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IEA DSM TASK XVI

"Competitive Energy Services
(Energy Contracting, ESCo Services)"

Integrated Energy Contracting (IEC)

A new ESCo Model to Combine Energy Efficiency and (Renewable) **Supply in large Buildings and Industry**

- Discussion Paper -

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1 Abstract

One of the most urgent energy policy and energy economics challenges continues to be 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. Since the mid of this decade, Energy Services have climbed high on political agendas and have even reached the headline of energy legislation [2006/32/EC].

“Energy Contracting” (EC) is cited many times as a smart multi-purpose-instrument, which will help to overcome market barriers for Energy Efficiency (EE). While a number of obstacles can be overcome with the EC concept, the realistic potentials, the pros and cons, the limits and added values of ESCo products in comparison to in-house implementation need further clarification.

Energy Performance Contracting (EPC) projects, if implemented properly, have successfully delivered guaranteed energy savings of 20 % and above since they were first introduced in Europe around 1995. Nevertheless, their share in the ESCo market is around 10 % only and market diffusion is essentially limited to the public sector and spread very unevenly throughout Europe.

Besides requiring dedicated and persevering project developers, the EPC model itself imposes obstacles from a methodological point of view, especially if the cost baseline is difficult to determine or if adjustments of the baseline are necessary due to changes in utilization of the building or enterprise. As a consequence, transaction cost of EPC projects are particularly high, resulting in minimum energy cost baselines of 100.000 €/a and above. Also the ESCo’s risks associated with the EPC savings guarantee may imply considerable safety surcharges.

The latter problems are not encountered with the Energy Supply Contracting (ESC) model, because no baseline is needed to measure savings. Further on, the ESC-model is also common in other end-use sectors such as industry or housing. The short fall is, that the scope of ESC measures is typically limited to the energy supply side, not covering demand reductions in the building or the production process itself.

This contribution is on advancements of the ESC model. The objective is to enhance the scope of services by integrating demand side conservation measures in the fields of building technologies, building envelope and user behavior.

An important issue is the discussion of suitable quality assurance and performance verification instruments for the EE-measures implemented as a substitute for the EPC-savings guarantee. As a result we propose 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.

Besides discussing the new IEC model, we present experiences from pilot projects procured by Landesimmobiliengesellschaft Steiermark (Real Estate Company of the State of Styria), Austria. The building owners retrofit goals, the procurement and awarding criteria applied and first project results.

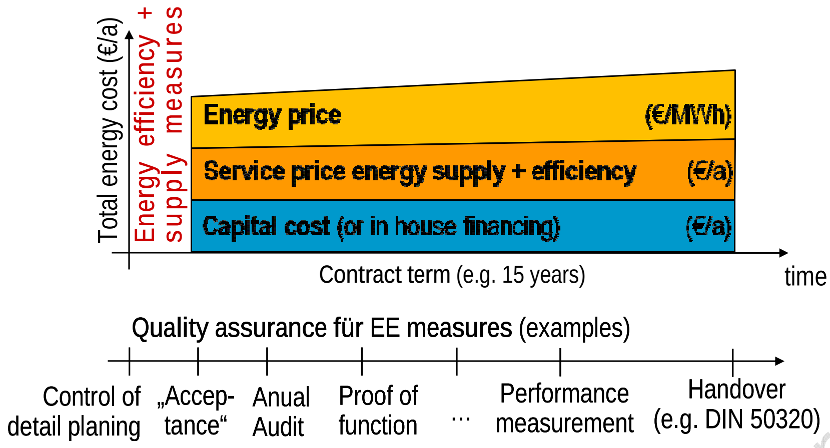

Figure 1 Integrated Energy Contracting Model with quality assurance instruments (examples) to combine energy efficiency and supply

Experience from up to now eight projects has proven the feasibility of the IEC model. In addition to competitive energy prices, energy end-use savings of up to 30 % heat, 12 % electricity and 20 % water consumption have been achieved by integrating demand side measures (e.g. controls, hydraulic adjustment, solar, top floor insulation and user behavior) into the ESC scheme. CO_2 reductions are above 90 %, mainly due to switching to a combination geothermal and biomass energy sources.

The value of the future savings cash flow reaches up to € - 250,000 (net savings, including all cost of the EE measures), which could be used to co-finance comprehensive refurbishment of the building shell.

Also for Integrated Energy Contracting (IEC), the decision of the building or business owner to want to invest in energy efficiency remains a basic requirement. We conclude that the proposed Integrated Energy Contracting model achieves to combine the simpler approach of the ESC business model whilst extending the scope of the energy conservation measures to the complete building or enterprises and to all consumption media, e.g. heat, electricity or water.

The EPC savings guarantee is replaced by individual quality assurance instruments, which secure the functionality and performance of the efficiency measures implemented, but not it's exact quantitative outcome over the project cycle, which largely depends on factors external to the ESCo's influence such as changes in ambient climate conditions or utilization of the facility.

Work remains to be done to increase electricity savings and to achieve comprehensive refurbishment including the building shell. Furthermore, fiscal and balance sheet related implications of the IEC Model will have to be reviewed in comparison to EPC.

Subject to further experiences, the IEC model might be a solution, which is more widely applicable to combine energy supply and delivery of EE potentials in large volume buildings and enterprises. Perhaps energy efficiency will achieve a higher market diffusion in combination with energy supply (from Renewables)?

In case of questions or ideas for further co-operation, your feedback is highly welcome. You can reach the author at Bleyl@Grazer-EA.at.

2 Introduction and Motivation

Generally any energy supply should first of all focus on energy conservation by evaluating all possible demand reduction opportunities. Only afterwards the remaining demand should be supplied as efficiently as possible - including renewable supply options. Otherwise climate protection goals are not achievable.

A good example for this thesis is the reduction of all electrical and thermal cooling loads including solar shading options before assessing and implementing an air conditioning unit. Or taking a commercial sector example: Before installing a new air compressor, the necessary pressure level should be reviewed, distribution leakages sealed, all compressed air consumers checked and possibly substituted by electric tools and the air intake temperature reduced.

The literature provides numerous support for this thesis. To quote a prominent source: According to the International Energy Agency (IEA), the improvement of end-use efficiency is the largest contributor to CO_2 saving potentials. „At the point of use, the largest contributor to avoided CO_2 emissions is improved end-use efficiency, accounting for nearly two-thirds of total savings. Fuel savings, achieved through more efficient vehicles, industrial processes and heating applications, contribute 36% in 2030, while lower electricity demand, from more efficient appliances, industrial motors and buildings, represents 29%. Switching to less carbon-intensive fossil fuels, mainly from coal to gas in power generation, and improved supply-side efficiency account for a further 13%. Increased use of Renewables in power generation and of bio-fuels in transport account for 12%. Increased reliance on nuclear is responsible for the remaining 10%, in comparison to their reference Scenario" [IEA 2006].

Another prominent example is the CO_2 abatement cost curves published by McKinsey, which report negative abatement cost for a variety of energy conservation measures such as thermal insulation, lighting, climatisation or electric drives [McKinsey 2007].

Reduced to a simple common denominator this means: Without comprehensive energy conservation measures in all sectors of consumption, climate protection goals are not achievable. Furthermore, many measures generate a positive cash flow if looked at from a project- or life cycle cost perspective.

One of the most urgent energy policy and energy economics tasks continues to be the search for suitable implementation instruments for the before mentioned energy saving potentials. Due to their scattered nature[1] which are spread across all consumption sectors (in contrast to centralized supply systems), only concerted actions of all stakeholders concerned and a mix of instruments will deliver: Legislative regulations and minimum standards, information and labeling campaigns, financial incentives and subsidy programs, voluntary agreements between associations and politics and last but not least market based instruments.

[1] By example of the housing sector: Out of 21.1 million occupied rental apartments in Germany, 23 % are single or double family houses, an additional 30 % is located in three to six apartment houses [Eikmeier et al. 2009, p. 114]

And there is a need to join forces between energy efficiency and renewable energy advocates.

Since the mid of this decade, Energy Services (ES) have climbed high on political agendas and have even reached the headline of energy efficiency legislation [2006/32/EC]. "Energy Contracting" (EC) is cited many times as a smart multi-purpose-instrument, which will help to overcome market barriers. But the realistic potentials, the limits and added values of ESCo products are not well enough understood yet.

In this contribution we introduce a new, market based implementation model for energy efficiency and supply (from Renewables), labeled as **Integrated Energy Contracting** (IEC). The model builds on established products of the ESCo industry for the execution of energy efficiency potentials. The core objectives of this publication can be summarized as follows:

1. To unite energy conservation and (renewable) energy supply into an integrated approach,
2. To support the ESCo industry and it's clients with a new and hopefully simpler product applicable for all energy carriers and water in larger buildings and industry,
3. To discuss quality assurance instruments and simplified measurement and verification methods for energy efficiency measures[2] and
4. To increase understanding of Energy Contracting as a tool to implement energy efficiency projects: Pros and cons, potentials, limits and added values of ESCo products in comparison to in-house implementation

To rule out possible misunderstandings: The goal is not to question the existence of the Energy Performance Contracting model, in particular where it is marketable (mainly in large public sector buildings). Rather an additional ESCo product approach for energy efficiency projects shall be presented for discussion to support the search for suitable implementation instruments as mentioned earlier.

This work is carried out in the framework of the International Energy Agency demand side management implementing agreement. It's Task XVI on "**Competitive Energy Services** (Energy Contacting, ESCo Services)" brings together Energy Contracting experts from currently six countries around the world, who join forces to advance ESCo models and markets [IEAdsm 2009].

On the empirical side, the analyses draws on recent and ongoing real world projects of the Styrian „Landesimmobiliengesellschaft", Austria, who procured and implemented Integrated Energy Contracting services in eight public sector buildings. The analyses is supplemented with more than fifteen years of practical ESCo project and market development experience and research of the author, both as ESCo and market facilitator.

A number of Graz Energy Agency cooperation partners from ESCo industry, energy agencies and others have peer reviewed this paper and have given helpful

[2] Some of the considerations on quality assurance for energy efficiency measures (in particular chapter 4.3) may be of interest to Energy Performance Contracting and in-house implementation as well

comments. Namely, I would like to thank Ing. Alfred Scharl, Landesimmobiliengesellschaft Steiermark for his commitment and endeavor to implement the first Integrated Energy Contracting projects together.

The author wishes to thank the IEA participating countries and the Austrian Federal Ministry of Transport, Innovation and Technology for their financial support within the framework of the IEA research co-operation.

The findings of this publication have to be considered as work in progress. For feedback, inquiries and ideas for cooperation, please contact Graz Energy Agency, attention to Jan W. Bleyl-Androschin (bleyl@grazer-ea.at).

3 (Methodological) **Limitations of Standard ESCo Products**

3.1 Definition and Concept

We focus on some key features here, assuming that the reader has a basic knowledge of the Energy-Contracting (EC) concept and building energy efficiency.[3] In a narrow sense we define[4] EC as:

„Energy Contracting - also labeled as ESCo or Energy Service - is a comprehensive energy service concept to execute energy efficiency projects in buildings or production facilities according to minimized project cycle cost.

An Energy Service Company (ESCo) implements a customized energy service package (consisting of planning, building, operation&maintenance, optimization, fuel purchase, (co-)financing, user behavior …). The ESCo provides guarantees for all inclusive cost and results and takes over commercial and technical implementation and operation risks over the whole project term of typically 10 to 15 years (after [Bleyl+Schinnerl 2008])

The Energy-Contracting concept shifts the focus away from selling units of final energy (like fuel oil, gas or electricity) towards the desired benefits and services derived from the use of the energy, e.g. the lowest cost of keeping a room warm, air-conditioned or lit.

Energy Contracting (EC) is not about any particular technology or energy carrier. Instead EC is a flexible and modular "efficiency tool" to execute energy efficiency projects, according to the goals of the facility owner. It is an instrument to minimize life- or project cycle cost[5], including the operation phase of the building. The ESCo acts as coordinator and manager of interfaces towards the customer and has to deliver the commissioned energy service to the customer at "all inclusive" prices as displayed in Figure 2.

ESCo products provide either useful energy (Energy Supply Contracting - ESC) or energy savings (Energy Performance Contracting - EPC) to the end user. And they achieve environmental benefits due to the associated energy and emission savings as well as non-energetic benefits such as increase in comfort or image gains.

[3] For further basics on Energy Contracting you may refer to e.g. www.grazer-ea.at, www.contracting-portal.at, [SenStad+BE 2002], [dena 2004], [Bleyl+Schinnerl 2008 u. 2008a], [dena 2009], [Eikmeier et.al. 2009] (this list is not exhaustive).

[4] Most existing EC definitions fall short with regard to important properties of "real" EC services such as outsourcing of risks to the ESCo, guarantees for "all inclusive" cost and results of the measures implemented or optimization according to project cycle cost (cf. [2006/32/EC], [Bertholdi et.al. 2007], [CEN/CLC/TF 189], [DIN 8930-5], [GEFMA 540], [UZ 50], [VDMA 24198] this list is not exhaustive)

[5] Here the sum of investment, operation and maintenance cost over the project term, also labeled as total or life cycle cost. E.g. capital-, consumption- and operation cost according to [VDI 2067] or [ÖNORM M 7140]

At Energy Supply Contracting efficient supply of useful energy such as heat, steam or compressed air is contracted and measured in Megawatt hours (MWh) delivered. The model usually includes purchasing of fuels and is comparable to district heating or cogeneration supply contracts. The scope of energy efficiency measures is limited to the energy supply side, e.g. the boiler house (cf. chapter 3.3).

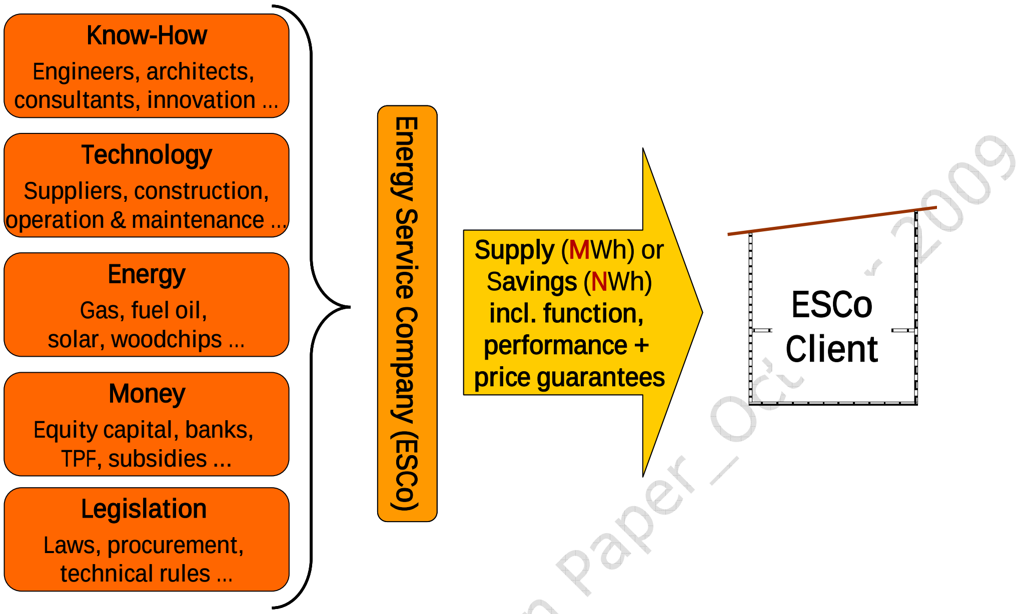

Figure 2 Energy Contracting: Components of service package and outsourcing of interfaces and guarantees to an ESCo

As for Energy Performance Contracting, the focus is on reducing final energy consumption through demand side energy efficiency measures. The scope is extended to the entire building including measures such as technical building equipment (e.g. HVAC), user behavior or the building envelope insulation as indicated in Figure 3. The business model is based on delivering savings compared to a predefined baseline, also labeled as Negawatt hours (NWh).

3.2 Energy Supply is dominating the ESCo Market

Reliable market data on national or European ESCo markets are scarce or not publicly available. Nevertheless there is sufficient evidence that Energy supply contracting projects dominate the market. The "Verband für Wärmelieferung" (German association of ESCos) reports 85 % market share based on the 2008 survey of it's members. [VfW 2009]. This number corresponds to the results of a recent comprehensive market query performed by Prognos AG: „Almost two thirds of the respondents declared, to make more than 80 % of their turnover with energy supply contracting including the replacement of the existing installations" [Prognos 2009].

ESC is applied in different end-use sectors such as housing, commerce, industry or public buildings, without being able to provide concrete numbers or market shares. For the housing sector specifications of minimum project sizes exist: [Eikmeier et.al. 2009] detail 100 kW_{therm} as lower threshold based on transaction cost logics and empirical results from a market query. In a simple approximation this corresponds to annual energy cost of about € 20.000,-.

The market share of EPC projects is estimated at about 10 %. At least in Europe it is practically limited to the public sector[6]. The „Verband für Wärmelieferung" reports a market share of 8 % [VfW 2009]. In the Prognos market query, only 6 % of the respondents make 20-40 % of their turnover with EPC products, while the rest is below this value or gives no indications at all [Prognos 2009]. Regarding project sizes chapter 3.4 is pinpointed for reference.

From the relative market dominance of Energy Supply versus Energy Performance Contracting projects and the greater spread in different consumption sectors, the theses can be drawn, that marketable product innovations are easier if they are based on the ESC model.

Since ESC projects are usually limited to the supply of useful energy, sizable consequences on the saving potentials achievable through current Energy Contracting models can be derived, as shown in the next chapter.

3.3 Limitations and Efficiency Potentials of Standard ESCo Products

Standard Energy Supply Contracting (including solar ESC) is basically limited to improving the efficiency of the final energy conversion from end-use to useful energy. The scope is often confined by the walls of boiler room as displayed in Figure 3). This translates into typical efficiency gains of about 20 % from old to new installations, e.g. through condensing boilers, frequency controlled high efficiency pumps and regular operation & maintenance procedures. Associated CO_2 reductions may be higher, if low carbon or renewable fuels or innovative technologies (e.g. solar, CHP) are applied.

Also for existing installations, efficiency gains of typically 10 % can be achieved (in many cases with little investments) by putting them under an EC-regime, due to the inherent incentives of the EC model to reduce final energy cost [Eikmeier et.al. 2009].

In contrast, the scope of the Energy Performance Contracting and the proposed Integrated Energy Contracting (IEC) model (c.f. chapter 4) encompasses the complete building or factory. Typical measures are energy management and controls, HVAC-technologies like hydraulic adjustment of the building heat distribution network, air conditioning system or lighting. And not to forget: The behavior of the building occupants.

With EPC higher conservation potentials can be unlocked: The „Energiesparpartnerschaft" in Berlin and the „Federal Contracting Campaign" in Austria concurrently report of savings between 20 and 25 % in their large public

[6] Two possible explanations are: Besides budgetary necessities of public institution for third party financing, the existing high saving potentials due to backlogs in building retrofit and modernization facilitate a WIN-WIN situation between building owner and ESCo. The latter also applies to the cost of the saving guarantee (cf. chapter 3.4)

pools of buildings [ESP Berlin 2009] [Bundescontracting 2009]. In special purpose buildings such as hospitals or swimming pools considerably higher savings are reported: „Pool 12 Berliner Bäder Betriebe“ achieves 33,5 % [ESP Berlin 2009], 2 swimming facilities in Vienna report of 50 % heat- and 60-76 % water savings [Siemens 2009].

Figure 3 illustrates the typical scope of services of the above mentioned Energy-Contracting models and the IEC model.

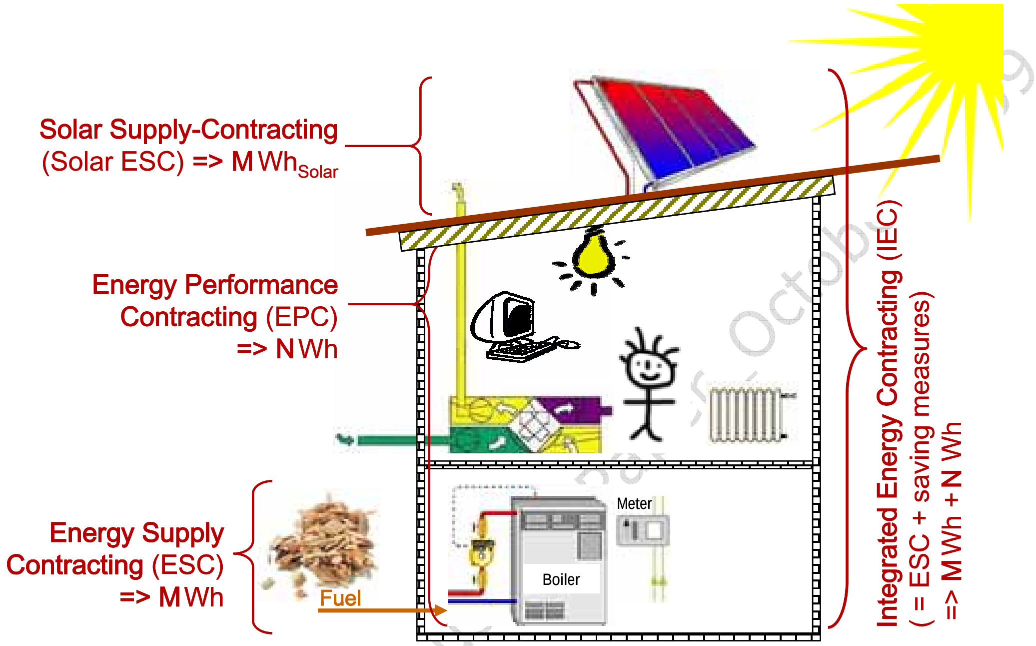

Figure 3 Scope of services of different ESCo models

Also simple building shell measures such as an insulation of the upper floor ceiling or a window retrofit can be included in the scope of services, although this is not common EPC practice.

Further on, the scope of the energy service can be extended to a comprehensive refurbishment of the building (deep retrofit) including the complete building shell (e.g. insulation, exchange of windows or passive solar shading through selective window films). Corresponding experiences have been documented scarcely (some reports by [GEA 2009] [Bleyl+Schinnerl 2008a]). The achieved results reach up low energy building standards.

3.4 The Baseline and other EPC Problems

The EPC business model (cf. chapter. 3.1) is based on delivering energy savings in comparison to a (calculatory) baseline. Hereby three sets of problems may arise:

1. Savings (avoided consumption, "Negawatthours") can only be measured indirectly as difference between consumption before and after implementation of the EE-measures (relative measurement: savings = baseline - consumption). In reality two problems occur:
   - The baseline itself maybe difficult to determine (with enough accuracy) due to a lack of availability of historic data (e.g. from bills or meters)
   - The determined baseline is not a constant but subject to changes in climate and energy prices. Moreover, problems may arise from changes in utilization of the building or production process, from variable loads or from architectural modifications. Especially the latter changes may cause considerable difficulties and cost for ESCo and facility owner in adjusting the baseline.

   In addition to the resources necessary (high transaction cost), the baseline determination and correction may cause risks and a considerable degree of insecurity between the (prospective) project partners.
2. EPC-Measurement and verification of the savings (M&V)[7] cause high expenses in relation to the saving potentials, which is amplified by the often highly scattered nature of saving potentials. Unlike investment cost, a share of M&V cost accrue continually and decrease the future savings potentials to refinance EE-investments.[8]
3. In Practice, only very few EPC projects include building envelope measures such as facades, windows or upper floor insulations, although these measures constitute a substantial share of the saving potential. Without trying to explain this empirical evidence here, the question arises, whether the EPC model is suitable to execute comprehensive refurbishment projects?
4. Also the ESCo's risks associated with the EPC savings guarantee may cause considerable safety surcharges and result in additional cost for the client. For the savings guarantee, the ESCo has to account for possible increased energy consumption, e.g. from user behavior or inaccurate saving calculations and data bases, which may result in additional cost for the customer.

As a consequence, transaction and M&V cost of EPC projects are particularly high, resulting in minimum energy cost baselines of 100.000 €/a and above. By example: The up to now 23 building pools of the Berlin „Energy Saving Partnership" – as one

[7] [IPMVP_2009]: Some advice and guidance on M&V can be obtained from http://www.evo-world.org/index.php

[8] Wherever possible, we recommend direct measurements of the energy saved: E.g. for heat recovery: Measurement of MWh hours recovered instead of indirect measurement (baseline- ex post consumption) For illustration of the latter option cf. [Hita 2009]

of the most successful EPC campaigns – have an average energy cost baseline of 1,88 Mio €/year [ESP Berlin 2009].

The above mentioned problems and the potentially high cost for the baseline creation and maintenance over the contract term have led to general reservations towards the EPC model by some potential clients.

Also the widespread and raised expectation, EPC projects must be refinanced from future energy cost savings only and create immediate budget relieves in addition is not achievable for all projects. For many potential projects, a more realistic correction towards a partial refinancing from future energy cost savings would be helpful, e.g. to extend the model to comprehensive building refurbishment (cf. [Bleyl+Schinnerl 2008]).

Another point for discussion is, whether the immateriality of energy savings makes it more difficult to make EPC products tangible and marketable or not? Reduced to a simple denominator the question could be phrased as follows: Is the fact that „nobody has ever seen or touched a „Negawatthour" a substantial obstacle to the market penetration of EPC?

3.5 Conclusions for the further development of ESCo products

For the development of future ESCo products, the results of the previous subchapters are summarized as follows:

1. **Energy Supply Contracting** (ESC):
   - Heat supply projects dominate the ESCo market and are common in several end-use consumption sectors such as housing, commerce and industry, public buildings and the tertiary sector. ESC projects have also proven their value for the implementation of renewable supply projects or innovative technologies such as combined heat and power systems. Minimum energy cost baseline of heat supply projects of circa € 20,000 per year are roughly one order of magnitude below those of EPC projects.
   - However, large demand side energy efficiency potentials remain untapped, because the scope of services is limited to the provision of useful energy or in other words to the plant room.
   - The ESC business model is more flexible with regard to changes in energy consumption, due to the direct measurement and billing of the useful energy delivered.
2. The **Energy Performance Contracting model** (EPC) provides a more comprehensive approach and refers to saving potentials in the complete property. In practice though, a number of (methodological) problems, mainly in the areas of baseline determination and maintenance, measurement & verification as well as appraisal of risks and cost of the savings guarantee hinder a more widespread distribution (cf. chapter 3.4). With an ESCo market share of about 10 %, the market acceptance of EPC is significantly lower than with ESC products and quasi limited to the public sector and special purpose buildings such hospitals or swimming facilities.

From the above observations we derive the thesis, that marketable ESCo product innovations are easier to be achieved on the bases of the ESC model.

Centrally, the scope of services of the ESC model shall be extended to the complete building or business to tap higher saving potentials. At the same time the (methodological) problems of the EPC model should be avoided or at least simplified.

The objectives are to unite energy conservation and supply (from renewable sources) in an integrated product and to develop higher saving potentials then with standard ESC. Moreover, other end-use sectors should be reached out to and transaction cost should be reduced to also access smaller projects.[9]

Nevertheless, EC will remain to be an „energy efficiency tool“, which needs to win customer recognition in a fair competition with other modes of implementation. EC will not be able to solve all obstacles in the way of energy efficiency. Independent of the choice of implementation model, the decision of the building or business owner to want to invest in energy efficiency remains a basic requirement.

[9] For further remarks on chances and limitations of EC models in comparison to in-house implementation please refer to [Eikmeier et al. 2009, p. 30f. and 93f.]

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4 The Integrated Energy Contracting Model

4.1 Objectives and customized scope of services

The Integrated Energy Contracting 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;
2. **Efficient supply of the remaining useful energy demand**, preferably from renewable energy sources

As compared to Energy Supply Contracting, the range of services and thus the saving potential to be utilized is extended to the overall building or commercial enterprise (cf. chapter. 3.3 and Figure 3). The scope is not limited to heat energy but the model can equally be used for other consumption media such as electricity, water or compressed air.

The results to be achieved by the energy service encompass modernization of the installations, lower consumption and maintenance costs and improvement of the energy indicators (e.g. energy performance certificate or benchmarking of buildings). In addition, non-energy-benefits such as emission reductions or increase in comfort and image shall be achieved.

For implementation, the building owner assigns a customized energy service package and demands guarantees for the results of the measures taken by the ESCo (cf. definition of contracting in Chapter 3.1).[10] The necessary components for implementing energy (efficiency) projects are summarized in Figure 4 in an integrated energy service package with result guarantees given to the client.

Most energy efficiency projects differ in their contents and general conditions. Therefore, it has proved to be necessary and sensible to adapt the scope of services specifically to the individual project. This also means the building owner can – depending on his own resources – define what components of the energy service will be outsourced and which components he carries out himself (e.g. ongoing on-site maintenance provided by a caretaker or financing[11]).

[10] In principle implementation can also be done in-house within an "Intracting model", provided the building owner has the suitable resources and controlling instruments for monitoring and verifying the results

[11] In contrast to widespread opinions, the ESCo service package does not automatically need to include financing (as is the prevailing case in the US EPC market). Financing can be provided by the building owner, the ESCo or a third financing partner, depending on who can offer the better conditions. In any case, the ESCo can be used as a vehicle and facilitator for financing. This topic has been elaborated in more detail in [Bleyl+Suer 2006] or [Bleyl+Schinnerl 2008a].

All the tasks shown in Figure 4, such as planning, construction and financing, as well as all the ongoing components of the service, such as operation and maintenance, optimization, purchasing of fuel and quality assurance, have to be covered either by the building owner or the ESCo throughout the contractual period.

In case of outsourcing the functional, performance and price guarantees provided by the ESCo and the assumption of technical and economic risks by the ESCo constitute an added value for the client.

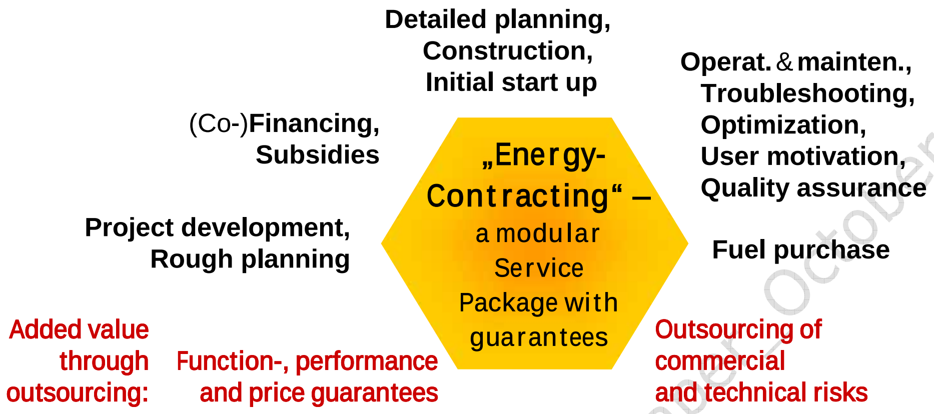

Figure 4 Energy Contracting: a modular energy service package with guaranteed results for the client

In principle the service package can also be subdivided into two parts, “useful energy supply” and “energy efficiency measures and management”, and assigned separately, if sensible.

4.2 Business model

The ESCo will take over implementation and operation of the energy service package at it’s own expenses and responsibility according to the project specific requirements set by the client. In return, the ESCo will get remuneration for the useful energy delivered, depending on the actual consumption[12] as well as a flat rate service remuneration for operation & maintenance, including quality assurance. As mentioned earlier, financing is a modular component of the service package (cf. footnote 11).

The business model of Integrated Energy Contracting is based upon the standard Energy Supply Contracting model and is supplemented by quality assurance instruments for the energy efficiency measures as a substitute for the energy saving guarantee (for details, please refer to chapter 4.3).

[12] From customer perspective, pricing of the service part “energy supply” is comparable to that of standard district heating.

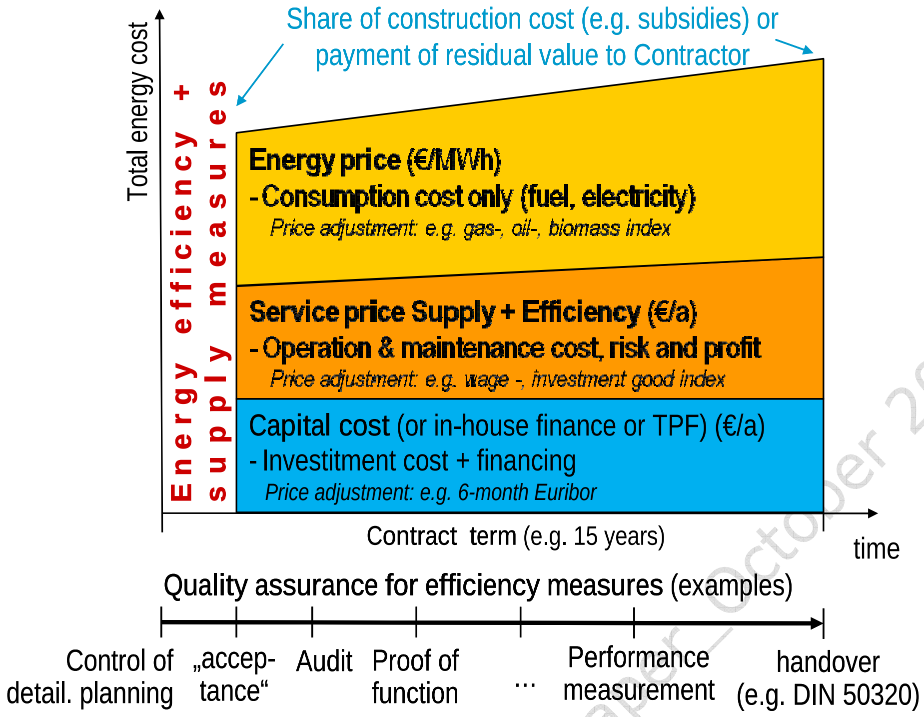

Figure 5 Integrated Energy Contracting Business Model with Quality Assurance

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

- **Energy price** (dependent on actual consumption): To rule out incentives to sell more energy, the ESCo is to calculate the consumption related cost[13] only (in economic terms: the marginal cost)[14], i.e. exclusively the expenditure for fuel[15] and auxiliary electricity.
  During the contractual period, the prices will be adjusted every year retrospectively by using statistical energy price indices depending on the fuel used (e.g. gas or biomass index), which are defined in the IEC Contract.
- **Service** (or basic) **price Energy Supply** (flat rate): All operation related cost, i.e. the cost for operation&maintenance, personal, insurance, management etc. of the energy supply infrastructure as well as entrepreneurial risk.
  During the contractual period, the prices will be adjusted every year retrospectively by using statistical indices such as wage or investment good indices.
  Service price Energy Efficiency (flat rate[16]): In analogy to the above service price all operation cost of the energy efficiency measures. As is shown in Figure 5, the two basic prices can be combined.

[13] For a definition of consumption and operation related cost, refer to [VDI 2067]

[14] 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.

[15] Fuel can also be purchased by the client in case of better purchasing conditions and charged with the energy price.

[16] Possibly supplemented with a bonus-malus settlement

- (Optional) **Capital cost** of energy efficiency and supply investments: If (co-) financed by the ESCo, the ESCo will get an annuity remuneration for it's capital cost minus subsidies and building cost allowances.
  During the contractual period, the prices will be adjusted by using statistical indices such as 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, project or life cycle costs (LCC) will be calculated at the Integrated Energy Contracting model, which should be considered at the comparison with an in-house implementation.

Awarding of contracts is usually being done within a combined competition of solutions and prices based on a functional description of the energy services.

4.3 Quality assurance substitutes energy savings guarantee

Due to the potential EPC problems described in chapter 3.4, the EPC-savings guarantee and the exact measurement and verification of the actual savings achieved is replaced by quality assurance and simplified measurement and verification procedures for the energy efficiency measures installed. The objective is to reduce (transaction) cost and to simplify the model.

Therefore, an important issue is the discussion of practicable quality assurance instruments (QAI) as a substitute for the energy performance guarantee. The concept is displayed in the following figure (on the basis of the business model displayed in Figure 5).

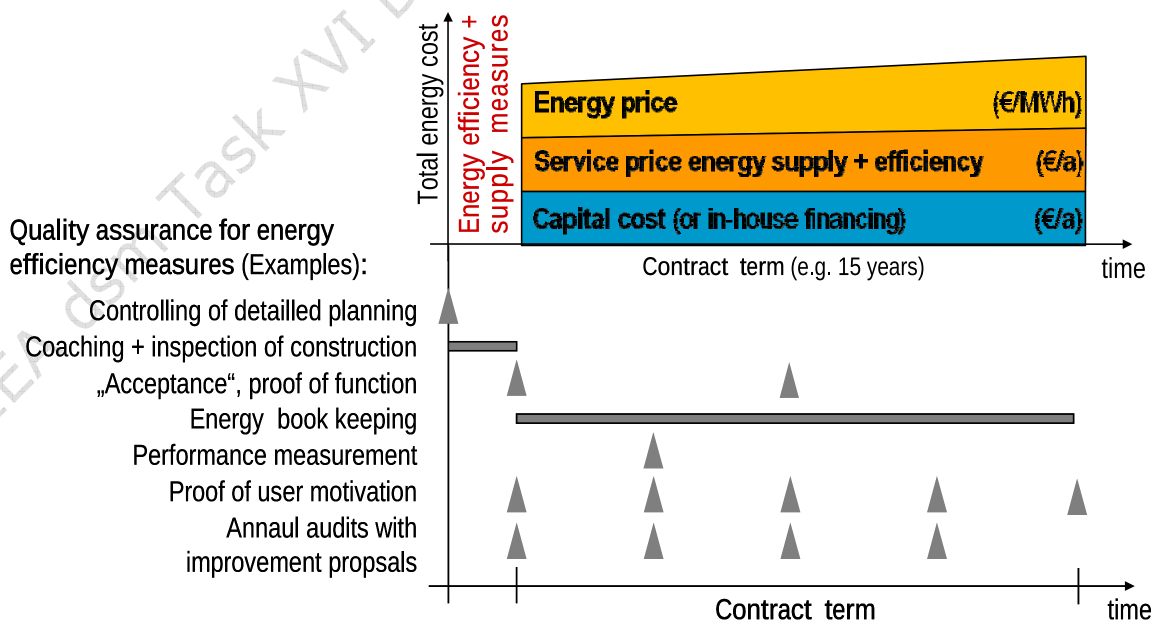

Figure 6 IEC business model: Quality assurance instruments as substitute for the EPC savings guarantee

Two examples for QAI: One-time performance measurement for a new street lighting or thermographic analyses for verifying the quality of the refurbished building shell replace the annual measurement and verification of the savings guarantee, which may imply high risks and safety reductions. QAI can be defined specifically for each implemented measure.

The objective is to minimize expenditure while securing the functionality and performance of the efficiency measures implemented, but not it's exact quantitative outcome over the project cycle, which largely depends on factors external to the ESCo's influence such as changes in ambient climate conditions or utilization of the facility.

Basically, quality assurance can be provided both by the client and by the ESCo (cf. chapters 4.3.1 and 4.3.2). The QAI can either be specified by the client or suggested by the ESCo as part of the competition of solutions during the procurement process.

On the other hand, it should be discussed as to whether the saving incentives and control through QAI are sufficient to motivate the ESCo to continual efficient operations and optimization. Depending on the results of the pilot projects, the introduction of penalties may have to be put up for discussion, e.g. if quality assurance is not fulfilled.

Beyond the IEC approach the introduction of compulsory short-term, medium-term and long-term quality assurance instruments seems to be worth considering for all energy efficiency projects, no matter whether outsourced to an ESCo or implemented in-house. The economic and organizational logic of project or life cycle consideration makes it necessary to integrate the operating phase. For example mandatory commitment to quality assurance as early as in the purchase contract can lead to an increased awareness of quality in the construction and later on in the operation phase.

4.3.1 Quality assurance provided by the client (examples)

Possible quality assurance instruments for EE measures that can be provided by the client or third parties are the following:

1. (Functional) specifications to communicate and document energy related objectives and requirements (e.g. quality standards, maximum energy indicators, request of renewable energy sources with proof of origin ...)
2. Coaching and control of detailed planning by an (independent) energy specialist;
3. Third party construction supervision by an (independent) energy specialist;
4. "Acceptance" after construction phase (compliance with functional specifications, thermographic pictures, blower door, proof of function ...);
5. Energy book keeping – comparison of target and actual values (alternatively provided by the ESCo);
6. Expertise by an (independent) energy specialist (2nd opinion report);
7. ...

This list does not claim to be complete but shall serve as a basis for discussion.

4.3.2 Quality assurance provided by the ESCo (examples)

Possible quality assurance instruments for energy efficiency measures that can be provided by the ESCo are the following:

1. Detailed analysis of the planned measures (verification of rough analyses);
2. Proof of function: e.g. commissioning, parameter and operating protocols;
3. One-time verifications after commissioning, e.g. performance tests, efficiency measurements, thermographic pictures and analyses, blower door test, acceptance protocols …;
4. Recurring verifications, e.g. proof of user motivation, efficiency measurements, control of emission values, return temperature limitations, compliance with heating curves …;
5. Obligation for annual reporting (auditing): energy balances, comparison of target and actual values or benchmarks, suggestions for saving measures …;
6. Computational saving verifications, e.g. nominal power savings times operating hours …;
7. Maintenance protocols …;
8. **…**

Besides, the ESCo takes over technical and economic risks during construction and operation of the energy efficiency installations on it's own accounts (for the scope of services defined in the contract) throughout the contractual period.

The use and combination of the different QAI as well as their exact design must be chosen according to the requirements placed by the parties involved in the project.

The reasonable ratio between quality assurance and control, on the one hand, and expenditure on the other hand, certainly requires experience and fine tuning and cannot be defined generically. The guiding principle should run as follows, "As little as possible and as much as necessary."

5 Integrated Energy Contracting in Practice

The idea of combining energy supply with demand side energy saving measures is not entirely new off course. For example, the following projects with at least individual demand side efficiency measures are documented in the dena guideline Energy Supply Contracting [dena 2009]:

- Jugendausbildungszentrum (Youth Training Centre) Berlin-Zehlendorf (10 buildings with a heated area of 12,744 m^2): In addition to the erection of a small scale CHP (Combined Heat and Power) plant, a new heat distribution network was built in order to reduce losses and a metering and billing system for electricity and heat was introduced within the Energy Supply Contracting project.
- Heide-Grundschule (Primary School) Berlin Adlershof (school with a gymnastic hall and three additional buildings supplied by a local heating network with a useful area of altogether 8,900 m^2): In addition to the new gas-boiler plant the classrooms were equipped with thermostatic valves. Besides, consumption measurement, remote control and parameterization of the facilities were implemented.

However, integration of demand side saving measures into Energy Supply Contracting projects has rather been the exception up to now because the standard scope of services at ESC is limited to the boiler room (cf. Figure 3).

5.1 Landesimmobiliengesellschaft Steiermark (State Real Estate Company of Styria)

The Landesimmobiliengesellschaft Steiermark (State Real Estate Company, Styria) LIG administers and manages more than 420 buildings in Styria, about 200 objects with an overall area of more than 700,000 m² being owned by LIG. LIG is a 100% subsidiary of the State Government of Styria, Austria [LIG 2009].To our knowledge, LIG is the first institutional building owner that has systematically applied the concept of Integrated Energy Contracting.

The original motivation of LIG was to substitute heating oil with energy carriers that are renewable as far as possible. In the course of project development, the objectives of LIG's IEC call for tenders were extended and concretized as follows:

1. Implementing demand side saving measures with pay back times of less than 15 years in the fields of building technology, building shell and user motivation and increasing the energy indicators of the buildings;
2. Comprehensive refurbishment of all oil fired heating plants;
3. Reducing CO_2 emissions (which implies a change of energy carriers) and minimizing the overall energy cost.

In 2007/08, the first Europe-wide IEC call for tenders was executed for five buildings with a net floor area of approx. 11,000 m^2. In 2009 Pool 2, which consisted of three real estates with altogether 20.000 m^2, was procured and is currently being implemented. Commissioning is planned for autumn 2009. Still another pool of buildings is under preparation.

The call for tenders was designed as a competition of prices and solutions, based on functional specifications. It was procured in the framework of a negotiated procedure according to public procurement law. To evaluate the ESCo proposals, the following criteria were applied: 1. Lowest project cycle cost for energy supply; 2. Lowest CO_2 emissions and 3. Highest energy cost savings through demand side saving measures proposed by the ESCo.

For all short- to medium-term EE measures with a pay back period of less than 15 years, the bidders could make proposals while stating investment costs, energy cost savings and proposals for quality assurance instruments. These quotations were assessed by a commission entrusted by the client.

Up to now, two pools of buildings have been tendered for, resulting in competitive energy prices for heat supply, almost exclusively from renewable sources. On the demand side an increasing number of saving measures could be procured. In Pool 2, the following energy savings compared to the baseline resulted from the negotiated procurement procedures, subject to monitoring and verification after implementation of the measures in the buildings:

- Thermal energy: 16.8 – 30.8 %
- Thermal power: 0 – 27.6 %
- Electric energy: 4.8 – 11.8 %
- Water: 0 – 20 %
- CO_2: 92 % (primarily due to the change of the energy source (geothermal and biomass))
- Value of future savings cash flows: € -15,000 up to – 250,000 including all cost of the EE measures. The negative values represent net savings over the project term.
- Quality assurance instruments (selection): review of detailed planning, “acceptance” after construction phase, computational saving verifications, adjustment protocols, thermographic recordings, measurement of solar thermal output, …

Upon completion of the construction works, the ESCo has to verify compliance with quality standards defined in the functional specifications and the QAI for the energy efficiency measures implemented, in the course of “acceptance”.

The ESCo will control and operate the building technology primarily in a web based manner, also allowing access to the building owner to inquire the operating state of the installations, possible failures and consumption data. Furthermore, the ESCo will take over operation, maintenance and replacement of the installations specified in the contract.

The fact that the electricity saving rates are relatively low might indicate the necessity for better preliminary work done by the party preparing the tender specifications and, on the whole, more attention paid to the topic of electric end-use efficiency.

From the upper limit of thermal saving of approx. 30 % achieved, it is quite obvious that thermal overall refurbishment of the building shell within the specified pay back period of 15 years (this corresponds to the contractual period) cannot be implemented without additional subsidies or co-financing (from the negative savings cash flow). For future projects, it is thought about extending the amortization period in order to enable comprehensive refurbishment of the building shell and thus to implement additional energy efficiency measures.

5.2 "Good Practice" Example

The Retzhof of LIG (Landesimmobiliengesellschaft Steiermark – State Real Estate Company Styria) is a complex of buildings consisting of a castle from the 16th century as well as two seminar and guest houses from 1960 and 2009 with an overall useful area of approx. 4,000 m^2, which are used as hotel and seminar house.

Figure 7 "Schloss Retzhof": Seminar House of the Province of Styria

The energy related initial situation before refurbishment and the new building can be summarized as follows: high energy costs, inefficient natural gas boiler, no insulation of the castle building (protection of a historic monument) as well as demolition of the old boiler house to make room for the new guest house, including the new heating centre. The consumption indicator amounted to approx. 185 $kWh/m^2/year$.

From the building owner's perspective, the following goals were in the centre of interest:

1. Replacing the old boiler installation due to demolition;
2. Outsourcing of energy supply and financing of the investments;
3. Reduction of energy demand and costs through demand side saving measures as well as CO_2 reduction

The project was implemented with the support of Grazer Energieagentur GmbH within an Integrated Energy Contracting Model. Central issues are: Combination of energy efficiency measures and supply of useful energy, measure specific quality assurance instruments substituting the EPC savings guarantee. The ESCo contract was awarded in a combined competition of prices and solutions in the course of a two-phase negotiating procedure. The business model is summarized in Figure 1 in the Abstract. oder Verweis auf vorige Abbildung).

The most important contractual relationships and cash flows are summarized in the following two charts:

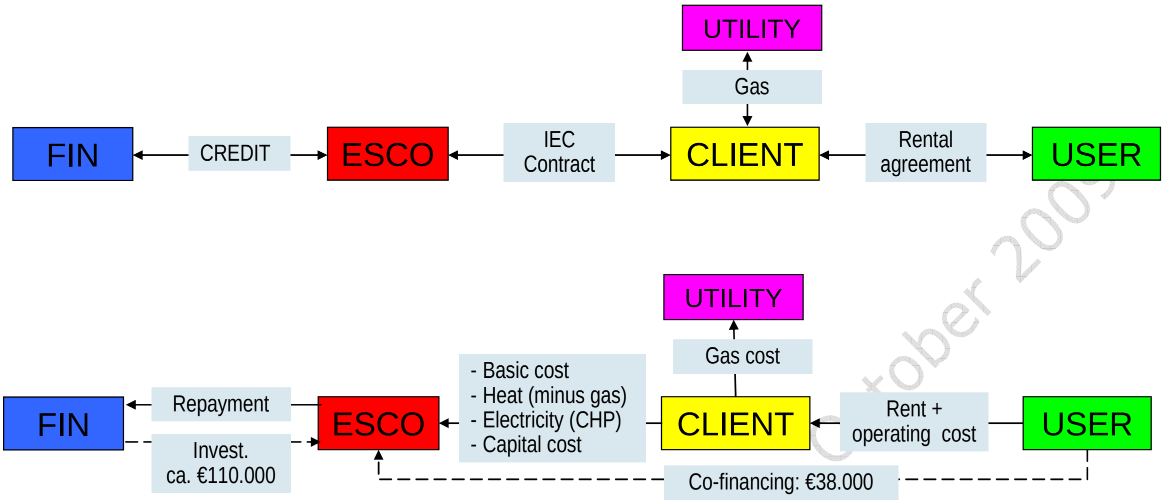

Figure 8 Retzhof: Contractual relationships and cash flows (overview)

From the building owner's perspective, some important experiences and innovative approaches of the project can be summarized as follows:

1. The combination of energy efficiency and supply of useful energy within the IEC Model basically works.
2. From the building owner's perspective, a coordinating and controlling function is even necessary for an ESCo acting as a general contractor. Especially if other building construction projects are simultaneously been carried out as in-house implementation (here: newly building the guest house).
3. The development of comprehensive energy (efficiency) projects requires committed facilitators and a long breath.
4. As for the castle, which is subject to protection of a historic monument, only the insulation of the top floor is possible without problems. The solution with cellulose blown up in an open way is cheap and functional, provided that the loft is not utilized.
5. Thanks to co-financing of the investments by using funds provided by the user of the building, the ongoing capital costs could be reduced by approx. 30 %.
6. The ESCo invests in the CHP plant upon it's own risk. Re-financing will be done by selling electric current to the building owner during the contractual period.

These results apply subject to a systematic monitoring and verification in the course of annual auditing of the buildings. Furthermore, experience from ongoing operation needs to be expected.

6 Discussion of Results and Outlook

Opening up energy saving potentials remains one of the most important and, at the same time, most difficult tasks, which can only be advanced in a concerted action with as many players active in energy policy and industries as possible as well as the end-users of energy themselves.

Also for Integrated Energy Contracting (IEC), the decision of the building or business owner to want to invest in energy efficiency remains a basic requirement. For the implementation of energy efficiency projects, IEC offers an innovative "efficiency tool". IEC allows to combine energy saving and supply (from renewable energy sources) in an integrated approach and they can be executed within a competition of solutions and prices according to life cycle cost.

The IEC business model builds on Energy Supply Contracting (ESC), which is known and applied in several energy end-use sectors. The scope of services and thus opening up of saving potentials is extended to the overall building or enterprise and to all consumption media, such as heat, electricity and water. At the same time (methodological) problems of Energy Performance Contracting (EPC), e.g. those possibly occurring when creating and adapting baselines, measurement and verification or risk surcharges for the saving guarantee, are avoided or at least simplified.

The potentially complex EPC savings guarantee is replaced by individual quality assurance instruments, which secure the functionality and performance of the efficiency measures implemented, but not it's exact quantitative outcome over the project cycle, which largely depends on factors external to the ESCo's influence such as changes in ambient climate conditions or utilization of the facility.

Experience collected in up to now eight projects have confirmed the practical feasibility of the IEC model. The résumé of the building owner "Landesimmobiliengesellschaft Steiermark" (State Real Estate Company Styria) as client and the ESCos concerned can be stated to be positive and is reflected in the preparation of new IEC projects. Other stakeholders have expressed their interest, examples being DECA (Dachverband der Österreichischen Contractoren – Umbrella Association of the Austrian ESCos) or ESCo Europe (European Conference of the ESCo Industry). However, also with IEC experience shows: The development of comprehensive energy (efficiency) projects requires committed facilitators and a long breath.

The fact that an upper limit of thermal savings of approx. 30 % is achieved makes it quite obvious that a comprehensive refurbishment of the building shell within the specified pay back period of 15 years cannot be implemented without additional subsidies or co-financing (e.g. by cross subsidizing from the savings cash flow of other efficiency measures). As for electricity, additional endeavors will be necessary to achieve higher saving rates.

In the next step, the results of annual auditing will have to show to what extent the quality assurance instruments agreed contractually are sufficient to ensure the calculated energy and CO_2 savings. In this context, committed control assumed by the building owner definitely is an important success criterion. Even the introduction of penalties in the event the saving targets are not reached may have to be discussed. Also experiences from the IPMVP protocol with regard to quality assurance should be investigated in more detail [IPMVP_2009].

A more thorough comparison of transaction costs and results between the IEC and the EPC models would be useful, in particular in view of the problems described in chapter 3 and suitable minimum project sizes. Furthermore, fiscal and balance sheet related implications of the IEC Model will have to be reviewed in comparison to EPC.

Last but not least, it remains to be seen what contribution IEC will make to the search for suitable efficiency tools mentioned in the introduction. Perhaps energy efficiency will achieve a higher market diffusion in combination with (renewable) energy supply?

High priority should be placed on the development of new projects in the end-use sectors of public institutions, tertiary sector, trade and industry as well as housing in order to facilitate climate protection policies and sustainable cost reductions. Implementation can be executed by outsourcing to an ESCo or as 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.

As practical experience has been limited up to now, the results of this publication should be seen as "work in progress". In case of questions or ideas for further co-operation, your feedback is highly welcome. You can reach the author at Bleyl@Grazer-EA.at.

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