MICROEJ®

SOFTWARE-DEFINED EVERYTHING

VEE Energy: Unlocking True Grid Intelligence Through Software-Defined Smart Meters

VEE Energy is an AI-powered solution that modernizes the smart grid at the Edge, transforming standard meters into intelligent, adaptable devices without costly hardware upgrades. This software-defined approach allows utilities and device manufacturers to add edge intelligence and deploy new applications quickly, driving innovation in grid management and energy efficiency. Trusted by leaders like Schneider Electric and Landis+Gyr, VEE Energy enhances grid reliability, supporting the transition to AMI 2.0 with flexible, scalable, software-driven solutions.

KEY BENEFITS

1

Future-Proof Customization Capabilities to Keep Up with Smart Grid Evolutions

- → Utilities and third parties can develop custom applications for evolving energy needs, such as distributed resource management and demand-response program
- → Enables safe integration with third-party solutions, including AI applications
- → Virtual Device (meter replica) and free, branded development environment provided

2

Accelerated Innovation for Fast Device Development and Deployment:

- → Fast and flexible product development through parallel workflows (SW, HW, BSP)
- → Dynamic and safe deployment of new apps without requiring a complete firmware update
- → Enhanced security and reliability through app sandboxing

3

Enhanced Interoperability and Edge Intelligence:

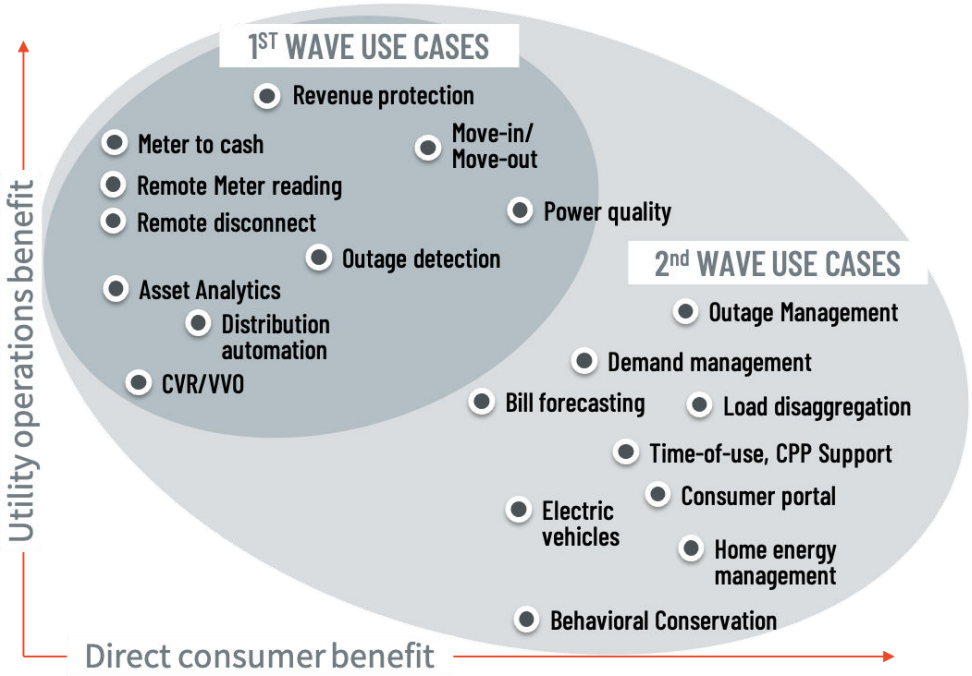
- → Customizable communication functions to meet specific customer needs, including IoT connectivity, home ecosystem integration, and EV compatibility
- → Provides better control over energy and resource usage with decisions at the edge, leveraging granular analytics, signal processing, and machine learning

4

Comprehensive Reference Design

- → VEE Energy implementation on virtual device provided
- → Includes MICROEJ SDK, virtual device, app examples (such as player-recorder, waveforms), and edge-to-cloud connectivity examples.

UNLOCKING THE POTENTIAL OF AMI 2.0



In an era of data overload, the key for utilities is not the volume of information but the ability to analyze and act on it. While cloud-based data aggregation is a start, the true potential lies in intelligent endpoints that process and act on data at the edge, in sync with the overall infrastructure.

This shift is central to AMI 2.0, the next phase of smart metering, which addresses a second wave of use cases by offering real-time data analysis and insights. This shift facilitates:

- **Demand Response Programs** to optimize grid management and reduce peak demand.
- **Integration of Distributed Energy Resources** to effectively manage solar, EVs, and other resources, delaying costly infrastructure upgrades.
- **Enhanced consumer savings** by providing detailed usage information for better energy management.

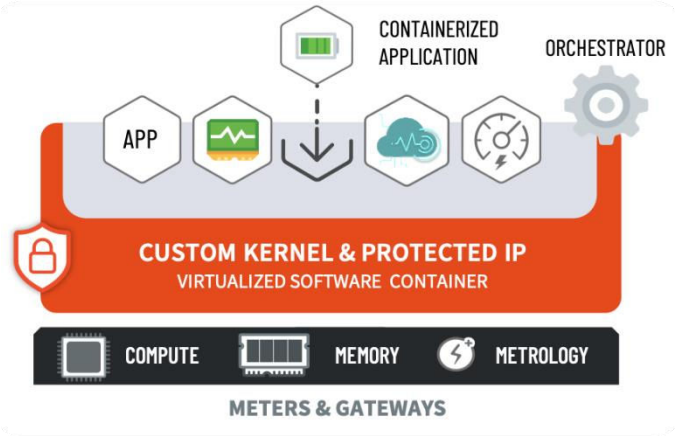
To achieve these benefits, utilities need finer control at the user level, requiring smarter meters and compatibility with home devices. MicroEJ VEE Energy supports this evolution by offering a customizable application runtime that enhances meter intelligence and edge decision-making. This integration of edge computing and centralized analytics also helps utilities operate more efficiently and respond faster to issues.

Aligned with AMI 2.0, VEE Energy enables utilities to better manage distributed resources, improve grid intelligence, and adapt to evolving consumer needs and regulations by providing a secure and flexible software foundation, supporting a more resilient and responsive energy infrastructure.

VEE ENERGY: TOWARDS A SOFTWARE-CENTRIC BUSINESS MODEL

BUSINESS AGILITY WITH APP ECOSYSTEMS

VEE Energy's app containers empower leaders in energy management to enhance user experience and streamline operations with greater agility. By enabling downloadable apps across all VEE-powered devices, utilities can quickly adapt to market demands and introduce new features dynamically.



The flexibility of VEE Energy enables the seamless creation of unique applications across different meter types, eliminating common implementation hurdles, accelerating development while upholding high security standards.

VEE Energy solution fosters collaboration with third-party developers, tapping into a global pool of over 20 million engineers skilled in C, JavaScript, and Java.

AI-DRIVEN EDGE INTELLIGENCE WITHOUT COSTLY HARDWARE UPGRADES

With built-in digital signal processing (DSP) and edge AI capabilities, VEE Energy leverages the power of existing hardware and specialized hardware accelerations to efficiently execute complex algorithms.

VEE Energy app containerization offers a cost-effective and scalable path for deploying AI-driven innovation on current devices, transforming energy meters into agile, AI-enabled smart devices.

FUTURE-PROOFING AND LONG-TERM DEPLOYMENT

Given that smart meters often remain deployed for up to 20 years, ensuring their continued relevance is essential. VEE Energy's software-centric design enables metering companies to easily update their devices with new functionalities, regulatory compliance, and security features.

With VEE Energy, energy management companies can balance the delivery of cutting-edge features with cost efficiency throughout the device lifecycle. By minimizing the need for frequent hardware overhauls and facilitating secure, incremental updates, VEE Energy allows businesses to adapt to future market demands without significant investments, making their products more sustainable and cost-effective over time.

ENHANCED DEVICE SECURITY AND RELIABILITY

VEE Energy prioritizes security and reliability, which are critical for metering devices in challenging environments. VEE Energy utilizes secure app off-loading, meaning that malfunctioning or faulty apps cannot disrupt the entire system. **App containerization ensures continuous operation of the device, enhancing overall reliability.**

Untrusted apps are verified through a Binary App Verifier before integration, effectively identifying and excluding malicious software. Strict isolation prevents harmful applications from accessing critical system resources, protecting the integrity of the device. **VEE Energy security framework enables metering companies to comply with industry standards and safeguard sensitive data, ensuring high performance and minimizing operational risks.**

FAST CUSTOMIZATION FOR A FRAGMENTED MARKET

VEE Energy empowers meter companies to swiftly develop and deploy product variants that cater to diverse utility markets, particularly in rapidly growing regions like India and Africa. With the ability to rapidly develop and deploy software apps, energy management firms can customize solutions to address specific regulatory, technical, and customer requirements, facilitating quicker market entry. This agility not only enhances competitiveness but also allows for the introduction of valuable features such as flexible billing and demand response capabilities.

Consequently, companies can lower both development costs and time-to-market, enabling them to deliver high-value features while effectively managing production and operational expenses. In addition, this strategy ensures that devices remain relevant over time, minimizing the need for costly redesigns.

BETTER INTEGRATION WITH LEGAL CODE SEPARATION

Traditionally, metering companies have relied on separate hardware components to isolate legal or sensitive code, a process that increases complexity and cost. VEE Energy offers a more sophisticated solution through virtualization and multi-sandboxing. This advanced approach securely separates legal and application code within the same device, eliminating the need for additional chips while ensuring airtight security.

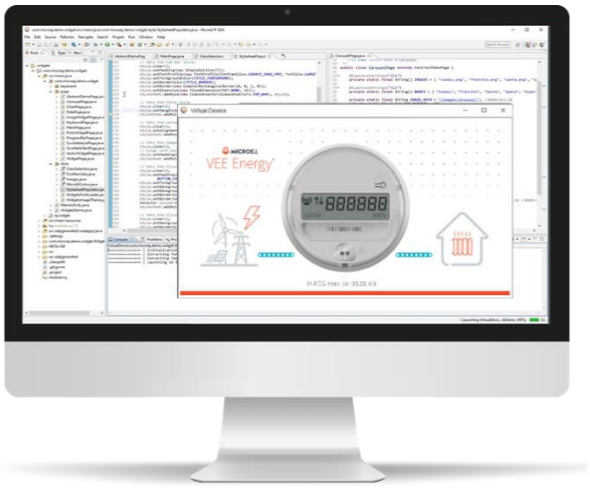
For metering companies, this means reduced hardware costs and simplified system architecture. More importantly, the compartmentalization of sensitive operations provides an unparalleled level of enhanced protection against cyber threats, safeguarding proprietary technologies and sensitive data.

ACCELERATED DESIGNS

TAKE ADVANTAGE OF TRUE DEVICE SIMULATION

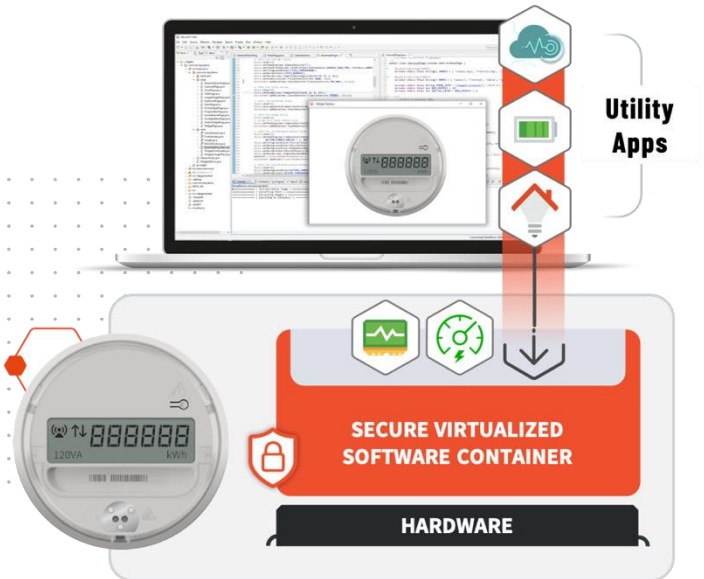
VEE Energy provides a robust simulator that creates a comprehensive 'Virtual Device' – a simulated meter replica - for smart meters.

Virtual Devices support the simulation of sensors, algorithms, and network connections, facilitating complete application development.



A CUSTOMIZABLE UTILITIES SDK FOR FAST APP DEVELOPMENT

VEE Energy comes with a free, customizable SDK to enable utilities and third-party developers to swiftly design, test, and deploy new applications, offering innovative services to both utilities and consumers.



- Develop on an accurate virtual meter with all inputs/outputs
- Robust development environment with extensive software libraries
- IDE agnostic: VSCODE, IntelliJ IDEA, Android Studio, Eclipse
- Modern build system with Gradle
- Multilanguage framework (C, Java, JavaScript…)
- Software-defined metrology
- Secure app ecosystem ensured via app sandboxing

EXAMPLES OF READY-TO-USE APPLICATIONS

VEE Energy provides a suite of pre-integrated, customizable applications designed to deliver advanced edge intelligence efficiently:

- **Live Waveform Data:** Stream real-time voltage and current samples for instant monitoring and analysis. The feature allows visualization of energy peaks as they occur, enhancing the accuracy and timeliness of insights.
- **Meter Data Player/Recorder:** Record and playback data from actual meters, including electric current and voltage, on a simulator. This application accelerates the testing and validation of other applications by utilizing real-world data in a controlled environment, ensuring accuracy and reliability.
- **Diagnostic Tools:** Access application logs, deploy new applications, and optimize performance. This functionality streamlines implementation, enhances overall system performance, and reduces potential downtime.

EXCLUSIVE SOFTWARE FEATURES

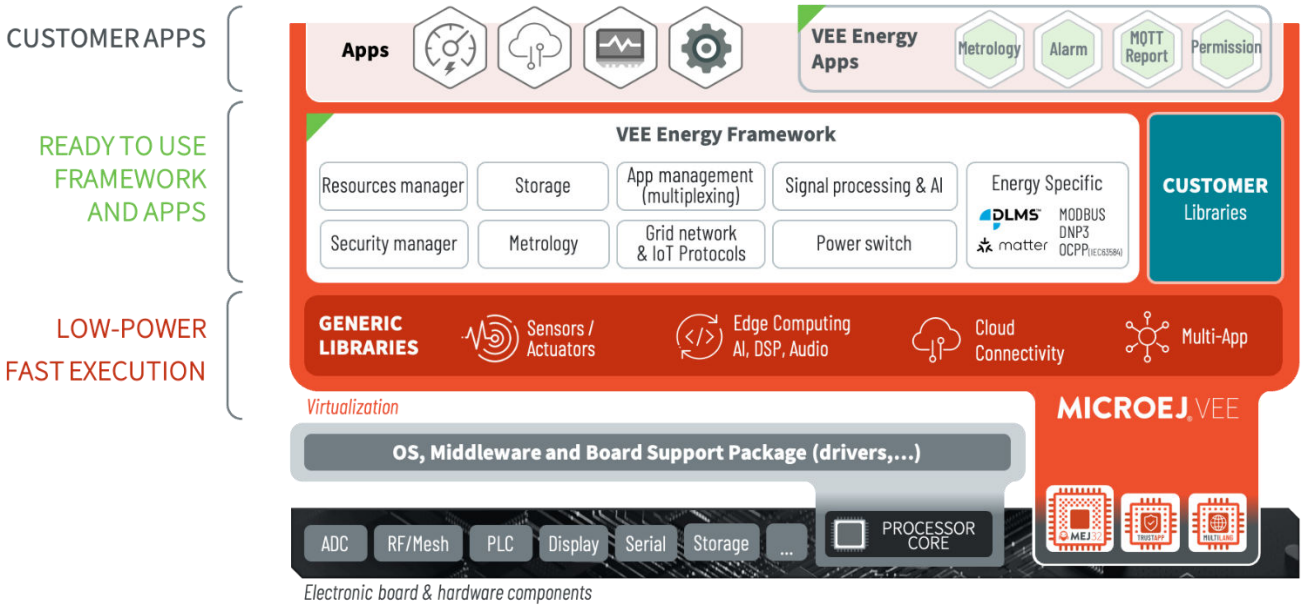
VEE Energy provides a range of advanced software features designed to accelerate product development:

- **Comprehensive Framework**: VEE Energy integrates diverse components, including signal processing, AI, security and a curated selection of APIs, ensuring robust functionality across various energy applications.
- **Customizable Apps**: VEE Energy includes example apps for smart meters, offering adaptable templates for different utilities and product variants. These templates streamline the customization process, providing a rapid starting point for development.
- **Resource Security Manager**: Enhances system reliability by ensuring that a faulty app does not compromise the entire system's performance.
- **App Management and Analytics**: Allows for local management and analysis of applications, providing valuable insights and control.
- **Metering Framework**: Supports essential metrology functions, data storage, and power switching for comprehensive meter management.
- **DSP and AI**: Facilitates local analytics with Digital Signal Processing (DSP) and AI, enabling advanced data analysis and decision-making on the device.
- **DLMS UA-attested library:** Supporting secure and efficient implementation of IEC 62056-21 standards and COSEM data models, portable across any MCU/MPU for flexible deployment.

IOT IS OUR FOCUS:

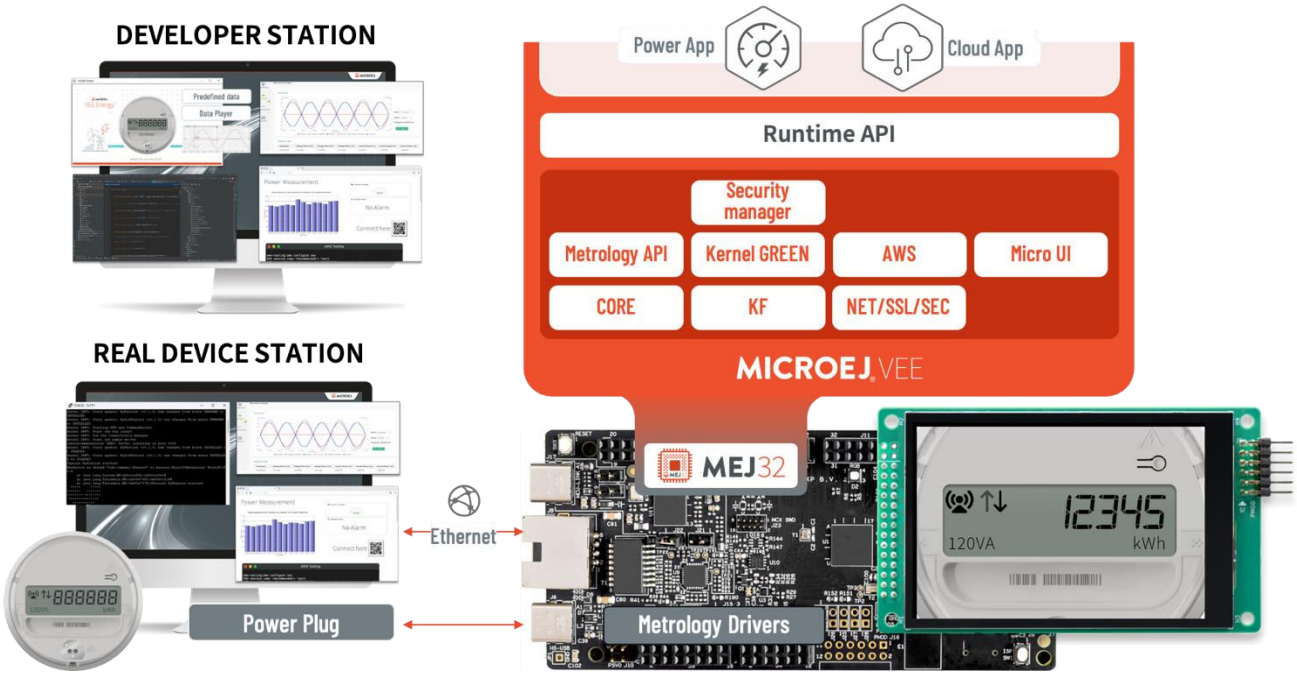
VEE Energy offers comprehensive IoT solutions for smart meters, supporting a wide range of wired and wireless protocols, including Ethernet, Wi-Fi, Bluetooth, and NB-IoT. VEE Energy secure implementation ensures secure data transport with SSL/TLS and supports key IoT protocols like MQTT, HTTP/HTTPS, and MATTER. This extensive compatibility makes MicroEJ a reliable choice for smart metering applications.

VEE ENERGY BLOCK DIAGRAM



VEE ENERGY REFERENCE DESIGN

MicroEJ provides a VEE Energy reference design as a demonstrator of the technology. This reference design is based on the MCX-N MCU from NXP and is easy and inexpensive to replicate. It allows experimenting with Apps, modular design, connectivity and edge intelligence in the energy context.



EXTENSIBLE WITH PARTNERS

The VEE Energy ecosystem includes partners that bring added value to smart meters through algorithms and software providing unique capabilities. Partner add-ons algorithms and software components have been tested with VEE Energy for seamless integration. Partner add-ons require a license from each partner (not covered by VEE Energy license).

With Kalki-Io, Kalkitech offers robust communication protocols and analytics capabilities, enabling efficient monitoring and control of critical infrastructure systems. The platform supports a wide range of industry-standard communication protocols, including IEC 61850, DNP3, and Modbus, making it highly suitable for distributed energy resource (DER) management and integration.

Matter is an open-source protocol for seamless, secure smart home device interoperability, overseen by the Connectivity Standards Alliance (CSA). It is becoming increasingly relevant for smart grid applications where seamless integration and communication between various energy devices and systems are essential for efficient energy management and distribution.

STRAIGHTFORWARD LICENSING

VEE Energy is licensed as a single license including MicroEJ VEE Core and all the VEE Energy components.

The license to VEE Energy grants the right to duplicate MicroEJ's VEE Energy libraries and apps along with MicroEJ VEE Core for the duration of the VEE Energy multi-year contract.

INCLUDED IN VEE ENERGY LICENCE

- VEE Energy Framework
- VEE Energy example apps
- Includes VEE Core License:
  - Sandboxed applications
  - Virtual devices and SDK
  - Real device starter kit (Dev. Board)
  - Extensive software libraries
  - Low power optimization

SEPARATE LICENSES FROM PARTNERS

- Partners add-ons

POWERING MILLIONS OF SMART METERS

TRUSTED BY INDUSTRY LEADERS

VEE Energy powers millions of award-winning smart meters worldwide. Our robust partnerships with renowned providers and silicon vendors create a dynamic ecosystem of possibilities in the industry.

BROUGHT TO YOU BY MICROEJ

VEE Energy stands as a registered trademark of MicroEJ, pronounced as “micro-EDGE”.
MicroEJ is a software vendor of cost-driven solutions for embedded and IoT devices. We are focused on providing device manufacturers with secure products in markets where software applications require high performance, compact size, energy efficiency, and cost-effective development.

Today more than 120+ companies in the world with currently over 450 million products sold, have already chosen MicroEJ to design electronic product applications in a large variety of industries, including smart home, wearables, healthcare, industrial automation, retail, telecommunications, smart city, building automation, transportation, etc.

Learn more about VEE Energy at:
https://www.microej.com/market/energy-utilities/ or reach out to hello@microej.com for more details.

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