

# Energy Management Systems

Unlocking new levels of flexibility, customer value,  
and business opportunities

**November 2025**

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# Foreword

The energy world is at a pivotal turning point. What once seemed like a future scenario is happening now—homes and buildings are becoming active players in Europe’s energy transition. At the center of this shift lies the power of Home and Building Energy Management Systems (HEMS and BEMS), which are increasingly unlocking flexibility, savings, and resilience.

This report explores this ongoing transformation. It offers compelling insights for key stakeholders across the ecosystem, from OEMs and solution providers to energy retailers, installers, and integrators. Each player in the space has new challenges and opportunities arising at the moment as new flexible value pools surpass traditional ones.

The next chapter of Europe’s energy story is being written today.

# Executive Summary

**The EMS market is gaining traction.** Home and Building Energy Management Systems (HEMS and BEMS) are increasingly becoming a key element of Europe's energy transition. They enable passive consumers to become active market participants, driven by the convergence of regulatory mandates, electrification trends, distributed energy adoption, and digital innovation—unlocking new revenue pools far beyond traditional monetization approaches for EMS players. We see the following key insights:

- **New value pools will surpass the old:** Traditional behind-the-meter HEMS/BEMS revenues (EMS hardware, embedded software, and installation only) are maturing. The next growth engine is flexibility from the full integrated system: shifting, storing, and trading energy across devices and markets. For example in Germany,, new flexibility HEMS value pools will surpass traditional ones between 2030 and 2035.
- **Flexibility creates tangible value already today, even more so in the future:** Early use cases based on dynamic pricing can already deliver €350–450 annually in savings per single family home (approx. 20-30% of a typical bill). With bi-directional EVs and advanced trading, these savings could increase 2–3x by 2035, when flexibility will become a must-have rather than a nice-to-have for end-customer buying decisions. Reaching this value depends, among other factors, on EV and vehicle-to-grid penetration, as well as regulation (incl. further upsides in case of dynamic grid charges).
- **The battle for the customer interface is on:** OEMs and energy retailers are closing the gap, as digital disruptors push into the market with end-to-end solutions. Many are converging on EMS; some through open, multi-partner ecosystems and others as proprietary, end-to-end solution providers.
- **EMS is a critical control point:** Orchestrating devices, data, and markets defines who captures flexibility value—and who owns the customer relationship. This makes EMS a critical control point, alongside others. Owning the EMS means owning a relevant part of the interface, the data, and the customer relationship.
- **EMS-enabled flexibility unlocks value for customers and the system:** For end users, this means lower bills, greater resilience, and improved sustainability. For providers, it creates new recurring revenues and deeper customer integration. And for the energy system, it delivers reduced grid costs, improved reliability, and smarter renewable integration. It also affects sales of energy solutions; for example, positioning heat pumps as more attractive than gas boilers due to reduced electricity costs and flexible energy retail tariffs.
- **Business model innovation is taking off:** From energy-as-a-service and subscriptions to trading spreads and performance-based pricing, EMS players are evolving from hardware providers to long-term service partners. Here, full-solution providers have the advantage of offering simple and attractive pricing models directly to end customers, while an ecosystem play poses greater challenges.
- **Europe is accelerating unevenly:** Most EU countries share a similar target picture, but history shapes the status quo and trends. Germany scales PV, batteries, and heat pumps but lags in smart meters; the Nordics lead in DER integration; the UK drives pricing frameworks and incentives. Regulation is becoming an enabler, resulting in market ecosystems emerging from different use cases to reach the target picture.

**The clear message:** The tipping point is here. For EMS to truly take off, regulatory enablement (e.g., smart meter roll-out, supporting frameworks, and the removal of barriers), customer acceptance through simple business models, and technology integration are essential. Companies that move now to seize this opportunity will shape the flexibility economy; those that wait will be left behind. This is the moment to act boldly.



# Energy's Next Big Bang: Why EMS Will Redefine the Market

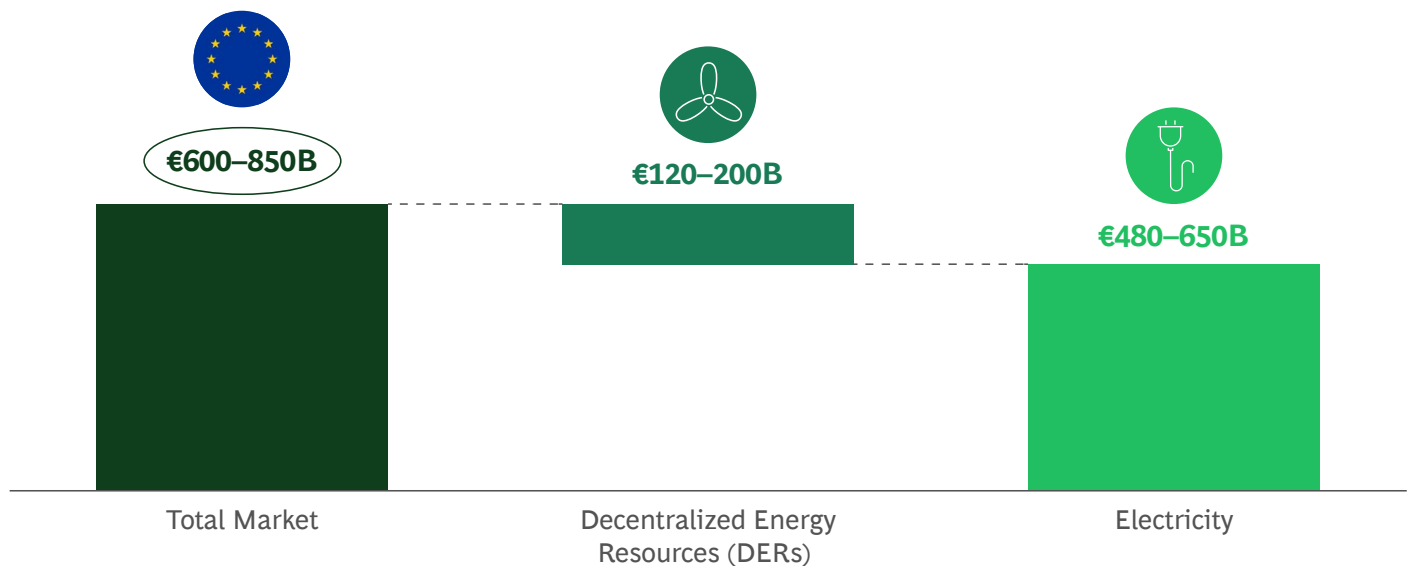
The energy world is changing, and it's happening quickly.

The quiet revolution happening in European homes and buildings is set to change how we consume energy—often without us even noticing. At the heart of this disruption are **Energy Management Systems (EMS)**—the intelligent digital platforms orchestrating decentralized energy resources like rooftop photovoltaic (PV), batteries, EVs, and HVAC, including heat pumps. An EMS, for instance, can automatically charge an EV when solar power is abundant at midday, store excess electricity in the home battery, and then use it in the evening to run a heat pump when the electricity price is high. In doing so, it minimizes costs and maximizes savings.

BCG analysis has found that EMS has the potential to **significantly change the traditional energy value chain**, turning passive customers into active energy participants, unlocking new profit pools, and becoming a decisive influence on capturing traditional value pools. In Europe alone, EMS directly influences **€600–850B** across both the electricity system and distributed energy resources (DERs) such as solar PV, batteries, and heat pumps. This transformation is predicated upon the ability to unlock new value through flexibility, and **EMS is the key control point to make that flexibility tangible**. It enables control over when and how electricity is consumed, stored, or traded—creating savings for houses and new monetization opportunities for providers.

## EXHIBIT 1

Flexibility through EMS influences several markets in Europe  
– from electricity to DERs



# A Primer on Essential Terms

Let's take a quick look at some key terms that are essential to understand what's happening.

## Energy Management Systems (EMS)

A combination of software and (in most cases) hardware that monitors, controls, and optimizes energy flows across generation, consumption, and storage assets. The goals are to reduce costs, lowering emissions, and unlocking value from flexibility. Modern EMS platforms operate across multiple scales — from individual households to commercial buildings and industrial sites — and increasingly interface with user preferences, market signals and grid requirements. Virtual EMS solutions that leverage cloud-to-cloud connectivity to link assets are gaining traction. (For a deeper exploration please see the **“Focused Insight III”** on a closer look at EMS and the technology backbone, which are included after the main text.)

## Traditional EMS value pools

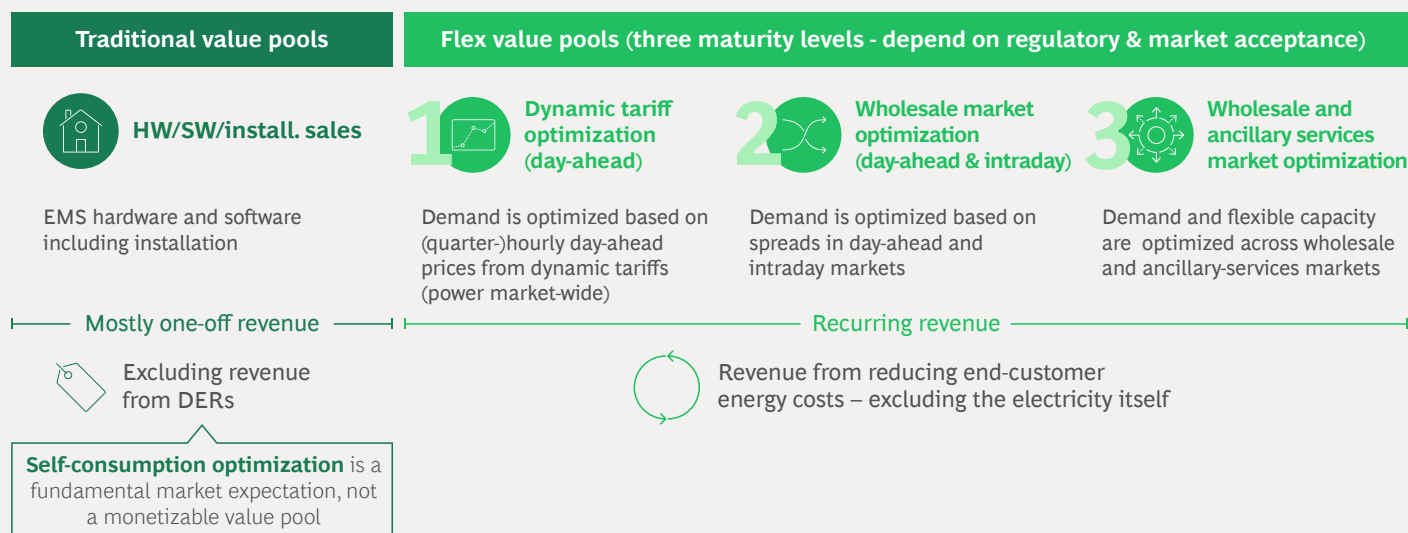
Traditional value pools are revenues from the sale of EMS hardware, embedded software, and installations. They are typically one-off capital expenditures focused on behind-the-meter applications like maximizing PV self-consumption.

## Flexibility (“flex”) value pools

Flex value pools monetize the flexibility of distributed energy resources (DERs). This can happen in several ways: mechanisms like dynamic electricity day-ahead prices that change hourly or even sub-hourly basis (Level 1); through optimization in both day-ahead and intraday markets and in power and ancillary services markets (Level II); and through full market integration in power and capacity markets (Level III). Unlike traditional pools, they usually generate recurring revenue.

### EXHIBIT 2

## Two value pool types – flex value pools with three maturity levels



## From Devices to Data: Competition Shifts to the Customer Interface

EMS will transform the power sector. It is no longer about selling energy or hardware/ software—it's about controlling how, when, and where energy is consumed, stored, or traded. In fact, we expect EMS to become a centerpiece of the residential and light-commercial energy space.

How players finish in the EMS race will determine who owns the interface, the data, and ultimately the customer relationship. In a decentralized energy world, that's where the power lies—literally. Capturing the flexibility value pools requires ownership of customer control points. EMS is the most critical of these, making it the essential lever to access flexibility at scale.

### The Battle for EMS: Many Players Want to Own the Customer Access

The fight has begun. Many players want to own the customer interface—and they're not afraid to move beyond their traditional roles. Across both HEMS and BEMS, competitive dynamics are shifting as OEMs, retailers, and digital players converge. Device makers, energy retailers, digital-native disruptors, tech enablers, and full solution providers are all involved.

- **Device giants** are racing closer to the customer interface. Once content to sell heat pumps, batteries, or inverters, they're now trying to bind all other components and technologies into their own EMS to both stay relevant and prevent others from hijacking their relationship to the installers and avoid commoditization.
- **Energy retailers** are expanding beyond commodity supply. Facing squeezed margins, declining gas businesses, and increasing competition from digital retailers, they're bundling smart pricing with EMS and hardware packages. Their aim is to shift from being commodity suppliers to becoming energy “platforms.” Smaller players tend to see value in not offering hardware, choosing instead to dock onto existing solutions.
- **Tech enabled full-energy solution providers** sit at the center, wiring the whole system together. EMS platform providers are quietly powering much of the ecosystem behind the scenes, while vertical full-stack players are grabbing the customer—from roof to app—with all-in-one packages.
- **Digital-native disruptors** are entering quickly from the side. Starting as sleek apps with dynamic pricing, they're expanding into hardware, optimization, and trading. Their goal is clear: control of the: interface, data, margin.

**Everyone is converging on EMS.** Everyone wants to own the “brain” of the new energy home. Whoever succeeds will control not only how energy flows, but **who profits from it**.

For a deeper exploration please see the **“Focused Insight I”** on HEMS/BEMS business models and competitive dynamics which is included after the main text.

#### EXHIBIT 3

### The battle for EMS – Market archetypes converging on the customer interface



## The Flex Gold Rush: €350+ per Home each Year Is Just the Start

For all (potential) EMS players, this is more than hardware and software—it's an additional source of recurring revenue.

We see early value pools already delivering **€350+ annually** per single family home through basic use cases like smart EV charging or dynamic tariff optimization (Flex Level I). With market maturity, advanced use cases like wholesale market optimization on day-ahead and intraday markets and aggregated flexibility for ancillary services could **2–3x that figure**. As an illustrative example, in a light-commercial buildings with 4 wall boxes, a 12 kW battery, and a 26 kW HVAC system including heat pumps, the value already exceeds €1,000 per year. With similar growth projections, additional value potential could come from optimizing against dynamic grid charges (if implemented widely), peak shaving, and vehicle-to-grid solutions.

Importantly, customers are increasingly willing to share these savings if the provider is offering an easy-to-use, “install and forget” solution, making the business model real. But the clock is ticking. Only those who can build or access trading, data, and optimization capabilities will capture this opportunity. Furthermore, this shift doesn't just unlock new value pools—it actively influences customer choices: From EV charging solutions to heating systems like heat pumps, the ability to monetize flexibility increasingly shapes what energy solutions customers buy.

For a deeper exploration please see the **“Focused Insight II”** on HEMS/BEMS value pools, which are included after the main text.

## Keeping up the momentum: What Needs to Happen for EMS to Scale?

Despite momentum, full EMS disruption depends on three key enablers: customer acceptance & economic viability, market & regulatory conditions, and technology maturity & integration.

### CUSTOMER ACCEPTANCE & ECONOMIC VIABILITY: “WANT TO CHARGE YOUR EV FOR FREE?”

Consumers won't adopt EMS just for the tech—they need to feel the benefit. That's why smart business models are driving acceptance. E.ON's “Flex Charge” program offers EV drivers up to €240 per year for letting the utility control overnight charging. Octopus in the UK goes further: lease a BYD EV and get free charging for life if you let them tap your battery for vehicle-to-grid trading. These models are simple, rewarding, and real. EMS adoption won't scale because people want dashboards. Rather, it will scale because the deal is too good to ignore.

### MARKET & REGULATORY CONDITIONS: “NO SMART METERS, NO SMART ENERGY”

Smart meters are the backbone of any EMS—without them, there's no dynamic tariff, no optimization, and no value. But Europe's rollout is uneven: Germany sits at <5% smart meter coverage, while France and the UK are above 60% and climbing. Italy and the Nordics are already nearing full coverage. What's holding Germany back? It's a combination of factors including complex rules, scattered responsibility across approximately 800 DSOs, and sluggish momentum. A possible way forward is to give EMS providers a larger role, and some are already stepping in. Consider the example of 1KOMMA5°, which has partnered with Solandeo to procure up to half a million of their smart meters. Policy is catching up too, but hitting these numbers requires urgency and industry coordination. The reality is that if there's no smart meter, there's no smart energy.

### TECHNOLOGY MATURITY & INTEGRATION: “LOCK-IN OR PLUG-IN”

While DER technologies are powerful, they're often fragmented, making interfaces the key challenge for EMS. Two paths exist: closed, proprietary, fully integrated systems that offer seamless operation but risk vendor lock-in, and open ecosystems that rely on shared standards. Cloud-to-cloud integration is becoming increasingly important in this context, enabling virtual EMS platforms to connect directly with third-party DER systems without relying on local device-level protocols. Initiatives like EEBUS in Europe and ChargeScape in the U.S. are pushing interoperability, while some EMS platforms certify “Ready for EMS” hardware to ensure smooth integration. Both approaches are key to making EMS a scalable, future-proof solution—not just a clever app stapled on top of a collection of closed devices.

## The Strategic Imperative: Build, Partner, or Be Left Behind

Integrated solutions fundamentally reshape market dynamics. By bundling different verticals into a single EMS solution, they concentrate the customer interface at one control point. This creates a material risk for individual component players. Even with strong products, they risk losing direct access to customers and being relegated to commodity supply while orchestrators capture the data, customer relationship, and monetization potential. As a result, every player—whether OEM, retailer, startup, or integrator—now faces the same question: What’s your “right to win” in a world where EMS connects the different verticals, and thereby enables energy value creation?

- If you’re a **hardware player**: can you stay relevant along the customer interface and avoid the commoditization trap?
- If you’re a **retailer**: can you offer more than a stable price? How can you safeguard your retail margin and capture additional flexibility value?
- If you’re an **EMS platform/aggregator**: can you scale distribution and partnerships fast enough? Will virtual EMS solutions displace hardware-based ones?
- If you’re a **solution integrator**: can you enable higher customer value from integration and lock in the customers?

Whether you’re an OEM, utility, software provider, or integrator, your future relevance depends on one thing: orchestrating customer energy flows and monetizing the value. If you can’t, someone else will.



# Outlook

## Winning in the Future EMS Landscape

The future of Energy Management Systems will be defined by one decisive factor: the ability to monetize flexibility at scale. HEMS and BEMS will no longer be optional add-ons, but rather the central layer connecting devices, customers, and markets. Success will depend on more than technology. It will hinge on a combination of elements, including customer acceptance & economic viability, market & regulatory conditions, and technology maturity & integration.

One essential question looms over this yet-unwritten chapter in the story of EMS: **Which will prevail—open ecosystems or closed, proprietary systems?**

**Open ecosystems** promise broad compatibility, flexibility, and customer choice. By connecting a wide range of devices and markets, they can become the “default” option for users who value universality and future-proof integration.

**Closed, proprietary systems**, in contrast, can succeed when providers deliver an exceptionally strong value proposition: e.g., simple bundles, attractive financing models, and a seamless “one-stop shop” experience. Customers may accept lock-in if they are convinced that the package provides higher value, less risk, or greater convenience.

**Both paths are viable.** Success will depend on the ability to combine technical capability, energy market expertise, and customer-centric packaging. Providers unable to deliver a clear value proposition risk being reduced to component suppliers, while those who master it will control the customer interface and capture recurring flexibility revenues.

Ultimately, the race remains open. Open architectures may become the standard in many contexts, but closed systems will thrive where players differentiate clearly and win customer trust with superior integration and tangible benefits. The decisive factor will not be the openness of the system itself, but whether providers can convincingly answer the customer’s core question: **“What’s in it for me?”**

Now is the time for players to make bold strategic bets—whether by building, partnering, or acquiring—to secure a position at the very center of the flexibility economy. Those who act decisively will shape the future EMS landscape; those who hesitate risk being left behind.



# EMS Value Pools

Our analysis shows that the EMS market in Europe is undergoing a fundamental shift in how value is created and captured. Historically, solution providers have generated revenue through **traditional EMS value pools**—selling EMS hardware, software, and installation services. But this model is maturing. The next phase of growth will be unlocked through **flexibility value pools**, and the key strategic question becomes: **how can EMS players participate in the savings they generate for their customers?**

## Traditional Value Pools: EMS Hardware, Embedded Software, Installation

The starting point for EMS monetization remains the traditional value chain. We see OEMs and solution providers earning revenue through:

- Hardware sales (e.g., EMS hardware, gateways, sensors sold bundled as part of a larger DER installation)
- Embedded software licenses or embedded EMS apps
- Installation services and system integration (often bundled within a larger installation)

These components form the basis of the “equipment stack” and remain essential. Furthermore, this traditional pool is largely **one-time and CapEx-driven**. Some parts of it are still growing—especially as electrification (EVs, heat pumps, etc.) expands the addressable device base—but it is structurally limited by its transactional nature and does not allow ongoing revenue from system operation or energy optimization. For example, in Germany, the traditional value pool of annual distributed PV and battery installations is already decreasing from its 2023 high.

## Self-Consumption Optimization: Table Stakes, Not a Profit Driver

### HEMS

In the HEMS space, optimizing **self-consumption (local optimization)** is now considered standard. A well-configured EMS will optimize rooftop PV, a home battery, and selected house loads to minimize grid draw. Our

discussions with industry stakeholders confirm that this use case is **crucial to end-user ROI**. It can drive up to several hundred euros in annual savings per house, but, **these savings accrue solely to the customer**.

Customers are not “sharing” these savings with the EMS provider, as they are a core part of the end-customer business case. Without them, there would be no savings and thus no Capex payback. In this sense, self-consumption optimization is not a monetizable value pool in its own right for EMS providers. Rather, it’s a table stake delivered as part of the traditional package of hardware, embedded software, and installation.

### BEMS

In the BEMS space, local optimization of energy flows including self-consumption is not fully commoditized. Thus it can be monetized. A BEMS coordinates building assets such as HVAC, lighting, and on-site energy generation modules in light-commercial and commercial buildings to reduce overall power consumption and optimize asset operations. Unlike residential HEMS, BEMS customers typically accept ongoing fees for monitoring capabilities and corresponding transparency, seamless system intelligence, and performance optimization. This is especially true when linked to operational savings or additional revenues that are significantly larger than corresponding HEMS benefits.

Externally managed energy optimization services that allow businesses to focus on their core operations present particularly attractive monetization models.

Given the greater complexity of BEMS behind-the-meter optimization—including numerous devices, sensor layers, and office rooms - the potential for meaningful efficiency gains is significantly higher than in residential use cases. Digital-first players demonstrate that monetization is viable, particularly when optimization is embedded in data-rich, operations-driven analytics. This creates a compelling opportunity for software-led EMS models focused on continuous energy optimization. Across sites, EMS providers can capture part of the value through subscription fees, service fees through contracts, or—in some cases—performance-based pricing models. In a more limited form, this also holds true for light-commercial buildings, where BEMS show strong similarities to residential HEMS.

# The Strategic Shift: Toward Flexibility Value Pools

Our analysis has identified fundamental advantages intrinsic to flexibility value pools, which can offer use cases like dynamic price optimization, load shifting, aggregated flexibility for grid services, or smart EV charging. These use cases unlock real-time monetary benefits through energy arbitrage, avoided grid costs, or balancing markets. Critically, they open the door for EMS providers to claim a share in this value.

We define three maturity levels of flex value pools:

- 1. Dynamic tariff optimization (day-ahead):** Demand is optimized based on based on quarter-hourly and hourly day-ahead prices from dynamic tariffs (power market-wide)
- 2. Wholesale market optimization (day-ahead & intraday):** Demand is optimized based on spreads in day-ahead and intraday markets
- 3. Wholesale and ancillary services market optimization:** Demand and flexible ca-pacity are optimized across wholesale and ancillary-services markets

**Beyond the defined flex value pools, further opportunities exist.** In particular, dynamic grid fees and **peak shaving** can unlock additional value. Dynamic grid fees align charges with real-time network utilization, lowering consumer costs and easing grid stress. Peak shaving, or reducing peak demand, generates savings for households and businesses while supporting system stability. A prominent example is high-power EV charging, where EMS-controlled batteries can smooth extreme load peaks and avoid costly grid fees. Though not yet part of this

model, these levers will gain importance as regulation evolves and DSOs/TSOs adopt dynamic fee structures. This will help grid operators reduce costly grid expansion needs.

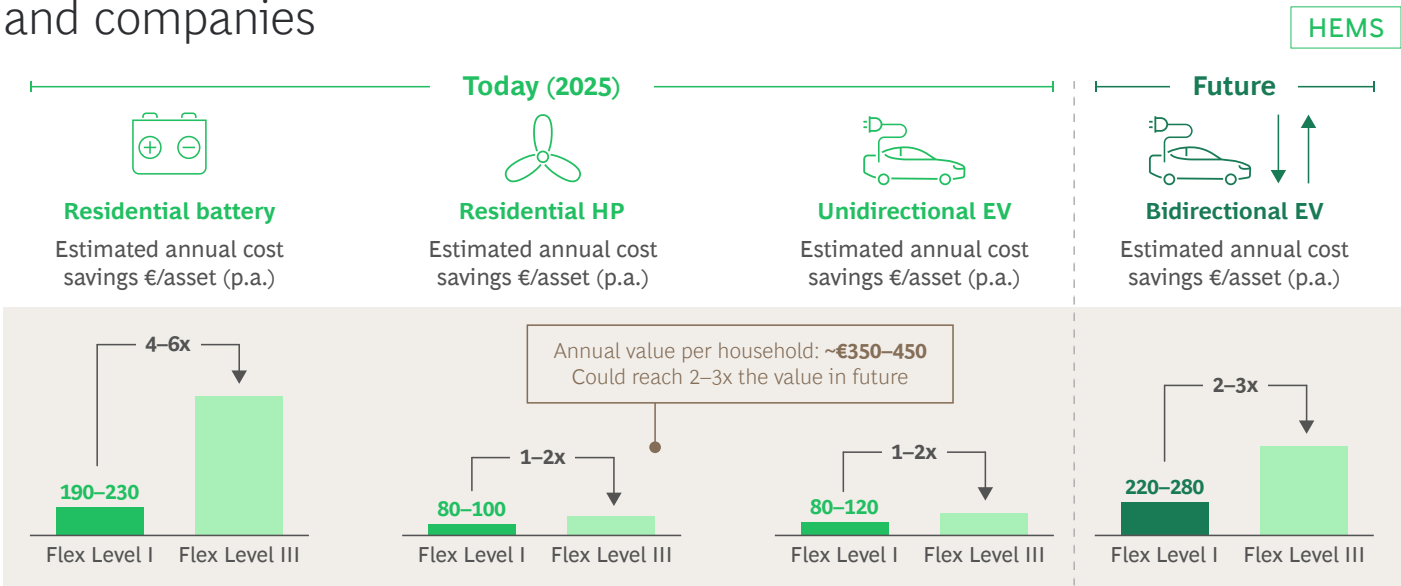
Our market modeling shows that **each individual house with the relevant DER assets in Flex Level I could unlock between €350–450 per year as of 2025.** This number could even double or triple with full wholesale market optimization (including intraday) and ancillary services markets (Flex Level III). Considering the additional potential from dynamic grid charges or peak shaving, the real potential is likely even greater. And unlike self-consumption, we see clear willingness among customers to **share part of these gains with the provider**, especially when they involve complexity or risk. The offers must, however, be easy to understand:

“Dynamic pricing often works best in residential markets in the form of simple flat packages – customers want comfort, not complexity. Intraday trading is exciting but requires explanation, e.g., customers must understand why the storage is discharging. Otherwise, the providers will face numerous questions.”

**DR. TORSTEN HAGER**  
Business Development Director at Hager Group

## EXHIBIT 4

EMS solutions have great value potential for both customers and companies



## Monetization Potential: The Provider's Share of Customer Savings (Take Rate)

Flex value pools are determined by two key factors: customer savings from flexibility, and the provider's share of those savings — the so-called “take rate.” This defines the revenue opportunity for EMS players. This creates a genuine win-win situation: customers benefit from lower energy costs while providers generate recurring revenues. In conversations with EMS providers, we explored **how and where solution players can monetize flex savings**. We observed several patterns emerging in the HEMS space:

- **Dynamic tariff optimization:** Providers in the HEMS market typically offer a monthly subscription model and integrate this in a broader EMS package to make clear, easy-to-understand offers to the client. As a side effect, the actual take rate is not clearly visible. Consequently, take rates tend to be somewhat higher than for classic energy contracts—projected at 15–25% by 2030. In contrast, companies serving the BEMS market tend to be more transparent and apply a **markup on spot market prices** and/or charge **a monthly flat fee** for smart price optimization—with effective take rates of 10–20% on the gross savings they generate by 2030 as the market gets more competitive.
- **Wholesale market optimization and aggregated flexibility:** In more advanced flexibility use cases, EMS providers also typically bundle their services in a way that is easy for customers to understand—but as a result, the final electricity price becomes even less transparent. This creates room for providers to capture significant value, although effective take rates are expected to decrease over time toward 20–30% by 2030.

This shift is crucial. While **customers often remain the asset owners**, EMS providers become the **operators of monetized flexibility**, creating recurring revenues and stronger customer relationships. In practice, EMS players are evolving from “system sellers” to **flexibility managers and profit-sharing partners**. Digital-first providers such as Tibber already demonstrate this, e.g., through dynamic pricing and smart load control. Aggregators like Next Kraftwerke show how virtual power plants can pool thousands of assets and share revenues with customers. And while energy service companies such as 1KOMMA5° and Enpal are expanding beyond hardware into EMS-enabled offerings, linking home solar, storage, and heating systems to grid services, not all archetypes can successfully tap this value pool.

Providers should remember that in terms of maintaining trust and health customer relations, transparency is essential—but especially always to emphasize that flexible energy management is ultimately a win-win for both providers and consumers. What remains open, however, is whether the take rate should be realized as a percentage of customer savings or as a fixed monthly fee:

“Take-rate models depend on flexibility spreads: they work well when spreads are high, but collapse when they fall. A fixed monthly license fee, with all flex savings remaining with the customer, offers a more stable approach.”

**PHILIPP SCHRÖDER**  
CEO and Co-founder of 1KOMMA5°

# Example: Market Size and Growth in Germany

As part of this study, we conducted a detailed analysis of the German HEMS market through 2035. The traditional HEMS market is expected to triple in size, reaching €600–800M by 2035. The development of flex value pools is even more dynamic. Currently hardly monetized, they are projected to reach up to €1,150–1,400M by 2035 with the considered use cases (day-ahead, intraday and balancing markets)—surpassing traditional value pools. This creates significant opportunities for expanding and evolving business models across the energy and technology value chain. Flex value pools also hold potential in areas not yet widely considered, such as dynamic grid charges or vehicle-to-X solutions.

The main driver behind this development is the increasing penetration of HEMS in the residential segment. The number of installed HEMS systems capable of managing dynamic pricing is expected to rise from around 0.5M in 2025 to approximately 10M by 2035. Several trends support this growth: the obligation to offer dynamic energy pricing (since 2025), the rapid rollout of heat pumps, residential battery storage systems, and electric vehicles

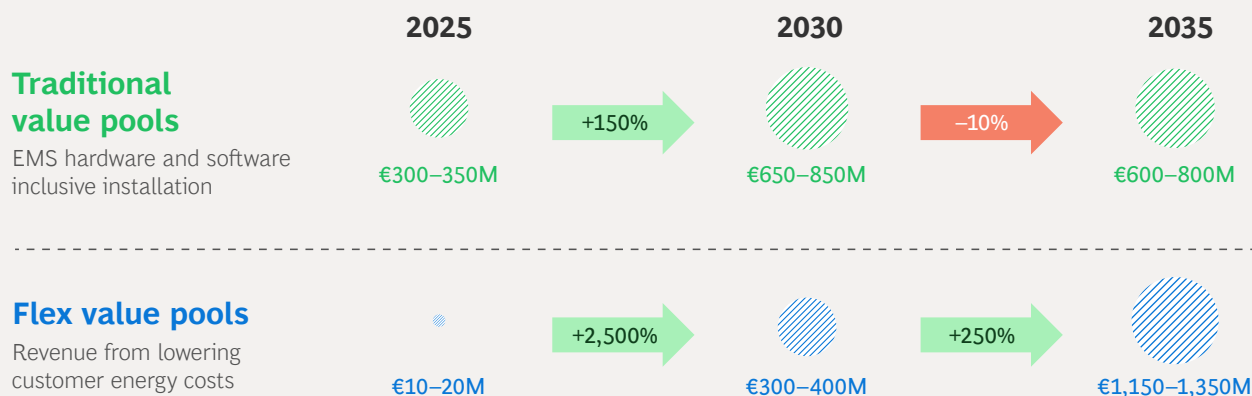
(including bidirectional charging). In addition, the expanded use of flexible control and aggregation in the energy market further drives adoption. Regulatory initiatives such as §14a EnWG and related funding programs further accelerate market adoption. On the other hand, obstacles must be overcome. To successfully scale and monetize HEMS in Germany, smart meter penetration must reach 20% of houses by 2030 – and reaching this target will require significant effort:

“Germany is dramatically lagging in smart meter rollout. A faster smart meter rollout is essential to unfold the full potential of new flexibility models.”

**DR. PHILIP BECKMANN**  
Advisor and former CEO of tado

## EXHIBIT 5

Flex value currently negligible, but will surpass traditional value pools between 2030 and 2035







# HEMS and BEMS Ecosystem and Dynamics

The EMS market is no longer defined by single revenue pools, but rather by the ability to integrate multiple sources of value. In this chapter, we outline the key company archetypes shaping HEMS and BEMS markets and analyze how different players stack value pools to strengthen their competitive position.

## EMS Archetypes and Monetization Strategies

While the HEMS market is ultimately decided by the homeowner, the actual choice set is typically limited. Installers act as gatekeepers, presenting only a small number of preferred solutions from which the homeowner selects. By contrast, the BEMS landscape involves a broader set of internal stakeholders.

In commercial and institutional segments, customers often require alignment across energy procurement, facility management (internal or external), operations, finance, and potentially fleet management for EV integration. This fragmentation often makes integrated EMS solutions harder to sell and scale in BEMS, despite their strategic relevance. This structural difference explains the fundamentally different market landscapes for HEMS vs. BEMS.

### HEMS

The HEMS ecosystem has grown gradually, with each archetype evolving from distinct starting points and successively expanding its role within the value chain.

From a behind-the-meter perspective, **component OEMs** like Hager have traditionally occupied upstream positions in the value chain, supplying individual DER components such as EV chargers or batteries into larger EMS-optimized systems. Some players have already started to explore vertical integration, either through partnerships (e.g., Panasonic's investment in Tado) or by embedding intelligence into their components.

“Traditional hardware OEMs are at a crossroads: either risk commoditization of their core business—or extend along the energy value chain through EMS-driven software and service business models and hence offer customers significantly higher value with lower energy costs.”

### CHRISTIAN WAGENBLAST

**Project Director New Energy Business at Bosch**

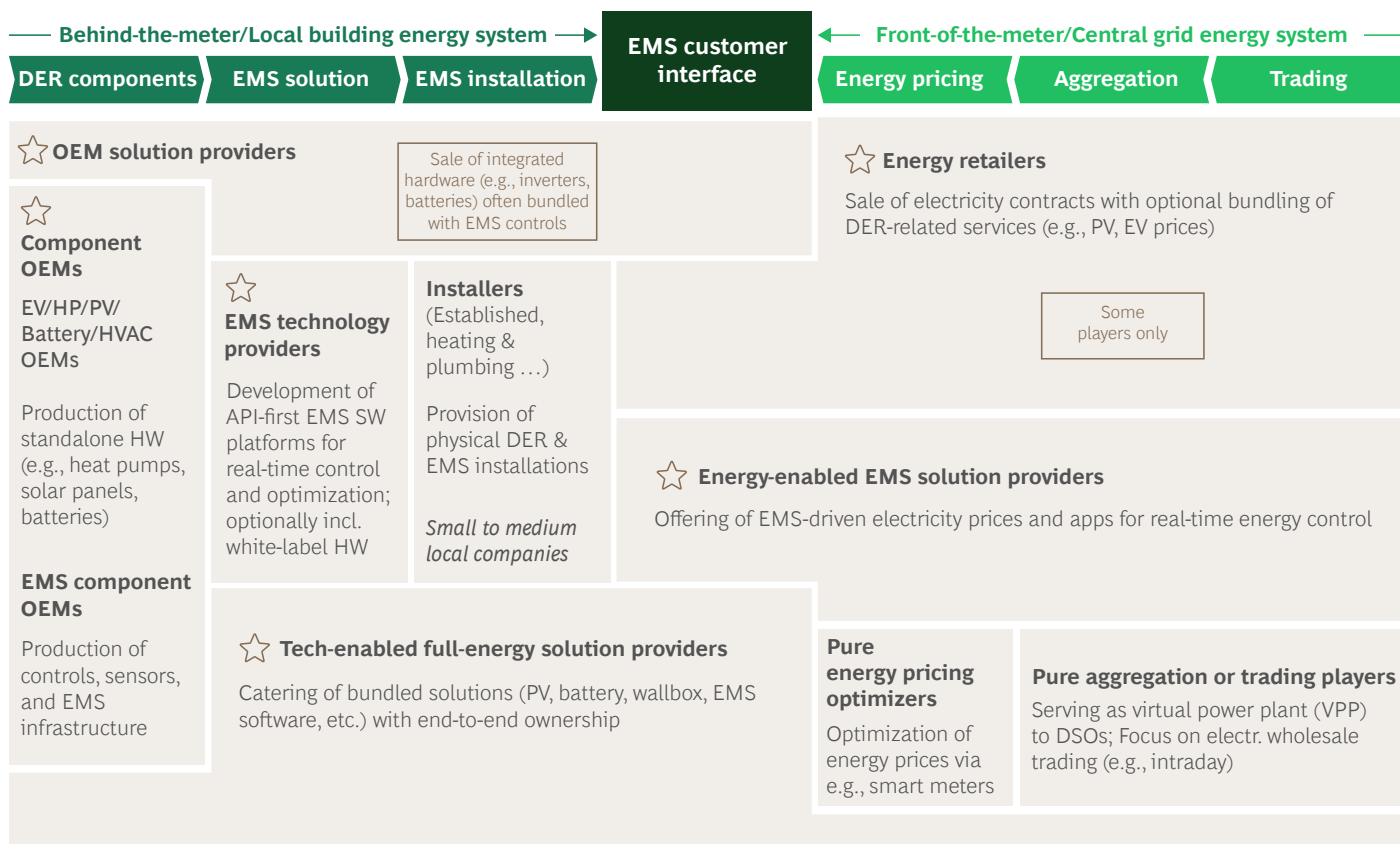
By contrast, **OEM solution providers**, such as Bosch, typically originate from strong positions in integrated hardware systems. These players have established system architecture and are embedding EMS capabilities directly into their hardware portfolios. They increasingly focus on proprietary ecosystems that bundle analytics and software to retain design control and capture more of the value across the value chain.

**EMS technology providers**, like gridX and Enode, started as software-native companies focusing on real-time control, API-first architectures, and adaptive EMS platforms. Over time, some expanded into analytics hardware through OEM partnerships or white-label solutions, improving system integration and channel access.

## EXHIBIT 6

# The HEMS market is highly competitive

HEMS



☆ Relevant player archetypes for EMS control points

**Tech-enabled full-solution providers**, such as Enpal or 1KOMMA5°, have emerged by vertically integrating across the entire value chain under one brand. Many evolved from installation- and operations-focused backgrounds. Others entered from the opposite direction, such as front-of-the-meter energy players, moving into more customer-facing residential EMS offerings. Most of the installed hardware includes white-label or externally sourced products.

In the front-of-the-meter business, **energy retailers**, like Enel, initially focused on energy delivery, but have gradually started to offer DER-related offerings like PV modules. Many have also integrated EMS functionality, whether through proprietary developments or white-label platforms.

In contrast, **energy-enabled EMS solution providers** like, Tibber, blend the roles of EMS platform and energy supplier. They have built integrated stacks—covering price provisioning, energy management optimization, trading, and in some cases aggregation. Their development path shows growing monetization ambitions around flexibility and load control, delivered through a unified digital interface.

As focused players, **pure energy price optimizers**, such as Rabot Energy, have emerged and focus narrowly on matching household energy consumption with dynamic prices, based on real-time price signals of the day-ahead market and smart meter data. These players could also serve as interesting ecosystem partners for companies that have gaps in their own offerings.

Finally, there are **pure aggregation or trading players**: Aggregators operate virtual power plants (VPPs), pooling residential DER flexibility at scale, and selling it to DSOs and TSOs. Trading players, by contrast, typically emerge from wholesale or intraday markets, focusing on arbitrage and market access. Both groups usually manage a significant portfolio beyond HEMS/BEMS, reflecting their broader portfolio play.

BEMS

While the BEMS market has followed a broadly similar trajectory across the value chain, notable structural differences remain.

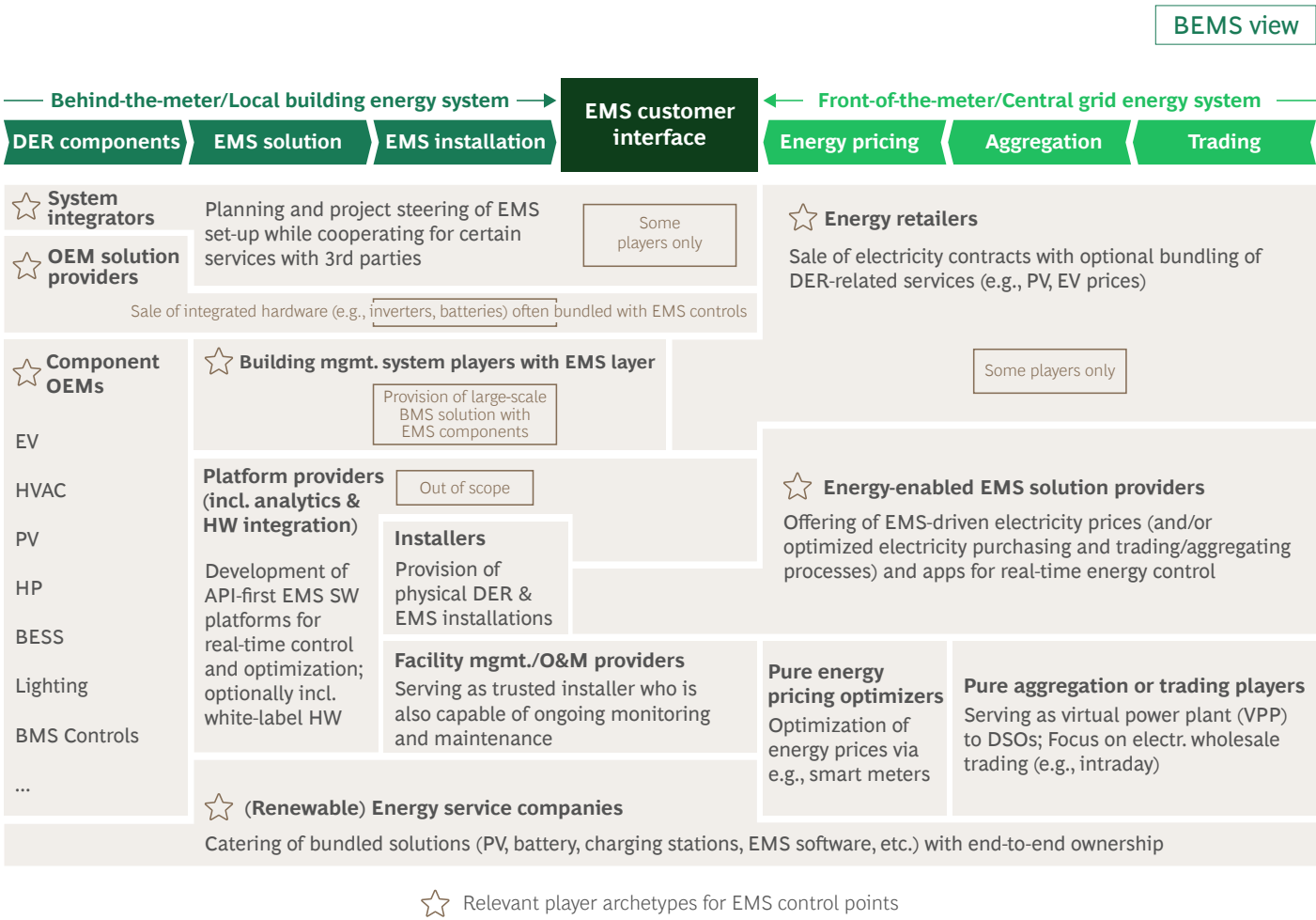
The BEMS value chain is anchored by the same **component OEMs, OEM solution providers**, and energy retailers as in the HEMS market. However, the

configuration and interplay of players diverges significantly. Additionally, **energy-enabled full-solution providers**, pure energy optimizers, **pure trading players**, and **pure aggregation players** operate with comparable value propositions to those in the HEMS market. However, the BEMS landscape is characterized by a distinct set of players, with BEMS specialists focusing exclusively on commercial customer segments:

BEMS-specific behind-the-meter players include **system integrators**, like SCADA-Automation. They act as technical orchestrators of EMS deployments, steering multi-stakeholder projects and ensuring compatibility across OEM components, analytics platforms, building-specific requirements. Most importantly, the integration with the building management system (BMS). They often serve as the central interface between hardware suppliers, software vendors, and customers.

EXHIBIT 7

The BEMS market is equally competitive, yet more fragmented



**Building management system players with an EMS layer**, such as Schneider Electric, offer proprietary systems for controlling HVAC, lighting, and access management. These companies are now embedding EMS capabilities as a natural extension of their core building management system offerings.

**Platform providers**, like Spacewell, entered the market through software innovation and offer EMS tools for visualization, analytics, and remote control. They position themselves as hardware-agnostic and API-enabled, serving as EMS enablers for hardware-centric players, installers, or energy retailers. Some also offer white-label solutions for business partners.

Combining the entire value chain, **(renewable) energy service companies**, such as ENFRA, deliver turnkey EMS-enabled energy systems that combine PV, battery storage, charging infrastructure, control software, and energy trading. These companies typically operate under contracting-based agreements that guarantee energy cost savings over the contract duration.

## Revenue Stack Explained

We believe the most successful EMS models will **stack both traditional and flex value pools**. In practice this means:

- Providing compelling bundles of EMS hardware, software, and installation as part of an integrated hardware or cloud-to-cloud solution (traditional value)
- Offering self-consumption optimization as a must-have feature (non-monetizable but essential)
- Unlocking dynamic pricing and flex trading as monetizable services with recurring revenue (flex value)
- Further addressing additional value pools (DER asset sales, retail margins) by owning the end-customer interface

This hybrid model creates a **win-win**: customers reduce their energy bills, while EMS providers secure long-term revenue streams beyond the initial system sale. The depth of monetization depends on:

- Technical capability to optimize across assets (e.g., batteries + EV + heat pump/HVAC)
- Regulatory frameworks enabling flex trading
- Trust and transparency with customers (e.g., clear value proposition and value sharing mechanisms)



# EMS and Technology Backbone

Energy Management Systems (EMS) are emerging as a central control layer in the transition toward a decentralized, electrified, and intelligent energy system. Our analysis shows that EMS enables the orchestration of distributed energy resources (DERs) - from solar PV to EV charging - by integrating hardware, software, and data into a single, optimized platform.

## EMS TECHNOLOGY STACK

We distinguish three core layers in the EMS technology stack:

- **Gateway layer:** Enables device communication, collects real-time energy data, and executes local control logic. Includes energy meters, control units, and protocol converters.

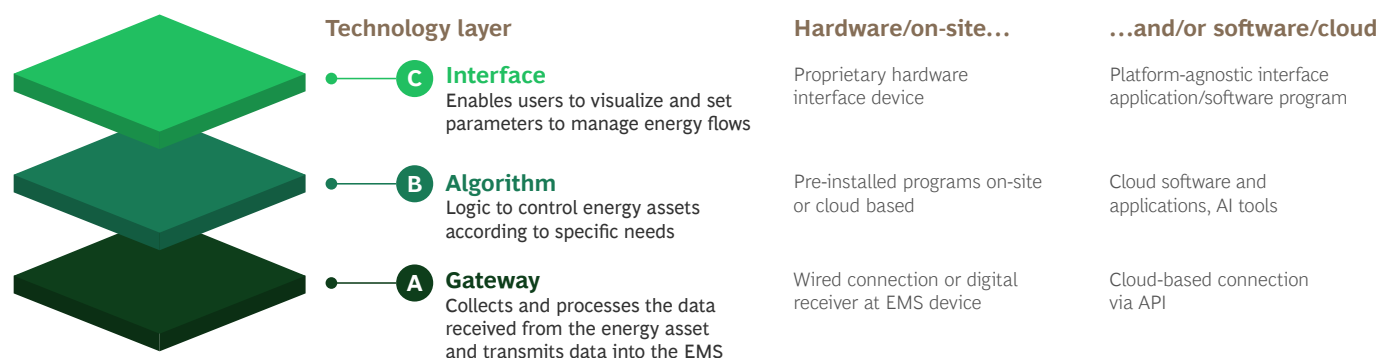
- **Analytics and optimization layer (local/cloud-based):** Processes consumption and generation forecasts, applies control rules, and optimizes energy flows based on market prices, weather, and user-defined goals. This algorithm layer can range from simply trained algorithms to sophisticated AI models.
- **Interface and market integration layer:** Connects to users (via app or dashboard), manages API integration (e.g., for pricing or flexibility markets), and enables participation on trading platforms including access to ancillary grid services.

This architecture can be delivered as a proprietary embedded solution or a platform-agnostic cloud service — depending on provider strategy and target customer.

## EXHIBIT 9

Three layers make up an EMS system. The algorithm is at the heart of optimization

### Technology stack of energy management systems





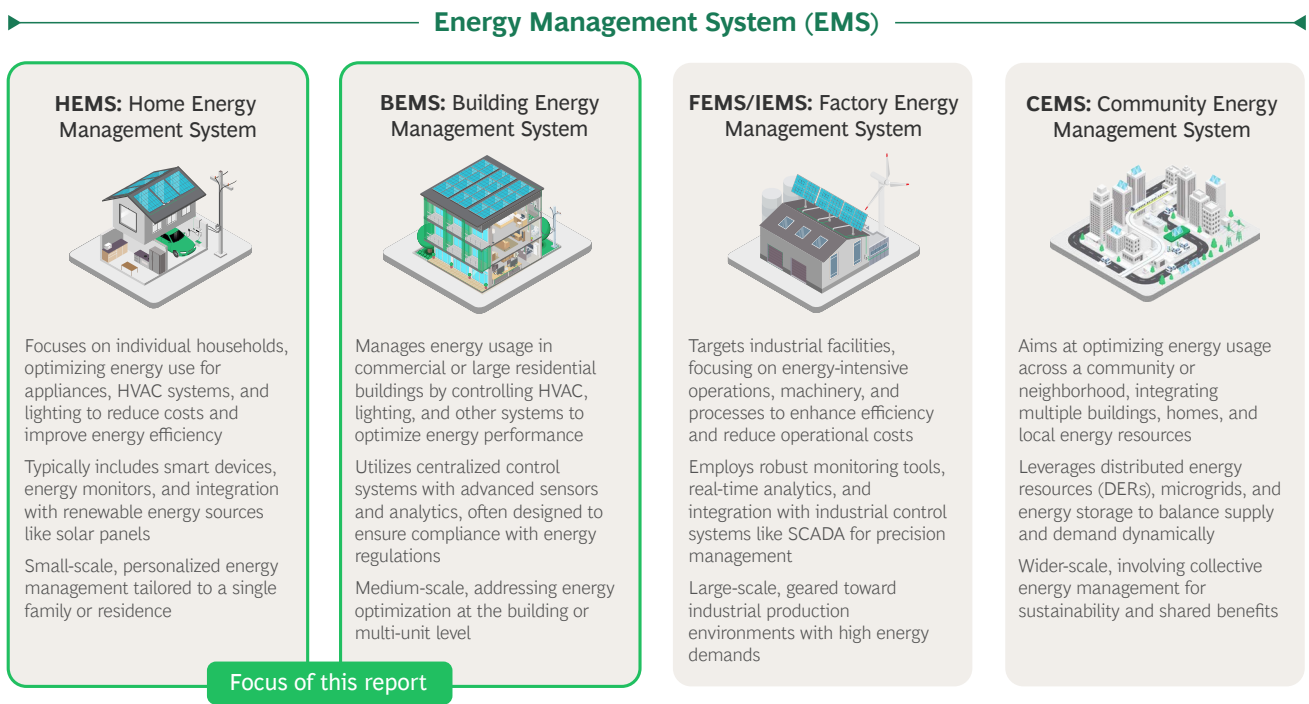
EMS SEGMENTATION

We distinguish four EMS system types based on application context and scale. This report has focused on two of them: Home and Building Energy Management Systems (HEMS, BEMS). From a strategy perspective, the

distinction between EMS types remains relevant for positioning and go-to-market models. However, the market is shifting toward **vertical expansion across software, services, and trading**. Many of the aspects discussed here are also relevant for FEMS and CEMS, thereby opening up additional major value pools.

EXHIBIT 8

HEMS and BEMS represent two of four different EMS system types



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## Acknowledgments

We thank Dr. Tobias Dittrich and Valentin B. Krüper for their valuable support and contributions to this paper, as well as Paul Cumbo and Kelly Parmeter for their editorial guidance.



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