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SIF CoolDown Alpha

Show and Tell

29th April 2025

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Agenda

1 **Introduction to CoolDown**

2 **CoolDown Alpha findings**

3 **Q&A**

Housekeeping:

- This session will be recorded.
- To minimise distractions, participants have been muted.
- If you have any questions during the presentation, please use the Q&A function. We will address questions at the end.
- After the presentation, we will take questions from the Q&A function, or you can raise your hand and be taken off mute to ask.

Who are Electricity North West?

- We're the North West's power network.
- Our overhead lines, underground cables and substations bring power to 5 million people in 2.4m homes and businesses.
- We invest billions of pounds in the region focusing on key areas of **safety**; **reliability**; **customer service** and **net zero.**

We deliver a reliable essential service for everyone in the North West, 24/7.

Number of customers **2.4m**	Overhead lines **12,519km**	Underground cables **44,872km**	Submarine cables **23km**	Total network length **57,415km**

Introduction to CoolDown

CoolDown is a Strategic Innovation Fund (SIF) project

About SIF

- A competitive **£450m fund** managed by **Ofgem** and **Innovate UK** for **energy networks** working in partnerships with each other and other innovators.
- Aims **to find and fund ambitious, innovative projects** with the potential to **accelerate the transition to net zero,** and shape the future of networks

SIF projects have up to three phases. CoolDown has just finished its Alpha phase

Discovery	Alpha	Beta
< £150k	< £500k	> £500k
Completed in May 2024	Findings being presented today	Planning to apply for funding in mid-to-late 2025

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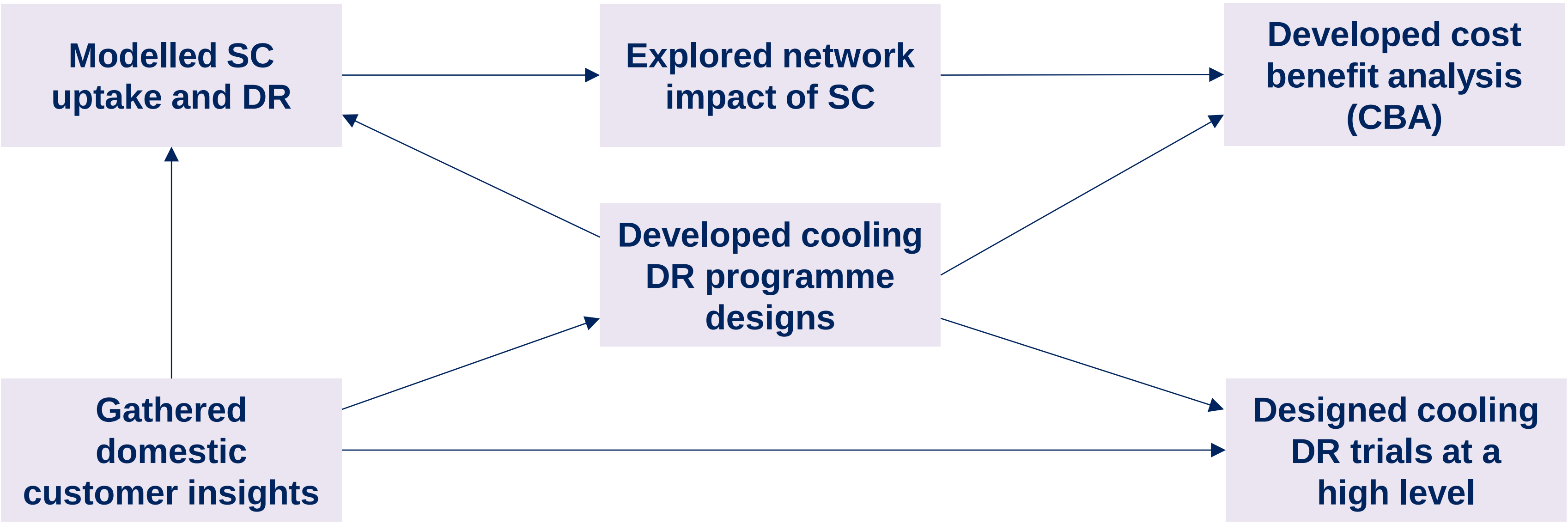
CoolDown explores the impact of future cooling growth and flexibility on UK distribution networks

Why is CoolDown needed?

- As the UK warms, space cooling (SC) demand is increasing.
- CoolDown assesses:
  - The bounds of the increase in SC demand.
  - Its impact on distribution networks.
  - The potential flexibility associated with it and how it can be harnessed.

CoolDown Alpha:

- Modelled the impact of current and projected domestic and commercial SC uptake at the distribution network level.
- Explored domestic SC uptake and flexibility potential via interviews and surveys.
- Developed cooling demand response (DR) programmes to incentivise SC flexibility.
- Modelled the network and consumer benefits achievable from unlocking space cooling DR.



6 project partners

Electricity North West – Bringing energy to your door
Guidehouse
IMPACT – From insight to influence
nationalgrid
Oaktree Power
UCLC – Consulting with Experts

Your speakers for today

Rachel Stanley

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Electricity North West

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Innovation Project Manager

Electricity North West

Alice Broomhall

Research Director

Impact Research

Callum Coghlan

Senior Consultant

Guidehouse

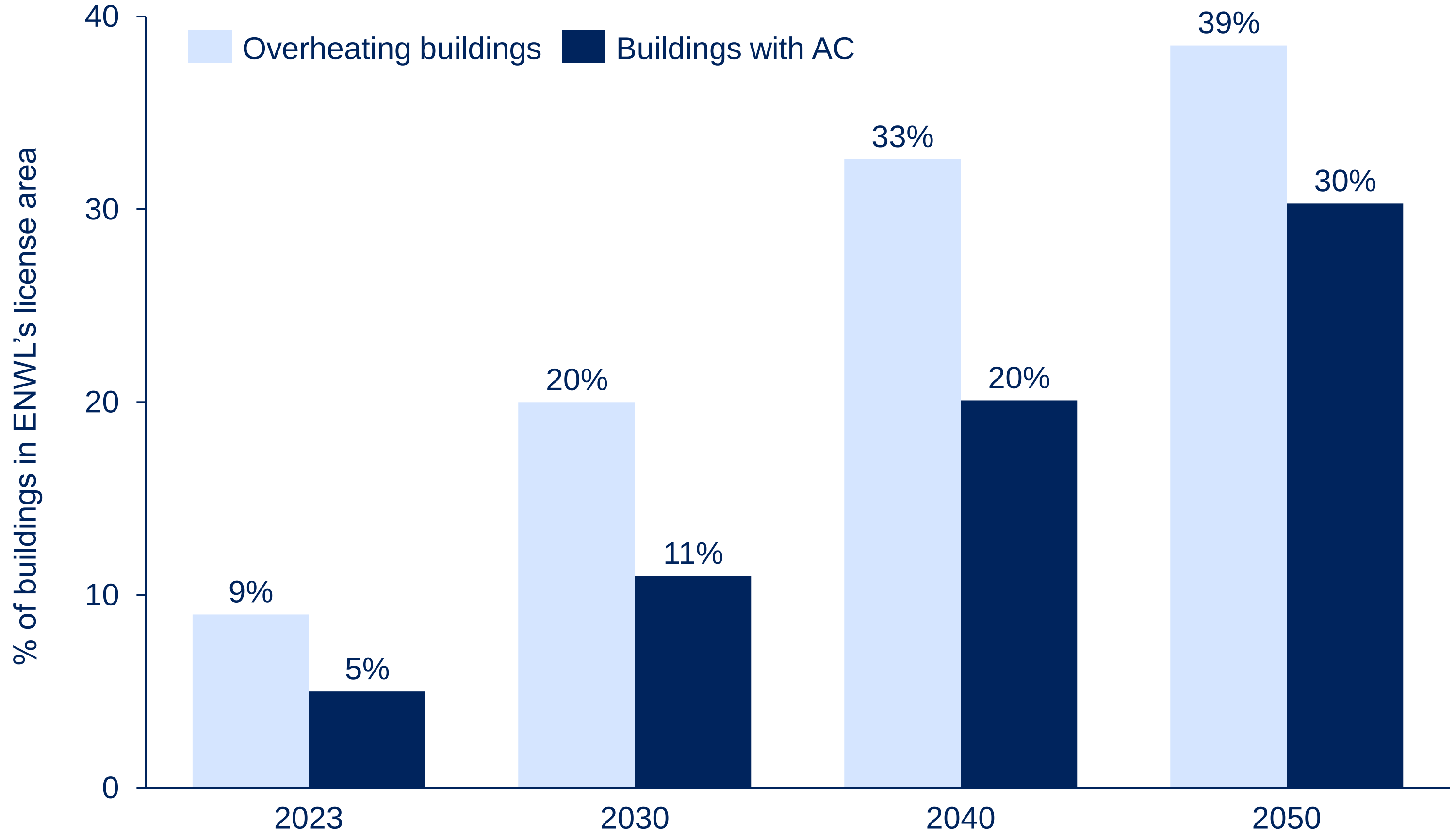
CoolDown Alpha findings

We modelled the growth in cooling across over 2,000 ENWL substations

1. Refined, updated and defined the SC uptake and DR model from Discovery phase.
2. Characterised >2,000 substations into 20 archetypes using monitored load data.
3. Modelled baseline cooling uptake in the archetypal substations for 2023, 2030, 2040 and 2050.
4. Modelled cooling DR scenarios for 2030, 2040 and 2050, informed by findings from other work packages.
5. Scaled up the results from the 20 archetypes back to the 2,438 ENWL substations.

Our model finds that 30% of buildings install AC by 2050 due to a rise in building overheating

Proportion of overheated buildings and buildings with AC installed across the 2,438 ENWL substations modelled in the project

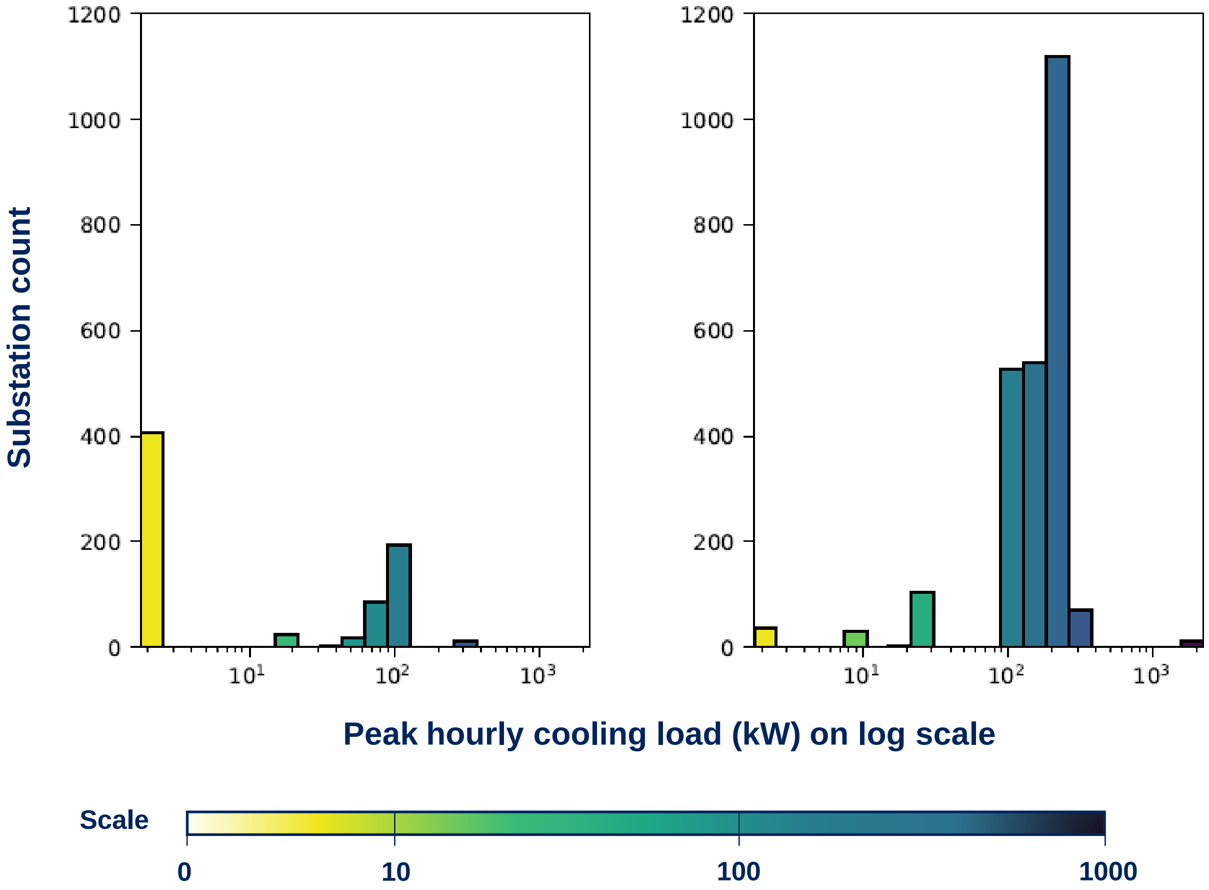


39% of all buildings will overheat by 2050. This leads to 30% of all buildings installing active cooling technologies by 2050.

Cooling growth leads to a significant rise in peak summer cooling demand across all substations

Modelled SC uptake and DR

Distribution of maximum peak cooling load across the 2,438 ENWL substations modelled in the project in 2023 (left) and 2050 (right)



By 2050, all modelled substations have cooling demand.

Compared to 2023, 6x as many substations have a peak cooling load between 100-300kW by 2050.

We used this modelling to explore the impact of cooling growth and cooling DR on distribution networks

Explored network impact of SC

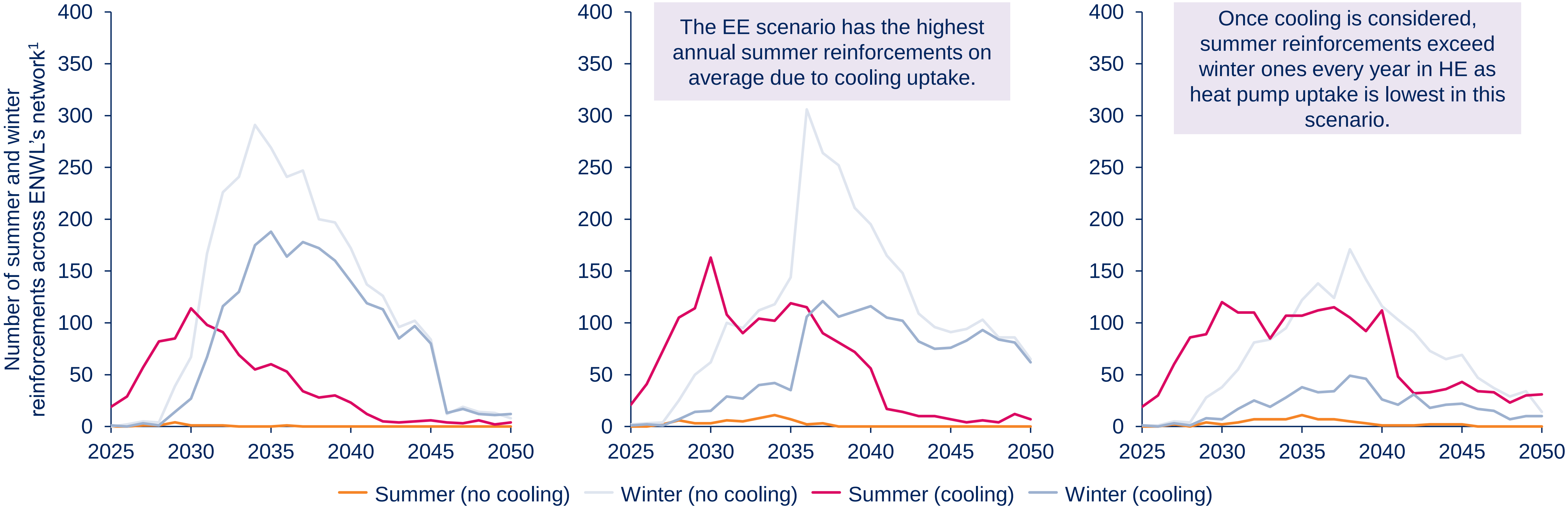
1. Gathered the ENWL substation data required for network impact analysis.
2. Inputted cooling uptake and DR projections from model and analysed its impact on ENWL substations.
3. Scaled up the results of the analysis to all substations GB-wide.
4. Identified cost and benefit streams, input assumptions, and scenarios for the CBA.
5. Iterated drafts of the CBA with partner review to provide a view of cumulative net benefits from cooling DR.

Cooling could cause a significant shift in reinforcement need from winter to summer, upending network planning

Explored network impact of SC

The exact impact of the shift depends on the DFES scenario considered, but the shift from winter to summer reinforcements is consistent across all three.

Holistic Transition (HT) | **Electric Engagement (EE)** | **Hydrogen Evolution (HE)**



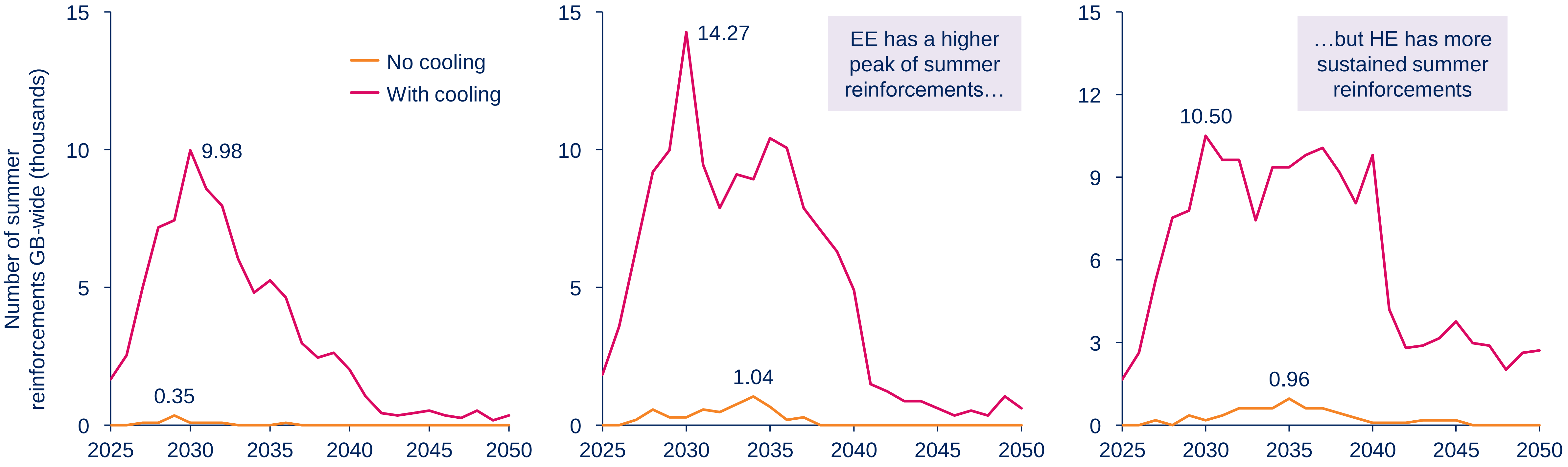
[1] Out of sample of 2,438 included in our analysis.

Scaled GB-wide, thousands of substations will need earlier reinforcement, highlighting a need for flexibility

Explored network impact of SC

Cooling growth GB-wide triggers large-scale reinforcement that DNOs should consider when planning their networks. Absence of early reinforcement and/or flexibility procurement planning could exacerbate network constraints.

Holistic Transition (HT) | **Electric Engagement (EE)** | **Hydrogen Evolution (HE)**

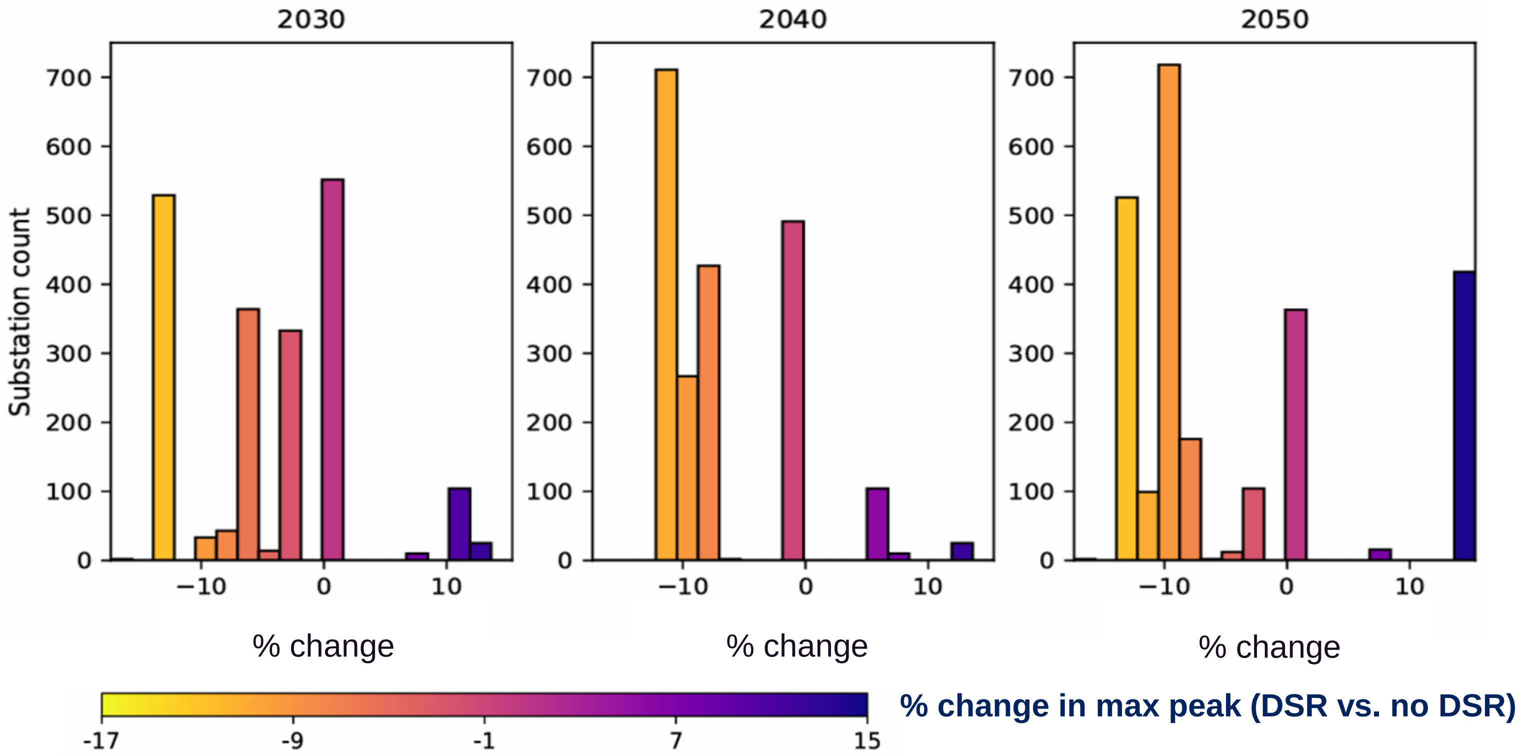


Cooling DR could reduce substation and network level peak demand, but may result in secondary peaks

Explored network impact of SC

Cooling DR decreases peak load in by >10% by 2050 in over half of the 2,438 ENWL substations modelled in WP2.

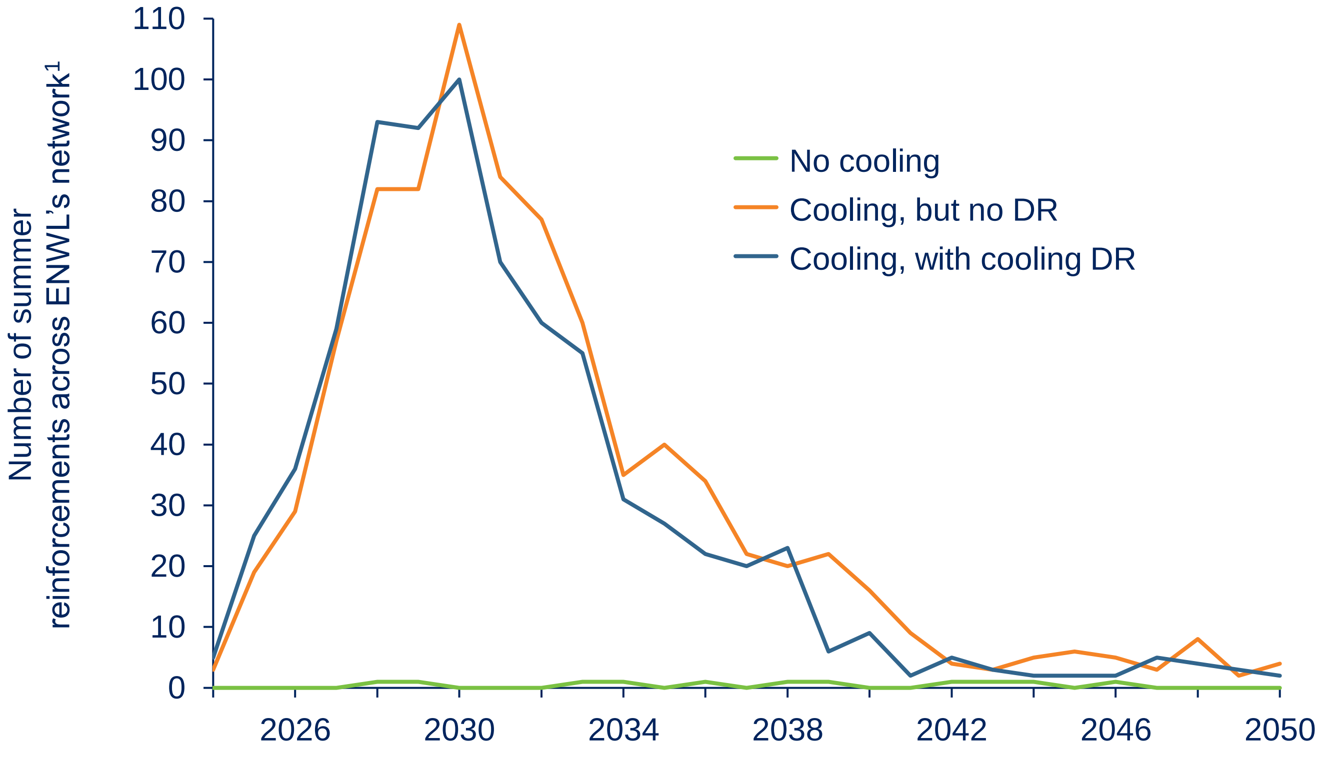
Change in peak hourly cooling demand due to DR across 2,438 ENWL substations (negative means reduced peak demand, positive means increased peak demand)



Flexing cooling load can defer reinforcement needs, buying distribution networks more headroom

Explored network impact of SC

Modelled number of summer-peaking ENWL substation reinforcements triggered per year for the Holistic Transition DFES



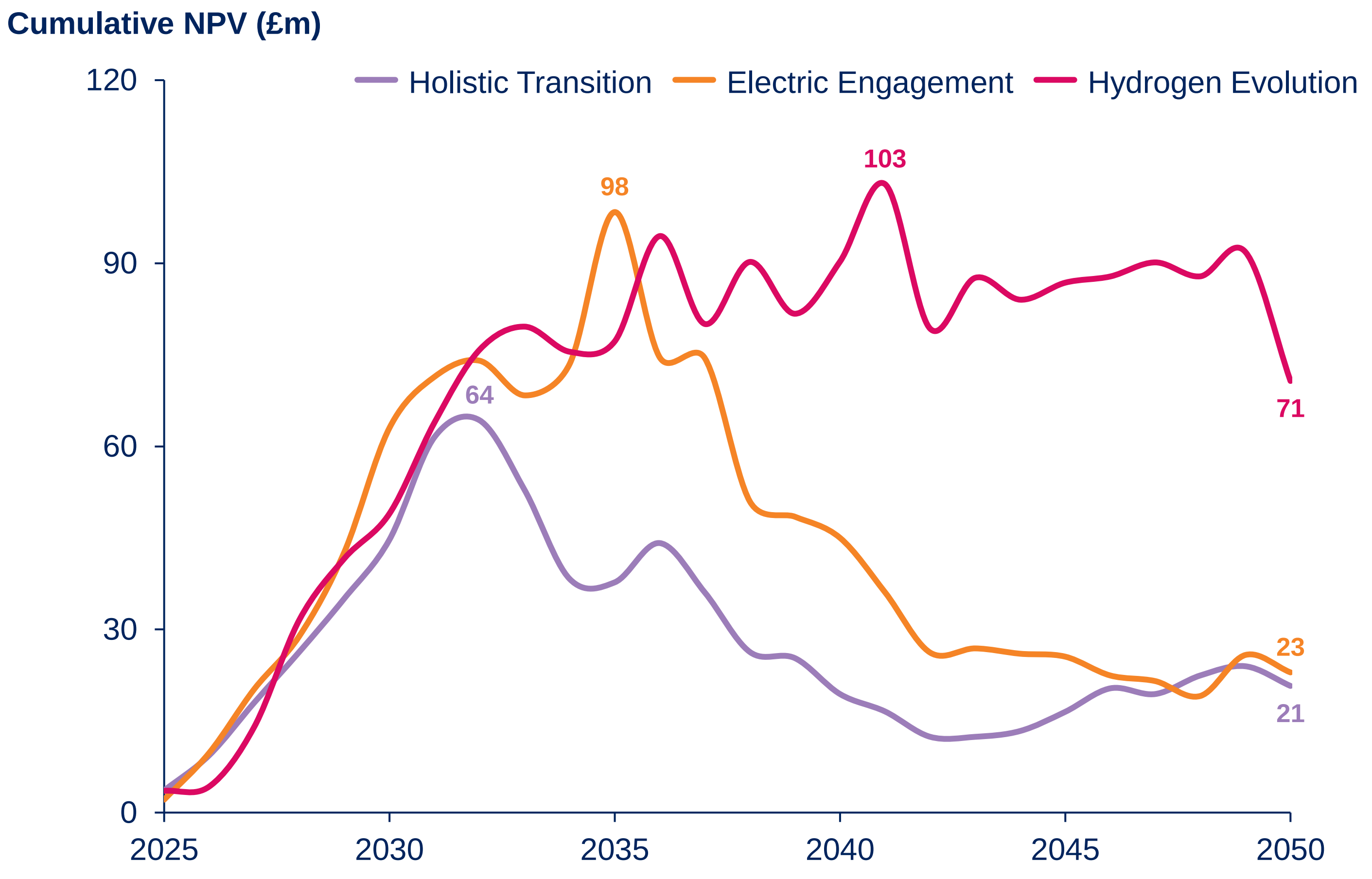
Throughout the 2030s, the DR reduces the number of substations reinforcing in that year due to a summer trigger.

[1] Out of sample of 2,438 included in our analysis.

Cooling DR could deliver up to £103m net discounted financial benefits to GB energy consumers by 2042

Developed cost benefit analysis (CBA)

Cumulative discounted net present value (NPV) of cooling DR rollout GB wide

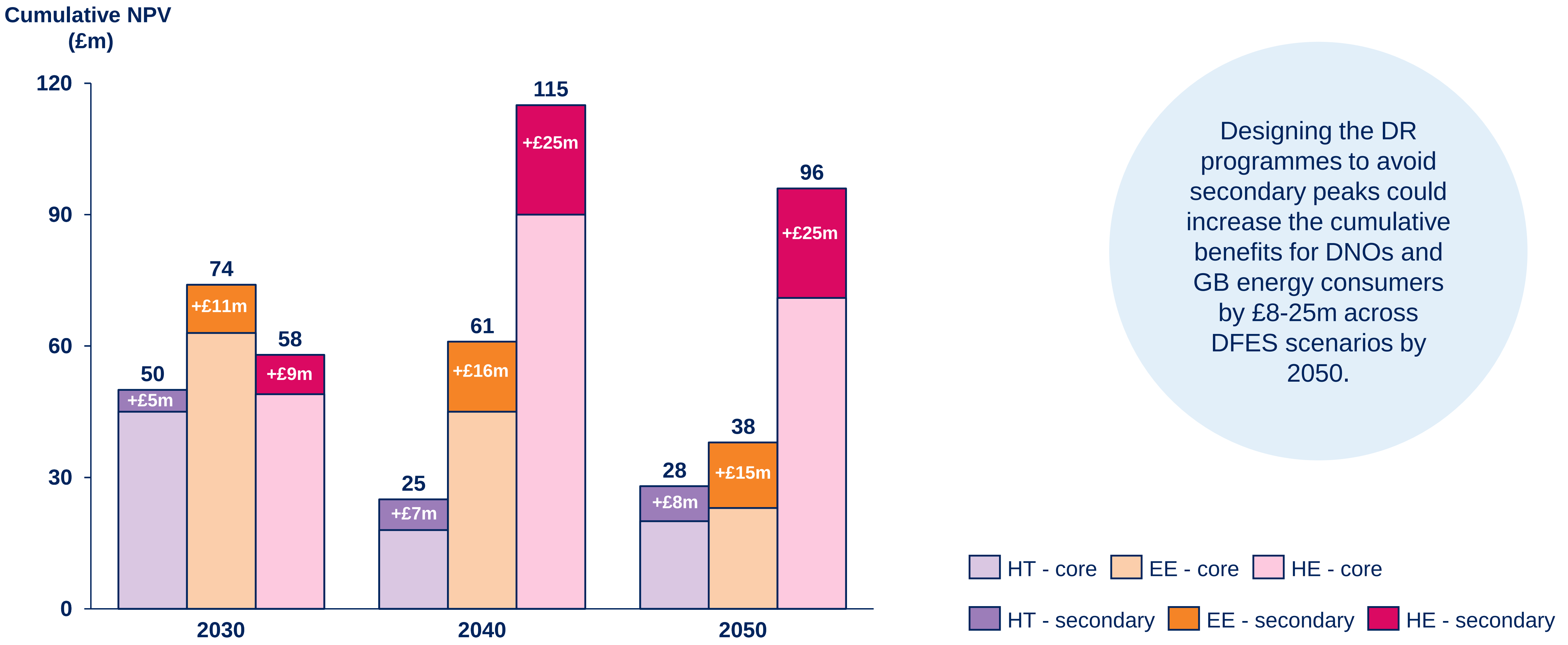


Reinforcement deferral from cooling DR could deliver up to £71m in cumulative benefits across DFES scenarios to GB energy consumers by 2050.

Mitigating against secondary peaks from DR can further increase cumulative net benefits by £8-25m by 2050

Developed cost benefit analysis (CBA)

Comparison of cumulative NPV from cooling DR with and without substations seeing secondary peaks (displayed for three DFES scenarios)



Designing the DR programmes to avoid secondary peaks could increase the cumulative benefits for DNOs and GB energy consumers by £8-25m across DFES scenarios by 2050.

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We surveyed 1,000 domestic AC users and considerers to understand their AC behaviours

1
Designed quantitative survey for AC users and considerers across the UK.

2
Administered quantitative survey, plus cognitive interviews.

3
Analysed results of surveys and initial interviews and created discussion guide for focus groups and in-depth interviews.

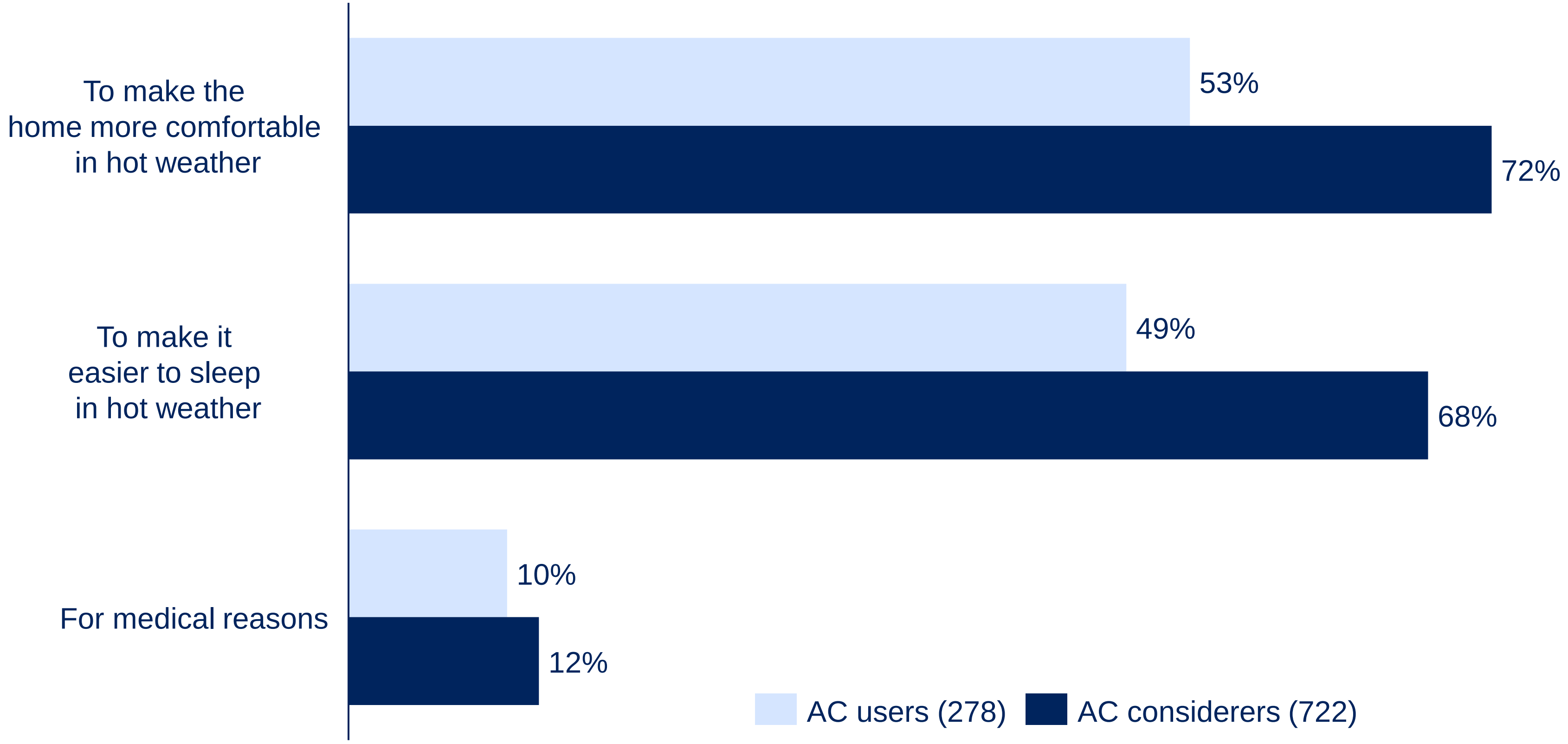
4
Conducted focus groups and in-depth interviews to gain deeper insights into customer behaviour.

5
Analysed data across all surveys focus groups and interviews.

Increased thermal comfort management needs, especially overnight, drive cooling uptake in the future

Gathered domestic customer insights

Most cited reasons for domestic AC installations according to surveyed customers



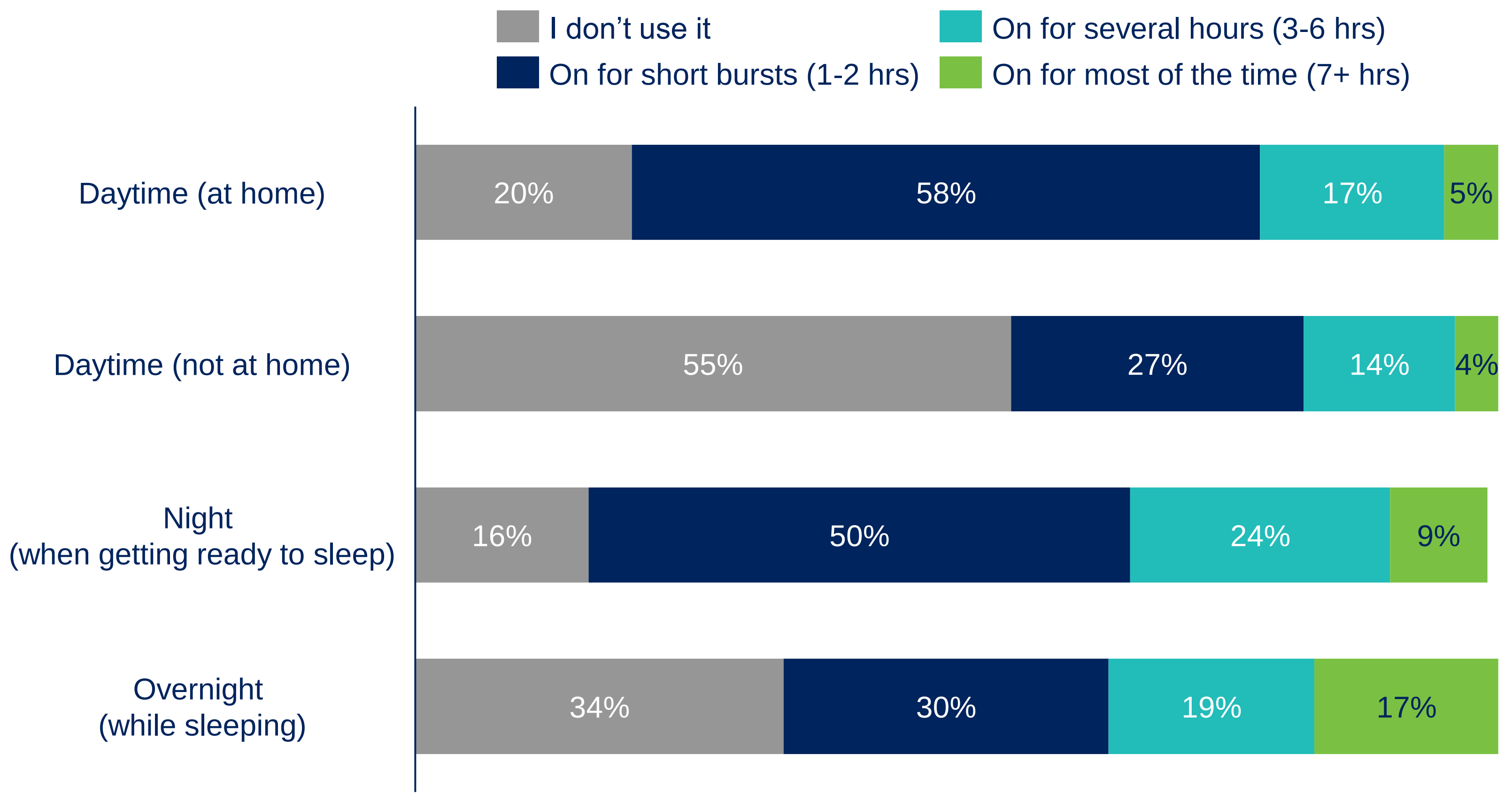
8% of households have AC. 20% plan to purchase it in the next two years.

Primary motivators for domestic AC purchase include improving comfort in hot weather, improving sleep, and managing health concerns.

Domestic AC usage varied greatly, but evening and nighttime were important for many

Gathered domestic customer insights

How and when do domestic AC users operate their cooling?



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

Two in three users turn their AC on above 24C. The preferred cooling temperature set-point is 19-22C.

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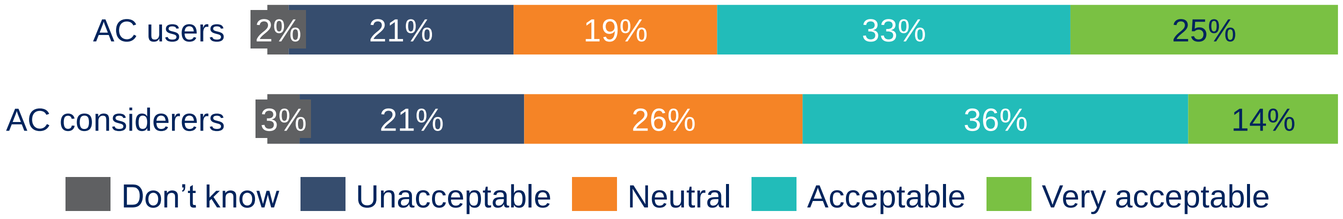
A majority of respondents were amenable to flexing their cooling demand to help the network

Gathered domestic customer insights

Acceptability of being asked to change the way AC is used on hot days to help the network



Event duration: 1-2 hours most acceptable.

Notice: 24-hour minimum notice desired.

Event frequency: Typically 1-2 events per day.

Participants preferred event-based flexibility to tariff-based flexibility

- Event-based flexibility payments seen as an incentive.
- Participants can choose whether to participate or not, giving them more control.
- There may be limits to event-based DR as AC users did not want to drastically change their usage behaviour. They already only use AC when they really need to due to 'AC guilt' and cost concerns.

We developed detailed cooling DR programme designs and a high level strategy for trialling them

1. Developed guiding principles for the DR programmes.
2. Assessed DR programme longlist from Discovery and identify design gaps.
3. Designed 2 DR programmes each for commercial and domestic cooling.
4. Designed cooling DR trial criteria and assessed feasibility.
5. Explored high-level cooling DR trial logistics

9 guiding principles underscored the design of the cooling DR programmes

We agreed nine guiding principles collaboratively as project partners. We used them to develop the cooling DR programme designs and fed into decisions on which programme designs to prioritise for a proof-of-concept trial.

1. Customer satisfaction
2. Measurable impact
3. Customer safety
4. Scalability
5. Customer comfort
6. Simplicity of design
7. Transition to BaU
8. Transparency
9. Universality

We designed two DR programmes for commercial cooling customers and two for domestic for trialing

Commercial cooling DR arrangements designed

Programme	Cooling DR mechanism	DR parameters
Scheduled Direct Load Control	FSP turns down customer's cooling via direct load control.	**Event length**: 60–90 mins. **Notice Period**: At least 4 hours. **Event frequency**: 60-90 mins between events if multiple per day.
Peak Time Rebates	Customer turns down their own cooling to receive financial rewards from their FSP.	

Domestic cooling DR arrangements designed

Programme	Cooling DR mechanism	DR parameters
Peak Time rebates	Customer turns down their own cooling to receive financial rewards from their FSP.	**Event length**: 1-2 hours preferred, max 4 hours. **Notice Period**: At least 24 hours. **Event frequency**: 1-2 events per day.
Fixed Time of Use Tariff	Customer turns down their own cooling in response to tariff price signals.	Tariff structure fixed and agreed at sign-up.

Roles of the stakeholders in a DR programme

£/kW/h Availability and/or £/kWh Utilisation payment

Contracted kW of flexibility delivered

DNO sets flex requirements on annual/biannual basis

FSP / Supplier assesses participation and provides customer payment

Fixed upfront payment and/or £/kWh payment for cooling turn down

Cooling consumption turned down as per DR programme

Customers turn down cooling consumption

We defined trial criteria that will ensure diverse and meaningful results

Meeting these five trial criteria and the partner requirements outlined will make sure cooling DR trials are large and diverse enough to deliver meaningful, BaU replicable learnings on cooling flexibility GB-wide.

- At least 1 MW aggregated cooling demand amongst participating commercial buildings.
- At least 200 participating households/domestic buildings with AC (fixed or portable) installed.
- At least 2 participating DNOs.
- At least 2 participating FSPs – one with commercial customers and one with domestic customers.
- Participating commercial buildings must be willing to allow Direct Load Control over their cooling assets.

We considered various logistical elements for a proof-of-concept cooling DR trial

Designed cooling DR trials at a high level

Trial location:
- Network-wide. Focus on ENWL's license areas initially.
- Potentially expand into additional DNO license areas in future trials.

Recruitment criteria:
- Target office/retail buildings for commercial DR trials.
- No restrictions for domestic DR trials.

Priority DR programmes:
- Scheduled Direct Load Control and Peak Time Rebates for commercial DR trials.
- Peak Time Rebates and Fixed ToU tariff for domestic DR trials.

Payment approach
- Mirror payment approach in DR programmes designed.
- Add participation incentives in initial trials to maximise participation.

Trial variables in priority order:
- External temperature
- DR event length and frequency
- DR event payment amount
- Notice period given to customers

Impact evaluation:
- Conduct the trials as a Randomised Control Trial.
- Use the Differences in Differences approach to calculate the aggregate flexibility unlocked in each event.

Customer engagement:
- Regularly engage with participants through surveys, focus groups and interviews before, during and after the trials.

Vulnerable customers:
- Establish envelopes within which domestic customers should operate their AC.
- Post trial, check if they have not exceeded these limits.

Thank you for listening and we welcome any questions!