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EU PROJECTS CLUSTERING EVENT

SMART ENERGY SERVICES

SmartSPIN · sensei · CREW · frESCo · SMART EPC

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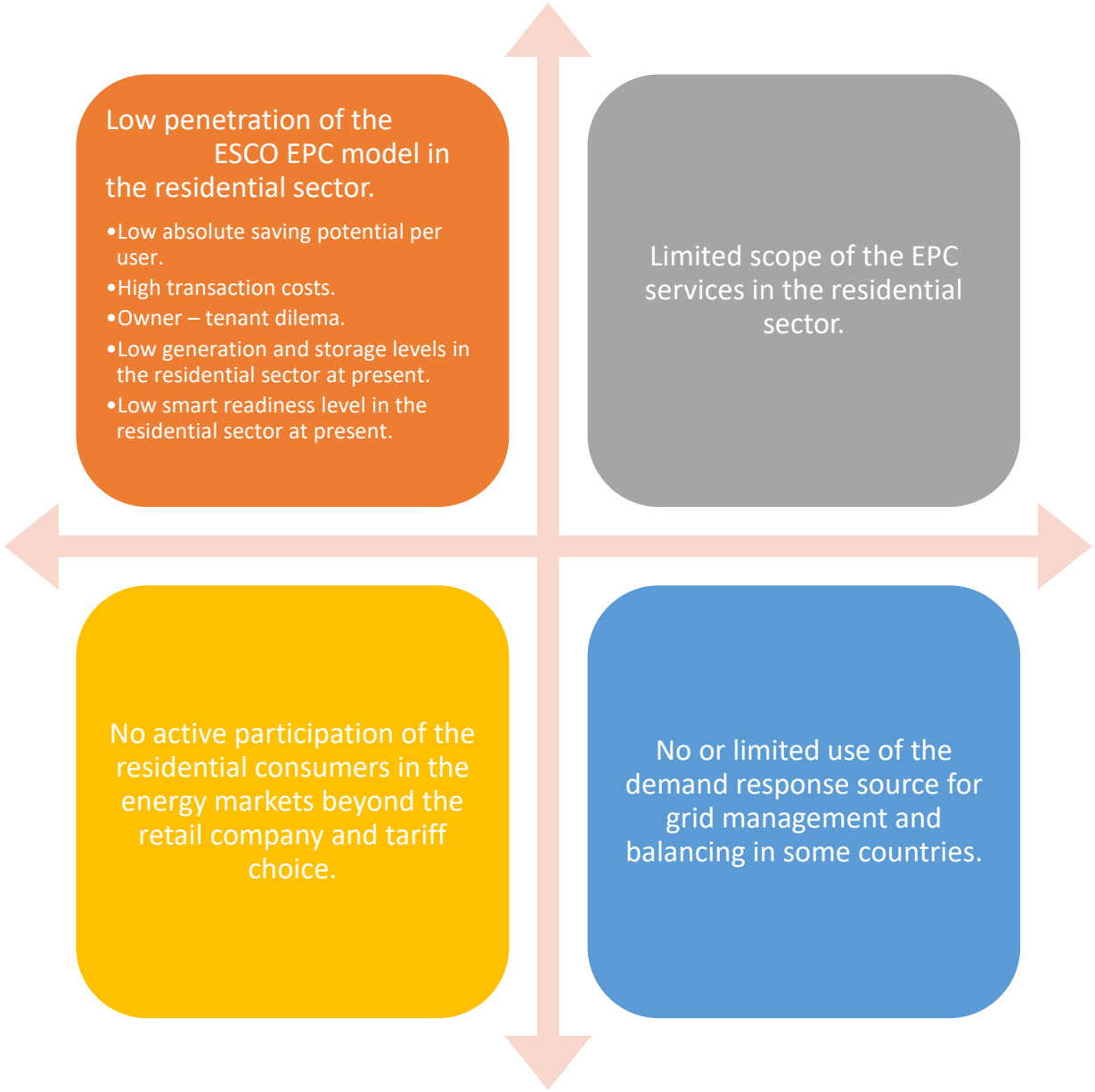
frESCO P4P Energy Services and Business Models for the Residential Sector

- frESCO Project and smart solutions
- New frESCO Energy Services
- New frESCO Business Models
- frESCO Enablers / Barriers
- frESCO lessons learnt and Conclusions

frESCO project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 893857.

Situation of current EPC in Residential sector



frESCO Solution

NOVEL HYBRID SCHEMES that reduce payback thanks to simultaneous cost savings (from energy efficiency) and revenues creation (through demand response)

NEXT GENERATION of EPC UNDER A P4P APPROACH

Building retrofitting (installation of smart equipment for metering, sensing, actuating)

Installation of distributed generation and storage (PV&batteries/EVs)

Flexibility services

Energy efficiency measures, spanning behavioral transformation

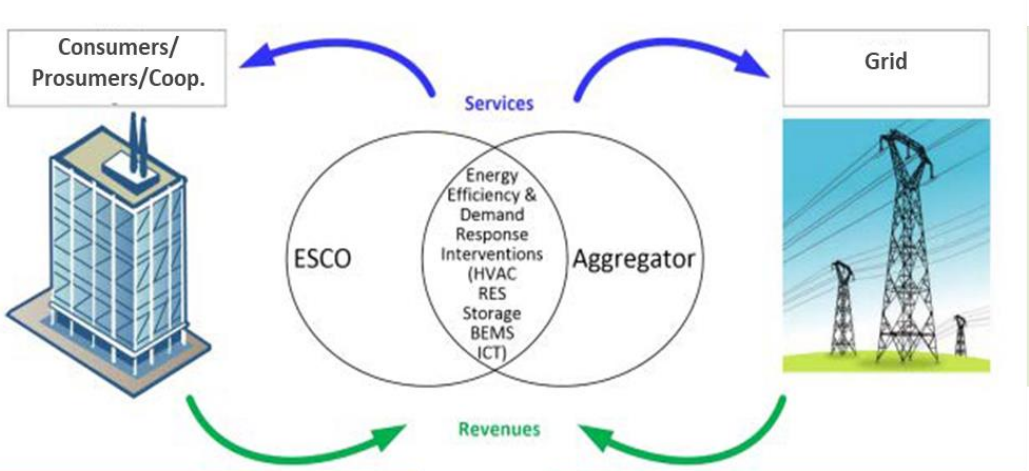
Self-consumption optimization (smart automation at both building and energy community level)

non-energy services (Comfort preservation, IAQ, Security, Well-being, etc.)

frESCO P4P Energy Service Concept

Consumers/Prosumers/Coop.

- Cost reduction thanks to Demand adaptation to tariff
- Improvement of comfort conditions
- Favorable offers for installation of smart meters
- Empowerment through active participation in Energy market and energy autonomy



Grid

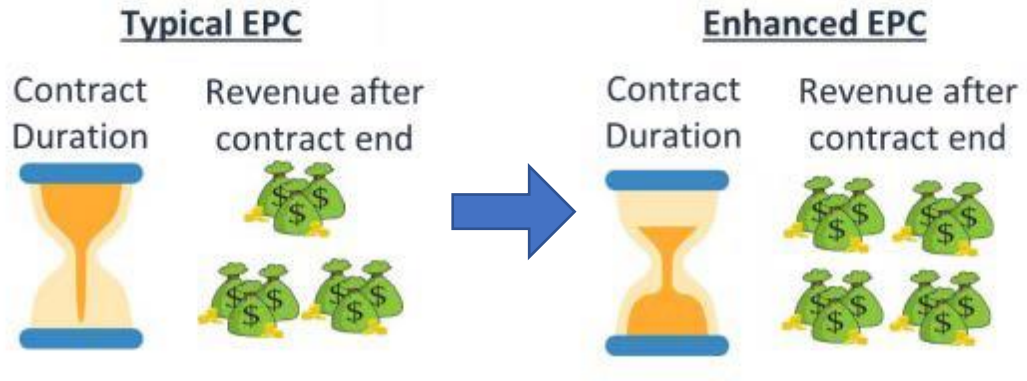
- Operation stability, Resilience and Security of supply
- Cost reduction avoiding network reinforcement
- Congestion reduction and network losses minimization
- Planned maintenance facilitation

ESCOs

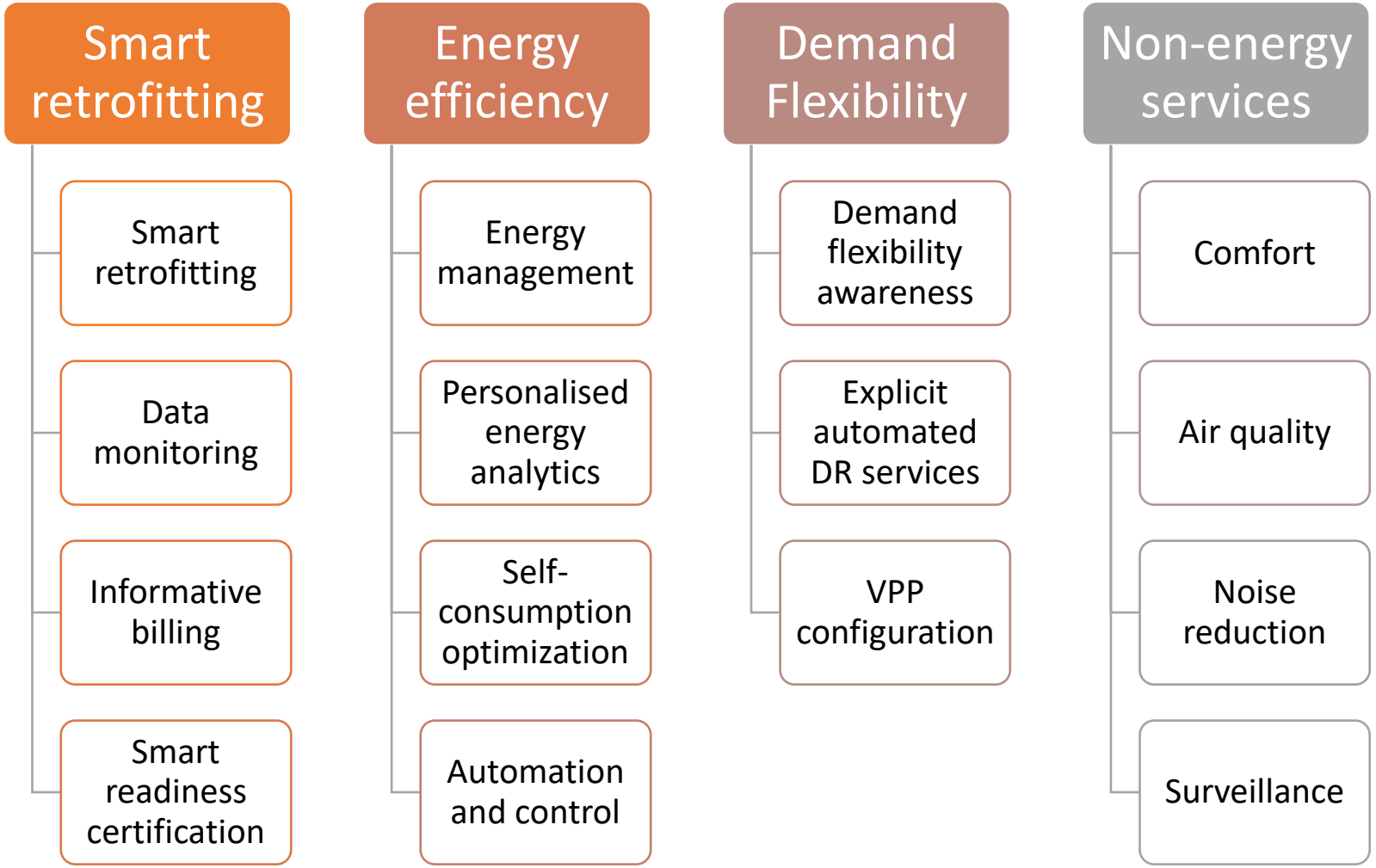
- New Savings from user behaviors improvement
- New Savings from Self-consumption optimization
- New Revenues from flexibility analysis → selecting best energy deal → bid excess flexibility in energy market
- Higher savings thanks to enlarged portfolio and enter in a new market

Aggregators

- New Revenue by utilizing stand-by flexibility to provide EE services that improve performance
- New Revenue by monetizing non-energy services (e.g. human comfort, health and security aspects)
- Higher revenues thanks to an enlarged portfolio (and market sector) for flexibility provision

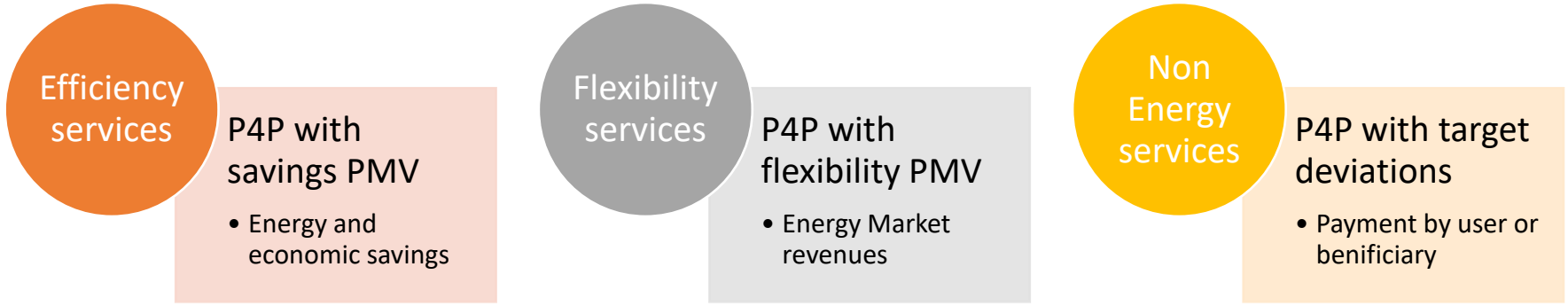


frESCO Energy Services Proposal

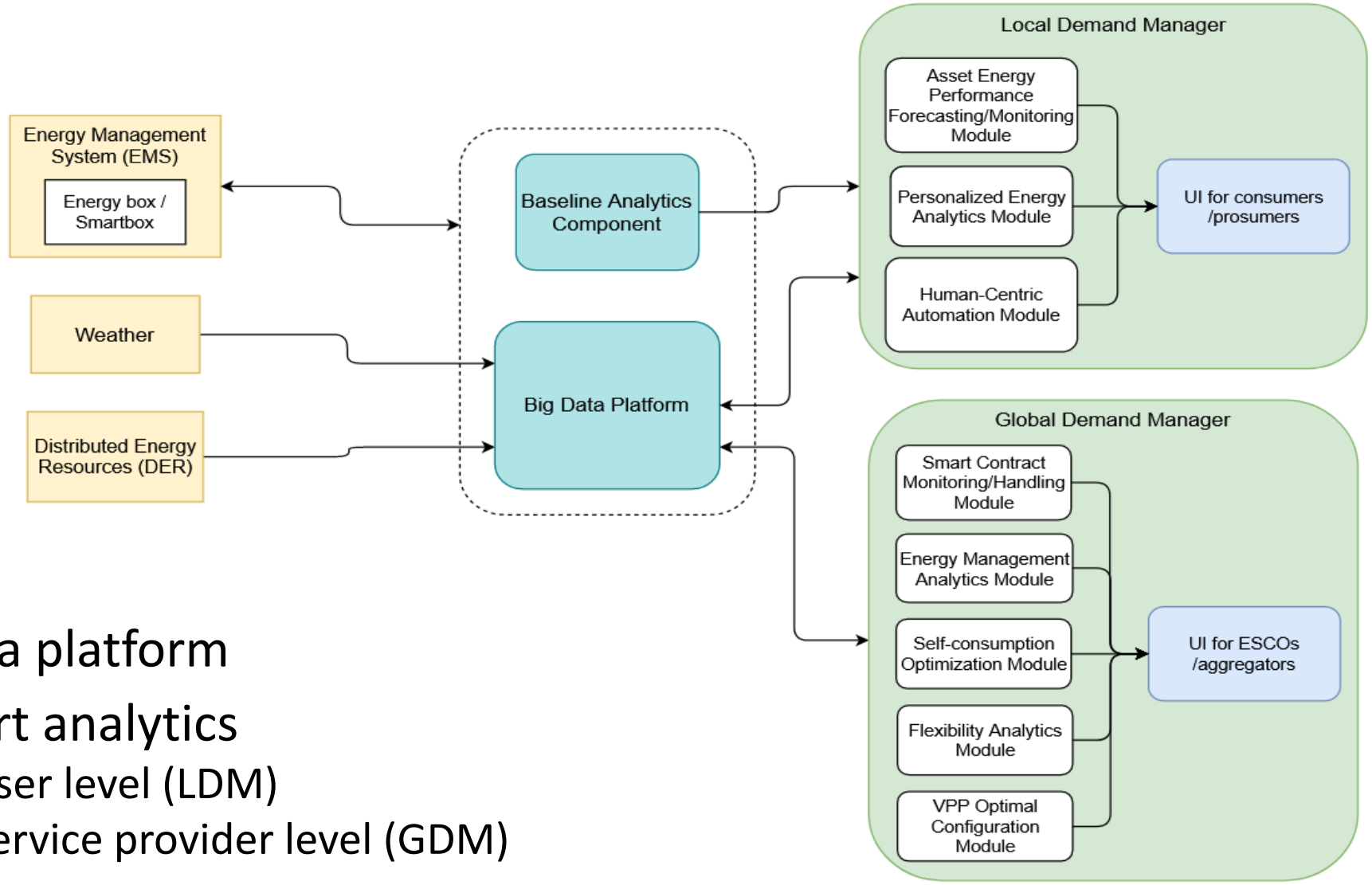


P4P Approach

- Specific PMV methodology for energy efficiency and flexibility
- Data driven baselining and forecasts
  - Efficiency PMV: Holistic dwelling assessment with seasonal baseline and possible regular adjustments. Payments derived from verified energy and economic savings.
  - Flexibility PMV: Load-based assessment with short term baseline and no adjustments. Payments derived from market revenues from the trading of verified demand flexibility

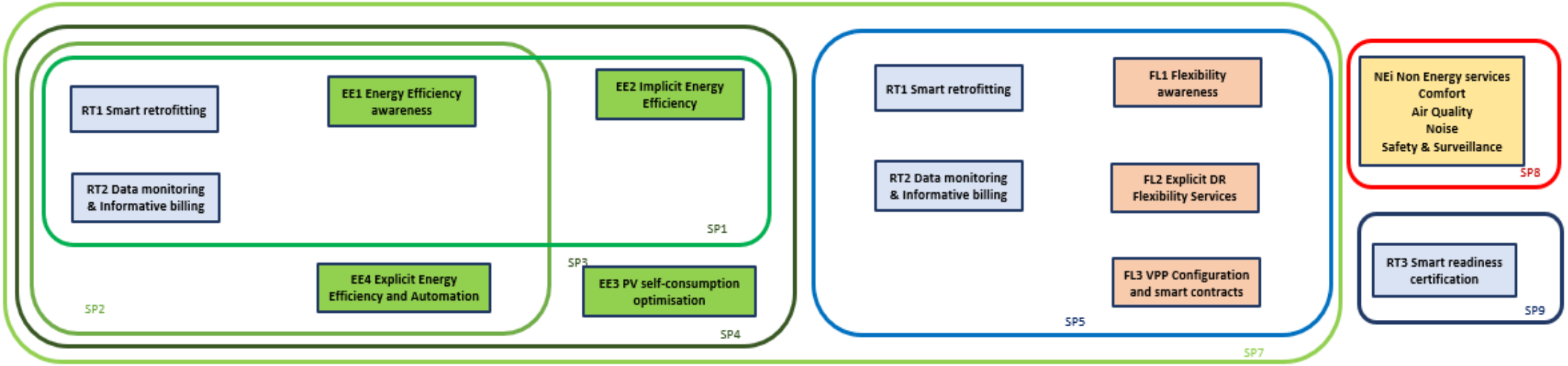


frESCO Technological Solution Architecture



- Big data platform
- AI smart analytics
  - At user level (LDM)
  - At service provider level (GDM)

frESCO Energy Service Bundles



ESCO

- SP1: Energy monitoring and implicit energy efficiency pack
- SP2: Energy monitoring and explicit energy efficiency pack
- SP3: Energy monitoring and holistic energy efficiency pack
- SP4: Energy monitoring and holistic energy efficiency for prosumers

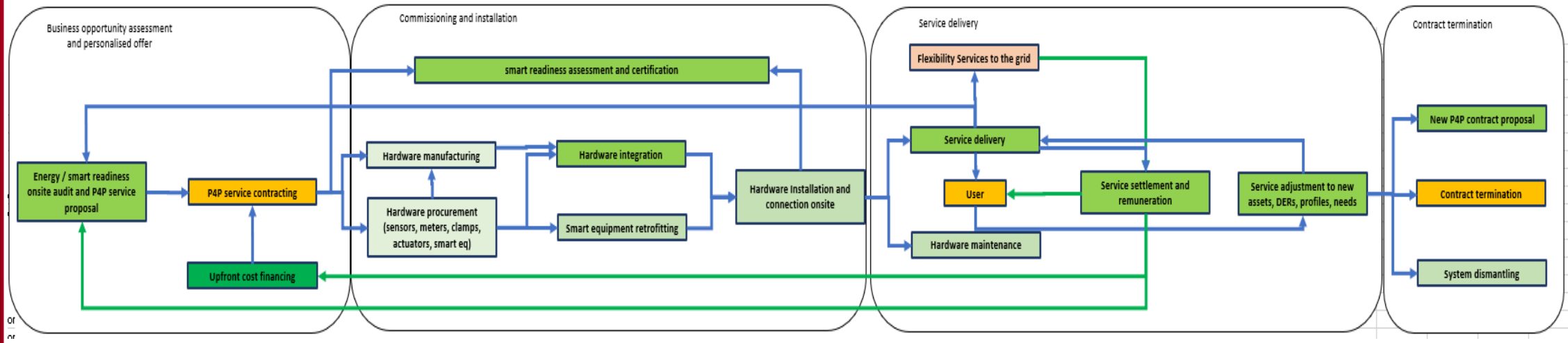
Aggregator

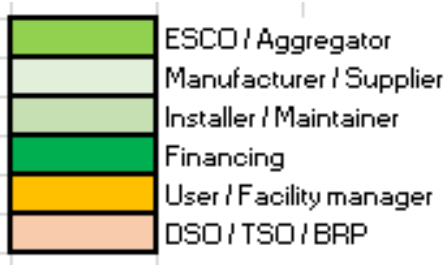
- SP5: Energy monitoring and demand flexibility pack

ESCO/ Aggregator

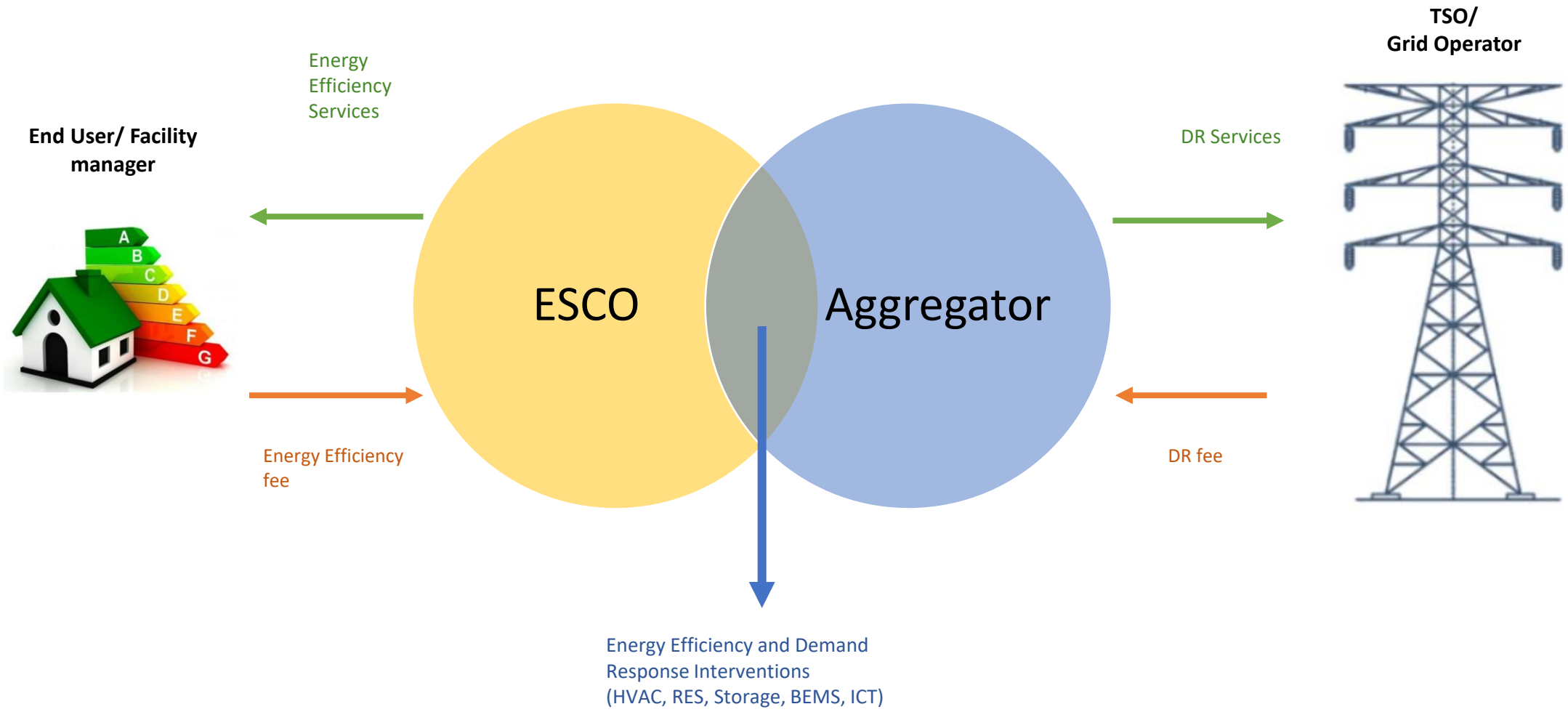
- SP6: Energy monitoring, energy efficiency and demand flexibility pack
- SP7: Energy monitoring, energy efficiency and demand flexibility for prosumers
- SP8: Non-energy service pack.
- SP9: Smart readiness assessment and certification

frESCO Service Value Chain

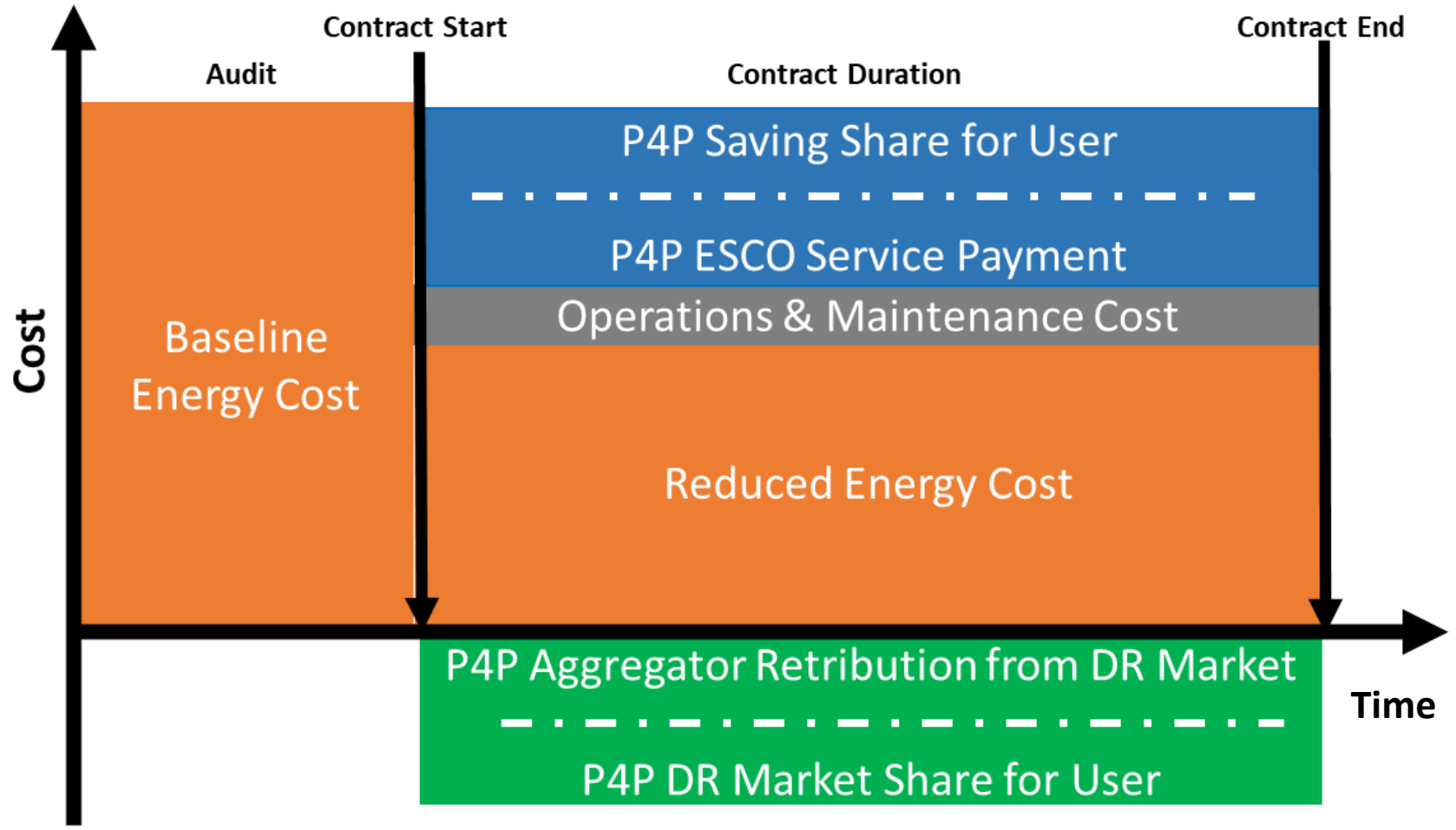




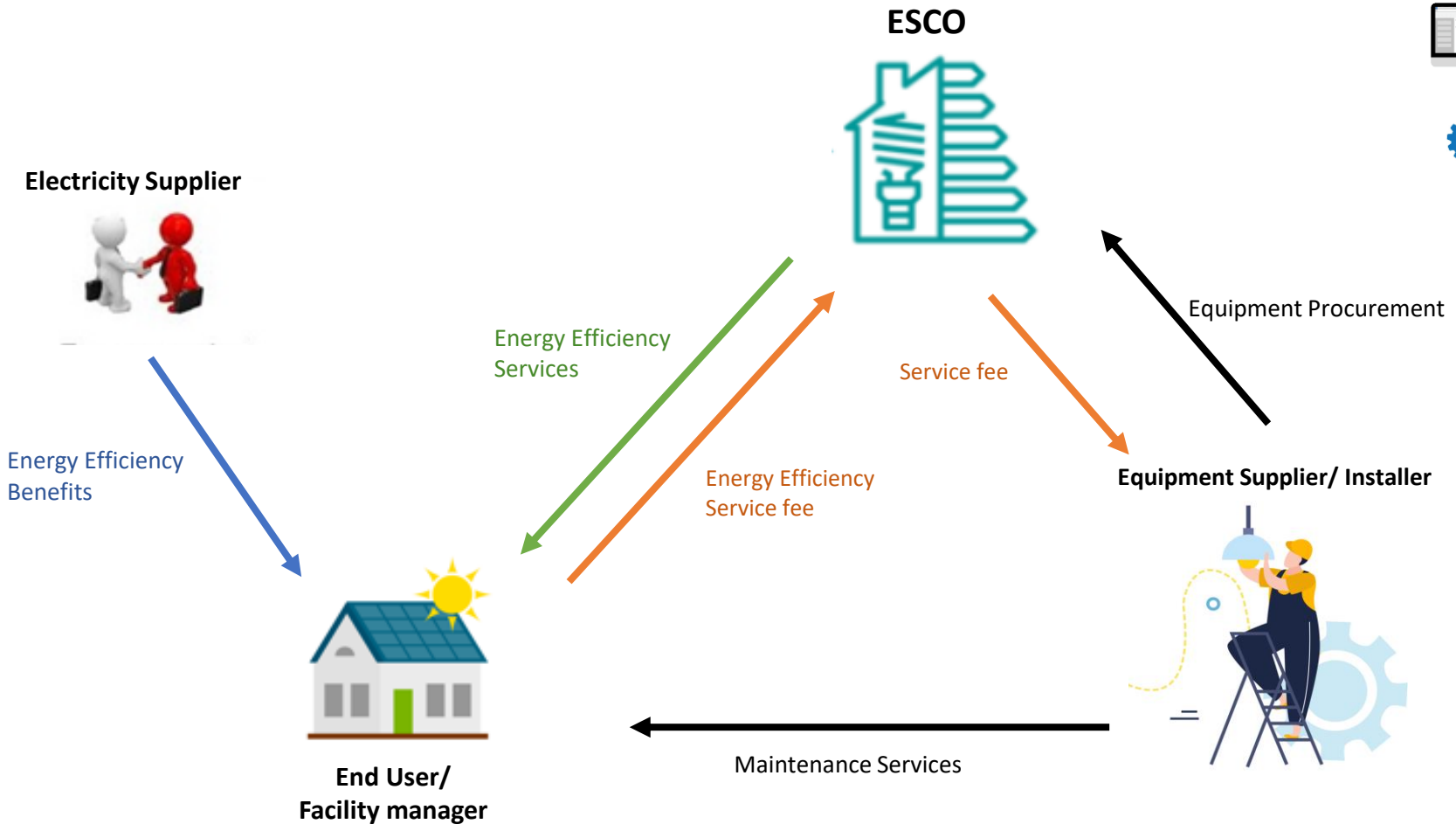
frESCO Business Model Categories



Pay-for-Performance framework proposition



The ESCO BM (1)

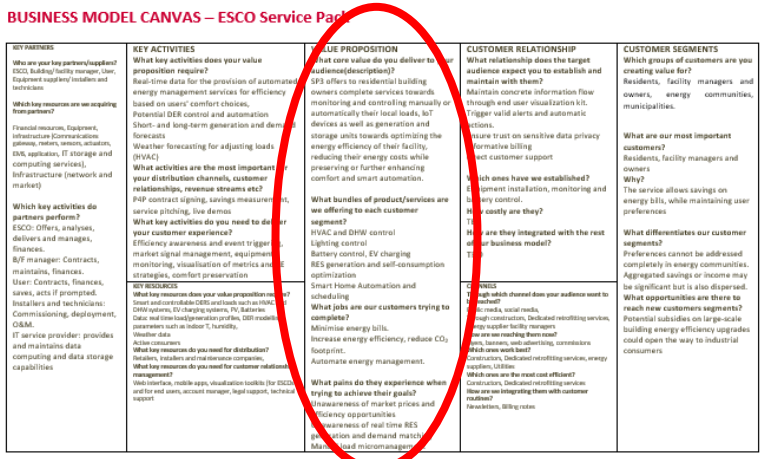


Real time PVM

Data Monitoring

Automation

The ESCO BM (2)


BUSINESS MODEL CANVAS – ESCO Service Pack

KEY PARTNERS

Who are your key partners/suppliers? ESCO, Building/ facility manager, User, Equipment suppliers/ installers and technicians

Which key resources are we acquiring from partners?

Financial resources, Equipment, Infrastructure (Communications gateway, meters, sensors, actuators, EMS, application, IT storage and computing services), Infrastructure (network and market)

Which key activities do partners perform?
ESCO: Offers, analyses, delivers and manages, finances.
B/F manager: Contracts, maintains, finances.
User: Contracts, finances, saves, acts if prompted.
Installers and technicians: Commissioning, deployment, O&M.
IT service provider: provides and maintains data computing and data storage capabilities

KEY ACTIVITIES

What key activities does your value proposition require?
Real-time data for the provision of automated energy management services for efficiency based on users' comfort choices,
Potential DER control and automation
Short- and long-term generation and demand forecasts
Weather forecasting for adjusting loads (HVAC)

What activities are the most important for your distribution channels, customer relationships, revenue streams etc?
P4P contract signing, savings measurement, service pitching, live demos

What key activities do you need to deliver your customer experience?
Efficiency awareness and event triggering, market signal management, equipment monitoring, visualisation of metrics and RE strategies, comfort preservation

KEY RESOURCES

What key resources does your value proposition require?
Smart and controllable DERS and loads such as HVAC, DHW systems, EV charging systems, PV, Batteries
Data: real time load/generation profiles, DER models parameters such as indoor T, humidity,
Weather data
Active consumers

What key resources do you need for distribution?
Retailers, installers and maintenance companies,

What key resources do you need for customer relationship management?
Web interface, mobile apps, visualization toolkits (for ESCO and for end users, account manager, legal support, technical support

VALUE PROPOSITION

What core value do you deliver to your audience(description)?
SP3 offers to residential building owners complete services towards monitoring and controlling manually or automatically their local loads, IoT devices as well as generation and storage units towards optimizing the energy efficiency of their facility, reducing their energy costs while preserving or further enhancing comfort and smart automation.

What bundles of product/services are we offering to each customer segment?
HVAC and DHW control
Lighting control
Battery control, EV charging
RES generation and self-consumption optimization
Smart Home Automation and scheduling

What jobs are our customers trying to complete?
Minimise energy bills.
Increase energy efficiency, reduce CO_2 footprint.
Automate energy management.

What pains do they experience when trying to achieve their goals?
Unawareness of market prices and efficiency opportunities
Unawareness of real time RES generation and demand matching
Manual load micromanagement

CUSTOMER RELATIONSHIP

What relationship does the target audience expect you to establish and maintain with them?
Maintain concrete information flow through end user visualization kit.
Trigger valid alerts and automatic actions.
Ensure trust on sensitive data privacy
Informative billing
Direct customer support

Which ones have we established?
Equipment installation, monitoring and battery control.

How costly are they?
TBD

How are they integrated with the rest of our business model?
TBD

CHANNELS

Through which channel does your audience want to be reached?
Public media, social media,
through constructors, Dedicated retrofitting services, energy supplier facility managers

How are we reaching them now?
Flyers, banners, web advertising, commissions

Which ones work best?
Constructors, Dedicated retrofitting services, energy suppliers, Utilities

Which ones are the most cost efficient?
Constructors, Dedicated retrofitting services

How are we integrating them with customer routines?
Newsletters, Billing notes

CUSTOMER SEGMENTS

Which groups of customers are you creating value for?
Residents, facility managers and owners, energy communities, municipalities.

What are our most important customers?
Residents, facility managers and owners
Why?
The service allows savings on energy bills, while maintaining user preferences

What differentiates our customer segments?
Preferences cannot be addressed completely in energy communities. Aggregated savings or income may be significant but is also dispersed.
What opportunities are there to reach new customers segments?
Potential subsidies on large-scale building energy efficiency upgrades could open the way to industrial consumers

Value Proposition

Core Value

- Complete services towards monitoring and controlling manually or automatically local loads IoT devices as well as generation and storage units
- Optimization of energy efficiency of the facility,
- Reducing energy cost
- Preserving or further enhancing comfort and smart automation

Pains Experienced

- Unawareness of market prices and efficiency opportunities
- Unawareness of real time RES generation and demand matching
- Manual load micromanagement

Services

- HVAC and DHW control
- Lighting control
- Battery control, EV charging
- RES generation and self-consumption optimization
- Smart Home Automation and scheduling

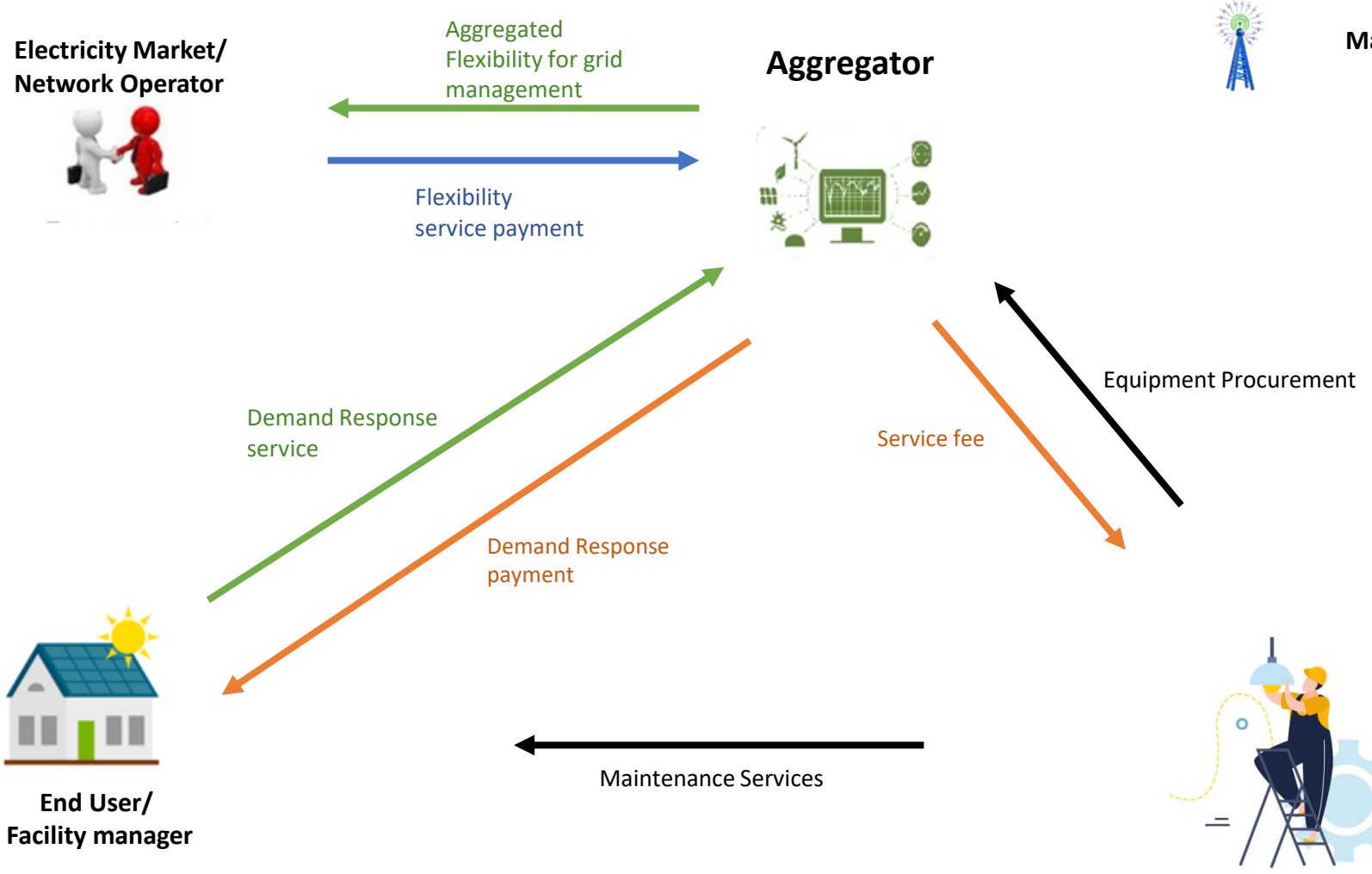
Jobs to complete

- Minimise energy bills
- Increase energy efficiency, reduce CO_2 footprint
- Automate energy management

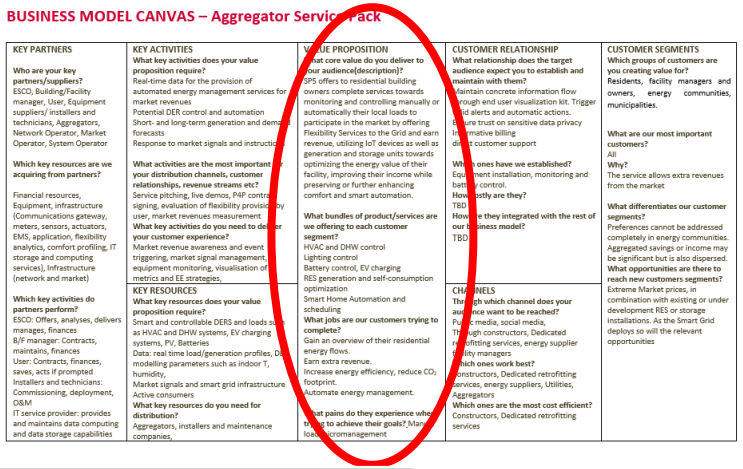
The ESCO BM Value Proposition Canvas

PRODUCTS/SERVICES	GAIN CREATORS		GAINS	CUSTOMER JOBS
Explicit and implicit energy management services based on user comfort choices. Real time condition monitoring and optimal scheduling of loads. Optimisation of RES production. Weather forecast integration. Demand and generation forecast. Alerts/ suggestions. Price signal integration.	Load control according to price signals. • Energy savings obtained from user behavioural change • Energy Savings obtained from automatic operation of loads • Economic savings by price-based optimal scheduling Energy savings while keeping the same level of comfort Optimisation of RES production and consumption	frESCo	Energy savings by reducing eventually the energy consumption, implicitly or explicitly Economic savings by price-based optimal scheduling Increased savings from optimal self-consumption management	Energy bills are one of the major concerns of dwellers. The market is open to incorporate technology to make energy savings. However, not all users are willing to lose control of their decisions and mistrust new technology. Many want to keep the control of their decisions or, at least, be informed of automated events and be able to override them at will.
	PAIN RELIEVERS		**PAINS**	
	Minor disturbance in terms of time Option to delete Partial control option SA incentives P4P contract		Onsite domestic access Data sharing Partial or total automated control over loads or DER There have to be significant loads (EV, storage, DWH etc for the savings to have an impact There has to be a minimum	

The Aggregator BM (1)



The Aggregator BM (2)


BUSINESS MODEL CANVAS – Aggregator Service Pack

KEY PARTNERS	KEY ACTIVITIES	VALUE PROPOSITION	CUSTOMER RELATIONSHIP	CUSTOMER SEGMENTS
Who are your key partners/suppliers? ESCO, Building/Facility manager, User, Equipment suppliers/ installers and technicians, Aggregators, Network Operator, Market Operator, System Operator **Which key resources are we acquiring from partners?** Financial resources, Equipment, infrastructure (Communications gateway, meters, sensors, actuators, EMS, application, flexibility analytics, comfort profiling, IT storage and computing services), Infrastructure (network and market) **Which key activities do partners perform?** ESCO: Offers, analyses, delivers manages, finances B/F manager: Contracts, maintains, finances User: Contracts, finances, saves, acts if prompted Installers and technicians: Commissioning, deployment, O&M IT service provider: provides and maintains data computing and data storage capabilities	**What key activities does your value proposition require?** Real-time data for the provision of automated energy management services for market revenues Potential DER control and automation Short- and long-term generation and demand forecasts Response to market signals and instructions **What activities are the most important for your distribution channels, customer relationships, revenue streams etc?** Service pitching, live demos, P4P contract signing, evaluation of flexibility provision by user, market revenues measurement **What key activities do you need to deliver your customer experience?** Market revenue awareness and event triggering, market signal management, equipment monitoring, visualisation of metrics and EE strategies, **KEY RESOURCES** **What key resources does your value proposition require?** Smart and controllable DERS and loads such as HVAC and DHW systems, EV charging systems, PV, Batteries Data: real time load/generation profiles, DER modelling parameters such as indoor T, humidity, Market signals and smart grid infrastructure Active consumers **What key resources do you need for distribution?** Aggregators, installers and maintenance companies,	**What core value do you deliver to your audience(description)?** SPS offers to residential building owners complete services towards monitoring and controlling manually or automatically their local loads to participate in the market by offering Flexibility Services to the Grid and earn revenue, utilizing IoT devices as well as generation and storage units towards optimizing the energy value of their facility, improving their income while preserving or further enhancing comfort and smart automation. **What bundles of product/services are we offering to each customer segment?** HVAC and DHW control Lighting control Battery control, EV charging RES generation and self-consumption optimization Smart Home Automation and scheduling **What jobs are our customers trying to complete?** Gain an overview of their residential energy flows. Earn extra revenue. Increase energy efficiency, reduce CO_2 footprint. Automate energy management. **What pains do they experience when trying to achieve their goals?** Manual load micromanagement	**What relationship does the target audience expect you to establish and maintain with them?** Maintain concrete information flow through end user visualization kit. Trigger valid alerts and automatic actions. Ensure trust on sensitive data privacy Informative billing direct customer support **Which ones have we established?** Equipment installation, monitoring and battery control. **How costly are they?** TBD **How are they integrated with the rest of our business model?** TBD **CHANNELS** **Through which channel does your audience want to be reached?** Public media, social media, Through constructors, Dedicated retrofitting services, energy supplier utility managers **Which ones work best?** Constructors, Dedicated retrofitting services, energy suppliers, Utilities, Aggregators **Which ones are the most cost efficient?** Constructors, Dedicated retrofitting services	**Which groups of customers are you creating value for?** **Residents, facility managers and owners, energy communities, municipalities.** **What are our most important customers?** All **Why?** The service allows extra revenues from the market **What differentiates our customer segments?** Preferences cannot be addressed completely in energy communities. Aggregated savings or income may be significant but is also dispersed. **What opportunities are there to reach new customers segments?** Extreme Market prices, in combination with existing or under development RES or storage installations. As the Smart Grid deploys so will the relevant opportunities

Value Proposition

Core Value

- Complete services towards monitoring and controlling manually or automatically local loads to participate in the market by offering Flexibility Services to the Grid and earn revenue
- Utilizing IoT devices as well as generation and storage units towards optimizing the energy value of the facility
- Improving income while preserving or further enhancing comfort and smart automation

Pains Experienced

- Load micromanagement
- Non-access to flexibility markets without an aggregator
- Unawareness of market prices and flexibility opportunities
- Unawareness of real time RES generation and demand matching

Services

- HVAC and DHW control
- Lighting control
- Battery control, EV charging
- VPP configuration tool
- Blockchain-enabled smart contracting
- Smart Home Automation and scheduling

Jobs to complete

- Gain an overview of residential energy flows.
- Earn extra revenue
- Increase energy efficiency, reduce CO_2 footprint.
- Automate energy management
- Value added services to grid operators for congestion and balance management, and grid optimal sizing

The Aggregator BM Value Proposition Canvas

PRODUCTS/SERVICES

Automated energy management services based on user comfort choices

Real time condition monitoring and adjusting of loads

Use of RES generation and storage as a source of flexibility

Weather forecast integration

Blockchain-enabled smart contracts

VPP configuration

Adjust of loads and production (via storage) to meet Flexib. demands

GAIN CREATORS

Load control according to price signals.

- Revenue obtained from user behavioural change
- Revenue obtained from automatic operation of loads
- Economic savings by price-based optimal scheduling and responsiveness

PAIN RELIEVERS

Minor disturbance in terms of time

Option to delete

Partial control option

Market incentives

P4P contract

GAINS

Revenue by providing FL services to the network operator, implicitly or explicitly

Economic savings by price-based optimal scheduling

Increased revenues from optimal market participation and allocation of DER production

PAINS

Onsite domestic access

Data sharing

Partial or total automated control over loads or DER

There have to be significant loads (EV, storage, DHW etc for the FL services to have an impact

There has to be a minimum smart readiness level

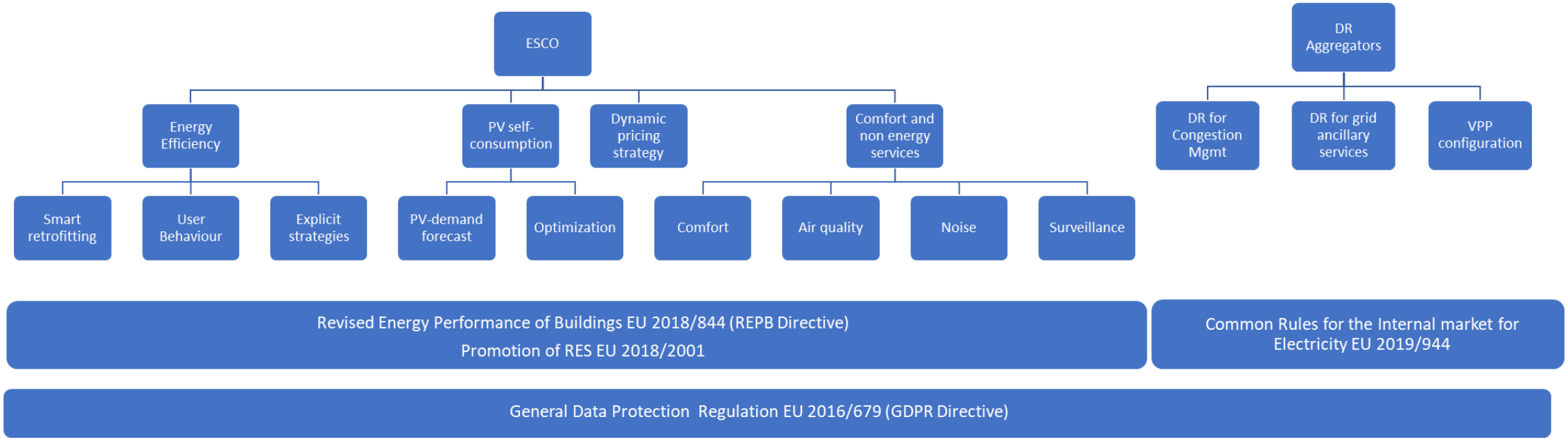
CUSTOMER JOBS

The market is open to incorporate technology to make energy savings but also energy revenues as well. However, not all users are willing to lose control of their decisions and mistrust new technology. Many want to keep the control of their decisions or, at least, be informed of automated events and be able to override them at will.

frESCO testing pilot sites

- Thassos island (Greece): green hotel bungalows with PV generation and storage
- Krk Island (Croatia): single-family residential buildings
- Gironde (France): Social housing single family residential buildings
- Madrid (Spain): Block of apartments residential building with collective PV

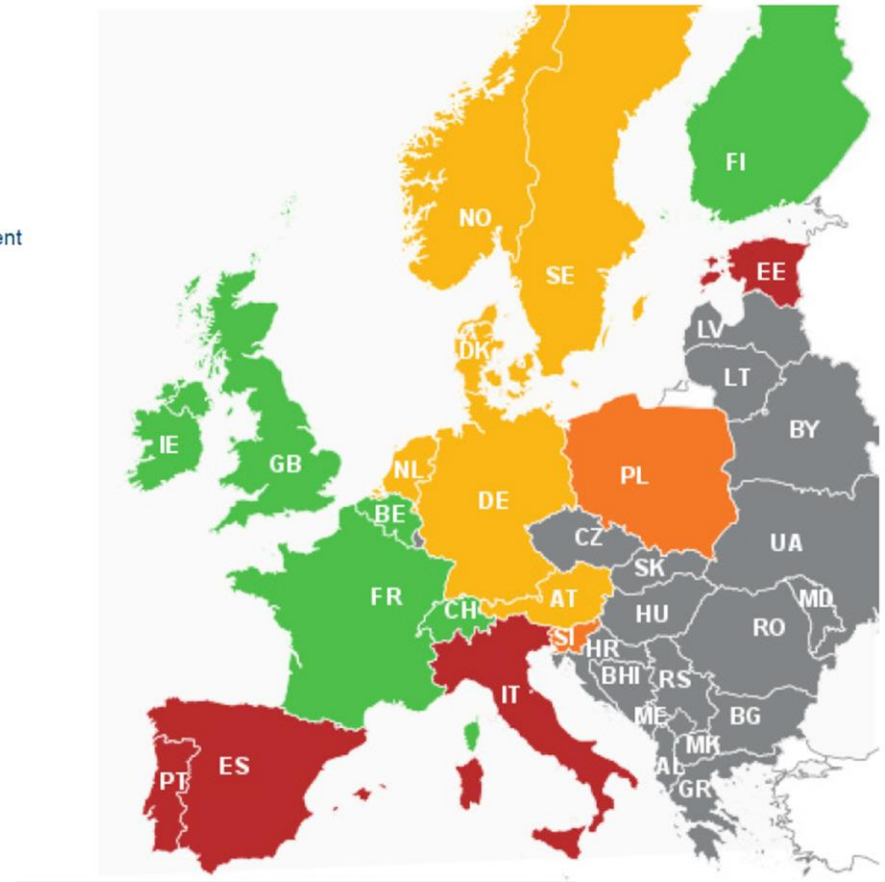
frESCO Regulatory Barriers



frESCO Regulatory Barriers

Explicit Demand Response market situation in Europe. Source: SEDC 2017

Markets are still closed for aggregated DR in Spain, Greece and Croatia, but they are already open and operating in France, with limitations



frESCO Regulatory Framework: Barriers & Enablers

- ✓ Low cost of silicon-based PV and new favourable self-consumption regulations enable a fast and likely burst of this technology.
- ✓ Revised Technical Building Regulation sets mandatory minimum RES contribution for new buildings.
- ✓ National regulation of EP in buildings rely on increasing use of RES, self-consumption and the participation of domestic users in energy markets.
- ✓ Default regulated domestic retail tariffs move towards ToU tariffs enabling Dynamic Pricing strategies.

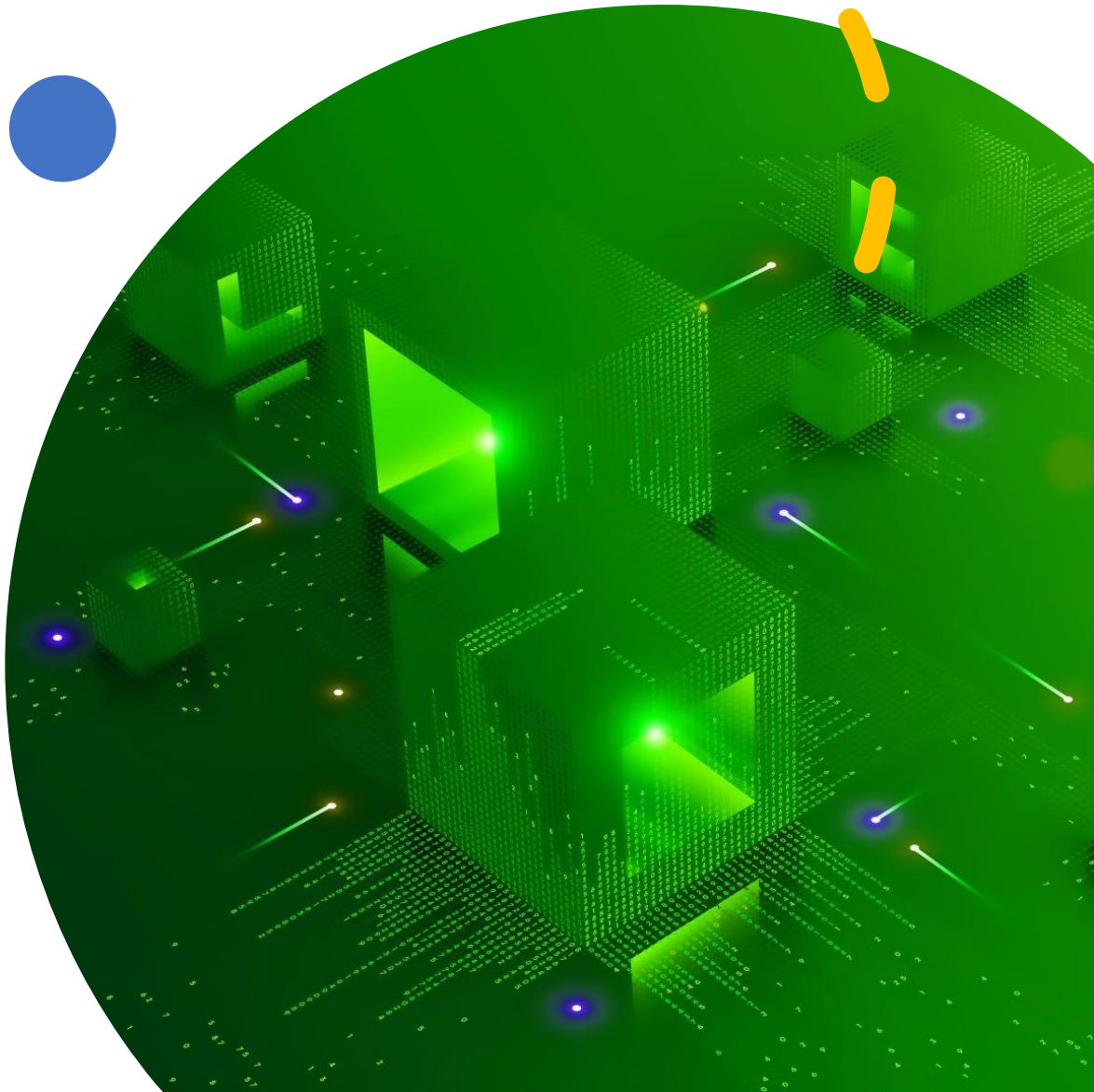
- x Demand Response aggregation is not yet permitted in many national energy markets and constrained in others.
- x Delays in REPB directive transposition in many countries and the downturn of the construction sector in Europe slows down the nZEB policy expansion.
- x The lack of a complete smart meter network and the difficulty to obtain real-time metering hinder the data-driven solutions
- x Lack of proven, flexible PMV methods.
- x Consumer mistrust to share data and allow the deployment of explicit DER control strategies.
- x Low level of M2M communication standardization to incorporate legacy systems.

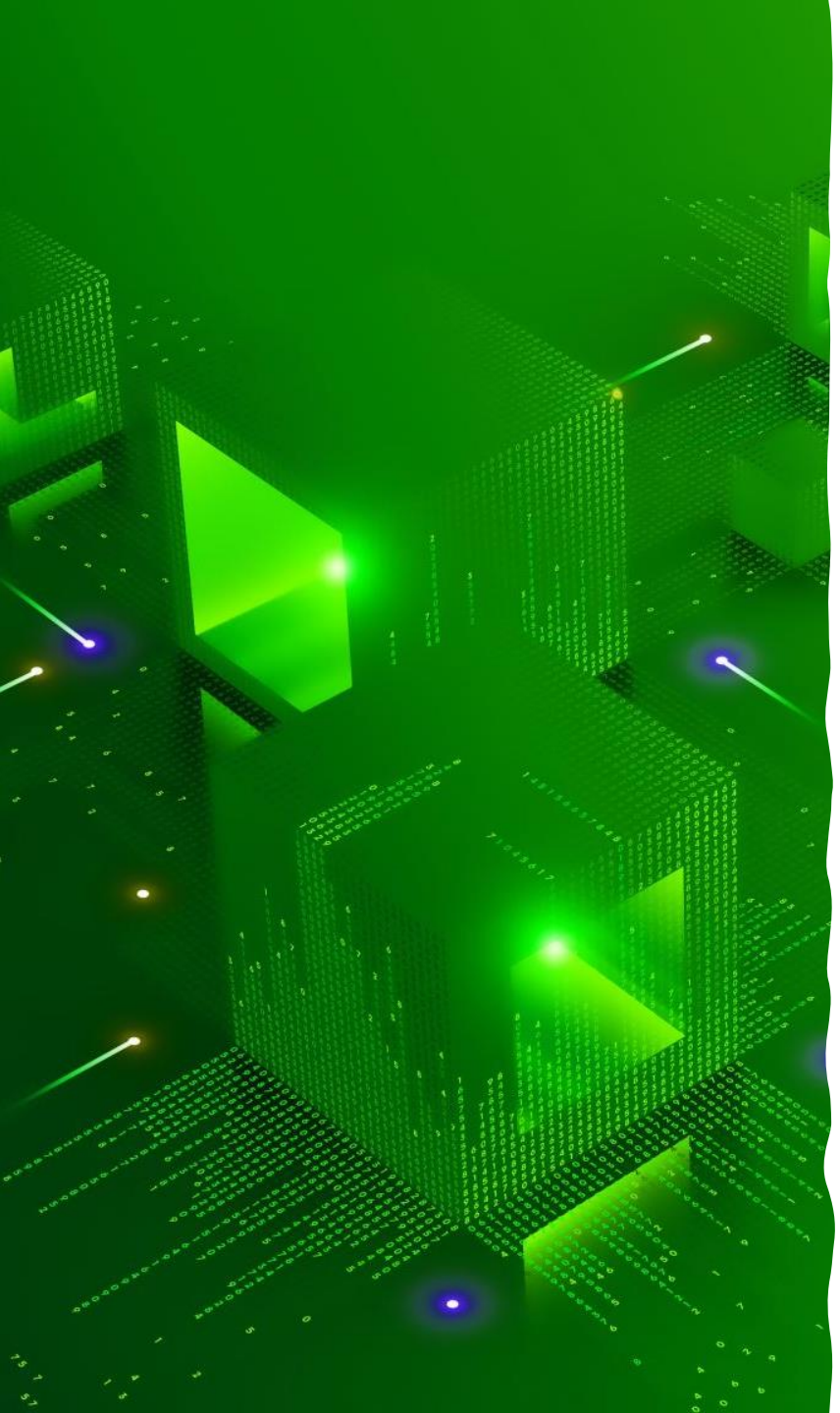
frESCO Regulatory Framework: How frESCO contributes to barrier mitigation?

- ✓ The frESCO hybrid energy services that combine a twofold revenue stream (savings and DR market remuneration) help reduce the usually long ESCO payback times in the residential sector.
- ✓ The Optimal VPP configuration and aggregation services enable to meet easily and reliably the minimum bid amounts to participate in DR markets by residential consumers. (France: 1 MW minimum bid)
- ✓ Data anonymization and encryption techniques ensure data privacy and security.
- ✓ The specific frESCO PMV protocols and methodology, based on short term dynamic forecast and baselining based on continuous data collection, enable a fair, transparent, accurate and trustful performance measurement for the P4P contract approach.
- ✓ The varied frESCO living labs ensure a smooth and precise testing of the solutions in different type of buildings, users, countries, climates and technologies.

Lessons Learnt

- **Low smart readiness of many residential buildings** and high gas dependency limit the opportunities of smart energy services nowadays in the residential sector.
- **Data interoperability** is a great handicap to integrate different data sources in the residential sector.
- There is a **high reluctancy to explicit demand response** and explicit efficiency strategies through automated control by residents.
- **Not** all dwellings present **favourable business cases** for the new smart services. They are affected by consumption profiles and the existence of flexibility and self-consumption assets.
- **Implicit efficiency strategies are highly dependent on the users behaviour** and reactions to recommendations. A parallel educating effort addressed to end users is key for the success of the new generation of smart services.





Conclusions

- Big data and AI are proven technologies that open a world of possibilities for the development and implementation of innovative energy services in the domestic sector
- The residential sector has a huge but still unexplored energy performance potential for ESCOs and P4P contracts is the tool.
- The combination of Energy Efficiency and Demand Response based on data usage improve the economic feasibility of the EPC and reduce investment payback time.
- P4P contracts and the new PMV methodologies enable a fair, trustful, transparent and accurate settlement of savings and revenues.
- Regulatory framework is moving towards barrier abatement, market opening and use of data for new service models.

https://www.fresco-project.eu/

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