WeForming

**Mojtaba Kamarlouei**
Builtrix

**Duncan Gibb**
Regulatory Assistance Project

**Ângelo Casaleiro**
R&D Nester

# Turning Portugal's buildings from passive consumers into grid assets

For Europe to decarbonise its building stock, the role of buildings in the energy system must change. Homes, businesses and public buildings will need to do more than passively consume energy. They must produce it as well. By making buildings a flexible interface between energy production and energy demand, as well as a valuable flexibility resource able to help stabilize the grid, the transition to clean energy will be more cost-effective, efficient and energy secure. WeForming, a project funded by the EU's Horizon Europe Programme  focuses on creating regulatory and business pathways to support the widespread adoption of smart buildings. A key output of this project has been a regulatory blueprint, which outlines key considerations for policy makers looking to scale smart buildings.

## A strong technical base, an incomplete framework

Portugal has one of the cleanest power systems in Europe, with 11% solar, 26% wind and 29% hydropower in electricity generation in the first 6 months of 2026. But using this clean power for heating in buildings is another challenge. Portugal's homes still rely heavily on bioenergy combustion (45%), oil products (15%) and fossil gas (12%) for heating. Intelligent, grid-friendly buildings (iGFBs) combine on-site generation, storage, flexible loads and smart controls that respond to grid signals and are central to that shift. Deploying these buildings at scale means tackling a set of regulatory barriers that still hold the sector back.

One key component of iGFBs is self-consumption and energy sharing. In Portugal, this is governed by a law which declares four models of self-consumption (individual, collective, renewable energy communities and citizen energy communities) and lets households and businesses produce, store, and sell energy, while offering flexibility from renewable generation. Portugal also sees a high smart meter penetration rate of 99%, one of the leading countries in Europe. Combined with the high share of renewable electricity generation, the technical foundation is present.

WeForming

Follow us for more articles

In recent years, Portugal's remuneration mechanism has moved away from feed-in tariffs towards valuing surplus energy, which prosumers can sell through aggregators or suppliers. Direct exchange between prosumers is allowed, enabling micro-grids and collective self-consumption. The framework supports time-of-use tariffs and flexibility services, which is an area where Portugal is among Europe's leaders.

## Behind the scenes: a shopping centre as a grid asset

Portugal's WeForming demonstration is located at Palácio do Gelo, a large commercial and leisure complex in Viseu. The building combines substantial electrical and thermal demand with on-site generation, absorption chillers, electrical chillers, HVAC systems and an ice-based thermal energy storage system. This makes it a relevant environment to test the practical operation of an intelligent grid-forming building under real commercial operating conditions.

Before the project, the main energy assets were operated through legacy systems with limited external data exchange and capability to respond dynamically to grid, tariff or market signals. This project enables collecting energy and operational data, mainly from thermal systems, before applying it in analytics and optimization, demonstrating a fully interoperable asset. This provided the basis for testing building-level flexibility while keeping the facility operator in control of operational decisions.

One of the main project outcomes was the reactivation of the building's ice storage system, which had been out of regular operation because it was initially designed for night-time charging and created unacceptable acoustic impacts for nearby residential areas. Instead of relocating the equipment, the demo tested a software-based operational strategy, developed by BUILTRIX. The platform identifies suitable daytime charging periods using information on weather conditions, occupancy patterns, tariff periods and equipment constraints. Field tests carried out early this year confirmed that the system could reach sub-zero charging conditions and stable ice-generation profiles during daytime operation, while maintaining the thermal comfort in the commercial areas.

The demo also assessed demand-side flexibility through HVAC setpoint optimisation and load-shifting strategies powered by a thermal digital twin. By moving away from static over-cooling practices and adjusting selected HVAC setpoints within acceptable comfort boundaries, the system reduced electrical demand during relevant operating periods without compromising indoor conditions.

In parallel, the Portuguese demo explored how building flexibility can be formalised, communicated and tested within balancing-market processes, with a specific focus on manual Frequency Restoration Reserve (mFRR), whose longer activation window — unlike faster automatic products — gives operators time to check a grid-service request against comfort, thermal-storage and equipment constraints before responding. This was tested through a balancing market simulator, developed by R&D Nester, using standardised information-exchange procedures and market-process logic aligned with the Manually Activated Reserves Initiative.

Overall, the results indicate that large commercial buildings can provide flexibility services when legacy building systems are combined with secure data exchange, forecasting tools, thermal storage and human-supervised operational control (human-in-the-loop)

## What's still holding smart buildings back

Although progressing on self-consumption, there are several regulatory barriers holding back the deployment of iGFBs in Portugal. Some of these were highlighted through a survey in the WeForming project that contributed to the development of the regulatory blueprint. The enabling framework for energy communities is incomplete, and few are legally recognised despite a proliferation of collective projects. A mandatory national assessment of barriers and potential of self-consumption also is overdue. In addition, grid access is increasingly a binding constraint, as first-come, first-served connection queues do not distinguish mature projects from speculative ones. This ends up slowing down connections for iGFBs.

In addition, iGFBs must integrate with existing smart-building systems across a variable building stock, which demands compatibility with different building types. The sensitive data these systems handle makes cybersecurity and data protection essential, both legally and for public trust. High upfront costs remain a significant financial barrier.

Finally, uptake of iGFBs in Portugal also is limited by low public awareness and trust in new technology, short-term thinking among both occupants and professionals, and weak commitment from building owners during renovation. The benefits of efficiency, grid stability, and lower bills need to be communicated clearly, and the workforce needs a reskilling pathway. Portugal also should undertake widespread building renovation projects so that heat pumps can run efficiently and flexibility can be properly accessed.

## Shifts in the policy framework

Recent policy developments in Portugal are increasingly relevant for the deployment of intelligent grid-forming buildings. The national test phase of the Smart Readiness Indicator, launched in late 2024, provides an important framework for assessing the capacity of buildings to monitor, adapt and optimise their operation in response to user needs and energy-system signals. This is directly relevant to buildings such as those in the Portuguese WeForming demonstration, where digital control, data availability and flexible operation are central to the business and regulatory case for smart electrification.

At the same time, the regulatory framework for grid access is beginning to recognise the role of flexible assets. The approval of general conditions for flexible connection agreements for producers and storage facilities is a relevant development, particularly in a context where grid-connection capacity is increasingly constrained. Although these provisions are not designed specifically for buildings, they create a regulatory direction that may support more efficient integration of distributed generation, storage and flexible demand. For iGFBs, this suggests a gradual move from a purely passive connection model towards a more dynamic relationship between connected assets and network conditions.

Portugal's updated electricity tariff framework is also relevant. More cost-reflective tariffs and stronger time-differentiated price signals can improve the value proposition for load shifting, thermal storage and demand response. In this sense, tariff design is not only a consumer-billing issue, but also an enabling condition for flexibility.

## Closing the gap

The urgency is clear. Europe is expected to need around five times more demand-side flexibility by 2030. The Iberian blackout of 28 April 2025 underlined the importance of resilience, controllability and flexibility in power systems with high shares of renewable generation and increasingly electrified demand. By increasing, reducing or shifting electricity demand when technically feasible, large buildings can support system operation while also creating new value from existing thermal and electrical assets.

With National Flexibility Needs Assessments due from every Member State in July 2026 and indicative non-fossil flexibility targets to follow by early 2027, Portugal has a narrow window to convert its flexibility potential into firm commitments.

To keep progressing, the rules and markets need to catch up to the technology. Portugal should complete the framework for energy communities and ensure that self-consumption, collective self-consumption and aggregation-related rights can be exercised effectively in practice. Recent developments in self-consumption and aggregation are positive, but they do not remove the need for more operational rules, clearer procedures and stronger implementation.

WeForming

Follow us for more articles

Recent steps on flexible connection arrangements and dynamic management of grid-injection capacity are important, but they need to be translated into transparent and predictable procedures. Connection-queue management should give greater weight to project maturity, system value and flexibility potential, so that technically ready projects are not delayed behind speculative or less advanced projects.

In addition, flexibility must be properly valued. Portugal should strengthen and operationalise cost-reflective and time-differentiated tariff signals so that iGFBs are rewarded for shifting energy demand, optimising thermal storage and reducing stress on the electricity system. In addition, tariff design should be treated not only as a consumer-billing mechanism, but also as an enabling condition for demand response.

Finally, smart electrification can only deliver if buildings are technically prepared. The country's high smart meter penetration and growing renewable generation are encouraging, but it is important to pair electrification with widespread building renovation, interoperable control systems and affordability safeguards. Heat pumps, smart meters and flexibility services will perform best in efficient buildings with appropriate digital infrastructure. Portugal has already built an important platform of renewable generation and smart meter deployment, and updating its regulatory framework, markets and building policy, will allow these assets to deliver full value for citizens and the energy system.


**Duncan GIBB**
Regulatory Assistance Project

**Ângelo CASALEIRO**
R&D Nester

**Mojtaba KAMARLOUEI**
Builtrix



Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.


## POWERED BY


Funded by the European Union

The WeForming project has received funding from the European Union's Horizon Europe Programme under the Grant Agreement No. 101123556.

UK Research and Innovation

The UK participant is co-funded by UKRI.