Optimization of Energy Usage

ODVA's Vision of Energy Optimization for the Industrial Consumer . . .

. . . comprehensive

. . . scalable

. . . inclusive

. . .open

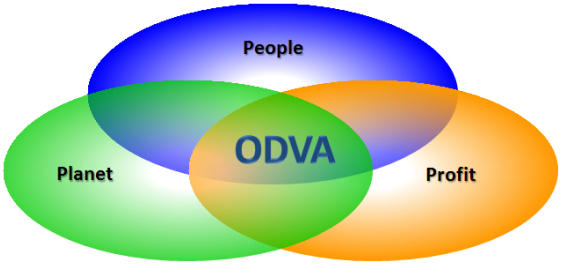
About ODVA

Founded in 1995, ODVA is a global trade association whose members are comprised of the world's leading automation companies that make and sell products compliant with ODVA technologies. ODVA's mission is to advance open, interoperable information and communication technologies in industrial automation and thus create value for our members, adopters, alliance partners and employees. ODVA's vision is to contribute to the sustainability and prosperity of our global community by transforming the model for information and communication technology in the industrial ecosystem. For more information about ODVA, visit ***www.odva.org****.*

Executive Summary

For the industrial sector, energy consumption statistics are eye popping. The industrial sector alone consumes about half of the world's total delivered energy, making it the largest end-use sector. Moreover, although global industrial energy consumption is projected to increase by more than 40%, as measured from the beginning of the recent economic crisis in 2007 to 2035, emerging economies in non-OECD countries will account for approximately 95% of this increase in consumption. [1, 2]

Thus, optimization of energy usage is a natural and necessary expansion of ODVA's application coverage for industrial automation. ODVA envisions an energy solution for the industrial energy consumer that will be comprehensive, scalable, open, and inclusive for both users and their vendors. Within this context, ODVA's vision of optimization of energy usage will emerge as the natural sweet spot to help industrial consumers meet their overall business objectives and achieve greater societal goals for sustainability. ODVA's energy approach will offer broad situational awareness of energy consumption and enable control strategies to optimize energy usage throughout the industrial ecosystem from the plant floor to the grid. This approach will enable businesses to improve productivity and thus profits while concurrently benefiting people and our planet through better utilization of energy resources.



In this white paper, ODVA describes the opportunity for optimization of energy usage (OEU™) in the industrial sector and an overview of ODVA's vision of a comprehensive approach to energy optimization for the industrial ecosystem including:

- OEU in the industrial ecosystem;
- ODVA's vision of OEU in the Production domain;
- Industrial use cases for OEU;
- ODVA's technical approach to OEU; and
- OEU in practice.

The audience for this white paper includes both sustainability executives at industrial consumers and product managers at device vendors who are seeking to map out their product roadmaps to support sustainability objectives and business goals.

OEU in the Industrial Ecosystem

OEU results from the industrial consumer being empowered with the ability to make informed choices regarding the use and conservation of energy. Although OEU is a natural expansion of ODVA's application coverage in the Production domain, ODVA envisions a comprehensive approach to OEU for the industrial consumer which encompasses three domains of the industrial ecosystem – production, enterprise and power grid – as depicted in Figure 1. This vision inherently recognizes the value of the smart use of energy for production processes, while enlarging the possibility to view and use energy as a shared resource and common currency across three domains critical to the industrial consumer.

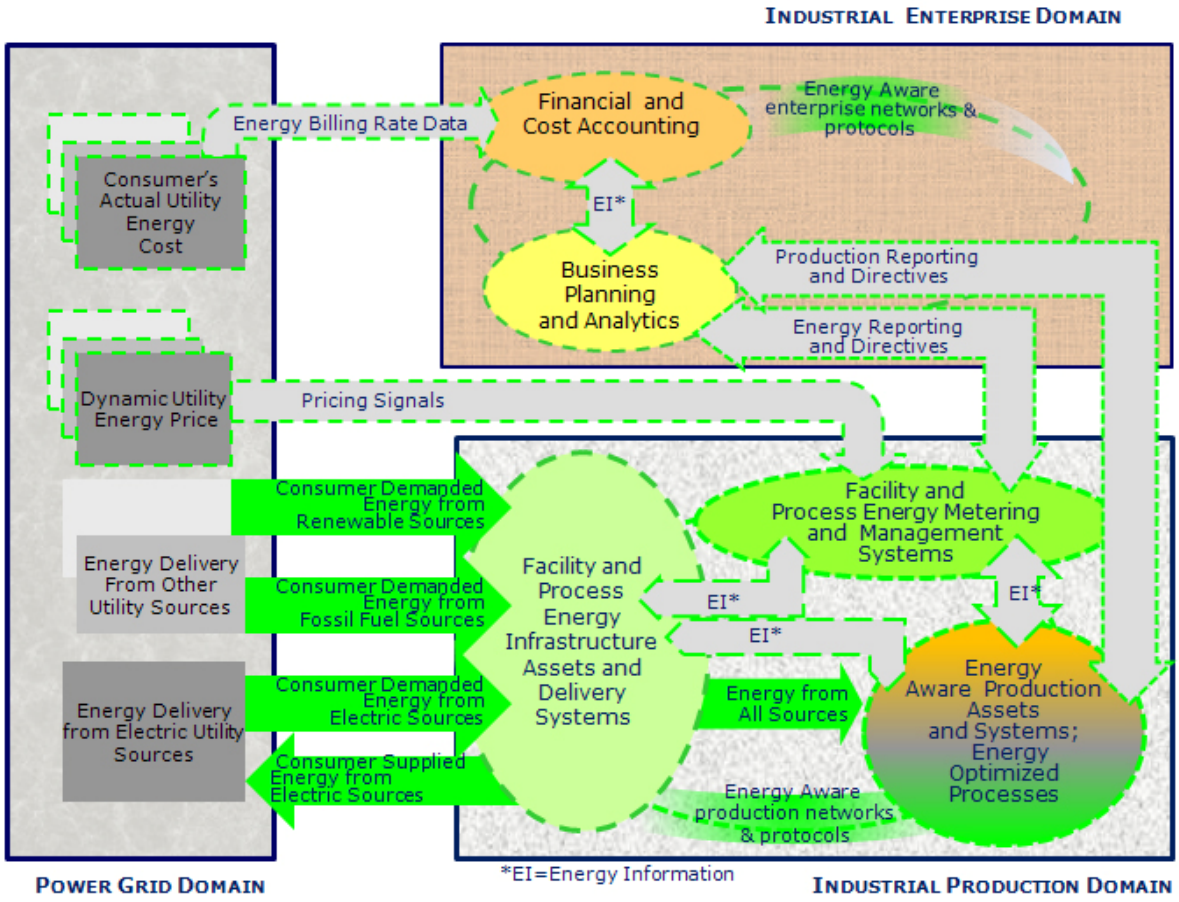


FIGURE 1: OEU IN THE INDUSTRIAL ECOSYSTEM

ODVA's plan for OEU leverages the core competency of ODVA's information and communication technologies, which are grounded in its media independent network protocol – the Common Industrial Protocol or CIP™. For OEU between processes and other systems in the Production domain, ODVA seeks to include energy-oriented objects and services within CIP that permit the transparent and seamless flow of energy information and enable systems to perform energy metering and management.
In the long term, OEU envisions demand-response mechanisms that will allow the industrial consumer to exchange energy with the power grid in a dynamic energy consumption-production environment.

ODVA's Vision of OEU in the Production domain

The Production domain, which consumes 80% of all energy used by industry[3], is the focal point of OEU. Within ODVA's vision, ODVA's large community of device vendors, who make and sell products for use in this domain, can collectively provide industry with an approach to OEU that is:

- **Comprehensive** in its long term view of the need for sustainability and the opportunities for return on investment;
- **Scalable** across the industrial ecosystem;
- **Inclusive** of products, devices and systems from the simple to the complex; and
- **Open** by virtue of its use of multivendor, interoperable standards managed by an independent, vendor-neutral organization.

The Production domain can be segmented into three layers - asset, system and process - where Assets combine together to create Systems, and Systems link together to define Process. OEU seeks to ensure that energy data is accessible in products at each of these layers in the Production domain in order to empower industrial consumers with the energy information they need to manage energy in a holistic manner. This approach forms the foundation for future energy optimization in terms of all of the interrelated components within the Production domain.

Further, technical innovations in energy optimization mechanisms in five key areas, as shown in Figure 2, offer the potential for measurable savings in energy consumption for the industrial sector which, by some estimates, could total more than $120 billion dollars in 2015[4,5]. Many of these mechanisms will fall within the next generation of productivity enhancements for manufacturing processes where energy becomes a measured cost and budgeted resource in the production bills of materials. However, information and communication technologies offer the possibility of an even greater vision – a vision which brings energy awareness of the Production domain into the Enterprise domain and enables the industrial consumer to transact energy for the best result to meet strategic objectives for return on investment and sustainability.

Industrial Use Cases for OEU

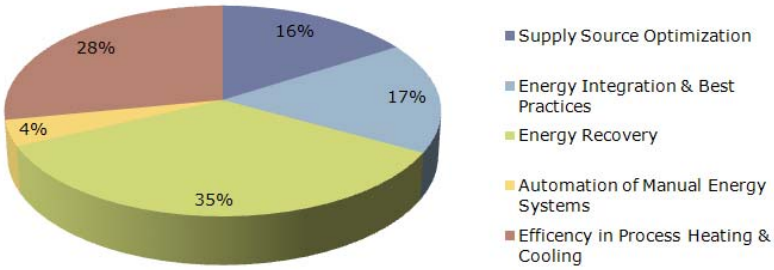


FIGURE 2: INNOVATION OPPORTUNITIES FOR SAVINGS IN INDUSTRIAL ENERGY CONSUMPTION

Although energy is critical to systems in the Production domain, production planners have not been provided with the tools needed to integrate energy explicitly in their resource allocation models for overall production efficiency. OEU will change this paradigm by enabling best practices in energy resource allocation by providing visibility to energy data throughout the layers of the Production domain. This visibility will allow businesses to apply familiar techniques currently used to make continuous improvements in processes in order to achieve new and continuous improvements in OEU.

Realization of OEU requires a three-pronged approach to typical use cases for the industrial consumer: (1) having awareness of energy usage; (2) consuming energy more efficiently; and (3) transacting energy for the best result. ODVA's three-prong approach for OEU results in natural groupings of use cases originating from a three-part working hypothesis:

Working Hypothesis for OEU Use Cases

1. *Energy is essential to produce products but has been an invisible line item on production bills of materials and consequently an unmanaged resource;*
2. *Energy should be a managed resource in the production domain; and*
3. *The availability of energy information and visibility of energy consumption will promote awareness by industrial consumers of the need to manage energy as a production resource which, in turn, will lead to best practices in OEU for the industrial consumer.*

OEU Use Case Type 1:
Awareness of Energy Usage

Energy awareness is the foundation of OEU. As a shared metric among all users and their vendors, energy awareness drives fundamental behavioral changes across all layers of the Production domain. Starting with simple and often free or low cost actions to reduce energy consumption (analogous to turning off the lights manually in an empty room), energy awareness works itself into the fiber of the corporate culture. Production planners will start including energy requirements into production bills of material. OEU helps to create a shared culture of best practices which paves the way for energy to be treated as a managed resource by the enterprise.

OEU Use Case Type 2:
Efficient Consumption of Energy

Efficient energy consumption is the accelerant for OEU. By leveraging automation and manufacturing execution systems, industrial consumers can consolidate energy information in order match overall power consumption levels and timing with specific production requirements. Energy monitoring and management promote efficient consumption and multiply the benefits of energy awareness by automating actions that reduce energy consumption. OEU allows existing automation to be enhanced to incorporate the functionality needed to realize new efficiencies in energy consumption in the Production domain, thus protecting the user's investment in existing technology.

OEU Use Case Type 3:
Transacting Energy for the Best Result

Transacting energy for the best result is the integrator for OEU. By leveraging asset management and internal facility and process energy delivery systems, the industrial consumer can interface with the Power Grid domain to procure and exchange energy for the best result. By dynamically and transparently managing demand-response mechanisms, industrial consumers will be able to transact energy to achieve individualized best results based on cost, source, supply or environmental impact.

The ODVA Technical Approach to OEU

Users will benefit from a multi-vendor, interoperable portfolio of products and solutions from ODVA's community of members for all three layers of the Production domain through the evolution of ODVA's open standards for OEU. To achieve this result, ODVA's technical approach will be:

"People do not use energy; they use devices and products. How devices and products are designed determines how we use them, which in turn determines rates of energy depletion."
Peter Crabb, Associate Professor of Psychology at Penn State Hazelton[6]

- Scalable – so that it will be easy for basic devices to be energy aware while still supporting optional supervisory functionality in more advanced devices in order to optimize energy usage at each layer of the production system;
- Flexible – so that energy information within a device can be accessed via multiple information and communication interfaces including, but not limited to, CIP; and,
- Prioritized – so that it will enable energy awareness in devices in the short term; will support delivery of a complete energy management application in the medium term; and will provide a comprehensive energy solution for the industrial consumer in the long term.

The foundation for ODVA's technical approach is the information and communication model for the OEU-enabled Asset. The OEU-enabled Asset is a network-connected, energy-aware device that has the ability to either measure or derive its energy usage based on its native

consumption or generation of energy, or report a nominal or static energy value. As shown in Figure 3, an OEU-enabled™ Asset is a device that contains the objects and services needed for basic energy awareness. Because the object-oriented approach of CIP allows for scalability in implementation, the device may support other more advanced functions for control of energy, aggregation and reporting of energy information or dynamic demand-response. OEU services in CIP will allow systems to monitor energy usage and manage energy for efficient energy consumption through dynamic control of energy state and analysis of energy information. Protocol neutral energy attributes allow for flexibility in the propagation of energy information via multiple protocols to facilitate an e-business model such as capturing energy requirements as a line item on production bills of material or to implement demand-response mechanisms for dynamic energy transactions.

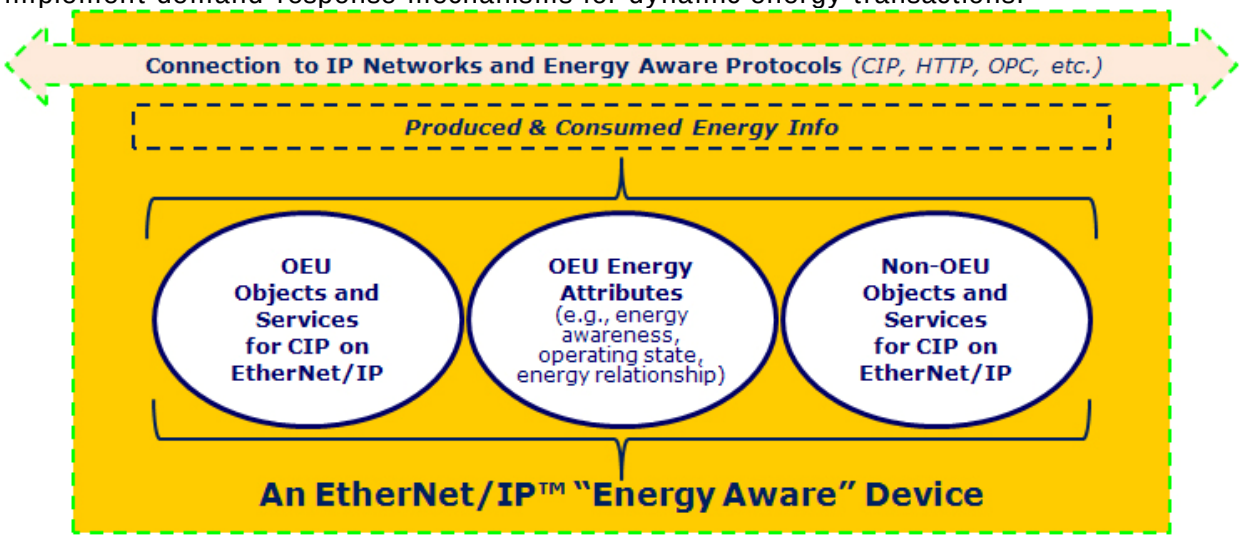


FIGURE 3: INFORMATION AND COMMUNICATION MODEL OF AN OEU-ENABLED ASSET

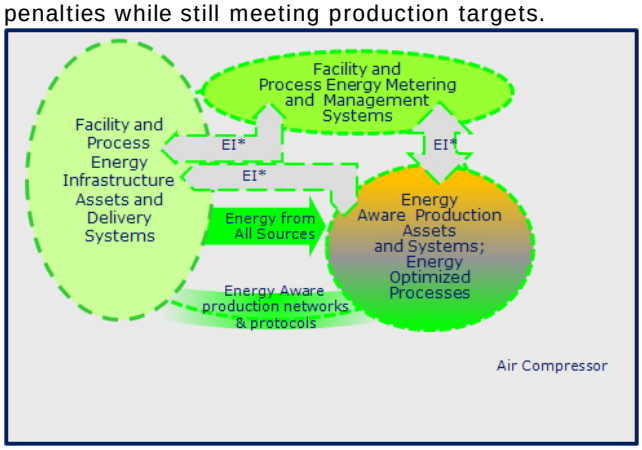
OEU in Practice: Realizing the Natural Sweet Spot of Sustainability

OEU allows industrial consumers to realize the natural sweet spot of sustainability. It views and treats energy as a shared resource within and between each domain of the industrial ecosystem. Within the Production domain itself, where the majority of energy is consumed, energy information needs to be available at all three layers – asset, system, process – where it is moved, presented, controlled and managed using a hierarchical organization. OEU is first realized when efficient consumption of energy is made possible through the energy integration of the process with energy systems for metering, management, and delivery. Ultimately, OEU will enable an optimized energy deployment and consumption approach that makes it possible to transact energy for the best result.

In practice, as an energy aware device or a self-contained machinery sub-system, an OEU-enabled production Asset will communicate its energy information up to the system level. Where a non-OEU-enabled Asset is a key energy consuming component in a System, the OEU approach allows energy information to be communicated through an ODVA-enabled energy meter or translated from non-CIP protocol for aggregation and assimilation of energy information from an entire System. Aggregated energy information from the Asset level is presented at the System level for further aggregation and/or assimilation. The result is that energy information can be consumed and manipulated more easily by systems such as PAC and SCADA where visualization and control decisions are made through the application of process-based decision rules.

Application Example: OEU-enabled Air Compressor

Typically a big energy consumer, an air compressor can be viewed as both an Asset and a system. As an OEU-enabled system, the compressor knows its overall energy footprint by virtue of its ability to aggregate the energy data from all of its native energy aware Assets or through energy data metered by an external device. Through integration of its energy information with the facility and process systems and automation of manual systems, a compressor can optimize energy usage through the implementation of best practices – such as adjusting operating parameters to reduce energy consumption while still maintaining adequate air output and pressure. When energy information is consolidated from the production domain and propagated back to the enterprise, business analytics can be used to plan when to operate the compressor to take advantage of lower tariff rates or avoid peak demand penalties while still meeting production targets.



The same actions of communication of energy information and its aggregation, visualization, or control can be applied throughout the Production domain at any level in production - the common data model is the key! This model reduces integration costs as energy information is moved through the production levels and is integrated with facility and process systems and the other industrial domains. The dynamic approach of OEU, further enabled by an IP-enabled communication model, allows processes to be optimized for efficient energy consumption while still balancing the key production goals of operator and product safety and operational efficiency.

ODVA's Commitment to OEU

ODVA views OEU as central to its long-term commitment to help industry realize its goals for sustainability. The definition and roadmap for OEU is the result of a lengthy investigation by ODVA and its leadership into the energy needs of industry combined with the strong interest by ODVA members to support the sustainability objectives of manufacturers. To help ensure the success of OEU, ODVA has established an ODVA energy initiative to help drive the activities within ODVA to ensure that OEU is part of ODVA's long term plans for innovation in its information and communication technologies and open standards. ODVA has established a Special Interest Group for Energy Applications to develop the standards needed for OEU. ODVA projects that OEU will start generating return on investment for users in 2012 with continuing incremental improvements possible each year as the focus and deliverables of ODVA's energy initiative progress through three phases from 2011 to 2020, as shown in Figure 4.

Fully realized, ODVA expects that OEU will provide the following benefits:

- Energy Integration and Best Practices based on energy awareness, device and process priority, events, price, and potential for self-actuating energy;
- Energy Efficiency in process heating and cooling;
- Supply Source Optimization and Energy Recovery through dynamic demand-response mechanisms, the ability to allocate alternate energy sources and/or sell excess electricity back to the power grid;
- Automation of Manual Energy Systems; and,
- Energy Integrity through power monitoring, intelligent power supplies and broad-based device support inclusive of network infrastructure.

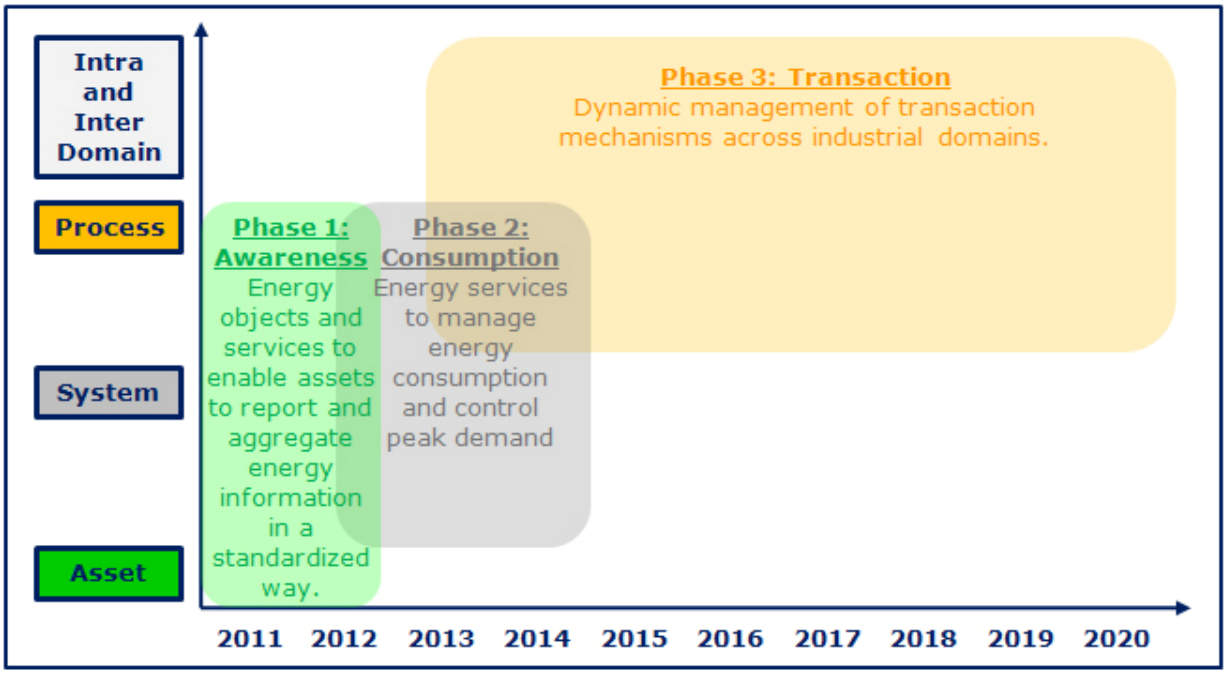


FIGURE 4: PROJECTED TIMELINE FOR IMPLEMENTATION OF OEU FUNCTIONALITY IN ODVA SPECIFICATIONS

ODVA expects OEU-enabled Assets to be available on EtherNet/IP in 2012. ODVA - with its core values of vendor-neutrality, open participation and open technologies - provides the ideal forum for building consensus among market leaders in industrial automation around the next generation of productivity enhancements for industry – Optimization of Energy Usage.

Footnotes

[1] "International Energy Outlook 2010." US Energy Information Administration.
[2] "http://www.oecd.org/document/25/0,3746,en_36734052_36761800_36999961_1_1_1_1,00.html" Organization for Economic Cooperation and Development.
[3] "http://www1.eere.energy.gov/industry/bestpractices/printable_versions/systems.html" ITP BestPractices: Industrial Energy Systems. US Department of Energy.
[4] Efficiency and Innovation in US Manufacturing Energy Use. National Association of Manufacturers
[5] Estimate made using data in World Energy Outlook: 2008. International Energy Agency.
[6] "Effective control of energy-depleting behavior." American Psychologist, Volume 47(6), Jun 1992, 815-816.