1. Energy-Performance-Contracting light

Main model feature: EPC light is a zero-investment business approach: Energy saving measures with zero-investment costs are implemented by the ESCO which include energy saving guarantee within an contract duration of two to three years. The ESCO recommends further low or high investment measures to be paid by the building owner. It is up to the client to decide if measures are to be implemented. If so, a share of the achieved savings of these measures can be attributed to the ESCO's savings guarantee. All technical devices still belong to the building owner.

Main Energy Saving Measures: The most applied measures are the operational optimisation of lighting systems, heating systems, ventilation systems, and use of the warm water generation. Training sessions of the technical staff are included, and optionally user motivation trainings can be provided. Mostly, the ESCO is responsible for the maintenance of the technical equipment.

Financing: The ESCO only has to calculate staff costs for the periodic inspection of the buildings including the technical devices. It gets bi-monthly or quarterly payments from public entity and the remaining payment after the final invoice of the achieved energy savings.

Measurement and Verification: Energy savings are calculated based on energy invoices and a defined baseline of energy costs or - if not yet available - meter readings. An annual climate correction is taken into account, if necessary, correction for changes of use or high level savings by measures implemented by the building owner are applied.

Risks and de-risking strategies: The ESCO bears several risks concerning the energy cost baseline, the energy saving guarantee, and operating errors. Additionally, the adjustments regarding user behaviour and other energy saving measures made by the building owner can be risky as well as the controlling of the energy savings. De-risking strategies in these context are a sound saving calculation by the ESCO and experiences with the operation and optimisation of technical equipment. Also the involvement of experienced project facilitators in the preparatory phase of the project is important as well as in the tendering procedure and evaluation of the savings. Furthermore clear contract rules are necessary to avoid conflicts regarding adjustment mechanisms.

The bankruptcy of the ESCO is a possible risk for the public entity, but because all technical devices belong to the building owner and there aren´t payments to a financial institution, this risk is very low. If savings are underachieved and the paid instalments are higher than the savings, it could be risky for the public entity as to whether

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the ESCO will pay back the difference between real achieved savings and paid instalments. To avoid these risks the public entity has to involve an in-depth due-diligence process within tender evaluation process.

Main Advantages:

- Saving Guarantee and risk transfer to the ESCO
- Detailed controlling of the annual energy consumption of every building
- The real savings are measured and documented.
- No investment for technical measures
- Profound proposals regarding low or high investment measures in the buildings
- Cooperation between public entity and experienced ESCO
- Entry for new ESCOs and PPP-unexperienced municipalities
- Short contract duration

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2. Energy-Performance-Contracting basic

Main model feature: In common EPC basic-projects the ESCO is accountable for the complete services: planning and installation of the technical measures, financing of the technical equipment, maintenance and energy management during the contract period. They guarantee the refunding of the complete costs through energy and maintenance costs savings during a fixed period. The public entity pays the cost savings that were really achieved to the ESCO.

Fixed prices (payment) during the contract period (6-15 y.) related to the fulfilment of basic project requirements defined in procurement requirements mostly targeting maintenance measures. Sometimes the public entity gets a defined share of the savings, therefore the municipality has to pay the ESCO only the remaining share. Bonus- malus payments are also included, if guaranteed energy and maintenance savings are over – or underachieved during the contract period. The technical equipment property is transferred from the ESCO to the municipality after the acceptance of the installation works by the municipality.

Main Energy Saving Measures:

Depending on the detailed situation in the building and the economical calculation of the savings and costs, the following measures are possible in principle:

- Lighting, air conditioning, ventilation, pumps, control
- Heating (heat pumps, biomass boiler, CHP, fossil fuel boiler), heating distribution, heat recovery systems, cooling systems, warm water generation, technical equipment for swimming pools, control
- Showers, flush
- Thermal collector, solar cell, biomass boiler

Sometimes, few measures regarding fire protection, heritage protection, pollutant disposal and authorizations are included.

Financing: Financing by the ESCO is applied as common financing model in EPC basic models. Very often the ESCO cooperates with a financial institution. The costs of the ESCO will be refunded by the energy cost savings and the maintenance cost savings. The public entity pays a monthly or quarterly instalment to the ESCO up to nearly 80 % of the saving guarantee, the remaining amount is paid after the annual saving invoice.

Furthermore, there are few more options regarding financing of EPC basic projects:

- An additional allowance by the public entity reduces the investment and financing costs of the ESCO. If a lot of

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construction measures are included in the project or the energy cost are very low and the refurbishment demand is high, the municipality has to finance a larger allowance.

- Sometimes, the funding of the projects is supported by Energy-Efficiency-Founds to improve the access to available capital.
- In few cases public entities finance all planning and investment costs by their own communal budget or by interest subsidy loans for public entities. In this case, the municipalities pay back the annuity to the financial institution themselves.
- Sometimes the municipality already receives a share of the savings during the contract period, therefore ESCOs can refund their costs only by the remaining amount of savings.
- The financing conditions can be improved by the application of forfaiting. Thus the ESCO receive a better interest rate and the municipality confirms that annuities will be paid to the financial institution in every case.

Measurement and Verification: Energy savings validated with an energy price fixed during the contract period related to the measured and verified energy savings during the contract period. Energy savings are deducted by the energy and water bills or meter readings. Sometimes fixed savings are defined e.g. regarding saving through new lighting systems or pumps to avoid huge adjustments within the operation period.

Because the ESCO has guaranteed the savings, it cares for the periodic controlling of the energy and water consumption, often supported by a remote access to fieldbuses and by a building automation system. All energy consumption related data are collected and documented in the annual energy report and, together with adjustments, in the annual invoice of savings. Additionally, the ESCO has to care for the quality assurance and maintenance of all installed technical devices.

Risks and de-risking strategies: Because of the greater extent of EPC basic measures and investments, the risks are higher comparable to the EPC light model. Risks exist related to the ESCO and related to the public entity. But, in every case, EPC basic includes a shifting of risks from the municipality to the ESCO. De-risking elements for both, the ESCO and the public entity, are integrated in the EPC basic business model.

Risks for ESCOs:

ESCOs are commercial stakeholders and they have to bear entrepreneurial risks. We describe now the main important risks and the most common de-risking strategies in current EPC basic-projects.

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a) Economic risks:

- The level of annual energy savings. If the real savings underachieve the guarantee very often and/or on a high level, then the ESCO can´t refund the complete costs by the savings.
- The right baseline: If the baseline is wrong, the energy saving calculation is also incorrect.
- Planning errors lead to massive impairments of users or of the building.
- The level of investment is higher than calculated.
- A lot of energy-related measures of the principal within the contract period. /The closure of buildings within the contract period.

These risks can be reduced by the integration of an experienced facilitator during the project preparation (baseline check, plausibility check of saving guarantee and calculated costs, planning check..), detailed planning and calculation of savings and investments possibly in cooperation with a professional engineer and a detailed measurement & verification system including data of applied technical devices, error protocols etc.

Additionally, clear contract rules concerning baseline adaptation, climate and user related adjustments, closure of buildings and energy related measures of the public entity are necessary to minimize the risks for the ESCO.

b) Technical risks:

- Failure of the technical equipment or assembly mistakes
- Operation risks, e.g. the technical staff of the principal adjust the technical set-points

Again, clear contract rules regarding the responsibilities of the contract partners are very important. The ESCO should have experiences with the used technical equipment considering the instructions from the manufacturers, and deploy qualified personnel or cooperate with professional partners.

c) Administrative risks:

- Delayed application for feed-in-tariff, subsidies or others by the municipality
- Delayed acceptance of installation work

All named risks can be reduced by clear contract rules, especially the responsibilities should be exactly regulated.

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Risks for public entities:

Because the most important risks are shifted to the ESCO, the remaining risks for public entities are very manageable:

- If the level of annual savings underachieve the share of annuity for the financial institution, then the public entity can´t cover the instalment to the financial institution only through the savings. Thus the municipality has to pay the difference from the communal budget.
- The bankruptcy of the ESCO.

Public entities can require an agreement fulfilment guarantee from the ESCO covered by an agreement between ESCO and a financing institution for the implementation of the measures during the implementation period and thereafter. The municipality has the technical equipment property after the implementation period, therefore the devices are operated by the technical staff of the municipality. This will also produce savings, but definitely less than by the ESCO.

Main Advantages:

- Detailed controlling of the annual energy consumption of every building
- The real savings are measured and documented
- End energy savings of 20 to 50% (depending on the bundles of measures) and therefore less energy and water demand (heating, electricity)
- Higher market value of the building
- A lot of measures are carried out in a relatively short time
- Additional supplements to the calculated investment costs aren´t possible
- The investment costs for the technical equipment are less in comparison to procurement without ESCO.
- Improved operational comfort (new control systems)
- The technical staff get trainings and a better qualification
- Comprehensive measurement bundles including also non energy-related measures which are necessary

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3. Energy Performance Contracting plus

Main model feature: EPC plus projects base on the EPC basic model (2.), the same mechanisms are used: the energy saving guarantee and the refunding of the complete costs through energy and maintenance costs savings during a fixed period; fixed prices (payment) during the contract period related to the fulfilment of basic project requirements; bonus-malus-payments regarding over – or underachieved saving guarantee and the property transfer from the ESCO to the municipality.

But the extent of measures is much broader: Besides the installation of technical equipment the ESCO is also accountable for the planning, installation and financing of the thermal insulation on the building envelop and of construction measures. Because of far higher investment costs and longer payback periods, this model is more sophisticated, particularly regarding financing.

Main Energy Saving Measures:

Depending on the detailed situation in the building and the economical calculation of the savings and costs, the following measures are possible in principle:

- Facade insulation; plinth insulation; basement ceiling insulation; roof ceiling insulation and replacement; replacement of windows, stairways, door replacement
- Construction measures one walls, ceilings, floors, swimming pools
- Lighting, air conditioning, ventilation, pumps, control
- Heating (heat pumps, biomass boiler, CHP, fossil fuel boiler), heating distribution, heat recovery systems, cooling systems, warm water generation, technical equipment for swimming pools, control
- Showers, flush
- Thermal collector, solar cell, biomass boiler

Financing: Financing by the ESCO (in cooperation with a financing institution) or financing by the ESCO in combination with capital of Energy Efficiency Funds are the most applied financing models in existing EPC plus projects. The first model is based on comparable approach as EPC basic financing, but the contract duration ranges between 20-25 years.

Besides these described options there are other approaches:

- Sometimes the public authority gives an additional allowance reducing the higher investment costs. This allowance can be paid once after the implementation of the measures, or as instalment payments during the contract period.
- Also public subsidies can be involved in the project to decrease the investment costs.

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- Additionally a combination of further financing instruments is applied, e.g. internal financing, loans of financial institutions and funds capital.

Measurement and Verification: Construction and insulation measures have not to be optimised during the contract period. Therefore all energy savings (building and technical measures) are deducted by energy and water bills or meter readings validated with a fixed energy price.

Also in EPC plus models the ESCO is responsible for periodic controlling of energy consumption, the periodic adjustment of technical parameters, annual energy reports and annual invoice of savings.

Risks and de-risking strategies:

Besides the risks described for EPC basic model there are few additional risks for EPC plus models:

Risks for ESCOs:

a) Economic risks:

- The ESCOs have a technical background and often no experience with the calculation of thermal insulation measures. They have to cooperate with external architects, engineers or other companies and balance all complete savings.
- The calculation of savings through insulation measures depends on many user-related facts and should be carried out very profoundly.
- Because the contract duration is much longer comparable to EPC basic, there are also more risks regarding the failure of the technical equipment and higher costs for the replacement of technical components.
- Because of the long contract times also the fixed interest period for the loan is limited and ESCOs have to calculate with a possibly higher interest rate.

All these risks belong to the entrepreneurial risks and can be minimized by a cooperation with very experienced planners, by the deployment of proven calculation software and established products.

b) Technical and administrative risks:

- Also the emphases of the HVAC change, less heating and cooling loads are necessary, ventilation systems are becoming more

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important. Bad planning on base of few experience has to be avoided.

- Architectural quality is becoming more important in context to measures on the building envelope. Therefore heritage protection restrictions, higher costs and a higher need for coordination has to be taken into account.

Also here, experienced personnel for the planning should be deployed and all eligible questions regarding measures on the building envelope should be harmonized before the dateline of the tendering procedure.

Main Advantages (in addition to EPC basic):

- Less thermal and cooling loads in the buildings
- Improved indoor climate quality (e.g. by new sun blinds)
- Better indoor space quality and therefore less illnesses of the users
- Increased architectural quality by a modern façade
- Wall insulation and highly efficient windows will reduce cold or hot indoor surfaces which allow putting good quality working places much closer to the wall than before the retrofit
- Better reputation of the building by environmental friendly construction
- Less interfaces

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