Sustaining Everything, Everywhere, All at Once!

A Full-stack Sustainable Computing Platform



Fanjing Meng, Hua Ye, Robert Barron











Fanjing Meng (Meg) STSM & CTO China Systems Lab mengfj@cn.ibm.com Hua Ye Technical Solution Architect IBM Technology Sales yehua@cn.ibm.com Robert Barron SRE Architect IBM CIO Hybrid Cloud Platform brobert@il.ibm.com





Agenda

- **Motivation & Challenges** •
- Sustainable Computing Definition
- **Full-stack Sustainability Optimization** \bullet
- **Proof-of-Concept in IBM Data Center** \bullet
- System Demo \bullet
- Take-aways \bullet

ASIA

PACIFIC

SRE

CON



Sustainability is all around us

•2022 IEEE • Future Technology Summit

-Sustainable Smart Cities and Future Technol

August 16, 2022 Silicon Valley, USA

Artificial Intelligence and Sustainable Computing for Smart Cities (AIS2C2)



ASIA

PACIFIC

SRE

(21-22, December, 2022, India)

SRE ASIA PACIFIC

SRE CON L Bustainable Data Center

9th International Conference on Green Computing and Engineering Technologies

CGCET®

1 1 000

PREVAIL 2022

Computin

"Energy Star" project launched by EPA in 1992

> Sustaining everything, everywhere, all at once!

- 23 September 2023 South Africa

How do we get there?

SREs are data driven!



Sustaining everything, everywhere, all at once!

1111

Aspirational activities

Switching programming languages can reduce the energy consumption by 50%

 $\overline{\mathbf{\omega}}$

Data centers around the world consume Terrawatt-hours 200 to 250 of electricity

5/



Sustaining everything, everywhere, all at once! Running workloads in a container platform instead of VMs can reduce infrastructure costs by 75%

<u>O</u>

Identifying extraneous VMs and "zombie" servers and shutting them down to conserve energy.

IBM Academy of Technology Innovation that Matters

500 + members

13,000 + affiliate members





5 National Medals of Science



Over 25,000 patents



https://ibm.biz/academy-tech

Metrics for Sustainability of a Full Computing Stack

	Metrics	Sustainable Physical Facilities			ustainabl Ifrastruct		Sustainable Cl Technology	Sustainable Business Applications& Data				
Efficiency	Greenness & Low-Carbon	PUE CUE REF CER ERF	ERE IUE	CLF GUE PLF	DCiE ITEEsv pPUE	EEUE ITEUsv WUE	1	TEE TEU		APEI EC EE		
Assurance	High- Efficient Operation Fire Sys. Opr Ventilation Sys. Opr Fire Sys. Opr Intelligent Sys. Opr		Numb. of accide Unplanned Rep Integrity of conf Timeliness & ac	blace Cap	acity usage rate	Policies & protocols Resource cont. & isol. Emergency response & risk assessment Problem Tracking &Evidence Gathering Business Continuity Guarantee		Application & Software env. maintenance App. migration &maintenance termination Data Maintenance				
Business A	Availability & Reliability	Redundancy Fault Tolerance Availability Grading UPS	Site Selection Fault Diag. & Treat	RTO & RPO CP	CE		Num of CPU Cores Storage Capacity Virtual FW Throughput	Num of priv/pub IP	App Health Throughput <i>QPS</i>	Resp. Ti Apdex Qry Err.		Error Rate DB Health Num of Conn.
Foundation	Physical Security Fire Security Security & Compliance		ecurity	Comm. Transm Trusted Verifica Border Protecti Identity Authent	ation	Da Network Architectur Network Access Co Intrusion Prevention User Access Contro Data Backup and R	ntrol	tiality Infrastructure Location Security Audit Mirror & Snapshot Protection	App Dev Secu App Trial Sec App Offline So Data Storage Data Distrib.	urity ecurity Security	App De Data C Data P	gr &Depl. Sec elivery Security Collect. Security Proc. Security Delet. Security

SRE ASIA PACIFIC

Sustaining everything, everywhere, all at once!

Sustaining everything, everywhere, all at once!

SRE CON

ASIA PACIFIC

Building & Facilities (DCIM, Power Managemen, Security)

Building & Facilities (HVAC, Lighting, Transmittion, Fire & Safety)

Sustaining everything, everywhere, all at once!

L0

ASIA PACIFIC

Physical

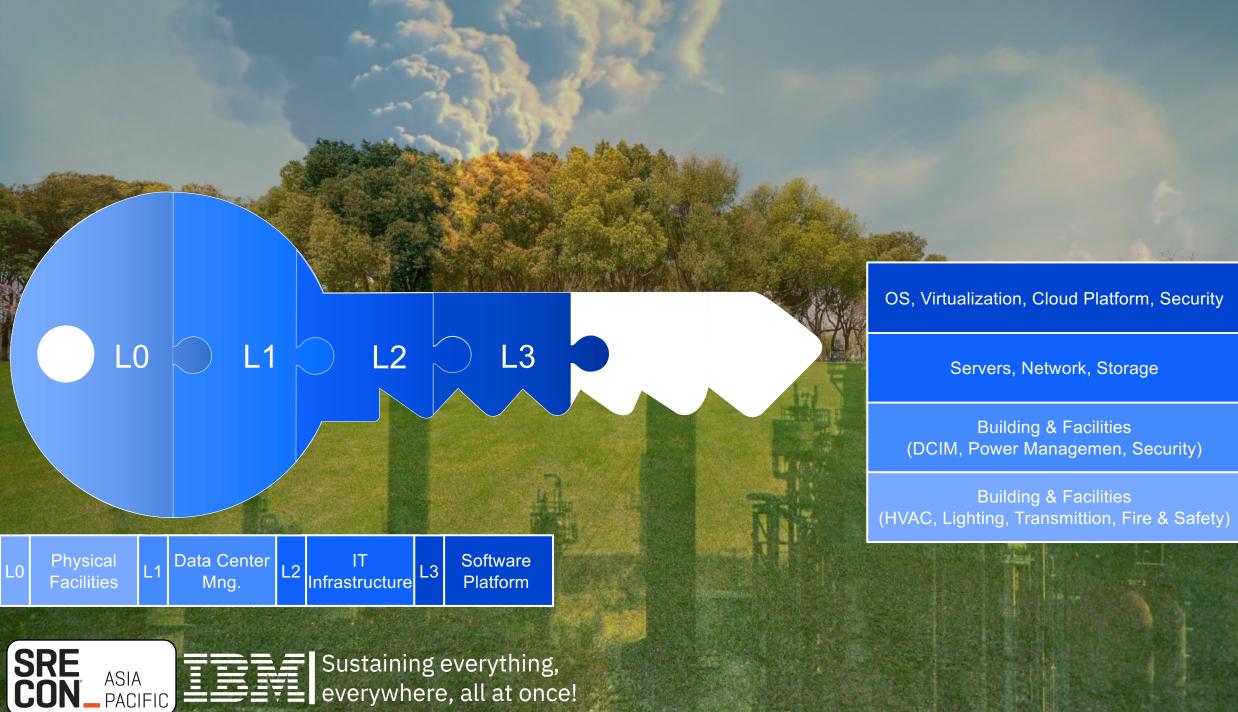
Facilities

L0

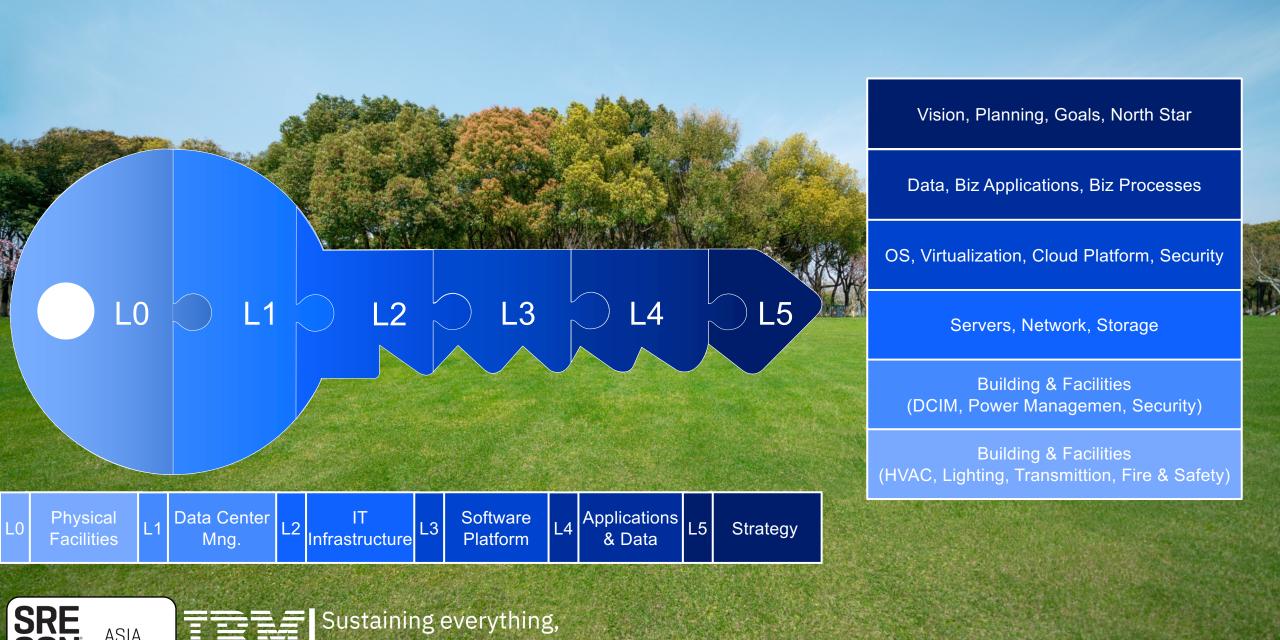
SRE CON L1

Data Center

Mng.



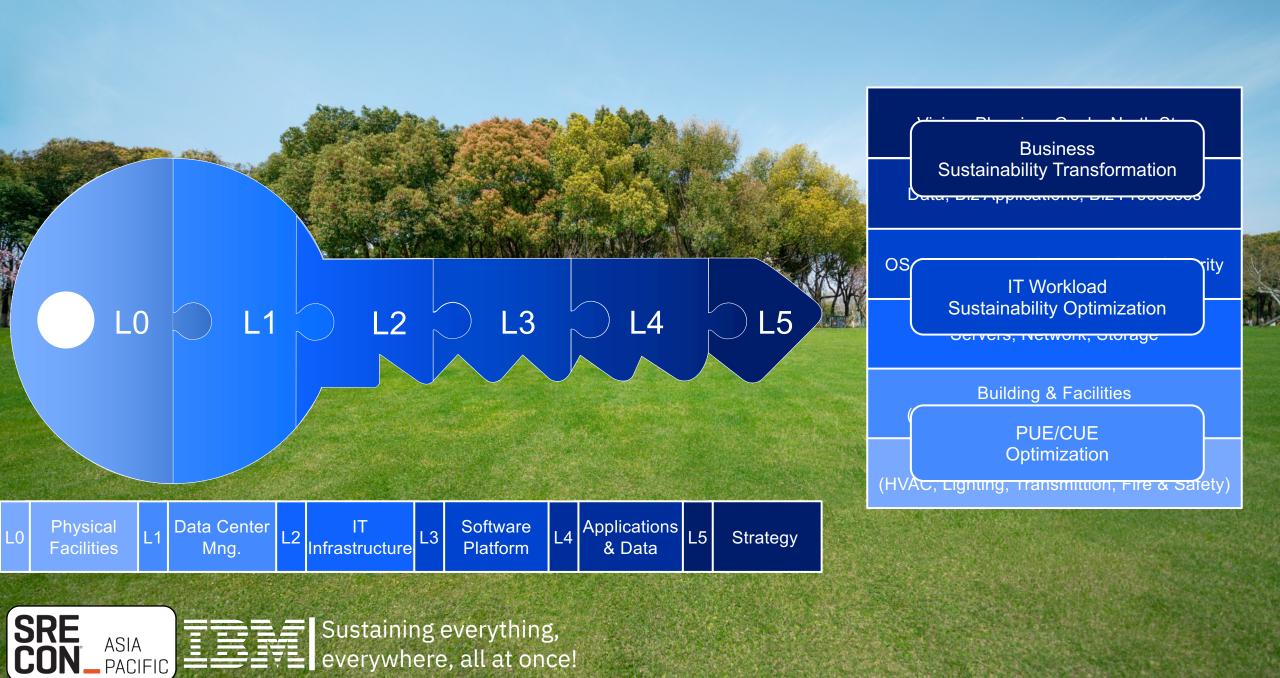
everywhere, all at once!

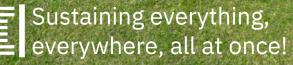


Sustaining everything, everywhere, all at once!

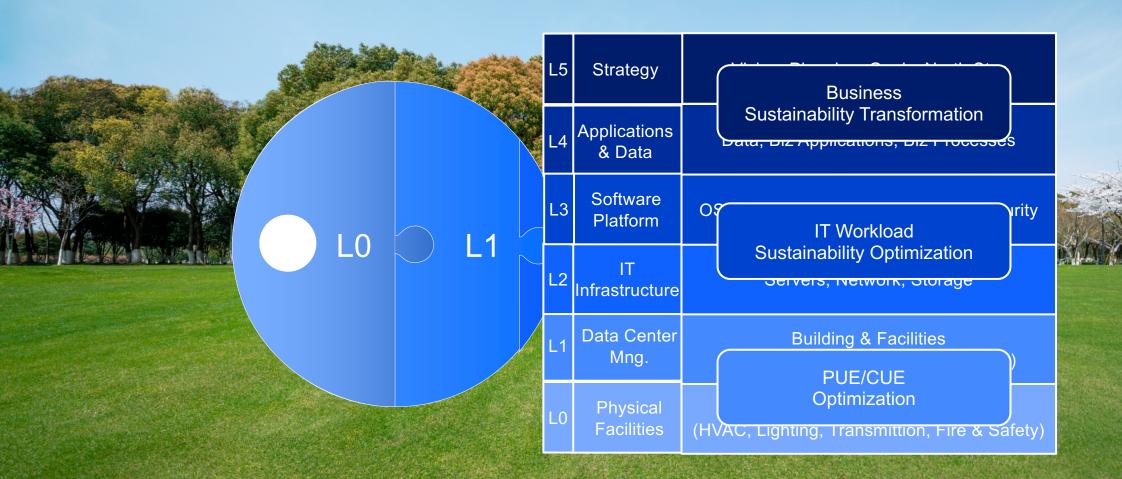
ASIA

PACIFIC

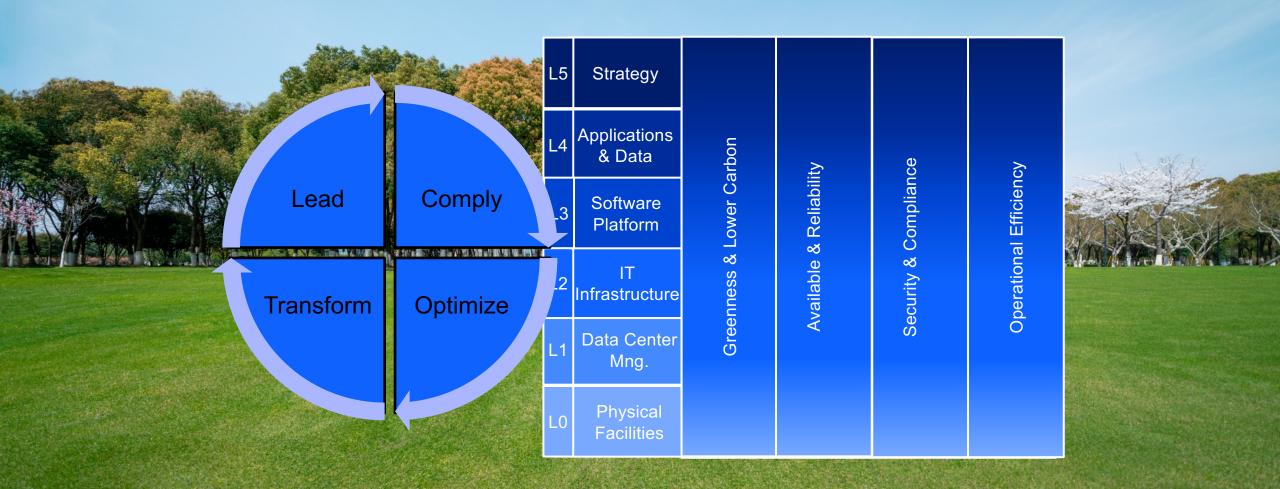




ASIA PACIFIC

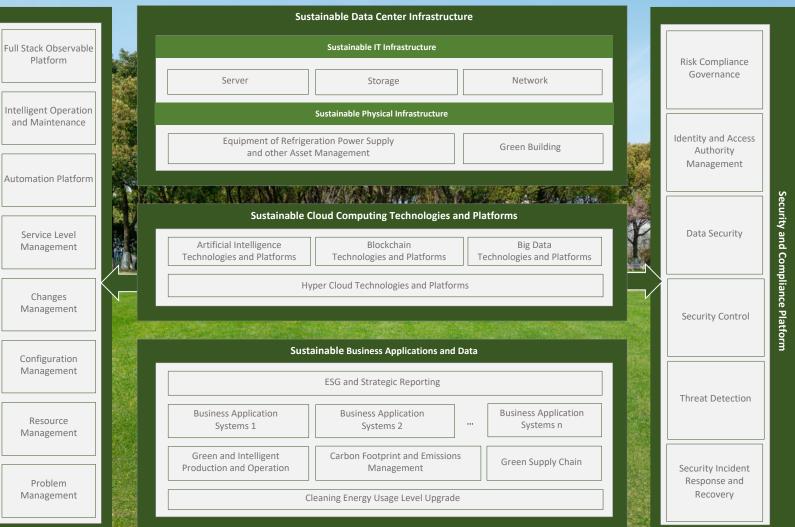








Green IT Sustainable Strategy (application load, operations plan...)



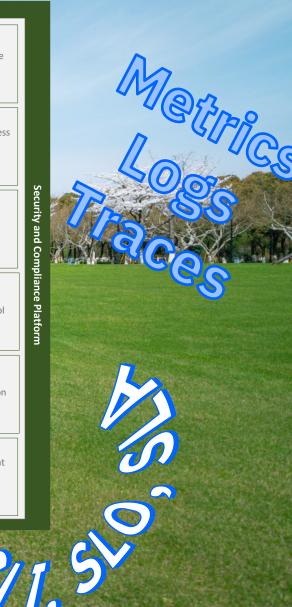
Sustaining everything, everywhere, all at once!

nation Platform

%%

ASIA PACIFIC

SRE



Full-stack Sustainability Optimization

PUE↓ != Sustainable Computing







CSC received the top data center award - DataCenterDynamics (DCD) China Energy Saving

Sustainable Strategy **IBM Consulting Sustainability Strategy Planning/Process** IBM Consulting Sustainability Strategy Planning/Proc L4 Business Reengineering/Sustainability Transformation... Reengineering/Sustainability Transformation... (Data, Process, Biz Applications) **Sustainable Industry Applications** IBM Maximo/TRIRIGA/Envizi/EIS/... IBM Maximo/TRIRIGA/Envizi/EIS/... Sustainable Software Platform Red Hat OCP/ Ansible/IBM Cloud Paks/Security/Instana/Turbonomic/... **Red Hat OCP/ Ansible/IBM Cloud** L2 IT Infrastructure Paks/Security/Instana/Turbonomic/... Sustainable Systems (Server, network, storage) IBM Z/LinuxONE/Power/Storage Slenvizi SustáSeave Detworkgraterage) maximo L1 Data Center Management 7/Linux⁴turbonomic Red Hat IBM Cloud Paks **IBM TSS Green Data Center(AI-based** (DCIM, power mgmt, security) Ansible INSTANA **Energy Saving/Intelligent Patrol** Robot/Air Flow optimization) L1 Data Center Management Sustainable Building Assat IBM Spectrum LO Data Center Building & Facilities (HVAC, lighting, transmission, safe, fire protection) sed Management **Optimization** LO Data Center Building & Facilities Robot/Air Flow optimization) Sustainable Building, Asset (HVAC, lighting, transmission, safe, fire protection)

<u>Management</u>

IBM TRIRIGA/MAS/Envizi

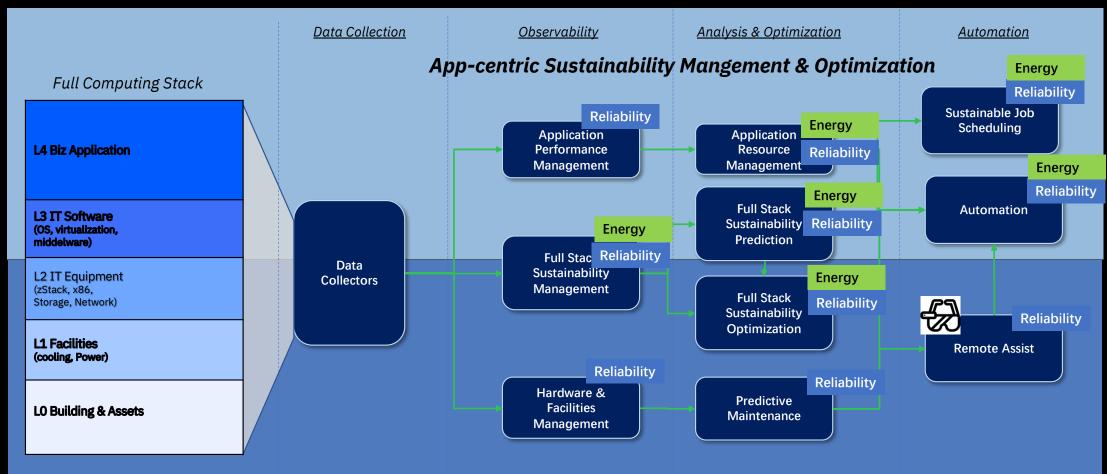
Sustaining everything, everywhere, all at once!

SRE

ASIA

PACIFIC

Full-Stack Sustainability Optimization Platform Overview



Data Center Sustainability Management & Optimization



Solution Demo

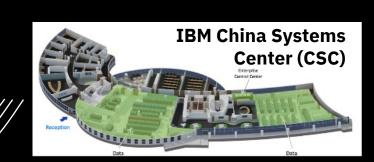
I BREHEIHDIGE

Full-Stack Sustainability Optimization

■ 2))	-	4 > >>	Ľ.	Û	>>
00:03					19:50



Deployed in IBM China Systems Center for daily operations and support visit, demo, testing, PoC, pilot and co-creation





AWARDS ED

CSC Received DataCenterDynamics (DCD) China – Energy Saving Award

Power Utilization Efficiency PUE Monitoring & Air Quality Real-time Monitoring IT HW & SW Monit Hardware Monitoring APM/ARM

Network Monitoring Network Traffic, Security & Behavior Monitoring

ASIA

PACIFIC

SRE

IT Infra and Facility Monitoring Intelligent Monitoring & Automation

Sustaining everything, everywhere, all at once!



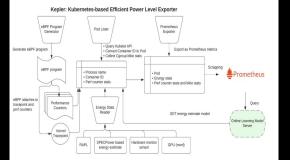
Online Lab Resource utilization Website monitoring

Working with Open Source Community on Sustainabilities

Apache Kepler: Kubernetes-based Efficient Power Level Exporter

Use eBPF to probe energy related system stats and exports as Prometheus metrics

https://github.com/sustainable-computing-io/kepler



as monitoring / Kepler Exporter Dashboard 🗠 ≺						No B 0 Crestanuar d C ar A							
Namespace oper	shift-kube api	sever - P	er konjo	iserver_th	ctr1.npgce	ble intel.com							
			urrent Erengy	Consumpt	on (mM)						Total Pod Energy Consumption (KN) in:	24m	
88 88 88 88 88 88 88 88 88 88 88 88 88				×28		×200				1.52 6 1.53 1.54 1.542500 1.542600 11 1.542500 1.542600 11 1.542500 1.542600 11 0.552600, malest path 0.552600, pathway path 0.552600, path 0.5526000, path 0.552600, path 0.5526000, path 0.5526000, path 0.5526000, path 0.55260000000000000000000000000000000000	1939 м.118 м.119 м.1188 м.1 — 1761. одо жийн дай — 1761. одо ж — 1764. одо жийн дай — 1764. одо ж — 1764. одо жийн дай — 1764. — 1764. одо жийн дай — 1764. Алад — 704 иринж Элексбен ад — 1744.	20 H1200 H1330 H adat, jaho ¹ — Oʻl mbe, nashar jaho ¹ — Oʻl mbe, nashar jano — Jöhendel, nagʻu Japano "Töhendel, nagʻi	5400 pete2
	Total Po	d Energy Consi	umption (KM)	in openahi	histerapi	server in 14					Tetal Energy Consumption (kW) by Namespe	or in 24km -	
9.27 1.03	5.15 1	2441	2 1.03			5.15 1		11.3 1					
							- 1						

Open Mainframe Project: Sustainability Grafana Dashboard

Visualize Sustainability Metrics for workload migration from x86 to LinuxONE

https://github.com/ambitus/sustainability-grafanadashboard

Applicable Participants and ap													
Image: set of the set of th													
Application Devices and Applic													
Addeduced Independent Addeduced													
3.81 vs 076 vs 2.35 vs 1.15 vs interactions of the second secon													
T 72.65%) 3.35 kpc 1.15 kpc 1 mm m													
A log coupt and a log coupt an	1.15 kg/h												
Auge Auge <td< td=""><td></td></td<>													
NE NE E NE													

Search or jump to	Pull requests issues Ma	rkatplace Explore	¢ ++ A-					
	y-grafana-dashboard 🕬 🕬	© Edit Prix + © Unwalch 2 + □ Wiki © Security L= Insights © Set						
P main + P 1 branch (which is a minutes age Of commits	Noost ® Rustainability Grafana Dashboard					
doc gratara-deshboards UCENSE	rafara-deshboards initial version 23 minutes ago							
README.nd		4 minutes ago	Y 2 forka teleasos					
sustainability	-grafana-dashboard		io releases published reade a new release					
Sustainability Grafana Da x86 to LinuxONE #Sustainability Metrics M	Packages 40 packages published Jublish your first package							



Sustaining everything, everywhere, all at once!

You can help...

- Sustainable Computing white paper
- Open Source project collaboratin
- Slack channel @ SREcon, email, twitter
- Sharing us your practices & challenges





Thank You !

Any questions or comments, please contact Meg (<u>mengfj@cn.ibm.com</u>)!



