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Immersion Cooling and Advanced Materials for Heat Recovery from Data Centers

Heat Recovery, Storage & Re-use in Data Centers: The MODERATOR approach

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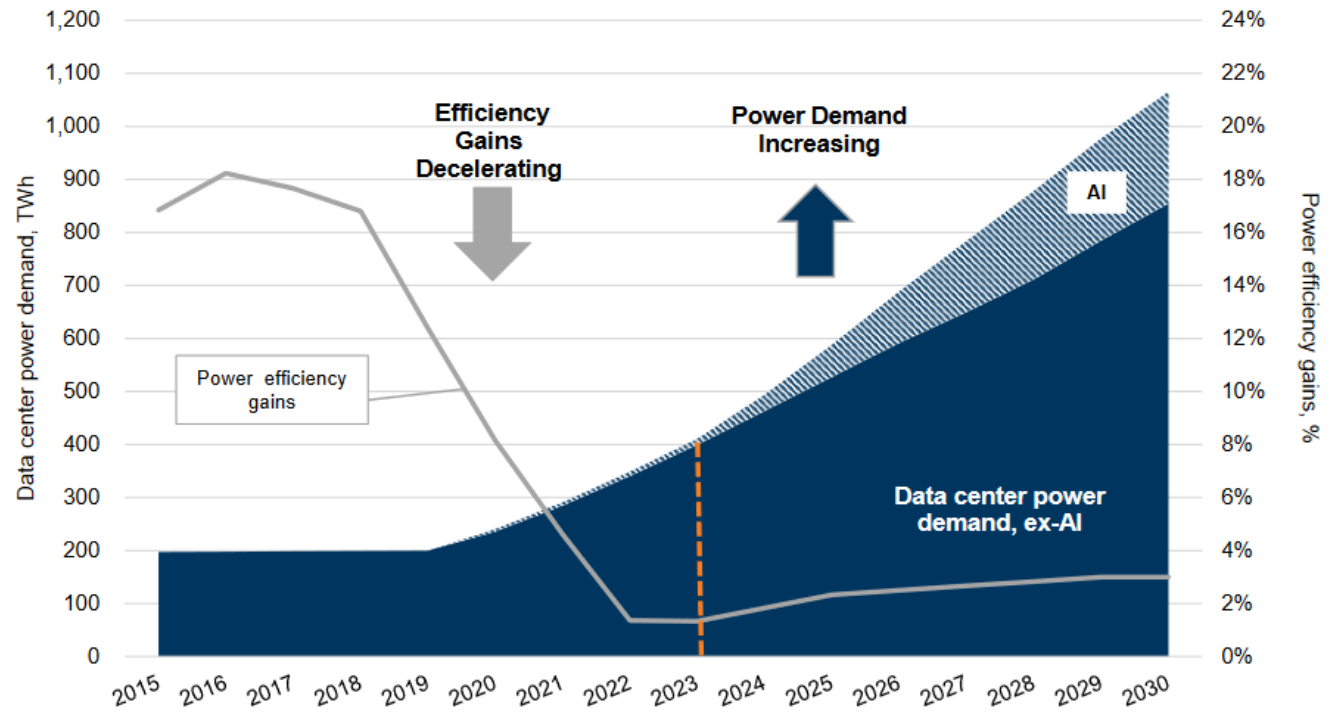
Co-funded by the European Union

Background

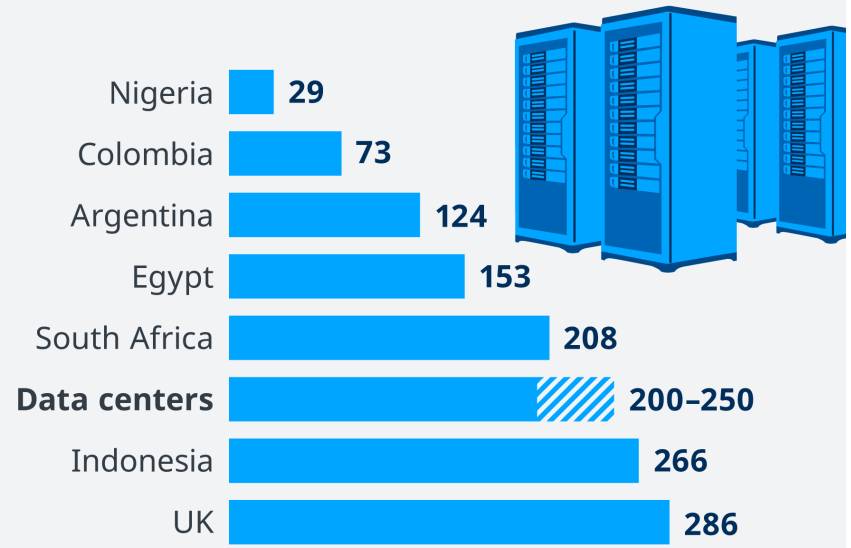
Data centers dynamics and heat recovery potential



Source: Masanet et al. (2020), Cisco, IEA, Goldman Sachs Global Investment Research

Data centers use more electricity than entire countries

Domestic electricity consumption of selected countries vs. data centers in 2020 in TWh

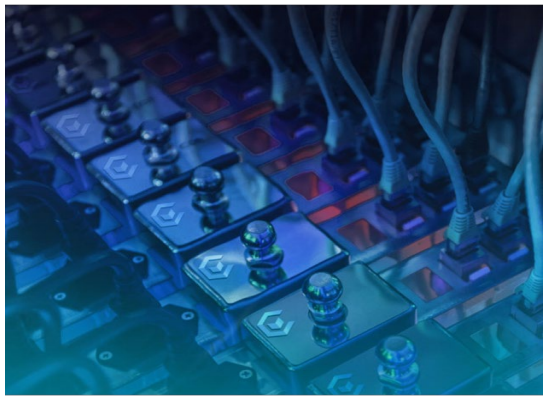


Source: Enerdata, IEA

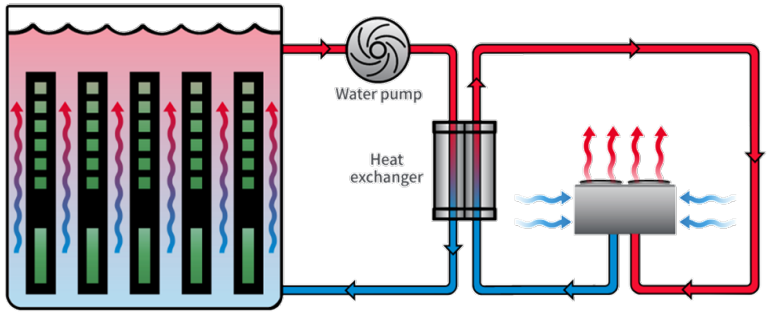
Even with low PUE (very efficient cooling systems) almost **all of the installed IT power consumption is converted into heat!**

Background

Immersion cooling as a game changer



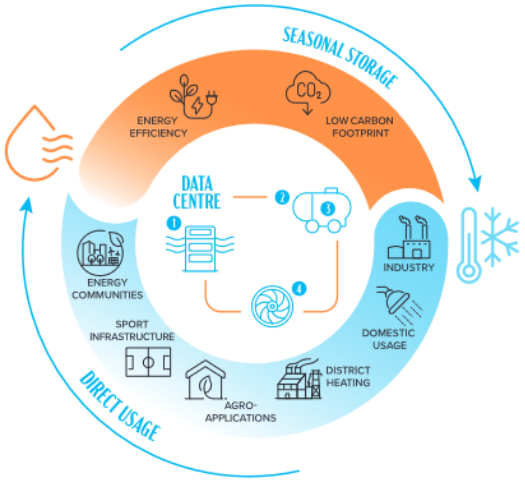
- Removal of the heat generated by the IT components using a single phase dielectric liquid, i.e. a fluid that conducts heat and acts as an electrical insulator, which absorbs the heat from the tank by convection and releases it to the environment through a conventional heat exchanging system
- Common dielectric fluids have a heat capacity by volume about 1,300 times higher than air, improving significantly the cooling efficiency
- PUE achieved = 1.1 (ideal PUE close to 1)
- The dissipated heat can be released from the “hot” fluid in another fluid for **direct exploitation** or in a heat storage system capable of storing heat **for prolonged periods (seasonal storage)**

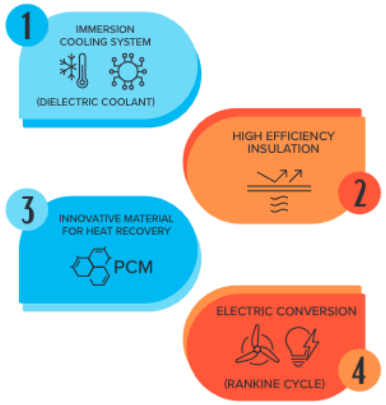


With the MODERATOR approach both main obstacles that hinder the reuse and further exploitation of waste heat from data centers can be efficiently tackled

Overall Goal

- Development and demonstration of an integrated prototype based on an immersion cooling system combined with novel and highly efficient long-term storage materials and systems
- On-site demonstration of different exploitation options (space heating, hot water production, electricity generation) of the recovered heat



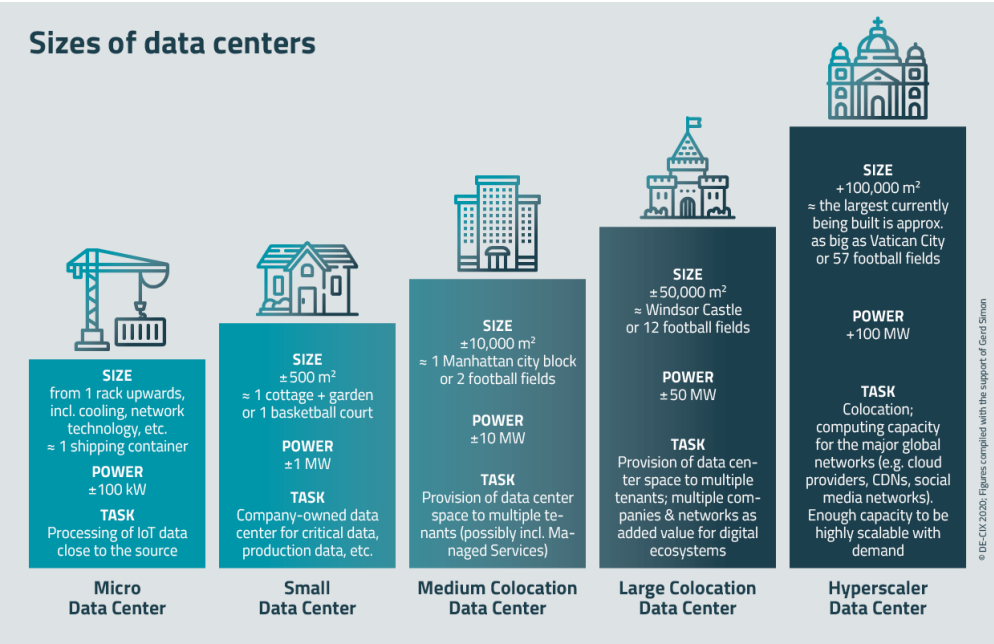


Three **key elements** ensuring the heat recovery and its storage over extended periods of time:

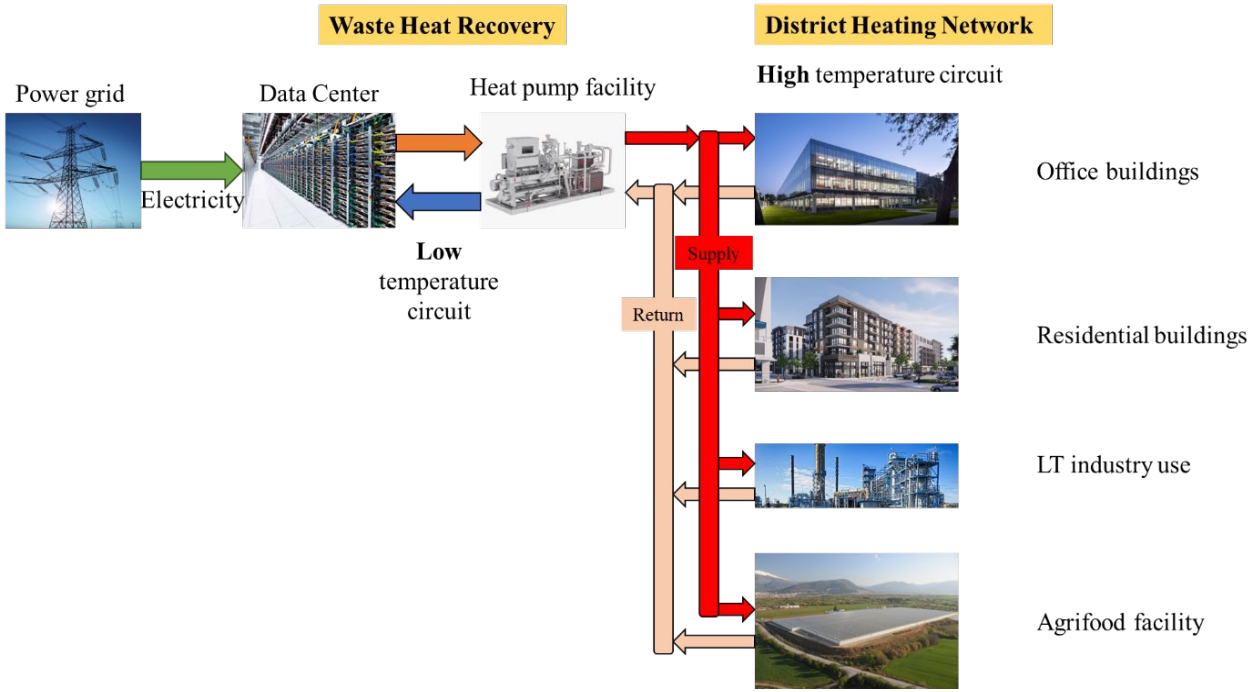
1. immersion cooling system
2. innovative phase-change material (PCM) for heat storage
3. highly efficient multilayered insulation system

- ✓ MODULARITY: The modular design approach allows easy and straightforward scale-up. It can find applications in small (few kW) to large (several MW) data centers, on a site-by-site basis.
- ✓ SIMPLICITY: Direct installation in any location (indoors or outdoors) without heavy facilities requirements.
- ✓ SUSTAINABILITY: Safe and clean for human health and the environment, exploiting recycled materials and being a by definition zero-effluent concept.

Indicative applications and potential end users mapping



Technologies for waste heat upgrade – Heat upgrading by coupling a heat pump with a Data Center in a District Heat Networking



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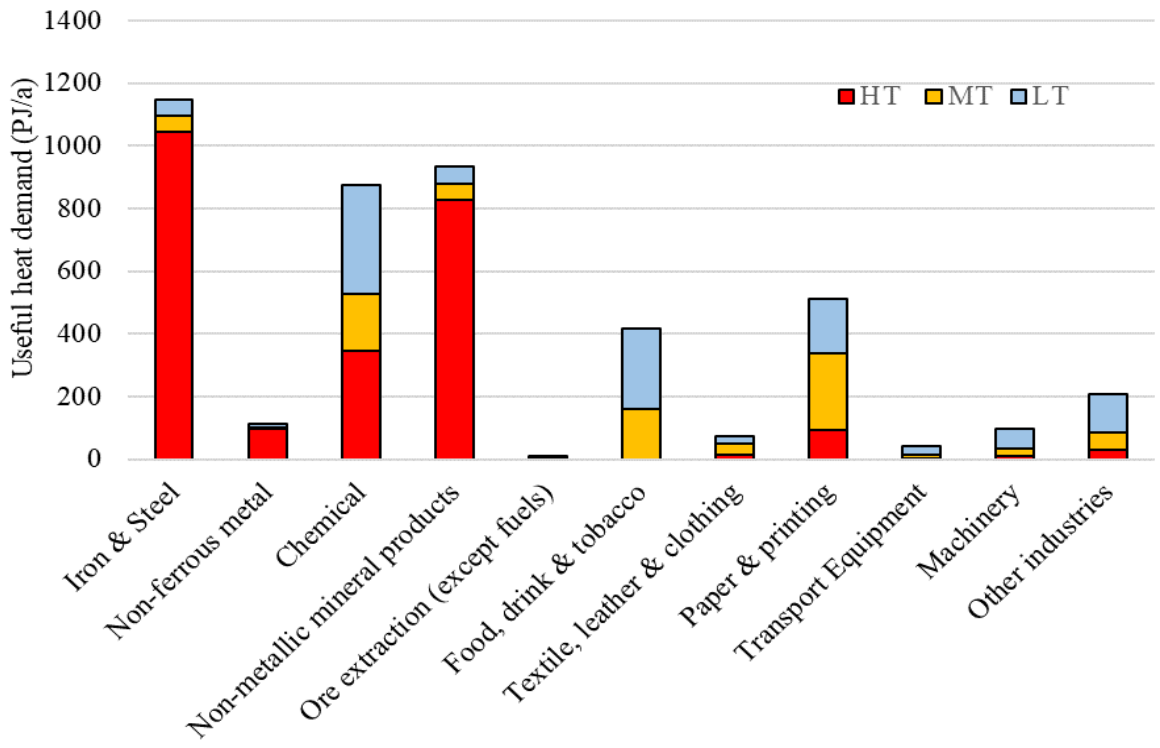
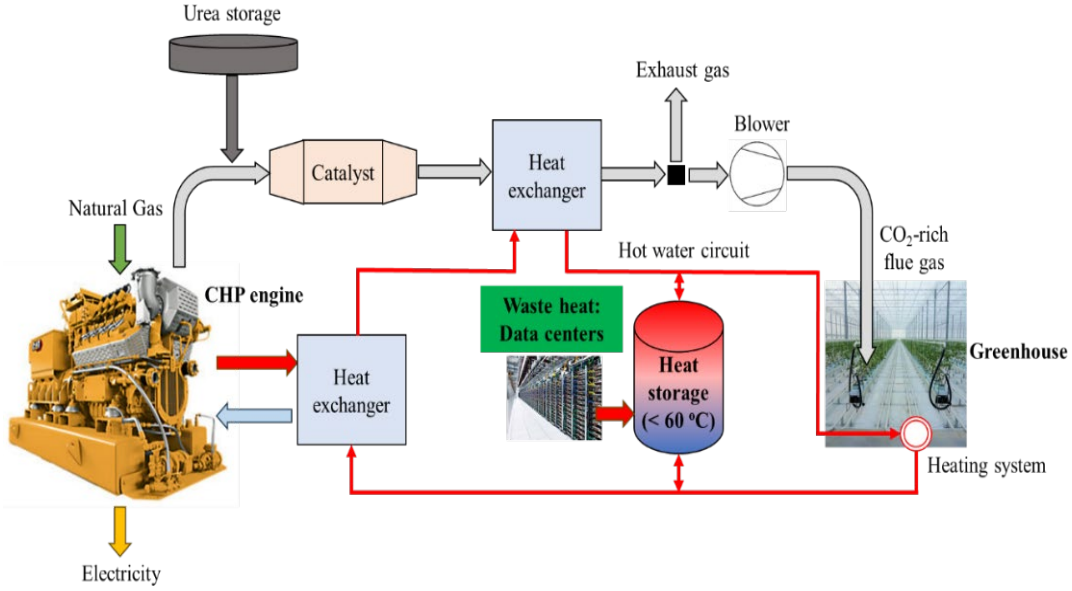
Indicative applications and potential end users mapping

Heat demand for the industry in the EU



Pardo et al., 2012. European Commission, Joint Research Centre, Institute for Energy and Transport.

Integration of a Data Center derived waste heat to the heating system of a greenhouse



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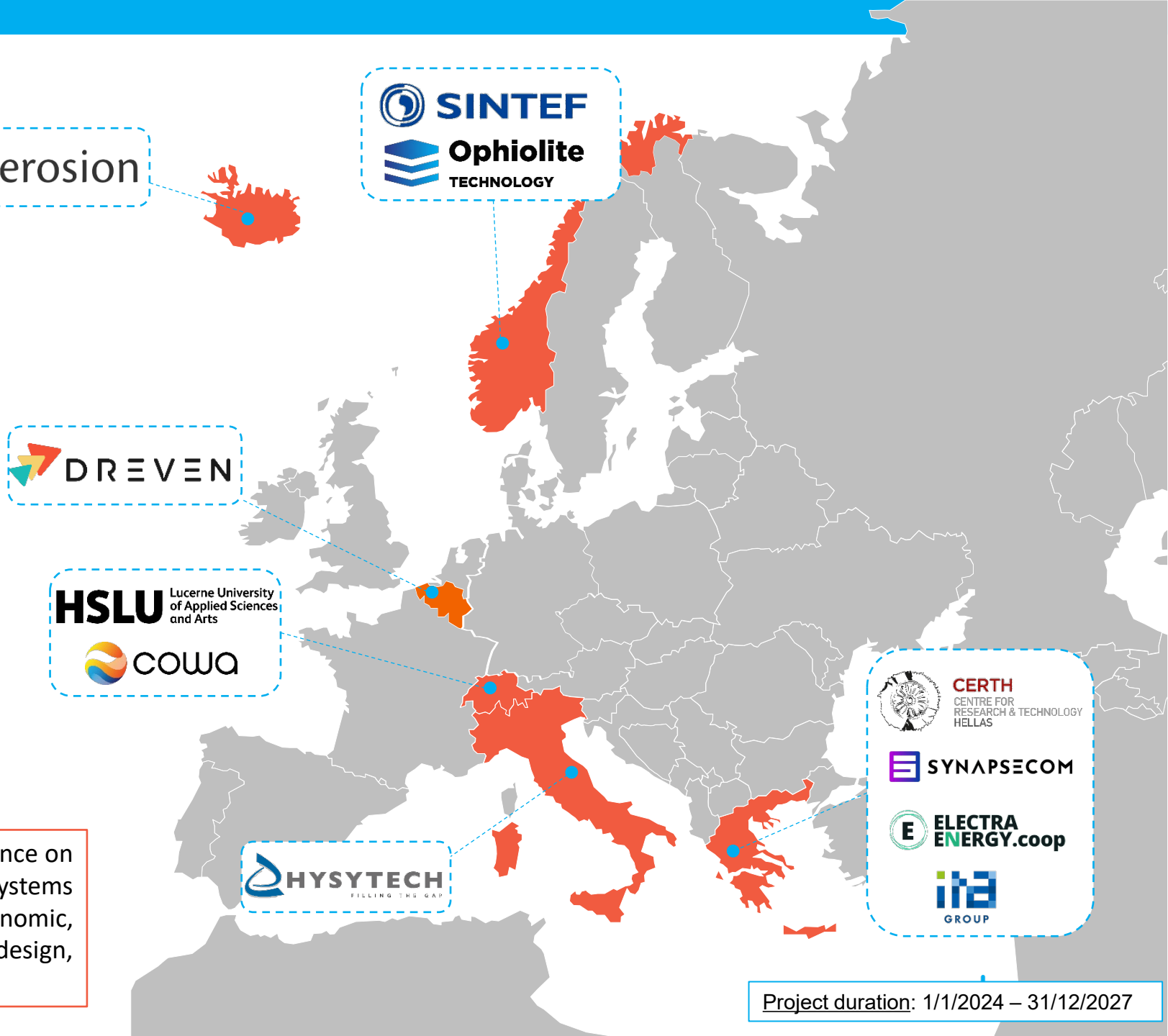
Consortium

	Partner	Country	Role
1	CERTH	Greece	Coordinator
2	SYNAPSECOM	Greece	Beneficiary
3	HYSYTECH	Italy	Beneficiary
4	SINTEF	Norway	Beneficiary
5	DREVEN	Belgium	Beneficiary
6	OPHIOLITE	Norway	Beneficiary
7	ITA	Greece	Beneficiary
8	GEROSION	Iceland	Beneficiary
9	ELECTRA	Greece	Beneficiary
10	HSLU	Switzerland	Associated Partner
11	COWA	Switzerland	Associated Partner

11 partners (3 research organizations, 8 SMEs) with experience on material science, system design, process engineering, systems operation, modeling and simulation, technoeconomic, environmental and socioeconomic assessment, roadmap design, dissemination and communication, etc.



Project duration: 1/1/2024 – 31/12/2027

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Thank you!

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