Survey on Interoperability of Energy Smart Appliances

Supporting the development of policy proposals for energy smart appliances.

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8 November 2022

Agenda

1. Introduction
2. Survey structure
3. Technical Data on Energy Smart Appliances
   - 3.1. Devices Manufactured
   - 3.2. Messages Exchanged
   - 3.3. Communication Standards / Protocols used
   - 3.4. Interoperability issues
4. Energy Smart Appliances and society
5. Summary

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2. **Survey structure**
3. **Technical Data on Energy Smart Appliances**
   - 3.1. Devices Manufactured
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4. **Energy Smart Appliances and society**
5. **Summary**

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1. Introduction

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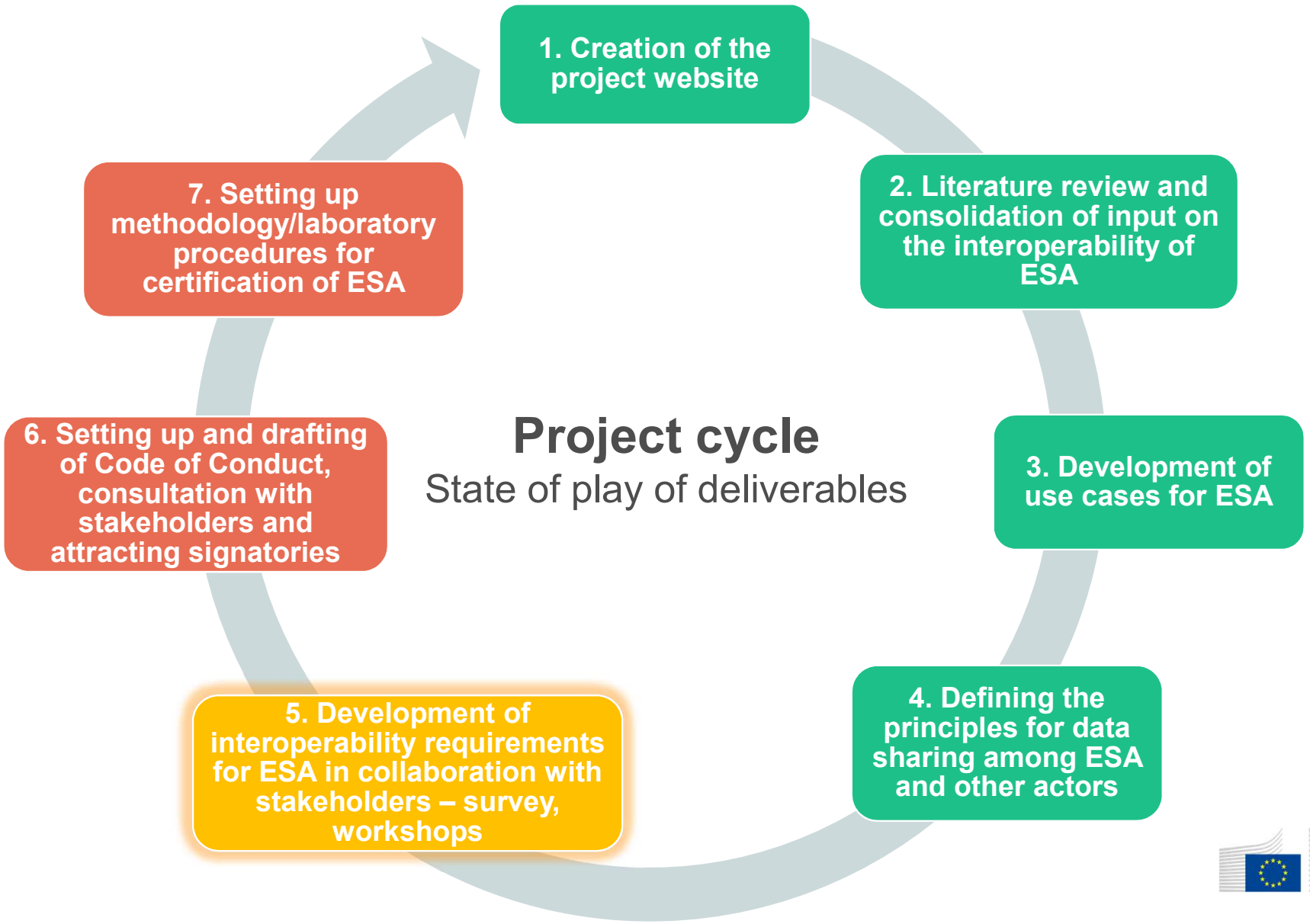
Project cycle

State of play of deliverables



Done

In progress

To do

European Commission

JRC delivered to ENER by today:

1. **Creation of project website** ☑
   https://ses.jrc.ec.europa.eu/development-of-proposals-for-energy-smart-appliances

2. **Literature review** ☑
   Ecodesign Preparatory work, Interconnect, SGTF EG1, ETSI Smart Appliances, California Legislation, Energy Star Initiative, Energy@ Home, IEA EDNA, APPLiA, EEBUS, BRIDGE and more

3. **Development of use cases** ☑
   36 Use Cases ⇨ 4 High Level Use Cases

4. **Defining the principles for data sharing among appliances** ☑
   Actors/ Message exchange of smart appliances

Technical report 2-3-4.*

*Energy Smart Appliances' Interoperability:
Analysis on Data Exchange from State-of-the-art Use Cases

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Support on the development of policy proposals for Interoperability (IOP) of Energy Smart Appliances (ESA)

Technical Report
ESA IOP: Analysis on Data Exchange from SoA Cases

Survey
on IOP of ESA

Technical Report
Survey results and IOP requirements for ESA

Workshop(s)
on IOP of ESA

Code of Conduct (CoC)
on IOP of ESA

Attracting signatories for CoC

EC

Stakeholders

European Commission

JRC's remaining tasks:

More info

5. **Development of interoperability requirements for ESA** ☒
   in collaboration with stakeholders, such as manufacturers, etc.
   - **Survey** on interoperability of ESA ☑
   - **Workshop** - **Ongoing**

6. **Setting up a Code of Conduct (CoC)** ☒
   Drafting the CoC, consulting the stakeholders and attracting signatories

CoC

7. **Setting up methodology/ laboratory procedures** ☒
   for the certification/conformity purposes of energy smart appliances.

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2. Survey structure

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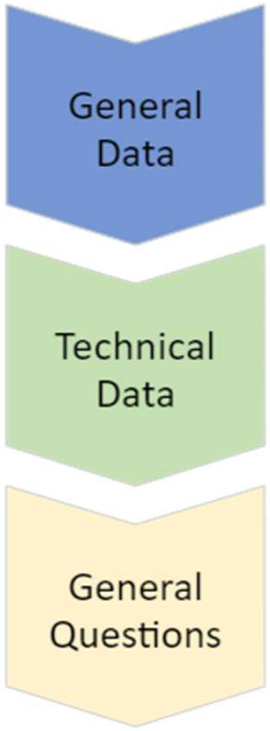
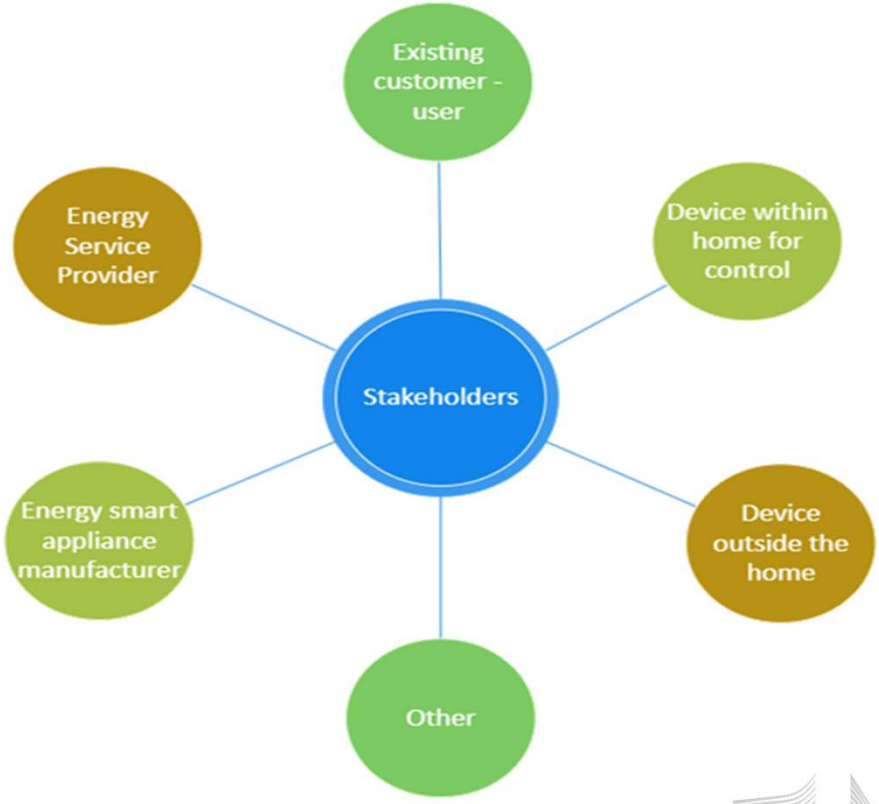
Survey structure: Scope

- Questions



- Stakeholders



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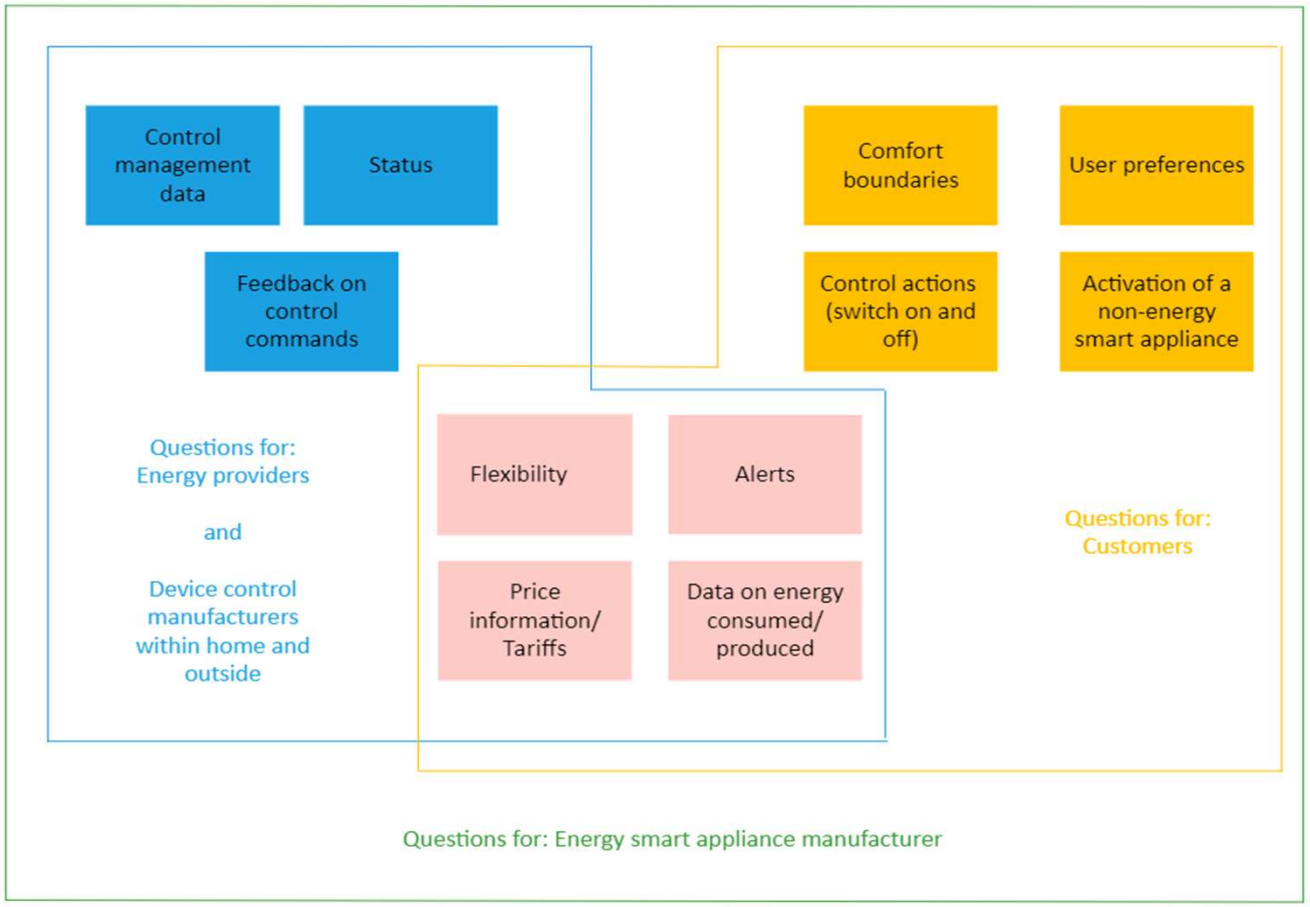
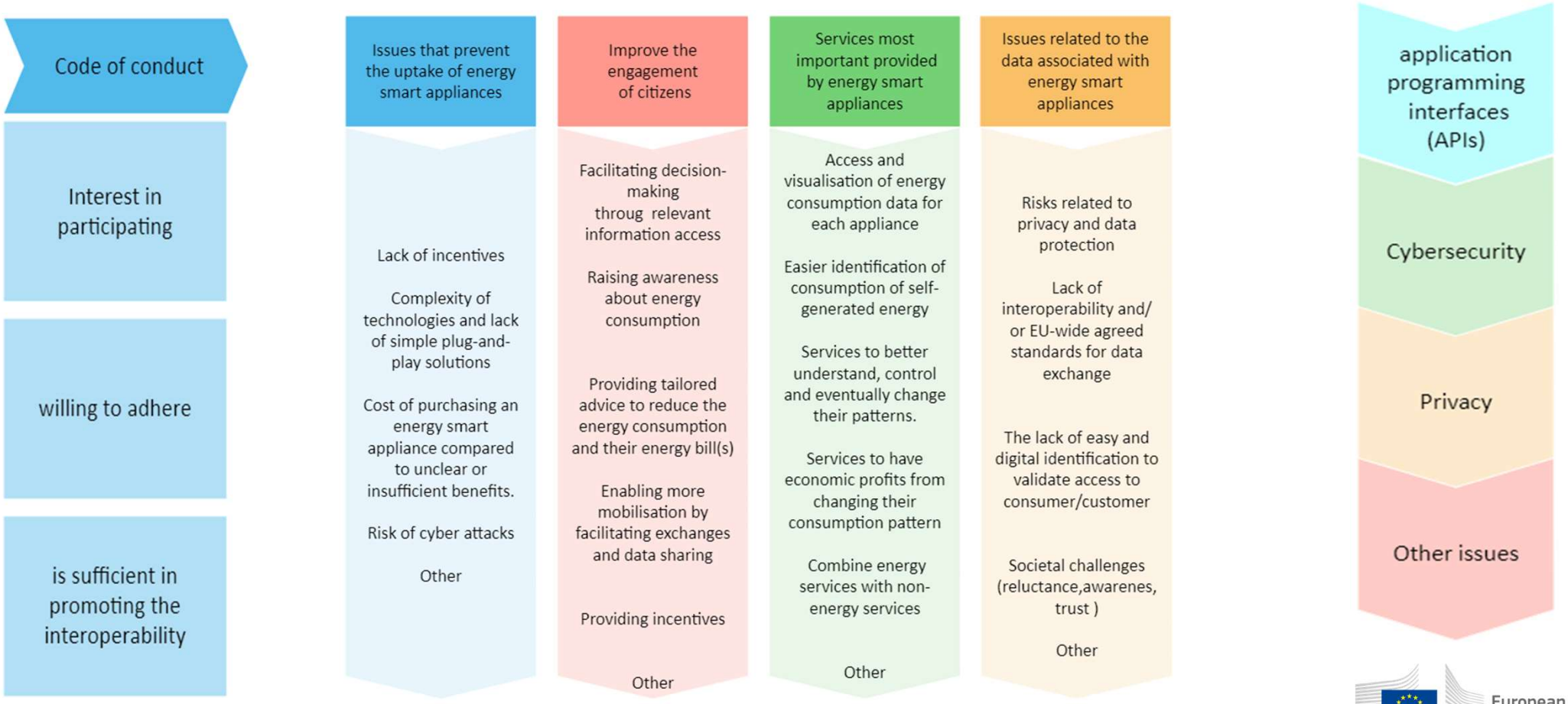
Survey structure: Technical Data



Survey structure: General Questions



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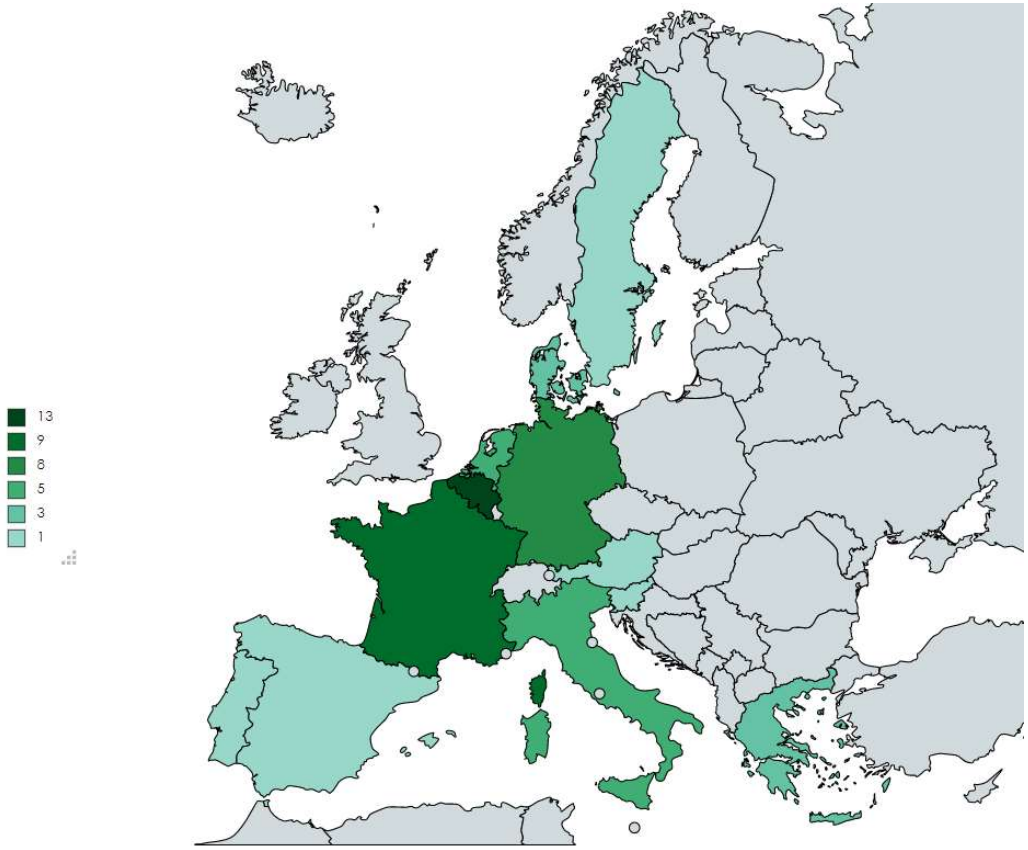
Survey structure: Participants



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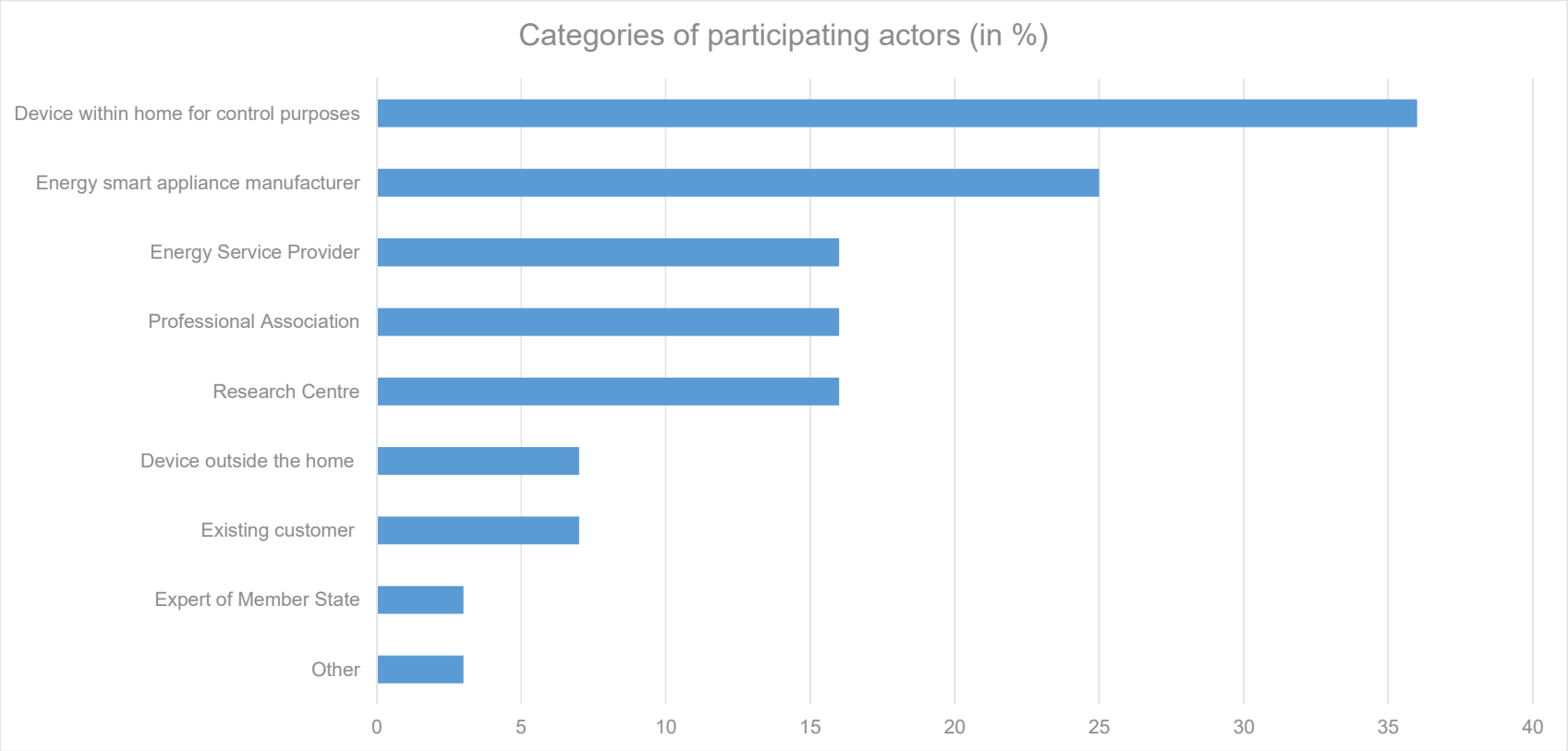
Survey structure: Participants



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3. Technical Data on ESA

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3.1. Devices manufactured

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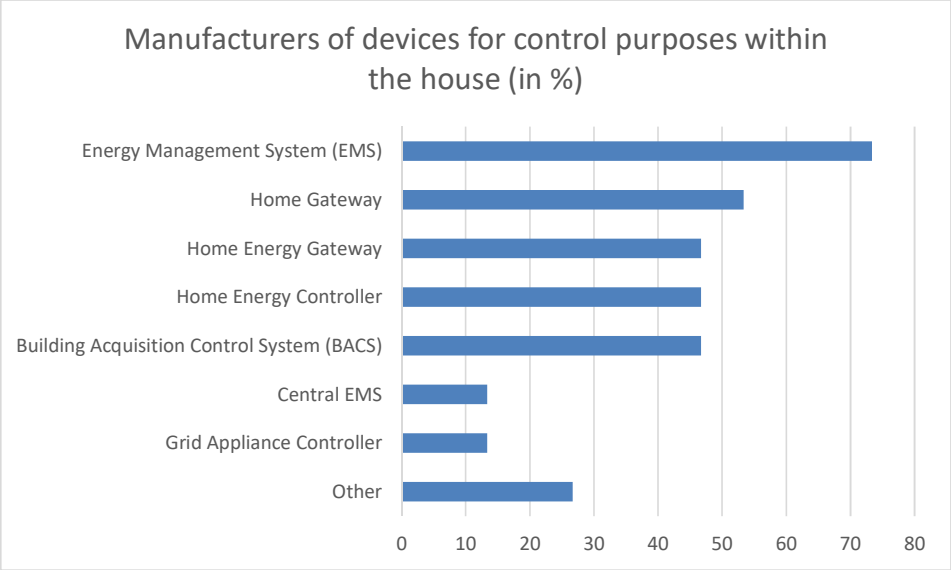
Types of devices manufactured

Number of participants that manufacture a specific category of devices

	% related to the no of participants active in the field	% related to the total no of participants	Absolute no
Manufacturers of devices for control within the house	**85%**	30%	17
Manufacturers of devices for control outside the house	**50%**	4%	2
Manufacturers of Energy Smart Appliances	**93%**	23%	13

Devices for control purposes

Devices inside home (sample 17 manufacturers):



Devices outside the house (sample 2 manufacturers)

Device manufactured	No of manufacturers	Device manufactured	No of manufacturers
Smart App	2	Linear Pilot Backend	1
Smart Charging App	2	Signal Receiver	1
Smart Storage System	2	VPP – intelligent load manager	1
Smart orchestrator	1	Platform	1

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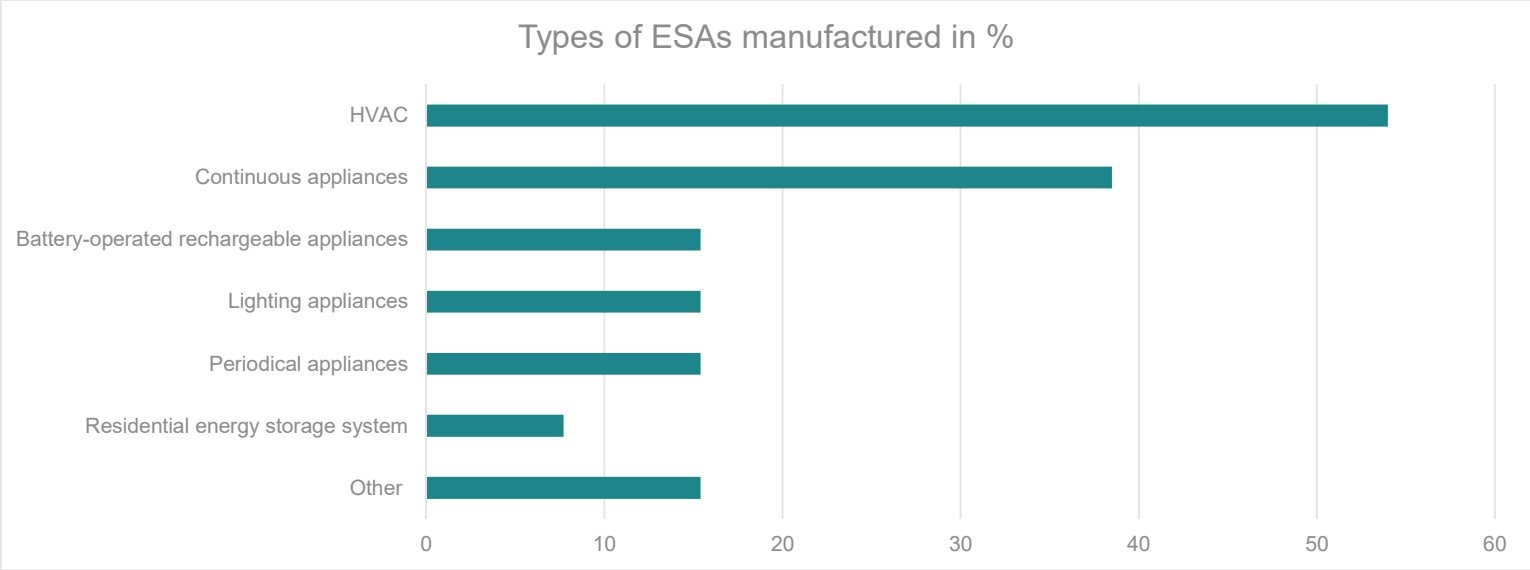
Energy Smart Appliances manufactured

Types of ESA manufactured (sample: 13 manufacturers)



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Types of ESA manufactured

HVAC (sample 7 manufacturers)

ESA	% of manufacturers related to the no. of manufacturers of HVAC appliances	Absolute no
Heating appliances	100%	7
Ventilation appliances	71%	5
Air conditioning appliances	71%	5

Continuous appliances (sample 5 manufacturers)

ESA	% of manufacturers related to the no. of manufacturers of continuous appliances	Absolute no
Water heaters/ kettles	80%	4
Electric storage water heater	80%	4
Electric ovens	40%	2
Electric hobs	40%	2
Vacuum cleaners	40%	2
Range hoods	40%	2
Refrigerators	40%	2
Freezers	40%	2

Types of ESA manufactured

Periodical appliances (sample 2 manufacturers)

ESA	% of manufacturers related to the no. of manufacturers of periodical appliances	Absolute no
Dishwashers	100%	2
Washing machines	100%	2
Tumble dryers	100%	2
Washer dryers	100%	2

Lighting appliances (sample 2 manufacturers

ESA	% of manufacturers related to the no. of manufacturers of HVAC appliances	Absolute no
LFL - Linear fluorescent lamp	100%	2
CFL - Compact fluorescent light	100%	2
GLS - general lighting service	100%	2
LED - light emitting diode	100%	2
High intensity discharge (HID) lamp	100%	2

Types of ESA manufactured

Battery-operated rechargeable appliances (sample 2 manufacturers)

ESA	% of manufacturers related to the no. of manufacturers of battery-operated appliances	Absolute no
Household appliances (shaving appliances, fans, vacuum cleaners etc.)	100%	2

Residential energy storage system (sample 1 manufacturer

ESA
Solar energy storage unit

Other appliances

- EV charger
- Solar PV smart inverter
- Shading door gates motors

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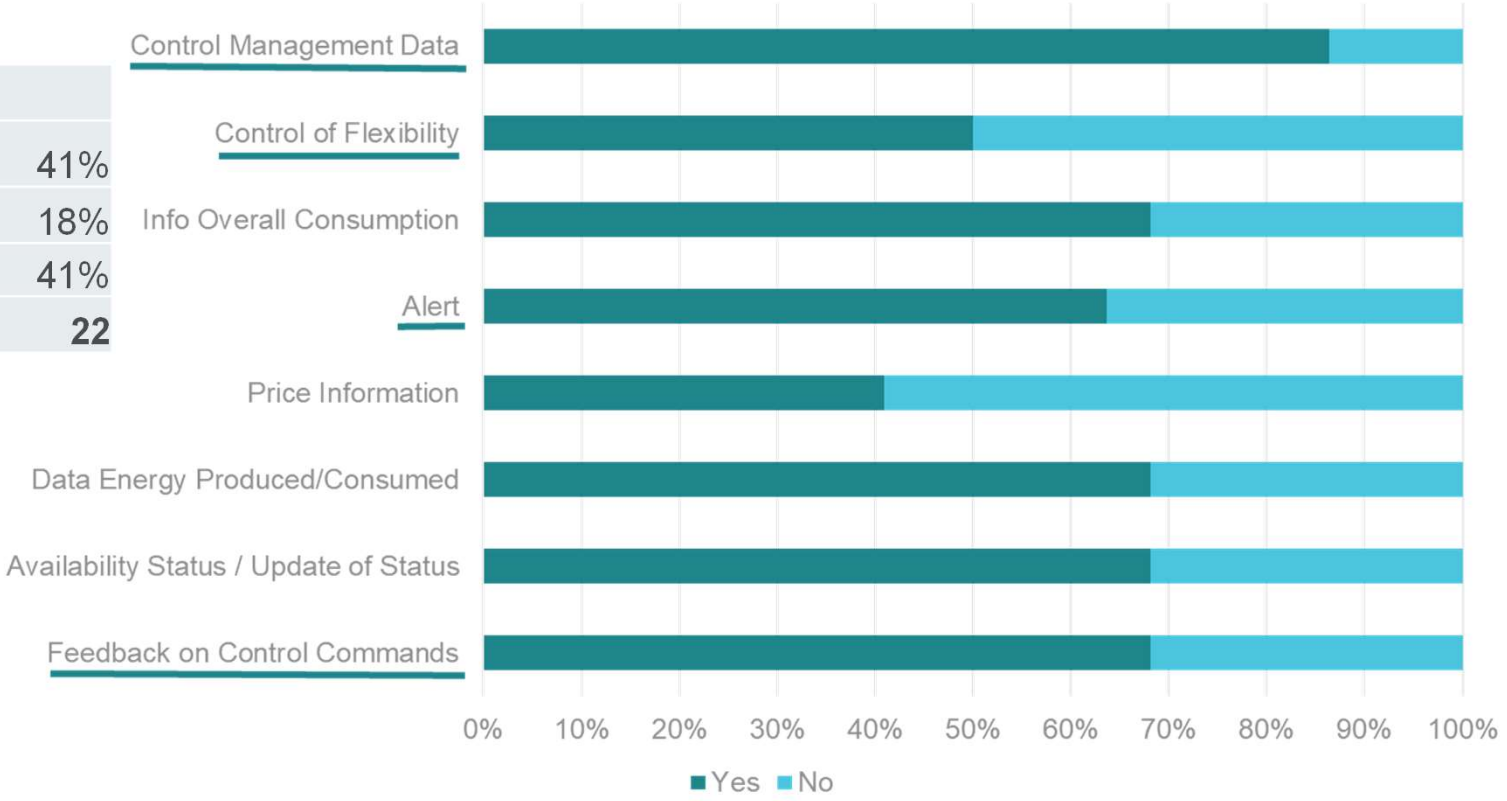
3.2. Messages Exchanged

Control Device within the home ↔ ESA

Type of stakeholder	
Control Device within the Home	41%
ESA	18%
Both	41%
Total answers	**22**



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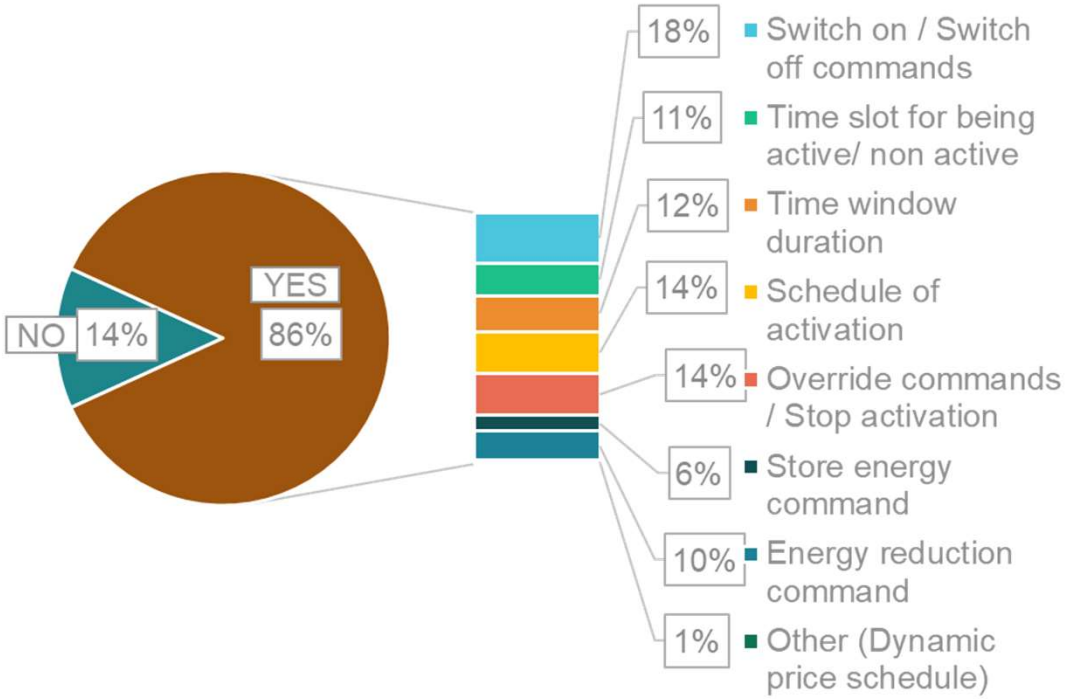
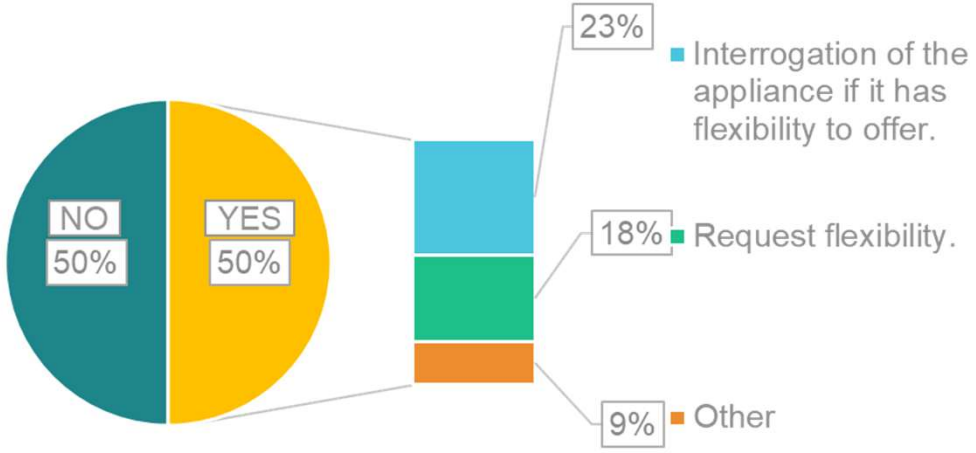
Control Device within the home ↔ ESA

Data Management



Control of the flexibility



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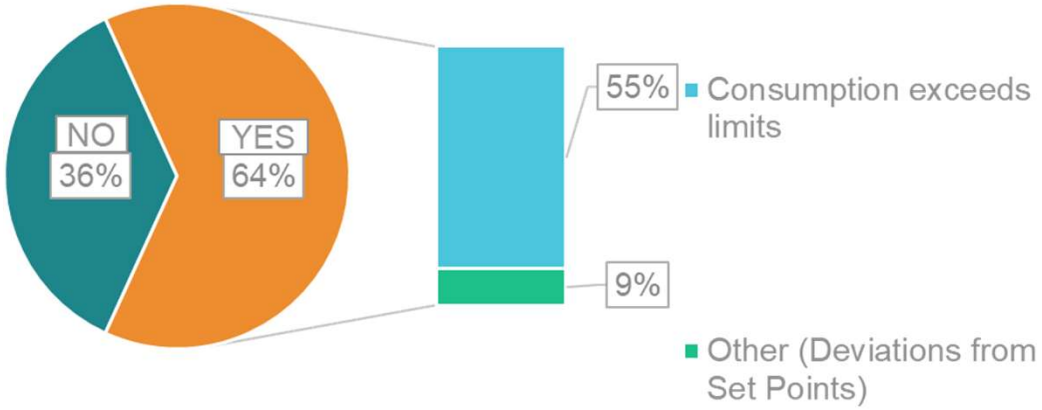
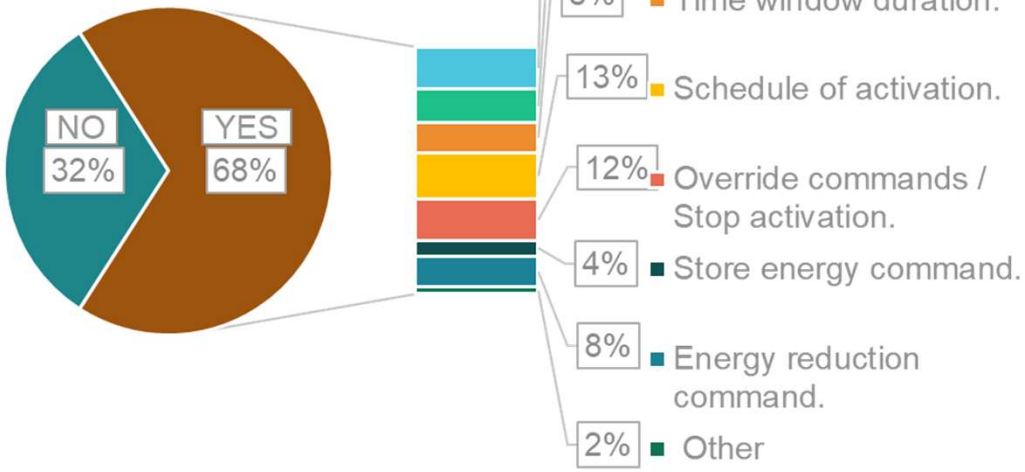
Control Device within the home ↔ ESA

Alerts



Feedback on control commands



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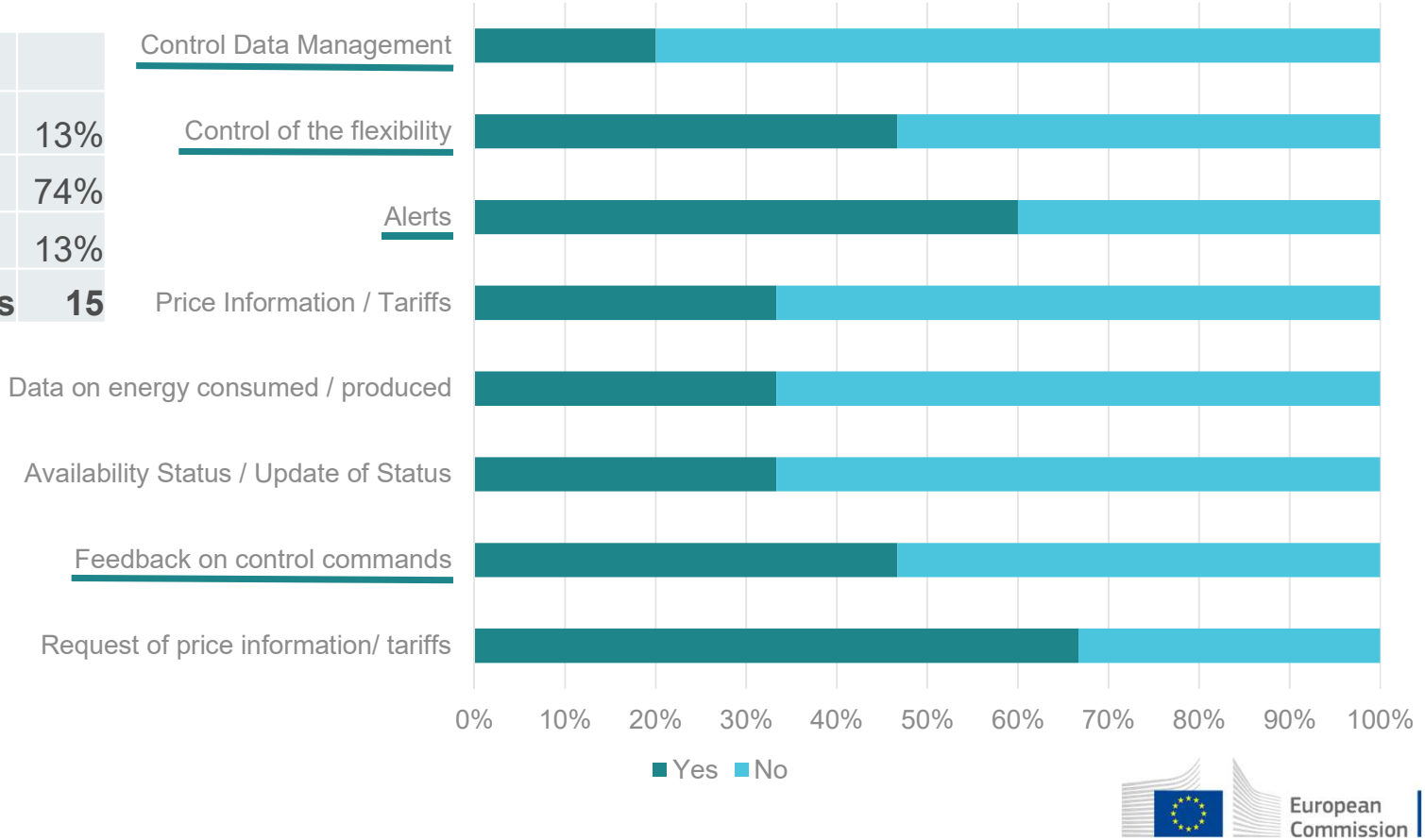
Control Device Outside the home ↔ ESA

Type of stakeholder	
Control Device outside the Home	13%
ESA	74%
Both	13%
Total answers	**15**



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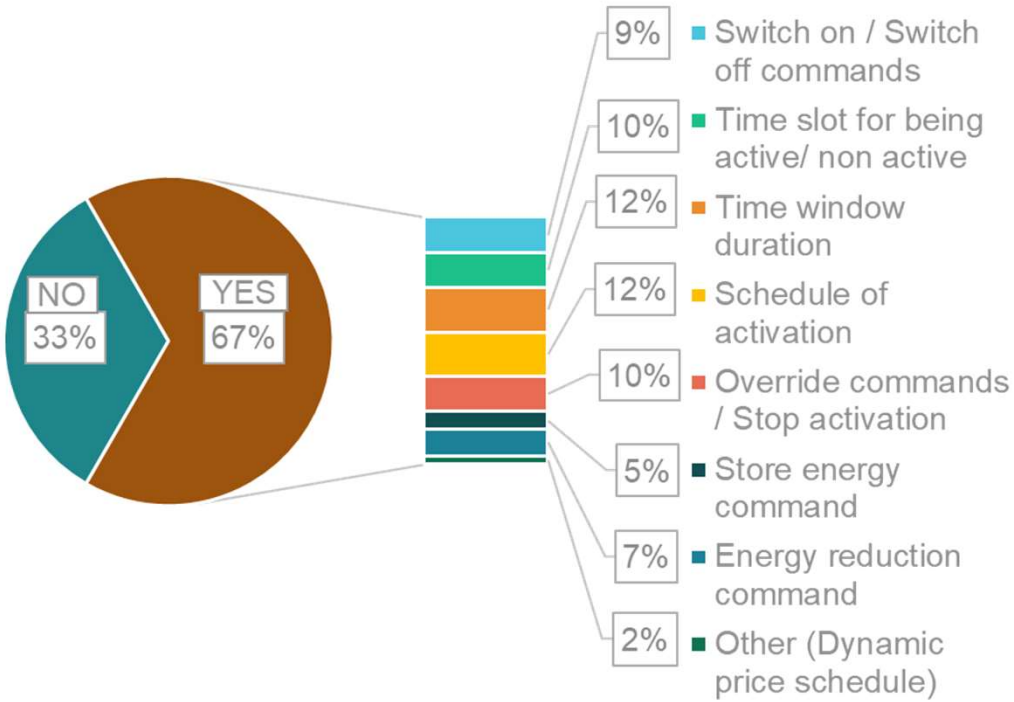
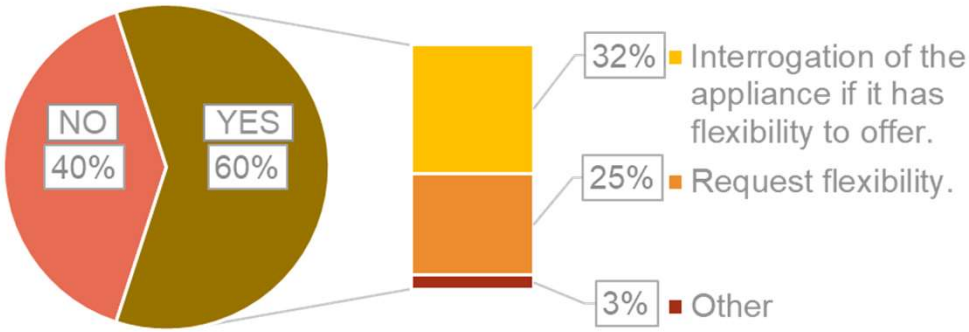
Control Device Outside the home ↔ ESA

Data Management



Control of the flexibility



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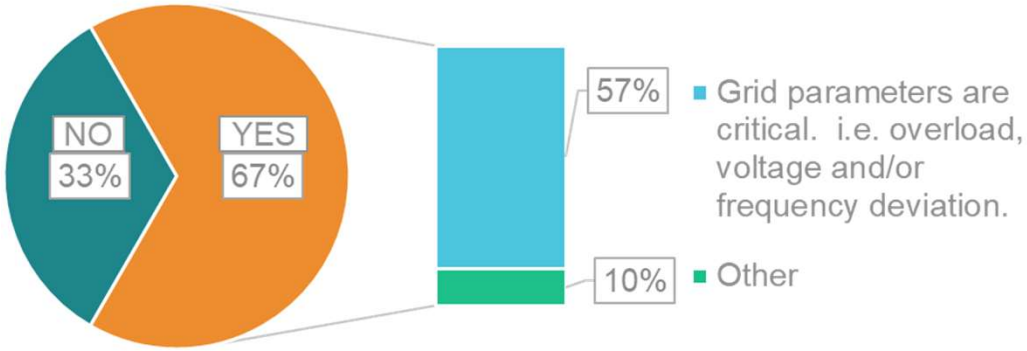
Control Device Outside the home ↔ ESA

Alerts



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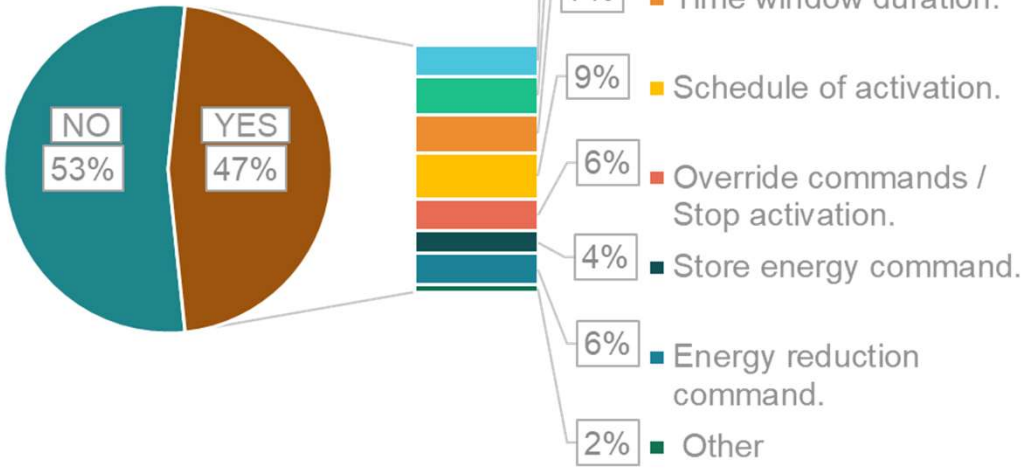

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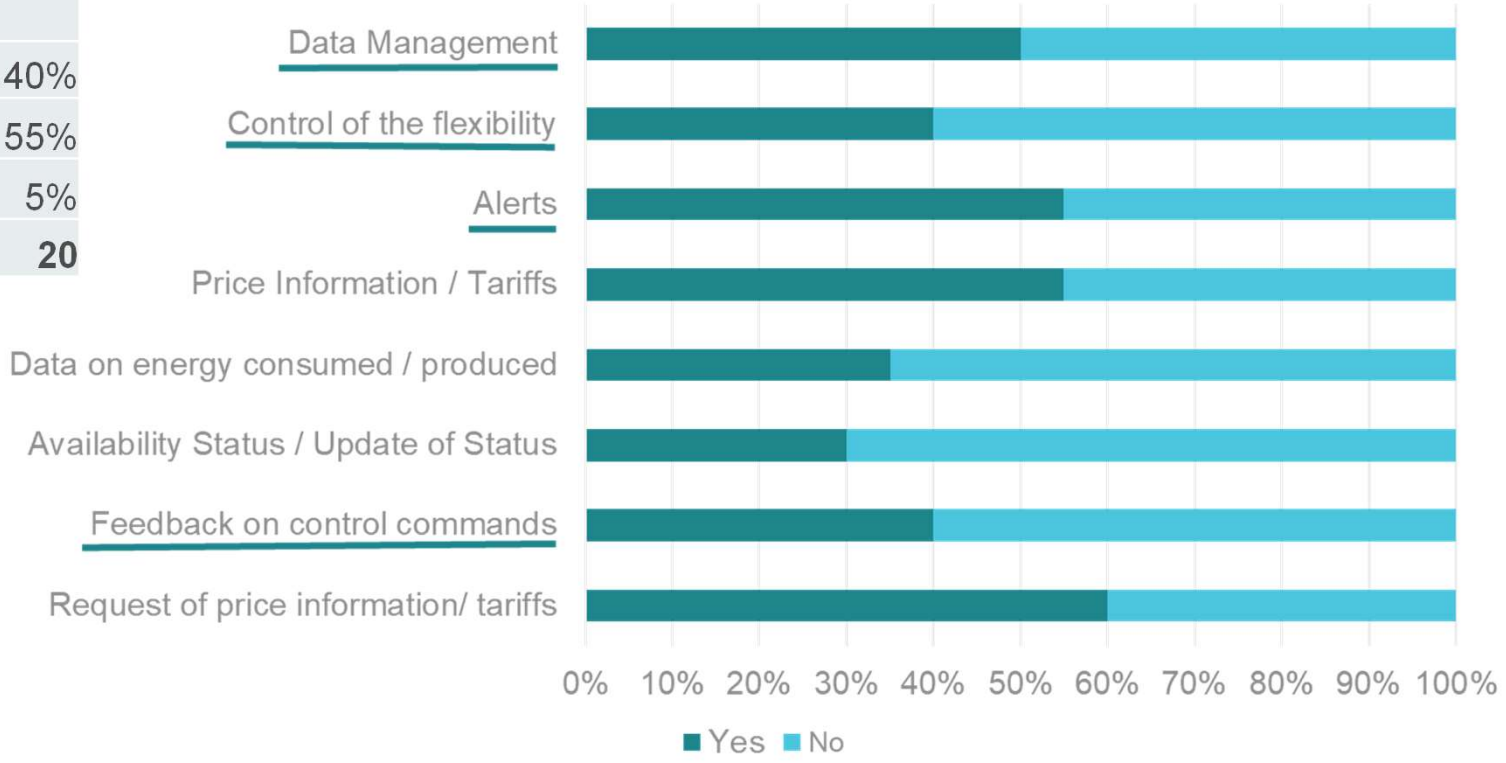
Energy Provider↔ ESA

Type of stakeholder	
Energy Provider	40%
ESA	55%
Both	5%
Total	**20**



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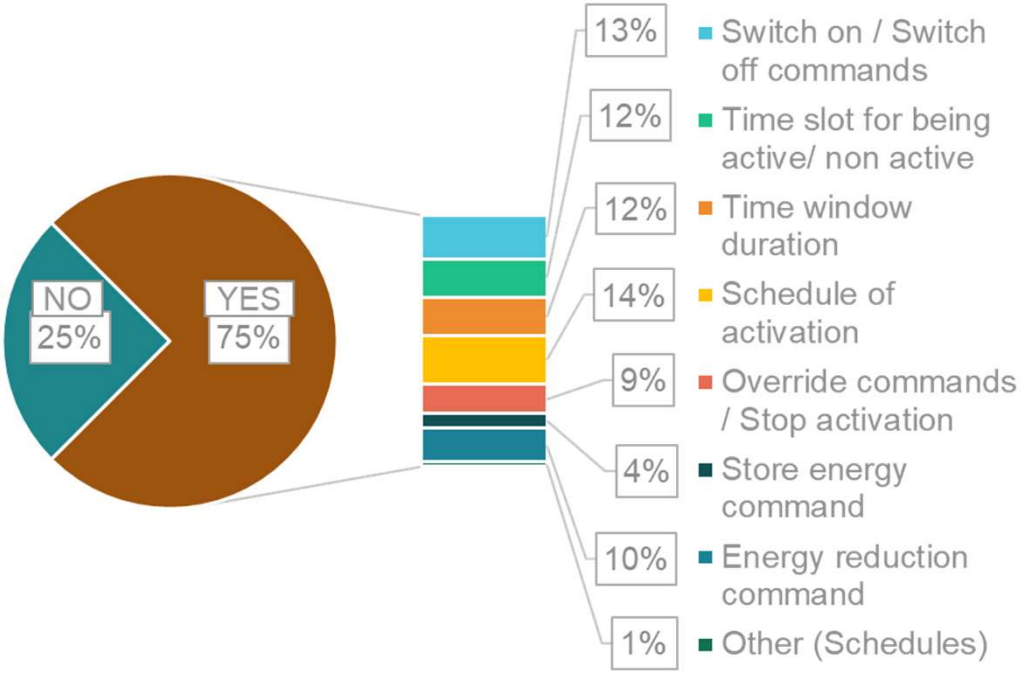
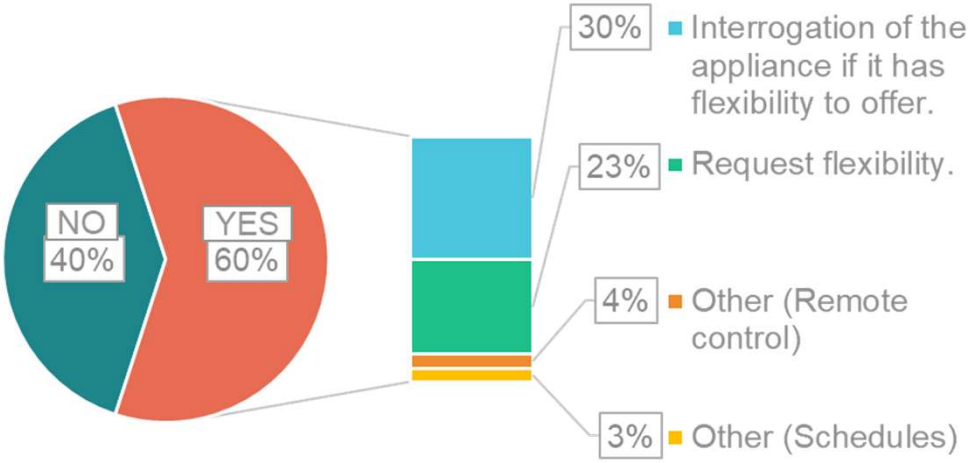
Energy Provider↔ ESA

Data Management



Control of the flexibility



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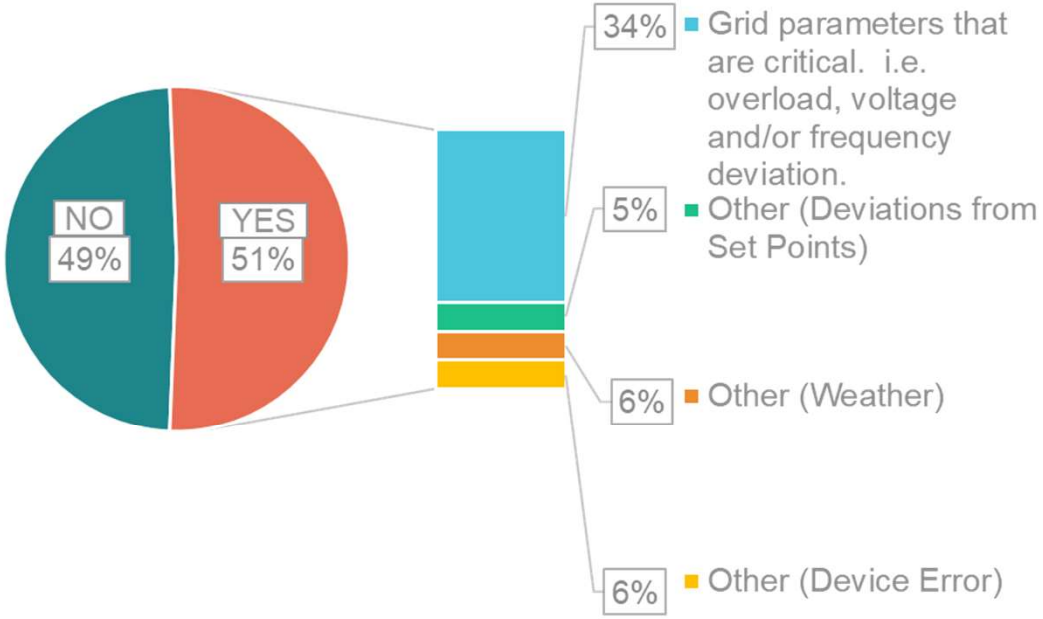
Control Device Outside the home ↔ ESA

Alerts



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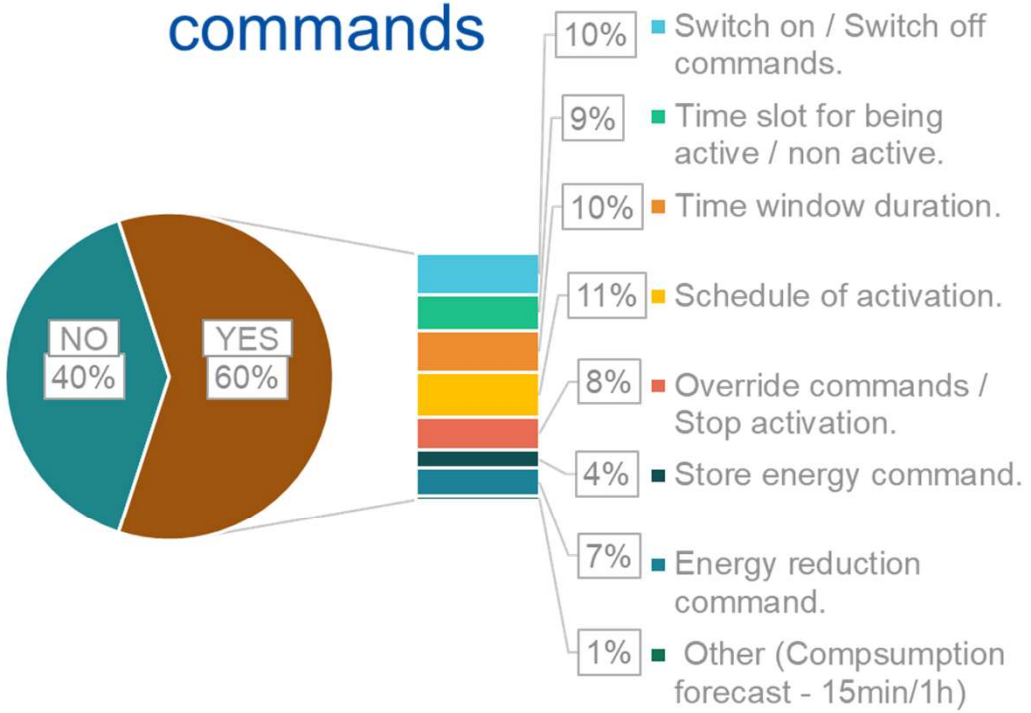

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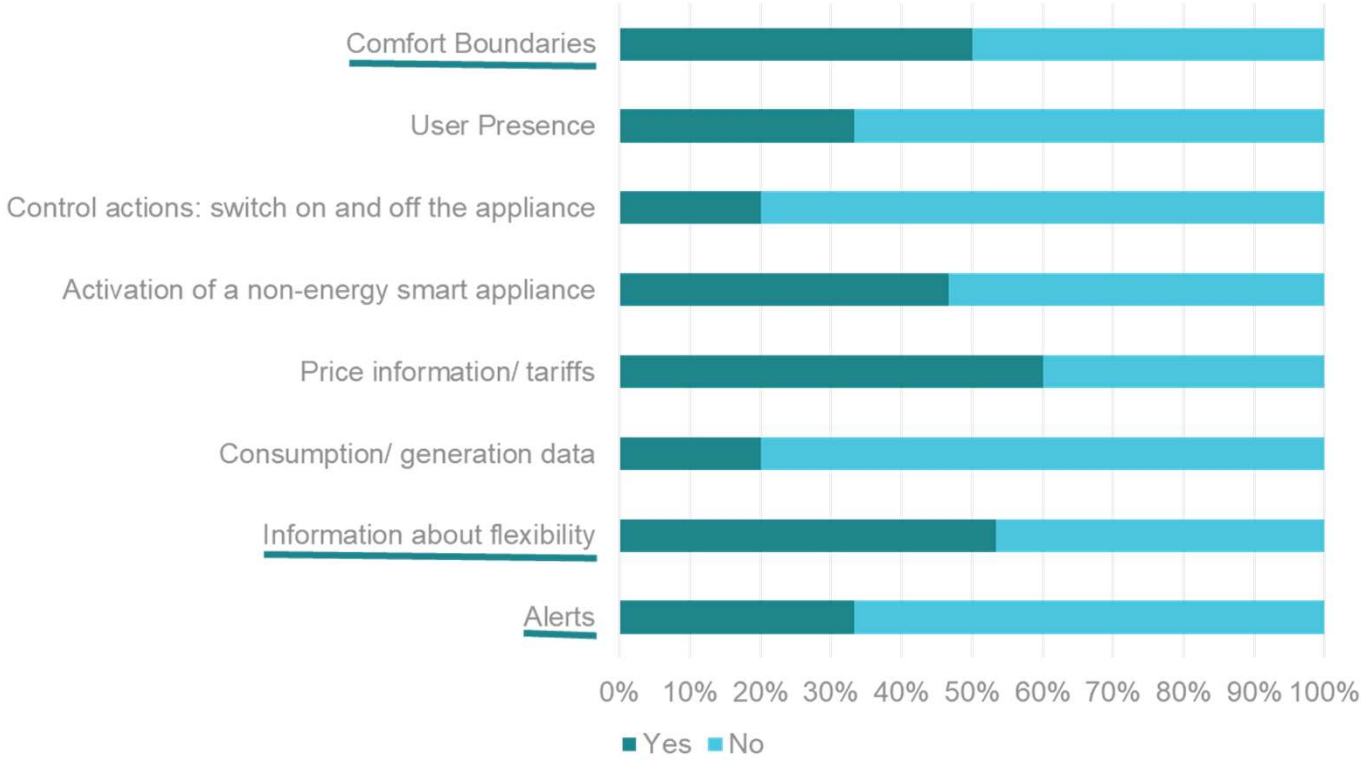
User / Costumer ↔ ESA

Type of stakeholder	
User / Costumer	20%
ESA Manufacturer	80%
Both	0%
Total	**15**



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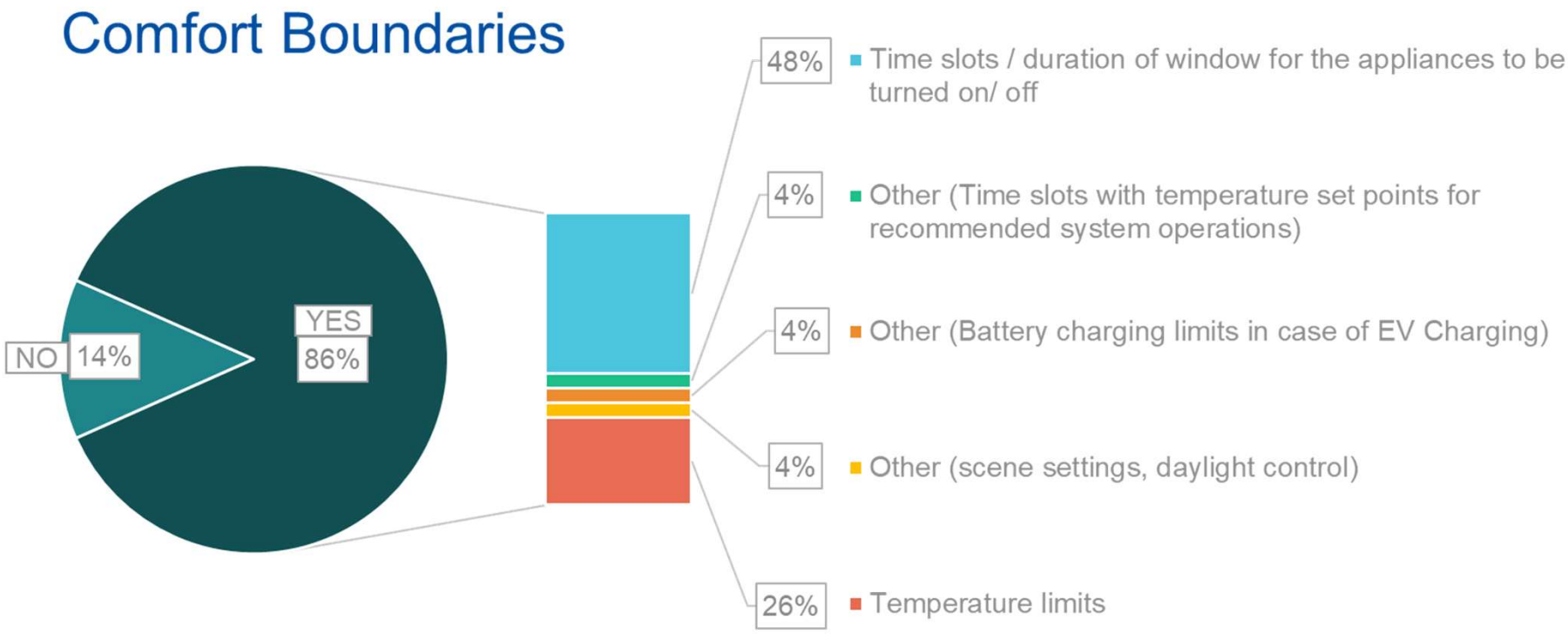
User / Costumer ↔ ESA



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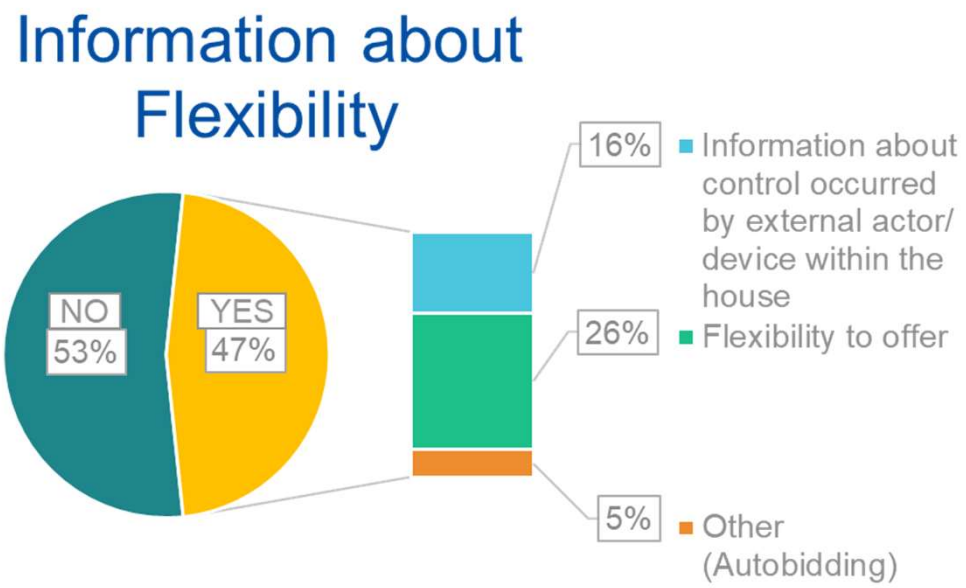
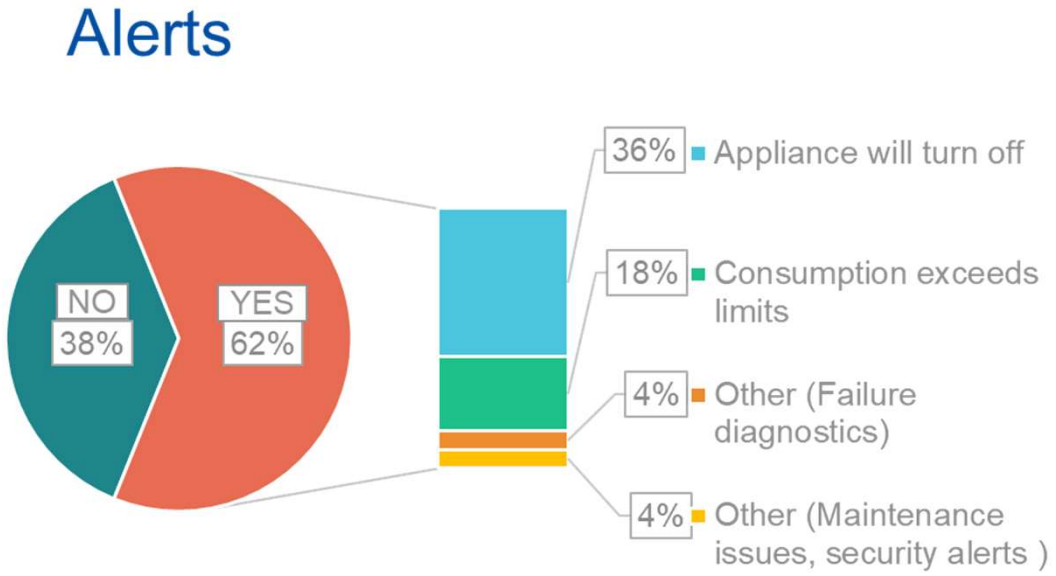
User / Costumer ↔ ESA





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3.3. Communication Standards/ protocols used

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Communication standards / protocols used

Communication standards/ protocols used	No of participants	Communication standards/ protocols used	No of participants
Modbus	9	OCCP	2
SAREF	8	OpenADR	2
EEBus	6	IEEE 2030.5	2
APIs (Rest, Local, etc)	6	BACnet	2
KNX	4	WiFi	2
ZigBee	3		

Other communication standards/ protocols

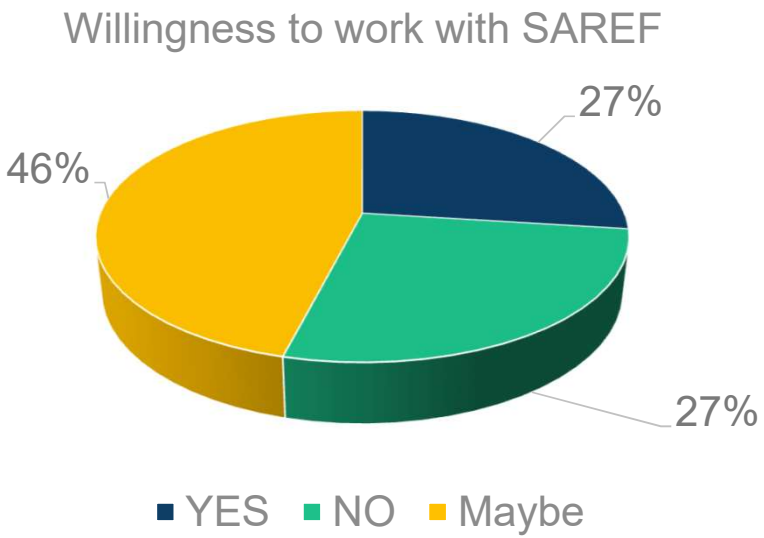
Communication standard/ protocol used		
Bluetooth	IO-HOME	Profibus
HTTP/TCP/IP	FlexOffer	BIM
OPC	ASHRAE 223P	

Other ontologies used

Protocols/ ontologies used			
REST API	Brick	Webservices	WiFi
IEEE 2030.5	IEC 104	OpenTherm	ZigBee
KNX	TCP/IP	OCPP	DALI
Haystack			

Issues related to SAREF

Willingness to work with SAREF



Suggestions for SAREF improvement

- Plugins should be added to reduce customization effort by non-experts
- Include the notion of time series and its support
- The specification needs to be covered by EEBus;
- The ontology needs to expand to encapsulate all data structures inherited from the IEC/CIM ontologies

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3.4. The interoperability issues

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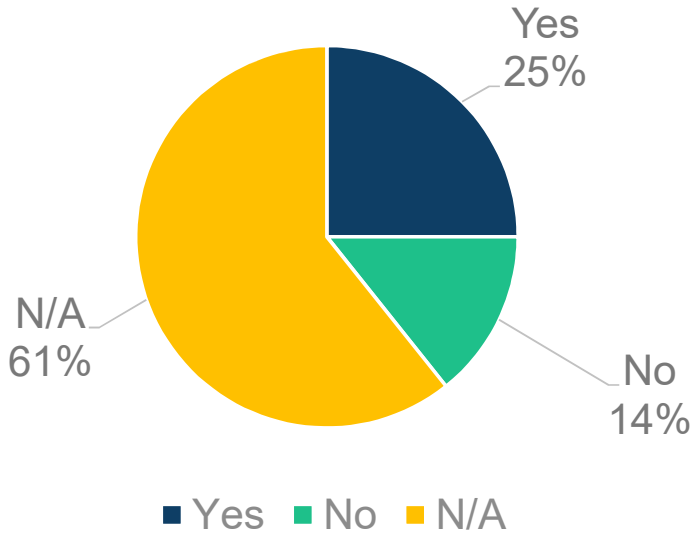
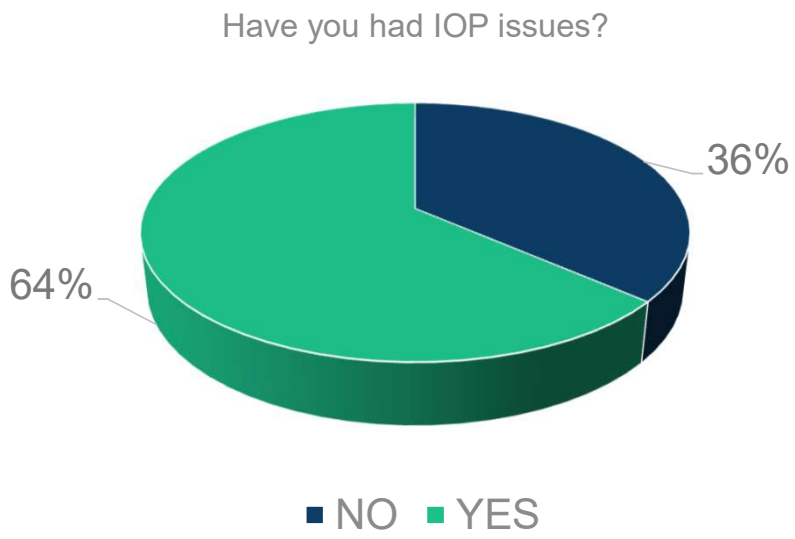
Question 11. Have you ever experienced interoperability issues?

Considering the whole sample of participants (56) :



Considering the 22 replies whether or not:



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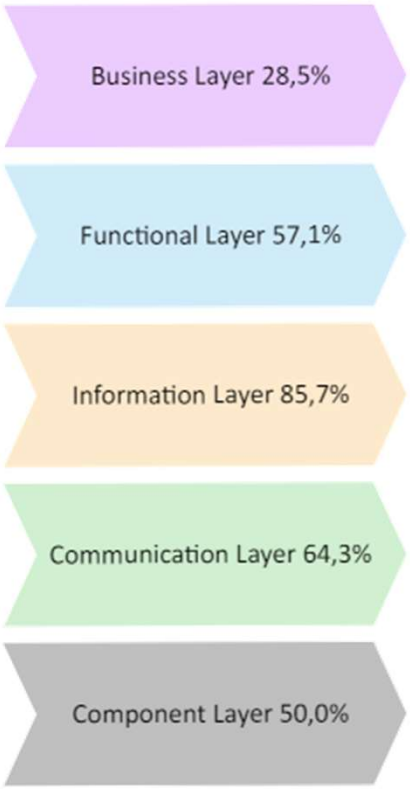
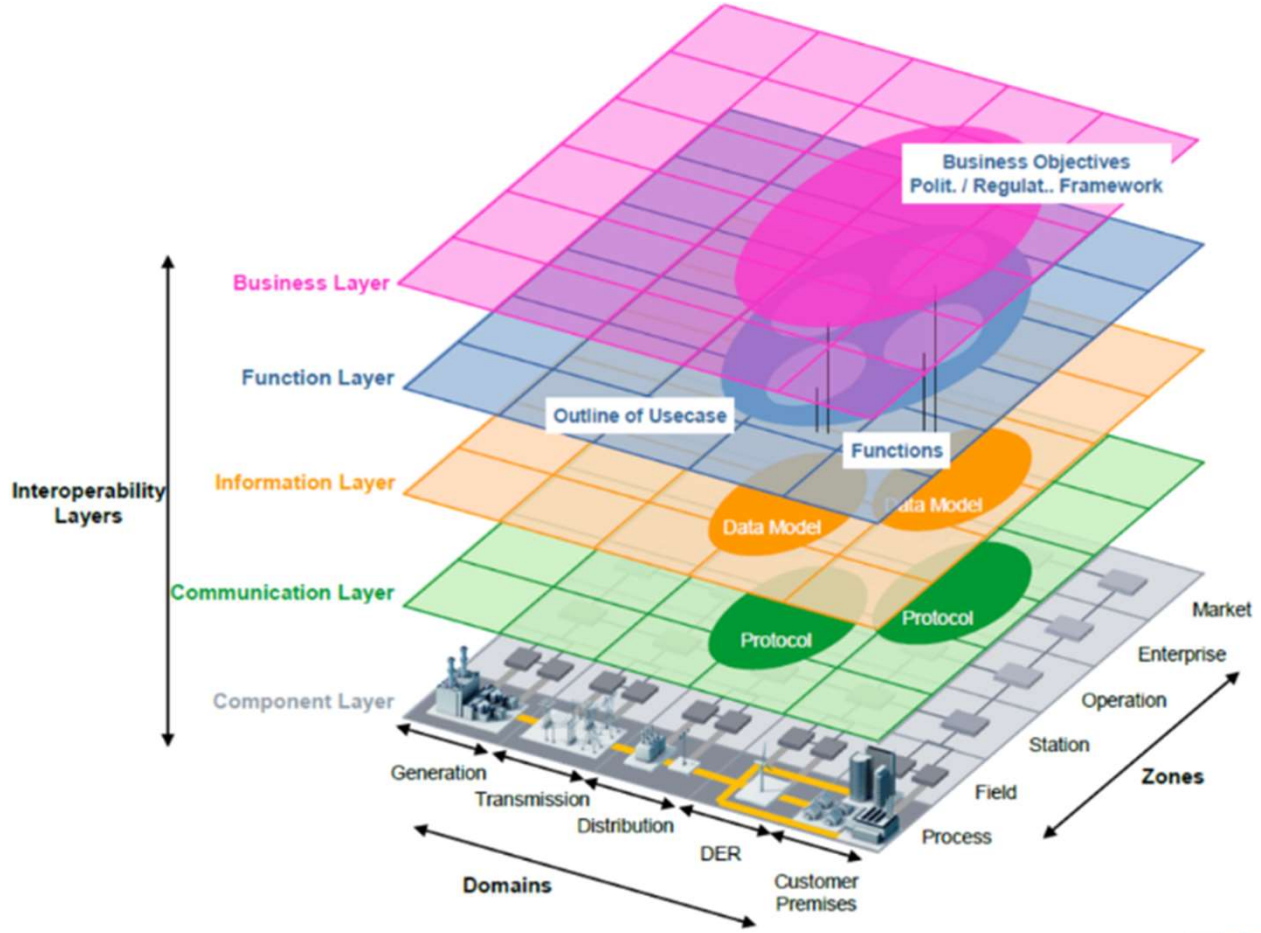
Which layer of interoperability?





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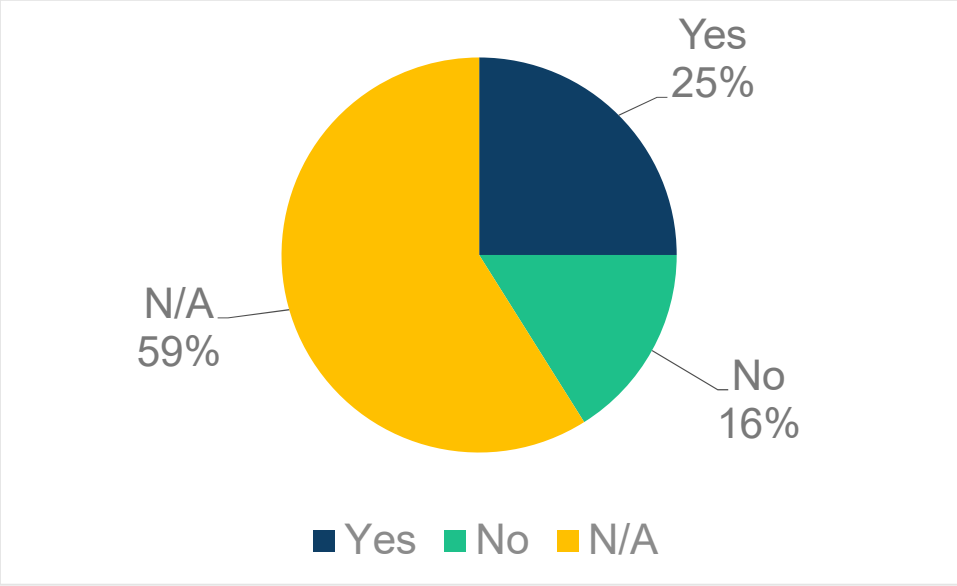
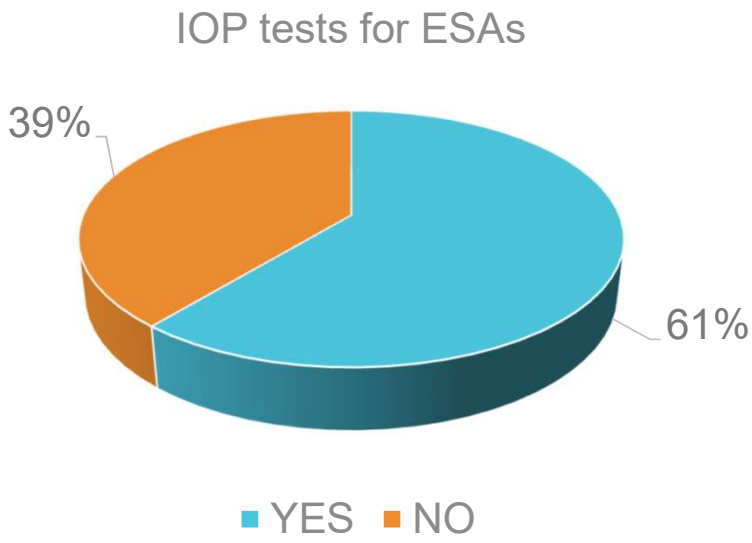
Question 12. Are you performing interoperability tests for ESAs?

Considering the whole sample of participants (56) :



Considering the 22 replies whether or not:



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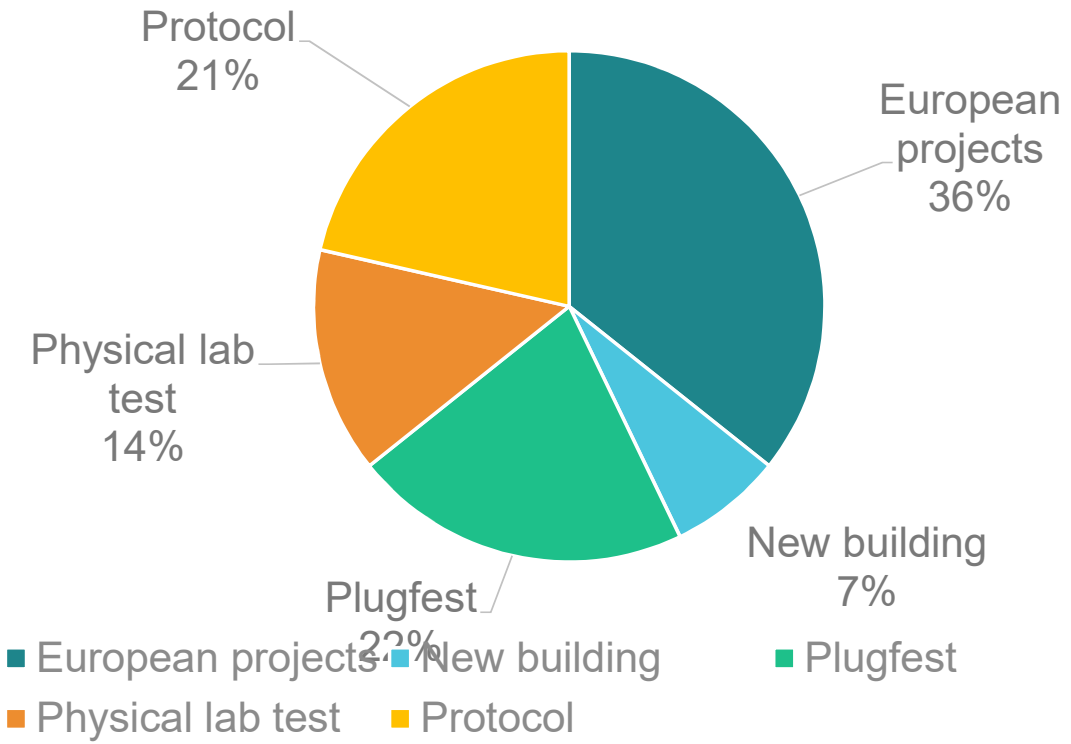
Which kind of tests have been performed related to IOP of ESA?



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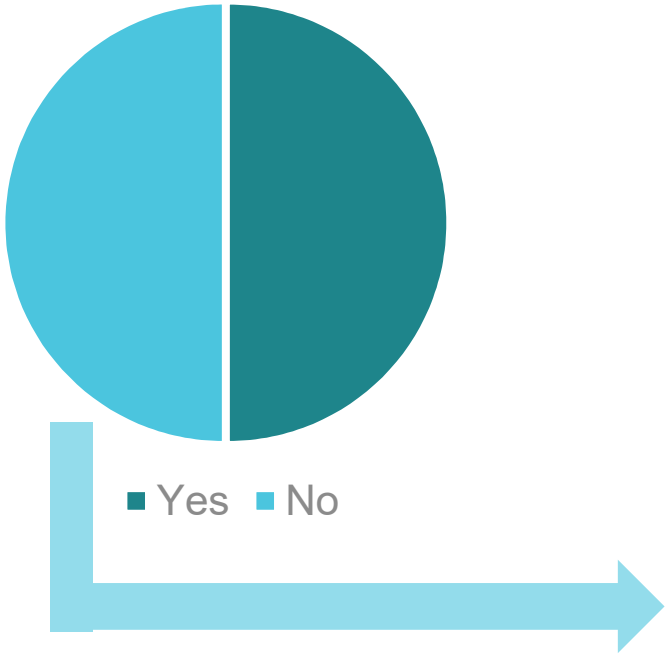
Methodology used

Specific methodology?



Which ones?

- Standard development and testing methods
- Interconnect platform
- Graph patterns
- Machine learning
- BACnet
- Plugfests
- Forecaster
- EEbus

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4. Energy Smart Appliances and their role in the society

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Code of Conduct for IOP of ESA 1/2

Initiative **launched** by the European Commission

Targeted towards...
ESA manufacturers and other actors in the industry.

The **goal** is

Achieving IOP of different
smart home actors **with ESA**.

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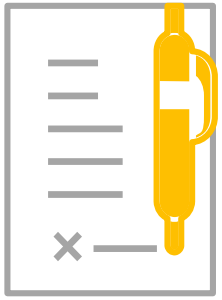
Code of Conduct for IOP of ESA 2/2

The **contents of CoC** yet to be **drafted and agreed** upon.

Signing/ **adherening** to the CoC
is completely **voluntary**.



Signatories **committing** taking
actions to **support IOP** related to ESA.

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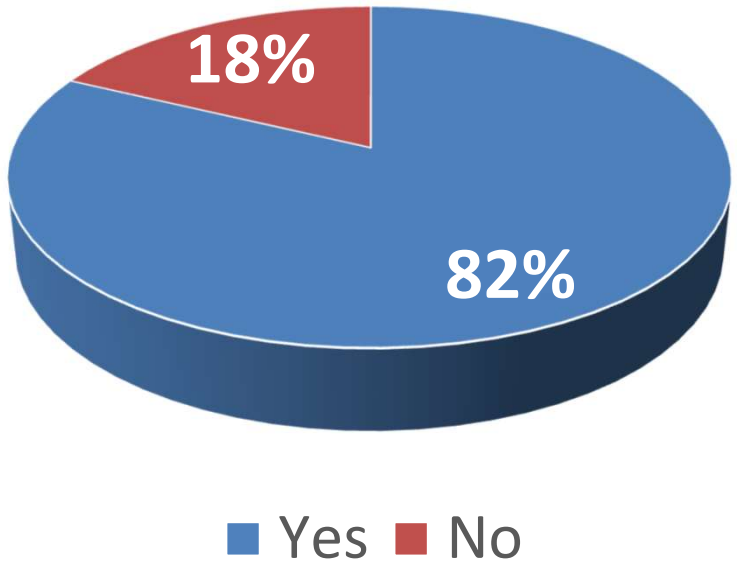
Interest in the participation in the design of Code of Conduct



Stakeholders who answered „**Yes**”:

- Manufacturing business – **43%**
- Not in the manufacturing business – **57%**

Good indicator that ALL actors are concerned with what CoC will bring.

Reasons for „**No**”:

- „*Prefering standards over CoC*”, „*Scope of the CoC not clear*”, „*Out of their business scope*”

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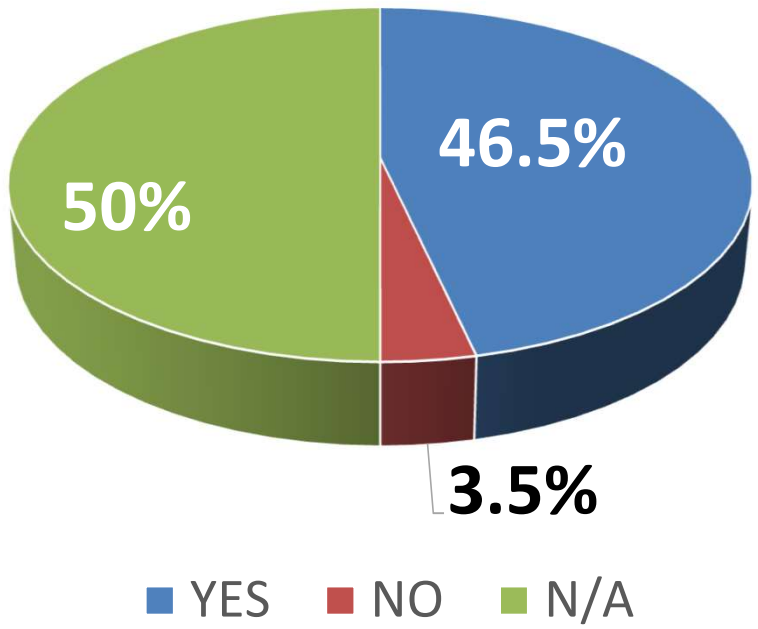
Willingness to adherence to CoC



Takeaways:

- Half are not concerned with adherence to CoC.
- All the others are **willing to adhere to the future CoC.**
- Only 2 of them not willing to adhere, reasons notably being:
  - „*Scope of the CoC not clear*”, „*CoC does not guarantee IOP*”
  - Both of them also answered they are not willing to co-design CoC.

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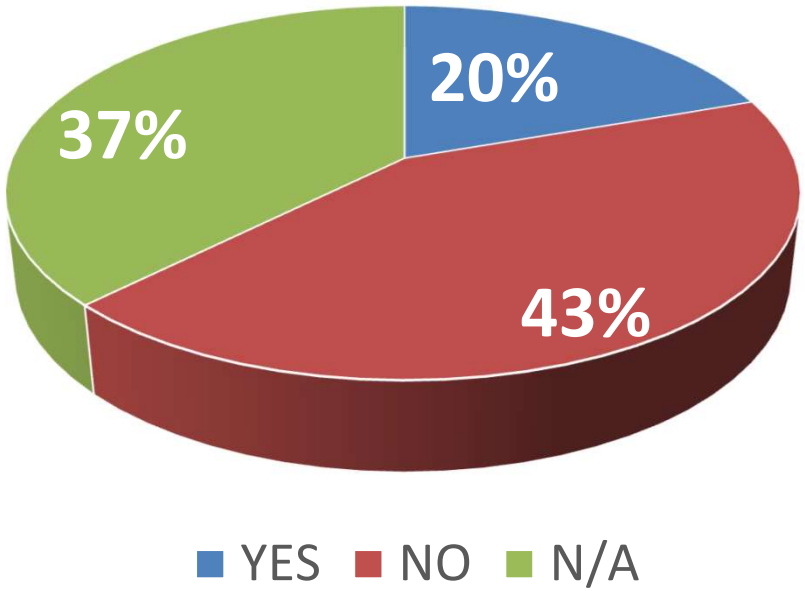
CoC sufficient in promoting IOP of ESA 1/2



Takeaways:

- Almost half of **all** participants are **NOT** in favour that it stays just on CoC, as expected.
- For many more this is not applicable or they are not sure.
- Worth mentioning that some of them consider CoC already sufficient.c

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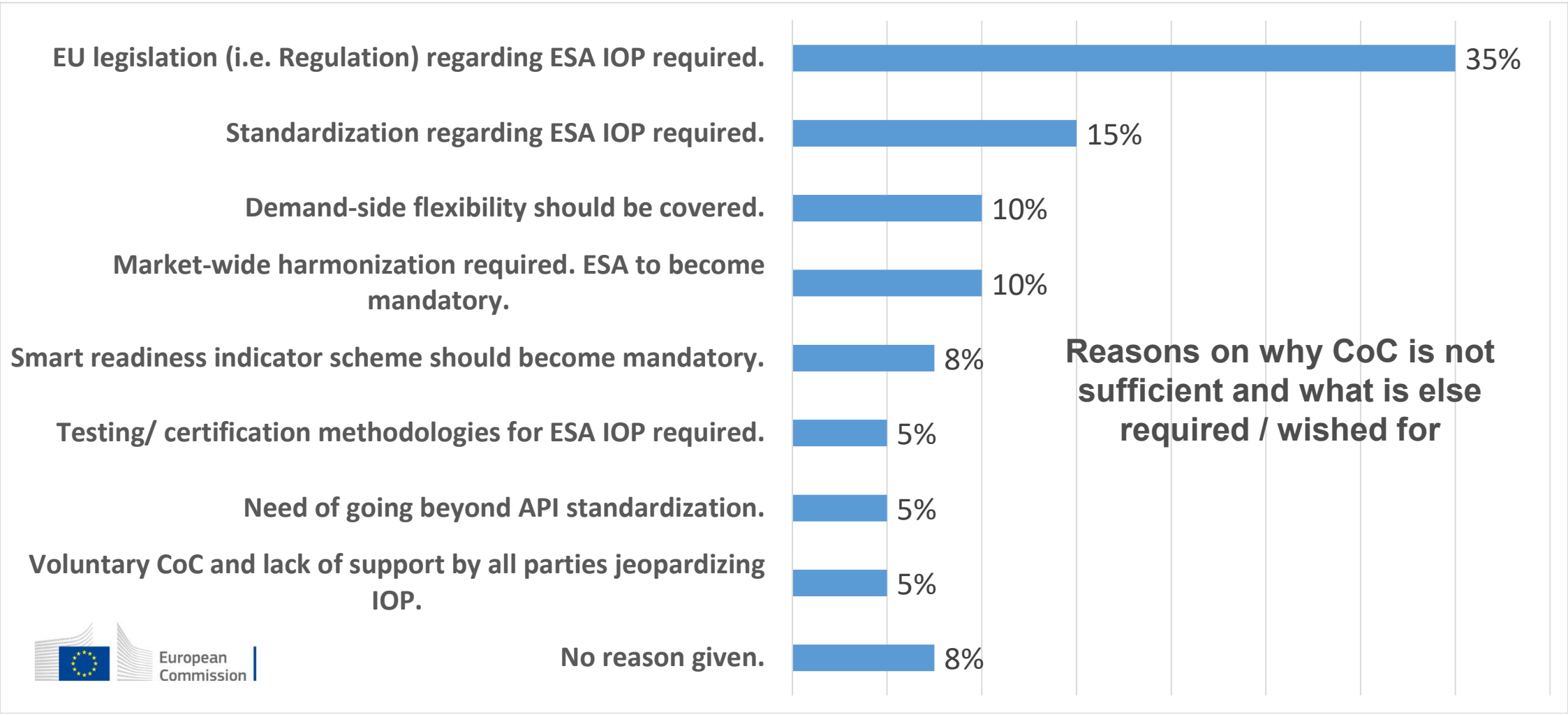
CoC sufficient in promoting IOP of ESA 2/2



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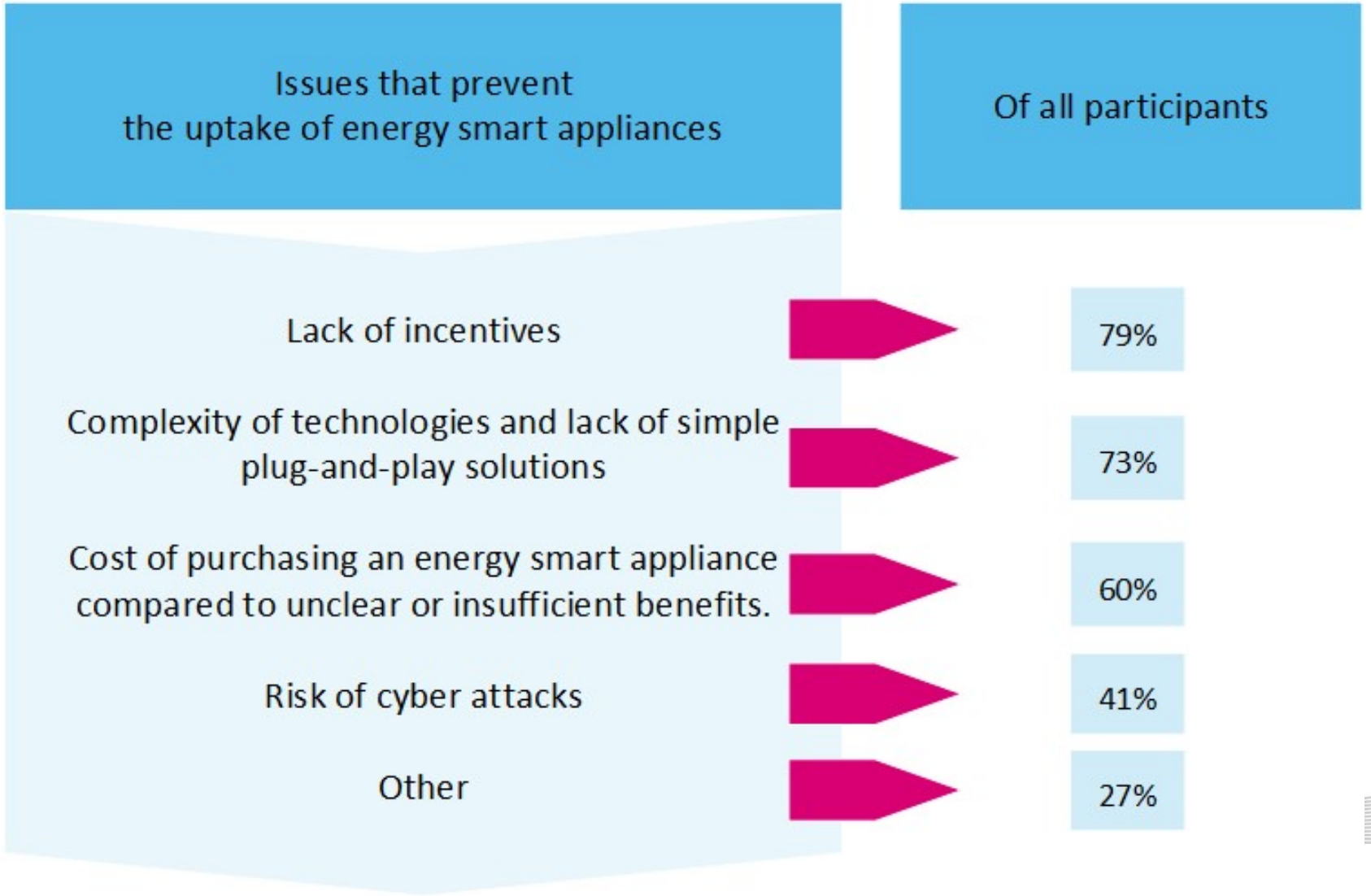
ESA and engagement of public 1/6



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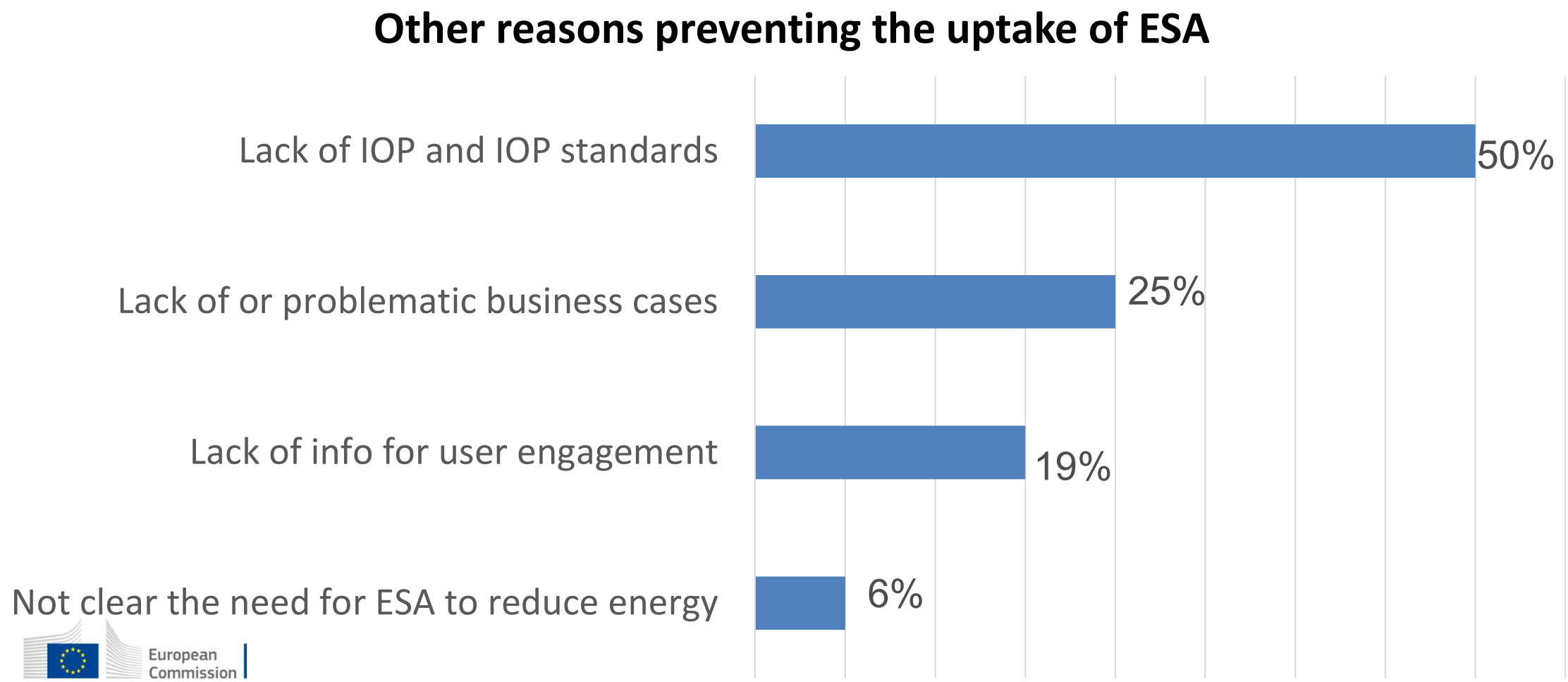
ESA and engagement of public 2/6



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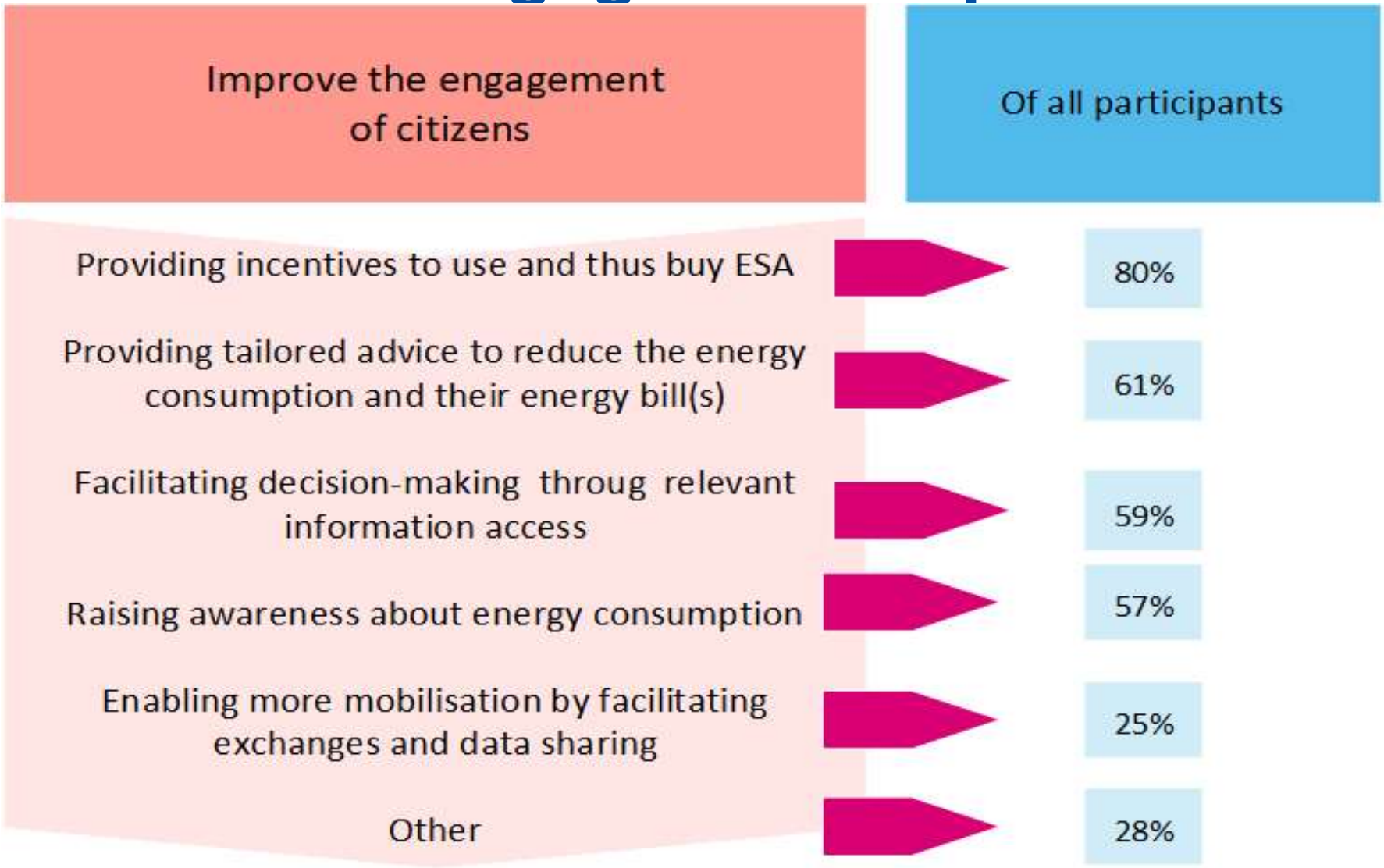
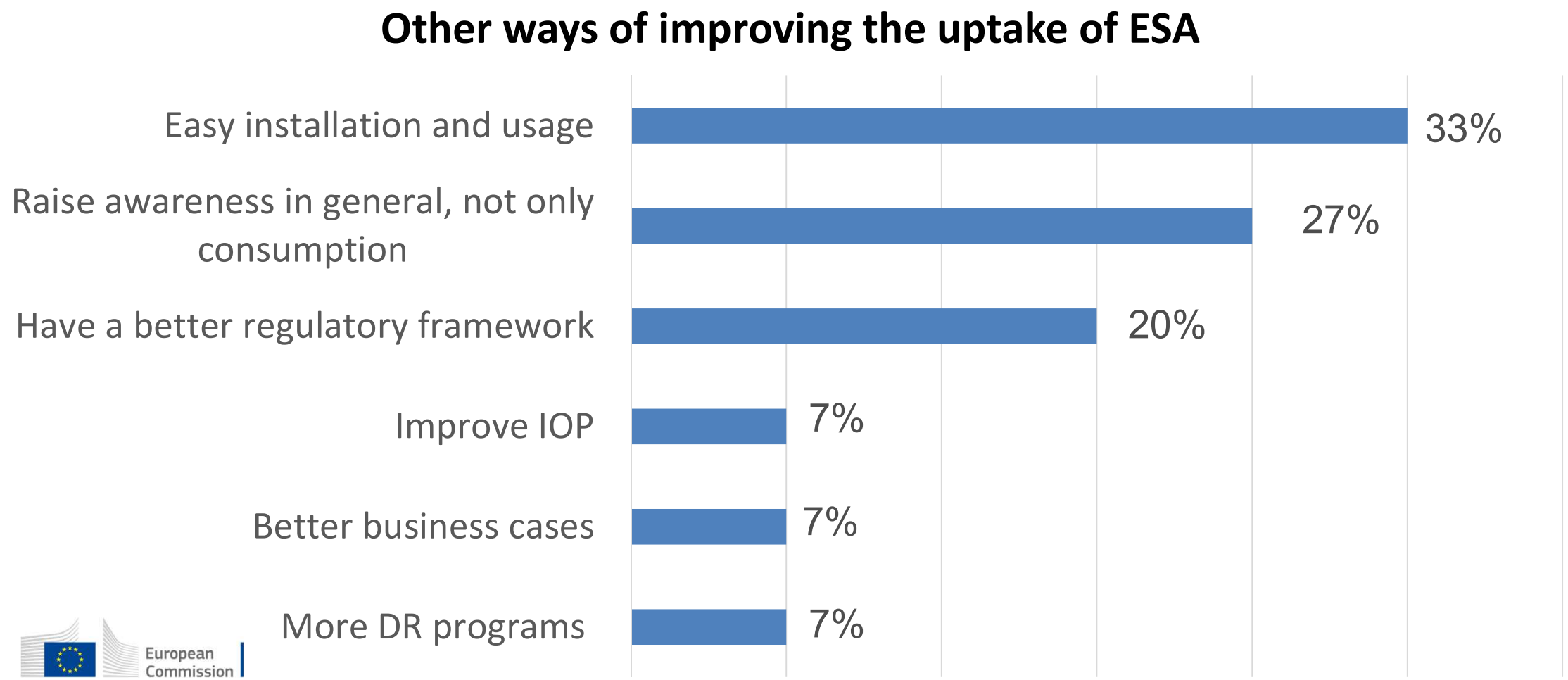
ESA and engagement of public 3/6



ESA and engagement of public 4/6



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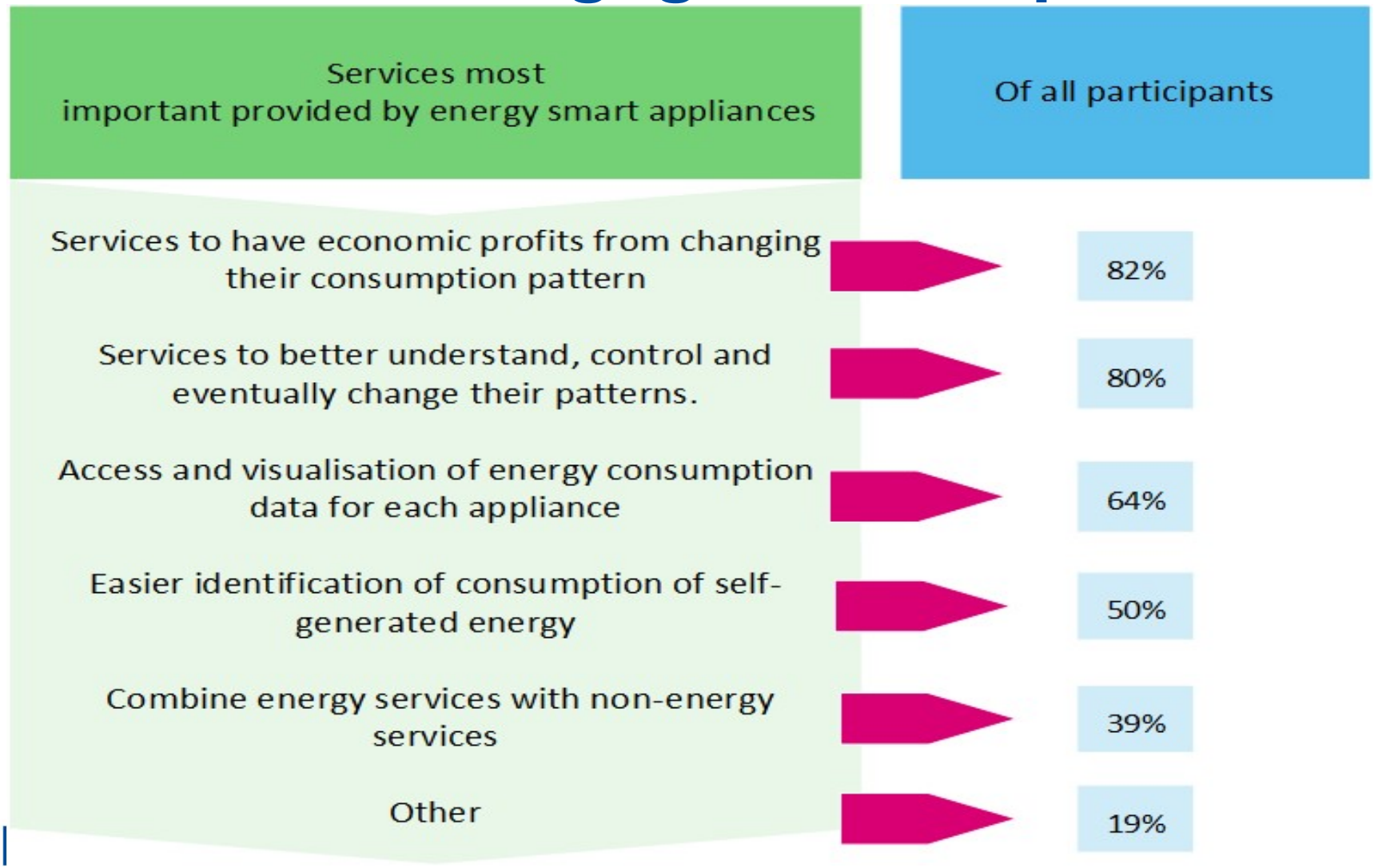
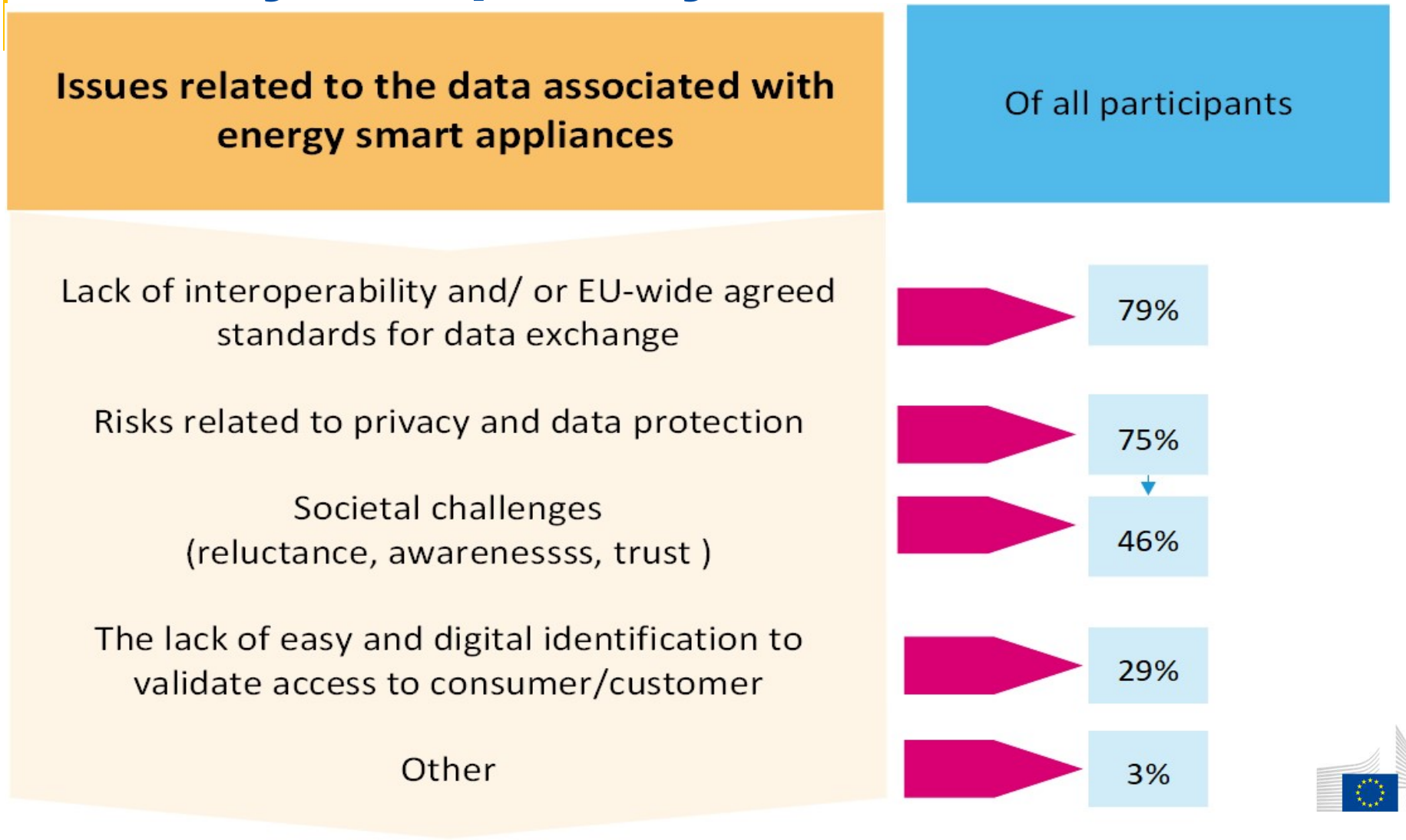
ESA and engagement of public 5/6



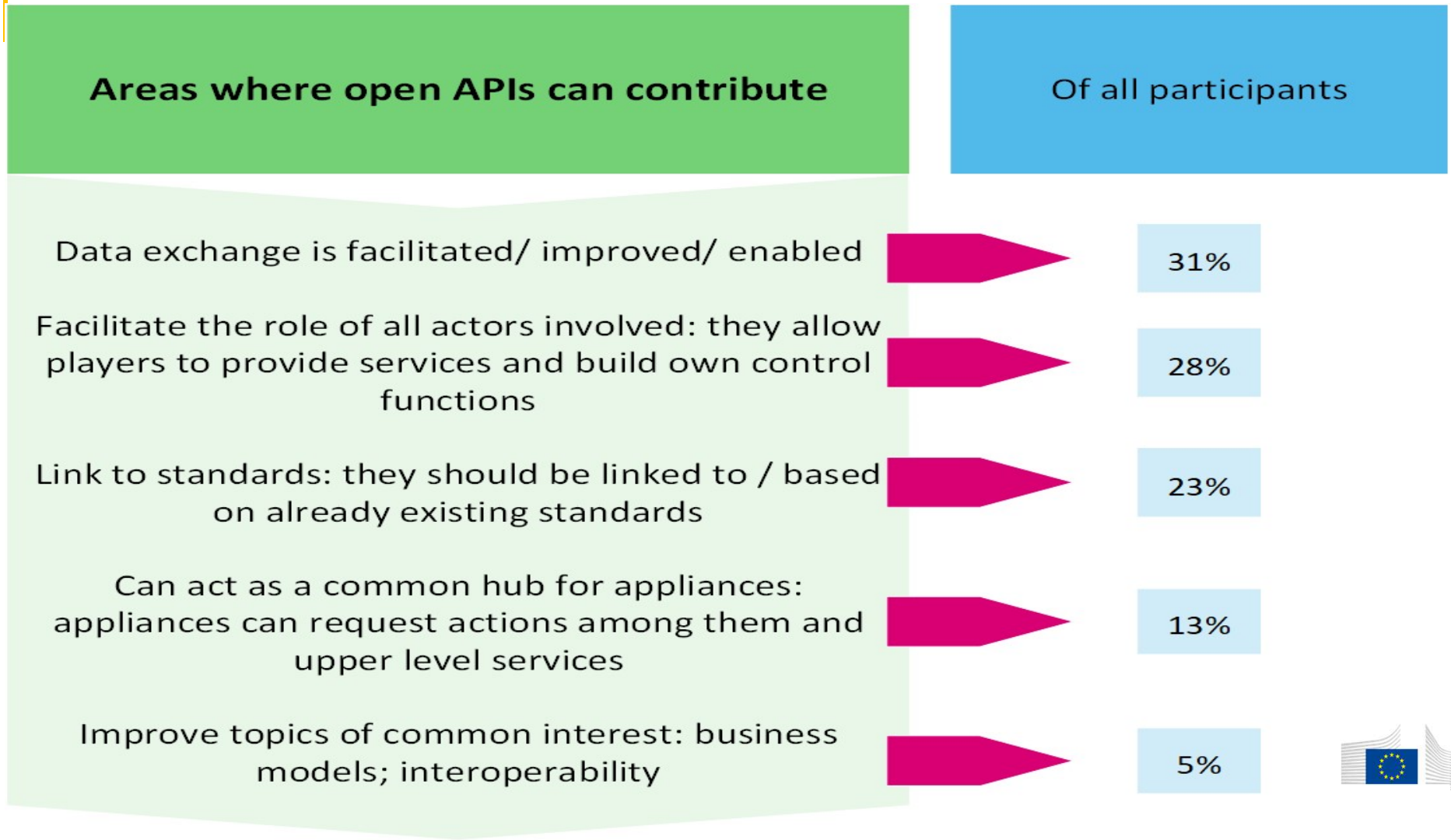
ESA and engagement of public 6/6

Other services that can be offered by ESA	
Use better critical resources, like water	Contribute in better integration of renewable energy
Inform on the state of electrical network, management of electrical peak	Facilitate collaboration of service providers
Ensuring better thermal comfort and in-door air quality	

Security and privacy issues 1/4



Security and privacy issues 2/4



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Security and privacy issues 3/4

Aspects of cybersecurity that have be considered for the IOP of ESA	Of all participants
Existing and future regulations need to be followed: Cyber Resilience Act; Radio Equipment Directive; EU cybersecurity concepts...	38%
Data protection is above all: encryption should be followed;	36%
End user security is important: IoT WiFi network can be used	10%
Interoperability of security protocols	5%
Web cybersecurity should be used: HTTPS, TLS	5%
Other existing security schemes should be used: BACNet, KNX	5%

Security and privacy issues 4/4

Main concerns/ issues about privacy for IOP of ESA	Of all participants
Follow existing standards and cybersecurity rules, ie. Data Act, GDPR (General Data Protection Regulation)	31%
Rules for data sharing, data access, data control, data protection, data quality: parties should know where data is sent; personal data should not be shared;	27%
Consent of customers for: data usage, connecting device	17%
Ownership of data by the customer	10%
Anonymization and storage of data when under analysis; encryption when in transit	8%
Consumer digital identification	6%

Concerns and additional issues about the IOP of ESA

Interference that can be created by ESA in the network – concern that they can disturb the Power Line Communications network – there should be a standard that limits the interferences created by ESA	The **CoC should consider that it is the ESAs that give quality of life services** to occupants
What happens to the device or software if company closes or if cloud disappears?	IOP issues: - **IOP tests should come with certification**, like in California through IEEE 2030-5 CSIP - Too rigid focus on IOP can hamper innovation - Ontologies as driver for IOP
How ESA connect to the IoT of the home?	**Data concerns:** - **Extra approval if data is used for research purposes** - Data Integrity
Is there going to be also a Business to business focus instead of Business to consumer focus?	**Regulations concerns**: - **Limited applicability of legislation**
Grid short term peak load demand when switching on and off the devices	Open APIs concerns: - Available between ecosystem and not between equipment
Solar PV smart inverters and EVs should be considered together with ESA	

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Agenda

1. Introduction
2. Survey structure
3. Technical Data on Energy Smart Appliances
   - 3.1. Devices Manufactured
   - 3.2. Messages Exchanged
   - 3.3. Communication Standards / Protocols used
   - 3.4. Interoperability issues
4. Energy Smart Appliances and society
5. Summary

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5. Summary

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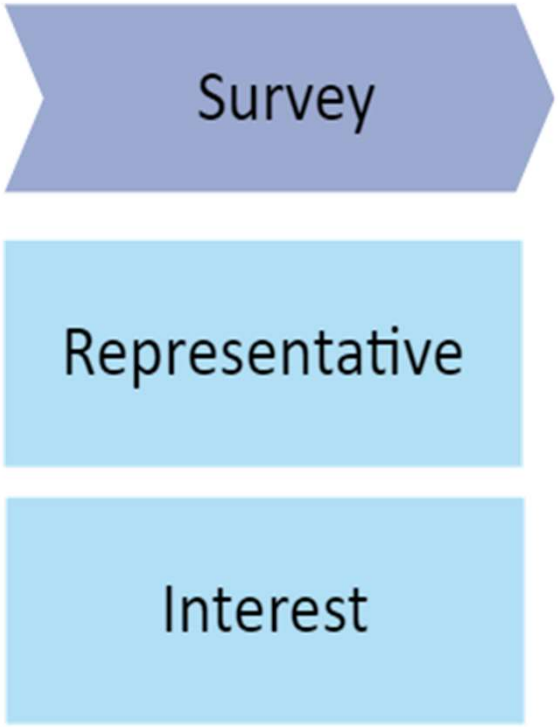
On the Survey



- **Interest for participating from several countries.**
- **Interest in joining the follow-ups of this project** (e.g. second Workshop)
- **Spontaneous interest of participation**
- **Accepted proposed classifications:**
  - ✓ **Actors**
  - ✓ **ESA categorization**
  - ✓ **Messages exchanged**

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What it is missing/need it.

- **Issues detected in all layers of interoperability.** Most complaints are related to the **information layer**
- **Need to define protocols**
- **Need to find more consumer/user representation**
- **Need to test and certify**
- **Need to include battery energy storage system BESS ↔ ESA**

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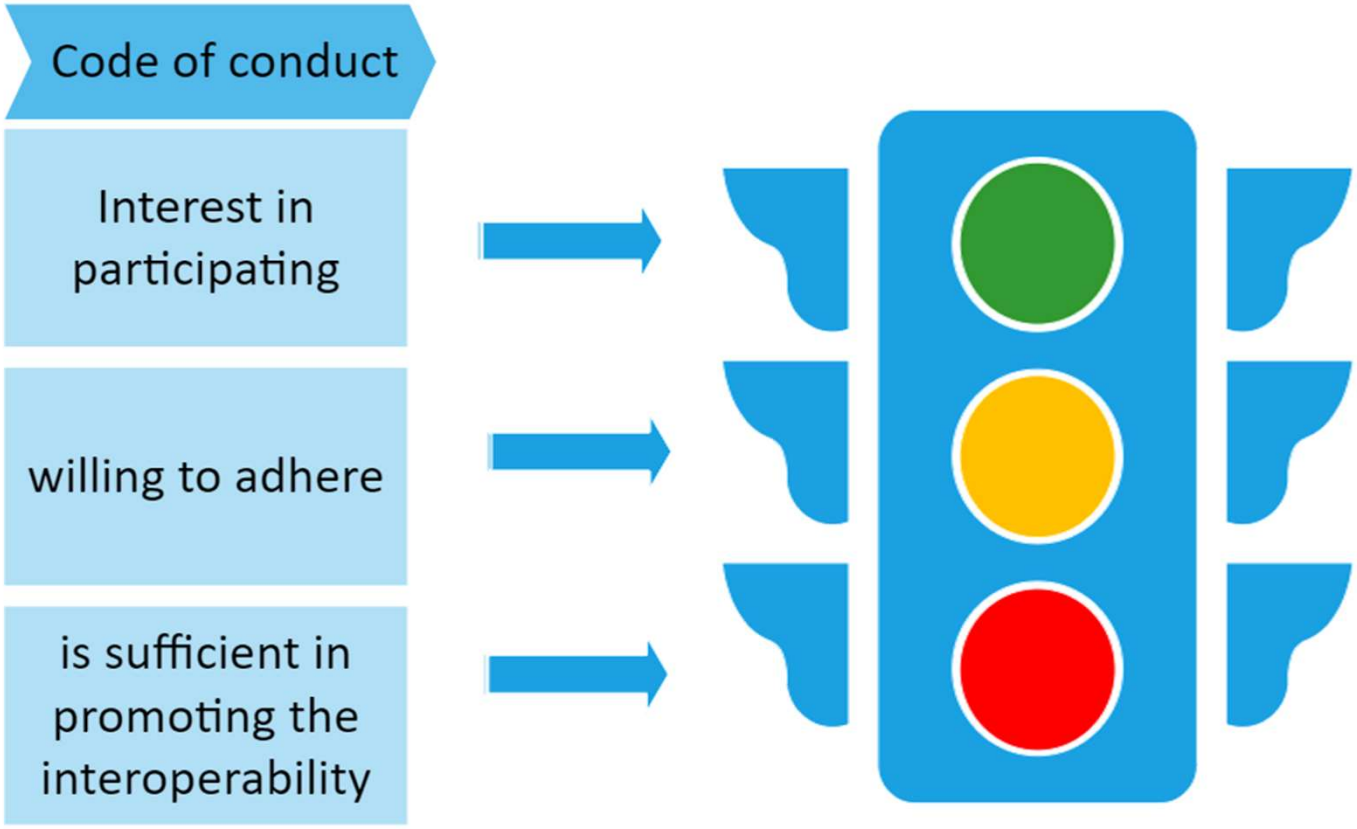
What about the Code of conduct ?



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Get involved!

Code of Conduct

Interoperability

Energy Smart Appliances

Project's Website

European Commission

Thank you
and keep in touch
Questions?

EU Science Hub https://joint-research-centre.ec.europa.eu/
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EU Science Hub – Joint Research Centre
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EU Science Hub
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Reference links

Smart Grid Interoperability Laboratory.

- *Smart Grid Interoperability Laboratory (Annual report 2021)*
  https://publications.jrc.ec.europa.eu/repository/handle/JRC128465
- *Smart Grid Design of Interoperability Tests (SG-DoIT)*
  https://ses.jrc.ec.europa.eu/sgdoit
- *Smart Electricity Systems and Interoperability:*
  https://ses.jrc.ec.europa.eu/

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