07 October 2025

METHODOLOGY FOR ESTIMATING THE COSTS OF LONG-DURATION SUPPLY INTERRUPTIONS

Report for SP Electricity North West

Economic Insight Ltd

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1

INTRODUCTION

Network resilience is a critical area of the service that Distribution Network Operators (DNOs) provide to customers and, reflecting this, Ofgem has made it one of the four consumer outcomes underpinning the ED3 framework.[1] The importance of network resilience was powerfully highlighted by Storm Arwen in November 2021, which left over a million customers without power. Of these, approximately 40,000 experienced outages lasting more than three days, and nearly 4,000 were without electricity supply for over a week.[2]

In response to this event, SP Electricity North West has identified the need for a storm resilience model to allow it to identify and target areas of the network which are vulnerable to extreme weather conditions. This is to support both the delivery scope of the Storm Arwen reopener and the development of network resilience plans for ED3.

To ensure that the optimal resilience investments are undertaken, it is necessary to understand the customer impact of long-duration supply interruptions. To allocate resources efficiently, investments should be made that generate greater customer benefits than the costs incurred to deliver them. However, estimating these customer benefits is challenging and there is currently no established method to do this. While Ofgem's Value of Lost Load (VoLL) provides an established way of estimating the cost of short-duration outages, it does not adequately reflect the more extensive harms caused by long-duration interruptions. As VoLL is based on willingness-to-pay and willingness-to-accept measures for relatively short outage scenarios, it does not capture harms that are only incurred over longer-duration interruptions.[3]

At RIIO-3, Ofgem are also placing increased emphasis on ensuring that consumer value is accounted for in network planning and investment decisions.[4] While the cost-benefit analysis methodology used in RIIO-ED2 submissions provides a robust baseline for assessing projects, it is relatively limited in scope and largely focuses on direct financial impacts to the network operator. While it does consider societal costs, these primarily focus on the environmental and safety drivers that support investment decisions, rather than the broader welfare impacts customers experience during extended outages.[5]

As part of its storm resilience work, SP Electricity North West has commissioned Economic Insight to develop a robust and practical methodology for calculating the cost of long-duration outages (where long-duration outages are defined as being outages over 12 hours). Our methodology uses the VoLL as a natural starting point for the costs of an outage. However, we recognise that this omits certain types of harm that are specific to long-duration interruptions. As a result, our methodology identifies, quantifies and adds a selection of the most significant additional costs to the VoLL to generate a robust estimate of the cost of long-duration supply interruptions.

Specifically, our methodology estimates, in monetary terms, the cost to household customers of long-duration interruptions for the ten cost factors set out in the figure below.

[1] *'ED3 Framework Decision'. Ofgem (2025).*

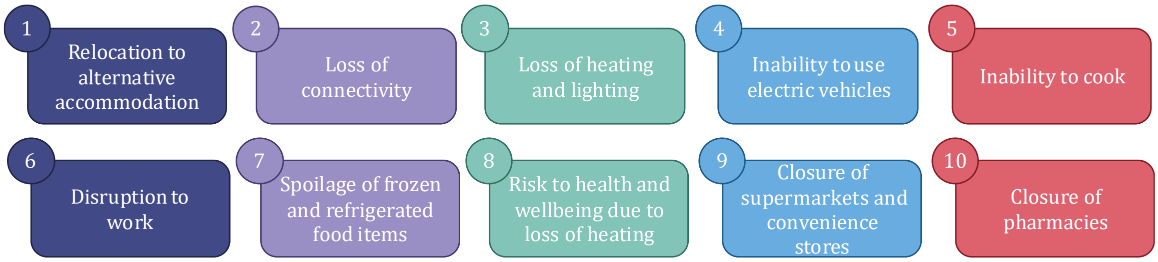
[2] *'Final report on the review into the networks' response to Storm Arwen'. Ofgem (2022); page 7.*

[3] *'The Value of Lost Load (VoLL) for Electricity in Great Britain'. London Economics (2013).*

[4] *'ED3 Framework Decision'. Ofgem (2025); page 98.*

[5] *'RIIO-ED2 Cost Benefit Analysis (CBA) Guidance'. Ofgem (2021).*

Figure 1: Main additional categories of harm from long-duration interruptions



Source: Economic Insight analysis.

Our methodology also accounts for the following factors:

- **Overlap with VoLL**: We consider the VoLL to be a natural starting point for calculating the harm from outages. Our approach adds in additional elements that are not well captured by the VoLL.
- **Customer variation**: We recognise that costs differ across different customer groups depending on their characteristics, and capture this within our methodology.
- **Outage scale and size**: We recognise that certain types of disruption will only occur during larger scale outages, and capture this within our methodology.
- **Second-order effects**: Our method incorporates indirect harms to households from the loss of access to local services during prolonged interruptions, such as supermarkets and pharmacies.

This report sets out our methodology for calculating the cost of long-duration supply interruptions. It is intended to enable SP Electricity North West to replicate and implement the method as part of a software module, while also providing clear and transparent documentation of the method for other stakeholders. We highlight that there is a degree of inherent uncertainty in our estimates; they are intended to be indicative and of the correct order of magnitude to support investment decisions, rather than being a precise measure for each individual household. In turn, we explain:

(i) Our identification and prioritisation of the relevant costs to quantify.

(ii) Our overarching approach to estimating the cost of long-duration supply interruptions, as well as our methodology for quantifying each of our additional cost areas.

2

IDENTIFICATION OF RELEVANT COSTS

2A Approach to the identification of relevant costs

In this chapter, we present the key additional costs to customers associated with long-duration supply interruptions. To determine these, we have conducted a detailed bottom-up analysis, first identifying the relevant costs, and then examining how these costs vary temporally, by household characteristics, and with respect to the geographic extent of the outage.

Building on this, we have assessed the significance of each cost category, taking into account:

(i) the magnitude of the harm per household;

(ii) the prevalence of the harm across the population; and

(iii) the directness of the cost.

From this assessment, we have identified a shortlist of the most significant costs to quantify in order to generate a robust estimate of the overall cost of long-duration supply interruptions.

In identifying the relevant costs, we observe that they fall into the following key categories.

- Loss of amenity
- Disruption
- Damage to goods
- Health risks
- Mitigation costs
- Loss of local services

In Table 1, we present our shortlist of the most significant costs broken down by each of these categories. For each cost, we describe how the harm is expected to vary temporally, by household characteristics, and with respect to the geographic extent of the outage. We also set out our initial view as to the extent to which we expect the costs to be captured in the VoLL. We highlight that our selection ensures that at least one cost from each major category of harm is captured, ensuring that we do not omit any of these key categories.

Table 1: Summary of most significant costs arising from long-duration outages

Cost category	Costs	Description	Variation in costs			Are these costs likely to be captured in VoLL?
			Temporal	*Geographic extent of the outage*	*Household characteristics*	
Loss of amenity	Loss of connectivity	Power outages cut access to the internet and prevent customers from charging their mobile phones, leaving people unable to access the internet or telecom services.	NA	NA	NA	Relevant for short-term interruptions. Severity increases with duration. *Partially included in VoLL.*
	Inability to use electric vehicles	Customers with electric vehicles will be unable to use them for travel due to the inability to charge them.	NA	The level of disruption depends on the extent of the area affected.	Only applicable for customers with electrical vehicles.	Not relevant for short-term interruptions. *Unlikely to be captured in VoLL.*
	Inability to cook	Households will be unable to prepare hot meals due to lack of electricity for kitchen appliances. They may have to find alternative food sources as a replacement.	NA	NA	Higher for vulnerable customers.	Relevance for short-term interruptions is low. *Unlikely to be captured in VoLL.*
Discomfort	Loss of lighting and heating	Power outages cause loss of heating and lighting which will cause discomfort to people.	Highest in winter.	NA	NA	Relevant for short-term interruptions. *Partially included in VoLL.*
Disruption	Disruption to work	Power outages disrupt productivity for customers working from home.	Highest during working week.	NA	High for households with working professionals.	Relevant for short-term interruptions. Severity increases with duration.

						Partially included in VoLL.
Damage to goods	Spoilage of refrigerated or frozen food items	Perishable food items stored in refrigerators or freezers will get spoiled.	Highest in summer.	NA	NA	Relevance for short-term interruption is low. *Unlikely to be captured in VoLL.*
Health risks	Risk to health due to loss of heating	Loss of heating could lead to worsening of chronic illnesses or trigger new health problems.	Highest in winter.	NA	Higher for vulnerable customers.	Relevance for short-duration interruptions low. *Unlikely to be captured in VoLL.*
Mitigation costs	Relocation to alternative accommodation	Power outages may force people to relocate to alternative accommodation such as hotels, accruing additional costs and disruption.	NA	NA	NA	Not relevant for short-term interruptions. *Unlikely to be captured in VoLL.*
Loss of local services	Closure of supermarkets and convenience stores	Power outages can lead to the closure of supermarkets, limiting access to food and essential supplies.	NA	The level of disruption depends on the extent of the area affected.	NA	Not relevant for short-interruptions. *Unlikely to be captured in VoLL.*
	Closure of pharmacies	Customers will be unable to purchase medicines they take regularly or for emergency needs.	Highest in winter.	The level of disruption depends on the extent of the area affected.	Higher for vulnerable customers.	Not relevant for short-term interruptions. *Unlikely to be captured in VoLL.*

3

QUANTIFICATION OF COSTS

3A Chapter structure

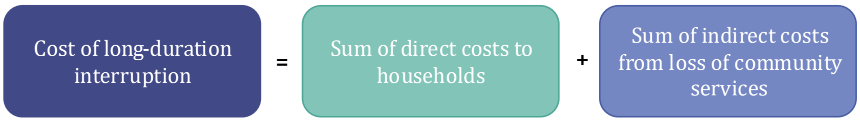
In this chapter, we set out our methodology for quantifying the harm from long-duration supply interruptions. In turn, we set out our overarching framework for estimating these harms, before setting out our methodology for estimating each additional cost area individually.

3B Overarching framework for quantification

Our methodology for calculating the costs of long-duration supply interruptions takes the VoLL as its starting point. The VoLL is derived from willingness-to-pay and willingness-to-accept research, but is based on scenarios involving relatively short interruptions (up to four hours).[6] As a result, it does not capture the harms that arise only in the context of long-duration outages. To address this gap, we have identified and quantified 10 additional cost categories which, when added to the VoLL, provide a more complete estimate of the total cost of long-duration supply interruptions.

The total harm from a long-duration supply interruption is the sum of the direct costs, borne by households when supply to their own property is lost, and the indirect costs, which arise when the outage affects community services or other locations that households depend on.

Figure 2: Overarching framework for quantification



Source: Economic Insight analysis.

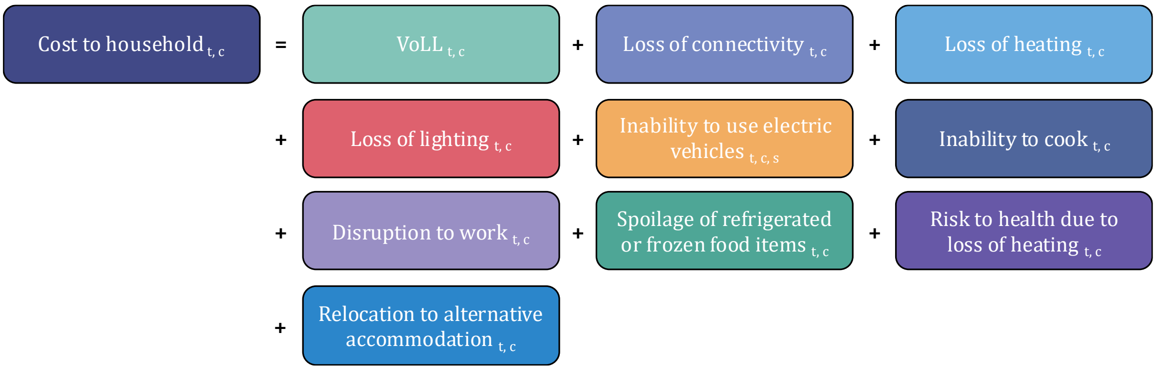
In the subsections below, we set out our approach to estimating each of these components.

Direct costs to households

Conceptually, our approach to estimating the costs to households can be expressed as an equation, where the cost of a long-duration supply interruption to each household equals the VoLL plus each of the additional cost components we have identified, each evaluated for the outage in question. This equation is shown in Figure 3, below.

[6] *'The Value of Lost Load (VoLL) for Electricity in Great Britain'. London Economics (2013); page 6.*

Figure 3: Overarching approach to estimating the direct costs to households



Source: Economic Insight analysis.

Each of these cost items will vary based on some combination of the following parameters:

– the duration of outage, denoted by subscript *t*;

– household characteristics, denoted by subscript *c*; and

– size of the outage, denoted by subscript *s*.

These direct costs are calculated at the household level, in line with the requirement that the methodology calculates the cost to customers at a service point level. The costs for each household affected by the outage can be summed to calculate the total direct costs to households.

As noted in Table 1, the harm associated with some cost categories varies by season. For example, the risk to health from the loss of heating will only be applicable in winter. Within the VoLL framework, this challenge was addressed by selecting a central estimate that reflects costs during a winter weekday at peak time. We adopt the same principle here, assuming peak harm rather than averaging over the year. This ensures that storm-resilience planning is grounded in the highest potential impacts, rather than being diluted by periods when the harm is lower.

The VoLL per household per day can be estimated in two ways: (i) by applying the national average daily electricity consumption, or (ii) by using the actual average consumption for a specific household, if data is available. For the purposes of this report, we calculate the VoLL in 2025 prices to be £22,600 per MWh.[7] Using the average annual UK consumption of 2.7MWh[8] per household per year, this translates into a VoLL of £167 per household per day.[9]

Summary of additional costs

We summarise our estimates for each additional cost area relating to households in Table 2, below. The methodologies underpinning these estimates are set out in more detail in the remaining sections of this chapter.

[7] *We have inflated Ofgem's RIIO-1 VoLL estimate of £16,000 which is based on a July 2013 report to July 2025 prices using the CPIH index.*

[8] *'Average gas and electricity usage'. Ofgem.*

[9] *VoLL per day = £22,600 × (2.7÷365) = £167*

Table 2: Summary of additional costs of long-duration supply interruptions

Cost area	Cost (£ per day)	Cost type	Factors driving cost variation
Loss of heating, lighting, and connectivity	£111	Continuous	NA
Inability to use electric vehicles	£35	Continuous	Only applicable to owners of electric vehicles Only applicable during large outages (>5000 households). Is only incurred for outages longer than 24 hours.
Inability to cook	£75	Continuous	1.5x scaling factor for vulnerable customers.
Disruption to work	£25	Continuous	Only applicable on weekdays.
Spoilage of frozen and refrigerated food	£86	Discrete – One off	Incurred once for outages longer than 24hrs.
Risk to health due to loss of heating.	£5	Continuous	Only applicable to vulnerable customers.

Source: Economic Insight analysis.

Worked example

Below, we present a worked example of how to calculate the harm for a given household and outage. We assume the following parameters:

- An outage duration of 5 days (covering four working days) and impacting 10,000 properties.
- The household is identified as highly vulnerable and has an EV charger installed.

We calculate the harm as follows:

$$\textit{Cost to household} =$$

$$(£167 + £111 + (1.5 \times £75) + £5) \times 5 + (£35 \times (5 - 1)) + (£25 \times 4) + £86 = \mathbf{£2,304}$$

Costs from the loss of community services

We have identified that the main community services that would lead to customer harm if they were closed during an outage are supermarkets and pharmacies. We consider that purchases from other retail outlets could likely reasonably be deferred until the outage was resolved at a minimal loss of utility.

The costs from the loss of community services are estimated at the service point level, with each service point representing the community service in question. In other words, our estimates capture the aggregate impact of losing each specific community service location. Supermarkets and pharmacies can be identified by using publicly available data. The sources of these datasets are provided in Table 3 below.

Table 3: Sources for locations of supermarkets and pharmacies

Community service	Source
Supermarkets	Geolytix – Supermarket retail points
Pharmacies	NHS - Consolidated Pharmaceutical list

Source: Economic Insight analysis.

We quantify the harm from the loss of each type of service by estimating the average number of customers affected by its closure and calculating the associated harm as the value of the time required to locate and access an alternative service location.

Summary of additional costs

We summarise our estimates for the costs from the loss of community services in Table 4, below. We note that these costs are on a per establishment basis (rather than per household), so reflect the costs to the wider community of the loss of a supermarket or pharmacy respectively. The methodologies underpinning these estimates are set out in more detail in sections 3I and 3J.

Table 4: Summary of additional costs of long-duration supply interruptions

Cost area	Cost (£ per location per day)	Cost type	Factors driving cost variation
Closure of supermarkets and convenience stores	£3,248	Continuous	Only applicable during large outages (>5000 households).
Closure of pharmacies	£393	Continuous	Only applicable during large outages (>5000 households).

Source: Economic Insight analysis.

Worked example

Below, we present a worked example of how to calculate the harm from a loss of community services for a given outage. We assume the following parameters:

- An outage duration of 5 days and impacting 10,000 properties.
- The outage impacts 3 supermarkets and 3 community pharmacies.

We calculate the harm as follows:

$$Costs\ from\ loss\ of\ community\ services = (£3{,}248 \times 3 + £393 \times 3) \times 5 = \mathbf{£54{,}615}$$

3C Loss of heating, lighting, and connectivity

Summary

Our approach estimates the harm arising from the loss of heating, lighting, and connectivity jointly by using the cost of switching to alternative accommodation as a proxy. We have identified that when customers seek out alternative accommodation, the issues that they are trying to address are the loss of heating and lighting, and connectivity. Therefore, this is a pragmatic way to estimate these difficult to isolate costs, as is detailed further below.

We estimate the daily cost of alternative accommodation to be **£111 per household**. We assume this accrues linearly over time given that customers will incur these costs from near to the start of the outage. We apply this cost to all households, regardless of whether they actually relocate. This is because:

- If households relocate, they avoid the harm but bear the monetary cost of accommodation.
- If households remain at home, they experience the discomfort and disruption directly.

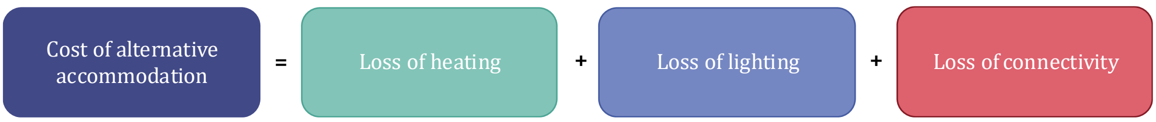
In both cases, the harm can reasonably be benchmarked using the market price of mitigation.

As outlined below, we consider there to be minimal overlap with the VoLL. Therefore, we add this cost directly to the VoLL.

Approach

We estimate the cost of losing heating, lighting, and connectivity by drawing an equivalence between these harms and the cost of alternative accommodation. This is illustrated in Figure 4 below.

Figure 4: Overlap between cost of alternative accommodation and other harms.



Source: Economic Insight analysis.

This is a market-based proxy for these costs, grounded in the cost of mitigating this harm as well as revealed preference.

- Some households choose to seek alternative accommodation, demonstrating that the cost of a hotel intersects with some households' true but unobservable reservation values. This gives us confidence that it can be used as a reasonable benchmark for the magnitude of these costs.
- Many households do not relocate during long-duration outages, but this decision is also influenced by uncertainty or affordability constraints rather than the absence of harm.

There are a number of factors that have implications for whether this proxy correctly measures the cost of losing heating, lighting, and connectivity:

- **Uncertainty**: Households may remain at home due to uncertainty over outage duration. With full information, more households might relocate, supporting the idea that hotel costs are a reasonable benchmark.

- **Affordability**: A household's decision not to relocate does not mean they avoid harm, only that the price of a hotel exceeds either their willingness or ability to pay. Even if a household cannot afford to seek alternative accommodation, their welfare loss remains real. Using market prices ensures these losses are recognised. We also note that, in some instances, the DNO will pay for alternative accommodation. Our method does not make a distinction between these instances and when customers bear the costs directly.

- **Additional amenities**: As hotels often provide additional amenities that go beyond heating, lighting, and connectivity, using hotel costs as a proxy has the potential to overstate the harm. To minimise this risk, we base our estimates on the cost of budget hotels. These offer a more limited service, reducing the likelihood that the estimate is inflated by unrelated amenities.

Key assumptions

In modelling the costs for this area, we have made the following assumptions:

- Households face two mutually exclusive options: relocate or remain at home without power. We assume that in both cases, the cost of lost services is reasonably approximated by the market price of alternative accommodation.

- We assume that the costs of moving to a budget hotel only reflects the costs of a loss of heating, lighting, and connectivity.

Overlap with VoLL

In our identification of costs, we found that there was likely to be a partial overlap between these costs and the VoLL, implying a risk of double counting. We set out these considerations in greater detail below:

- **Connectivity**. For short outages, households can rely on mobile networks and device batteries. In long outages, these buffers erode. As a result, the loss of communication and connectivity becomes significantly more harmful in longer outages. We therefore consider the overlap with VoLL in this area to be minimal.

- **Heating**. Residual warmth cushions short outages, but harm increases significantly as outages lengthen. We therefore consider the overlap with VoLL in this area to be minimal.

- **Lighting**. On winter evenings, even short outages can cause disruption, though the impact can be partially mitigated by candles, torches, or simply delaying light-dependent tasks until power is restored. Over long outages, these coping strategies may be exhausted, and the persistent lack of lighting severely disrupts normal routines and heightens risks to safety and wellbeing. We therefore consider the overlap with VoLL in this area to be limited.

Overall, while there is some overlap with the VoLL, primarily in relation to issues around lighting, we consider this to be limited. The harm in these areas from long-duration outages are significantly greater than those for short-duration outages, therefore we do not make an adjustment for overlap with the VoLL.

Calculations and proxies

To estimate the harm arising from a loss of heating, lighting, and connectivity, we calculate the cost of a household relocating to a budget hotel. We set out our calculations for the harm arising from this cost area in Table 5 below.

Table 5: Calculation of cost of relocation to alternative accommodation

	Component	Value	Calculation steps
	Average daily rate for alternative accommodation	£93	A
divide	Average number of occupants per room	2	B
equals	Average daily rate for outside accommodation per person	£47	C = A ÷ B
multiply	Average size of household	2.38	D
equals	Average cost of outside accommodation per day per household	£111	C × D
	Cost of relocation to alternative accommodation per day per household	**£111**	

Source: Economic Insight analysis.

The sources of the components used in the above calculations are set out in more detail in the table below.

Table 6: Proxies used in the calculation of the cost of relocation to alternative accommodation

Component	Proxy	Source	Notes
Average daily rate for alternative accommodation	Average price paid by Premier Inn customers.	Best UK hotel chains for 2025 - Which?	Premier Inn is the biggest budget hotel chain in the UK. We think it is a reasonable proxy for average price paid at budget hotels.
Average number of occupants per room		Group Bookings - Premier Inn	We assume two adults can stay comfortably in a room. This aligns with Premier Inn's policy to not allow more than two adults to stay in a room.
Average size of household	Average size of a household in England	Households by household size - Office for National Statistics	We use the 2024 edition of this dataset. We obtain the 2024 estimate from the tab 'England' in the workbook.

Source: Economic Insight analysis.

3D Inability to use electric vehicles

Summary

Our approach estimates the harm arising from an inability to use electric vehicles by using the cost of a rental vehicle as a proxy for the cost of mitigating this harm. We estimate the cost of a rental vehicle to be **£35 per day**. This cost will only be incurred by households that have an EV charger installed.

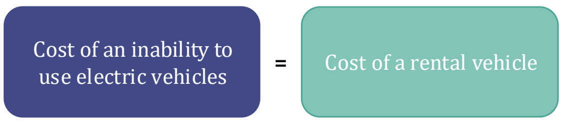
We assume that harm does not occur immediately following an outage, as most customers will have some residual charge in their EVs. However, even with remaining charge, drivers are likely to experience range anxiety and restrict non-essential journeys. Additionally, customers are likely to need to travel further to acquire food or to access other services, depleting their battery more quickly than normal. As a result, we model these costs as beginning to accrue from 24 hours into the outage.

As set out in Table 1, we do not consider there to be any overlap with the VoLL as this cost will not be relevant for short outages. Therefore, we add this cost directly to the VoLL.

Approach

We estimate the costs of losing the ability to use electric vehicles by using a market-based proxy grounded in the cost of mitigating this harm. This is illustrated in Figure 5 below.

Figure 5: Approach to estimating the cost of an inability to use electric vehicles



Source: Economic Insight analysis.

Although it is unlikely that most households would actually rent a replacement car during a long-duration outage, rental prices nonetheless provide a clear measure of what consumers are prepared to pay for access to mobility. The existence of a functioning rental market demonstrates that these prices intersect with at least some households' reservation values, meaning they are a reasonable benchmark for the harm from loss of access to mobility.

We recognise that rental prices vary significantly across vehicle types. However, much of this variation reflects the comfort, performance, or status of higher end vehicles rather than the basic value of mobility. To avoid overstating the harm, we base our estimate on the cost of smaller economy vehicles.

Key assumptions

In modelling the costs for this area, we have made the following assumptions:

- It will be difficult for households to access alternative charging stations during outages, both because of reduced access to the internet and the likelihood of increased demand. We therefore model the cost as the loss of vehicle access rather than the additional effort of finding a charging point.

- Households will begin the outage with some residual charge. As a result, we assume that the harm only begins after 24 hours rather than immediately from the start of the outage.

Calculations and proxies

We set out our calculations for the harm arising from an inability to use electric vehicles in Table 7, below.

Table 7: Calculation of the cost of an inability to use electric vehicles

	Component	Value	Calculation steps
	Average car rental prices per day	£35	
	Cost of inability to charge EV per day per household	**£35**	

Source: Economic Insight analysis.

The sources of the components used in the above calculations are set out in more detail in the table below.

Table 8: Proxies used in the calculation of cost of inability to use electric vehicles

Component	Proxy	Source	Notes
Average car rental prices per day	Average daily price of rental for an economy car.	Cheap Car Rent UK: Key Insights and Rental Trends	We use the economy car rental prices included in this source as a conservative estimate. Economy cars price range: £20 to £50 per day. We use the midpoint of this range (i.e. £35).

Source: Economic Insight analysis.

3E Inability to cook

Summary

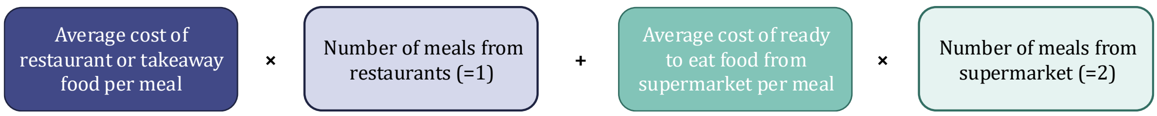
Our approach estimates the harm arising from an inability to cook by calculating the cost of replacement meals to account for the difficulties cooking during a long-duration power outage. We also account for the additional time taken to acquire food, as we assume that ordering food will not be possible during an outage. We estimate the cost of an inability to cook to be **£75 per day for non-vulnerable households.** We assume that customers that are considered to be highly vulnerable will incur greater costs as they will find it more difficult to travel and acquire food in the event of an outage. For this reason, we apply a **1.5x scaling factor** to the harm, implying a cost of **£113 per day for households with highly vulnerable customers**.

As set out in Table 1, we do not consider there to be any overlap with the VoLL as this cost will not be relevant for short outages. Therefore, we add this cost directly to the VoLL.

Approach

Customers may rely on takeaway food or ready to eat meals from supermarkets if they are unable to prepare food at home. We assume that customers rely on supermarkets for 2 meals a day and rely on restaurant or takeaway food for one of their meals. While this may not be true for any specific customer, we think it is a reasonable behavioural assumption for an average customer.

Figure 6: Overarching approach to estimate harm from an inability to cook



Source: Economic Insight analysis.

We also recognise that vulnerable customers will incur higher costs in this area. Not only will it be more difficult for them to seek out alternative food options, but they will also experience significantly more anxiety around food insecurity than non-vulnerable customers. For this reason, we apply a 1.5x scaling factor to this harm for customers who are categorised as 'highly vulnerable'.

Key assumptions

In modelling the costs for this area, we have made the following assumptions:

- The average person will rely on the equivalent of supermarket food for two meals a day and one takeaway or restaurant meal.
- Households with vulnerable customers suffer 1.5x as much harm from an inability to cook as households without vulnerable customers.

Calculations and proxies

We set out our calculations for the harm arising from an inability to cook in Table 9, below.

Table 9: Calculation of the cost of an inability to cook

	Component	Value	Calculation steps
	Average cost of a restaurant meal	£14	
multiply	Number of meals from a restaurant	1	
equals	Average spending on restaurant meals	£14	A
	Average cost of supermarket meal deal	£4	
multiply	Number of meals from a supermarket	2	
equals	Average spending on supermarket meals	£8	B
	Average travel time to source food (mins)	16.5 × 2 = 33	C
multiply	Value of non-working time (£/min), in 2025 prices	£0.26 * 1.07 = £0.28	D
equals	Average cost of time spent travelling to source food	£9	E = C × D
	Average cost of an inability to cook per person per day	£32	F = A + B + E
multiply	Average size of household	2.38	
equals	**Average cost of an inability to cook per household per day**	**£75**	
multiply	Scaling factor for vulnerable households	1.5	
equals	**Average cost of an inability to cook per vulnerable household per day**	**£113**	

Source: Economic Insight analysis.

Note: The value of non-working time is published in 2023 prices. To be consistent with the price base of other values used in the calculations, we have converted the value of non-working time to 2025 prices. The CPIH index for 2025 is, as of yet, only available for the first 8 months of the year. Therefore, we take an average of available data, i.e., CPIH index for January 2025 to August 2025 (inclusive) to calculate the price base conversion factor.

The sources of the components used in the above calculations are set out in more detail in the table below.

Table 10: Proxies used in the calculation of the harm caused by an inability to cook

Component	Proxy	Source	Notes
Average cost of restaurant meal	Average price of pub hot meal and restaurant main course, as of 2025.	Shopping prices comparison tool - Office for National Statistics	We first calculate the average price of pub hot meals and restaurant main course meals individually for the year 2025 (Jan 2025 – Aug 2025 inclusive). We then take the average of the two to estimate average cost of restaurant meal. We use the price data from the tab 'averageprice'. This tab uses Item_ID rather than Item_Description. We mapped the IDs and description using the details provided in the 'metadata' tab. Pub hot meal ID: 220107 Restaurant main course ID: 220128
Average cost of supermarket meal	Average price of meal deals across different supermarket chains in the UK, as of 2025.	Best value meal deal revealed as Asda launches £3.74 offer | The Independent	We take the average of the 2025 meal deal prices of supermarket outlets (without any membership).
Value of non-working time (£/min)	Based on the value of non-working time (£/hour) (i.e. £15.46). We convert this to value of non-working time (£/min) (i.e. £0.26). Note these values are in 2023 prices. We convert them to 2025 prices as shown above in the above calculations.	TAG data book - GOV.UK	We use the market price value of non-working time for commuting, provided in tab 'A1.3.1'.
Average travel time to source food	Average travel time to reach town centre (in minutes).	Journey time statistics: data tables (JTS) - GOV.UK	We use metrics from journey times to key services (JTS0102) which provides average minimum travel times to reach key services by mode of travel, from

			rural and urban areas in England. We use 2019 data on the duration to reach a town centre by *car* under *all rural*. We focus on rural areas, as typically, they are more likely to be affected by long-duration outages.
CPIH Index	CPIH Index	Inflation and price indices - Office for National Statistics	We use this to calculate the price conversion factor (1.07) to convert prices from 2023 prices to 2025 prices.
Average household size	Average size of a household in England.	Households by household size - Office for National Statistics	We use the 2024 edition of this dataset. We obtain the 2024 estimate from the tab 'England' in the workbook.
Scaling factor for vulnerable individuals	Scaling factor (multiple)	Assumption	We scale up the costs for vulnerable individuals to account for the fact that this group will find it more challenging to source alternative food options.

Source: Economic Insight analysis.

3F Disruption to work

Summary

Our approach estimates the harm that customers incur as a result of disruption to their normal working habits. We have identified three main categories of harm in this area: (i) additional commuting costs; (ii) the loss of flexibility; and (iii) loss of productivity. Each of these types of harm are applicable only to those who normally work from home. Our estimates for these costs are set out in Table 11 below.

Table 11: Summary of costs of disruption to work

Component	Cost (per household per working day)
Additional commuting costs	£12
Loss of flexibility from working from home	£7
Loss of productivity	£6
Total	£25

Source: Economic Insight analysis.

As we cannot observe each household's individual working patterns, we instead apply an average effect based on population-level parameters. These costs are specified on a 'per working day' basis and only apply on weekdays.

As outlined below, we consider there to be minimal overlap with the VoLL. Therefore, we add this cost directly to the VoLL.

Approach

We have identified three main categories of harm that customers incur as a result of disruption to their normal working patterns as a result of long-duration supply interruptions. These are set out in Figure 7 below.

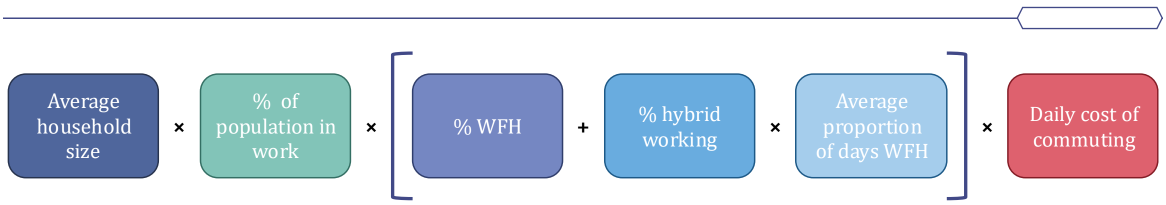
Figure 7: Overarching approach to estimate harm from disruption to work

Source: Economic Insight analysis.

Additional commuting costs

We calculate additional commuting costs based on the proportion of the population that would otherwise have worked from home. We assume that affected individuals will need to relocate either to an office or another location with power and connectivity. The daily cost of commuting is valued based on the additional time spent commuting. Our approach to this element of the harm is set out in Figure 8 below.

Figure 8: Additional commuting costs

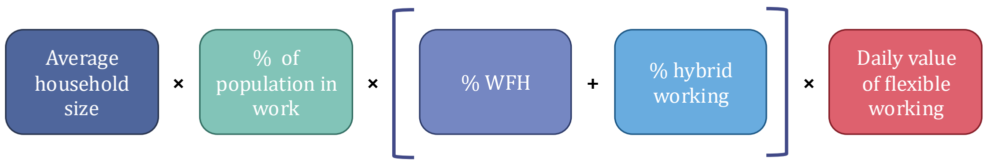


Source: Economic Insight analysis.

Loss of flexibility from working from home

We calculate the loss of flexibility associated with home working, recognising that individuals value the freedom and convenience it offers. The cost of losing this flexibility is estimated using survey evidence on the value that workers assign to flexible working. We apply this harm both to hybrid workers and those who work exclusively from home. Our approach to this element of the harm is set out in Figure 9 below.

Figure 9: Loss of flexibility of working from home

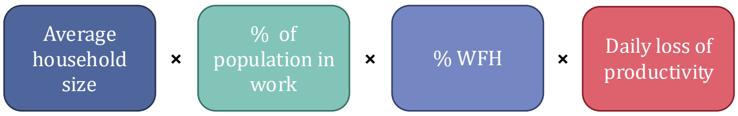


Source: Economic Insight analysis.

Loss of productivity

We calculate the loss of productivity from the disruption caused by the outage. We assume that individuals who normally work from home will face reduced productivity when relocating to less suitable workspaces. We value this loss on the basis that individuals will compensate for reduced productivity by working longer hours, using average weekly earnings to quantify the impact. Our approach to this element of the harm is set out in Figure 10 below.

Figure 10: Loss of productivity



Source: Economic Insight analysis.

Key assumptions

In modelling the costs of disruption to work, we have made the following assumptions:

- That the only people that have to change their working behaviour during an outage are those who would otherwise work from home. We assume individuals who work in-person are unaffected. This is because places of work are usually unaffected by long-duration outages, as these outages are most likely to occur in remote or rural areas. In addition, we assume that those who work in-person will continue to receive pay even if their workplace cannot open.

- Individuals who usually work from home will face disruption and reduced productivity if they must change their place of work. By contrast, hybrid workers are assumed not to face a productivity impact, as they already spend part of their week working from an office.
- As we have modelled these costs in relation to the disruption to home workers, we assume that these costs are only incurred during the working week.

Overlap with VoLL

For short-duration outages, work disruption tends to be temporary. Tasks can often be delayed or rescheduled until power returns, and for desk-based roles, battery-powered devices and mobile networks may provide a buffer. In these cases, productivity losses are limited.

By contrast, in long-duration outages batteries deplete, and connectivity is more likely to fail. Those working from home are therefore more significantly affected, requiring adaptations such as relocation. These impacts are substantively different from the temporary adjustments seen in short outages. As such, we consider overlap between the work disruption effects of long-duration outages and the VoLL framework to be minimal and therefore do not apply an adjustment to account for this.

Calculations and proxies

We set out our calculations for the harm arising from additional commuting costs in Table 12, below.

Table 12: Calculation of additional commuting costs

	Component	Value	Calculation steps
	Average size of household	2.38	
multiply	% of population in employment in the UK	61%	
equals	Average number of working individuals per household	1.45	A
	% of population homeworking only	16%	B
plus	% of population hybrid working × Average proportion of days working from home in a week	28% × 40% = 11%	C
equals	% of population working from home	27%	D = B + C
	Average commuting time per day (minutes)	29 × 2 = 58	
multiply	Value of working time (£/mins)	£0.50 × 1.07 = £0.53	
equals	Daily cost of commuting	£31	E

	Additional cost of commuting per day per household	**£12**	A × D × E

Source: Economic Insight analysis.

Note: The value of working time is published in 2023 prices. To be consistent with the price base of other values used in the calculations, we have converted the value of working time to 2025 prices. The CPIH index for 2025 is, as of yet, only available for the first 8 months of the year. Therefore, we take an average of available data, i.e., CPIH index for January 2025 to August 2025 (inclusive) to calculate the price base conversion factor.

We set out our calculations for the loss of flexibility of working from home in Table 13, below.

Table 13: Calculation of cost of loss of flexibility of working from home

	Component	Value	Calculation steps
	Average number of working individuals per household	1.45	A
	% of population homeworking only	16%	
plus	% of population hybrid working	28%	
equals	Overall % of population working from home	44%	B
	Average daily earnings	£135	
multiply	Implicit pay rise from flexibility to work from home	8%	
equals	Value of flexibility to work from home per day	£11	C
	Cost of loss of flexibility to work from home per day per household	**£7**	A × B × C

Source: Economic Insight analysis.

We set out our calculations for the loss of flexibility of working from home in Table 14, below.

Table 14: Calculation of cost of loss of productivity

	Component	Value	Calculation steps
	Average number of working people per household	1.45	
multiply	% of population homeworking only	16%	
equals	Average number of individuals fully working from home per household	0.23	A
	Average daily earnings	135	
multiply	% reduction in productivity due to relocation	20%	
equals	Value of additional work due to loss of productivity	£27	B
	Cost of loss of productivity per day per household	**£6**	A × B

Source: Economic Insight analysis.

The sources of the components used in the above calculations are set out in more detail in the table below.

Table 15: Proxies used in the calculation of cost of disruption to work

Component	Proxy	Source	Notes
Average commuting time per day	Average commute time to work in Great Britain as of 2023 (based on all modes of transport).	Transport Statistics Great Britain: 2023 Domestic Travel - GOV.UK	We use the average commute to work in Great Britain in 2023 figure under 'Why people travel: Travelling to work"
Value of working time (£/hour)	Based on the value of working (employers' business) time (£/hour) i.e., £29.92. We convert this to value of working time (£/min) i.e., £0.50. Note the values are in 2023 prices. We convert them to 2025 prices as shown above in the calculations.	TAG data book - GOV.UK	We use the market price value of working time in tab 'A1.3.1'. We specifically use the 'Average of all working persons' in our calculations.

Average household size	Average size of a household in England	Households by household size - Office for National Statistics	We use the 2024 edition of this dataset. We obtain the 2024 estimate from the tab 'England' in the workbook.
% of population in employment in the UK	Average employment rate of all aged 16 and above for the year 2025.	Employment, unemployment and economic inactivity - Office for National Statistics	We have used the UK employment rate (seasonally adjusted) for people aged 16 and above. Our values are taken from tab 'People' in the mentioned workbook. We take an average of the 3-month employment rate (%) for the period Jan 2025 to Jul 2025.
% of population homeworking only	% of all individuals homeworking only	Characteristics of homeworkers, Great Britain - Office for National Statistics	We use estimates calculated over the period Sep 2022-Jan 2023. We use the % homeworking only (All persons %) in tab '1'.
% of population hybrid working	% of all individuals hybrid working	Characteristics of homeworkers, Great Britain - Office for National Statistics	We use estimates calculated over the period Sep 2022-Jan 2023. We use the % hybrid working (All persons %) in tab '1'.
Average proportion of days working from home	Based on the number of days the majority of hybrid workers spend in office	State of Hybrid Work 2024 | UK Report	In our calculations we apply 40% (two out of five) to account for number of days hybrid workers work from home. This is based on the finding that the majority of hybrid workers prefer going to the office three times a week.
Average weekly earnings	Average weekly earnings of whole economy – regular pay for 2025	AWE: Whole Economy Level (£): Seasonally Adjusted Total Pay Excluding Arrears - Office for National Statistics	We have used seasonally adjusted average weekly earnings. The average weekly earnings for the year 2025 are calculated using data from the

			period January to July 2025, inclusive.
Implicit value of flexibility to work from home	Average value people attribute to the ability to work from home two or three days a week	Remote working is probably here to stay, and these are the reasons why | Institute for Fiscal Studies	Hybrid workers value the flexibility to work from home equivalent to an 8% pay rise. This is based on data from the Survey of Working Arrangements and Attitudes, and can also be found in Barrero et al (2023).[10]
% reduction in productivity due to relocation	% reduction in productivity due to relocation	Assumption	Disruption to work due to a power outage may cause a loss of productivity. We assume the value of loss of productivity to be 20% reduction in average daily earnings.

Source: Economic Insight analysis.

3G Spoilage of refrigerated and frozen food items

Summary

We estimate the cost of spoiled refrigerated or frozen food items to be **£86 per household**. Based on information from the Food Standards Agency, we assume that it takes 24 hours for food in a fridge/freezer to spoil. Therefore, we model this harm as incurred discretely for outages longer than 24 hours in duration.

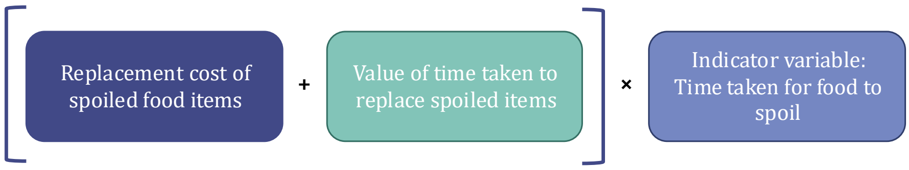
As set out in Table 1, we do not consider there to be any overlap with the VoLL as this cost will not be relevant for short outages. Therefore, we add this cost directly to the VoLL.

Approach

Our approach to estimating the costs of spoiled refrigerated or frozen food items is based on the replacement cost of these items, as well as the time and effort expended in replacing them. These costs will be incurred only once, and only if the duration of the outage exceeds the average time it takes for frozen/refrigerated food to spoil.

[10] *'The Evolution of Work from Home'. Barrero et al (2023); page 37.*

Figure 11: Overarching approach to estimate harm from the spoilage of frozen and refrigerated food items.



Source: Economic Insight analysis.

Key assumptions

In modelling the costs of disruption to work, we have assumed that the average time taken for frozen and refrigerated food to spoil is 24 hours. This is based on information from the Food Standards Agency, which states that a fridge only remains cold for 4 hours in the event of an outage, and that a half full freezer remains frozen for 24 hours.[11] Therefore, we assume that food in both a fridge or a freezer will spoil after 24 hours.

Calculations and proxies

We set out our calculations for the spoilage of refrigerated and frozen food in Table 16, below.

Table 16: Calculation of cost of the spoilage of refrigerated and frozen food items

	Component	Value	Calculation steps
	Average time taken for food in a freezer to spoil (in hours)	24	
	Indicator variable: Has frozen food likely spoiled?	*Let d denote the duration of power outage.* $\begin{cases} 1, & if\ d \geq 24\ hours \\ 0, & otherwise \end{cases}$	A
	Average value of food items stored in fridge or freezer	£71	B
	Average time to travel to a food store (in minutes)	9×2 = 18	
plus	Average time spent in a food store (in minutes)	37	
equals	Average total time taken to visit a food store (in minutes)	55	
multiply	Average value of non-working time (£/min)	£0.26 × 1.07 = £0.28	

[11] *'Food safety in a power cut – advice for consumers'. Food Standards Agency.*

equals	Average value of time taken to replace spoiled food items	£15	C
	Average cost of the spoilage of frozen and refrigerated items	**£86**	A × (B + C)

Source: Economic Insight analysis.

Note: The value of non-working time is published in 2023 prices. To be consistent with the price base of other values used in the calculations, we have converted the value of non-working time to 2025 prices. The CPIH index for 2025 is, as of yet, only available for the first 8 months of the year. Therefore, we take an average of available data, i.e., CPIH index for January 2025 to August 2025 (inclusive) to calculate the price base conversion factor.

The sources of the components used in the above calculations are set out in more detail in the table below.

Table 17: Proxies used in the calculation of the average cost of spoilage of refrigerated and frozen food items

Component	Proxy	Source	Notes
Average value of food items stored in fridge or freezer	Average weekly expenditure of all households on food and non-alcoholic drinks	Family spending workbook 1: detailed expenditure and trends - Office for National Statistics	We have used the 2024 edition of this dataset. We refer to tab 'A1' and use the headline figure £70.50.
Average time to travel to food store (in minutes)	Average minimum travel time to reach the nearest food store in rural areas (in minutes)	Journey time statistics: data tables (JTS) - GOV.UK	We use metrics from journey times to key services (JTS0102) which provides average minimum travel times to reach key services by mode of travel, from rural and urban areas in England. We use 2019 data on the duration to reach a food store by *car* under *all rural*. We focus on rural areas as, in general, they are more likely to be affected by long-duration outages.
Average time spent in supermarkets	Average time spent in supermarkets	Brits will spend eight-and-a-half months of their lives in supermarkets | Wales Online	We use 37 minutes mentioned in the article.
Average value of non-working time (£/min)	Based on the value of non-working time (£/hour) i.e., £15.46. We convert this to value of non-working time (£/min) i.e., £0.26.	TAG data book - GOV.UK	We use the market price value of non-working time for commuting in the tab 'A1.3.1'.

	Note the values are in 2023 prices. We convert them to 2025 prices as shown above in the calculations.		
CPIH Index	CPIH Index	Inflation and price indices - Office for National Statistics	We use this to calculate the price conversion factor (1.07) to convert prices from 2023 prices to 2025 prices.
Average time taken for food in freezer to spoil	Average time taken for food in freezer to spoil.	Food safety in a power cut - advice for consumers | Food Standards Agency	As stated in the source article, a fridge can stay cold for up to 4 hours when there is a power outage. It takes 48 hours for the frozen food to spoil if the freezer is full and 24 hours if the freezer is half- full. For simplicity, we use 24 hours as the threshold for the time it takes for both fridge and freezer contents to spoil.

Source: Economic Insight analysis.

3H Risk to health

Summary

Our approach estimates the cost of the risk to health to customers during a power outage by leveraging a study estimating the societal level harm and re-scaling the results to be able to apportion them to households experiencing a power outage. We estimate the health-related costs of cold homes for a highly vulnerable household to be **£5 per day**.

As set out in Table 1, we do not consider there to be any overlap with the VoLL as this cost will not be relevant for short outages. Therefore, we add this cost directly to the VoLL.

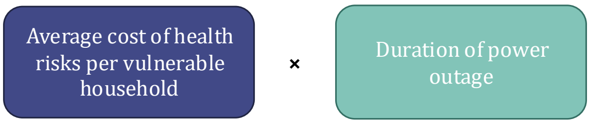
Approach

Our approach to estimating the risk to health and wellbeing is based on determining the cost of increased risk to health issues during an outage. To do this, we leverage a study which calculates the costs faced by the NHS due to lack of heating in homes. We adjust these societal-level costs to calculate a cost per affected vulnerable household per unit time. We note that these costs will only be applicable during winter months when heating is essential for households.

While all customers will incur the costs of discomfort relating to a loss of heating, it is our view that the health risks will predominantly be borne by vulnerable customers with pre-existing medical conditions. Therefore, we attribute these societal costs to vulnerable customers only. We make this adjustment by dividing the societal costs by an estimate of the number of vulnerable households living in excessively cold homes.

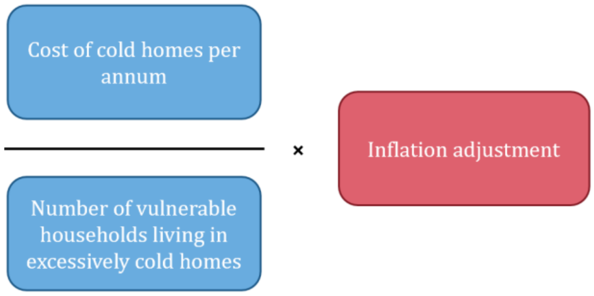
We have illustrated our high-level approach in the figure below.

Figure 12: Overarching approach to estimate the cost of the risk to health due to lack of heating



Source: Economic Insight analysis.

Figure 13: Calculation of the average cost of health risks per vulnerable household



Source: Economic Insight analysis.

Key assumptions

In modelling the cost of risk to health, we have made the following assumptions:

- We assume that the health costs of a chronically cold home are equivalent to the health costs relating to a loss of heating during a long-duration power outage. We note that the health effects of a chronically cold house are likely to be greater than a long-duration outage due to the extended period of time that the individuals are exposed to the cold. However, the cold experienced during a long duration outage may be more severe, as chronically cold homes may have some heating. Overall, we consider that these two scenarios are sufficiently comparable for our analysis.

- Additionally, we assume that the NHS costs relating to cold homes are an appropriate proxy for the harm that customers experience. While these capture the costs to the health system rather than individuals, they are driven by the same underlying health impacts that customers experience directly. The scale of NHS spending reflects the severity and prevalence of illness, making it a reasonable and evidence-based indicator of harm. While this approach does not capture all aspects of individual welfare loss, it provides a conservative estimate based on these tangible costs.

- It is likely that vulnerable customers will disproportionately bear the health impacts of long-duration outages due to pre-existing issues. As a result, we assume that the health effects are only incurred by customers that are categorised as 'highly vulnerable'.
- We assume that the changes to NHS treatment costs over time are due to inflation, and not to a change in underlying factors. Therefore, we only need to make inflation adjustments to ensure consistency with the current price base.

Calculations and proxies

We set out our calculations for the cost of the risk to health below in Table 18.

Table 18: Calculation of the cost of the risk to health

	Component	Value	Calculation steps
	Cost of cold homes per annum (in millions)	£544	A
	Number of vulnerable households living in excessively cold homes (in millions)	0.72	B
	Cost of cold homes per home per annum (in 2019 prices)	£756	C = A ÷ B
	Price basis conversion factor	1.27	D
	Cost of cold homes per annum per home (in 2025 prices)	£962	E = C × D
divide	Days per year of cold weather (October to March, inclusive)	182	
equals	**Cost of cold homes per day per vulnerable household**	**£5**	

Source: Economic Insight analysis.

Note: Price basis conversion factor = 2025 CPIH / 2019 CPIH. The CPIH index for 2025 is, as of yet, only available for the first 8 months of the year. Therefore, we take an average of the available data, i.e., CPIH index for January 2025 to August 2025 (inclusive) to calculate the price base conversion factor.

The sources of the components used in the above calculations are set out in more detail in the table below.

Table 19: Proxies used in the calculation of cost of risk to health

Component	Proxy	Source	Notes
Cost of cold homes per annum (in millions)	NHS costs of cold homes per annum (in millions)	BRE_cost of poor housing tenure analysis 2023.pdf	Total savings to the NHS from mitigating the 'excess cold' hazard in owner-occupied, private rented, and social rented homes. Relevant page numbers: 11, 15, and 18.
Number of excessively cold homes (in millions)	Number of excessively cold homes (in millions)	BRE_cost of poor housing tenure analysis 2023.pdf	Total number of owner occupied, private rented, and social rented homes facing the 'excess cold' hazard. Relevant page numbers: 11, 15, and 18.
Price basis conversion factor	CPIH index for the years 2019 and 2025	Inflation and price indices - Office for National Statistics	We calculate the conversion factor to be 1.27 using CPIH index for the years 2019 and 2025.
Average household size	Average size of England household	Households by household size - Office for National Statistics	We use the 2024 edition of this dataset. We obtain the 2024 estimate from the tab 'England' in the workbook.

Source: Economic Insight analysis.

3I Closure of supermarkets

Summary

Our estimate for the cost of the closure of supermarkets during a power outage are based on the additional time it takes customers to find the next nearest open supermarket. The costs are scaled up based on the average number of households served by each supermarket. We estimate the average cost of the closure of a supermarket to be **£3,248 per day.**

From our perspective, the incurrence of these costs will depend on the size of the outage. For example, small scale outages are unlikely to significantly impede finding an open supermarket. Therefore, we apply these costs only to large power outages (i.e. when more than 5,000 households are affected at once).

As set out in Table 1, we do not consider there to be any overlap with the VoLL as this cost will not be relevant for short outages. Therefore, we add this cost directly to the VoLL.

Approach

The costs relating to the closure of supermarkets due to an outage is equal to the value of the additional time spent to reach an alternative supermarket that is not affected by said outage. Our approach assumes that the customers will travel to an alternative location if their preferred supermarket is closed due to a power outage, and that it is unlikely that all the other supermarkets in the area will also be affected by the outage. We assume it takes twice the average minimum travel time to the nearest supermarket to reach an alternative supermarket.

We apply these additional travel costs to the average number of households served by a supermarket. We calculate the number of people affected by the closure of a supermarket using ONS data on supermarkets per 10,000 people in the UK. We then multiply by the frequency of supermarket visits to account for the fact that customers do not shop every day. This is based on the average number of supermarket visits per week. We also assume that households will shop collectively.

Key assumptions

Our approach to estimating the costs of the closure of supermarkets is based on the following assumptions:

- We assume that long-duration outages will be relatively localised, meaning households should be able to access an alternative supermarket within a reasonable time frame.
- We assume that the travel time taken to go to the next nearest open supermarket is twice the average minimum travel time to reach the nearest supermarket.

Calculations and proxies

We set out our calculations for the cost of closure of a supermarket below in Table 20.

Table 20: Calculations of the cost of closure of supermarkets

	Component	Value	Calculation steps
	Additional travel time to nearest open supermarket (in minutes)	9×2 = 18	
multiply	Value of non-working time (£/min)	£0.26 × 1.07 = £0.28	
equals	Cost of additional travel to next nearest supermarket	£5	A
	Average number of people dependent on a particular supermarket	3704	
divide	Average size of household	2.38	
equals	Number of households affected by the closure of 1 supermarket	1556	B

	Frequency of supermarkets visits	3	C
	Cost of closure of a supermarket to the households served per week	**£22,737**	D = A × B × C
	Average cost of closure of a supermarket to the households served per day	**£3,248**	D/7

Source: Economic Insight analysis.

Note: The value of non-working time is published in 2023 prices. To be consistent with the price base of other values used in the calculations, we have converted the value of non-working time to 2025 prices. The CPIH index for 2025 is, as of yet, only available for the first 8 months of the year. Therefore, we take an average of available data, i.e., CPIH index for January 2025 to August 2025 (inclusive) to calculate the price base conversion factor.

The sources of the components used in the above calculations are set out in more detail in the table below.

Table 21: Proxies used in calculations of the cost of closure of supermarkets

Component	Proxy	Source	Notes
Additional travel time to nearest open supermarket (in minutes)	Average minimum travel time to reach the nearest supermarket (in minutes)	Journey time statistics: data tables (JTS) - GOV.UK	We use metrics from journey times to key services (JTS0102) which provides average minimum travel times to reach key services by mode of travel, from rural and urban areas in England. We use 2019 data on the duration to reach a food store by *car* under *all rural*. We assume the next nearest supermarket will take double the travel time of the nearest supermarket to reach.
Value of non-working time (£/min)	Based on the value of non-working time (£/hour) i.e., £15.46. We convert this to value of non-working time (£/min) i.e., £0.26. Note these values are in 2023 prices. We convert them to 2025 prices as shown above in the calculations.	TAG data book - GOV.UK	We use the market price value of non-working time for commuting in the tab 'A1.3.1'.

CPIH Index		Inflation and price indices - Office for National Statistics	We use this to calculate the price conversion factor (1.07) to convert values from 2023 prices to 2025 prices.
Average number of people dependent on a particular supermarket	Calculated using supermarkets per 10,000 people.	Supermarkets - ONS	We use the number of supermarkets per 10,000 people in the UK, as of 2023. The number of people dependent on a supermarket equals 10,000 ÷ 2.7.
Frequency of supermarkets visits	Average supermarket visits per week	Brits will spend eight-and-a-half months of their lives in supermarkets | Wales Online	We use three times a week, as mentioned in the article.
Average household size	Average size of a household in England	Households by household size - Office for National Statistics	We use the 2024 edition of this dataset. We obtain the 2024 estimate from the tab 'England' in the workbook.

Source: Economic Insight analysis.

3J Closure of pharmacies

Summary

Our approach estimates the cost of the closure of pharmacies by calculating the cost of additional time to find an alternative pharmacy due to the closure of the regular pharmacy. These costs are scaled up based on the average number of households served by a pharmacy. The cost of the closure of a pharmacy is estimated to be **£393 per day**.

Similar to the estimation of the cost of closure of supermarkets, we expect the cost of the closure of pharmacies to be significant only for large outages. Therefore, we apply these costs only when more than 5,000 households are affected at once.

As set out in Table 1, we do not consider there to be any overlap with the VoLL as this cost will not be relevant for short outages. Therefore, we add this cost directly to the VoLL.

Approach

We estimate the cost of closure of pharmacies by calculating the value of the additional time spent travelling to an alternative pharmacy. We assume that the additional travel time to find an alternative open pharmacy is equivalent to the average time taken to travel to the town centre.

We use ONS data on the number of prescribing dispensaries per 100,000 people to calculate the average number of people served by a pharmacy. Unlike supermarkets, we expect visits to a pharmacy to be limited during a power outage. Where these visits can be deferred, they likely will be. We expect that only people who urgently require medication to seek out a pharmacy in an outage.

We identify the proportion of customers who may need access to pharmacy services during a power outage based on the 'Public perceptions of community pharmacy' report. As per the report, as of 2023, 8% of respondents visit a pharmacy "*at least few times a month*".[12] We assume that only this group of people are likely to require medication and will therefore seek out an alternative pharmacy.

We further adjust the number of affected people using the probability of a customer visiting a pharmacy on any particular day in a month, to account for the fact that not all customers who use a pharmacy "*at least few times a month*" visit a pharmacy daily. We apply the travel costs to this adjusted number of affected individuals to calculate the cost of the closure of a pharmacy.

Key assumptions

Our approach to estimating the cost of closure of a pharmacy is based on the following assumptions.

- We assume that the long-duration outages will be relatively localised, meaning households should be able to access an alternative pharmacy within a reasonable time frame.
- Only a small proportion of customers will sufficiently require emergency medication during a power outage that they will seek this out.

Calculation and Proxies

We set out our calculations for the cost of closure of a pharmacy below in Table 22.

Table 22: Calculation of the cost of closure of pharmacies

	Component	Value	Calculation steps
	Additional travel time to town centre to find a pharmacy	16.5 × 2 = 33	A
multiply	Value of non-working time, (£/min)	£0.26 × 1.07 = £0.28	B
equals	Cost of additional travel time to pharmacies per visit	£9	C = A × B
	Average number of people per pharmacy	5,442	
multiply	% of population that visits pharmacy 'at least few times a month'	8%	
multiply	Probability that a customer visits a pharmacy on any particular day in a month	10%	

[12] *'Public perceptions of community pharmacy 2023'. Ipsos.*

equals	Number of people affected by closure of pharmacy per day	44	D
	Cost of closure of a pharmacy to the households served per day	**£393**	C × D

Source: Economic Insight analysis.

Note: We assume the probability a customer visits a pharmacy on any particular day in a month to be 3/30 in our calculations. We are mainly concerned with customers who visit a pharmacy more than once a month. From an Ipsos 2023 report on 'Public Perceptions of Community Pharmacy', as of 2023, 8% of respondents in England visit a pharmacy 'at least few times a month'. We assume the number of days a customer (belonging to the 8%) visits a pharmacy in a month is 3 times. We then assume pharmacy visits are uniformly distributed throughout a month to determine the probability of a customer going to a pharmacy on any particular day in a month.

The sources of the components used in the above calculations are set out in more detail in the table below.

Table 23: Proxies used in the calculation the of cost of closure of pharmacies

Component	Proxy	Source	Notes
Additional travel time to town centre to find a pharmacy (in minutes)	Average minimum travel time to reach the town centre (in minutes)	Journey time statistics: data tables (JTS) - GOV.UK	We use metrics from journey times to key services (JTS0102) which provides average minimum travel times to reach key services by mode of travel, from rural and urban areas in England. We use 2019 data on the duration to reach a town centre by *car* under *all rural*. We assume that the additional travel time to find an alternative pharmacy is equal to the time taken to travel to a town centre.
Value of non-working time (£/min)	Based on the value of non-working time (£/hour) i.e., £15.46. We convert this to value of non-working time (£/min) i.e., £0.26. Note the values are in 2023 prices. We convert them to 2025 prices as shown above in the calculations.	TAG data book - GOV.UK	We use the market price for the value of non-working time for commuting in the tab 'A1.3.1'.

CPIH Index		Inflation and price indices - Office for National Statistics	We use this to calculate the price conversion factor (1.07) to convert prices from 2023 prices to 2025 prices.
Average number of people per pharmacy	Number of community pharmacies in England and Wales divided by population	Number of prescribing pharmacies in local areas, England and Wales - ONS	We use the latest edition available for this source. We use the data in tab 'Table 1' to calculate average number of people per pharmacy.[13]
% of population that visits pharmacy 'at least a few times a month'	% of respondent living in England that visits pharmacy 'at least a few times a month', as of 2023	Public Perceptions of Community Pharmacy 2023 Report - Ipsos UK KnowledgePanel	We obtained the data from Figure 3.1 on page 11, which shows the frequency of pharmacy use.
Probability that customer visits a pharmacy on a particular day		Assumption	We adjust the number of affected people using this probability to account for the fact that not all customers go to the pharmacy at once during a power outage. The rationale for this assumption is explained beneath Table 22.

Source: Economic Insight analysis.

[13] First, we calculate the population in each LAD in the following way: Population = (Number of dispensaries ÷ Dispensaries per 100,000 people) × 100,000. Then we calculate the number of people per dispensary by dividing the sum of the population by the sum of the number of dispensaries across all of England. This yields a figure of 5,442 people per dispensary.

Disclaimer

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