# Sustaining Everything, Everywhere, All at Once!

### A Full-stack Sustainable Computing Platform



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## 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

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### 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)



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(21-22, December, 2022, India)

# **SRE ASIA PACIFIC**

SRE CON L Bustainable Data Center

9<sup>th</sup> 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!

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### 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

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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	<b>Redundancy</b> 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

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Sustaining everything, everywhere, all at once!

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Building & Facilities (DCIM, Power Managemen, Security)

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

Sustaining everything, everywhere, all at once!

L0

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Physical

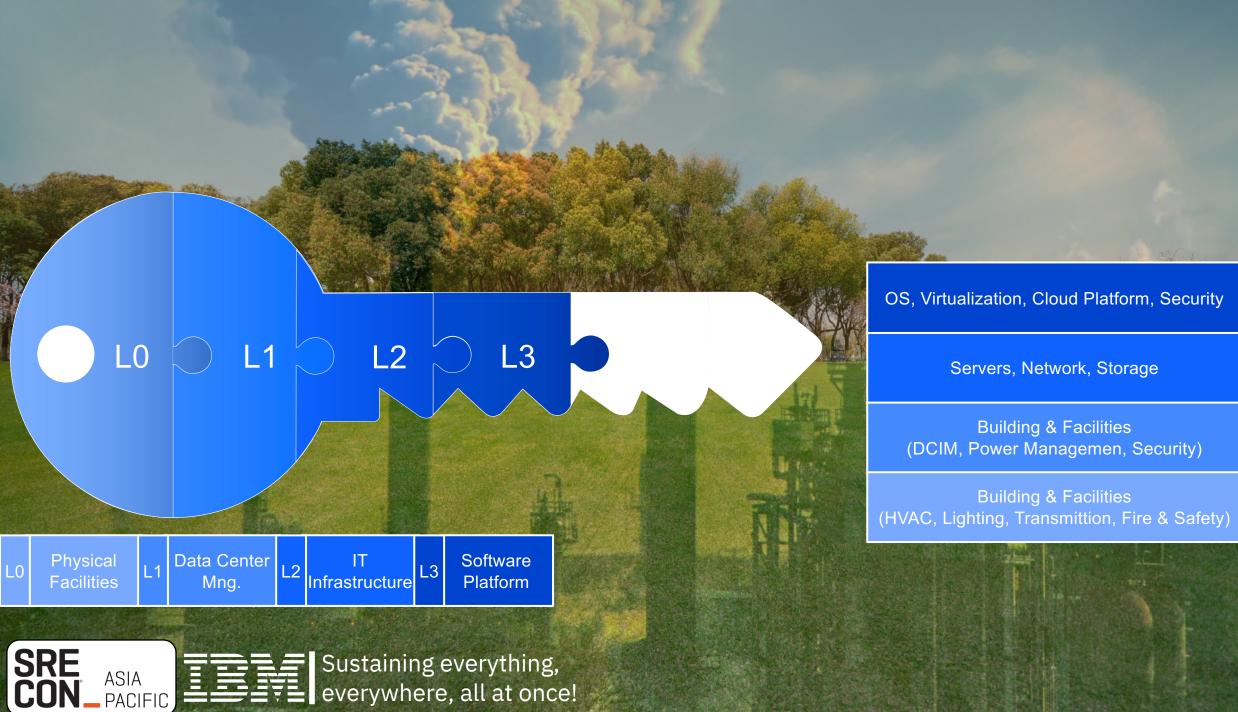
Facilities

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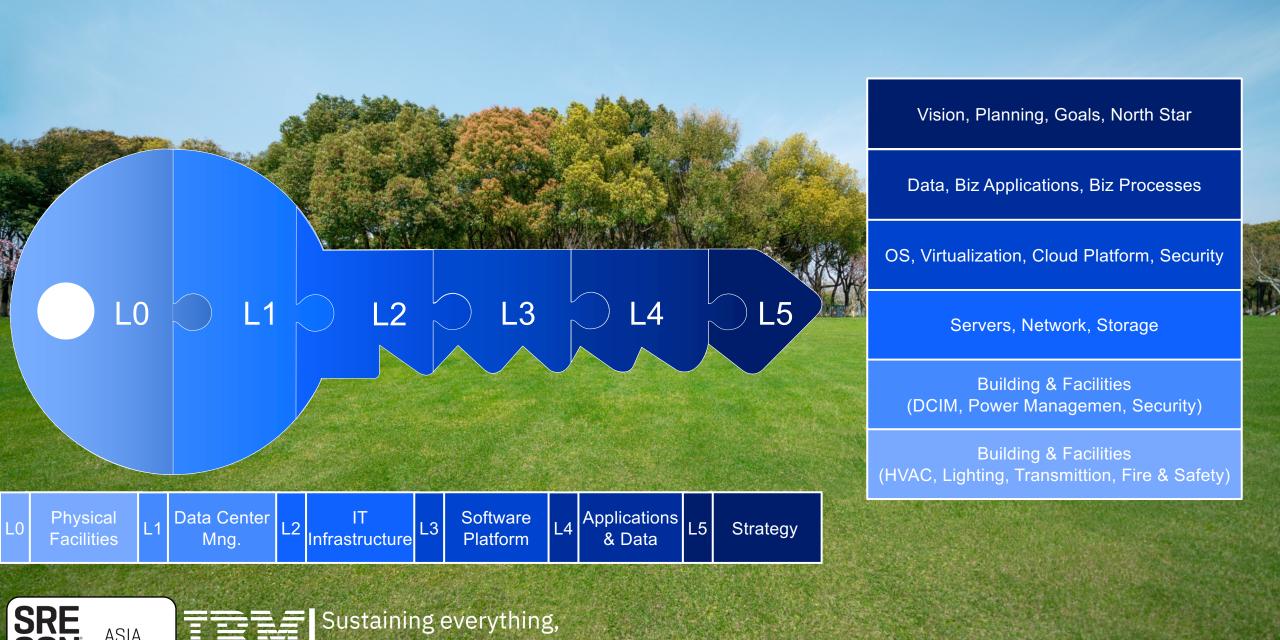
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Data Center

Mng.



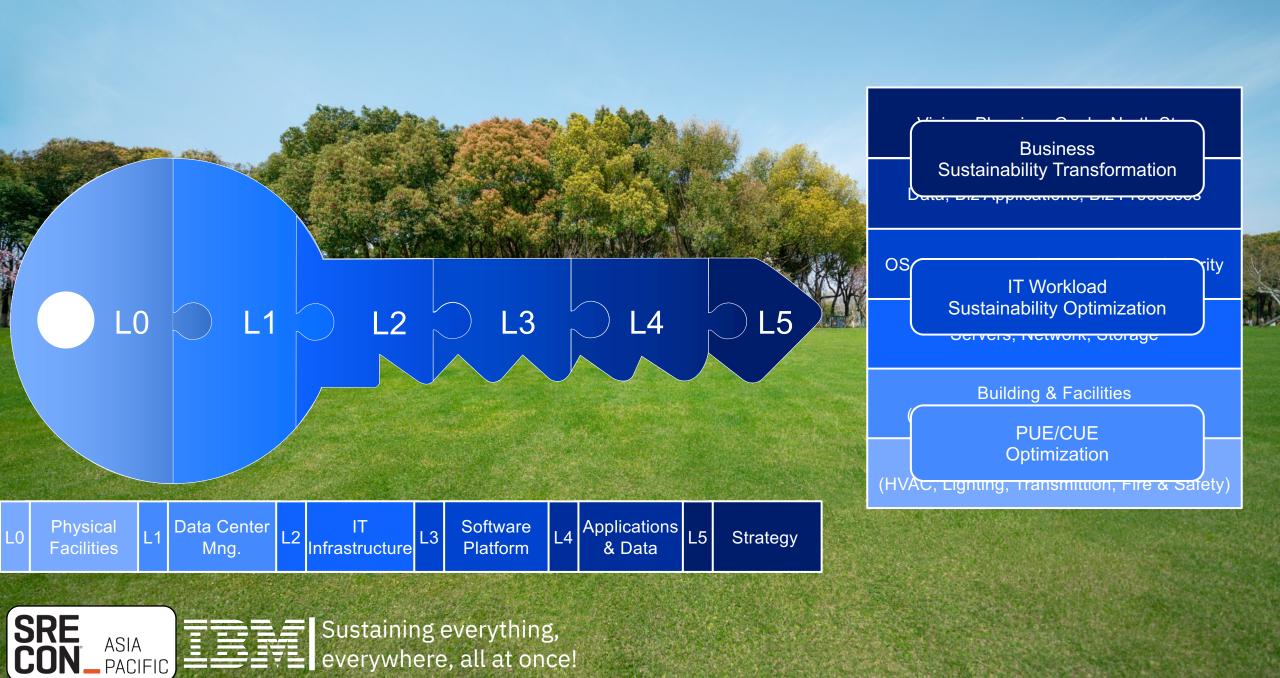
everywhere, all at once!

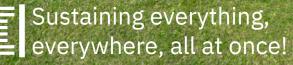


Sustaining everything, everywhere, all at once!

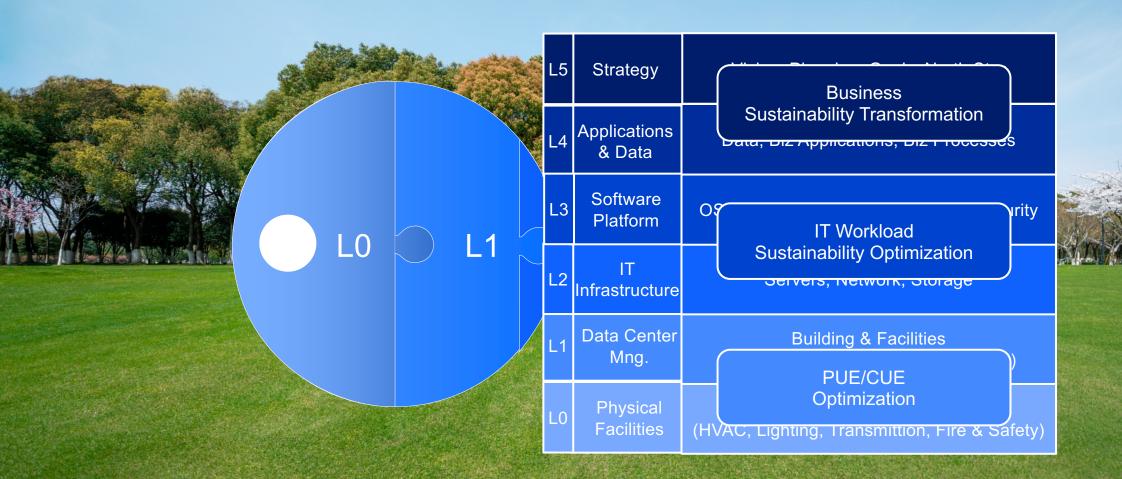
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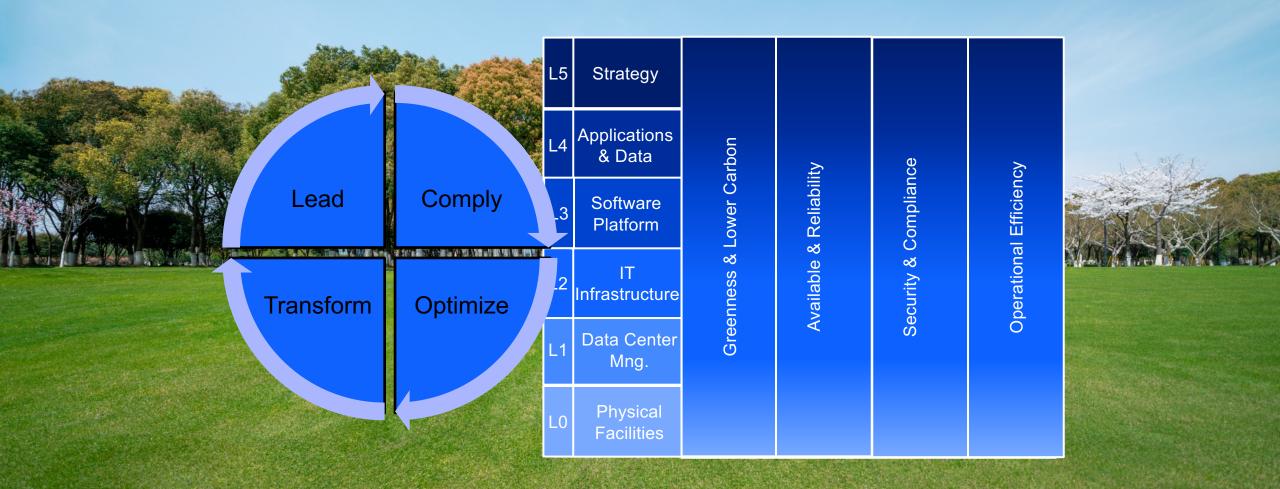




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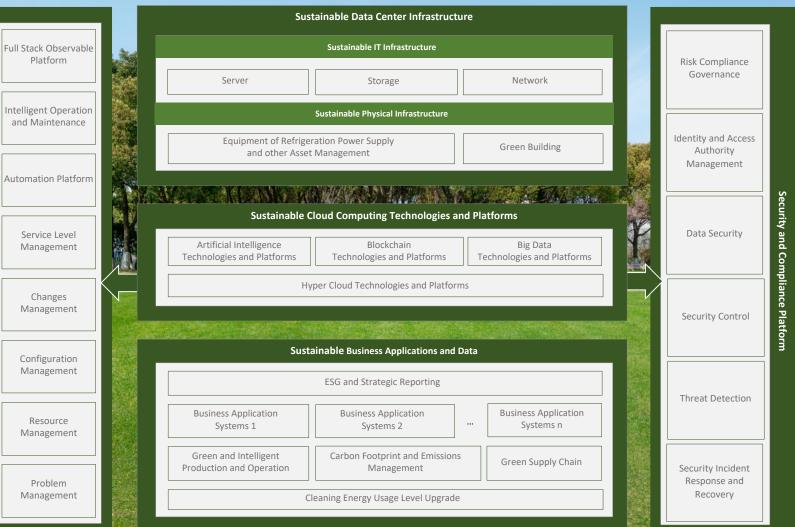








Green IT Sustainable Strategy (application load, operations plan...)



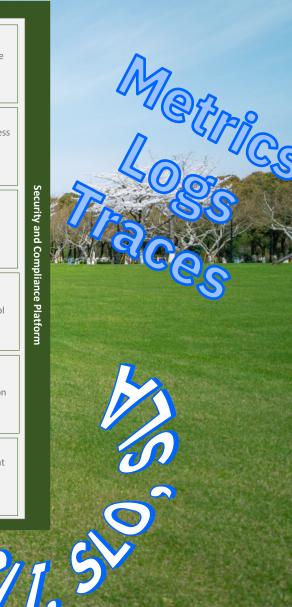
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nation Platform

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### 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/Linux<sup>4</sup>turbonomic 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

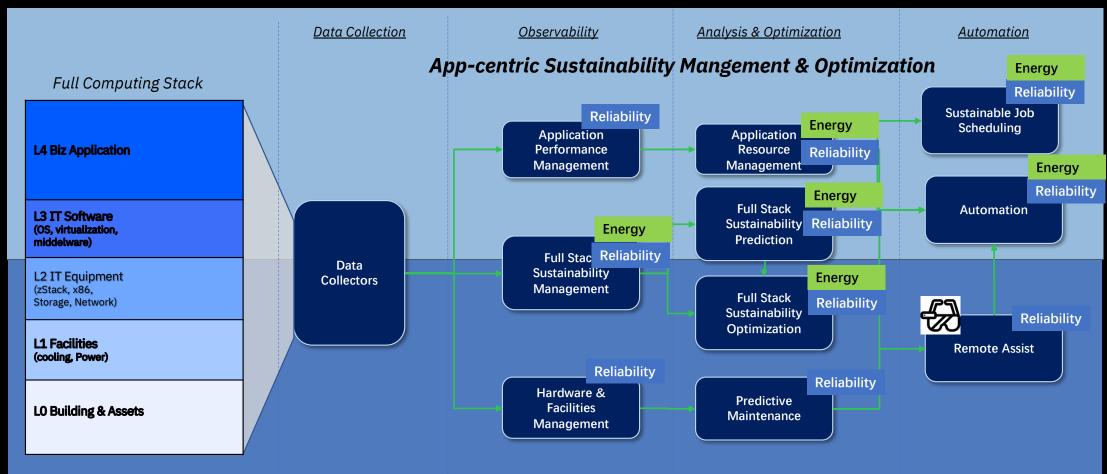
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### **Full-Stack Sustainability Optimization Platform Overview**



Data Center Sustainability Management & Optimization



### **Solution Demo**

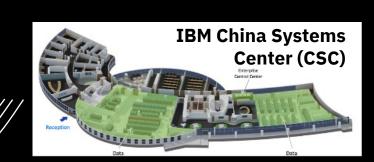
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## Full-Stack Sustainability Optimization

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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

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IT Infra and Facility Monitoring Intelligent Monitoring & Automation

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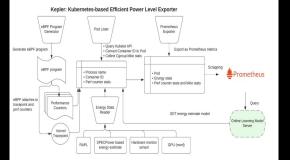
Online Lab Resource utilization Website monitoring

### 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							
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Open Mainframe Project: Sustainability Grafana Dashboard

Visualize Sustainability Metrics for workload migration from x86 to LinuxONE

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

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### 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>)!



