SUSTAINABILITY ALL THE WAY DOWN

SRI RAMKRISHNA
ONEAPI COMMUNITY MANAGER | INTEL

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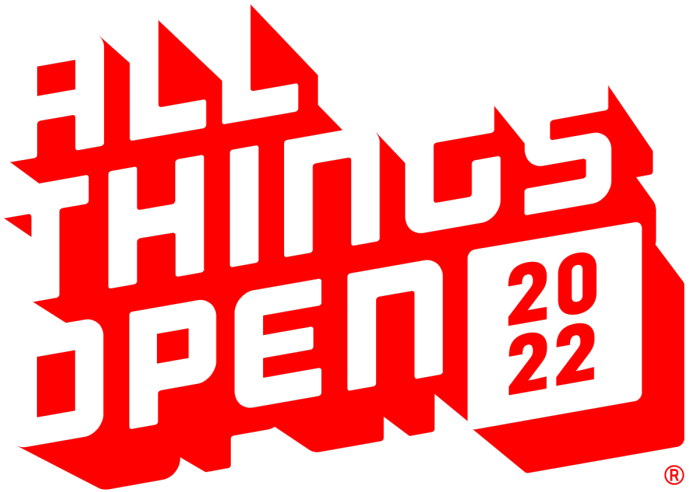
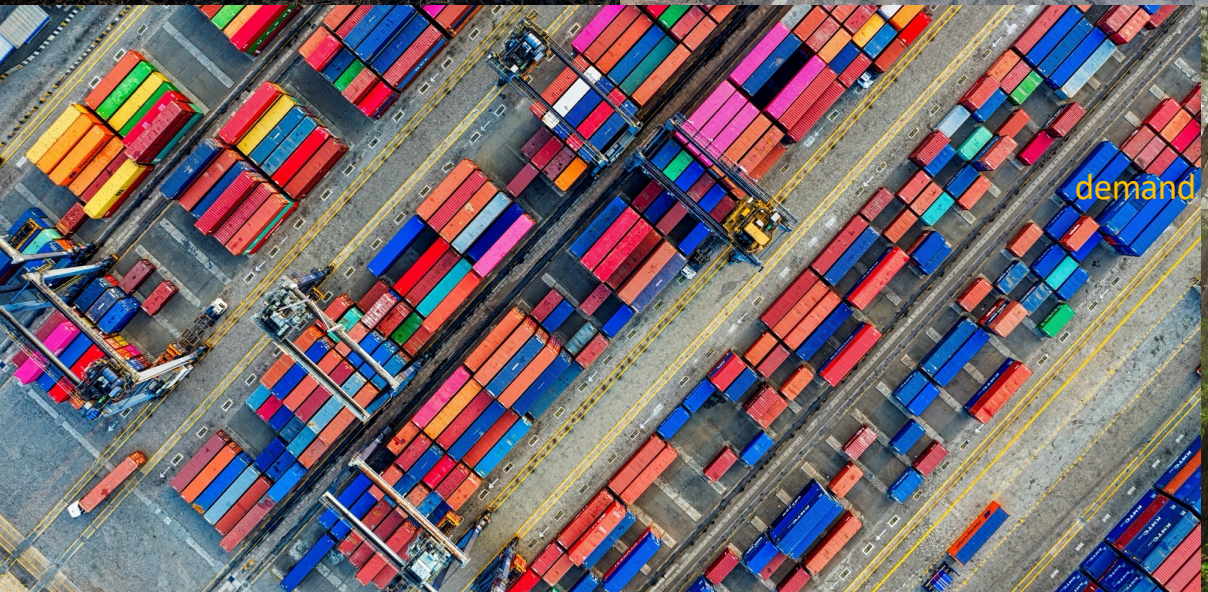
CHIEF ENGINEERING OFFICER | FLAX COMPUTING



SUSTAINABILITY DEMANDS COMPREHENSIVE APPROACHES

Renewable energy progress is great, and necessary, but **INSUFFICIENT**



carbon

footprint

growth

clouds
drive
demand

inefficient
toolchains

Green
Software
Foundation

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We are building a trusted ecosystem of people, standards, tooling and best practices for

GREEN SOFTWARE

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https://greensoftware.foundation/

software footprint

SUSTAINABILITY ALL THE WAY DOWN

Focusing on Software / Applications it the “top” of the stack

Hardware is at the “bottom” of the stack

The stack is **DEEP** and **WIDE**

Software and Hardware sustainability can work together to realize complete sustainability – across Scope 1, Scope 2, **Scope 3**

Let's talk about hardware and the sustainability work that's happening today

Open Is Necessary, But Not Sufficient Per Se

design, engineering and product expertise, rigorous commitment to component quality

[software]

requires baseline partnership across hardware & software

[hardware]

design, engineering and product expertise, rigorous commitment to component quality

devops – collaboration from designers & developers to operations

ORCHESTRATING AN OPEN HARDWARE + OPEN SOFTWARE STACK

from capacitors to CAP theorem to cognitive load

wide dynamic range of skills must be applied & appreciated

automation, analytics, and machine learning for all the things

OPEN HARDWARE, OPEN SPECIFICATIONS

- instead of every company making their own unique specifications
- we work together on common elements to consider
- specifications that e.g. maximize cooling and reduce heat
- high density servers for maximum computation per floor tile
- form factors that can use any space in any location – under desks, in closets of various sizes, outdoors – to drive edge computing
- design for use of off-the-shelf components that are already efficient in mass production
- re-use, re-purpose, revamp the Hardware Supply Chain

OPEN HARDWARE – OPEN COMPUTE PROJECT (OCP)

ENGINEERED SYSTEMS READY TO DEPLOY

Engineered, tested, supported as a single stack

Roll it in, turn it on

FLEXIBLE SCALE & CAPACITY

6 to 96 nodes per rack

>1,000 nodes per cluster

25/100G networking

PURPOSE-BUILT CONFIGURATIONS

Kubernetes

Converged/HCI

AI/ML

STANDARD RACK SIZE & POWER

No data center redesign

Leverage existing power

kubernetes RANCHER SUSE vmware

What Are As Built Drawings?

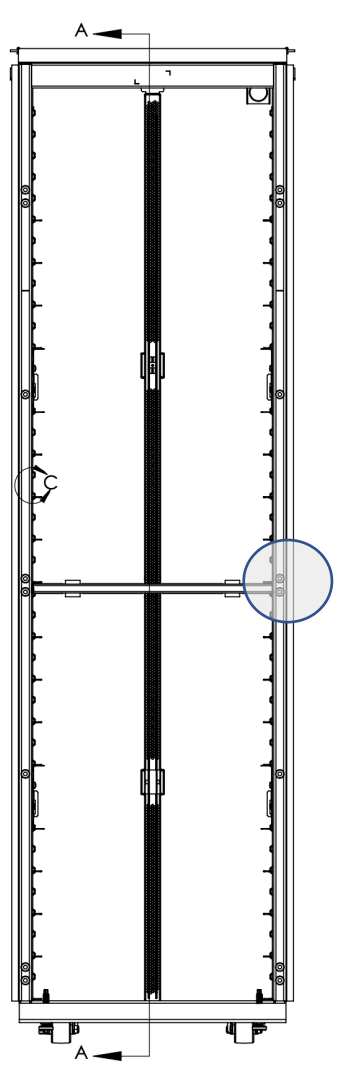
https://constructionblog.autodesk.com/as-built-drawings/

OPERATIONS | By Grace Ellis | September 1, 2021 | 13 min read

challenge in hardware over software – need "as-built" documentation

the "ground truth" isn't necessarily the most recent git commit

screws in the CAD became welds in the build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OPEN HARDWARE – READY TODAY

ACTUALLY, READY FOR THE PAST TEN YEARS

These are not pie in the sky ideas – they are already actively implemented under the aegis of the Open Compute Project and the Linux Foundation

Platinum

Alibaba (since 2017)

AMD (since 2012)

AMI (since 2018)

Ampere Computing (since 2019)

Meta (since 2011)

Microsoft (since 2014)

MiTAC (since 2017)

Nokia (since 2015)

Arista Networks (since 2019)

ARM (since 2018)

ASUS (since 2019)

AT&T (since 2015)

NVIDIA (since 2017)

Quanta Cloud Technology (since 2012)

Rackspace (since 2011)

Ragile Networks (since 2020)

Baidu (since 2019)

Bytedance Technology (since 2021)

Cisco (since 2014)

Delta Electronics (since 2016)

Rittal (since 2017)

Samsung Electronics (since 2019)

Schneider (since 2014)

Shell (since 2020)

Edgecore Networks (since 2016)

Google (since 2015)

HPE (since 2015)

Huawei (since 2021)

Sims Lifecycle Services (since 2020)

Submer (since 2018)

Target (since 2021)

Tencent (since 2018)

Hyve Solutions (since 2012)

IBM (since 2013)

Inspur (since 2016)

Intel (since 2011)

UL Inc. (since 2021)

Vertiv (since 2019)

Wiwynn (since 2014)

Gold

Seagate (since 2017)

ZT Systems (since 2019)

Silver

Celestica (since 2019)

Innolight Technology (since 2021)

Inventec (since 2014)

Sony Interactive Entertainment (since 2020)

OPEN Compute Project®

members

Data Center Facility

Sub-Projects:
Modular Data Center
Critical Facility Operations - Incubation
Advanced Cooling Facility - Incubation

Hardware Management

Sub-Projects:
OpenRMC
Hardware Management Module - Incubation
Hardware Fault Management - Incubation

Networking

Sub-Projects:
ONIE
Open Network Linux
SAI
SONiC

Open System Firmware

Rack & Power

Sub-Projects:
ACS Immersion
ACS Cold Plate
ACS Door Heat Exchange

Security

Server

Sub-Projects:
High Performance Computing - Incubation
Mezz (NIC)
Open Accelerator Infrastructure
Open Domain-Specific Architecture

Storage

Telco

Sub-Projects:
openEDGE

OPEN Compute Project®

projects

Project

- Server (65)
- Networking (48)
- Rack & Power (36)
- Telco (21)
- Data Center Facility (15)
- Storage (13)
- Security (Incubation) (2)

Show more

Contributor

- Facebook (52)
- Microsoft (35)
- Edgecore Networks (18)
- Intel (7)
- AT&T (6)
- Delta Electronics (6)
- Inspur (6)

Show more

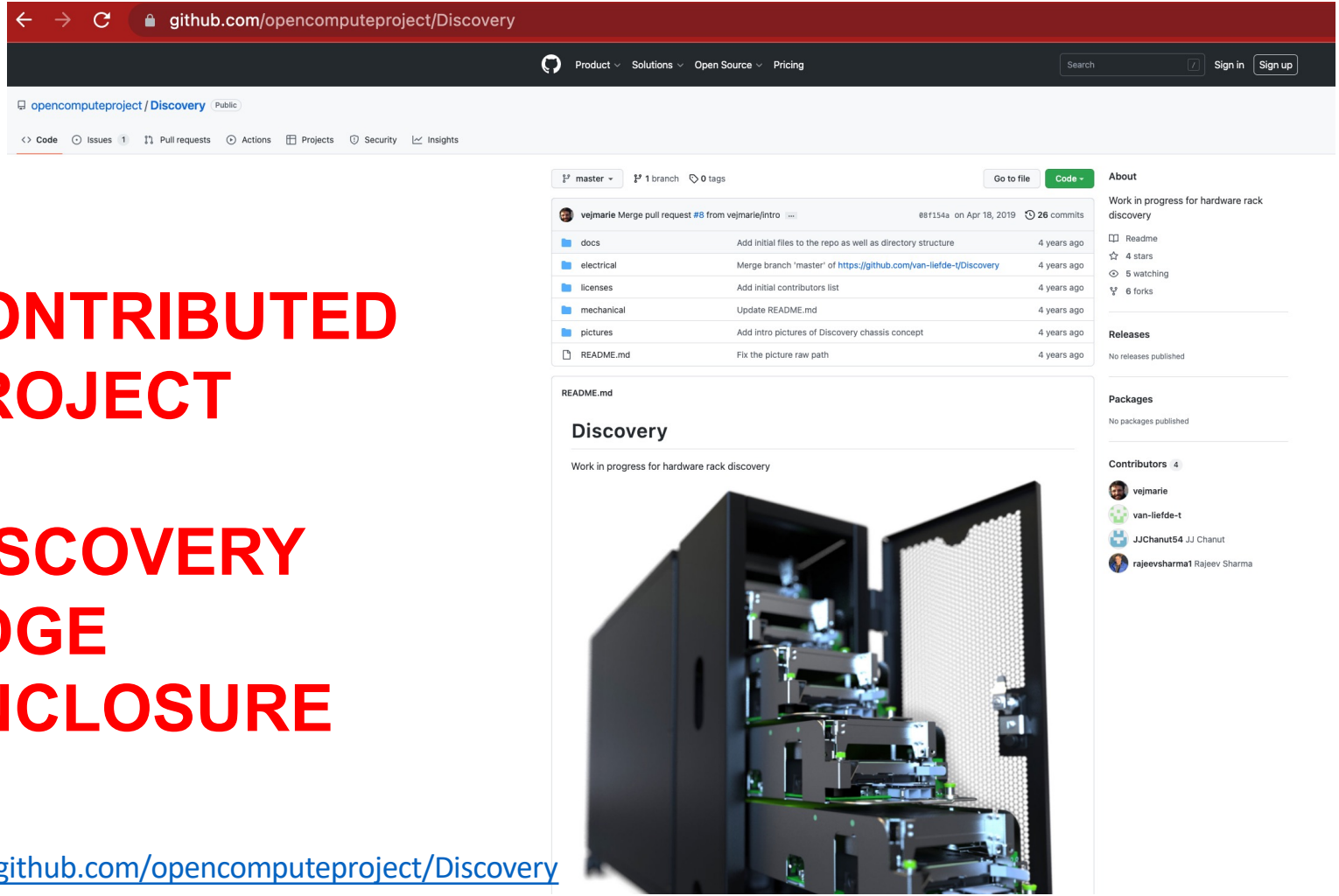
Family

- Network Switch (38)
- OpenRack v2 (24)
- OCS (18)
- OTHER (15)
- Olympus (14)
- Data Center (10)
- Storage (8)
- Telco (8)
- Power (7)
- OpenRack (6)
- SOC Boards (6)
- Server (6)
- 19" Server (5)
- Software (5)
- Accessory (4)
- Optical NW (4)
- ACS (3)
- CG-Openrack-19 (3)
- PCI Card (3)
- Access Point (2)
- Barreleye (2)
- Mezz Card (2)
- OCP Mezzanine (2)
- Security (2)
- uCPE (2)
- Debug Card (1)
- Honey Badger (1)
- Information (1)
- Open Vault Storage (1)

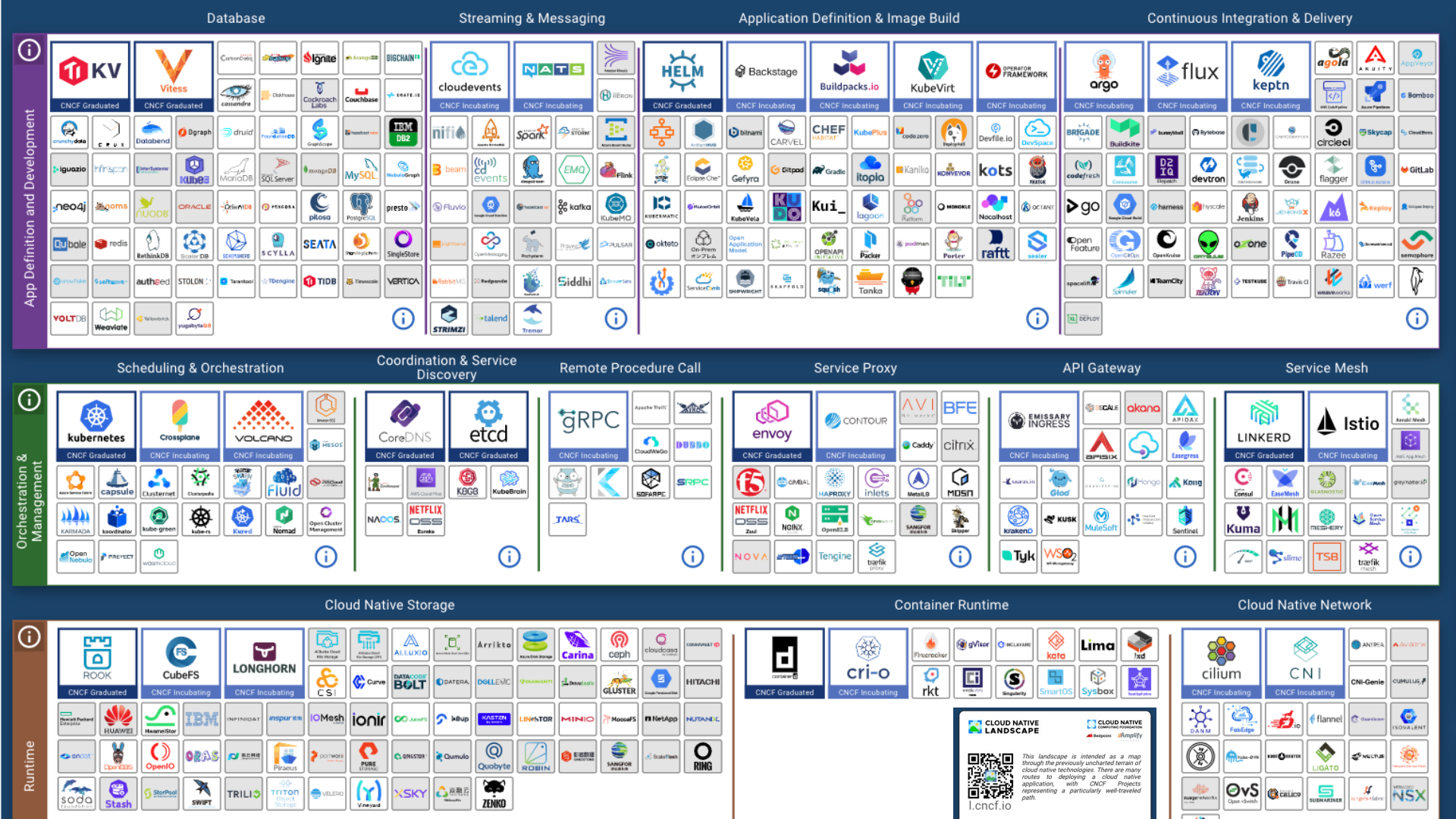
OCP 2022

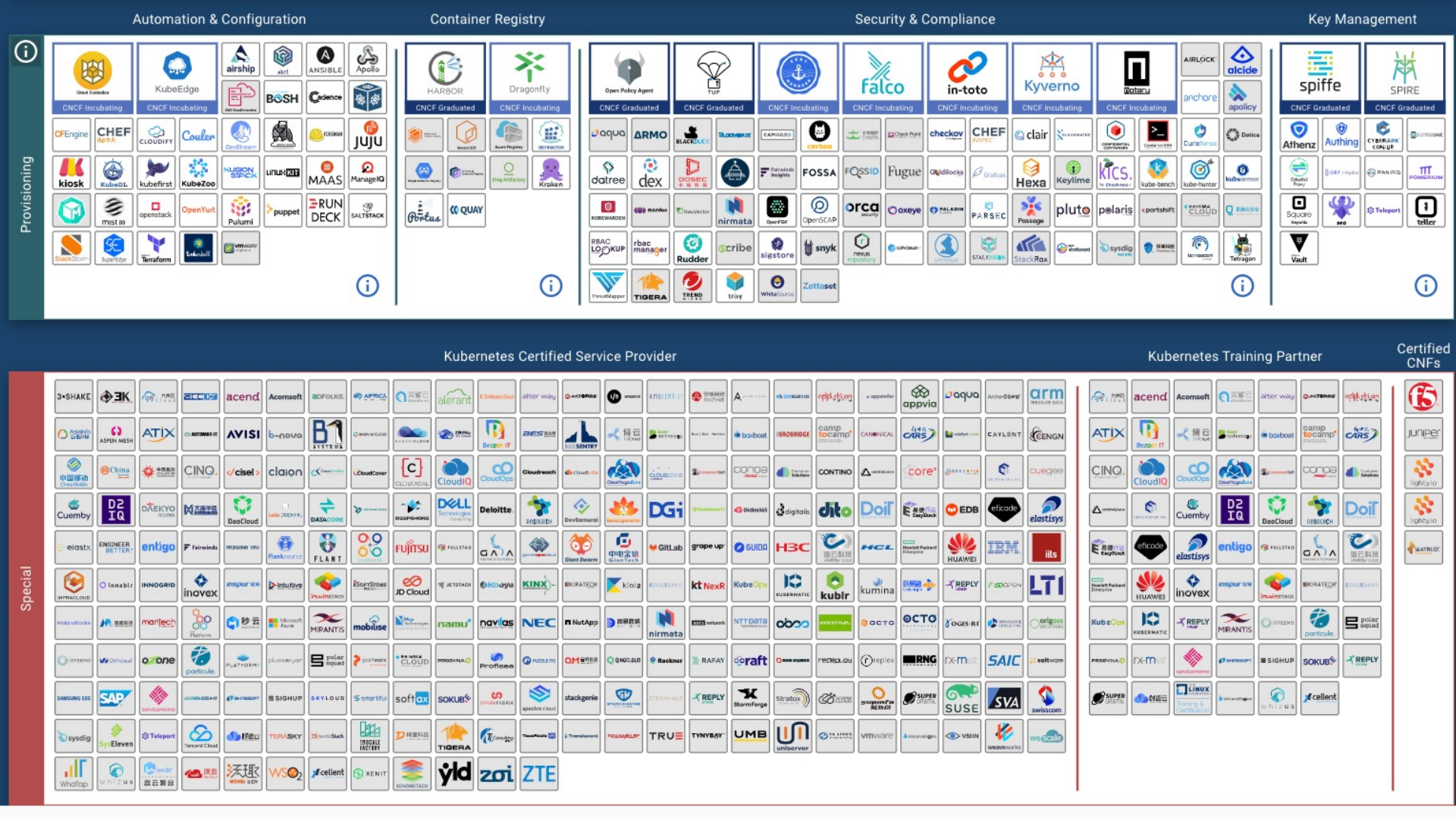
CONTRIBUTED PROJECT

DISCOVERY EDGE ENCLOSURE



https://github.com/opencomputeproject/Discovery


Database
Streaming & Messaging
Application Definition & Image Build
Continuous Integration & Delivery
App Definition and Development
TiKV
Vitess
cloudevents
NATS
HELM
Backstage
Buildpacks.io
KubeVirt
OPERATOR FRAMEWORK
argo
flux
keptn
CNCF Graduated
CNCF Incubating
Scheduling & Orchestration
Coordination & Service Discovery
Remote Procedure Call
Service Proxy
API Gateway
Service Mesh
Orchestration & Management
kubernetes
Crossplane
VOLCANO
CoreDNS
etcd
gRPC
envoy
CONTOUR
EMISSARY INGRESS
LINKERD
Istio
Cloud Native Storage
Container Runtime
Cloud Native Network
Runtime
ROOK
CubeFS
LONGHORN
cri-o
cilium
CNI
CLOUD NATIVE LANDSCAPE
This landscape is intended as a map through the previously uncharted terrain of cloud native technologies. There are many routes to deploying a cloud native application, with CNCF Projects representing a particularly well-traveled path.
l.cncf.io


Automation & Configuration
Container Registry
Security & Compliance
Key Management
Provisioning
CNCF Incubating
CNCF Graduated
Kubernetes Certified Service Provider
Kubernetes Training Partner
Certified CNFs
Special

REAL WORLD EXAMPLES

Blockheating uses the waste product of water cooled servers to greenhouses to produce tomatoes

https://www.datacenterdynamics.com/en/news/itrenew-and-blockheating-combine-edge-data-centers-greenhouses/

Open Compute open specifications on heating, cooling, and rack design

https://www.opencompute.org/wiki/Open_Rack/SpecsAndDesigns

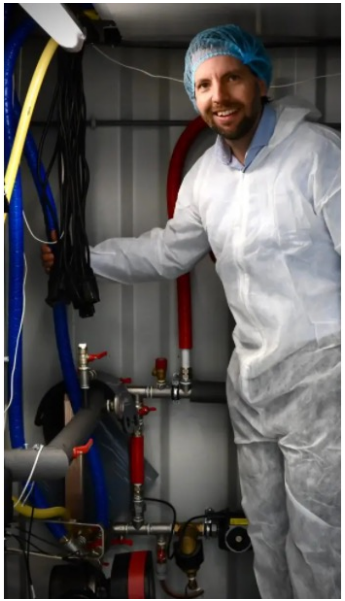
https://www.opencompute.org/projects/advanced-cooling-facilities-incubation

Open Compute Cross Project Sustainability Initiative

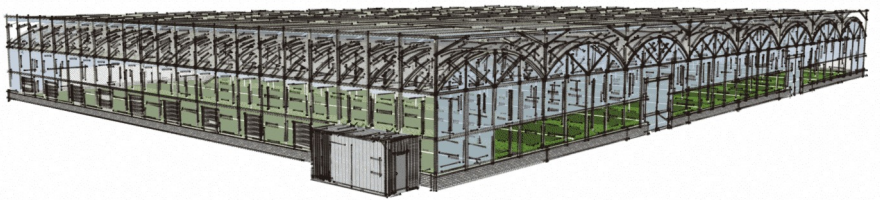
https://www.opencompute.org/projects/sustainability-initiative

CASE STUDY – AMSTERDAM

…FOR GREENHOUSES



blockheating
Recycling datacenter energy



CASE STUDY – AMSTERDAM

Green data centers require innovative partners

blockheating
Recycling datacenter energy

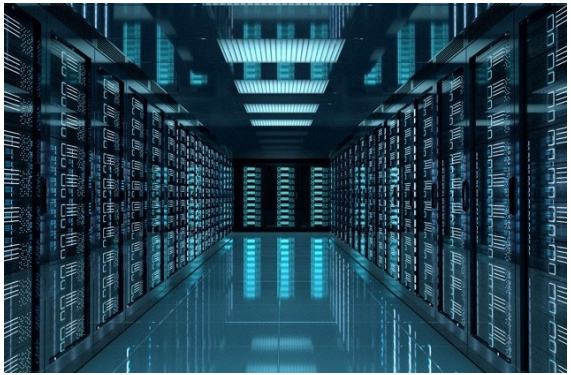
"WE'RE SAVING **20 – 30% ON AIR-CONDITIONING COSTS** BY GOING WITH OUR DECENTRALIZED APPROACH. **CONSTRUCTION TIMES ARE ALSO SIGNIFICANTLY** REDUCED. THOSE BENEFITS ALLOW US TO BE **SUSTAINABLE AND ECONOMICALLY COMPETITIVE AT THE SAME TIME**."

*"WE CHOSE ITRENEW FOR THEIR **SUSTAINABILITY CREDENTIALS, SUPERIOR TECHNOLOGY, 'OPEN COMPUTE' FLEXIBILITY**, AND THE SKILL OF THEIR ENGINEERING TEAM TO DELIVER ON OUR REQUIREMENTS AT SCALE—ALL OF WHICH HAVE **ENABLED US TO ACCELERATE OUR DEVELOPMENT**."*

JEROEN BURKS, CEO
BLOCKHEATING

CIRCULAR ECONOMY – HARDWARE

WHAT IF…



46

million servers

31

million tonnes CO2e

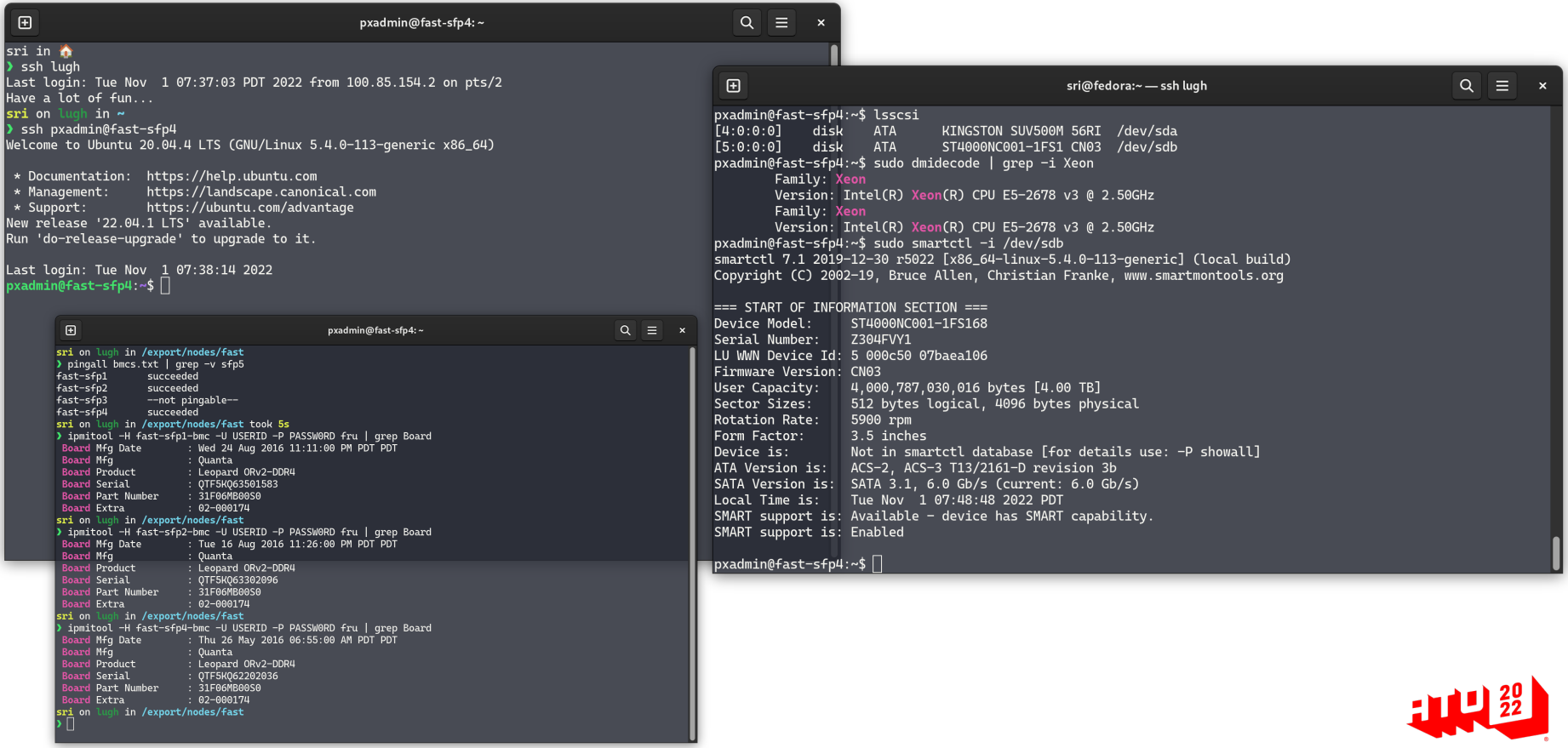
6.7

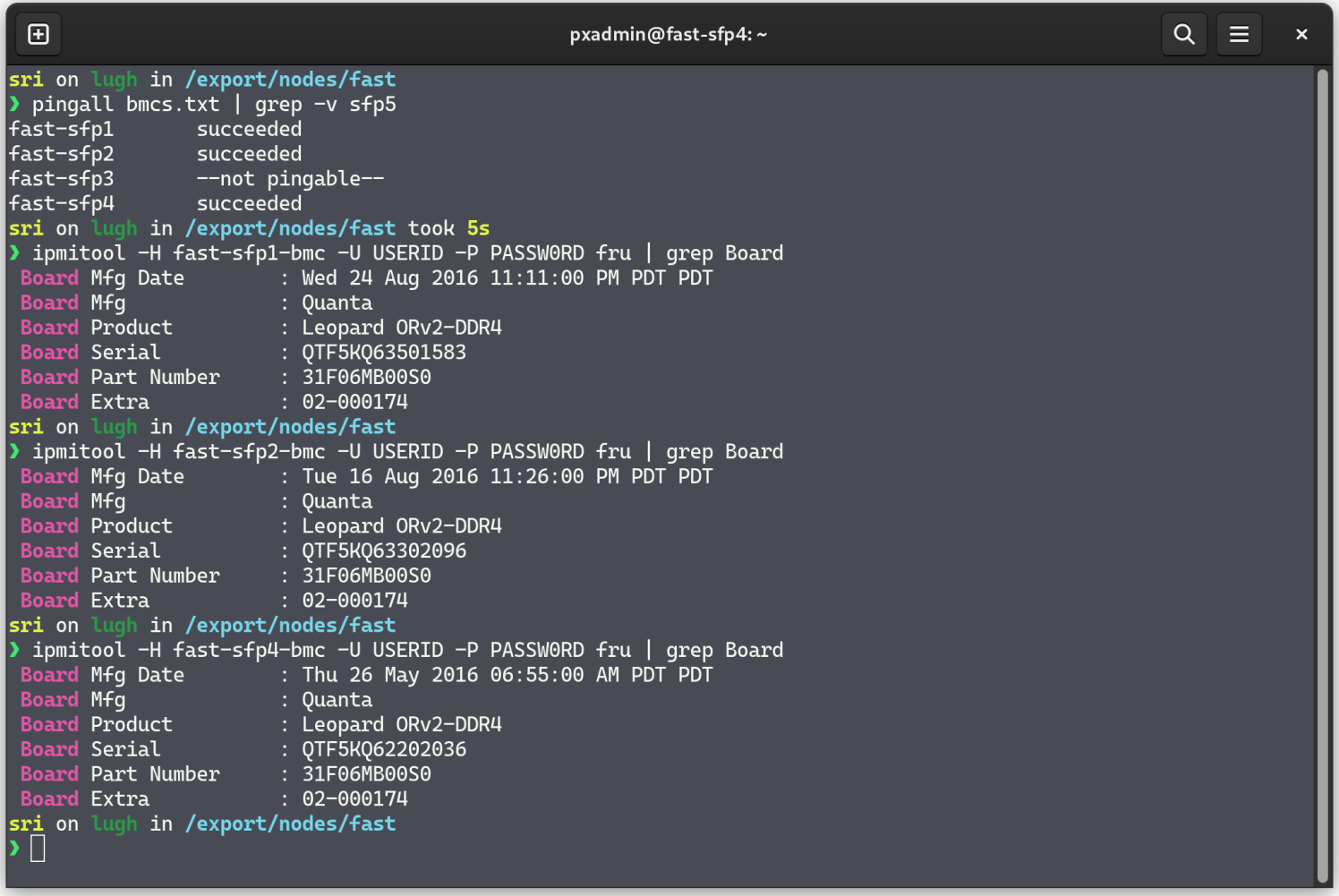
million cars' annual emissions

KUBERNETES AT HOME

- 4-node hyperscale cluster
- >100 cores; up to 2 TB memory
- 25G/100G networking; NVMe storage

KUBERNETES AT HOME (2)




pxadmin@fast-sfp4: ~
sri on lugh in /export/nodes/fast
❯ pingall bmcs.txt | grep -v sfp5
fast-sfp1 succeeded
fast-sfp2 succeeded
fast-sfp3 --not pingable--
fast-sfp4 succeeded
sri on lugh in /export/nodes/fast took 5s
❯ ipmitool -H fast-sfp1-bmc -U USERID -P PASSW0RD fru | grep Board
Board Mfg Date : Wed 24 Aug 2016 11:11:00 PM PDT PDT
Board Mfg : Quanta
Board Product : Leopard ORv2-DDR4
Board Serial : QTF5KQ63501583
Board Part Number : 31F06MB00S0
Board Extra : 02-000174
sri on lugh in /export/nodes/fast
❯ ipmitool -H fast-sfp2-bmc -U USERID -P PASSW0RD fru | grep Board
Board Mfg Date : Tue 16 Aug 2016 11:26:00 PM PDT PDT
Board Mfg : Quanta
Board Product : Leopard ORv2-DDR4
Board Serial : QTF5KQ63302096
Board Part Number : 31F06MB00S0
Board Extra : 02-000174
sri on lugh in /export/nodes/fast
❯ ipmitool -H fast-sfp4-bmc -U USERID -P PASSW0RD fru | grep Board
Board Mfg Date : Thu 26 May 2016 06:55:00 AM PDT PDT
Board Mfg : Quanta
Board Product : Leopard ORv2-DDR4
Board Serial : QTF5KQ62202036
Board Part Number : 31F06MB00S0
Board Extra : 02-000174
sri on lugh in /export/nodes/fast
❯

SESAME BY ITRENEW

INTRODUCING
SESAME FAST-START

Top 7
Cool Features

https://youtu.be/kHLm8h0RV-k

CIRCULAR ECONOMY – SOFTWARE

- near metal open source toolchains like coreboot, linuxboot, u-root keep machines in the market longer with community support
- open hardware can be re-designed, re-purposed for new uses like modular datacenter, edge computing at near-neutral carbon cost and lower TCO than new hardware
- open hardware doesn't just mean servers, but also switches
- augments software projects like LF's OpenSwitch [https://www.openswitch.net/]
- any software project that supports using off the shelf parts to build open infrastructure can leverage the supply chain provided by the circular economy

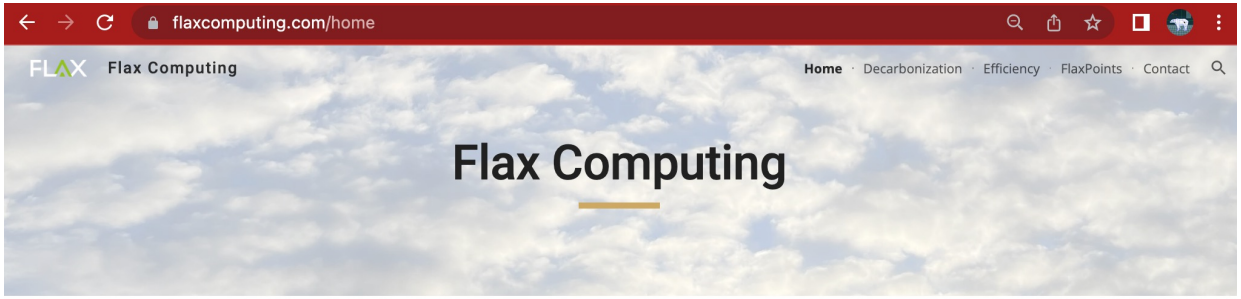
SUMMARY

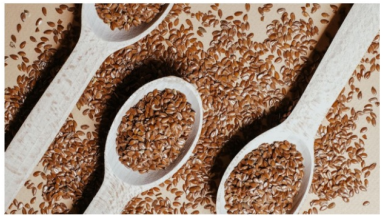
YES – improve the software toolchain and open source projects so that hardware is used at high utilization and high efficiency via efforts such as the Green Software Foundation

YES – leverage the supply chain and circular economy to benefit from open hardware and reduced carbon of recertified equipment

YES – adapt your infrastructure with open hardware and open source software – e.g. SONiC, openswitch, kubernetes, OpenBMC

YES – find ways to re-use the output of your on-premise cloud or datacenter





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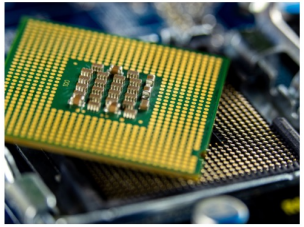
read about our key approaches to Decarbonization and improved Efficiency in your data centers worldwide, using the data-driven FlaxPoints methodology

contact us via info @ flaxcomputing.com or using our Contact form



FLAX

Decarbonization
& Efficiency

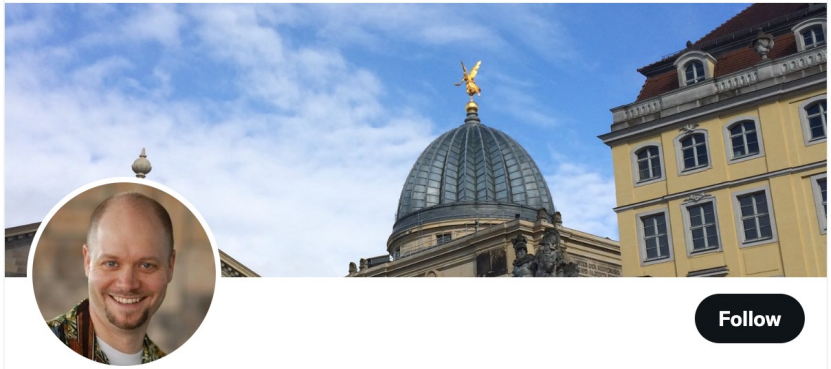
- www.flaxcomputing.com

FLAX

SUSTAINABILITY ALL THE WAY DOWN

Sustainability all the way down – means we don't just consider software but explore everything below it as well

If you have a sustainability program at your company – leverage open communities to navigate the cross-silo collaboration required to support open sustainable infrastructure as well as open code



Follow

Dr. Erik Riedel at #AllThingsOpen
@er1p

i build sustainable clouds; father of four; PhD; engineering leader, do-er, & mentor; practitioner of innovation & inclusion; he/him; my heart is in the work

Science & Technology · Boston, MA · linkedin.com/in/er1p
Joined January 2008

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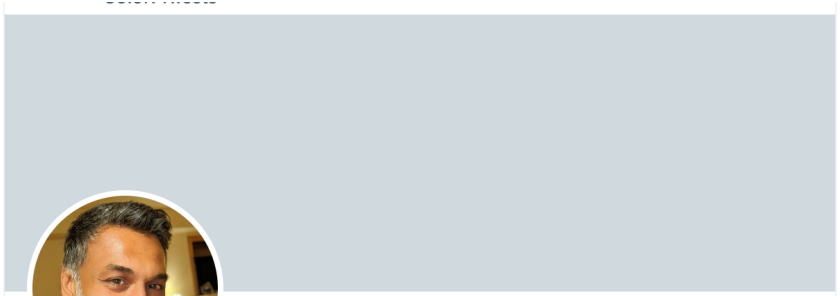

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absurdum expectum - embrace it
@sramkrishna

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Oregon, USA · Joined September 2007

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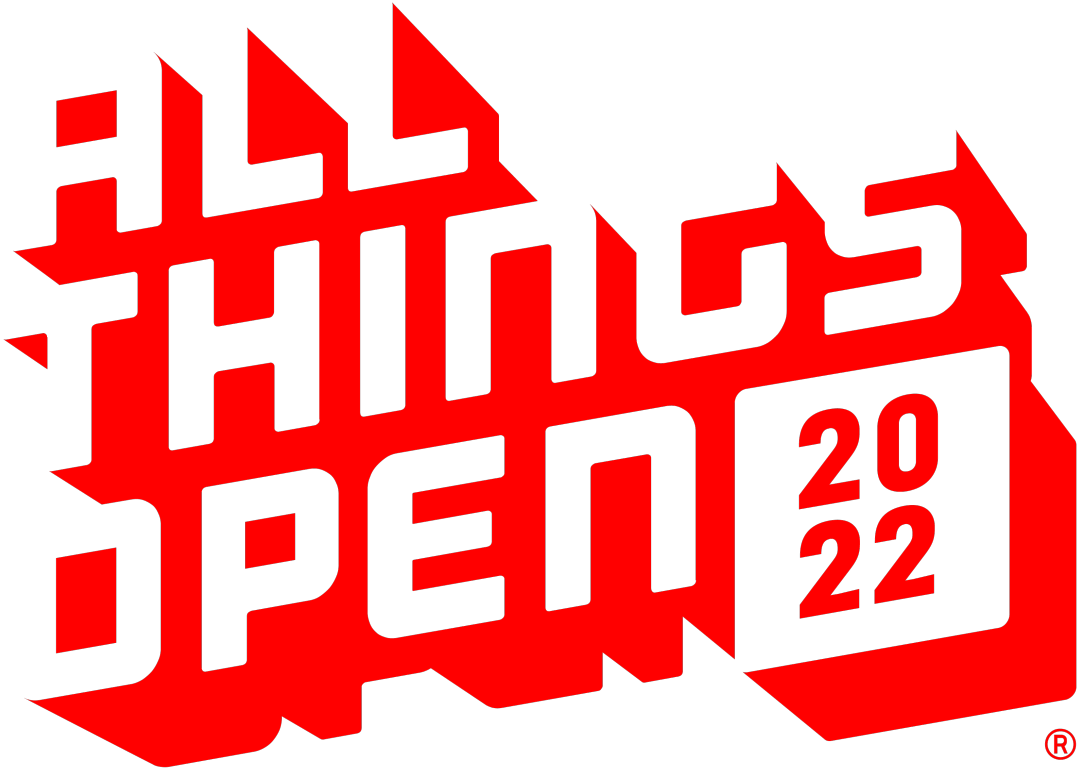
2022

2022

ACKNOWLEDGEMENTS

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https://unsplash.com/photos/MgtHZ4zlC1U
https://unsplash.com/photos/k39RGHmLoV8

Tom Fisk from https://www.pexels.com/photo/yellow-excavator-2101137
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BACKUP SLIDES

SPEAKERS

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