E F F L O C O M

Energy efficiency and load curve impacts of commercial development in competitive markets

EU/SAVE 132/2001

Summary Report

Date:	**2004-08-27**
Report ID	**EU/SAVE 132/01 EFFLOCOM report no. 9**
Class:	**Deliverable**
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Distribution:	**EC Restricted**

EFFLOCOM Partners:

SINTEF	Partner 1 / Coordinator	Norway
(Electricity Association (EA) *)	Partner 2	England)
VTT	Partner 3	Finland
Energy piano	Partner 4	Denmark
EDF	Partner 5	France
E-CO Tech	Partner 6	Norway

*) Until July 2003

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1 Introduction

The EU/SAVE project EFFLOCOM started July 2002 and was completed June 2004. Project partners from five countries, Norway, Denmark, Finland, France and England have been working in the project. The results are based on specific studies and six national projects that were included as EFFLOCOM pilots. Additional information from Sweden has been provided via a Swedish subcontractor.

The project has been seeking solutions to remove barriers to energy efficiency through research on customer response to different market based customer services in deregulated markets.

During the project period the focus has not only been on energy efficiency or Demand Side Management[1] (DSM) issues but also on the potential and incentives for Demand Response[2] (DR) in periods with shortage of production capacity.

The project has been divided into the following five phases:

- **Phase 1** forms the basis for the subsequent phases by studies of load profiles and evaluation of the potential of load reduction in peak hours.
- **Phase 2** analyses the impacts of deregulation on the load profiles for different customer categories and on national or regional level.
- **Phase 3** analyses the impacts of technology for direct communication for automatic meter reading and remote load control, and gives an overview and an evaluation of the incentives for load reduction and investments in needed technology.
- **Phase 4** summarizes the experiences and results from the 6 EFFLOCOM pilots.
- **Phase 5** gives an overview of the relevant framework for energy efficiency and demand side participation in the electricity markets in the involved countries and EU, and summarizes the results from the project with reference to the documentation from phase 1-4

[1] Demand Side Management: Permanent Energy reduction as a result of energy efficiency efforts

[2] Demand Response: Response by load reduction of limited duration (from one to a few hours) in case of production and/or transmission capacity shortage

2 Deliverables

Altogether 7 technical reports, 2 administrative reports and 3 conference papers are produced in the EFFLOCOM project, see table 1.

Table 1 Deliverables

Activity	Responsible	Deliverables
Phase 1	Electricity Association/ SINTEF	EFFLOCOM report no. 1, November 03 **"Phase 1 – Basis for Demand Response"**
Phase 2	Electricity Association/ SINTEF	EFFLOCOM report no. 2, November 03 **"Phase 2 – Influence of Competition on load curves"**
Phase 3	SINTEF	EFFLOCOM report no. 3, February 04 **"Description of Technology for Direct Communication"** EFFLOCOM report no. 6, June 04 **"Incentives for Demand Response and for Investments in Infrastructure and Technology"**
Phase 4	VTT	EFFLOCOM report no. 4, June 03 **"Description of the EFFLOCOM Pilots"** EFFLOCOM report no. 7, June 04 **"Results from the EFFLOCOM Pilots"**
Phase 5	SINTEF	EFFLOCOM report no. 8, August 04 **"Policies and tools for Demand Response EFFLOCOM results and recommendations"**
Project administration	SINTEF	EFFLOCOM report no. 5, September 03 "**Interim Progress Report"** EFFLOCOM report no. 9, August 04 **"Summary report"**
Conference papers	E-CO Tech	Norvik, Lund: **"How to achieve energy efficiency actions as an alternative to grid reinforcement"** ECEEE, Saint Raphäel, France, June 03.
	SINTEF	H. Sæle, O. S. Grande "**Incentives for reduction of electricity consumption in peak load periods, results from a large-scale test project in Norway."** Metering Europe 2004, Berlin September 04.
	SINTEF / VTT	I. Graabak, O. S. Grande and J. Ikäheimo and S. Kärkkäinen (VTT Processes, Finland): **"Establishment of automatic meter reading and load management, experiences and cost/benefit"**. IEEE Powercon, Singapore November 04.

3 Project results and recommendation

The results and conclusions from the different phases of the EFFLOCOM project and from the parallel national pilots are presented in the technical reports listed in the previous chapter and summarised in the EFFLOCOM report no.8 “Policies and Tools for Demand response - EFFLOCOM results and recommendations”. On this background the EFFLOCOM project group has agreed on the following general conclusions and recommendations with focus on Demand Response.

A. Load profiles and demand response potential

From the load curve analyses, including studies of total system load as well as customer category hourly load profiles from six countries: Denmark, Finland, France, Norway, Sweden and UK (England and Wales) we have learned that:

- All the involved countries have quite high temperature sensitivities during spring and autumn, being the result of electric space heating. Some countries show positive temperature sensitivities during summer – a result of cooling and air conditioning.

- For all the involved countries the consumption is higher during winter than the other seasons. This can be explained by use of electric space heating and use of lighting during the cold and dark season. France and UK, that have moderate temperatures during winter, also show a much higher demand during colder seasons due to less restricted building codes, and fewer requirements for insulation standards of buildings.

- All the involved countries show a big difference in the day profiles for working days compared to weekends.

- All the involved countries show reduction in the load during nights. All countries have two high activity periods during working days, one in the morning and one during evening. No radical changes in temperature sensitivity, peak load profiles, utilisation factors and distribution of annual energy consumption caused by deregulation are found.

- A large potential for demand response/load management in the industrial and the residential sector are found for all the involved countries. Estimates of the sector vice potential is available only from the Nordic countries where about 10-20 % of the peak load is reducible on hourly basis provided that the needed technology and economical incentives are in place. The load duration curves for all countries show that 5 % peak load reduction could be achieved by concentrated demand response efforts in 20-75 hours.

- Peak load reduction in one Nordic country gains the whole region due to high degree of coincidence in the peak hours.

Recommendation:

I. The potential of demand response should be identified for all countries.

II. Country based targets for annual released demand response potential, e.g. referred to yearly increase in peak load, should be considered as a supplement to the proposed EU Directive on energy efficiency and energy services [10] , Chapter II, where "Energy Saving Targets" for the member states are recommended.

B. Enabling technology

New technology for metering, direct communication for automatic meter reading and remote load control, together with web-based services for customer information and communication, makes utilisation of reducible loads more feasible.

The technology for direct communication used in the pilot tests has shown too low quality. Further development and testing of equipment is necessary to achieve cost effective solutions and quality, required by the power market, of transferred meter values.

Standardisation of the interfaces involved in the Direct Communication system and between this system and other IT-systems, like customer information systems and meter value database, is needed.

More frequent metering of a major part of the total load is needed to promote market based demand response:

- Hourly metering is needed to give incentives to load reduction in peak hours (capacity shortage).
- Weekly or monthly meter reading is needed to favour load reductions in periods with energy shortage.

The experiences with remote load control on price criteria in the Danish and Norwegian Pilot 3 were good. The concept provides automatic price elasticity in the market without continuously involvement from the customers.

Web-based solutions give a lot of opportunities for customer information and communication:

- Information of load control options, network tariffs and power products
- Display of customer metered time series and current electricity costs
- Interface to load control systems

So far investments in technology have been limited of economical reasons because the different actors do not find profitability alone. More cooperation between the stakeholders and regulatory arrangements are needed to secure that projects that are proven socio-economic beneficial will be accomplished.

Recommendation:

III. Improvements of Technology for metering and load control is needed

IV. Standards for the interfaces in "the meter value chain" should be defined

V. Hourly metering, alternatively weekly/monthly metering should be required by regulation

VI. The concept of market based automatic load control, e.g. when spot price exceeds a predefined limit, should be further developed.

VII. Economical incentives for a cost-effective development of infrastructure for automatic meter reading and load control should be provided through regulations from the authorities

VIII. Stable regulations and tax policies from the authorities are needed to reduce the regulatory risk of investments.

C. Incentives for demand response

In a deregulated environment the electricity price paid by the customers consists of the following elements:

- Network tariff (from network owner)
- Energy price (from the supplier)
- Taxes (from the authorities)

The following price signals give the best motivations for load reduction in peak hours in a deregulated market based system:

Network tariffs:

- Time of Use -tariffs with inter day variations in price
- Dynamic tariffs that are amplified in periods with shortage

Energy Price:

- Hourly spot price
- Hourly spot price combined with automatic load reduction when the spot price is high
- Time of Use -price e.g. with day /night variation

The taxes represent in most cases a major share of the electricity bill. In case the tax is a fixed price independent of the consumption, this represents a barrier for more extended use of price variations provided by the network tariffs and energy prices mentioned above.

Bilateral contracts for load reduction are proven efficient options for reserves and reliability purposes. Mainly larger industrial loads are used. An option market for reserves designed by the Norwegian TSO has led to increased demand side participation in the balancing market.

Recommendation:

IX. Time of Use tariffs and spot price energy products should be offered to all customers.

X. Bilateral contracts for load reduction should be further developed for reserves and reliability as well as demand side bidding purposes. Both industry and smaller aggregated loads should be involved.

4 Dissemination

The EFFLOCOM results were presented in 2 workshops. All the documentation is distributed to the EFFLOCOM partners and to the European Commission. The reports and workshop presentations can all be downloaded from the EFFLOCOM website (see below) from September 2004.

4.1 Workshops and presentations

The results from the project was presented in the following workshops:

- Copenhagen, Denmark, 13 June 2003**: "Demand Response and Forecasting"**
  20 participants from 7 countries.

- Trondheim, Norway, 10 June 2004: **"Load curve studies and Demand Response"**
  25 participants from 5 countries.

The project has additionally been presented and discussed in several national meetings and seminars and was presented on the "EU-Deep" workshop in Brussels 25 March 2004.

4.2 Website www.efflocom.com

The EFFLOCOM website was established at the start of the project and has served as a source of external and internal information exchange. The site contains a load curve data base (excel), 2 demonstrators from the project and all public documentation from the project.

The website will be maintained by the coordinator (SINTEF) at least 2 years from the end of the project. The EFFLOCOM front page is shown in figure 1.

Contents

The website contains the following information:

- Descriptions and web-links to the project partners and sponsors plus the EU commission.

- Description of the project plan, objectives and work plan

- Workshops: Contents of all papers that have been presented on the two project workshops i Copenhagen 2003 and in Trondheim 2004.

- Useload: Description of the model **Useload**, a program for load modelling, climate sensitivity calculations, and production of load profiles. Useload has been heavily used during the project.

- Dissemination: Microsoft Excel formatted files that contains data from the load curve studies (phase 1 and 2): Temperature data, hourly system load for all countries, load profiles for different seasons and day types, duration chart material with hourly resolution. Also ready for downloading is data describing system load for Norway Denmark, and Sweden segmented into different customer types.

- Demonstrators of Pilot projects from Denmark and Norway.

- Reports: All reports that are produced during the project will be ready for downloading in pdf format from September 2004.

- Internal pages: For project partners only (password protected).

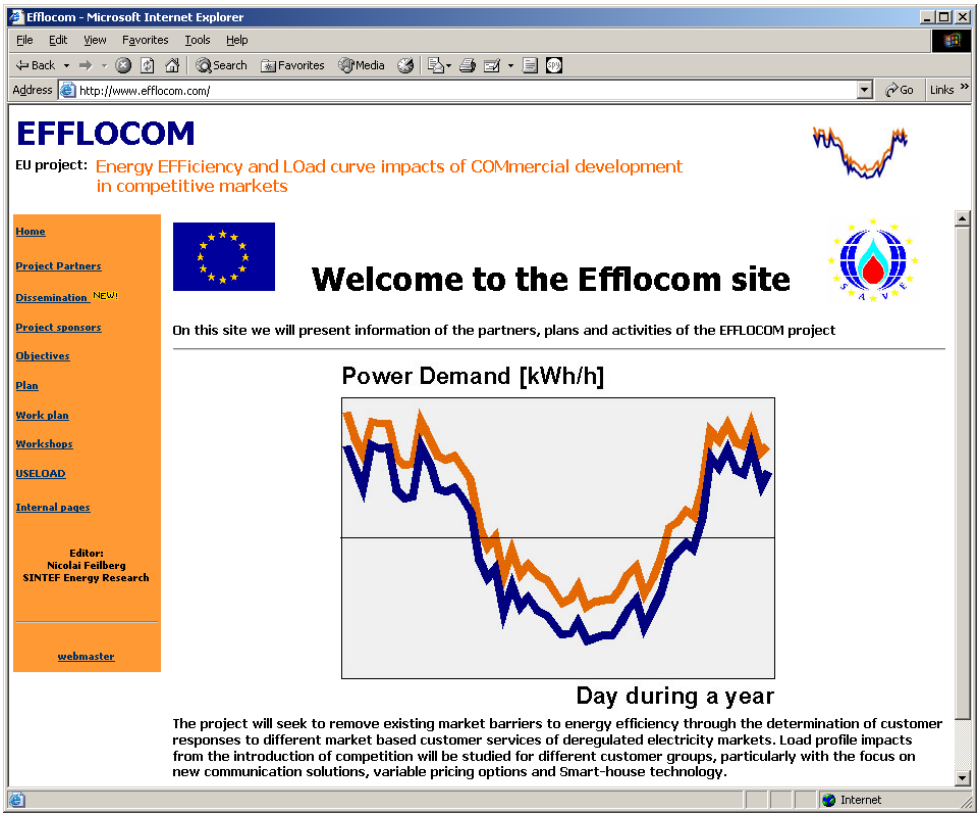

Figure 1 Front page of the EFFLOCOM website