



October 2017



## The Internet of Energy

### *Enabling Residential Demand Management*

#### 102GW of Residential Demand Flexibility to be Delivered by a Collaborative IoE Ecosystem by 2025

The "perfect storm" of the energy transition is well underway. Traditional centralized power generation is being replaced by distributed generation, electric vehicles, residential battery systems, and home energy management systems to create decentralized energy systems.

IDC forecasts that penetration of photovoltaics alone will increase by 25% in terms of installed capacity, while penetration of electric vehicles will triple in the next five years in Europe. IDC also expects the price of combined solar and energy storage systems for the residential sector to decline by 45%.

Given this, homes will have a strong and more *active* role to play in realizing the decentralized energy paradigm. Active homes are an aggregated unit that interact with the utility grid as a single entity, with an energy management system that manages the home's electrical services, including installed Internet of Energy (IoE) technologies, and interfaces with the grid. By integrating IoE technologies, active homes have the potential to support demand-side flexibility and back up capacity.

From a single technology perspective, the IoE has everything it needs to flourish. This IDC White Paper showcases how IoE technology uptake will only reach its potential if industry players can collaborate effectively to eliminate a series of hurdles for customers, and how it is the IoE ecosystem's responsibility to enable an attractive "active home" platform that third-party stakeholders want to leverage and to engage with their customers. If the IoE ecosystem unites, then the IoE will be able to deliver 102GW of residential demand-side flexibility by 2025.

The Internet of Energy (IoE) is a specialist subset of the Internet of Things. The IoE is composed of installed energy devices or appliances (typically supplied and installed by specialists) such as smart meters, solar installations, energy storage systems, and residential PEV charging infrastructure. Other IoE objects include high consumption appliances such as heating and cooling, hot water heating, and fixtures and fittings that come with a house. IoE devices or appliances will often have several users or owners during their life.

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*"The materialization of IoE is unquestionable. Timing is the variable, but we must be ready for it."*

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### *Validating with the Ecosystem*

IDC analysts conducted extensive primary field work to create this IDC White Paper. For the primary research, which was conducted between June and September 2017, IDC interviewed numerous executives from a broad spectrum of companies that are currently active in the developing IoE ecosystem. The organizations represented by the executives vary significantly, coming from businesses such as utilities, energy retailers, telco companies, white-goods manufacturers, home energy management executives, energy technology companies, IT companies, digital companies, and industry associations.

The different backgrounds of the executives, and the variety of businesses they represent, enabled IDC to gather comprehensive insight into the evolution of the IoE. The executive interviews were fundamental in supporting the validation of the IoE. Additionally, the interviewees agreed that active home platforms will need to play an important role for the IoE to materialize. While plausible alternatives to this scenario were identified by the executives, such as more than one platform representing a home's interests, or IoE devices interacting with external markets without ever being integrated under one roof, interviewees largely agreed that integration of a home's IoE devices to interact with the grid as a single entity would be the most viable scenario.

### *Introducing the Internet of Energy*

Internet of Energy technologies are energy devices and appliances installed in homes, such as solar panels, energy storage systems or batteries, energy monitoring solutions, electric vehicles, and related charging infrastructure. In addition to these newer energy technologies, objects like heating and cooling systems or hot water boilers, which are commonly found in homes today, are also considered to be IoE devices, once they have been modernized with the necessary sensors and communication modules to enable interaction with the outside energy market.

### *How Does IoE Differentiate from IoT?*

Internet of Energy technologies are a specialist subset of the Internet of Things composed of energy devices and appliances installed in homes. IoE technologies differentiate from typical consumer IoT devices by normally being supplied and installed by specialists, and usually remain within a house once the owners have moved on. Often IoE devices and appliances will have several users/owners during their life. Additionally, IoE appliance life cycles will usually be long, requiring support and upgrades throughout their lifespan.

### *How is the IoE Developing?*

From a single technology perspective, the IoE has everything it needs to flourish, from self-generation technologies for residential participation in energy systems, to sensors and communication modules to "smarten" high energy consumption appliances already deployed within homes, to an integrated communication infrastructure, to IT technologies including data analytics and cloud platforms. Internet of Energy technologies are also increasingly more competitive as related costs continue to fall.

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*"Adoption of IoE is growing significantly faster than two or three years ago."*

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*"The benefits of a holistic integrated approach to energy management at the home level are evident."*

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The executives interviewed by IDC confirmed that, after years of sluggishness, they are seeing the adoption of a wide variety of IoE technologies picking up speed and growing significantly faster than was the case two or three years ago.

Nonetheless, deployment of IoE devices and appliances is unstructured. The adoption of these technologies can be considered opportunistic, with consumers thinking: "My country is incentivizing the switch to plug-in electric vehicles, I'm due to replace my car, so I'll switch to a PEV, and this means I need to get the necessary charging infrastructure installed at my home." Little or no consideration is given as to how that vehicle and its associated infrastructure will integrate with other devices and appliances in the home.

This is especially the case with existing homes, in which large appliances (air conditioning, heating, boilers, etc.) will be gradually replaced or retrofitted one at a time. This point-to-point adoption of IoE technologies makes it difficult for the big picture of how all these devices fit together and should work toward a common goal. It should also be noted that today not even new-built homes are being designed with a common energy management system in mind.

#### *The Need for Convergence*

To unleash their full potential and allow interaction with utilities' grids, IoE technologies will need to converge onto a common energy management system within a home. Establishing a common energy management environment will be fundamental to coordinating the tasks and activities of the various and often unstructured IoE technologies being deployed within the home.

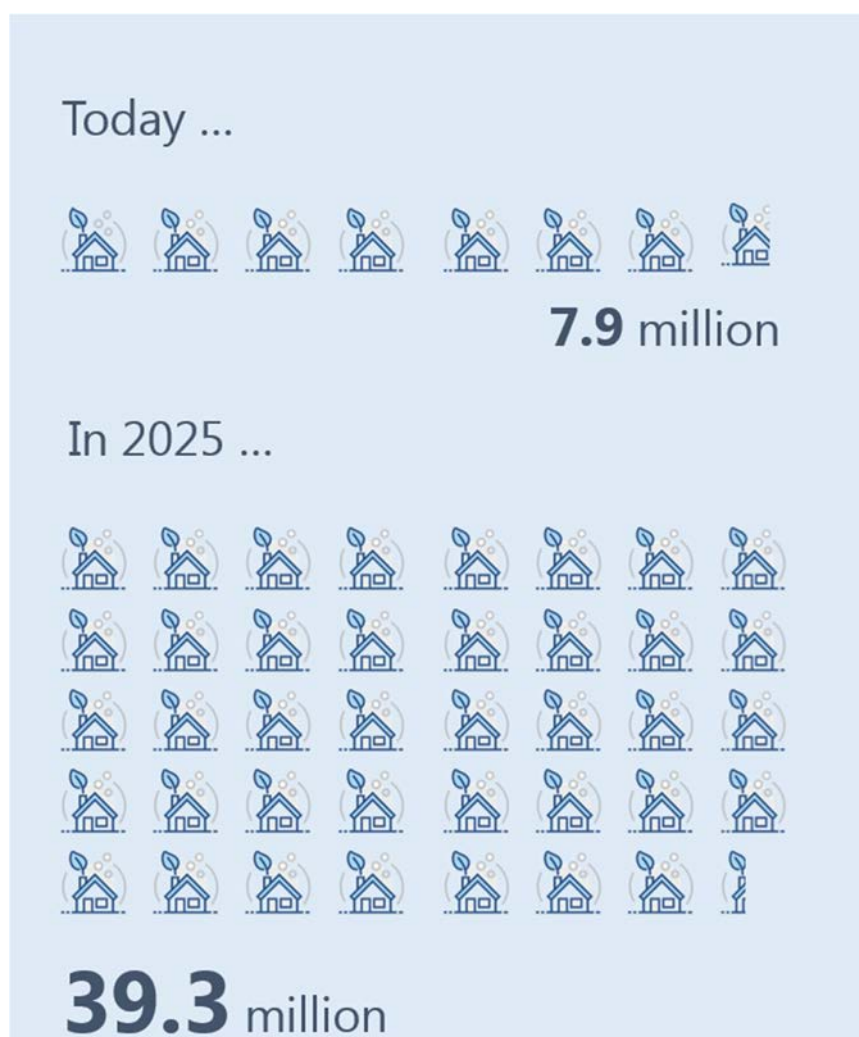
As a starting point for integration, single function home energy management solutions, such as smart thermostats, have emerged. IDC estimates there are 7.9 million homes equipped with some form of single function home energy management (HEM) solution across Europe today (see Figure 1). Uptake of such solutions is forecast to grow by 22% a year to reach close to 40 million homes by 2025, theoretically enabling them to deliver an element of demand management.

Thus far, within testing or piloting environments, HEM solutions have proved to optimize consumption within the home by 15%–20%. This clear gain for consumers could promote further uptake of IoE technologies.

Additionally, extensive piloting by energy suppliers has demonstrated the potential for HEM solutions to transform the customer relationship. Specifically, energy suppliers' net promoter scores improved significantly, increasing up to 30 points (from negative values, common across the board for utilities, to a neutral score of 0). Energy suppliers trialing HEM solutions also experience reductions in churn, in some case by over 50%.

Notably, the adoption of HEM solutions could grow 30% more than forecast if interoperability hurdles are addressed by IoE stakeholders, by collaborating through an IoE subsystem.

Figure 1  
Homes with HEM Solutions



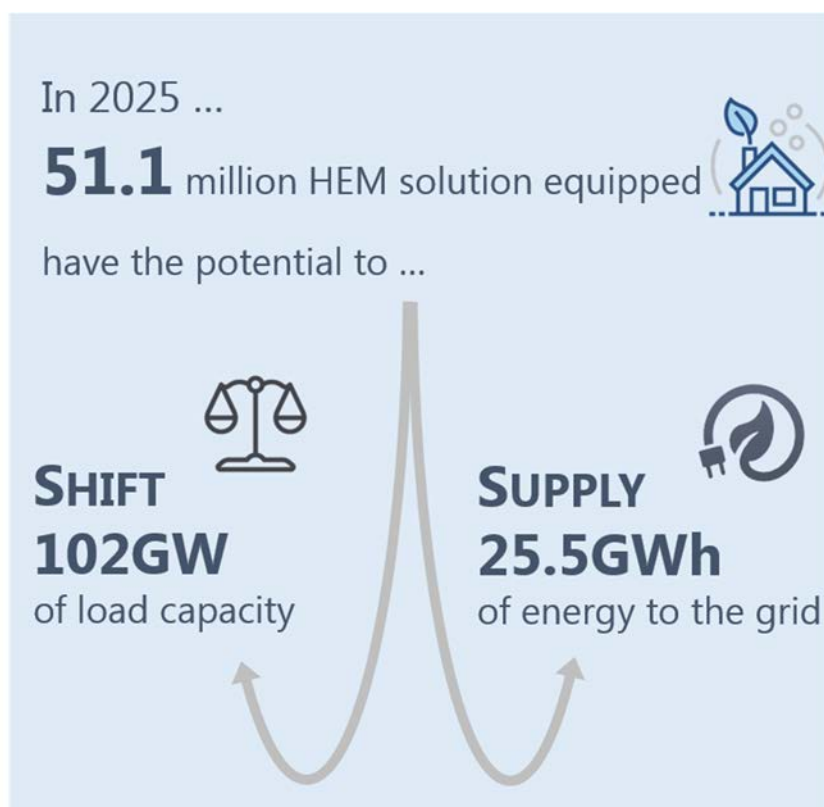
Source: IDC, 2017

### The Importance of IoE for Energy System Flexibility

As countries in developed markets retire some of their centralized baseload power generation, it is often being replaced with distributed generation. This will create a greater need for backup capacity and greater flexibility to be built into today's energy systems. The residential sector will play a major role in fulfilling these needs, by supporting greater system flexibility through demand-side response, energy storage, and distributed generation.

If interoperability hurdles are removed by IoE stakeholders, driving up HEM solution adoption by 30% more than originally forecast (reaching 51.1 million homes across Europe), then 102GW of load capacity could be shifted, creating the potential for 25.5GWh of energy to be supplied back into the grid (see Figure 2).

Figure 2  
Residential Demand Flexibility Potential



Note: Based on the assumption that on average each HEM solution equipped home could shift 2KW of load and supply 0.5KWh of energy back to the grid.

Source: geo estimates based on IDC estimates of HEM solution equipped homes.

### *The Key to Flexibility*

There is consensus among the interviewed IoE stakeholders that a prerequisite for flexibility on the demand side is for the consumers and prosumers to be properly rewarded first for their role and contribution. If consumers and prosumers fail to be sufficiently rewarded for their backup capacity contribution toward flexibility, then uptake of IoE technologies could be negatively affected.

Government-led initiatives are supporting the adoption of IoE technologies, from incentivizing the installation of solar panels, to seemingly getting serious in backing up the future success of electric mobility, to supporting demand response programs. Despite these positive steps in the right direction, it is simply not enough.

Scattered and standalone incentives for photovoltaics and EVs will not unleash the full potential of IoE technologies. Governments need to be more proactive in acknowledging the benefits of having more substantial demand-side support toward flexibility, by encouraging and incentivizing active homes. Active homes

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*"End users have a critical enabling role, so their interests must be contemplated and addressed first."*

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*"There need to be acceptable rewarding mechanisms in place for consumers contributing to flexibility markets."*

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should receive the same attention that EVs are receiving, as active homes can help address charging-related issues created by the deployment of EVs.

#### *What About Consumers and Prosumers?*

At the heart of every home are the people that live within the confines of its walls. Consumers and prosumers' willingness to invest in solar panels, electric vehicles, or sensors to "smarten" their heat pumps, which will unleash the IoE, needs to be incentivized with clear financial gains for homeowners or homebuilders. In addition to being financially appealing, there will also be a need for IoE technologies to be appealing on a human level, for instance by providing improved standards of living.

To be convinced that their interests are being served, it makes sense that holistic integration and management of IoE devices and appliances occur within the home first. A "first dibs" mentality prevails — once the needs of my household are met, then the needs of the wider ecosystem can be catered to. Additionally, such integration can also deliver noticeable improvements in living standards, which will be particularly attractive for consumers. This "all-under-one-roof" approach is believed to be most easily understood and accepted by consumers and prosumers, and is hence most likely to succeed.

Furthermore, while it is possible for each IoE device within a home to interact directly with the outside world, the benefits of a holistic approach to energy management at the home level are evident. The IoE executives IDC interviewed agree that holistic integration of IoE technologies within a home, giving rise to active homes, is the optimal way for clear benefits to emerge and be measured for consumers. Specifically, most consumers would prefer to receive a consolidated payment to reward them for all their shifted load capacity or energy supplied back to the grid, instead of receiving piecemeal paybacks.

Active homes will deliver greater value to consumers while positively contributing, rather than challenging, the resilience of the entire electricity system. In fact, active homes hold the key to demand-side flexibility and decentralized energy systems.

IoE executives firmly believe that "active homes" does not translate into active participation from consumers and prosumers. In fact, for large-scale participation from the mass market to occur, consumers and prosumers' role should be limited to selecting their preferred IoE device and simply "plugging it into" the active home. Consumers and prosumers must not be burdened, and everything should be fully automated. This means that the inherent complexities behind configuration and upgrades, integration of devices with different operating systems, communication, data collection, cleaning and analysis, for example, must have all been previously sorted out and harmonized by the numerous IoE ecosystem players — another reason why integration is so vital.



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*"The active home, as a single aggregated entity, is easily understandable and acceptable for the mass market."*

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*"For large-scale participation, inherent complexities must be masked to the mass market: it must be as simple as plug and play."*

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*"The greatest challenge to IoE is not the technology, which already exists today, but a lack of collaboration among players."*

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## The Need for Active Home Platforms

As mentioned, IoE technologies can communicate and interact directly outside the home, independent of one another. However, the integration of isolated solutions and the creation of active homes would deliver much greater value to homeowners — and enable them to play a far more critical part in demand-side flexibility.

Active home platforms will fulfill a need for holistic coordination of a home's IoE technologies. Homes with more than one independent system responding to external market signals, such as time of usage signals, will run into signal validation issues and, potentially, financial settlement issues. Having a single entity responding to external market signals, in the form of an active home platform, will eliminate a series of complications created by having multiple competing systems within a home.

The interviewed IoE executives agree that in the long run, harmonization of IoE devices within the confines of the home will be the most effective way to create value for consumers, and consequently for the entire IoE ecosystem.

### *What is Holding Back Active Home Platforms?*

For mass market participation to occur, an active home platform will have to hide all the complications (integration, communication, data management, etc.) for consumers.

To converge onto an active home platform, IoE technologies will need to share common, specialist data structures and security measures. However, there is a lack of collaboration and alignment among IoE ecosystem participants that is leading to a plethora of interoperability complications around communication and data management. It is up to the IoE ecosystem players to roll up their sleeves, eliminate the integration challenges, get behind the harmonization of all technologies within the home, and unleash the potential of active homes.

This will be difficult, as active home platforms will need to reconcile the numerous data management protocols and communication standards that currently exist in the myriad IoE devices being deployed today and that will be deployed in the future. Active home platforms will also need to process all the information being received from the numerous connected devices in order to optimize their performance for the benefit of the household. Simultaneously, the active home platform is tasked with managing "relationships" with external third parties such as neighbors, local businesses, local power aggregators, community energy players, and local municipalities and utilities. And of course, all this must be done in real time.

Essentially, for IoE deployment to scale quickly, it is imperative that ecosystem players get behind an active home platform — but this is no more than what the internet itself has achieved.

The technology already exists today to effectively enable active home platforms, with the cloud playing a major role, along with data integration, management, and analytics, and the necessary communication infrastructure. Technology is not holding IoE back, and it is the lack of collaboration among ecosystem players that

poses the greatest challenge and threat. This is beginning to be addressed by IoE frontrunners.

### The IoE Ecosystem

The IoE ecosystem is unfolding, revealing new participants on a daily basis. IoE ecosystem players include white-goods manufacturers, technology companies, utilities, telcos and communication service providers, entertainment and over-the-top content providers, insurance companies, and property market developers. This is a very promising sign as it indicates that the value of the IoE is being recognized.

#### *Introducing geo*

One of the companies that realized the value of the IoE early on, and is actively promoting collaboration among the various IoE stakeholders, is geo (Green Energy Options). geo was the recipient of the U.K.'s 2017 Queen's Award for Enterprise: Innovation, specifically for its Solo in-home energy monitor. To date, geo has specialized in three specific areas or markets: smart metering, solar monitoring, and smart heating. geo provides an end-to-end "under-one-roof" home package that includes not only some IoE devices but also the platform, cloud services, data analytics, aggregator, and consumer interfaces.

geo is actively developing its brand of an active home — Hybrid Home — focused on converging its three existing product areas into a connected system, developing a battery energy storage system designed to fit standardized battery cells that can be bought from a range of suppliers, and developing an integrated home/building energy management system that will interface with aggregator services and manage the active home.

geo is busy spreading its knowledge of the IoE to foster much-needed collaboration among industry players and help the ecosystem as a whole mature.

### The Benefits of IoE for the Ecosystem

The buzz of interest in the IoE ecosystem might also be its greatest challenge, as there is a lack of clarity about who will do what, with players uncertain of which role or game they want to play. Most IoE players are focused on carving out a space for themselves in this transforming space, and are almost exclusively driven by a need to succeed in the short term, selling more of their own product and grasping any revenue stream they can get their hands on.

However, across the board there is a lack of real understanding about the potential gains, both in the short and long term. Companies of all types continue to dip their toes into various areas of IoE, and are busy in a "trial and error" phase for new products and value-added services. They expect to continue these activities over the next two years, after which they hope to have more insight into what products, value-added services, and business models work best for them and which ones they should pursue in the long run.

All the companies interviewed by IDC that are active in the IoE indicated they have yet to actually quantify any concrete benefits they aim to achieve, for themselves or their customers. On top of the hard benefits of new revenue streams, they also aim to tap into the soft benefits. For instance, several companies indicated that they are

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*"It is the ecosystem's responsibility to enable an attractive active home platform bringing together everything customers want."*

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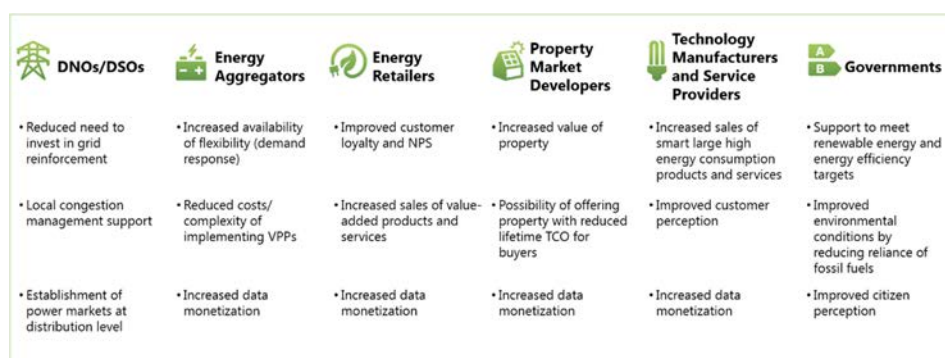
exploring what value-added services they can offer for free to improve their customers' perception of their company, improving their customers' loyalty and helping to reduce churn.

Notably, there are a growing number of consumers that are investing in EVs and solar panels with home batteries and which are opting to join community energy systems that promise some level of integration. This is a threat to the IoE industry, which is running out of time to cautiously trial and test. The first-mover advantage may differentiate future IoE leaders.

The IoE presents a myriad of opportunities for companies and organizations that finally move beyond the trial and test phases. There will be rewards for first movers and future IoE leaders. As the IoE ecosystem evolves, new participants that do not even exist today are expected to emerge. The major benefits for some of the key stakeholders in the IoE ecosystem are highlighted in the figure below.

For instance, IDC forecasts that the home automation use case of IoT (specifically hardware, software, services, and connectivity) could be worth almost \$10 billion by 2020, growing over the next three years at a CAGR of more than 35%. The IoT market (specifically hardware, software, services, and connectivity) for smart large appliances is expected to grow more than 50% between now and 2020, reaching \$3.2 billion.

**Figure 3**  
Major Benefits of Key Stakeholders in the IoE Ecosystem



Source: IDC, 2017

### Key Takeaways

The findings of the study show that the Internet of Energy could deliver very significant benefits, but its success depends on its ecosystem of participants, including governments, eliminating a series of hurdles related to regulation, imbalanced incentives, and integration (devices, data, communication, etc.). If key IoE stakeholders fail to address these challenges to create a unified and coordinated front, consumers and prosumers, the fundamental enablers of IoE, will struggle to understand what is in it for them, and consequently the adoption of IoE technologies and the rise of active homes will suffer.

If the ecosystem succeeds by collaborating through an IoE subsystem, then the IoE will be able to deliver 102GW of residential demand-side flexibility by 2025. To unleash this potential, IoE stakeholders should consider the following key takeaways:

- **Converge around the active home platform.** The IoE ecosystem is unfolding and stakeholders are overall still unsure which role they want to play. Consolidation is already underway, but further consolidation is expected. According to IoE executives we interviewed, few key stakeholders are needed, each with clear roles and responsibilities. It is widely believed that consolidation will occur around the providers of the active home platform. An attractive platform will be one that third-party stakeholders want to leverage to engage with their customers, and has the greatest potential to scale quickly. The advantages of open source and open standards are increasingly evident.
- **Make it worth it for consumers and prosumers.** Consumers and prosumers have no real interest in the IoE or active homes. What they are interested in is far more basic. The mass market is specifically interested in what's worth investing in. Consumers and prosumers need to be provided with a product or service offer that is simple and convenient for them. Additionally, the financial structures of the offer need to be rewarding for them, and everything should be fully automated.
- **Rationalize regulation and incentives.** Incentives and regulations need to be designed to reward flexibility and end-user buy-in, actively addressing the risks of an unbalanced energy system that limit the ability of the industry to deliver smart and flexible grids. Governments should do their part in encouraging the development of active homes — both new build and existing stock — in the same way they are incentivizing the adoption of electric vehicles.
- **Unleash the power of data.** Data monetization is considered a key benefit that the various IoE stakeholders aim to tap into. For data monetization to become a reality, all-encompassing and secure data platforms need to be created. To reap the most benefits, a data platform should be open source, so that third parties may also identify and offer additional value-added services.
- **Prioritize data protection.** Data security is always of paramount importance when handling consumer data. A key task for the active home platform provider is not only to protect its data assets and operate securely, but to get its ecosystem of IoE partners, as well as consumers and prosumers in general, to trust that they will protect their interests. This requires external audits, clear protocols in place in the event of a data breach, and transparency in communication.

## Appendix

### *Methodology*

This IDC White Paper explores the Internet of Energy, how it is developing, why the IoE is essential, what role consumers and prosumers play, why active home platforms are necessary, and the IoE ecosystem's role in unleashing its potential.

The paper demonstrates that the technological prerequisites already exist to unleash the IoE's potential, but IoE take-off is stalling due to a series of hurdles that the IoE ecosystem needs to address for customers to buy into it.

This research leverages a series of interviews conducted with executives from various types of companies that currently play in the IoE ecosystem, such as home energy management executives, utility executives, communication service provider executives, white-goods manufacturers, and industry association executives. The primary research was conducted between June and September 2017.

To protect the privacy of the companies interviewed and the interviewees themselves, the citations throughout this document have been anonymized.

## IDC UK

5th Floor, Ealing Cross,  
85 Uxbridge Road  
London  
W5 5TH, United Kingdom  
44.208.987.7100  
Twitter: @IDC  
idc-community.com  
www.idc.com

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Global Headquarters: 5 Speen Street Framingham, MA 01701  
USA P.508.872.8200  
F.508.935.4015 [www.idc.com](http://www.idc.com).

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