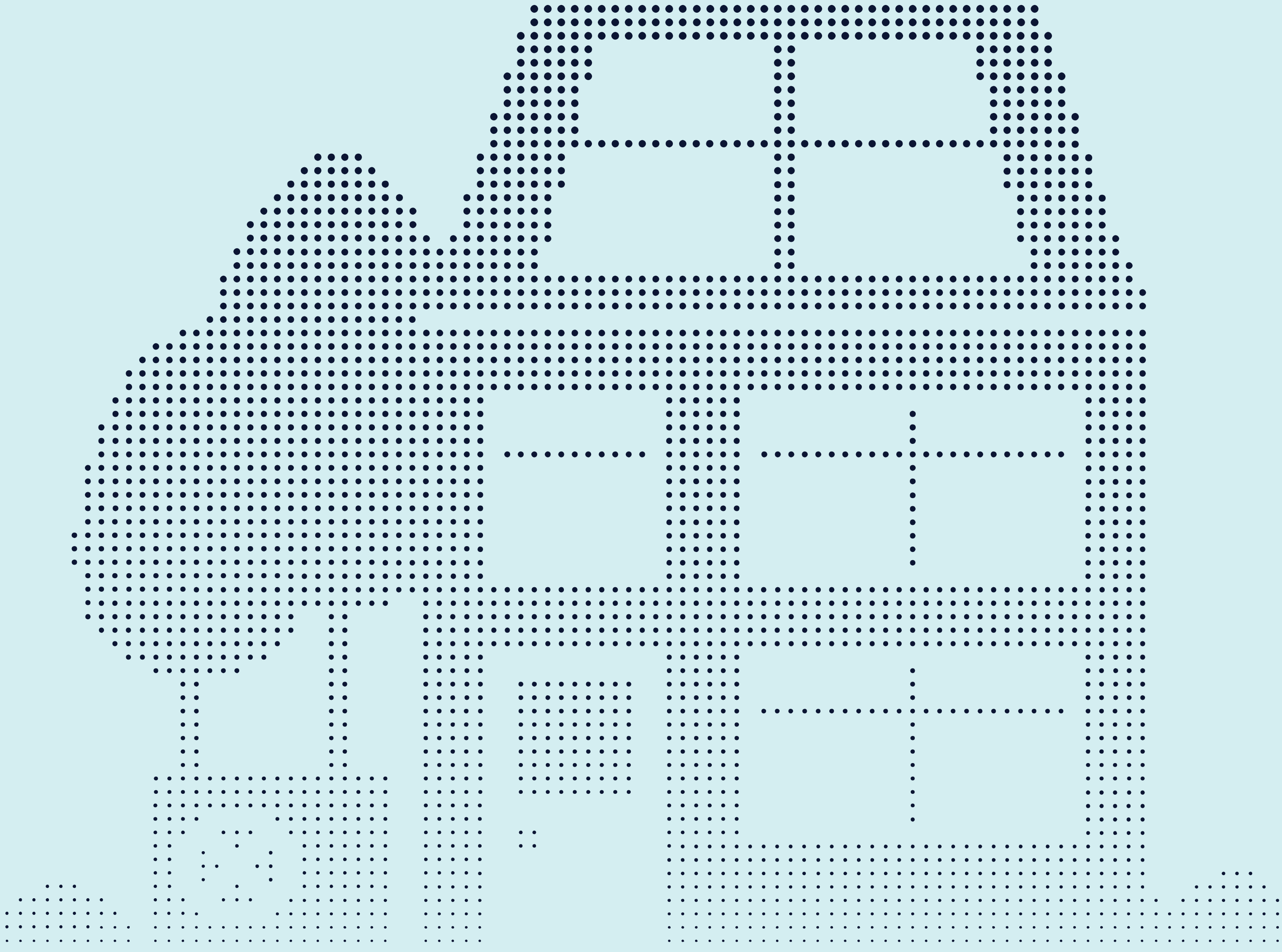
THE MCS FOUNDATION

2024

FUTURE HOMES SAVINGS

Modelling the running costs of new homes with renewables.



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Future Homes Savings

Modelling the running costs of new homes with renewables

SEPTEMBER 2024

About The MCS Foundation

Our vision is to make every UK home carbon-free. The MCS Foundation helps drive positive change to decarbonise homes heat and energy through our work programmes, grants and advocacy.

We support engagement programmes, fund research and facilitate innovative solutions to drive widespread adoption of renewables to help achieve a Net Zero future. In addition, the Foundation oversees the Microgeneration Certification Scheme (MCS) which defines, maintains and improves quality standards for renewable energy at buildings scale.

Designed by: Jimmy Davies, JimmyDavies.com

Contents

Glossary

Airtightness

The resistance to inward or outward air leakage through unintentional leakage points or areas in the building envelope. A lower score equates to a better airtightness.

Decentralised mechanical extract ventilation (dMEV)

Low energy, compact continuous running fan designed to promote good air quality by extracting stale air out of the building.

Heat Transfer Coefficient

A measure of the rate of heat loss per degree of temperature difference between inside and outside of the dwelling.

kgCO_2e/yr

Kilogram of carbon dioxide equivalent per year.

tCO_2e

Tonnes of carbon dioxide equivalent.

U-Value

The rate of transfer of heat through a particular section of construction. Measured in watts per square metre per kelvin (W/m^2K).

Wastewater heat recovery

Heat is extracted from shower/bath water, which then warms the incoming mains water, reducing the energy required to heat the water up to temperature.

Foreword

David Cowdrey
Acting Chief Executive
The MCS Foundation

The future of buildings standards in England could have a huge impact on households' energy bills, UK carbon emissions, and the domestic renewable energy sector.

With a new Labour Government promising to build 1.5 million new homes by 2029, it is essential that these homes are built to standards that ensure low bills and minimal carbon emissions. The UK's existing housing stock already contributes around a fifth of total carbon emissions, and new houses should help to reduce dependence on fossil fuels, not increase it.

Put simply, we should not be building houses in the next five years that will have to be retrofitted, at much greater cost, five or ten years later. Having solar panels, heat pumps, battery storage and EV charging as the default for new homes will achieve that. Building new 'smart homes', able to store electricity and transfer it back to the grid, will enhance the grid flexibility that is essential for electrifying heat and transport.

Yet integrating renewable energy into new homes is not only an environmental issue. Building in these technologies will, as this report shows, massively reduce energy bills for households. Crucially, the benefits of combining technologies – solar panels as well as heat pumps and battery storage – will achieve the greatest savings.

Combining heat pumps with battery storage and solar panels could save an average detached house as much as £1,489 a year, compared to installing a heat pump without solar panels or a battery. Over the course of a 25-year mortgage, a three-bed semi-detached home would see savings over nearly £39,000.

At the same time, providing quality assurance within the Future Homes Standard is essential to ensure confidence in renewables. That means requiring all renewables to be installed to MCS standards.

We urge the new Government to realise the benefits of a Future Homes Standard that includes MCS certified solar panels, heat pumps, and battery storage as the default for all new homes. The Government must resolve years of delay and uncertainty by introducing the Future Homes Standard without delay, and mandating renewables for low bills and resilient homes.

Executive Summary

This report presents modelling on the running costs of different housing archetypes with a variety of low-carbon technologies. The report is intended to inform decisions about the Future Homes Standard, and in particular whether to include solar panels and battery storage, as well as heat pumps, as the default for new homes.

The report is accompanied by an interactive model showing running costs for different housing archetypes, which can be found here: Future Home Standards – What should they be?

The Future Homes Standard – Options being considered

The UK's housing sector contributes 17% of the nation's total carbon emissions. The Future Homes Standard (FHS) is meant to address the emissions from new-build homes and is set for implementation in 2025. It will require all new homes to be "zero-carbon" ready, reducing emissions by 75% compared to 2013 standards.

In March 2024, the previous government consulted on two options for notional building standards (NBS) to achieve this target, known simply as **"Option 1"** and **"Option 2"**. Both options include high-efficiency air source heat pumps as the default for heating and include the same insulation standards. However, Option 1 mandates additional specifications including solar photovoltaic (PV) panels, which are absent from Option 2.

Neither of the two options currently being considered by Government include battery storage. The modelling of household running costs with different combinations of low-carbon technology that produced this report also considered battery storage. For the purposes of this report, we have named this **"Option 3"**, and it is identical to Option 1 but with the addition of battery storage.

Table 1 *- Additional specifications for each option*

Specification	Option 1	Option 2	Option 3
Solar PV	✓		✓
Heat pumps	✓	✓	✓
Wastewater heat recovery	✓		✓
Increased airtightness	✓		✓
Decentralised mechanical ventilation (dMEV) system	✓		✓
Battery Storage			✓

Modelling Options 1, 2 and 3

Running costs

The key finding from this modelling is that Option 1 always produces lower running costs than Option 2, and Option 3 always produces the lowest running costs of all. Running costs per month and per annum are set out below the full list of housing archetypes is available at the interactive model here: Future Home Standards – What should they be?

The model shows that dwellings built to both Option 1 and Option 3 standards have significantly lower annual running costs than homes built to Option 2 standards, as follows:

Table 1 *- Average running costs of dwellings built to Option 1, Option 2 and Option 3 standards.*

	Detached		Semi-detached		Terrace		Flat	
	Yearly	Monthly	Yearly	Monthly	Yearly	Monthly	Yearly	Monthly
Option 1	£603	£350	£623	£52	£551	£46	£977	£81
Option 2	£1,764	£147	£1,663	£139	£1,393	£116	£1,298	£108
Option 3	£275	£23	£321	£27	£287	£24	£614	£51

Table 2 *- Average running cost savings of dwellings built to Option 1 and Option 3 compared to Option 2 standards.*

	Detached		Semi-detached		Terrace		Flat	
	Yearly	Monthly	Yearly	Monthly	Yearly	Monthly	Yearly	Monthly
Option 1	£1,161	£97	£1,040	£87	£842	£70	£321	£27
Option 3	£1,489	£124	£1,342	£112	£1,106	£92	£684	£57

Solar savings and battery benefits

Constructing houses with heat pumps, solar panels and battery storage will require an additional cost for developers. The Government predicts that building homes with solar panels (Option 1) would increase developers' costs by £5,200 compared to Option 2. These upfront costs would be higher for Option 3.

However, the modelling work presented in this paper demonstrates that the savings from Option 1 and Option 3 significantly exceed any additional upfront costs. Homeowners see a substantial return on investment both annually and over a 25-year mortgage period through reduced energy bills.

For instance, the average cumulative energy savings from solar PV installation on a 3-bed semi-detached house (under Option 1) amount to £38,811 over the loan term of a 25-year mortgage, as shown in Figure 1. These capitalised savings far exceed the initial investment in solar PV.

Figure 1 *- Average capital costs of installing solar PV on each typology variation built to Option 1 standards. Average cumulative energy costs saved over the 25-year loan term including operational and maintenance costs is also displayed, as well as the values of those in today's prices (discount rate: 3.5%).*

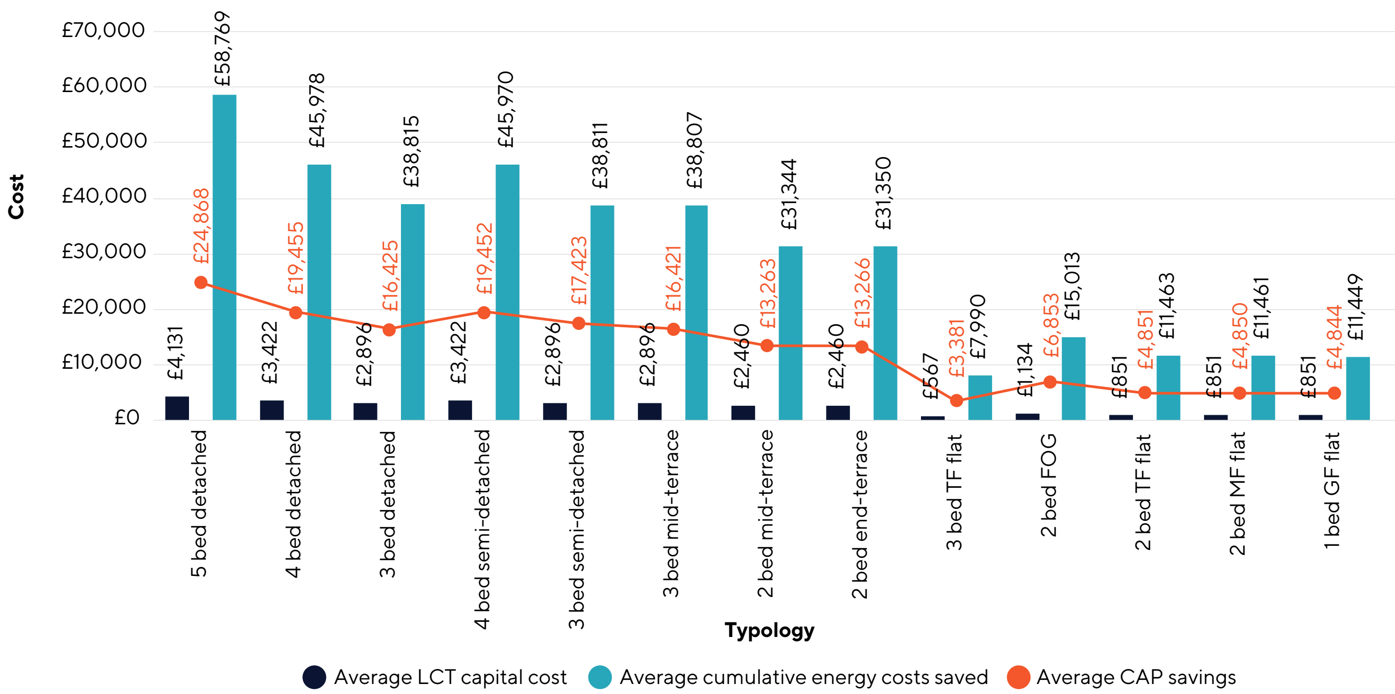
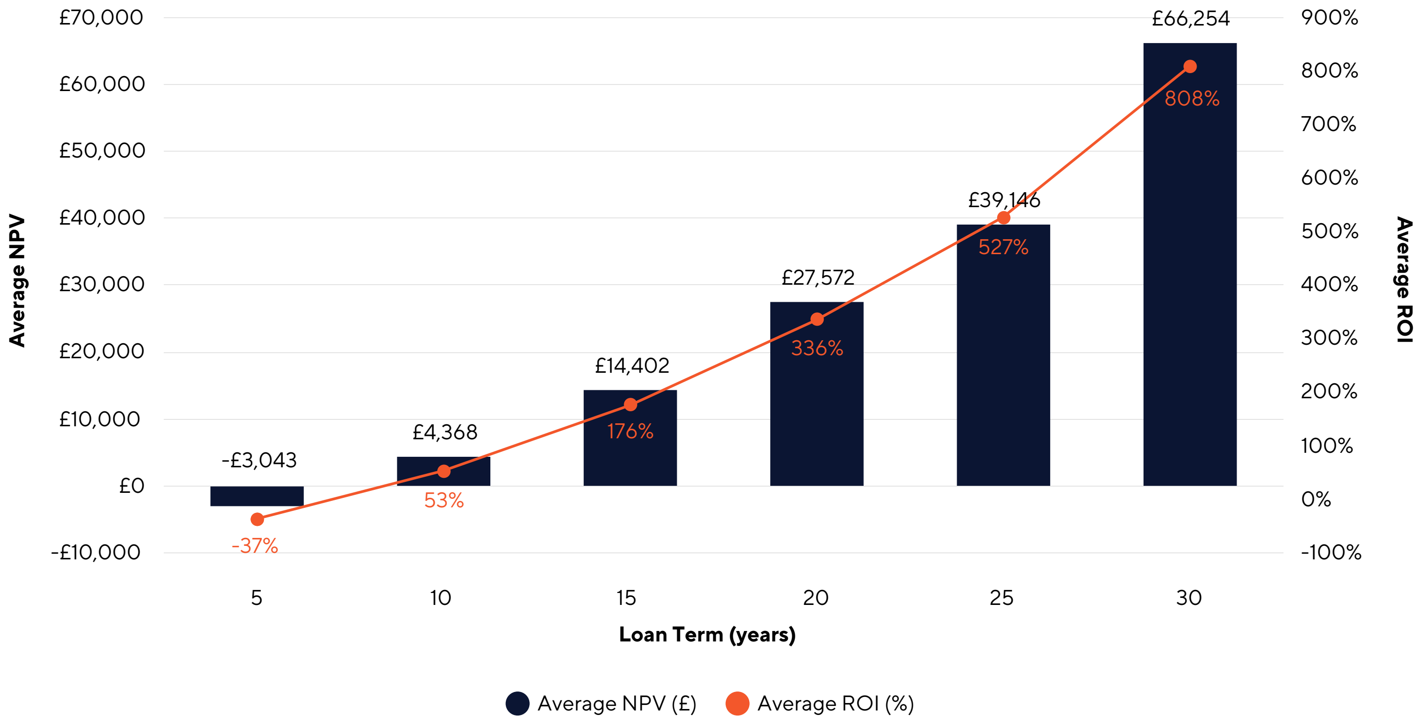


Figure 2 shows the modelled average Net Present Values (NPVs) and return on investment (ROI) for a 3-bed semi-detached house for a range of loan terms for Option 3. NPVs become positive shortly after year 5 and the ROI is greatest over a 30 year loan term, at 808%, with the NPV exceeding £65k. This suggests that the initial costs can be easily recouped, leading to substantial financial benefits thereafter.

Figure 2 *- Modelled average Net Present Values (NPVs) and return on investment (ROI) for a 3-bed semi-detached house built to Option 3 standards across a range of loan terms.*



This potential for savings annually and long-term could encourage lenders to offer mortgages under better terms based on improved affordability due to lower energy expenses.

Recommendations

The analysis here concludes that almost any combination of low carbon technology installed in a new home, whether solar PV alone or with battery storage, will deliver significant benefits over the system or mortgage's lifespan, as well as annual energy bill savings. This leads to the following recommendations:

1. **Government should amend the building regulations of the FHS by mandating solar PV for newbuilds.**

   We would also encourage including battery storage in the FHS NBS as this would greatly enhance self-consumption rates of energy, further decrease costs and reduce the strain on the grid. This will ensure new homes are not only net zero carbon, but also incur lower energy bills.

2. **Lenders should consider offering mortgages under better terms to those living with low carbon technologies.**

   This modelling demonstrates the increase in mortgage affordability from significantly reduced annual energy costs, which should be considered when evaluating a prospective homeowners' eligibility and potential borrowing capacity.

By adopting these measures, the UK can significantly reduce greenhouse gas emissions from the newbuild housing sector while providing financial benefits to homeowners and supporting sustainable development.

1.Introduction

Our housing stock contributes 17% of all greenhouse gas emissions produced in the UK.[1]

There is a considerable challenge in retrofitting existing homes to make them low-carbon, high-efficiency dwellings, and therefore it is essential that we build homes that are future proof from the outset. Despite this, up to now there have been no national building regulations in the UK to ensure that homes are being built as 'zero-carbon' ready. In 2006, the Labour Government set up the voluntary Code for Sustainable Homes, with the intention to develop this into a national regulation in 2016, known as the Zero Carbon Homes standard.[2]

However, this was scrapped by the Conservative Government in 2015, and almost a decade later, newly built homes are still not required to install low carbon heating or small-scale renewables like solar photovoltaic (PV) panels as standard. Since 2016, around 1,382,070 permanent dwellings have been built in the UK.[3]

According to Energy Performance Certificate (EPC) lodgement data of new properties, only 1.78% have achieved the top rating (A), while 80.9% received a B, 12.2% a C, 3.8% a D, 1% an E, 0.2% an F, and 0.06% a G.[4] It is likely that almost all of these properties will need to be retrofitted in order to meet our 2050 net zero targets.

EPC lodgement data of new properties

A	B	C	D	E	F	G
1.78%	80.9%	12.2%	3.8%	1%	0.2%	0.06%

In their recent progress report, the Climate Change Committee emphasise that electric heating should be the default in all new buildings.[5] Building energy-efficient, zero-carbon homes is a no-regrets action that offers numerous wider benefits beyond environmental sustainability. These include improved air quality, reduced reliance on volatile fossil fuels, and job creation in the green technology and construction sectors.[6]

1.2 The Future Homes Standard – Option 1 vs Option 2

The Department for Levelling Up, Housing and Communities under the previous government published the Future Homes and Buildings Standard consultation in December 2023, which concluded in March 2024.[7] The Future Homes Standard (FHS) is a set of building regulations that will be implemented in 2025, requiring new homes and non-domestic buildings to be 'zero-carbon' ready, with 75% fewer carbon emissions compared to 2013 building standards. These new standards seek to ensure that any homes built from 2025 will require no additional retrofitting and will be fully net zero with the decarbonisation of the electricity grid, currently planned for 2030 under the new government.[8]

The FHS builds on the current Approved Document Part L, an interim standard which mandates that new domestic dwellings be built with 31% fewer emissions compared to the 2013 building standards – addressing the conservation of fuel and power.
The key objectives of the FHS put forward in the consultation are as follows:

- significant carbon savings.
- new homes and non-domestic buildings that are high-quality and affordable to run today, and over the long term, with efficient, low-carbon heating, the option of renewable generation, and good levels of building fabric.
- new homes and non-domestic buildings that are 'zero-carbon ready', meaning that because they use electric or other renewable energy sources, no work will be necessary to allow them to achieve zero carbon emissions when the electricity grid is fully decarbonised. This means gas boilers, including hybrid and hydrogen-ready boilers, will not meet the proposed standards.
- cost-effective, affordable, practical and safe building solutions, meaning they are deliverable by industry given likely capacity, skills and supply chains, on sites across the country.

1.2.1 Heat pumps and heat networks are the default heating systems proposed

The consultation acknowledges that considering the 75% emissions reduction standard and the requirement that new homes will be 'zero carbon ready', it will not be possible to install fossil fuel heating systems in new homes from 2025. This includes both hybrid heat pumps and 'hydrogen-ready' boilers. Instead, it is expected that the primary heating sources for new builds will be heat pumps (air-source, ground-source, and water-source) and low-carbon heat networks.

1.2.2 The domestic notional building specification options

Two options were proposed in the consultation for the Notional Building Specifications (NBS) for domestic homes. These are [theoretical] examples of ways to achieve the proposed standard, but could differ in practice – for example, using a ground source heat pump rather than an air source heat pump. Here, both Option 1 and Option 2 feature high-efficiency air source heat pumps and the same insulation standards, as per the 2021 uplift to Part L. Where they differ is their approach to the trade-off between upfront capital costs for developers and lifetime running costs for homeowners.

For example, Option 1, which includes solar (PV) panels, wastewater heat recovery, increased airtightness, and a decentralised mechanical ventilation (dMEV) system, maximises carbon savings and minimises consumer bills, but has higher upfront costs for developers. Option 2 excludes these features, resulting in lower build costs but higher consumer bills compared to Option 1. In the recent consultation, the government predicted that Option 1 would result in a £5,200 uplift to developers' costs compared to Option 2.[9]

The MCS Foundation are strongly advocating for Option 1 of the NBS, where every new home in the UK must be built with a solar PV array covering the equivalent of 40% of ground area. (See Table 1).[10]

Table 1 *- Comparison of LCTs in the Option 1 and Option 2 notional building options.*[10]

Building Element	Option 1	Option 2
Roof U-value (W/m²K)	0.11	0.11
External wall U-value (W/m²K)	0.18	0.18
Floor U-value (W/m²K)	0.13	0.13
Window U-value (W/m²K)	1.2	1.2
Door U-value (W/m²K)	1.0	1.0
Heat source	A notional air source heat pump equivalent to ErP A++	A notional air source heat pump equivalent to ErP A++
Waste water heat recovery	Yes	No
Hot water system	Hot water storage vessel, 120mm insulation	Hot water storage vessel, 120 mm insulation
Airtightness (m3/m2.h @ 50Pa)	4	5
Ventilation	Decentralised mechanical extract	Natural ventilation, with intermittent fans
Solar panels	High efficiency solar PV panels covering equivalent of 40% of ground floor area (excluded for flats over 15 stories)	None

1.3 Option 3 – Battery Storage

The MCS Foundation is also advocating for battery storage to be added to Option 1 of the NBS – what we are calling 'Option 3'. Battery storage does not feature in either proposed FHS option, which we consider a significant missed opportunity. Electricity peak demand in the UK often occurs during the evening when solar PV systems are less productive. As a result, households may find it challenging to fully utilise the electricity generated.[11] The increase in deployment of distributed solar PV systems has raised concerns about the export of excess electricity to the grid during peak generation times, which could lead to grid imbalances and contingencies.[12] Pairing battery storage with solar PV installations can substantially help to address this issue as it doubles the PV self-consumption,[13] thereby significantly reducing both electricity imports and exports to the grid.

What's more, small-scale renewables like heat pumps, solar panels and battery storage are expected to become increasingly 'smart' in the future, which means they would be able to self-regulate and function flexibly in response to innovative energy tariffs.[14] New homes equipped with smart, flexible small-scale renewables will be able to optimise energy bill savings for homeowners, as well as contribute to the wider energy system.[15] Domestic batteries in particular could help to provide more low-carbon flexibility to the energy system, supporting the integration of renewables,[16] reducing the reliance on fossil fuel-based peak generation,[17] curbing carbon emissions[18] and stabilising electricity prices.[19] Therefore, we want to see the notional building specification for both heat pumps and low carbon heat networks include battery storage with capacity equivalent to solar peak.

In the recent consultation, the Ministry of Housing, Communities and Local Government[i] sought evidence on the potential benefits of incorporating solar PV into new builds for homeowners. Previous reports have started to address this, including a recent Solar Energy UK report which found that a typical new build could save between £974-£1,151 a year by incorporating solar PV.[20]

This report builds on that work by using econometric modelling to compare the relative costs associated with Option 1 and Option 2 of the FHS, to evaluate whether it is beneficial adding solar and battery storage to new builds. Part 1 of the report compares Option 1 and Option 2 in terms of annual energy demand, annual running costs, and the cost-benefit derived from building homes with solar PV for developers. Part 2 analyses the additional long-term benefits of installing battery storage (Option 3) alongside solar PV. Finally, it compares the annual and lifetime carbon emissions of Option 1, Option 2 and Option 3.

This report targets homebuyers, policymakers, and housebuilders, highlighting the economic advantages of using low carbon technologies (LCTs) in various types of new build homes. Furthermore, it aims to demonstrate to mortgage lenders that new builds constructed to Option 1 of the NBS minimises lending risk by lowering annual energy bills, thereby improving the mortgage affordability rating for prospective homeowners.

[i] Previously the Department for Levelling Up, Housing, and Communities.

2.Methodology

The modelling work for this report was conducted by Think Three, who developed an econometric tool to calculate the energy demands of UK dwellings, both with and without LCTs. This tool provides detailed calculations of energy use, costs, and carbon emissions for various typical UK home types, constructed to different levels of energy efficiency and use of LCTs. The MCS Foundation commissioned Think Three to evaluate the costs and benefits of installing solar PV and battery storage using the Home Energy Model specifications provided for both Option 1 and Option 2 of the Notional Building Specifications.[21] As described in Section 1.2, Option 1 and Option 2 feature air source heat pumps, and the model assumes this by default.

These savings clearly depend on some key assumptions.

Notably, the analysis presented here assumes that energy prices will continue to rise, following the general trend of the past two decades. This will be influenced by various global geopolitical factors and the UK's commitment to decarbonise the electricity and gas grids by 2050. Rising energy prices will make investments in offsetting imported grid energy attractive. However, even if energy prices fall, investing in LCTs remains beneficial, albeit slightly less so. Modelling different electricity price scenarios has shown that net present values (NPVs) remain positive even with decreasing energy tariffs.

Table 2 *- Typology metric*

House type	Typology	Total floor area (m^2)	Solar PV capacity (kWp) (40% floor area)	Size of battery storage (kWh)
Flat*	1 bed GF	70.56	1.215	5.00
	2 bed MF	70.56	1.215	5.00
	2 bed TF	70.56	1.215	5.00
	2 bed FOG	74.10	1.620	5.00
	3 bed TF	103.08	0.810	5.00
Terrace	2 bed end	80.10	3.645	10.75
	2 bed mid	80.10	3.645	10.75
	3 bed mid	97.86	4.455	10.75
Semi-detached	3 bed	97.86	4.455	10.75
	4 bed	121.12	5.265	10.75
Detached	3 bed	97.86	4.455	10.75
	4 bed	121.12	5.265	10.75
	5 bed	152.74	6.885	10.75

* GF = ground floor, MF = middle floor, TF = top floor, FOG = flat over garage

2.1 Price Input Assumptions

It is possible to select different tariffs for gas and electricity for the model, but for the analysis presented the following energy prices have been used:

- Gas – 7p/kWh
- Electricity – Standard Variable Tariff 27p/kWh
- Export tariffs – 15p/kWh for any excess generation spilled to the grid[ii]

2.2 Other Cost Assumptions

Assumptions for the Capital and Operational & Maintenance (O&M) costs for different LCTs have been used within the analysis to ensure upfront and ongoing costs are captured and assessed as part of any lifetime financial burden as well as its impact on mortgage creditworthiness calculations. Capital costs for additional LCTs over and above those that would be required to comply with minimum newbuild standards have been secured from known developer costs. Ongoing O&M costs covering replacement components over the mortgage term have been secured through discussions with industry and annualised in tandem with annual energy costs.

The full technical report can be found on Think Three's Website: Future Home Standards – What should they be?, including a detailed summary of all the inputs to and assumptions of the model.

[ii] 'Spilled to the grid' in this context means excess generation sold back to the grid that would otherwise be consumed within the home.

3.Findings

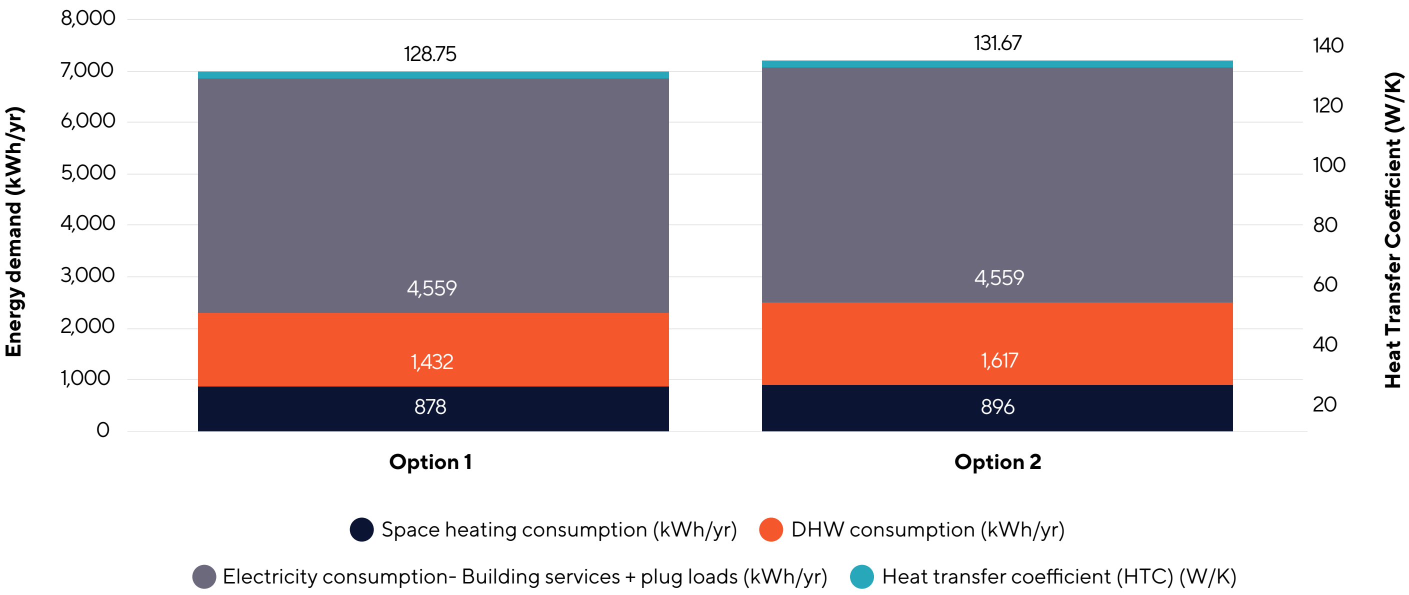
3.1 Option 1 vs Option 2 – the value of solar

3.1.1 Energy demand

In terms of heat loss and overall energy consumption, Option 1 and Option 2 are not too dissimilar if solar panels are disregarded.

Both Option 1 and Option 2 feature high-efficiency air source heat pumps and the same insulation standards, but vary in terms of air ventilation, airtightness, and whether the dwelling has a wastewater heat recovery system (Table 1). Figure 1 shows the average energy demand for the Option 1 and Option 2 specifications before solar panels and battery storage have been included. It illustrates the base consumption for all typical residential energy demands[iii] without using any local generation or battery storage to offset energy consumption. This gives an indication of the performance of the building envelope and fixed building services and therefore provides a useful method for demonstrating any disparity in fabric energy efficiency between the two scenarios. More specifically, the figure breaks down the annual base consumption for space heating, direct hot water (DHW), remaining electrical consumption including plug loads, and the Heat Transfer Coefficient (HTC) averaged for all detached house typologies (Table 2) for Option 1 and Option 2.

Figure 1 *- Average base energy consumption for Option 1 and Option 2 including average space heating consumption (kWh/yr), average domestic hot water (DHW) consumption (kWh/yr), and average electricity consumption for building services and plug loads (kWh/yr). Average heat transfer coefficient (HTC) is also displayed (W/K).*



[iii] Note that energy demand will differ based on individual household consumption rates.

The HTC is a measure of the rate of heat loss per degree of temperature difference between inside and outside of the dwelling. The higher the number, the more heat is lost through the building fabric, and vice versa. The HTC for a typical detached post-war UK home would be >500 W/K.[22] Here, the HTC for Option 1 and Option 2 are 128.75 W/K and 131.67 W/K respectively, indicating low levels of heat loss from the building envelope for both scenarios, but Option 1 having a slightly lower rate of heat loss. Average energy demand for space heating was 878 kWh/yr and 896 kWh/yr for Option 1 and Option 2 respectively. For reference, Ofgem estimates that a typical 2–3-bedroom house uses 11,500 kWh of gas per year – although it is important to note that this may also be used for cooking as well as space heating.

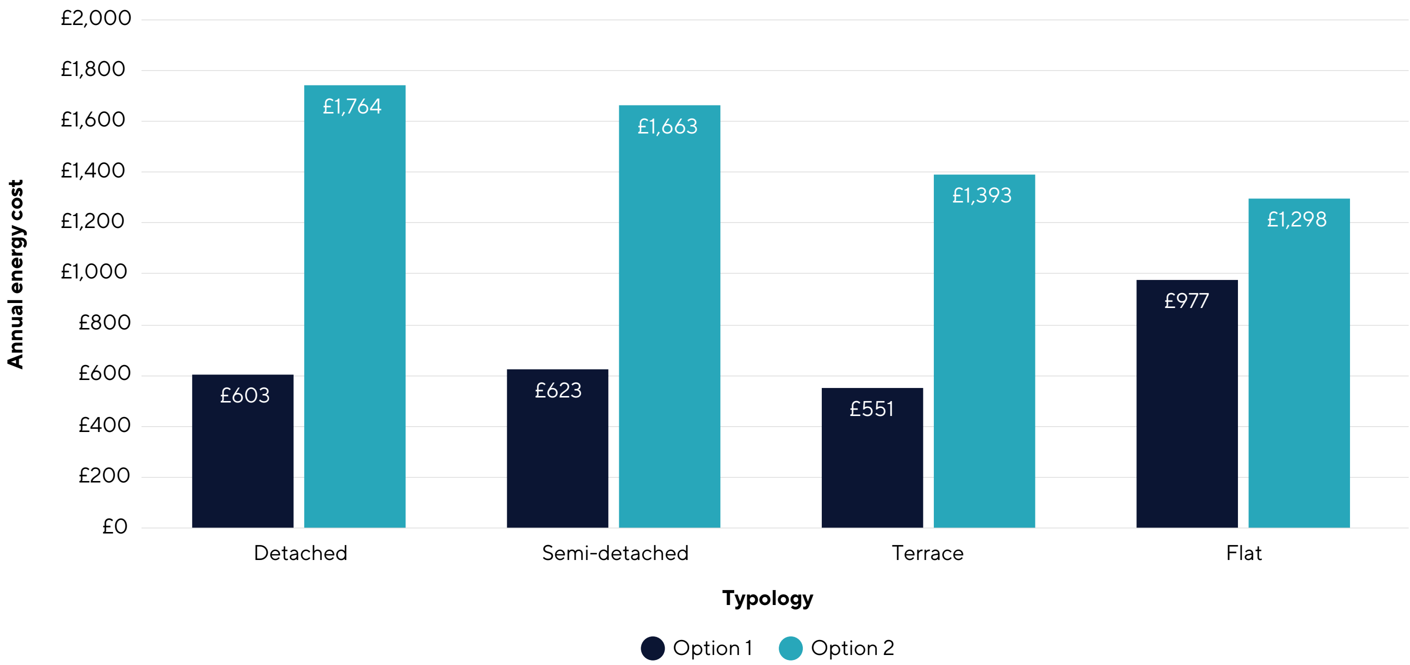
Option 1's slightly smaller values for both HTC and average energy demand for space heating can be explained by the inclusion of mechanical air ventilation and the increased air tightness (4 rather than 5). This means there would be less air leakage, more heat retained in the air of the dwelling and therefore a lower energy demand for Option 1 compared to Option 2, which has less stringent air tightness and only a natural ventilation system. Similarly, the values of domestic hot water consumption for Option 1 and Option 2 were 1432 kWh/yr and 1617 kWh/yr respectively. This is due to the addition of a wastewater heat recovery system in Option 1 dwellings, which feed heat energy from used hot water back into the system. Average hot water consumption is larger than average space heating in both scenarios, highlighting how it easier to reduce energy demand for space heating through fabric improvements compared to hot water.

Despite the minor differences, these findings are a good indicator that the overall energy demand for dwellings built under Option 1 and Option 2 would be very similar. This could be because Option 1's mechanical air ventilation and wastewater heat recovery system require electricity to function, thus increasing the overall demand. This suggests that the main component that will affect running costs will be whether solar PV is included or not. Both specifications tested use electricity as the primary fuel for meeting the space heating and hot water demands, and therefore local electrical generation using solar PV (Option 1) would be an ideal technology to offset electrical consumption for these residential utilities. This is illustrated in the following findings.

3.1.2 Annual running costs

Energy bills in a detached property built to Option 2 will be nearly 3 times the amount per year compared to a detached property built to Option 1.

***Figure 2** - Average annual energy costs for average detached, semi-detached, terrace and flat typologies built to Option 1 and Option 2 standards (£).*



Annual energy bills for an average detached house would be **£1,764** under **Option 2**.

Annual energy bills for the same house under **Option 1** would be **£603**.

Figure 2 displays the model results for average annual energy costs of the four different house typologies built to Option 1 and Option 2 standards. In all cases, the running costs for houses with solar PV (Option 1) are significantly lower compared to those without (Option 2), with annual savings ranging from £321 - £1,161 depending on typology. For example, annual energy bills for an average detached property built to Option 2 standards will be nearly three times the amount per year compared to a detached property built to Option 1 standards, at £1764/yr compared to £603/yr respectively.

An average terraced property built to Option 1 standards will pay £551/yr to cover their entire energy costs, which works out at around £46 per month. However, if the same property was built to Option 2 standards with no LCTs included, occupants would pay around £1393/yr which works out at £116 per month for all their energy.[iv]

These findings demonstrate the significant short-term savings for occupants that could be achieved directly from having solar PV incorporated in the dwelling, without need for any behavioural changes.

[iv] Note that monthly costs will vary depending on season – higher in winter and actually earning money in the summer.

Table 3 - Yearly and monthly energy bill costs for detached, semi-detached, terrace and flat typologies built to Option 1 and Option 2 standards.

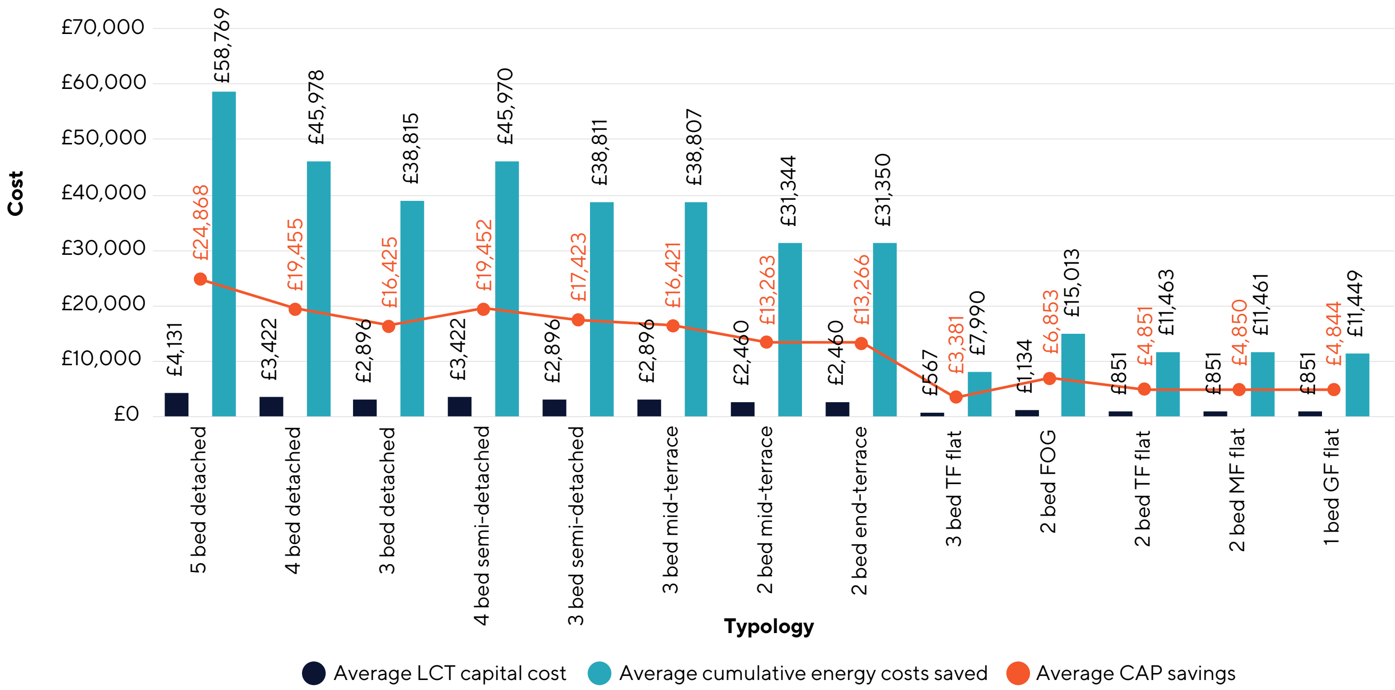
	Detached		Semi-detached		Terrace		Flat	
	Yearly	Monthly	Yearly	Monthly	Yearly	Monthly	Yearly	Monthly
Option 1	£603	£350	£623	£52	£551	£46	£977	£81
Option 2	£1,764	£147	£1,663	£139	£1,393	£116	£1,298	£108

The distribution of the greatest and smallest annual energy costs depending on house typology varies between Option 1 and Option 2; for example, the flat typology has the smallest modelled cost under Option 2 yet the greatest for Option 1. As indicated in Table 2, the flat typology used in this model had on average the smallest total floor area and number of people in the dwelling, and therefore unsurprisingly has the lowest annual running costs. However, with the inclusion of solar PV (Option 1), the flat typology has the highest associated costs. This is because the average roof space for solar PV deployment for flats were relatively smaller in the model, as they were taken from a 5-storey block (excluding the FOG), therefore reducing the amount of potential electricity generation via this technology when compared to detached, semi-detached and terraced properties. The more flats there are in a block, the less roof space is available to individual occupants, and therefore savings could be less when compared to other typologies. However, it would still be a reduction overall, and therefore deployment of solar on flats should not be disregarded, as PV arrays could be increased to deliver higher savings for flatted dwelling typologies.

3.1.3 Cost-benefit analysis

New homes built with solar PV will save homeowners between £7,990-£58,798 over a 25-year mortgage period.

Figure 3 *- Average capital costs of installing solar PV on each typology variation built to Option 1 standards. Average cumulative energy costs saved over the 25-year loan term including operational and maintenance costs is also displayed, as well as the values of those in today's prices (discount rate: 3.5%).*



The cumulative savings from Option 1 for a 3-bed semi-detached house equates to **£38,811** over a mortgage term.

8 in 10 UK adults believe solar panels should be mandatory for new-build homes

Figure 3 shows the average capital costs for solar PV, the average cumulative energy costs saved over the loan term (25yrs - accounting for any additional O&M costs), and the average value of those energy costs savings in today's prices (discounted using 3.5% discount rate) using the Option 1 specification for each typology. This shows that incorporating solar PV will deliver significant savings over time across all typologies, ranging from £7,990 to £58,769. For example, the average cumulative energy costs saved from having the solar PV installed on a 3-bed semi-detached house equates to an average of £38,811 over the loan term. Overall, the capitalised savings far outweigh the initial upfront investment in solar PV across all typologies. These reduced running costs and capitalised savings would translate into improved mortgage affordability for homeowners, which may support more favourable mortgages based on either the loan amount or the interest rate. Other than the clear economic advantages, incorporating solar PV from the outset has the additional benefit in that the house and roof can be designed to optimise solar generation.

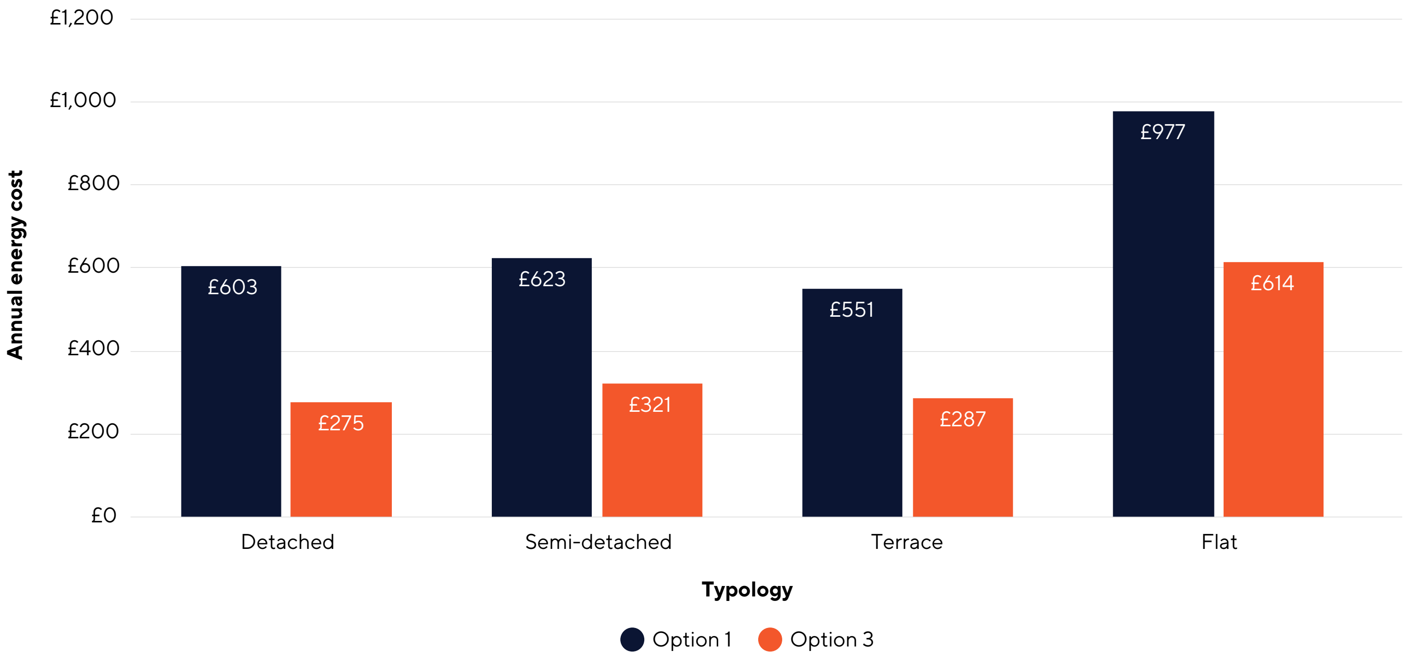
There is significant public support for solar PV. A YouGov survey commissioned by the MCS Foundation in December 2022 showed that 80% of people across the UK would endorse Government regulations making solar panels mandatory for new-build houses. Additionally, a January 2024 survey commissioned by the MCS Foundation found that 79% of MPs strongly support solar PV, with 83% of Labour MPs expressing this support. Overall, the findings presented here strongly suggest that solar PV should be included in the Notional Building Specification for the FHS.

3.2 Option 3 – The additional benefits of battery storage

3.2.1 Annual running costs

A terraced property with solar PV and battery storage will pay less than £24 per month on average for all energy bills.

Figure 4 *- Average annual energy costs for detached, semi-detached, terrace and flat typologies built to Option 1 and Option 3 standards (£).*



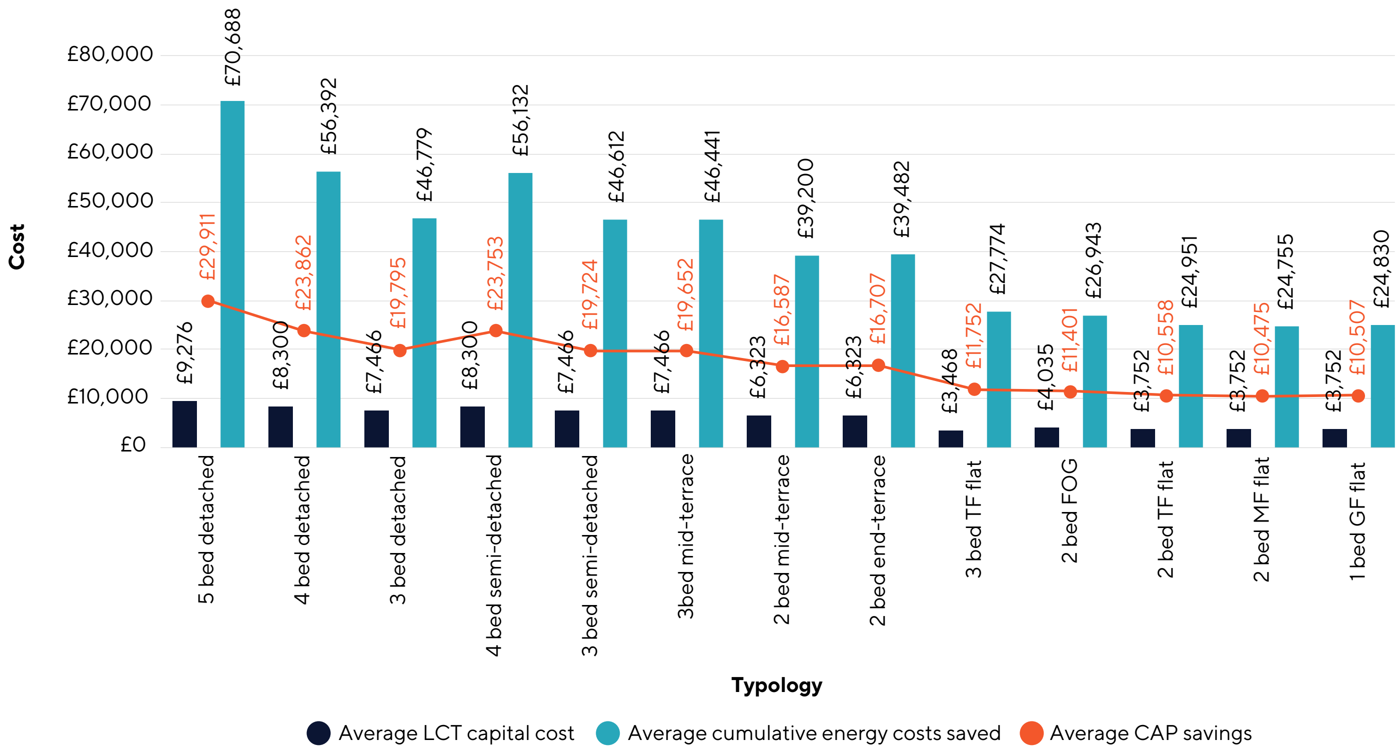
Where battery storage is coupled to the PV system, any excess energy generation during daylight hours can be stored for later use when there is no daylight, or when daylight demand exceeds PV production, increasing the self-consumption rate and reducing the strain on the grid.[23] Like Figure 2 in Section 3.1.2, Figure 4 shows modelled annual energy costs for the different typologies, but this time with the addition of battery storage (Option 3). In all cases, this results in lower average energy expenses when compared to Option 1 – for detached houses, they more than halve (54%). Similarly, average annual energy costs reduce by 48% and 49% for semi-detached and terrace typologies respectively under Option 3.

Flats remain with the highest modelled cost compared to the other typologies (due to the reasoning explained in Section 3.1.2) and only reduce by 37%. However, they have the greatest absolute reduction, taking an average of £363 off annual energy bills. This shows that including battery storage is a cost-effective option as it results in significant reductions to annual energy costs across all typologies. It is also worth noting that only standard tariffs were considered within the modelling, whereas it is expected that the benefits of battery storage could be higher with the use of flexible Time of Use Tariffs that benefit from cheap off-peak electricity.[24]

3.2.2 Cost-benefit analysis

Including battery storage alongside solar PV in flats would increase saved cumulative energy costs by over £10k across the 25-year loan term.

Figure 5 *- Average capital costs of installing solar PV and battery storage on each typology variation built to Option 3 standards. Average cumulative energy costs saved over the 25-year loan term including operational and maintenance costs is also displayed, as well as the values of those in today's prices (discount rate: 3.5%).*



> **The cumulative savings from Option 3** for a 3-bed semi-detached house equates to **£46,612** over a mortgage term.

Figure 5 provides the same information as Figure 3 in Section 3.1.3, but this time including battery storage as well as solar PV for the different typologies. Although the initial average LCT capital costs are larger than if only solar PV was installed, in all scenarios the average cumulative energy costs saved over the 25-year loan term are much greater when compared to installing solar PV without battery storage. For example, including battery storage will save an average 3-bed semi-detached house £46,612 over the 25-year loan term, compared to the £38,811 described previously (Figure 3). This is an average of £19,724 of those energy costs savings in today's prices. This means that even with the higher upfront cost of including battery storage, a return on investment is still achievable.

If the additional capital costs of installing the LCTs were passed to the purchaser through an increased sales price, the occupants would recover these costs (including any additional operational, maintenance and finance costs) both annually (as demonstrated in Section 3.2.1) and over the term of the mortgage. This could translate into an increase in borrowing capacity towards a new house purchase or potentially allow lenders to provide finance under more favourable terms.

3.2.3 Payback periods and return on investment

For an average 3-bed semi-detached house built to Option 3 standards, any upfront costs are made back in under 10 years, reaching an 808% return on investment by year 30.

Figure 6 *- Modelled average Net Present Values (NPVs) and return on investment (ROI) for a 3-bed semi-detached house built to Option 3 standards across the across a range of loan terms.*

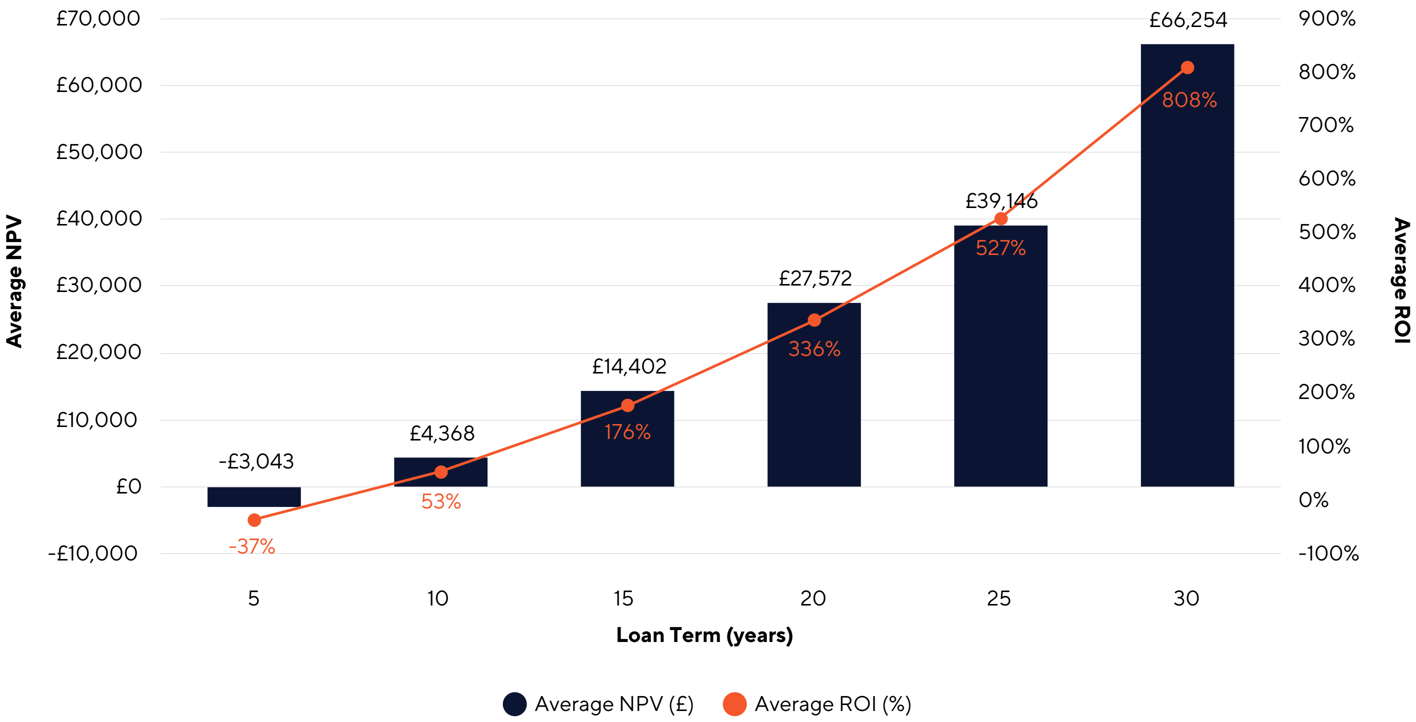


Figure 6 shows the modelled average Net Present Values (NPVs)[v] and return on investment (ROI) for a 3-bed semi-detached house built to Option 3 standards across a range of loan terms.. NPVs are positive sometime after year 5 and the ROI is greatest over a 30 year loan term, at 808%, with the NPV exceeding £65k . A positive NPV was present for all the typologies in the model analysis, suggesting that the initial investment into solar PV and battery storage is made back. These results should encourage lenders to consider downgrading the risks of lending to purchasers of new homes with solar PV and batteries installed. This could include offering mortgages under better terms given the increase in mortgage affordability from significantly reduced annual energy costs and the positive NPVs shortly after 5 years[vi] from the point of purchase.

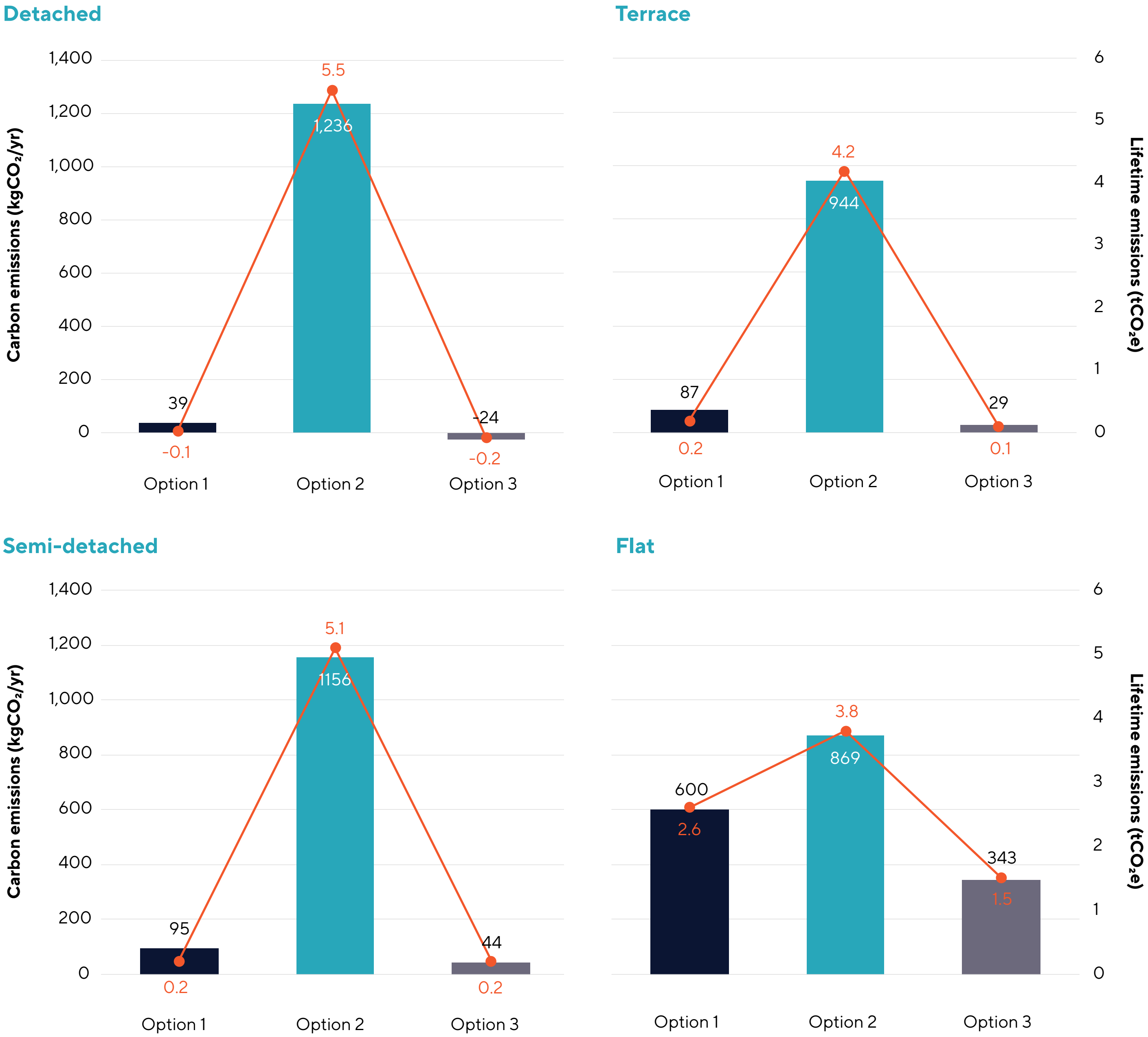
These findings demonstrate that installing battery storage and solar PV into new build homes successfully passes a cost benefit analysis, and therefore the inclusion of battery storage in the Notional Building Specification should not be disregarded by policymakers.

[v] NPVs – How much the investment is worth throughout the LCTs' lifetime, discounted to today's value.
[vi] 5yrs is a common investment hurdle rate before achieving a return on investment.

3.3 Carbon emissions

Option 1 could save over 5 tonnes of carbon for a detached property over its lifetime compared to Option 2.

Figure 7 *- Average annual carbon emissions (kgCO_2) and average lifetime emissions (tCO_2e) over the 25-year loan period.*



While this report primarily emphasises the financial advantages of installing solar PV on new homes, the model also highlights the substantial carbon emission reductions achieved by constructing dwellings to these standards. Figure 7 shows the carbon emissions for the Option 1, Option 2 and Option 3 specifications for detached, semi-detached, terrace and flat typologies. More specifically, it shows the annual carbon emissions ($kgCO_2e/yr$) and lifetime emissions over the lifetime of the property (tCO_2e). It indicates that for all typologies except flats, net-zero carbon emissions can be achieved with the deployment of solar PV from the offset. For example, for the detached house type, average annual carbon emissions when built to Option 2 of the NBS is 1236 $kgCO_2$/yr. However, with Option 1, which includes solar PV, this reduces to 39 $kgCO_2$/yr – which equates to -0.1 tCO_2e over the property lifetime.

These figures were calculated using the proposed PV capacities in the HEM consultation where the annual carbon emissions are very low, but not quite zero. This suggests that with a little extra PV, net zero emissions can be delivered immediately for most new housing typologies. As demonstrated in Figure 7, achieving net zero on flats will be difficult to achieve before we decarbonise the grid in apartment blocks of greater than 6, where communal energy systems may have to be deployed to reduce carbon emissions to very low levels. On blocks of up to 6 storeys, net zero emissions may be achievable where roofs can support large PV arrays. Further modelling of different roof profiles for flats would be required to test this outcome. Nevertheless, the average annual carbon emissions and lifetime emissions for the flat typology follow the same pattern as the others – they still reduce with the inclusion of solar and battery storage. Therefore, building homes with solar PV and battery storage will not only lead to significantly reduced running costs, but it will also substantially lower carbon emissions in the interim period before the electricity grid becomes fully decarbonised.

4. Conclusion

Option 1 of the Future Homes Standard NBS should be pursued over Option 2.

The evidence from the modelling undertaken provides a clear demonstration of the cost-benefits of including solar PV in new homes, and in doing so strongly indicates that Option 1 of the Future Homes Standard NBS should be pursued over Option 2. This is not only for the environmental benefit, but the significant financial benefits to the homeowners. For example, annual savings range from £321 - £1,161, and lifetime savings from £7,990 to £58,769, depending on typology.

Furthermore, the extra benefits of using battery storage should not be overlooked; the ability to store excess energy generation reduces overall energy costs even further, from 37-54%, and the additional upfront costs are easily negated within a few years. Homeowners living in new homes equipped with both solar PV and battery storage would save between £684 - £1,489 annually compared to homes built to Option 2, and expect to save £24,755-£70,688 over a 25-year mortgage period. It is also worth noting that only standard tariffs were considered within the modelling, whereas it is expected that the benefits of battery storage could be higher with the use of flexible Time of Use Tariffs.

The overarching conclusion is that almost any combination of LCTs installed in a new home, whether solar PV or with the addition of battery storage, will be cost-neutral and deliver significant short- and long-term benefits. Short-term savings are demonstrated by the significantly lowered annual running costs, which could lead to improved mortgage eligibility and borrowing capacity of the homeowner. The long-term savings are also clearly illustrated. If the additional capital costs of installing LCTs were passed to the purchaser through an increased sales price, the occupants would recover these costs (including any additional operational, maintenance and finance costs) both annually and over the term of the mortgage. Mandating LCTs in newbuild homes will also have a transformative effect on the market for low carbon home retrofit, where familiarity with LCTs in new construction has a trickle-down effect on the wider refurbishment market.

1. **Government should amend the building regulations of the FHS by mandating solar PV for newbuilds.**

   We would also encourage including battery storage in the FHS NBS as this would greatly enhance self-consumption rates of energy, further decrease costs, and reduce the strain on the grid. This will ensure new homes are not only net zero carbon, but also incur lower energy bills.

2. **Lenders should consider offering mortgages under better terms to those living with low carbon technologies.**

   This modelling demonstrates the increase in mortgage affordability from significantly reduced annual energy costs, which should be considered when evaluating a prospective homeowners' eligibility and potential borrowing capacity.

By adopting these measures, the UK can significantly reduce greenhouse gas emissions from the housing sector while providing financial benefits to homeowners and supporting sustainable development.

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