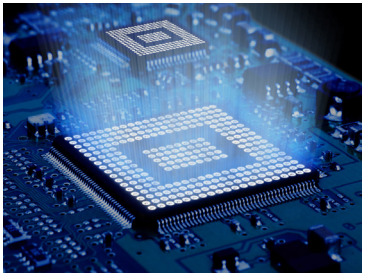
TAKING THE HEAT OUT OF DATA CENTRE COOLING

EXUVIA



Increases in server performance, combined with pressure to reduce the environmental impact of the digital infrastructure industry, has prompted a re-evaluation of both cooling, and the power equation.

Clearly the data centre market needs a step-change, and single and dual-phase immersion cooling can help facilitate a desired shift from the current inefficient model of traditional air-cooling.

However, a number of myths have proliferated concerning these emerging technologies. Drawing on our direct experience of integrating and deploying single and dual-phase immersion cooling within hybrid, heat-exchanger based data centre solutions - this document sets out to dispel some of those myths.

Myth 1: Immersion cooling is expensive to deploy

× While there might be a 20% uplift on tank / rack CapEx, this is offset against other build cost savings:

- ✓ No false floors or ceilings required.
- ✓ No CRAC units required.
- ✓ Pipework and related components are both reduced and simplified.
- ✓ Less gas is required for fire suppression which can be installed directly to racks.
- ✓ IT boards are simpler.

In fact, improved efficiencies offer a 40+% *reduction* in OpEx spending.

Introducing immersion technology does not mean completely replacing existing equipment. Legacy IT can be retained and deployed alongside on-chip technology within heat-exchanger based racks.

Myth 2: No IT-manufacturer support

- ✕ Server / component manufacturers are adopting immersion cooling standards.
- ✕ Manufacturers are recognising the need for support:
  - ✓ Dell
  - ✓ Gigabyte
  - ✓ Lenovo
  - ✓ Supermicro
  - ✓ HP

Myth 3: Operational risks

- ✕ Concerns about leaks or the corrosion of IT can be mitigated in a number of ways:
  - ✓ Risk prevention is built in via leak detection, active monitoring systems, and alarm states.
  - ✓ IT is unaffected due to the improvements within the fluids used.
- ✕ Concerns about Health & Safety can be mitigated by the incorporation of standardised safe working practices when working on immersed equipment.
- ✕ Assumptions that immersion-based technologies are difficult to operate are incorrect:
  - ✓ It simply requires a methodical way of working.
  - ✓ No standard server maintenance is required, therefore simplifying operational requirements.

Myth 4: Immersed cooling can simply 'plug & play'

- ✕ Immersed cooling options require correct mechanical and electrical infrastructure in place. However:
  - ✓ They can be configured to pre-existing equipment.
  - ✓ Solutions can be standalone or integrated with other heat-exchanger based cooling technologies.

Deployment of single and dual-phase immersion cooling creates new opportunities for data centre operators and, with greater synergy occurring between the data centre and *IT infrastructure,* this enables greater flexibility.

For example:

Deployment of cascaded cooling enables the integration of otherwise disparate cooling technologies:

- ✓ In-row
- ✓ Rear doors
- ✓ On-chip
- ✓ Immersed (single and dual-phase).

Solutions can be matched to individual client requirements, be these standard applications or high-performance compute (HPC).

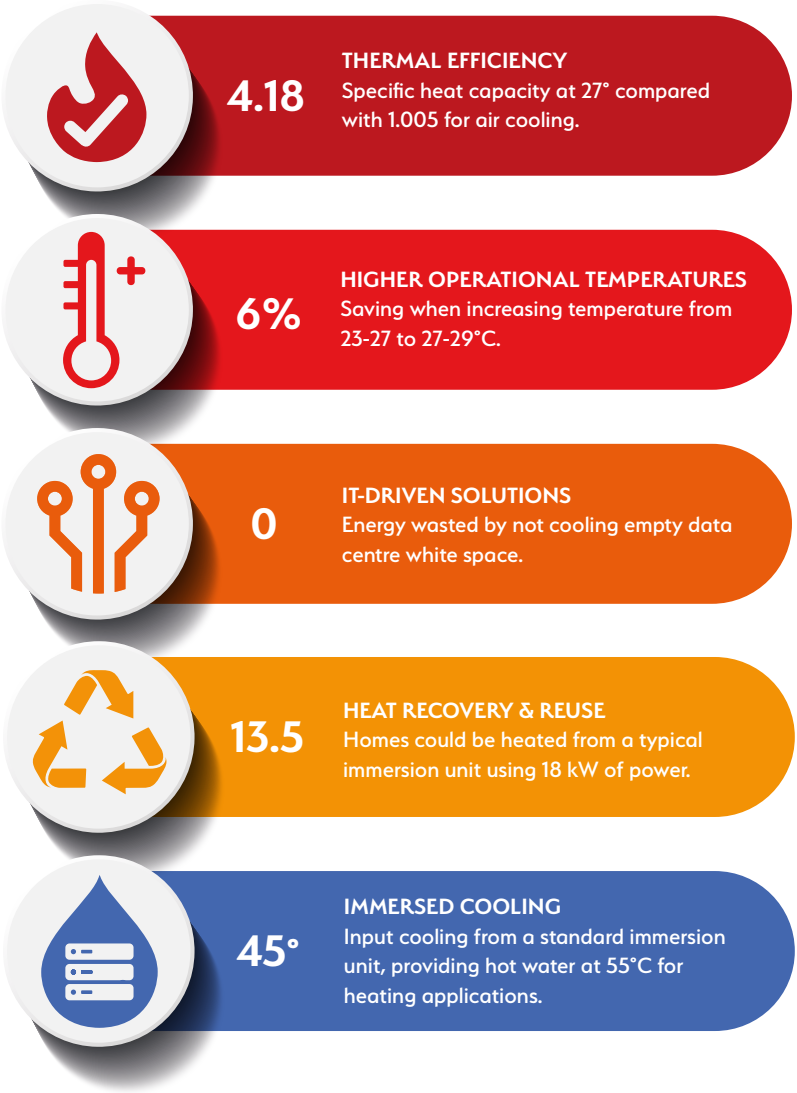
With application layer monitoring integral to the data centre solution, operators are given greater flexibility and control of the data centre environment. This enables:

- ✓ Feedback for throttling back CPU loads if required.
- ✓ Active monitoring.
- ✓ Remote management from outside the data centre.
- ✓ Load utilisation to enhance energy saving.
- ✓ Potential integration with data science applications for predictive loads – highlighting potential hardware failure before it happens.

Cascaded thermal cooling can be integrated with external environmental factors:

- ✓ Overnight, there is increased cascading facilitated by the drop in external temperature. Therefore the cooling runs more slowly.
- ✓ During the day, warmer external temperatures mean that the chains can be decreased.

The graphic below highlights some of the OpEx savings that can be made via the integration of heat exchanger-based cooling. Data for heat recovery and single phase immersion are based on a typical 25-50kW tank.



Detailed below are some of the savings that can be made if deploying an exclusively single phase solution.

15%

REDUCED FLOOR SPACE
Average reduction in space required to accommodate immersed units.

4%

NO FALSE FLOORS / CEILINGS
Average reduction in build costs; reduced fire risk.

4%

NO CRAC UNITS
Average reduction in cost, as well as reduced data hall space required.

10%

REDUCED & SIMPLIFIED PIPEWORK
Average reduction in pipe lengths and components required

80%

REDUCED FIRE SUPPRESSION
Average reduction in gas required due to simplified and direct-to-source fire suppression.

25%

REDUCED M&E OVERHEADS
Average reduction in M&E required to efficiencies against IT load.

Immersion cooling presents an opportunity for the digital infrastructure industry to commit to reducing its environmental footprint.

It is increasingly recognised that PUE is an outdated and misused metric that is misleading in reflecting data centres' true energy usage.

The time has come to adopt a measurement that models the energy matrix more genuinely.

The Green Grid proposes the following:

PUE (Power Usage Effectiveness)
'Perfect' PUE= 1.00 → $PUE = \frac{\text{Total energy}}{\text{IT energy}}$

ERF (Energy Reuse Factor)
'Perfect" ERF = 100% → $ERF = \frac{\text{Reuse energy}}{\text{Total energy}}$

ERE (Energy Reuse Effectiveness) → $ERE = (1 - ERF) \times PUE$