energy storage

IEA Technology Collaboration Programme

Legislation and Regulation as Enabler for Flexible Energy Storage in Building Masses

Sustainable Building Design Lab, UEE,
Applied Sciences, University of Liège, Belgium
shady.attia@uliege.be

Prof. Shady Attia

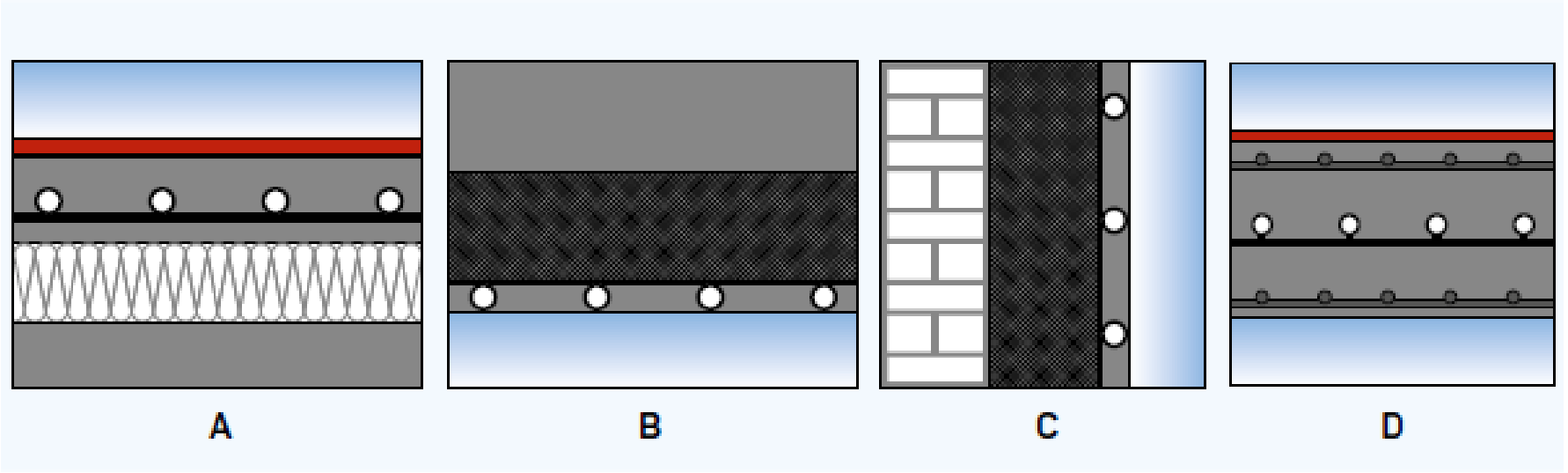
LIÈGE université
SBD Lab

35th ES On-Seminar - 16 October 2025 (09:30–11:00 CET)

From Buildings to Flexibility Assets

- **Thermal activation works technically. The question is: *will Europe's rules, markets, and policies allow it to scale?***

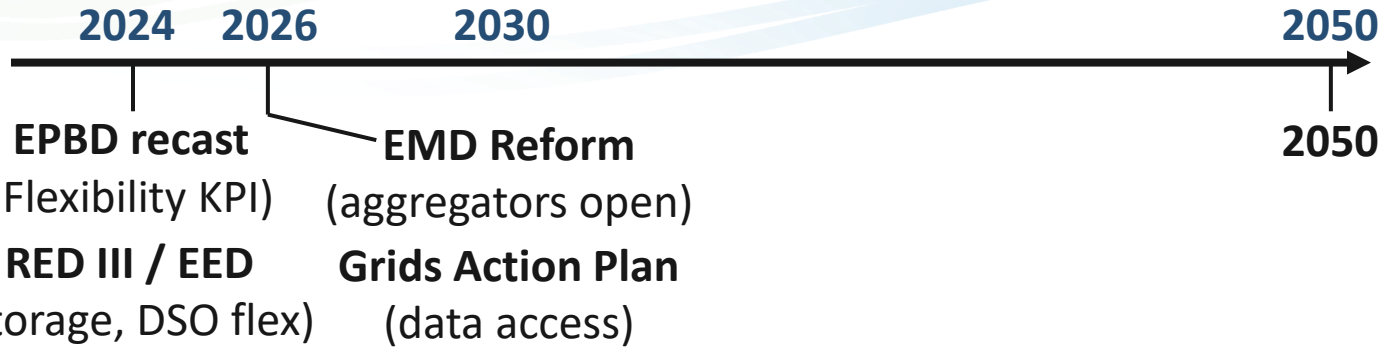
- **Task 43 interviews in four countries—Germany, Denmark, Belgium, and Spain—and how upcoming EU reforms could finally unlock building-mass flexibility.**



Examples of water-based embedded radiant systems: a) floor, b) ceiling, c) wall and d) TABS. Credit: Bjarne W. Olesen

Ritter, D., Rohringer, C., Afshari, A., Andrés-Chicote, M., Hernandez-Cruz, P., Duenzen, K., Bauknecht, D., & Attia, S. (2025). *Activating the electrical energy flexibility of residential thermal systems: An analysis of non-technical barriers in six countries.* Unpublished manuscript.

EU Energy and Building Policy Landscape (2025-2030-2050)



Policy	Key Date
EPBD Recast (1275)	**In force 2024 → transpose by 2026**
EED (2023/1791)	**2023 → 2030 targets –11.7 % energy**
RED III (2023/2413)	**2023 → 2030**
EMD Reform (1711& 1747)	**July 2024 → apply 2025**
EU Grids Action Plan	**2023 → 2030**

Why it matters for TABS

Add *thermal-storage flexibility KPI* to EPC/EPB; optional SRI credits.

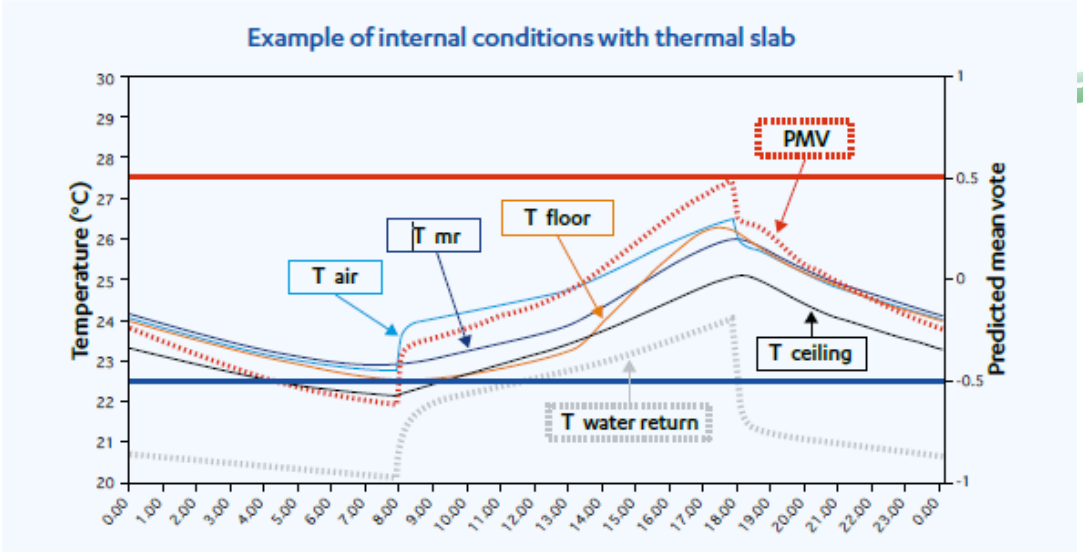
Allows counting demand-side flexibility in national energy plans.

Calls for **storage/aggregation** integration at the Distribution System Operator level.

Opens markets to **aggregators** & demand-response assets.

Prioritises **digitalisation + data access** = core for TABS control.

Europe Enters the 15-Minute Market

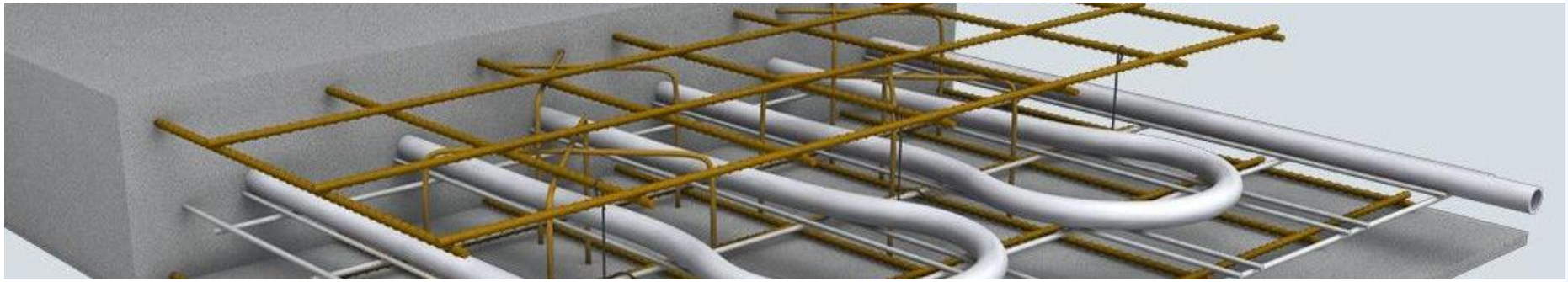


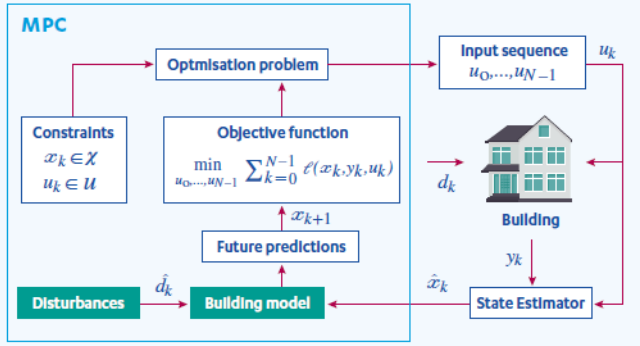
- **From hourly to 15-minute Day-Ahead clearing (SDAC) by Sep 30, 2025.**
- **Smart-meter data = 15-minute resolution across the EU.**
- **Dynamic tariffs emerging:**
  - BE Flanders capacity tariff (peak 15 min)
  - ES time-of-use 3 tiers
  - DK hourly real-time
- **New revenue layers: DA arbitrage + peak-charge avoidance + local DSO services.**

ACER. (2024, March). *Implementation of the 15-minute Market Time Unit (MTU) in the Single Day-Ahead Coupling (SDAC): Status update and target go-live date.* Agency for the Cooperation of Energy Regulators (ACER). Retrieved October 11, 2025, from https://www.acer.europa.eu

Flexibility Strategies for TABS in the 15-Minute World

- **Model-Predictive Control (MPC):** generate 96-point schedule D-1.
- **Two objectives:** minimise cost & monthly peak (15-min billing).
- **Stacked revenues:**
  - Day-Ahead arbitrage,
  - Peak-charge avoidance,
  - Local DSO flex markets (RED III)
- **Portfolio aggregation:** pool many stable buildings = firm flexibility.
- **Digital enablers:** 15-min data + open APIs (EN ISO 52120).



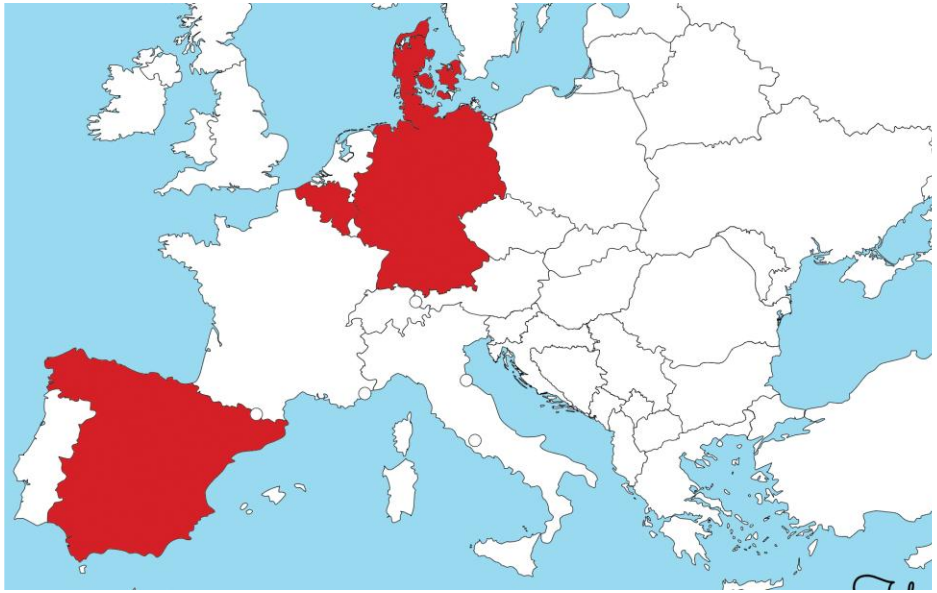


Courtesy: https://www.uponor.com & (Drgoňa et al. 2020)

Evidence from Task 43 Subtask C Interviews

26+ interviews from 4 countries.

Country	Awareness	Market readiness	Optimism
DK	5	4	4
DE	4	3	3
BE	4	3	4
ES	3	1	2



- **Expert Voices**
- **“ People think TABS are slow—no, they are stable.” – *Bjarne Olesen***
- **“There are no active barriers, only missing incentives.” – Andrés Valverde Peña. *(Spain)***
- **“Architects reject what they never tried.” – *Lieve Helsen***
- **“Mass is storage, not just structure.” – *Xzing Xue***

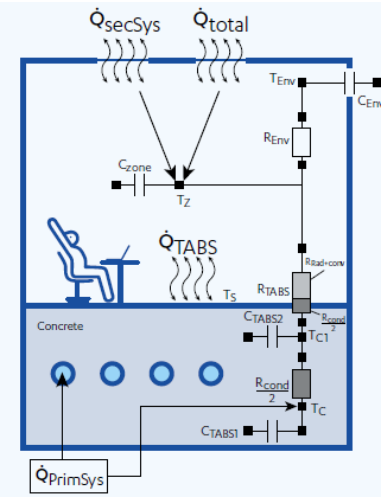
Ritter, D., Rohringer, C., Afshari, A., Andrés-Chicote, M., Hernandez-Cruz, P., Duenzen, K., Bauknecht, D., & Attia, S. (2025). *Activating the electrical energy flexibility of residential thermal systems: An analysis of non-technical barriers in six countries.* Unpublished manuscript.

EU-Wide Barriers and Policy Pathways

Barrier Type	Core Issue	Policy Lever
Regulatory invisibility	EPC & EPB ignore dynamic thermal storage	① **Add Flex-KPI in EPBD Annex I**
Market access	< 1 MW threshold excludes buildings	② **Implement aggregator access under EMD**
Skills gap	Few trained engineers for MPC/TABS	③ **EU Pact for Skills modules**
Awareness & demonstration	Policy makers see no data	④ **Label "Flex-Ready Buildings" (Horizon EU 2026)**

To unlock flexibility, four levers matter:

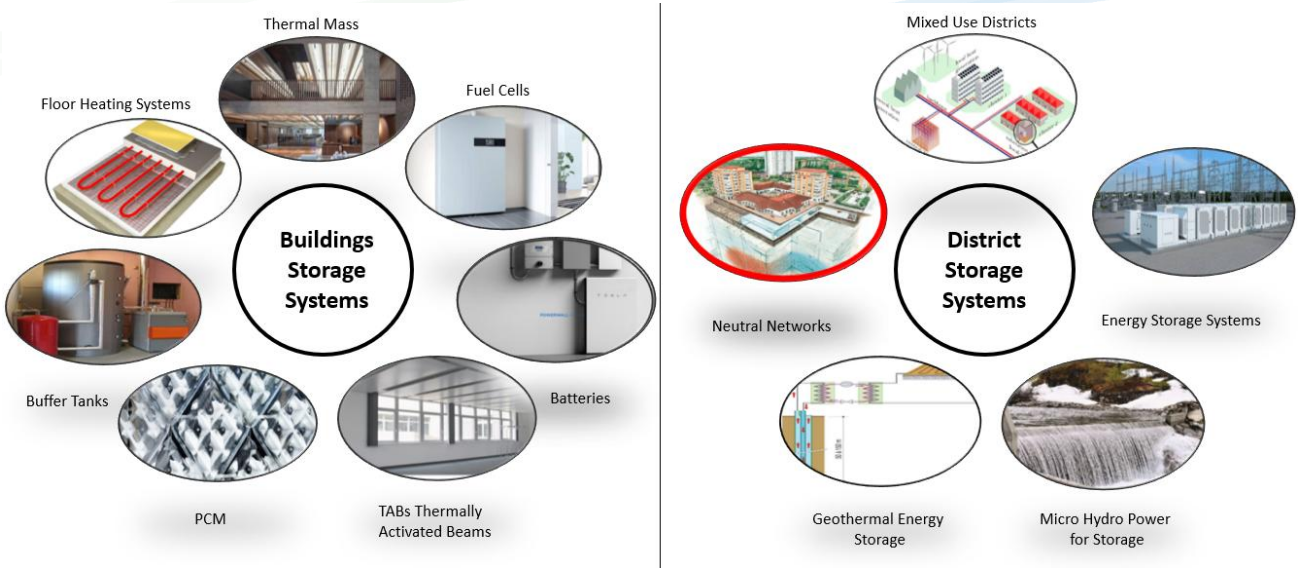
- **First, regulatory recognition—put flexibility KPIs in the EPBD.**
- **Second, market access—open aggregators to sub-100 kW assets.**
- **Third, skills—train architects and facility managers in predictive control.**
- **And fourth, demonstration—EU programmes should fund *Flex-Ready Buildings* as visibly as they fund PV roofs.**



Ritter, D., Rohringer, C., Afshari, A., Andrés-Chicote, M., Hernandez-Cruz, P., Duenzen, K., Bauknecht, D., & Attia, S. (2025). *Activating the electrical energy flexibility of residential thermal systems: An analysis of non-technical barriers in six countries.* Unpublished manuscript.

Boydens, W., Helsen, L., Olesen, B. W., Ferkl, L., & Laverge, J. (eds.). (2020). Renewable and storage-integrated systems to supply comfort in buildings

Looking Ahead: 2030 → 2050



Thermal storage, the hidden engine of carbon neutrality.

- **By 2030 → TABS & other thermal storage provide > 10 GW flexibility potential in Europe (≈ 15 % of building-sector load).**
- **By 2050 → climate-neutral EU = fully electrified heat + intermittent RES → buildings must serve as flexibility sponges.**
- **Risk: timber/lightweight construction reduces thermal mass.**
- **Strategy: hybrid cores, PCM ceilings, concrete modules as structural storage.**

Closing Message: Aligning Technology, Market, and Policy

- **Empirical validation:** Task 43 results demonstrate that **TABS can shift 4–6 kWh/m² · day** with minimal comfort deviation (ΔT < 0.5 K) when operated under predictive control.
- **Grid & system potential:** Across the EU, activating thermal mass in tertiary and residential buildings **could supply ≈ 10–12 GW of short-term flexibility;** equivalent to a large pumped-hydro plant fleet.
- **Market alignment:** The new 15-minute Day-Ahead market (ACER, 2024) and aggregator access under the Electricity Market Design reform (2024/1711 & 1747) now **create real economic signals for demand-side flexibility.**
- **Regulatory inertia:** Current EPBD/EPC methodologies remain quasi-static, excluding dynamic storage behaviour; thus, no **regulatory or financial credit is given for thermal-mass flexibility**.
- **Strategic policy path:** Incorporate **thermal-storage indicators** in EPBD Annex I and the Smart Readiness Indicator, **lower aggregator thresholds (< 100 kW)**, and **launch EU programs for "Flex-Ready Buildings.**"

energy storage

IEA Technology Collaboration Programme

The Energy Storage TCP
Looking forward to the discussion.

Views, findings, and publications of the ES TCP do not necessarily represent the views or policies of the IEA Secretariat or its individual member countries.