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System integration of a computing cluster, a heat recovery system and an adsorption chiller for cold production

Our starting point:

The environmental footprint of the IT sector is growing quickly. To reduce it, reusing the servers' heat is one of the most efficient levers. We see these types of systems more and more, but in order to push this trend even further, we need to develop new services using IT waste heat.

This research project aims at **producing cold with servers' waste heat**.

Experimental setup:

The system prototype involves the integration of **Qarnot computing boilers** and an **adsorption chiller**.

The Qarnot boilers host 24 OCP servers within a thermally insulated enclosure and are optimized to reuse IT waste heat.

The Adsorbus adsorption chiller is a machine based on a silica gel/water pair. Whereas driving temperatures above 70°C are usually applied, it enables operation at a low driving temperature of approximately 60°C.

An adsorption chiller works as a chiller but instead of being mechanically driven, it is thermally driven: **the silica gel works as a compressor and is regenerated by the IT waste heat.**

The aim of this experiment was to evaluate the amount of cold produced by such a system, to find the optimal IT load (number of OCP servers running), and to check that PUE and ERE remain best in class.

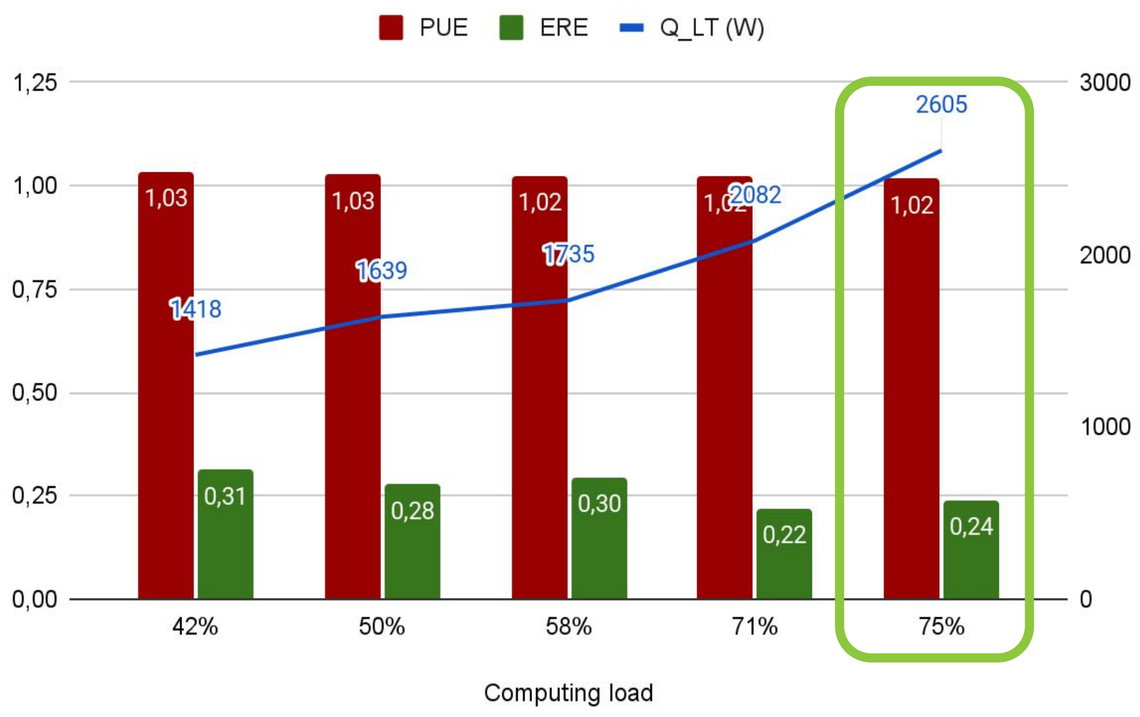

Fig 2. PUE, ERE, thermal COP and cooling load relative to computing load

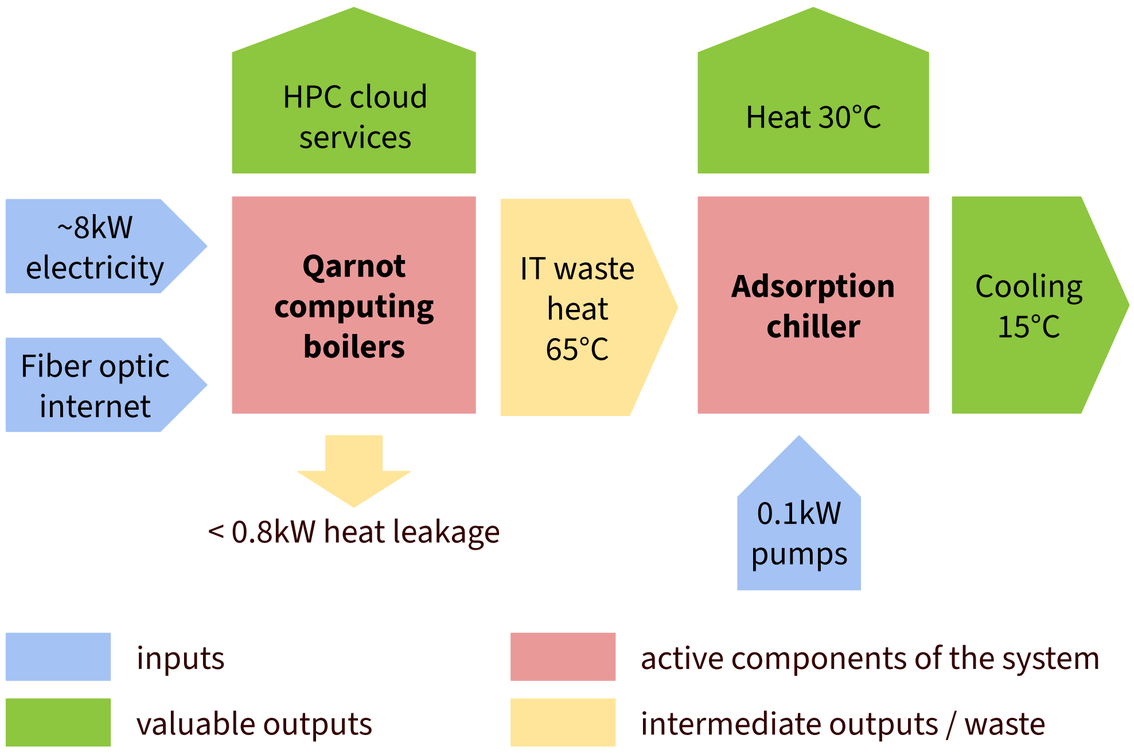

Fig 1. Diagram of the system

Results and future works

- We found an optimum cold production for a 75% computing load, corresponding to 18 running OCP servers. Beyond this, the silica gel doesn't absorb as much heat and the servers risk to overheat.
- The quantity of cold produced can be as high as 2.6kW, which would correspond to a COP (Coefficient of Performance = useful heat / Work put into the system) of 26, considering the IT heat is a waste. This COP can be compared to industrial AC COP which are usually between 3 and 4 which validates the high potential of such a technology compared to regular chillers.
- The output includes a cold loop as well as warm loop which is necessary to the adsorption chiller: this excess heat can be evacuated, or in some cases, can be used: for instance hospitals need both AC and heat for some of their processes.
- Finally, PUE remain as low as 1.02 and ERE as low as 0.24

These results open new perspectives as the next generation of adsorption chillers will be able to produce cold with waste heat temperatures as low as 55°C.