The Final Liberation of Adam Smith

Our profession, Energy Efficiency Promoters, has been held hostage – as has the entire society – by hardcore neoclassical economists for too long a time. But we may now see the end of this captivity. They have preached to us the gospel of Adam Smith and the blessing of the invisible hand. A hand that acts secretly to make the market deliver everything we need according to our preferences; we have the necessary information and the prices are right. If we deem energy efficiency as good then it will be supplied in the right amount. No need to bother – just relax!

Adam Smith in his opus, *The Wealth of Nations*, showed that when the butcher, the brewer and the baker acted in their pure self-interest they would deliver the right amount of ingredients for one’s dinner. A Swedish journalist, Katrine Marçal (née Kielos), remarked a few years ago that Adam Smith would still have remained hungry if his mother had not prepared his meals! She did so not as an actor on the market, but as an act of motherly care and without being paid. If it was also done in her ‘self-interest’ that can be debated.

Adam Smith may have been misinterpreted since he also wrote a book, *The Theory of Moral Sentiments*, in which he claimed that even if man was inclined to be selfish he was understanding himself only by observing other people and thereby the morals of his own activities. This part seems to have disappeared in modern economics and in the mathematisation of the discipline. This hardcore interpretation of economics as being, almost as physics, a way to discover the natural ‘laws’ has...
taken over. It has turned into an engineering science where you learn to design a machine to create welfare. No people involved only invisible hands.

Still this model is useful! Not to design policies BUT as a way to map the territory. By assuming that all humans can be economically rational, we are able to calculate how far we can go and how far we are off target. We are actually using this way of thinking every time we think about the potential for energy efficiency. We are doing it when considering the difference between business as usual and the targets we would like to set in terms of the economy or climate or jobs or environment or… It serves well to understand the static dimensions of a society.

BUT this model is NOT useful for designing policies that entice people and organisations to move in the desired direction. For this, we need a dynamic model inhabited by HUMANs with all their (our) flaws. Such models require the thinking of behavioural economics. This is the discipline for which Robert H. Thaler was awarded the Nobel Prize in economics this year and for that matter Daniel Kahneman, George Akerlof and Robert Shiller had the same prize in earlier years.

Thaler pronounced in his thank you address after the banquet that he had discovered traces of human life in economics where many other economists avoided such strange existences and preferred the textbook creatures that he calls ECONs. In the presentation before delivering the prize to Thaler the representative of the Nobel awarding committee said that this could be seen as the ‘final liberation of Adam Smith!’ Let us hope that it is so and that we may now turn to a more fruitful debate on how we can design policies that enable people to embrace energy efficiency with enthusiasm.

This article was contributed by Hans Nilsson of fourfact, Sweden and the IEA DSM Advisor (first published in the eceee December newsletter).

Recognizing the IEA DSM Programme’s interdisciplinary approach to connect technical experts with behavioral experts, Phase 4 will consider three aspects:

- **Responsive.** The pro-activity and reactivity of the technological energy producing or consuming end-nodes, but also of the (aggregated) users in providing responsiveness to different types of stakeholder requests in the energy commercial system and physical infrastructure.

- **Prosumer.** In the energy transition, which is taking place at an increasing pace, traditional consumers of electricity are transitioning to a dual role of consumer and producer of electricity – a prosumer. Traditional suppliers will buy more and more electricity from these new customers, and with this comes challenges. From a grid stability perspective there is the possibility of disruptive production capabilities due to this growing group of small, dispersed producers and the increasing use of the electricity grid due to the increasing number of HVAC (heat pumps) and electric mobility (EVs).

- **Networks.** The scope of networks considers the role of the physical grid, the aggregator, and the increasingly varying grid configuration continues on page 3
ranging from rural communities using PV to smart cities with possible EV-charging congestion. The physical aggregation as well as the virtual aggregation is considered. In this virtual aggregation, information and communication technology plays an important role in managing the end user interaction and the transactions between stakeholders.

The Task’s new work will be divided into four subtasks.

SUBTASK 14
Context analysis, use cases and smart city pilots

In modern societies, digitalization of all kinds of processes is taking place at an increasing pace. This also holds true for the electricity sector. Commercial value creation can be achieved with an increasing penetration level of small-scale energy monitoring. At the management and control level, it can be achieved by connecting customers to the mainstream Internet.

A key role in this transition is attributed to electricity flexibility and flexibility aggregation. ICT enables flexible aggregation topologies. Apart from self-consumption as an option, aggregation may be done (simultaneously) on the locational level, confined to a certain area, or on the global level, sharing certain optimization objectives, for example, commercial portfolio optimization in the market or pairing renewable production and consumption in communities.

These technologies, however, cannot be massively rolled out in one step. Pilot tests with Virtual Power Plants (VPPs), which started 10-15 years ago, are still needed and their scaling up, especially within Smart City contexts. Smart City concepts also stress the importance of integrating information and energy streams as well as designs and layouts of physical grids in the context of DG-RES and energy storage embedding.

Subtask 14 will focus on:

• Defining the existing context, common practices and state-of-the-art in the sector as a whole and on a per-country basis.

• Analyzing and refining the role and level of aggregator and aggregation in common use cases.

• Deriving the energy transition and the Smart City context based on the EU and individual country perspective.

SUBTASK 15
Metering, monitoring and coordination methods required to increase prosumer responsiveness

An important conclusion of the Task’s Phase 3 was that end-user tariff components only have a distant link to the impact of the consumption and production of electricity of the electricity system as a whole. The electricity market cost mapping is mostly calculated from synthetic profiles derived from an averaged set of electricity consumers or producers. In this way, end-user demand response actions that generate flexibility cannot be rewarded on an individual basis. Reconciliation using real measured profiles, based on the smart meter readings, makes it possible to map this price component more precisely on the actual power profile of the customer. In a number of countries, experiences with these types of reconciliation already exist.

For the transport and distribution components of the end-user electricity price also a similar mapping mismatch of real cost to tariffs occurs. Asset recovery based tariffs like connection capacity fees are common. Also, tariffs based on the maximum capacity used in a certain period hardly form a suitable component for rewarding end-user demand response. Distribution grids previously having a one-design-fits-all-principle are becoming more and more diverse. Functionality ranges from extended residential areas with high penetration of heat pumps to cities with large capacity requirements for (fast) charging of EVs. These changes require distribution tariffs with better opportunities to reward “grid-friendly” user behavior.

A third electricity price component is government energy taxes and subsidies. Several tax levying and subsidy...
schemes exist on the electricity commodity. On some occasions renewable in-feeds reach their saturation limits. On the market level, subsidized priority in-feed of wind energy can lead to lower day-ahead prices that reduce the allocated amount of low-CO2 fossil generators. Also, curtailing schemes for PV to stabilize the grid is complex to implement due to loss of accompanying subsidies. Priority in-feed of wind and net metering of PV need alternatives to reach their original goals.

A considerable part of the increase of flexibility delivery will take place via automated controls operated via “soft” coordination algorithms and techniques (e.g., openADR) and by establishing and maintaining virtual power plant objectives and connections. The interaction of these information architectures with possible tariff scheme component modifications has to determined and evaluated.

Subtask 15 work will focus on:
- Developing view on how to come to a better mapping of commercial tariffs on DR and DG customer behaviour.
- Inventorying of current and future distribution grid asset management, operation modes and associated tariff scheme components.
- Developing view on possible new tax and subsidy schemes.
- Assessing the relation to already existing and future automated control schemes.

**SUBTASK 16**

**Coupling to innovative user feedback, billing and transactive energy schemes**

Energy management apps on smart phones in combination with smart meters allow instant, day-to-day feedback on energy usage. But these systems do not allow transforming this information into financial transactions. Financial transactive activities do exist though, for example, the Gridwise alliance, a consortium of energy service providers and technology developers in the US, has defined a transactive energy framework that aims to split large overall transactions between stakeholders in commercial and grid operation into micro-transactions. This scheme enables multiple parallel transactions between actors in the electricity system to reconcile portfolio and grid management operations and services. And, in the Netherlands, the USEF (the Universal Smart Energy business Framework) consortium, has designed a reference implementation that is being field tested. In addition, block-chain based transactive energy models have also been proposed. Using smart contracts, blockchain technology allows traceability and visibility of micro-transactions on energy delivery and production even without currency exchange. These activities are expected to have a large impact on aggregation of small-scale renewable energy systems.

Subtask 16 work will focus on:
- Inventorying existing feedback, reconciliation and billing systems for electricity.
- Assessing a number of pilots that have been implemented on micro-transaction based approaches.
- Developing a common view on user interaction, feedback and billing innovation.

**SUBTASK 17**

**Conclusions and Recommendations**

Conclusions and recommendations will focus on realizing responsive prosumer networks and will include a ranking based on impacts, costs and likely future penetration of suggested frameworks.

For more information on the Task work and how to join contact the Operating Agent, René Kamphuis at rene.kamphuis@tno.nl and visit the IEA DSM Task 17 webpage.
PART 1: Peer-to-peer in the energy transition

This is part one of two articles on peer-to-peer energy trading. Part one introduces the global and institutional context in the forms of the energy transition and the roles of the IEA and other international organisations in facilitating this transition. It then goes on to introduce the concept of peer-to-peer trading and the role that blockchains (also called distributed ledgers) play as an enabling technology in this space. Part two will assess the risks, challenges, and areas of research focus that arise in bringing such a transformative technology into practice.

Introduction

As we move towards increased reliance on renewable, distributed, intermittent energy sources, the successful integration of these resources into conventional centralised energy systems becomes increasingly challenging. To provide a functioning energy system in this context requires distributing balancing services close to the distributed generation in order to minimise bi-directional flows of energy over the distribution network. Doing so reduces network congestion, avoids expensive infrastructure upgrading, and increases network resilience.

Peer-to-peer energy trading provides one solution to this grid-edge management problem. This approach sees ‘prosumers’ buying and selling energy directly with each other. This is frequently facilitated by local energy storage and building energy management systems, using mechanisms that require little or no intermediary support from traditional actors in the energy system such as energy suppliers. Increasingly, such trading mechanisms are seen not only as providing a necessary balancing service in the energy transition, but also as a way of re-engaging consumers and placing them at the heart of the energy system. Such a vision is made possible using blockchains, more appropriately called distributed ledgers, which can securely account for, and settle, transactions of energy over either local or long-distance networks. Such a vision creates both opportunities and challenges for the energy system, and whilst it is tempting to think that there may be a rapid transition to such a diverse and collaborative energy economy, in practice this is unlikely for physical, regulatory and social reasons. This article walks through the fundamentals of peer-to-peer energy trading, assessing its impact on different existing actors within the energy system, and highlighting a range of opportunities and challenges that such a system presents for policy makers and regulators.

The IEA and International Institutional Context

The energy transition is closely studied and well documented in recent IEA publications. ‘Tracking Clean Energy Progress: 2017’ lists the macro drivers, noting four key technologies on track to deliver the 2°C goal of the Paris climate accord. These are: electric vehicles, energy storage, solar PV, and onshore wind. This is reflected in comments by Adnan Amin, Director-General of the International Renewable Energy Agency (IRENA), reporting that the majority of capacity and...
Peer-to-peer energy trading has been done in a limited capacity over private wire networks for decades. It is, however, only very recently that it has become scalable over public networks and become seen as part of the wider energy transition.

Transactive energy is technically similar to what in Europe goes under a variety of titles including ‘Community self-consumption’ (France), and ‘Tenant self-consumption’ (Germany). France, in April 2017, made changes to Article D of their Energy Code to support electricity self-consumption at the grid edge. Germany has likewise recently amended their German Renewable Energy Sources Act (EEG 2017) to explicitly include consumption of PV electricity by buildings tenants. Both of these anticipate changes foreshadowed in the proposed forth EU Electricity Directive, which substantially enhances measures to proactively support consumer participation in the energy system. (Butenko 2017)

Blockchains and their role in the energy system

There are hundreds of potential use-case applications of distributed ledgers in the energy system. Burger et al (2016) divide these into those providing platforms, and those supporting processes. Platform applications include peer-to-peer trading, but also include trading platforms and decentralized generation. Processes include a range of back-office applications from billing to sales and marketing. This article focuses only on peer-to-peer energy trading which, while far-reaching, is certainly not the easiest use-case to implement, nor the one most likely to yield the most immediate utility and return on investment.

The electricity system requires two fundamental systems to make it work: the physical system for transmission of electricity (the network); and the informational system for accounting who generated the energy, who has used it and that they’ve paid for it (the balancing, settlement and billing systems). This breaks down into the following components: a meter for measuring exported electricity; a data structure for recording the amount exported; a mechanism for matching and contracting between parties (buyers and sellers); a
meter for measuring imported electricity by the buyer; and a way to financially settle the transaction. These functions exist in the current energy system, but at a considerable cost, making transacting small amounts of energy uneconomic.

Clearly, to make the system balance, both electrically and financially, the producer can’t sell the same unit of energy to more than one buyer, so a system is needed that prevents this from happening. Normally, this is done through some trusted authority that records and balances all exchanges. Now, using distributed ledgers, we have a ledger that all parties can have a copy of, and one that is automatically updated every time a transaction is made. With this distributed, constantly updated, and cryptographically secure ledger, a trusted central authority is no longer needed - thus saving the costs of maintaining it. Each party can simply check their copy of the ledger so see that the seller has units of energy for sale, and that the buyer has funds to cover the sale. Thus, in the energy context, a distributed ledger is simply a record of all transactions (production, consumption and sales) distributed to all market participants and all updating simultaneously by consensus in a secure and un-hackable manner.

There is one additional important feature of some distributed ledgers of use in the energy system. This is the capacity to run ‘smart contracts’. These are pieces of code that automate trading between parties. Buyers and sellers set strategies for offering and bidding, and when terms match, a trade is automatically executed. This, again, reduces costs and speeds up settlement processes making trading smaller amounts of energy economically viable. The addition of ‘smart contracts’ powerfully extends their capacity and applicability in domains such as energy trading.

An important distinction in the taxonomy of blockchains is who can hold (and therefore view) a copy of the ledger. The archetypal application of blockchain is ‘Bitcoin’ - the cryptocurrency for which they were developed. Here everybody who holds Bitcoin holds a copy of the ledger, which contains every transaction that has ever occurred by all parties since its inception (currently over 8GB). This is a ‘Public’ ledger open to all. Consequently, it is open to anybody to attack, and therefore challenging to cryptographically secure. The ingenious system of cybersecurity developed to do this, called ‘proof of work’, is highly secure - but makes transactions slow, and the system energy intensive to run. This makes it unsuited for energy trading applications.

An additional challenge is that it has now also been shown possible to re-identify individuals through their pattern of transactions thus effectively making public data deemed as private in many data protection jurisdictions. This is compounded by the fact that, for carbon accounting purposes, most governments will want to register renewable energy generation assets to specific meters to create a ‘chain of custody’ of low carbon energy entering the system. To do this would also mean encoding each meter’s unique identification number into the ledger, thus linking re-identified energy trading data to a physical asset of known address. Such chain of custody applications of distributed ledgers are important and valuable, but create further challenges under data protection legislation.

It is for these (and other) reasons that in the energy area many view ‘permissioned’ or ‘consortium’ blockchains as a more viable option. These are where access is governed by rules determined by a regulator or a self-regulated consortium. Because access is vetted, securing such ledgers from outside attack is easier and energy cost of securing them is lower. Additionally, because access is restricted, issues of accessing personal data is easier to manage and additional information can be encoded into the blockchain without compromising consumers’ privacy. The use of public versus permissioned ledgers is a contentious one in the field, with many believing that permissioned ledgers are antithetical to the spirit of openness and collaboration that underlies technologies such as Bitcoin. In practice, systems are now emerging that use hybrid structure containing both public and permission ledgers at different levels. In the energy field, it seems likely that pragmatics will prevail given the necessarily highly regulated nature of critical national infrastructure systems like electricity grids.

While the terms blockchain and distributed ledger are used interchangeably in this report such use is not strictly speaking correct. Blockchains are one type of distributed ledger - one in which the ledger is held in a series of encrypted blocks of data (each containing data from tens to thousands of trades). Each of these blocks is then linked together in such a way that attempting to change the encrypted data in any block in the chain corrupts that entire copy of the chain. However, because there are thousands of copies of the blockchain distributed on thousands of computers, these corrupted copies are easily identified as being wrong by comparing them with the others, and the corrupted chain can then be replaced.
through a consensus process. This linear chain of blocks is, however, only one form of distributed ledger. Others are based on complex networks or meshes of blocks. The best known of these is IOTA, a ledger built for the Internet of Things. This is just one example of what is becoming a rapidly growing family of distributed ledger architectures tailored around specific applications. There is an increasing consensus that there will ultimately be a plethora of different ledger structures with systems to support interoperability. Polkadot is one example of such initiatives.

Peer-to-peer trading: how it works

Peer-to-peer trading can be realised in many ways — this section describes one implementation applicable to many liberalized energy market contexts. This entails treating the peer-to-peer participants as a ‘balance group’. This balance group estimates its net position for the following day in the form of a ‘balance schedule’ — a 24-hour profile of net demand in time periods corresponding to the wholesale market. It then purchases enough energy from the wholesale market in each period to cover their estimated requirements. Any imbalances (differences between projected and actual demand) are then settled through the wholesale market.

Alternative market structures such as peer-to-peer could potentially pose an existential threat to traditional energy suppliers. While the extent of the threat is probably exaggerated, it could certainly change both their size and role in the energy system.

The primary economic function of energy suppliers in a deregulated energy market is to mitigate counterparty risk between the wholesale market and consumers. There is therefore likely to be an ongoing role for suppliers in mitigating the financial risk of settling imbalances on the wholesale market faced by smaller peer-to-peer markets. This is particularly the case where the peer-to-peer trading is occurring within a local community that may only have a few tens or hundreds of participants. Likewise, participants in the wholesale market are not going to want to take the cost, administrative complexities, and financial risk of default arising from dealing with large numbers of consumers and peer-to-peer balance groups. In this context, a supplier provides the legal framework, financial risk mitigation, and interface to the services of the wider energy system.

Over time however, there are factors intrinsic to distributed ledgers and the energy transition that are likely to reduce imbalances, and the risk of financial default. Imbalances can be reduced by a range of factors. Day ahead prediction of demand at the individual meter level is likely to improve as penetration of smart metering increases, and sophisticated models are constructed that account for building physics, weather and consumer lifestyle. Integrating energy storage on the consumer side of the meter will allow buffering of supply and demand over hours or days to match predicted and actual demand more closely. Demand Side Response, through a combination of dynamic time of use tariffs, consumer feedback devices and ‘Internet of Things’ automation of loads, can again shift demand to match the projected profile. Coordinated scheduling of demand in time across participating properties in the peer-to-peer network, coordinated by smart contracts executed on the blockchain trading platform, can make the collective profile match the day ahead balance schedule submitted to the system operator. Finally, scaling both the number and type of participants (residential, commercial and industrial) can both reduce statistical fluctuations from small numbers, and square the balance schedule profile, to make attractive and stable blocks of energy to buy from the wholesale market at least cost. Thus, the emerging technologies that make peer-to-peer work (generation, storage, smart metering and blockchains) can themselves work to minimise imbalances and thus reduce the cost to participants. On the financial risk side, near instant settlement of accounts using smart contracts, where supply is conditional on availability of credit on the ledger system, can vitally eliminate default risk. In such a system, the role of suppliers could be radically diminished for those customers participating in peer-to-peer markets.

The other important role of suppliers, however
– that of providing a near universal service of an essential good and (in many countries) delivering policy objectives related to energy poverty and maintaining priority services registers for those for whom loss of energy may be life threatening – will need to continue for the foreseeable future. There is a substantial risk with peer-to-peer energy trading of creating ‘energy gated communities’ of affluent, technology literate consumers for whom trading-off capital costs against operating costs is viable. Such communities could potentially push the cost of servicing the national infrastructure onto a decreasing body of those least able to afford it. This presents important challenges for policy makers and regulators that will need to be addressed as the technology develops.

Conclusion

The energy system is undergoing an unprecedented period of change. For decades, policies driving renewable energy have driven research and development into new forms of generation that are decarbonised and decentralised. This is driving generation to the grid edge and making it intermittent. To manage this requires digitalisation of control systems leading to development of smart grids and a shift to prioritisation of flexibility and local balancing services to maximise grid asset utilisation and accommodate greater renewables penetration. As generation scale drops to kilowatts and generation moves to rooftops, transaction costs must fall to near zero to make balancing and settlement economically viable. Peer-to-peer energy trading on blockchains provides one mechanism to make such markets viable. Blockchains provide the transaction layer that may partially disintermediate energy suppliers and almost entirely disintermediate financial institutions.

Peer-to-peer energy trading presents a fundamental challenge to the policy, regulatory, and institutional structure of the energy system. This challenge, however, is in-line with the greater transformation and disruption of the energy system arising from the energy transition. In part two of this article, the risks, challenges, and areas of research needed to realise peer-to-peer energy trading will be addressed.

This article was contributed by David Shipworth of University College London and the U.K.’s IEA DSM Executive Committee representative. Part Two will be published in the next issue of the IEA DSM Spotlight in March 2018.

References and Resources

Videos

‘Peer-to-peer energy trading on blockchains’ – David Shipworth <https://www.youtube.com/watch?v=AcufQeaOK1U>


Podcasts

Epicenter episode 174 – Carsten Stoker: ‘How blockchains will power the energy grids of tomorrow’, Epicenter – Weekly podcast on Blockchain, Ethereum, Bitcoin and Distributed Technologies, Duration 1:05:53


Reports


Academic articles


The DSM University learning platform, jointly run by the IEA DSM Technology Collaboration Programme (DSM TCP) and Leonardo ENERGY, uses webinars to engage DSM and Energy Efficiency professionals in current topics of the day. The university has held 37 webinars, all of which are posted online and can be found on the IEA DSM website, the Leonardo ENERGY website, and on the DSM University YouTube channel.

2017 may be coming to end, but the DSM University certainly is not and held its last webinar for the year on Behaviour Change on December 21st.

We look forward to you joining us in 2018 for another round of informative, engaging and resource rich webinars. Topics in the works include, Applications in growing economies (Tanzania, Mongolia) and Energy efficiency and renewables in Japan and China. Please check the DSM University webpage for updates.

#29 Mind your business, towards a more user-centered business model
DSM Task 25, Renske Bouwknekt, Ideate

#30 From programmes to markets – how to leverage market forces for energy efficiency
Jan Rosenow and Richard Cowart, RAP and Steve Thomas, IEA

#31 Integration of energy efficiency and renewable energy – multiple benefits!
Peter Lund, Aalto University

#32 Big data for greater energy efficiency
Kornelis Blok, Delft University

#33 Blockchain applications for peer-to-peer community energy trading
David Shipworth, University College London

#34 Innovative business models for scaling up energy efficiency
Saurabh Kumar, EESL India

#35 PAT – Innovative programme to promote industrial energy efficiency
Ajay Mathur, Bureau of Energy Efficiency, Government of India

#36 Building deep energy retrofit: using dynamic cash flow analysis and multiple benefits to convince investors
Jan Bleyl, IEA DSM Task 16

#37 How to design, implement and evaluate behaviour change interventions in a sector that is often overlooked but has huge energy efficiency potentials: hospitals
Sea Rottman, IEA DSM Task 24 and Reuven Sussman, American Council for an Energy-Efficient Economy (ACEEE) and Kady Cowan, Carolinas Healthcare System
Perform, Achieve and Trade (PAT): An Innovative Programme to Promote Industrial Energy Efficiency

The PAT (Perform, Achieve and Trade) programme was designed in response to the Indian Government’s commitment in the National Action Plan on Climate Change (NAPCC) 2008. As part of its National Mission on Enhanced Energy Efficiency, India was required to put into place a “market based mechanism to enhance cost effectiveness of improvements in energy efficiency in energy-intensive large industries and facilities, through certification of energy savings that could be traded.”

The Energy Conservation (EC) Act, 2001 already provided for:

- Energy-intensive industrial units to be identified as “designated consumers” (DCs)
- Energy consumption norms to be specified for DCs
- Accreditation of energy auditors who can assess energy use in DCs

Designing energy conservation norms for India was a challenge. After plants were audited, it was found that in every sector there were some using the world’s most energy efficient units and others using two to six times that amount of energy to produce a tonne of product. Thus the public policy problem had a large bandwidth.

After consultations with stakeholders, the PAT programme was launched. The Bureau of Energy Efficiency (BEE) under the Indian government’s Ministry of Power describes the programme as “a regulatory instrument to reduce specific energy consumption in energy intensive industries, with an associated market based mechanism to enhance the cost effectiveness through certification of excess energy saving which can be traded.”

The first PAT cycle was started on 31 March 2012. Its rules and targets were notified the same month and amended in 2016. One cycle lasts three years, during which every plant – including the world’s best – is required to improve its specific energy consumption (SEC), which is defined as ‘energy entering the factory gate over a year/material leaving the factory gate over the year’.

Plants with lower SECs are given lower targets and those with higher SECs are given higher targets. The idea is to encourage industries to surpass their targets. And, those that do receive Energy Savings Certificates (ESCerts) for excess savings that can be traded for compliance with plants that didn’t meet their targets or banked for the next cycle.

To implement the PAT programme, certified auditors were accredited by the BEE and audit agencies were empanelled. Familiarisation workshops were also held in all states of India, at least once a year. Organisations such as the Confederation of Indian Industry - Sohrabji Godrej Green Business Centre (CII-GBC), the Center for Study of Science, Technology and Policy (CSTEP) and The Energy and Resources Institute (TERI) assessed and documented technology options to bring about energy efficiency in the large industries targeted such as aluminium, iron and steel, chlor alkali, etc. In addition, technical committees were set up in each sector to address implementation issues.

The impact of the first PAT cycle included 8.67 million toe (mtoe) of energy saved as against the target of 6.6 mtoe, emission reduction of 31 million tonnes of carbon dioxide and Rs 9,524 crore (US$1.5 billion) in saved energy consumption and avoided generation. This is apart from the capacity building, skill development and investment of Rs 24,517 crore (US$4 billion) in energy efficient technologies for domestic manufacturing. However, it was also found that operational parameters were changing and would be different for baseline implementation in further cycles.

In the second PAT cycle (2016-2019), three more industries were added to those in the first cycle and a total energy savings target of 8.869 mtoe was set.

India is now in its third PAT cycle (2017-2020) under which 308 DCs from already notified sectors have been

continued on page 12
identified for baseline verification for inclusion. Of these, the verification of 273 DCs has been completed and 116 new ones have been included with a target of 1.01 mtoe.

A typical cycle looks like this –

There are many lessons to be learnt from the success of the first PAT cycle.

One is the consultation aspect. There was an extensive consultation process in the design and implementation phase, which aided with the acceptability. The draft document was widely circulated, and discussed in 96 sectoral and regional/state meetings. In addition, frequent letters were sent to DCs, and state and sectoral meetings. Technical committees considered inputs from DCs before developing normalisation rules. Inputs were assessed, and key changes made in the design and in enhancing ownership of the mechanism. These changes included differentiated savings and normalising savings to account for differences in baseline year and target year.

Auditing and check auditing by third-party auditors, accredited by an open process, also built credibility and fairness.

Another lesson is in providing the legal backing, which is important for an exercise of the scope of PAT. For this, an amended EC Act was passed by the Indian parliament in 2010. While the earlier version already included specification of DCs, energy consumption norms, and third-party assessment by accredited auditors, the amendment provided the legal mandate for issuance of certificates for excess savings and their trading.

There is also a lesson in the success of PAT itself. Overachievement of the target in the first PAT cycle led to reflection on the need for a more stringent methodology for targets. When the results of the second and third PAT cycles come in, they will be able to serve as inputs for future design and implementation of this unique scheme.

This article was contributed by Ajay Mathur, Ph.D., Director General of India’s Energy and Resources Institute and India’s Executive Committee member in the IEA DSM Programme. Dr. Mathur also presented this programme as part of the DSM University webinar series last October that you can watch on the Leonardo Energy website.
to change behaviours, and several large-scale efforts have been undertaken via utilities (e.g., with Opower), only very few have managed to sustain long-term 30% reductions in energy use. Without achieving societal change in (energy) consumption habits and routines, it will be close to impossible to achieve the carbon targets that can stall runaway climate change.

Business Models for DSM Energy Services

The following three country reports summarize the outcomes from interviews with experts to gain insight in the context in which their business models operate. Context can have a significant impact on the feasibility of different business models as it can act as a barrier or opportunity for entrepreneurs. In DSM Task 25: Business Models for a more effective market uptake of DSM Energy Strategies context is defined as all factors influencing the entrepreneur and her business that she cannot influence. These factors range from national and international policy, subsidies and targets as well as special events and trends. For this work, we focused the role for the end-user and looked at context from three perspectives: scientific, policy, and practice (business developers / entrepreneurs). And, have highlighted the work of three countries that participated in DSM Task 25. To learn more about the specifics of this work, please visit the Task 25 webpage.

Dutch context analysis and Business Models case studies for a more Effective uptake of DSM energy services for SMEs and communities

Norwegian context analysis and Business Models case studies for a more Effective uptake of DSM energy services for SMEs and communities Coming Soon.

South Korean context analysis and Business Models case studies for a more Effective uptake of DSM energy services for SMEs and communities Coming Soon.

Swedish context analysis and Business Models case studies for a more Effective uptake of DSM energy services for SMEs and communities

Swiss context analysis and Business Models case studies for a more Effective uptake of DSM energy services for SMEs and communities

Results and Outlook Task 25