NSF 23-532 Design for Environmental Sustainability in Computing (DESC)

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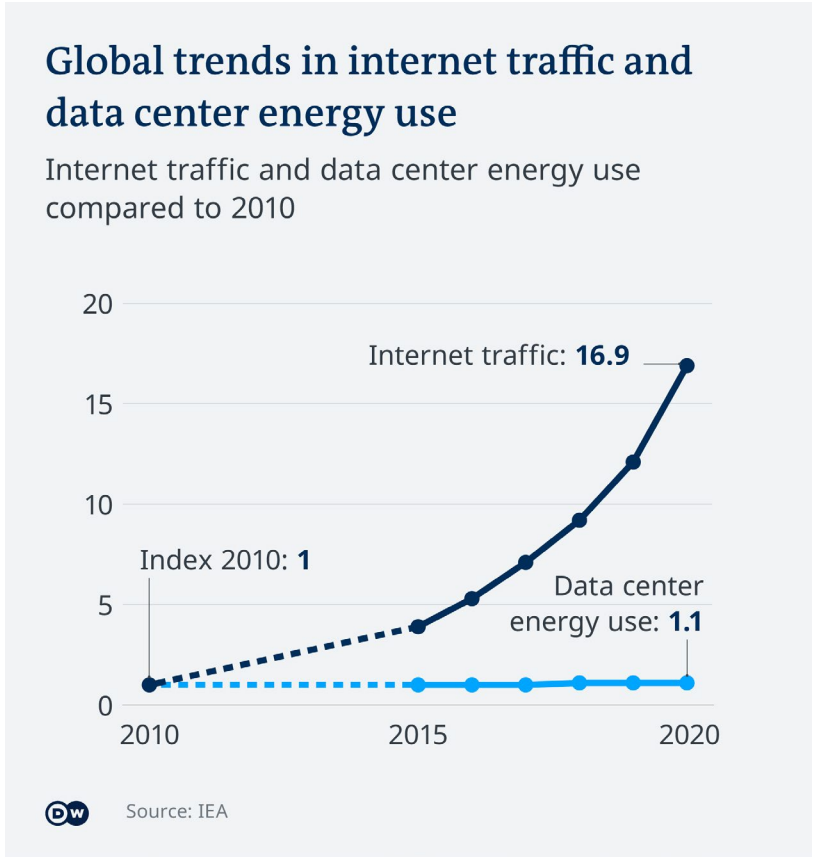
Motivation

International Energy Agency

- **1%** of all global electricity is used by data centers
- data centers consume 1/5 of world's power by 2025



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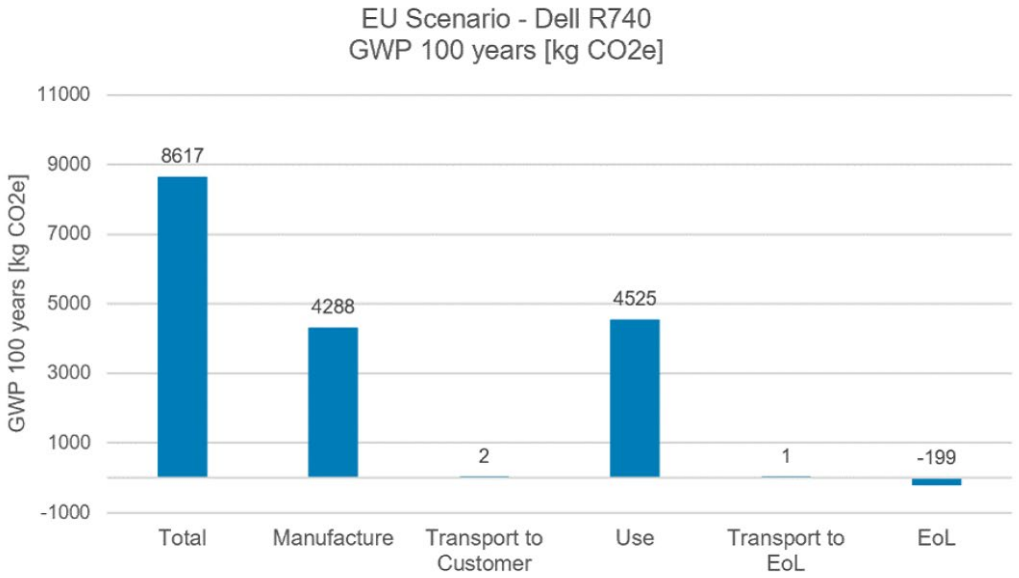
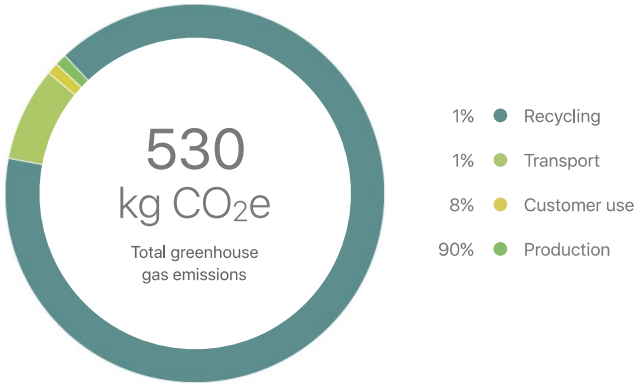
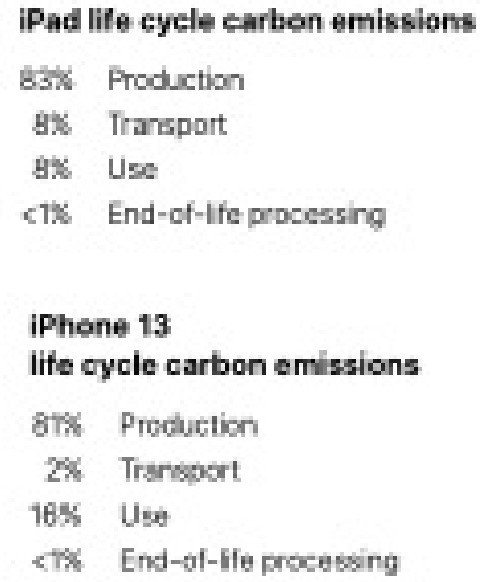
Embodied Energy/Carbon

- Servers can be 50% of total
- Can be much higher for **energy optimized** compute







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E-waste

- Recovery of rare-earth materials is important
- E-waste has negative environmental impacts

Motivation

- Understudied problems
  - Embodied carbon, GHG emissions, depletion of rare earth materials, e-waste
- Compounding computing community trends
  - Device proliferation, planned obsolescence, big data, dark silicon, resource-insensitive software, compute intensive applications (AI, blockchain)
  - Correcting this requires a mindset change, new metrics, visibility into the problem
- Example: Datacenters
  - 1% of global electrical supply in 2019 (similar carbon footprint of aviation industry)
  - Heavy usage of batteries, diesel generators, toxic coolants, embodied (see below), etc.
- Example: Embodied carbon higher than operational carbon footprint
  - Half of the overall carbon footprint of datacenter class servers for a 4-year use lifetime
  - 4X higher for tablets and mobile phones, and 10X higher for low-cost desktop computers
- *Energy Efficiency alone is insufficient to solve these challenges….*

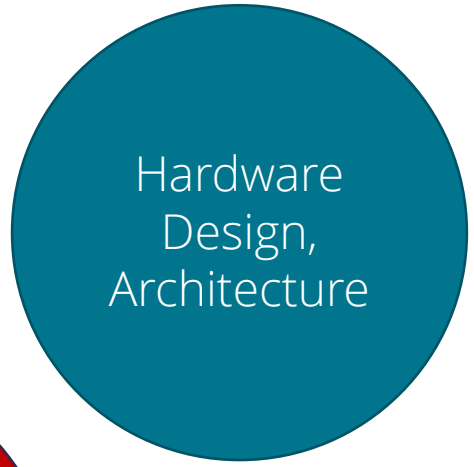
NSF 23-532: Design for Environmentally Sustainable Computing (DESC)

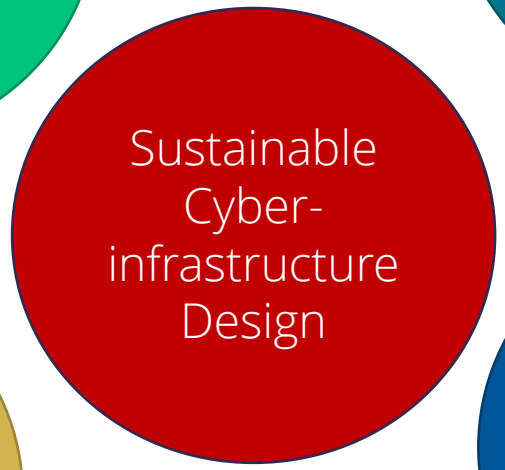
DESC objective: build a community of interdisciplinary researchers for disruptive improvements in the sustainability of next-generation computing.

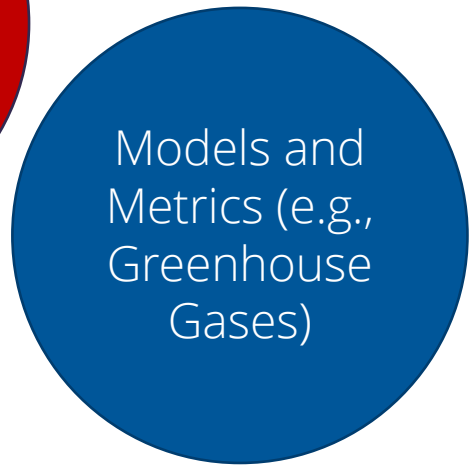
Key Challenges:

- **Applying principles of sustainable and lifecycle science to computing**
- **Defining, measuring and optimizing computational sustainability**
- **Pushing the pareto-optimal boundary**
- **Promoting design for environmental sustainability as a top tier goal**
- **Leveraging opportunities for sustainability across the computing continuum**
- **Avoiding planned obsolescence**

Sustainability Projects are Solicited from and across All CISE Disciplines







Boundaries for DESC

These Items are out of scope for DESC:

- Purely performance and/or energy efficiency computing projects
- Projects that use computing to advance other sectors of sustainability
- Projects that seek to advance economic or social justice of computing alone

DESC projects should:

- Seek transformative, potentially cross-disciplinary, and/or clean-slate approaches to improve environmental sustainability at any level across the computing continuum
- Be able to quantify and measure the improvement to environmental sustainability beyond energy efficiency
- Be ambitious and forward-thinking

Best Practices

- Attend webinars/**townhalls/office-hours** of the solicitation if available.
- Send questions to **desc@nsf.gov**.

- Read the solicitation closely. Ensure your submission complies with submission rules.
  - There are also many useful examples of topic areas of interest.

- Contact NSF program director with a one-page summary before submission.

- During the webinar
  - Type in questions at Q&A

Types of Projects – Round 1

Type I Small Projects

Research activities with 3-year duration and 1-2 PIs

Budgets up to $600,000

Deadline: March 17, 2023

PI, Co-PI, Senior Person may submit ≤ 2

PI, Co-PI, Senior Person on a large may submit ≤ 1

Type II Large Projects

Interdisciplinary or cross-layer efforts requiring larger teams

Budgets up to $2,000,000 and up to 4-year duration

Deadline: March 17, 2023

PI, Co-PI, Senior Person may submit ≤ 1

PI, Co-PI, Senior Person on 2 smalls may not submit

Type III Workshop Projects

Workshops to catalyze research activities

Budgets up to $100,000 and up to 1 year duration

No deadlines

No PI, Co-PI, Senior Person Limits

Limits are independent of other NSF programs *including CISE Core Programs*.

A PI/Co-PI/Senior Person May Participate in ≤2 small awards and ≤1 large award during the life of the program. There are no limits on workshop awards.

Type I Small Projects

Deadline: March 17, 2023

Subsequent Deadlines: September 13, 2024 and September 12, 2025

Up to 10 awards expected for each deadline

15 Page Project Description

Type I Small Projects may be standalone projects or serve as preliminary exploration for a Type II project

Small projects intending to seek Large funding

Type I projects must be self contained

Should clearly articulate how it prepares for research to be done in the Type II project

Successful Type I projects of this variety should present the broad vision of the entire project duration

Type II Large Projects

Deadline: March 17, 2023

Subsequent Deadlines: September 13, 2024 and September 12, 2025

Up to 2 awards expected for each deadline

20 Page Project Description

A Management of Coordination Plan of up to 3 pages is required for Type II projects

Award of a Type I Small Project is not a prerequisite to seek Type II Large funding

Successful Type II Large Projects may be supported by a Type I Small or Related Award

Awardees from the Design for Sustainability in Computing Dear Colleague Letter (22-060) could demonstrate readiness for Type II Large funding.

PIs should clearly enumerate how Type II research is novel but also builds on Type I or equivalent funding.

Concurrent DSC DCL and Type I Small funding is allowed with a Type II Large Award *HOWEVER*

Type I Small and Type II Large funding for connected projects should NOT be sought in the same funding round

Additional Review Criteria for Type I&II Projects

Reviewers will be asked to comment on:

whether relevant notions of environmental sustainability are addressed

For instance, projects should not purely address energy efficiency.

how the sustainability vision will be attained as well as theoretically and experimentally evaluated

The project should be impactful for environmental sustainability of computing. The proposal should clearly describe how this will be done for the project through theory and experiment.

definition of sustainability metrics and (1) sufficiency to reach beyond performance and energy efficiency, (2) whether they can successfully capture the impact on the environmental sustainability, and (3) their ability to be quantified and evaluated.

DESC projects should be able to define reasonable environmental metrics (e.g., GHGs, wastewater, VOCs, e-waste) and use them the quantify and evaluate the projects impact on sustainability

Type III Workshops

Deadline: Submit Anytime

Subsequent Deadlines: It is expected more workshops will be funded early in the program to prepare researchers for submitting Type I and II proposals.

Up to 5 awards expected for each deadline

8 Page Project Description

Type III project proposals must be prepared in accordance with the guidance for Conference Proposals contained in PAPPG Chapter II.F.

Successful Type III Workshops will catalyze researchers in areas within scope of DESC

Workshops could encourage exploration of environmentally sustainable computing for a particular CISE topic area but need not directly related to a particular proposal.

However, it is envisioned that PIs from the workshop could form teams to submit Type I and Type II proposals.

There are no limits on PIs participating in Type III Workshop Proposals

Additional Review Criteria for Type III Workshop Projects

Reviewers will be asked to comment on:

the notions of environmental sustainability advanced by the workshop

The workshop should be able to articulate how the topic area is relevant to environmental sustainability

the vision for advancing environmental sustainability both theoretically and experimentally

The workshop can promote discussion about how a particular field can advance sustainability and discuss strategies both conceptually and potentially in some detail related to experimentation.

the potential for seeding new metrics, approaches, and research ideas in environmental sustainability for a discipline within CISE.

Workshops are a good place to discuss and settle on appropriate metrics related to the discipline being discussed and how it can quantify impact on environmental sustainability

ICT is part of the climate crisis and sustainability is
We need decadal impact to reach stated

DESC: Q&A

- Make computing more sustainable with respect to broader range of environmental issues
- Grow an interdisciplinary community of researchers with long term impacts.
- We are seeking your project ideas and submissions to address the key challenges of DESC. Submit 1-page project ideas to desc@nsf.gov for feedback on suitability