



# DEEP ENERGY RENOVATION

TRAPPED IN  
OVERESTIMATED  
COSTS AND STAGED  
APPROACH

Policy brief

April 2018

# Headlines

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- **One-step deep energy renovation** is achieved in France at **an average renovation cost of €316/m<sup>2</sup> for dwellings in multi-family buildings and €374/m<sup>2</sup> for detached single family homes.**
- A **cap on energy consumption** and a **cap on the cost of one step deep energy renovation** make energy renovation companies changing their business model.
- **Private investors** should be attracted by **one-step deep energy renovation** as the **return on investments is well above 5%** in more than half of French projects.
- **Industrialisation and digitalisation** of **one-step deep energy renovation** will lead to **further cost reduction.**

## THE CHALLENGE

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The 2018 EPBD recast requires Member States to develop renovation strategies to *“support the **renovation** of the national stock of residential and non-residential buildings, both public and private, into **a highly energy efficient and decarbonised building stock by 2050**, facilitating the cost-effective transformation of existing buildings into **nearly-zero energy buildings**” (nZEB).*

The EPBD recast, if effectively implemented, will create an nZEB renovation market of at least 250 million dwellings and 7 billion m<sup>2</sup> of non-residential buildings, over the period 2018-2050.

## THE CONTEXT

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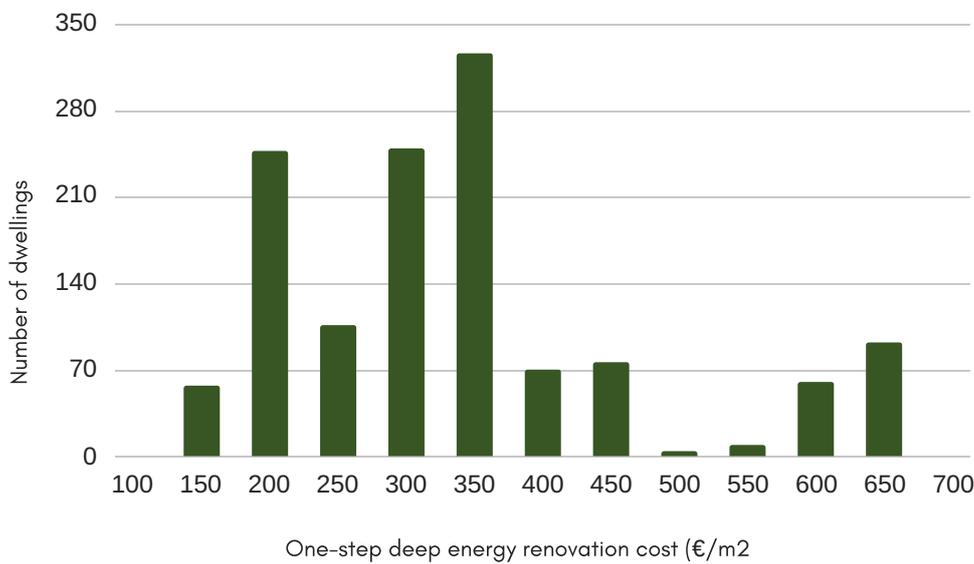
The emerging energy renovation market in Europe, estimated at €109 billion in 2015, is currently a market of **staged energy renovation** works, usually consisting of the installation of **one measure at a time**, which results in **multiple disruptions** to consumers and **technical deadlocks** that increase the **risks of lock-in** and which **lowers the savings achieved**.

This **step-by-step approach** to energy renovation is usually justified by claims that the costs of undertaking all works in one step are prohibitive. This is reported by many EU funded projects that explore how to achieve deep renovation in one step. For example, the CITYNVEST project reported a **cost over €1,200/m<sup>2</sup> for deep renovation** while the ZEBRA project reported costs varying from **€330/m<sup>2</sup> in Poland to €2,500/m<sup>2</sup> in Denmark for nearly-zero energy renovation**.

## ACTUAL COST OF DEEP ENERGY RENOVATION EVIDENCE FROM THE FRENCH BBC OBSERVATORY

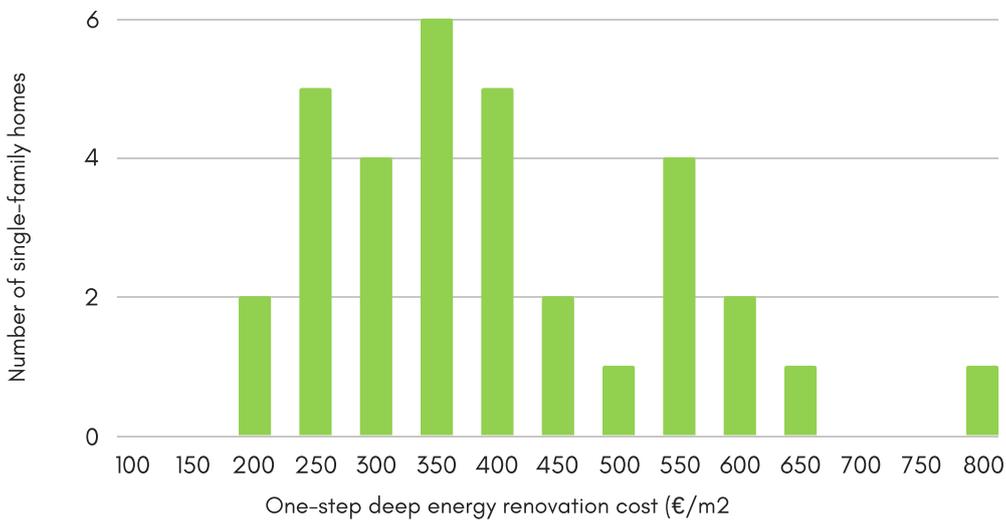
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OpenExp analysed data on energy renovation costs as provided by the French Observatory for Low Energy Buildings, known as the BBC Observatory (See Box). The results show that **deep energy renovation** is being achieved in France at an **average renovation** cost of **€316/m<sup>2</sup> for dwellings in multi-family buildings** (Figure 1) and **€374/m<sup>2</sup> for detached single family homes** (Figure 2). This is significantly lower than the costs reported by EU funded projects. The range in costs between BBC projects are due to the compactness of buildings (ratio of the building's volume to its external surface area) and to the technical constraints related to each building.



**FIGURE 1:**

*Frequency of energy renovation costs of BBC renovated dwellings in multi-family buildings*



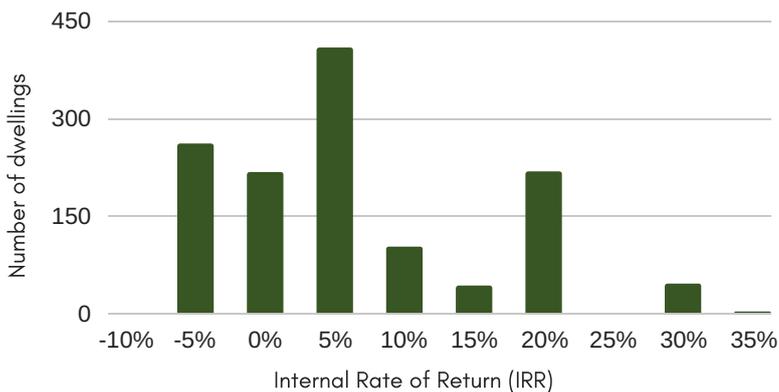
**FIGURE 2:**

*Frequency of energy renovation costs of BBC renovated single-family homes*

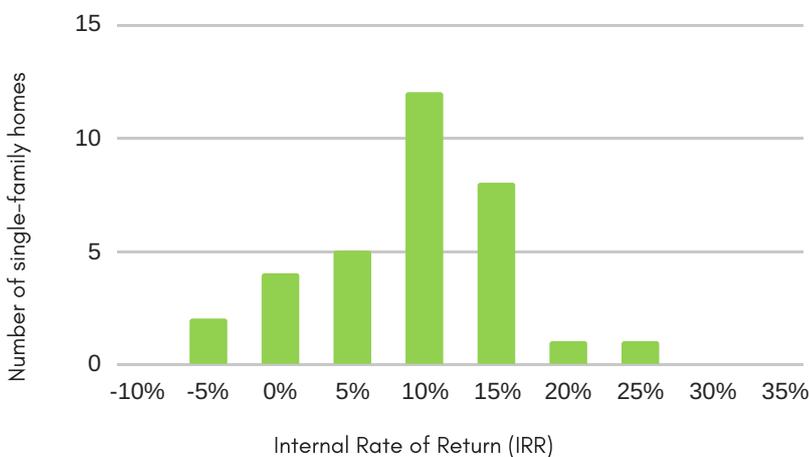
The energy efficiency measures that were implemented in the 1,296 dwellings in multi-family buildings and the 33 detached single-family homes for which detailed technical and economic data are available, include the insulation of walls (mainly external), roofs and floors (where relevant) and the replacement of windows, heating systems (including insulation of pipes) and installing controls for heating and ventilation systems. The thickness of the insulation and the efficiency level of the technical systems installed varies with the climate zones, occupancy patterns, existing construction materials and the technical feasibility of each measure to achieve the BBC consumption level.

# COST-EFFECTIVENESS OF DEEP RENOVATION

Investors pay great attention to the Internal Rate of Return (IRR) that they can achieve in a project. It is usually calculated on the assumption that: i) the energy savings achieved after renovation will be maintained over a period of 20 years; ii) a weighted average energy price at 0.125 €/kWh and iii) a 1% annual increase in energy prices.



**FIGURE 3:** Frequency of Internal Rate of Return of BBC renovated dwellings in multi-family buildings



**FIGURE 4:** Frequency of Internal Rate of Return of BBC renovated detached single-family homes

OpenExp found that under the assumptions noted above, **the IRR is positive for 818 dwellings in the multi-family buildings and 27 detached single-family homes** (Figure 3, 4). The IRR varies from +32% to 0% for dwellings in multi-family buildings and from 23% to 0% for single-family homes.

The higher IRR (above the return expectation) should increase the attractiveness of deep energy renovation projects to private investors. BBC projects have all benefited from the public finance available in France for energy renovation.

However, if a **5% minimum return expectation** is assumed, this would mean **305 dwellings in multi-family buildings and 22 detached single-family homes** would have been **financed by private investors without any subsidies**.

OpenExp found that under the assumptions noted above, the IRR is negative for 478 dwellings within multi-family buildings and 6 single-family homes. It varies from -1% to -10% for multi-family buildings and from -1% to -9% for single-family homes. Data available do not allow further investigation to explain the negative IRR.

# LESSONS LEARNED FROM THE FRENCH BBC RENOVATION PROJECTS

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**Deep energy renovation** is much more **affordable** than previously reported. Moreover, **deep energy renovation** is **cost-effective** if:

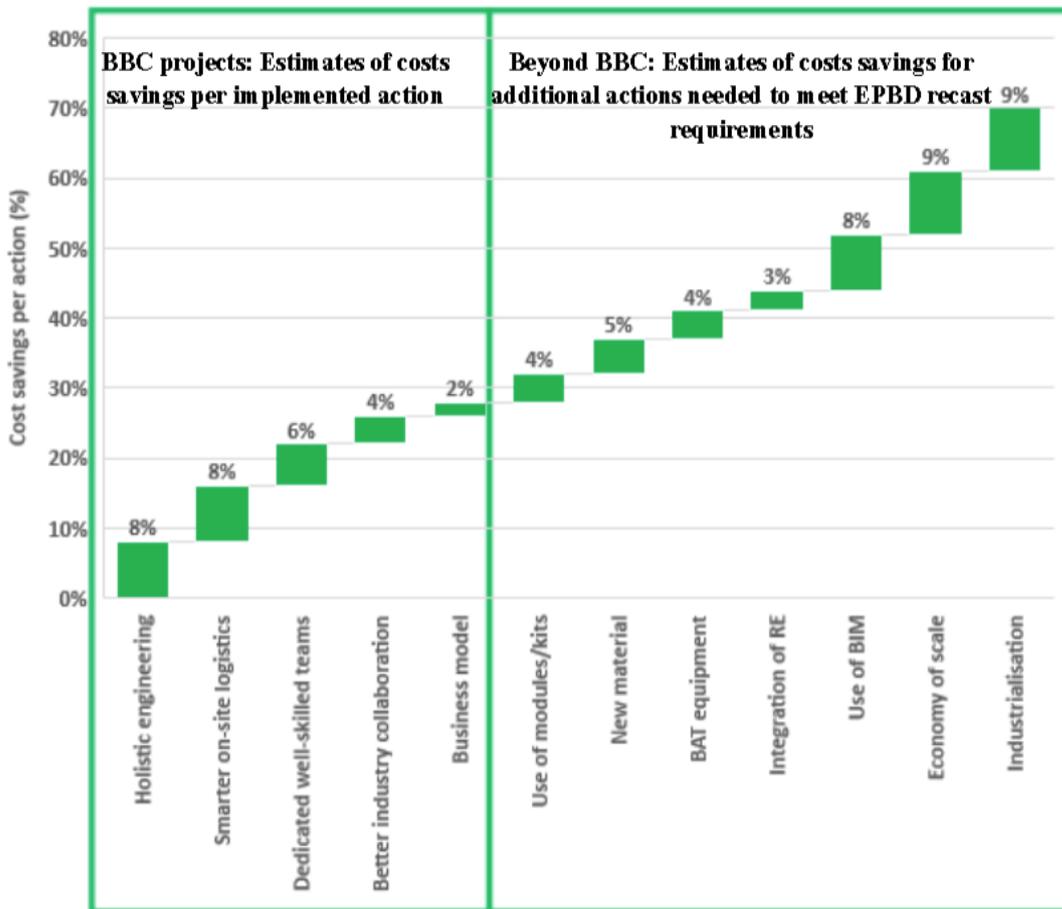
- Energy renovation is conducted in **one step**.
- **A cap** is set for the **absolute primary energy consumption** to achieve after renovation.
- **A cap** is set for the **budget** to deliver the targeted absolute primary energy consumption.
- All available **public finance** (EU finance, tax credits, reduced VAT, reduced property tax, eco-loans and EEOs) for energy renovation is **bundled**.
- Energy renovation companies provide **offers** based on an **improved renovation process** through an early collaboration of all parties.
- **Energy renovation costs** are calculated for the **holistic solution** proposed to meet the **absolute primary energy consumption** set and not as the sum of the costs for each measure taken separately.

## LOOKING TO THE FUTURE

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A significant effort across Europe will be needed to make Europe's buildings highly energy efficient and decarbonised by 2050, as required by the EPBD recast. **Scaling-up the BBC practice of one step deep energy renovation**, in France, could be very effective and may serve as a suitable model right across the EU28 countries. Making existing buildings **nearly-zero energy** will require the **integration of renewable energy solutions alongside the energy efficiency measures** considered for the French BBC renovated buildings. The combination of both actions will make **nearly-zero energy buildings cost-effective and affordable for all**.

Further cost reductions are available beyond the cost reductions achieved in the French BBC renovated projects analysed here. Initial analysis shows (Figure 5) that the use of



**FIGURE 5:** One step deep energy renovation cost reduction cascade

**digital technologies, advanced automation, Building Information Modelling (BIM) and off-site prefabrication of nearly-zero energy renovation kits** (which must combine efficiency and renewable technologies) **will further reduce energy renovation costs,** especially if **public finance (EU and national) is bundled** to make **large-scale renovation projects** attractive for private investors.

Undertaking a more thorough analysis of cost reduction factors, such as those listed above, would be beneficial to pursue.

## The French BBC (Bâtiment Basse Consommation) Observatory

The French BBC Observatory is the largest publicly available European database providing technical and economic data for deeply renovated buildings. The depth of the renovation is based, in every case, on the need to meet the requirements of the French BBC label. The BBC label is a voluntary label introduced in 2009 by EFFINERGIE, a non-governmental organisation. The label aims at transforming the French building stock into low energy consumption buildings. The French Law for Energy Transition and Green Economy required, when it was introduced in 2015, the overall building stock to be at the BBC consumption level by 2050.

Renovated buildings are BBC certified if the primary energy consumption of the regulated loads (heating, cooling, lighting, hot water and auxiliaries for heating, cooling, ventilation and hot water) is lower or equal to  $80 (a+b)$  kWh/m<sup>2</sup>.yr; where a and b are coefficients allowing for energy consumption adjustments based on a projects' location (climate zones and altitudes). The highest primary energy consumption of a BBC certified building, if the worst combination of coefficients a and b occurs, is 120 kWh/m<sup>2</sup>/yr. Further details on the calculation of primary energy consumption if energy is produced locally and on BBC requirements on air tightness are included in the operational manual of the BBC label.

The BBC Observatory includes in total 539 renovation projects out of which 298 have been certified by independent third parties and 242 projects which are the result of calls, launched by pioneer regions in France, to renovate their building stocks to the BBC consumption level.

The BBC Observatory provides technical information for 550,000 m<sup>2</sup> renovated non-residential buildings and 9,380 renovated dwellings corresponding to 694,000 m<sup>2</sup> of residential buildings. Detailed economic data is provided for 1,296 dwellings in multi-family buildings and 33 detached single-family homes. More than 90% of the projects included in the BBC Observatory were built in the period between the Second World War and the implementation of the first French performance-based building energy code in 2000.

Technical data provided by the BBC Observatory include a detailed description of the building (the construction material, the existing heating, cooling and ventilation systems), the number of dwellings, the location (climate zone and altitude), the construction year, the building type (single-family homes, multi-family homes), the ownership type (private, social housing), the total number of square meters and the number of renovated square meters as well as the primary energy consumption before and after renovation. It also includes a detailed description, for each project, of the efficiency measures implemented and the renewables solutions used, if any.

Economic data provided by the BBC Observatory include the overall cost of the renovation and the cost of the energy renovation works. The latter being broken-down per efficiency measures for some projects. Information on public finance used to support BBC projects is also provided for few projects.

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