Conservation First! The New Integrated Energy-Contracting Model to Combine Energy Efficiency and Renewable Supply in Large Buildings and Industry

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Abstract

Any renewable supply should first of all focus on energy conservation by evaluating all possible demand reduction opportunities. Only afterwards the remaining demand is supplied as efficiently as possible – preferably from renewables. 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.

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].

This contribution introduces a new, market based implementation model for energy efficiency and supply (preferably from renewables), labelled as **Integrated Energy Contracting** (IEC). IEC builds on the in many markets more widely applied Energy Supply Contracting (ESC) model, but extends the scope of service to the entire facility in order to achieve higher saving potentials than with standard ESC. The core objectives of this publication are:

1. To unite energy conservation and (renewable) energy supply into an integrated approach,
2. To discuss quality assurance instruments and simplified measurement and verification methods e.g. deemed savings) for the energy efficiency measures.
3. The underlying goal is to increase understanding of different ESCo models as tools to implement renewable and energy efficiency projects and to discuss pros and cons, potentials, limits and added values of ESCo products in comparison to in-house implementation.

The intention is not to question the EPC model, wherever it is marketable, which is predominantly in large public sector buildings. Rather an additional ESCo approach for EE and RE projects shall be proposed in order to increase the saving potential of the ESC model, to decrease transaction and measurement & verification cost, to make performance based ESCo services available to smaller projects and to build on success of the ESC model to reach out to additional end-use markets.

Besides discussing the new IEC model, we present results from pilot projects procured by Landesimmobiliengesellschaft Steiermark (Real Estate Company of the State of Styria), Austria. Experience from up to now eight projects has proven the feasibility of the IEC model. In addition to competitive energy prices, final energy savings of up to 30 % heat, 12 % electricity and 20 % water consumption have been achieved. In 2010, LIG’s IEC activities have been recognized with the Energy Globe Styria Award.

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 higher market diffusion in combination with renewable energy supply? And maybe a less technical approach to verify savings and thus a simplification of (pseudo-)exact, indirect saving measurements, would serve the purpose of establishing EE as a resource well?

Introduction and Motivation

Any renewable supply should first of all focus on energy conservation by evaluating all possible demand reduction opportunities. Only afterwards the remaining demand is supplied as efficiently as possible – preferably from renewables. 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 a (solar driven) air conditioning unit. The literature provides numerous supports 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. Increased use of renewables in power generation and of bio-fuels in transport account for 12% in comparison to the reference scenario“ [IEA 2006]. Reduced to a simple common denominator this means: Without comprehensive energy conservation measures, climate protection goals are not achievable.

One of the most urgent energy policy and energy economics tasks continues to be the search for suitable implementation instruments to execute energy saving potentials. The level of success is far from satisfactory as the continuous increase in final energy consumption reveals [EC 2011].

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 Energy Service Company (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 renewable and 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 discuss quality assurance instruments and simplified measurement and verification methods (e.g. deemed savings) for the energy efficiency measures.
3. to increase understanding of different ESCo models as tools to implement renewable and energy efficiency projects and to discuss 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.

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 manager and market facilitator.

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-Contracting, ESCo Services)” brings together experts on Energy-Contracting from currently six countries around the world, who join forces to advance ESCo models and markets [IEA DSM 2009].

(Methodological) Limitations of Standard ESCo Products and their Markets

Definition and Concept

Most existing definitions fall short with regard to important properties of “real” Energy-Contracting (EC) services such as outsourcing of commercial and technical risks to the ESCo, guarantees for results and “all inclusive” cost of the measures implemented or optimization according to project cycle cost (cf. [2006/32/EC], [Bertholdi et.al. 2007], [EN 15900], [DIN 8930-5], [GEFMA 540], [Satchwell et.al. 2010], [UZ 50], [VDMA 24198] this list is not exhaustive). These features may constitute an added value in comparison to standard in-house implementation.

Therefore, in a narrow sense we define EC as:

> *Energy-Contracting - also labelled as ESCo- or Energy Efficiency Service - is a comprehensive energy service concept to execute energy efficiency projects according to minimized project cycle cost.*
>
> *Typically an Energy Service Company (ESCo) acts as a general contractor and implements a customized service package (consisting of e.g. design, building, (co-)financing, operation & maintenance, optimization, fuel purchase, user motivation).*
>
> *As key features, the ESCo’s remuneration is performance based and it provides guarantees for the outcome and all inclusive cost of the services and takes over commercial as well as technical implementation and operation risks over the project term.* (after [Bleyl+Schinnerl 2008])

The EC service 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 carrier (e.g. the lowest cost of keeping a room warm, air-conditioned or lit). In other words: The ESCo’s remuneration depends on the output of the services provided and not the inputs (like fuels or man-hours) consumed, thus inducing an intrinsic interest for the ESCo to increase efficiency and to reduce final energy demand.

EC services are 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, including the operation phase of the building.

Typically the ESCo serves as a general contractor and is responsible for coordination and management of the individual components and interfaces of the service package towards the customer. It has to deliver the commissioned energy service (Megawatt hours of useful energy or energy savings (“Negawatt hours”)) to the customer at “all inclusive” prices as displayed in figure 1.

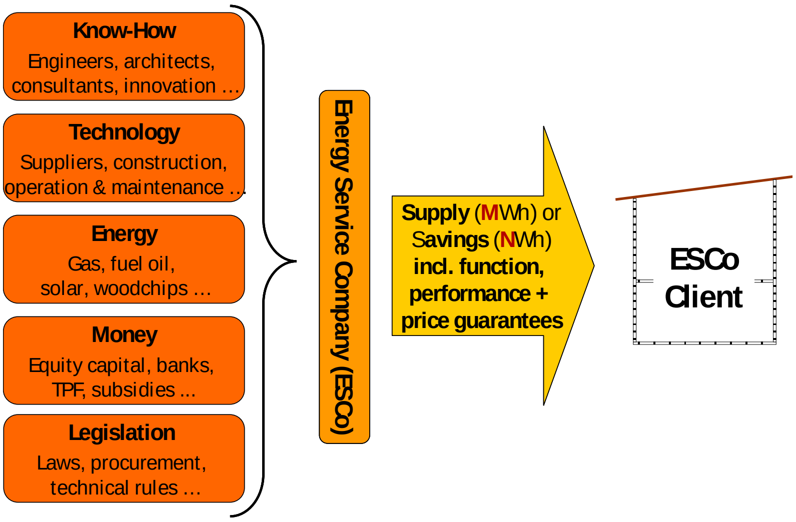

Figure 1: Energy-Contracting: An integrated energy efficiency service with outsourcing of risk, interfaces and guarantees to an ESCo

The two basic ESCo business models provide either useful energy (Energy Supply Contracting - ESC) or energy savings (Energy Performance Contracting - EPC) to the end user. Both business models result in a reduction of final energy demand. 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.

At ESC efficient supply of useful energy such as heat, steam or compressed air is contracted and measured in Megawatt hours (MWh) delivered. The model often includes purchasing of final energy (fuels) and is comparable to district heating, cogeneration supply contracts or the French "Contract chauffage". The scope of energy efficiency measures is usually limited to the energy supply side, e.g. the boiler room in the basement (cf. Figure 2).[1]

As for EPC, 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 2. The business model is based on delivering savings (also labeled as "Negawatt hours" (NWh)) compared to a predefined baseline.

Energy Supply is Dominating the ESCo Market in many European Countries

Reliable market data on national or European ESCo markets are scarce, sometime not very reliable or not publicly available. Nevertheless there is sufficient evidence that Energy supply contracting projects dominate the market. The "Verband für Wärmelieferung" (one of Germany's ESCo associations) reports an 85 % market share of ESC based on the 2008 survey of its 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].

Excursus to the US ESCo market: In a recent study of the US ESCo industry, ESC projects appear not to be surveyed: "... companies that only provide onsite generation or renewable energy systems ..." are excluded. Nevertheless an increasing ESCo revenue share of currently 14 % for renewable energy and onsite generation technologies bundled with energy efficiency improvements are reported. The applied business model is not specified though [Satchwell et al 2010].

ESC is applied in different end-use sectors such as housing, commerce, industry or public buildings, without being able to provide reliable numbers or market shares. For the housing sector specifications of minimum project sizes exist: [Eikmeier et.al. 2009] detail a thermal load of 100 kW 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,-. Upper project sizes are not limited and may go up to 10 MW or more for large industrial installations and encompass supply of heat, steam, (back-up) electricity or compressed air.

The market share of EPC projects is estimated between 10 to 15 %. At least in Europe it is practically limited to the public sector[2]. 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 "The Baseline- and other EPC Problems" is pinpointed for reference.

From the market dominance of ESC versus EPC projects and the greater spread in different consumption sectors, the theses is derived, that marketable product innovations are easier if they are based on the ESC model.

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

Limitations and Efficiency Potentials of Standard ESCo Products

Standard ESC (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 2. 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 % through a Re-Commissioning process 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].

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[1] Savings achieved can still be calculated by comparing to a previous energy cost baseline.

[2] Three 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. And off course regulations and statutory provisions on different levels force public entities to implement energy policy goals.

The market for EPC projects is largely limited to public institutions on federal, state and regional levels including special purpose buildings like universities, hospitals and leisure facilities. Projects are spread very unevenly across the German landscape. “EPC hotspots” are particularly observed where independent market facilitators such as energy agencies engage on behalf of buildings in preparing concrete projects owners and putting them out on the market for ESCos to bid for.

Excursus: US market data show a similar picture: 84 % of the ESCo’s revenues stem from EPC projects in public institutions, consisting of federal buildings and so called “MUSH” markets (municipal and state governments, universities and colleges, K-12 schools and hospitals) [Satchwell et al 2010].

With EPC somewhat higher efficiency 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 pools of buildings [ESP Berlin 2009] [Bundescontracting 2009]. Typical measures are energy management and controls, HVAC-technologies like hydraulic adjustment of distribution networks, air conditioning systems or lighting. And not to forget: The behaviour of the building occupants.

Figure 2 illustrates the typical scope of services of the above mentioned Energy-Contracting models and the IEC model.

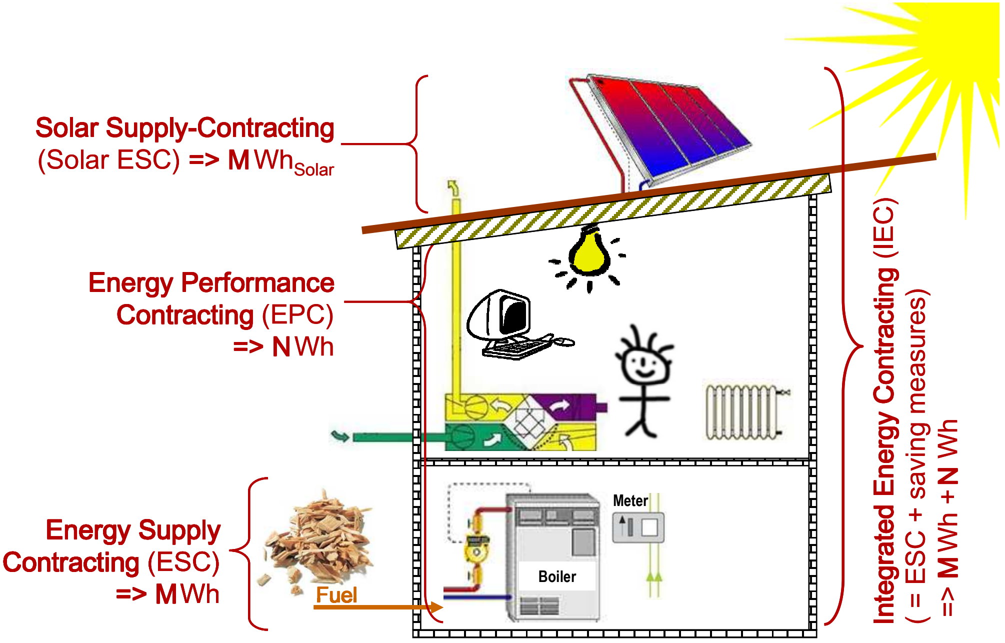

Figure 2: Scope of services of different ESCo models

Also simple building shell measures such as 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.

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], two swimming facilities in Vienna report of 50 % heat- and 60-76 % water savings [Siemens 2009] through additional saving measures.

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 to low energy building standards.

The Baseline- and other EPC Problems

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

1. Generally, savings (“Negawatthours”) can only be measured indirectly as difference between consumption before and after implementation of the EE-measures (relative measurement: savings = baseline – ex post-consumption). In reality two major difficulties occur:
    - The baseline itself may be difficult to determine (with enough accuracy) due to a lack of availability of historic data (e.g. from bills or meters)

- The determined energy cost baseline is not a constant but subject to changes in climate conditions (e.g. ambient temperatures, solar radiation …) and in energy prices. Moreover, problems may arise from changes in utilization of the building or production process (e.g. from variable loads, operation hours or from architectural modifications). Especially the changes in utilization may cause considerable difficulties, cost and insecurity for ESCo and facility owner in adjusting the baseline.

In addition to the resources necessary (high transaction and operation cost), the baseline determination and adjustment may cause a considerable degree of insecurity and monetary risks for the (prospective) project partners.

2. EPC-Measurement and verification (M&V) of the savings may cause high expenses in relation to the saving potentials. This 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. This emphases the need to balance accuracy and cost, in particular for smaller EPC projects.
3. 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 increases in energy consumption, e.g. from user behaviour 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 larger projects only with minimum energy cost baselines of 100.000 €/a and above. By example: The up to now 24 building pools of the Berlin „Energy Saving Partnership" – as one of the most successful EPC campaigns in Europe – 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 and ESCos.

Another observation reveals, that 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. This empirical evidence raises the question, whether the EPC model is suitable to execute comprehensive refurbishment projects?

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 too many projects.

Yet another point for discussion may be, whether the immateriality of energy savings ("NWh") makes it more difficult to make EPC products tangible and marketable? 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? What can be done to better visualize savings? Maybe a combination of EE and renewable supply is easier to market?

Conclusions for the further development of ESCo models

Based on the results of the previous subchapters, the following table summarizes typical market properties of ESC and EPC products:

	ESC	**EPC**
End-use markets	Public institutions, residential, commerce, industry	Public institutions (including universities, hospitals, leisure facilities)
Project Size: Minimum Energy Cost Baseline	**> 20,000** €/a	**> 100,000** €/a (ESP Berlin: 1,88 Mio €/a)
Efficiency potentials	**15 – 20 %** => limited scope of service	**20 – 25 %** (up to 30 – 50 %)
Share in ESCo market (in Germany 2008)	**85 – 90 %**	**10 – 15 %**
Business model / Performance measurement	**Useful energy** (**M**Wh**)**	**Energy savings** („**N**Wh") => Baseline problems => High transaction cost

Table 1: ESC vs. EPC: Summary of typical market properties

At **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 at least one order of magnitude below those of EPC projects.
- The ESC business model is more robust and more flexible with regard to changes in energy consumption, due to the direct measurement and billing of the useful energy delivered.

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 energy supply equipment in the plant room).

At **Energy Performance Contracting model** (EPC):

- The EPC model provides a more comprehensive approach and refers to saving potentials in the complete facility.
- 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 "The Baseline- and other EPC Problems").
- 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, swimming facilities or universities.

Last but not least, the widespread expectation, EPC projects must be completely refinanced from future energy cost savings and even create immediate budget relieves in addition is achievable only for projects with high saving potentials, thus severely limiting the application of EPC as an energy efficiency tool. 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]).

For the development of additional ESCo products we conclude:

1. From the above market observations and analyses we derive the thesis, that marketable ESCo product innovations are easier to be achieved on the bases of the more widely spread ESC model.
2. Centrally, the scope of services of the ESC model should be extended to the complete building or business in order to tap higher saving potentials.
3. (Methodological) problems of the EPC model should be avoided or at least simplified, wherever possible. Decreasing transaction as well as measurement and verification cost could make performance based ESCo services available also to smaller projects.[3]
4. Future models should also build on the success of the ESC model to reach out to additional end-use markets.
5. We particularly recommend applying the simpler and more robust ESC model, wherever energy flows can be measured directly with acceptable effort. Practical applications may be electricity or heat supplied from renewable - or combined heat and power systems but also MWh saved through EE-technologies like heat recovery installations[4].

The objectives should be to unite energy conservation and supply (from renewable sources) in an integrated product and to develop higher saving potentials than with standard ESC.

To restate clearly: We do not want to question the application of the EPC model, wherever it finds its markets. Rather an additional ESCo approach for EE and RE projects, applicable for all energy carriers and water shall be proposed.

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[3] 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.]

[4] Hita 2009 illustrates the complexity of an indirect measurement (baseline- ex post consumption) for an EPC model for a heat recovery system.

The Integrated Energy-Contracting Model

Objectives and Customized Scope of Services

The IEC service 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 standard 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. figure 2). The scope is not limited to the supply of heat energy. Instead the model is intended to be used for all energy carriers and consumption media such as heat, electricity, water or compressed air.

The results to be achieved by the energy efficiency 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.

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 implies 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 from other sources).

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 Energy-Contracting in chapter "Definition and Concept").[5] The necessary components for implementing energy (efficiency) projects are summarized in figure 3 in an integrated energy service package including guarantees for the output of the service to the client.

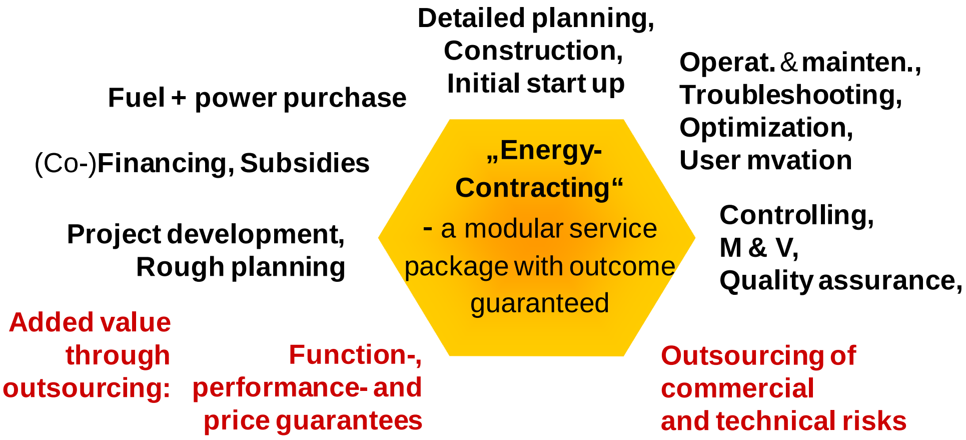

Figure 3: Energy-Contracting: A modular energy service package with guaranteed results for the client

All the tasks shown in figure 3, such as planning, construction and financing, as well as operation and maintenance, optimization, purchasing of fuel, quality assurance and measurement & verification, 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 may constitute an added value for the client.

Business Model

The Integrated Energy-Contracting model is based upon the more widespread and more robust Energy Supply Contracting business model and is supplemented by quality assurance instruments (for details, please refer to chapter "Quality Assurance Substitutes Energy Savings Measurement") for the energy efficiency measures. The

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[5] 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

latter shall serve as a substitute for the potentially complex and costly saving measurement and verification (as outlined in chapter "The Baseline- and other EPC Problems").

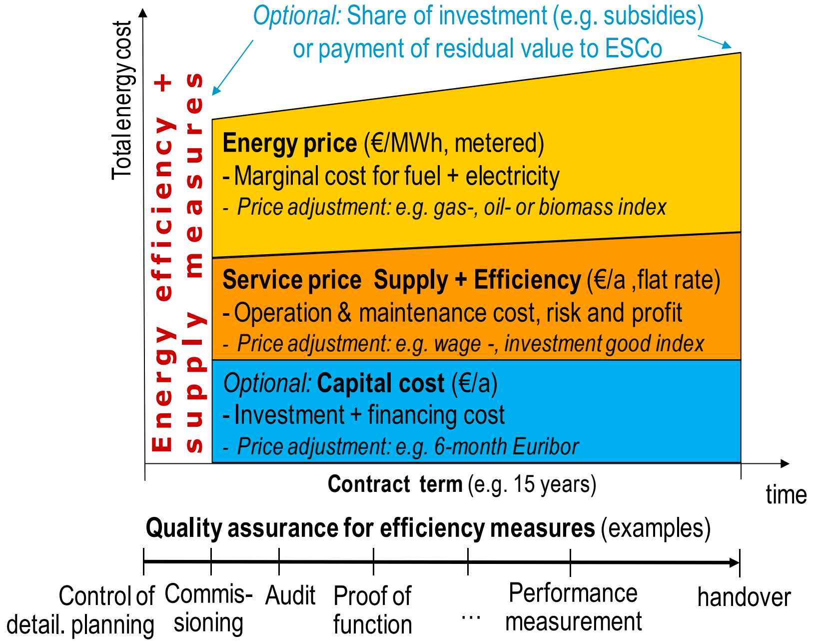

Figure 4: Integrated Energy-Contracting Business Model with Quality Assurance

The ESCo will take over implementation and operation of the energy service package at its own expenses and risk according to the project specific requirements set by the client. In return, the ESCo will get remuneration[6] for the useful energy delivered, depending on the actual consumption as well as flat rate remuneration for operation & maintenance, including quality assurance. Financing is a modular component of the service package.

The ESCo's remuneration is made up of the following three price components[7]:

- **Energy price** (per MWh of useful energy metered): Covers the marginal "consumption related" cost per MWh of useful energy supplied. To rule out incentives to sell more energy, the ESCo's calculation of the energy price should include consumption related cost only (in economic terms: the marginal cost), i.e. exclusively the expenditure for fuel and auxiliary electricity. [8],[9]
  To account for final energy price developments during the contractual period, the ESCo's energy price will be adjusted by using statistical energy price indices depending on the fuel used (e.g. gas or biomass index), which are defined in the IEC Contract. Such, the risk (and chances) of final energy price development remains with the ESCo's client.

- **Service** (or basic) **price** for **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 (typically every year retrospectively) by using statistical indices such as wage or investment good indices.
  Service price for **Energy Efficiency** (flat rate[10]): 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.
  Service price Energy Efficiency (flat rate[11]): In analogy to the above service price all operation cost of the energy efficiency measures. As is shown in figure 4, the two basic prices can be combined.

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[6] The price structure of the ESC model is comparable to that of standard district heating.

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

[8] Alternatively, fuel can also be purchased by the client in case of better purchasing conditions and cleared with the energy price.

[9] 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.

[10] Possibly supplemented with a bonus-malus settlement

[11] Possibly supplemented with a bonus-malus settlement

- **Capital cost** of energy efficiency and supply investments may or may not be part of the service package. If (co-) financed by the ESCo, the ESCo will get a remuneration for its capital cost minus subsidies and building cost allowances.
  During the contractual period, the prices may 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.

Quality Assurance Substitutes Energy Savings Measurement

To avoid or least to reduce the (potential) EPC problems described in chapter "The Baseline- and other EPC Problems", the (pseudo-) exact measurement and verification of the actual savings achieved is replaced by quality assurance and simplified measurement and verification procedures (e.g. deemed savings).

The individual quality assurance instruments (QAIs) for the EE-measures installed shall secure their functionality and performance, but not their exact quantitative outcome over the entire project cycle. One reason being, that the outcome may largely depend on factors external to the ESCo's influence (such as changes in ambient climate conditions or utilization of the facility). The objective is to simplify the business model and to reduce (transaction) cost by balancing measurement and verification cost and accuracy.

The concept is displayed in the following figure (on the basis of the business model displayed in figure 4).

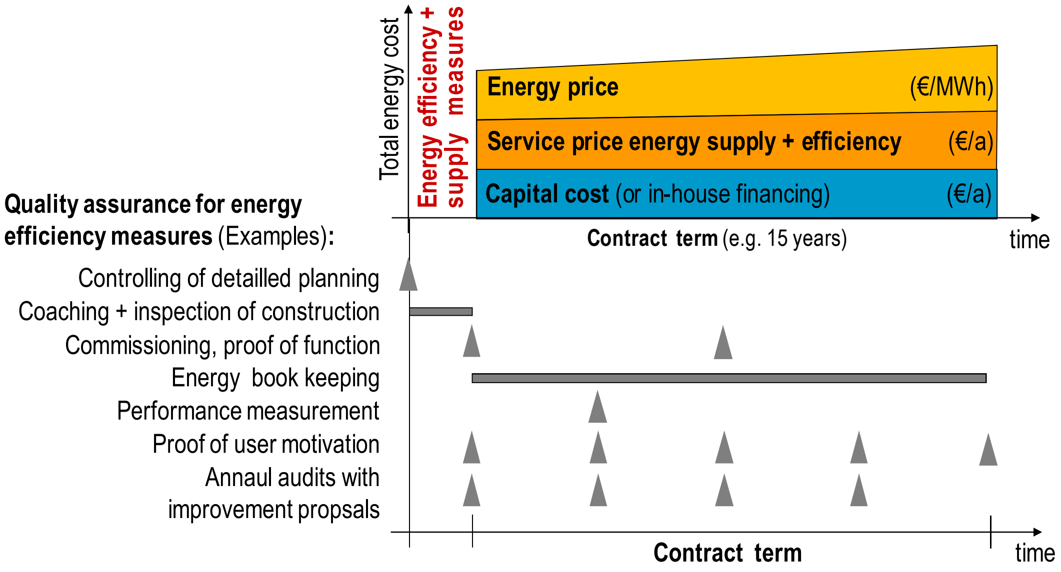

Figure 5: IEC business model: Sample quality assurance instruments as substitute for savings measurements

Appropriate QAI's will need to be defined specifically for each EE- measure implemented. Two examples: A one-time performance measurement for a new street lighting or one-time thermographic analyses for verifying the quality of the refurbished building shell replace the annual measurement and verification of the savings guarantee.

QAI's can be specified either by the client or suggested by the ESCo as part of the competition of solutions during the procurement process or the detailed project design. The selection of QAI's as well as their exact design will depend on the specific requirements of the project scope and the parties involved.

As mentioned earlier, an important point of discussion is to find a reasonable ratio between quality assurance and verification efforts, on the one hand, and expenditure for M&V on the other hand. This certainly requires experience and fine tuning and cannot be defined generically. Nevertheless, the guiding principle should run as follows: "As little effort as possible and as much as necessary in order to secure the general project savings goals."

Maybe a less technical approach of verification and thus a waiver of (pseudo-)exact, indirect saving measurements (often driven by technically oriented stakeholders), would serve the purpose of establishing EE as a resource well?[12] When EE-measures are implemented in-house (without outsourcing to an ESCo), facility owners tend to happily accept much less verification of the outcome of the measure.

On the other hand, it needs to be discussed as to whether the saving incentives and control through QAI's 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 satisfactorily.

Beyond the application of QAI's for the IEC model, 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 optimization mandates to integrate the operating phase into the procurement process. For example mandatory commitment to quality assurance as early as in the purchase contract should lead to an increased awareness for quality assurance activities in the construction and later on in the operation phase.

Quality assurance can be performed both by the client and by the ESCo as outlined in the next subchapters. An important issue is the discussion of individual and practicable quality assurance instruments (QAI) in the next subchapters. [13]

Integrated Energy-Contracting in Practice

The Landesimmobiliengesellschaft Steiermark (LIG) (State of Styria owned real estate company) administers and manages more than 420 buildings in Styria, about 200 buildings with an overall area of more than 600,000 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. In 2010, LIG's IEC activities have been recognized with the Energy Globe Styria Award 2009.

Experience from up to now eight projects has proven the feasibility of the IEC model. In addition to competitive prices for the useful energy supplied, 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 of solar, geothermal and biomass energy sources.[14]

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. In particular renewable and energy efficiency advocates need to join forces.

Also for Integrated Energy-Contracting (IEC), the decision of the building or business owner to want tap into energy efficiency and renewable resources 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 many energy end-use sectors such as public buildings, residential, commerce and industry. 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, high measurement and verification efforts or risk surcharges on the saving guarantee, are avoided or at least reduced.

We particularly recommend applying the simpler and more robust ESC model, wherever energy flows can be measured with acceptable effort. (e.g. electricity or heat supplied from CHP- or renewable energy systems but also

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[12] E.g. Defining a building standard and verifying it (such as Class B according to EPBD) may be sufficient to a building owner?

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

[14] More details on IEC good practice examples can be accessed through [IEA DSM 2009]

MWh saved through EE-technologies like heat recovery installations). Savings achieved can still be calculated by comparing to a previous final energy baseline, if needed.

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 its 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.

Experiences collected in up to now in eight projects have confirmed the practical feasibility of the IEC model. The résumé of the building owner "Landesimmobiliengesellschaft Steiermark (LIG)" (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). In 2010, LIG was awarded with the Energy Globe Styria 2009 for their IEC projects.

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 future, 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 and deemed savings should be investigated in more detail.

High priority should be placed on the development of new projects in the end-use sectors of public institutions, tertiary sector, commerce and industry as well as housing in order to facilitate sustainable cost reductions and climate protection policies. 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.

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 higher market diffusion in combination with (renewable) energy supply? And maybe a less technical approach to exactly verify savings and thus a waiver of (pseudo-)exact, indirect saving measurements, would serve the purpose of establishing EE as a resource well?

However, also with IEC experience shows: The development of comprehensive energy (efficiency + renewables) projects requires committed facilitators and a long breath to convince all stakeholders involved. No ESCo or ESCo model will be able to solve all obstacles in the way of energy efficiency. Independent of the choice of implementation model, the voluntary or regulation driven decision of the building or business owner to want to invest in energy efficiency remains a basic requirement.

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