EPISENSOR

Selecting Electricity Meters for
Effective Energy Management

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Summary

IoT has transformed energy management by facilitating highly accurate, real-time energy monitoring and the integrations necessary for visualising and analysing real-world energy data within minutes. This data empowers energy managers to make meaningful decisions about the introduction of onsite renewable energy sources, battery infrastructure, demand flexibility, carbon impact, energy efficiency, and much more. However, given the vast and varied specialist market energy monitoring technology, selecting the right devices for your energy management project can be challenging.

This guide has been written specifically for Facilities Managers, Energy Managers, and System Integrators to help with selecting and evaluating electricity metering systems.

It's intended to be a practical reference guide and checklist for anyone involved in energy metering equipment selection, to ensure you make informed decisions aligned with your energy management goals or those of your clients.

Written by experts with over 30 years of experience in IoT and energy management, you can expect to learn about the essential capabilities and 'must-have' features for effective monitoring of electricity consumption. Whether you're planning a new energy management project or looking to upgrade or expand existing systems, this guide will equip you with the knowledge to choose meters that meet your needs and contribute to effective energy management strategies.

Understanding
Electricity Meter Accuracy

What is the Electricity Meter Accuracy Class?

Electricity meter accuracy class refers to the level of precision a meter can achieve when measuring electrical energy consumption. It is typically expressed as a percentage and is defined by international standards. The accuracy class tells you how close the meter's measurements are to the actual energy consumed, under specified operating conditions.

For example, a Class 0.5S meter has a maximum permissible error of ±0.5% under reference conditions. However, as we'll explore later in this guide, the real-world accuracy can be quite different from this nominal value.

IEC Standards for Electricity Meters

The International Electrotechnical Commission (IEC) has established several standards describing electricity meter accuracy requirements. These standards ensure consistency and reliability in energy measurements across different applications and regions. When evaluating meters, look for compliance with these standards as a baseline requirement.

For most **energy management** applications, meters complying with IEC 62053-22 Class 0.5S are sufficient. Higher accuracy classes (like 0.2S) are not required for most energy management applications and can increase costs without providing proportional benefits.

IEC 62053-21

Specifies requirements for static meters for active energy (Class 1 and 2)

IEC 62053-22

Defines requirements for static meters for active energy (Class 0.2S and 0.5S)

ⓘ **Suitable for most energy management projects**

IEC 62053-23

Outlines requirements for static meters for reactive energy (Class 2 and 3)

Factors Affecting
Meter Accuracy

1. System-Level Accuracy vs. Individual Component Accuracy

When assessing meter accuracy, it's crucial to consider the **entire measurement system** rather than focusing solely on individual components.

This approach provides a more realistic representation of the measurement accuracy that can be expected in real-world applications. When comparing data collected to energy bills, it's the system-level accuracy that matters.

System-level accuracy encompasses:

> The electricity meter itself

> Current transformers (CTs)

> Voltage transformers (VTs) or potential transformers (PTs), if used

> Wiring and connections

> Environmental factors

Factors Affecting
Meter Accuracy

2. Callibration

Proper meter calibration with its associated current transformers (CTs) is essential for achieving high system level accuracy. Calibration involves adjusting the meter's readings to match a known reference standard.

This process prevents various factors from affecting accuracy, such as:

- > CT ratio errors

- > Phase angle errors

- > Non-linearity in the measurement circuit

- > Temperature effects

Factory calibration, where meters and CTs are calibrated together as a system before shipment to site, is ideal for ensuring optimal performance from electricity meter installation. For example, some advanced metering systems come factory-calibrated with their CTs as standard.

It's worth noting that recalibration is not usually required after the initial factory calibration for most energy management applications, provided the meters are installed and used within their specified operating conditions.

Factors Affecting
Meter Accuracy

3. Accuracy Calculation and Specifications

Understanding how meter accuracy is defined is crucial for interpreting product datasheets correctly. Accuracy classes are often expressed as a percentage of the meter's **full-scale value** (the maximum measurement capability), not the actual measured value. This means that while the **absolute error** remains constant across the measurement range, the **relative error** increases at lower loads.

For example, a meter with Class 1 accuracy (±1% of full scale) and a full-scale value of 300 A will have an absolute error of ±3 A *regardless of the measured current*. At full load (300 A), this represents a relative error of ±1%. However, at a lower load of 30 A, the same absolute error of ±3 A translates to a relative error of ±10% (effectively meaning meter data could be off by up to 10% vs the actual value).

This highlights that even if a meter claims a high level of accuracy, it may not provide precise measurements at lower loads, which are common in many applications. It's essential to consider the meter's performance across the entire expected load range and not just at full scale.

We'll explore a detailed example calculation in Section 6 to illustrate how system-level accuracy is affected by these factors in real-world conditions.

> **Key Takeaway:** Accuracy classes are often expressed as a percentage of the meter's full-scale value, not the actual measured value. This means that while the absolute error remains constant, the relative error increases at lower loads. Check with your supplier how the meter performs across the full measurement range!

Factors Affecting
Meter Accuracy

4. Measurement Range and Load Considerations

Meters need to maintain high accuracy across a wide range of loads to be effective in real-world applications. The measurement range, which defines the span from minimum to maximum load where the meter maintains its specified accuracy, is an important specification to consider. A wide measurement range is crucial for accurate readings across varying load conditions.

When selecting current transformers (CTs), it's important to match their rating to the expected load range:

01 › Estimate the expected load range for the application.

02 › Choose CTs with a rated current that places the expected load within 20-80% of the CT's measurement range.

03 › Consider using Rogowski coils for applications with widely varying loads.

04 › Be aware of potential overload conditions and ensure the CT can handle short-term overloads without saturation.

Further reading: Considerations when choosing Current Transformers.

Factors Affecting
Meter Accuracy

5. Power Factor Effects

Power factor is the ratio of real power (measured in watts) to apparent power (measured in volt-amperes) in an electrical system. It's a dimensionless number between 0 and 1, with 1 indicating that all power is being used effectively to perform work, and lower values indicating that some power is being wasted.

Accuracy specifications are usually quoted for pure resistive loads (power factor = 1). However, real-world conditions often involve varying power factors. These can affect measurement accuracy. Power factor variations can impact the magnitude and phase angle measurements, potentially leading to significant errors if not accounted for.

When evaluating meters, look for:

S Meters with an "S" in their class rating
(e.g., Class 0.5S) are designed to maintain accuracy across a wider range of power factors

Ability to measure active, reactive, and apparent power separately

Performance specifications across different power factors

Factors Affecting
Meter Accuracy

6. Sample Rate and Data Granularity

The **frequency at which a meter samples the electrical parameters is crucial** for capturing fast variations in power consumption. Higher sample rates allow for:

> More accurate monitoring of rapid load changes

> Better representation of non-sinusoidal waveforms

> More precise energy consumption profiling

For example, a sample rate of 8kHz provides high-resolution data for accurate measurements, which is considered best-in-class for energy management applications.

Data granularity is another important consideration. The **ability to produce data at frequent intervals (e.g., every second)** allows for detailed analysis of energy consumption patterns. However, it's important to balance this with your data storage and analysis capabilities within your BMS or energy management platform.

Factors Affecting
Meter Accuracy

7. Temperature and Environmental Effects

Meter accuracy can be affected by environmental conditions, particularly temperature. When evaluating meters, consider:

> Operating temperature range

A wide range, such as –30°C to 60°C, ensures reliable operation in various environments

> IP (Ingress Protection) rating

High ratings like IP67 provide excellent protection against dust and water ingress, meaning systems can be installed both indoors and outdoors, as well as in extreme industrial conditions (such as consistent power washing)benefiting both indoor and outdoor installations

> Temperature coefficient

How much the meter's accuracy changes per degree of temperature change

> Self-heating effects

Lower power consumption in the meter reduces self-heating

Key Takeaway:

Meters with high environmental ratings and wide operating temperature ranges contribute to long-term stability, accuracy, and reliability in a variety of installation settings.

Factors Affecting
Meter Accuracy

8. Current Transformer Safety and Selection

Current transformers (CTs) are vital components of the metering system. They are used to safely measure large currents by producing a lower current proportional to the current in the circuit being monitored. However, traditional CTs can pose safety risks if not properly selected and installed. If a traditional CT's secondary circuit becomes open while the primary circuit is energised, it can generate dangerously high voltages, which can be a serious hazard for installers and damage equipment.

To mitigate these risks, use CTs with built-in safety features that prevent high voltage generation under open-circuit conditions. This protection is not solely due to a milliamp output but is a result of internal design elements such as built-in burden resistors or voltage-limiting devices. For example, CTs designed with internal burden resistors limit the voltage that can develop across the secondary winding if it becomes open-circuited.

Another safe option is to use CTs that inherently prevent dangerous voltages under open-circuit conditions, such as **Rogowski coils**.

What are Rogowski Coils?

Rogowski coils are air-cored CTs that produce a voltage output proportional to the rate of change of current, and they do not produce high voltages under open-circuit conditions. Meters with an on-board integrator that can support Rogowski coils provide valuable flexibility and safety in various applications.

Factors Affecting
Meter Accuracy

9. Installation and Configuration

Ease of installation and configuration can significantly impact the overall accuracy and reliability of a metering system.

Key Factors to consider include:

> ### Pre-configuration
>
> Meters that come CTs pre-configured and connected reduce the potential for installation errors.

> ### Power supply
>
> Meters that can be powered from the load they're monitoring simplify installation compared to those requiring an external power supply.

> ### Communications setup
>
> Systems with plug-and-play communications are easier to set up than those requiring complex protocol configuration.

> ### Included accessories
>
> Check if all necessary accessories (CTs, cables, etc.) are included to avoid compatibility issues

Systems that minimise on-site configuration can significantly reduce installation time and the potential for errors.

What's next? In the next section, we'll discuss how to plan your energy management project, including determining the number of metering points needed and considerations for system scalability.

Energy Management
Project Planning

1. Determining the Number of Metering Points

When planning an energy management project, one of the key decisions is determining how many metering points to install. A common rule of thumb is to aim for visibility of every €/$ 5,000 to €/$ 15,000 of annual electricity spend. For example, in an organisation with a total annual electricity spend of €/$ 1 million, this approach would suggest deploying between 67 to 200 metering points.

However, the exact number will depend on various factors, including:

- The complexity of the facility's electrical system.
- The diversity of loads and processes.
- The potential for energy savings in different areas.
- Budget constraints.
- Regulatory requirements.

It's important to start with a strategic approach, focusing on major loads and areas where you suspect inefficiencies. As you gather data and gain insights, you can then **expand your metering system to cover more granular areas of interest, referred to as sub-metering.**

Energy Management
Project Planning

2. Flexibility and Scalability

Energy management projects are quite often a voyage of discovery. As you gather data and identify inefficiencies, you may need to add more metering points or relocate existing ones. Therefore, flexibility to expand the system easily is crucial.

When evaluating metering systems, consider:

› Scalability

How many meter points can a single Gateway or data concentrator support? Systems that can scale to hundreds of 3-phase meter points from a single Gateway offer excellent flexibility for future expansion.

› Software adaptability

The energy management software you choose should be able to easily incorporate new metering points and adjust its analytics accordingly.

› Ease of adding new meters

Wireless systems often offer greater flexibility for expansion compared to wired solutions.

› Data handling capacity

Ensure the system can handle the increased data flow as you add more metering points.

By choosing a flexible and scalable system from the outset, you can ensure that your energy management project can evolve and grow alongside your understanding of your facility's energy usage patterns.

> **Key Takeaway:** A common rule of thumb is to aim for visibility of every €/$ 5,000 to €/$ 15,000 of annual electricity spend when determining the number of metering points. Choose a system that is easy to scale and integrate so you can add meters as needed.

Evaluating Electricity Meters for Success in Energy Management

When reviewing meter specifications and supplier websites, it's important to look beyond the headline figures and consider how the meters will perform in real-world conditions. Here, **we examine what is considered 'gold standard' and identify 'red flags' to watch out for during the procurement process.**

Key Considerations When Evaluating Electricity Meters

🎯 Accuracy and Performance

1. What is the accuracy of the metering solution?

✅ The supplier should provide a system-level accuracy that accounts for the meter, CTs, and any other components. A Class 0.5S accuracy (according to IEC 62053-22) is excellent for energy management applications. The supplier should be able to explain how this accuracy is calculated and maintained across different load levels.

❌ **Red Flags:**
- Only stating meter accuracy without considering CTs and other components
- Inability to explain how system-level accuracy is determined
- Accuracy classes lower than 0.5S for energy management applications

2. What is the measurement range of the metering system?

✅ The meter should maintain its specified accuracy across a wide range of loads, typically from 5% to 120% of the rated current. The supplier should be able to explain how accuracy is maintained across the full measurement range.

❌ **Red Flags:**
- Narrow measurement ranges that don't cover the expected load variations
- Significant accuracy reductions at lower load levels

3. How does the meter perform across different power factors?

✅ The meter should maintain specified accuracy across a range of power factors (typically 0.5 lagging to 0.8 leading). Look for "S" class meters (e.g., 0.5S) which are designed for better performance across varied power factors.

❌ **Red Flags:**
- Only specifying accuracy at a unity power factor (e.g. 1)
- Significant reductions in accuracy at non-unity power factors (less than 1)

Key Considerations When Evaluating Electricity Meters

🎯 Accuracy and Performance (cont.)

4. What is the sample rate of the meter?

✅ A sampling rate of 8kHz or higher is considered best-in-class for energy management applications. This allows for accurate capture of rapid load changes and better representation of non-sinusoidal waveforms.

❌ **Red Flags:**
- Sample rates of multiple seconds, which will miss important variations in power consumption
- Inability to specify the actual sampling rate

5. What parameters does the meter measure?

✅ Comprehensive metering solutions should measure a wide range of RMS (Root Mean Square) parameters, including:
- Voltage and current (per phase and average)
- Active, reactive, and apparent power
- Power factor
- Frequency
- Individual harmonics (at least up to the 15th order)

❌ **Red Flags:**
- Limited to basic parameters like total kWh only
- Meters that measure current only and not voltage or power factor, as these will be wildly inaccurate
- Inability to measure reactive power or power factor

Key Considerations When Evaluating Electricity Meters

Installation and Usability

1. How are the meters configured for installation?

✅ Meters should come pre-configured with their CTs, requiring minimal on-site setup. The supplier should offer options for factory configuration based on site requirements.

❌ **Red Flags:**
- Requiring extensive on-site configuration of CT ratios and other parameters
- Lack of clear documentation or support for the configuration process

2. How is the meter powered?

✅ The ability to power from the monitored load simplifies installation. If this isn't possible, the meter should have flexible power supply options (e.g., wide-range AC/DC input).

❌ **Red Flags:**
- Requiring a separate auxiliary power supply for each meter without clear justification
- Narrow input power range that may necessitate additional power conditioning

3. What types of current transformers (CTs) does the meter support?

✅ The meter should support a variety of CT types, including split-core CTs for easy installation and Rogowski coils for high-current applications or installations with space constraints. Support for Rogowski coils is particularly important for future-proofing and flexibility.

❌ **Red Flags:**
- Limited CT options
- Lack of support for Rogowski coils
- Proprietary CT connections that limit future flexibility

Key Considerations When
Evaluating Electricity Meters

Installation and Usability (cont.)

4. What accessories are included with the meter?

✅ All necessary components for a complete installation should be included or specified as additional items. This typically includes CTs, voltage taps, and any required communication modules.

❌ **Red Flags:**
- Needing to source critical components separately without clear guidance
- Unclear or incomplete bills of materials for a typical installation

Data Management and Communication

1. What communication protocols does the meter support?

✅ The meter should support modern, standards-based protocols that offer security and flexibility. Zigbee or similar protocols are good for their ease of use and robust features. Cellular options are also good for certain applications. The supplier should be able to explain the pros and cons of each supported protocol for your specific application.

❌ **Red Flags:**
- Reliance on older or proprietary protocols that may limit future integration options
- Protocols with limited data rates or high latency (e.g. some LoRaWAN implementations)
- Modbus, while widely supported, can be difficult to configure and work with, especially for cloud integration

Key Considerations When Evaluating Electricity Meters

Data Management and Communication (cont.)

2. What is the data reporting interval, and can it be adjusted?

✅ The meter should be capable of reporting data at frequent intervals (e.g. every second) for detailed analysis, but also allow for longer intervals to manage data volume. The ability to adjust reporting intervals without requiring a site visit is valuable.

❌ **Red Flags:**
- Fixed, infrequent reporting intervals (e.g. 15-minute intervals only)
- Inability to adjust reporting intervals remotely

3. What local data logging capabilities does the meter have?

✅ The meter should have substantial local storage to prevent data loss during communication outages. Capacity for months or years of local data storage is excellent. The supplier should be able to specify the storage capacity in terms of a number of data points or a time period at a given reporting interval.

❌ **Red Flags:**
- Limited local storage (only days or weeks)
- No local storage capability
- Unclear specifications about storage capacity or data retention period

4. In what format is the energy consumption data provided?

✅ The system should provide a value representing the kWh consumption during each reporting interval. This format is more useful for analysis than cumulative kWh data. The supplier should be able to explain how their data format facilitates easy integration with energy management software and data analysis tools.

❌ **Red Flags:**
- Only providing cumulative kWh data without the ability to easily calculate interval consumption
- Proprietary data formats that may complicate integration with third-party software

Key Considerations When Evaluating Electricity Meters

Data Management and Communication (cont.)

5. How does the system handle data retrieval after a communication

✅ The system should automatically backfill missing data once communication is restored, without requiring manual intervention. The supplier should be able to explain the process and any limitations (e.g., maximum outage duration that can be recovered).

❌ **Red Flags:**
- Manual processes required to retrieve missing data
- Inability to recover data after short communication outages

6. What safety features are incorporated into the CTs?

✅ The meter should have substantial local storage to prevent data loss during communication outages. Capacity for months or years of local data storage is excellent. The supplier should be able to specify the storage capacity in terms of a number of data points or a time period at a given reporting interval.

❌ **Red Flags:**
- Limited local storage (only days or weeks)
- No local storage capability
- Unclear specifications about storage capacity or data retention period

7. What is the environmental rating of the meter?

✅ The meter should have a high IP (Ingress Protection) rating, with IP67 being excellent for both indoor and outdoor installations. This level of protection contributes to long-term reliability and accuracy by protecting the internal components from dust and water ingress.

❌ **Red Flags:**
- IP ratings lower than IP54, particularly for industrial or outdoor settings
- Lack of clear environmental specifications

Key Considerations When Evaluating Electricity Meters

Data Management and Communication (cont.)

8. What standards does the meter comply with?

✅ The meter should comply with relevant international standards for metering accuracy, ideally IEC 62053-22 for meter accuracy (Class 0.5S or better). The supplier should be able to provide certificates or test reports demonstrating compliance.

❌ **Red Flags:**
- No mention of compliance with international accuracy standards
- Inability to provide documentation supporting compliance claims

Security and Future-Proofing

1. How are firmware updates handled?

✅ The system should support secure, over-the-air (OTA) firmware updates. This is essential for maintaining security and adding new features over time. The supplier should be able to explain:

- The update process and any downtime required
- How update integrity and authenticity are verified
- The typical frequency of updates and what they include

❌ **Red Flags:**
- No support for firmware updates
- Updates requiring physical access to each meter
- Unclear or insecure update processes

Key Considerations When Evaluating Electricity Meters

Security and Future-Proofing (cont.)

2. What cybersecurity measures are in place?

✅ The system should incorporate robust cybersecurity features, including:

- Encryption of all communications from end to end
- Secure authentication for device access and management
- Regular security patches and updates via OTA firmware updates

❌ **Red Flags:**

- Lack of basic security features like encryption
- No clear process for addressing security vulnerabilities
- Inability to provide detailed information about security measures

3. How flexible is the system in adding new features or adapting to new requirements?

✅ The system should have a clear roadmap for future enhancements. Look for:
- Regular software/firmware updates that add new features
- Ability to enable new functionality through licence upgrades rather than hardware replacement
- Open APIs or similar interfaces that allow for integration with new systems or technologies

❌ **Red Flags:**

- No clear plan for future enhancements
- Rigid systems that cannot adapt to changing requirements without complete replacement

Key Considerations When Evaluating Electricity Meters

Security and Future-Proofing (cont.)

4. How easy is it to add new meters to the system?

✅ The system should allow for easy addition of new metering points without requiring significant reconfiguration or downtime. Look for:
- Plug-and-play functionality for new meters
- Automatic discovery and integration of new devices
- Ability to add meters without disrupting existing measurements

❌ **Red flags:**
- Complex procedures for adding new meters
- Need for system-wide reconfiguration when adding devices
- Limitations on the number of devices that can be added

Support and Longevity

1. What kind of technical support and documentation is available?

✅ The supplier should offer comprehensive support, including:
- Detailed installation and user manuals
- Regular training sessions or webinars
- Responsive technical support (specify response times)
- Online knowledge base or FAQs

The supplier should be able to provide sample documentation and explain their support process.

❌ **Red Flags:**
- Limited or unclear support options
- Lack of comprehensive documentation
- Long response times for technical queries

Key Considerations When Evaluating Electricity Meters

Support and Longevity (cont.)

2. What is the expected lifespan of the metering system?

✅ Quality metering equipment should have a lifespan of 10-15 years or more. The supplier should be able to provide:

- Expected lifespan under typical operating conditions
- Any regular maintenance requirements to achieve this lifespan
- Track record of long-term reliability from existing installations

❌ **Red Flags:**

- Short expected life spans without clear justification
- Lack of information on long-term reliability
- Frequent need for replacement parts or maintenance

3. What warranty is provided, and what does it cover?

✅ Look for a comprehensive warranty that:

- Can be extended to at least 5 years
- Covers all hardware components
- Includes clear returns procedures
- Provides access to a helpdesk for support

The supplier should be able to provide detailed warranty terms and explain the claim process.

❌ **Red Flags:**

- Short warranty periods (less than 2 years)
- Warranties that exclude key components or common failure modes
- Unclear or complicated warranty claim processes

Key Considerations When Evaluating Electricity Meters

Support and Longevity (cont.)

4. How many metering points can the system support?

✅ The system should be able to scale to support your future needs. Look for:

- Ability to support hundreds of 3-phase meter points from a single data concentrator or Gateway
- Clear explanation of any limitations on system size
- Examples of large-scale deployments

❌ **Red Flags:**
- Low limits on the number of supported meters
- Significant performance degradation as the system scales
- Need for complete system overhaul to add more meters

5. How does the system integrate with other energy management software platforms or building management systems (BMS)?

✅ The system should offer flexible integration options, such as:

- Pre-built integrations with leading energy management software providers
- Standard protocols for integration with building management systems
- RESTful APIs for custom integrations

The supplier should be able to provide documentation on integration methods and examples of successful integrations with other systems.

❌ **Red Flags:**
- Closed systems with no external integration options
- Integrations that require expensive, proprietary middleware
- Lack of documentation or support for integration efforts
- Reliance solely on protocols like Modbus, which can be difficult to work with for cloud integration

Example: Real-World Accuracy Calculation

To illustrate the importance of understanding meter specifications in real-world contexts, let's consider a detailed example calculation for a variable load in a manufacturing plant:

System characteristics:

- **Nominal line-to-line voltage:** 400V (phase voltage: 230V)
- **Current transformers:** 300A/5A, Class 1 accuracy
- **Meter:** Class 1 accuracy
- **CT cable length:** 3m (not accounted for in calibration)
- **Load:** Manufacturing process varying between 80A and 300A

Accuracy Calculation
Manufacturing - cont.

Full-scale value calculation:

- Full-scale current: 300A
- Full-scale power: 300A * 400V * √3 = 207.8 kW

We use √3 (approximately 1.732) because we're calculating the total power across all three phases in a balanced system. The √3 factor accounts for the phase relationship between voltage and current in a 3-phase system.

Accuracy calculation:

- Meter accuracy: Class 1 (±1% of full scale) = ±2.078 kW
- CT accuracy: Class 1 (±1% of full scale) = ±2.078 kW
- Cable effect (estimate): ±0.5% of full scale = ±1.039 kW
- System-level accuracy: Sum of errors = ±5.195 kW

Measurement Error:

a) At high load (300A):

- True power: 300A * 400V * √3 = 207.8 kW
- Measured power: 207.8 kW ± 5.195 kW
- Relative error: (5.195 / 207.8) * 100 = ±2.5%

b) At low load (80A):

- True power: 80A * 400V * √3 = 55.4 kW
- Measured power: 55.4 kW ± 5.195 kW
- Relative error: (5.195 / 55.4) * 100 = ±9.4%

This example illustrates how the error can be significantly higher than the accuracy class might suggest, especially at lower loads. At full load, the error is 2.5%, which is already higher than the Class 1 specification. However, at the lower end of the load range, the error increases dramatically to 9.4%.

It's important to note that this calculation doesn't account for additional factors such as power factor variations, harmonics, or temperature effects, which could further degrade accuracy in real-world conditions.

> **Key Takeaway:** It's crucial to consider system-level accuracy and the full range of operating conditions when specifying metering equipment for energy management projects. Traditional meter specifications can be misleading, especially for loads with high variability.

Advanced Metering Features

Modern electricity meters often have advanced features that can significantly enhance energy management capabilities. What to look for:

1. Power Quality Monitoring

While detailed power quality analysis isn't typically necessary for basic energy management, some level of power quality monitoring can be valuable.

Power quality refers to the 'health' and stability of your electrical supply—it's not just about having electricity, but ensuring that the electricity is clean and stable. Poor power quality can lead to equipment malfunctions, reduced lifespan, inefficiencies, and increased energy costs. Issues like voltage dips, swells, transients, harmonics, and frequency variations can disrupt operations.

Imagine electricity as a highway and your equipment as cars travelling on it. If the road is smooth and well-maintained, cars can travel safely and efficiently. But if the road has potholes, sudden bumps, or obstacles—representing voltage sags, spikes, and harmonics—it can slow down the cars or even cause damage.

Advanced meters with power quality monitoring capabilities can measure and report on:

› Voltage variations

Identifying fluctuations that can affect equipment performance (sags, swells, transients)

› Power factor

Monitoring the efficiency of power usage and identifying opportunities for correction.

› Current and voltage harmonics

Detecting distortions in the electrical waveform that can cause overheating and inefficiencies.

› Frequency variations

Ensuring the stability of the supply frequency, which is critical for sensitive equipment.

By monitoring these parameters, you can identify and address power quality issues, which can lead to improved equipment performance, extended equipment life, and energy savings.

Advanced
Metering Features

2. Demand Flexibility Capabilities

If your organisation participates in or plans to participate in demand flexibility programmes, look for meters with built-in capabilities. These might include:

- Real-time power monitoring
- Ability to receive and respond to demand response signals
- Load control or curtailment features

💡 **What is Demand Flexibility?** Demand Flexibility allows commercial and industrial energy consumers to earn financial incentives in return for reducing, delaying or interrupting their electricity consumption - or moving to backup power for short periods.

3. Local Data Logging

Local data storage is crucial for ensuring data integrity in case of communication outages. When evaluating meters, consider:

- **Storage capacity:** Look for substantial local storage. Months or years of local data storage is excellent.
- **Data retention:** Ensure the meter can retain data for extended periods.
- **Data recovery:** Check how easily data can be retrieved from local storage once communication is restored.

4. Interval vs. Cumulative kWh Data

The way energy consumption data is presented can significantly impact its usability. Two common approaches are:

1. **Cumulative kWh**: Shows total energy consumed since a specific start point. This appears as an ever-increasing line on a graph.
2. **Interval kWh:** Shows energy consumed in each reporting interval (e.g. every 15 minutes). This is much easier to graph and analyse.

When evaluating meters, choose products that provide a value representing the kWh consumption during each reporting interval, as this format is generally more useful for energy management purposes.

Checklist for Evaluating Electricity Meters

Use this checklist when evaluating electricity meters for your energy management project.

Rate each aspect as **Good**, **OK**, or **Poor** based on the supplier's responses to the questions above. This evaluation process, in conjunction with your organisation's unique needs and priorities, should help you make an informed decision on electricity metering equipment.

Electricity Meter Evaluation Checklist

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| Supplier | | Date | |

Aspect	Good	OK	Poor
Accuracy and Performance			
System-level accuracy			
Measurement range			
Performance across power factors			
Sampling rate			
Range of measured parameters			
Installation and Usability			
Pre-configuration			
Power supply options			
CT support (incl. Rogowski)			
Included accessories			

Electricity Meter Evaluation Checklist

EPISENSOR

Aspect	Good	OK	Poor
Data Management and Comms			
Communication protocols			
Data reporting intervals			
Local data logging			
Energy data format			
Data retrieval after outages			
Safety and Compliance			
CT safety features			
Standards compliance			
Environmental rating			
Included accessories			
Security and Future-Proofing			
Firmware update process			
Cybersecurity measures			
Adaptability to new requirements			
Ease of adding new meters			

Electricity Meter Evaluation Checklist

Aspect	Good	OK	Poor
Support and Longevity			
Technical support and docs			
Expected lifespan			
Warranty coverage			
Scalability and Integration			
System scalability			
Integration capabilities			

Key Takeaways

In summary, the key points to remember when selecting electricity meters include:

- Look for system-level accuracy and performance across your expected load range.

- Prioritise ease of installation, scalability, and the ability to add new meters easily.

- Ensure the system provides the data granularity and storage capabilities you need.

- Consider safety features, particularly for CTs, and compliance with relevant standards.

- Evaluate the security measures, including encryption and over-the-air firmware update capabilities.

- Look for pre-built integrations with leading energy management software providers.

- Consider the long-term support, warranty, and future-proofing aspects of the metering system.

By staying informed about meter accuracy considerations and leveraging advanced metering solutions, energy professionals can contribute to more efficient, sustainable, and cost-effective energy usage within their organisations and client base.

As you embark on or expand your energy management projects, keep these principles in mind, use the provided checklist, and choose solutions that provide the accuracy, flexibility, and scalability needed to support your organisation's energy efficiency goals.

Related Content

IEC 62053-22: Standard for static meters for active energy (classes 0,2 S and 0,5 S)

OIML R 46-1 / R 46-2: International Organisation of Legal Metrology Recommendations for active electrical energy meters

"Handbook of Energy Audits" by Albert Thumann and William J. Younger

"Energy Management Principles: Applications, Benefits, Savings" by Craig B. Smith

"Pocket Handbook on Electrical Measurements" Siemens AG, 1966

Remember, while these resources provide valuable information, the field of energy management is continually evolving. Stay connected with industry associations, attend relevant conferences, and engage with meter manufacturers to stay abreast of the latest developments and best practices in energy metering and management.

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