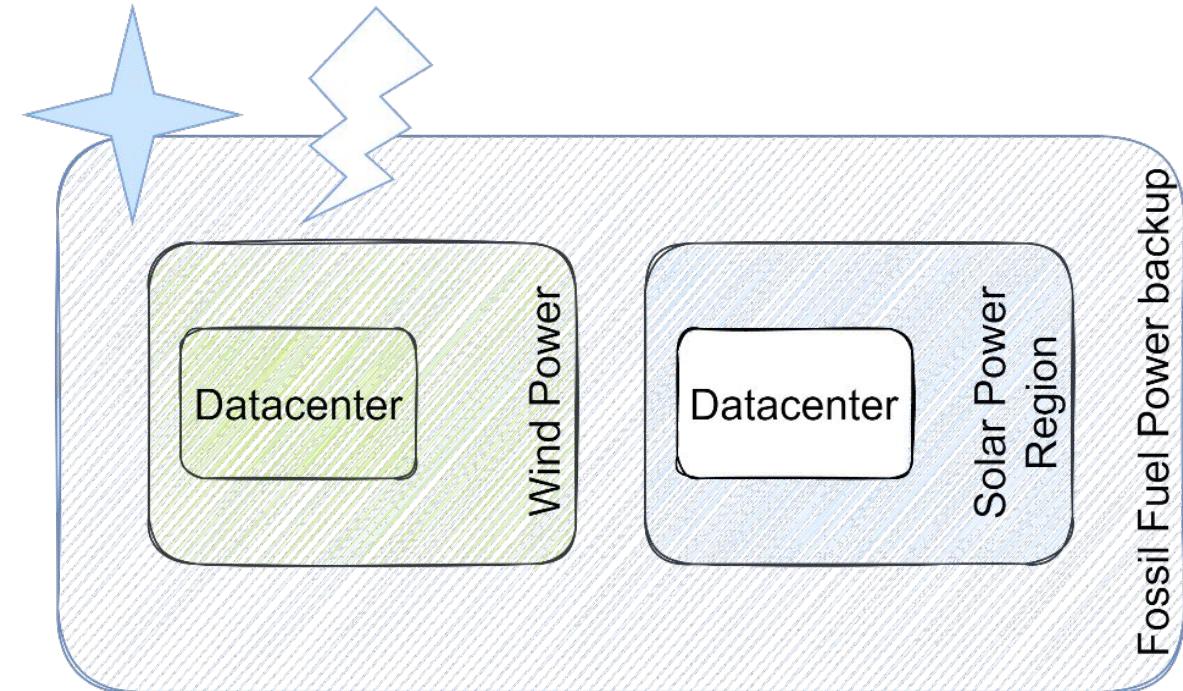
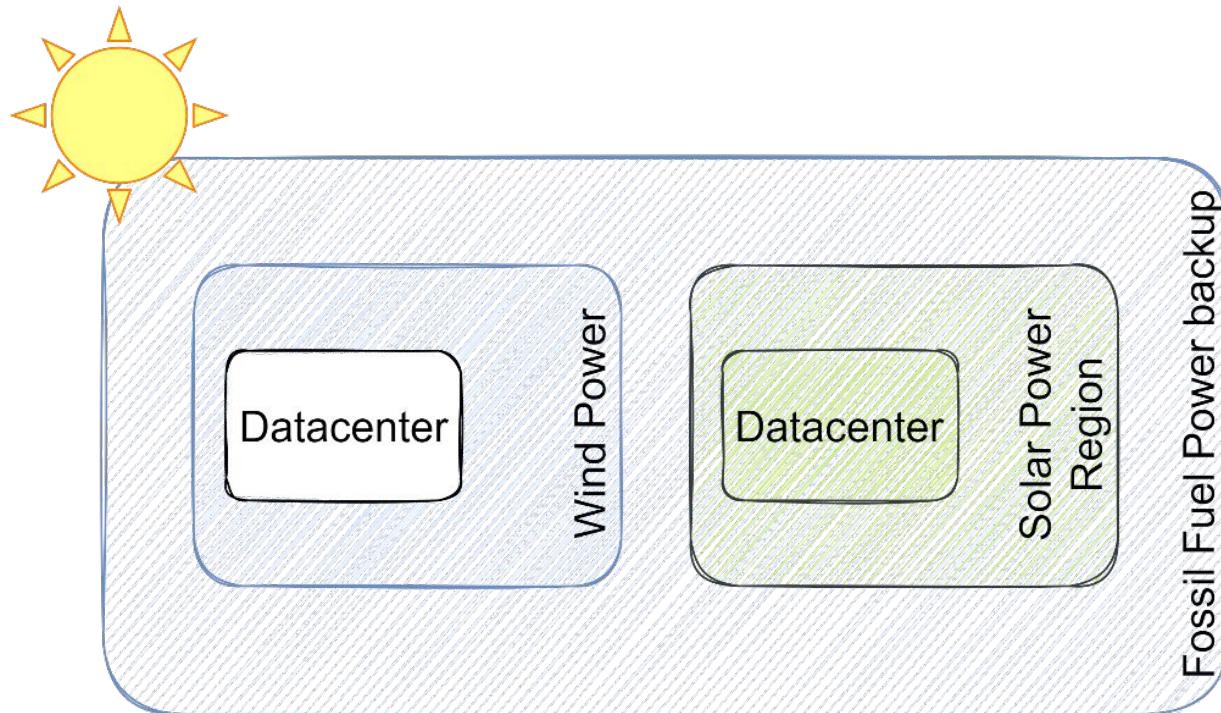
Servers

- Carbon Intensity
- Fossil Fuel Percentage
- Electricity Generation Cost
- Electricity Transmission Cost

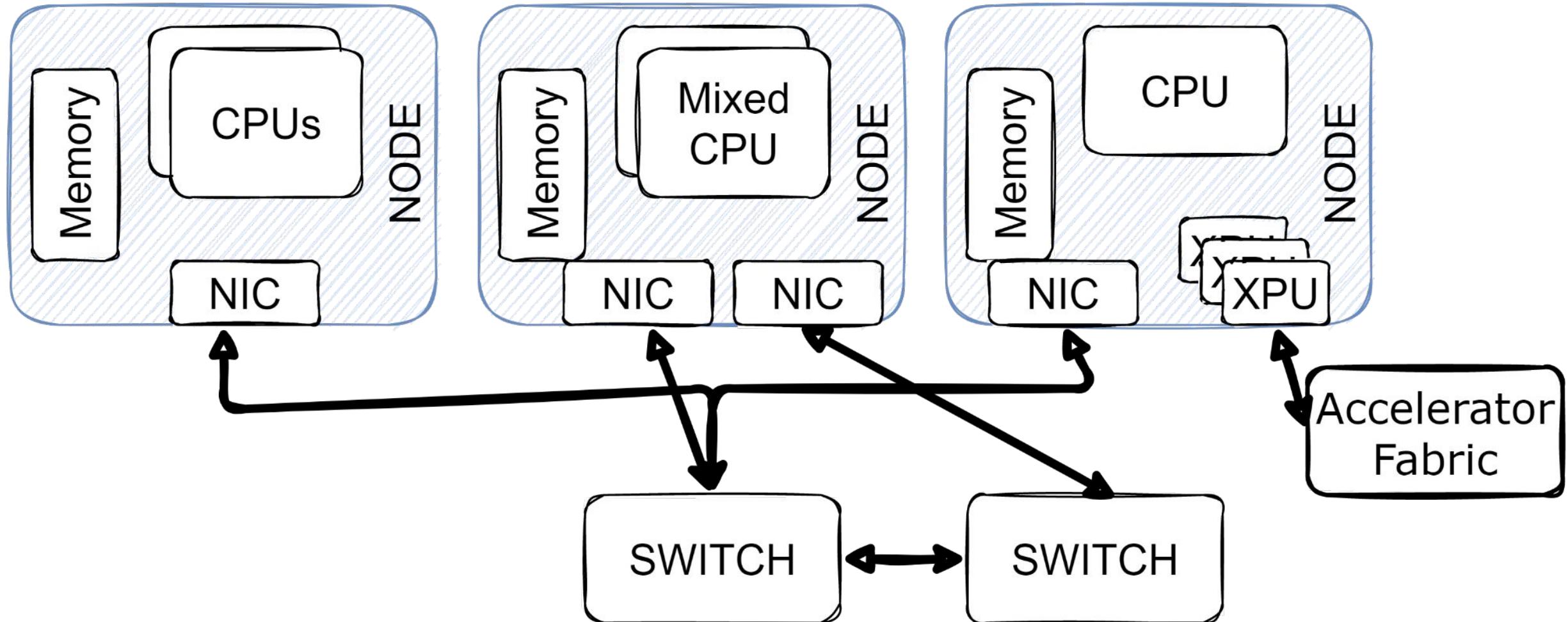
- Data Center Lighting Density
- Data Center Cooling System Efficiency
- Air Flow Efficiency
- Water Usage Efficiency

- Deployed Hardware Utilization
- Thermal Temperature
- Subsystem Power Consumption
- Compute/Network/Storage Utilization

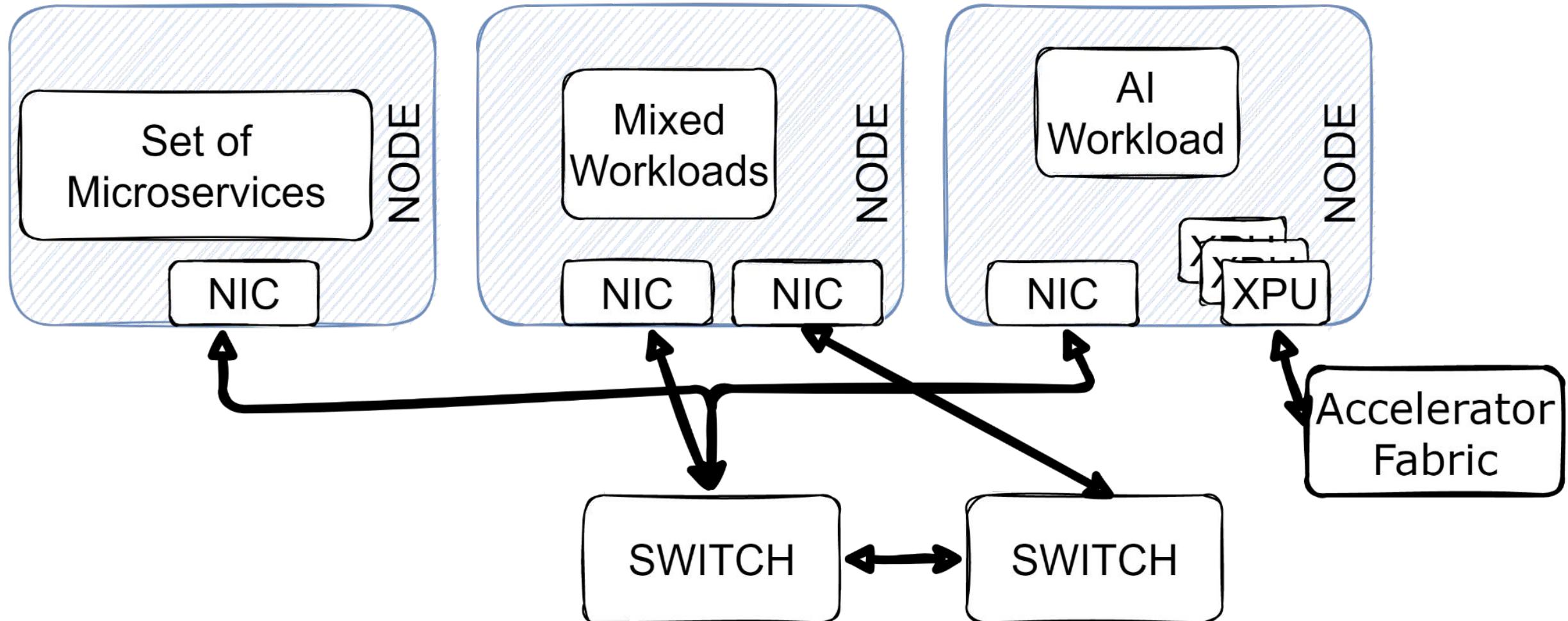
Cloud Native Sustainability: Intercluster



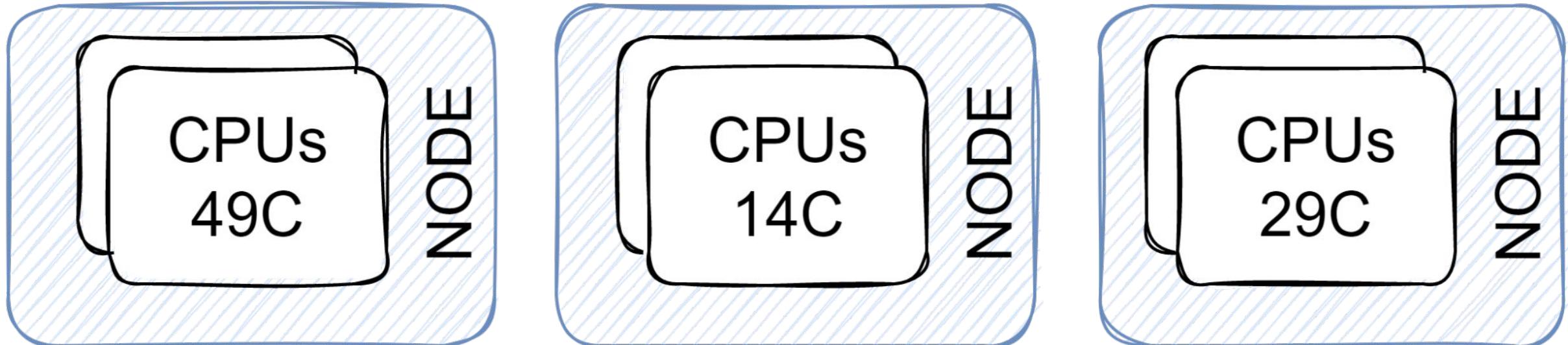
Cloud Native Sustainability: Intracluster



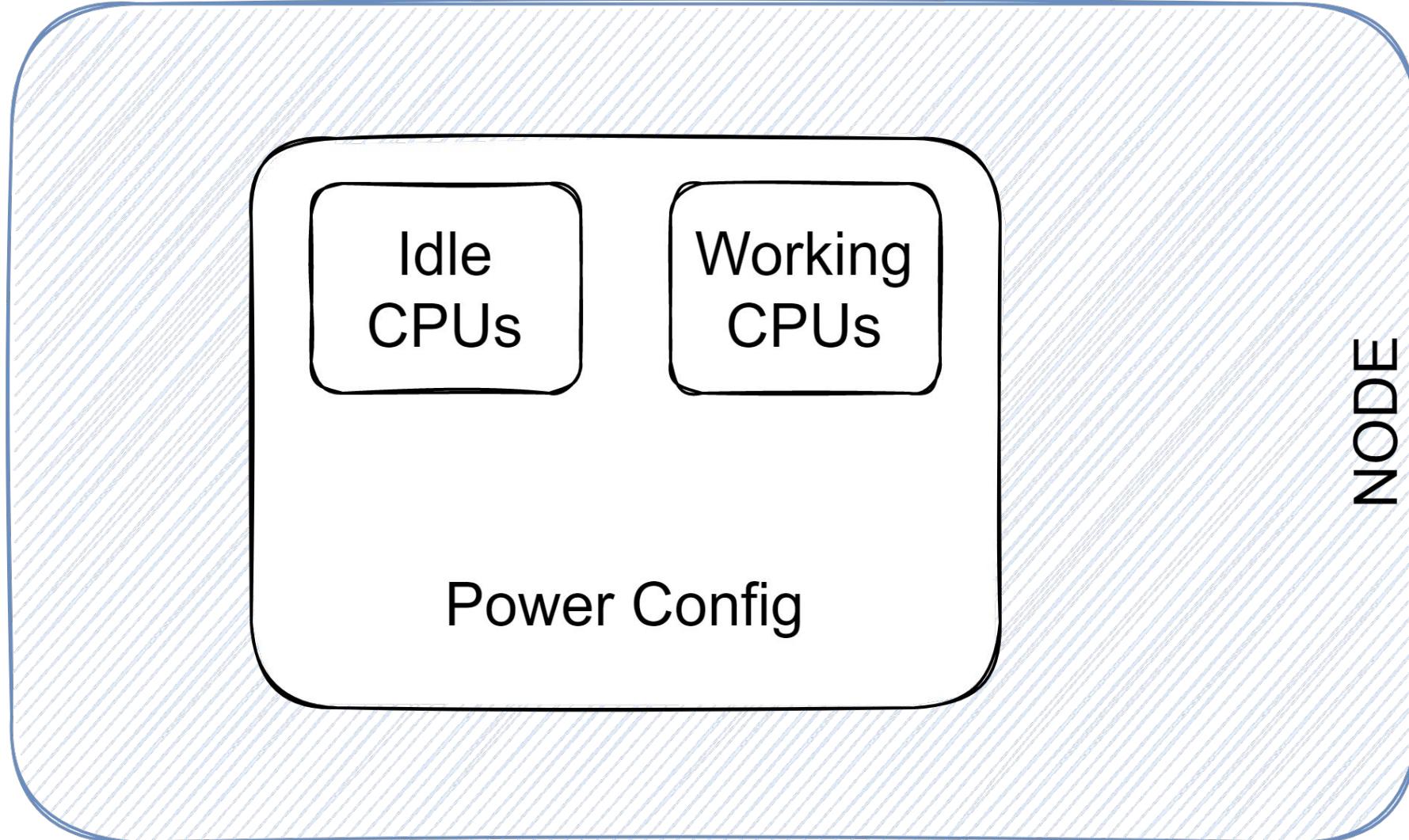
Cloud Native Sustainability: Intracluster



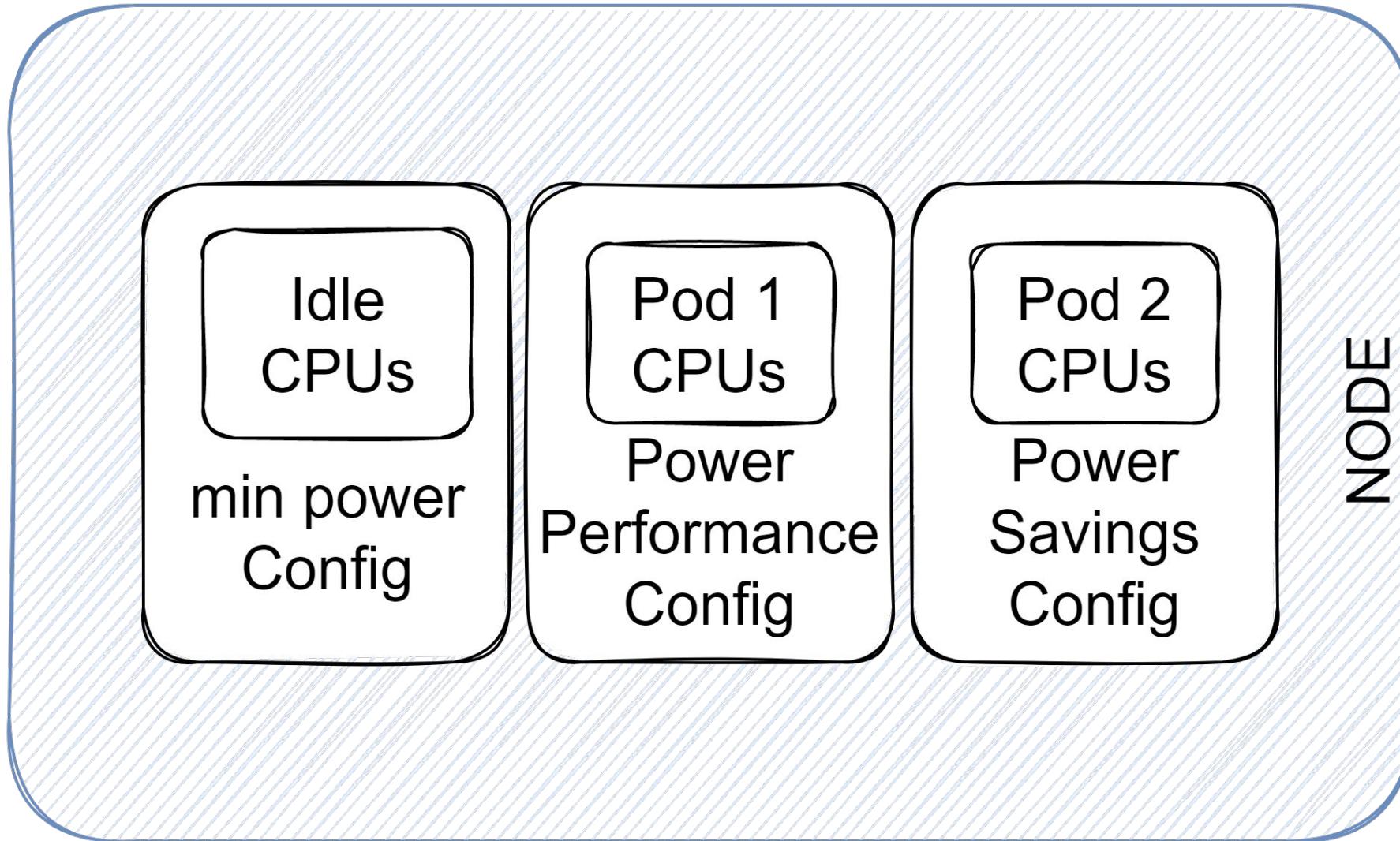
Cloud Native Sustainability: Intracluster



Cloud Native Sustainability: Node-level



Cloud Native Sustainability: Node-level



Cloud Native Sustainability: Cooling

Space Type	IT	Transformer	UPS	Cooling	Lighting	Total PUE
Closet	1	0.05	-	0.93	0.02	2.0
Room	1	0.05	0.2	1.23	0.02	2.5
Localized	1	0.05	0.2	0.73	0.02	2.0
Midtier	1	0.05	0.2	0.63	0.02	1.9
High-end	1	0.03	0.1	0.55	0.02	1.7
Hyperscale	1	0.02	-	0.16	0.02	1.2

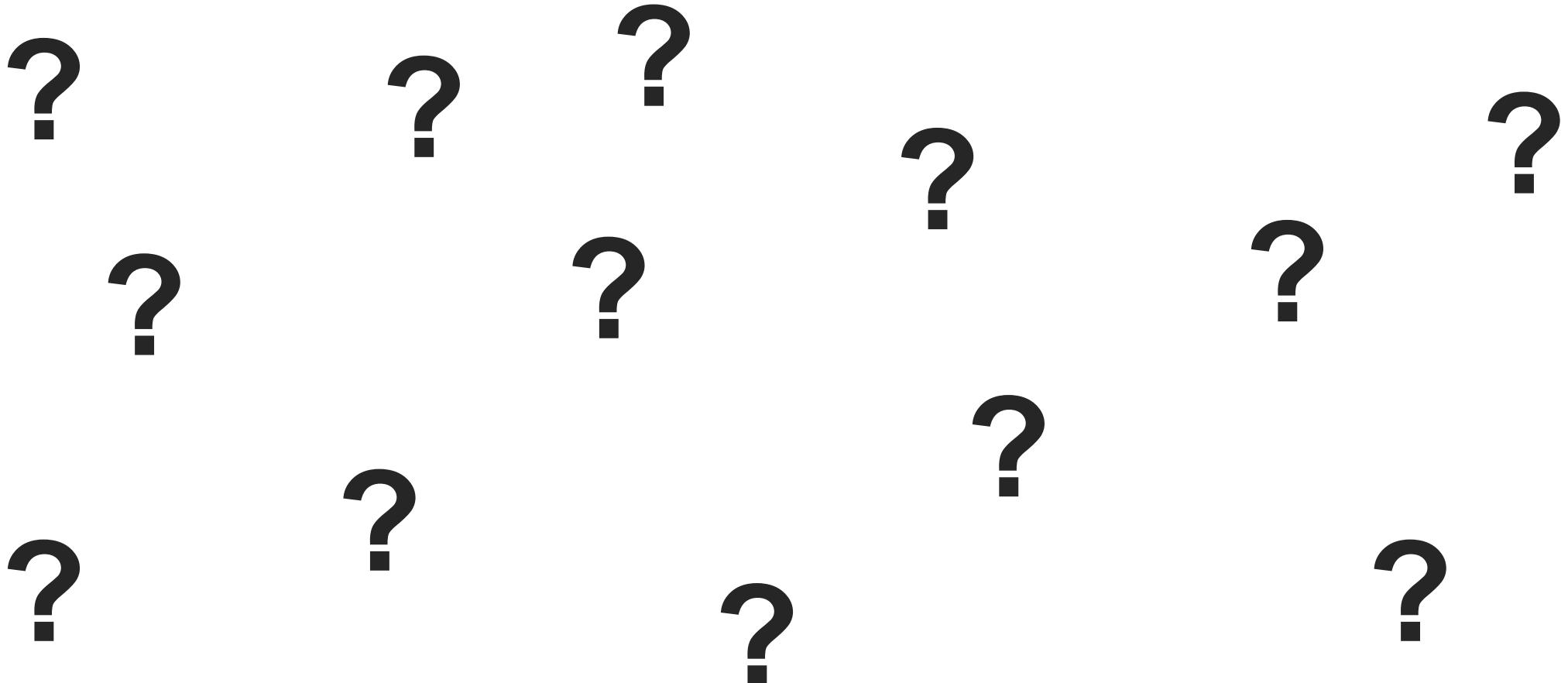
Source: [United States Data Center Energy Usage Report](#), 2016

Cloud Native Sustainability: Cooling

Factors:

- Ambient Temperature
- Cooling Techniques
- Smart Controls

QUESTIONS?



Charter: In-Scope

- **Identify, define, and develop** tooling to assess and improve environmental sustainability approaches, including
 - **Quantify** the energy consumption of cloud native implementations individually as well as in common integration patterns
 - **Recommendations and strategies** to develop, package, distribute, deploy, and operate cloud native implementations to reduce energy consumption and carbon as well as the various environments they operate in and which impact their consumption
 - **Capabilities, benchmarks, and processes** to evaluate technological and architectural health of projects
- **Community outreach and engagement** on the work of this TAG
- **Collaboration** with other environmental or sustainability organizations, initiatives, activities, and efforts that may fall outside of the CNCF (Cloud Native Computing Foundation)

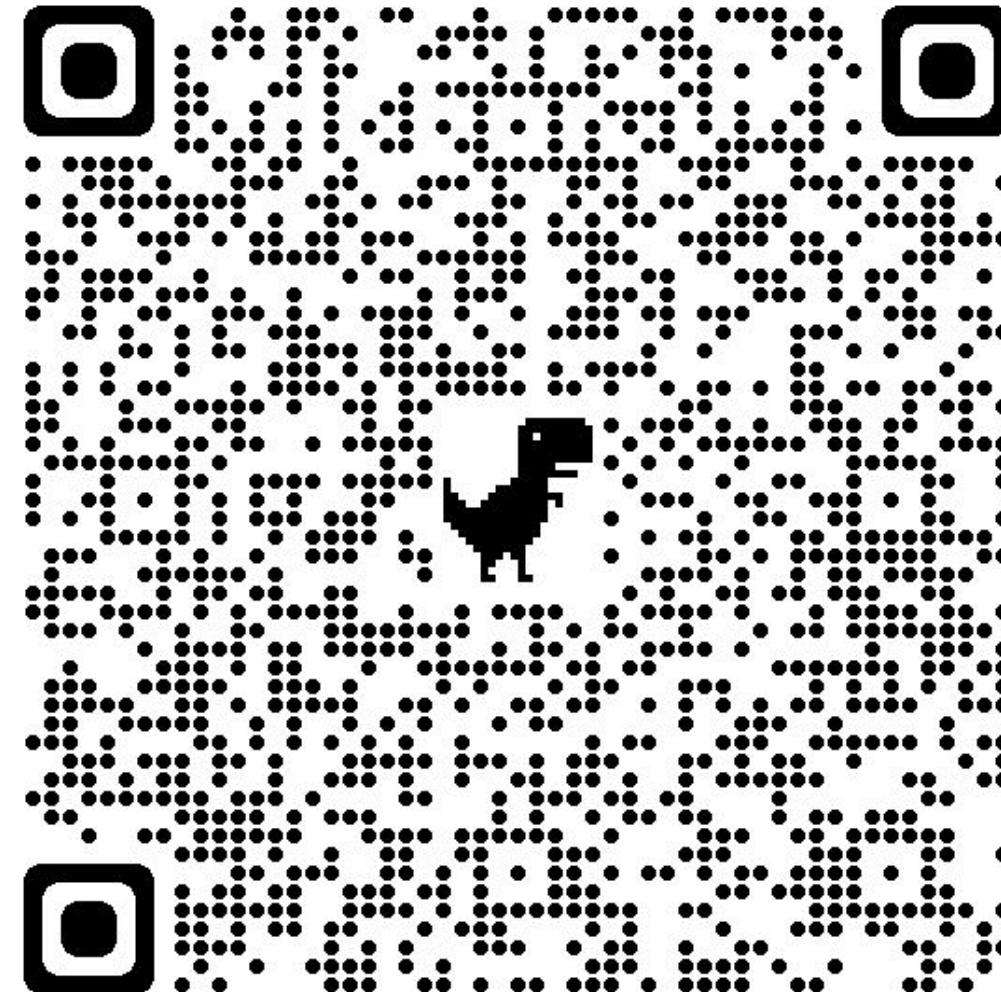
Charter: Out of Scope

- Form an umbrella organization beyond the CNCF
- Establish a compliance and standards body beyond the CNCF space
- Evaluate individual company infrastructures
- Focus outside of cloud native technologies

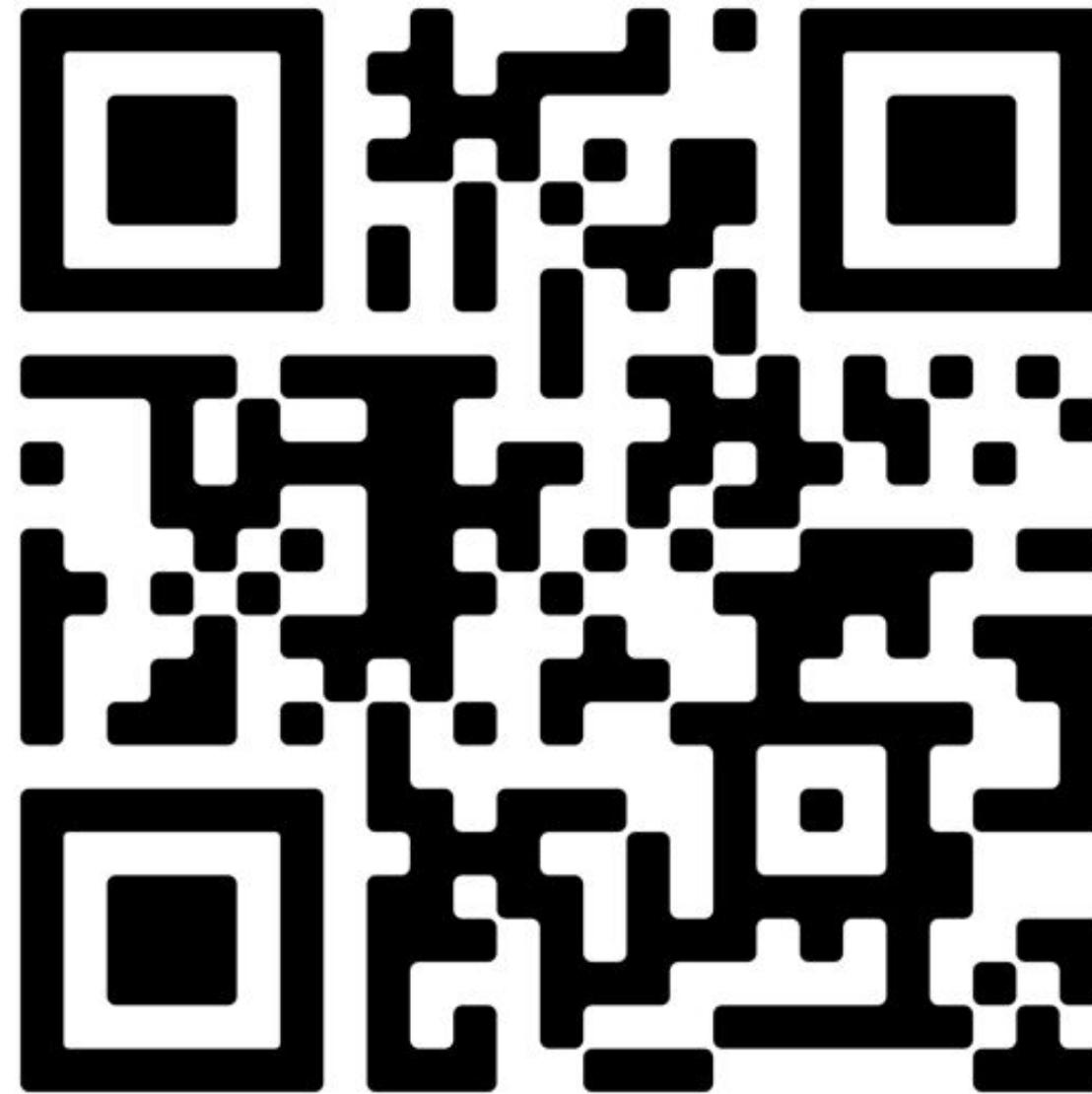
Charter: Deliverables

- **Landscape** for carbon and energy efficiency in the form of metrics, measurements, and management techniques
- Environmental sustainability **recommendations** and **optimizations** to new and existing projects within the landscape
- **Reports on gaps** in the environmental sustainability coverage of the landscape
- **Reviews, inputs, and recommendations for proposed projects** for CNCF hosting and advancement
- **Suggestions for improvements** for CNCF internal processes, for example, education for sustainability

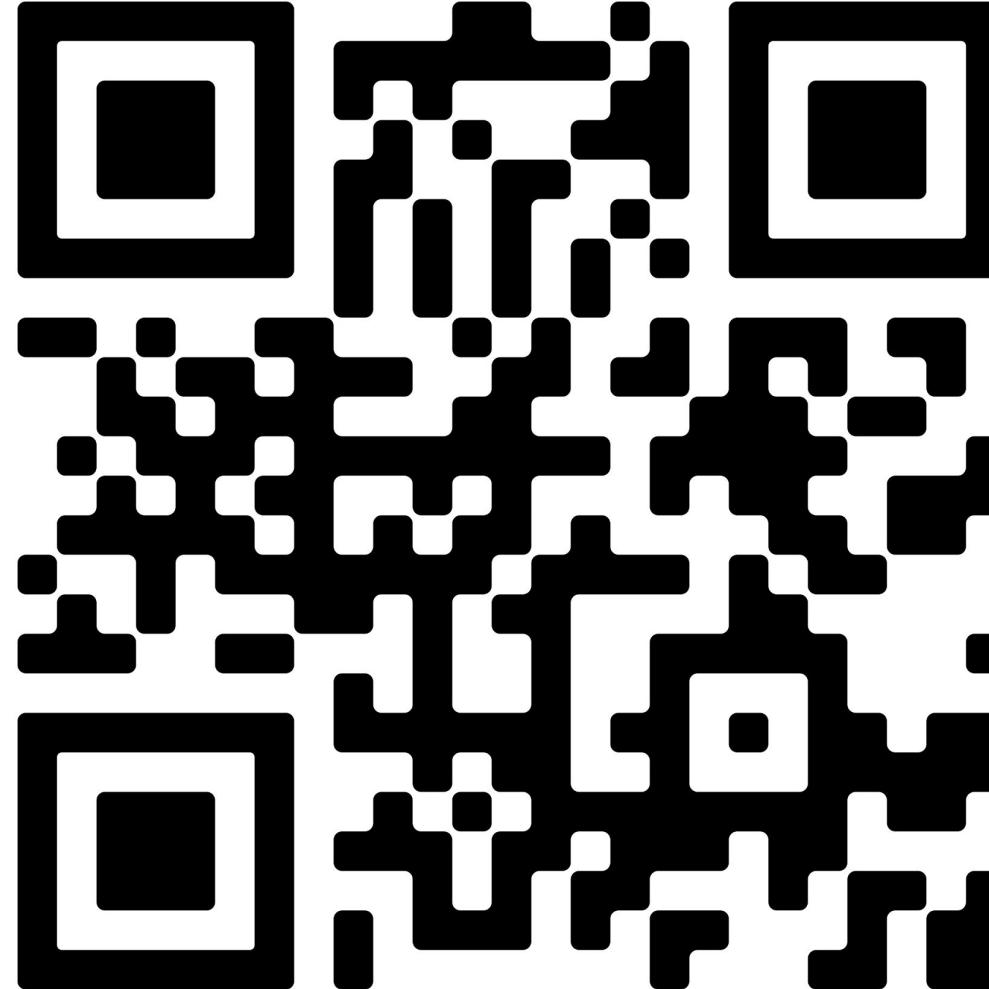
Landscape Document: IN PROGRESS



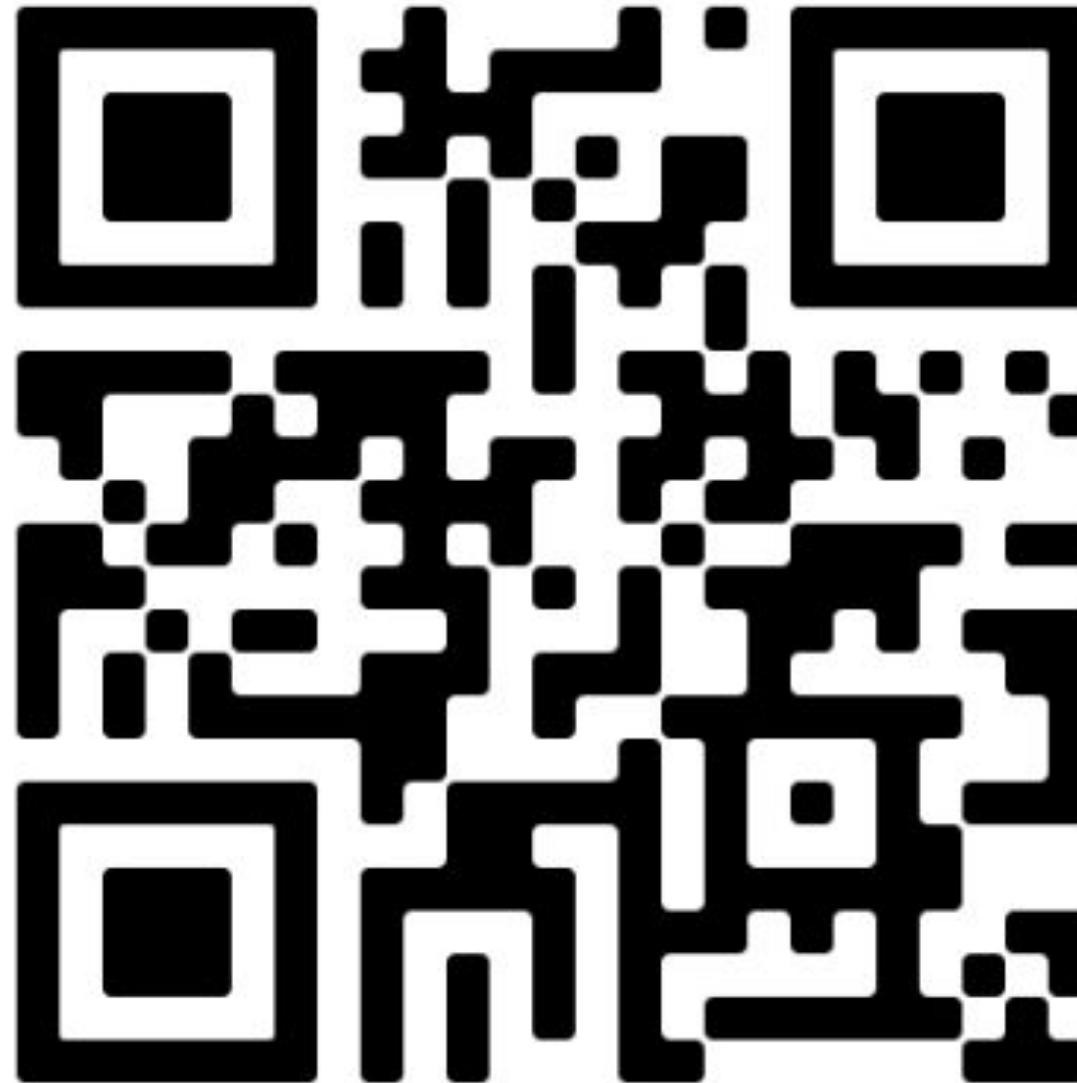
Kepler



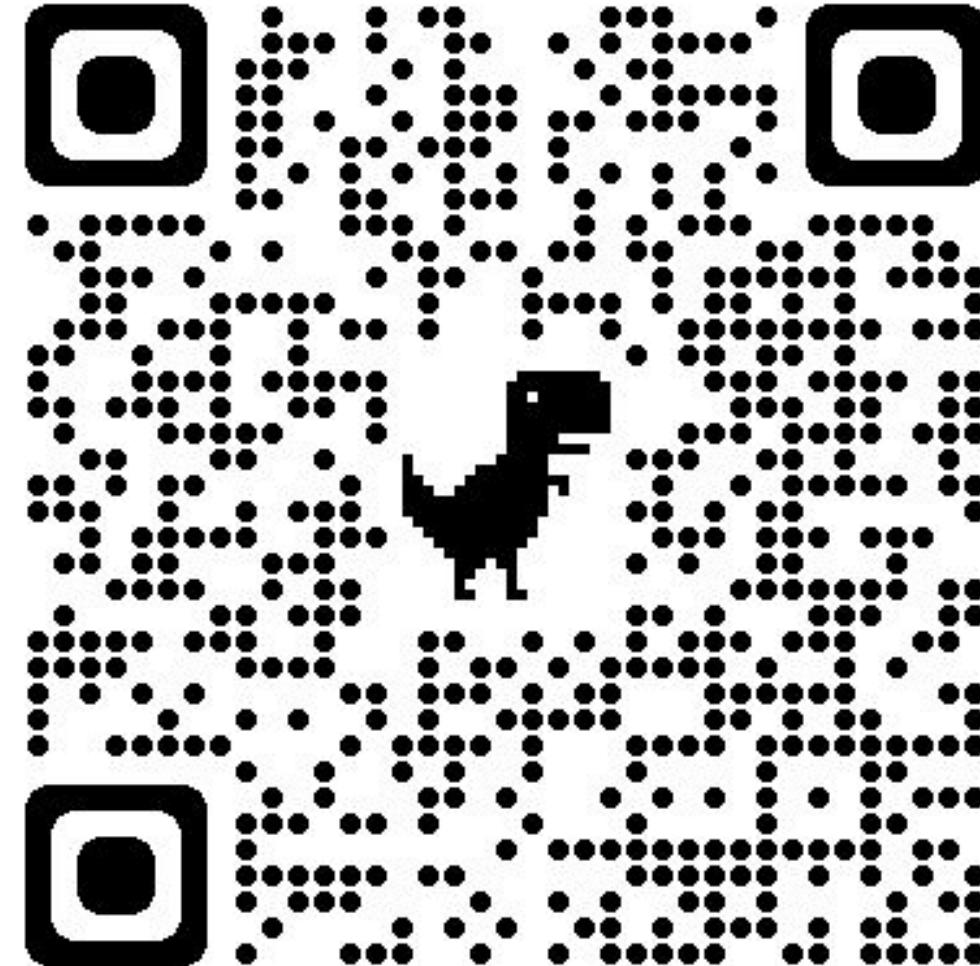
Green(Ing) CI/CD with Flux

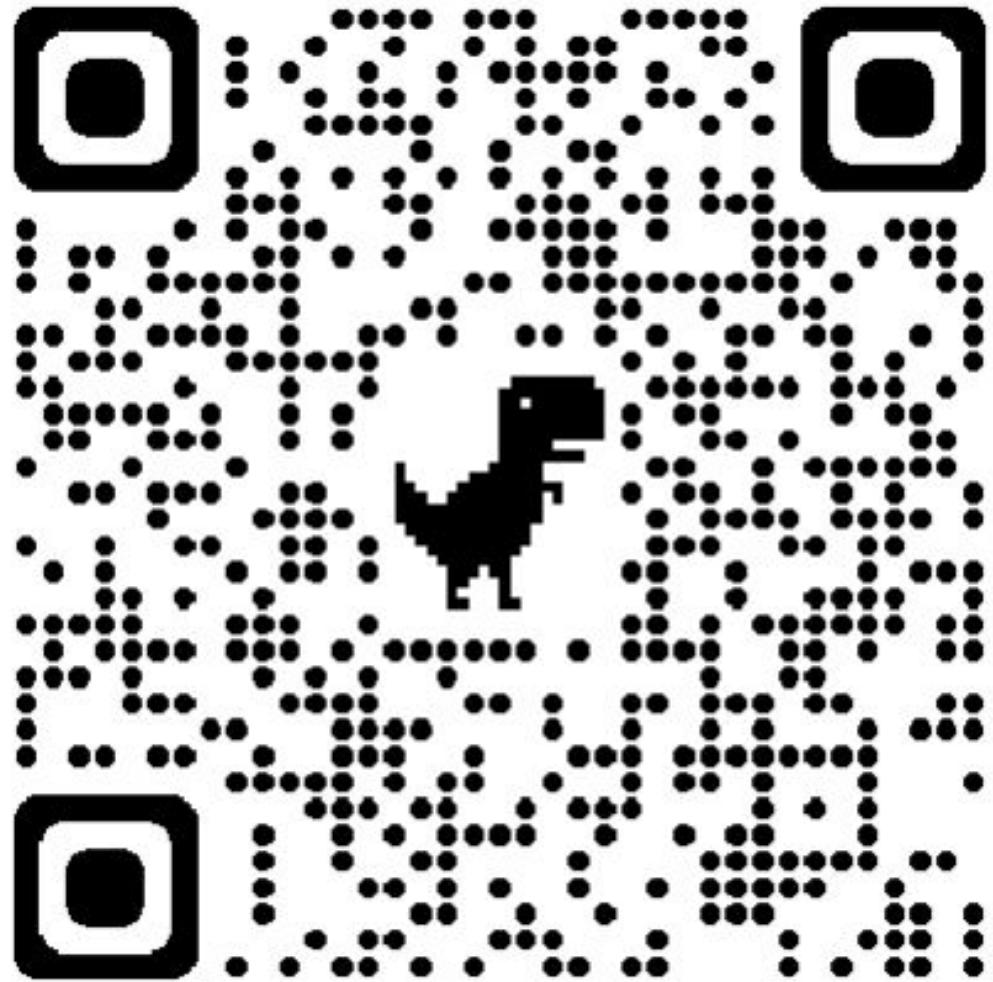


KEDA: Carbon Aware Scaling PoC



End User Sustainability Survey





cncf_env_sustainability_tag

@CNCFEnvSustTAG

Let's meet in person
Thursday,
10:30AM-12PM
outside of Room 260