# Options for setting a net zero energy offset price

## Evidence for Cornwall Council Climate Emergency DPD

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| Revision: | Version 2 |
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| Issue date: | 29th June 2022 |

# 1 Introduction

This report has been issued as additional evidence to support Cornwall Council in taking forward recommendations set out in the CSE's report ''Carbon offsetting within an energy intensity policy framing".[4]

This is to provide recommendations for an energy offset price (in £/MWh) that would be sufficient to meet a shortfall in on-site renewable generation under Policy SEC1 2b (Sustainable Energy and Construction - Residential) of Cornwall Council's Climate Emergency Development Plan Document (DPD).

## 1.1 Rationale

Through their Climate Emergency Development Plan Document (DPD), Cornwall Council have acknowledged the important role that net zero new housing has in leading and catalysing the transition to a net zero local economy. This position is backed by the Committee on Climate Change (CCC), in the advice that has subsequently been adopted under the UK Government's legally binding carbon budgets.

Policy SEC1 2b sets out a requirement for new housing to demonstrate a net zero energy balance over an operational year. Whilst not the same as net zero carbon (see section 4.2), this has been decided for two main reasons:

1. The performance gap. The gap between predicted and actual housing energy use has never been greater, leading to high energy bills than predicted.[1] Energy is a far more familiar metric than carbon that can be more readily assessed and understood by planners and developers alike at early stages of development, as well as measured on the household energy bill.
2. UK electricity grid decarbonisation. As the UK electricity grid continues to decarbonise, the carbon factors used in calculating emissions from energy use will continually change. Requiring net zero energy use in development measures the constant metric that helps ensure new that development doesn't avoid its climate emergency (or fuel poverty) responsibilities, hiding poorer performance behind a decarbonising national grid.

## 1.2 Offsetting mechanisms

Whilst many different offset mechanisms are possible, the analysis in this report assumes that offsetting will take the form of cash-in-lieu payments to Cornwall Council for the investment in local energy projects. This is the most transparent mechanism for the purposes of setting an accurate local offset price and ensures developments' needs and benefits are realised locally.

It is also assumed that offsetting will only apply to an onsite renewable energy shortfall where renewable generation has first been maximised and the Local Planning Authority (LPA) considers that there are sufficient site constraints to deem offsetting necessary. This means

[1] Var. (2021). *Making SAP and RdSAP 11 fit for Net Zero.* Available here: https://bit.ly/3r5wzRn

that energy offsetting cannot be used as a mechanism to avoid energy efficiency or onsite renewable energy measures.

Whilst an equally important topic, this report does not consider the offsetting of embodied energy, such as the energy (and carbon) used in the production of materials and construction. This report relates solely to the operational energy requirement of Policy SEC1.

# 2 Setting the right price

In setting a net zero offset rate locally there are two main considerations: maximising onsite renewables and not increasing the burden on existing district wide decarbonisation plans. Net zero offsetting should without exception be a last resort. Reaching a net zero economy by 2030 will almost always be more cost effective to integrate net zero measures within new development's design and construction than it will be to retrofit existing stock.

Historically, establishing offsetting prices for planning policies has been set based predominantly on the first priority (maximising onsite renewables). Whilst this has accelerated the deployment of renewables, relying on this alone allows new development to offset with 'low hanging fruit', typically large-scale renewables. This would address a net zero energy balance from new development but can reduce opportunities for others and drive up the cost of offsetting for sectors that are less able to meet net zero requirements onsite. Figure 1 below demonstrates the importance of considering the wider impact when setting a net zero offsetting policy.

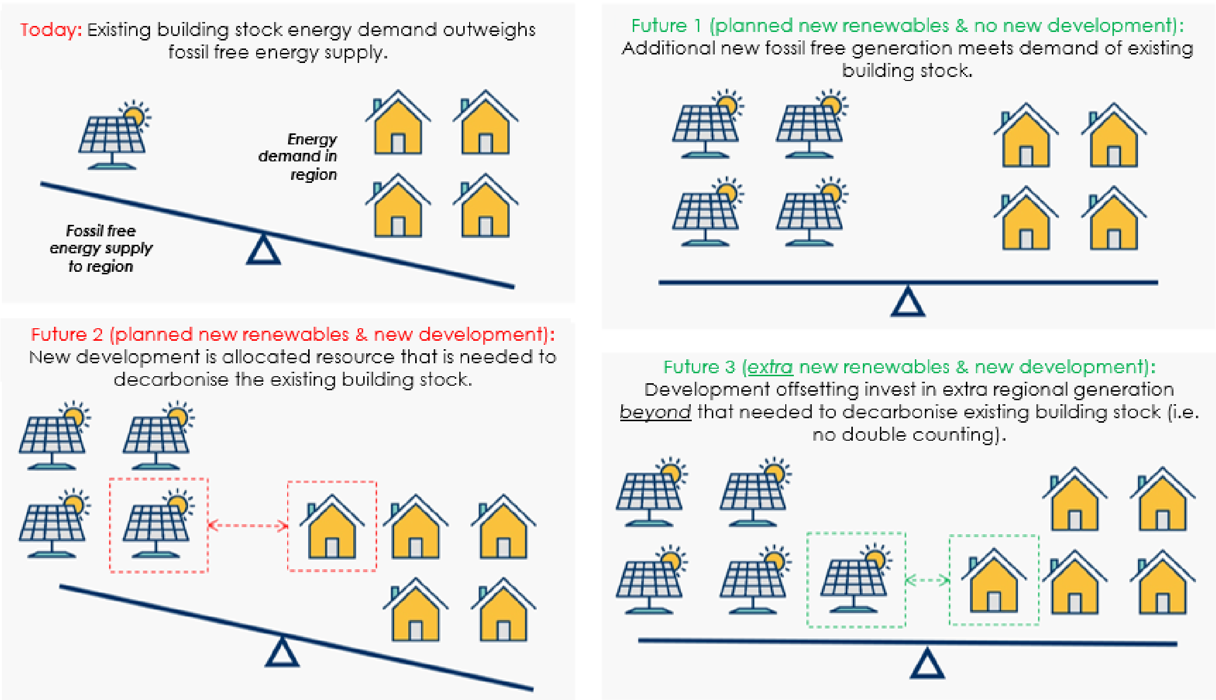


*Figure 1 Balancing net zero at a regional level without double counting*

## 2.1 Rate of savings

Wider principals of carbon offsetting are not covered in this document. However, it is critical that any investment of cash-in-lieu contributions is spent at the same rate as a development would emit residual energy (and therefore carbon). Failure to do so would require higher offset prices to play 'catch-up' with development emissions; offset payments in bank accounts do not save carbon.

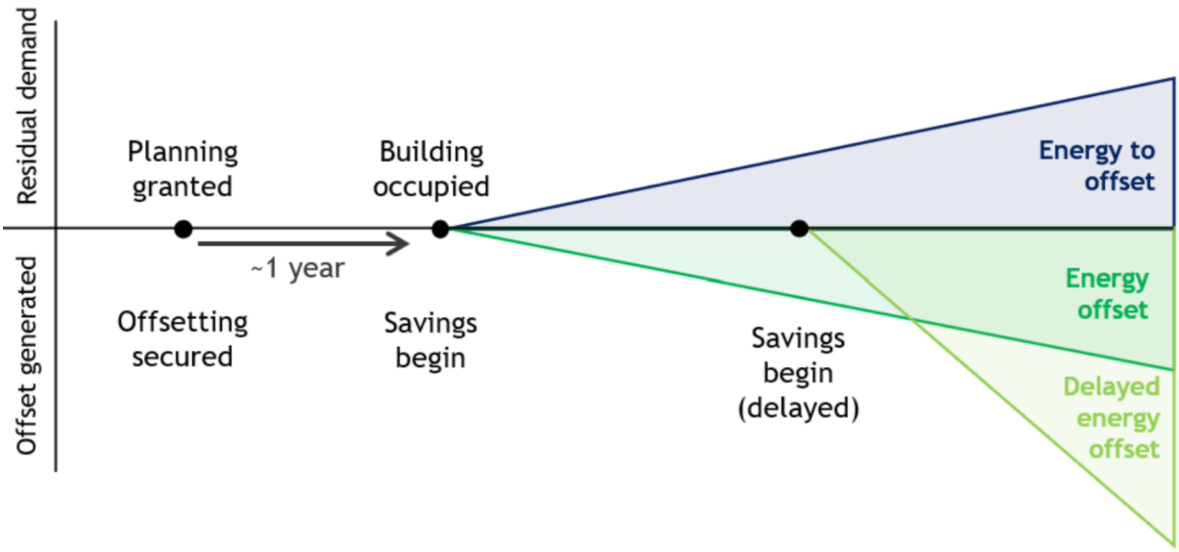


*Figure 2 Rate of savings concept*

## 2.2 Energy & carbon imbalance

In balancing the burden on developers and planning authorities alike, the energy balance in Policy SEC1 is an oversimplification of how the energy system works in practice. Whist the policy ensures that the total MWh of renewable energy supply balances demand over a typical year, both will not be doing so at the same time. As an example, peak solar PV energy generation occurs in summer months during the day, whereas peak heating demand occurs in the morning and evenings during the winter.

It is important to address this equilibrium both to manage the upstream balance of carbon emission and to reduce energy bills to homeowners (as when not generating, energy must be purchased from the national grid). This principal applies equally to onsite measures as it does offsite measures.

For the offsetting case considered in this report (solar PV generation), the specification of a Lithium ion (Li-ion) battery has been included. Whilst this cannot fully balance seasonal peaks and troughs it supports the smoothing out of daily imbalances in supply and demand. Additional seasonal imbalances in energy and carbon are assumed to be addressed upstream by the UK energy grids, through the redistribution and storage of excess supply at peak times.

# 3 Methodology

## 3.1 Scenarios

Whilst many different generation projects could be considered to set a local offset price, this study focusses on retrofitting solar PV panels onto existing Cornwall Housing Limited (CHL) building stock by way of a pilot scheme. This provides a good benchmark as it is the type of project most likely could be delivered through existing Cornwall Council programmes (an active programme has recently delivered PV on 600 CHL homes). Solar PV is also the most likely technology to be installed onsite for new developments.

Three scenarios have been developed to assess the cost of a 3kW domestic installation (typical array size for a small residential roof) under different conditions. Rates must be fully inclusive of all costs that would be incurred in a counterfactual scenario, so offsetting can be fully financed and achievable. This may include:

- Administrative costs
- Annual maintenance
- Panel degradation over time
- Scheme outages[2]
- Inverter warranty / replacements over the scheme life
- Energy imbalance due to delayed installations (Figure 2).[2]

Table 1 below sets out the typical capital costs (in 2022 prices) that would be incurred by Cornwall Housing for a 3kW PV scheme. Admin costs will vary in practice, decreasing as the size of the offsetting scheme increases.

*Table 1 Capital cost scenarios: 3kW PV housing installation in Cornwall*

| | | Low cost | Mid-range | High cost | Reference |
|---|---|---|---|---|---|
| Capital cost (no battery) | £ | 4,500[1] | 4,900[2] | 7,200[3] | 1,3: Naked Solar Cornwall indicative rates. 2: UK Gov ref (BEIS) for 0-4kW |
| Capital cost (incl. battery) | £ | 8,100 | 8,500 | 10,800 | £1,200/kW additional allowance (battery replacement not allowed for) |
| Extended inverter warranty | £ | 500 | 500 | 600 | 10% allowance capped at £200/kW |
| Admin & maintenance | % | 5% | 10% | 10% | Assumption (% of capital) |
| Total Cost (no battery) | £ | 5,250 | 5,940 | 8,580 | |
| Total Cost (incl. battery) | £ | 9,030 | 9,990 | 12,540 | |

Solar PV projects can currently generate power for ~25 years, by which time the panel degradation is expected to be sufficient to merit a full system replacement. Based on solar irradiance in Cornwall, an assumed panel degradation of 0.7% per year and system outages of 0.3% per year, Table 2 sets out the expected generation of this 3kW scheme for different panel orientations on a 30-degree roof slope. Irradiance data is based on MCS data tables.[3]

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[2] Not included in this analysis as assumed minimal.

[3] MCS (2012). *Guide to the Installation of Photovoltaic Systems*. Available at: bit.ly/3hrzJt9

*Table 2 3KW PV system – generation forecast*

| | | South | South East/ South West | East/ West |
|---|---|---|---|---|
| Lifetime generation | kWh | 74,100 | 70,200 | 59,900 |
| Average annual generation | kWh/yr. | 3,000 | 2,800 | 2,400 |

Dividing the scheme costs over 25 years, then again by the generation, gives a resulting energy cost in £/MWh. These are given in Table 3 for all scenarios considered and form the basis for a range of offsetting prices to be considered.

*Table 3 Energy offset prices to develop a 3kW solar PV scheme (£/MWh)*

| System type | Panel orientation | Low cost | Mid-range | High cost |
|---|---|---|---|---|
| 3kW PV without energy storage | South | £71 | £80 | £116 |
| | South East / South West | £75 | £85 | £122 |
| | East / West | £88 | £99 | £143 |
| 3kW PV with energy storage | South | £122 | £134 | £169 |
| | South East / South West | £129 | £141 | £179 |
| | East / West | £151 | £165 | £210 |

# 4 Worked examples

## 4.1 Example house

Following the energy hierarchy, 'fabric first' developments should have a low demand by default. An SEC1 policy compliant home should have a total energy use no greater than 40kWh/m$^2$ with offsetting only permitted where this demand cannot be fully met through onsite generation due to site specific constraints.

The example in Table 4 considers a home that is only just meeting the Council's energy use target and cannot install sufficient solar panels to balance this. Offsetting payments are requested to cover the full development life. This is assumed as 30 years (mirrors London Plan offsetting policy guidance), as opposed to the 25-year life of the PV scheme used as offset. As the offset price is per MWh not per year, it is not necessary that these lifetime periods are the same.

*Table 4 Example building calculation – three scenarios*

| | | *Scenario* | | | Calculation reference |
|---|---|---|---|---|---|
| | | *8 panels* | *9 panels* | *10 panels* | |
| Building energy use | kWh/m$^2$ | 40 | | | *A* |
| Floor area (GIA) | m$^2$ | 90 | | | *B* |
| Solar panels | number | 8 | *9* | *10* | *C* |
| Energy from solar PV* | kWh/yr. | 2,776 | *3,123* | *3,470* | *D* |
| Residual energy | kWh/yr. | 824 | *477* | *130* | *E (A x B – D)* |
| Development life | years | *30* | | | *F* |
| Offset amount | MWh | 108 | 108 | 24.7 | *G (E x F ÷ 1,000)* |
| Offset price | £/MWh | 100 | | | *H* |
| **Offset charge** | **£** | **£2,472** | **£1,431** | **£390** | **J (Gx H)** |

**Assumption based on SE/SW facing unshaded PV panels in Cornwall.*

This example passes the test of promoting onsite energy first; it should always be cheaper for a developer to increase their design from an 8-panel scheme to a 10-panel scheme than pay this offsetting cost. To restrict administration of the scheme, the council may wish to only pursue collection of offset funds under a pre set cap. For this example, a cap of £500 would mean that a single dwelling scheme with 10 PV panels would not be required to make offset payments. If the scheme increased to two dwellings this would the exceed this threshold.

#### Other offsetting prices

A £100/MWh offset charge would be sufficed to fund the installation of east/west orientated Cornwall Housing PV schemes at mid-range cost without a battery (see Table 3). If Cornwall housing wished to install schemes with batteries or scheme with higher costs, an increase in offset price to £150/MWh or £200/MWh may be required to cover costs. For the 8-panel house considered in Table 4 this would increase the offset charge from £2,472 to £3,708 and £4,994 respectively.

## 4.2 Comparison with UK Carbon Values

In lieu of examples of energy offsetting[4], one of the most robust comparisons for offsetting values is the UK Government's Green Book Carbon Values. Documentation on how to use these figures for valuing greenhouse gas emissions in policy appraisals is given here. These values were updated in 2021 to reflect both the UK's commitment to net zero by 2050 and requirements to offset within the UK's terrestrial boundaries.

This guidance is also the reference used by the Greater London Authority (although prior to these updates) to set the London Plan offset price. The price was matched to the BEIS Green Book high price in 2017. For the reasons set out in Figure 1, the "High" prices (Table 5) remain the most appropriate comparison for offsetting emission from *new* development so that offsetting is truly additional.

*Table 5 Extract, BEIS carbon values and sensitivities 2020-2100 for appraisal, 2020£/tCO2e*

| | Carbon Values | | |
|---|---|---|---|
| | Low | Central | High |
| **2020** | 120 | 241 | **361** |
| **2021** | 122 | 245 | **367** |
| **2022** | 124 | 248 | **373** |
| **2023** | 126 | 252 | **378** |
| **2024** | 128 | 256 | **384** |
| **2025** | 130 | 260 | **390** |

Using the 8-panel house in Table 4 as an example, the offset charge can be calculated for carbon in a similar way to energy rates. This is done through the addition of a carbon factor for the energy that is used/generated. Table 6 shows this calculation using the BEIS 2023 high price of £378/$tCO_2e$.

*Table 6 Scenario 3 comparison using BEIS Carbon offset values*

| | | | |
|---|---|---|---|
| Energy to offset | kWh/yr. | 824 | A |
| Carbon intensity of electricity grid | $kgCO_2e$/kWh | 0.240[5] | B |
| Development life | years | 30 | C |
| Total emissions to offset | $tCO_2$/yr. | 3.36 | D (A x B x C ÷1000) |
| Carbon price | £/$tCO_2e$ | 378 | E |
| Offset Charge | £ | £2,240 | F (D x E) |

Carbon offsetting is highly dependent on the carbon factor used in calculations, nonetheless

[4] CSE (2022). Carbon offsetting report – Carbon offsetting within an energy intensity policy framing.

[5] This figure is derived from BEIS Green Book (2021) for consistency in methodology – it differs from the carbon values used in Building Regulations.

the BEIS 2023 (high) carbon value is within 10% of the £100/MWh figure tested in Table 4. This 10% discrepancy can be accounted for in a number of different ways:

- The BEIS offsetting methodology is different, considering various offsetting mechanisms across the UK rather than local offsetting
- Ongoing maintenance costs are understood to be excluded in the BEIS cost
- The BEIS numbers are in 2020 prices and do not account for inflation since this analysis was done.

# 5 Conclusions

An energy offset price of £100/MWh (in 2022 prices) would be sufficient to fund the installation of solar PV panels on existing Cornwall Housing homes at mid-range prices and east/west panel orientations. This rate falls within 10% of a like for like comparison with the UK Government's Green Book values for 2023 (high scenario).

An energy offsetting price in £/MWh should apply across the full development lifetime (deemed as 30 years) using the formula below.

*site energy demand (MWh) – site energy generation (MWh) x 30 (years)*

To restrict administration for minor developments with a minimal shortfall, Cornwall Council may wish to set a minimum threshold (such as £500), below which the collection of offset payments is not enforced.

As offsetting to achieve net zero *energy* is only a proxy of net zero *carbon*, energy storage is also an important part of addressing any supply and demand imbalances that may occur. Whilst there is a preference for addressing energy storage onsite, this is not part of the SEC1 policy. If costs for offset projects were high, or energy storage was incorporated in these offsetting projects, this price charged to developers would need to increase to £150-£200/MWh.

Lastly, regardless of price decided on, it is important that all prices are subject to periodic review or linked to market price inflation. Not doing so would allow market inflation to erode the impact of such measures over time meaning that payments are insufficient to deliver the energy offsetting needed for net zero new development.