

SMART 2020: PATHWAYS TO SCALE



7 December, 2009

By Molly Webb (mwebb@theclimategroup.org)

ABOUT THE PROJECT

In 2008, The Climate Group on behalf of the Global e-Sustainability Initiative (GeSI), with independent analysis by McKinsey & Company found that Information and Communications Technologies (ICT) are a key solution in the fight against climate change and could enable emissions reductions of 7.8 Gt CO₂e in 2020, or 15% of business as usual emissions in 2020. Energy efficiency – along with halting deforestation – is one of the most cost effective emissions abatement solutions in the short term, to 2020. And we must act now.

The SMART2020 report (<http://www.smart2020.org>) raised awareness of the opportunity for ICT. Now there is now a need to assess the progress of 'smart' technologies to address climate change challenges with real case studies. Supported by partners BT and the Digital Energy Solutions Campaign (DESC), The Climate Group is gathering case studies on what is being implemented in key energy and fuel efficiency market growth areas. In this summary paper, we have analysed the initial case studies to understand what barriers remain and to highlight 'disruptive' trends.

The case studies outlined below are highlights from the growing database of projects and pilots documented on the [smart2020.org](http://www.smart2020.org) website. These and the other cases point to the need for incentives and organisational capacity to develop strong cross-sector partnerships, standards development, changes to how utilities are regulated, and holistic energy efficiency policy across the economy.

Summary of recommendations:

- Provide real-time energy information for all
- Develop a global set of 'smart grid' standards for open communications and interoperability
- Set policies for 40% energy efficiency in all sectors
- Develop pilot projects for market transformation in urban areas

ENERGY INFORMATION AT OUR FINGERTIPS

If only toasters could talk. Well, now they can - almost. With Google's PowerMeter, reading your energy consumption in real-time is as fast as checking email. One Google employee watched her dashboard of her home energy consumption while at work, and saw it was rising dramatically. Worried, she called her neighbour, who found that her toaster was about to explode.

Luckily, her neighbour was home. But there is another option. AlertMe, a home energy control system, can turn off your appliances from your mobile phone or desktop.

AlertMe started as a home security system and has found new life as a control system for home energy use. When a home in Cambridgeshire in the UK was fitted with an AlertMe Energy kit, the residents found that using the service they could nearly halve their energy consumption, and their bills. AlertMe kit was easy to install: several 'smart' plugs go into the wall sockets where you want to track energy consumption from appliances, and a home energy hub sits in the home wirelessly connected to the appliances, reading their consumption. Either using the AlertMe web interface or a mobile phone, you can turn off appliances even when you're not at home. Over 8 months, the residents saved £500 pounds or around 40% of their electricity bill.

The ease of reading energy consumption with Google PowerMeter combined with the controls of AlertMe puts a new and powerful type of information at our fingertips: energy information. Simply monitoring energy can be surprising: Some users have found that their neighbours energy consumption is being attributed to their bill, or that their television is an energy 'vampire' consuming more than their refrigerators and can easily be switched off to save energy for those 23 hours a day when it is not in use. And when the cheapest and easiest way of reducing power generation is to not consume energy at all, AlertMe and other systems like it are the front line in the war against emissions.

"Many consumers feel they can't protect themselves from rising energy costs or do anything to stop climate change. However, more than a quarter of all energy use happens in our homes and now AlertMe Energy gives consumers the power to monitor, control, and reduce the energy they use, saving money and reducing their carbon footprint," says Pilgrim Beart, founder and CEO, AlertMe.

THE SMART GRID

However, we can't expect everyone to care that much about their energy consumption, particularly if it means a difference of perhaps just £2/day in energy bills. In Boulder, CO, the local utility realised that the energy system of the future was going to need to be more resilient, able to handle renewable power generation and also able to provide consumers with a range of services including electric vehicle charging or smart billing. They decided to embrace this future with one of the most complete smart grid pilots in the world.

But **Xcel Energy's SmartGridCity** didn't start with consumers; instead - along with a group of partner organisations - it decided to focus first on what is invisible to the consumer, the electricity grid. The grid was built and remains to this day a one way system, starting with generation of power through transmission and distribution. In its progress from generation to consumption, anywhere from 10-30% of the generated power can be lost, depending on the distance and efficiency of the system. The distribution network can be optimised by reducing problems with voltage, which is done by controlling what are called 'vars' in the system. Vars can be compared to the froth in a soda can, and if the right mix of vars isn't achieved, they impede efficient energy transmission.

Current Group, one of the members of the consortium, using their OpenGrid software, sensors and 2 way communications on the grid, were able to reduce voltage problems by 90%, achieving 3-5% reduction in overall power requirements in the city of 100,000 people. They were able to achieve this without needing to rely on the consumer to change behaviour. *"To me, that's icing on the cake,"* says Brendan Herron of Current Group about the participation of customers. *"But you wouldn't want to run your mobile phone service by telling customers when to call, you'd run your networks as optimally as possible and eventually you'll get to the point where customers will get a menu of options. We need those actions that focus on every user, not just on those few who participate. It's the stuff that we do 365 days a year -- all day long -- that we need to make more efficient."*

The potential for system optimization on a national or global scale is significant. For example, a 3% reduction in U.S. baseline generation would mean 123 million metric tons of carbon wouldn't be released into the atmosphere - every year, the equivalent to eliminating the need for approximately 22 coal plants or taking 15% of cars off the road.

Of course, this has implications for the entire business model of utilities, which today make their profits by selling more power. But companies like Xcel Energy and many others realise that the reliability, reduction of outages and other carbon benefits will be huge, and eventually, they'll be looking to provide consumers with a whole range of new services that cannot even be imagined today. This relies on utilities and regulators working out how

to incentivise conservation.

What's clear is that Current Group, Xcel Energy and the other partners could not have achieved the savings each on their own, a variety of partners were needed.

TRANSITIONING BUILDINGS

Built during the Great Depression, the Empire State Building symbolizes America's limitless potential. Today the building is undergoing a major sustainability retrofit to become a leading example of economic and environmental revitalization.

Consulting, design, and construction partners Clinton Climate Initiative (CCI), Johnson Controls Inc. (JCI), Jones Lang LaSalle (JLL), and Rocky Mountain Institute (RMI), recently completed an 8 month modelling and analysis project which will save up to 38 percent of the building's energy and \$4.4 million annually. Among the main initiatives undertaken in retrofit which has just begun and will pay back within 2 years is a tenant energy management system, demand control ventilation (using CO₂ sensors to determine occupancy) and other digital controls. Johnson Controls will monitor the energy savings using the standard international performance measurement and verification protocol (IPMVP), and they will split the energy saving benefits with the Empire State Building over a 15 year period. This retrofit will put the Empire State building in the top 10% of efficient buildings in the US.

In the Empire State Building, the project team included engineers, property managers, energy modellers, energy efficiency experts, architects, and building management. Coordination also included the tenants. Involving tenants and considering their perspective early on is critical because more than half of the energy efficiency measures that will be implemented at the Empire State Building involve working both with tenants and within their spaces. Though coordinating a diverse set of partners wasn't easy, it allowed for optimal energy savings.

"What makes this an innovative, replicable model for other commercial buildings is the process and complete system-wide approach to identifying optimal energy efficiency improvement measures, as compared to component by component," stated Iain Campbell, Vice President and General Manager, Global Energy and Workplace Solutions, Johnson Controls, Inc. *"Looking at the interaction of different measures allows smarter decisions regarding retrofitting buildings."*

In the Empire State Building, maximizing profitability from the energy efficiency retrofit leaves almost 50 percent of the CO₂ reduction opportunity on the table. The building owner, while still selecting an optimal package of measures with a high net present value, sacrificed 30 percent of profit to deliver more CO₂ reductions and improve the lighting and tenant comfort within the building. Changes in energy prices and/or the cost of energy efficiency technologies may help to better align profit maximization and CO₂ reduction. However, as things stand currently, there is a gap between the socially desirable amount of CO₂ reduction and the financially beneficial amount of CO₂ reduction from a building owner's perspective.

DISRUPTIVE TRENDS

Robert Mathams had his 'a-ha' moment when a delivery truck arrived at his university in Manchester to deliver a pool table from London, and was going to return empty. Aware of the environmental damage this was sure to cause, Robert saw a business opportunity. Researching further, he recognized that 25% of lorries on Britain's roads run empty, resulting in an un-necessary 36 million tonnes of CO₂ emissions every year - That's 7.2% of the UK's carbon footprint. Allowing more trucks to run full means fewer trucks need to be used to deliver the same amount of goods. He set up Shiplly.com, an online transport marketplace that replaces the traditional subscription-based business model of the freight exchange. Aimed at end consumers, hauliers bid in a reverse auction to keep their vehicles full and offer the consumer a low price. Now, your e-bay delivery in the UK can be sent on a lorry that might otherwise have been driving home empty.

Over 16 months, Shiplly's service has saved 2,095,210 kg of CO₂ (and counting) Savings equate to flying from London to New York 3,446 times.

To start, Robert needed funding to develop his software, but encountered no regulatory challenges; and the economic downturn may have been a boon: Shiply was featured in a Road Haulage Association 'Business Survival Toolkit' explaining how their solution could help haulers save fuel and stay on the road. A carbon price wasn't necessary to make the business case attractive.

While the deployment and adoption of enabling technologies - i.e.: internet access to enable Shiply's solution, GPS to enable Seoul's personal travel assistant - is proceeding at pace, the commercial deployment of the energy services are not proceeding as quickly. We're still waiting in frustration at the bus station without information on when it's arriving, most of us don't have access to multi-modal transport options on our mobile phones, and buildings still blast heat in the middle of summer when with current communications standards, this waste could be avoided. Partly this is due to lack of end-to-end standards in smart grid, buildings and transport, but much is due to misaligned incentives, where the societal benefits are clear, but who pays for them is not.

As innovation and environmental objectives become more interlinked, scaling solutions will not only rely on a price for carbon. New business models like Shiply's achieve initial success in the market, but may run up against unforeseen challenges as they grow. For example, Shiply has just launched in Germany and will face new regulatory challenges as cross-border trips become increasingly requested. 'Cabotage' rules prevent the exchange of goods between countries and though Shiply recognizes the importance of protecting local businesses, they also recognize the carbon emissions savings opportunity from reducing the number of trips taken empty. In the case of the Empire State Building, carbon regulation that changed energy prices by less than two percent per year had little effect on the financial performance of the modelled packages, and it was necessary to bring all partners together to sacrifice some potential profit in order to increase emissions reductions.

UNLOCKING EFFICIENCY

The key to unlocking the solutions lies in:

- **Partnerships:** Partnerships are needed to maximise energy efficiency. Partnerships between private and public enterprise and between companies with complementary skills sets can gain significant leverage.
- **Cross-sector implementation.** Interoperable solutions across domains is still not widely adopted. Sector or domain specific initiatives are much more common. With the exception of a few initiatives, such as the Connected Urban Development programme, most of the existing products still play to only one or two market segments (eg: Buildings or Logistics). There is still a gap in End-to-End solution integration.
- **Optimisation, not only behaviour change.** Particularly in smart grid, it's not as easy to involve the consumer as we might have thought, though some initiatives in transport are starting to reach these. Imagine AlertMe applied not to one building but to many, where Google PowerMeter information could be centralised, coupled with financial incentives. Behaviour change on massive scale is then possible. but the financial incentives are not there.
- **Policies beyond a carbon price:** Policy intervention may need to come from unexpected places. Optimising for the socially acceptable amount of carbon may run into regulation that was put in place for different reasons - i.e.: anti-competitiveness. We will need to transform markets with carrots and sticks in all sectors, not only with a carbon price.

RADICAL EFFICIENCY

To realise the potential of radical energy and resource efficiency that is possible through an ICT-enabled infrastructure, the key is making near real-time energy and resource efficiency available and accessible by individuals and companies. This enables us to develop solutions that give appropriate feedback about the impact of activities, and to develop systems in the future that either automate or allow customers to change behaviour as

a result. As the information becomes available, governments need to encourage standards for the accounting for and communication of what will become sensitive and valuable data.

User-generated content was the foundation of the Web 2.0 boom, and user-energy information will be the source of new markets within a decade. With a strong global agreement to tackle climate change that provides caps on emissions, ICT infrastructure will be a key enabler in the short term of carbon efficiency on a global scale.

Recommendations

- **Provide real-time energy information for all by 2020**

As smart meters are already being rolled out in Europe and the US in particular, it is crucial that this information is readily available to the *user* of the gas or electricity that is being metered, as easy to read as a phone bill. A global solution to climate change should include a commitment to providing citizens access to energy information which will be the basis for a range of services in homes and businesses to better manage their consumption.

However, information alone is not sufficient or useful without the ability to act on the information. To make this information “actionable”, a number of other policy changes will need to be implemented simultaneously, some of which are outlined below.

Most important, regulatory shift is required in the power sector, to provide incentives for selling less power. Some demand-shaving experiments have taken place, but utilities and regulators will need to become partners in a new set of regulatory changes that allow competition around a range of new services for the consumer – from electric vehicle charging to selling home-generated power back to the grid – that will become the future power industry’s bread and butter.

- **Develop a global set of ‘smart grid’ standards for open communications and interoperability**

To enable a competitive market, open communications and interoperability standards for smart grid and metering technology will be crucial. Multiple companies must be able to compete to provide metering services, and grid intelligence that supports a range of optimisation and end-consumer services. The standards development process is already underway in key economies such as Europe, the US and Korea. Government and industry will need to collaborate to ensure this is developed before billions in investments are made.

- **All sectors should aim for a 40% efficiency objective**

A number of recent reports and announcements catalogue a range of energy efficiency and carbon intensity objectives of 40%. EasyJet calls for 40% efficiency in next generation aircraft, IEA’s most ambitious emissions reduction scenarios call for 40% reduction in buildings’ energy use by 2050, and GSMA’s Mobile Green Manifesto aims for 40% carbon intensity across the sector by 2020, including 40% energy efficiency in networks and mobile handsets.

Though timescales for the implementation of this target vary, the intention is to spur the market for energy and resource efficiency and the decarbonisation of power. Incentives for creating markets in energy efficiency will not be driven by carbon price alone. Energy efficiency regulation – such as those for appliances - can contribute to innovation and market transformation, as will innovation in financing mechanisms for building retrofit, for example.

- **Develop pilot projects for market transformation in urban areas**

As efficiency across sectors is a largely untapped opportunity, disruptive business models should be analysed to identify policy barriers in adjacent sectors. As in the case of Cisco’s Connected Urban Development Programme, pilot projects must be developed and analysed and public-private partnerships at city level will yield benefits across multiple sectors.