

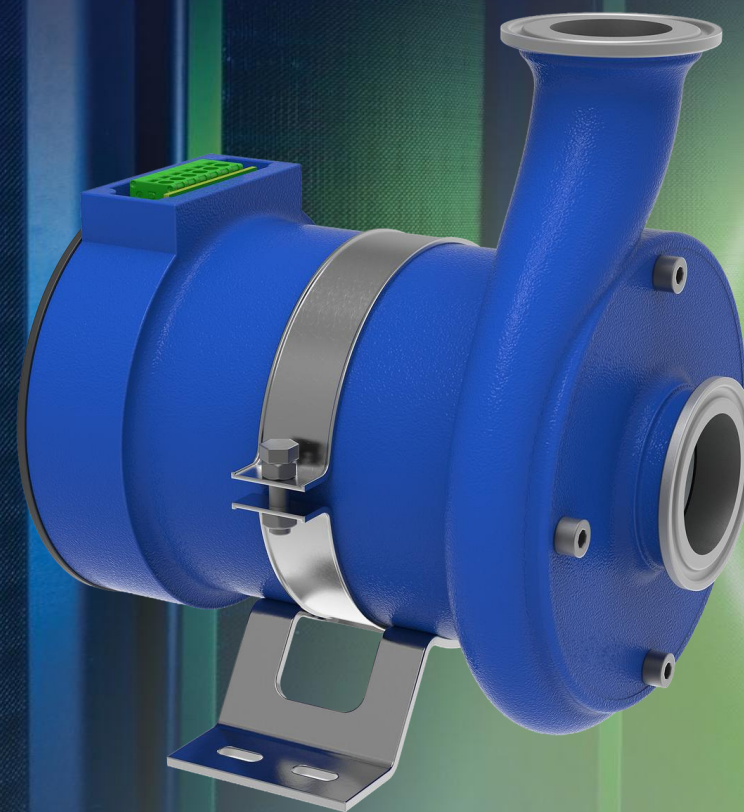
The Pump Inside the CDU

How one rotating component influences the lifetime and the energy budget of in-rack CDUs

Data Centre World Asia Singapore

Critical Infrastructure Theatre

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Introduction



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What Brinkmann brings to the data centre industry



75+ years of pump engineering

Family owned, third generation, headquartered in Werdohl, Germany



Liquid cooled, leak free CDU pumps

Sealless canned motor design, built for in-rack and in-row CDUs



Everything under one roof

Hydraulics, motor, drive electronics, monitoring, and software



Active in the OCP community

Contributing to CDU design guidance and liquid cooling workstreams



Efficiency & reliability for the Singapore market

CONSIDERATIONS FOR SINGAPORE



DC-CFA2: second Data Centre Call for Application

Launched 1 December 2025 by the Singapore Economic Development Board (EDB) and IMDA

200 MW

of new data centre capacity to be made available

potentially more through new green energy pathways

PUE ≤ 1.25

at 100 % IT load, or better

plus Green Mark Platinum and at least 50 % green energy

- Singapore allocates data centre capacity in megawatts
- Nowhere else does component efficiency translate this directly into permission to build

Source: EDB/IMDA fact sheet on the DC-CFA2 launch, 1 December 2025

THE OCP TARGET

Service life: 10 years.

Driven largely by the pump as the rotating component.

OUR JOB AS PUMP MAKERS

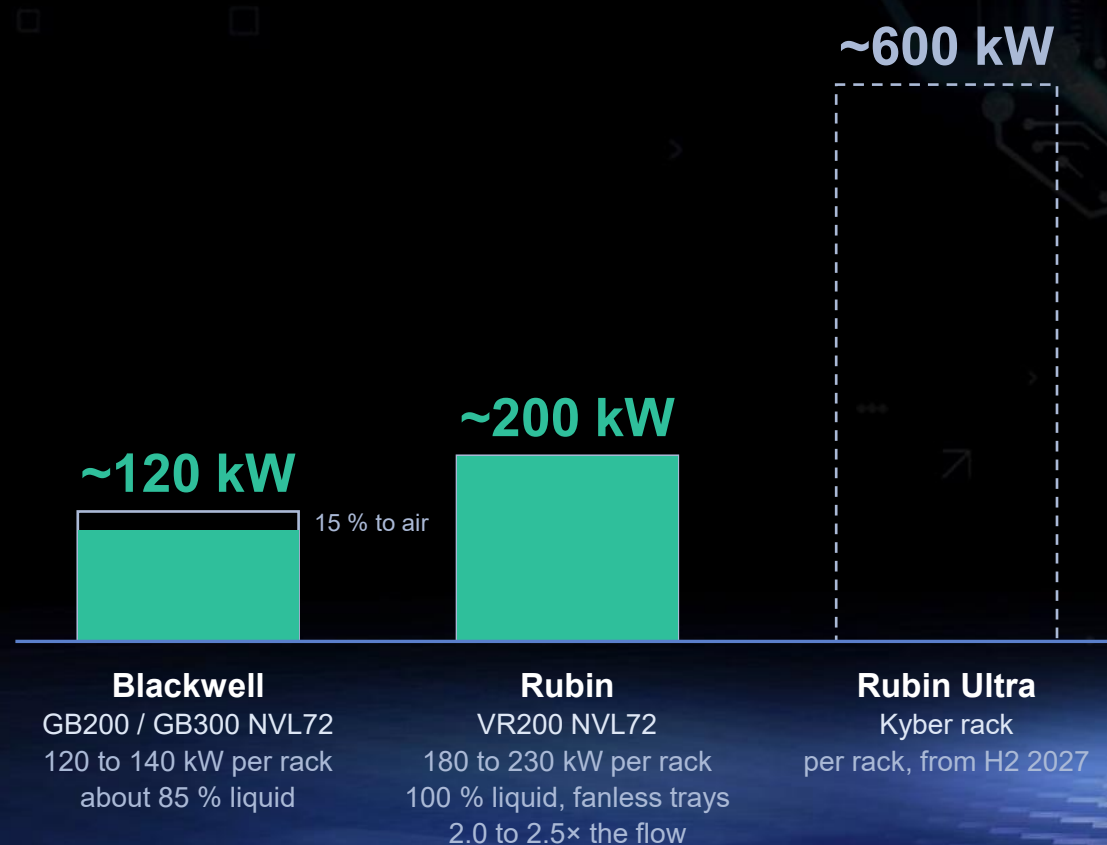
- Optimized thermal management to reduce heat emissions into the CDU enclosure
- Optimized sealless design, reduce wear parts next to live IT
- Wetted materials per OCP guidelines: maintain long-term fluid purity, minimize material erosion
- Effective redundancy and multi-pump operation: pump groups with seamless switching

Efficiency and reliability are one design task: a pump that runs cool lasts longer, and the pump that lasts defines the CDU.

Why the bar keeps rising and what it means for the pump

WHAT EACH GPU GENERATION PUTS INTO THE LIQUID LOOP

Solid: heat into the liquid loop per rack. Outline: total rack power.



WHY THE PRESSURE KEEPS RISING

A growing share of pump work is consumed inside the CDU itself:

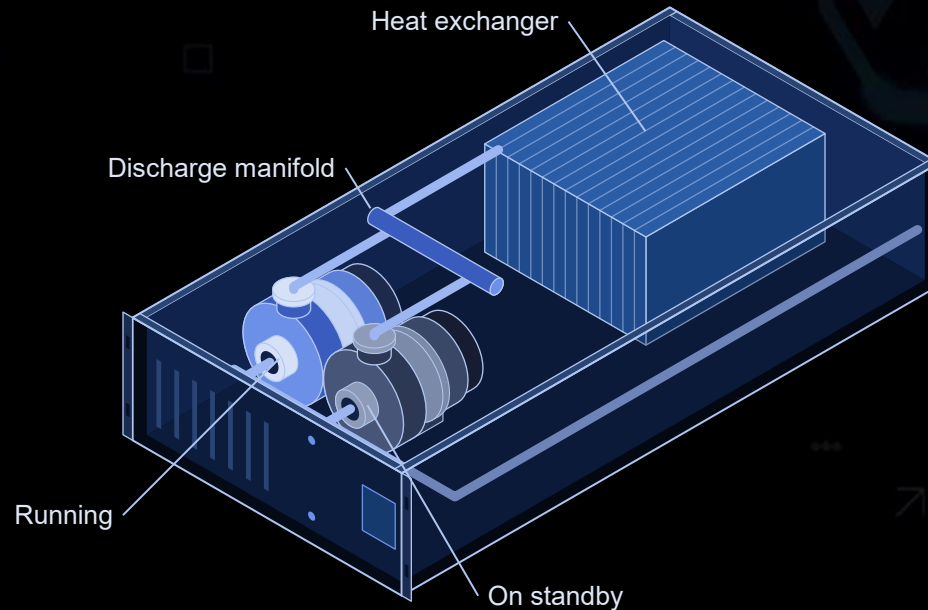
- 1 Internal pressure losses rise with the square of flow**
 Higher pipe velocity, more friction
- 2 The heat exchanger has to work harder**
 Denser core to move twice the heat, more pressure drop across it.
- 3 New cold plates demand higher outlet pressure**
 20 to 25 kPa per plate for Blackwell, 30 to 40 kPa for Rubin, microchannels below 150 micron.

Same envelope, four times the hydraulic power

100 kW CDU

150 l/min · 2.0 bar

one pump running, one on standby



0.50 kW

one pump running

SAME ENVELOPE



same chassis, same pump space

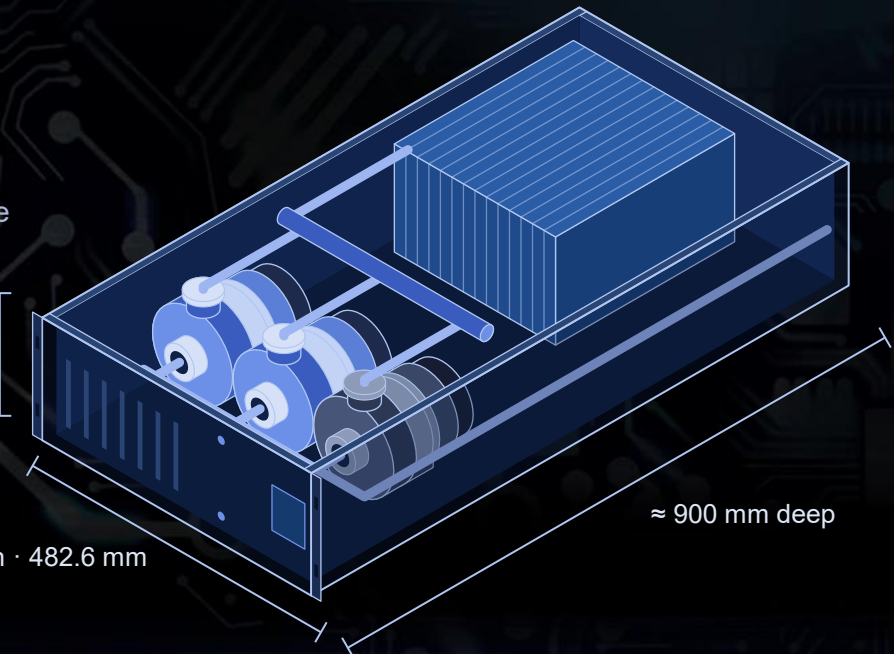
4U · 177.8 mm

19-inch rack width · 482.6 mm

200 kW CDU

300 l/min · 4.0 bar

two pumps running in parallel, one on standby



≈ 900 mm deep

Hydraulic power the pump array must deliver

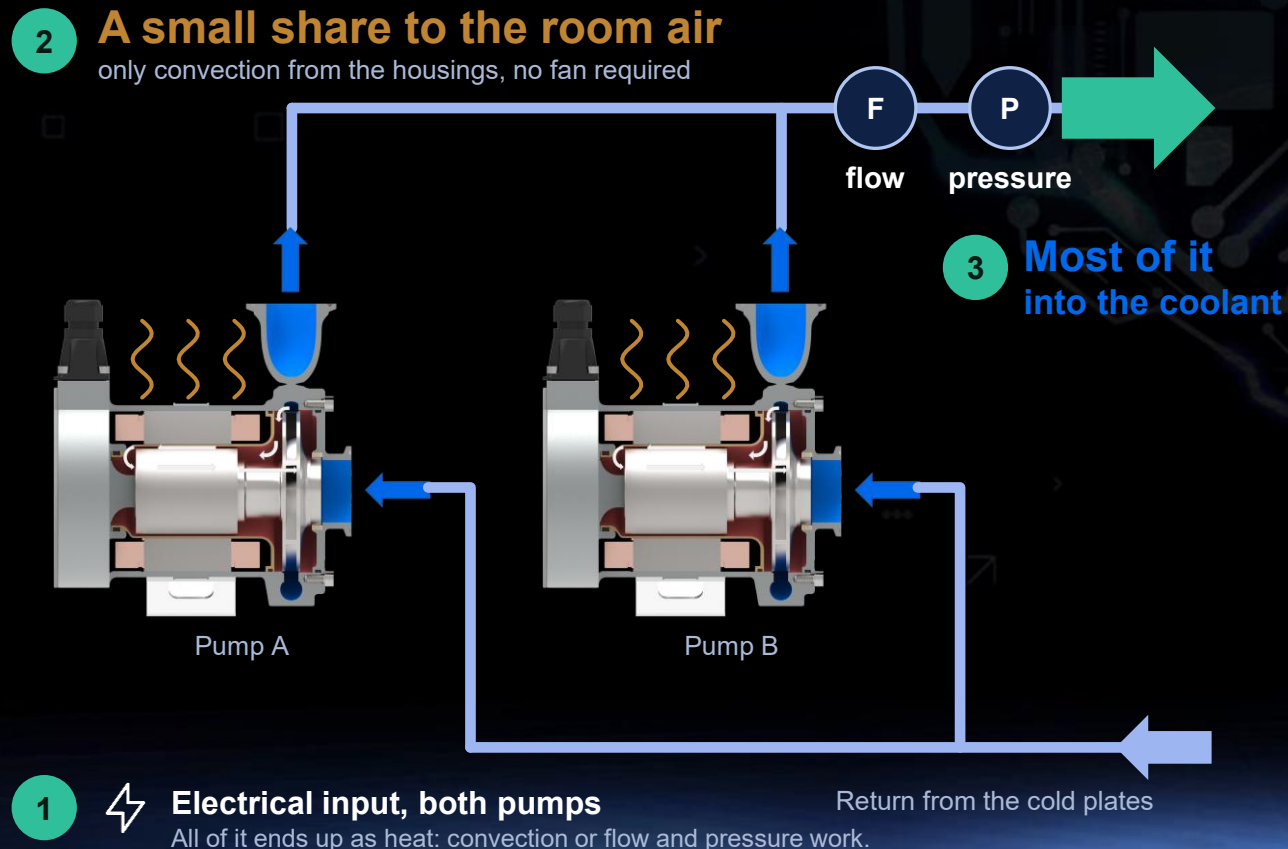
× 4

2.00 kW

two pumps running, each
at twice the pressure

The CDU has not grown. The thermal requirements have. Same pump space, four times the hydraulic power achieved through: Efficiency, speed, thermal management, and integrated packaging.

What happens to the electric pump energy?



WHAT THE PARTIAL FLOW DOES

- 4 Liquid-cooled motor**
The fluid carries the motor heat away. No fan, like the chips.
White arrows: impeller → rotor cavity → hollow shaft → back to suction.
- 5 Fluid-lubricated slide bearings**
Two surfaces that never touch: the PG25 film carries the load. No re-greasing, low wear, also at higher speeds.
- 6 Hermetically sealed by a static shell**
The can keeps the winding dry, no rotating seal. If a pump fails, the liquid stays inside.

One partial flow, three jobs: cooling, lubrication, containment. Loop heat is the efficient path (free cooling), room air requires more compressor work.

How pump efficiency influences PUE and token generation

Pump efficiency (wire-to-water)	Electrical input	Share of 200 kW rating
45 %	4.44 kW	2.22 %
50 %	4.00 kW	2.00 %
55 %	3.64 kW	1.82 %
60 %, our target	3.33 kW	1.67 %

Power consumption for controls, valves and sensors comes on top.

The pump is the largest single consumer in the CDU
 → Efficiency directly affects CDU power consumption

How it applies to the Singapore market

- DC-CFA2, Dec 2025: PUE 1.25 at 100 % IT load
- 2022 round asked 1.3, the bar tightens with each round
- pump at 45 %: ≈ 0.022 PUE points (≈ 8.9% of budget)
- at 60 %: ≈ 0.017 (≈ 6.7% of budget, 25 % savings)
- **across a 100 MW site: about half a megawatt of additional IT hardware (>2x Rubin racks)**

EDB/IMDA fact sheet, December 1, 2025

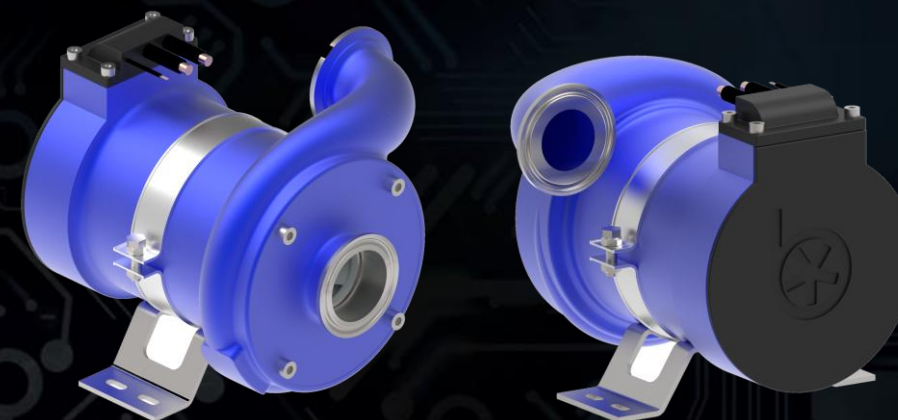
Pump efficiency is energy density: every pump kilowatt saved is additional IT hardware you can deploy from the same CDU.

One pump, four disciplines, optimized together



Under one roof

Efficiency is won or lost at the interfaces. Hydraulics, motor, containment, and drive electronics



A SIMPLIFIED DESIGN



No mechanical seal

Hermetically sealed: nothing to wear, or leak next to live IT. Even if a pump fails, the fluid stays inside the system.



No motor fan

One less moving part, no airflow dependency. The pumped fluid cools the motor.



No roller bearings

Slide bearings run in the medium. Bearing geometry and partial flow are optimized together, so wear stays low, also at higher speeds.

AN INTEGRATED DESIGN



Shorter build

Impeller and rotor share one shaft: no extra bearing frame or coupling assembly as in a magnetically coupled pump.



Full control over materials

Every wetted part follows the OCP guidance on material compatibility to avoid leaching.



Integrated cables, IP55

Protected against splashing during hot swaps and against condensation in the enclosure.

Why pump and CDU must be engineered together

TOGETHER FROM THE FIRST DESIGN PHASE

Hydraulic interfaces, packaging, system flow optimization, and multi-pump behavior are decided early. They decide whether a good pump becomes a well integrated pump.



Packaging and interfaces

- **Customized flange configurations:** integrate directly with the CDU's manifold type, shorter piping, tighter packaging
- Hot-swap ready integration



Multi-pump control

- **Dual pump operation:** minimizing pressure loss vs single pump operation
- **Switch to the spare pump:** without thermal spikes



Following the heat load

- **Integrated variable speed:** full speed for training, a fraction for inference
- **Data transfer via Modbus:** proven protocol, continuous transfer of condition monitoring data sets w/ only one cable (Temp, Current, Energy)

Pump efficiency and reliability are connected.
Liquid cooled, high-efficiency pumps can decrease PUE, and increase token generation.

CONTINUE THE CONVERSATION

Booth C45

- Scaling liquid cooled, leak free pump design to row- and skidded CDUs
- 800 V DC power architectures and the effects on manufacturers' roadmaps