

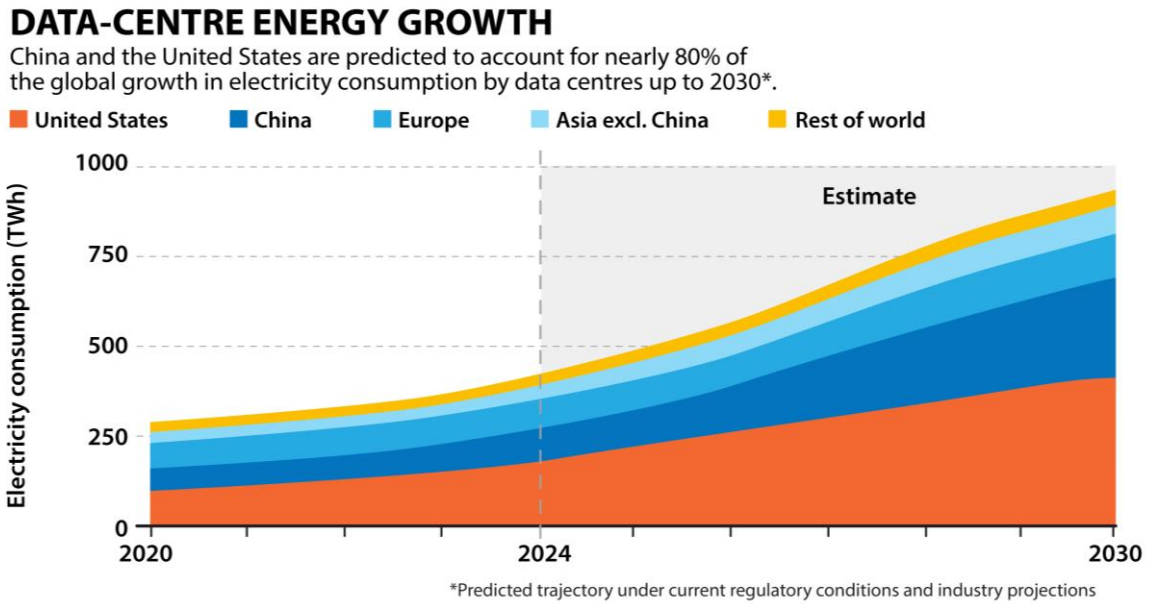
# Data Center Immersion Fluids (DCIF) Consortium

Mr. Peter Morgan

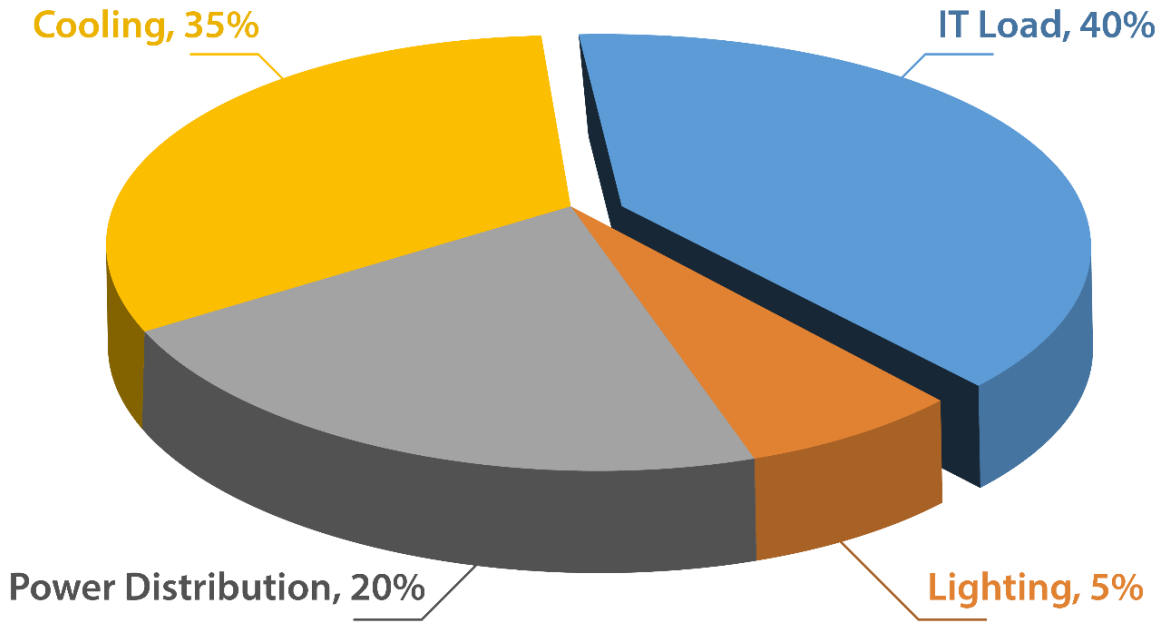
Sr. Program Manager, Southwest Research Institute (SwRI)

# Data Center Cooling - Overview

- 35-50% of power consumed goes to cooling
- Power consumption expected to surge 12% by 2028




IEA (2025), *Data centre electricity consumption by region, Base Case, 2020-2030*, IEA, Paris. https://www.iea.org/data-and-statistics/charts/data-centre-electricity-consumption-by-region-base-case-2020-2030. Licence: CC BY 4.0



# The Evolution of Data Center Cooling

**Air Cooling**

**Up to ~60kW/rack**

Fans, CRAH/CRAC, etc…



**Indirect Liquid Cooling**

**~50 – 100 kW/rack**

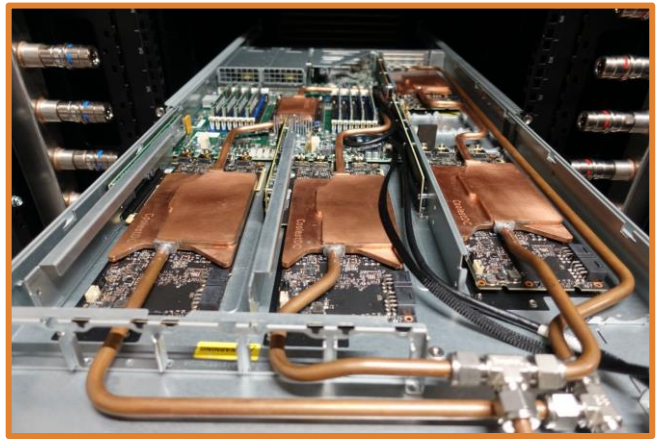
Rear Door Heat Exchanger



**Direct Liquid Cooling**

**Up to ~200kW/rack**

Cold Plate



**>200kW/rack**

Immersion Cooling



As power densities continue to increase, data centers are moving toward direct liquid cooling technologies, including immersion cooling, where standardized qualification methods are still emerging.

THE CHALLENGE

# Industry Lacks Standard Qualification Methods

**There is no standardized approach for evaluating:**

- **Signal Integrity**
- **Material Compatibility**
- **Safety**
- **Aging**
- **Heat Transfer**

# Data Center Fluids Understanding

- Market is quickly growing and changing to increase performance and efficiency – optimized hardware design hasn't been realized
- Current hardware is designed for air environments to cool equipment which is much less effective
- By advancing the understanding of the stressors on immersion fluids—thermal, chemical, environmental, and mechanical—the industry can develop more robust and efficient solutions that meet the ever-increasing demands of modern IT infrastructure
- The industry is in need of an independent test house which is aligned with OCP, which can facilitate unified industry-wide material compatibility and reliability testing for immersion cooling.

# Southwest Research Institute (SwRI)

- $950M+ annual research volume
- 3,000+ staff members
- 1,500-acre state-of-the-art campus
- 75+ years of independent, multi-disciplinary R&D
- 100% independent, non-profit organization



WHY SWRI?

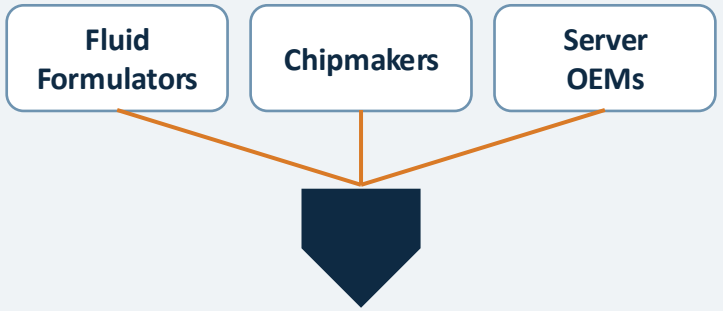
# An Independent, Trusted Convener

### PROVEN CONSORTIUM MODEL

**40+ Years**

Managing complex, multi-million dollar joint industry programs.

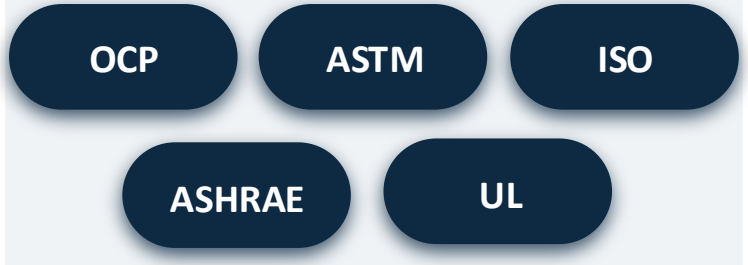
### SAFE & NEUTRAL GROUND




**SwRI IP FIREWALL**

Where fierce market competitors safely pool funds to solve mutual, pre-competitive bottlenecks.

### STANDARDIZATION AUTHORITY




Decades of experience developing foundational test methods that become global industry benchmarks.

# Consortium Goal

- To advance the industry's understanding of the unique stressors placed on IT equipment in immersion environment and enable the development and optimization of immersion technology
  - Develop way to measure and assess these stressors (standard test methods)

- Establish SwRI as the central, OCP-aligned independent test facility

# Value Across the Immersion Cooling Ecosystem

| | |
|---|---|
| **Semiconductor / IT Platform** | Signal integrity, hardware reliability, qualification methods |
| **Server OEM / ODM** | Hardware validation, compatibility, standardized testing |
| **Fluid Companies** | Fluid qualification, aging, benchmarking, independent validation |
| **Cooling Infrastructure** | Thermal performance, system optimization, test methods |
| **Immersion OEMs** | Independent validation, interoperability, customer confidence |
| **Hyperscalers** | Reduced deployment risk, influence research, procurement support |
| **Colocation** | Best practices, independent data, lower operational risk |

# Technical Research

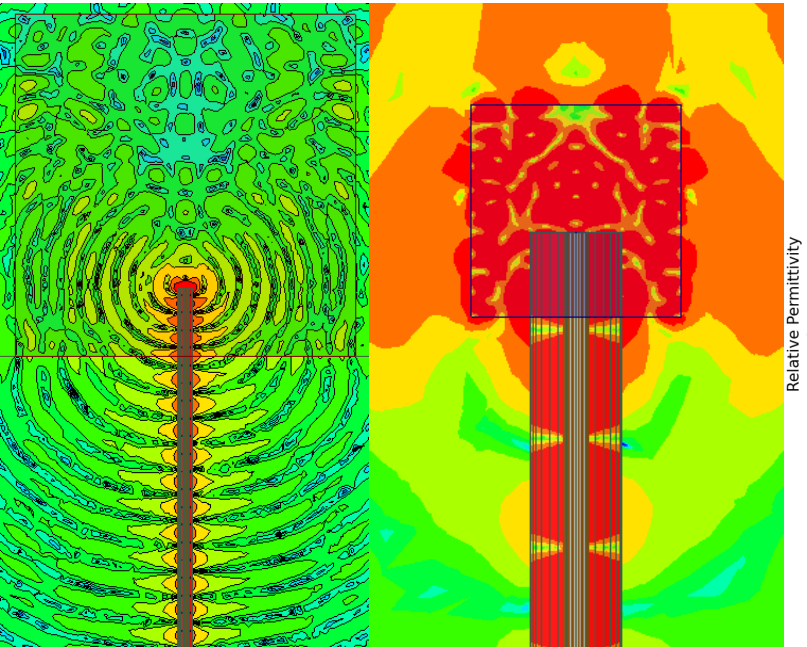
| | Signal Integrity | Material Compatibility | Safety | Aging | Heat Transfer |
|---|---|---|---|---|---|
| Semiconductor / IT Platform | X | X | | | X |
| Server OEM / ODM | X | X | X | X | X |
| Fluid Companies | X | X | X | X | X |
| Cooling Infrastructure | | | X | | X |
| Immersion OEMs | X | X | X | X | X |
| Hyperscalers | X | X | X | X | X |
| Colocation | | X | X | X | X |

- **Member-Driven Work Scope - Research topics would be based on member input**

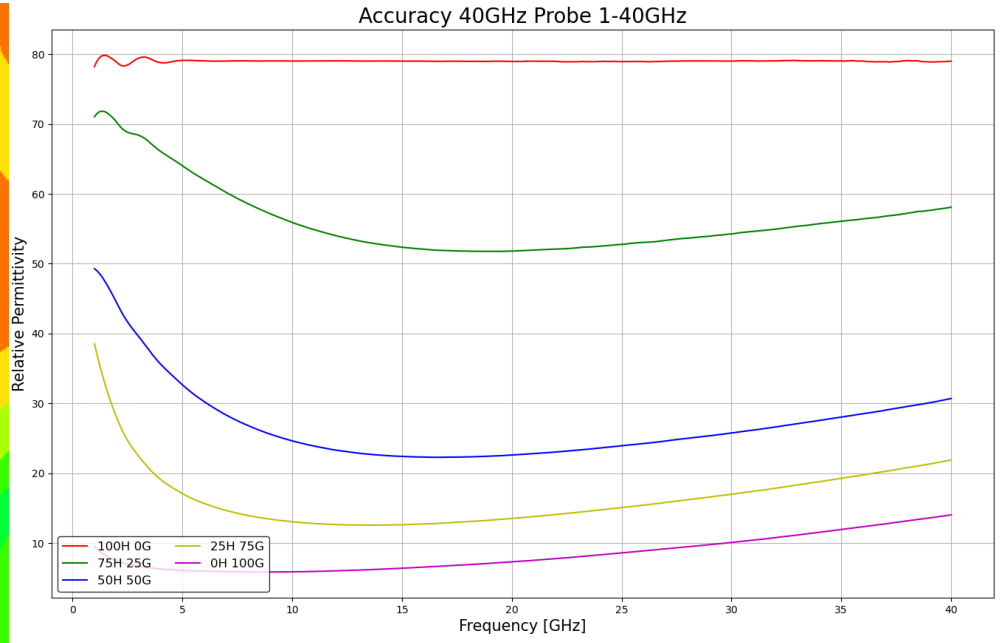
SwRI-Internally Funded

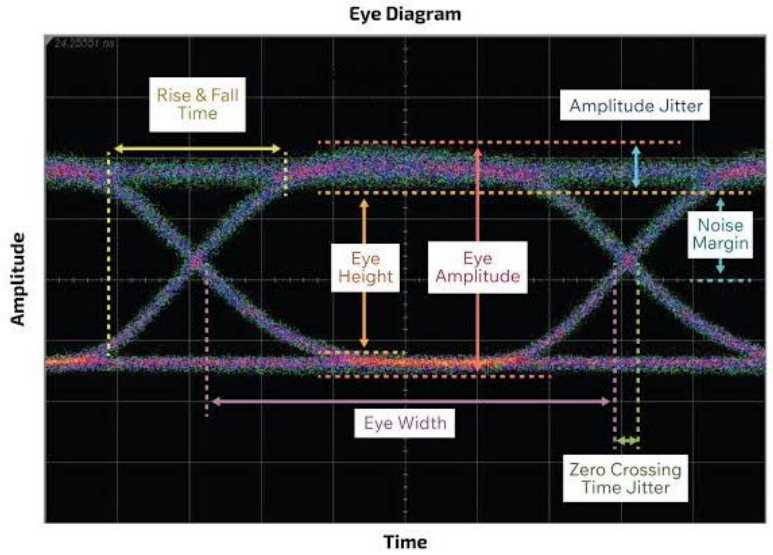
# Signal Integrity

- Evaluating dielectric properties of data center immersion coolants at frequencies approaching 40GHz.
- Use measured properties to understand how immersion fluids may affect RF and high-speed electrical performance (Eye Diagrams).
- Combine dielectric and signal integrity measurements to better characterize coolants suitability for high frequency electronics.







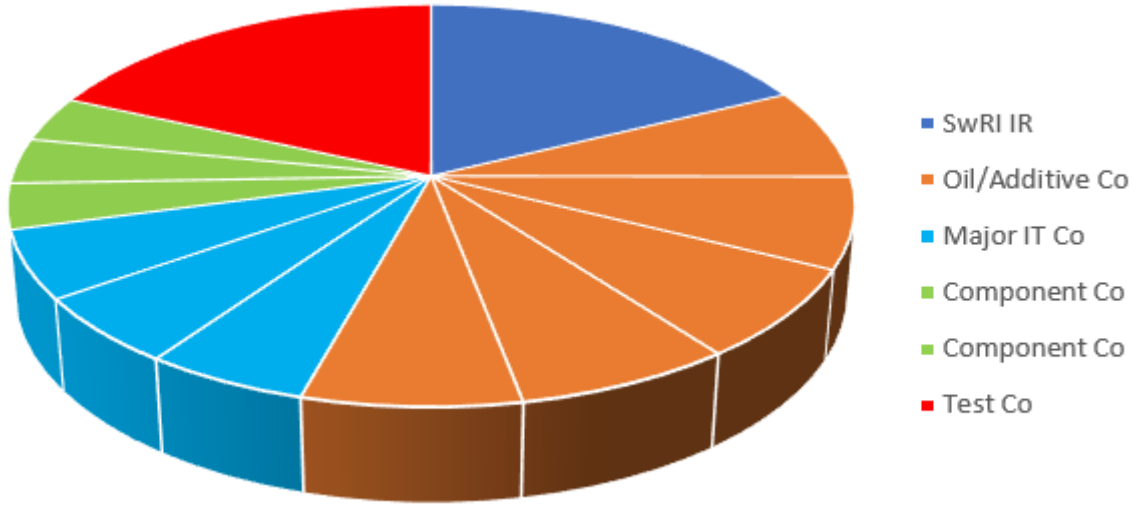
# Open Compute Project (OCP) Potential Involvement

- 30% funded research would be dedicated to OCP community topics
  - Facilitation of industry standards
  - Resolving major industry challenges for immersion cooling
  - Independent location for OCP related lab research
  - Participation in relevant project activities by SwRI
  - OCP Immersion Project Steering Committee would consult with SwRI
    - OCP would not receive a vote
    - OCP would not be able to share or publish information unless approved through the normal IP terms
  - Research topics proposed by OCP and voted by members, as slated for publication
    - Member voting will take place before initiation of OCP-proposed research topics
    - Publications will be anonymized and will exclude any member-provide IP

# Research Budget

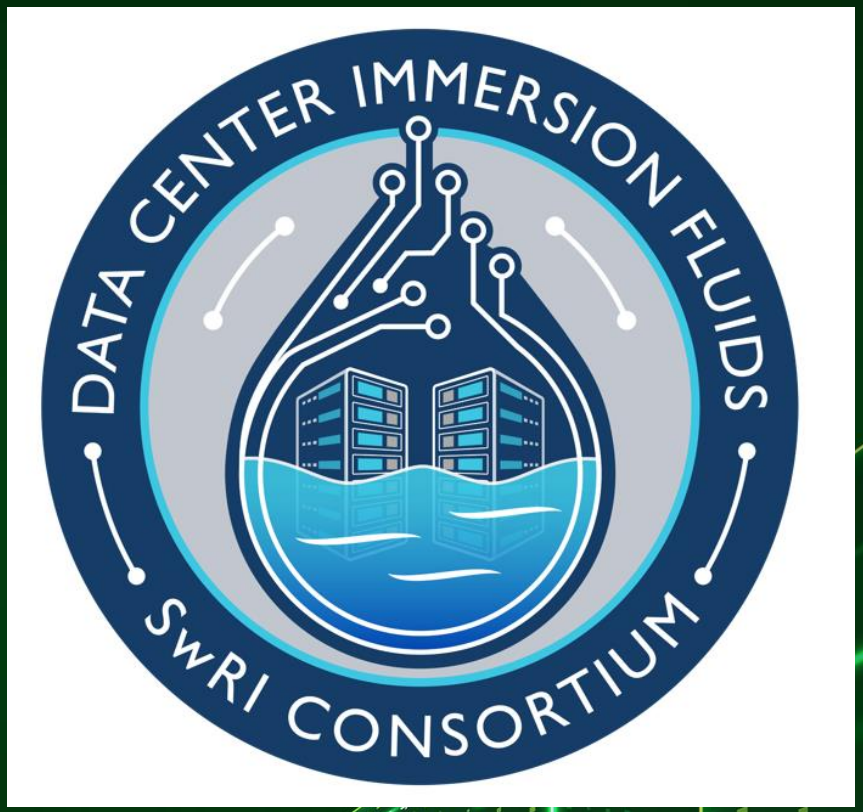
- 4-year consortium
- $1.0 M annual budget needed to start
  - ~10 x ROI for Oil/Additive
  - ~13 x ROI for Major IT
  - ~20 x ROI for Component
- SwRI-Funded Internal Research
  - $1.5 M to date
  - More proposed

| Type | Price/year |
|---|---|
| Oil, Additive Companies | $100,000 |
| Major IT Companies | $75,000 |
| Component Companies | $50,000 |
| Testing Company | $250,000 |



# Call for Action

- Join the membership
  - Facilitation of industry standards
  - Resolving major industry challenges for immersion cooling
  - Independent location for OCP related lab research




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