NOTE FROM THE CHAIRMAN

Large-scale Deployment Programmes Pave The Way For Sustainable Energy Systems

After the COP-15 meeting in Copenhagen it has become sufficiently clear to the world that the threat of climate change is imminent and calls for actions go well beyond what has been undertaken so far. The IEA Secretariat has in its publication, “World Energy Outlook 2009” (WEO), demonstrated the magnitude of such a task by showing which measures are needed to cut back greenhouse gas emissions to a level that enables us to even have a chance to put the brakes on climate change.

The most remarkable fact in this message, and contrary to what most debate and newspaper articles make us believe, is that by far the biggest share of the solution is on the demand side – in the improvement of the end-use energy efficiency! More than 50% of the reduction has to come from energy efficiency measures.

In reality, it means that we are facing an unprecedented deployment of energy efficiency technologies in a short period of time. A surge of “organised and orchestrated” energy efficiency measures that go far beyond the “spontaneous” efficiency installations in the market – such that are made continuously to improve productivity when old equipment is replaced.

The good news is (a) that it can be done, (b) that it can be done with profit, and (c) that the margins for profit will further grow while we are doing it, due to the market learning processes. The way to make it all work is large-scale deployment programmes – also known as DSM or Demand Side Management.

Hans Nilsson
IEA DSM Chairman

THINK TANK Competitive Energy Services
(Energy contracting, ESCo services)

Energy contracting incorporates many aspects of the implementation process, such as economic, financial, organisational, legal and technological issues, in order to achieve guaranteed performance and results of the efficiency technology to be deployed. The IEA DSM Task XVI Think Tank is working to further develop and document innovative and competitive energy contracting models and issues. Countries participating are gaining specific “know-how” that they can apply in their national implementation activities.

In 2009, the Think Tank tackled the topics:
• Integrate Energy Contracting: A New ESCo Model

Means for decarbonising till 2030 (IEA WEO 2009)
to Combined Energy Efficiency and (Renewable) Supply

* Energy Contracting: How Much Can it Contribute to Energy Efficiency in the Residential Sector?

**Integrate Energy Contracting: A New ESCo Model to Combine Energy Efficiency and (Renewable) Supply**

One of the most urgent energy challenges is the search for suitable “tools” to execute energy conservation potentials. The level of success is far from satisfactory as the continuous increase in final energy consumption reveals, despite energy services rising to the top of political agendas and headlining energy legislation.

This Think Tank activity conducted an analysis of the methodological limitations of standard ESCo products to draw conclusions for the development of future models. On the empirical side, the analysis drew on the projects of Landesimmobiliengesellschaft Steiermark (State Real Estate Company of Styria, Austria) that procured and implemented Integrated Energy Contracting services in eight public sector buildings.

**The Results**

The outcome of this work was the recommendation to use an Integrated Energy Contracting (IEC) model to unite energy conservation and renewable energy supply into an integrated approach. The concept of the IEC business model including quality assurance is displayed in Figure 1.

Transaction cost: Absolute and relative to investment cost for ESC projects over thermal load

The Landesimmobiliengesellschaft Steiermark projects were used to examine the building owner’s retrofit goals, the use and type of procurement and awarding criteria, and the project’s first results. The experiences from the eight projects supported the feasibility of the IEC model. In addition to achieving competitive energy prices, energy end-use savings (up to 30% heat, 12% electricity and 20% water consumption) were achieved by integrating demand side measures (e.g., controls, hydraulic adjustment, solar, top floor insulation and user behavior) into the ESC scheme. CO₂ reductions were above 90%, mainly due to switching to a combination of geothermal and biomass energy sources.

The IEC model could prove to be a solution that is widely applicable to combine energy supply and delivery of EE potentials in large volume buildings and enterprises. However, IEC experience shows that the development of comprehensive energy efficiency projects requires:

- committed facilitators,
- time, and
- building or business owners that will tap into energy efficiency resources (either voluntarily or through regulations).

Perhaps energy efficiency can achieve a higher level of market penetration if combined with the renewable energy supply.


**Energy Contracting: How Much Can it Contribute to Energy Efficiency in the Residential Sector?**

Energy Contracting (EC), as a market-based instrument to access saving potentials, has climbed high on political agendas and has even reached the headlines of energy efficiency legislation. But its real potential and the limits and obstacles of Energy Service Company (ESCo) products in the residential sector are not yet well understood, as the limited market success and the repeated statements by different stakeholders tell us.

This Think Tank activity conducted a conceptual analysis of Energy Supply Contracting (ESC) as the market prevailing product as well as an economic analysis of transaction cost and a life cycle cost comparison between in-house and ESCo implementation. The results were then compared with the empirical data of a comprehensive market query, interviews and workshops with stakeholders and case studies. To complete the project, experts studied statistical housing data to estimate suitable ESCo market potentials in the residential sector.

**The Results**

Germany served as a case study leading to the following conclusions. Over the range of 30–1,000 kW<sub>thermal</sub> installations, the life cycle cost comparison revealed no significant cost advantage for ESCo compared to in-house projects. And, the cost effective minimum project size was 100 kW<sub>thermal</sub> for ESC-projects, derived from transaction cost accrued to implement ESC projects. This figure was confirmed through the market query. The market query further revealed around 250 ESCos, whose dominant product in the residential sector is Energy Supply Contracting. Based on their specialised know-how, competent ESCos achieve an average efficiency

**continued on page 3**
gain of around 5%. They are more likely to implement innovative and renewable technologies. Although there is still a lack of market data, it can be implicitly derived from other market data and results of our query that the actual market coverage for ESC in the residential sector is between 10 and 20%.

In the German residential sector, a market potential of 12.3 TWh/a is considered “preferentially suitable” for ESC (this accounts for only 5.6% of the total statistical demand). An additional, “conditionally suitable” potential amounts to 102.0 TWh/a, mainly limited by the small size of the buildings.

We concluded that the Energy Contracting potential for the residential sector is confined by three major restrictions (in addition to the lack of a suitable legal framework)
- high transaction costs
- scope of efficiency measures are limited to the boiler room
- lack of independent market facilitator agents to serve as mediators between ESCos and their clients. The facilitator’s task is to consult with customers to help them define concrete projects and to request and evaluate ESCo proposals.

Based on these conclusions, we recommended EC product standardisation to access the “conditionally suitable” market. Additional efficiency potentials of 20–50% can only be tapped, if demand side building technologies, building envelope (e.g., building insulation, improved glazing) and targeting user behaviour are integrated into energy service schemes, (e.g. with the Integrated Energy-Contracting model).

This work was carried out in cooperation with Bremer Energieinstitut, Prognos, Energetic Solutions and Prof. Clemens Arzt. To read the complete abstract visit, http://www.ieadsm.org/Files/Task/20%20ESCo%20Services%20(09%20Energy%20Contracting%20-%20Residential%20Market%20-%20Energetic%20Solutions%20-%20Prof.%20Clemens%20Arzt)/Publications/090709_T16_EC%20residential%20market%20IAEE09%20abstract_GEA_Bleyl.pdf

Think Tank 2010

(Public) Procurement of Energy Services:
A Guide How to Purchase Energy Services

Comprehensive Refurbishment of Buildings:
Collection and Documentation of Good Practice Examples

For more information contact the Task Operating Agent, Jan Bleyl, bleyl@grazer-ea.at or visit the Task web page, http://www.ieadsm.org/ViewTask.aspx?ID=16&Task=16&Sort=0

XXI

Standardization of Energy Savings Calculations – A Timely Task

Recent International Actions
In February 2010, ISO discussed the Chinese proposal on standardisation of “Criteria on the methods for calculating and evaluating the economic benefits of electricity saving measures”. And in early March the Joint Working Group of the European Committee for Standardization (CEN) discussed the draft energy savings calculations standard that addresses top down calculations (using energy efficiency indicators) and bottom up calculations (using a four steps approach from unitary energy savings to savings in the target year). This draft is now to be discussed by the full membership of CEN.

Also in February 2010, the OECD Annex I Expert Group of the United Nations Framework Convention on Climate Change discussed the outcomes of Copenhagen, COP-15. A key issue discussed was standardising the Clean Development Mechanism (CDM) baselines, which would result in enhancing the effectiveness of the CDM instrument.

IEA DSM Response
At the second DSM Task XXI Experts Meeting this month these two topics 1) criteria on methods for bottom up calculations and 2) standardisation of baselines will be discussed. Participating experts will also use information from the French and Italian White Certificates programmes to identify key elements and default values for energy savings calculations. By the summer of 2010, the first two Task reports will be available for comments by the participating countries (Norway, Netherlands, France, Switzerland, Republic of Korea, USA and Spain).

If you are interested in joining this Task or want to learn more, contact the Operating Agent, Harry Vreuls of NL Agency, http://www.ieadsm.org/ViewTask.aspx?ID=16&Task=21&Sort=0, and visit the IEA DSM website, www.ieadsm.org.
This is the fourth 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
Orion New Zealand Limited (Orion) owns and operates the electricity distribution network in the central Canterbury region on the South Island of New Zealand. Orion is owned by Christchurch City Council and Selwyn District Council.

Orion’s distribution network area covers 8,000 square kilometres of diverse geography, including the city of Christchurch, Banks Peninsula, farming communities and high country regions (see Figure 1).

Figure 1. Map of New Zealand showing Orion’s Network Area (outlined in dark green)

Drivers for the Program
Orion draws energy from the national high voltage electricity transmission network at 10 grid exit points, via transformers that connect distribution load to the transmission network. Orion then transports the energy from the grid exit points to approximately 185,000 homes and businesses through the low voltage distribution network.

In New Zealand as a whole, peak and energy demands on the electricity network have been growing at about the same rates from 1990 (see Figure 2).

To cover the costs involved in meeting peak demand, the transmission company in New Zealand, Transpower, charges parties connected to the national transmission network based on an average of the 12 highest peaks (by half-hour) over a year at the various grid exit points. This creates an incentive for Transpower customers to minimise peaks.

Since around 1990, Orion has been working actively to limit the growth in peak demand to improve the utilisation of both its distribution network and the national transmission network, and consequently reduce the costs per kilowatt-hour of energy delivered to end-use customers in the Orion service territory.

Program Implementation
To achieve the decoupling of peak and energy demand growth in its service territory, Orion has used a mix of direct load control and pricing initiatives.

Direct Load Control
In the Orion service territory, about 90% of residential electric hot water heaters are controlled through ripple control in which control signals to switch the heating elements on or off are transmitted through the power lines.

continued on page 5
to relays at customers’ premises. Orion promotes two direct load control methods for peak reduction through ripple control:
• peak control water heating; and
• night only water heating.

Peak Control Water Heating
Peak control water heating is aimed both at consumers who have water heaters with smaller tanks and at consumers who use larger quantities of hot water. For these consumers, Orion uses the ripple system to switch off water heating elements during peak loading periods, and cycles through up to 16 groupings of water heating load to ensure sufficient heating is provided.

Peak load control is used when the demand in Orion’s network area reaches a certain threshold; in 2007, this was 570 MW. When the load approached this level, Orion commences switching off water heaters in groups to keep demand from exceeding the threshold level. To limit the potential impacts on customers, Orion cycles the controlled water heaters, switching on one group of water heaters while switching off a different group to maintain the load below the threshold level.

To maintain service standards and encourage appropriate design of hot water systems, Orion has set service level targets whereby it aims to have individual water heaters switched off for no more than seven hours per day, and no more than four hours in any seven hour period. The heating elements in water heaters with tanks larger than 100 litres can be switched off for several hours without customers noticing any reduction in the supply of hot water.

During the period 2005 to 2007, Orion used peak control to switch water heaters for an average of 54 hours a year, typically in the winter months (June to August).

Night Only Water Heating
Night only water heating is aimed at consumers who have water heaters with larger tanks. Orion uses the ripple system to switch on these heaters only at night, permanently shifting this load away from peak times.

This option has been so successful that Orion must progressively stagger switching on the night water heater load over a period of time to avoid setting night-time peaks. In some areas, Orion uses peak control to lower loading levels while night water heating load is being turned on.

Orion also provides an option that includes an afternoon heating boost to night only water heaters to ensure that hot water is available in the evening.

### Table 1. Tariff Schedules for the Electricity Retailer Contact Energy as at May 2008

<table>
<thead>
<tr>
<th>Tariff type</th>
<th>Variable price*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anytime use tariff</td>
<td>19.267 cents/kWh</td>
</tr>
<tr>
<td>Controlled load tariff</td>
<td>17.129 cents/kWh</td>
</tr>
<tr>
<td>Day/night - day tariff</td>
<td>21.765 cents/kWh</td>
</tr>
<tr>
<td>Day/night - night tariff</td>
<td>9.256 cents/kWh</td>
</tr>
</tbody>
</table>

* All tariffs have a fixed tariff of 60.53 cents a day as well

### Pricing Initiatives

#### Controlled Water Heating Loads
Customers with controlled water heating in the Orion service territory receive pricing incentives delivered through their electricity retailer.

Table 1 shows tariff schedules for the electricity retailer Contact Energy as at May 2008. Contact customers on the Controlled Load tariff save 10% on the standard Anytime Use tariff, under which water heaters are not controlled. Under the Day/Night - Night tariff, used for night only water heating, customers pay only about 50% of the Anytime Use tariff.

#### Commercial and Industrial Loads
Sometimes the use of direct load control is not enough to keep the load on the Orion network from exceeding the required threshold. During periods when loading levels reach a set threshold, Orion initiates a second load reduction measure based on peak demand pricing and targeting larger commercial and industrial loads. These periods are called “control periods”.

Orion has estimated its long run average incremental cost to deliver electricity at peak times, and reflects this cost in its peak demand charges. With this cost-reflective pricing approach, the decision to reinforce the network for load growth is effectively passed to consumers - they can elect to use energy at peak times and accept the cost of delivery, or avoid peak times and save.

The start and end of a control period are signalled to consumers in real-time via ripple signals, text messages and emails. Orion identifies control periods for major customers (those with half-hour metering and loads greater than 250 kVA), and records their average loadings during these periods (typically over a total of 80 to 100 hours per year). This average loading then forms the basis of Orion’s control period demand charge, which is currently set at NZD139.20 per kVA per year (for delivery only). Over the duration of...
the control periods, this equates to a delivered cost of electricity of NZD1.50 to NZD2.00 per kWh, compared with the normal delivered cost of electricity of NZD0.12 to NZD0.20 at other times.

Control periods vary in length and the signal is withdrawn when loading levels fall to lower levels. To help customers respond, Orion provides 10 minutes advance warning for control periods and ensures that each control period lasts for at least 30 minutes. Control periods are only signalled during the core winter months when loading levels peak.

‘General Connections’ Loads
Orion also uses a similar pricing approach for smaller ‘general connections’ loads, using ripple signals to identify peak periods for demand pricing, and applying charges based on each electricity retailers’ reconciled allocation of grid metering during these periods.

Results
Orion has been one of the most successful electricity distributors in New Zealand in minimising peak demand growth.

Figure 3 shows the results of Orion’s efforts, with a noticeable improvement in the load factor (ratio of energy delivered to peak demand) after 1990. Note that the demand is the maximum individual half-hour value, which is somewhat volatile, and consequently the load factor can fluctuate from year to year. On average, the trend in Orion’s load factor has been to increase by 0.7% per year since 1990, (50.7% in 1990 to 60.9% in 2008) but this rate of growth has slowed in recent years.

Orion has achieved a 90% penetration for controlled water heating in its service territory. Figure 4 shows the impact of peak control measures on a typical cold winter day. On this graph, the blue line shows the actual load level and the red line is a calculated estimate of the load level that would have occurred if peak load control of water heating had not been done. Figure 4 also shows the effect of two control periods in causing end users to shed load.

Because of the DSM measures implemented, Orion is to a high degree able to prevent peak demand from exceeding a set level. Figure 5 shows the demand in the Orion service territory for various days in June 2007. Figure 5 shows that roughly the same peak value is obtained on different days as peak demand is shifted to off-peak periods, either between the morning and afternoon peak or after the afternoon peak. This peak shifting results in lower payments to Transpower and has reduced the requirement for investment in Orion’s
own network. These effects lead to lower network charges to Orion’s end-use customers.

If Orion’s load factor was still at its 1990 value of 50.7%, the peak demand on the network would be 750 MW instead of 630 MW, an increase of 120 MW. Orion estimates that the additional cost for delivery of this peak load would equate to approximately NZD12 million per year for distribution and NZD6 million per year for transmission (or approximately 11% more). This is based on an estimated Long Run Average Incremental Cost (LRAIC) of new transmission capacity of around NZD50/kW and a distribution LRAIC of NZD100/kVA per annum.

Peak load reduction can also provide additional savings from a lower investment requirement for peaking generation (though generation capacity has not been a constraint in the New Zealand market until recently).

*This article was contributed by David Crossley of Energy Future Australia Pty. Ltd. For more information on this case study and others, visit Task XV, Network Driven DSM at http://www.ieadsm.org/ViewTask.aspx?ID=17&Task=15&Sort=1.*