Holistic Modular Energy-efficient Directed-cooling UC Solution (HoMEDUCS)- Cat B

COOLERCHIPS™

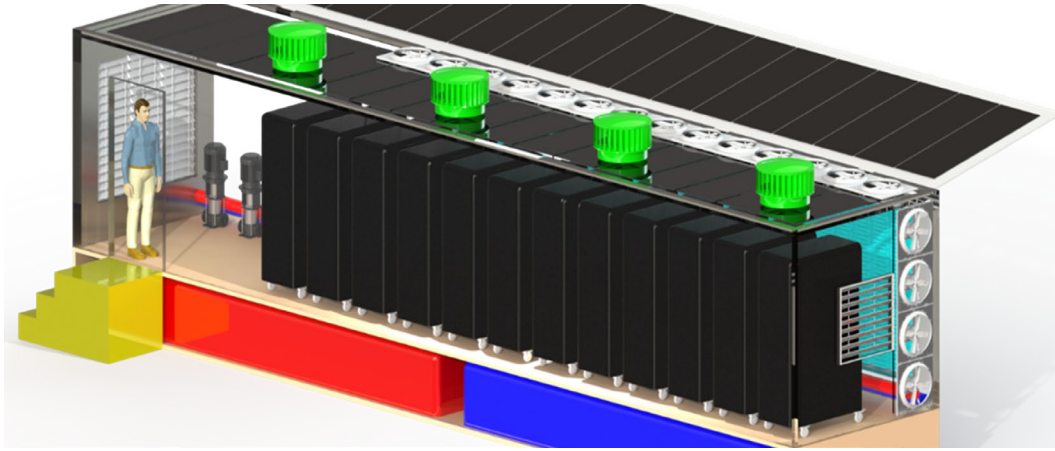
UC Davis (PI- V. Narayanan)

Team Members: U. Michigan, R&D Products, GEM containers, Siebold Systems, Eaton Electrical, Skycool, Creation Engineering

Project Vision

High efficiency, low-cost, robust, environmentally friendly, compact modular datacenter thermal management

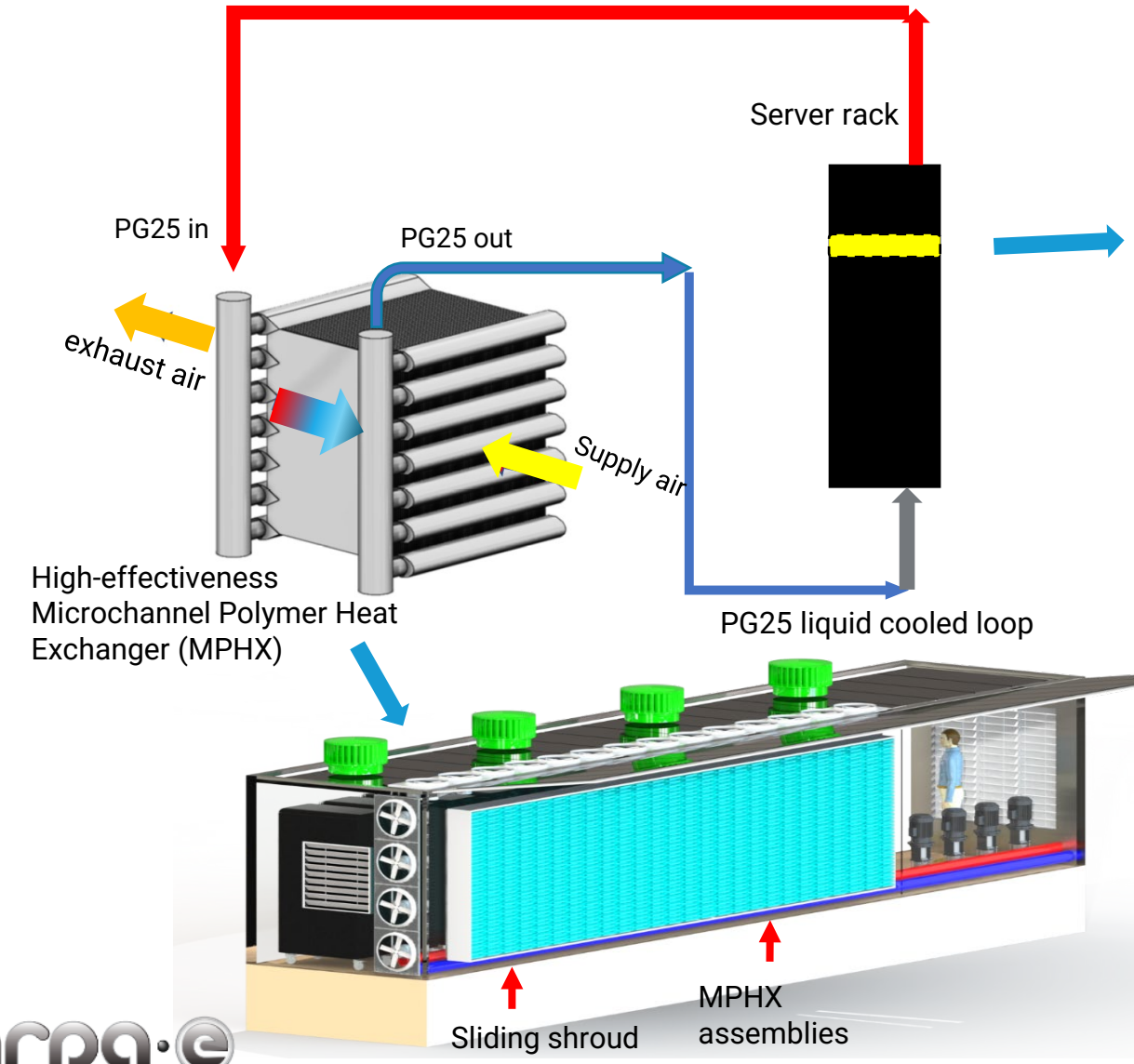
Combines innovations in heat extraction, dissipation, and radiative cooling with thermal storage

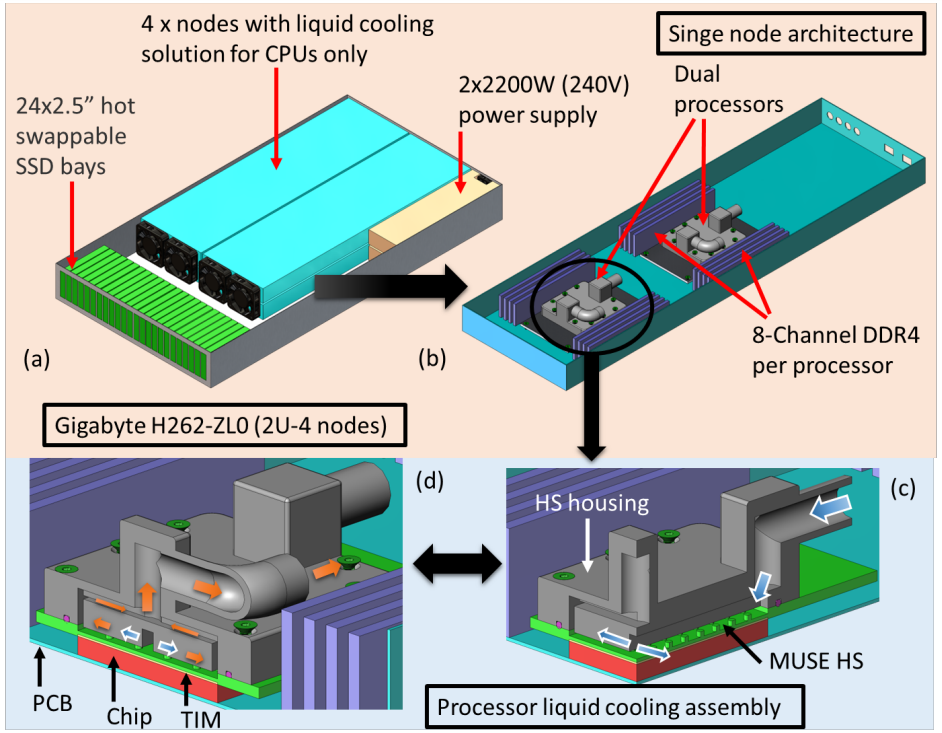


Total Project Cost:	$3.99 M
Length	36 mo.

COOLERCHIPS Kickoff Meeting
October 18 & 19, 2023

Concept Detail- Liquid loop





FOA Metrics	Units
Resistance Target	0.02 K/W (chip to coolant inlet)
Cooling Power % of IT power	5 %
System availability	99.982 %
Chipset	Intel Sapphire Rapids
Chip Power	350 W; TTVs – up to 1 kW
Power per server	2800 W per 2U (2 x 2U demo); 3kW per U modeling
Demonstration power mid project	> 4 kW

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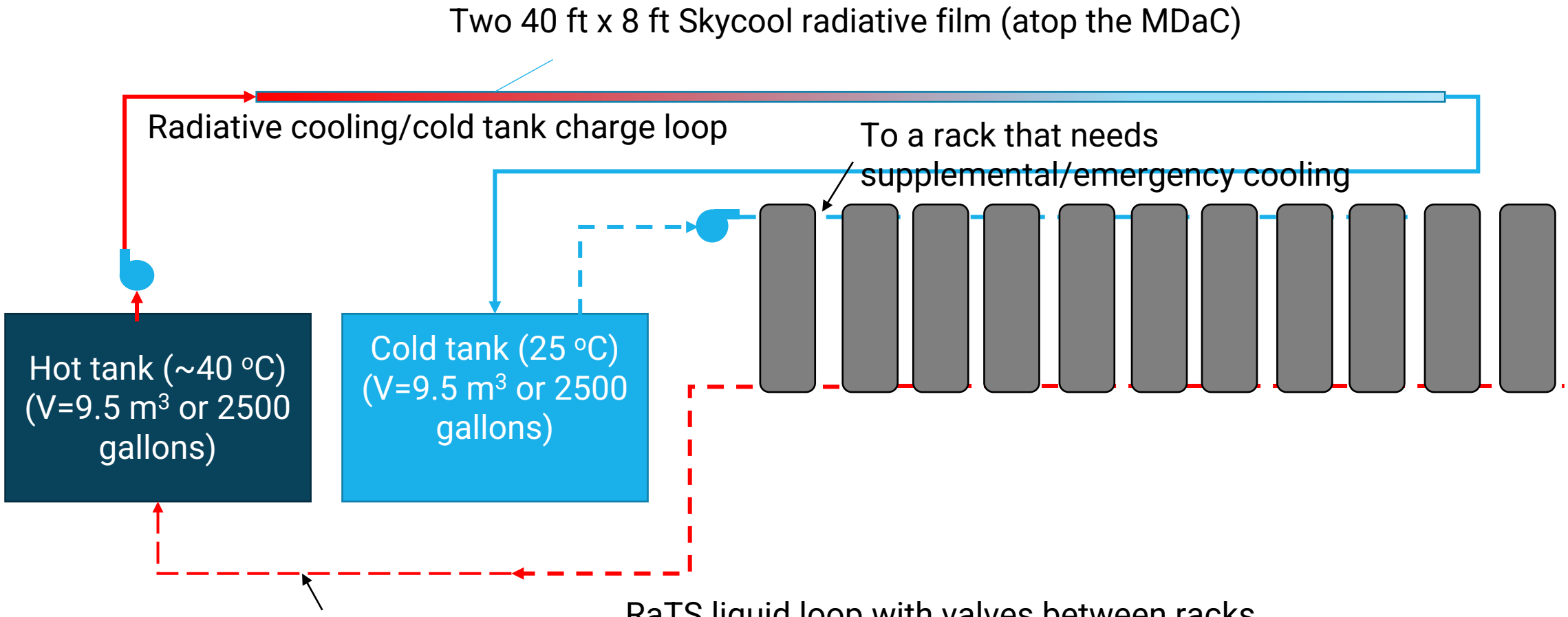
Concept Detail- Radiative Loop with Thermal Storage



Mode 1- Direct cooling through radiative panels coupled to heat exchangers located within the datacenter

Mode 2- with thermal storage- supplemental or emergency cooling to a rack from the cold tank (~1 hr)

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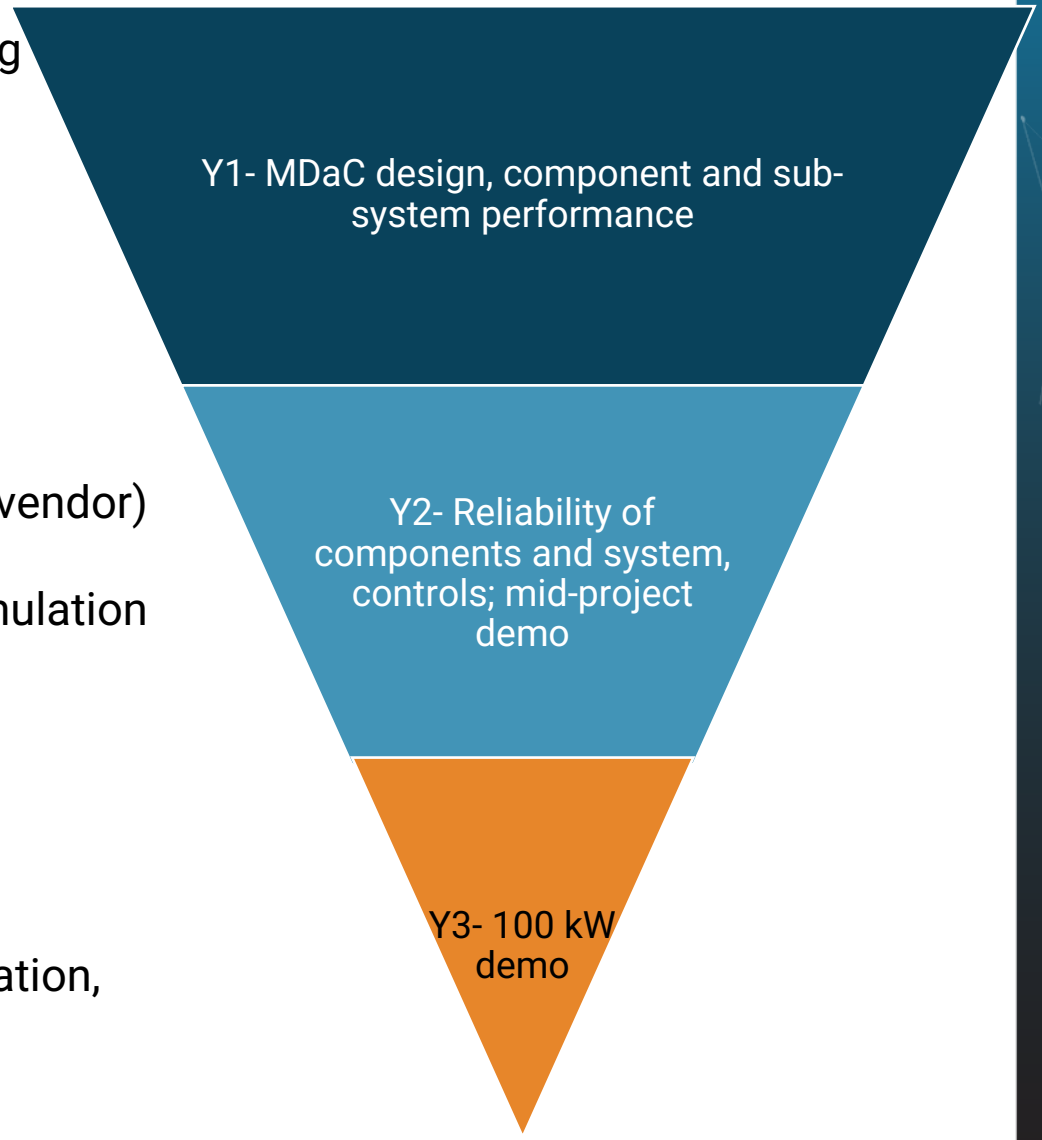
Task Outline & Technical Objectives

Twenty-one tasks with associated milestones broken into the following categories:

1. MDaC design (UCD, Siebold systems, GEM containers, Eaton, AAF Flanders)
2. Server + silicon level design (UCD, Intel, Creation Eng., UCD HPC, Advanced HPC, others)
3. Component fabrication- polymer HX (R&D Products, UCD, welding vendor)
4. Cooling system and component level design and performance simulation (UCD, Skycoool, S. H. Bhavnani, others)
5. Controls and Reliability (UCD, M. Muhlheim, Cat C partner)
6. Techno-economic cost modeling and T2M (UCD, Michigan)
7. Component, sub-scale system and MDaC 100 kW demo (UCD, Creation, UCD HPC, R&D Products, other vendors)



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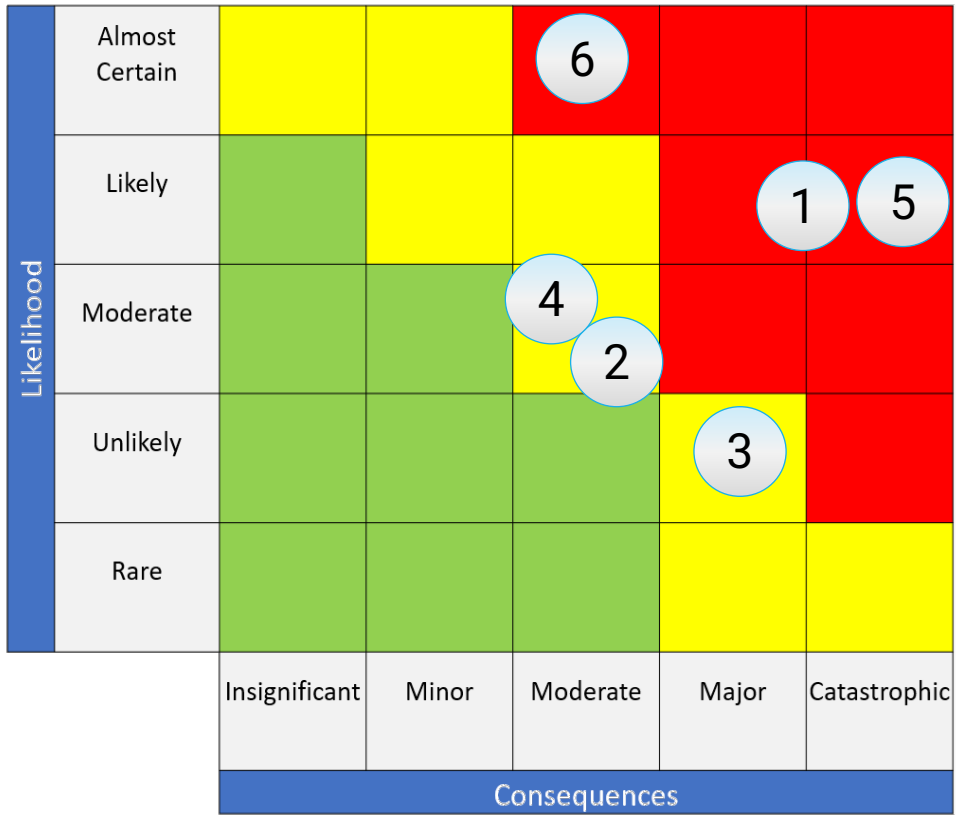
Challenges and Risks



Risk Status

Risk	#
MPHX- ABS does not result in robust modules at the required temperature of heat dissipation	1
MUSE heat sink performance is not significantly better than state-of-the-art	2
Technology may become obsolete in a few years	3
Unfamiliarity with performance and/or sizing proposed new technologies (MPHX, DiAC, RaDiACS loop)	4
Lower availability than current technologies	5
Early adopters question the techno-economic analysis and the rapid payback periods that preliminary analyses show	6

Technology-to-Market Approach

- *IP/Licensing*
  - IP on component level technology; license technology to interested parties starting with our partners
- *Anticipated first markets*
  - Universities starting with UC Davis, potentially leading to other University interest within UC system and beyond; National Laboratories

Needs and Potential Partnerships

- Advisory board members
- Reliability modeling (Cat C partner)
- Collaboration on regulatory analysis? (all Cat B teams)
- Potential stakeholders for market research Questions: Pros/cons of edge computing; Best use cases for edge computing; What would make edge computing more attractive?
  - Stakeholder groups of interest
    - Users (e.g., National Labs, universities, large companies)
    - Data center manufacturers
    - Data center operators
    - Standards and testing entities
- Cat A teams- potential for integration of your technologies

Q & A

https://arpa-e.energy.gov