DSM Spotlight

The Newsletter of the International Energy Agency Demand-Side Management Programme October 2011

ieadsm energy efficiency

XVII The Need for DER Integration

Why Integration?

When a country implements an energy policy to promote energy efficiency, distributed generation and renewable energy resources, the share of distributed energy will increase, including that from intermittent energy sources such as wind, solar, small hydro and combined heat and power (micro-CHP). The electricity generation from these intermittent energy sources is hard to predict so countries are combining distributed generation with energy storage and demand response. By doing this, a country can decrease the problems caused by distributed generation and increase the market value of the intermittent energy. However, how to integrate these components is not an easy task. To explore this issue, the participants in *IEA DSM Task XVII, Integration of Demand Side Management, Energy Efficiency, Distributed Generation and Renewable Energy Sources* are analysing how best to integrate distributed generation with energy storage and demand response.

IEA DSM Contribution

Task participants are evaluating the quantitative and country specific effects of Distributed Energy Resources (DER) technologies on the power system and on the involved stakeholders. The first phase of this work was the analysis of the situation, including over 50 case studies and demonstration projects from Austria, Finland, Italy, Netherlands, South Korea, Spain, and the US. A State of the Art report provides a summary on the integration

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NOTE FROM THE CHAIRMAN

DSM - The Next Generation

Over the past few years a number of IEA DSM Programme champions have retired or taken their business elsewhere due to declining research budgets. The latest on the list of people signing off are our (now honorary) chairman Hans Nilsson and vice-chairman Paul Davidson. We thank you for your work in and outside the DSM Programme.

I would like to take a moment to briefly look back on what has been achieved, and what has not. To start with the "what has not" we can refer to the last issue of this newsletter, where Hans Nilsson discussed the "M" word. We have yet to be able to (re)claim the Market.

I was not working in this field during the early days of demand side management, but I can imagine that policymakers and politicians thought of DSM as the silver bullet – a quick fix to tell the market how to behave efficiently because that's what management is all about.

The professionals I've had the pleasure to work with in our Programme have always been much more realistic. Much can be achieved by using our lessons learned, but only with constant attention and a lot of elbow grease to put the experiences into practise. For people with the maximum attention span of one election, DSM hasn't been something to score with politically and so we've lost our market share.

Hans Nilsson recently looked at the number of scientific publications on DSM and concluded that there are too few publications. But despite this fact, we do have the answers to a lot of questions raised in the energy efficiency and CO_2 emission reduction debate. And

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PARTICIPATING COUNTRIES

- Australia
- Austria
- Belgium
- Canada
- Finland
- France
- Greece
- India
- Italy
- South Korea
- Netherlands
- Norway
- Spain
- Sweden
- Switzerland
- United Kingdom
- United States

status of the various fields of the electricity system, such as electricity generation, electricity demand, communication, control and monitoring, integration analysis and regulation, policy and business.

> "... a country can decrease the problems caused by distributed generation and increase the market value of the intermittent energy."
>
> **SEPPO KÄRKKÄINEN**
> **Task Operating Agent**

Now in the second phase, Task participants from Austria, Finland, France, Netherlands and Spain are assessing the penetration of DER technologies (for example, HP, EVs, PV, microCHP, SM and energy storages) at customer sites. An essential part of this work is to discuss future scenarios for 2020 and 2030. A comprehensive analysis and report on the effects – respective cost and benefits – will be produced at the end of the Task in the second quarter of 2012.

The preliminary analysis of some penetrating technologies (heat pumps, smart metering and electric vehicles) conducted during the second phase of Task XVII shows major differences in the penetration of technologies based on country-specific policy, regulations and market situations. Findings include:

- In the Netherlands, the impact of a high concentration of heat pumps ("hotspots") are causing overload and exceed the designed connection power.
- In Finland, the estimated potential for demand response of heat pumps is 2 to 3 times higher compared to Austria. This is most likely due to the more frequent use of built-in direct electrical peak heating for cold days. This also was observed in the Netherlands.
- The need for gradual control of the heat pump load in respect to grid impact and intra-building comfort optimization strategies seems to be obligatory to integrate heat pumps into DSM programs. Market beneficiaries operating such service have to consider and support this.
- Cooling and heating hybrid heat pump technology (reversible heat pumps) could increase potential, especially for winter and summer peaks. The technology trend is heading in this direction.
- The need for recommended and regulated functionality of smart meters in relation to DR functionalities in the participating countries and country specific requirements was discussed in relation to the recommendation of the EU DG-TREN experts group on smart meters (EG 1) and the EU commission mandate "441."
- Incentives for electric vehicles in Finland, the Netherlands and Norway vary regionally. Spain is among the first country to already have modified the law for the electric sector and introduced the "Charge Manager" as a new subject and the "Energy charging service" as a new activity.

To learn more visit Task XVII, Integration of Demand Side Management, Energy Efficiency, Distributed Generation and Renewable Energy Sources, or contact the Task Operating Agent, Seppo Kärkkäinen of Elektraflex, Finland seppo.karkkainen@elektraflex.com.

Chairman *from page 1*

as Hans has so clearly stated "We have to reclaim the market for our thoughts, our work and our results."

This leads us to the next question "What has been achieved?" In this Programme, we have successfully framed the problem in a way that's comprehendible for the "layperson" by clearly defining the concept of load shape and load management, instruments for peak shaving, load shifts, and valley filling. The 2010 Annual Report starts with a beginner's guide to DSM in the Chairman's report, which links simple theory to a world of models, good examples and best practices studied in past and present Programme projects. On top of that, the DSM Programme's work is one of the few that links producers and consumers.

Outside the Programme, there are signs in recent reports of the IEA and conclusions of Ministerial meetings that the world is discovering the wealth of IEA knowledge generated by the outgoing generation. Now it's up to the present generation of the DSM Programme to ensure that this feedstock for energy efficiency is mined in a sustainable way. This will require that DSM advocates not only passionately "sell" what's already there, but also build on our heritage with new ideas and examples. The latter is something for the next issue.

Rob Kool
Chair IEA DSM

XVI Conservation First! A New Integrated Energy-Contracting Model

Any renewable supply should first of all focus on energy conservation by evaluating all possible demand reduction opportunities. Only afterwards should the remaining demand be supplied as efficiently as possible – preferably from renewables. Otherwise climate protection goals are not achievable.

One of the most urgent energy policy and economic challenge is the search for suitable “tools” to execute energy conservation potentials. The level of success is far from satisfactory as seen by the continuous increase in final energy consumption. In recent years, Energy Services have climbed high on political agendas and have even reached the headline of energy legislation [2006/32/EC]. Building on this, the IEA DSM *Task XVI: Competitive Energy Services* has developed a new, market-based implementation model for energy efficiency and supply (preferably from renewables) – **Integrated Energy Contracting (IEC)**. The new IEC model builds on the widely applied Energy Supply Contracting (ESC) model, but extends the scope of service to the entire facility to achieve higher saving potentials than with ESC.

The IEC service model combines two objectives:

1. **Reduction of energy demand** through the implementation of energy efficiency measures in the fields of building technology (HVAC, lighting), building shell and user motivation; and
2. **Efficient supply of the remaining useful energy demand**, preferably from renewable energy sources.

As compared to the standard ESC model the range of services, and thus the saving potential, extends to the overall building and all the energy carriers and consumption media such as heat, electricity, water and compressed air (see Figure 1).

To implement, the building owner assigns a customized energy service package and demands guarantees for the results of the measures taken by the ESCo. The necessary components for implementing energy (efficiency) projects are summarized in Figure 2 in an integrated energy service package, which includes guarantees for the output of the service to the client.

All the tasks in Figure 2 (i.e., planning, construction, financing, operation and maintenance, optimization, purchasing of fuel, quality assurance, measurement & verification) are to be covered by either the building owner or the ESCo throughout the contractual period.

The Business Model

The Integrated Energy Contracting model is based on the popular Energy Supply Contracting business model and is supplemented by quality assurance instruments for the energy efficiency measures in lieu of the EPC model’s potentially complex and costly saving measurement and verification.

The ESCo will take over implementation and operation of the energy service package at its own expense and risk

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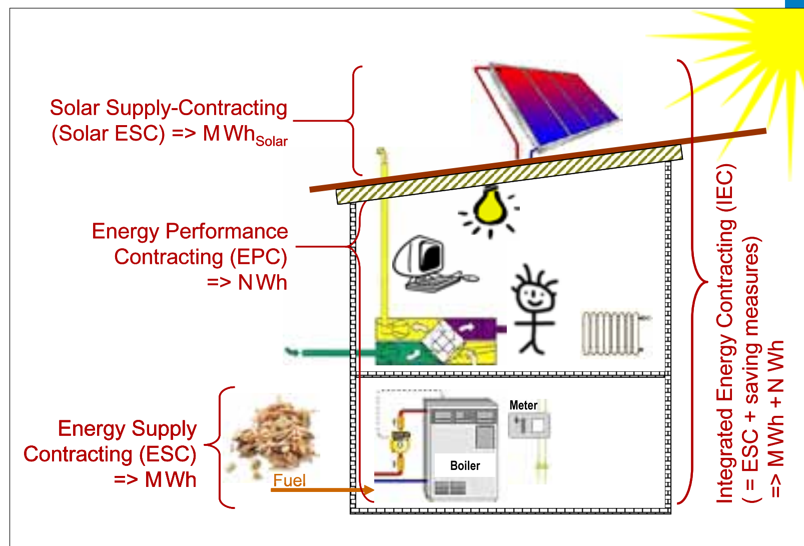

Figure 1. Scope of services of different ESCo models

according to the project specific requirements set by the client. In return, the ESCo is remunerated[1] for the useful energy delivered, depending on the actual consumption, as well as a flat rate remuneration for operation and maintenance, including quality assurance. Financing is a modular component of the service package.

The ESCo's remuneration is made up of the following three price components:

- **Energy Price** (per MWh of useful energy metered): Covers the marginal "consumption related" cost per MWh of useful energy supplied. To rule out incentives to sell more energy, the ESCo's calculation of the energy price should include consumption related cost only (in economic terms, the marginal cost), exclusively the expenditure for fuel and auxiliary electricity.[2, 3]

  To account for final energy price developments during the contractual period, the ESCo's energy price will be adjusted by using statistical energy price indices depending on the fuel used (e.g., gas or biomass index), which are defined in the IEC Contract. Thus the risk (and chances) of final energy price development remains with the ESCo's client.

- **Service** (or basic) Price for Energy Supply (flat rate): All operation related cost, that is the cost for operation and maintenance, personal, insurance, management, etc. of the energy supply infrastructure as well as entrepreneurial risk.

  During the contractual period, the prices will be adjusted (typically every year retrospectively) by using statistical indices such as wages or investment indices.

  Service price for Energy Efficiency (flat rate): All operation costs of the energy efficiency measures.

  As shown in Figures 3 and 4, the two basic prices can be combined.

- **Capital cost** of energy efficiency and supply investments may or may not be part of the service package. If financed by the ESCo, the ESCo will be remunerated for its capital cost minus subsidies and building cost allowances. During the contractual period, the prices may be adjusted using statistical indices such as the 6-Month Euribor.

In the above mentioned price components, all the ESCo's expenditure items for the defined scope of services throughout the contractual period must be included ("all inclusive prices"). Correspondingly, the project or life cycle costs should be calculated in the Integrated Energy Contracting model, which should be considered when comparing with the in-house implementation.

The awarding of contracts is usually done through a combined competition of solutions and prices based on a functional description of the energy services.

The Quality Assurance Substitutes Energy Savings Measurement

To avoid or to at least reduce the potential of EPC problems the (pseudo) exact measurement and verification of the actual savings achieved is replaced by quality assurance and simplified measurement and verification procedures (e.g., deemed savings).

The individual quality assurance instruments (QAIs)

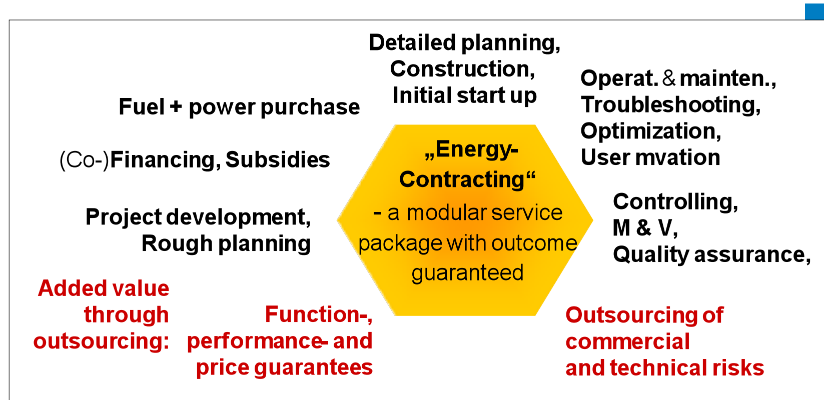

Figure 2. Energy Contracting: A modular energy service package with guaranteed results for the client

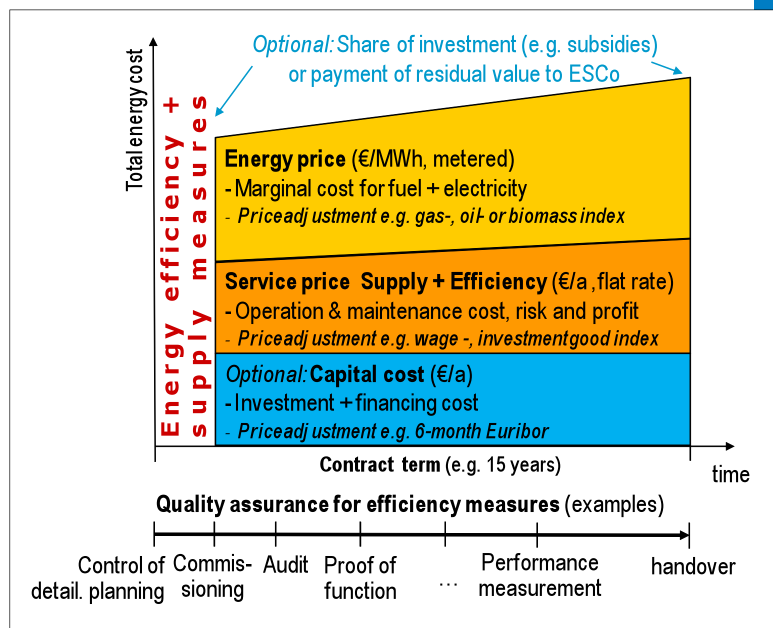

Figure 3. Integrated Energy Contracting Business Model with Quality Assurance

[1] The price structure of the ESC model is comparable to that of standard district heating.

[2] Alternatively, fuel can be purchased by the client in case of better purchasing conditions and cleared with the energy price.

[3] Still another and further reaching approach for discussion would be to set the energy price below the marginal cost (e.g. by shifting 10% of the work costs to the basic price) in order to offer an additional saving incentive to the ESCo.

for the EE measures installed should secure their functionality and performance, but not their exact quantitative outcome over the entire project cycle. One reason for this is that the outcome may largely depend on factors external to the ESCo's influence (e.g., changes in ambient climate conditions or facility use). The objective is to simplify the business model and to reduce (transaction) cost by balancing measurement and verification cost and accuracy.

The concept is illustrated in Figure 4 (on the basis of the business model in Figure 3).

QAI's can be specified either by the client or suggested by the ESCo as part of the competition of solutions during the procurement process or the detailed project design. The selection of QAI's as well as their exact design will depend on the specific requirements of the project scope and the parties involved.

As mentioned earlier, an important point of discussion is to find a reasonable ratio between quality assurance and verification efforts, on the one hand, and expenditure for M&V on the other hand. This certainly requires experience and fine-tuning and cannot be generically defined. Nevertheless, the guiding principle should be "As little effort as possible and as much as necessary in order to secure the general project savings goals".

Integrated Energy-Contracting in Practice

Experiences collected in eight projects confirm the practical feasibility of the IEC model. To our knowledge, Landesimmobiliengesellschaft Steiermark (LIG), a State of Styria owned real estate company, was the first institutional building owner to systematically apply the concept of Integrated Energy Contracting. LIG administers and manages more than 420 buildings in Styria (about 200 buildings with an overall area of more than 600,000 m^2 are owned by LIG). In 2010, LIG's IEC activities were recognized with the Energy Globe Styria Award 2009. The positive results of the LIG project have encouraged the implementation of other IEC projects and raised the interest of other stakeholders, including DECA (Dachverband der Österreichischen Contractoren – Umbrella Association of the Austrian ESCos) and the ESCo Europe (European Conference of the ESCo Industry).

Outlook

When implementing energy efficiency projects, IEC offers an innovative "efficiency tool." IEC allows the combination of energy savings and supply (from renewable energy sources) and the competition of solutions and prices according to life cycle cost.

A high priority should be placed on the development of new projects in the end-use sectors of public institutions, tertiary sectors, commerce and industry as well as housing in order to facilitate sustainable cost reductions and climate protection policies. Implementation can be executed by outsourcing to an ESCo or through in-house implementation. What is important is to optimize investment decisions according to project better life cycle cost and to ensure the results of the energy efficiency measures on a long-term basis.

It remains to be seen what contribution the IEC model will make in the search for suitable efficiency. Perhaps energy efficiency will achieve higher market diffusion in combination with (renewable) energy supply. And, maybe a less technical approach for verifying savings and thus a waiver of (pseudo) exact, indirect saving measurements, will serve the purpose of establishing EE as a resource.

No matter what, the IEC experience shows that the development of comprehensive energy (efficiency + renewables) projects require committed facilitators and a long breath to convince all stakeholders involved. No ESCo or ESCo model will be able to solve all obstacles in the way of energy efficiency. Independent of the implementation model selected, the voluntary or regulatory driven decision of the building or business owner to want to invest in energy efficiency remains the basic requirement.

This article is excerpted from the paper "Conservation First! The New Integrated Energy-Contracting Model to Combine Energy Efficiency and Renewable Supply in Large Buildings and Industry" written by Jan W. Bleyl, Operating Agent for IEA DSM Task XVI, Competitive Energy Services. For more information visit DSM Task XVI or contact Mr. Bleyl, Bleyl@Grazer-EA.at.

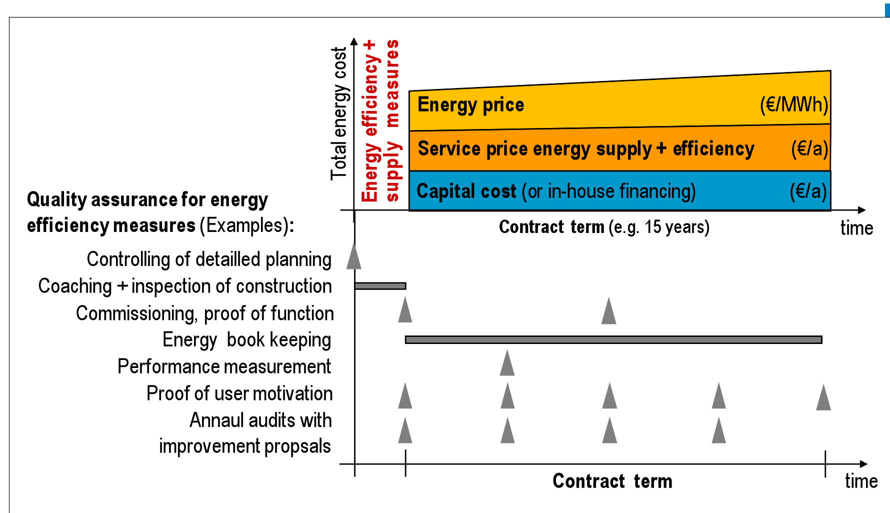

Figure 4. IEC business model: Sample quality assurance instruments as substitute for savings measurements

case study

Binda-Bigga Demand Management Project - Australia

This is the 10th article in a series highlighting the case studies of DSM Task XV, Network Driven DSM. *This Task demonstrated that DSM can be successfully used to support electricity networks in two main ways 1) by relieving constraints on distribution and/ or transmission networks at lower costs than building 'poles and wires' solutions, and 2) by providing services for electricity network system operators, achieving peak load reductions with various response times for network operational support.*

Introduction

The implementor for this project, the Sustainable Energy Development Authority (SEDA), was established in 1996 by the State Government of New South Wales, with a mandate to reduce greenhouse gas emissions through promoting energy efficiency and increased use of renewable energy. SEDA operated as an independent government agency until mid-2004 when it was merged with another New South Wales Government department.

The project proponent, Country Energy, was the holding company for two businesses as the owner and operator of an electricity distribution network and as a retailer of electricity, natural gas, bottled gas and water. The two businesses were ring-fenced from each other and carried out their functions independently. In 2011, subsequent to the Binda-Bigga project, the retailing and electricity distribution businesses were split into two separate entities with different owners. The retailer retained the Country Energy name and the distribution business is now known as Essential Energy.

In 2004, at the time of the Binda-Bigga project, Country Energy Network managed Australia's largest energy supply network in regional and rural areas across 95% of the State of New South Wales, serving around 870,000 customers.

Binda and Bigga are two small rural settlements near Crookwell about 230 km south-west of Sydney. The Binda-Bigga area has about 250 electricity customers, mostly residential.

The electricity line that runs from Binda to Bigga and then further on to Grabine was installed by Country Energy in the 1980s. In 2004, overall load growth on the line was relatively low, but as peak electricity use increased in the area the line was reaching its maximum capacity. The base electrical load used for the line was 750kVA, however, peak demand had been registered at 1,000kVA.

Fault levels and voltage levels were a concern along the line, especially during storm events, due to the length of the line and the rugged country through which the line passes. Many customers in Binda and Bigga were experiencing unacceptable voltage fluctuations that could be resolved only by extensive reconductoring of the line.

In 2004, Country Energy contracted SEDA to relieve the electrical demand on the Crookwell to Grabine feeder during times of winter evening peaks. The aim of the contract was to defer the need for the upgrade of the Crookwell to Grabine feeder by reducing the demand for energy during the winter evening peak periods (the four hours from 6 pm to 10 pm).

Figure 1.Peak Winter Demand on the Crookwell to Grabine Feeder

Appliance	Rec. Retail Price	Price in Energy Saver Package (excl. GST)	Serving to the Customer
Rinnai Granada (unflued heater)	$899	$250	$649
Rinnai EnergySaver (flued heater)	$1,699	$1,000	$699
Chef Stove	$699	$250	$449
Rinnai Granada + Chef Stove	$1,598	$470	$1,128
Rinnai EnergySaver + Chef Stove	$2,398	$1,200	$1,196

Figure 2. Cost of Gas Appliances Offered in the Energy Saver Package

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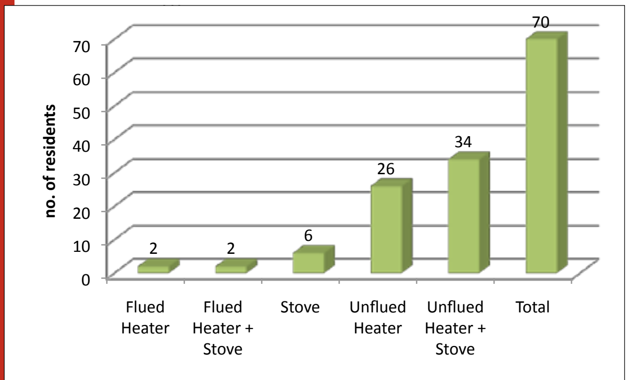

Figure 3. Type of Energy Saver Package Purchased

Initial Investigation

There were two winter peaks on the Crookwell to Grabine feeder, one around midnight due to off-peak hot water controlled loads and an evening peak (see Figure 1). The evening peak tended to occur on days when the minimum temperature dropped as low as minus 9 degrees Celsius.

In January 2004, SEDA conducted a survey of Binda and Bigga residents to explore what might have been causing the peaks in electricity demand during winter evenings. Results showed that a typical winter energy bill was over AUD 250 each quarter – a large percentage due to room heating and cooking end-uses.

Project Objectives

The following objectives were established for the project:

- to reduce the electricity load on Country Energy's Crookwell to Grabine feeder by 200kVA by 2006 during winter evening peaks (the four hours from 6 pm to 10 pm);
- to deliver real benefits to rural customers through reducing their energy consumption and improving the quality of supply for residents on the Crookwell to Grabine feeder;
- to reduce greenhouse gas emissions through fuel substitution of electric appliances to gas.

DSM Strategies

Two DSM strategies were investigated:

1. Cogeneration Option: the installation of a cogeneration plant at the Grabine State Recreation Park to achieve a reduction of 100kVA in peak electrical demand.
2. Domestic Solution: a range of strategies to facilitate the uptake of energy efficient products and measures, primarily achieved through fuel substitution of residential appliances from electricity to bottled gas to achieve a reduction of another 100kVA in peak electrical demand.

After an initial investigation, the Cogeneration Option proved uneconomical, so the Domestic Solution was the method to be used to reach the required demand reduction of 200kVA.

The Domestic Solution facilitated a range of residential DSM strategies:

- developing an Energy Saver Package;
- engaging local project partners;
- offering Energy Smart Home audits;
- implementing marketing and communications campaigns; and
- holding community forums in Binda and Bigga.

Energy Saver Package

The Energy Saver Package was developed as the primary mechanism to achieve the required demand management reduction. To reduce the demand on the electricity feeder during the peak time, the Package was structured around appliances that would reduce electricity demand from residents cooking an evening meal and heating their homes.

The Energy Saver Package enabled residents to affordably switch from electric to gas appliances (see Figure 2) through:

- discounted gas room heaters and cooking stoves (a maximum of two appliances per household);
- free installation of gas appliances and gas bottles, and removal of electrical appliances for metal recycling; and
- gas credits of AUD 170 per appliance – equivalent to free gas for a year.

To achieve the peak demand reduction target of 200kVA, 98 gas appliances needed to be installed.

To qualify for the Energy Saver Package customers had to:

- be connected to the Crookwell to Grabine Feeder, and be a Country Energy customer;
- agree to surrender their electric heaters and stoves at the time of installation of the new gas appliances;
- commit to leaving gas appliances installed and operational for a period of 5 years; and
- submit signed a Customer Form and payment by 30 September 2004 (extended to 31 October 2004).

The Energy Saver Package, designed to be easy for residents, delivered and installed the new gas appliances in the customers' homes and took the old electric appliances to be recycled.

Energy Smart Home Audits

Energy Smart Home audits were offered to residents in Binda and Bigga to facilitate the uptake of energy efficient products and measures. The audits also provided the opportunity for residents to have assessed the suitability of their home/appliances for the gas appliance offer.

The three components of an Energy Smart Home audit comprise a Star Rating, a virtual home audit

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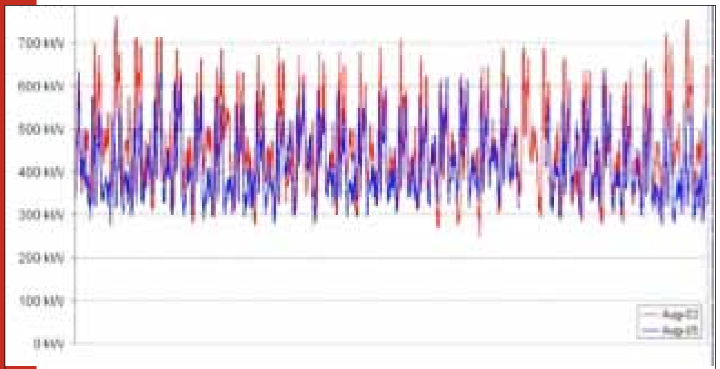

Figure 4. Load on the Crookwell to Grabine Feeder Before and After Implementation of the Bigga-Bigga Demand Management Project

and a personal visit from an Energy Assessor. The audit provides a measure of energy efficiency for a home by comparing its rating to an average. The result is a star rating between 1 and 5, with 5 being the most energy efficient. Moving up just one star can save AUD 150-300 per annum.

Residents were offered an Energy Smart Home audit for AUD 20, rather than the normal AUD 100, and the cost of the audit was redeemable against the purchase of a gas heater or stove (as part of the Energy Saver Package).

Marketing and Communications

The Energy Saver Package was promoted in print, a brochure and poster detailing the Energy Saver Package options, and at two community forums. The community forums were held in Binda and Bigga and presented information on the Energy Saver Package, Energy Smart Home audits, Green Power, and tips on saving energy around the home and reducing bills as well as demonstrations.

Results

Overall 70 customers purchased an Energy Saver Package, purchasing 106 appliances in total, between July and October 2004. This exceeded the target of 98 appliances and included:

- 60 unflued room heaters (56%);
- 42 cooking stoves (40%); and
- 4 flued room heaters (4%).

Of the 70 Energy Saver Packages purchased, the most popular package was the "unflued room heater + cooking stove package" (34 customers), followed by the sole purchase of an unflued heater (26 customers) (see Figure 3).

Only 17 customers were already connected to a bottled gas supply with 53 customers requiring gas connection including slab, bottle delivery, piping and wiring. A total of 106 electric heaters and stoves (64 room heaters and 42 cooking stoves) were removed and recycled.

Figure 4 shows the reduction in the peak load on the Crookwell to Grabine feeder after implementation of the Binda-Bigga Demand Management Project.

The network augmentation solution involving an upgrade of the Crookwell to Grabine feeder was estimated to cost AUD 412,500 over a five year period. The cost to Country Energy of the demand management project was AUD 108,000 (an average rate of $540/kVA reduced). This represents the cost savings from deferring the investment in network infrastructure for five years. Binda-Bigga residents contributed an additional AUD 28,412 to the cost of the gas appliances.

Conclusion

This project is an interesting example of a successful small-scale fuel substitution project with an extremely high take-up rate by the end-user participants.

This article was contributed by David Crossley, Managing Director of Energy Futures Australia Pty. Ltd and Senior Advisor at The Regulatory Assistance Project. For more information on this case study and others, visit DSMTask XV, Network Driven DSM.

Visit the DSM Programme's website for easy access to reports, news and contact information.

www.ieadsm.org

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