

Promising business models for emerging energy applications (smart heat, electric vehicles, energy storage)

13th October 2016

Agenda

- **Workplan**
- **Smart heating**
- **Electricity storage**
- **Electric vehicle**
- **Conclusions**

CREARA developed an extended database of successful and emerging smart heating, electricity storage and electric vehicle business models



Description of tasks

- **Identification of BMs for long-list covering the following technologies:**
 - Smart heating
 - Electricity storage
 - Electric vehicle
- **Characterization of BMs**
- **Research**
 - Internal CREARA knowledge
 - Secondary sources: reports, corporate websites, etc.

- **Evaluation of the key aspects of BMs to determine their potential replicability**
- **Classification of BMs in terms of:**
 - Financial attractiveness
 - Innovation
 - Replicability
 - Scalability
 - Etc.

- **Global findings**
 - Main trends
 - Most common applications
 - Main technologies, etc.
- **Identification of main barriers and potential solutions to facilitate the implementation of BMs**



- **Today's presentation:**
 - Global findings
 - Barriers
 - Solutions
 - Main trends

Scope

193 BMs

15 BMs

Key:

BM = Business Model

Source: CREARA Proposal

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The large diversity of available heating technologies generates a wide range of market barriers which can be overcome by simplifying the market and growing awareness on this technology

	Barrier	Solution	Global Impact
REGULATORY	1 Lack of regulation in smart heating : Lack of regulatory knowledge in smart heating systems	• Building trust on smart heating systems: Assemble independent, statistically valid, hard data on the costs and benefits of smart heating systems	✓ ✓
	2 Building requirements: Higher requirements might reduce the potential for savings in HVAC ¹ systems	• Reward R&D² : Further R&D in the development and design of energy efficient buildings	✓ ✓ ✓
MARKET	3 Uncertainty and misinformation: Consumers may decide not to invest in these technologies due to lack of awareness on their capabilities	• Accurate information: Increase information and knowledge about existing technological options and their capabilities	✓ ✓ ✓
	4 Small scale suppliers: Production levels have not reached a sufficiently high volume of the market in order to gain economies of scale	• Improve economies of scale: Work on deploying the small scale renewable heating and cooling technologies, where the largest potential lies	✓ ✓
	5 No supply chain coordination: The complexity of the technology and the market makes it difficult/costly to drive and coordinate innovative BMs	• Encourage supply chain coordination: Involve manufacturers, installers, and district network operators to align their efforts to penetrate heating market	✓ ✓ ✓
	6 Split incentives: Those responsible for paying energy bills (tenants) are not the same entity as those making the investment in new efficient heating systems (the landlord or building owner)	• Establish new BMs: Allow building owners to recover the costs for investments in efficient heating systems from their tenants (i.e. PACE ³ financing model)	✓ ✓
ECONOMICAL	7 High initial cost: Smart heating systems have higher costs than conventional alternatives	• Attractive financing programs: Implement attractive financing programs and rebates to replace less efficient technology	✓ ✓

Relative global impact valuation: ✓ Little impact ✓✓ Impact ✓✓✓ High impact

Note: ¹ Heating, Ventilation and Air Conditioning; ² Research and Development; ³ Property Assessed Clean Energy
 Source: CREARA Analysis

Innovation in the heating market is not focusing on technologies (already mature) but on empowering clients to extract greater savings through ICT-based BMs

Findings

- **Active players in the Smart heating market:**
 - Traditional manufactures (OEMs) such as Daikin or Dimplex
 - Integrators such as utilities and engineering companies
 - ICT specialists offer monitoring and control systems only
- **Most BMs offer complete heating solutions that include implementation, monitoring and control, financing and energy supply services**
- **Most innovative BMs are found in US and UK, although there are large international companies (such as Daikin) that offer their BMs worldwide**
- **Heating and cooling market is very complex and involves many stakeholders, as a consequence there are a wide variety of barriers (regulatory, market, technological and economical)**
- **Even though not all barriers are regulatory, the majority can be overcome by regulatory incentives promoting financing programs and increasing the information in a local and national scale**

Trends

- **Companies with extensive experience in heating and cooling systems are centering their attention on developing monitoring and control tools (online platforms, smartphone apps, etc.) in order to manage remotely the heating system and facilitate the reduction of heating and energy costs to clients**
 - E.g. NEURA, Lennox, Rheem, Fifthplay, Ecobee etc.
- **Most companies offering monitoring services are starting to add automatic control services, eg.**
 - Set temperature depending on presence
 - Adjust consumption to off-peak periods in order to save money
 - Turn off the heat when it is not needed
 - Send alerts to the client regarding their consumption, etc.
- **Some technologies are still to integrate monitoring and control to enable clients to increase savings**
 - E.g. air-sourced heat pump, ground-source heat-pumps, hybrid heat systems

Source: CREARA Analysis

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The main identified barriers are regulatory because of the immaturity of the electricity storage market. In this sense, changes including an international standardization to build trust on this technology should be implemented

	Barrier	Solution	Global Impact
REGULATORY	1 Battery recycling standards and regulation: Due to its toxic components, batteries need to be properly collected and recycled	<ul style="list-style-type: none"> International battery recycling standards and regulations: Establish international standards and protocols for battery's recycling 	✓ ✓
	2 Discrepancies across markets: The heterogeneity of the ES ¹ market regulation adds a level of complexity for developers who want to deploy storage system resources across multiple markets	<ul style="list-style-type: none"> Increase homogeneity of regulation across markets: Power system entities should work together to simplify and better align market and policy requirements 	✓ ✓ ✓
	3 Double fees: Energy storage providers must pay double TNUoS ² and DUoS ³ charges as they act as both generators and consumers	<ul style="list-style-type: none"> Decreased fees: Apply lower network fees for storage that better reflect the complementary benefits of energy storage 	✓ ✓ ✓
	4 Functional classification limitations: Owners of ES assets are not fully able to earn revenue from its various applications due to regulatory restrictions	<ul style="list-style-type: none"> New functional classifications: Enable new BMs to emerge by economically rewarding ES services to the grid 	✓ ✓
ECONOMICAL	5 Risk and uncertainty: Uncertainty has a great impact on investments, which might hinder the deployment of storage systems due to the potential risks	<ul style="list-style-type: none"> International regulation: Find a common ground in regulation to avoid political changes and encourage specific financial solutions for heading against investment risks (regulatory and tax changes) 	✓ ✓
TECHNICAL	6 High technology costs: Storage technology costs are high compared to conventional power sources	<ul style="list-style-type: none"> Reward R&D: Continued research into energy storage technologies to reduce costs 	✓ ✓ ✓

Relative global impact valuation: ✓ Little impact ✓✓ Impact ✓✓✓ High impact

Note: ¹ Electricity Storage; ² Transmission Network Use of Systems; ³ Distribution Use of Systems
 Source: CREARA Analysis

The ES market has developed strongly in countries with favorable regulation, allowing companies to provide BMs with greater benefits for their clients

Findings

- **Active players in the electricity storage market:**
 - Fully integrated energy solutions with ES (Green Charge or Solar City)
 - Battery manufacturers (Tesla or Stem)
- **Most BMs offer implementation of electricity storage solutions together with a financing plan and monitoring software, but few of them offer control features or maintenance to the customer**
- **BMs were principally found in the US, and Germany, taking advantage of favorable regulation policies and incentives such as tax rebates, retrofits and shared savings agreements**
- **Regulatory barriers have the highest impact due to differences across markets and double fees applied to electricity storage systems because of its double performance as generators and consumers**

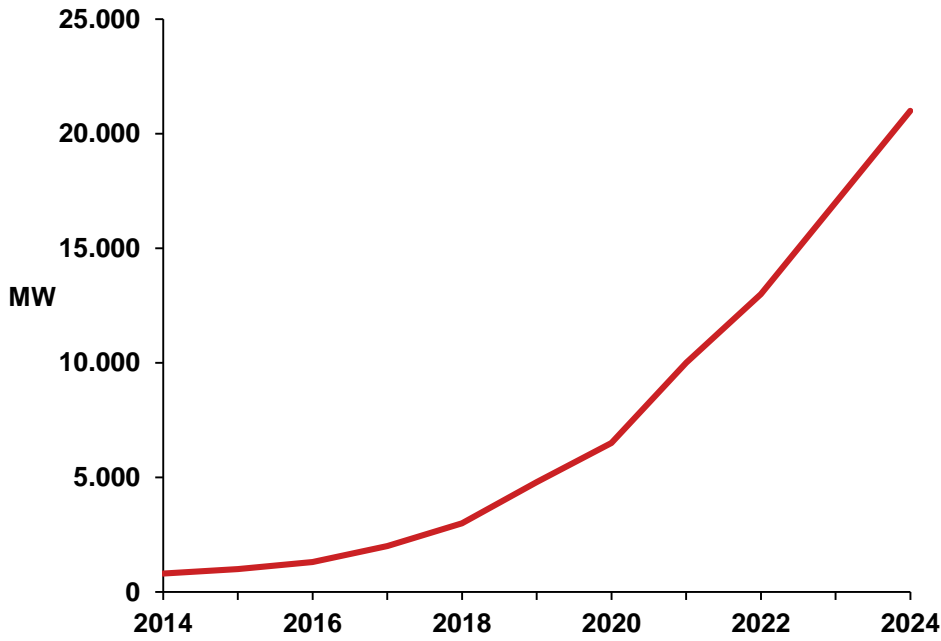
Trends

- **Many new companies are entering electricity storage markets worldwide, to provide a one-stop solution for storage systems (including monitoring and management software) in order to optimize energy consumption and lower electricity bills of final consumers**
 - E.g. Tesla, Ice-Energy, Orison, etc.
- **Many business models are focusing on RES integration, where storage systems are combined with PV installations in households and industrial facilities. Several benefits can be highlighted from this trend:**
 - Load shifting from low demand hours to peaks
 - Optimization of renewables resources, counteracting supply fluctuations
 - Extra reduction of utility bills
 - Providing ancillary services to the grid
 - Possibility of becoming a net-zero installation
- **Another important trend is the emergence of so called community installations, where distributed storage systems are connected and controlled in a unified manner. This offers several benefits such as:**
 - Serving as a robust, fast-responding and flexible alternative to generation
 - Storing low priced energy and using that energy when the price is high
 - Providing most types of ancillary services that are needed to keep the electrical grid stable and reliable

Source: CREARA Analysis

Although the analyzed BMs are focused on behind-the-meter ES, there is also a growing market in utility-sided BMs. In particular, Germany is an example of an early adopter for these solutions due to its favorable regulatory framework

Expected grid-scale ES global power capacity evolution



- Utility-scale energy storage is expected to continue breaking into the mainstream electricity industry in 2016
- Mechanical technologies, such as pumped hydro, compressed air, and flywheels, continue to dominate the market for ES
 - However, the emergence of advanced battery chemistries, including flow batteries are expected to gain about 70% of share in grid-scale ES by 2024
- The market is projected to move away from R&D projects and push toward full commercial deployments
 - As it is still an emerging market there are no defined BMs further than trials and particular projects
- Frequency regulation is the targeted primary applications, but there are also a market opportunities for secondary applications such as: RES integration, peak shifting, black start, off-grid systems, etc.
- With a current total of around 120 MW power and 180 MWh energy capacity, the German market sends a clear signal to investors that battery storage provides a value-creation opportunity in the regulated market for ancillary services
- The Swedish utility Vatenfall and the American solar provider SolarCity are examples of companies pushing for the deployment of grid-scale ES systems in order to make it commercially feasible and attractive

Source: Clean Technica; Energy Storage for the Grid and Ancillary Services by Navigant; CREARA Analysis

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The majority of the identified barriers are related to the technology itself due to the lack of an international standardization and regulation, which will foster the coordination between the different stakeholders

	Barrier	Solution	Global Impact
TECHNICAL	1 Electric vehicle's long charging times: EV's ¹ batteries take long times for fully charging (typically 6-8 hours for a full charge)	<ul style="list-style-type: none"> Fast battery charging systems: Investigate in order to improve the batteries charge time and charging methods 	✓ ✓ ✓
SOCIAL	2 Uncertainty and lack of information: People are unfamiliar with electric vehicles, uncertain about their costs and benefits, and have diverse needs that current electric vehicles might not meet	<ul style="list-style-type: none"> High quality information: Provide high quality information about EVs to reduce the information gaps and encourage customers to purchase 	✓ ✓ ✓
	3 Small driving range: The concern that an EV's driving range will not be enough for the needs of the driver could be a psychological barrier that damages the customer purchase decision	<ul style="list-style-type: none"> Compensate for lack of autonomy : Deploy extensive plug-in vehicle charging network or offer the possibility to swap their EV for a ICE² vehicle for a limited number of days every year (Nissan) 	✓ ✓
ECONOMICAL	4 Electric vehicle's high cost: The electric car is very expensive and the user prefers to buy a diesel or gasoline car that is much cheaper than the EV	<ul style="list-style-type: none"> Economic benefits: Car-sharing BMs and the creation of financial plans and incentives for EVs that encourage customer purchasing decision 	✓ ✓
REGULATORY	5 Operational of charging stations: Lack of unified charging solutions (connectors types and charging vs. battery replacement)	<ul style="list-style-type: none"> Regulatory framework for charging stations: Establish impartial regulatory framework in which charging networks are regulated by a third party 	✓ ✓ ✓
	6 Need for a charging infrastructure: EV users have difficulties in finding public charging stations	<ul style="list-style-type: none"> Local government regulation: Government should promote the creation of local charging networks and a free access database with information about all the available charging stations in the city 	✓ ✓ ✓

Relative global impact valuation: ✓ Little impact ✓✓ Impact ✓✓✓ High impact

Note: ¹ Electric Vehicle; ² Internal Combustion Engine
 Source: CREARA Analysis

The expansion of EV sharing projects, combined with BMs that offer guarantees and finance services, are contributing to accelerate the evolution of this technology

Findings

- **Active players in the electricity vehicle market:**
 - Traditional vehicle manufacturers (Renault, Nissan, Citroen)
 - Offering both EVs and ICEs
 - Offering innovative solutions specially designed for a transition from ICEs to EVs
 - New electric vehicle manufacturers (Autolib, Next Green Car)
- **Most BMs offer implementation of EV solutions together with financing plans, energy supply, maintenance services and most of them also offer warranties for the EV's battery**
- **BMs were principally found in the US, UK, Spain and Germany, and further we have found BMs which are implemented worldwide by large international companies such as Daimler AG, Renault and Nissan**
- **Apart of the classical barriers related to EV, like battery capacity, high cost and driving range, the most important barrier is the lack of regulation about the management of charging stations**

Trends

- **Initiatives like Car2Go, Autolib and CityScoot offer BMs based on EV sharing, that improves urban mobility through a non-carbon based technology. Battery management and lifetime will be particularly important for the evolution of these kind of BMs. The common characteristics of these BM are:**
 - Service provider has to develop a public station charging network
 - Providers offer implementation, financing and maintenance of the service whereas the client pays a fixed rate for it
 - There are always an interaction between the service and the customer through web services or mobile apps
- **Important vehicle manufacturers like Renault, Volkswagen and Citroen have incorporated EV into their portfolios. These companies are offering the following advantages in order to differentiate from competitors:**
 - Different financing options: down-payment, leasing with variable monthly rate, renting, etc.
 - Battery warranties, maintenance and road assistance services
 - Freedom to charge the vehicle at home or at many public charging points
- **New innovative technologies are a key factor in EV business, specially all the electric battery improvements**
- **Some companies, like Nissan in Spain, are offering BMs that combine EVs with combustion vehicles giving the possibility to swap their EV for a ICE vehicle for a limited number of days every year in order to lower the barrier of autonomy**

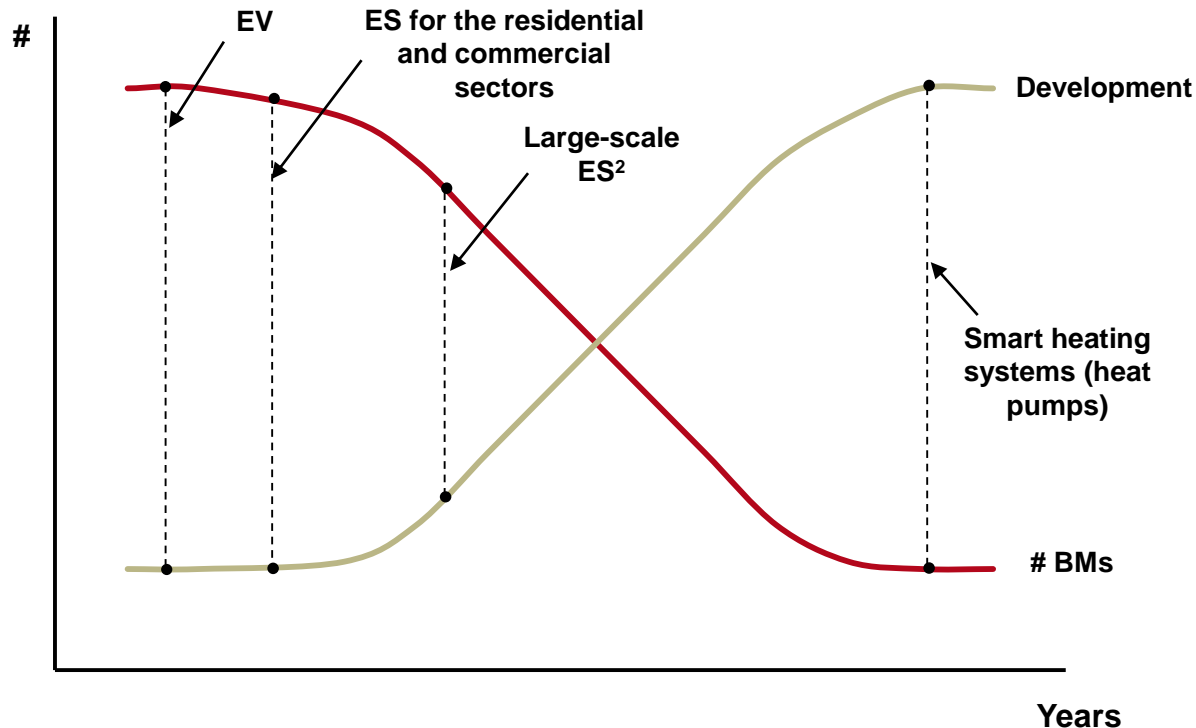
Source: CREARA Analysis

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The technological advances, mainly led by the ICT¹ sector, are opening new business opportunities and challenges for the companies to enhance their obsolete BMs

Relation between the quantity of available BMs and technologies' development

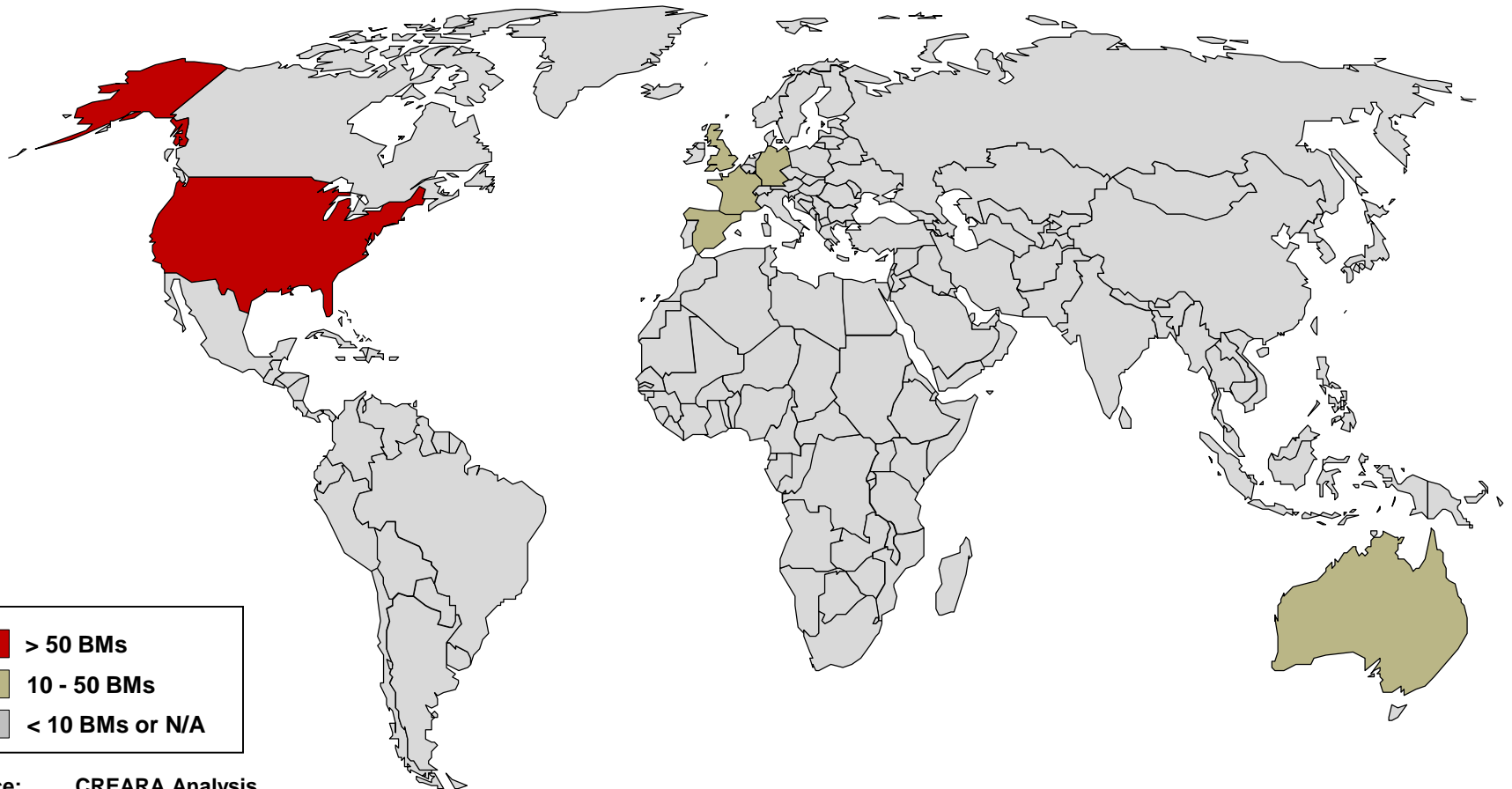


- **When a technology's market is in an initial growth phase (not mature technologies) the BMs are not yet standardized**
 - Storage and EVs present a high diversity of BMs, mainly due to the nature of these markets and the development of new innovative technologies
 - Smart heating presents a more standardized market where BMs differ from each other in terms of the innovation of the monitoring and control appliances enclosed in the smarter solution packages
- **ICT technologies are a key driver across all technologies**
- **The BMs transformation is driven mainly by:**
 - Greater connection and data exchange between devices (Internet of Things)
 - Easy access to the information from different devices (cloud computing)
 - Fast analysis of large volume of data

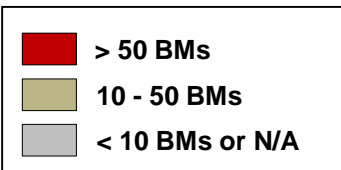
Note: ¹ Information and Communications Technologies; ² The utility-scale energy storage trend found in Germany is not included
 Source: CREARA Analysis

The US contributes the largest number of BMs to our database as a result of having the most developed regulation framework

Number of identified BMs by country



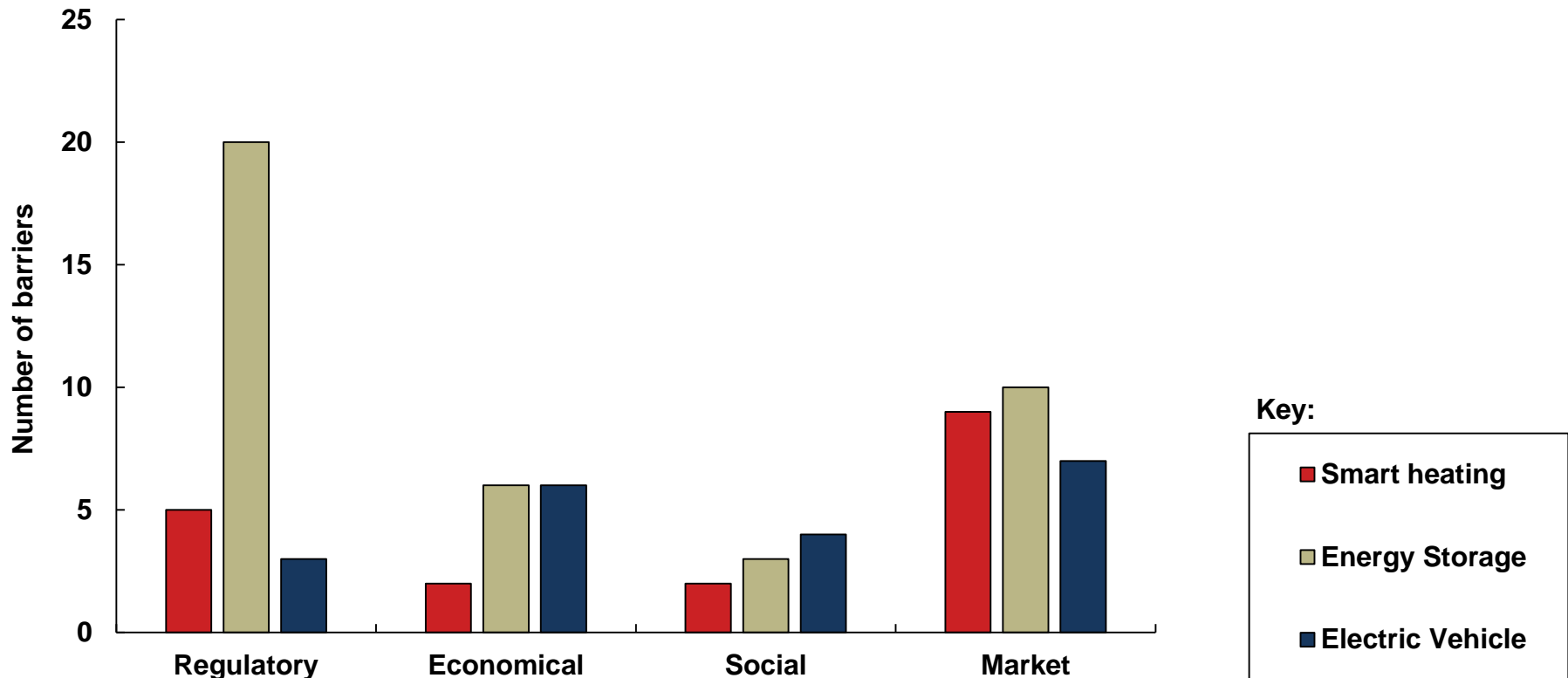
Key:



Source: CREARA Analysis

Energy storage faces the largest number of barriers mainly due to the lack of a favourable policy framework

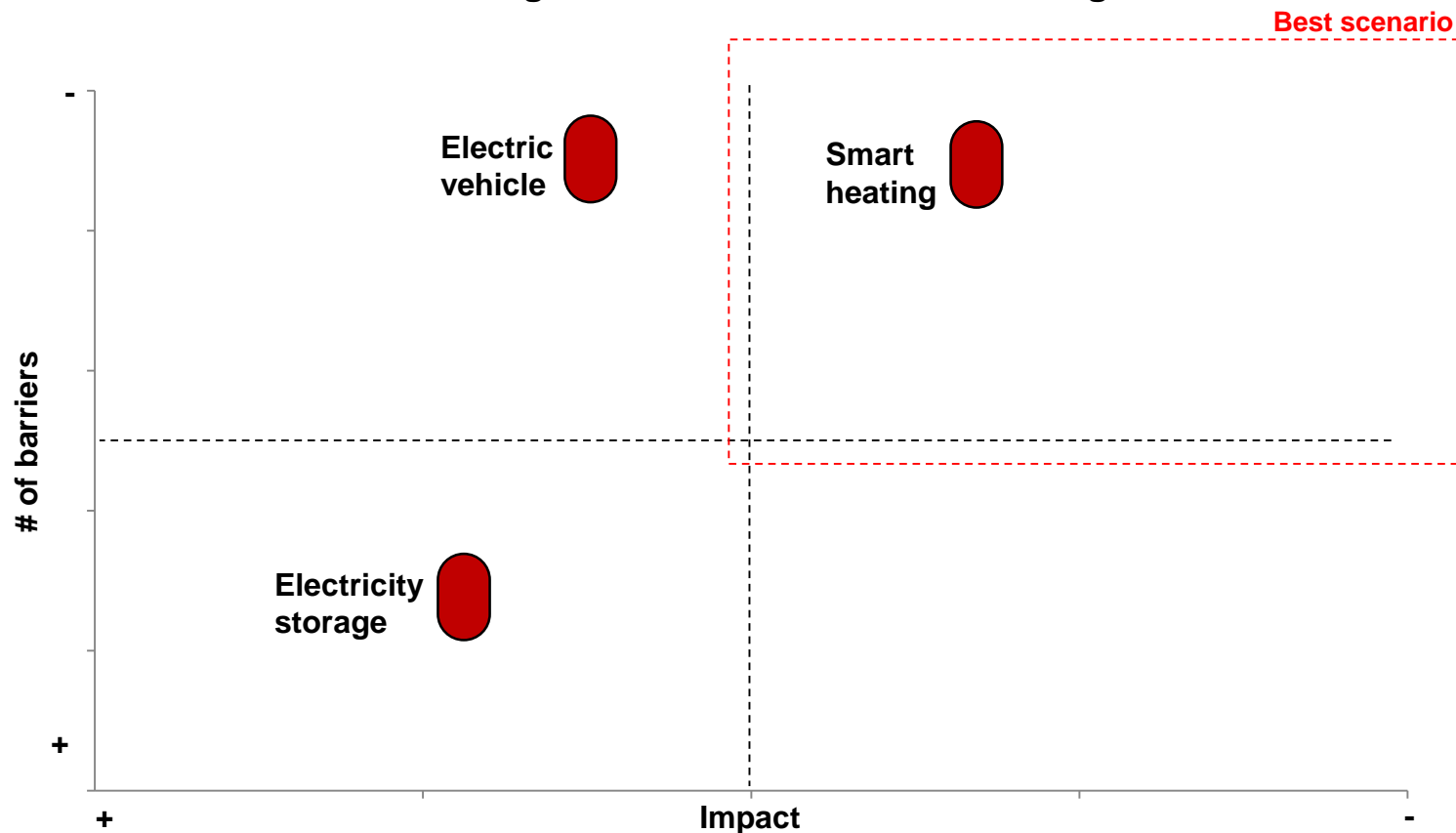
Number of identified barriers in terms of type and technology



Source: CREARA Analysis

Mature technologies like smart heating have less barriers to overcome and these have less impact to its market

Positioning Matrix of the different technologies



Source: CREARA Analysis

Companies are adding a wide variety of complementary services to their core-value proposition in an effort to offer attractive solutions to final clients

Drivers across all technologies

Distributed generation

- **An important trend of the analyzed BMs is the integration of RES systems fundamentally by the combination of these technologies with solar modules**
 - Smart heating systems are combined with solar collectors for heating and PV modules principally for electricity (for heating is also possible)
 - The option to combine electricity storage with renewable generation has helped the development of storage systems specially in the residential and the commercial sectors (industrial scale is expected to grown in countries with favorable regulation)

ICT

- **Companies are focusing their core-value proposition on providing one-stop solutions, including monitoring and control tools to make their BMs more attractive**
 - In the case of EV, companies are developing online platforms to facilitate the access to information (e.g. in the case of car sharing making easier the payment through a mobile app or information of the charging infrastructures)

Selling solutions not products

- **Some of the companies lower the barrier of implementing the products or services due to the need of large investments by offering financial services to the client**
 - For example: Leasing, renting, subsidies, etc.
- **The business models that were analyzed show a trend to solutions that enable clients to adapt them to their specific needs which helps companies to differentiate from competitors**
 - All models aim to provide a service that allows decreasing energy costs of the final client/ consumer which can be considered a major concern for any consumer
 - The product and service provider normally offers continuing support and maintenance, this permits them to build long-term relationships with the client (greater loyalty) and protect margins for future sells
 - From a demand point of view it helps to focus on core competences (business)

Source: CREARA Analysis



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