National Energy Services Framework

Energy Performance Related Payments (EPRP)

Guide

July 2014

Contents

1. Introduction

1.1 Background

As part of the National Energy Services Framework, this *Energy Performance Related Payments Guide* has been developed by the Department of Communications, Energy and Natural Resources (DCENR) and the Sustainable Energy Authority of Ireland (SEAI) in order to give practical assistance for the development of Energy Performance Related Payments (EPRPs). Further information on the government policy framework, and other energy service contract types (Energy Performance Contracts and Local Energy Supply Contracts) is available on the SEAI website (www.seai.ie).

This is a practical guide to organisations wishing to incorporate EPRPs into their product, works or service contracts. It begins by explaining in detail what an EPRP is and the benefits associated with its use; it then discusses how to structure an EPRP; this is followed by guidance on different types of EPRPs. Measurement and Verification is explained and then practical advice provided on implementing EPRPs and associated considerations. It provides a standard, structured approach to developing a project that incorporates energy performance related payments and is full of practical examples. Its target audience is client organisations in the public and private sector wishing to implement EPRPs in their facilities[1].

The **process** you follow when implementing an EPRP for a **works contract** is the same as for EPC, i.e. you identify a project, evaluate the business case (i.e. costs and benefits), then look at whether the traditional supply and build contact, EPRP, or EPC is most appropriate for the particular project and client. This guide is complimentary to that process, which is outlined at http://www.seai.ie/Your_Business/Energy-Contracting/Project-Development-Process-Overview/Project-development-process-overview.html The first two stages of the project development process should be completed prior to structuring an EPRP for a works project. This guide can then be used to complete the project development stages, stages 3 to 5.

In the case of EPRPs for products or services, the process you follow is simpler, more intuitive. The client knows what needs to be implemented and develops an EPRP arrangement to ensure the energy savings from the project are realised; this guide will help develop the EPRP. For larger purchases of products or services i.e. a large facilities maintenance contract, then the preparation stages of project scoping and business case assessment of the project development process should be completed before structuring the EPRP.

This guide assumes for the most part the business case for the project, stage 2 of the project development process, is complete.

SEAI support is available to help you fund the development of an EPRP for your project, be it procuring works, products or services. Review the SEAI website to establish the latest guidance on available supports at http://www.seai.ie/Your_Business/National_Energy_Services_Framework/Technical-Assistance/.

One should also consider working with an Obligated Energy Supplier and get their support in implementing an EPRP; more information on OES is available on the SEAI website.

Finally public sector organisations are advised that all products should be selected from the triple E[2] product register, or satisfy the SEAI published energy efficiency criteria. Where private sector organisations use products from the Triple E register, these qualify for tax relief in the form of Accelerated Capital Allowances.

1.2 What is an Energy Performance-Related Payment?

Everybody is familiar with manufacturers' warranties, which typically state that a product will be free from defects in design and workmanship, and that if a product fails within its first year the purchaser is entitled to a replacement at no cost. Similarly, if one engages a contractor to undertake works, the contact specifies a defects period and requirements for the resolution of defects. The works contract generally involves the client withholding the final payment - a portion of the overall contract value - pending the resolution of all defects; this is generally referred to as 'retention'.

[1] The term 'facility' is used generally here; it may be a building, a site with several buildings, a water treatment or pumping facility, or even a public lighting installation. The process described herein is the same for all.

[2] Triple E sets minimum criteria that products are required to meet to be listed. For products, these criteria are regularly updated, and aim to ensure that only the top 10 - 15% most energy efficient products in any technology are listed.

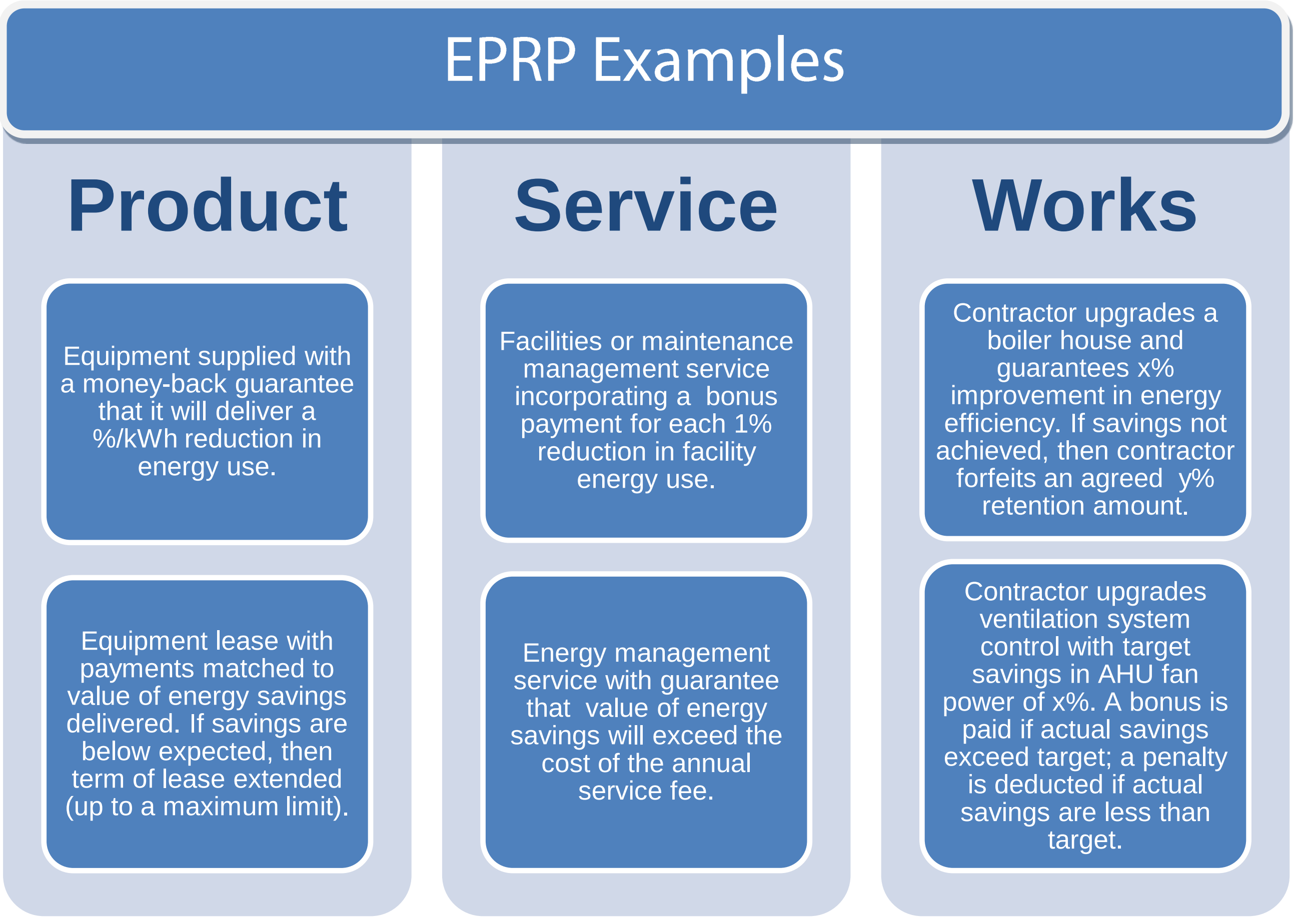
An EPRP is simply an additional guarantee that not only will the product or works actually fulfil the function for which it was intended, but it will do so in a way that will improve energy performance. It ensures not only the agreed functionality, but also a pre-specified and measurable improvement in energy efficiency will be achieved. A portion of the overall payment for the product, service or works is contingent on **demonstrated** performance.

What is an ESCO?
An Energy Services Company delivers energy services and/or other energy efficiency improvement measures in a user's facility, and accepts some degree of financial risk in so doing.
Source: EU Energy Services Directive

An EPRP may be provided for a product, a service or a project (works); Fig. 1.1. provides some examples of how an EPRP might be applied, although there are many other options.

In this guide we may refer to the supplier, vendor or contractor as an Energy Services Company, or ESCO. We refer to clients or customers as Hosts.

Figure 1.1: Examples of EPRP



1.3 What are the benefits of using EPRPs?

EPRPs are a useful marketing tool: EPRPs provide Hosts with reassurance that projected **energy savings will be achieved**, thus encouraging them to make the purchase. This builds trust between the ESCO and the Host and gives the Host confidence; in turn, this helps get sales “over the line”, and stimulates the market for energy efficient products and services.

EPRPs motivate the supplier or contractor to improve efficiency: Provided the EPRP is financially significant to the vendor, they will be motivated to ensure guaranteed savings are achieved. Furthermore, if there is a gain-share element to the EPRP, they will be motivated to put effort into maximising the savings, often by tuning the installation post-commissioning.

EPRPs align the vendor’s objectives with the client’s: Instead of working to finish the job and receive final payment, an EPRP means the vendor looks beyond this to the energy performance of the product, service or installation: this is often the primary reason the client chose to undertake the work in the first place.

EPRPs reduce client technical performance risk: By providing the client with a guarantee, the vendor has a stake in the energy performance of whatever is provided; and because they are expert in this area, they will know how to deliver on the guarantee. So this reduces the performance risk to the client (i.e. the risk that the actual savings will be less than the projected savings).

EPRPs make it easier to get funding to invest in energy efficiency and renewable energy: Regardless of whether the funding is internal or external, an EPRP demonstrates that consideration has been given to measuring the savings and managing the performance risk.

Although the ESCO does not generally finance the works for EPRP projects, through the reduction in client risk relating to an investment performing and improving efficiency, the client will be more comfortable borrowing money to make an energy efficiency investment. Furthermore, a financier will derive a certain comfort that the vendor, as an expert, is responsible somehow for the energy savings; this helps to reassure the financier that the savings will emerge and can be used to repay the loan. While in general it is expected that most EPRP projects will not be ESCO- or third party-financed, this is possible (discussed below). SEAI envisage that most EPRPs will be funded by the host from own funds or a 3rd party, rather than by the ESCO.

EPRPs deliver energy performance: For all the foregoing reasons, EPRPs facilitate investments in energy efficiency, ensure energy efficiency is delivered, and expand the market for energy efficiency products, services and works.

SEAI Vision

All purchases where practicable, be it for products, services or works, will have an appropriate form of EPRP arrangement, and that these EPRPs will deliver proven energy savings, and build trust between buyers and suppliers.

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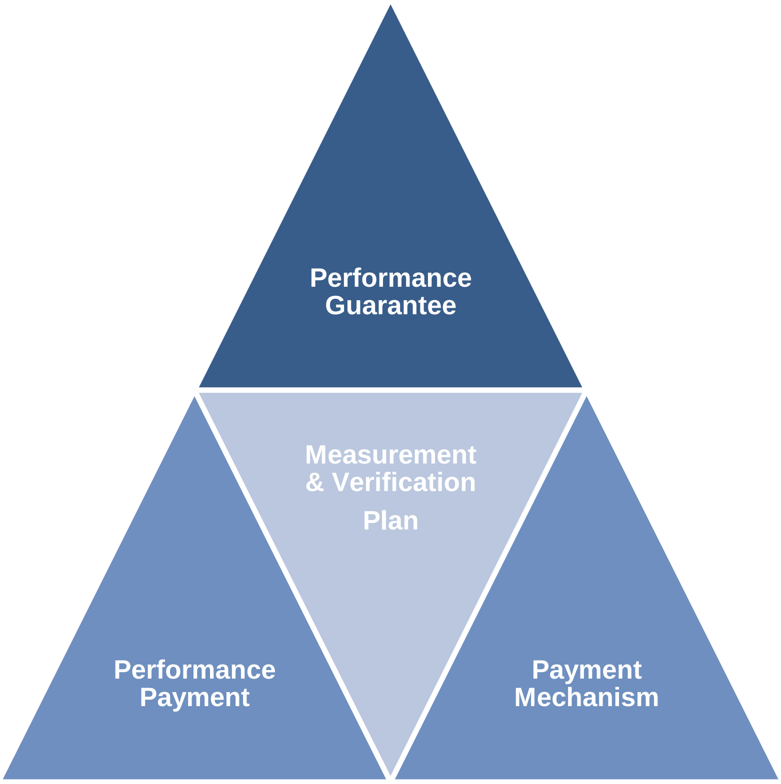
2. Structuring an EPRP

2.1 Essential Components of EPRP agreements

An EPRP doesn't involve a special contract, rather it involves incorporating energy performance-related clauses into whatever contract or agreement you would have used in any case. The agreement should contain the four key components, as illustrated in Figure 2.1.

Figure 2.1: Four key components of EPRP agreement
[Note to designer – include graphics instead of the bullet points to explain each of the 4 components below]



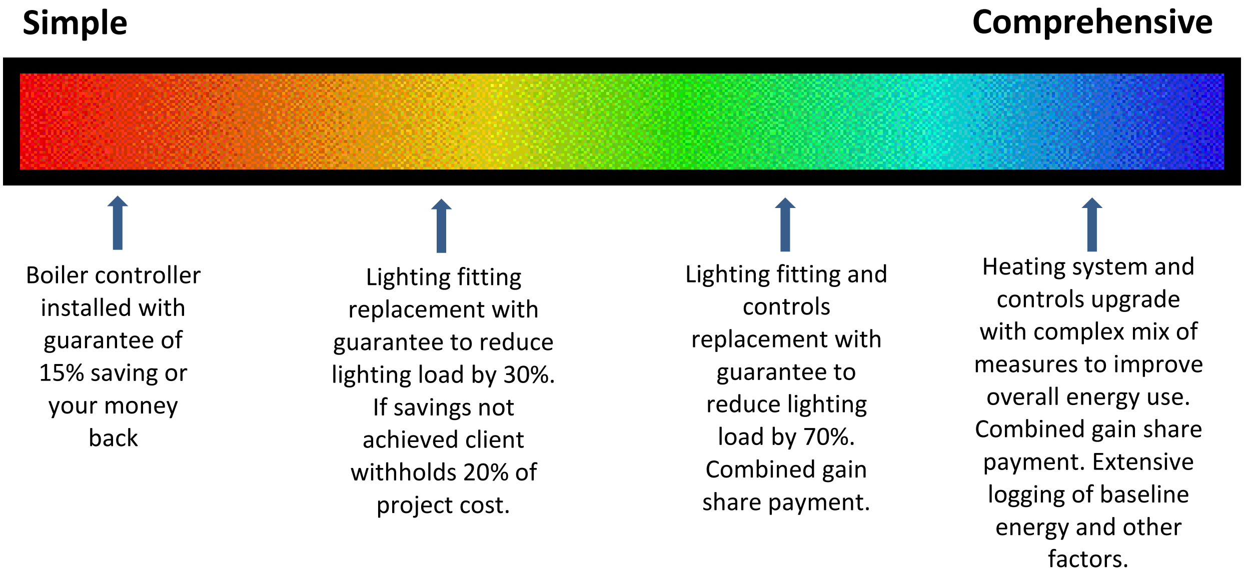
- **Performance guarantee** – This is the 'Energy Performance' in EPRP, and is a definition of what is being guaranteed. This may be a % improvement in energy efficiency, a kilowatt-hour reduction in energy use, etc. This should be specific and measurable.
- **Performance payment** - This is the 'Payment' in EPRP and identifies the impact to the vendor if the performance guarantee is/isn't achieved. For example, the contractor may lose a percentage of their original price if guaranteed performance is not achieved and/or there may be a bonus to the vendor if the guarantee is exceeded.
- **Payment mechanism** – This identifies how and when the client will make the performance payment in practical terms. For instance, in a works contract the client may withhold final payment; in a service contract the penalty may be deducted from the next service payment.
- **Measurement & Verification (M&V) Plan** – This is a plan to measure performance which will identify how it will be established whether or not the guarantee was achieved. This generally includes baseline energy data, and related considerations. It forms part of the contract. At the end of the guarantee period (or periodically for an extended guarantee) a measurement and verification report must be prepared which documents savings based on the method outlined in the measurement and verification plan.

2.2 The Spectrum of EPRPs

An EPRP is a mechanism that aligns the supplier's energy efficiency objectives with the client's by transferring some of the performance risk to the supplier. EPRPs can range from the very simple, to very comprehensive, as the examples in Section 3 illustrate. So there is a range, or spectrum, of options and care should be taken to ensure that more complexity is only added where it makes sense to do so, and particularly that the level of effort is proportionate to the value of the savings being achieved.

In the case of simpler projects, such as light fitting replacements, the project is straightforward, the risk that identified savings won't materialise is low, savings may be measured and verified using before and after measurements; as a result the EPRP can be straightforward, e.g. a simple savings target can be set and if the saving isn't achieved, a specific level of project retention is withheld. Also, the risk should be borne by the product supplier and designer, who control the factors affecting efficiency, rather than the installation contractor.

However, if lighting controls (e.g. occupancy switching and daylight dimming) are added to the fitting replacement, the project savings are harder to measure;, the calculation of savings depends on a variety of factors from the fittings supplied, to lighting design, to the tuning of the controls by the installer. In this case a gain-share performance payment (described below in section 3) is likely to be more appropriate, the measurement and verification requires logging over a period of time and so retention of final payment pending the verification of savings is required.The risk should be borne by all parties, who each influence the efficiency of the project. So this is an example of a more comprehensive project with a more complex EPRP.



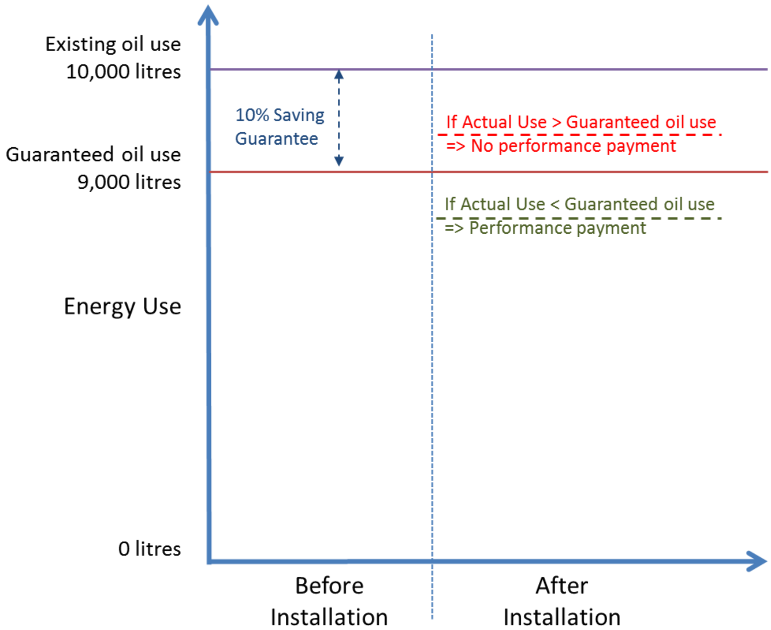
3. Performance Guarantee & Payment Options Examples

To illustrate the above concepts a number of examples are discussed below. They focus in particular on the Performance Guarantee and the Performance Payment, which are closely linked (directly or indirectly); a more detailed explanation of Measurement and Verification is discussed in Section 4. Three types of performance guarantees and performance payment options are discussed, with starting with a simple minimum performance guarantee, and ending with a combined gain share arrangement, both of which are mentioned in the spectrum above.

3.1 Minimum Performance Guarantee

Consider the example of an oil boiler using 10,000 litres of oil per annum, illustrated in the chart below. A vendor of a boiler controller guarantees that their product will reduce existing oil use by at least 10%, i.e. to 9,000 litres. If actual use after installation is greater than the guaranteed oil use (e.g. 9,300 litres), then the vendor will remove the product and the host will get their money back. If actual use after installation is lower than the guaranteed oil use (e.g. 8,700 litres), then the host will pay the vendor in full. The host agrees to pay 50% now and 50% on demonstrated performance. They agree to set up the product to operate week on- week off and monitor weekly oil use over 10 weeks.

Figure 3.1: EPRP with minimum performance guarantee



The Payment Mechanism must also be specified. In the above example full payment is withheld pending the verification of savings: this is possible because the product does not have a significant installation cost, the product can be removed and re-used, and the time to measure and verify savings can be reasonably short (minimum cash flow implications). It is also appropriate because the only benefit of installing the controller is to achieve an energy saving.

<table>
<tr><td rowspan="5">[Graphic designer to insert a mini graphic of above pyramid here and relate them to each line on right]</td><td colspan="2">EPRP Example Summary</td></tr>
<tr><td>Performance Guarantee</td><td>Minimum performance - 10% reduction in oil use</td></tr>
<tr><td>Performance Payment</td><td>Money back if performance not demonstrated</td></tr>
<tr><td>Payment Method</td><td>50% payment now, 50% on demonstrated performance / money back</td></tr>
<tr><td>Measurement & Verification</td><td>Week on, week off for 10 weeks. Simple comparison.</td></tr>
</table>

For more complex installations, or installations where the customer gets other benefits, then a partial Payment Mechanism might be appropriate. For example, a vendor guarantees a new lighting installation will deliver a 50% energy saving, and agrees that 15% of final contract amount is withheld pending verification of savings. If the savings are less than the guarantee of 50%, then the customer does not have to pay the final 15%.

The size of the Performance Payment should be considered carefully: if it is too high it is likely to reduce competition to only those bidders who are comfortable that they can achieve the guaranteed level and have the financial strength to absorb loss of payment; if it is too low, it may not be sufficiently motivational to the winning ESCO to ensure guaranteed savings are achieved.

The timing of payment is also part of the payment mechanism. For a simple guarantee and M&V based on simple before and after measurements, the performance payment could be made as soon as the saving is measured and verified. Where M&V takes more time, involving logging and adjustments, then perhaps the performance payment could be structured to be paid in stages.

A **public sector** client must be careful to avoid setting a minimum Performance Payment level that is so high as to drive out all bidders except, perhaps, an incumbent who is familiar with the facility. In such cases a gain share arrangement, discussed below, may be more appropriate.

3.2 Gain share arrangement

A slightly more complicated arrangement than a minimum Performance Guarantee is to adopt a gain share, or sliding scale, arrangement.

Consider, for example, a facilities management contract including the provision of cleaning, security and general maintenance services. Clearly there is an opportunity for the service provider to influence energy use in the facility as part of the overall delivery of services – typically one would expect 5-15% savings from improved housekeeping practices (some of which would involve the host's staff).

However, as the EPRP element is unlikely to be a dominant factor in the structure of the contract or the selection of the service provider, the parties agree to include a simple Performance Payment gain-share arrangement in the contract whereby the service provider gets a bonus of 1% of its annual service fee for each 1% energy saving.

It is important that the value of the energy savings and cost of the bonus (for each energy type) be established to ensure it is both adequate to be motivational, but not so high as to disproportionately reward the service provider (no point paying a €10,000 annual bonus for an €8,000 annual saving!).

Limits are also required. In the above example the energy savings of 5-10% might typically be expected from improvements to operating practices/housekeeping, assuming no investments in energy conservation measures. The 15% limit is to prevent a windfall gain to the service provider.

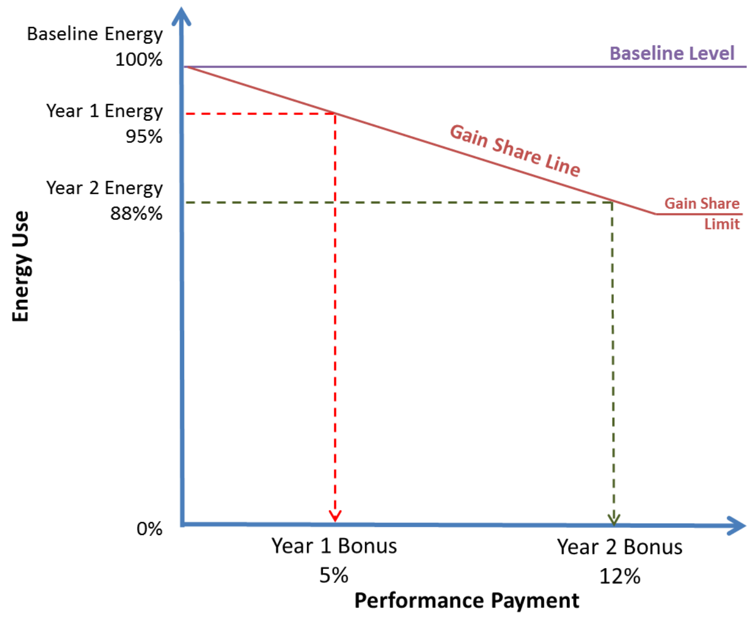
Savings will be measured based on measured use at the utility meters, with gas use corrected for degree days. It is agreed that savings achieved by separate implementation of energy efficiency investment projects by the client will be measured on implementation and excluded from the overall savings.

The bonus is paid at the end of each contract year following submission of a simple M&V report by the FM company.

A sunset clause is agreed after 3 years, effectively re-setting the baseline every year after year 3 (i.e. in year 4 the new baseline is year 1 energy use).

As illustrated below, in year 1 of the contract energy use is reduced to 95% of the baseline, so a 5% bonus is paid; in year 2 energy use is reduced to 88%, so a 12% bonus is paid.

Figure 3.2: EPRP Gain Share Arrangement



In the above example the gain share Performance Payment is **indirect**, i.e. for each 1% reduction in energy use, the vendor will be paid a 1% bonus on <u>its</u> fee. An alternative approach is **direct** gain share; for example, for each

1% reduction in energy use, 0.2% of the value of that reduction (i.e. 20% of the total saving) will be paid to the ESCO. This gives the ESCO a share of the actual savings. For EPRPs, indirect payment is generally more appropriate as the payment is linked to the ESCOs bid; direct payment is closer to a full Energy Performance Contract (EPC) arrangement where savings are shared.

<table>
<tr><td rowspan="5">[Graphic designer to insert a mini graphic of above pyramid here and relate them to each line on right]</td><td colspan="2">EPRP Example Summary</td></tr>
<tr><td>Performance Guarantee</td><td>0-15% energy saving</td></tr>
<tr><td>Performance Payment</td><td>1% bonus on its fee for every 1% energy saving up to 15%.</td></tr>
<tr><td>Payment Method</td><td>Bonus at the end of each contract year.</td></tr>
<tr><td>Measurement & Verification</td><td>Annual M&V Report
Based utility meter readings with adjustment to gas use for degree days
Savings from energy projects excluded
Sunset clause after 3 years</td></tr>
</table>

3.3 Combined – Gain share with minimum guarantee

In this case a minimum energy performance level is set and a sliding scale of payments for any savings beyond this level. As with gain share, the Performance Payment may be direct or indirect.

When setting the gain levels, the previous considerations apply. Also, care should be taken to establish the likely euro value of any gain to ensure they are proportionate to the value of the energy savings and to set maximum and minimum limits. For example, a badly structured arrangement might result in an ESCO being paid a Performance Payment amount that is equivalent to the value of five years of energy savings!

Example of Product with minimum guarantee and gain share arrangement
A heat pump vendor proposes the supply and installation of a heat pump, costing €120,000. To incentivise a customer to purchase a heat pump, a vendor proposes a Performance Guarantee to the customer that the heat pump will deliver an energy saving which can be valued at €15,000 per annum. The vendor proposes that the customer will pay 25% of the cost on order, 25% on delivery, 25% completion and beneficial use, and 25% be withheld pending demonstrated performance over a 12 month period (Payment Mechanism).

The Performance Guarantee & Payment is structured as follows:

- Savings less than €10,000, final €30,000 payment withheld completely
- Savings more than €15,000, full €30,000 payment made
- Savings from €10,000 to €15,000, final €30,000 paid pro-rata between 0% and 25%.

The vendor anticipates that there may be teething problems and structures the guarantee so that monthly readings are taken and if performance is not achieved in the first 12 month period, the guarantee will roll forward by a month until the next 12 month period, etc. to a maximum of 6 months.

The vendor identifies a number of risks including that the customer may switch off the heat pump or that the customer may operate the heat pump at a high supply water temperature set point, reducing the operating efficiency of the heat pump. The vendor addresses such risks through specific contract clauses and by monitoring key parameters (discussed below).

The vendor knows that historical energy records are inadequate and is concerned about the time and expense required to gather baseline energy data prior to the retrofit. In order to measure and verify energy savings the following is agreed between the parties in a Measurement & Verification Plan (discussed further in Section 4):

- The existing boiler will be disabled.
- Using reference sources and a boiler flue gas analysis, the seasonal efficiency of the existing boiler is estimated to be 75%. This is a critical point of agreement which side-steps the need for historical baseline data, but significantly reduces the accuracy of the savings calculation, and both parties should be aware of this.
- The vendor will install an electricity meter into, and heat meter out of, the heat pump during the installation process. The meter types and accuracy are noted. Readings will be logged using a local data logger, and can be downloaded on site visits. The customer is free to take manual meter readings, but it is agreed that the logged raw data will provide the basis of any calculations and be used in the event of dispute.

- A temperature sensor connected to a logger will record supply water temperature to ensure this is maintained at or below 40ºC.
- Energy prices – energy prices of 22cent/kWh of day rate electricity, 8 cent/kWh of night rate electricity and 10cent/kWh of oil, which are based on prevailing prices for each additional unit purchased at the time of the guarantee. These reference prices won't change even if actual energy prices change as to do so would transfer energy price risk to the vendor.
- Energy savings over the 12 month period will be calculated using agreed formulae (shown below).

The actual readings were:

- Day electricity units = 45,000 kWh
- Night electricity units = 30,000 kWh
- Heat supplied = 195,000 kWh

Avoided oil use = actual heat supplied / agreed boiler efficiency
= 195,000 kWh / 75% = 260,000 kWh

Energy cost savings = avoided oil cost – actual electricity cost
= 260,000 x 0.10 – (45,000 x 0.22 + 30,000 x 0.08)
= €26000 – (€9900 + €2400)
= €13,700.

Final Performance Payment = retained payment x % of Performance Guarantee Actually Achieved

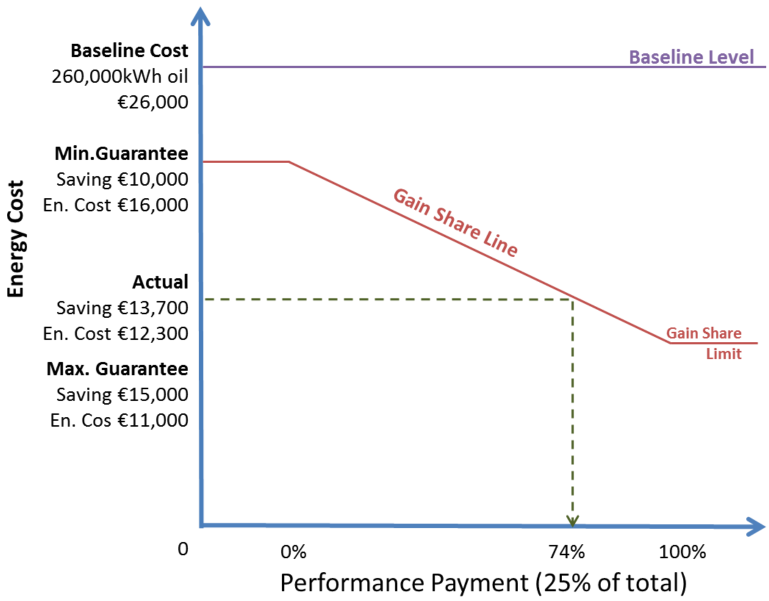
= retained payment x $\frac{\text{(actual saving – minimum saving)}}{\text{(maximum saving – minimum saving)}}$

= €30,000 x $\frac{(€13{,}700-€10{,}000)}{(€15{,}000-€10{,}000)}$

= €30,000 x 74%
= €22,200.

The gain share parameters and actual outcome are illustrated below.

Figure 3.3: EPRP Gain Share with Minimum Guarantee



<table>
<tr><td rowspan="3">[Graphic designer to insert a mini graphic of above pyramid here and relate them to each line on</td><td colspan="2">EPRP Example Summary</td></tr>
<tr><td>Performance Guarantee</td><td>Minimum €10000 energy saving
Maximum €15000 energy saving</td></tr>
<tr><td>Performance Payment</td><td>• Savings less than €10,000, final €30,000 payment withheld completely</td></tr>
</table>

right]		• Savings more than €15,000, full €30,000 payment made • Savings from €10,000 to €15,000, final €30,000 paid pro-rata between 0% and 25%.
	Payment Method	Retention of final payment for 12 months pending M&V of performance.
	Measurement & Verification	Baseline efficiency assumed. Post-retrofit energy measured for 12 months.

Observation: Using an estimate of existing heating system seasonal efficiency of 75% is risky for both parties. As a result, the use of a sliding scale payment mechanism as described is better than an all-or-nothing final payment, as it softens the blow if the full target is not achieved. The ultimate aim of M&V is to assess the quantity of savings that materialise so the performance payment can be made. In this example a simple M&V approach was agreed by both. Both parties are very confident the savings will arise so they compromise on the M&V regime so as to save costs.

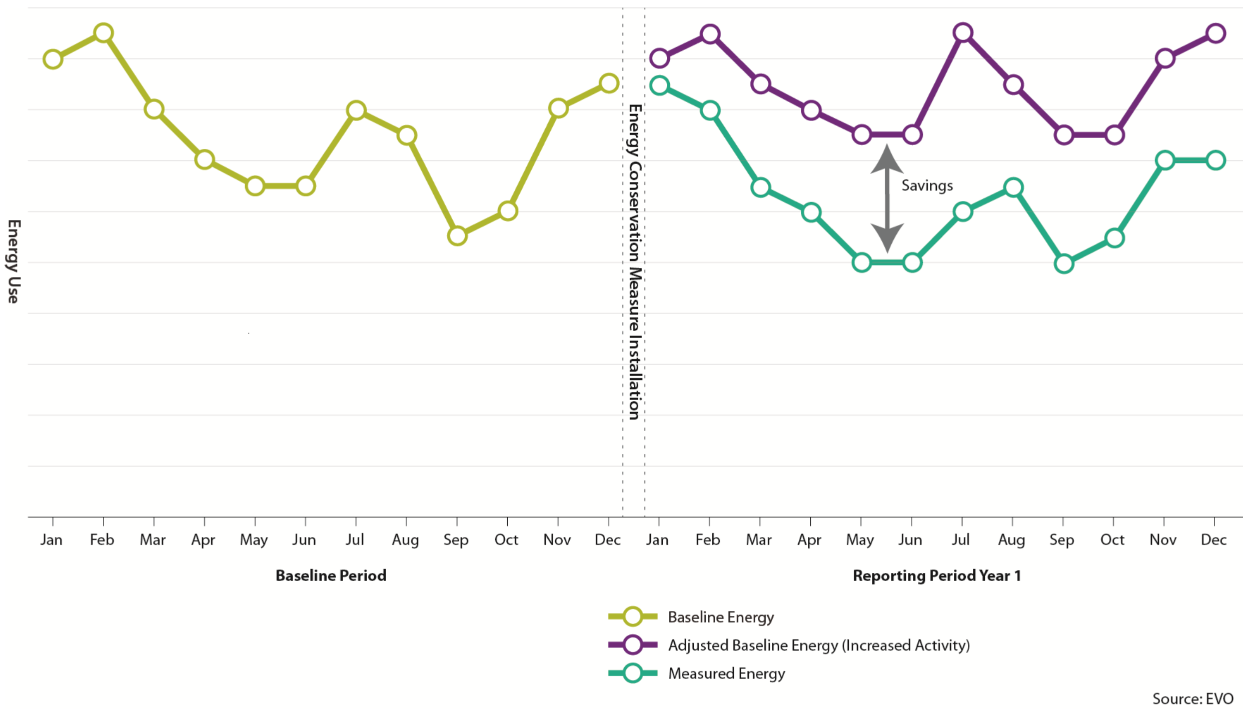
Both the gain share and the combined gain share with minimum guarantee arrangements have the advantage of motivating the ESCO to work hard to maximise energy savings. Gain share arrangements are thus best suited where the **bidders have a good influence over the final energy savings**, e.g. in works contracts with significant savings arising from good quality installation, commissioning and tuning the controls, or in service contracts where the ESCO has a high degree of influence on energy use.

4. Measurement & Verification

Energy Performance Related Payments (and Energy Performance Contracts) involve payments to Energy Service Companies (ESCOs) for delivering energy savings. It stands to reason that those savings have to be quantified, but as savings are really unused energy they cannot be directly measured; a method is needed to calculate the savings. This method must be sufficiently robust to withstand scrutiny, and in many cases accommodate foreseeable changes in *variables* such as weather and less foreseeable developments such as change of opening hours over the term of the contract.

M&V theory – based on the International Performance Measurement and Verification Protocol
The solution, at its simplest, is to **measure** energy use before and energy use after, with the difference representing the saving, or the avoided energy use (refer to Fig. 2.5). For simple projects, such as replacing light fittings with higher efficiency models, the difference between the instantaneous electrical load before and after the works, multiplied by an agreed typical number of annual operating hours will amount to the energy savings.

Figure 4.1: Measuring energy savings



In a slightly more complex project, the upgraded light fittings might also have automatic controls for occupancy and/or daylight levels; a new or existing sub-meter will measure and verify the savings by recording electricity use for a period of time before and after. The energy use measured before, or *Baseline* energy, should be recorded for a sufficiently long period to represent one operating cycle. Depending on the facility and the controls, an operating cycle might be a day, a week, a month or a year. For instance, occupancy controls in a busy hospital might require one or several weeks of baseline data; daylight controls in an educational building might require one year of baseline data to capture variations in daylight hours and in term/out of term activity. Indeed, the less variable the energy profile, the more accurately energy savings can be measured and verified.

In the above examples the lighting retrofit is isolated by measuring electricity use at the point of supply to the light fitting, lighting circuit or lighting sub distribution board; this is referred to as the ***'retrofit isolation'*** method. The area where the meter is installed and the service provided (i.e. light output) is referred to as the '***measurement boundary'.***

In cases where a number of energy conservation projects are implemented in a single facility, some measures are likely to interact with others. For example, a substantial improvement in lighting may result in less heat from the light fittings, and this in turn increases the space heating requirement, which results in an adverse interaction with a heating efficiency upgrade project. Such *interactive effects* can be difficult to take account of, so in some cases it is better to define the measurement boundary as the *whole facility*, with the utility meters being the point at which energy is measured.

Two advantages of using the utility meters are that generally a lot of historical data is available from the energy vendors, and billing meters are regarded as 100% accurate. If one is using other sub-meters, then the *accuracy* of the meters over the operating range for which they are used should be considered, as inaccurate meters introduce errors into the savings calculations and reduce *confidence* in the results. Sub- meters should be carefully selected and calibrated.

What is IPMVP?

The International Protocol for the Measurement and Verification of Performance was introduced to the Irish market by the Sustainable Energy Authority of Ireland in 2011, and its principles were employed to measure and verify energy savings in the Better Energy Workplaces grant schemes of 2011 and 2012. The protocol provides a framework for the measurement, computing and reporting of energy (and water) savings, and the above section identifies many of its principles and terms *in italics*. The protocol was developed by the Efficiency Valuation Organisation, and a list of Certified Measurement and Verification Professionals is available at www.evo-world.org.

In cases where no baseline energy data is available, such as a new or previously unmetered facility, a simulation model can be constructed to provide a baseline energy use, but this model must be subsequently calibrated against actual energy in use patterns. Such *calibrated simulations* can be time consuming to construct and calibrate. The alternative may be for an EPRP which guarantees the efficiency (or energy use) of the new installation, without reference to energy savings[3].

Some activity variables that affect energy use will change over the course of the baseline period and the *reporting period* i.e. the period during which savings are calculated and reported (generally reflecting the term of the contract or guarantee), and due account must be taken of this in the calculation of energy savings. One of the most common adjustments is to take account of changes heating fuel consumption due to changes in weather. In such cases the Degree Day method is generally employed. Other examples are production volumes in a factory, bed-nights in a hotel or hospital, number of occupants in a leisure centre, etc. Often a simple mathematical regression analysis can be employed, but this requires recording the variable over the baseline period at similar time intervals e.g. weekly fuel use requires weekly degree day data.

Gathering good baseline data is an essential part of measuring and verifying savings. In many instances the operating cycle over which you wish to record baseline data is one year, so it is a good idea to identify and address this requirement early in the project development process; waiting until the ESCO is in place may result in either works progress being delayed, to allow meters to be installed and logging to commence, or insufficient metering and hence less accurate quantification of savings. So the advice in terms of metering and gathering baseline data is to act now.

If you are planning an EPRP (or EPC) it is suggested you identify the following early in the process:

- what needs to be measured and recorded (energy data, activity variables, static factors)
- where it should be measured (measurement boundary),
- the minimum baseline period (based on the operating cycle)
- the frequency of the recordings (perhaps start with regular manual readings but install data logging later).

What if IPMVP is impractical or too expensive?
The basis of good M&V is that there is measurement and verification, including measurement **before** and after., Without measurement before, M&V won't comply with the IPMVP.

However for some projects good baseline data is not available, nor is there time to determine a baseline to IPMVP. Perhaps there is a limited time to implement the project (e.g. need to spend the project budget before year end) or the value of the savings doesn't justify full measurement of the baseline. The first step is to challenge these assumptions as good practice is to do full M&V. In many cases IPMVP Option A provides a solution, where one key parameter is measured and another is estimated. For instance, the heat out of a boiler in its baseline year is not known, but its fuel input is known. Option A allows the fuel input to be combined with estimated efficiency to give the heat output. Estimates can be based on historical data, manufacturer's specifications or engineering judgement. Also, IPMVP Option D, Calibrated Simulation, may also be appropriate using relatively simple mathematical models for simple applications (and calibration).

Estimated Baseline: If necessary and appropriate to the EPRP, you can do a form of M&V (which is not IPMVP compliant) where baseline data is estimated. Estimates can be based on limited historical data, manufacturer's specifications, or engineering calculations combined with judgement. In such instances, estimates should be conservative (i.e. err on the side of underestimating savings). Both parties must understand the method used to establish the estimates and accept the estimated values. However, there MUST be measurement installed as part of the project and measurement of performance afterwards. Furthermore, the measured data must be compared to the baseline estimate and checked to ensure the estimates are sensible to sense check the estimates.

Deemed Savings: This is an approach to estimating energy savings, usually used for projects with well-known and consistent performance characteristics. This method involves calculating savings based on historical evaluations for similar installations elsewhere. Deemed savings approaches may be complemented by on-site inspections.

Which M&V should I use?
Generally SEAI advocate full M&V to IPMVP; it can be done simply and still be IPMVP. IPMVP is robust and if properly applied will result in accurate verification of savings. M&V with estimated baselines should only be

[3] Strictly speaking the International Performance Measurement and Verification Protocol requires energy savings to be measured and verified, so energy efficiency guarantees, or guarantees of future energy use, are not compliant. They may, however, adopt the other principles of the IPMVP.

considered in exceptional circumstances, such as where baseline data is non-existent and there is no time to wait to develop a baseline, or where the costs / effort of IPMVP M&V is not justified based on the value of savings. In most cases, especially projects with savings greater than €10,000, one should perform M&V to IPMVP.

The M&V Plan - a core element of M&V

As noted in Section 2, a Measurement and Verification Plan forms part of the EPRP agreement. This document specifies (in advance of contract commencement) what energy data will be recorded, how energy savings will be calculated and how any routine adjustments (such as for changes in weather) will be made. As well as baseline period energy, it will include any baseline period conditions which are expected to remain static such as opening hours, log of indoor air temperatures, lux levels, etc. Throughout the contract regular reports should be issued employing the methods outlined in the M&V Plan, to quantify the actual savings.

The M&V Plan and subsequent M&V Reports can be prepared by the client, the ESCO or a qualified consultant. Where M&V is central to contractual payments, if the ESCO prepares the M&V Plan and subsequent M&V Reports, it would be prudent for the client to arrange for a suitably qualified professional to review these with care.

In conclusion

Good M&V practices involve a number of components: specification and installation of suitable meters (temporary or permanent depending on the duration of the baseline period and reporting period) at appropriate measurement boundaries; recording energy use baseline energy use, activity variables and static factors; preparing a measurement and verification plan; incorporating that plan into the contract; and ongoing reporting of performance over the life of the contract. While good M&V practices are essential, there is a balance to be struck between accuracy and cost. In the case of EPRPs, where the guarantee may be for a single operating cycle and is typically 12 months or less, cost-effective methods are essential. However, where accuracy is being traded off for cost, it is essential that both parties are aware of the nature of the trade-offs; this can be achieved by documenting such decisions in the M&V plan, and will minimise the risk of any subsequent dispute.

5. Implementing EPRPs

5.1 Practical Considerations

When setting up the EPRP, it is recommended to bear in mind the SMART acronym for targets, i.e. Specific, Measurable, Achievable, Realistic, and Time-bound. The nature of the guarantee and the consequences are entirely up to the client and the ESCO, and will vary depending on a variety of factors discussed below.

5.1.1 Rationale for purchase and role for EPRP in this

The nature of the guarantee will be influenced by whether the rationale for the purchase is driven by energy saving objectives and financed by expected payback, or the purchase is required in any case and EPRP provides a means of maximising the energy-related potential. An example of the former is a decision to replace a working boiler justified entirely on the pay-back of the project, whereas an example of the latter is a decision to replace end of life boiler plant because it is required. If the project is entirely justified on energy savings then a stronger guarantee and consequence is likely to be required: it is a pure energy project.

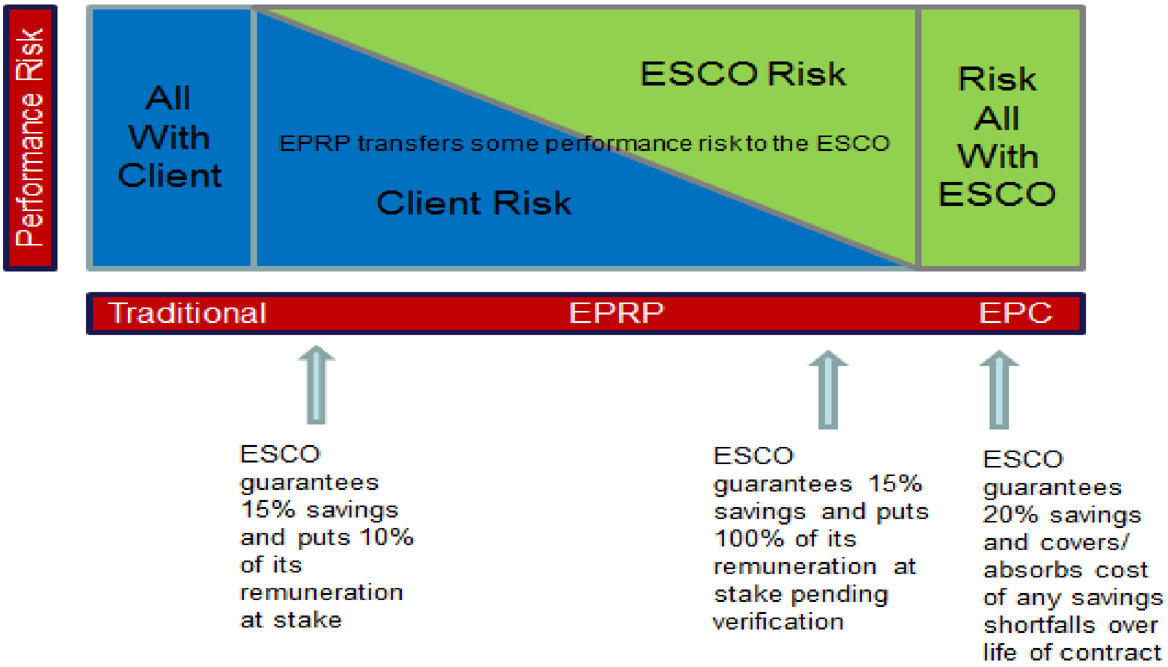
5.1.2 Objectives

The objectives of the EPRP may include alignment of client and ESCO objectives, maximising energy savings, transfer of technical performance risk to ESCO, and a mechanism to finance the product, service or works.

- Maximising energy savings – this is generally best achieved by agreeing a sliding scale incentive with the ESCO, where more savings result in a higher payment; less savings result in a scaled penalty.
- Technical performance risk transfer – transferring the risk that actual savings may be less than predicted savings is a fundamental benefit of EPRP (and EPC). Traditionally, all the risk lies with the client. In the case of EPRP, the risk is shared between the client and the ESCO, but this shared risk will motivate the ESCO to ensure actual savings match or exceed the predicted savings. In the case of EPC, all the performance risk is with the ESCO. This is illustrated if Fig. 5.1.
- Mechanism for financing product, service or works – EPRP does not provide as effective a financing mechanism as EPC, nor does it provide as many financing options as EPC, but the guarantee is likely to provide a degree of comfort to the financier of the works that projected savings will materialise.

The contract performance clauses should be clearly related to the execution of the contract and made known to the bidders during the procurement process. The performance clauses apply after the contract has been awarded and can have legal implications for the contractor.

Figure 5.1: Energy performance risk – traditionally, with EPRP and with EPC



It is good contracting practice to only transfer risks to another party if the other party can manage those risks; otherwise you will be charged disproportionately for the risk transfer. Similarly, it is advisable that the financial impact associated with non-performance be sufficient to ensure the ESCO is motivated to persevere with the project until performance is achieved, but not be so high as to drive up the ESCOs price disproportionately.

5.2 Procurement Considerations

When one is procuring a product, service or works using a competitive tendering approach, a core principal is that bids are comparable; this is essential for public bodies. When incorporating an EPRP into the tender, there are two ways of achieving this:

i. Client Defined Guarantee - Ask all bidders to provide the same energy performance guarantee.

ii. Bidder Proposed Guarantee - Allow each bidder to bid different energy performance guarantees, but establish a quantitative mechanism whereby the value of the guarantees are comparable and can be incorporated into the award criteria that gives it a proportional weighting.

i. Asking all ESCOs to provide the same energy performance guarantee

This method is quite straightforward, and is particularly suited to works contracts and service contracts where the bidders are competing primarily on price for more or less similar works or services. For example, a number of contractors bid for the refurbishment of a heating system or for a maintenance/facilities management service, but where there is an energy performance element to the work.

For instance, if a school is arranging summer works, the school may develop an EPRP to ensure the energy efficiency objectives of the project are achieved. This EPRP would be included in the Request For Tender documentation, and all contractors advised that in submitting their price and signing the tender, they also accepting the terms of the EPRP. In this case, all contractors will be submitting prices on the exact same basis and so comparison of tenders will be as normal (e.g. lowest price, most economically advantageous tender with normal criteria or lowest life cycle cost). It is essential that the EPRP and associated terms be provided to the bidders in advance so they have the opportunity to account for this in their pricing.

Ideally a single entity designs and builds the project, and is thus solely responsible for the energy performance associated with EPRP. In cases where there is a separate designer and contractor, the designer is responsible for and efficient design and the contractor for building it so that it works efficiently, but energy performance is a combined measurement. As a result, it is preferable that both sign up to the same EPRP and agree to equal responsibility. Indeed, a contractor is likely to be reluctant to sign up to EPRP if the consultant has not provided a similar guarantee.

In this case the client must have a clear understanding of what saving is achievable, as it is the client who states the required performance and payment mechanism.

ii. Allowing each bidder to propose different energy performance guarantees

A shortcoming of bidder-defined guarantee, described in (i) above, is that it reduces the potential for a really efficient product/service provider to win the contract. Essentially, all bidders are competing on price. An alternative approach is to allow the bidders propose different energy performance guarantees, and to take account of this in the competitive tendering process.

Doing this requires one to develop a tender scoring mechanism that has an appropriate weighting for the guarantee.

This method is difficult to implement for complex works contracts, and better suited to the design and supply of a single product (or possibly specialist service) where each bidder is offering a different proprietary product / technology / service that have the same functional utility, but different levels of energy performance.

A good example is where different bidders are proposing different light fittings, all are guaranteeing the level of service/functionality required (i.e. specified lux levels) but one is proposing LEDs and another is proposing T5 fluorescent fittings. The technologies have different installation, operation (energy use), and maintenance costs, and different product life – how does one compare the offerings?

One widely-accepted approach to assessing the value of the guaranteed performance is using the life-cycle cost approach. This method takes account of initial, operation, maintenance, disposal and product life costs. In this case the financial value of the guaranteed performance needs to be assessed. Guidance on life-cycle costing is available from the Green Public Procurement website (http://www.greenpublicprocurement.ie/about/life-cycle-costings/).

Tendering Tip

As the guaranteed performance needs to be assessed as part of the award criteria, the request for tender documentation should specify that bids will be assessed based on Most Economically Advantageous Tender.

As the life-cycle approach values the savings for each year over the product life, it tends to give a high value to any saving and de-emphasise initial costs. In order to avoid bidders submitting high initial costs and effectively offsetting these by guaranteeing high levels of energy savings to win the contract, the penalty for not meeting their energy performance guarantee should be relatively high.

Life-cycle costing is not always suitable because the other life-cycle cost information may not be available, or because it is a service contract, or due to concerns about bidders playing the system as described above. In this case the tender scoring criteria can be weighted, as illustrated in the example table below:

Criterion	*Weighting*[4]	*Bidder X*	*Bidder X Score*
Cost	*50 marks*	*€50,000 (Mid of 3)*	*25 marks*
Guarantee	*10 marks*	*15% saving (Best)*	*10 marks*
Qualitative (e.g. relevant experience, product quality)	*40 marks*		*30 marks*
Total	*100 marks*		*65 marks*

[4] The tenderer must evaluate the weightings as they see fit, this is just an example.

Allowing the bidders provide different energy performance guarantees is not always suitable. For instance, if the above lighting retrofit example included the provision of occupancy and daylight controls, the actual savings would be dependent on actual occupancy and daylight levels, which are likely to vary in different parts of the facility. The bidders could potentially bid different guarantees based on different assumptions about occupancy, and this would clearly be inequitable. Although one could come up with sophisticated approaches, reverting to a simpler standard gain-share arrangement for the entire contract or just the controls element is likely to provide motivation to the vendor to optimise the controls post-installation.

Summing up on Procurement

If one is doing a complex project, particularly a works project, then a structured approach to evaluating whether or not EPRP should be adopted is advisable and we recommend following the 5-stage process to evaluate the project as a whole.

If one is doing a simple project, or buying a standard product or service, then there may be no need to deliberate at length on whether or not to use EPRP (versus traditional approach to procurement or an Energy Performance Contract). This guide can be used to help develop your own EPRP, particularly Section 5.3

Your procurement method will depend on if you are private or public sector, and the value of what you are procuring.

It is generally simpler to compare tenders if all bidders sign up to a client-defined EPRP. However, the client needs to really understand EPRP, what level of savings are achievable and who influences the achievement of these savings. The alternative is for ESCOs to tender different EPRPs and assess each base on the Most Economically Advantageous Tender or life-cycle costing; in either case, one must think through how one is going to score or value the savings guarantees.

5.3 Pulling the EPRP together

It may be helpful to use the table below to bring structure to your EPRP, or to identify alternative EPRPs for comparison.

EPRP *Title*	
Function	*Product / Service / Works*
Rationale	*Rationale for purchase and role for EPRP in this*
Objective	*What are you trying to achieve with the EPRP? The objectives of EPRP may include alignment of ESCO objectives with the client; maximising energy savings; transfer of technical performance risk; and a mechanism to finance the product, service, works.*
Overview of how it will work	*Brief description, including which performance option is being used, i.e. Minimum performance guarantee; Gain share arrangement; Combination.*
Performance Guarantee Statement	*Use the phrasing you propose for the invitation to tender. Identify the unit (e.g. %, kWh or euro).*
Payment Guarantee Quantification	*Express the guarantee in kWh and euro terms. This may be a range. Where ESCOs are bidding different guarantees, the ESCOs will each bid a specific value which will be used as part of the evaluation, e.g. ESCO A guarantees a 5% saving, ESCO B guarantees a 7% saving.*
Performance Payment Statement	*Use the phrasing you propose for the invitation to tender.*
Performance Payment Limits	*It order to avoid a disproportionate risk or windfall to the ESCO, payment limits are recommended.*
Payment Mechanism	*Identify how/when you will make the performance payment in practice. For instance, in a works contract the client may withhold final payment; in a service contract the penalty may be deducted from the next service payment. Consider the cash flow implications to the contractor.*
Measurement & Verification	*How will performance be measured and verified? What metering and monitoring will be required? Will baseline data, including activity variables and static factors, be required and, if so, what is the programme to gather this? Who will prepare the M&V Plan and the M&V Report?*
Programme	*Define when the M&V period begins and ends. Allow time for system tuning post-commissioning. If appropriate, may allow a re-test if the initial test fails.*
Competitive tendering approach	*If you are adopting competitive tendering, how will you compare the different tenders? Will they all provide the same performance guarantee, or will each bidder to propose different energy performance guarantees?*
Tendered Payment Quantification	*Quantify the range of payments, which may be positive or negative, in kWh and euro terms. This will be the same for all ESCOs, e.g. €10,000 for achieving the guarantee, although ESCO A has only to achieve 5% saving to get the full payment, whereas ESCO B has to achieve 7% saving to get full payment.*
Likely degree of influence of EPRP on ESCOs	*Evaluate the euro payment range in the context of the overall contract value and nature of the contract. Is it proportionate? Does it achieve the objective identified above?*
Risks	*Consider any risks, particularly possible unintended consequences, associated with the proposed EPRP.*

Appendix A EPRP Case Studies

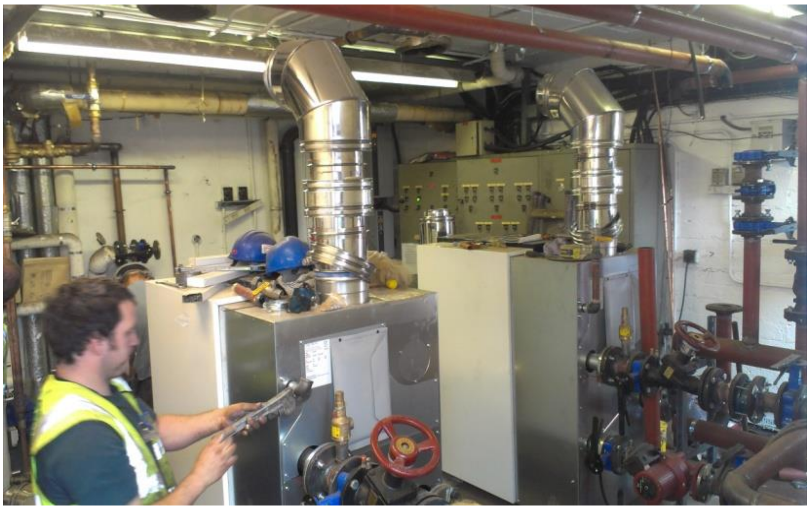
A1. EPRP – Dublin Port Headquarters

Crane lifts new boilers and microCHP to rooftop boiler house

Project Overview

Name of projects	Port Centre Boiler House Refurbishment Port Centre Ventilation Controls Retrofit
Client Name	Dublin Port Company (DPC)
ESCOs	Consultant: PowerTherm Solutions Mechanical Contractor: T Bourke & Co. Controls Contractor: Standard Control Systems
Year contract signed	2012
Type of facility	Office building
Scope of works	***Boiler House Refurbishment*** The boiler house refurbishment involved the removal of 2 oil-fired combi-boilers, LTHW pumps and pipework, MCC and controls panel and associated pneumatics. The upgrade included the installation of 2 286 kW modulating and condensing gas-fired boilers; 4.5 kWe / 12.5 kWth icrochip with condenser module and 1500 litre buffer vessel; LTHW pumps, pipework, valves and commissioning sets with lagging of same; DHW calorifier; new MCC and controls panel; extensive electricity, gas and heat metering; ancillary equipment. Advanced control strategies were developed to maximise boiler efficiency using direct modulation and weather compensation. Using advanced control also allowed for the CHP to be used as lead heat generator, then charging the buffer vessels when there is no heat load, then discharging the buffer vessel when the heating is first started in the morning, while avoiding charging of the buffer vessel during the day. The CHP (and boilers if required) are used to maintain domestic hot water at temperature when there is no space heating load, while avoiding wasteful cycling or heat loss into the space heating circuits.

	Ventilation Controls Retrofit The ventilation controls retrofit included the removal of pneumatic controls for the Variable Air Volume (VAV) boxes in offices, and installation of BMS control units and electro actuators on the VAV boxes, and room temperature sensors. Whereas before office temperature control was erratic, each office is now monitored and controlled via the BMS, and the temperature control of the main AHU can be harmonised with the requirements of the offices.
Any non-energy works and how were these treated?	n/a

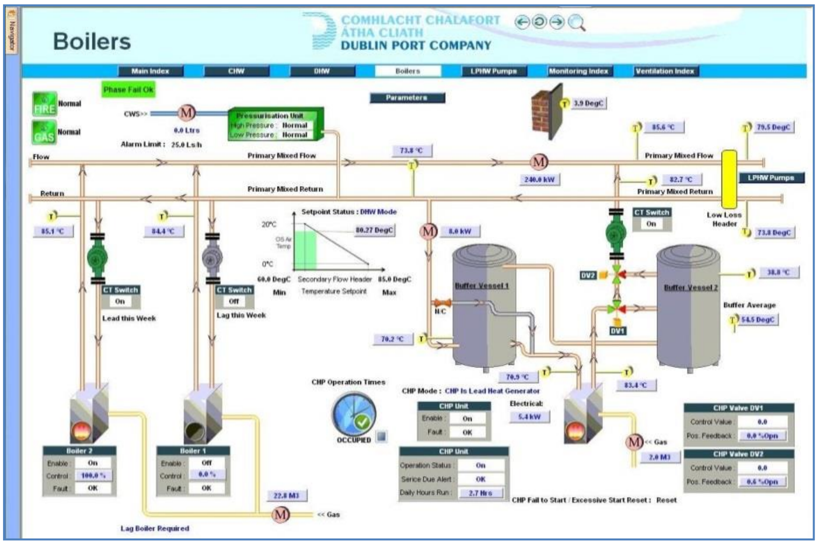


New condensing gas boilers and pipework being installed

Energy Performance-Related Payment

EPRP overview	***Boiler House Refurbishment*** The consultant and the main contractor each guaranteed separately to the client that the project would achieve a 15% energy-efficiency improvement in fossil-fuel use. If this guarantee was not achieved, each would lose 7.5% of their respective contract values. ***Ventilation Controls Retrofit*** This involved a pain/gain share arrangement – performance was measured by evaluating electrical savings. If 100% of the target electrical kWh savings are achieved, the parties receive 100% of their respective fees. For each 1% of additional savings, the contractor will receive a bonus of 0.5% of their fee, up to a maximum of 5%. For each 1% savings falling short of target, the contractor will incur a penalty of 0.5% of their fee, up to a maximum of 5%.
Contractual arrangements for EPRP	***Boiler House Refurbishment*** The standard NEC3 Engineering & Construction Contract was used in conjunction with DPC Health, Safety and Environmental requirements. In addition to the Works Retention of 5%, an Energy Performance Guarantee Retention (also a percentage of overall contract value) was included. A short attachment to the contract detailed the terms of this energy guarantee retention. ***Ventilation Controls Retrofit*** As this was a smaller contract, a purchase order was issued to the successful bidder. The request for quotation documentation incorporated

	the terms of the pain/gain share arrangement.
Measurement & verification of savings	An M&V plan including baseline energy data was prepared by the consultant (a certified M&V professional) for each project. After several months it was demonstrated that savings from both projects were substantially in excess of the guaranteed amount.



Controls graphic illustrates the new installation and control

Procurement Process

Procurement process	Traditional public procurement was used for the projects. For each project, bidders responded to a detailed Invitation to Tender, specifying the works. Bidders were required as part of their submission to accept the terms of the performance guarantees.
Extent of survey analysis by all bidders	A brief explanation of the expected energy-efficiency impact of the various works was provided by the design consultants in the ITT. Contractors surveyed the building to establish cost of works and satisfy themselves that the energy savings guarantee level was achievable.
Final award criteria	Accepting the performance guarantee was a minimum condition of all tenders. Cost, quality of plant and equipment, contractor experience in similar projects, quality of tender documentation, HS&E standards were all considered as award criteria.

Project Viability

Cost of works	Circa €300k (ex VAT) for both projects, including design. An SEAI grant reduced the cost to DPC by 35%.
Projected savings	Electricity savings of 13%
	Gas savings of 27% (degree-day adjusted)
	Note that actual savings are higher than was projected.

Financing

Financing arrangement (debt and equity)	Client-financed (with 35% funding from SEAI under BEW 2012 scheme)
Source of finance and rate of interest	n/a
Balance sheet allocation of	n/a

debt

Other

Annual service fee	No
Allocation of energy price risk	n/a
Inflation	n/a

A2. EPRP – Port of Cork

Project Overview

Name of project	Public Sector Port Project
Client name	Port of Cork
ESCO	Longship
Year contract signed	n/a
Type of facility	Port/harbour
Scope of works	The ESCO undertook lighting, heating and insulation upgrades to buildings, water saving projects and specific works to dockside cargo handling equipment such as straddle carriers and mobile cranes which are used to move containers around the facility. Local energy metering is also being installed.
Any non-energy works	n/a

Energy Performance-Related Payment

EPRP overview	The project was financed and is owned by the customer, with grant assistance from SEAI.
Contractual arrangements for EPRP	There is a gain share agreement between the customer and the ESCO, whereby if actual savings are 4%–6% of overall energy use, the ESCO will be paid their fees in full. If, however, savings are below 4% of overall energy use, the customer may claw back a percentage of the fees paid to the ESCO. If savings exceed 6% of overall energy use, the ESCO will be paid a bonus.
Measurement & verification of savings	Savings were monitored and the final fee was to be paid at the end of 2012.

Procurement Process

Procurement process	n/a
Extent of survey analysis by all bidders	n/a
Final award criteria	n/a

Project Viability

Cost of works	€270,000
Project savings	It was calculated that these projects would result in a 5% overall reduction in energy use by the Port in 2012 relative to 2011.

Project Structure

Energy performance-related payment	If actual savings are 4%–6% of overall energy use, the ESCO will be paid their fees in full. If, however, savings are above or below this threshold, the fee to the ESCO will be reduced or increased respectively.
Distribution of savings	The customer supplied the capital (via grant aid from SEAI), thus gets all

	the savings.
Term of contract	n/a
Allocation of technical performance risk	See 'Energy performance-related payment' above

Financing

Financing arrangement (debt and equity)	100% customer-financed
Source of finance and rate of interest	SEAI supplied capital grant aid.
Balance sheet allocation of debt	n/a

Other

Annual service fee	n/a
Allocation of energy price risk	n/a
Inflation	n/a

A.3 EPRP – Kerry County Council Pump upgrades

Kerry county council completed a pump upgrade project in 2012 which utilised an EPRP arrangement. The following clause was inserted into the tendering documentation. As a result, the system with the best energy design was selected, and its performance assessed before 10% of retained costs were paid.

"To complete commissioning of the plant, the contractor shall employ an independent energy consultant to measure and report on the pump / motor overall energy performance of the completed installation. Payment of the Energy Performance portion (10% of full amount) is contingent upon the overall pump / motor efficiency of the completed installation matching or exceeding that specified by the Tenderer in Appendix 3.
Where the Tenderer specifies the installed system will have an overall pump / motor efficiency of X%:

- The Tenderer will receive the full Energy Performance Payment (10% of contract value) where the overall pump / motor efficiency of the completed installation is X% or above as shown by the independent energy consultant.
- Where the overall pump / motor efficiency of the completed installation is less than X% but not less than (X-5)%, the portion of the Energy Performance Payment payable by the Client will increase linearly from €0 Energy Performance Payment for not more than (X-5)% to 10% of contract payable for attaining X% or higher overall efficiency
- Where the overall pump / motor efficiency of the completed installation is less than (X – 5)%, the system will be deemed not to be performing in an efficient manner and the installation will be deemed not to be compliant with the specification. Successful commissioning will require the plant installation to achieve an overall pump / motor efficiency of not less than (X-5)%
- Tenderer to include for cost of independent Energy Consultant in Tender submission
- A tolerance of +/- 2% is allowable."

A.3 EPRP – North Tipperary County Council pump upgrades

NTCC, advised by Tipperary Energy Agency, have retrofitted a lot of their water services stock. They have developed a life cycle assessment model to tender for projects.

In the tendering process, marks are awarded for a pump systems life time costs as opposed to direct comparison of pump capital costs. The capital cost of a pump > 10kW typically equates to only six months energy running costs. It pays significantly to ensure the best pump is selected for the application.

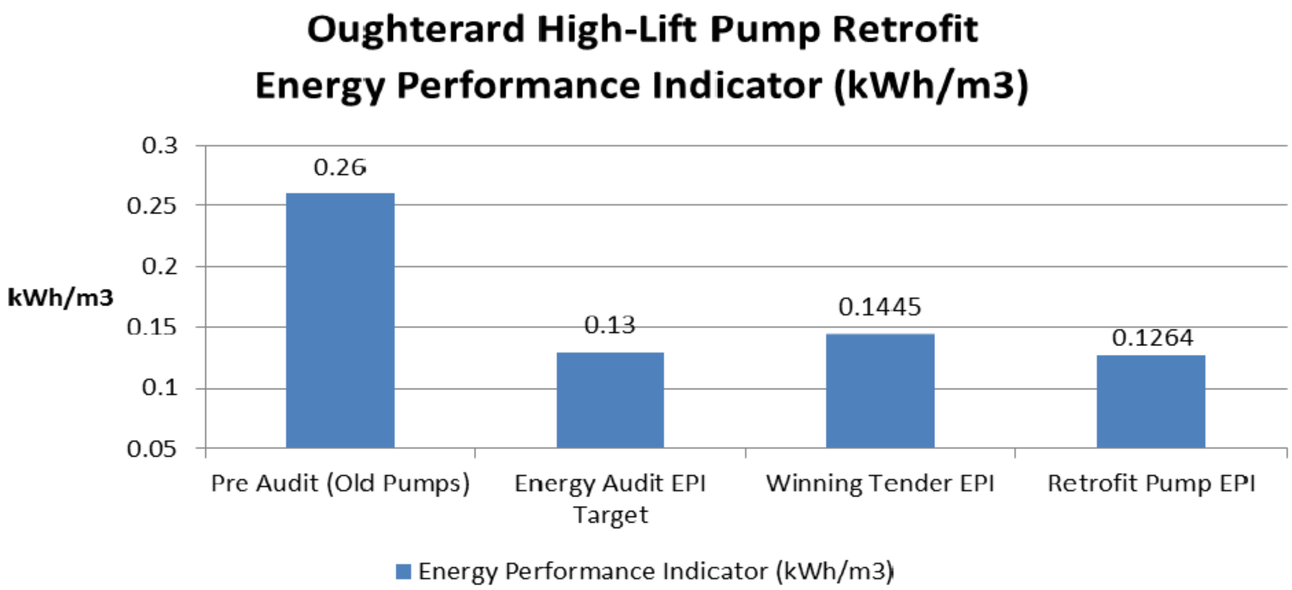
The table below is an extract of the main elements used to calculate a 5 year cost for the pumping systems. Tenderers bid in the five year running costs. This forms the basis for awarding maximum awards in the tendering process. In this case the project is awarded on the lowest cost, but it is the lowest running costs as opposed to upfront capital costs.

The retention, approximately 5% was withheld pending proper commissioning and measurement to confirm the pumping system operated as designed.

Response:	kWh /m3	M3/year	Euro/ kWh	Cost Per annum	Cost 5 year
Retrofit pump @ 185 m3/h		60,7725		0.16	
Retrofit pump @ 160 m3/h		26,7180		0.16	
Total energy cost (A)					
Fixed price lump sum capital cost (B)					
Total 5 year cost (Energy + Capital) (A+B)					

The result of using this process is the bidders now know they need to be proposed the best energy solution, and ensure they are installed and commissioned properly. Pump systems are a 'no brainer' for EPRP, as the design and commissioning are crucial to achieving the savings. A 1% difference in efficiency of the pumps tendered can equate to one third the cost of the capital costs in terms of five year energy costs.

Results
The results are impressive. The graphic below highlights the performance improvements.


Oughterard High-Lift Pump Retrofit
Energy Performance Indicator (kWh/m3)
kWh/m3
0.3
0.25
0.2
0.15
0.1
0.05
0.26
0.13
0.1445
0.1264
Pre Audit (Old Pumps)
Energy Audit EPI Target
Winning Tender EPI
Retrofit Pump EPI
Energy Performance Indicator (kWh/m3)