

The Organizations' Motivation for Energy Conservation: A Way to Structure the Market in the Commercial Sector

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The commercial sector is very heterogeneous and those organizations operating the buildings and the activities within the buildings are complex. Customer type or type of organization, type of building, likely conservation potential etc. are probably not enough sharp tools for structuring the commercial sector for the purpose of being successful in promoting conservation.

As a result of the project described in this paper, we have tried to structure the market in the commercial sector by combining the technical-economical potential with the motivation of energy conservation. The motivation of energy conservation is a measure of the organizations' performance in energy questions. The degree of motivation is correlated to the willingness to use energy more efficiently in the future, to the presence of fiery spirits, to the likelihood of implementing suggested measures, to the size of the organization and electricity consumption, to the degree of total responsibility for a building owner, the operation of the building, the activities in the building and the electricity contract.

In sports centres, markets, schools, shops, warehouses and offices we find the highest share of organizations that have big saving potentials and at the same time high degrees of motivation.

Introduction

Vattenfall AB (Ltd) is a state owned power company. Vattenfall owns and operates 50% of the total electricity generation capacity in Sweden. The generation system is a 50/50 hydro and nuclear system. Most of the electricity, 85%, is delivered to utilities not controlled by Vattenfall.

A comprehensive energy conservation project called Uppdrag 2000 conducted by Vattenfall ended in December 1991. The main purpose was "to estimate the real possibilities to decrease the electricity consumption in Sweden ... " at an electricity price-level about 50% higher than 1991. The focus in this 375 millin SEK-project (70 million US dollars) has been to demonstrate energy conservation in close cooperation with customers. Energy efficient measures have been implemented in 50 industrial premises, 60 commercial buildings and about 300 single family houses. The focus has not only been on the technological and economical potentials. Customer acceptance, response and reactions have also been important factors in the project. To estimate the possibilities of conservation on the national level, a number of statistical investigations have been conducted.

The project had a research profile when it started. The perspective was the phasing out of the two first of twelve nuclear power plants in Sweden in the years 1995-96. This decision has been changed, the nuclear power plants are allowed in operation until the year 2010. Meanwhile the

import and export capacity has been extended. The cooperation with our neighbor countries and maybe with the European Community will increase. The power capacity has been raised in the nuclear power plants. Today, energy conservation is not important as a least cost planning option in the short term, when most production companies have an over capacity to produce electricity. The role of energy conservation is instead slightly turning over to be a complementary service in the future competition between power companies to get new customers and more important to improve the relations with present customers. The government has proposed that the networks should be open for third party actors which will lead to an increased competition between power companies in Sweden.

Vattenfall has now started a department called Energy Efficiency, formed as an affiliated company to Vattenfall AB acting as an Energy Service Company helping customers to implement energy efficient measures from audit to financing based on the business concept "shared savings". This "company" operates on the Swedish market and intends to expand on the European market.

In the project Uppdrag 2000 we decided to conduct a rather huge energy audit study including interviews in a random sample of 900 commercial buildings. The purpose was to get a better description of the energy-end uses in

the commercial sector, to get data about the buildings and the installations, to calculate cost effective measures in each building and the total potential for energy savings on the national level, to estimate the motivation of conservation in the organization and to study the correlation between the energy conservation potential and the motivation.

The results from this so called STIL-project (STatistical Investigation in the Commercial sector, in Swedish Lokaler) are very useful. For instance market potentials for different kinds of products can easily be calculated. A first cut of an energy market analysis by subsector for a geographical area/utility can also be established. A demand for key values describing end-uses has also risen among market people at utilities and forecasting people at power companies. Customers are also asking for key values as reference values for their buildings.

The data and results can be used for structuring the market in the commercial sector finding the most cost effective segments for marketing conservation services.

The STIL-Methodology

The STIL-project is an energy audit and an interview study in the commercial sector. It's a complementary study to the demonstration projects within Uppdrag 2000. The goal was to estimate the conservation potentials on the national level. Therefore a statistical method was chosen with the utilities' customer registers as the sample frame. A random sample of 900 buildings was selected stepwise. In the first step 36 utilities were chosen and among them the total number of 900 buildings were randomly selected in the second step. Finally, when the consultant visited the customer he sometimes found a number of buildings and in those cases he chose one or two buildings.

Energy Audits

The consultants collected data for 2-3 days as an average, equipped with some monitoring instruments for measuring electric motors for fans, the lux intensity and CO₂-emission. The cooling equipment in markets and sport centres were investigated by specialists.

Each building has been evaluated in a computer model based on energy balance principals covering both heat and electric energy. The input data and the treatment of the electricity end-uses in the model are very detailed. Eighty different energy efficient options were tested for each building.

Two sets of economical criteria were used in the evaluation.

The customer perspective: a pay-back criterion, 4 years limit for private building owners and 7 years limit for official building owners, 1991 energy price level.

The Uppdrag 2000 perspective: the net present value criterion, 5% real discount rate, the economic length of life of the measures is 5-20 years, electricity price level 30-40% higher than year 1991 depending on type of customer tariff, other energy prices 10% higher than year 1991.

Interviews

Key persons tied to the building have been interviewed. These persons are:

- the building owner
- the person responsible for operation and maintenance
- the person responsible for the activities in the building
- the employee's ombudsman (representative) in working environment questions

These persons were questioned in the following areas:

- 1) Planning: Competence of staff, planned investments, goals for the energy consumption, presence of responsible person in energy questions, energy conservation results.
- 2) Guidelines for the operation of the building
- 3) Investments carried out, big and small
- 4) Follow-up activities concerning the energy consumption, feedback and information network
- 5) Special activities: Training, meetings, special fiery spirits, campaigns, other ideas.

Methodology for Calculating the Motivation for Energy Conservation

Points are given for each answer in the questionnaire. Most of the answers are given a fixed number of points. For some answers the number of points given varies depending on the depth of the activity. The total sum of

points is the measure of the organization's degree of motivation for energy conservation.

In each question area there is a maximum of points that can be received. The maximum of points for an area

depends on the importance of that area compared with other areas and which person that have been interview.

The maximum number of points that is possible to achieve is the following for the three persons interviewed:

<u>Question Area, Number of Points</u>	<u>Owner</u>	<u>Responsible for Operation & Maintenance</u>	<u>Responsible for Activity in Building</u>
1. Planning	110		40
2. Guidelines		100	30
3. Investments		100	
4. Following up activities		90	40
5. Special Activities		100	140
Total	110	390	250

The total number of points that is possible to score is 750. Most points are available for the persons taking care of the building; the owner and the responsible person for operation and maintenance, 500 points. The reason for this is that most of the responsibility in energy questions belong to them.

Results

Different criteria can be used for structuring the market in segments. Such criteria can be:

- the total energy consumption in the subsector
- the size of the energy consumption and energy costs in each building
- the intensity of the energy consumption and costs
- the technical and economical potential for energy conservation
- the potential for a specific technology
- the size of the technical and economical potential in each building
- the degree of motivation for energy conservation in the organization
- the best combination of conservation potential and degree of motivation for conservation

In this paper a stepwise structuring of the market will be presented according to the criteria above.

The Energy Perspective - Consumption and Costs

Normally we start with the total energy consumption by subsector because it's an indication of the importance of the subsector itself. This is often done without any thoughts of the conservation possibilities or the structure of the organizations, acceptance etc. Another criteria used in common is the size of the electricity consumption per customer. In the following figure the total electricity consumption by subsector classified by size of consumption per customer is presented. (High means customers with high voltage tariffs and low means customers with low voltage tariffs, the upper electricity consumption limit for a low voltage customer is about 1000 MWh/year.)

Customers in offices all together have the highest electricity consumption. About 40% of the consumption comes from high voltage customers. Typically, the high voltage customers are few but very big electricity consumers. In Figure 2 this fact is pictured.

High voltage customers represent only 2% of the total number of customers (greater than 20 MWh/year) but 30% of the consumption. And vice versa the low voltage customers with a consumption less than 100 MWh/year represent 65% of the total number, but their consumption only represents 20% of the total. Customers with a consumption less than 20 MWh/year are excluded in Figure 2. They represent 65% of the very total number of customers and less than 10% of the consumption.

The size of the consumption also reflects the total cost for electricity.

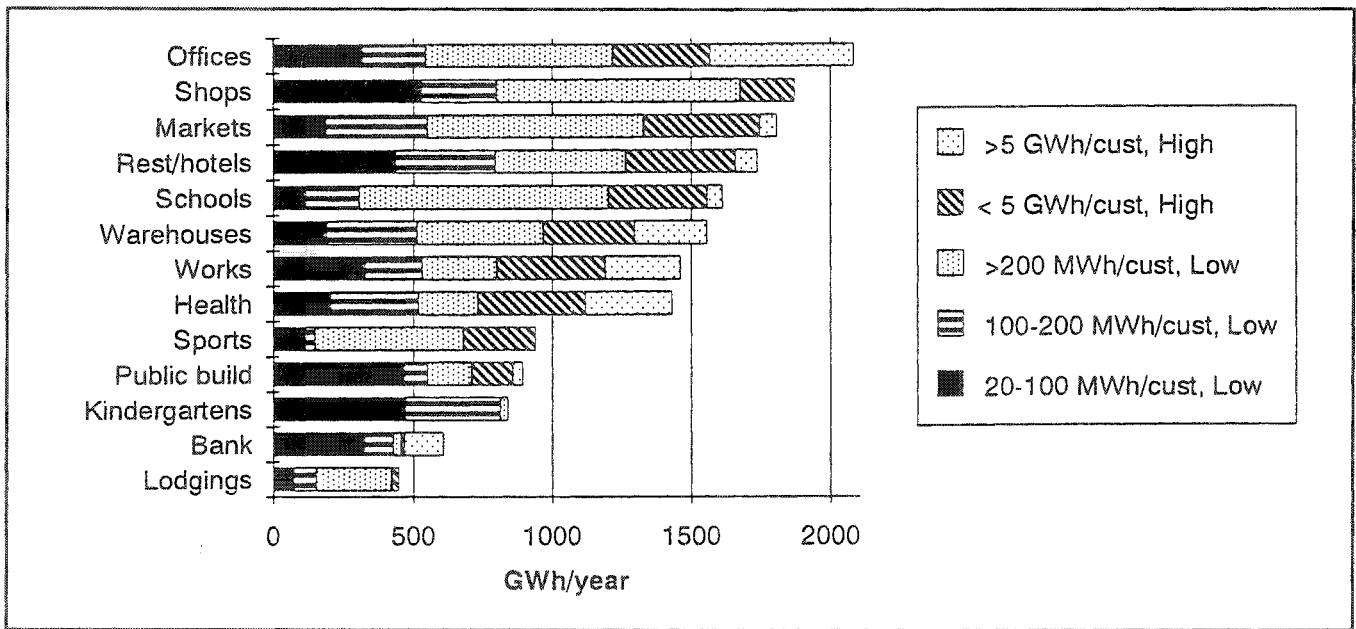


Figure 1. Electricity Consumption in the Commercial Sector by Size of Consumption Per Customer

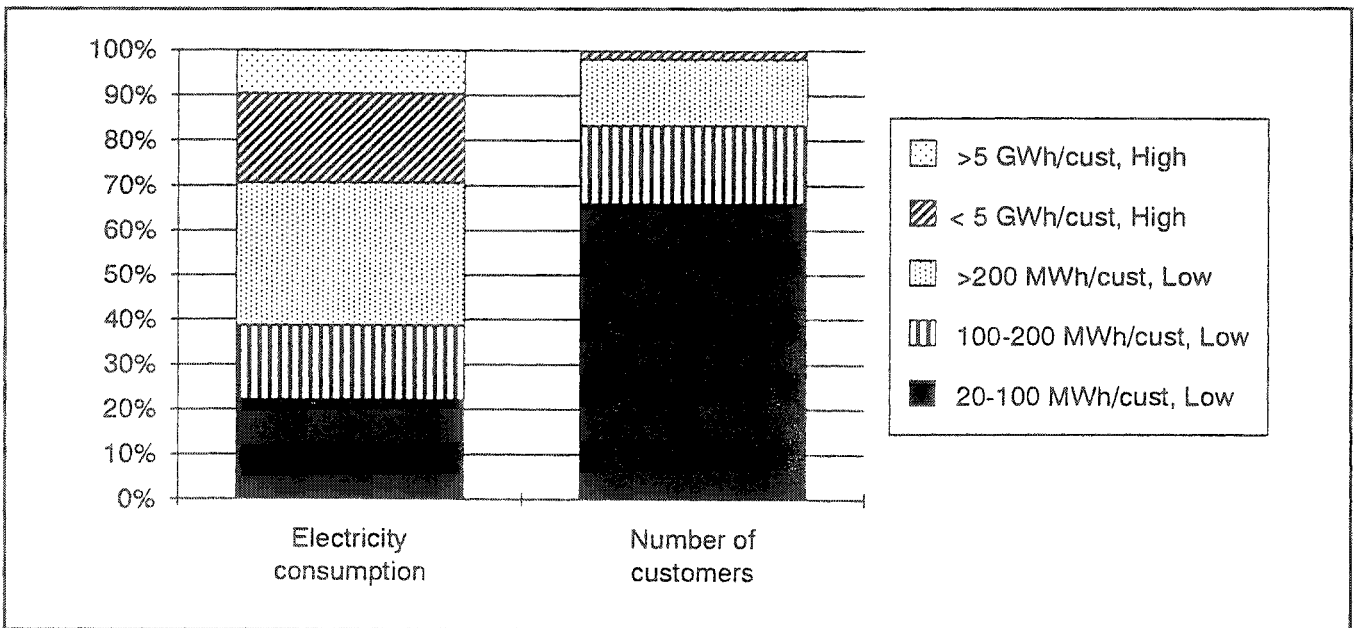


Figure 2. Electricity Consumption and Number of Customers in the Commercial Sector by the Size of Consumption Per Customer

Another criteria that can be of interest is the intensity of energy consumption and costs. This is shown in Figure 3.

The intensity of electricity consumption and costs are highest in markets.

Energy costs are generally low in commercial buildings compared with other costs, though 28% of the building owners think the electricity cost is big compared with other costs. Another interesting aspect is that the energy cost is one of the few cost elements that can be influenced by the building owner.

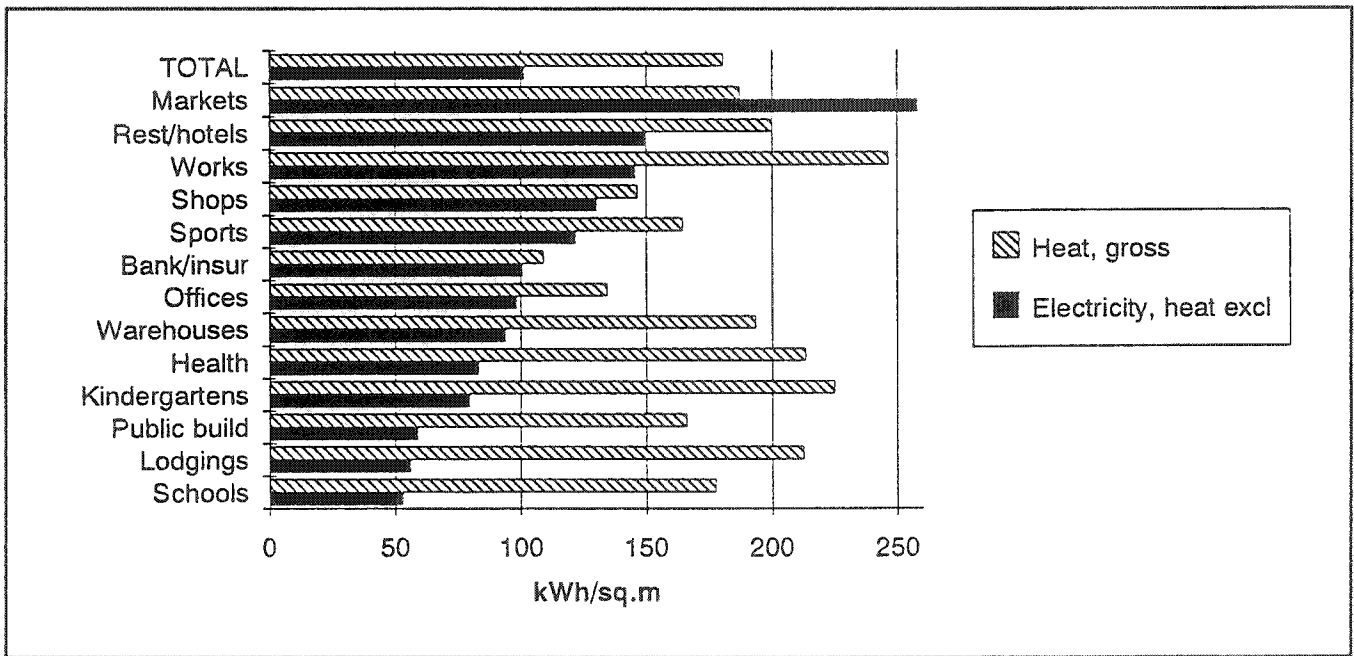


Figure 3. Specific Use of Electricity and Energy for Heating in Commercial Buildings

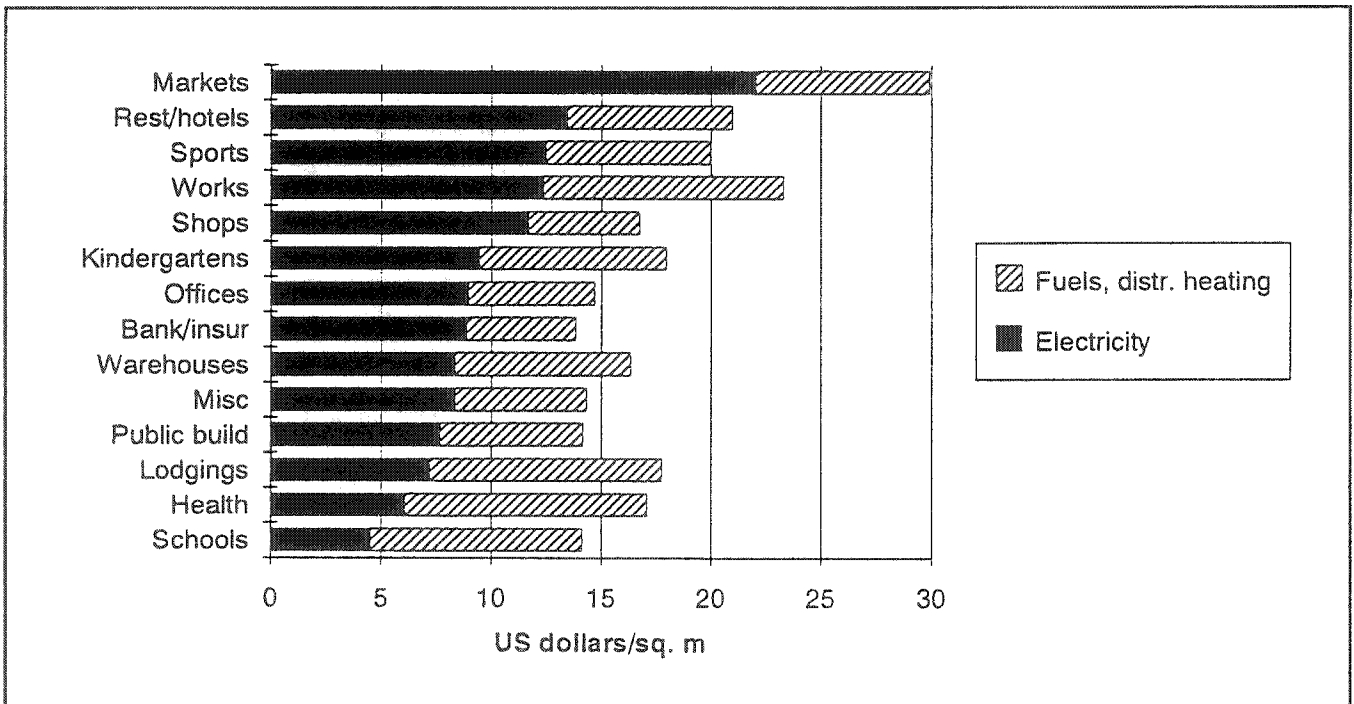


Figure 4. Costs for Energy in Commercial Buildings per sq.m

The Energy Perspective - Conservation Potential

In the STIL-project the technical and economical potential for energy conservation is estimated with two sets of economical criteria; the customer perspective and the Uppdrag 2000 perspective (see Energy Audits section). In the customer perspective we found that:

- 80% of all commercial buildings have a cost effective potential
- the average potential among these 80% is; 10% for electricity and 11% for oil and district heating
- the average energy cost savings are 12%

- the number of cost effective measures is 3-4 per customer
- the average pay-back is 2 years
- half of the potential is coming from improved operation and maintenance
- there is a big electricity conservation potential in coordination with renovation, reconstruction (50%) and new construction (20%).

The electricity conservation potential can be classified by the size of the potential in groups of buildings as follows:

<u>Class of Potential</u>		<u>Conservation Potential</u>	<u>Number of Customers</u>
Low potential	< 5%	5%	39%
Medium potential	5 - 20%	31%	40%
High potential	> 20%	64%	21%
Total		100%	100%

Commercial buildings with a high conservation potential, 21% of the total number, take care of two thirds of the total conservation potential.

In Figure 5 the average technical and economical potentials in the commercial sector are presented.

Markets and shops have the highest potential for conservation of electricity. Lighting measures dominate the potential. After that comes measures on ventilation, windows, insulation and cooling in markets. With a 30-40% higher price on electricity the total potential increases to 15%.

The Motivation for Energy Conservation

The degree of motivation for conservation has been estimated in each organization. This measure, based on energy activities that the organization has carried out, reflects the efficiency of the organization in energy conservation questions. The degree of motivation also indicates the likelihood of the organization to realize conservation possibilities.

The motivation is low in general. The maximum possible score is 750 points. The average score was 132 points and the highest individual score 490 points. Depending on the score all organizations have been classified as low, medium or high motivated organizations. Only 7% are classified as high motivated and 39% as low. The corresponding conservation potentials are also presented in the table below.

The share of low, medium and high degree of motivation of the organizations within each subsector in the commercial sector is indicated in Figure 6.

The different building types are ranked after highest share of medium and high motivated organizations. Schools and kindergartens have the highest share of both medium and high motivated organizations. Schools, kindergartens, sports centres, markets, offices, works, warehouses and shops have a comparatively high share of high motivated organizations.

Some interesting results that shows the difference between organizations with different level of motivation are presented in the table following Figure 6.

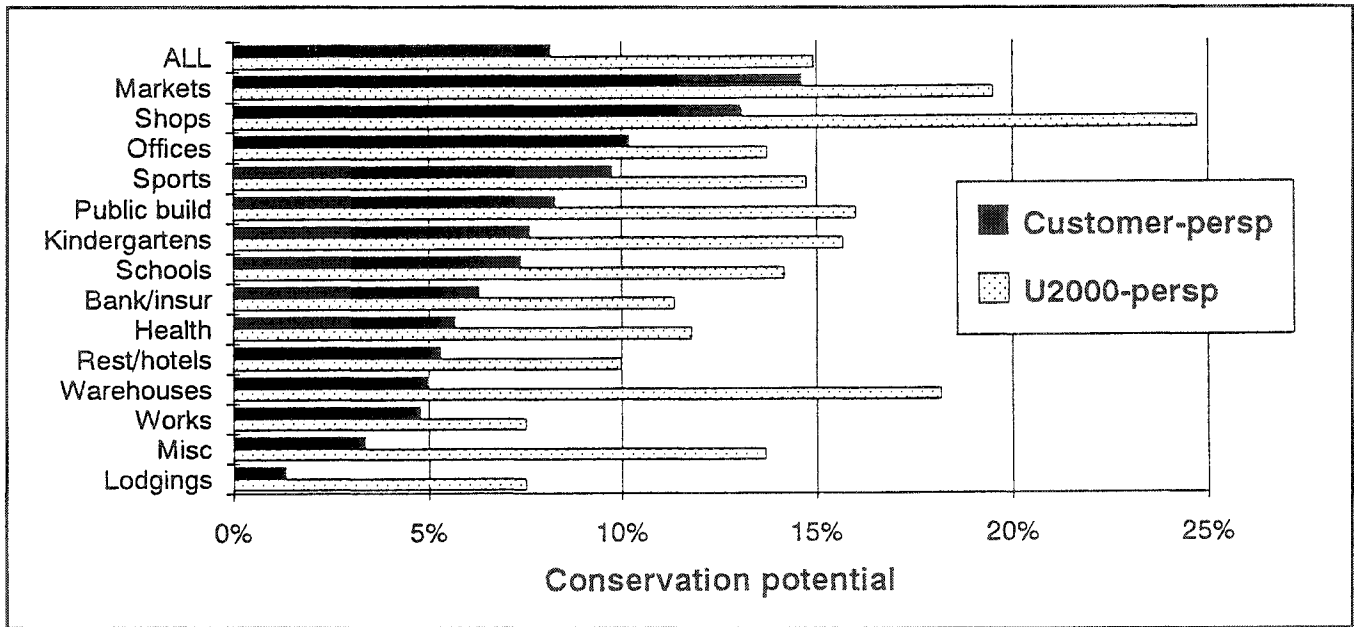


Figure 5. Electricity Conservation Potential in Commercial Buildings, Two Perspectives

Degree of Motivation	Conservation Potential	Number of Customers
Low	24%	39%
Medium	58%	54%
High	18%	7%
Total	100%	100%

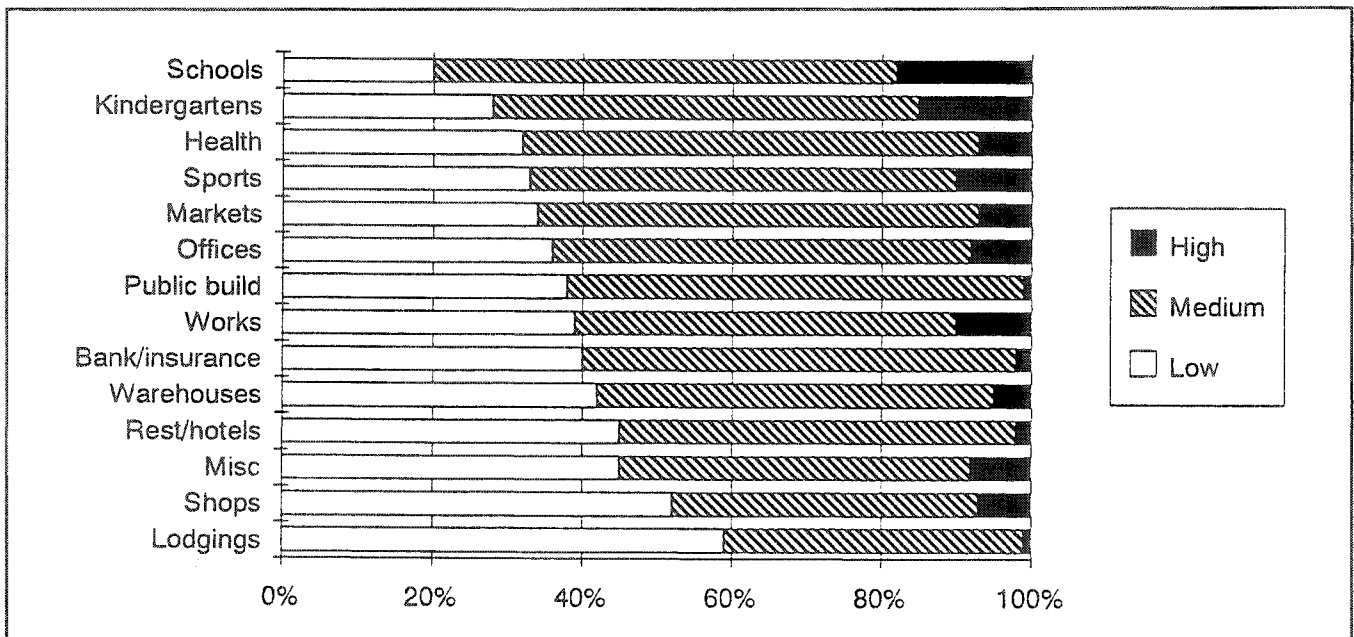


Figure 6. The Classification of the Organizations in Low, Medium and High Degree of Motivation for Conservation by Building Type

	<u>Low Degree of Motivation</u>	<u>Medium Degree of Motivation</u>	<u>High Degree of Motivation</u>
Energy audit carried out before	7%	20%	28%
Measures installed as a result of that audit	18%	57%	64%
Probably installing measures as a result of this audit	55%	75%	80%
Special responsible person for energy questions	17%	49%	76%
Presence of a fiery spirit	10%	40%	80%
Will to increase the energy efficiency in the future	61%	62%	69%
Attitude towards the energy bill:			
low	41%	45%	34%
high	23%	31%	35%
Average size of the building, sq.m/building	760	1390	3340

The Combination of Potential and Motivation

If we combine the conservation potential classified in groups of low, medium and high with the degree of motivation classified the same way, all buildings with corresponding results can be put into a matrix like the one on the next page.

The potential increases from top to bottom and the motivation from the left to the right in the matrix. With a higher degree of motivation we have found a positive correlation with

- the willingness to use energy more efficiently in the future
- the presence of fiery spirits
- the likelihood to implement measures as a result of the suggestion in the energy audit being carried out
- the size of the organization and electricity consumption
- that the building owner also is the responsible body for the activities in the building and the electricity contractor

In the matrix we can see that the saving potential per customer in percentage neither increases nor decreases with the degree of motivation. Though, the conservation potential expressed in MWh/customer increases with a higher degree of motivation. This is a result of the fact that big consumers and organizations have a higher degree of motivation in general.

The most interesting commercial buildings are displayed in the matrix. In the bold information (**big savers with a high degree of motivation, BSHDM**) we find 17% of the total number of buildings and 53% of the total conservation potential. This is of course the focus group where we can expect high efficiency from the efforts in implementing energy conservation. The problem is to find these buildings for a utility. The size of the organization and consumption could be an indication to start with.

Two criteria for making efficient segments in the commercial sector based on the results in the group of big savers with a high degree of motivation above could be the following:

- the average saving potential in MWh/customer should be as high as possible

		Degree of Motivation			Total
		Low	Medium	High	
P o t e n t i a l	Low <5%	15 GWh/yr	55 GWh/yr	15 GWh/yr	85 GWh/yr
		1%	3%	1%	5%
		1%/cust	3%/cust	1%/cust	
		15%	21%	2%	39%
		90 MWh/cust	180 MWh/cust	575 MWh/cust	
	Medium 5-20%	155 GWh/yr	345 GWh/yr	95 GWh/yr	595 GWh/yr
		8%	18%	5%	32%
		1%/cust	9%/cust	10%/cust	
		16%	21%	3%	40%
		85 MWh/cust	165 MWh/cust	285 MWh/cust	
High >20%	285 GWh/yr	680 GWh/yr	225 GWh/yr	1195 GWh/yr	
	15%	36%	12%	64%	
	30%/cust	28%/cust	29%/cust		
	8%	12%	2%	21%	
	110 MWh/cust	190 MWh/cust	460 MWh/cust		
Total	455 GWh/yr	1080 GWh/yr	335 GWh/yr	1875 GWh/yr	
	24%	58%	18%		
	39%	54%	7%		

1st row, potential, GWh/year
2nd row, share of total potential
3rd row, savings per customer
4th row, share of total number of customer
5th row, electricity consumption per customer

- the presence/share of big savers with high degree of motivation in the total subsector that can be identified should be as high as possible

The top commercial buildings in the respect of the best combination of the two criteria in the group of big savers with a high degree of motivation are presented in the following table:

In Figure 7 these two criteria are presented per subsector.

	Savings Potential Per Customer in the BSHDM Group	Share of BSHDMs in the Total Group
Sport centres	90 MWh	27%
Markets	80 MWh	29%
Schools	100 MWh	18%
Shops	90 MWh	20%
Warehouses	95 MWh	17%
Offices	110 MWh	14%

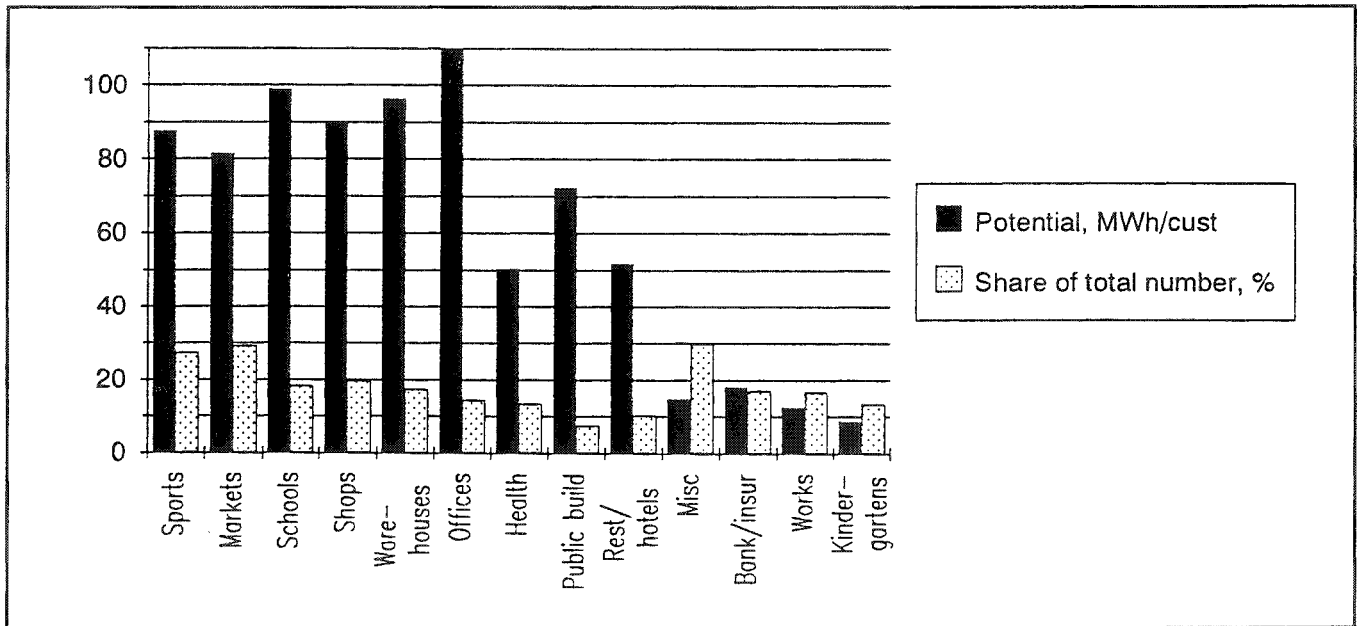


Figure 7. Commercial Buildings with Big Conservation Potentials and High Motivation

This means that if we start to visit customers in the segments of, for instance, sport centres and markets, every third is a big saver with a high degree of motivation and the average saving potential are 90 MWh and 80 MWh respectively.

Conclusions

We know that the market for energy services is not 100% of the calculated technical and economical potential. One way to structure the market in the commercial sector for a utility is to combine the technical-economical potential with the organizations' performance in energy questions. The motivation for energy conservation is one measure that reflects the organizations' performance. The degree of motivation is correlated to the willingness to use energy more efficiently in the future, to the presence of fiery spirits, to the likelihood to implement suggested measures, to the size of the organization and electricity consumption, to the degree of total responsibility for a building owner, the operation of the building, the activities in the building and the electricity contract.

In sports centres, markets, schools, shops, warehouses and offices we find the highest share of organizations that have big saving potentials and at the same time a high degree of motivation.

Acknowledgements

The STIL-project was a project within the conservation project Uppdrag 2000. Swedish Energy Development (SEU AB) and the Department of energy efficiency at NUTEK have been co-financers. Thirty six utilities and nine hundred building owners have successfully cooperated and made this project possible to realize. Sydkraft AB and the regions of Vattenfall AB have been responsible for all the work related to the utilities, building owners and consultants. Anders Göransson, Energidata Göteborg AB and Ulla Lindahl Insikt AB have been two of the most active persons in the project dealing with development of models, training, evaluation and report writing. The model for calculating the motivation of conservation has been developed by Ulla Lindahl.

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