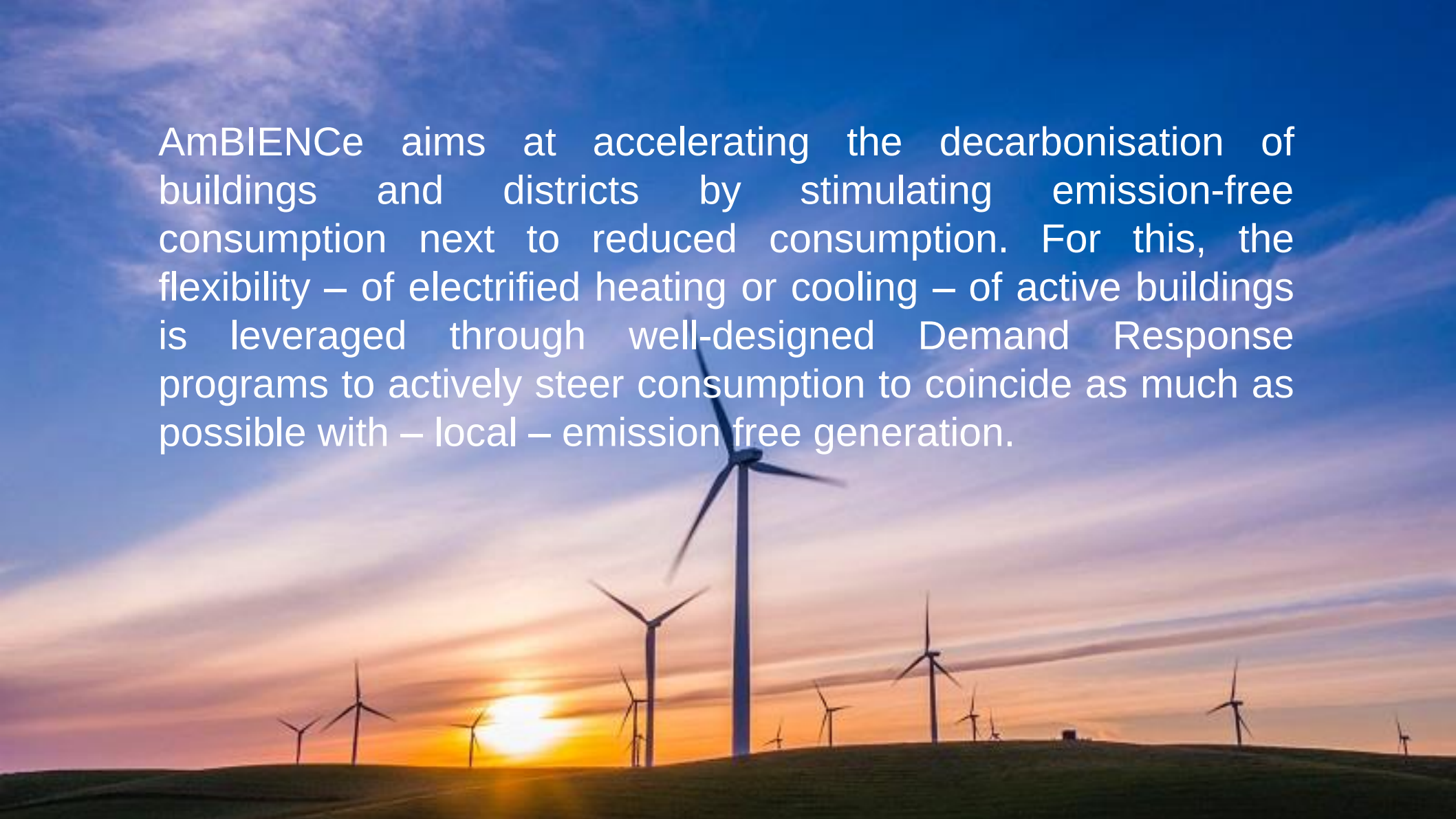
Accelerating the transition to a low-carbon future through innovative business models and price based service contracts

The Clean Energy for all Europeans package aims to facilitate the transition away from fossil fuels and to deliver on the EU's Paris agreement commitments for reducing greenhouse gas emissions. Targets for 2030 include improving energy efficiency by 32.5% and the share for renewable energy by 32%.


Today we will talk about how two Horizon 2020 funded projects are testing innovative business models that will combine building level flexibility with Energy Performance Contracting to accelerate the transition to a low carbon future.



AmBIENCe aims at accelerating the decarbonisation of buildings and districts by stimulating emission-free consumption next to reduced consumption. For this, the flexibility – of electrified heating or cooling – of active buildings is leveraged through well-designed Demand Response programs to actively steer consumption to coincide as much as possible with – local – emission free generation.

NOVICE delivers a new business model for ESCOs that takes advantage of revenues from both energy efficiency and demand response flexibility. Enhanced Energy Performance Contract and MoU will guarantee building owners a minimum level of energy savings and occupant comfort whilst ensuring that the maximum value can be extracted from the flexibility potential of on-site energy assets.

Today’s speakers are

Maarten De Groote has over 15 years’ experience in energy efficient, sustainable and smart buildings, and joined VITO/EnergyVille as Senior Expert early 2019 where he coordinates the Positive Energy District programme and manages project teams for public clients (EU, national and local).

Today’s speakers are

Jo Southernwood is a skilled energy researcher and project manager who joined the IERC in February 2017. With over 10 years’ experience of working in the energy efficiency and low carbon technology sectors, Jo has a deep understanding of the challenges associated with building services and energy management.

Agenda

15:05 – 15:30 – AmBIENCe project

Energy Performance Contracting models
Active building Energy Performance Contracting
Business value of demand response in active building Energy Performance Contracting

Agenda

15:30 – 15:45 – NOVICE project

Overview: what is an Enhanced Energy Performance Contract and what are the benefits?

Case studies and lessons learned: Impact of demand response on thermal comfort of occupants

Agenda

15:45 – 16:00 – Q&A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AmBIENCe Project - Accelerating the transition to a low-carbon future

21 April 2020 - webinar

Maarten De Groote

Senior Expert Built Environment & Smart Cities

Vito / EnergyVille

Introducing Energy Performance Contracting

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Introducing Energy Performance Contracting

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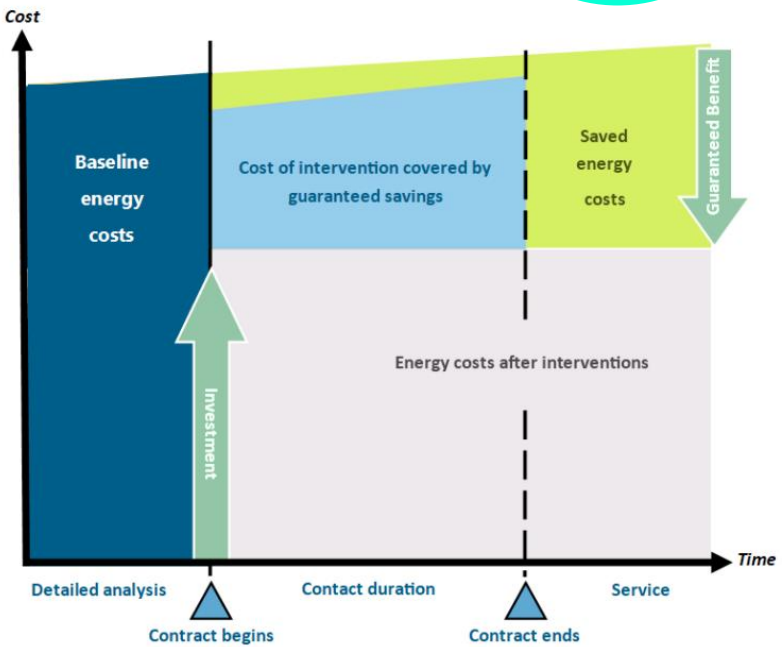
Significant costs & savings in operation phase of the building

Building owners & users are mostly no energy experts



Introducing Energy Performance Contracting

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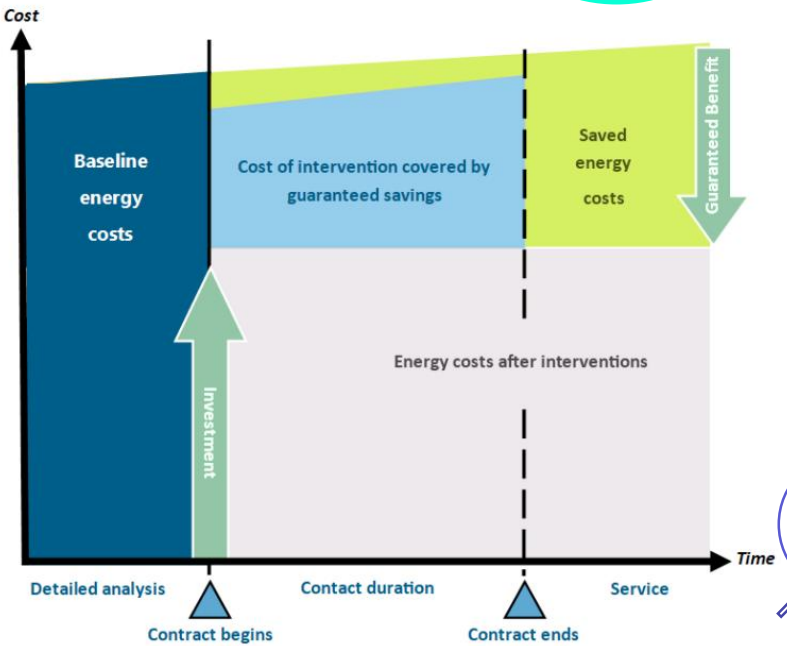

- Outsources energy savings and management
- From optimisation of operations to deep energy retrofits
- Shifts risk of under performance to a private party (i.e. ESCO)
- Potential extension with ESCO Financing to provide an overall integrated solution
- Maintenance is mostly incorporated → Maintenance & Energy Performance Contracts (M-EPC)

The EPC model is flexible & adoptable

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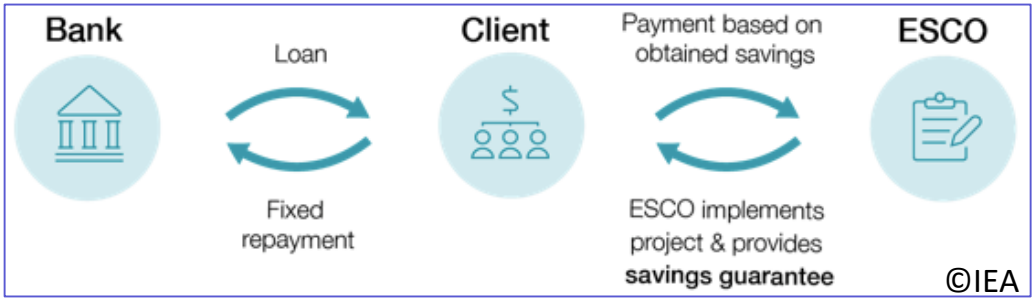
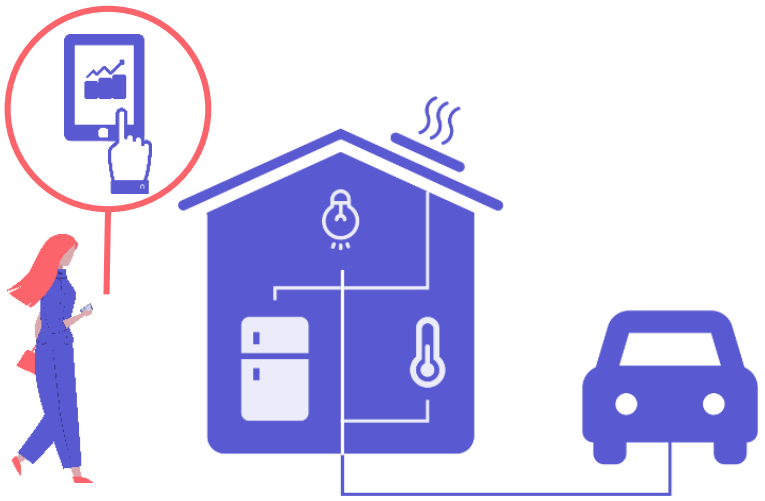
Flexible approach

- Guaranteed Savings Model (50% of EU market)
- Shared Savings Model (20% of EU market)
- Energy Supply Contracting (30% of EU market)



New Opportunity:
Buildings become more digital and smarter



Active management: significant emission savings in a cost-effective way (5 to 30% for space heating)

-**Smarter:** enabling buildings to answer the flexibility need of the energy system

More digital: adding sensors, meters, ICT, …

- to improve comfort, security, ….
- to support M&V (e.g. but not exclusively in the context of EPC)

What is energy flexibility? An example …

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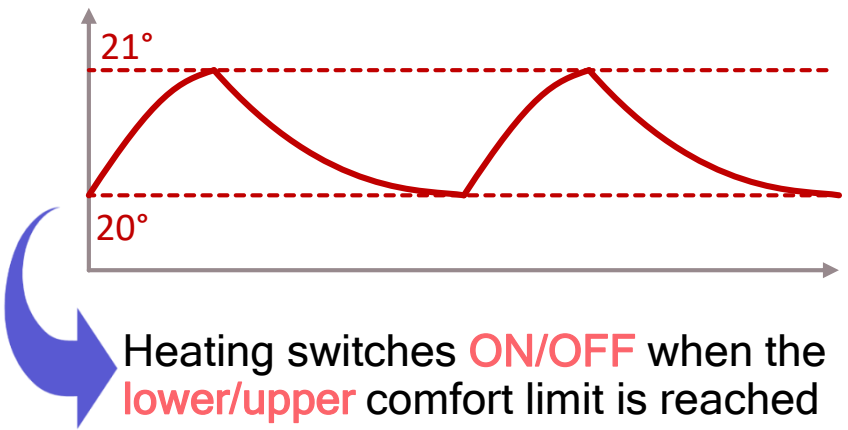
Heating of building with
traditional ON/OFF control



Heating switches ON/OFF when the
lower/upper comfort limit is reached

What is energy flexibility? An example …

ambience

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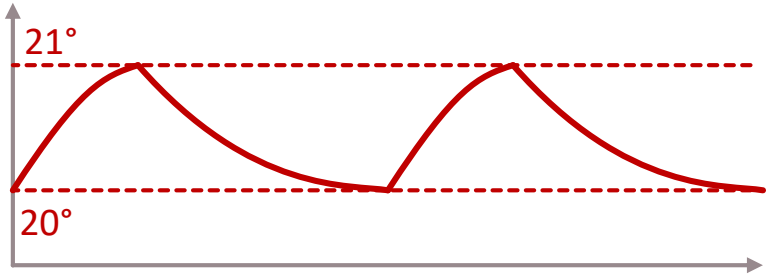

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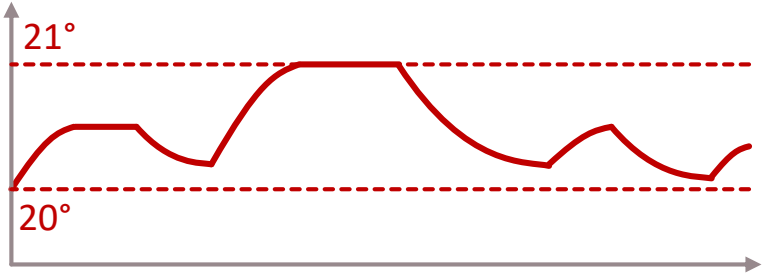
Heating of building with smart control



Heating switches ON/OFF whenever it wants as long as the comfort is not compromised

What is energy flexibility? An example …

ambience

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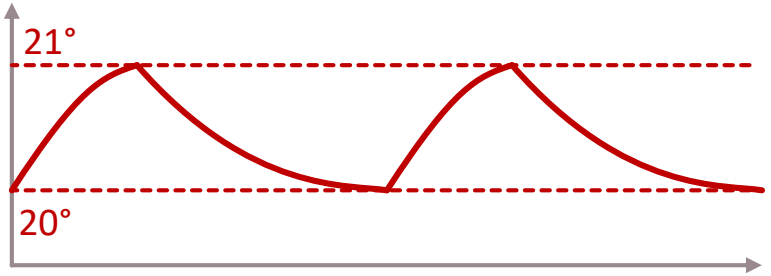

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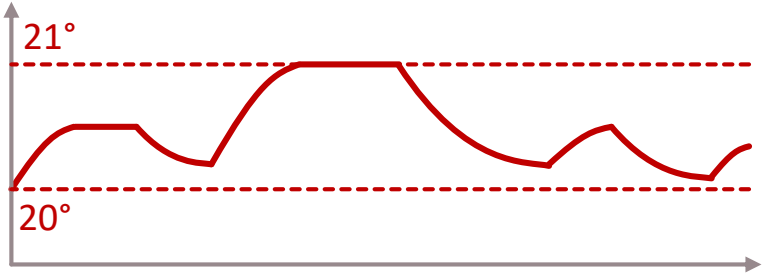

Heating switches ON/OFF whenever it wants as long as the comfort is not compromised

This is “energy flexibility”

Example : single family house

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	Gas (heating & DHW)	Electricity	Total
Original situation • No wall insulation • No roof insulation • Single glazing	kWh_{th}: 31.059 €: 1.662 CO2: 6.212 kg	kWh: 3.605 €: 960 CO2: 613 kg	kWh: 34.664 €: 2.622 CO2: 6.825 kg

Example : single family house

ambience

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Envelope renovation • PUR cavity • 12cm mineral wool • Double glazing	kWh_{th}: 11.870 €: 635 CO2: 2.374 kg	kWh: 3.605 €: 960 CO2: 613 kg	kWh:15.475 €: 1.595 CO2: 2.987 kg

60% energy savings

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PV (6.5kWp) and Heat Pump	kWh: - €: - CO2: -	kWh: 7.583 €: 1.150 feed-in tariff (€ 431 with net metering) CO2: 968 kg (-692 kg)	kWh: 7.583 €: 1.150 (€ 431 with net metering) CO2: 968 kg (-692 kg)	Injection saves CO2 elsewhere

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Active control of heating & DHW (excl. battery storage)	kWh: - €: - CO2: -	kWh: 7.432 €: 933 (€ 391 with net metering) CO2: 657 kg (-522 kg)	kWh: 7.432 €: 933 (€ 391 with net metering) CO2: 657 kg (-522 kg)	25% less injection to & offtake from the grid Relative low carbon intensity

Example : single family house

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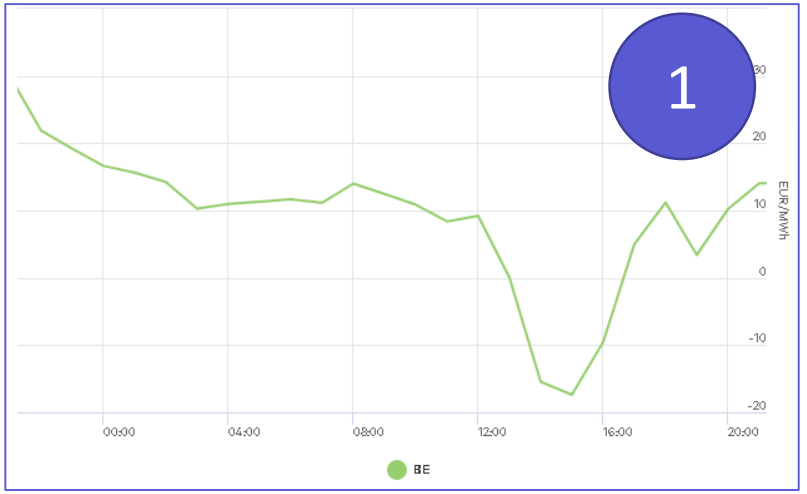
Clear benefits for residential buildings, but aggregation is appropriate…

saves
ewhere

25% less injection to & offtake from the grid

Relative low carbon intensity

Demonstrating forecast & system imbalance 19 April 2020



1. Negative prices on spot market = indication of surplus

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Demonstrating forecast & system imbalance 19 April 2020

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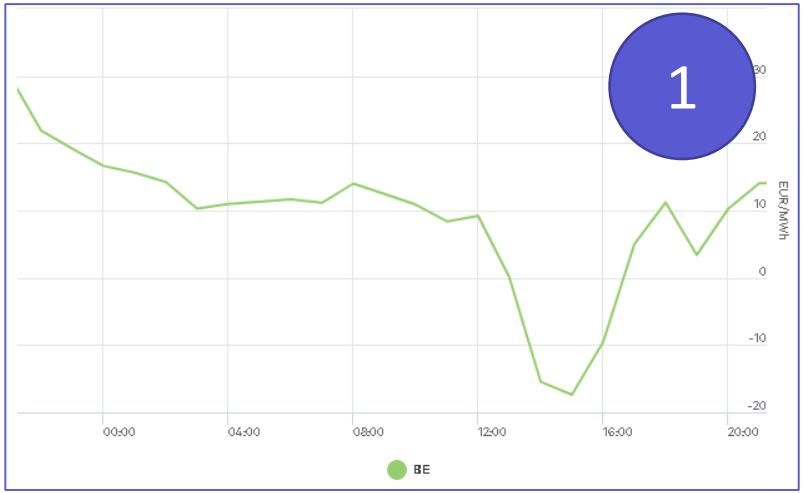

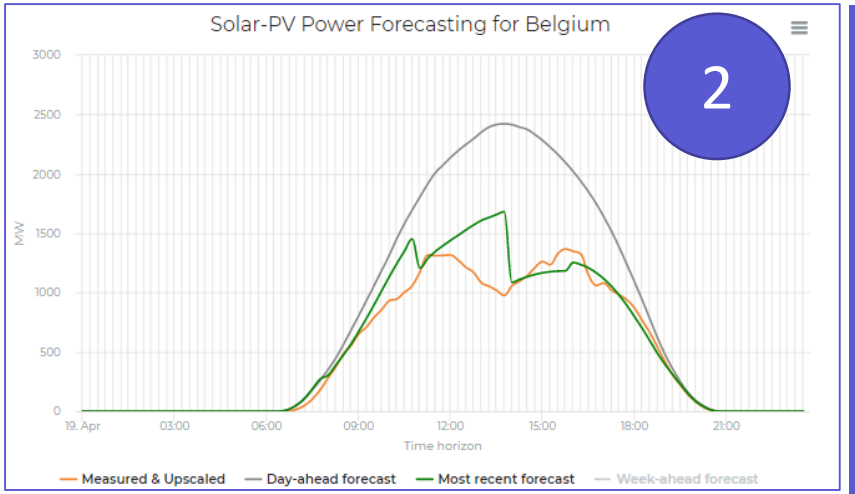

1. Negative prices on spot market = indication of surplus
2. Less sun than expected (>1000MW)

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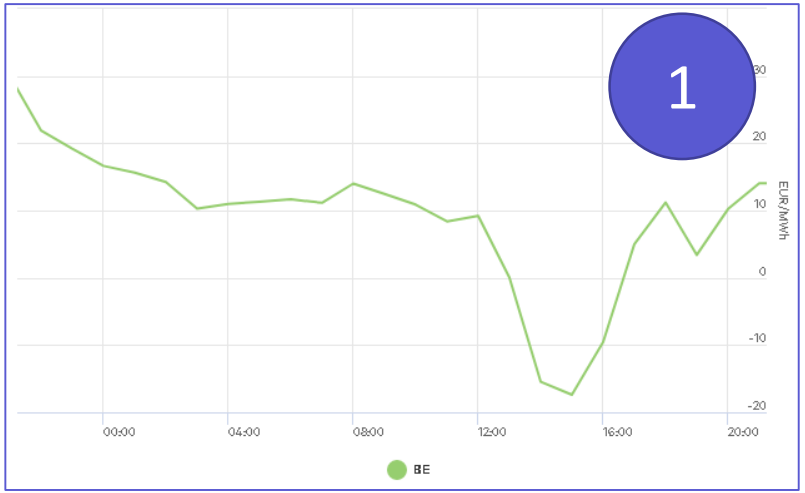

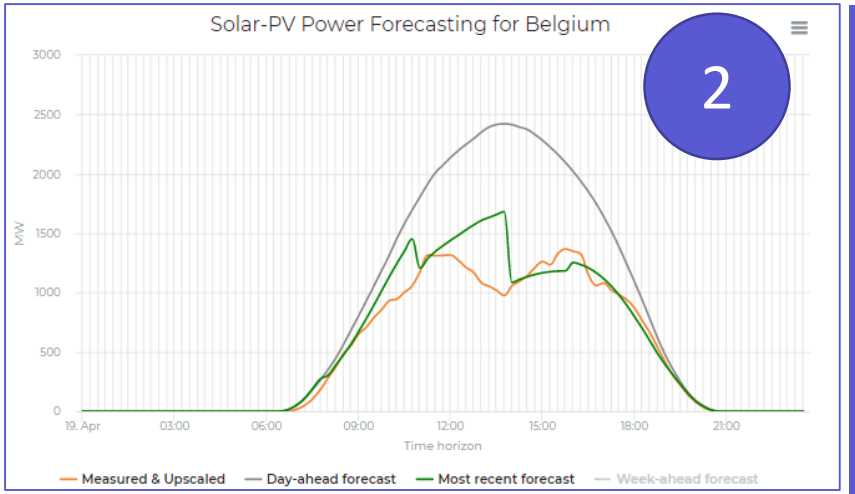

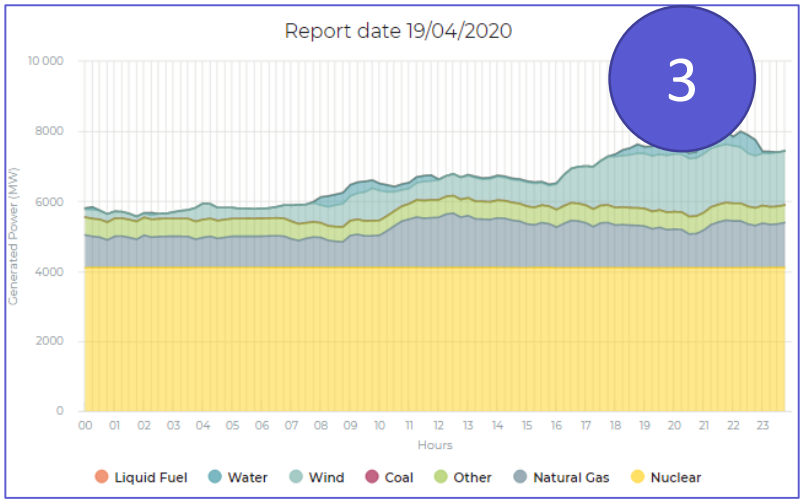

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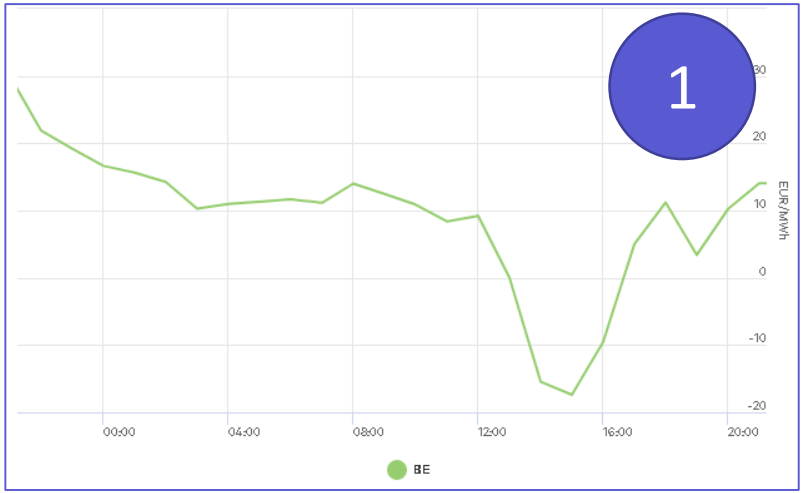

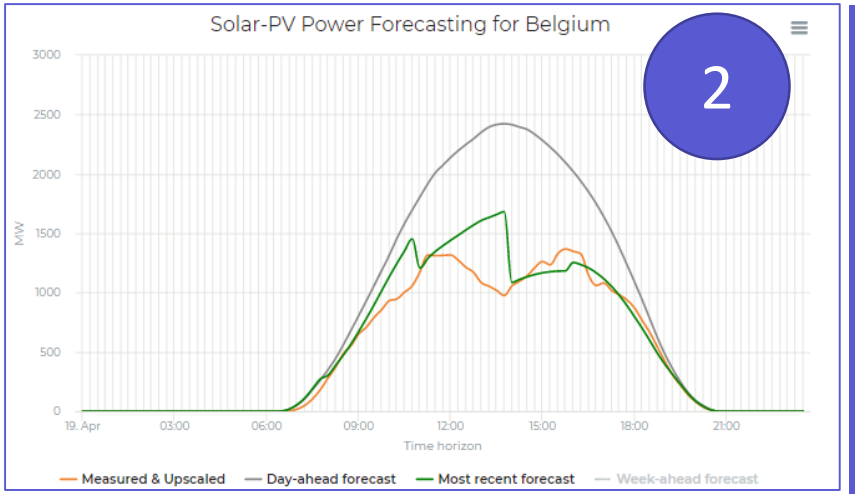

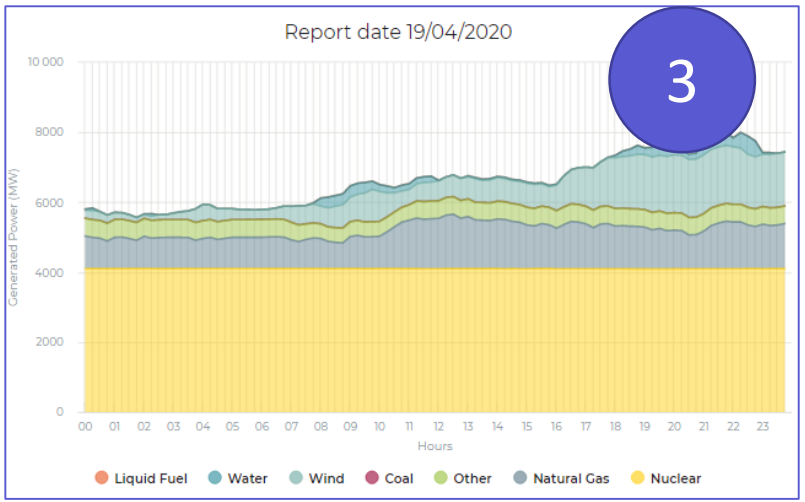

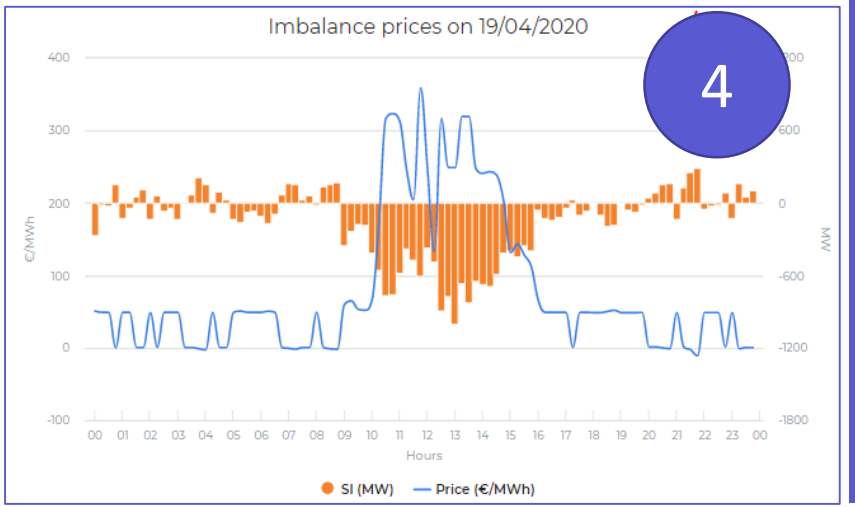

1. Negative prices on spot market = indication of surplus
2. Less sun than expected (>1000MW)
3. Hardly compensation classic plants
4. Large imbalance >€350/MWh (normal range €30-40)

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Combining EPC & Demand Response

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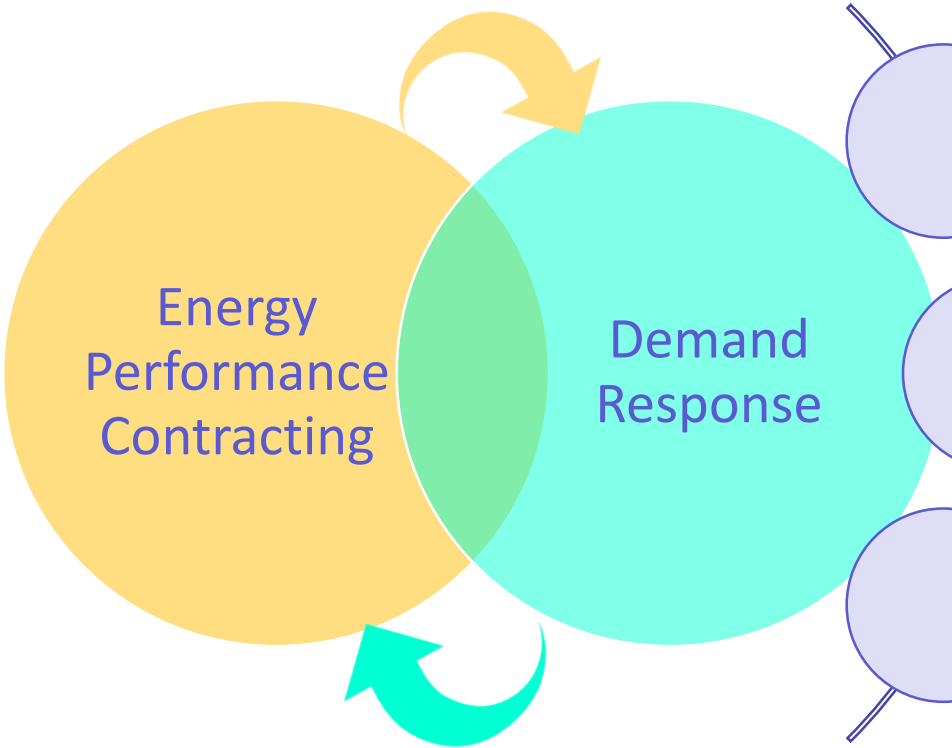


EPC & DR are two worlds with different Technologies, Services, Business Models, End Customer Profiles & Actors

Twofold opportunity

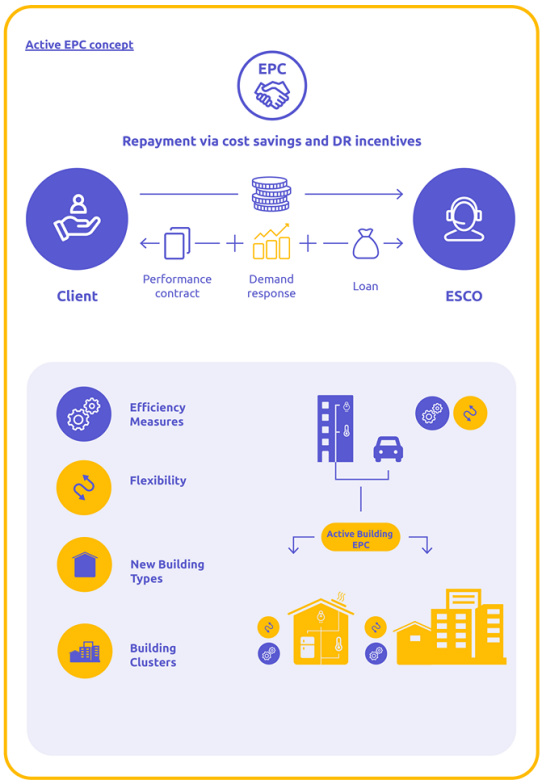
- Can an EPC model support the uptake of Demand Response?
- Can Demand Response improve the business case of EPCs?

On the intersection we improve the EPC model into a single consistent new concept

New Concept

The AmBIENCe concept extends the traditional EPC concept in **3 dimensions:**

Traditional EPC



Active Building EPC

- Extending energy performance guarantees related to energy efficiency to include the valorisation of flexibility through Demand Response (DR) services
- Tailor EPCs to a broad scope of building types: residential, hospitals, education, offices, commerce, etc
- Extending the scope of EPCs to groups/clusters of buildings under the concept of (local) energy communities.

The business value of DR in active building EPC

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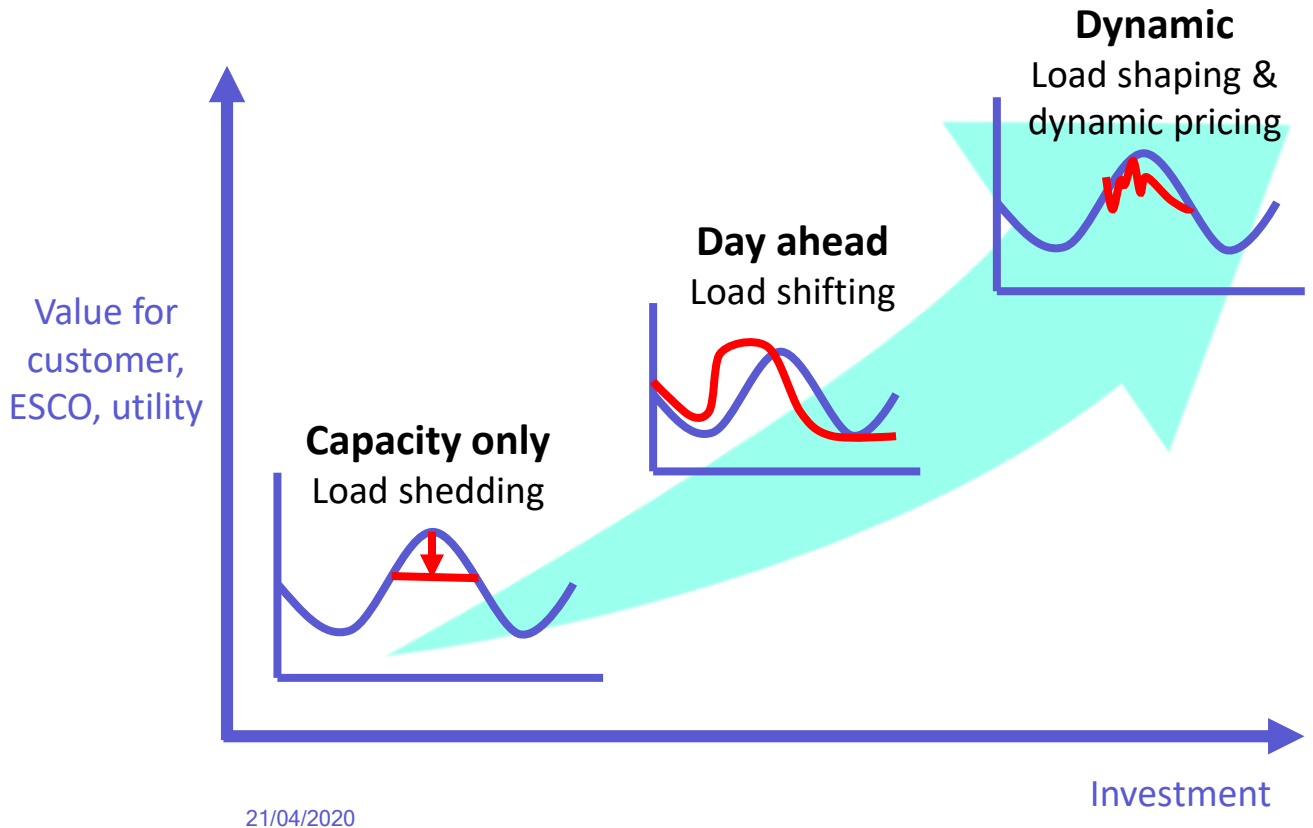

Business value for end-customer		
Cost reductions by avoiding higher energy prices	Additional revenue streams (onsite generation, storage, or shiftable loads)	Better understanding of consumption patterns

Active managed Buildings
with Energy Performance Contracting

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GOALS: WHAT will we do?

Extend the Energy Performance Contracting concept to include Demand Response value streams, valorizing the flexibility that is available in Active Buildings*.

Make this Active Building EPC concept applicable to a broader range of buildings (incl. residential) and clusters of buildings.

Develop a tool that supports the forecast of the DR value stream in the EPC contracting phase, along with a matching M&V methodology for the operational phase.

Validate the concept, tool and M&V methodology through two pilots (real buildings, real ESCOs).

Engage with all relevant actors and stakeholder groups (from building managers to ESCOs, policy makers and financial institutions) to remove barriers and ensure applicability.

***Active Buildings:** equipped with sensors, meters, ICT that enables them to optimally control the consumption of flexible assets and storage.

Analysing the active building EPC concept & business models in IT, BE, ES, PT

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	Italy	Belgium	Spain	Portugal
Current status of EPC/ESCOs				
Current status of DR services				
Current status of other enabling factors				

Analysing the active building EPC concept & business models in IT, BE, ES, PT

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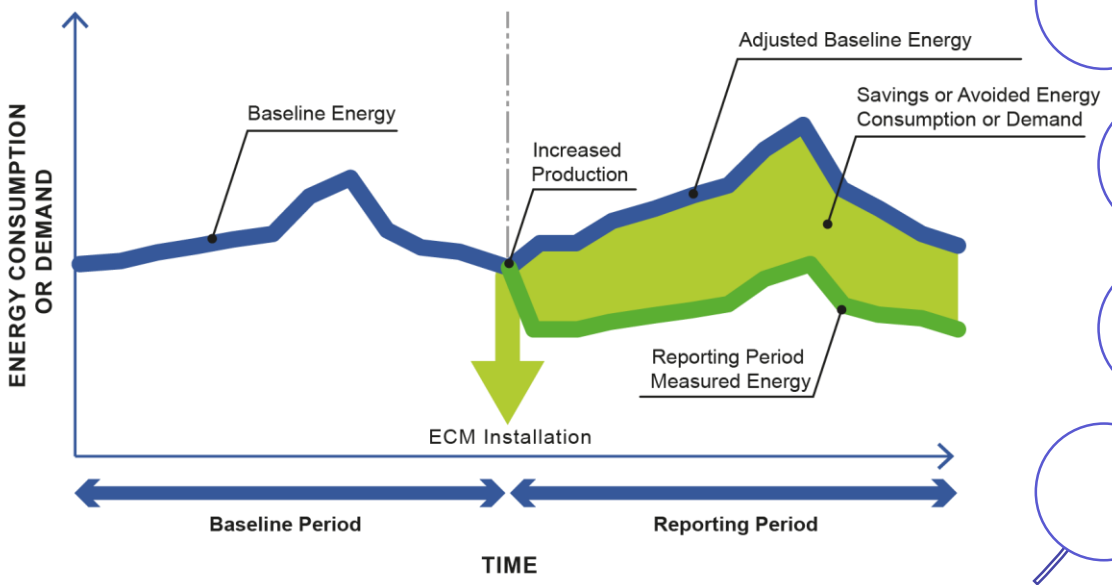
Tailored M&V towards flexibility



Source: evo-world.org

- Measurement and verification algorithm using before/after measuring scheme to evaluate the changes in energy use
- For the monitoring phase, improved and extended M&V methods for demand response services will be proposed
- Hight time resolution for monitoring
- AmBIENCE will analyse the need for specific DR-related routine and non-routine adjustments factors

Is active building management the silver bullet?

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Is active building management the silver bullet?

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Lower energy consumption

Is active building management the silver bullet?

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Lower energy consumption

Decreased energy bills

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Lower energy consumption

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Secure building operation

Is active building management the silver bullet?
An additional layer of opportunities

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- Lower energy consumption
- Decreased energy bills
- Higher comfort & wellbeing
- Guaranteed performance
- Secure building operation
- Improved business case through flexibility

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No #847054.

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NOVICE: The benefits of Enhanced EPCs

Jo Southernwood
Senior Research Engineer
International Energy Research Centre

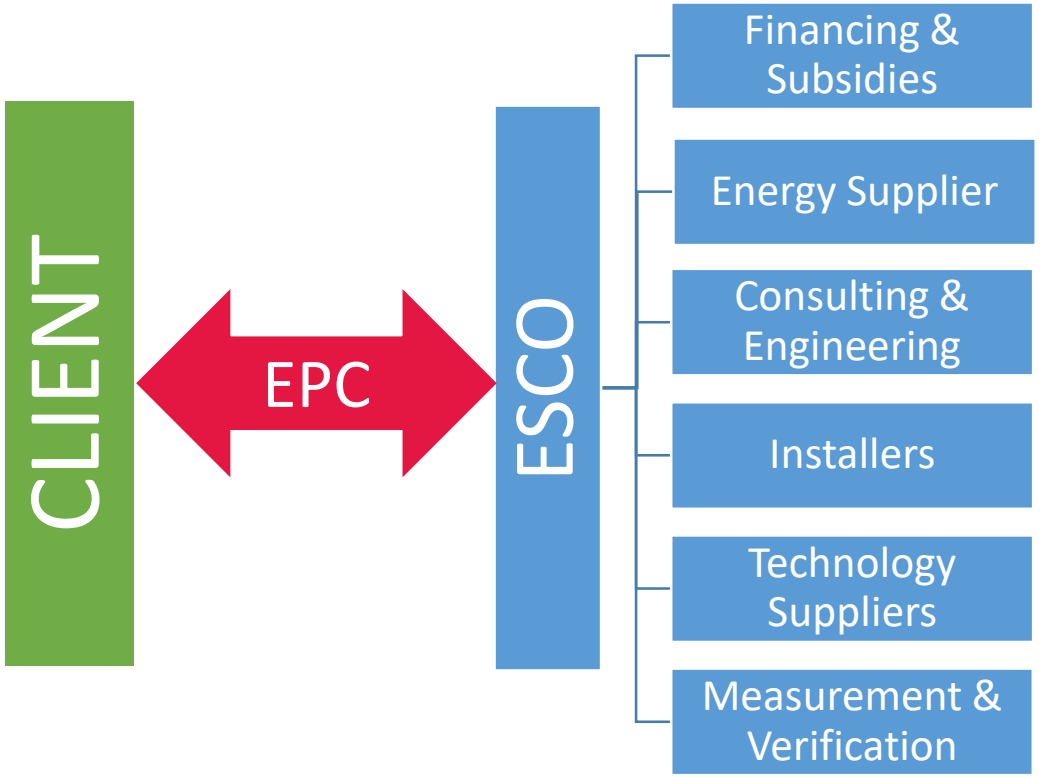
21st April 2020

This project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 745594

Traditional EPC model

Energy Performance Contracts (EPCs) have many advantages:

- Client does not require upfront capital.
- Finance for the project is provided by the ESCO or a third party finance provider.
- Energy Savings are guaranteed by the ESCO, removing the operational risk from client.
- The loan is repaid from the savings on energy bills.
- Single contract between client and ESCO covers all energy efficiency measures.
- Deeper renovations can be achieved through taking a whole building approach.

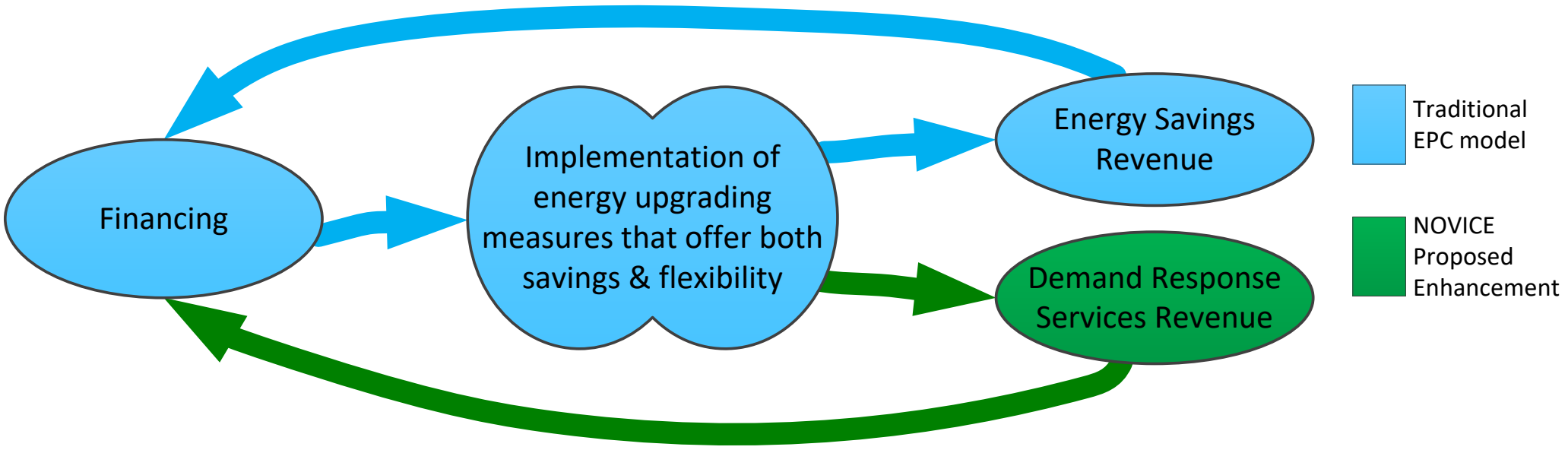


Barriers to EPC

Uptake of EPCs has been slow in many countries because:

- EPCs are complex contracts.
- High cost of procurement & contract development.
- Contract durations of 5-15 years are typical.
- ESCOs find it difficult to obtain finance - loans tend to be secured based on client credit rating, not energy saving potential of project.
- Lack of government support and lack of information about EPCs.

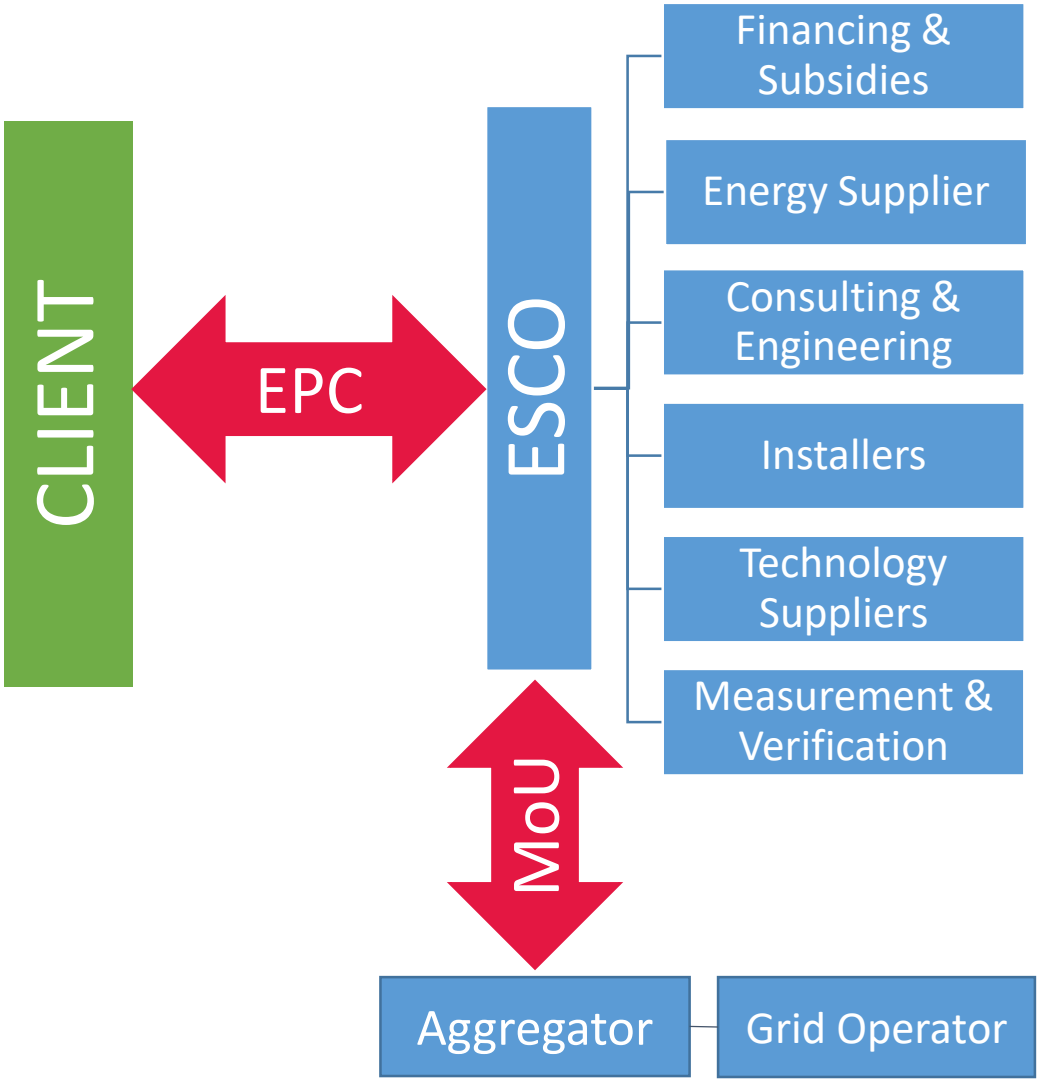
NOVICE in a Nutshell: An Enhanced EPC



NOVICE Enhanced EPCs

How do they work?

- NOVICE project is looking at an Enhanced EPC business model for ESCOs.
- It considers demand response as well as energy efficiency measures
- This creates a dual revenue stream – one from energy efficiency, another from demand response.
- The ESCO remains the single point of contact for all measures but uses the services of a demand response aggregator to provide services to the grid.
- A Memorandum of Understanding (MoU) governs the relationship between ESCO and Aggregator



NOVICE Enhanced EPCs - How do they work?

WHAT is guaranteed?

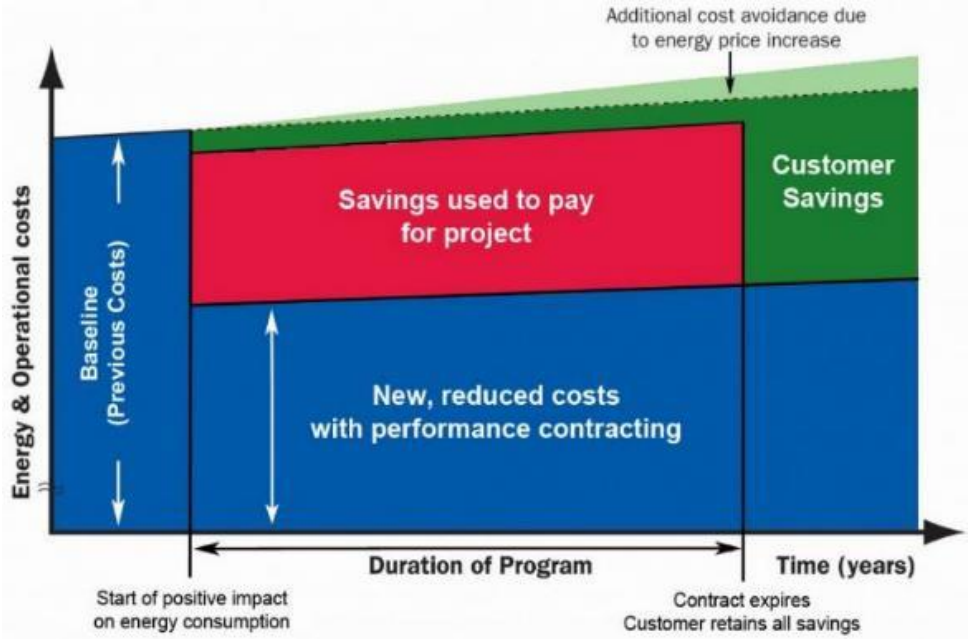
- Energy savings
- Cost savings
- Thermal comfort parameters
- Operational availability
- Recovery time

WHO is responsible?

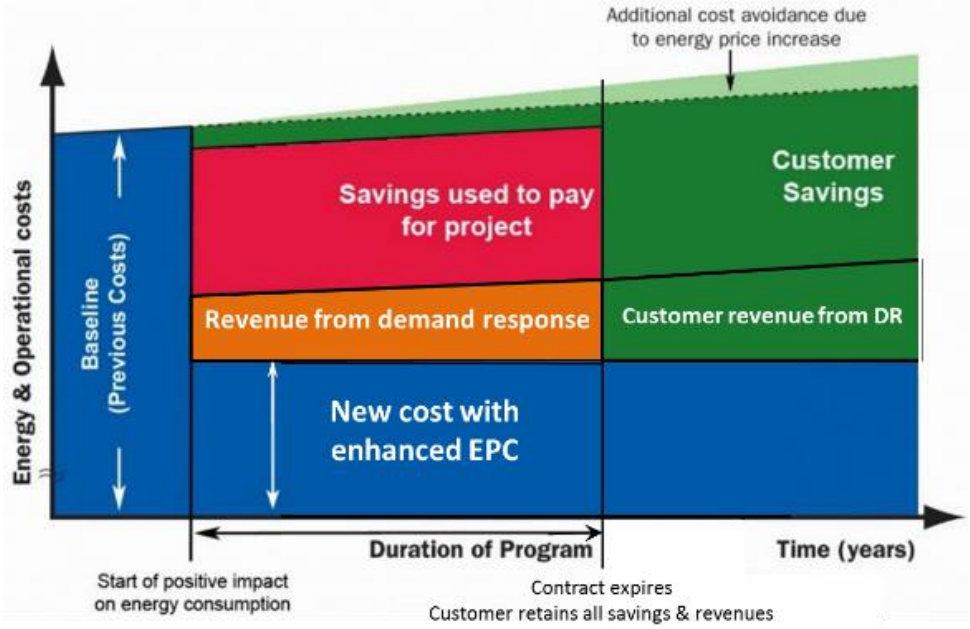
- Client facing contact
- Setting the baseline
- Split of revenues
- Sharing information

Traditional EPC vs Enhanced EPC finance

Traditional

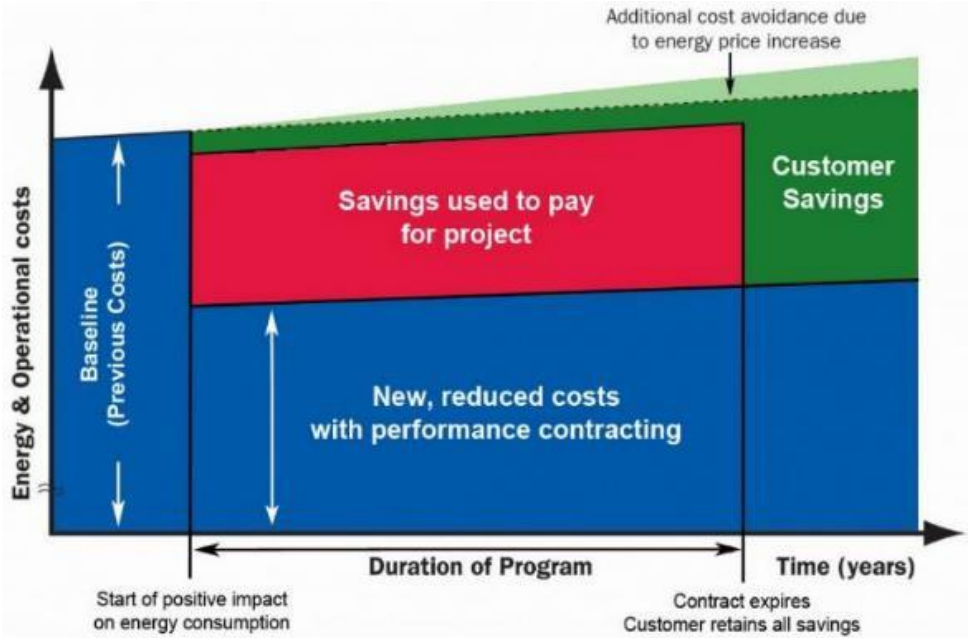


Enhanced

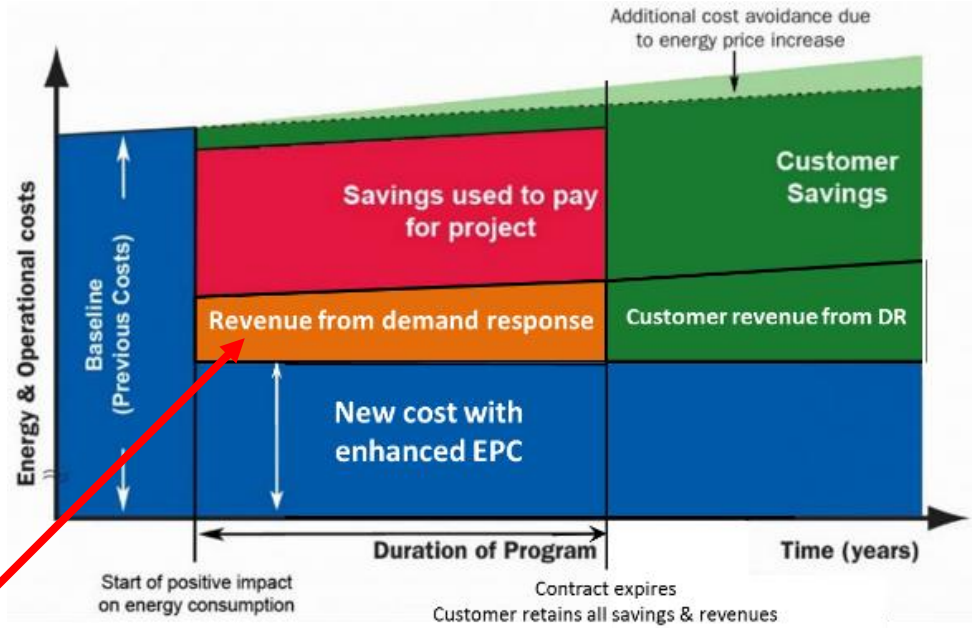


Traditional EPC vs Enhanced EPC finance

Traditional



Enhanced



What's the value of this orange bar? By how much can we reduce contract duration?

Case Studies

Office with Data Centre

Opportunities register for office with data centre in Ireland				
	Annual saving (€)	**% of Saving**	**CAPEX**	**Simple Payback**
Energy saving opportunities	€110,000	85%	€290,000	2.6 years

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Opportunities register for office with data centre in Ireland				
	Annual saving (€)	**% of Saving**	**CAPEX**	**Simple Payback**
Energy saving opportunities	€110,000	85%	€290,000	2.6 years
Demand response opportunities	€20,000	15%	0	-
Total	**€130,000**		**€290,000**	**2.2 years**

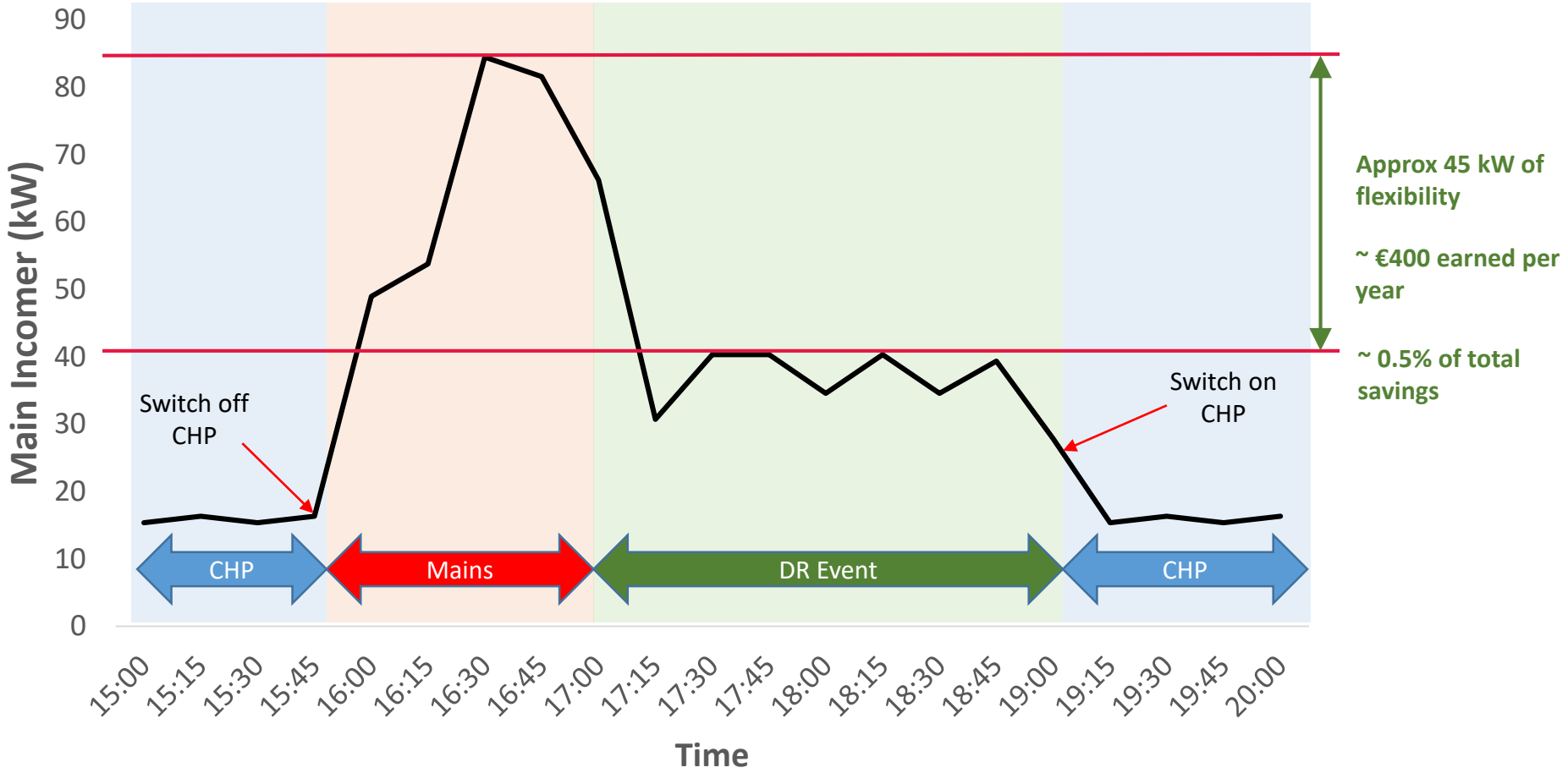
15% reduction in payback period at no extra capital cost to the client

Leisure Centre

How Flexible?

- Aggregators in Ireland only want to deal with large industrial sites
- So NOVICE simulated a demand response event at a leisure centre in Dublin
- All non essential HVAC equipment was shut down for 2 hours between 5pm-7pm
- How much flexibility is available?
- Would building users notice a DR event?

How much flexibility is available from this building?



Learning from case studies

- Including DR opportunities in an EE opportunities register can improve the business case for energy upgrades as a whole.
- Sites with large loads, energy generation and energy storage are more suitable for NOVICE
- Sites able to participate in more than one DR programme are more suitable for NOVICE
- The maturity of the DR and electricity markets in each country can significantly impact suitability for NOVICE.

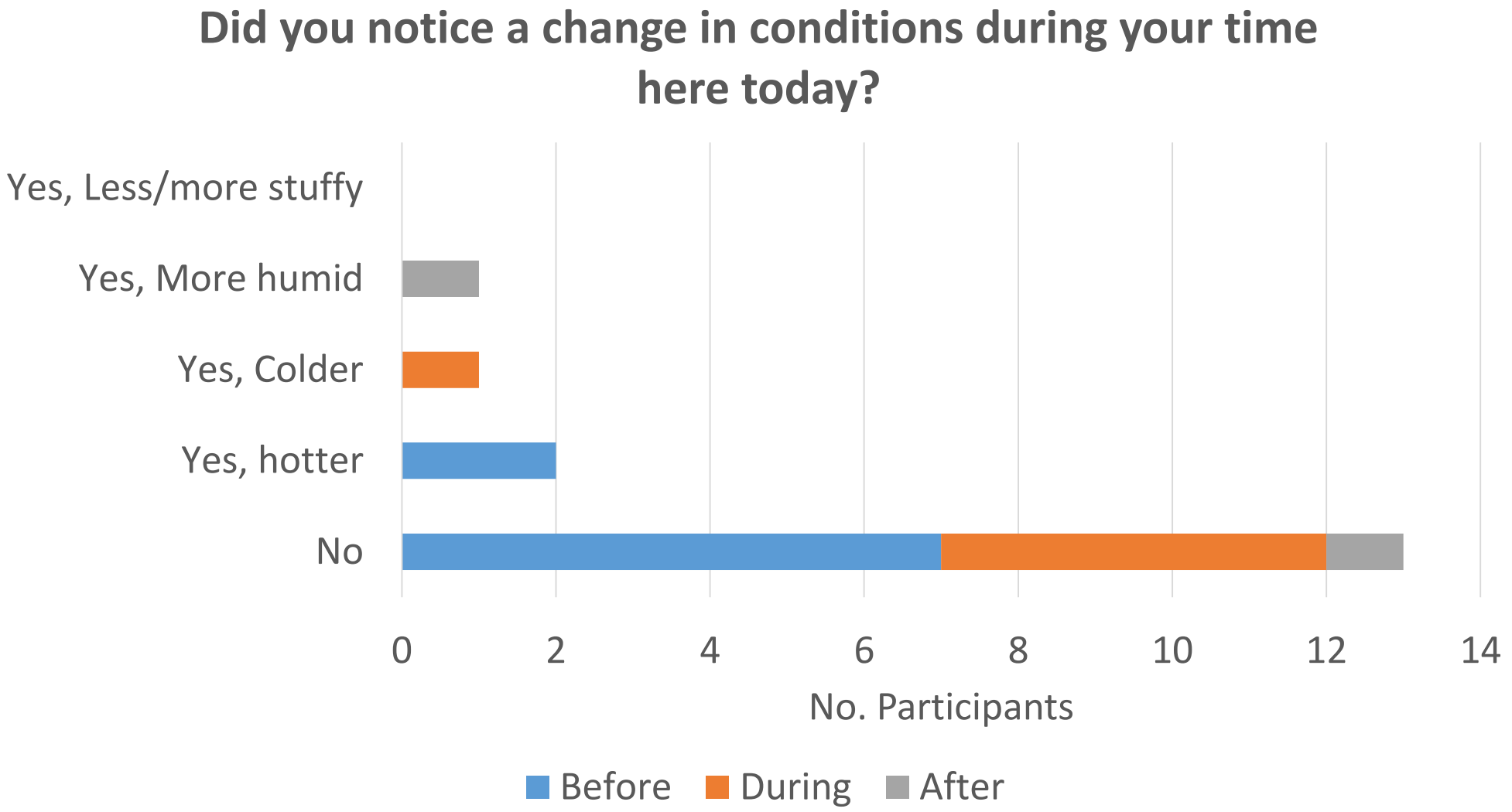
What about building users?

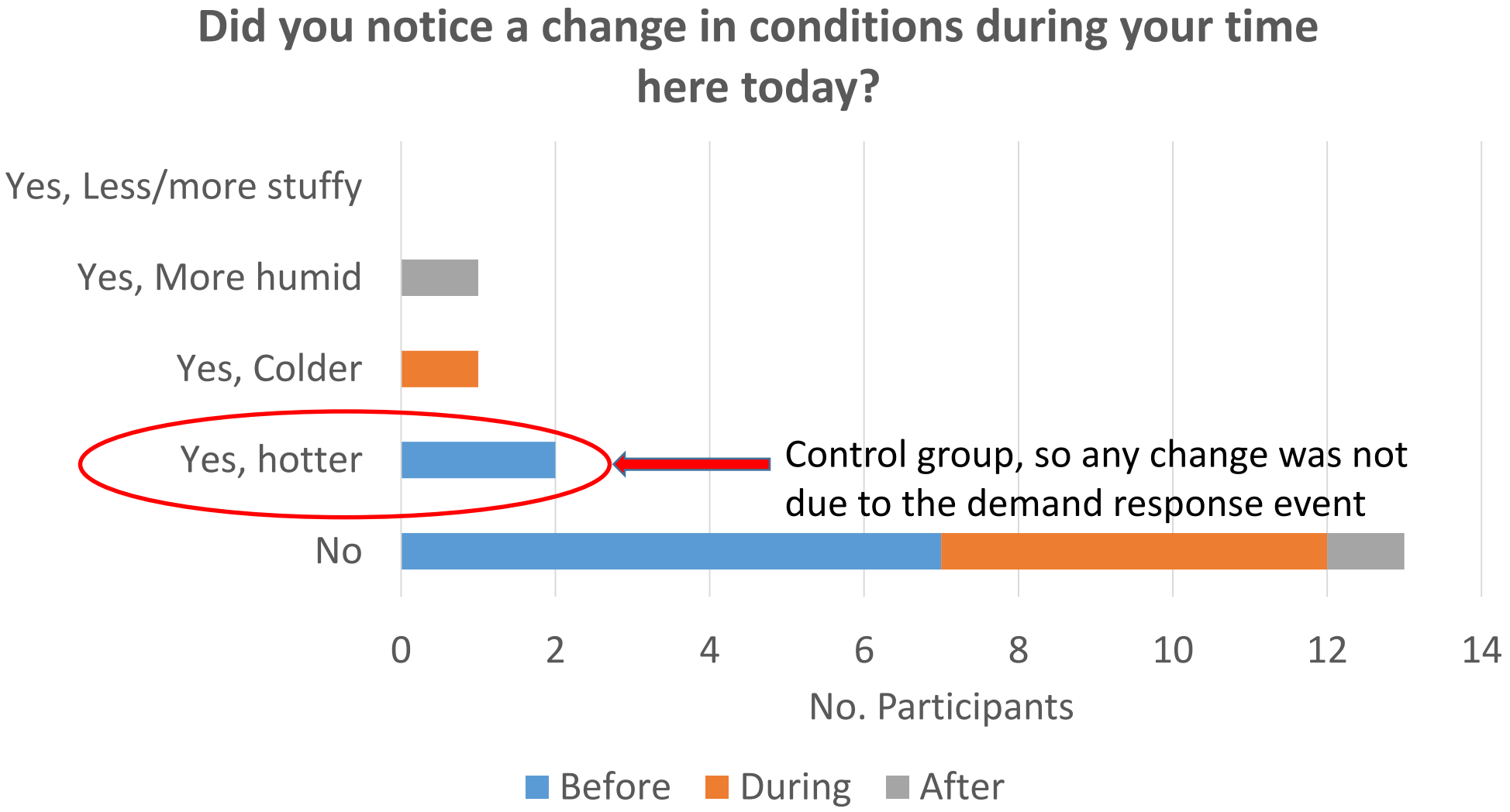
- Carried out a survey with building users
- Control group: Before DR event started
  Test Group: During & after event
- Participants were not told about the DR event to avoid any bias - 'anchoring' effect
- A range of questions were asked to gauge satisfaction with temperature, humidity and air quality.

1	What is your gender?
2	What was your main activity in the last 20 minutes?
3	How satisfied are you with the temperature in the area we are in now?
4	How would you rate the humidity levels in the area we are in now?
5	How would you rate the air quality in the area we are in now?
6	In which other area of the leisure center did you spend most time today?
7	Thinking about that area, and the time you spent there, how satisfied were you with the temperature in that area?
8	How would you rate the humidity levels in that area at the time you were there?
9	How would you rate the air quality in that area at the time you were there?
10	Did you notice any change in conditions during the time you were there?
11	If you would like to make any other comments about the temperature or air quality at the leisure center today, please do so below.
12	Please indicate which items of clothing from the list below the participant is wearing.
13	What is the date?
14	What is the time now?
15	What time did the DR event start?
16	Record the approximate outdoor temperature and seasonal conditions

We asked:

"Did you notice a change in conditions during your time in the leisure centre today?"


Did you notice a change in conditions during your time here today?
Yes, Less/more stuffy
Yes, More humid
Yes, Colder
Yes, hotter
No
0
2
4
6
8
10
12
14
No. Participants
Before
During
After


Did you notice a change in conditions during your time here today?
Yes, Less/more stuffy
Yes, More humid
Yes, Colder
Yes, hotter
No
Control group, so any change was not due to the demand response event
0
2
4
6
8
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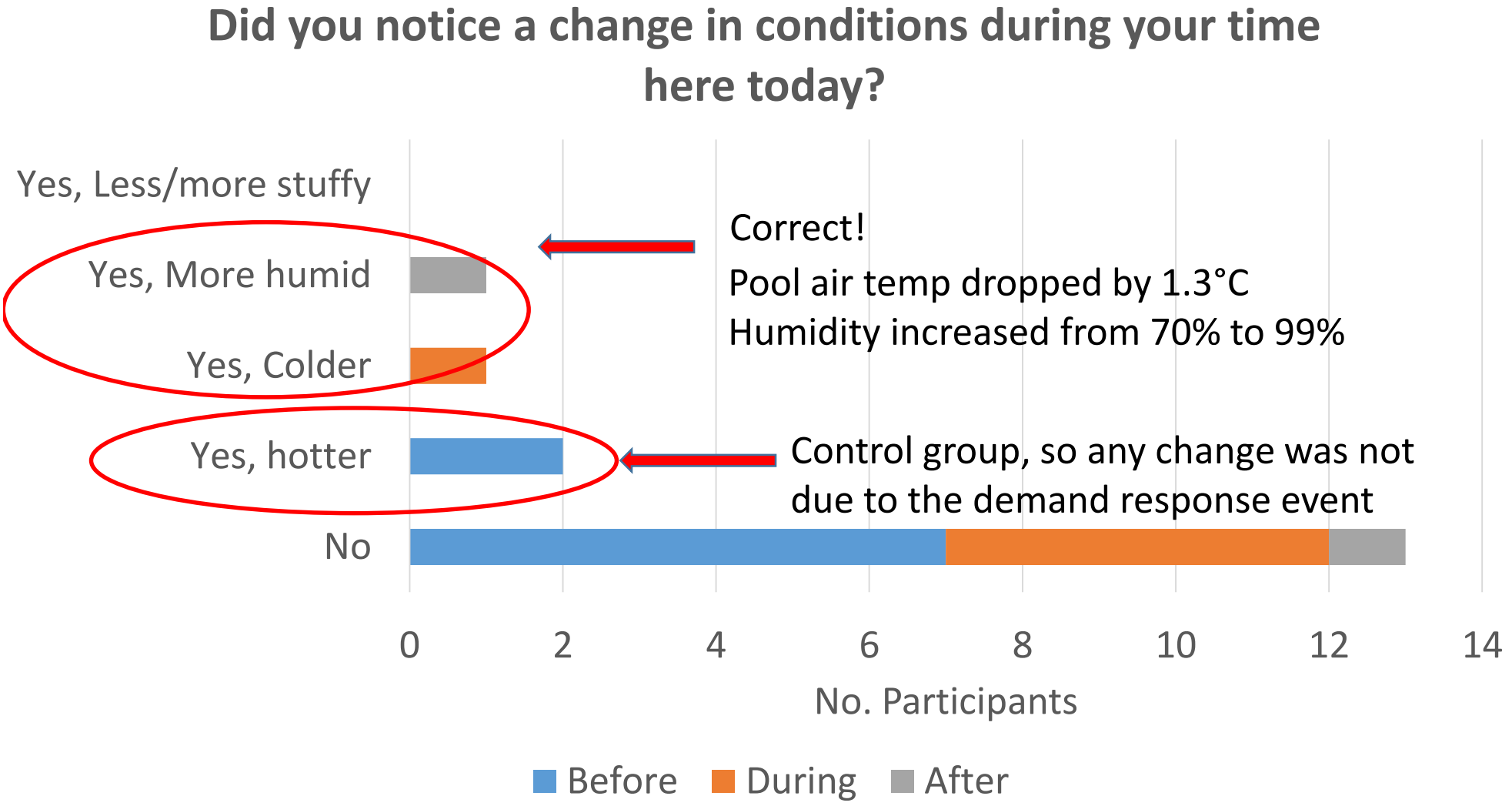
14
No. Participants
Before
During
After


Did you notice a change in conditions during your time here today?
Yes, Less/more stuffy
Yes, More humid
Yes, Colder
Yes, hotter
No
Correct!
Pool air temp dropped by 1.3°C
Humidity increased from 70% to 99%
Control group, so any change was not due to the demand response event
0
2
4
6
8
10
12
14
No. Participants
Before
During
After

Thank you!

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