BUILDINGS PERFORMANCE INSTITUTE EUROPE

IS EUROPE READY FOR THE SMART BUILDINGS REVOLUTION?

Executive briefing

An analysis of the readiness of EU countries to transition to smart buildings concludes that no Member State is fully prepared to take advantage of the benefits smart buildings will entail. The leading countries in terms of a smart-ready environment (Sweden, Finland, Denmark and the Netherlands) have implemented more progressive and holistic approaches to decarbonise the energy system, including taxes, subsidies and stringent building regulations. But even in these cases, there is still ample room for improvement.

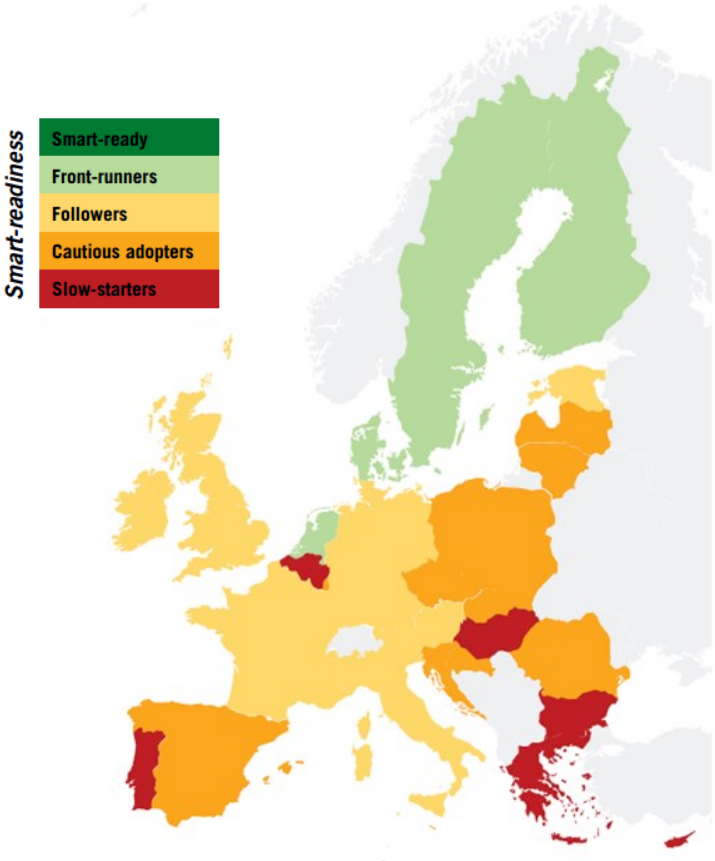
In a smart-ready built environment, citizens and businesses are empowered by the control of their own energy system, producing, storing, managing and consuming energy – whether passively or actively.

Based on a novel approach, BPIE was able to draw a full picture of the smart-readiness level of the European building stock - as shown by the map on the right - which falls short by not reaping the benefits of efficient and smart buildings. By mapping 15 indicators and grading the performance of each country, the overall modest score illustrates that there is a major infrastructure challenge ahead.

INDICATORS OF SMART-READINESS

The report maps the smart-readiness level in the 28 EU Member States based on 15 essential indicators[1]. These indicators are interdependent and are given equal importance in the analysis. For every indicator, the countries are given a score between 1 (not smart-ready) and 5 (smart-ready). For example, the smart-ready level of performance of the building stock is a highly-energy-efficient building stock, in line with the requirements for nZEBs (nearly Zero-Energy Buildings). A score of 1 is then given to countries with a highly inefficient building stock, with an average U-value higher than 1.80, which represents a non-insulated wall built in the post-war period.

The following pages shed some light on each indicator's range[2].



[1] These indicators were derived from the ten principles of a smart-built environment as outlined in the report "Smart Buildings in a decarbonized energy system", 2016, http://bpie.eu/publication/smart-buildings-in-a-decarbonised-energy-system/

[2] For an in-depth look at the scoring methodology and formula, consult the full report at http://bpie.eu/publication/is-europe-ready-for-the-smart-buildings-revolution/

BUILDING ENVELOPE	
Grade	U-value
5	<0.29
4	0.29 - 0.80
3	0.81 - 1.30
2	1.30 - 180
1	>1.80

The smart-ready level is similar to nZEB regulations (W/mK = 0.29), while the lowest score is given to countries with an average U-value (W/mK) higher than 1.80.

FINAL ENERGY CONSUMPTION	
Grade	kWh/m^2
5	<50
4	50 - 115
3	116 - 182
2	183 - 248
1	>248

The smart-ready level is equal to existing nZEB examples (kWh/m^2 = 50), while a lower score is given to countries with an average kWh/m^2 higher than 248.

ABILITY TO KEEP ADEQUATELY WARM/COOL	
Grade	Share (%)
5	>99
4	92 – 99
3	84 – 91
2	75 – 83
1	<75

The smart-ready level is equal to a society where nearly all occupants can afford to keep their home and workplace adequately warm/cool. The lowest score is given to countries with more people at risk of poverty or social exclusion than the EU average in 2014.

HEALTHY LIVING AND WORKING ENVIRONMENT	
Grade	Share (%)
5	>99
4	92 – 99
3	84 – 91
2	75 – 83
1	<75

The smart-ready level is equal to a society where nearly all occupants have a healthy living and working environment. The lowest score is given to countries with more people at risk of poverty or social exclusion than the EU average in 2014.

SMART METER DEPLOYMENT	
Grade	Share (%)
5	>99
4	50 - 99
3	25 - 49
2	1 - 24
1	<1

The smart-ready level is set to be equal to a full deployment of smart meters. The lowest score is given to countries where the smart meter deployment had not started by 2015.

CONNECTIVITY	
Grade	Score (%)
5	>99
4	92 – 99
3	84 – 91
2	75 – 83
1	<75

The smart-ready level is equal to a highly-connected society. The lowest score is given to countries where one out of four households does not have access to broadband.

FLEXIBLE MARKET	
Grade	Score
5	>90
4	75 - 90
3	60 - 74
2	45 - 59
1	<45

The smart-ready level is equal to a framework that is very flexible and competitive. The lowest score is given to countries with very little competition on the electricity market and with barriers for consumers to switch provider.

DYNAMIC PRICING	
Grade	Evaluation of electricity market
5	Fully dynamic pricing
4	Hourly pricing (for majority of users)
3	Hourly pricing (for minority of users)
2	Static Time of Use pricing
1	Fixed pricing

The smart-ready level is equal to a framework with fully dynamic pricing. The lowest score is given to countries where the electricity market has none of the dynamic pricing characteristics.

DEMAND RESPONSE	
Grade	Evaluation of DR market
5	Commercially open
4	Open for majority of actors
3	Open only for major industries/actors
2	Very low participation
1	Closed

The smart-ready level is equal to a framework that is commercially open for demand response. The lowest score is given to countries with a closed market for demand response.

BUILDING ENERGY STORAGE	
Grade	Share of dwellings
5	>1
4	1 - 3
3	0,1 - 0.99
2	0,001 - 0.099
1	<0,001

The smart-ready level is equal to a built environment where 3% of the building stock has been equipped with building energy storage in the past year. The lowest score is given to countries with next-to-no market penetration of building energy storage.

ELECTRIC VEHICLES	
Grade	Share of EVs from new car registrations
5	>75
4	50 – 75
3	25 – 49
2	10 - 24
1	<10

The smart-ready level is equal to a scenario where all new vehicles are electric. The lowest score is given to the countries with almost no market penetration of electric vehicles.

RENEWABLE ENERGY	
Grade	Share of gross energy consumption
5	>50
4	38 – 50
3	24 – 37
2	10 – 23
1	<10

The smart-ready level is equal to the results of an analysis of power system flexibility, where the mid-term regime (of 50% variable renewable energy) requires storage, demand flexibility and a dynamic energy market. The lowest score is given to countries with less than 10% of gross final energy consumption from renewables.

PHOTOVOLTAICS	
Grade	Share of gross energy consumption
5	>8
4	6 - 8
3	3 – 5
2	1 – 2
1	<1

The smart-ready level is equal to the High-Ren scenario for Europe outlined in the IEA's technology roadmap[3]. The lowest score is given to countries with almost no market penetration of PV.

HEAT PUMPS	
Grade	Share of primary energy consumption
5	>6.50
4	4.01 - 6.50
3	1.51 - 4.00
2	0.10 - 1.50
1	<0.10

The smart-ready level is equal to the IEA's BLUE map scenario for 2050[3], where the capacity of heat pumps needs to grow by 6.6 more times compared to today's level. The lowest score is given to countries with an insignificant share of energy production from heat pumps.

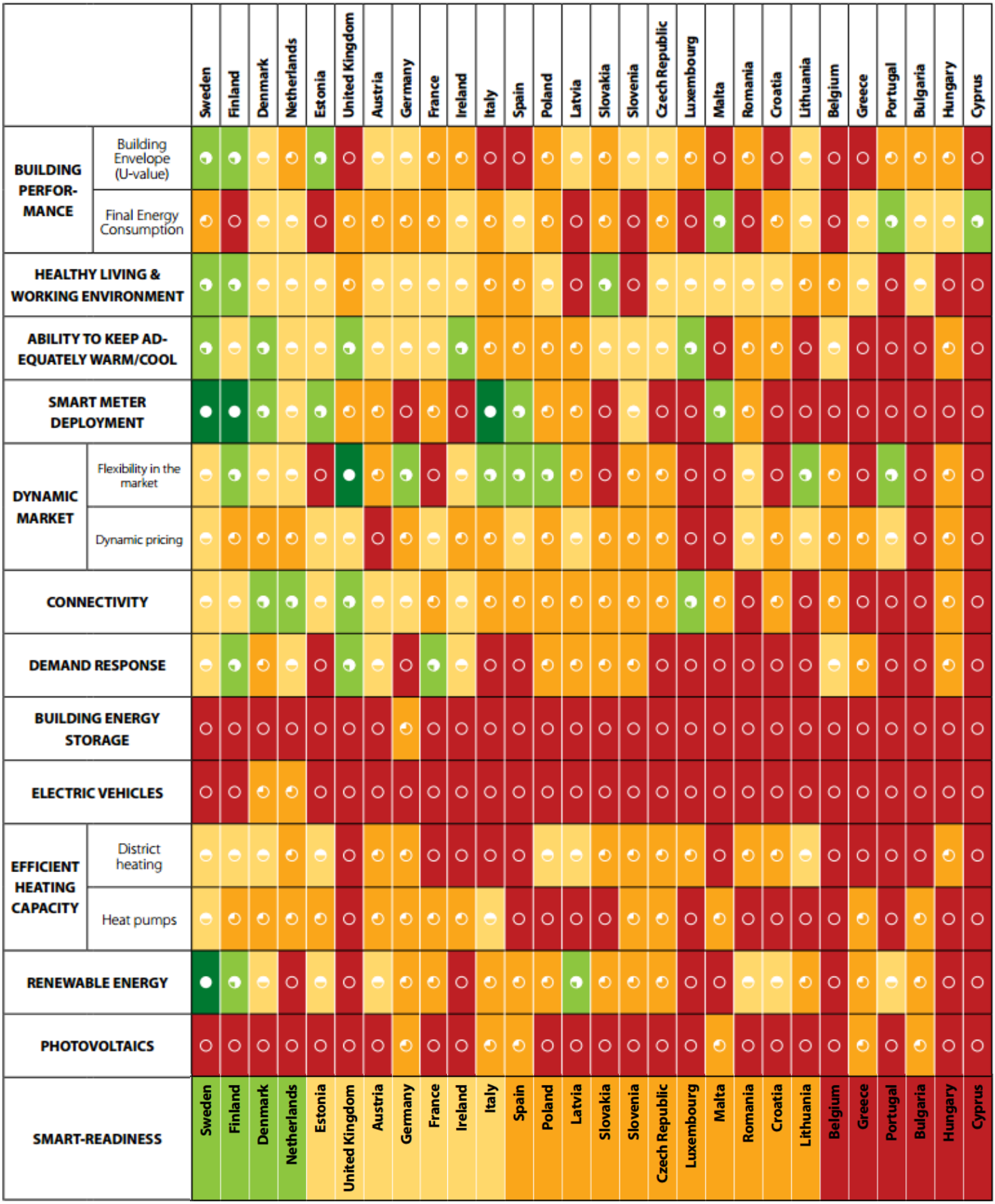
DISTRICT HEATING	
Grade	Share of DH in final energy consumption for heating
5	>50
4	34 - 50
3	18 - 33
2	1 - 17
1	<1

The smart-ready level is equal to the ambitious scenario of the Heat Roadmap Europe project for Europe's energy future[4]. The lowest score is given to countries with an insignificant share of district heating.

[3] International Energy Agency , "Technology Roadmap: Energy-efficient Buildings: Heating and Cooling Equipment," [Online] Available: https://www.iea.org/publications/freepublications/ publication/buildings_roadmap.pdf, 2011.

[4] Connolly, David; Mathiesen, Brian Vad; Østergaard, Poul Alberg; Møller, Bernd; Nielsen,Steffen; Lund, Henrik; Trier, Daniel; Persson, Urban; Nilsson, Daniel & Werner, Sven, "Heat Roadmap Europe 2: Second Pre-Study for the EU27," STRATEGO, [Online] Available: http://vbn.aau.dk/da/publications/heat-roadmapeurope-2050%28a855df3d-d211-45db-80de- 94ee528aca8d%29.html, 2012.

Smart-built environment results for each country based on the indicators[5]



[5] Dark green represents smart-ready, while red illustrates a less positive grade. The exact score (from 1 to 5) for each indicator is given by the partial or full fill of the circle.

Out of the 15 indicators analysed, four are essential to gain a deeper understanding: *the energy performance of the building stock; deployment of smart meters; demand-response availability and share of energy for renewable sources.*

Building performance

A highly-energy-efficient building stock, made possible by deep renovation and efficient new buildings, is a prerequisite to a smart-built environment as it enables demand response. The analysis shows that the energy performance of the European building stock is on average poor both in terms of designed and actual energy use.

Smart meters

Sweden, Finland and Italy have completed their roll-out of smart meters – with over 95% of homes equipped. While other countries – Malta, Spain, Estonia, Denmark, Latvia, Poland, Austria and the Netherlands - have made some progress, many countries have not shown significant growth in the use of smart meters.

Demand response

Adaptive solutions - such as demand response - are only in their infancy, especially in the residential and commercial sectors. The leading countries are currently Finland, France and the United Kingdom with a commercially-open demand-response market.

Renewable energy sources

The indicator assesses the amount of renewable energy in the energy system. The European average in 2014 was 16%, on the path to the EU renewable target of 20% by 2020 and 27% by 2030, although a decarbonised building stock will require a much higher share of renewables.

CASE STUDIES

Progressive policies and innovative front-runner projects illustrate the economic viability of smart buildings and their multiple benefits. Some examples are given below.

Heat pumps in Finland

Heat pumps have become a popular heating source in Finland. The country's vision is that by 2020 there will be 1 million heat pumps (in a country with a population of 5.4 million) running with an installed capacity of more than 6000MW, generating more than 10TWh of renewable energy annually. Policies to achieve this vision include tax deductions of renovation work (€2000 – €3000 for labour costs) and a subsidy programme of up to 20% when oil and electric-heating systems are replaced by a heat pump, biomass or a district heating system.

Sweden has already finished the deployment of smart meters

Since the 1st of July 2009, billing of electricity use in Swedish homes must take place monthly and should be based on real consumption data. 95% of the smart meters in Sweden can collect hourly readings while about 80% are prepared for a two-way communication. This transition has been induced by a legal decision to make monthly-meter-reading available to customers, which in turn led to a decision by distribution companies to roll-out smart meters to meet this requirement.

District heating in Denmark brings energy security, renewables and smart cities

In a dynamic energy market, smart buildings connected to district heating could sell their excess energy, cutting down the heat-load peak, allowing the district heating supplier to avoid running peak-load boilers, often fuelled by conventional energy sources. District heating could integrate excess heat (e.g. heat recovery of cooling systems or data centres), heat pumps driven by photovoltaic solar panels, as well as geothermal and solar thermal energy. District heating is a cornerstone of Denmark's many smart cities (for example, in Sønderborg where it has enabled a greater uptake of renewables and smarter energy use). Today, most Danes receive their heating from a district heating system.

KfW push for PV home-storage solutions in Germany

The German government offers a 30%-investment-grant on equipment purchased with low-interest loans provided by the German State-owned development bank KfW. The scheme has helped boost the residential energy storage market from almost zero installations two years ago to around 1,000 per month. By the end of 2015, around 35,000 households and commercial operations in Germany had invested in a PV-battery system.

France is opening up for demand response

France is the first country to have put in place workable market rules for demand response. For example, regulators have made it possible for third-party aggregators to have contracts with consumers to provide demand response without the supplier's agreement. Imbalances are neutralised by the transmission system operator (TSO), whereas a sourcing price for electricity is defined centrally thus enabling the balance-responsible-party to avoid being penalised by demand response activation.

Amsterdam is boosting the roll-out of electric vehicles

Electric vehicles are heavily subsidised in the Netherlands, with additional subsidies available in Amsterdam. The Dutch capital has taken an active role in encouraging electric vehicles since 2009, prompted by a desire for cleaner air. Having established 1,500 charging points serving 5,000 users a month, the city is keen to maintain this momentum. Drivers of electric vehicles can also enjoy the benefits of preferential parking permits and exemption from registration taxes.

CONCLUSION

- All EU Member States must ensure that their building stock, energy infrastructure as well as regulatory and financial frameworks are future-proof, in order to reap the benefits of the pending smart building revolution.
- Several case studies illustrate the importance of dynamic and self-learning control systems, which empower occupants with control over their own energy consumption and production. Today, these systems play an insignificant role in the residential building sector, but the importance of the technology is set to grow quickly.
- The roll-out of smart infrastructure should be supported by the EU legislation, such as enabling a flexible electricity market that fosters adjustability for consumers, competition among utility companies and innovative business ideas.
- Data quality and availability of smart building indicators (such as dynamic and self-learning control systems) are currently not adequate to foster an optimal science-based development in the sector.
- The introduction of a smartness indicator in the "Clean Energy for All Europeans" package, the 2016-released European energy legislation package, is welcomed, but needs concretisation and enforcement to lead Europe towards a smart and decarbonised building stock by 2050.

For an in-depth analysis, see BPIE's report at:

http://bpie.eu/publication/is-europe-ready-for-the-smart-buildings-revolution/

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The Buildings Performance Institute Europe is a European not-for-profit think-tank with a focus on independent analysis and knowledge dissemination, supporting evidence-based policy making in the field of energy performance in buildings. It delivers policy analysis, policy advice and implementation support.

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