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# Agenda

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



Sustainability is all around us



2022 IEEE  
Future Technology Summit  
Sustainable Smart Cities and Future Technology  
August 16, 2022  
Silicon Valley, USA

SRE CON ASIA PACIFIC

SRE CON EUROPE MIDDLE EAST AFRICA  
Sustainable Data Center

Artificial Intelligence and Sustainable Computing for Smart Cities (AIS2C2)

Jointly Organized By  
(21-22, December, 2022, India)

"Energy Star" project launched by EPA in 1992

PREVAIL 2022  
IBM

9th International Conference on Green Computing and Engineering Technologies

(ICGGET®)  
22 - 23 September 2023  
South Africa

SRE CON ASIA PACIFIC

IBM Sustaining everything, everywhere, all at once!

How do we get there?



Sustaining everything,  
everywhere, all at once!

# Aspirational activities

Switching programming languages can reduce the energy consumption by 50%



Running workloads in a container platform instead of VMs can reduce infrastructure costs by 75%

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



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

Over 25,000  
patents

6  
Nobel  
Laureates



10  
Medals of  
Technology



5  
National Medals  
of Science



6  
Turing Awards



<https://ibm.biz/academy-tech>

# Metrics for Sustainability of a Full Computing Stack

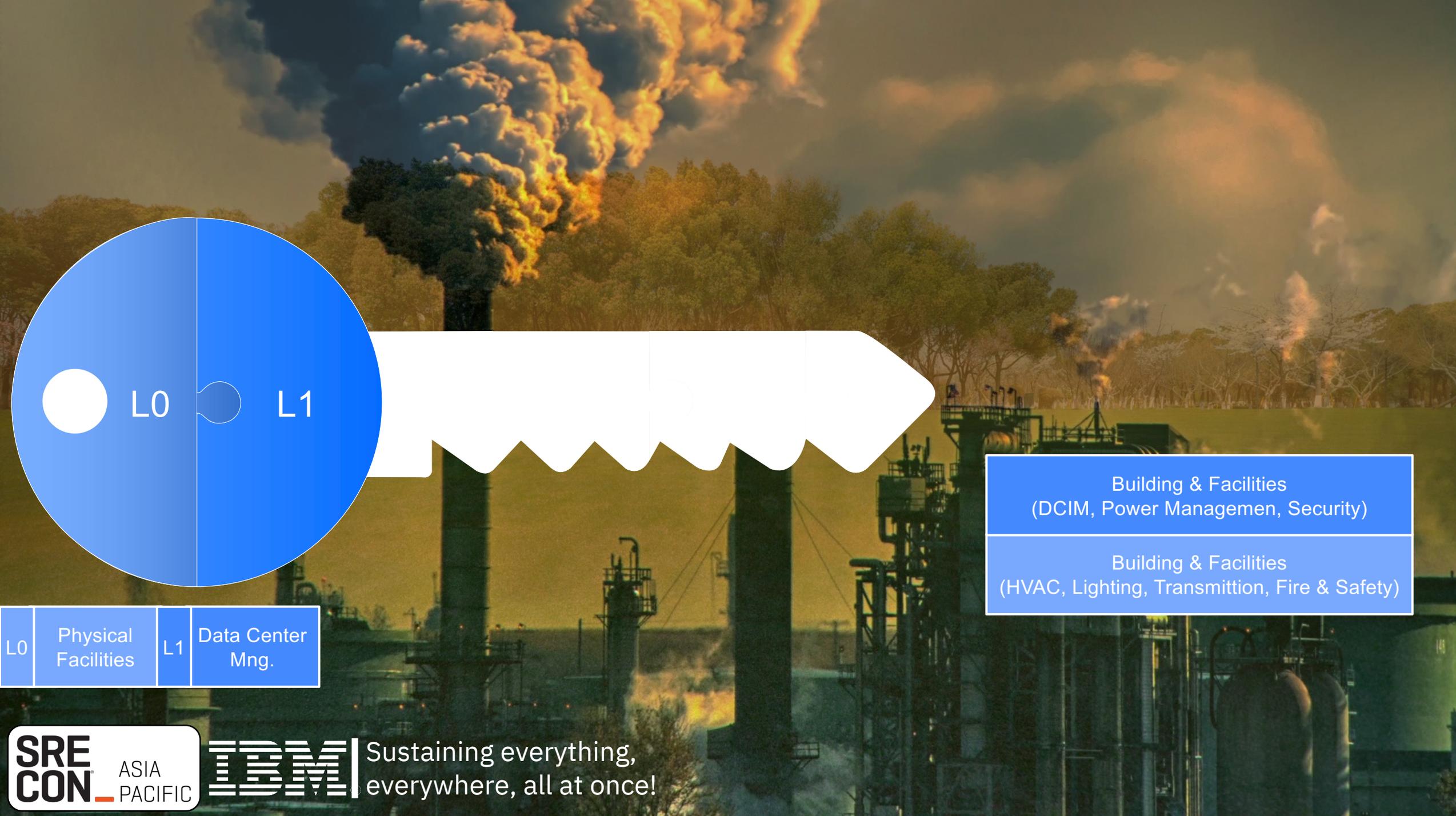
Metrics	Sustainable Physical Facilities	Sustainable IT Infrastructure	Sustainable Cloud Computing Technology & Platform	Sustainable Business Applications & Data						
Efficiency Greenness & Low-Carbon	<i>PUE</i>									
	<i>CUE</i>									
	<i>REF</i>									
	<i>CER</i>	<i>ERE</i>	<i>CLF</i> <i>DCiE</i> <i>EEUE</i>	<i>ITEE</i>	<i>APEE</i>					
	<i>ERF</i>	<i>IUE</i>	<i>GUE</i> <i>ITEEsv</i> <i>ITEUsv</i>	<i>ITEU</i>	<i>EC</i>					
			<i>PLF</i> <i>pPUE</i> <i>WUE</i>		<i>EE</i>					
Business Assurance High-Efficient Operation	<i>MTBF</i>									
	<i>MTTR</i>									
	<i>SLA</i>									
	Electric Sys. Opr	Ventilation Sys. Opr	Numb. of accidents	Change of record	Policies & protocols	Resource cont. & isol.	Application & Software env. maintenance			
	Fire Sys. Opr	Intelligent Sys. Opr	Unplanned Replace	Capacity usage rate	Emergency response & risk assessment		App. migration & maintenance termination			
			Integrity of configuration management DB		Problem Tracking & Evidence Gathering		Data Maintenance			
		Timeliness & accuracy of config. item status		Business Continuity Guarantee						
Business Assurance Availability & Reliability	<i>Redundancy</i>									
	<i>Fault Tolerance</i>									
	<i>Availability</i>									
	Grading	Site Selection	<i>RTO &amp; RPO</i>							
	<i>UPS</i>	Fault Diag. & Treat	<i>CP</i>	<i>CE</i>	Num of CPU Cores	<i>Image Size</i>	App Health	Resp. Time	Error Rate	
					Storage Capacity	Num of priv/pub IP	Throughput	<i>Apdex</i>	DB Health	
				Virtual FW Throughput	Num of Instances	<i>QPS</i>	Qry Err. Rate	Num of Conn.		
Foundation Security & Compliance	Physical Security		Data Integrity and Confidentiality							
	Fire Security		Comm. Transmission	Network Architecture		Infrastructure Location		App Dev Security		App Migr & Depl. Sec
	System Security		Trusted Verification	Network Access Control		Security Audit		App Trial Security		App Delivery Security
			Border Protection	Intrusion Prevention		Mirror & Snapshot Protection		App Offline Security		Data Collect. Security
			Identity Authentication	User Access Control				Data Storage Security		Data Proc. Security
				Data Backup and Recovery				Data Distrib. Security		Data Delet. Security



**SRE  
CON** ASIA  
PACIFIC



Sustaining everything,  
everywhere, all at once!



L0 L1

Building & Facilities  
(DCIM, Power Management, Security)

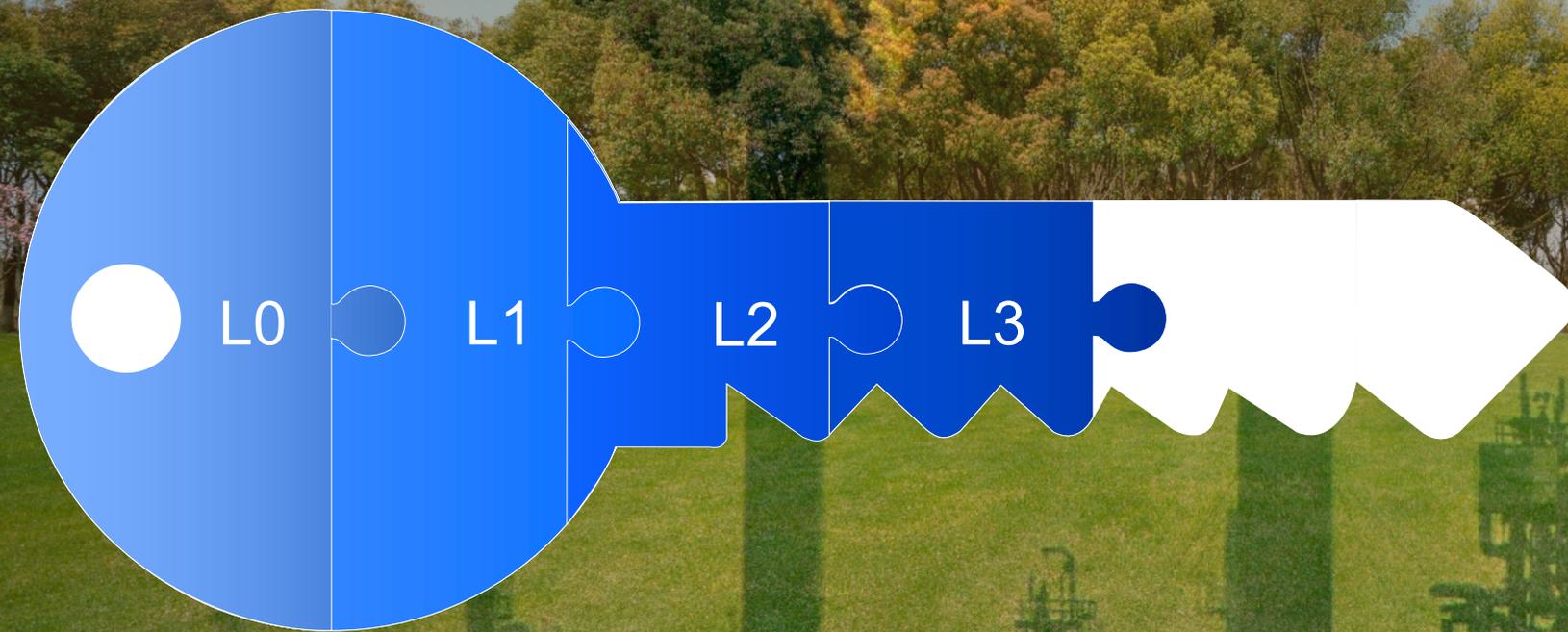
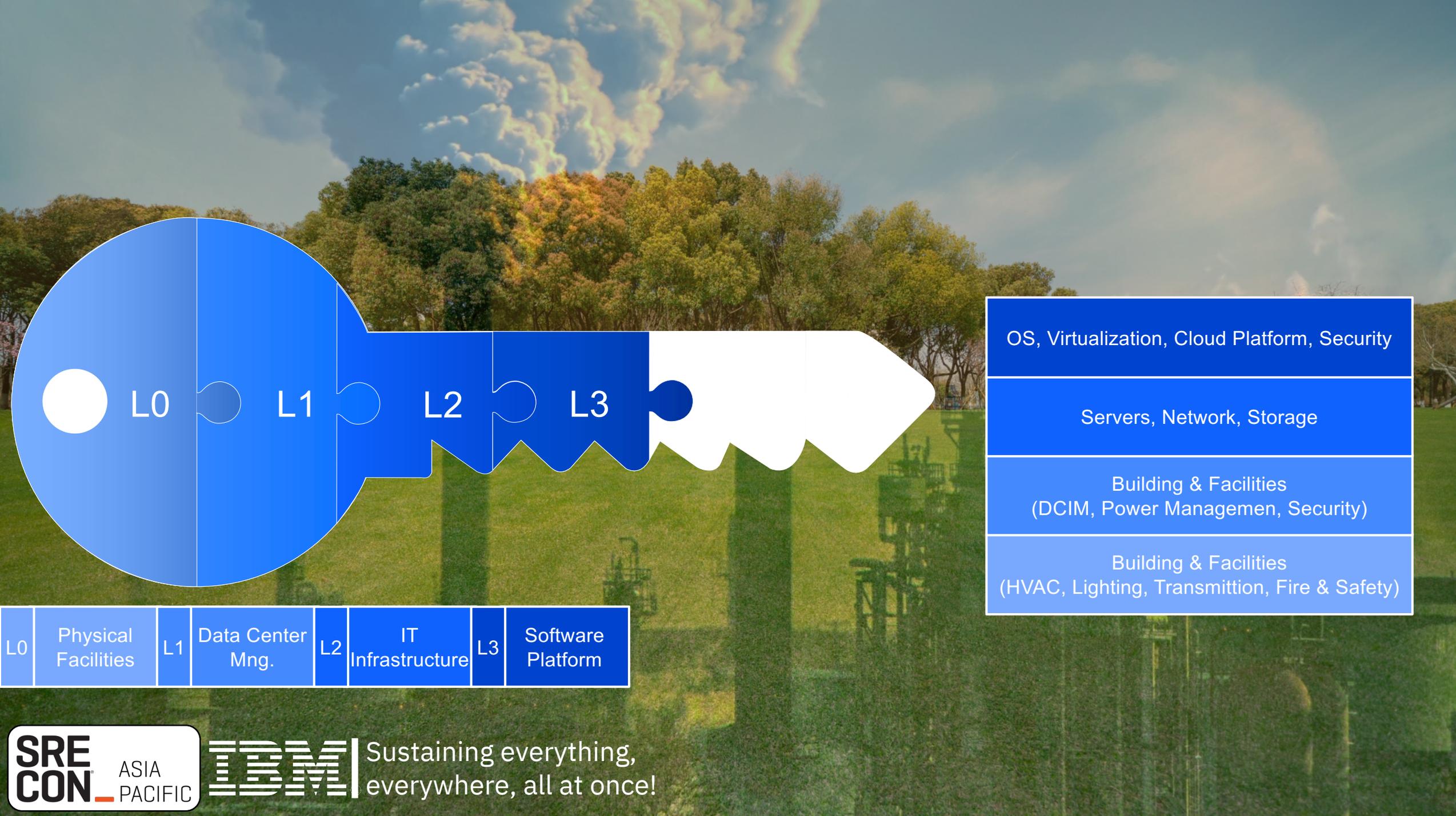
Building & Facilities  
(HVAC, Lighting, Transmission, Fire & Safety)

L0	Physical Facilities	L1	Data Center Mng.
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**SRE CON** ASIA PACIFIC



Sustaining everything,  
everywhere, all at once!

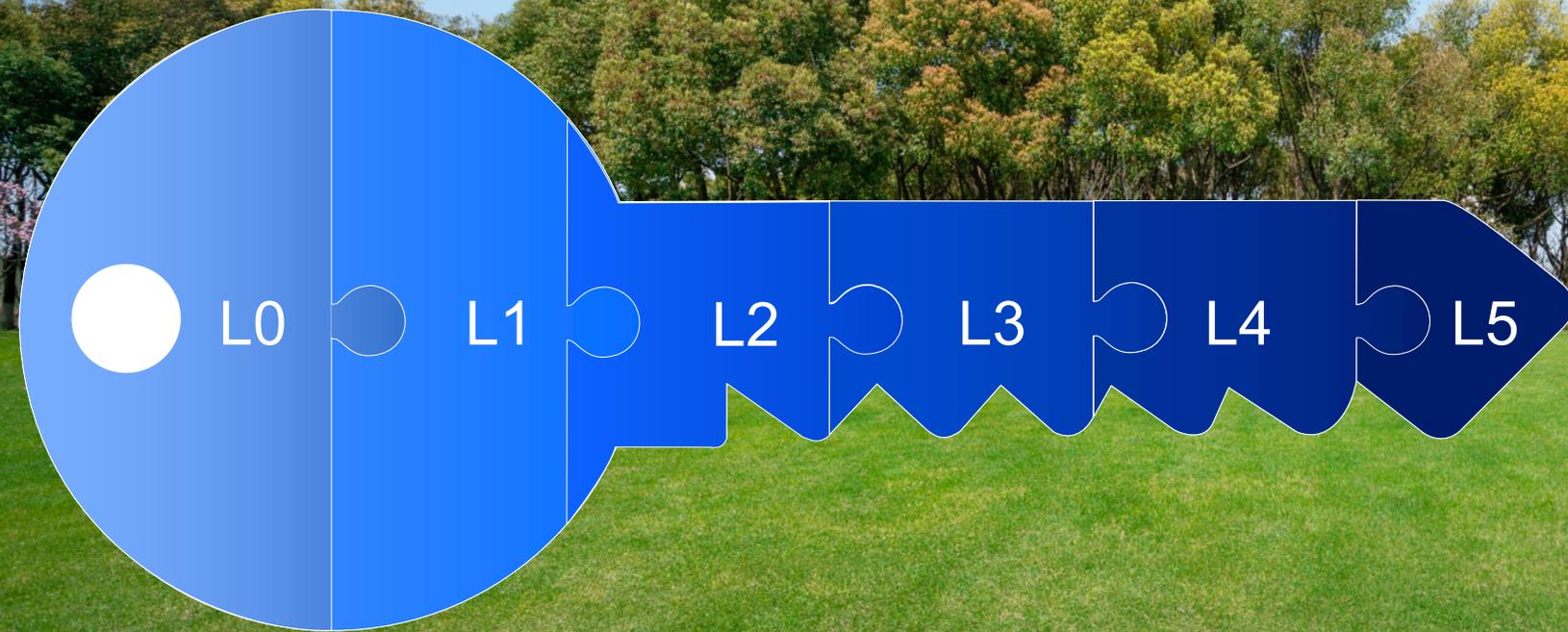


OS, Virtualization, Cloud Platform, Security
Servers, Network, Storage
Building & Facilities (DCIM, Power Management, Security)
Building & Facilities (HVAC, Lighting, Transmission, Fire & Safety)

L0	Physical Facilities	L1	Data Center Mng.	L2	IT Infrastructure	L3	Software Platform
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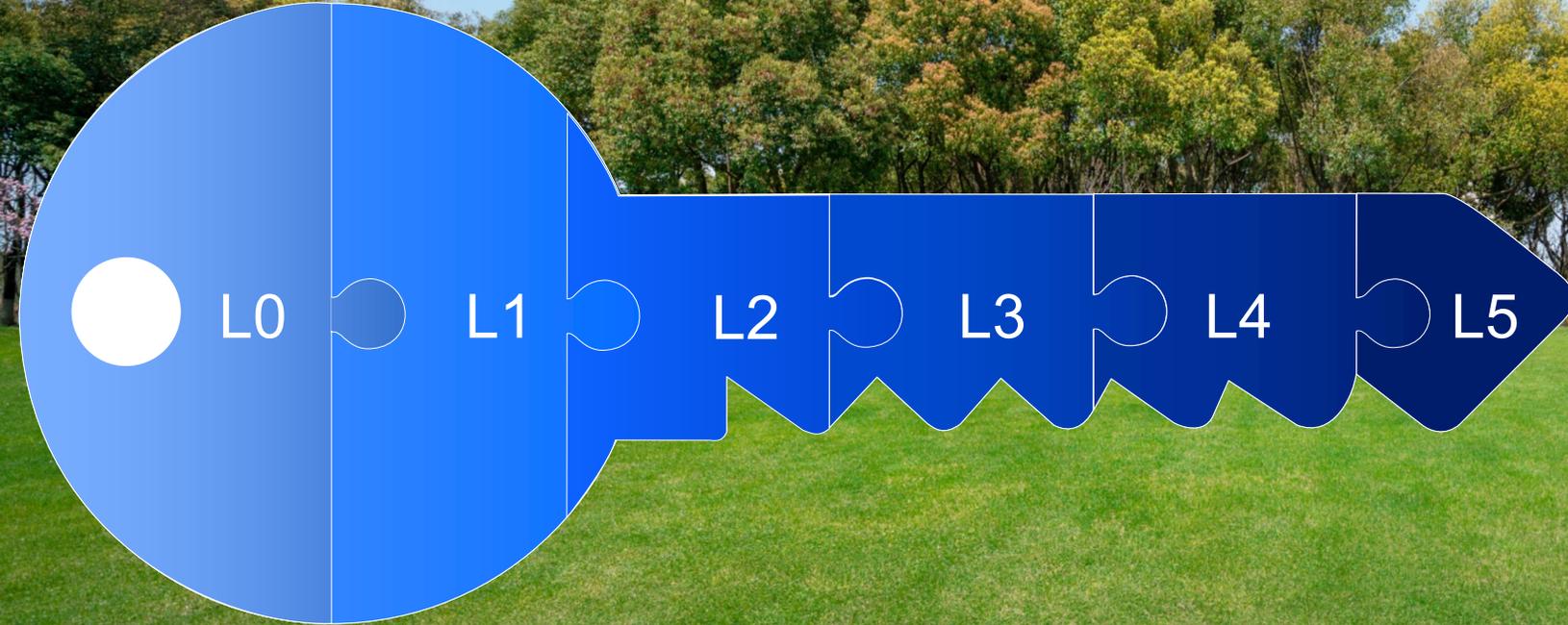


Sustaining everything, everywhere, all at once!

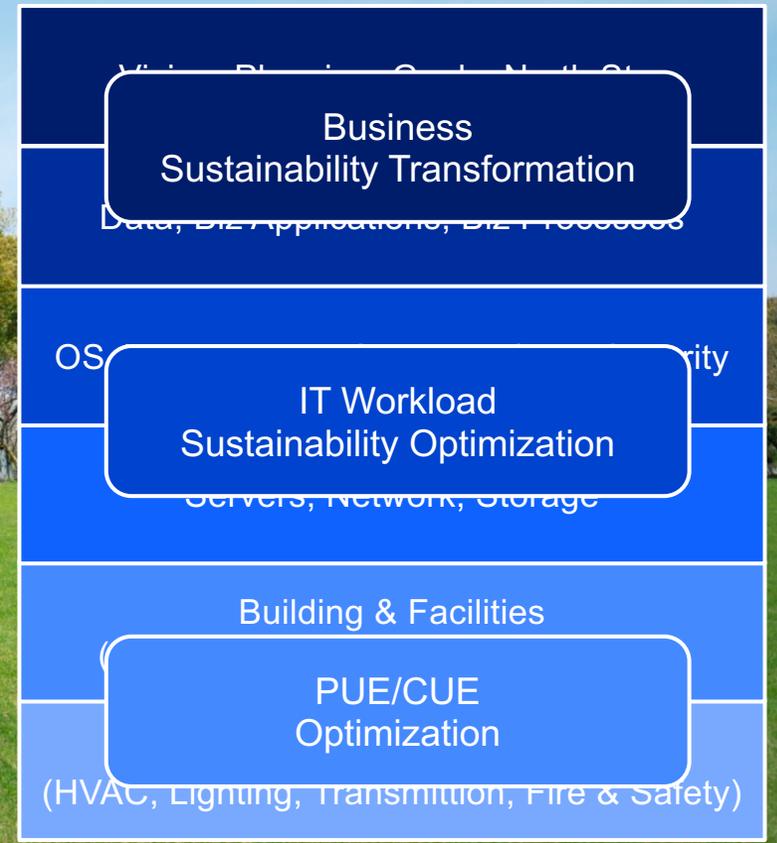


L0	Physical Facilities	L1	Data Center Mng.	L2	IT Infrastructure	L3	Software Platform	L4	Applications & Data	L5	Strategy
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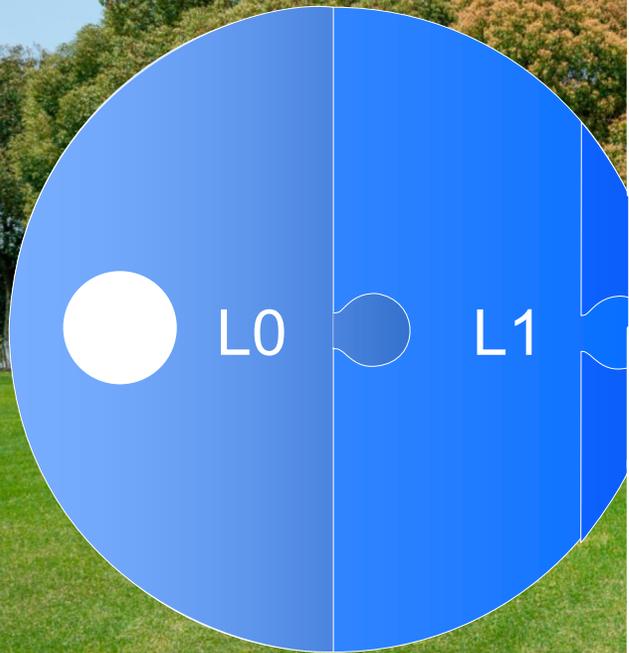
Vision, Planning, Goals, North Star
Data, Biz Applications, Biz Processes
OS, Virtualization, Cloud Platform, Security
Servers, Network, Storage
Building & Facilities (DCIM, Power Managemen, Security)
Building & Facilities (HVAC, Lighting, Transmission, Fire & Safety)



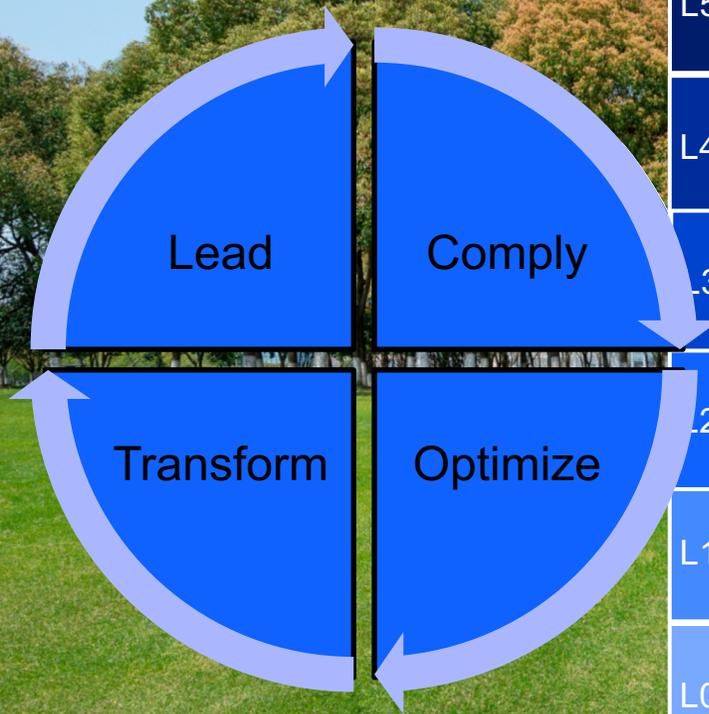
L0	Physical Facilities	L1	Data Center Mng.	L2	IT Infrastructure	L3	Software Platform	L4	Applications & Data	L5	Strategy
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Sustaining everything, everywhere, all at once!



L5	Strategy	Business Sustainability Transformation
L4	Applications & Data	Data, Biz Applications, Biz Processes
L3	Software Platform	OS, Security
L2	IT Infrastructure	Servers, Network, Storage
L1	Data Center Mng.	Building & Facilities
L0	Physical Facilities	PUE/CUE Optimization (HVAC, Lighting, Transmission, Fire & Safety)



L5	Strategy	Greenness & Lower Carbon	Available & Reliability	Security & Compliance	Operational Efficiency
L4	Applications & Data				
L3	Software Platform				
L2	IT Infrastructure				
L1	Data Center Mng.				
L0	Physical Facilities				

KPIs  
KPIs  
KPIs

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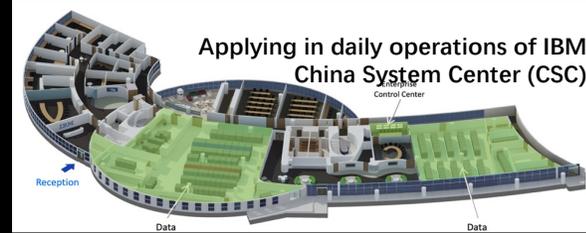
Metrics  
Logs  
Traces  
APIs, OTS, STS

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



# Full-stack Sustainability Optimization

DatacenterDynamics  
**AWARDS**



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

**PUE ↓ != Sustainable Computing**

**3. Biz Sustainability Transformation**

**2. IT Workload Sustainability Optimization**

**1. PUE/CUE Monitoring & Optimization**



## Sustainable Strategy

IBM Consulting Sustainability Strategy Planning/Process Reengineering/Sustainability Transformation...

## Sustainable Industry Applications

IBM Maximo/TRIRIGA/Envizi/EIS/...

## Sustainable Software Platform

Red Hat OCP/ Ansible/IBM Cloud Paks/Security/Instana/Turbonomic/...

## Sustainable Systems

IBM Z/LinuxONE/Power/Storage

## Sustainable Data Center

IBM TSS Green Data Center(AI-based Energy Saving/Intelligent Patrol Robot/Air Flow optimization) ...

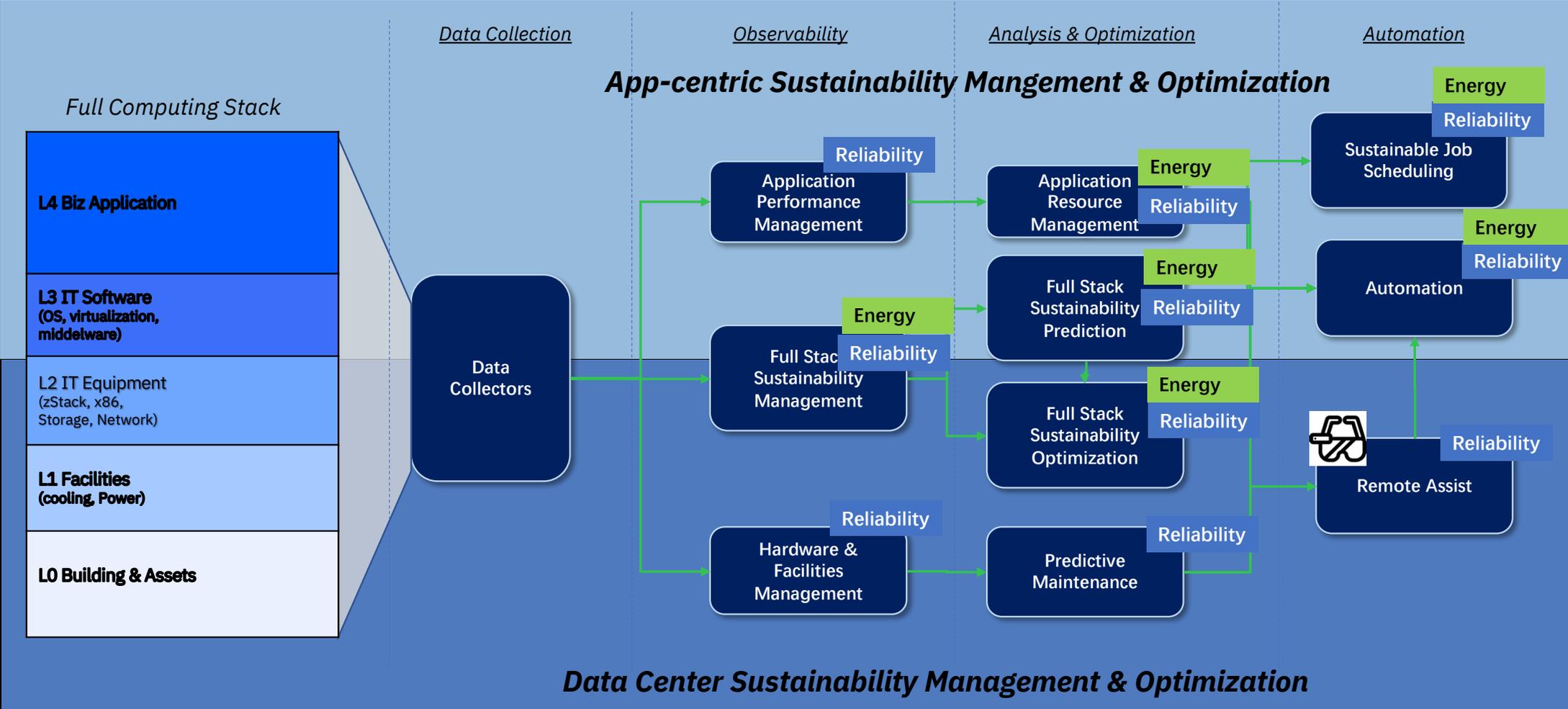
## Sustainable Building, Asset Management

IBM TRIRIGA/MAS/Envizi



Sustaining everything, everywhere, all at once!

# Full-Stack Sustainability Optimization Platform Overview



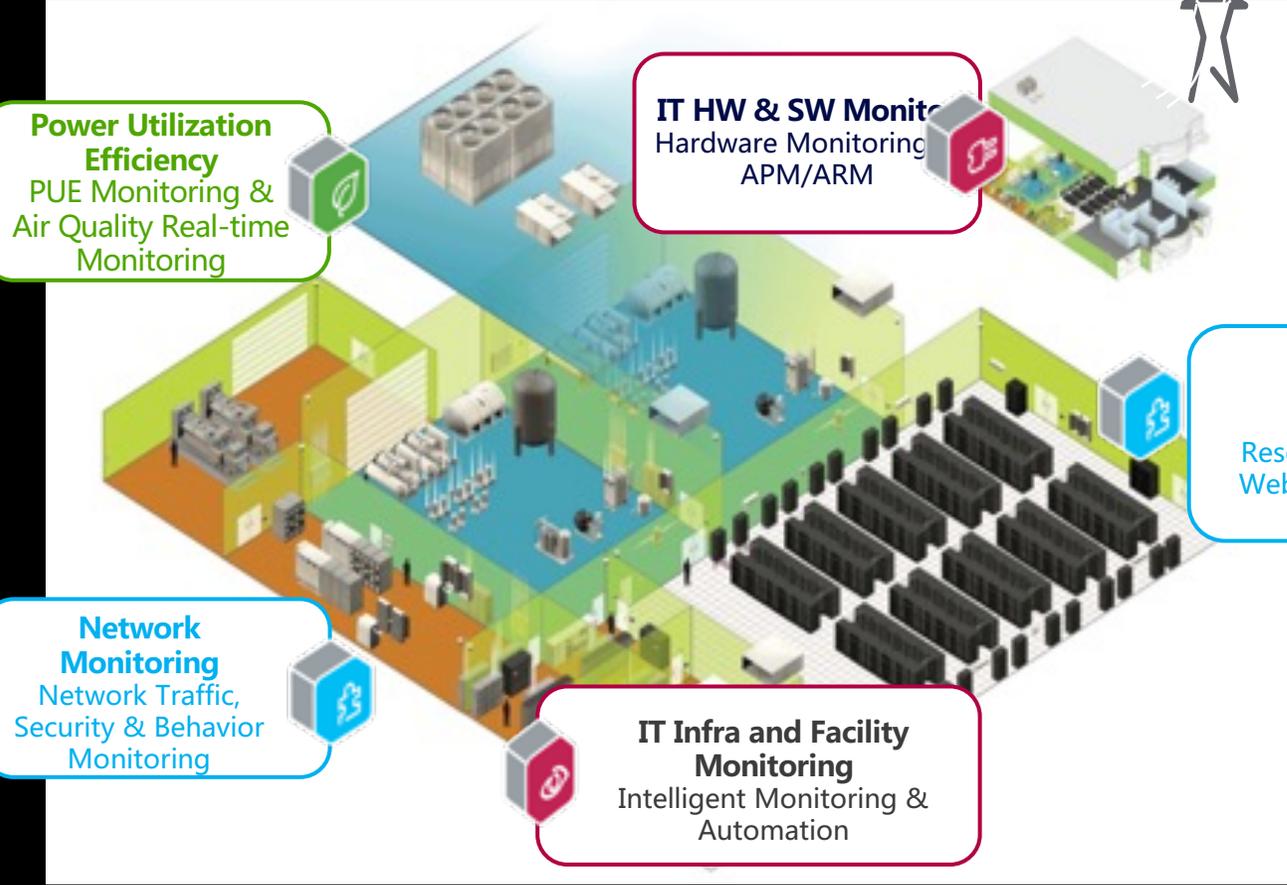
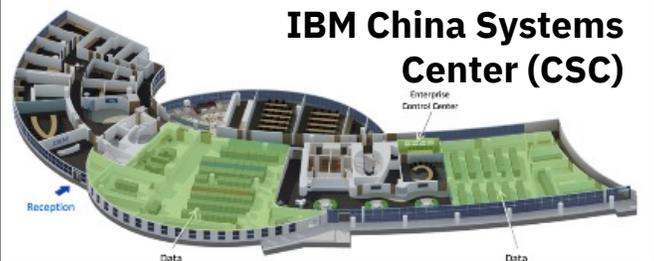
# Solution Demo

## IBM全计算堆栈可持续管理 优化解决方案

Full-Stack Sustainability  
Optimization



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

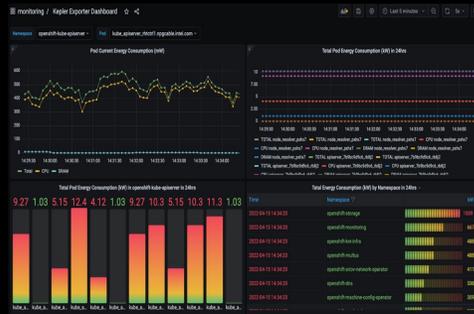
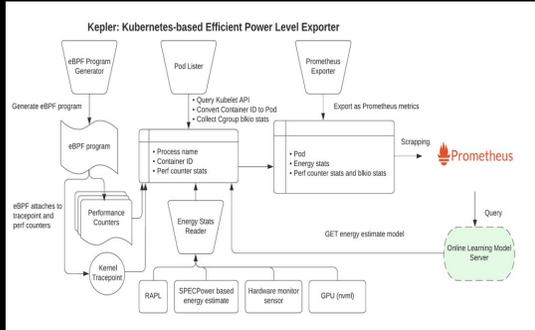


# Working with Open Source Community on Sustainabilities

## Apache Kepler: Kubernetes-based Efficient Power Level Exporter

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

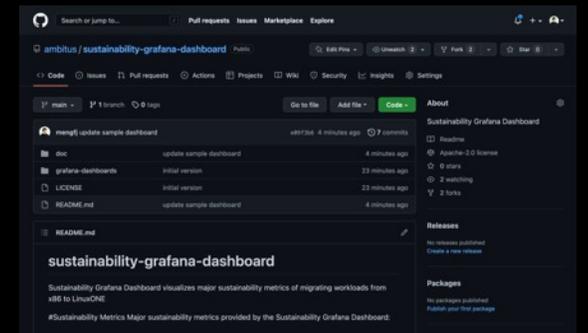
<https://github.com/sustainable-computing-io/kepler>



## Open Mainframe Project: Sustainability Grafana Dashboard

Visualize Sustainability Metrics for workload migration from x86 to LinuxONE

<https://github.com/ambitus/sustainability-grafana-dashboard>



# 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 ([mengfj@cn.ibm.com](mailto:mengfj@cn.ibm.com)) !

