EnergyPro

The real problem with energy efficiency – there is no market
The solution: create a market for measured efficiency

October 2015

Executive Summary

The benefits of improving energy efficiency include; better productivity, improved margins, improved competitiveness, acting as a hedge against energy price volatility and reduced need to invest in energy supply infrastructure as well as other benefits such as reduced emissions and improved health. Barriers to improving the uptake of economic opportunities for improving efficiency have been documented for many years but the fundamental problem is that until recently it has not been possible to measure efficiency in similar terms to energy supply. Consequently support programmes are based on mandates and do not directly reward the desired results, units of energy saved. Improvements in Measurement & Verification (M&V) and IT now allow a switch towards a weights and measures approach to energy efficiency which will allow the creation of a market in which energy efficiency can compete directly with energy supply, incentives will be aligned and new financing methods similar to Power Purchase Agreements can be introduced, thus allowing an increase in investment flowing into efficiency. Switching to a measured energy efficiency approach will create a platform for all sectors to access effective energy efficiency. This radical new approach to energy efficiency policy and financing is now being trialed in the USA and the UK could take a leading role in introducing it in Europe.

The Opportunity

The benefits of improving energy efficiency, or productivity, are now better recognized than ever before. As well as the direct benefits of reduced energy costs, reduced need for energy imports and reduced environmental impact, both locally and nationally, the co-benefits or non-energy benefits are being increasingly recognized and valued. These can include; job creation[(1)] and economic development, increased footfall and sales in retail[(2)], increased productivity[(3)], reduced absenteeism, and better health outcomes[(4)]. Work by the IEA[(5)] and others suggest that these benefits when properly assessed and valued can be worth many times the value of the energy savings alone.

Although the economic potential for improved energy efficiency is large, DECC's own estimates put it as equivalent to 22 power stations[(6)], uptake of that potential remains relatively slow. The geopolitical situation, and growing energy supply risks[(7)], demand a robust response on energy which is predicated on indigenous energy supplies (gas and where viable without subsidies renewables), and an aggressive energy efficiency programme. To achieve the objectives of improved energy security, reduced energy costs and reduced environmental impact it should be a national target to increase the rate of improvement in energy efficiency across all sectors of the economy. However the traditional ways of addressing this issue, which are based on regulation, top-down programmes and exhortation are not effective.

Barriers to improving energy efficiency

Energy efficiency suffers from several problems including; low priority compared to other investment opportunities, small-scale investments, lack of lobbying power compared to energy supply. Over several decades there have been many studies[8] on the barriers to improving energy efficiency but none have addressed the fundamental problem which is **there is no market for energy efficiency, only a market for products and services that improve efficiency**. Therefore energy efficiency cannot compete directly with energy supply and financing efficiency is inherently more difficult than financing supply options.

Since the initial drive to improve energy efficiency and reduce energy waste in the 1970s (in response to the 1973 and 1979 oil shocks), energy efficiency has suffered from being regarded as something that requires top-down government programmes, regulations and exhortation. The consequence of this is that much efficiency investment is driven by top down programmes in which organisations or individuals are rewarded for following a centrally designed, top down process. Schemes such as CERT, CESP, ECO and Green Deal follow this pattern. Supply chains are not truly incentivized to deliver efficiency, only to follow a specified process or set of products such as insulation, condensing boilers or low-energy lamps and these top-down programmes suffer from excessive costs. Energy suppliers are forced to undertake activities which, whatever their rhetoric, fundamentally are in conflict with their underlying business model.

The solution

Energy efficiency should compete with energy supply. Much evidence exists that delivering energy efficiency is cheaper per unit than any energy supply option[9], it can be delivered quickly, has no environmental impact, and does not suffer from the NIMBY problem. Energy efficiency cannot compete freely with energy supply because until recently we have not been able to measure units of efficiency and value them. **Technology is now emerging to make measuring efficiency accurate and reliable and this can enable a real market for efficiency to develop, with all of the financing options available to energy supply.**

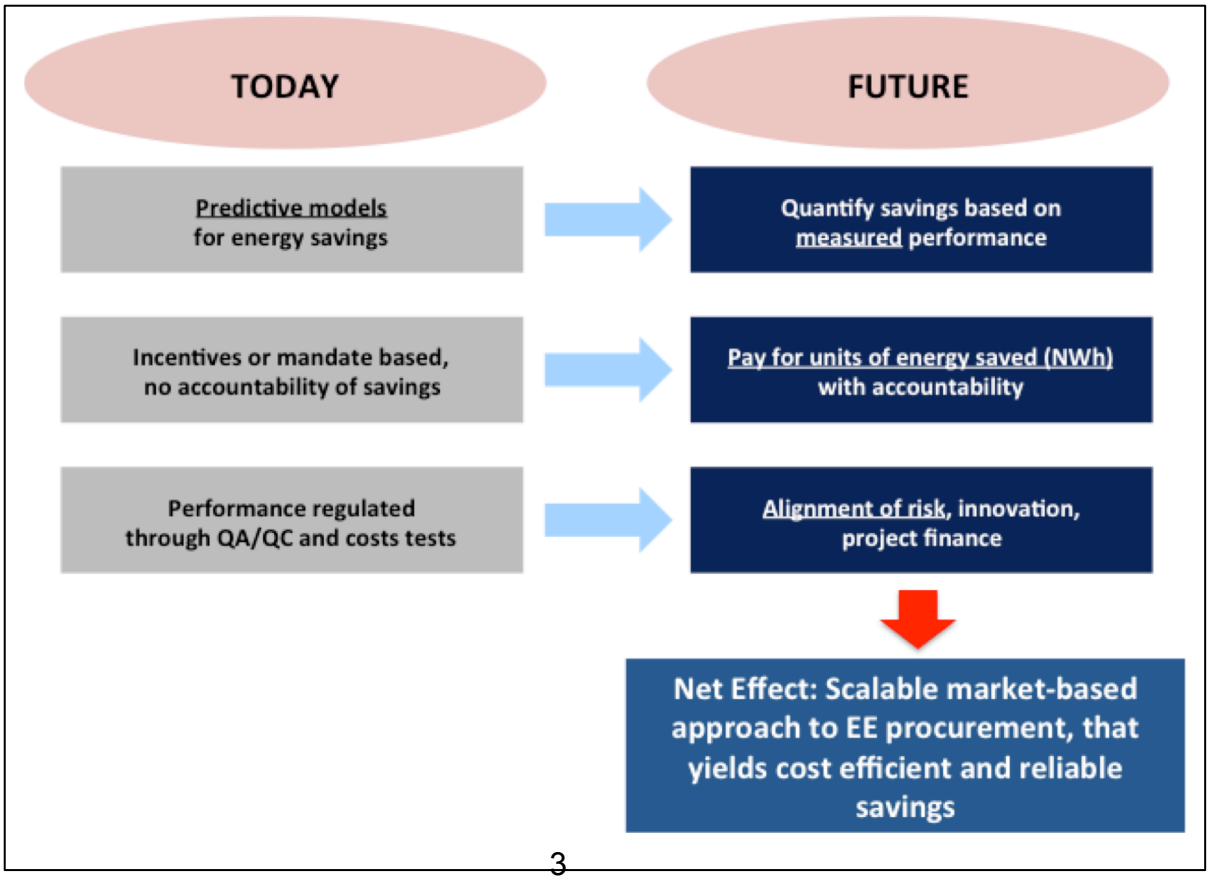
Benefits of a metered energy efficiency approach

The concept of the negawatt (and negawatt-hour) to represent energy efficiency is well known. With a combination of Measurement & Verification Protocols and cloud based metering technology it is now possible to actually measure negawatt-hours with similar accuracy as fiscal meters measure energy supply. A standardized “weights and measures” protocol to define a tradable unit of saved energy will facilitate a real market for efficiency.

Adopting the concept of metered energy efficiency and the underlying technology would enable:

- a “pay for performance” market that would reward property owners and efficiency vendors for accountable results – a market in which a standardized unit of saved energy can be bought, sold and valued within economic structures that drive scalable commodity markets.

- energy users to truly compare energy supply options with energy efficiency options as energy efficiency vendors could offer £/MWh options for energy efficiency projects.
- energy supply companies to develop hybrid products combining energy supply and efficiency as well as profit from energy efficiency in the same way that they do from energy supply.
- energy efficiency – demand reduction – can be properly counted as a resource for the energy market and properly rewarded with time based tariffs.
- energy traders to value energy efficiency in the retail and wholesale markets.
- make developers of projects accountable for actual, real and measurable, savings.
- building an open database of actual project performance which could be used by energy users, developers and financiers to make decisions about efficiency projects as well as evaluate contractors actual performance.
- an incentive for developers and building owners to improve efficiency – the emergence of buyers for efficiency (energy traders) would turn energy cost savings into revenue – thus increasing the priority of efficiency.
- lowering the cost of efficiency by removing bureaucratic processes and providing a simple price per MWh, this would enable building owners to compare energy supply and efficiency and effectively auction their energy efficiency "reserves".
- creation of financial products similar to Power Purchase Agreements (PPA) to be created. PPAs are the basis of energy supply project financing, the equivalent (Negawatt Power Purchase Agreement, NPPA), would do the same for energy efficiency – greatly increasing the flow of capital into energy efficiency.
- a Feed-in tariff for energy efficiency that reflects the whole system benefits (NB the market can, and we believe should, be created without a FiT – this is just an option).



Government action to support market development

Government could support the development of a real functioning market for energy efficiency by convening the relevant stakeholders to define a common weights and measures approach. Stakeholders could include:

- OFGEM
- BSI
- National Grid
- DNOs
- Building owners
- Energy suppliers
- Financial institutions.

The output should be a clear definition of energy efficiency that can be rewarded and paid for appropriately – a "pay for performance" approach. The definition should be sufficiently clear and certain that energy suppliers, DNOs and National Grid can count on the energy efficiency resource and pay appropriate prices for efficiency delivered either continuously or at certain times.

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October 2015
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Footnotes

1) Numerous studies globally have examined this issue. The UK Energy Research Centre in a meta-study concluded that energy efficiency created 0.3-1 jobs per annual GWh saved. The American Council for an Energy Efficient Economy (ACEEE) concluded that energy efficiency creates 21 jobs per $1m spend as opposed to 12 jobs per $1m spend in energy supply and 17 in the economy as a whole.
2) Several studies support his proposition, particularly in relation to LED lighting. Marks & Spencers is currently undertaking work with the Green Building Council to properly value this and other non-energy benefits of green buildings.
3) Supported by studies from IEA and the Regulatory Assistance Project in the USA as well as specific case studies where investing in efficiency has increased productivity or removed production constraints e.g. Costa Coffee example.
4) The impact of improving efficiency on health, particularly in cases of fuel poverty, are well documented. In addition there is evidence that more efficient buildings reduce absenteeism from work.
5) Capturing the multiple benefits of energy efficiency. IEA. 2014
6) DECC Energy Efficiency Deployment Office. The Energy Efficiency Strategy. 2012
7) The recent National Grid report states that spare capacity on the electricity grid will fall to 1.2%, a high risk level requiring extreme actions to secure supplies and demand cuts. Fuel supply risks are increasing as energy imports increase. Specific threats include instability in the Middle East, growing oil demand in oil producing countries such as Saudi Arabia where domestic demand could equal supply by the 2030s and

aggression by Russia. Despite not being immediately dependent on Russia for gas, 40-50% of steam coal which generates c.20% of UK electricity comes from Russia.

8) Studies on barriers to energy efficiency have been undertaken for at least thirty years. Work by UNIDO and many others have summarized and categorized the various types of barriers.

9) Many studies around the world have shown that the levelized cost per MWh delivered by energy efficiency is lower than the cost of purchasing energy. For example a meta-study by Policy Exchange reported the cost of energy efficiency ranging from below £10 per MWh to £40 per MWh. The ACEEE found that energy efficiency programmes across the US were delivering energy at a levelized cost of between $2 and $5 per MWh which is one half to one third of the cost of generation alternatives.

Appendix. The measured energy efficiency approach

Developments in the USA

Recent work by the by the California Public Utilities Commission (CPUC), US Department of Energy, Building Performance Institute, and Green Button Alliance have produced a suite of tools that provide the foundations for an open-standard, open-source, open-data energy efficiency meter called the Open Energy Efficiency Meter, which is capable of measuring negawatts in standardized units in real time, thus providing transparent, timely and affordable monitoring of energy efficiency results on a project and portfolio basis. The Open Energy Efficiency Meter is currently under review by the American National Standards Institute.

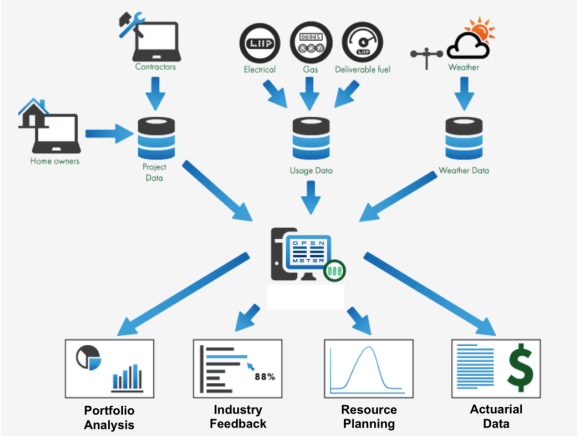
Seattle City & Light is purchasing saved energy units from the Bullitt Center using a 20 year power purchase agreement and a proprietary energy efficiency meter (the DeltaMeter™). In a May 2015 Greenbiz article, Jeanne Clinton, CPUC Special Advisor for Energy Efficiency, noted that the Seattle pilot could put "efficiency on a level playing field with investments with other energy supplies" and "offers tremendous opportunities as one of several approaches that could be used to try to double our pace of [energy] savings".

The Natural Resources Defense Council has submitted a proposal to the CPUC to conduct a residential pay-for-performance pilot using the Open Energy Efficiency Meter. In addition the California Independent System Operator (CAISO) is proposing a new distributed energy resource (DER) provider process that allows aggregators to assemble DER portfolios including energy efficiency and demand response.

The Open EE Meter

The Open EE Meter platform is built on existing open industry tools including HP-XML, Green Button, and the DOE Standard Energy Efficiency Data (SEED) Platform. All source code is Open Source and available for scrutiny and contribution for stakeholders.

The EE-Meter is based on an open standard calculation that is both transparent and replaceable and represents the equivalent to a standard weights and measures for energy savings.



The DeltaMeter™

The DeltaMeter™ employs EnergyRM's unique, patented technology suite for modeling building behavior. With the DeltaMeter, for the first time, actual delivered energy efficiencies can be continuously metered and verified with utility grade accuracy and reliability—enabling an entirely new class of energy transactions, efficiency investments, and financing opportunities.

At very low cost, the DeltaMeter:

- Automatically measures energy and demand reduction, to transaction specified degrees of accuracy, at transaction specified intervals
- Accurately and reliably verifies that energy and demand reductions are met
- Preserves audit paths and records
- Scales effectively over the full spectrum of building use types, construction methods, sizes and climates
- Allows future adjustments and modifications, as needed, to account for changes in weather, building use hours, building operations, and building physical attributes ("routine" and "non-routine" changes, in IPMVP terms)
- Using the same unique modeling approach, supplies the critical data enabling operators to
- ensure persistence of energy and demand reductions over the life of a contract by monitoring current vs. design performance.

The DeltaMeter™ employs core technology that, like other building behavior modeling tools, starts with an inverse modeling approach (i.e. the structure of the target building is inferred from its real-world performance). But unlike other tools, the DeltaMeter™ also processes:

- Both statistical and thermodynamic models—allowing rapid, low-cost analysis that can model changes in buildings, and;
- Simultaneously analyzes all fuels used in the building, and their interactions.

DeltaMeter's well-tested and validated core technology has immediate application as a low-cost, high-reliability precision measurement and verification tool in a number of transaction models. New Buildings Institute and EnergyRM have used the technology as a sophisticated analysis tool for individual building energy diagnostics (FirstView™ signatures); as a superior benchmarking and baseline certification tool (EPA trial; State of Oregon's "Cool Schools" program); and as a service-area portfolio assessment tool (ProspectView™ mapping capability). The DeltaMeter™ also enables something more significant: a powerful new transaction model, making energy efficiency measures functionally equivalent to supply-side resources—both as a utility resource, and in the energy finance system.

Enabling As-Delivered Transactions with Metered Efficiency Yields

In both the utility service-delivery and building-management contexts, the DeltaMeter™ functions much as any other energy meter, tracking delivered supplies, such as electricity and natural gas. However, the energy it meters is specifically the energy being yielded by energy-efficiency measures - that is, it measures the energy being saved. This capability fundamentally transforms the nature of efficiency resources, over a utility's entire distribution grid. In the words of one highly regarded independent expert who has studied it in-depth:

"This enhanced process is sufficiently robust to meet the requirements to be part of a utility's energy supply portfolio"
—Quantum Energy, International Performance Measurement and Verification Protocol (IPMVP) assessment for DeltaMeter™

The DeltaMeter™ turns energy efficiency yield into a supply-side option, with all the attributes necessary to allow utilities to use it rigorously to meet their obligation-to-serve. Currently, efficiency yield suffers from three disabling issues:

- Energy yield from efficiency is costly to analyze, measure and verify.
- Previously available measurements fail to support persistent delivery of continuing information about the actual yield to the utility.
- Existing transaction systems, and the Measurement and Verification infrastructures that support them, focus on justifying equipment purchases, not on maintaining a supply of energy. They do not measure ongoing efficiency yield; and thus they cannot enable utility-grade cash flows from energy efficiency.

Without utility grade cash flows, access is barred to the unsubsidized low-cost capital markets that finance the utility system. The DeltaMeter resolves all these issues.

- Its analysis, scoping, measurement and verification processes are substantially cheaper to deliver than conventional approaches—cheap enough to be deployed continuously as a meter—thanks to extensive automation. It requires as inputs only conventional utility meter data, plus simple information such as building square footage and use; and is readily adjustable, in a fully-auditable fashion, to track both routine and non-routine changes in weather, building operations and occupancy, and building structure.
- Its ability to tightly measure both actual and expected performance, each tuned to current building realities, means persistence tracking is also highly automated. The meter simultaneously measures delivery and provides operator feedback on operating effectiveness.
- It allows energy efficiency retrofits to be recognized as generators of energy yield, rather than reducers of energy use. Metered delivery of that energy becomes a new energy resource utilities can contract to buy or invest in.

Utility-based cash flows from such sales for the first time enable cost-effective energy efficiency retrofits at an investment risk profile comparable to other energy resources enabling financing by the same long-term, low-cost capital markets that routinely serve conventional utility energy-supply infrastructures.