Chemours™

Opteon™

Enabling Next Generation Data Centers with Two-Phase Immersion Cooling

January 2025

Chemours at a Glance

Founded
2015

Sales
$6.0 Billion in 2023

Employees
6,200 (~5,000 in manufacturing)

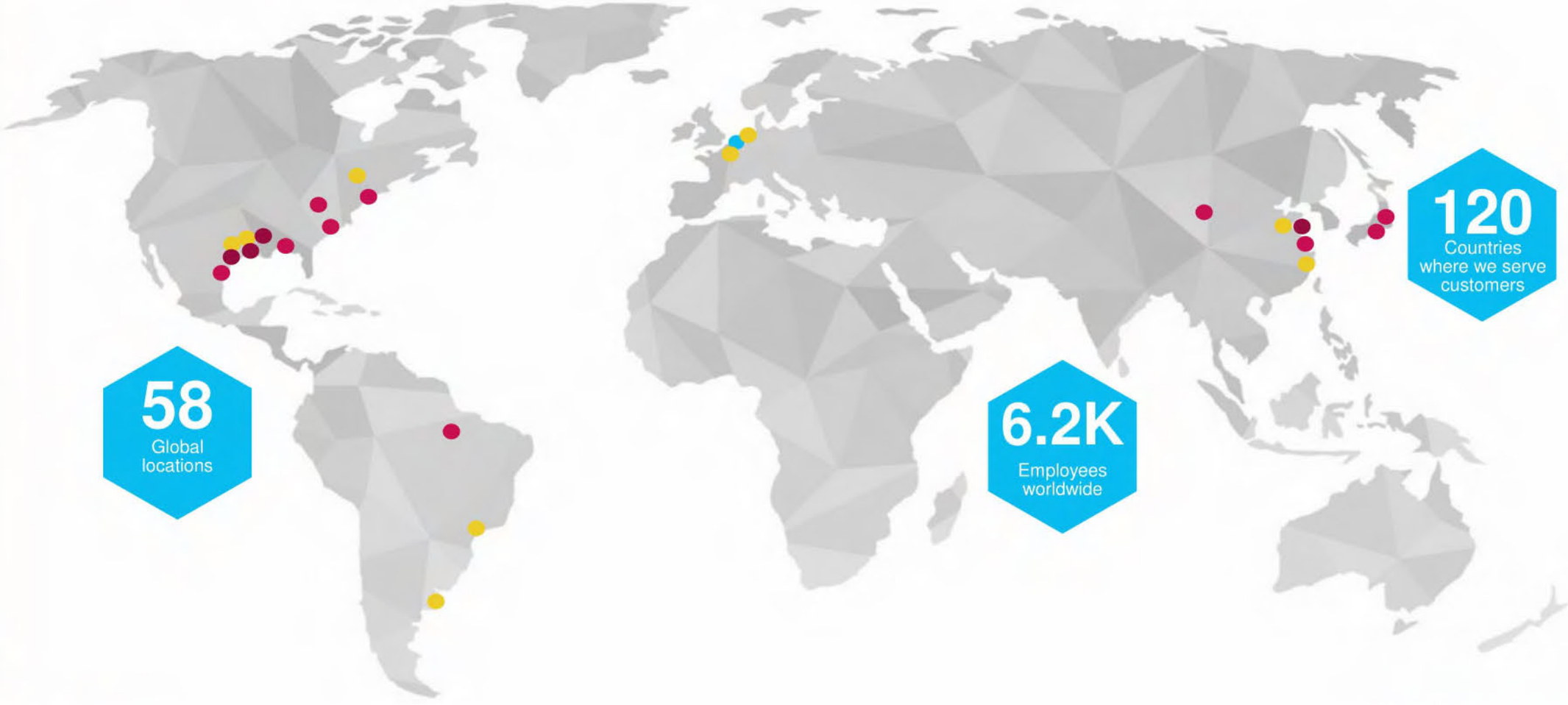
HQs
Delaware

NYSE
CC

Opteon™

Chemours™

Chemours Global Reach



Opteon™

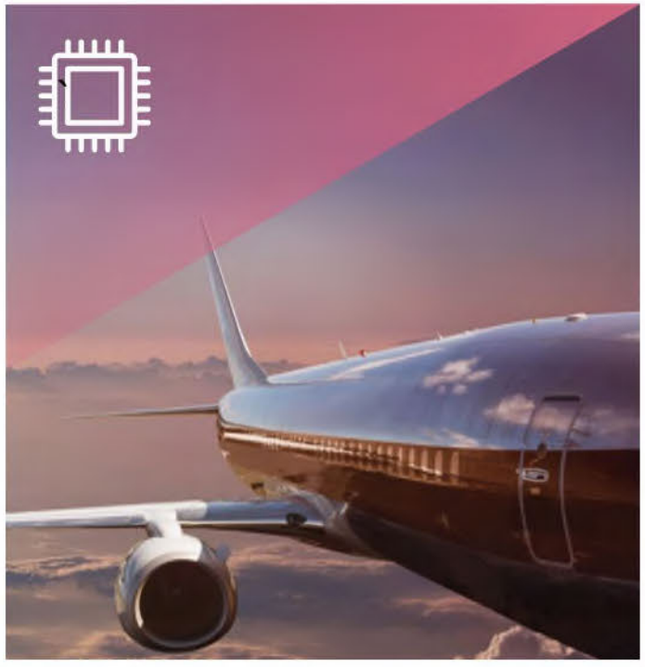
Chemours™

Our Businesses

THERMAL & SPECIALIZED SOLUTIONS

TITANIUM TECHNOLOGIES

ADVANCED PERFORMANCE MATERIALS



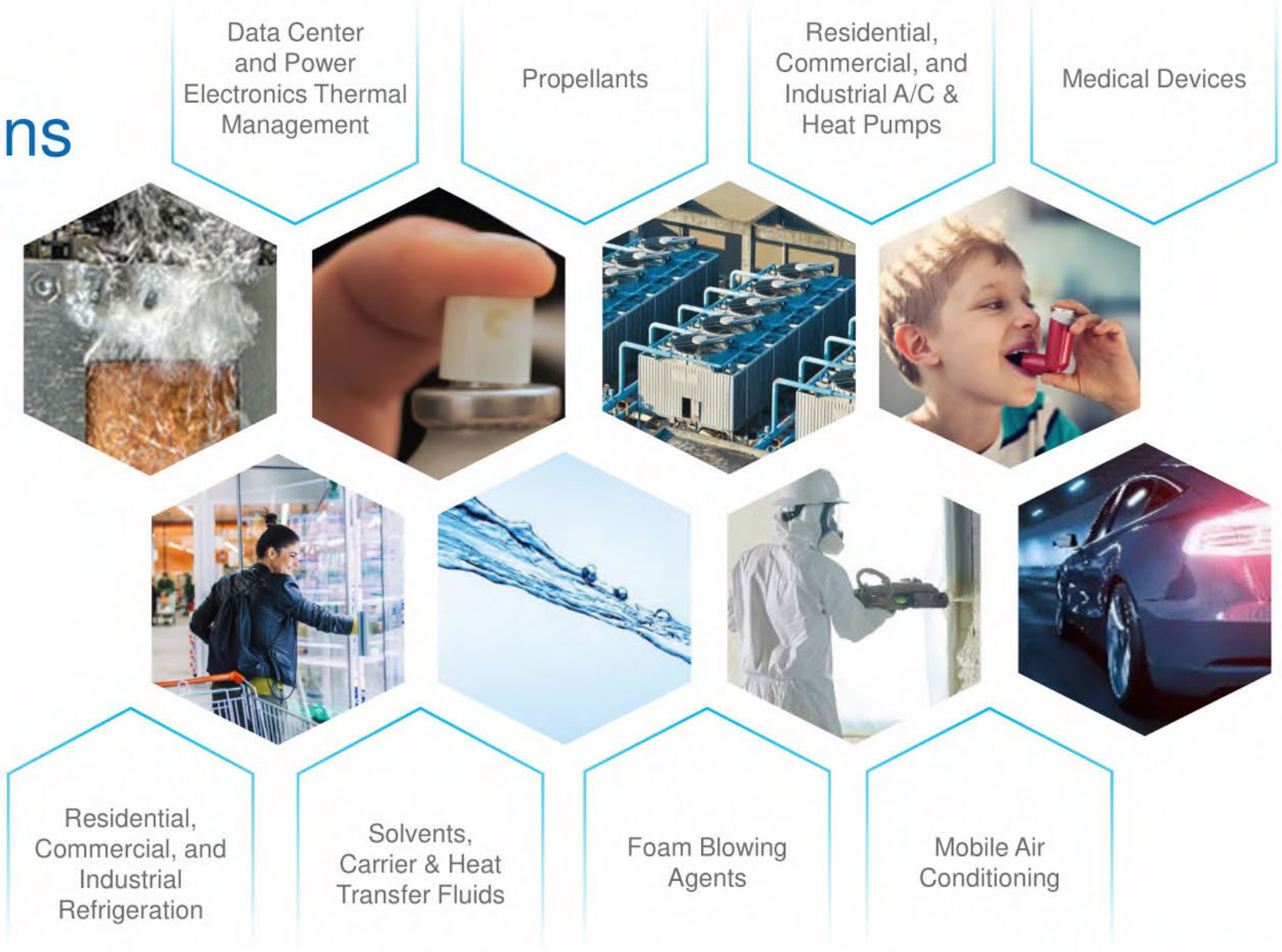
Opteon™

Chemours™

Thermal and Specialized Solutions Target Applications

Freon™

Opteon™



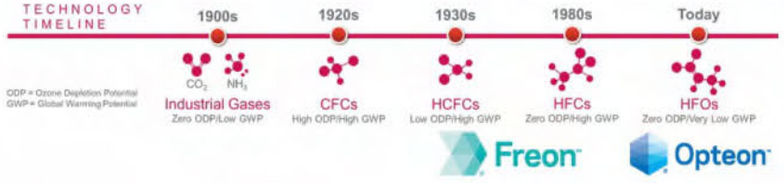
Opteon™

Chemours™

Thermal & Specialized Solutions

A Legacy of Innovation

90 Years of Innovation in Thermal Management



HFO adoption cadence

EU Mobile Air Conditioning → US Mobile Air Conditioning → EU Stationary Refrigeration → US Stationary Refrigeration

Your Partner for Today and Tomorrow

Leadership with New Fluid Technologies

Category leadership in next-generation technology

- Co-developed HFO technology
- Advantaged process technology at Corpus Christi facility
- Robust international patent portfolio; no single patent will significantly affect our market position

Experience bringing new HFO fluids to market

- Opteon™ YF for air conditioning (2012), GWP < 1 (AR5)
- Opteon™ MZ for foams, chillers (2018), GWP = 2 (AR5)
- Opteon™ ME for foams, other apps (2021), GWP = 7 (AR5)
- Opteon™ 2P50 for 2P Immersion (2023), GWP= 10 (AR6)

Opteon

Chemours

Chemours Discovery Hub – Innovation Center

- New 312,000 sq ft R&D facility hosting 180+ labs including joint development programs with the academic, private, and government sectors
- Located adjacent to the campus of University of Delaware for excellent industry/academic partnerships
- Integrated for Chemistry and Materials expertise
- Watch 'Welcome to The Chemours Discovery Hub' | Microsoft Stream

Opteon™

Chemours™

Chemours – DOE Examples of Ongoing Collaborations

- **Data Centers Cooling:**
  - CRADA with ORNL: Ultra-Low GWP Refrigerants to Reduce Carbon Footprint in Data Centers
  - Supply ARPA-E CoolerChips projects with fluids for evaluation in Data Centers cooling
    - Intel (Purdue and ACT): Enabling Two-Phase Immersion Cooling to Support High TDP
    - UTA (UMD and IIT): Holistic Co-Design of Novel Hybrid Cooling Technology for the Data Center of the Future
- **Air Conditioning and Heat Pumps:**
  - Sub in DE-FOA-0002804 Ultra-high Temperature Cascade Industrial Heat Pump For Waste Heat Recovery
  - Supply fluid to DE-FOA-0002804: Holistic Optimization of a High Temperature Heat Pump System with Internally Cooled Screw Compressors
- **Fuel Cells and Water Electrolysis**
  - Prim in DE-FOA-0002922: “Durable, High-Performance Membranes for Proton Exchange Membrane Water Electrolysis” - Development of next generation water electrolyzer membranes
  - Sub in DE-FOA-0002922: ”H2CIRC: Circular Recycling for the Hydrogen Economy” - Development and pilot demonstration of recycling technologies for fluoropolymers and platinum group metals in the hydrogen economy

Opteon™

Chemours™

Data Center Challenges

Opteon™

Chemours™

Solving the Data Center Energy & Water Crisis

Liquid cooling represents one of the most significant technological advancements for the cooling of electronics to date

Data Center Challenges

By 2026, traditional air-cooled systems will no longer be able to meet the cooling needs of most next-generation high-performance computing chips

Contribution to global energy consumption is expected to increase from 1% to 3%-4% by 2030

Energy efficiency improvements will reduce from 16% /yr. to 2% /yr. with commercial technologies

Data Centers consume billions of gallons of fresh water per year specifically for IT cooling

Next generation computing technologies cannot be cooled by traditional AC systems

Global land usage for data centers is expected to increase from 43MM^{2} to 64MM^{2} by 2030

Opteon™

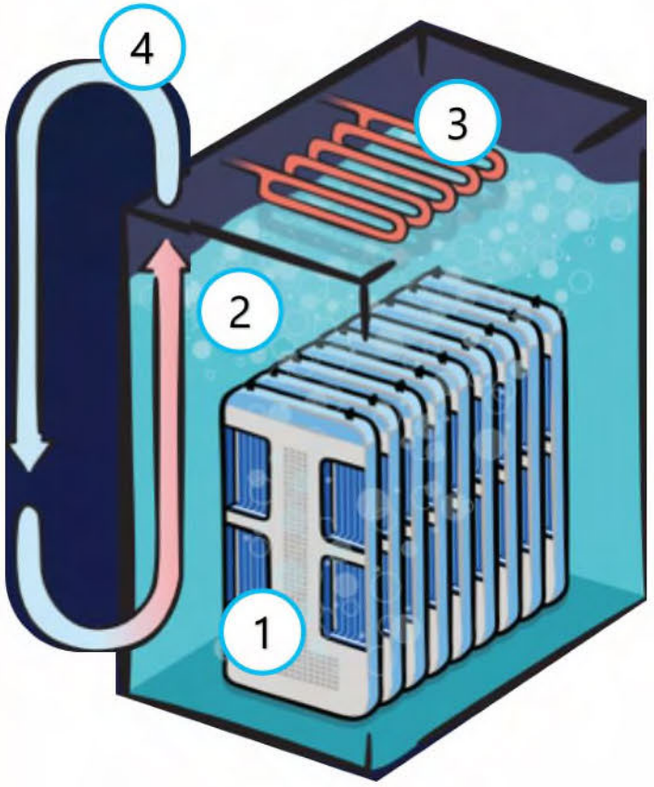
Chemours™

What Is Two-Phase Immersion Cooling

Opteon™

Chemours™

Two-Phase Immersion Cooling (2-PIC) in Data Centers



How 2-PIC works

1. Electronic equipment is placed inside a sealed tank files with Opteon™ dielectric fluid
2. The heat from the electronic equipment causes the fluid (thanks to its deal boiling point) to boil
3. Vapor rises and condenses back to a liquid when it makes contact with the condenser coils
4. The fluid returns to the pool

Advancing next-generation computing speeds

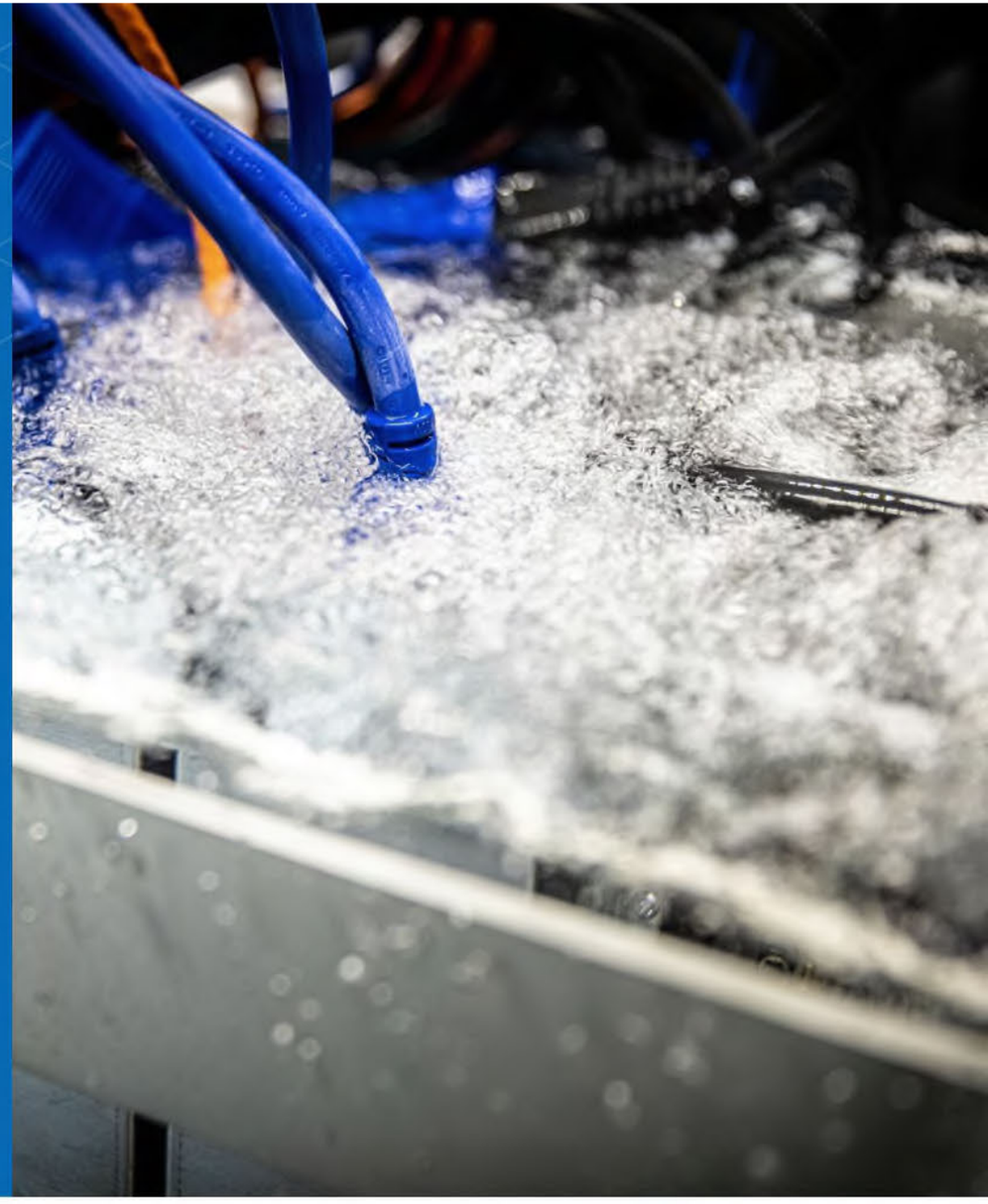
Competing cooling technologies simply lack the necessary heat-transfer capabilities required to enable high-powered computing and ever-faster processing speeds

Opteon™

Check out our explainer video

Chemours™

Opteon™ 2P50 Overview



Opteon

Chemours

Opteon™ 2P50 Applications

Two-Phase Immersion Cooling for Data Centers

Two-Phase Direct to Chip Cooling

Power Electronics Immersion Cooling

Battery Cooling

Heat Transfer Fluid for High Temperature Process Cooling

Opteon™

Chemours™

Data Center Cooling Architecture Score Card

	Power per Rack Limit	High-power Chips	Energy Efficiency	Total Cost of Ownership	Ease Maintenance	Fire Hazard	Regulations	Weight
Air Cooled (Freon™ R-410A, Opteon™ R-454B)	Up to 20 kW							
Single Phase Direct-to-chip (Water/Glycol)	50-125 kW							
Two Phase Direct to Chip (Opteon™ SF33)	Up to 175 kW							
Single Phase Immersion (Hydracarbons)	Up to 110 kW							
Two Phase Immersion (Opteon™ 2P50)	500 kW+							

Best Better Poor

- Chemours currently has products being utilized in 3 of 5 of the architectures being used today or considered for tomorrow
- While all next generation architectures share a common value proposition for reducing energy, water, and space; limitations are present with longevity and the maximum thermal Design Power (TDP) that can be achieved
- Two-phase immersion cooling represents the best opportunity to have a lower cost architecture with greater value and capability than alternative architectures

Opteon™

Chemours™

2 Phase Immersion Cooling Advantages

Two Phase Immersion Cooling when compared to air cooling in data centers can generate up to[1]

40%

Lower Energy Consumption per MW

Near Zero

Water consumption vs. 8.23 MGal per year

60%

Reduction in Data Centers footprint

35%

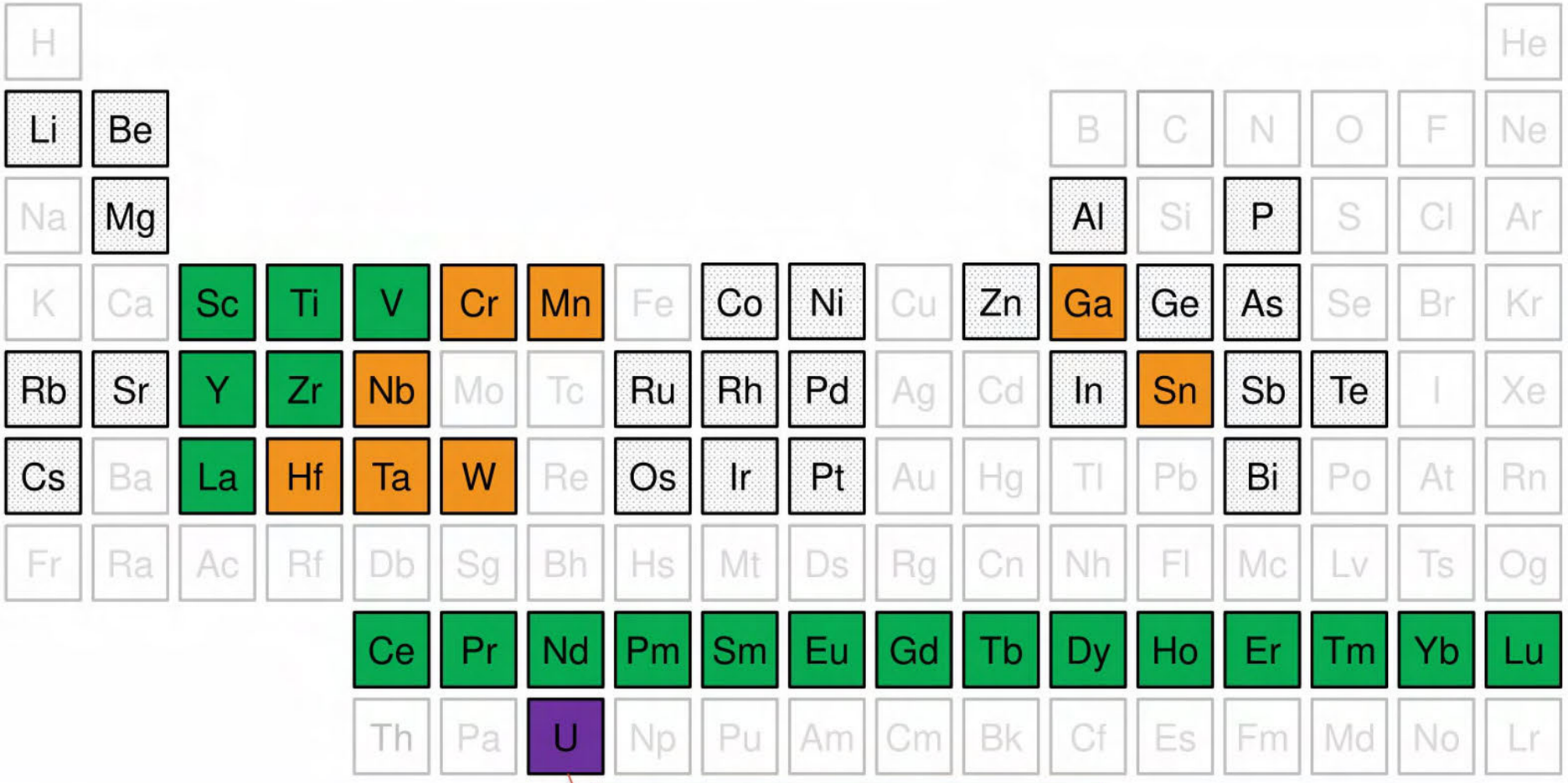
Lower Construction Cost ($/MW)

Opteon™

https://liquidstack.com/content/uploads/2022/05/2022-Case-Study.pdf

Chemours™

Critical Minerals at Chemours



Non-critical elements

USGS Critical Minerals

Chemours current targets 1 2 3

Chemours future targets 2

Not considered

Uranium is Contained within Chemours' Monazite which is utilized by Energy Fuels 1 3

Chemours CBI

Chemours™ COURAGEOUS CHEMISTRY™