Greening research infrastructure

Session 16 | Great room 3 | 2.00-2.55PM

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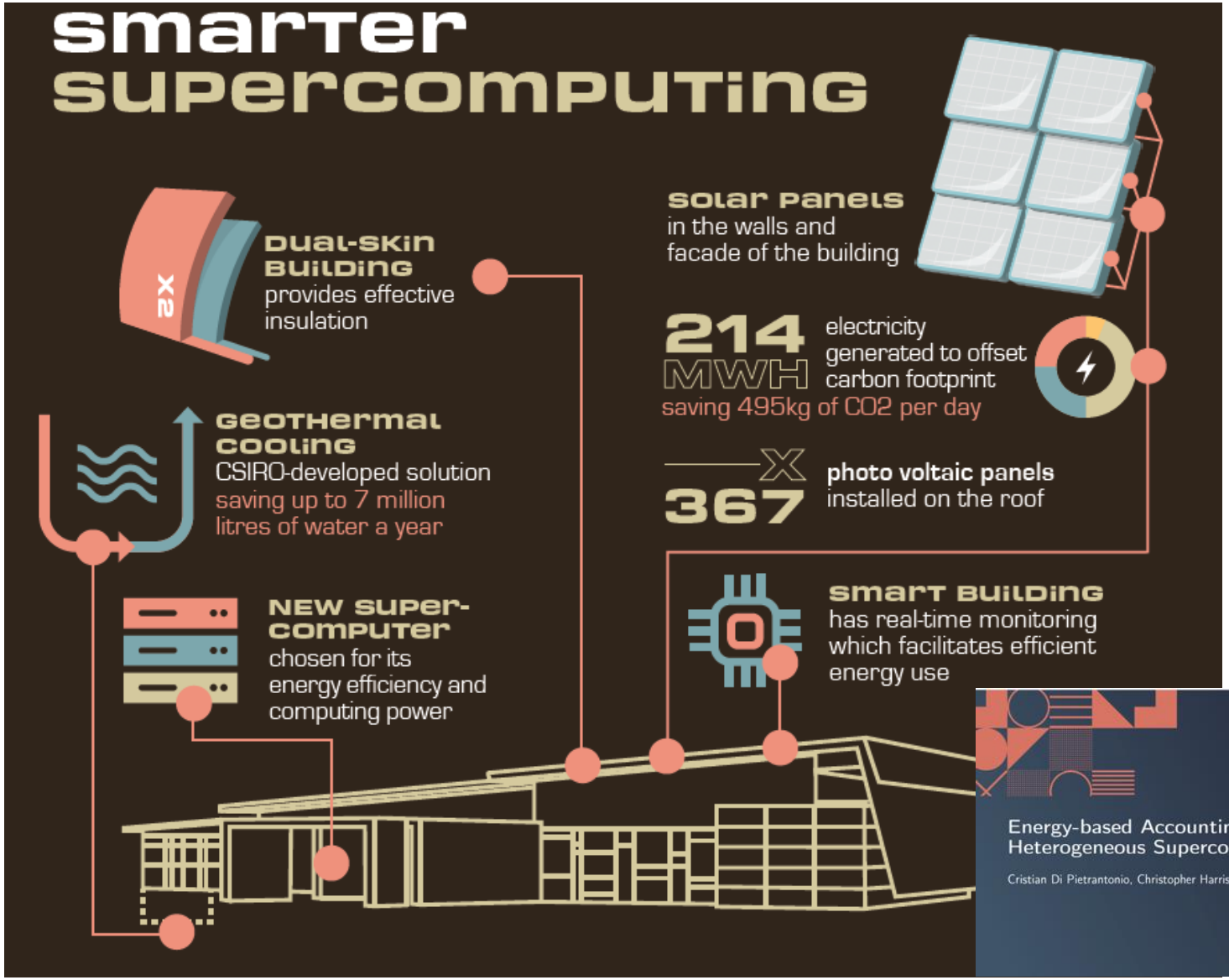
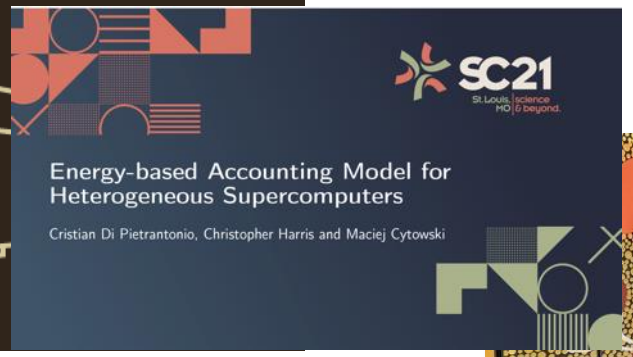
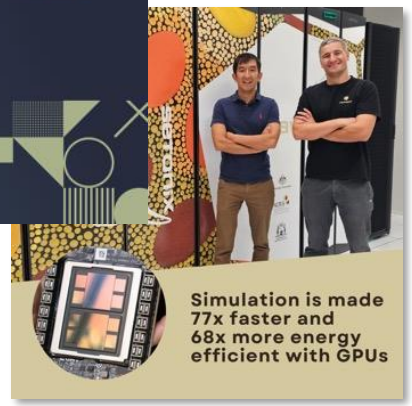


- Integrated Sustainable Design Review
- Hydrogen Power System Feasibility Study
- Stygofauna Analysis – Mullaloo Aquifer
- Decadal Review of Ground Water Cooling System
- Vibration and EMF Monitoring and Assessment
- Thermal Battery Technology





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Design and engineering – Sustainable power – Optimised use

GreenDIGIT Project for Greening Future Digital Research Infrastructures

Yuri Demchenko
GreenDIGIT Project, University of Amsterdam

ICRI2024 Session/Panel “Greening Research Infrastructures”
4 December 2024

GreenDIGIT Project: Founding Digital RIs (ESFRI)

- **EBRAINS** - An open research infrastructure that gathers data, tools and computing facilities for brain-related research
- **EGI** - International federation delivering e-Infrastructure and open solutions for advanced computing and data analytics in research and innovation
- **SLICES** - Scientific Large-scale Infrastructure for Computing and Communication Experimental Studies
- **SoBigData** - Distributed, Pan-European, multi-disciplinary research infrastructure aimed at using social mining and Big Data to understand the complexity of our contemporary, globally interconnected society

Sustainability Aspects: Energy Efficiency – Decarbonisation – Environmental Impact

- **Energy Efficiency in Digital Infrastructures**:
  - **Definition**: This refers to optimizing digital infrastructures to consume as little energy as possible for a given workload or service. It's about achieving more computational or storage results with less energy input.
- **Decarbonization of Digital Infrastructures**:
  - **Definition**: This specifically targets the reduction of carbon emissions associated with the operation and maintenance of digital infrastructures.
- **Reducing Environmental Impact of Digital Infrastructures**:
  - **Definition**: This is a more comprehensive consideration of the various ways digital infrastructures might affect the environment, going beyond just energy consumption and carbon emissions.

Architecture, Design,
Recommendations

Operation,
Monitoring, KPI

Lifecycle, Policy,
Training

GreenDIGIT project (2024-2027) – Objectives

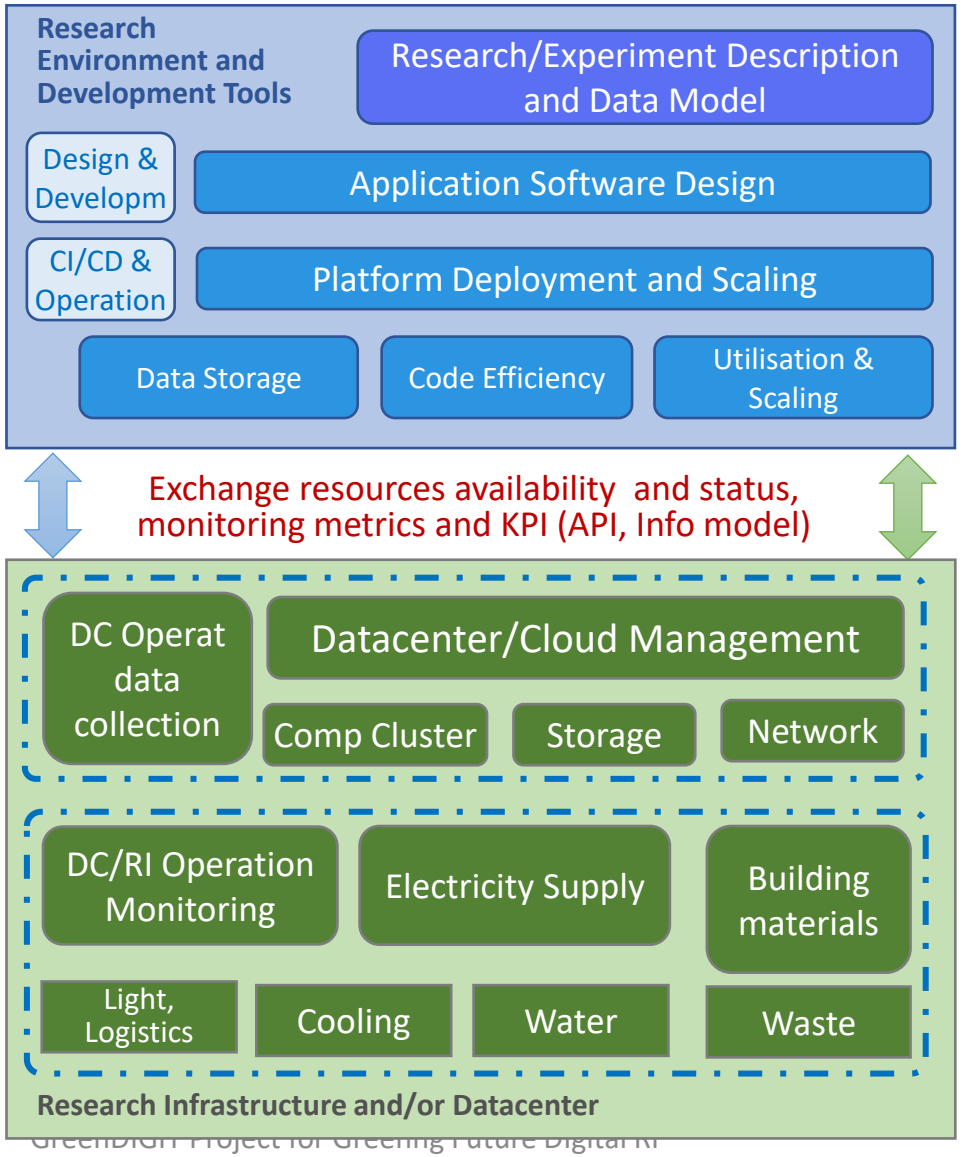
- **O1: Assess the status and trends** of low impact computing within 4 DIGIT RIs (EGI, SLICES, SoBigData, EBRAINS) and wider ESFRI community, to produce **recommendations and roadmaps** for RIs green transition.
- **O2: Provide reference architecture and design principles**, reflecting on the **whole RI lifecycle** and including the digital infrastructure components.
- **O3: Develop new and innovative technologies, methods, and tools** for digital service providers within European Research Infrastructures.
- **O4: Develop and provide for researchers the tools** to support the design and execution of environmental sustainability aware scientific applications with Open Science and FAIR data management considerations.
- **O5: Educate and support RI service providers and researchers** about good practices on environmental impact conscious lifecycle management and operation of infrastructures and services.

Shared Responsibility in Sustainability – Reflecting Operational and Management Aspects and Roles

GreenDigit

Users responsible for sustainability ***on*** the RI

Providers responsible for the sustainability ***of*** the RI



Standards and regulations
Software Development Quality and Design Patterns

Project/Researcher Responsibility:
Applications Development, Deployment, Operation, Energy usage and KPI monitoring

Provider/Operator Responsibility:
Research Infrastructure or Datacenter, Monitoring Energy and environmental impact metrics and KPI

Standards and regulations
Datacenter and RI Building and Operation

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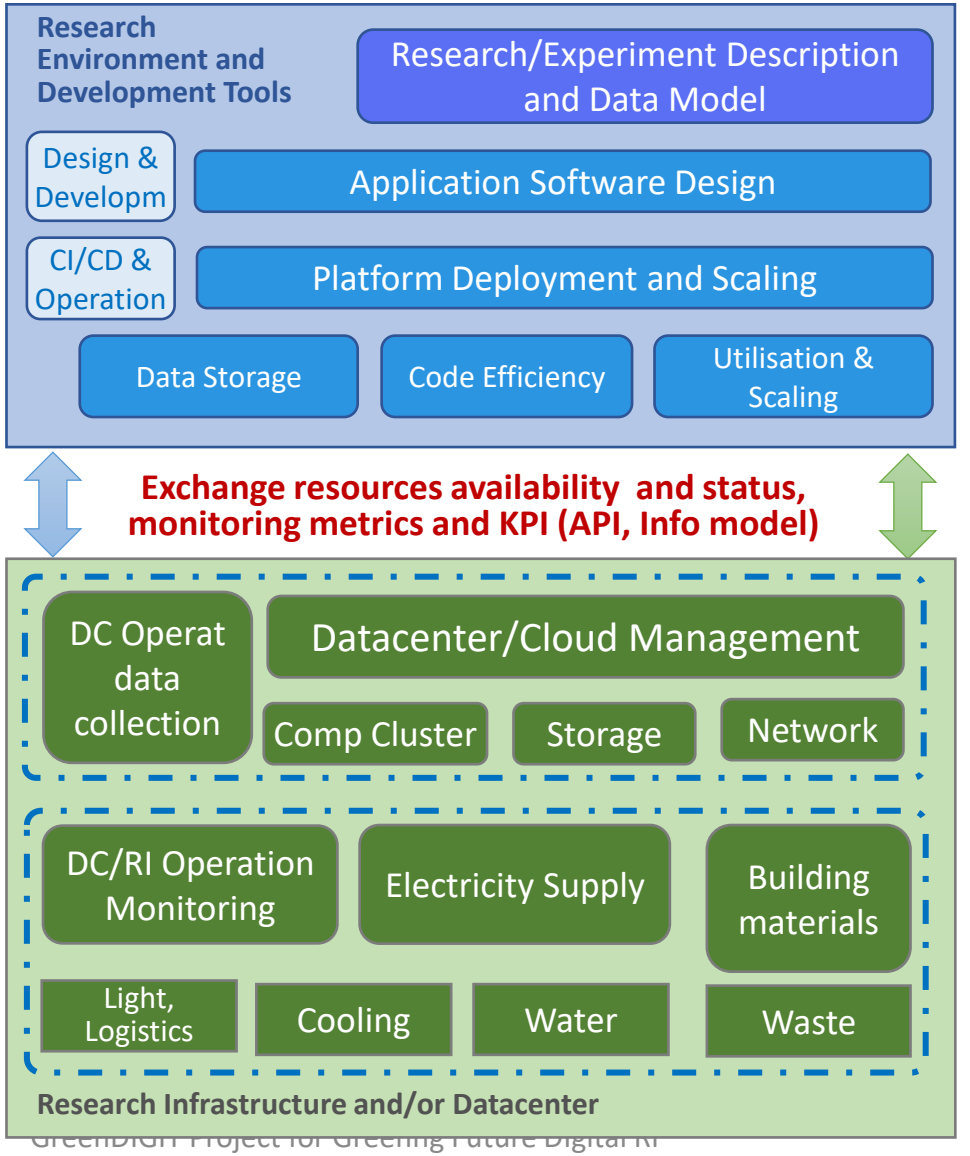

Standards and regulations
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Sustainability by Design

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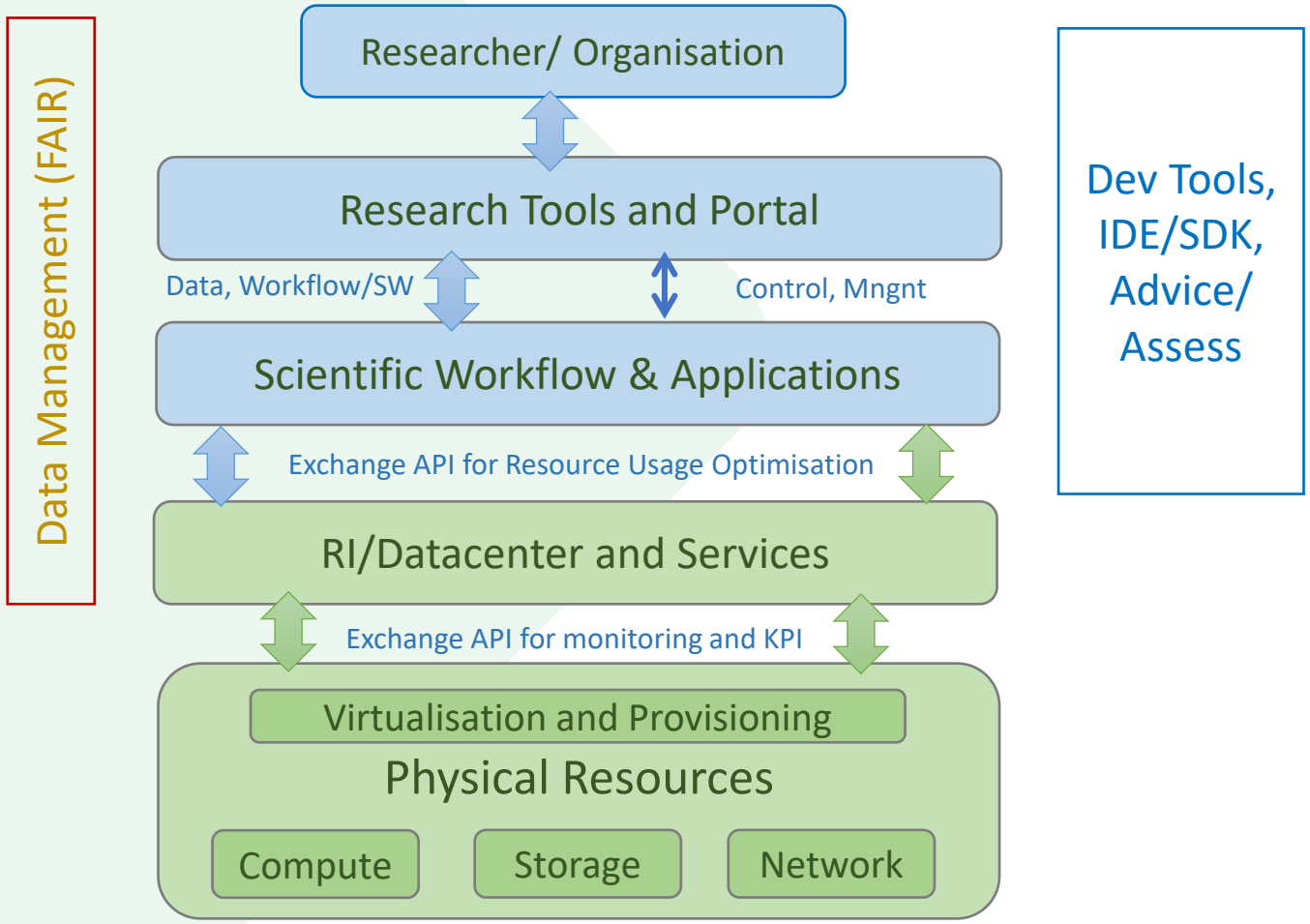
RI Sustainability by Design Components/Aspects



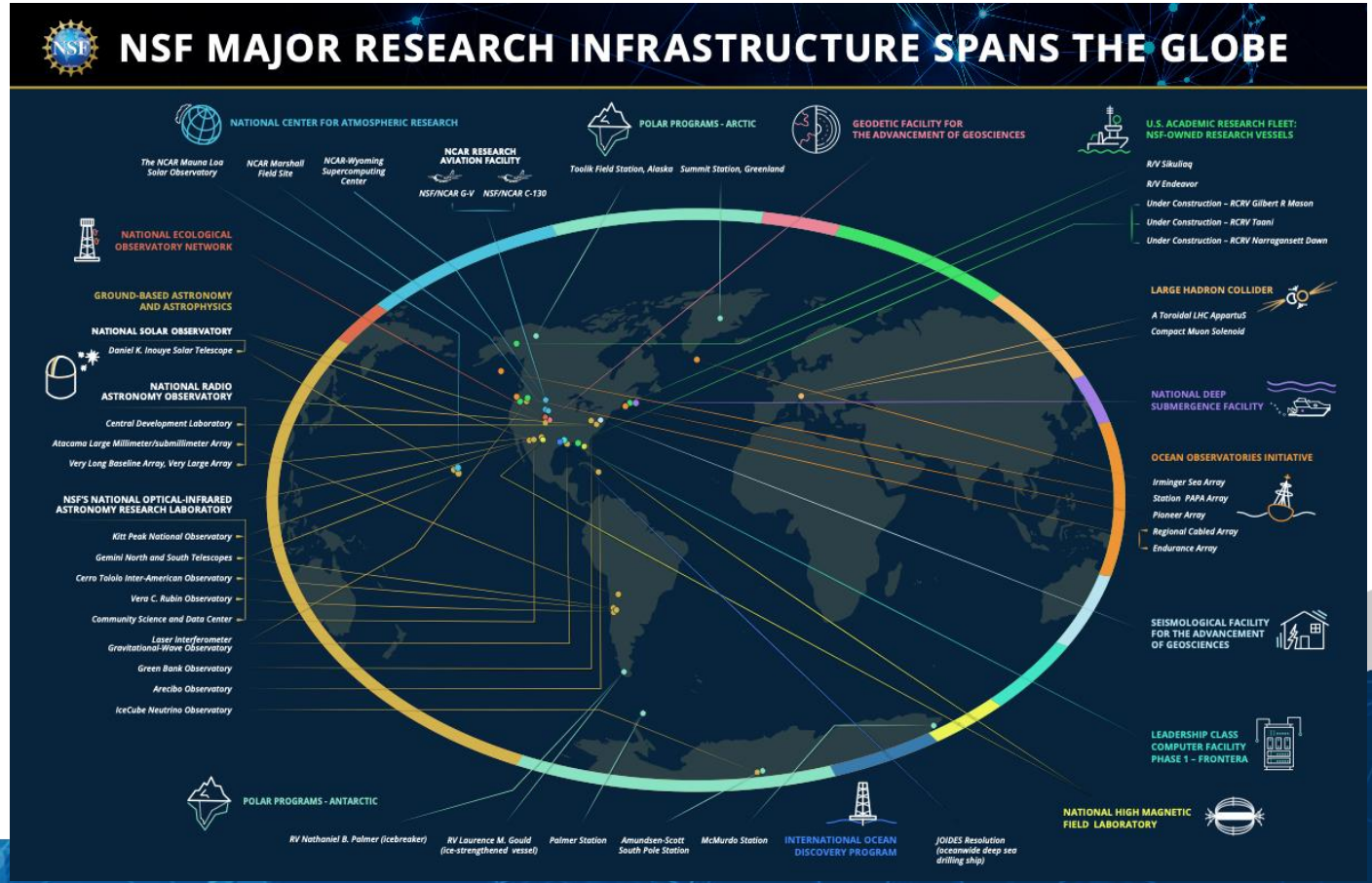
- **Architecture for Sustainability by Design**
  - Functional components, layers, API, Requirements
- **Software and application components that can be optimised during design and controlled during operation**
  - Green aware API including necessary energy, performance, environment information
- **Common information/data model and metadata (naming)**
  - Including Requirements, KPI, Metrics **+ FAIR**
- **RI and applications lifecycle**
  - RI lifecycle stages (concept, design, development, deployment, operation, decommissioning) and scientific workflow and research data

Discussion Topics to Facilitate Environmental Sustainability

- Energy efficiency **on/of** Research Infrastructure/Research Environment
  - Environmental Sustainability and emerging GenAI/LLM powered science
- Shared Responsibility in Environmental Sustainability
- Research community cooperation and contribution for targeting and achieving environmental sustainability
  - Joint workshops and events are an effective way to go

US National Science Foundation (NSF) Research Infrastructure

- NSF supports many types of Research Infrastructure (RI) across the globe with varied energy consumption and environmental considerations
  - Some of the RI is simply energy hungry, such as the computing RI or the particle accelerators (for example, CERN's energy consumption is up to ~1.3 TWh/year, with the Large Hadron Collider (LHC) accounting for 55% of the total consumption.)
  - Some of the RI is in hard-to-reach and/or delicate environments, such as mountain-peak astronomical observatories or the Antarctic facilities.
- Both environmental and cost-of-operation factors are considered when RI is being developed or upgraded



Few General Considerations / Discussion Points

- Science funding agencies, such as NSF, generally do not set the environmental or energy policy
  - NSF's actions at any given time have to be consistent with the policies set elsewhere in the US government
    - For RI located outside of the US, the local regulations also apply
  - NSF's funding decision are heavily driven by the scientific community priorities via the "gold standard" peer merit review process
- The time scales associated with the expected lifecycle of large scale RIs can exceed the time-scale of both national political cycles and novel technology development
  - Individual RI's operational sustainability plan, or ability to maintain particular practices and priorities through its lifecycle, should account for the potential social and technological environment changes
  - Lower cost-of-operation per unit of science delivered is likely to be welcomed by any taxpayer everywhere
- Evolution of scientific community's practices can be driven by both mandates and incentives
  - Incentives (as opposed to mandates) may provide a more organic, and thus more sustainable, evolution pathway with fewer unintended side effects

Amazon Carbon-free energy goal

500+

Global renewable energy projects (as of Jan 2024)

28+

Gigawatts of total renewable capacity (as of Jan 2024)

100%

Renewable energy reached across our business in 2023

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A more sustainable future, together

The **Amazon Sustainability Exchange** provides free, publicly available information that democratizes our guidelines, playbooks, scientific models, and other resources to help others make meaningful progress toward a net-zero carbon future.

"We know that driving change means staying focused on bringing entire industries along with us."

-Kara Hurst, Amazon Chief Sustainability Officer

Focus Areas

Buildings | **Carbon neutralization** | **Carbon-free energy**

Human rights | **Transportation** | **Waste & circularity** | **Water stewardship**

Explore the exchange: https://exchange.aboutamazon.com/

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A data-driven approach to sustainability strategy, enabled by cloud computing

Sustainability **OF** the cloud

Delivering a sustainable IT fleet – taking advantage of the cloud and AWS efficiency

Sustainability **IN** the cloud

Optimizing workloads on AWS with the Sustainability pillar of the Well-Architected Framework

Sustainability **THROUGH** the cloud

Deploying cloud-based solutions and advisory support to accelerate sustainability objectives