Energy outsourcing with a focus on efficient lighting: effective approaches derived from experience from the Czech Republic

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ABSTRACT

The goal of this article is to present the process used during ELI[1] (Efficient Lighting Initiative) program activities in the Czech Republic within the field of support for energy services and outsourcing in the lighting area. The article describes the elementary problems experienced when running a business in this area, and the process of providing this type of services from marketing, through project plans, to the carrying out and long-term provision of services. Because the activities in this area require a differentiated approach to customers, this lecture focuses on a specific customer target group – cities and villages and their street lighting, some example is given also on internal lighting in commercial and public buildings.

PREFACE

Outsourcing is a challenge of the future. In today's business environment, which is characterised by concentrated pressure on efficiency and cost cutting, outsourcing is becoming one of the most frequently employed tools. Concentration on the core business and outsourcing of activities that someone else can do better is increasingly popular. "Do what you do the best", top managers, and representatives of state and local administration say. We are seeing traditional corporations, which used to perform all possible activities, gradually outsourcing operations that someone else can do more efficiently and, especially, more cheaply. It is generally the rule that the volume brings efficiency and companies that for example provide transport for large industrial companies or waste management for municipalities confirm that.

The energy sector is one of the areas where outsourcing has already become common. It is not unusual to see private firms take over industrial companies' energy centres, district heating systems of towns and villages, or even school and hospital boiler-houses. So-called Energy Contracting is one of the methods of getting rid of problems not linked to the core business. However, it also has certain disadvantages. The true energy manager will notice the absence of an important word – Performance. As world's leading energy saving experts puts it: "we do not need GJ and kWh for our life; we need heat and light." There are many ways to fulfil this saying, however the most effective are undoubtedly those which include Performance or Efficiency as one of the main service parameters..

In the early nineties SEVEn, The Energy Efficiency Center, o.p.s., introduced the concept of the ESCO and EPC into the Czech Republic, and since then we have been

1. Efficient Lighting Initiative, a three-year, US$15 million program designed by the International Finance Corporation (IFC) and funded by the Global Environment Facility (GEF) to accelerate the penetration of energy-efficient lighting technologies into emerging markets in developing countries. ELI will lower market barriers to efficient lighting in Argentina, the Czech Republic, Hungary, Latvia, Peru, the Philippines and South Africa through a set of multi-country initiatives, local and global partnerships, and interventions tailored to individual country conditions.

The ELI logo

working in the field continuously. The main goal of our activities has been to set up a healthy business environment in this field, to overcome legal and organizational barriers as well as to help develop successful projects. The achieved goals, mainly the establishment of several ESCOs since 1994 with the help of SEVEn, gave us a unique set of experiences. One of the most recent notable results was a change in some of the legislative barriers experienced by state and municipal organisations in using EPC as an effective tool for financing energy efficiency projects. Previously, all our experience was in the field of heating, but over the last 2 years we have also been working in the lighting sector.

In the Czech Republic, Latvia and Hungary, the international ELI program, with its central focus on electricity savings in lighting, has concentrated among other things on the examination and initiation of activities leading to the development and expansion of services or energy services providers. We are interested in ascertaining whether lighting, an integral part of the energy needs of customers, could become an attractive candidate for outsourcing. Although the program's activities have not yet finished and much is yet to be done, we can already discuss some of our experiences and conclusions.

The program's activities in the Czech Republic focus on two basic areas – the provision of information, education and support for the supply side ("suppliers"), or Energy Services Companies (ESCO), on the one hand, and the much more important education and stimulation of the demand side, i.e. consumers and lighting systems users, on the other. Only an educated customer knows what services are available, is aware of the value of the services offered, can assess the differences and pick the best supplier.

Some terms have to be specified in more detail before we move forward:

- When mentioning energy services we are referring to the provision of the required level of comfort for a customer (in this case, in terms of lighting) at the minimum possible cost. The offer of a supplier is connected with the added value of the service for example in the form of financing possible energy saving measures. If it is possible to repay the investment through energy cost savings alone, as we will discuss later, we call it EPC (Energy Performance Contracting). The service is on a long-term basis and the supplier guarantees certain parameters of the service in advance, including economic parameters.
- Suppliers are mostly electric and light installation companies of various sizes (from single electricians to companies with hundreds of employees), light sources and lighting fixtures producers, and ESCOs providing heating and electricity supplies and also some lighting activities.
- Customers are industrial, commercial and other companies - from industrial companies to retail chains, office buildings and especially state and local administration, including public lighting systems.

BARRIERS

Interior lighting as a service has several characteristic features: lighting systems are parts of larger units, it is only rarely possible to measure their electricity consumption independently, it is very complicated to precisely set their optimum level for each location and time, and, last but not least, lighting systems, including costs for their provision, have low priority because they are not considered to be the most pressing issues companies face. The first barrier that a possible supplier of this service must overcome is thus to persuade a decision-maker that lighting is something that is worth dealing with, that it is something that can bring cost savings and other benefits.

The situation is unfortunately made even more difficult because suppliers rarely offer the full benefits of their products. Our experience shows that the tendency of suppliers to stress the sale of hardware still persists. This means that suppliers are endlessly emphasising the technical advantages of the supplied technologies, including high-tech technologies. However, in using this approach they are not always offering the customer the most important thing – the best way of satisfying his needs. This is why education in "energy efficiency marketing" is one of our key activities. Effective energy efficiency marketing entails offering services by detailing not only the technical aspects of an offer, but in addition, and more importantly, by demonstrating the economic and energy advantages of the supplied services.

The following general barriers need to be overcome:

- Unclear position concerning the legal enforceability of contracts
- Bidding/Tendering costs
- Insufficient energy historical records, from which to set baselines
- "I can do better and cheaper myself" syndrome in public employees (and waiting for subsidies)
- General lack of trust in an external organisation
- Troubles related to the project and savings accountancy

Through education, training and awareness campaigns ways round many of these barriers can be found.

PUBLIC LIGHTING (STREET LIGHTING)

Public lighting is a completely specific area when discussing supplier and customer barriers. Public lighting in the Czech Republic consists of 950 000 light points with an average output value of 140W. The consumed electric en-

ergy (kWh) of roughly 98% of public lighting systems is directly measured. All lighting systems are owned by municipalities. Municipal budgets are also used to pay for expenses connected with electric power consumption and maintenance, the development of new systems and the replacement of those nearing the end of their service life. The maintenance systems vary. Most towns have established a Technical Service Company, which is usually a limited or stock company, 100% owned by the town and taking care, among other things, of streetlighting. Some towns and villages hire private companies to maintain streetlighting systems. ELI activities in the CR and the operations of recently created ESCOs have made public lighting outsourcing an increasingly interesting alternative to current options. The aim is to make municipal public lighting spending more efficient by transferring the responsibility for administration, operation and maintenance to private entities, ESCOs.

Persuading decision-makers about the advantages of public lighting outsourcing (such as the long-term lease, and operation and maintenance by an ESCO), has proved to be a serious challenge although outsourcing is a very advantageous tool that can deliver high-quality municipal lighting at lower cost if the contract is written well. The main problem is that decision-makers fear the complexity of contract relations[2], are unwilling to enter into long-term agreements and are locked into a particular way of thinking.

It is clear that local authorities must be careful when dealing with ESCOs and must ensure several basic conditions are met, including the following:

- Before negotiations to find an external contractor or ESCO begin, it is necessary to carry out an assessment of the current condition of the municipal lighting system, an energy audit and possibly also calculate the system capacity. This will give municipal decision-makers some idea about the potential system improvements that can be achieved, and enable a more critical assessment of ESCO tender applications.
- The city must set priorities for lighting system development, that is to define the importance of various parameters such as energy and maintenance costs, future conceptions about system development, its ownership etc.
- The conducting of a feasibility study is another preliminary step. A feasibility study will assess the efficiency of the whole possible reconstruction project.
- After approving the public lighting system reconstruction, the city must set tender conditions, pick the winner and carry out the project goals.

Public lighting projects improve the lighting of towns and villages, the aesthetic appearance of the streets and at the same time lower electricity consumption (lower costs). Experience with the economics of such projects in the Czech Republic shows that it is common to propose that a city uses the difference between the operation and maintenance costs for the system before and after the reconstruction for covering the initial energy saving investment. The difference usually covers the cost of the replacement of light sources and lighting fixtures. The payback period for the investment is 4-8 years. Other costs, such as the cost of the replacement of lampposts, their paint, switchboard repairs etc., must usually be covered from city budgets because the return on investment with the inclusion of these costs deteriorates significantly.

The EPC (Energy Performance Contracting) method in which investment is paid back from energy savings thus covers part of the costs for public lighting renovations. An ESCO, when employing the EPC method, secures the funds, performs the reconstruction and provides services connected with the operation of the system until the investment is paid off. After the investment is paid off, all profits stemming from the operational costs savings go to the owner of the system, i.e. the municipality.

There are following technical areas for possible energy savings:

- Lighting audits - revealing over equipped and under equipped areas.
- Reduction of the wattage of hitherto used discharge lamps (savings 20-30%).
- Reduction of the number of light points according to new calculations.
- Replacement of luminaries with more efficient ones.
- Introduction of electronic lighting control according to the necessary light intensity (start at 230V and voltage regulation to the level of 176V for areas with possible decline of luminous intensity) - savings 30-40%.

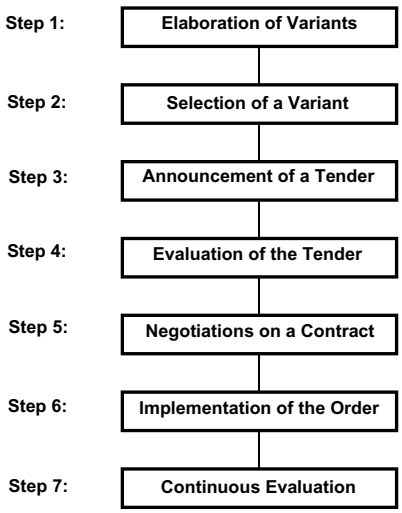
TENDER PROCEDURE

One of the most important steps when preparing a long-term outsourcing scheme for municipalities is a high quality public tender, which is either called due to law requirements or because a municipality wants to carry out the best possible assessment of various offers and select the best one:

Placing public orders (this applies to all subjects with any right for reimbursement for provision from public sources – sources of the state, regions etc.) is governed by law in the Czech Republic This legislation also applies for orders relating to public lighting. When placing an order it is necessary to bear in mind the fundamental objective, to secure over the long term the most reliable operation of public lighting of appropriate quality given the limitation determined by the amount of money that can be used for the given purpose from the public budget. The quality of lighting is determined by the standards mentioned in the

2. For more details, see the Czech Republic Public Procurement Act (No. 199/1994 Coll.), in the wording of later modifications and amendments.

Figure 1



previous section. However, it allows for a certain degree of flexibility, therefore the target values should be approved by a local board of representatives on the basis of a variety of proposals for public lighting renovation.

The selected variant can be introduced as a simple delivery of technical elements by one company, while other services (operation and maintenance) are entrusted to another company or carried out by using one's own resources. In this case, the equipment supplier is interested in the best possible purchase price regardless of costs connected with operation and maintenance. Guarantees are only provided for the equipment's operation, not for operational characteristics – companies are not interested in further costs related to the equipment's subsequent operation.

Another possibility is using the supplier's services not only for the simple delivery of equipment but also for its operation with a guaranteed level of energy costs. Usually, companies providing energy services of this type are called Energy Service Companies (ESCOs). Where savings from energy consumption costs are used to finance investments in energy savings it is called Energy Performance Contracting (EPC).

From the viewpoint of the customer (the state, region, town or municipality), the most important thing is not attaining the cheapest possible delivery of technical elements, but long-term high-quality services with the lowest possible costs. Nevertheless, the conclusion of a contract requires a lengthy preparation process, necessary when attempting to balance the risks of a long-term relationship and reach an agreement that will bring as many advantages to both parties as possible.

Although the Public Procurement Act (Article §69a) mentions the area of financing energy savings by a third party (another title for EPC, the third party meaning an ESCO entering a bilateral supplier – energy consumer relationship), to date no regulation or legal provision regulating this part has been issued. However, the Act can also be used in the current form, and the preparation of an order must be adapted to this type of relationship.

The entire procedure of preparing the placement of a public order, selecting the best offer etc., can be divided into several distinct steps (Fig. 1):

Steps 1 and 2 precede the announcement of a public procurement – only on the basis of the passing of a resolution of the respective authorities is it possible to prepare tender documentation for selection of applicants on the basis of a public order **(Step 3). In Steps 1 and 2** one specific variant need not be chosen, nevertheless, the selection procedure should at least narrow down the number of possibilities to no more than three. However, the variants should not only focus on technical design but, primarily, on quality elements – the required standard of lighting.

Tender documentation for an offer of a comprehensive service, including the operation and financing of investment, not only includes a description of the standards required, but also a description of the current lighting system, power consumption and energy consumption costs, if possible, in the past three years. The contractor of a public order should also enable an on-the-spot inspection and answer any other questions concerning the subject of the order. Criteria should be primarily oriented to complying with the standards and financial aspects of the entire contract, i.e. both the equipment's delivery and operation.

Evaluation of the public order **(Step 4)**

Recommended criteria (in order of importance with a suggested level of significance in the final evaluation)

1. The project's quality		70%
(divided to the subcriteria below)		
1.1. Average annual calculated costs	40%	
1.2. The contents of the draft contract	30%	
1.3. The project's economic and financial characteristics	15%	
1.4. Technical design	10%	
1.5. The project's managerial characteristics	5%	
2. The company's credentials		15%
3. References to projects implemented		15%
Total		100%

On individual criteria and their significance in the overall evaluation (the significance of criteria, their exact number and structure depend on the contractor's requirements – here orientation data used in some selection procedures are stated):

1. The project's quality is the most important criterion, with financial and contractual characteristics taking precedence over technical matters - for a supplier it is not usually so important what technical elements and devices will be used since it mostly involves similar equipment.

1.1. Average annual calculated costs are all costs paid by the contractor[3] over the contract's duration to an ESCO. They comprise both repayment instalments of the invest-

3. This also means a legal entity created (established) by the contractor.

ments and /or loan and operating costs, including maintenance, other ESCO costs, the company's profit and financial costs (interest, leasing payments etc.). To enable a comparison of individual offers' values, it is necessary to apply them on the same basis. Therefore, firstly, total annual costs are discounted at the current value (i.e., the same sum expended today has a higher current value than a nominally identical sum expended later (the effect of the gradual devaluation of money and the inclusion of entrepreneurial risk) and secondly, discounted values are converted to average annual costs (the sum total of discounted costs for the duration of the contract divided by the number of years).

1.2. A very important part of the offer is the draft contract. In the case of long-term contracts of this type, it is crucial to stipulate both mutual guarantees (see below) and mutual relations when changing contractual parameters, namely, due to external effects (for example, prices of electric power supplied) and, for example, the municipality's requirement for a higher level of lighting.

1.3. Evaluation of the manner in which, and the sources from which the investment will be financed, a company's stability, its financial capability to meet pledges, how realistic the cost level in Point 1.1. is etc.

1.4. Evaluation of the technical standard of a design, including elements used and how they are linked.

1.5. Evaluation of the proposed method of project management and the management's specific composition.

2. A company's credentials are important when dealing with more complicated orders, although this requirement is usually resolved through the use of qualified subcontractors. In such a case, the order conditions must stipulate an obligation to disclose information about the subcontractor3. References to projects implemented are also important for extensive and financially demanding orders. Some firms, sufficiently experienced in the area of installation, can be disadvantaged by the fact that hitherto they have not implemented any order connected with the provision of comprehensive services. In this case, it is necessary to proceed carefully so that even firms such as these can successfully compete for similar orders.

For large orders (above approximately CZK 10 million (EURO 312 500)), a two-stage public tender may be appropriate (Chapter III of the Act), whereby in the competition's first stage the most suitable applicants are selected for the competition's second stage. Only then is the order of preference for the applicants definitely set. The advantage of this procedure is that, during negotiations over conditions, agreements can be reached concerning aspects of the future contract, which may not always be easy to define in purely monetary terms (although eventually they will manifest themselves in the financial relationship between both subjects concerned).

After a supplier has been chosen, negotiations begin on the contract (Step 5) containing the provision that the winning applicant will carry out his own inspection of the current equipment and energy costs, as well as the finalized draft contract. Guarantees are an important part of contractual negotiations - on the part of the ESCO, guarantees concerning the quality of delivery, the operation of equipment and the level of energy costs required to meet the standards set out in the tender documentation; and on the part of the contractor, guarantees concerning the meeting of all future payments. In connection with guarantees, sanctions for breaching guaranteed agreements are also set, as well as the possibilities and conditions for withdrawing from the contract etc.. The standards that can be changed over the course of the contract's duration (time of lighting, its intensity in various localities and time periods etc.) are also determined, although such changes must be dealt with in the manner stipulated in the contract. Final agreement on the draft contract is followed by the completion of the final contract. The main parts of the Contract should be the following:

- Subject of the Contract (Measures proposed for installation, Economical benefits of the project, Baseline, Methodology of the savings calculation, Time schedule, Contractual parties' responsibilities)
- Guarantees (Savings, Technical)
- Financial calculations (Project price, Fees, Payments, Invoicing)
- Others (Insurance, Conflicts, Changes, Rescission, Confidence etc.)

In the next step (**Step 6**) the selected ESCO commences implementation of the order. After delivering, installing and putting the equipment into operation, the ESCO assumes full responsibility for the contractually agreed parameters.

In the course of operating the public lighting system the attained parameters are continuously monitored and contractual agreements assessed (**Step 7**). On the basis of this, the contractual payment conditions are modified in a corresponding manner and/or other contractual measures, subcontracts agreed etc.

INDOOR LIGHTING

The public lighting issues described in the previous section are the "easier case" from an outsourcing standpoint. It is a clearly defined service area, measurable, guaranteed and exactable. The situation is more complex in case of indoor lighting. ELI activities in the Czech Republic have so far been focusing on pilot projects in the commercial sector. Several food retail chains have been approached and a number of projects are currently being prepared together with a definition of the conditions for the delivery of services. One of the key factors in initiating successful EO/EPC projects in CEE countries is the building of an effective business culture. To this end local retail managers have to be trained in preparing appropriate contracts, and on the supply side, the companies offering these energy services need to be as fair and open as possible in business dealings.

What are the key parameters that define and characterise 'lighting systems' and 'lighting services'?: A lighting system refers to as a system that can be independently monitored and measured (kWh), and lighting services can be defined as the basic lighting requirements of a customer from the

system (illumination level, colour of lighting, daily operating hours, defect rate, etc.) . All these service requirements can be stipulated in the contract that a supplier signs with a customer. It seems that this type of service can be advantageous for both sides in local conditions. Thus both a supermarket and a supplier, which is a local electric equipment installation provider, can benefit from the service.

The installation of electronic ballast into current lighting systems, is just one of the advantageous technologies that can be used within the framework of a contract on services in this area. The example given in Annex 1 shows what a project of this type could look like.

CONCLUSION

At the end has to be said that activities of ELI programme are ongoing process. We have seen in the municipal area, that outsourcing works and there have been few examples of finished tenders and contracts yet. These successful projects have to be disseminated as a tool for rising awareness of municipal decision makers. The ESCo companies need other "nursing" as well, i. e. assisting in making contracts and establishing financial relations. Hopefully these ESCos will be later on enhanced their outsourcing experience to the internal lighting projects as well.

ACKNOWLEDGEMENTS

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Fig. 2: The following table shows the project's initial and calculated parameters

Basic Data *(2*58W linear fluorescent lamps, replacement of electromagnetic inductors and starters with electronic ballasts)*			*(units)*	
[1]	Baseline	System wattage	*W*	51 504
[2]		Lifetime	*hours*	10 000
[3]		Hours of Operation	*hours/day*	13
[4]		Cost of Electricity	*EURO/kWh*	0,05
[5]		Investment Cost	*EURO*	0
[6]	New technology	System wattage	*W*	40 368
[7]		Lifetime	*hours*	25 000
[8]		Hours of Operation	*hours/day*	13
[9]		Cost of Electricity	*EURO/kWh*	0,05
[10]		Investment Cost	*EURO*	5 438
[11]		Days of operation	*days/year*	330
		Discont Rate	%	10%
		No. Of Luminaires	*pieces*	348
		Investment Cost	*CZK/luminaire*	16
Calculated data				
[12]	Operation		*hours/year*	4 290
[13]	Electricity Savings		*kWh/year*	47 773
[14]	Costs Savings		*EURO/year*	2 180
[15]	Investment Difference		*EURO*	5 438
[16]	Simple payback		*years*	2,49

ANNEX1: CASE STUDY: CHAIN OF XY[4] SUPERMARKETS

Introduction to the issue

The **supermarket** chain XY operates amongst the most modern collection of premises in the Czech Republic and, in terms of the number of outlets and turnover, represents one of the five leading companies in the retail sales sector.

Construction or refurbishment of individual stores began back in 1991 and since then the network of shops has increased to more than one hundred units. In terms of their technological equipment, individual outlets are state-of-the-art, however, particularly in the case of older buildings there are still possibilities for improvement. Here we deal specifically with one of the systems necessary for efficient operation – lighting.

The lighting systems of XY supermarkets are significant electricity consumers. Random research in several shops has revealed that the systems usually comprise of tens to hundreds of light-fittings, supplied with two linear fluorescent lamps (T8) with an input of 58W, with an electromagnetic ballast (inductor) and a starter. The total power input of each light fitting represents approximately 148 W (i.e. input of light sources and ballast circuits).

When using modern components in lighting systems, it is possible to achieve remarkable savings of electric energy and thus also operating costs. Electronic ballasts are just one of the applicable technologies, but they mean the possibility of up to 30% electricity savings. Their advantage lies in the possibility of attaching them to existing light-fittings. Another example of modern technology use is automatic regulation responsive to levels of natural lighting.

The following simplified technical and economic calculation of relighting in a selected supermarket serves as a demonstration.

Calculation of energy savings in the XYZ model project

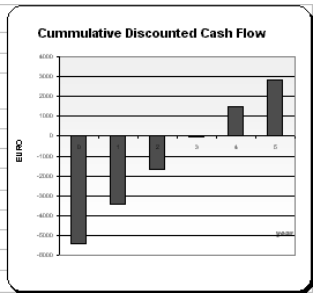
The XYZ store is one of the larger outlets. It is equipped with a total of 348 light-fittings with 2*58W T8 sources, electromagnetic ballasts and starters. Light sources work throughout the store's entire shopping hours, including the time prior to opening and the finishing of operations.

The idea of the project is to replace the current electromagnetic ballasts with electronic ballasts, which should result in an approximate 30% saving of energy consumption. Ballasts can be used as a direct replacement for existing ballasts; all the other technologies (the light-fitting body, fluorescent lamps) will remain unchanged. Reconstruction of one body takes roughly 20 minutes and, of course, can be carried out after the store has closed.

4. we are keeping the supermarket name confidential so we will call them XY

Fig. 3: Economic calculation of the project's cash flow is as follows:

Use of Ellectronic Ballasts					XYZ Supermarket		
		All figures in EURO					
	years	0	1	2	3	4	5
	Investment Costs (EURO)	-5437,5					
	Energy Costs Savings (EURO/year)		2179,7	2179,7	2179,7	2179,7	2179,7
	Cumulative Simple Cash Flow	-5437,5	-3257,8	-1078,2	1101,5	3281,2	5460,8
	Discounted Savings		1981,5	1801,4	1637,6	1488,7	1353,4
	Cumm. Discounted Cash Flow	**-5437,5**	**-3456,0**	**-1654,6**	**-17,0**	**1471,7**	**2825,1**
	Simple Payback	**2,49**	*years*				
	NPV	**2825,1**	*CZK*				
	Discounted Payback	**3,01**	*years*			Discount	10%
	IRR	**28,8%**					



Summary of the model project

Preliminary calculation of the model example has confirmed that an investment of CZK 174,000 (EURO 5438) can achieve annual electricity cost savings of CZK 69,749 (EURO 2180) in a single store, i.e. it is possible to achieve a full return on the investment, discounted with regard to the amortised value of money, within approximately 3 years.

When generalising the above calculation for the whole chain of XY stores (about 100 units), we arrive at investments of CZK 17.4 million (EURO 0,543 million) and annual savings in operating costs of approximately CZK 7 million (EURO 0,219 million).