CONSERVATION FIRST! A NEW ESCO MODEL TO COMBINE ENERGY EFFICENCY AND RENEWABLE SUPPLY

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1. Introduction

"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." [Bleyl 2009]

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. 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. Increased use of Renewables in power generation and of bio-fuels in transport account for only 12%." [IEA 2006].

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. But the realistic potentials, the limits and added values of ESCo products are not well enough understood yet. And there is an urgent need to join forces between energy efficiency and renewable energy advocates.

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 renwable and energy conservation 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 for the supply and energy efficiency measures and
3. To increase understanding of Energy Contracting as a tool to implement renwable and 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 model 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.

2. (Methodological) **Limitations of Standard ESCo Products and their Markets**

2.1 Energy Supply Contracting is Dominating the 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. 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 2.3 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 is 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 in the power station, sizable consequences on the saving potentials achievable through current Energy Contracting models can be derived, as shown in the next chapter.

2.2 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 Fig 1). 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 3) 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 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].

Fig 1illustrates the typical scope of services of the above mentioned Energy-Contracting models and the IEC model.

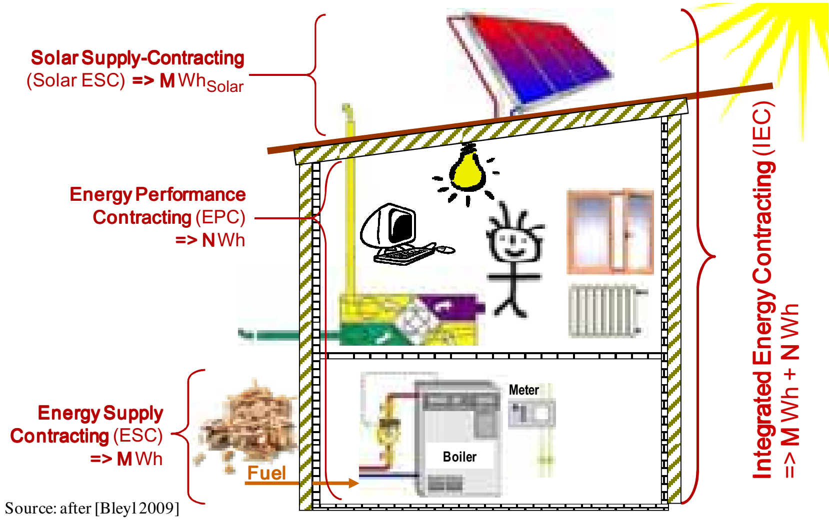

Fig 1 Scope of services of different ESCo models

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, 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.

2.3 Conclusions for the Further Development of ESCo Models

For the development of future ESCo products, the results of the previous subchapters are summarized in the following table:

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. 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.

	ESC	EPC
End-use markets	Residential, Industry, Commerce, Public …	only Public Buildings, Hospitals, Leisure
Efficiency potentials	**15 – 20 %** (limited scope of service)	**20 – 25 %** (30 – 50 %)
Project Size: Minimum energy cost baseline	**~ 20,000** €/a	**> 100,000** €/a (ESP Berlin: 1,88 Mio €/a)
Share in ESCo market (in Germany 2008)	**~ 90 %**	**~ 10 %**
Business model	**M Wh**	**Savings** („**N** Wh“) **=> Baseline problems => high transaction cost**

Table 1. ESC vs EPC: Market properties

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.

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.

3. The Integrated Energy-Contracting Model

3.1 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. 2.3 and Fig. 1). 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.[1] The necessary components for implementing energy (efficiency) projects are summarized in Fig. 2 in an integrated energy service package with result guarantees given to the client.

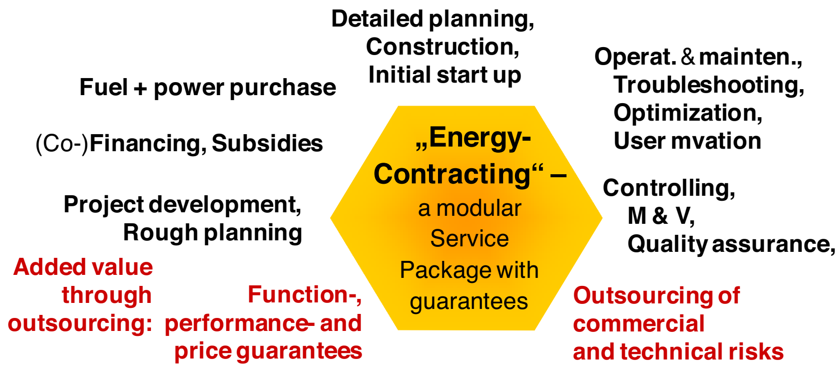

Fig. 2 Energy Contracting: a modular energy service package with guaranteed results for the client

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 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).

All the tasks shown in Fig. 2, 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.

3.2 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 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.

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 3.3).

The ESCo’s remuneration is made up of the following three 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 only (in economic terms: the marginal cost), i.e. exclusively the expenditure for fuel and auxiliary electricity.

[1] 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

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).

- 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): In analogy to the above service price all operation cost of the energy efficiency measures. As is shown in Fig. 3, the two basic prices can be combined.
- (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.

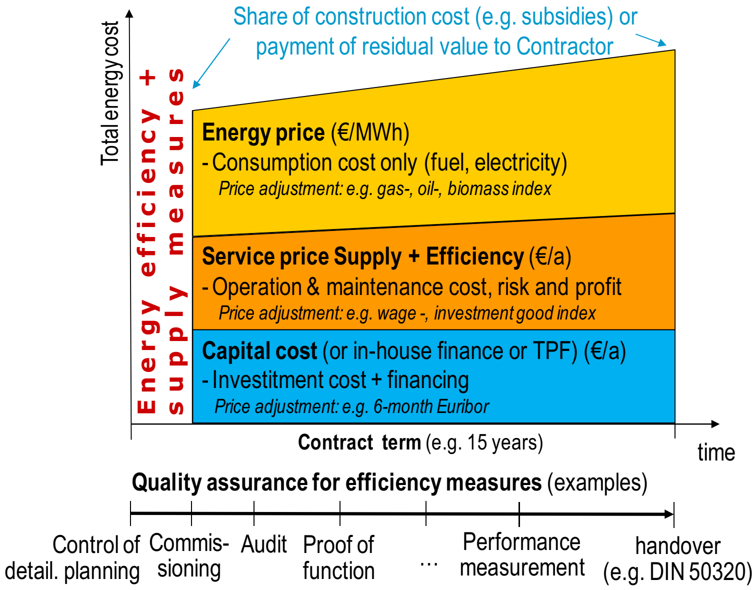

Fig. 3 Integrated Energy Contracting Business Model with Quality Assurance

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

3.3 Quality Assurance Substitutes Energy Savings Guarantee

Due to the potential EPC problems mentioned in chapter 2, 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 Fig. 4).

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.

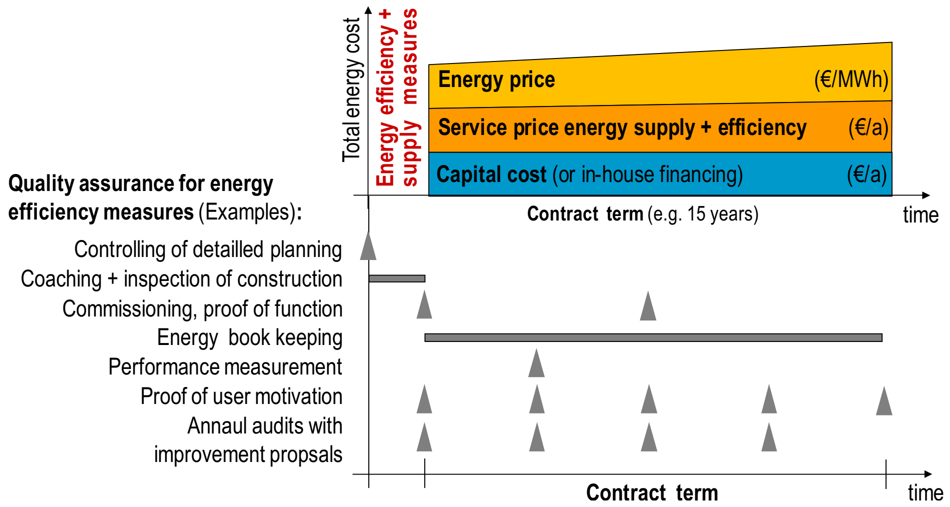

Fig. 4 IEC business model: Quality assurance instruments as substitute for the EPC savings guarantee

Basically, quality assurance can be provided both by the client and by the ESCo. 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.

3.3 Good Practice Examples

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 m^2 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.

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 of solar, geothermal and biomass energy sources.[2]

4 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 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 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 + renwables) projects requires committed facilitators and a long breath to convince all stakeholders involved.

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.

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?

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 renewable energy supply?

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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[2] More details on good practice examples will be presented at the EUROSUN conference

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