SIF CoolDown Alpha
Work Package 5

D5.2: Commercial arrangements design

28 January 2025

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Executive summary

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We designed three cooling DR commercial arrangements for commercial buildings

CoolDown Work Package 5 (WP5) has designed three cooling Demand Response (DR) programmes for domestic buildings. WP6 (High-level trial design) will consider which of these could be most appropriate for an initial Beta stage trial of domestic cooling DR.

		DR programmes for commercial customers		
	Parameters	**1) Scheduled direct load control**	**2) Peak time rebates**	**3) Fixed Time-of-Use tariff**
DNO-FSP Interaction	ENWL flex product	Operational Utilisation & Variable Availability		Peak Reduction
	DNO-FSP payment structure	Availability: £/MW/h Utilisation: £/MWh		Utilisation: £/MWh
	Notice period given to FSP	Availability terms agreed at time of trade, refined week-ahead. Utilisation instruction issued day-ahead.		Utilisation agreed at time of trade
FSP-Customer Interaction[1]	Technology eligibility criteria	Centrally controlled cooling tech. only	Any cooling tech.	Any cooling tech.
	FSP/supplier-customer payment structure	Will vary by FSP/supplier. Examples include fixed upfront payments, £/MWh compensation for flex delivered, etc		FSP/supplier designs tariff to incentivise cooling usage outside these windows
	DR event length and frequency	30 mins – 2 hours, with at least 60-90 minutes between events to allow for recovery. Will be a variable parameter in the trials		
	Notice period given to customer	DR event schedule released week-ahead. Day-ahead utilisation instruction given to FSP by DNO. FSP can inform customer up to 4 hours till event. Will be a variable parameter in the trials		Tariff structure agreed upon sign-up
	Likely customer response to event	FSP will turn down/off their customers' cooling. Customer override is allowed.	Customers will turn down/off their cooling themselves.	

[1] Note that the FSP may not necessarily have direct contact with the consumer. The FSP may partner with an electricity supplier that deals directly with customers.

We designed two cooling DR commercial arrangements for domestic buildings

CoolDown Work Package 5 (WP5) has designed two domestic Demand Response (DR) programmes for commercial buildings. WP6 (high-level trial design) will consider which of these could be most appropriate for an initial Beta stage trial of commercial cooling DR.

		DR programmes for domestic customers	
	Parameters	**1) Peak time rebates**	**2) Fixed Time-of-use tariff**
DNO-FSP Interaction	ENWL flex product	Operational Utilisation & Variable Availability	Peak Reduction
	DNO-FSP payment structure	Availability: £/MW/h Utilisation: £/MWh	Utilisation: £/MWh
	Notice period given to FSP	Availability terms agreed at time of trade, refined week-ahead Utilisation instruction issued day-ahead	Utilisation agreed at time of trade
FSP-Customer Interaction[1]	Technology eligibility criteria	Any cooling tech.	
	FSP/supplier-customer payment structure	Will vary by FSP/supplier. Examples include fixed upfront payments, £/MWh compensation for flex delivered, etc.	Supplier designs tariff to incentivise cooling usage outside these windows
	DR event length and frequency	Up to 4 hours, with up to 4 events per day depending on event length. Will be a variable parameter in the trials	
	Notice period given to customer	Availability terms agreed upon sign-up, months in advance of event. Utilisation instruction issued day-ahead. Will be a variable parameter in the trials	Tariff structure agreed upon sign-up
	Likely customer response to event	Customers will turn down/off their cooling themselves	

[1] Note that the FSP may not necessarily have direct contact with the consumer. The FSP may partner with an electricity supplier that deals directly with customers.

Next step: Designing a high-level approach to trial design for Beta

WP6 will deliver a high-level design for a potential Beta phase. It will develop criteria to assess the feasibility of both commercial and domestic cooling DR trial and explore the logistical requirements for a successful trial. Ultimately, WP6 will lay the groundwork for a potential Beta trial, and feed into the go/no-go decision at end of Alpha.

Objectives of Work Package 6

- Deliver high-level trial design of the cooling demand response commercial arrangements designed in WP5.
- Define high-level criteria for a Beta phase trial and assess feasibility.
- Design high-level logistics for a trial e.g., locational bounds, priority commercial arrangements, etc.

Approach

1. Design trial criteria and assess feasibility through group workshops.
2. Explore high-level Beta trial logistics through workshops.
3. Summarise approach to Beta trial design in a report.

Why is a Beta trial needed?

- Improve confidence in the knowledge gathered on cooling consumption behaviour.
- Validate amount of cooling flex (MW) that cooling DR can unlock.
- Validate the network benefits cooling DR can unlock.
- Optimise cooling DR parameter such as event length, notice periods and tariff structures to maximise the flex (MW) unlocked.
- Refine the programme designs to ensure a seamless BaU transition.

Context

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CoolDown is exploring strategies to reduce the impact of increased cooling demand on the grid

About CoolDown

- As the UK warms due to climate change, space cooling demand from commercial and domestic buildings will increase, potentially resulting in increasing the volume and frequency of summer peak demand periods.
- In current distribution network planning, the potential impact of this increased load is poorly understood, as is space cooling's potential to provide flexibility.
- CoolDown aims to improve the understanding of the impact of residential and commercial space cooling on the distribution network by producing improved uptake and demand projections.
- The project is also developing novel commercial arrangements to incentivise and unlock space cooling flexibility, thus reducing network reinforcement requirements and electricity bills.

Commercial arrangements progress in Discovery

- Outlined the UK's DR landscape and key lessons applicable to cooling DR design.
- Profiled design parameters for cooling DR programmes and evaluated UK-specific context where available.
- Longlisted of 9 potential programme designs for UK cooling DR.
- Evaluated each design's potential and shortlisted 5 designs for further exploration in the Alpha phase.
- Identified key barriers to the development of UK cooling DR and made recommendations to overcome them.

Commercial arrangements objectives in Alpha

- Engage with domestic and commercial cooling customers, flexibility service providers and distribution network operators to overcome the barriers identified in Discovery.
- Produce 2-3 commercial arrangements each for commercial and domestic cooling customers. These arrangements may be trialled in the Beta phase.

This report:

1. Outlines the methodology adopted to design the 5 cooling DR programmes.
2. Summarises the 5 cooling DR programmes designed.
3. Outlines next steps for developing trials testing some of these arrangements.

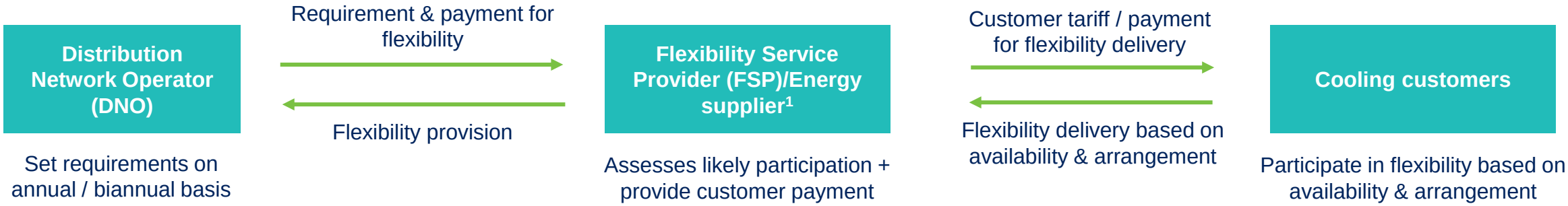
We shortlisted 5 cooling DR programmes from Discovery for deeper design work in Alpha

Of the 9 cooling DR programmes longlisted in CoolDown Discovery, we shortlisted five for further exploration in Alpha. These five were deemed the most promising for development and testing in a UK-first cooling DR trial. Four designs were discarded due to a lack of suitability for the UK market or because the required technologies are too nascent in the UK for near-term exploration.

No.	Target customer	Programme	Payment structure	Notice period	Event length	Eligible tech.	DNO use case	Time horizon
1	Commercial	Price-based: peak time rebates	Availability and utilisation	15 mins	1-6 hours	Technology Agnostic	Operational Utilisation + Variable Availability	Near
2	Commercial	Incentive-based: direct load control	Utilisation	2 mins, 15 mins or week ahead	1-6 hours	Central ACs	Operational Utilisation	Near
3	Commercial	Incentive-based: direct load control	Availability and utilisation	Day ahead	1-6 hours	Central ACs	Operational Utilisation + Scheduled availability	Near
4	Residential & commercial	Price-based: time of use tariff	Tariff	At sign up	1-6 hours	Technology agnostic	Peak reduction	Medium
5	Residential	Price-based: peak time rebates	Availability and utilisation	2 hours	1-6 hours	Technology agnostic	Operational Utilisation + Variable Availability	Medium
6	Commercial	Price-based: critical peak pricing	Tariff	Day ahead	1-6 hours	Technology agnostic	Operational Utilisation	Near
7	Commercial	Incentive-based: interruptible load	Utilisation	At sign up	1-6 hours	Technology agnostic	Peak reduction	Near
8	Residential	Incentive-based: direct load control	Availability and utilisation	2 mins, 15 mins or day ahead	1-6 hours	Heat pumps or split systems	Operational Utilisation + variable Availability	Long
9	Residential	Incentive-based: direct load control	Availability	2 mins, 15 mins or day ahead	1-6 hours	Heat pumps or split systems	Operational Utilisation + Variable Availability	Long

We considered the entire flexibility value chain when designing the cooling DR arrangements

In the UK, Distribution Network Operators (DNOs) do not interact directly with customers. Suppliers and aggregators, also known as FSPs, act as intermediaries. This model demands that commercial arrangements be designed with both the DNO-FSP and FSP-customer relationships in mind. The graphic below shows a summary of these customer relationships.

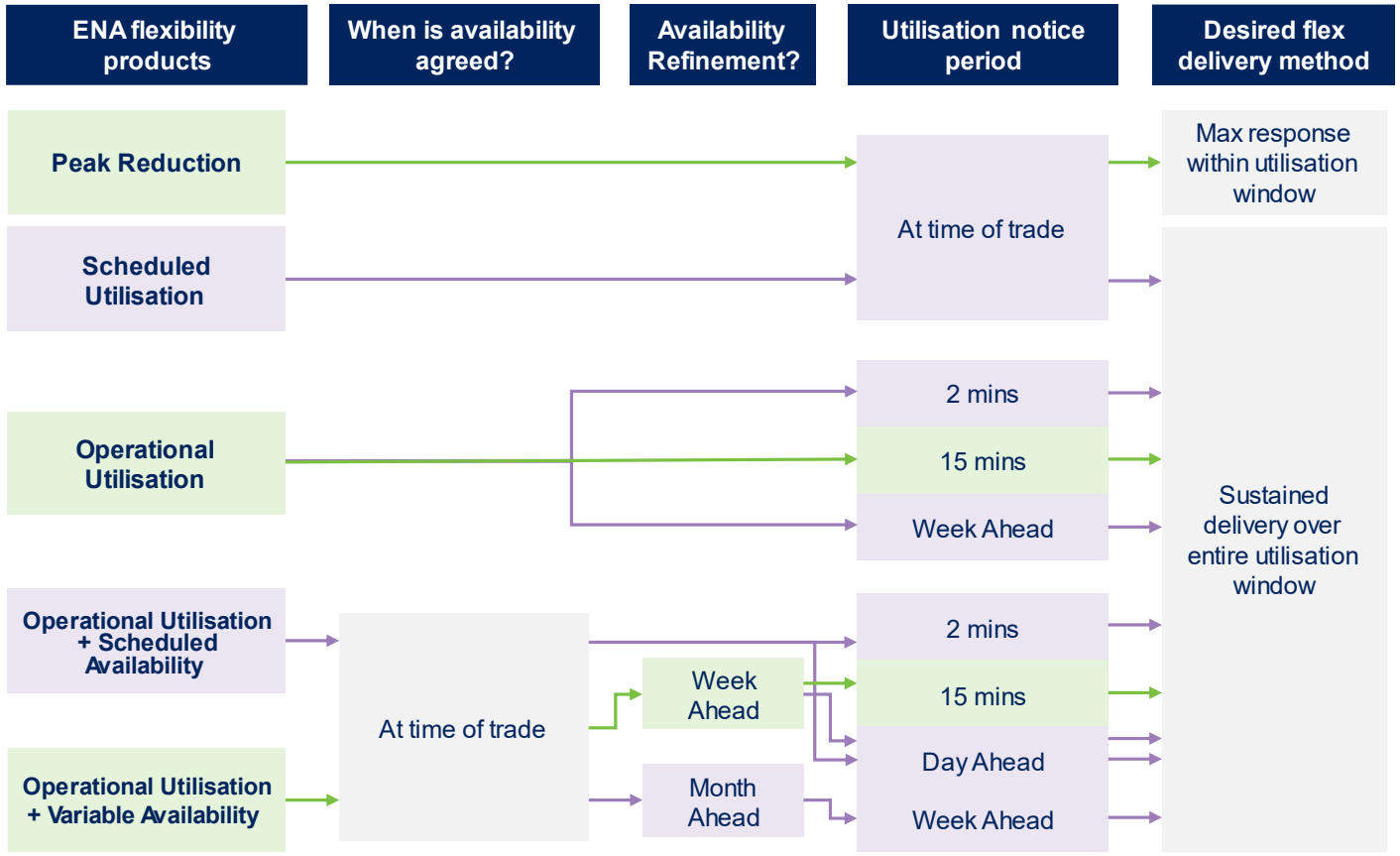


DNO-FSP arrangement	FSP/supplier-customer arrangement
• DNOs publish flex requirements and prices on a competitive market platform. FSPs compete to secure contracts. • Exchange of availability and / or utilisation payment. • Payment from the DNO should match contractual reliability of delivery. • DNO payments for procuring flexibility should be cost-competitive with costs of deferring reinforcement.	• Flexibility delivery by commercial customer based on ability to deliver flex and commercial arrangement design. • Customers may receive availability (upfront credit payment, fixed reduction on standard tariff, etc.) and/or utilisation payment (payment upon flex delivery). The payment structure varies amongst the different FSPs. • The customer typically does not decide which flexibility markets to participate in. This decision lies with the FSP.

[1] In some cases, the supplier plays the role of the flexibility service provider/aggregator as well. Examples of suppliers who do this are Octopus Energy and E.On.

The arrangements should align with the standardised flex products that DNOs have agreed to procure

In 2023, the ENA collaborated with FSPs, Ofgem, and DNOs to standardise the flexibility services[1] to help minimise the barriers to participation for FSPs in DNO flexibility markets. The cooling DR programmes in this report were designed in alignment with these flexibility products.



- FSPs have led the push for DNOs to standardise their suite flexibility products.
- Therefore, DNOs have worked together to align on a set of standard flexibility products published by the ENA.
- DNOs can procure flexibility through any of these products. The products procured by ENWL have been highlighted in green in the diagram.

Legend	
	Flex products procured by ENWL[2]
	Flex products not procured by ENWL

[1] ENA standardised flexibility products
[2] ENWL flexibility products

Methodology adopted to design the cooling DR programmes

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We adopted a workshop-based approach to design cooling DR programmes for future trials

Objectives

- Engage with commercial customers, Distribution Network Operators (DNOs) and Flexibility Service Providers (FSPs) to develop 4-6 commercial arrangements to unlock flexibility from space cooling electricity demand.
- These commercial arrangements will be an input to Work Package 6 – High-level trial design

Partners involved

1) Electricity North West Limited	DNOs
2) National Grid Electricity Distribution	
3) OakTree Power	FSP for commercial buildings
4) Impact	Domestic cooling customer engagement lead
5) Guidehouse	Work package lead

Approach

1. Developed guiding principles for the commercial arrangements design through a workshop with project partners.
2. Assessed the feasibility of the longlist of commercial arrangement outputs from Discovery.
3. Produced 3 commercial arrangements for commercial cooling through a series of 4 workshops with project partners and bilateral conversations with FSP OakTree Power.
4. Produced 2 commercial arrangements for domestic cooling through a series of 4 workshops with project partners and using the results from Impact's domestic consumer survey.
5. Summarised and qualitatively evaluated the commercial arrangements for Beta testing in D5.2.

9 guiding principles underscored the design of the cooling DR arrangements

These guiding principles were agreed collaboratively with the project partners through a workshop. They were used to design the commercial arrangement designs. This will then help decide, in work package 6, which arrangements may be trialled in Beta.

#	Guiding principle	Description
1	Customer satisfaction	Customers should trust their DNO/supplier and feel like they are being compensated fairly for their participation in the commercial arrangements.
2	Measurable impact	Flexibility provided at an individual and aggregated level needs to be measurable to understand the micro & macro impacts delivered by the arrangements.
3	Customer safety	Trials must not put customers in positions of unsafe living/operating conditions.
4	Scalability	Commercial arrangements should be scalable across the UK in BaU.
5	Customer comfort	Arrangements should deliver a bearable alteration in comfort levels with respect to the payments received for flexibility delivery.
6	Simplicity of design	Arrangements should be easy-to-understand, consistent across all customers regardless of localised network impact.
7	Transition to BaU	Arrangement design should closely reflect reality to gain insights into realistic domestic and commercial customer behaviour.
8	Transparency	Stakeholders across the flexibility value chain should be aware of all contractual obligations and associated fees within the arrangement.
9	Universality	Arrangement design should as accommodating as possible to the customer types in the regions where flexibility is being procured.

Commercial arrangements for commercial consumers

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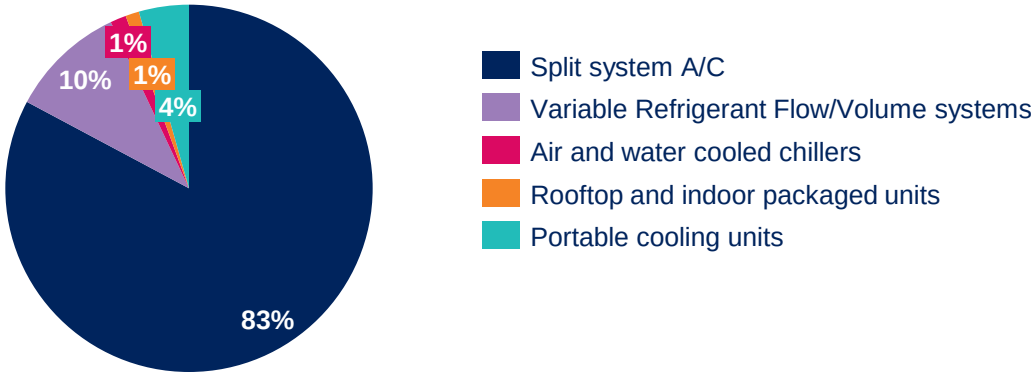
Data on commercial space cooling buildings and technologies influenced the DR programme designs

Office and retail buildings are the largest commercial consumers of space cooling in the UK.

2019 space cooling energy consumption by sector[1] for commercial buildings

Total commercial space cooling energy consumption: 6.2TWh/yr

Types of active cooling technologies[1] in commercial buildings in the UK



Key takeaways on commercial cooling energy consumption

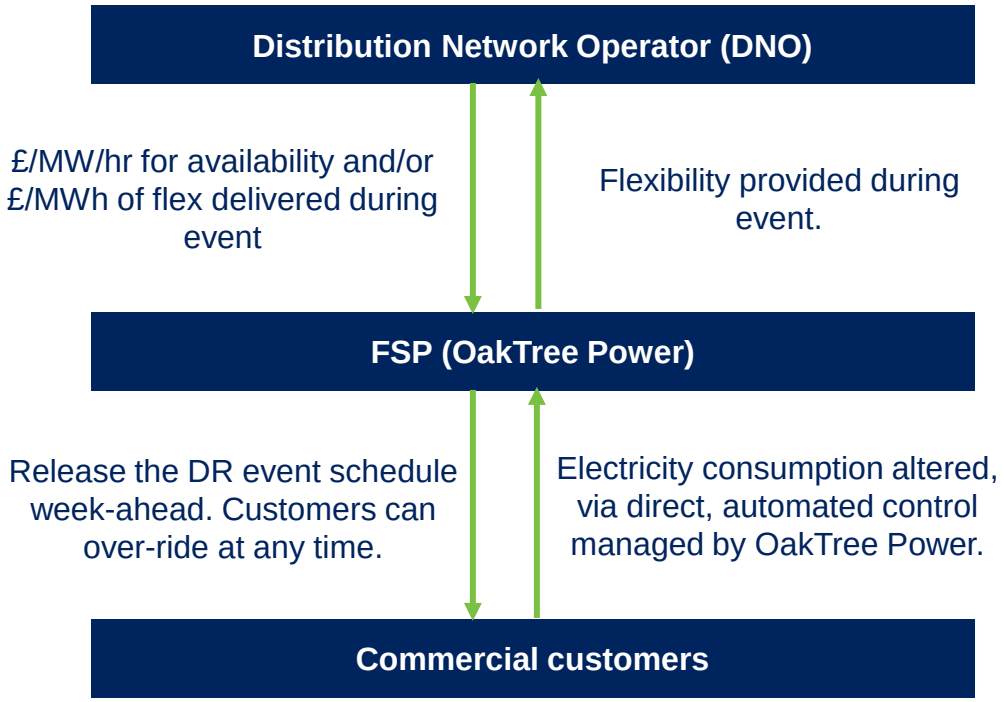
- 6.2 TWh of energy was used for non-domestic building space cooling in the UK in 2019. Offices and retail accounted for ~70% of UK's non-domestic space cooling demand.
- WP5's designed commercial cooling DR arrangements therefore focus on incentivising participation by office and retail buildings to unlock widespread DR from the commercial sector.
- Split system A/Cs are the preferred type of active cooling technology in commercial buildings, representing over 80% of active cooling technologies amongst commercial buildings.
- Variable refrigerant flow/volume systems are the next most common technology (~10%). These tend to be used in higher-end new build and refurbishment projects.
- WP5's designed commercial cooling DR arrangements aim to be technology agnostic but primarily focus on unlocking cooling flex from split system A/Cs and Variable Refrigerant Flow/Volume systems to enable broad participation.

[1] BEIS research paper 2021 - Cooling in the UK

Case study: OakTree Power's experience with commercial building demand turn down

OakTree Power are an FSP who provide energy management services for commercial (mainly office and retail) and industrial buildings across the UK. They manage their client's electricity consumption in an automated manner and help them unlock revenues from electricity cost savings and participation in distribution and transmission flex markets. The commercial cooling DR programmes were designed keeping these learnings in mind.

Overview of OakTree Power's role in DNO flex markets



Learnings from OakTree Power's experience with cooling DR

- OakTree flexes many different assets for its clients, including cooling. These learnings are based on cooling being part of a wider portfolio of assets being used to help buildings save on their electricity costs.
- Trialing CoolDown's cooling DR arrangements with more customers will provide more granular insights to FSPs and DNOs on the limits of cooling incentives and the level of incentives required to maximise participation rates of commercial cooling flex.
- For OakTree, successfully flexing cooling load involves delivering the required kW without the customer noticing that the cooling was turned down.
- From experience, commercial buildings will accept cooling flex for 90 minutes with a minimum notice period of 4 hours.
- Customers use cooling to maintain internal building temperatures within acceptable ranges. Often, non-temperature related factors, such as visits from important clients, can drive cooling consumption up.
- Temperature-related comfort levels vary by customer. Some customers impose strict, temperature set point constraints while others adopt an empirical, perceived occupant comfort approach which is not tied to building temperature.
- The ability to override the direct control at short notice is vital for commercial buildings. Customers are unwilling to sign up to DR programmes if they will be penalized for doing so.
- FSP-customer payment arrangements vary by FSP. OakTree agree the percentage split of flexibility revenues earned from the DSO with their customers upon sign-up.

Programme 1: Scheduled Direct Load Control - Overview

In this design, commercial customers would aim for a pre-determined reduction in consumption during DR events. This amount would be agreed with the FSP, who would receive an availability payment for their commitment to meeting that amount from the DNO. They would then turn down their customer's cooling load directly and compensate them for this. The customers can opt out of flex delivery any time.

DNO-FSP interaction			FSP/Supplier-customer interaction			
DNO flex product	**Payment structure between DNO and FSP**	**Notice period given to FSP**	**Eligible customers**	**DR event length**	**Notice period given to customer**	**Likely customer response to event**
Operational Utilisation and Variable Availability	£/MW/hr of availability + £/MWh of demand turned down during event window	Availability terms agreed at time of trade, refined week-ahead Utilisation instruction issued day ahead	Commercial buildings with central cooling controlled by FSP/supplier	30 mins – 2 hours. Will be a variable parameter in the trials	DR event schedule shared week-ahead. Min. 4 hours utilisation instruction given. Will be a variable parameter in the trials	• FSP will turn down customer's cooling consumption. • Manual override possible without penalty.

Note: ENWL currently procure this flex product with a 15 min utilisation instruction timing.

Distribution Network Operator (DNO)

Sets requirements on annual / biannual basis

£/MW/hr of availability + £/MWh of flex delivered during event

Flexibility provision

Flexibility Service Provider (FSP)/Energy Supplier

Assesses likely participation + provide customer payment

Varies by FSP. Examples include fixed upfront payments, £/MWh of flex delivered, etc.

Cooling consumption turned down directly by FSP during event windows

Commercial customers

Cooling turned down by FSP via direct load control

Guidehouse

Programme 2: Peak Time Rebates - Overview

In this design, commercial customers would aim for a pre-determined reduction in consumption during DR events. This amount would be agreed with the FSP. They would receive an availability payment for their commitment to meeting that amount from the DNO. They would then instruct their customers to turn down their cooling load and compensate them for this. The customers can opt out of flex delivery any time.

DNO-FSP interaction			FSP/Supplier-customer interaction			
DNO flex product	**Payment structure between DNO and FSP**	**Notice period given to FSP**	**Eligible customers**	**DR event length**	**Notice period given to customer**	**Likely customer response to event**
Operational Utilisation and Variable Availability	£/MW/hr of availability + £/MWh of demand turned down during event window	Availability terms agreed at time of trade, refined week-ahead Utilisation instruction issued day ahead	Commercial buildings with any type of cooling technology	30 mins – 2 hours. Will be a variable parameter in the trials	DR event schedule shared week-ahead. Min. 4 hours utilisation instruction given. Will be a variable parameter in the trials	• Customers will turn down cooling consumption. • Customers can decide not to participate without being penalised

Note: ENWL currently procure this flex product with a 15 min utilisation instruction timing.

Distribution Network Operator (DNO)

Sets requirements on annual / biannual basis

£/MW/hr of availability + £/MWh of flex delivered during event

Flexibility provision

Flexibility Service Provider (FSP)/Energy Supplier

Assesses participation + provide customer payment

Varies by FSP. Examples include fixed upfront, £/MWh of flex delivered, etc.

Cooling consumption turned down by customer during event windows

Commercial customers

Cooling turned down during event window

Guidehouse

Programme 3: Fixed Time of Use (ToU) tariff - Overview

In this design, the FSP would create a fixed tariff structure for their commercial customers. The commercial customers would aim to reduce their cooling consumption during the peak price periods. They would achieve electricity cost savings by shifting their cooling consumption to times when the electricity prices are lower.

DNO-FSP interaction			FSP/Supplier-customer interaction			
DNO flex product	**Payment structure between DNO and FSP**	**Notice period given to FSP**	**Eligible customers**	**DR event length**	**Notice period given to customer**	**Likely customer response to event**
Peak reduction	£/MWh of demand turned down during event window	Event windows agreed at time of trade. FSP designs tariff to incentivise cooling usage outside these windows.	Commercial buildings with any type of cooling technology	30 mins – 2 hours. Will be a variable parameter in the trials	Tariff structure agreed upon sign-up.	• Customers will turn down cooling consumption. • Customers penalised through peak pricing if they do not participate.

The Fixed ToU tariff programme is likely to be least preferred amongst commercial cooling customers

OakTree Power's industry experience and discussions from the workshops concluded that the Scheduled Direct Load Control DR programme would likely be preferred by commercial customers. The ToU tariff programme would likely be least preferred as it does not allow them the flexibility to opt out of the programme closer to real time. This will need confirming via a trial in the Beta phase.

#	Commercial cooling DR programme	Qualitative evaluation
1	Scheduled Direct Load Control	• Expected to the preferred programme for customers with compatible technologies. • Automated device management by the FSP simplifies logistics for commercial customers. • Ease of opting out of individual DR events with no penalty offers customers flexibility on participation. • However, participation is limited to commercial buildings with central cooling technologies with smart control technologies to enable direct load control by the FSP.
2	Peak Time Rebates	• The ease of opting out of participation with no penalty allows them the flexibility to decide when to participate in DR. • Furthermore, buildings with any cooling technology can participate in this programme. • However, customer control requirement introduces logistical complexities, possibly disincentivising building managers from signing up. It could also result in higher levels of 'non-delivery' during DR events.
3	Fixed Time of Use tariff	• Expected to be the least preferred programme. • Fixed tariff structure limits flexibility to opt out of reducing cooling consumption during peak periods. This limits attractiveness, especially amongst buildings with less predictable cooling loads.

Commercial arrangements for domestic consumers

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Methodology adopted by Impact in WP4 to improve understanding of domestic cooling

In WP4, Impact surveyed ~300 air con users and ~700 air con considerers to gain a deeper understanding of domestic consumer cooling behaviour and assess their willingness to being asked to flex their air con usage in response to network signals for financial compensation. The domestic cooling DR programmes were refined in keeping with these findings.

Quantitative survey methodology: 1,000 x 15-minute interviews conducted in November 2024

Questionnaire development:

- With input from ENWL, Guidehouse and UCLC.

Cognitive depth interviews:

- 5 online via Zoom
- Mix of air con users and considerers
- Survey refined and improved understanding

Pilot interviews:

- 100 online via panel.
- Data quality checks made.

Main stage fieldwork:

- 1,000 online via panel.
- 278 with domestic air con users.
- 722 with people planning to buy air con.

Qualitative survey methodology: 2 x focus groups and 6 x depth interviews conducted in December 2024

Discussion guide development:

- Content was driven by the results of the quantitative stage.
- With input from ENWL, Guidehouse and UCLC.

Depth interviews:

- 6 online via Zoom.
- Mix of air con users and considerers.
- All had a vulnerability.

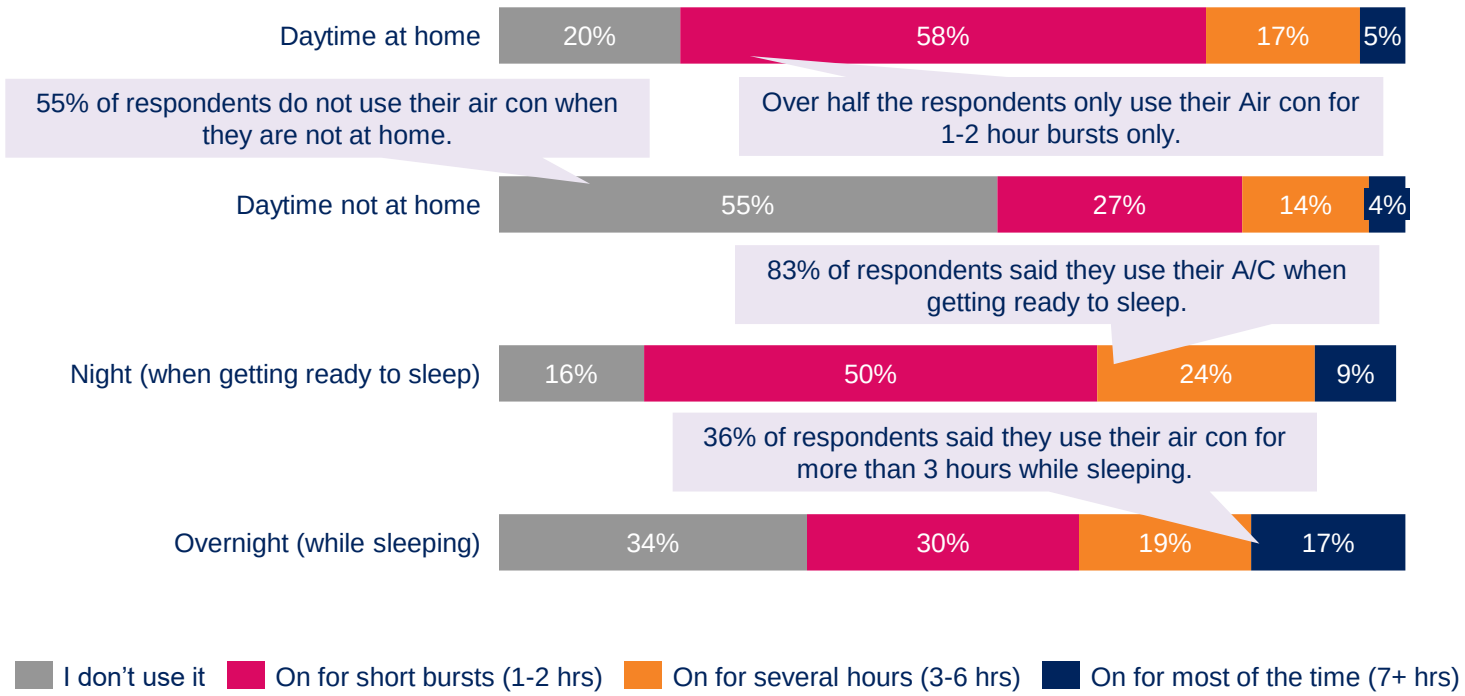
Focus groups:

- 2 focus groups via Zoom.
- 8 in the air con considerers group, 7 in the air con user group.

WP4 survey responses painted a mixed picture of domestic cooling usage behaviours

The uptake of domestic cooling is still nascent in the UK, but this is expected to increase in the future with warming temperatures and additional building overheating. The responses to the question on air con usage patterns from Impact's survey has helped to better understand domestic cooling consumption behaviours.

Q) During a typical hot week, how do you use your air conditioning?



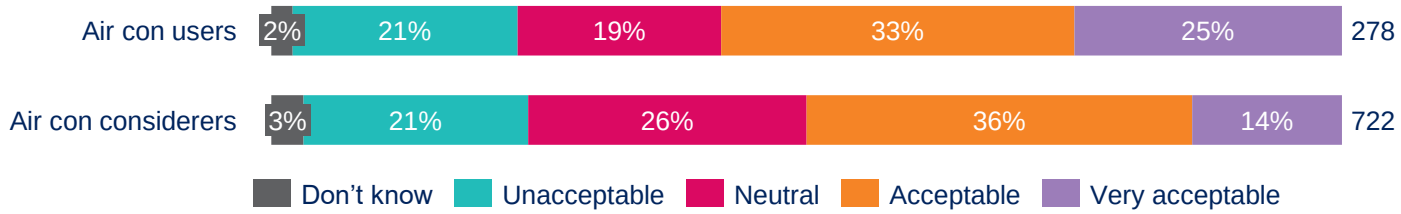
Domestic cooling usage is likely greater in the late evening/early night when residents get ready for bed

- Daytime domestic cooling consumption may be high for short periods of times on weekends, when people are more likely to be at home. 55% of the respondents said they do not use their air con when they are not at home.
- Domestic cooling consumption could be highest in the late evening, with over 83% of respondents using their A/C when getting ready to sleep. Depending on the level of future domestic cooling uptake, this could result in distribution network congestion, and the need for cooling demand flexibility during these hours.
- Air conditioning may run for longer in the late evening/overnight, with 33% and 36%, respectively, of respondents saying they use their air con for 3+ hours. However, they may be using this at a lower intensity compared to the daytime when they run it for short bursts.

The survey also built understanding on domestic cooling customers' willingness to flex

The survey respondents indicated that a preference for 1-2 hour events up to 3-4 times daily, with a 24 hour minimum notice period. Keeping these findings in mind when designing the domestic cooling DR programmes may encourage high customer engagement during potential trials and in BaU.

Q) How acceptable is it to you that your energy supplier could ask you to change the way you use electricity on hot days on behalf of the electricity network operator



Qual research findings relating to minimum notice period

*"I think **the day before** personally that's what octopus do." (Female, aged 52, Air con user)*

*"**You want to be able to plan in advance a bit**. You wouldn't want to be like, there's an event in 30 minutes, I guess turn your air con off or whatever. So maybe just say as long as possible, **at least a couple hours before**." (Male, aged 30, Air con considerer)*

Q) What is the maximum duration you think would be acceptable for your electricity supplier to ask you to reduce your air con usage on a hot day?

	Accepting of network control		Less accepting of network control	
	Air con users	Air con planners	Air con users	Air con planners
< 1 hour	3%	4%	17%	14%
1 or 2 hours	33%	47%	51%	55%
3 or 4 hours	53%	38%	22%	16%
5 or 6 hours	8%	5%	3%	4%
All day	1%	2%	2%	1%

Key takeaways on ideal cooling DR parameters

- **Event duration:** Most respondents agreed that 1-2 hrs would be the most acceptable duration. Air con users who were more accepting of flexing their cooling demand to support network constraints were willing to accept 3-4 hr event lengths.
- **Event frequency:** Air con users said they would accept 1-2 events per day, while considerers said they would accept 3-4 events per day. Some respondents said they would rather have a greater number of shorter events.
- **Min. notice periods:** Respondents generally preferred a 24 hours minimum notice period. Anything below 2 hours was deemed undesirable. They would also need reminders on the day to turn down their cooling consumption.
- **Method of flex delivery:** Methods varied, but most respondents said they would turn their air con unit off rather than power it down/turn the thermostat up.

Programme 1: Peak time rebates - Overview

In this design, domestic customers will aim for a pre-determined reduction in consumption during DR events. This amount would be agreed with the FSP, who will receive an availability payment for their commitment to meeting that amount from the DNO. They will then instruct their customers to turn down their cooling load and compensate them for this. The customers can opt out of flex delivery any time.

DNO-FSP interaction			FSP/Supplier-customer interaction			
DNO flex product	**Payment structure between DNO and FSP**	**Notice period given to FSP**	**Eligible customers**	**DR event length**	**Notice period given to customer**	**Likely customer response to event**
Operational Utilisation and Variable Availability	£/MW/hr of availability + £/MWh of demand turned down during event window	Availability terms agreed at time of trade, refined week-ahead Utilisation instruction issued day ahead	All domestic cooling customers with any type of cooling technology	1-4 hours. Will be a variable parameter in the trials	2 hours to day-ahead. Will be a variable parameter in the trials	• Customer controlled • Customers expected to turn up thermostat but may turn cooling off entirely without specific instructions..

Note: ENWL currently procure this flex product with a 15 min utilisation instruction timing.

Distribution Network Operator (DNO)

Sets requirements on annual / biannual basis

£/MW/hr of availability + £/MWh of flex delivered during event →

← Flexibility provision

Flexibility Service Provider (FSP)/Energy Supplier

Assesses participation + provides customer payment

Varies by FSP. Examples include fixed upfront payments, £/MWh of flex delivered, etc. →

← Cooling consumption reduced to benefit from rebate

Domestic customers

Cooling turned off/turned down during event window by customer.

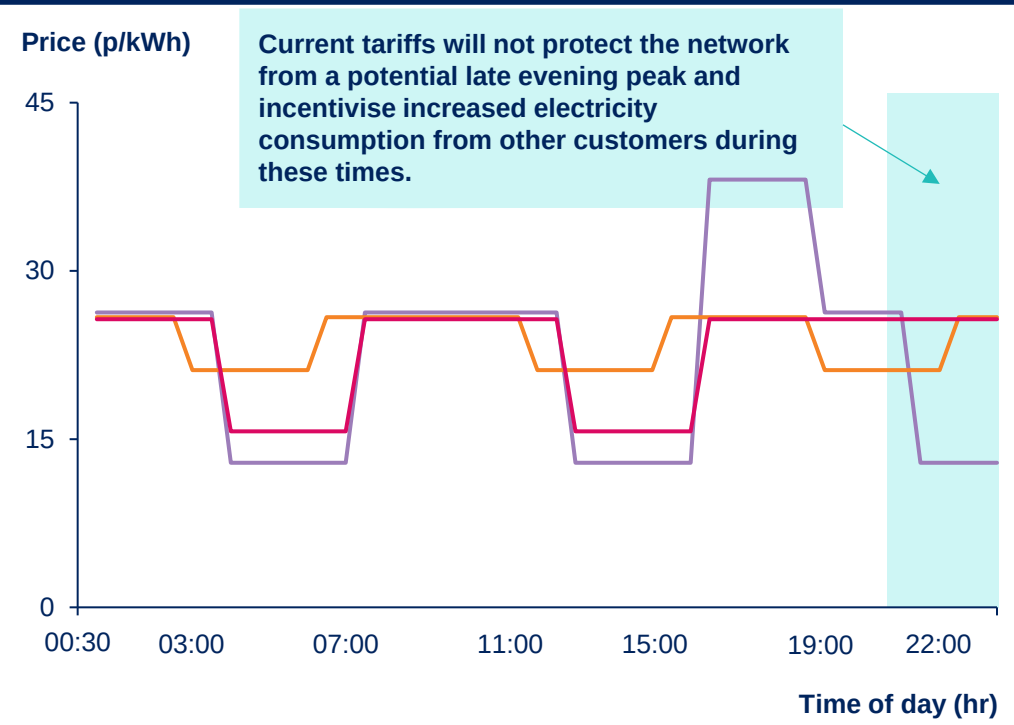
Programme 2: Fixed Time of Use (ToU) tariff - Overview

In this design, the FSP will create a fixed tariff structure for their commercial customers. The commercial customers would aim to reduce their cooling consumption during the peak price periods. They will achieve electricity cost savings by shifting their cooling consumption to times when the electricity prices are lower.

DNO-FSP interaction			FSP/Supplier-customer interaction			
DNO flex product	**Payment structure between DNO and FSP**	**Notice period given to FSP**	**Eligible customers**	**DR event length**	**Notice period given to customer**	**Likely customer response to event**
Peak reduction	£/MWh of demand turned down during event window	Event windows agreed at time of trade. FSP designs tariff to incentivise cooling usage outside these windows.	All domestic cooling customers with any type of cooling technology	1-4 hours. Will be a variable parameter in the trials	Tariff structure agreed upon sign-up.	• Customer controlled • Customers expected to turn off cooling if no instruction on how to turn down demand is provided.

Current tariffs will not protect the network from increased late evening cooling consumption

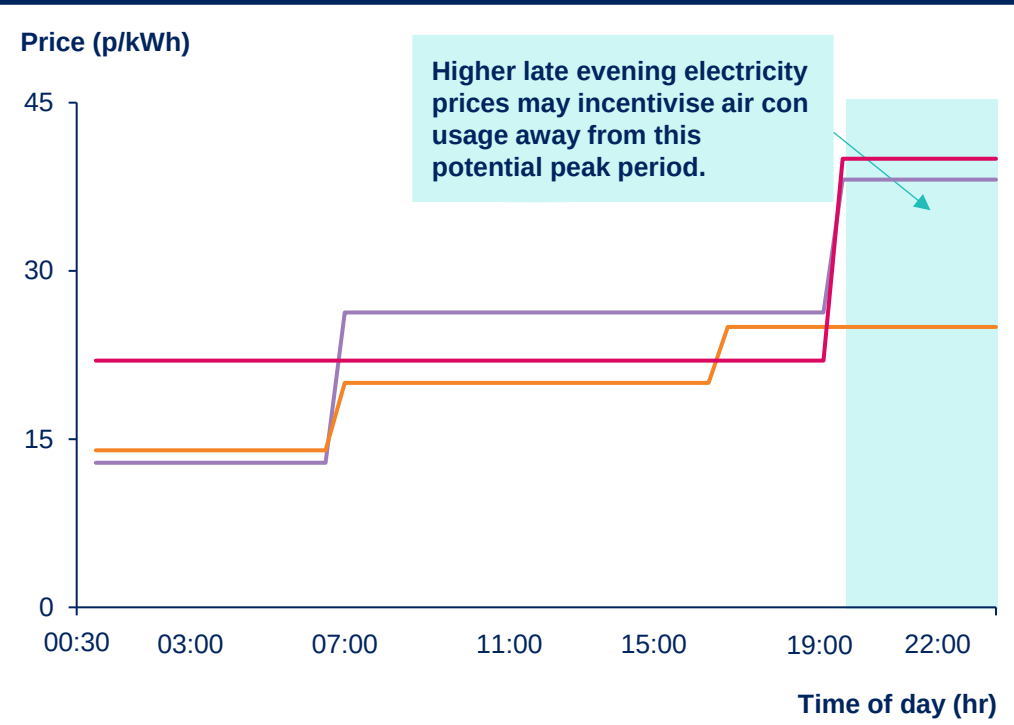
Smart electricity tariffs today – Current tariffs will not protect against a potential late evening peak from increased cooling usage



Examples of electricity tariffs on the market today

- Octopus Cosy: Reduced rates between 4-7am, 1-4pm and 10-12pm
- OVO Smart Economy 9: Reduced rates between 3-6am, 12-3pm and 730-1030pm
- EDF Heat pump tracker tariff: Reduced rates between 4-7am and 1-4pm

Example tariffs to protect against potential network congestion in the late evening period from rise in domestic air con usage



Example tariff designs to mitigate a late evening network peak from increased cooling consumption

- Tariff 1: Reduced rates overnight and increased rates during potential late evening peak
- Tariff 2: Reduced rates overnight. Late evening rates match early evening rates.
- Tariff 3: Increased late evening eates only.

Qualitative evaluation of the commercial customer cooling DR programmes

Impact's survey responses suggested that the Peak Time Rebates programme would likely be preferred by domestic customers. The survey respondents accepted that they would adjust their behaviour to save money where they can but needed to feel in control. Hence, rebates more appealing as can choose whether to participate or not without feeling penalised.

#	Commercial cooling DR programme	Qualitative evaluation
1	Peak Time Rebates	• Expected to be the preferred programme. Impact survey respondents were more supportive of this programme type. They cited the ease of opting out of participation with no penalty as a key requirement when deciding whether to sign up to a cooling DR programme. • The programme structure was also seen as more rewarding psychologically. Survey respondents said this design made it feel like their electricity supplier was giving them something 'for free' while the tariff programme made it feel like they were being penalised for using their air con.
2	Fixed Time of Use Tariffs	• Expected to be the least preferred programme. The lack of flexibility to opt out of having to reduce their cooling consumption at peak periods, due to the nature of a tariff programme is deemed unattractive. • Air con users said they didn't want to change their cooling behaviour as they only use air con when they really need to. They would prefer to adjust other electricity use behaviour (e.g., washing machine / dishwasher) but not air con in a heatwave. • A better understanding of real domestic cooling asset usage profiles, and how these interact with other low carbon technologies like solar PV and home batteries, is needed to authoritatively design a useful tariff structure.