Energy Services in The Netherlands

Current Status and how to Stimulate Development

a Master´s graduation thesis by Joost van Barneveld

Lawrence Berkeley National Laboratory

Universiteit Utrecht

Author

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Joost van Barneveld

Master's program *Sustainable Development, track Energy and Resources*
Faculty of Geosciences, Utrecht University
Student number 3544176
joostvanbarneveld@gmail.com

Supervisor

Dr. Robert Harmsen

Faculty of Geosciences, Utrecht University
Department of Innovation and Environmental Sciences
r.harmsen@uu.nl

Second Reader

Prof. Dr. Ernst Worrell

Faculty of Geosciences, Utrecht University
Department of Innovation and Environmental Sciences
E.Worrell@uu.nl

Overseas Supervisors

Andrew Satchwell

Energy Markets and Policy group, Lawrence Berkeley National Laboratory
Environmental Energy Technology Division
ASatchwell@lbl.gov

Peter Larsen

Energy Markets and Policy group, Lawrence Berkeley National Laboratory
Environmental Energy Technology Division
phlarsen@lbl.gov

Lawrence Berkeley National Laboratory

Universiteit Utrecht

Abstract

The Dutch ESCO market has been assessed in terms of policy, financing and current and forecast market developments. A summary market research has been carried out for the United States ESCO market. This research leads to the conclusion that the Dutch ambitions in Energy Efficiency for the built environment and the legal framework that surrounds it hold opportunities for ESCOs to develop a viable business. The Dutch government and her subsidiaries are the greatest prospective client of energy services. If the Dutch government wants to fulfill their EU commitment of being a launching customer for energy services in The Netherlands, they should specifically include ESCOs in their energy efficiency improvement projects for their own building stock.

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Conversions

	non-SI	SI					
1	BTU	=	**1,055**	J	=	1.055	kJ
1	therm	=	**$105.5*10^6$**	J	=	105.5	MJ
1	GWh	=	**$3.6*10^{12}$**	J	=	3.6	TJ
1	TWh	=	**$3.6*10^{15}$**	J	=	3.6	PJ
1	foot	=	**0.3048**	m			
1	sq. Foot	=	**0.0929**	m^2			
1	gallon	=	**3.785**	l			
1	$\$/ft^2$	=	**7.46**	€/m^2	08/24/2011 rate		

Nederlandse Samenvatting

De Europese Unie en Nederland als lidstaat staan voor energie-uitdagingen in termen van voorzieningszekerheid, (on)afhankeijkheid, broeikasgas emissies en handelstekorten. Een van de belangrijkste middelen om deze problemen op te lossen is door actief te streven naar verhoogde energie efficiëntie in de gebouwde omgeving. De middelen om deze besparingen te bereiken zijn uitegezet op Europees niveau in (oa.) de Energy Services Directive en de Energy Performane of Buildings Directive. Op nationaal niveau zijn er talloze sectorakkoorden tussen industrie en overheid. Daarnaast adviseert Europees beleid met klem om Energy Service Companies te gebruiken als een belangrijk middel om deze besparingen te leveren.

ESCO's bieden hun klanten energiebesparingen en dus financiele besparingen door hun gebouwen en installaties op een veelomvattende manier te reviseren of te renoveren. Een groot voordeel van ESCO's is dat hun *core business* en winst direct gebonden zijn aan de energiebesparing die zij bij hun klanten bereiken. Deze besparingen lopen vaak op tot meer dan 30%.

Bovenstaande context leidt tot de onderzoeksvraag:

Gegeven dat ESCO's kunnen bijdragen aan energie-efficiëntie in de gebouwde omgeving, hoe kan de ontwikkeling van een energy services industrie in Nederland worden gestimuleerd ?

De Nederlandse overheid heeft zeggenschap over 46% van de potentiële markt voor energy services, en zij wordt door Europese regelgeving aangespoord om als *launching customer* voor ESCO's op te treden. De Rijksgebouwendienst (RGD) is een grote potentiele klant van ESCO's, maar kiest ervoor om haar renovaties uit te voeren zonder ESCO's te betrekken. Deze methode bereikt wellicht niet maximale energiebesparingen. Tevens kan het de potentiële omzet die ESCO's in Nederland kunnen behalen schaden en daarmee de toekomstige ontwikkeling van ESCO's buiten de RGD context.

In een gelijkaardige omgeving wat betreft de uitdagingen en potentieel is er in de Verenigde Staten een levensvatbare en winstgevende industrie ontwikkeld die energie-efficiëntie verbeteringen levert tegen optimale kosten met flexibele eisen voor kapitaal. De omzet in deze sector is voor 84% afhankelijk van publieke investeringen.

Met die inzichten luidt het antwoord op de onderzoeksvraag:

De Nederlandse overheid moet een consistent beleid voor de langere termijn ontwerpen, waarbij gebouwbeheerders die onder haar (in)directe invloed staan het afnemen van energie services serieus en pro-actief moeten overwegen.

Een strategie om dit te bereiken is een nationaal actieprogramma voor de ontwikkeling van energiediensten te ontwerpen en te implementeren. Dit programma omvat ten minste financiële ondersteuning, het delen van informatie en het oprichten van een platform van belanghebbenden in de Nederlandse energy services industrie. Daarnaast wordt de Nederlanse industrie aanbevolen zich door een branchevereniging te laten vertegenwoordigen, die als een van haar taken heeft het beoordelen van en een keurmerk uitdelen aan haar leden. Een specifiek advies richting de RGD luidt dat zij, om maximale energiebesparingen en ESCO-marktontwikkeling te bewerkstelligen, haar huidige prestatiecontracten praktijk moet herzien om ESCO's een kans te geven zich in de RGD markt te ontwikkelen.

Executive Summary

The European Union and The Netherlands as a member state face energy challenges in terms of security, (in)dependency, greenhouse gas (GHG) emissions and trade deficits. One of the most important means to alleviate these issues is by actively striving after increased energy efficiency in the built environment. The means to achieve these savings in the built environment have been set out in the Energy Services Directive, the Energy Performance of Buildings Directive and numerous Dutch domestic sectoral agreements. In addition, the European policy strongly suggests that Energy Service Companies (ESCOs) are an important vehicle to deliver these savings.

ESCOs offer their clients to save energy and thus money by having their buildings and installations retrofitted in a comprehensive manner. The benefit of ESCOs is that the ESCO core business and profit are tied to generating cost-effective energy savings and in reducing the energy consumption of their customers. These companies often deliver total energy savings in excess of 30%.

The context above has motivates the following research question:

Given that the ESCOs can contribute to improving Energy Efficiency in the built environment, how can the development of an energy services industry in The Netherlands be stimulated ?

The Dutch government has jurisdiction over 46% of the prospective Dutch ESCO market, and is encouraged by European legislation to act as a launching customer for ESCOs. The State Building Service is a big potential client of ESCOs, but chooses to renovate their buildings without involving ESCOs. This method may not achieve maximal energy efficiency increases. Additionally, their practices may hamper potential ESCO revenue and therefore future development of ESCOs outside the RGD context.

In a similar environment as to what concerns the challenges and potentials, the USA have seen a viable and profitable industry developing that delivers energy efficiency improvements for optimal costs and with very flexible capital requirements. It is found that public investments in this industry are the biggest source of revenue with 84%.

The answer to the research question then yields:

The Dutch national government should develop long term consistent policy that requires building managers under their (in-) direct jurisdiction to pro-actively consider having their buildings serviced by energy service companies.

A strategy to achieve this is to design and implement a national program for the stimulation of energy services industries, containing financial support, sharing of information and the installation of a stakeholder platform to monitor and steer the process. Additionally, the supply side of energy services should organize themselves in a national association of energy service companies that at least assesses and accredits its members. A specific recommendation towards the state building service, to maximize energy savings and stimulate the ESCO market, is that they should reconsider their current performance contracting practices to give ESCOs a chance to develop in the government buildings market.

1 Introduction

1.1 Relevance and context

The combined nations of the European Union have seen an energy dependency increase from 46% in 1998 to 55% in 2008, close to 1% point growth annually (Eurostat, 2010), where energy dependency is defined as energy imports divided by gross consumption (including non-energy use, e.g., for feed stocks). The cost associated with importing this energy can be estimated to excess € 100 billion annually in 2020 (European Commission, 2011)

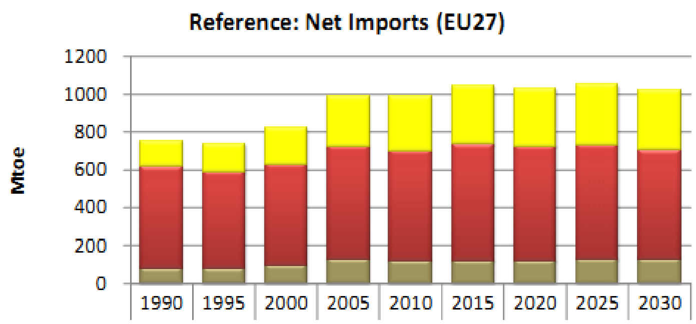

Figure 1: EU net energy imports (MTOE). Solids, oil, nat. gas bottom up. (European Commission Directorate-General for Energy, 2009)

This situation is considered problematic for a number of reasons. First of all, energy dependency may cause energy uncertainty in case of geopolitical tensions. Secondly, importing the aforementioned amount of energy and the costs associated with it may hamper European competitiveness, since energy expenses at that level would imply approx. 7% of EU GDP(Eurostat, 2008) spent on energy imports.

In addition, the European Member States have committed themselves to reduce anthropogenic greenhouse gas emissions by 20% in 2020 such as to display their effort to limit global warming to less than 2° Celsius (European Council, 2009)

In light of rising prices for all fossil fuels and growing net demand (European Commission Directorate-General for Energy, 2009), European policy is strongly directed towards turning the trend on fossil fuel energy dependency.

The EU has a double-sided approach to address these issues. Focus is on increasing the share of (domestically generated) renewable energy and increasing Union-wide energy efficiency[1].

The most cost efficient way of achieving the goals endorsed by the European Parliament to reduce energy consumption is by increasing energy efficiency in the built environment (European Commission, 2011). A special role therein is set aside for Energy Service Companies, or ESCOs (The European Parliament & The European Council, 2006, 2010).

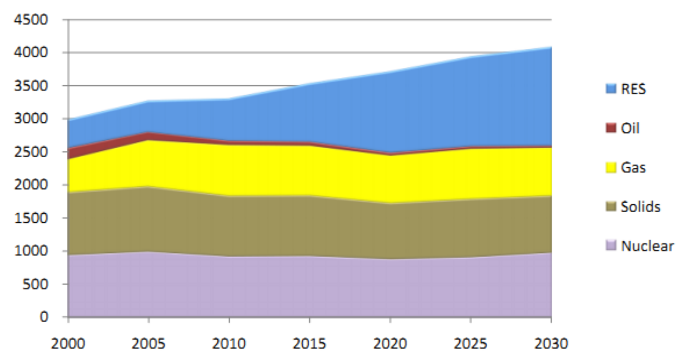

Figure 2: Electricity Generation by source (TWh) (European Commission Directorate-General for Energy, 2009)

[1] http://ec.europa.eu/clima/policies/package/index_en.htm

1.2 The ESCO opportunity

ESCOs have been a topic of interest over the last decade. Studies towards ESCOs have been conducted from a multitude of perspectives; from worldwide market assessments (Bertoldi, Rezessy, & Vine, 2006; Vine, 2005) to specific aspects as financing and policy(Bleyl-androschin, 2009; Freehling, 2011; Jackson, 2010; Sorrell, 2007). The business model of Energy Performance Contracting (EPC) holds a number of benefits that are interesting to a broad range of actors. In a most concise of explanations, ESCOs offer their clients to save energy and thus money by having their buildings and installations refit in a comprehensive manner; from windows to lighting, from air-conditioning fine-tuning to installing thermal energy storage, floor isolation, employee education and so on. In fact, any measure that saves energy and has a positive to neutral effect on the payback period of the project is eligible. These projects and services can be offered on a fixed-fee basis that leaves the client to implement, operate and/or finance the project, and they go under the name of Energy (Efficiency) Services (E(E)S). ESCOs are distinct from generic Energy Service (ES) providers in the sense that – according to Bertoldi et al., 2006 –

- The ESCO guarantees energy savings that are the result of its services
- The ESCO finances the investments privately, or arranges financing based on the guaranteed energy savings
- The ESCO's reward is directly tied to the achieved energy savings.

A very important remark lies in the fact that to determine savings in any way, a baseline needs to be present to refer to. This means that the building should already exist to determine a baseline from. Energy Performance Contracting (EPC) that is offered by ESCOs is therefore a method that is exclusively available to existing buildings.

The Dutch government can benefit from ESCO development as well. Their main motivation is a mandatory greenhouse gas reduction target for the non-ETS sectors[2] set by the EU of -16% (European Council, 2009). This target can be met by increasing the share of renewables to 14% - mandatory by the EU (The European Parliament & The European Council, 2009) – and by increasing energy efficiency in all sectors. Although both EU and Dutch policy do not state a mandatory improvement target, energy efficiency is very high on the agenda. This shows most prominently in the EU passing an *Energy Performance of Buildings Directive* (The European Parliament & The European Council, 2010) which has informally been called the ESCO directive, and the Dutch government setting an indicative EE improvement target of 20% by 2020 compared to 2005, combined with sectoral agreements that span almost every sector. Additionally, the Dutch government may be interested in ESCOs because of their ability to generate jobs (Schneider & Steenbergen, 2011) and to meet European Union and national ambitions for energy efficiency (EE) and GHG emissions.

The ESCO concept is interesting for the private sector to make a profit by developing such services, to help implement their sustainability goals, to reduce their greenhouse gas (GHG) emissions and to save costs. The benefit of ESCOs over ES is that the ESCO core business and profit are tied to generating cost-effective energy savings and in reducing the energy consumption of their customers. Developments directed towards this business model have been observed since the first oil crises (Vine, 2005). With a predicted rising oil price (IEA, 2010) and government GHG targets the interest for ESCOs has been

[2] Includes non-CO_2 GHG emissions

increasing accordingly for a multitude of reasons. First of all, the market for energy services (ES) like EPC is underdeveloped (Boonekamp & Vethman, 2009; Marino, Bertoldi, & Rezessy, 2010; Schneider & Steenbergen, 2011), while there is a potential for EPC projects in both technical and economic terms (Boonekamp & Vethman, 2009; Daniels & Farla, 2006; Schneider & Steenbergen, 2011). Therefore, a business involving EPC projects has a viable case in a developing market. Estimates of gross annual turnover range from 21 to 65 million euros (Schneider & Steenbergen, 2011). On the demand side of energy services, clients can expect total care of energy matters, state of the art equipment in turn-key energy efficiency projects and custom made financing solutions.

Energy service performance contracting is therefore a relevant concept to help improve EE in the Dutch built environment. Implementation of EPC may help generate renewable energy, increase energy efficiency, lower GHG emissions, create jobs and improve the European and Dutch economies' competitive position.

With the motivation and relevance given above, the research question is:

Given that ESCOs can contribute to improving Energy Efficiency in the built environment, how can the development of an energy services industry in The Netherlands be stimulated ?

1.3 Framework and Method

The ESCO business takes place in a very interesting but complicated field of mixed motivations and means from both the market and the government or regulatory bodies. Private parties (individual citizens) play a smaller to insignificant role because ESCO projects typically feature high transaction costs such that projects become feasible from an energy bill that is considerably higher than any household pays. This matter will be discussed in chapter 4.

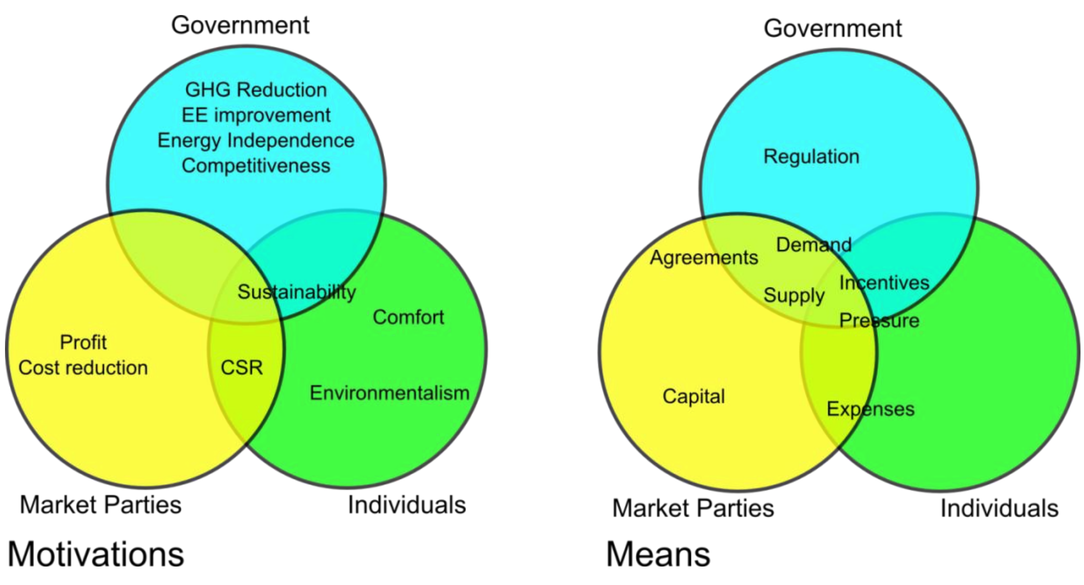

Figure 3 actors in the ESCO market, their motivations and their means

See Figure 3: the left part of the figure shows that all parties have diverse goals that overlap only when it comes to Corporate Social Responsibility (CSR) and sustainability. Interestingly, the ESCO business model is able to tie all these motivations together as discussed in section 1.2 and chapter 2. The means to implement ESPC projects or develop an ESCO industry, on the right side, have a great degree of overlap.

It is this overlap that makes the subject of EPC so interesting and complex simultaneously, and it is in understanding this overlap where the answer to the research question lies.

To answer the research question is to understand what motivations the different actors have, and how their means can be brought together to achieve the different actors' ambitions. The following information or data is required for this understanding:

- The workings of ESCOs and EPC
- The current and future ESCO market in The Netherlands in terms of potential, barriers and opportunities per market sector
- Dutch and European policy concerning energy efficiency for the built environment in general and policy that affects ESCOs and EPC specifically
- US policy on energy efficiency for the built environment
- Data on the origins of US ESCO revenues
- Performance of US ESCOs per economic sector or client type

Data for the first four points is supplied by literature study. Wherever possible, peer-reviewed articles are used. A large part of data also comes from (inter)national research groups that support policy and decision makers, such as the International Energy Agency (IEA), the US Energy Information Administration (EIA), the Energy Research Center of the Netherlands (ECN), the Dutch (CBS) and European (Eurostat) statistics offices, private consultancy firms and ministries or departments.

Data for the last two points is supplied by the Lawrence Berkeley National Laboratory (Berkeley Lab) from their ESCO database. The origin, usability and limitations of this data are discussed in section 6.5.

The information on the Dutch ESCO situation is analyzed in terms of potential, barriers, incentives and opportunities. Political influences are assessed by evaluating building energy policy in terms of their focus on specific market segments and where the economic potential lies. The analysis focuses specifically on policy for existing buildings since this is where the ESCO market takes place.

The US data is analyzed in terms of what policy has driven ESCO development, ranging from federal regulations to state specific policy and buildings codes. Finally, a synthesis of the Dutch and US policy and market studies shows whether or not the Dutch policy and practices focus on the right needs for the development of ESCOs in the Netherlands. This leads to recommendations on where the Dutch efforts for stimulating a domestic ESCO market should be focused, what to do and what to change in terms of policy, practices and market organization.

2 How do ESCOs work ?

The position has been taken that ESCOs are an interesting link in the EU and Dutch national energy savings and GHG ambitions. Additionally, there is profit to be made and clients can reap the benefits of single-operator energy services. Now, what actually is an ESCO and what distinguishes them from other parties involved in energy efficiency ?

2.1 History and context

Since the oil crises in 1973 and 1979 and the rising oil prices of more permanent nature since the 1990's (IEA, 2010), private companies have been seeking to reduce their energy cost and/or ensure supply. This has led to the increased interest in energy efficiency, since increased energy efficiency allows parties to derive the same service from the energy source with less energy input. Accordingly, the emergence of ESCOs can be traced back to the late 1970s (Bhattacharjee, Ghosh, & Young-corbett, 2009). Federal and state legislation in the USA required utilities companies to provide energy conservation services. These early ESCOs thus created operated as subsidiaries of utilities companies and began selling energy efficient products to clients of their parent companies. Later they became involved in how to most efficiently use these products, signaling the start of energy services and the sales of shared savings (Geller, Harrington, Rosenfeld, Tanishima, & Unander, 2006).

2.2 Different approaches to energy services

Building owners and industrial parties have a number of options to reduce their energy bill and secure supply. The energy value chain that Bleyl and Schinnerl (2010) devised illustrates where energy users may intervene:

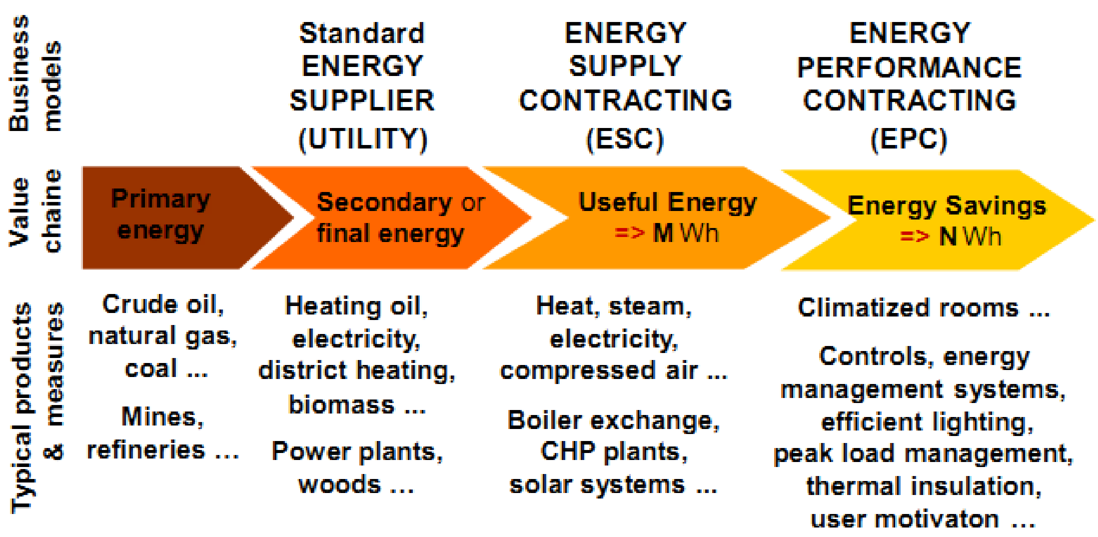

Figure 4: Energy services value chain (Bleyl-Androschin & Schinnerl, 2010)

For the following section we will assume that the energy consumer wishes to reduce energy expenses and maximize security of supply. To do so, the consumer may switch to a different fuel source that is either cheaper or more readily available. If this option is not available – for example, an office building with a gas boiler will probably not switch to coal – a cheaper utility company may be found. Both of these methods do not involve at all the way in which the energy is actually used.

Energy services in any form enter the stage where energy consumers rethink the reason why they actually use energy. Steinberger et al. (Steinberger, Vanniel, & Bourg, 2009) discussed this matter, the essence of which can be summarized as follows:

> *No energy consumer is interested in the actual consumption of energy. Rather, it is in the services that energy delivers where its value lies.*

As an example, a building owner is most probably interested in getting his building heated or cooled, or having adequate lighting. The energy bill resulting from these demands can be seen as a mere side-effect.

Appreciating this insight, we can discuss Energy Supply Contracting (ESC) and Energy Performance Contracting (EPC). With ESC, the consumer is supplied with services derived from energy such as heat, steam or cooling; it may however also be electricity in the case of cogeneration or renewable sources. The ESC is paid by the consumer a rate for the services delivered. It is the ESC's game to acquire the required energy for as cheaply as possible to ensure a viable business. However, the ESC is not concerned with how the (converted) energy is actually used on-site. Lastly, ESC can be applied to new as well as existing buildings.

Energy Performance Contracting on the other hand goes one step further. The EPC supplier, which we will call an Energy Service Company (ESCO), offers their client final energy services. Motive power instead of compressed air for example, or a constant temperature and humidity level in offices. The client now pays for these final services instead of kilowatt hours or joules of steam delivered. Consequently, the utilities bill for any energy used for which the client has a service contract with the ESCO goes directly to the ESCO. It is now the ESCO's goal to minimize these costs of conversion from basic energy to energy services, and it almost looks like the most basic of equations for energy efficiency:

$$\eta = \frac{useful\ output}{total\ input} \rightarrow \frac{services\ delivered}{energy\ costs}$$

It is important to note that EPC is only viable in situations where there is room for efficiency improvement. Were the facilities already running at maximum efficiency, there would be no way for the ESCO to reduce the energy expenses and thus make a profit.

2.3 ESCO basics

Now that the reader knows where in the value chain ESCOs fit and what their core business is about it is time to zoom in to basic ESCO operations. See Figure 5.

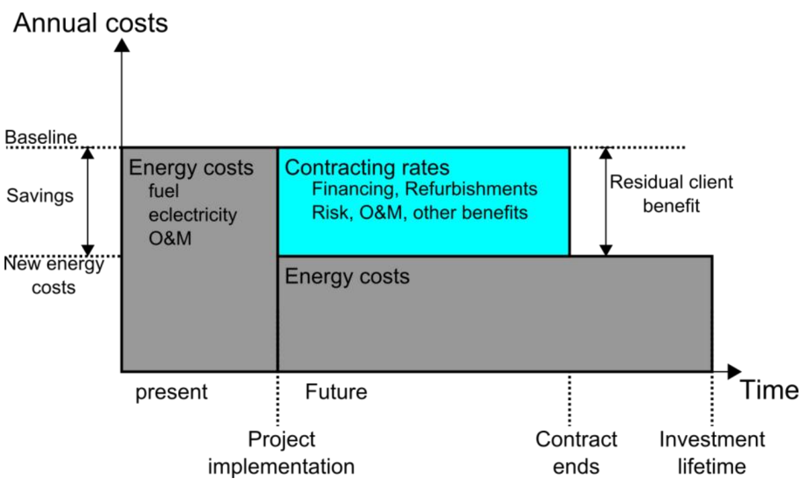

Figure 5: Typical EPC scheme

In this typical scenario, the ESCO approaches a client that has a certain baseline energy cost. This baseline is measured by the ESCO following a detailed measurement and verification (M&V) protocol, which will be discussed in section 3.6. For simplicity, the baseline in this setup has been kept constant over time. Again, requiring a baseline means that EPC can only be applied in existing buildings since a reference scenario needs to exist. Next, the ESCO assesses the options for energy usage reduction or efficiency improvements[3], again following a detailed M&V protocol. Once the ESCO has identified the baseline and room for improvement, the ESCO and the client need to agree on a contract. Important terms in this contract are the baseline itself, M&V, risk allocation, (third party) financing and allocation of excess benefits or expenses. These parameters will be discussed in chapter 3.

Once the agreements have been signed and sealed, it is time to deliver. While the contract lasts, the client has only one party to deal with for all the services that the ESCO delivers. The ESCO on its turn keeps tight control over how the project performs. This is part of why EPC contracts usually include O&M arrangements (Sorrell, 2007). It enables the ESCO to have control over all the equipment to ensure optimal operation and thus maximal economic performance.

During the contract there are several risks that may affect the client, the ESCO or both. First there is a technical risk, which usually lies with the ESCO. The technical risk includes equipment malfunction and underperformance, but may also consist of bad contract design or other administrative matters. It is the ESCO that has a contractual obligation to deliver the services obtained from energy for the price that the client and the ESCO agree upon. If the ESCO has difficulties delivering these services it is their problem, even though the installations may be in the client's premises.

Another risk that comes up is that of bankruptcy or economical non-performance of the client. EPC projects typically have a duration of around 5 – 10 years (Vine, 2005), due to the equipment payback periods involved in EPC projects. If the client defaults during the contract period the ESCO is stuck with an investment they cannot use. Resale is sometimes possible where it concerns generators or

[3] There is a subtle difference between these two. For example, the client may have equipment running that is not used, or have rooms heated or lit where no personnel is ever present. Stopping these "leaks" does not improve efficiency since the service is discontinued altogether.

removable installations, but insulation and windows for example have no resale value. This risk can be ensured or transferred to another party, which will be discussed in section 3.7

Finally, upon successful completion of the contract duration, the ESCO and the client are no longer tied to each other. Agreements need to be made on to whom the residual value of the installations flow, but for the rest the ESCO has made their profit during the contract period and the client is left with a functioning installation and accompanying benefits for the rest of the installation's lifetime. For optimal performance, the client and the ESCO may agree on extended O&M.

3 EPC Economics

We now have a basic understanding of what ESCOs are, how they operate and how a typical project evolves over time. Factors as economical and technical risk, M&V and Third Party Financing (TPF) have been introduced. How do these factors influence ESCO project arrangements ? What role does the tax environment play and how do all these factors influence transaction and installation costs ?

This section deals with the factors that are generally inherent to EPC arrangements. Factors that are perceived as either incentives or barriers by Dutch actors involved in the EPC business will be discussed in section 8.

3.1 Debt, capital, balance and divided ownership

Usually an EPC project has to attract external capital because the ESCO or Client capital may not be sufficient or reserved for other investments. This capital can be supplied by a Financial Institution (FI), which in turn demands securities or collaterals and interest. It depends on the creditworthiness of the ESCO and/or the client what interest rate is charged and what securities are required. This introduces a choice: who attracts the external capital ?

Debt to asset ratios[4] are an important measure for FIs to determine creditworthiness of debtors. If a debtor has a small debt to asset ratio, the creditor may assume that the debtor has a large sum of liabilities, such that changes in business climate or cashflow may hamper payment of the amortizations: the debtor has a smaller buffer. It may therefore be beneficial to have the debt in another party's balance, or have no debt in any balance at all; this can be the case with leasing and forfeiting.

An important construction to circumvent these issues is to have legal and economic ownership separated (Bleyl-Androschin & Schinnerl, 2010). The difference is who has control over the asset, and in whose books it is. For example, credit financing usually leads to both economic and legal ownership: The debtor buys equipment with the capital that was lended to them. On the other hand, with leasing, the lessor is the legal owner of the asset: they bought the asset and have final control over it, whereas economic ownership may be assigned to either the lessor or the lessee: Economic ownership means that the economic owner has the asset in their books and thus covers the depreciation.

Project implementation requires two components: the equipment itself, and the labor required for preparation (Taylor, Govindarajalu, Levin, Meyer, & Ward, 2008). These ingredients come with their associated costs. This includes for example notary fees, consultancy, the interest required and transaction costs. The former are called the hard(ware) costs, the latter the soft costs. The soft costs form the majority of the transaction costs. Financing soft costs is possible but comes at a higher price, since there is no way of recovering these expenses once made.

For the following sections, a number of considerations are important to keep in mind:

Not the whole project needs to be financed by external capital (Bailey & Johnson, 2009). The client or the ESCO may put in private equity or capital to reduce financing costs. These funds may come from the corporate investment capital, but this ability is limited due to the corporation requiring capital for its

[4] Debt to asset ratios can be conceptualized as the fraction (total liabilities) / (total assets). A ratio >1 means the company has more debt than assets or is highly leveraged, a ratio <1 means the opposite.

core business. Another method is to have the budgeted energy and O&M expenses directed towards the project's financing (Bleyl-Androschin & Schinnerl, 2010).

Lastly, the more "complex" a financing option becomes, the higher the transaction costs (Bleyl-Androschin & Schinnerl, 2010; Taylor et al., 2008). As a rule of thumb, the benefits of choosing a specific form of financing have to outweigh the costs of choosing that form over the other. However, there may be hidden benefits such as the division of risk or the convenience of dealing with only one party in a project.

3.2 The Principal/Agent problem

An important current affair is that of the principal/agent problem. This problem, otherwise known as the split incentive problem, occurs when ownership, use and utilities billing for rented premises are divided (OECD/IEA, 2007). It is the owner's responsibility to invest in the (energetic) quality of his building, since any change in the value of the premises directly affect the owner's balance and the building is the owners property. The user, be it a tenant or a company, pays a certain fee to the building owner as compensation for the use of that building, but not for the energy consumed in that building. That bill comes from the energy company and is paid by the tenant/user. So, if the owner invests in energy efficiency, the benefits from this investment directly flow to the tenant for the larger part, only leaving possible value increases of the building to flow to the owner's balance (Ryghaug & Sorensen, 2008). In other words, the owner gets little to no return on his investment.

On the other hand, the tenant/user may invest in more energy efficient equipment in the building they occupy. However, this severely limits the scale of projects that are carried out this way: The building owner may not agree with extensive modifications, or may be reluctant to take over equipment or investments when the tenant moves out.

In essence, both parties are locked into a situation where they have great incentives not to invest because of divided costs and benefits (Tambach, Hasselaar, & Itard, 2010). Basically, the business of ESPC is one way of solving this issue, if all parties can agree on the particular solution for their situation. That is to say that the owner and user of the building agree on what measures are to be installed, at what cost and how the benefits are to be divided

3.3 Tax environment and subsidies

Although subsidies and taxes are a policy matter, many countries share general characteristics on this topic. It is these general characteristics that will be discussed here.

The taxes that are most important to this topic – acknowledging the European context of VAT instead of sales tax - are the Value Added Tax (VAT) and corporate tax. VAT is a fixed percentage imposed on the sales value of virtually any good, some exceptions like medicines noted. To prevent accumulation of VAT over the progress of a value chain, commercial parties such as corporations can have the VAT returned[5], such that only the final non-commercial consumer pays the VAT over the final sales price of the good. Some parties are not able to have their VAT returned; public authorities for example do not always have this possibility (Bleyl-Androschin & Schinnerl, 2010). For them, it may be more attractive not to buy the

[5] http://belastingdienst.nl/zakelijk/omzetbelasting/btw_aftrekken/welke_btw_aftrekbaar/

goods but rent or lease them. This can reduce the acquisition price by at least 15% in the EU[6]. If one chooses for a rental or lease construction, the fees count as an operating expense that is deductible from corporate taxes[7].

Corporate tax is levied over the taxable profit that a corporation yields. Expenses that are necessary to conduct business are deductible from this tax. This includes interest, depreciation of investments and operational costs such as utility bills[7,8]. A number of special regulations for the deduction of investments are present in The Netherlands. These go under the names of EIA (Energie InvesteringsAftrek), MIA (Milieu InvesteringsAftrek) and VAMIL (Vrije Afschrijving MILieu-investering) and they will be discussed in section 5.2.7

For the deduction of investments and operating costs it is important who has these costs in the books. If one of the parties involved in the EPC project is in a more favorable tax regime, it may pay off to have this party keep the expenses or investments in the books, that is to say: parties can divide legal and economic ownership such as to profit most from tax deductions.

Subsidies, or more appropriately, financial support from the government, can come in a number of ways. The EPC project may receive a grant, certain equipment such as solar Photo Voltaic (PV) or Combined Heat and Power (CHP) may be subsidized, or the government backs a credit to reduce interest rates. The first two measures directly improve the project's financial performance; it reduces the investment costs. Loan guarantees reduce the interest rate, but if the party receiving the loan can deduct interest expenses from its tax a guarantee holds little added monetary value. A guarantee may however remove the barrier that a creditor perceives, such that a credit is assigned instead of not. Hence, a loan guarantee may not affect the project's profitability but it may be crucial to obtain a credit in the first place.

Table 1: Oversight of tax deduction options for public versus private parties

	Public parties	Private parties
Vat deductible	Not necessarily	Yes
Corporate tax deductible	no	Yes
Equipment targeted subsidies	yes	Yes
Grants	yes	Yes
Loan Guarantees	yes	yes

[6] http://ec.europa.eu/taxation_customs/taxation/vat/how_vat_works/index_en.htm
[7] http://www.belastingdienst.nl/zakelijk/ondernemen_kosten/ondernemen_kosten-02.html
[8] http://belastingdienst.nl/zakelijk/ondernemen_investeren/ondernemen_investeren-10.html#P103_12976

3.4 Payback periods and investment decisions

Recent research (Jackson, 2010) suggests that a large amount of EE projects is denied because of too simplistic risk assessment tools, most notably Pay Back Period (PBP), Internal Rate of Return (IRR) and Net Present Value (NPV). Jackson identifies EE investment opportunities in firms to take two distinct forms: Structural process improvements in light of new technologies and methods, and short period shutdowns for routine or emergency maintenance. These periods can be well used to implement EE investments.

Classical methods to determine project financial feasibility are

- PBP. To account for risk in this method, the desired PBP is set extremely low to as low as 2 years
- NPV
- IRR – setting the NPV to zero and solving for the desired interest rate. If the internal interest rate is higher than the cost of capital or the cost of finance, a project may be considered feasible.

$$NPV = \sum_{t=1}^{T} \frac{S}{(1+i)^t} - I$$

Note that both NPV and IRR methods require a payback period T to be fed into the algorithm (where S is savings, I is investments, and *i* the rate of return).

Accounting for uncertainty in NPV estimates is possible by altering the equation to yield

$$E(NPV) = \sum_{t=1}^{T} \frac{E(S)}{(1+i+r)^t} - E(I)$$

However, the risk factor *r* is difficult to estimate as few comparable projects are available to determine the risk factor. Other models such as the Capital Asset Pricing Model are unsuitable because the investment cannot be sold once the investment is made, as is especially the case with windows or façade upgrades.

Surveys conclude that payback analysis is more frequently used than NPV or IRR (Jackson, 2010). Four percent of firms use only one risk assessment model, all using only PBP. Five percent of multi-criteria firms did not use PBP analysis, whereas 90% of firms using either NPV or IRR also used PBP. The reason for applying rule-of-thumb decisions is most probably the complexity associated with EE investments. Loss aversion is mentioned as a reason for using these simple tools. For example, setting NPV to zero and dividing by S allows one to solve for T given any IRR. An IRR of 30% then requires a PBP of 3.1 years. Adding confidence intervals of 50% reduces the PBP to 2.0 years, effectively setting the IRR to 50% - an extreme demand for investments. However, these rates are considered required by the accounting rules of many firms, thus discarding many investments with probable outcomes on profitability. In short, risks associated with EE investments are often regarded very high (Jackson, 2010).

3.5 Credit financing

Credit financing is the most conventional way of financing EPC projects (Freehling, 2011; Taylor et al., 2008). The FI supplies capital to the ESCO or the Client under certain conditions: that the money is used for a pre-determined purpose (the ESCO project), paid back within a certain amount of time with a certain amount of interest, and collaterals(Bleyl-Androschin & Schinnerl, 2010). Creditors demand collaterals from the debtor as a means to back the credit in case of a debtor's non-performance. These collaterals can be assets from the debtor, the asset financed by the creditor, a principal that guarantees the debtor's performance, or (a share of) the guaranteed performance by the ESCO of the project (Freehling, 2011).

The borrower is either the ESCO or the client, but in general the party with the easiest access to credit. This reduces interest and therefore total project costs. Depending on who is assigned the credit, the debtor becomes both legal and economic owner of the asset financed with the credit. Credit financing typically covers 70 – 80% of the project's hardware costs (Bleyl-Androschin & Schinnerl, 2010).

Figure 6: traditional TPF. ESCO assumes both technical and financial risk (Bleyl-Androschin & Schinnerl, 2010)

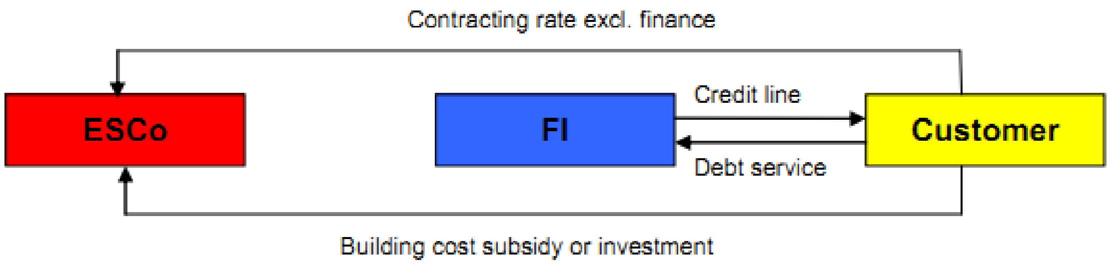

Figure 7: Alternative TPF: ESCO receives contracting fees, but financing goes directly from the client to the FI (Bleyl-Androschin & Schinnerl, 2010)

A distinction has to be made between project based credits and balance based credits. With project based credits, the collaterals and securities required originate for the largest part from the project cashflow itself to safeguard the credit. Balance based credit refers back to the financial situation of the debtor itself: its assets, equities and historic credit line, regardless of the project's profitability (Freehling, 2011; Taylor et al., 2008). It requires little explanation that project based crediting requires more knowledge about energy service performance contracting than balance based credits; This has implications for the costs, because expertise comes at a price and may not always be available. Lastly, the ESCO has to be able to back its guarantee on the project's performance. This security can be in the form of a security note by a bank, or it can be insured by a credit insurance company.

3.6 Measurement and verification

Measurement and verification play a key role in any ESCO project, since the "product" being sold is actually the absence of consumption, an intangible good. All parties involved in the project must agree on how much of a certain commodity is not being used, and in relation to which previous situation. These "negawatts" need to be measured and verified in a manner that satisfies all parties. M&V is especially important if the savings are guaranteed by the ESCO where this guarantee serves as collateral. The creditor needs to be able to follow the origin of the guarantee. This stresses the need for uniform measurement and reporting.

The International Performance Measurement and Verification protocol (IPMVP) (Efficiency Valuation Organization, 2010) is such a standard measurement and verification protocol. It is widely used for energy efficiency and retrofitting projects for buildings as well as parts thereof and installations. It is managed by the Efficiency Valuation Organization (EVO) and is acknowledged worldwide. It contains the world's current best practice guidelines towards evaluating energy efficiency projects in industry and commercial sectors (Ginestet & Marchio, 2010). EVO states that the benefits of using the IPMVP are, among others:

- A trusted methodology. Upon showing IPMVP adherent savings reports, ESCOs usually receive prompt payments
- Lower transaction costs: A standard method for measuring and reporting is already present, eliminating the need to further customize contracts
- International credibility for savings reports, facilitating the trade in energy savings worldwide.

The outset for the protocol is to supply anyone worldwide involved in energy efficiency measurements with a uniform method of reporting, measuring and planning. In their own words:

> "*To develop and promote the use of standardized protocols, methods and tools to quantify and manage the performance risks and benefits associated with end-use energy-efficiency, renewable-energy, and water-efficiency business transactions*" – (Efficiency Valuation Organization, 2010)

To this end, the report contains detailed guidelines on how to conduct measurements, determine baselines, deal with uncertainty or absence of data and how to set measurement boundaries. Scenarios specific for a range of situations are present: From installing only a handful of easily measurable Energy Conservation Measures (ECMs) to complete complex overhauls without meters present in some or all of the buildings. These scenarios are called options, and they will be discussed below. First, the general principles are discussed.

M&V should be as accurate as the M&V budget allows, paying explicit attention to the financial implications of under-reporting – increasing the perceived uncertainty and thus possibly the cost of capital – and over-reporting, which increases the costs of the project and therefore affects profitability. Reporting should be complete in the sense that measurable parameters are measured in as far as they are significant. Less significant parameters may be estimated. If estimations are to be made, they should be conservative or lower estimates. The IPMVP strives to generate results that are consistent between different kinds of projects, in the sense that the same considerations are made no matter what field of expertise the protocol is applied to. Lastly and perhaps most importantly, the reporting should be transparent; this means that all M&V activities should be fully disclosed whether it be project planning or project reporting.

The protocol then starts off with a very basic formula, the terms of which are elaborated on throughout the protocol:

Savings = Baseline use – Reported use ± Adjustments

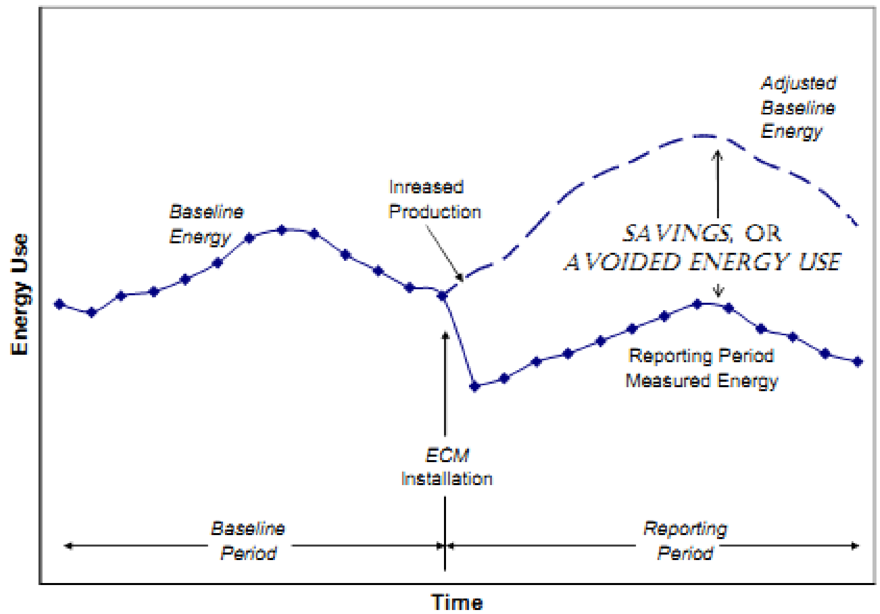

Figure 8: Baseline, savings and adjustments (Efficiency Valuation Organization, 2010)

Baseline measurements should always be as complete as possible. Effects of production volume, weather, occupancy of the premises and general performance of big factors in energy consumption should be taken into account here. This enables the reporter to determine actual savings independent of these often fluctuating parameters.

To measure energy consumption of any project, a suitable measurement boundary has to be set. This requires the ability to perform measurements within that boundary. Consequently, a decision has to be made of what to measure within that boundary: all equipment that is present, or only the new/modified equipment ? Sometimes estimates will suffice, for example when an installation has a constant load and a constant power demand. The next question is whether to monitor continuously, periodically or only once. Equipment with variable load, such as HVAC systems, is best monitored continuously. For other equipment like lighting a one-time measurement may suffice, given that the hours of operation are known. A last consideration is that of interactive effects. These arise when, for example, lighting is refitted to consume less power. This leads to a direct decrease in the lighting's power demand, but it has implications for the heating and cooling demand of that same room.

For some projects it is impossible to carry out measurements on (parts of) the project's performance. There are two distinctions to make herein. First, the building or complex that is the subject of the project may not have separate metering available, while the measures installed cannot be measured separately. This can be the case for a lecture hall insulation project on a university campus that receives one utilities bill for all buildings on the campus combined. Second, the building may have separate metering installed, but the scale and diversity of the measures is such that separate metering of all the component measures would not make sense, or is practically impossible.

All these considerations have led to the development of four different so called *options*. The protocol advises the user when to apply which option in what scenario. An oversight of these options is given in Appendix A: Oversight of M&V options in IPMVP

As a last and interesting observation, refurbishment projects may have Non-Energetic Benefits (NEBs). For example, improved air conditioning or a healthier climate in general may lead to improved productivity and reduced absenteeism. Another NEB could be avoided O&M. Also, companies that want to display an active CSR policy can include EPC projects in their CSR portfolio. Some of these NEB's can be monetized, such as avoided O&M, whereas worker happiness or even productivity is more difficult to factor into a contract.

3.7 Lease and advanced financial constructions

This section deals with advanced methods of risk and debt division. They are not commonly used as standalone measures since the majority of projects is credit financed[9]. However, they are still interesting to give a complete picture of what possibilities ESCOs have to finance their projects.

3.7.1 Leasing

One way of dealing with balance issues, ownership and risk division is a lease construction. Leases come in two flavors: A financial lease and an operational lease. This distinction will be covered later on, as the lease basics will be explained first.

When a lessor engages in a lease contract with the lessee, the lessee pays the lessor for the exclusive right to use that asset. The lessee does not engage in a credit (Bleyl & Suer, 2010). This means that the debt does not show on their balance, and neither does the lessee pay interest in the sense that this interest is to be mentioned in tax applications. Instead, the lessee pays the lessor a fixed amount of annuities. Even more so, in an operational lease, the asset is no in the lessee's books as well. This is favorable for the lessee's debt to asset ratio (Taylor et al., 2008). However, the annuities that the lessee is committed to are a factor in assessing the lessee's overall cashflow. This may still affect the lessee's creditworthiness when they seek to raise capital for other purposes.

Two different contractual relations for a leasing agreement are shown below:

[9] LBL project database

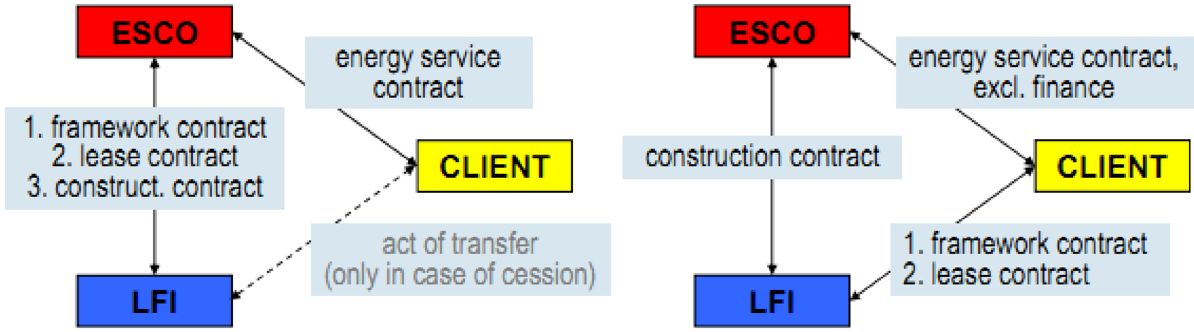

Figure 9: Contractual arrangements: Lease between ESCO and FI (left) and lease between client and FI (right) (Bleyl-Androschin & Schinnerl, 2010)

In the first (left) case, the ESCO leases from the FI. The client has only one party to deal with in the ESCO arrangement, and the ESCO takes both the financial and the operational risk.

In the right case, the ESCO assumes only the operational risk to begin with, whereas the FI takes the financial risk. This division of risk is an important parameter for the cost of capital. For the most financially advantageous setup, the party with the smallest risk should engage in the lease. Cashflows for both setups are shown below.

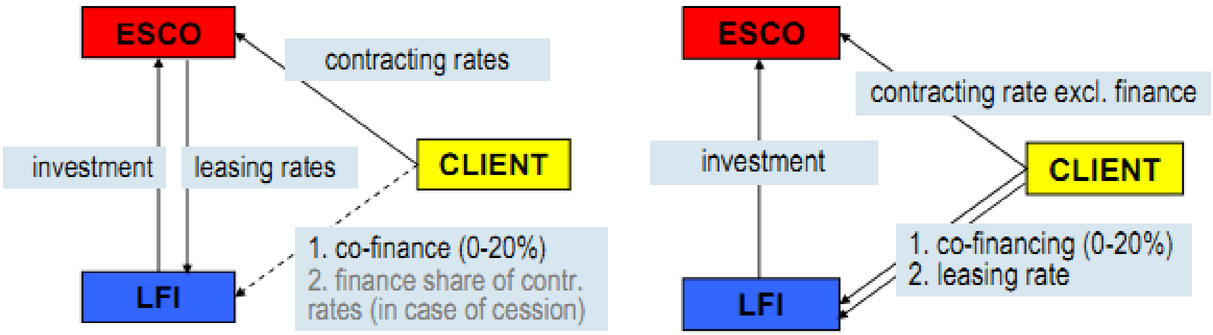

Figure 10: Project cashflows: Lease between ESCO and FI (left) and lease between Client and FI (right) (Bleyl-Androschin &

An option is for the ESCO to cede the lease contract (Bleyl-Androschin & Schinnerl, 2010). This means that the ESCO passes on the right to receive that part of the contract that is designated to pay the lease – not the operations – to the lessor. The client now has two parties to deal with; the ESCO for the operational part of the contract, and the lessor to pay the lease to. Doing so, the ESCO passes the *financial* risk on to the lessor, whereas the *operational* risk still remains with the ESCO.

An interesting legal issue arises when we discuss the difference between a lease and a normal credit. Cashflows for both situations are given below. For keeping oversight, in both situations the ESCO takes the credit / operational lease.

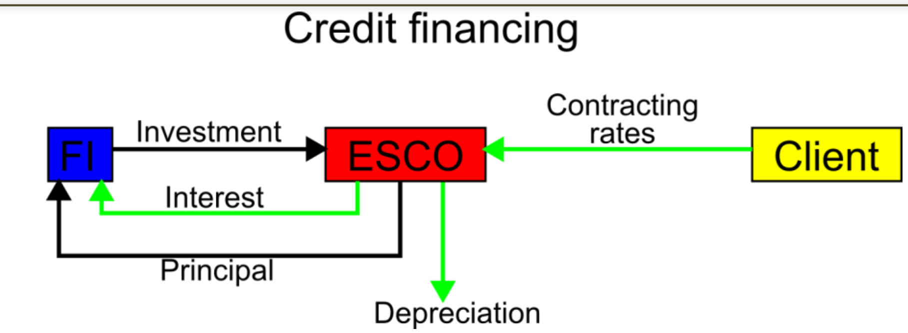

Figure 11: Credit financing cashflows. Deductible expenses in green

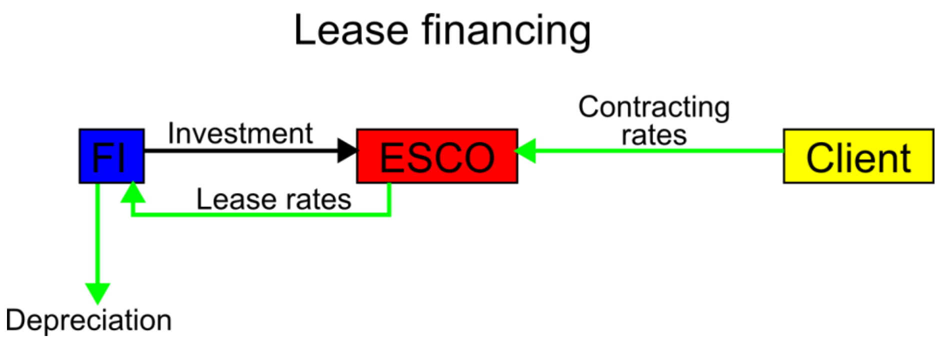

Figure 12: (operational) Lease cashflows. Deductible expenses in green

In a credit financing situation, the ESCO becomes economic and legal owner of the assets provided to the client. The ESCO can deduct interest and depreciation from its taxable income as operational expenses, but not the principal. For the client, the contracting rates are an operational expense and therefore deductible as well.

In a (operational) lease financing situation, the ESCO pays the lease rates to the FI, which are an operational expense and thus tax deductible. The client still pays only their tax deductible contracting rates as in the credit situation (Bleyl-Androschin & Schinnerl, 2010; Taylor et al., 2008). Now, in this leasing case, both the ESCO's expenses as well as the client's expenses are tax deductible, leading to a net lower revenue from taxes for the government. If this setup were not further regulated, all parties would gain a nice tax cut.

Of course, governments worldwide rather not let this happen. To ensure that not the full cost of the assets is deducted from tax, the FI is prohibited to automatically transfer ownership of the assets to the lessee (Bleyl-Androschin & Schinnerl, 2010). The lessor then seeks to sell the asset, and this implies that the asset should be removable from its place of installation after the contract period has expired. This is possible, for example, for generators or solar PV installations, but not for assets that become a part of the building such as windows, insulation and facades. This matter thus limits the availability of lease financing to movable assets, ruling out comprehensive ESPC measures that often include building shell modifications.

Now let's get back on the financial lease vs. operational lease construction. An operational lease is the most common implementation. In that case, the lessor acquires the assets that the lessee wants to use and charges a flat fee to the lessee for the exclusive right to use these assets. The assets are legally owned by the lessor – it is his property – and are in the books of the lessor, meaning that the lessor has the assets on its balance as well as the depreciation.

A financial lease is more comparable to a credit, except that legal ownership is with the lessor. The lessee still pays the lessor for the right to use the asset, but has the depreciation on their account instead. This may be desirable if the lessee is in a more favorable position than the lessor to write off depreciations, for example when either of the parties is in a different tax regime.

Finally, VAT comes into play in an interesting way. In a lease, the FI is always the party acquiring the asset and thus the one that has to pay VAT. Since an FI is always a commercial party able to deduct these expenses, this situation may be favorable for parties that cannot deduct the VAT. Also, the VAT is pro-rated over the lease term to the lessee, such that this chunk – usually around 20% in the EU – does not have to be paid up front all at once.

Leasing financial institutions – more than standard creditors – examine a proposed project more carefully, since they take a financial risk by becoming the legal owner of the asset. This motivates them to conduct more in depth research towards the project profitability, and have more knowledge on a specific field of financing in general – for example, the field of energy services. Although this expertise comes at a price, leasing financial institutions also often handle acquiring subsidies and seek to gain the lowest overall cost of the asset. This is beneficial for the ESCO and the client because it reduces their paperwork and preparation time, and may increase the subsidies and tax incentives hauled in.

3.7.2 Cession and forfeiting

Cession and forfeiting is a financing form not often used yet, but it may hold several advantages that are not present in leasing and credit financing(Bleyl-Androschin & Schinnerl, 2010). When the ESCO has taken a credit or engaged in a lease, they may choose to cede their claims on the client towards the FI. As such, the FI now directly receives the financing part of the ESCO contracting rates, such that the ESCOs debt is amortized by the client (Bleyl-Androschin & Schinnerl, 2010). If this goes paired with the FI assuming financial (not operational) risk, the ESCOs debt to asset ratio is technically restored to the situation before the project. Also, the client’s receivables may function as a collateral towards the FI, which in turn may reduce the cost of capital as the FI assumes lower risk with extra collaterals. This construction can be used at any point in the project’s lifetime to refinance the project, for example when the ESCO wants to improve its credit rating. A diagram of the cashflow and contractual relations is given below.

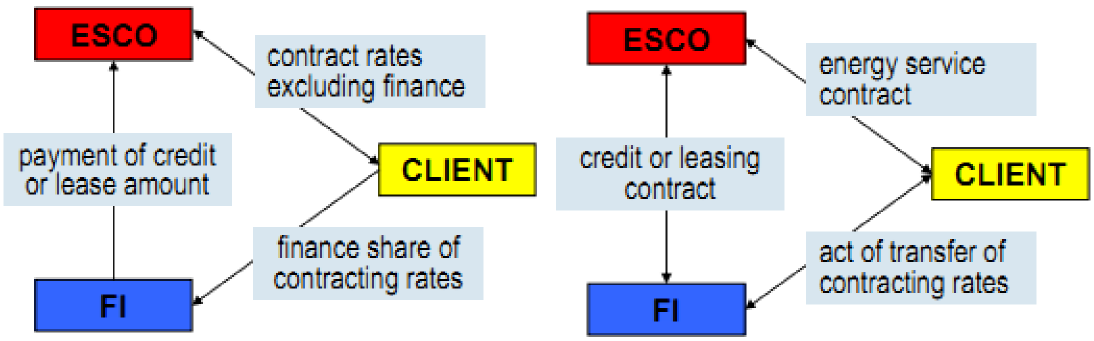

Figure 13: Cession cashflows (left) and contractual arrangements (right) (Bleyl-Androschin & Schinnerl, 2010)

Pure forfaiting is another option. In this case, the ESCO does not engage in a credit or a lease, and neither does the client. Instead, the project's future cashflow is sold to an FI upfront. The FI then pays the ESCO the discounted sum, with which the project is financed. See below.

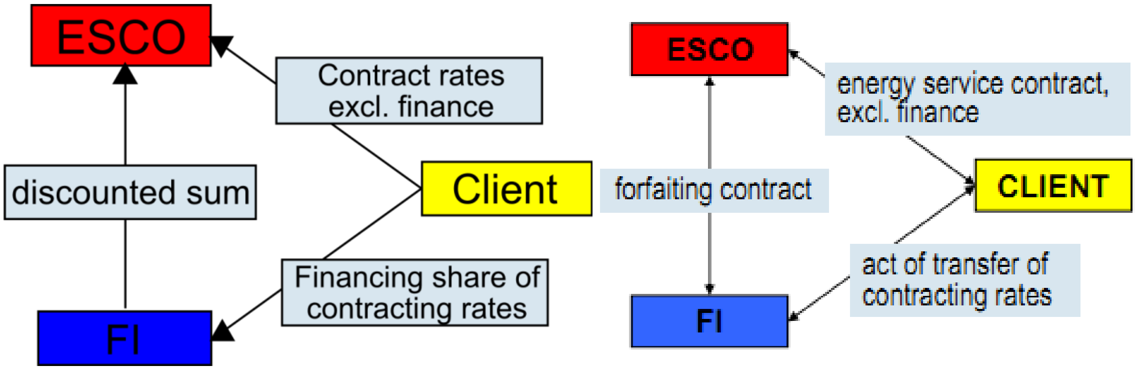

Figure 14: Forfeiting cashflows and contractual arrangements (Bleyl-Androschin & Schinnerl, 2010)

A major advantage of this arrangement is that it enables parties to divide ownership, performance risk and financial risk in an optimal situation, so as to reduce finance costs to a minimum. As with leasing, all payments by the client and the ESCO are flat rates without interest that can be filed as operational expenses.

A hurdle for this setup is that the receivables need to be undisputed which implies the presence of trust between all the parties. This is easier to overcome as the FI has more knowledge about energy services projects. On the other hand, a lack of trust may lead to increased capital costs.

4 Current situation and potential

Now that the reader knows the details of ESCOs and EPC, it is time to study the industry in The Netherlands. How, if at all, are ESCOs currently operating in The Netherlands ? What kind of other ESCO-like activity is there, how may those activities interact with ESCO operations and their profitability ? This section ends with the market potential and estimates of future ESCO revenue. Or, to be concise: the section begins to explain what's already happened and finishes with what is still left and in which sectors

This section is largely based on two studies towards the Dutch ESCO market. In 2009 an assessment has been performed at the Energy Research Center (ECN) of The Netherlands by Boonekamp and Vethman (2009) as part of the ChangeBest[10] program. More recently, BuildDesk (a policy consultancy firm) published a market assessment commissioned by Agentschap NL[11] towards the potential of ESCOs in The Netherlands, by Schneider and Steenbergen (2011). Both studies concluded that there is so little ESCO activity in The Netherlands that it is hard to give a comprehensive analysis of the current state of the market. However, both studies performed market potential analyses that are in mutual agreement, and both studies conducted interviews with market parties that gave important insights as to how market parties perceive barriers and opportunities, both economic and political in nature.

4.1 Current ESCO market

Compared to other (European) nations, The Netherlands has an underdeveloped energy services market (Bertoldi et al., 2006; Bleyl-androschin, 2010; Marino et al., 2010; Okay & Akman, 2010; Vine, 2005). Although there are over a thousand ES companies presently operating in The Netherlands, only 50 of them consider energy efficiency as their core business (typifying them as an ES supplier), of which only 20 state to assume any kind of financial risk in delivering their services (typifying them as an ESCO) (Boonekamp & Vethman, 2009). Only two of these twenty companies are subsidiaries of energy companies, the larger part is a subsidiary of some large construction company and the rest is independently owned. Most of these companies deliver services of the thermal energy storage (TES) type, which has been on the rise in recent years.

The sectors in which Dutch EESC operate are limited, mostly to public administration, commercial offices and healthcare facilities. They focus on energy-efficient architectural design, CHP, thermal energy storage and heat pumps, insulation and O&M. A large part of these technologies are applied in new building projects. Commercial buildings and (central) government buildings are the largest customer groups of ESCOs, however some specialized ES suppliers do exist, focusing on public swimming pools for example. When industrial customers are targeted, their core production processes are usually left untouched. Instead, focus lies on supporting facilities as compressed air, offices or other buildings. In general, Dutch ESCOs tend to target energy consumers with bills from €200.000 up to €500.000. The main reason for this high threshold is the high transaction cost involved with EESC projects (Schneider & Steenbergen, 2011).

The (public) housing sector remains largely uncovered by ESCOs. The first barrier is the principal/agent problem. If housing corporations or landlord invite an ESCO to improve the energy efficiency of their

[10] http://www.changebest.eu/ This initiative is part of the EU's implementation of directive 2006/32/EC, see section 5.1.5

[11] Agentschap NL is the Dutch agency for innovation, sustainability and international entrepreneurship.

dwellings, these improvements need to be reflected in the rates that the tenants pay. The annual increase in rental rates is fixed for public housing in Dutch law, whereas the tenants pay their utilities bill directly to the utilities company. Private parties face a similar problem as they need to renew their rental agreements with their tenants. The issue for public housing is currently in motion as the Dutch government has developed policy that links the rental rates in the residential sector to the energy performance of a building. Secondly, and perhaps more important in a technical sense, are the high transaction costs. This is related to the housing corporation's inability to cluster homes in such a way that ESCO projects become feasible for their properties. For small scale landlords this problem of transaction costs is even more significant; one may assume that no landlord's property or his tenants reach the astronomically high utilities bill of €200k - €500k.

4.2 ESCO Market potential

Between € 21 – 65 M annual revenue from clients starting at € 200.000

The Energy Research Center of the Netherlands, ECN, estimates The Netherland's economical potential for the EES market to be in the range of € 35 – 165 M (Boonekamp & Vethman, 2009). The larger parts come from the services sector (€ 21 – 65 M) and the housing sector (€ 12 – 62 M). These numbers are derived from the gross attainable yearly energy savings of 10 and 8 PJ primary energy in the housing and services sector respectively. It is important to stress that the 10 – 8 PJ figure by Boonekamp & Vethman is the total achievable savings potential *before* this is converted to ESCO revenue. The methodology to derive EES revenue from primary energy savings has not been described in detail, but among others the following factors have played a role: economic achievability of measures, implementation rate, the fraction of savings that go into EES revenue, the fraction of savings actually achieved by using EES.

Schneider and Steenbergen (2011) used a more documented approach to estimate the total EES(C) market size in terms of both energetic and monetary achievable savings and EES revenue. Their primary energy savings value is what ESCOs could actually achieve, as opposed to Boonekamp & Vethman's gross figure for EE potential. Their basis is a bottom-up approach using a database with the gross floor area of the majority of non-residential buildings. They then continued to determine which measures could be offered as an energy service and factored in the (maximum achievable) penetration of each measure. This results in the maximum technical potential, which is converted to an annual figure by factoring in the renovation pace of buildings and the lifetime of each measure.

To assess the market potential, figures for typical payback times and contract durations in each sector have been factored in, discarding unfavorable projects. They then continued to factor in the possible rate of success, specific for each sector such as commercial offices, hospitals, government buildings and so on. This rate of success is determined by factors such as combined ownership and use, and prior successes for specific markets or building types. It enabled the authors to devise a method of quantifying parameters such as trust, acquaintance and support.

Doing so, the following results were obtained:

Table 2: GHG reductions, energy savings and estimated annual turnover per sector. All figures on annual basis. Turnover figures in million Euros nominal.

Indicator	Education	Healthcare	Retail	Offices	Offices (Gvt.)	Ware houses	other	total
CO_2 reduction (Mton)	0.18	0.32	0.11	0.25	0.1	0.06	0.06	1.07
Energy savings (PJ)	0.13	0.23	0.09	0.23	0.06	0.05	0.05	0.86
Current turnover								4
potential turnover 2011-2012	11	9	6	24	12	4	3	69

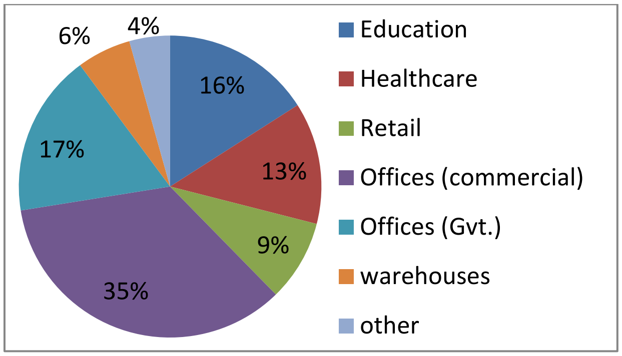

Figure 15: Potential market shares per segment

It is important to stress that these future revenues come from *existing* buildings because both Boonekamp & Vethman and Schneider & Steenbergen based their assessments on inventories of existing buildings' floor areas.

4.3 Barriers perceived by ESCOs

Barriers that market parties involved in the ESCO business perceive can be diverse and general, ranging from lack of trust to technical difficulties as determining the client's baseline. The general issues will be discussed first, after which we will zoom in to market segments that take up a big share of the potential market: Offices, educational facilities and healthcare.

On the demand side, a big share of the barriers is inherent to the fact that the market is underdeveloped. Demand side parties find it difficult to grasp what an ESCO or EPC project actually entails, and what it means for their enterprise specifically. They have little knowledge of the concept, such that the option of EPC doesn't even spring in their minds, if they even consider EE at all. It is an old Dutch saying that the unknown is unloved.

Trust, knowledge and information are as important as quantitative factors

Oftentimes potential clients have no priority towards EE in their company. An element in this factor may be that they believe that EE is something that comes from the top down, i.e., government and regulation takes care of it. Another more tangible factor is that enterprises direct their capital to their core business, such that EE investments lose in competition with other investment opportunities.

Another difficulty is that those EE projects that are implemented are not being implemented by ESCOs. The potential client may, for example, have the necessary knowledge and means in house, such as the case of the RGD, section 4.6. Unfamiliarity with EPC also leads to lost opportunities for ESCOs. A cultural factor herein is that potential clients do not consider the concept of Total Cost of Ownership (TCO) of their premises. Sometimes, when potential clients are aware of EPC, they have too high expectations of the concept that the ESCO cannot deliver. Finally, the demand side may experience internal resistance towards the EPC concept when the client has an in-house facility service that regards the ESCO as a threat to their operations. It may also be that the client lacks the knowledge to assess the ESCO's offer in terms of legal and financial implications.

Barriers that originate from the immaturity of the market are present on the supply side of the market as well. Aside from the internationally acknowledged general understanding[12] of what EPC is, Dutch ES suppliers rank installation and exploitation of TES installations or insulation in new building projects under the EPC umbrella. This confusion adds to the uncertainty that the demand side perceives.

Specific difficulties are experienced by Dutch EPC suppliers that originate from the very aspect of EPC. These are how to arrange financing or capital, risk division between parties, legal, technical and organizational matters.

As discussed in section 3.7, EPC projects can be financed project based or balance based. The Dutch EPC projects that are carried out usually rely on project financing. Although this may be beneficial since the actual financial position of the client is less relevant, the assessment of the feasibility of a project in financial terms towards the FI is labor intensive. This raises the transaction costs. Also, since the projects are financed separate from the client's balance, FIs demand a large amount of collateral and securities that smaller clients cannot provide.

The long contract duration that is typical for EPC introduces risks of technical or economic non-performance as discussed in chapter 3. The absence of standards or established methods of contract drafting, M&V and financing in The Netherlands increases these risks, since for each EPC proposal one has to reinvent the wheel. The desire for standards is therefore strongly pronounced by parties from the supply side as well as the demand side.

Finally, an unstable policy environment concerning environmental issues has a big impact on the feasibility of EPC projects (Boonekamp & Vethman, 2009). During the last decade, the Dutch government has often either called to life or discontinued policy and subsidies that affect innovative enterprises in the environmental sector. Several studies (K V Organisatie-advies, 2010; Meijer, 2007) concluded that this effect is detrimental since it increases the entrepreneurial risk because of uncertain external factors.

As seen in Figure 15, the offices (35% + 17%), education (16%) and healthcare (13%) sectors take up large fractions of the potential market. It therefore pays off to discuss their specific situation.

Commercial office owners that want to implement EPC face the difficulty of claiming the energy benefits an EPC project delivers from their renters – the classic split incentive. Building owners then may

[12] See section 1.2

choose to include energy costs in the rental agreement; however this means that the building owner takes on the financial risk of energy costs that the renter makes, which is not in control of the property owner. For the government offices sector, the problem arises that they cannot always make use of the Energy Investment Deduction (EIA, See section 6.2.7) since this tax incentive is only available to corporations that make a profit. They may then choose to have the ESCO incur the expenses on EE investment. This introduces issues as legal and economic ownership, adding to the transaction costs because of increased complexity. Or the ESCO is reluctant to take the assets on their balance to maintain a certain desired debt to assets ratio.

The healthcare industry is reported to have little incentive towards implementing EE because of the relatively small fraction that energy expenses make up, according to interviewed professionals from the healthcare sector (Schneider & Steenbergen, 2011). If they do acknowledge the desirability of EE improvements in their facilities, this is because of their commitment towards CSR, followed by arguments of monetary savings. Increase in value of the properties that the healthcare sector occupies is a minor argument. Buildings are usually purpose built to be a hospital and remain in ownership of the hospital indefinitely. There is therefore no resale value on which the value increase can be capitalized. Lastly but just as important is that the healthcare sector is reluctant to outsource HVAC operations. This is because clean air of constant quality is very important to the product hospitals deliver, so they want to keep tight control over it.

The education sector has a large building stock and hence potential market share. A distinction has to be made between elementary and high schools versus colleges and universities, which we will call lower education and higher education respectively. Lower education premises are usually funded and owned by the municipality in which they are situated. This instantly creates the situation that any ESCO dealing with lower schools has to deal with at least two parties: the school's board as the building user and utilities payer, and the municipality as the building owner. Lower education schools in The Netherlands have tight budgets, such that lower energy bills or refurbishment of their buildings funded by EPC projects is a welcome opportunity. They do need the consent of the municipality before committing to real estate expenses or investments, since lower schools are by law not allowed to spend their budget on real estate. Therefore, this is a classic split incentive case. Higher education parties often have their premises in own possession, such that their situation is similar to that of office building owners with the exception of laboratories or other energy-intensive equipment often present; their additional energy use may increase the viability of EPC in higher education, if the equipment can be made more efficient.

4.4 Market opportunities for ESCOs

As seen in the barriers section, there is a great demand for standardization and clarity in general; to reduce uncertainty and misunderstanding and to increase trust. Also, there is demand for examples and best practices. These needs can be satisfied by founding a central organ such as the American National Association of Energy Service Companies (NAESCO) that offers standards, best practices and mediation in bringing parties together; it should act as a knowledge base. Related initiatives already exist, such as the Meer met Minder (MmM) program for private home owners and the Platform Energy savings for the Built Environment (PEGO). The latter serves as a knowledgebase primarily towards and between higher level parties, such as policymakers and industry officials. Actors in the Dutch ESCO sphere acknowledge that a more focused knowledge mediator is beneficial.

An interesting opportunity lies in the commercial offices sector. Currently, 14% of all Dutch office space is vacant (Schultz van Haegen, 2011). It is reasonable to assume that parties seeking office space will take the best offer in terms of TCO. This creates an opportunity to refit the vacant buildings such that they become more attractive, with the added benefit that there is no nuisance of construction since the office is vacant anyway. This way, the owner of the vacant building can increase the value of his property, attract new tenants and charge them higher rates because of the increased comfort and lower energy bills (Boonekamp & Vethman, 2009).

The government offices sector is another interesting opportunity. Since the Dutch government set targets for using exclusively nearly zero energy buildings and 100% sustainable procurement by 2018 (EL&I, 2007), they will need to either occupy new office buildings, or have their current buildings renovated.

Finally, the healthcare sector has shown increasing interest in CSR. Their advisors can be informed of the EPC opportunity. Additionally, a significant share of their building stock is approaching the end of its economic life and has to be renewed. Finally, housing corporations increasingly facilitate the needs of the healthcare sector that is involved in long term care, for example by supplying homes for the elderly with nursing and healthcare incorporated. These corporations are tied to EE commitments via the Covenant Energy Savings Corporation Sector (Rijksoverheid & Woningcorporaties, 2008), see section 5.2.4

4.5 Case Studies

4.5.1 City Hall, Sittard

Examples of ESPC projects in the Netherlands are rare. Boonekamp and Vethman (2011) typified the range of ESCO-like companies operating in the Netherlands and globally the ways in which they operate, but details are very scarce. One find is an ESPC project carried out for the city of Sittard (Bleyl-androschin, 2010). This example is of particular interest because it is one of the first and few pure energy performance contracting arrangements.

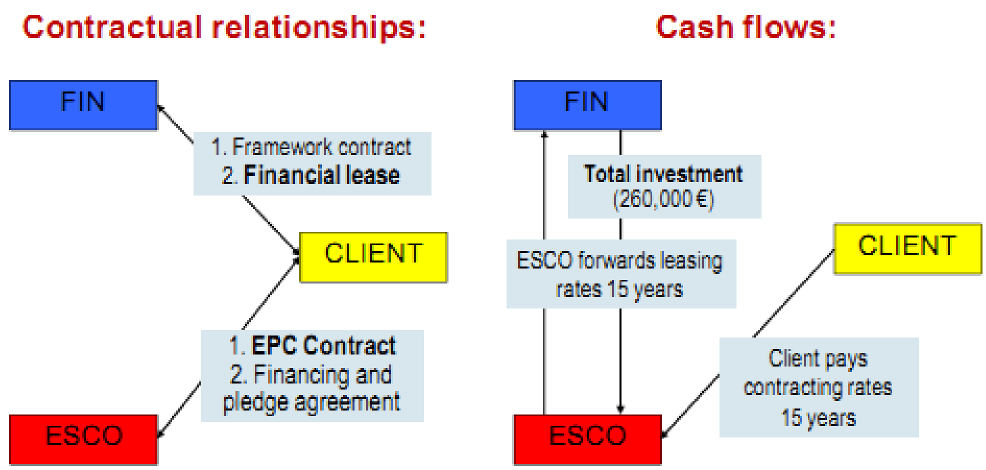

Figure 16: Project setup for the Sittard municipality ESCO project (Bleyl-Androschin & Schinnerl, 2010)

The project setup is given above. The city of Sittard is engaged in an energy service performance contract with Essent Energy Services, who hired independent contractors to implement the measures physically. The capital is provided by a financial lease from ING to Sittard. Essent then uses the money from the lease to cover operations and implementation expenses while being paid for these services by Sittard. In the payments, Sittard forwards the leasing fees to Essent who then passes them on to ING. Using this construction, Essent is able to make use of Sittard's excellent credit rating, because Sittard is a municipality. This ensures the lowest cost of capital. Essent continues to operate the facilities for the agreed term, and extra savings are split on a 50/50 basis.

4.5.1 The Rotterdam Green Building program

The city of Rotterdam has taken the initiative to improve the performance of their complete building portfolio[13] as part of the Clinton Climate Initiative[14]. In the long term all real estate owned by the city of Rotterdam should be thoroughly renovated to reduce energy and water usage significantly. As a first part and pilot of this project, the city's nine public swimming pools have become involved in EPC.

The swimming pools have attracted the Dutch construction company Strukton as their ESCO supplying guaranteed savings, with third party financing supplied by the BNG (Bank Nederlandse Gemeenten, Dutch Municipal Bank). Project implementation is due in 2012; the 10 year contract ends in 2022. Significant savings are projected in this period, as displayed in tables 2 and 3.

[13] http://www.rotterdam.nl/eCache/TER/10/95/654.html
[14] http://www.clintonfoundation.org/what-we-do/clinton-climate-initiative/cities/building-retrofit

Object	% Besparing Elektra (kWh)	% Lokale opwekking Elektra (kWh)	% Besparing Gas (m3)	% Minder Warmtegebruik (MJ)
Schuttersveld	26%	91%	31%	
Bad West	27%	88%	36%	
Overschie	20%		60%	
Wilgenring	22%	70%	30%	
Alexander	27%		63%	
Afrikaanderplein	21%		56%	
IJsselmonde	22%		55%	
Charlois	22%			35%
Hoogvliet	27%		58%	

Table 3: Rotterdam Green Building Program results

Totale besparing 2012-2021	Eenheden	% Besparing t.o.v. baseline
Gas (m^3)	5.246.837	43%
Elektriciteit (kWh)	7.412.343	24%
Lokaal opgewekt (kWh)[1]	9.696.000	32%
Water (m^3)	50.045	9%
Warmte (MJ)	13.290	35%
Teruglevering (kWh)	744.692	-
CO2 (…)	pm	-

Table 4: Rotterdam Green Building program results

4.6 State Buildings Service (RGD)

It is remarkable that both Boonekamp et al. and Schneider et al. assign a very significant EPC market share to government buildings. Although Marino et al. in their 2010 study (Marino et al., 2010) make no reference to it, in their 2007 study (Bertoldi, Boza-kiss, & Rezessy, 2007) they mention that the Dutch government's central buildings service (RijksGebouwenDienst, RGD) is implementing energy savings projects and building refurbishments for government buildings.

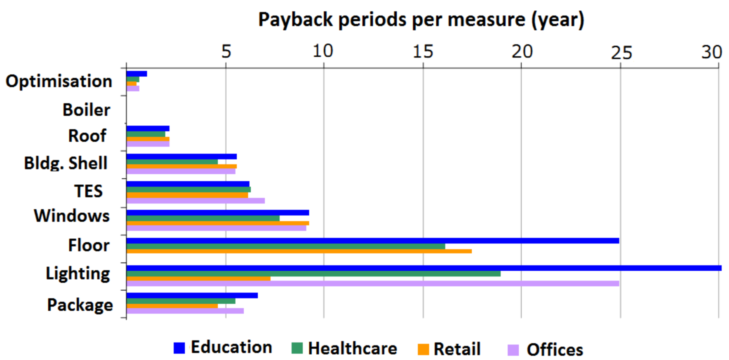

Figure 17 Payback period in years in The Netherlands (Schneider & Steenbergen, 2011)

The 2010 RGD report (Rijksgebouwendienst, 2010) confirms this finding, and the scale of the operation is not to be underestimated. The portfolio includes prisons, museums, laboratories, courthouses and general office buildings. The operations being conducted are not a total haul over or combination of measures often found with normal ESCO operations. Instead, the RGD has primarily been focusing on retuning the HVAC equipment for minimal energy consumption, claiming energy savings of up to 30% (Rijksgebouwendienst, 2010). One might be led to believe that there is still a reasonable amount of work left for ESCOs in buildings after the RGD projects, but taking out the most profitable measures seriously affects the total package profitability. See Figure 17

One may reason that the expectations of Boonekamp and Schneider of the government buildings market may be based on energy services instead of EPC delivered to the government. This is however not the case, since both Boonekamp and Schneider explicitly exclude ES providers from their analyses. The RGD activities are not a desirable development. It could not only stall ESCO interest in government complexes due to lower profitability of the project mix (see Figure 17: optimization has the shortest payback period), but could also lead to a lower total amount of energy saved per building: If the "low hanging fruits" cannot finance the more expensive measures or those with a longer payback time, these measures may not be implemented at all, leading to a loss of opportunity to save energy and money.

Aside from this current operation, the RGD together with Agentschap NL have issued a study towards future office space use and how to improve their building portfolio. This study has been issued because the Dutch government is committed to sustainable procurement since 2010 (DHV, 2010). The sustainable procurement rules for existing buildings can be summarized as follows: Buildings that undergo a renovation must implement all economically viable measures to reduce energy consumption up to a PBP of 20 years. When it concerns technical building installations this PBP is 10 years (VROM, 2010a). Buildings that are newly acquired (but *not* by construction) or rented must have at least energy label C. If this demand cannot be met, the building's energy label should improve with at least two steps until it reaches label C, or all measures with a PBP of less than ten years should be applied (VROM, 2010b). Newly constructed buildings will be omitted in this discussion since they are either covered by EPBD and ESD regulations (see chapter 5) or not interesting for EPC projects, since EPC implies existing buildings.

The current building stock energy labels are depicted in Figure 18.

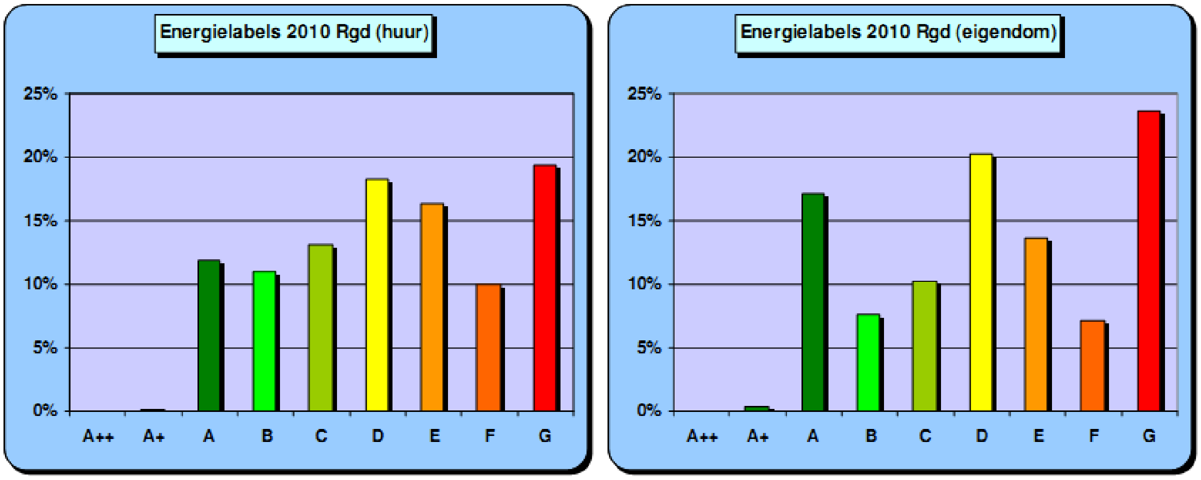

Figure 18: National government building stock. Based on sample size of 170 buildings or 1.850.000m^2 (DHV, 2010)

The DHV report mentions three scenarios in which the building stock could improve EE. The first considers only RGD buildings (either rented or owned) without big changes in used floor area. A second scenario considers only RGD buildings as well, but envisions a 29% decrease in floor area due to shrinking government and more efficient use of space. A third scenario assumes that 20% of commercial offices will "follow" the RGD trend. This last scenario will not be discussed as it seems improbable and the focus of this section lies on the RGD.

By applying the criteria for sustainable procurement, the buildings in ownership of RGD in2020 will have the label assignment as shown in Figure 19.

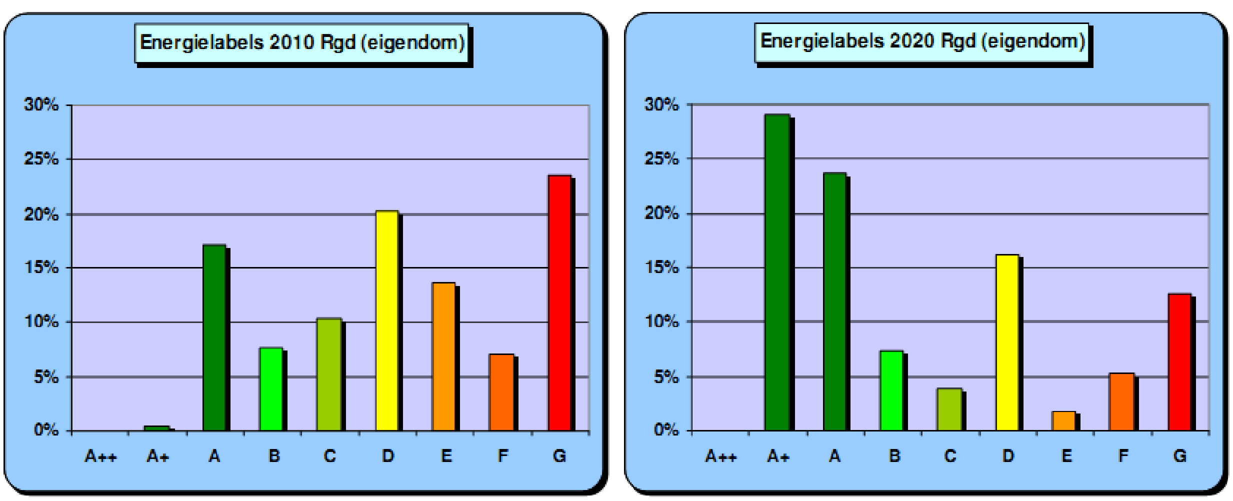

Figure 19: Label distribution in 2010 and 2020 for RGD owned buildings (DHV, 2010)

Rented buildings in 2020 should have energy labels as shown in Figure 20

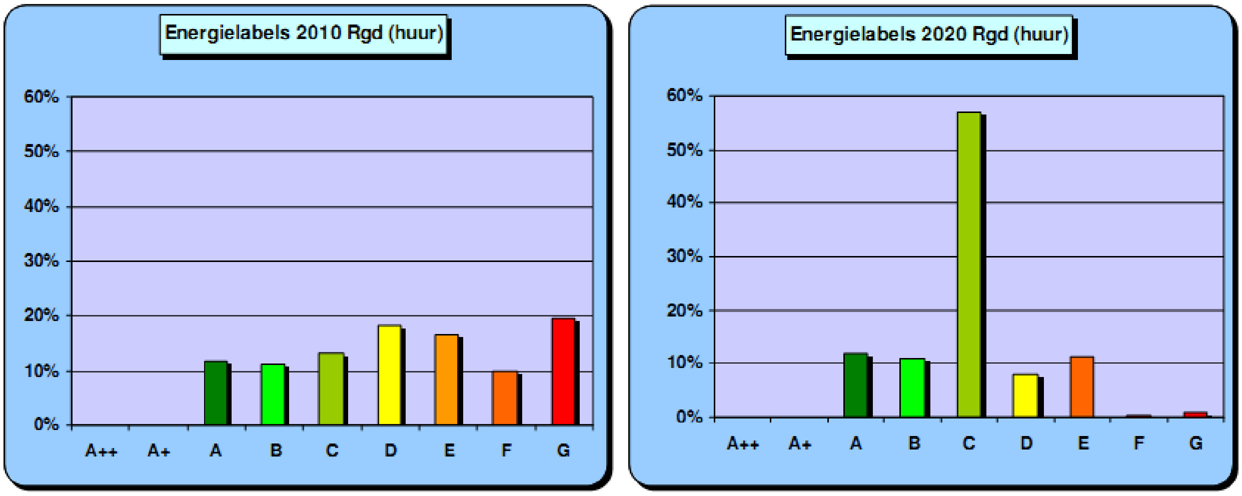

Figure 20 Label distribution in 2010 and 2020 for rented buildings (DHV, 2010)

This policy is assessed to have an effect of around 15% GHG emission reduction in 2020 annually, for rented as well as owned buildings. Since it is safe to assume that the buildings do not cause significant GHG emissions other than CO2 one may assume that the EE increase lays in the same region. It leads to an average energy label B for the entire stock(DHV, 2010), but keeps the majority of the sum of buildings that are rented or owned in class C or lower; see Figure 19 and Figure 20.

When the expected decrease in floor area is taken into account, another picture arises. See Figure 21-Figure 22

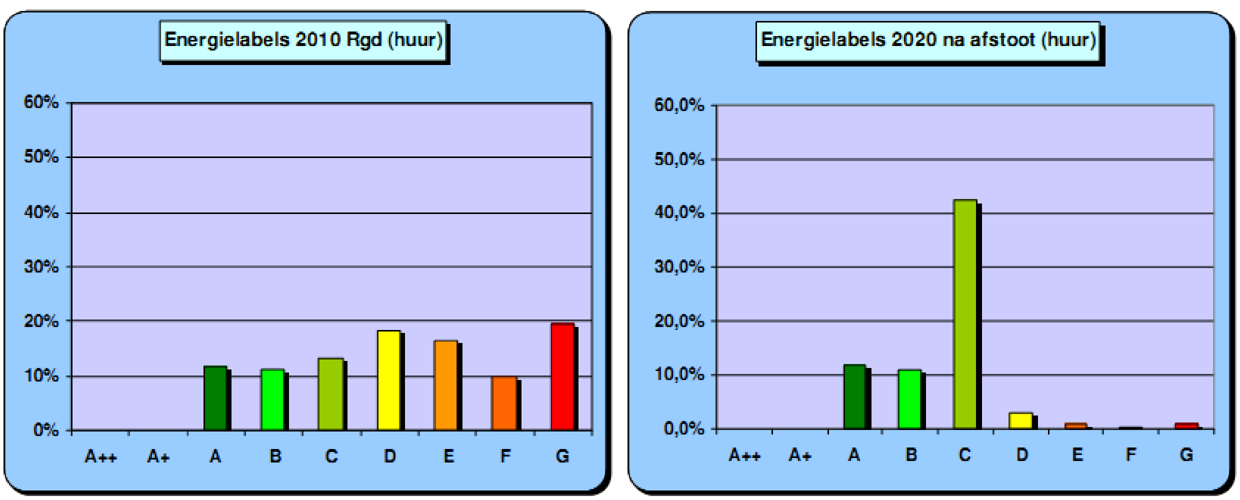

Figure 21 Label distribution in 2010 and 2020 for rented buildings after vacating old buildings (DHV, 2010)

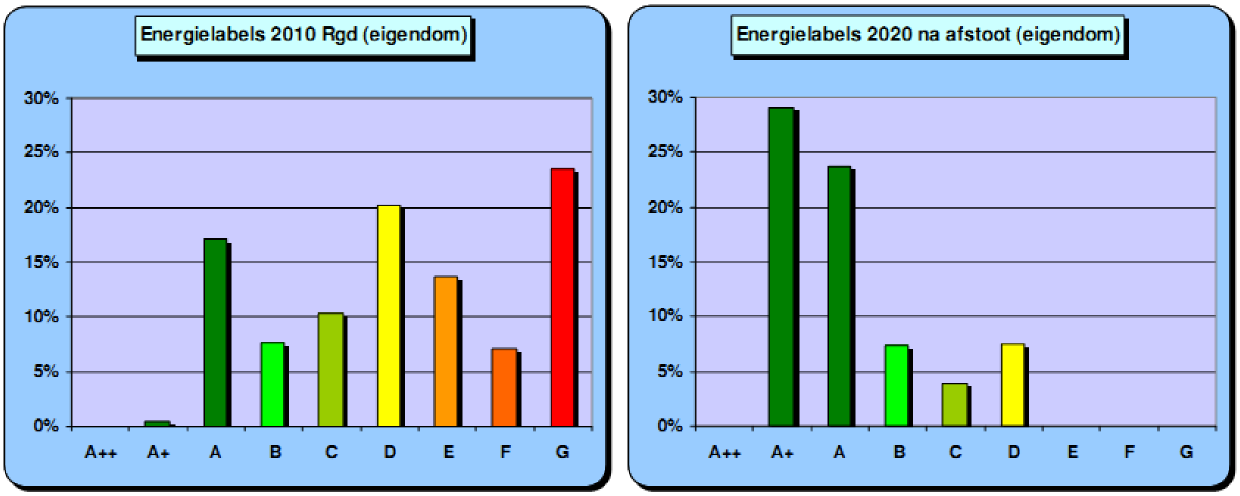

Figure 22 Label distribution in 2010 and 2020 for RGD owned buildings after vacating old buildings (DHV, 2010)

With decreasing need for floor space, RGD chooses to vacate the most inefficient buildings. This does indeed greatly improve their energy efficiency, by an extra 32%, but this improvement should only count if the buildings are physically removed from the Dutch building stock: otherwise it is just a matter of bookkeeping without real effects because the older buildings may become occupied by other parties.

It seems that a 16% increase in EE for buildings in ownership is on the low side, but one must keep in mind that the increase is over the total portfolio. If renovating 40% of the buildings yields a 16% increase in EE, the renovated part sees an EE increase of 40%, which is on the high end. However, new construction and acquisition also takes place and these new buildings are targeted to have at least label A (DHV, 2010). This also influences the mix. Unfortunately, the DHV report does not give disaggregated statistics to settle this matter. A hint for what improvements are applied in the buildings lies in the fact that measures with a PBP up to ten years for minor renovations are included in the 16% figure (DHV, 2010). The possibilities for major renovations are described more vaguely but should be at least as comprehensive as those for minor renovations. The question remains whether the PBP of ten years is the limit *per measure* or for the *total package*. As the sustainability procurement directives put it, it seems that only *per measure* PBPs are considered.

Finally, the RGD is implementing prospective renovations and new construction on basis of Design, Build, Finance, Maintain and Operate (DBFMO) contracts (Rijksgebouwendienst, 2008). This is a type of performance contract that integrates a broad range of services to be delivered to the client. Services range from the availability of paper in printers to catering, but also energy related services such as temperature control, lighting and air conditioning. It remains unclear what the main target is for these arrangements: much emphasis is put on having one single party to deal with for all the services one requires in a building. Energy Efficiency however is barely mentioned and does not necessarily seem to be the main aim of these arrangements. Although renovations have been implemented using this contract form (Rijksgebouwendienst, 2008), the emphasis of these constructions lies on new buildings. DBFMO Contracts are subject to public tendering and are usually won by ad-hoc consortia of a mix of parties that are necessary to deliver the services. Due to the ad-hoc nature of these arrangements and the broad range of services involved, an ESCO as in the classic definition given in chapter 1 seems to have little chance to develop a steady business by winning these tenders. Additionally, DBFMO contracts are less attractive to commercial property owners since a change in tenancy may cause a change in desired services, introducing the need to revise contracts.

In conclusion, the RGD does show effort to improve the efficiency of their buildings. The question remains whether the ambitions are high enough and whether the technology mix and contracting arrangements are designed to reach maximum EE improvements. Additionally, considerable focus seems to lie on new buildings while renovation receives less attention, especially when considering the proposed vacation of the most inefficient buildings.

5 Policy Review

Markets tend to favor the most cost-effective solutions to supply and demand problems, but these solutions include only factors that can be expressed in monetary terms. Therefore, factors that do (not yet) have a price will not be regarded. These factors are thus external to the solutions provided and appropriately called externalities. This has adverse effects, for example: project developers and investors may choose to design a building that is cheapest to build so as to have a bigger chance of selling it. One may assume that the cheapest cost of construction eliminates possibilities of installing the most efficient equipment in that building. The aggregated effects of these decisions lead to higher energy consumption than strictly necessary on a nation-wide or union-wide scale. Governments find these effects unwanted because of the goals that they strive after: energy security, GHG emissions reduction and a competitive economy. This is why governments draw up energy policy: To steer the market in a direction that it would not necessarily naturally go.

Knowing why (energy) policy exists in the first place, this section explores what policy exists that affects the ESCO business and the motivations behind it.

5.1 EU Policy

The EU policy review is meant to give the reader an overview of all policy that is relevant to the ESCO business. Legal documents that specifically mention ESCOs or that have been designed to stimulate EPC are discussed in more detail, whereas legislation that has to do with renewable energy and GHG emission targets are more summarily mentioned in section 5.1.6.

5.1.1 Overview: Aim and context

As discussed in the introduction, the EU has set themselves an indicative energy efficiency goal of 20% increase with respect to a 2005 baseline level. Hard targets are a union-wide GHG reduction of 20%, where member states with a weak or upcoming economy are allowed higher emissions (from lower reductions targets to even rising emissions of as much as 20%) to stimulate economic development, and the more economically developed member states are required to reduce emissions up to 20%. A similar approach is present in the Renewable Energy Sources (RES) directive. A union-wide 20% share of renewable energy sources is to be reached by assigning member states targets for the year 2020 between 10% (Malta) and 49% (Sweden).

These targets are motivated by GHG emission reductions such as the EU effort to limit global warming to 2 [degrees] Celsius (European Council, 2009), where a more tangible motivation lies within the medium-term future developments of the EU energy supply. See figures Figure 23 – Figure 26

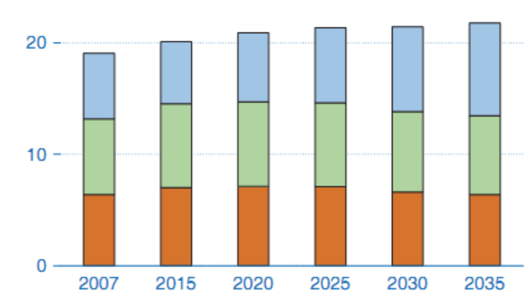

Figure 23: Nat. gas consumption in OECD Europe (trillion cubic feet) Industrial, Buildings, Electricity bottom up (IEA, 2010)

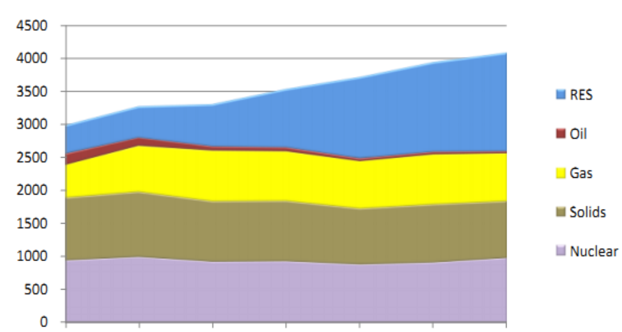

Figure 24: Elec. Generation by source (TWh) (European Commission Directorate-General for Energy, 2009)

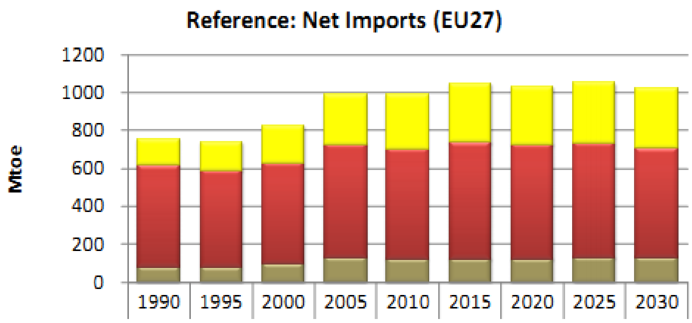

Figure 25: EU net energy imports (MTOE). Solids, oil, nat. gas bottom up. (European Commission Directorate-General for Energy, 2009)

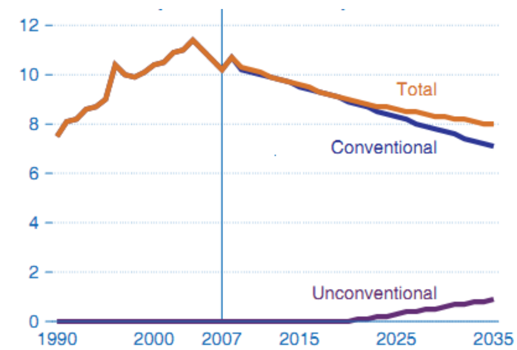

Figure 26: EU nat. gas production,(trillion cubic feet) (Office of Integrated Analysis and Forecasting, 2010)

These figures show that the EU fossil fuel consumptions will maintain a constant level, while production of natural gas is on the decline. That this means imports is shown in Figure 25. These imports come with a price tag of around 7% of EU GDP in 2020(Eurostat, 2008), which hampers EU competitiveness.

The European Union therefore has much to gain with savings. The origin of these savings is portrayed in Figure 27. Heating and cooling is given the biggest share, followed by savings on transport. The heating and cooling savings originate from non-industrial users, so it would come from the built environment. The differences between savings targets in the 2007 and 2009 baselines can be explained by the financial and economic crisis of 2008, which led to sharp decreases in consumption; if consumption declines, so do achievable savings. Another cause for the lower savings estimate is that the economic crisis is expected to delay investments in EE.

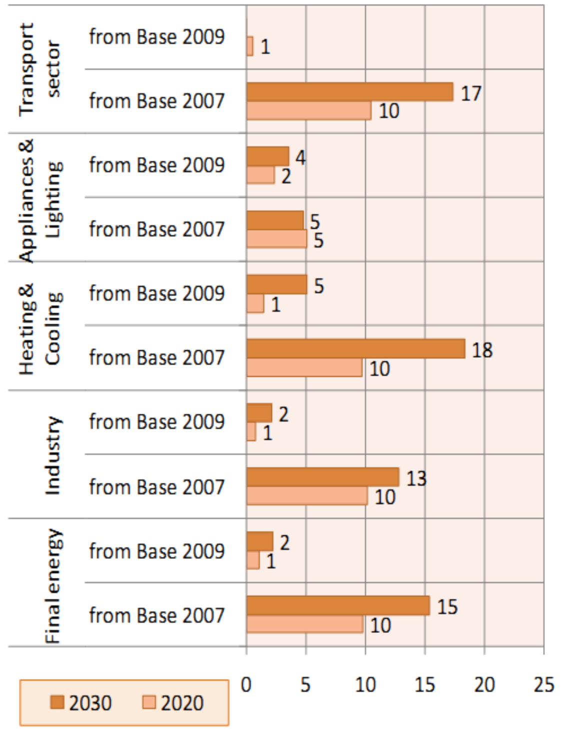

Figure 27: Expected savings for the reference scenario (European Commission Directorate-General for Energy, 2009)

In conclusion, the European Union needs to reduce (fossil) energy consumption not only to reduce GHG emissions but also to remain a competitive economy by reducing spending on energy imports. The built environment generates the biggest share of savings since it consumes 40% of all EU energy, and it is exactly this reason why policy on the built environment's energy consumption is so important.

Now, we have seen that ESCOs can mean a lot for reducing energy consumption in the built environment, such as in the Rotterdam example, or as will be demonstrated in chapter 6. How does the EU embrace the ESCO concept ? This is to be discussed in sections 6.1.3 – 6.1.5. First, the basic workings of EU policy in general will be explored.

5.1.2 EU Policy basics

The European Union has been forged upon compromises and inclusive agreements since its inception in 1952, then known as the European Coal and Steel Community. It operates so as to get as much of its Member States aboard on proposals for regulations as possible. Therefore, there are three main mechanisms by which EU policy is issued; *Directives, Decisions* and *Regulations*. Their role is described in Article 249EC (the Maastricht Treaty) as follows:

> *In order to carry out their task and in accordance with the provisions of this Treaty, the European Parliament acting jointly with the Council, the Council and the Commission shall make regulations and issue directives, take decisions, make recommendations or deliver opinions.*
>
> *A regulation shall have general application. It shall be binding in its entirety and directly applicable in all Member States.*
>
> *A directive shall be binding, as to the result to be achieved, upon each Member State to which it is addressed, but shall leave to the national authorities the choice of form and methods.*
>
> *A decision shall be binding in its entirety upon those to whom it is addressed.*

A directive is a legal document with most often – but not necessarily – indicative goals and terms. Member states should develop national legislation to achieve the goals stated in the directive and are free to implement them however they see most fit, usually before a certain deadline. Directives can be enforced by regulations, yielding instant union-wide applicability and enforceability, or particular member states can be called to responsibility with decisions. There is no hierarchy between these instruments. Rather, they are often connected in a certain policy area to pursue a goal that is set out by the European parliament, commission or the council.

Nowhere in EU legislation are mandatory targets for energy efficiency or energy savings stated specifically. They are however largely related to the mandatory GHG emissions reductions target. In numerous directives, the mechanism of achieving GHG reductions through efficiency improvements is welcomed as the most cost efficient approach, since demand side reduction also has other beneficial economic effects. Another example of implicit EE regulation are the objective of zero-energy buildings around 2020. A downside of this approach is that no Member State can be held accountable for (not) achieving the energy savings/efficiency objectives. As a consequence, most EU member states have no mandatory targets for energy efficiency as well, although energy efficiency improvements are generally perceived as the preferable option by member states.

5.1.3 EU Energy Efficiency plan

The EU Energy Efficiency Plan (EEP) (European Commission, 2011) is the backbone of the European efforts to improve union-wide energy efficiency. Although it does not imply any legally binding requirements upon member states or EU bodies, the document lays out what the EU commission wants and suggests means how to achieve it.

It was preceded by the 2006 EU Energy Efficiency *Action* Plan. This plan stated similar objectives and targets for the EU energy efficiency by 2020, and gave suggestions to member states as to how these targets may be met. Most "actions" to be taken that were suggested in the document concerned directions towards the European Commissions to implement existing or upcoming policy, or contained general ideas that the Union or member states should strive after. Many of these suggestions can be found back in later directives such as 2010/31/EU and the EPBD recast (see sections ahead).

In late 2010, the European Parliament was not satisfied with the progress of energy efficiency improvements and the impact policy had on these improvements. The Parliaments initiative of 15/12/2010 (INI/2010/2107) expressed these concerns, stating that "*Academic evidence clearly supports the view that efforts need to be stepped up*" to achieve more than half of the prospective savings. The parliament suggested that, first of all, existing policy should be enforced and complied with, whereas energy efficiency should become an integral part of all EU policy, most notably transport, finance, industrial policy and education. The parliament called for an assessment of energy savings potentials and renovation targets for at least public buildings in the EU. These public buildings should lead by example towards a zero-energy standard. Part of the initiative was also a proposal for financial aid and tax regulations. A substantial part of the Parliament's statements were transposed into the 2011 EU Energy Efficiency Plan, which is discussed in greater detail below. Why the plan has lost the word *action* is difficult to say. It may have been that the legislator did not want to inflate the word action anymore on plans with inherently unsure outcomes. The 2011 EEP does however contain a great deal of more tangible and (proposed-) binding legislation.

> *"The Action Plan is intended to mobilize the general public and policy-makers at all levels of government, together with market actors, and to transform the internal energy market in a way that provides EU citizens with the globally most energy-efficient infrastructure, buildings, appliances, processes, transport means and energy systems."*
>
> Energy Efficiency Action Plan, 2006

Stating the need to improve EU-wide energy efficiency by 20% relative to projections for 2020, the 2011 EU EEP addresses the currently insufficient pace of EE improvement. Only half of this target is being met at the current pace. The Energy-Efficiency Plan (EEP) addresses this by introducing new measures that – according to the accompanying assessment – should have the desired impact.

The EEAP claims to generate financial savings of up to €1000,- per household annually, two million jobs, to reduce the EUs GHG emissions by 740 Mton and improve industrial competitiveness. The intent of the plan is to propose more stringent measures with legally binding regulations, while still enabling Member States to maintain their national energy efficiency and greenhouse gas targets. Should EU-wide energy efficiency improvements still lag behind by 2013, the European Commission will propose legally binding national targets for 2020.

> *"The greatest energy saving potential lies in buildings"*

Public authorities are encouraged to lead by example. Owning 12% of the EU building stock, the EC by this directive urges public authorities to double their renovation pace – with respect to the overall renovation rate – to 3% of total floor area annually. Energy Performance Contracting is seen as an important tool to achieve this goal. Citing the difficulties with trust and measurement and verification, the EC will propose legislation to overcome this problem.

While buildings in the EU can potentially achieve cost effective savings of 50% - 75%, this potential remains largely untapped. One of the reasons cited is the Split Incentive. This legal issue will be addressed by the EC by requiring Member States to implement legislation to overcome or mitigate the Split Incentive issue.

Training qualified personnel is essential to achieving the energy efficiency targets. Whereas currently 1.2 million sufficiently trained workers are available, 2.5 million professionals will be needed by 2015. The EC therefore launches an initiative to assess the needs of the construction- and installation sector, such that an appropriate training scheme can be developed to supply a sufficient amount of skilled workers.

ESCOs are again explicitly addressed as a means to achieve comprehensive refurbishment of buildings. Their specific financial needs are addressed, and supply of sufficient liquidity, loan (-guarantees), credit lines and revolving funds is mentioned as an important task of the EC as well as its member states. The EU also suggests that barriers and ambiguities from a legal origin should be removed as much as possible.

Specific attention is paid to the small and medium sized enterprise sector. Their inability to attract sufficient funds to implement energy efficiency investments is recognized and action should be taken to enable SMEs to attract funds. Larger companies should receive mandatory regular energy audits and are encouraged to take part in voluntary agreements to improve their energy efficiency. For industrial energy users, measures are being considered to subject their equipment (e.g. for motors, pumps, heating, drying and distillation) to an equivalent of the successful eco-design directive.

Payback period remains to be an issue impeding energy efficiency investments. National and European financial support to overcome payback time hurdles are the following:

- The Cohesion Policy[15] allocates approximately € 4.4 to energy efficiency, cogeneration and energy management
- The Intelligent Energy Europe Program, with its tool ELENA(European Local Energy Assistance), has granted € 18 million to overcome market failures. Doing so, a multiplier effect has enabled beneficiaries to mobilize € 1.5 billion in investments
- Intermediate finance by international financial institutions (e.g., World Bank, International Monetary Fund)
- The European Economic Recovery Program, providing € 1 billion for research into energy efficiency in the built environment
- The Framework Program for research, technological development and demonstration (2007-2013).

Additionally, with still 40% of windows in the EU single glazed and another 40% non-coated double glazed, the EC sees large potential in window upgrades and equipment targeted policy (e.g., applying eco-design directives to windows, HVAC installations or generation equipment).

Lastly, the document addresses the requirements of directive 2006/32/EC concerning smart metering and detailed billing. Although already required, the EC urges Member States to implement legislation such that this directive is met. This not only enables consumers to become more energy aware, but also lays the ground for a smart grid.

[15] The Cohesion Policy is a program that strives to alleviate economic disparities between member states and regions by means of a fund to which all member states contribute.

5.1.4 Energy Performance of Buildings Directive

The Energy Performance of Buildings Directive (EPBD) (The European Parliament & The European Council, 2010) lays down a framework that should help get the energy performance of buildings on the agenda. It introduces important requirements such as labeling and mandatory system upgrades for buildings that undergo renovations.

> *"Buildings account for 40 % of total energy consumption in the Union. The sector is expanding, which is bound to increase its energy consumption. Therefore, reduction of energy consumption and the use of energy from renewable sources in the buildings sector constitute important measures needed to reduce the Union's energy dependency and greenhouse gas emissions"*
>
> 2010/31/EU

The directive aims to lay down a framework in which an energy services market can develop, although this is not explicitly stated. The means provided by the directive, to be implemented by Member States, are as follows:

A common general framework for assessing and reporting energy performance of buildings should be implemented by all Member States. Minimum energy performance standards should be drawn up and applied to new buildings and existing buildings or parts thereof that are subject to major renovations. The standards also apply to building equipment such as HVAC that are upgraded, replaced or newly installed. These minimum standards should at least cover cost-optimal improvements, but Member States are not required to set standards that are not cost-effective over the estimated economic life-cycle of a building. Member states should develop a nationwide system of building energy performance assessments accompanied by publicly available energy performance certificates. Certificates in public buildings must be publicly displayed, whereas certificates of private buildings (homes, offices, industry) must be made available to prospective new owners upon change of ownership, tenancy or occupation otherwise. Certificates are valid for no longer than 10 years and must include recommendations for at least the cost effective measures available to improve energy performance, unless there is no room for improvement. The certificate system is to be controlled by an independent national body. Member States are allowed and encouraged to design and implement financial instruments to aid the process of improving the energy performance of buildings. Findings on the workings of these instruments are to be reported to the EC, while the EC can assess these findings and recommend (best) practices from other Member States in reply. HVAC (or technical building-) systems with powers exceeding 20kW are to receive regular inspections concerning their energy performance. Topics include control adjustments, appropriate size in relation to the building and technical performance. From 2020 on, Member States shall ensure that all new buildings or those buildings that undergo "major renovations" are "nearly zero-energy" buildings. For buildings occupied by public authorities this deadline is 2018.

5.1.5 Energy Services Directives

The energy services directive (2006/32/EC) (The European Parliament & The European Council, 2006) was intended to lay down a framework on which private parties could construct initiatives to offer energy services to their peers. A recast of this directive, combining it with the cogeneration directive (2004/8/EC), is currently in draft status. First, directive 2006/32/EC will be introduced, after which the motivation for and extra provisions of the new draft will be discussed.

The 2006/32/EC preamble explicitly mentions creating more incentives for the demand-side of energy services, where the public sector should include energy-efficiency criteria in public tenders. These motivations are in light of the finding that the recent liberalization of the EU energy market has not led to increased demand for energy services. The general target of the directive is to increase the overall energy efficiency in the EU by 9% from 2008 – 2016, it is however not enforceable. The means to achieve these savings are by designing, implementing and monitoring *National Energy Efficiency Action Plans* (NEEAPs), to be delivered for review to the European Commission.

On a national level, authorities should ensure the availability of energy audits for households and small consumers and stimulate energy companies to supply energy services. They even have the possibility of making providing these services compulsory for energy companies, and nations should ensure wide availability of all information relating to energy efficiency.

The binding terms to national authorities by the directive are as follows

- Energy companies are required to deliver aggregated statistical information to national authorities
- Energy companies should refrain from activities impeding the development of energy services
- End-consumers must be able to receive competitively priced independent energy audits
- Energy companies may be required to contribute to funds to finance energy efficiency

Member states shall ensure that there are sufficient incentives for an energy services market to be developed, specifically that these services can be supplied by installation companies, energy retailers, advisors and consultants.

Furthermore, member states are required to remove any incentive (e.g., subsidies) that increases the use of any energy source, except when it concerns purely fiscal measures, and replace any existing metering equipment with "smart meters"; where cost effective and technically possible, but mandatory for any new connection to the grid. These meters must provide detailed information on usage, time of usage, rates applied, historic information and comparison with benchmarks to customers. Utilities companies are required to make these data available to the customers. Lastly, member states are allowed to set up funds available to all providers of energy efficiency measures or customers that demand energy and energy efficiency services.

The 2011 recast and combination of 2006/32/EC and 2004/8/EC acknowledges the findings of the 2011 EEP that the current pace of efficiency improvements is not on track. The EC and the Parliament restate their ability to lay down binding national targets if the pace of improvement is not satisfactory by 2013. They stress the importance of 20% union-wide energy savings by 2020. In general, the recast re-affirms the goals and means set out in the previous directives while supplying a great deal of further details how member states should achieve the desired savings. It is these additional and/or updated requirements that will be discussed below, in as far as they are relevant to the ESCO business. This means that (additional) requirements for distribution and generation companies will be omitted, as will be most of the CHP requirements. It will suffice to say the EC has high expectations of CHP and demands that member states actively pursue the installation of CHP and report on progress of CHP developments, potentials and legislature.

> *"The European Union is facing unprecedented challenges resulting from increased energy import dependency and scarcity of energy resources, and the need to limit climate change and overcome the economic crisis. Energy efficiency is a key means to help address those challenges"*
>
> 2011 ESD recast

Upon approval of the newly proposed directive, member states shall establish and publicize an inventory of all buildings of their public bodies. It should include the floor area, the energy performance and the purpose of the buildings. The inventory has to be updated annually and progress report on a 3% annual renovation rate for these buildings must be included. All public bodies of a member state are encouraged to implement energy management systems in their EEPs.

Energy distributors and retailers (called Suppliers from now on) are required to achieve 1.5% energy savings annually at their customers, of which 90% must have a long-term structural effect. That means that these savings should not originate from advising their customers to put down the heating for a few weeks. The savings must be verifiable and the suppliers can be penalized for non-compliance. The suppliers are obligated to deliver to their customers *detailed* information on load profiles and data mining results, as opposed to the aggregated data required in 2006/32/EC.

Part of this data should come from detailed metering by smart meters. A separate paragraph is devoted to making actual energy consumption data available in a comprehensible manner to all energy consumers; upon request and at least once monthly for electricity, once every two months for natural gas. Additionally, consumers must be offered access to on-line oversights of their (historical) energy use. Customers may demand this information be made available to ESCOs or ES providers, while Suppliers are obligated to supply consumers with information on where to gain advice on energy efficiency improvements.

The Energy Services sector is specifically addressed. Member states have to make publicly available a list of available ES providers, what these providers are able to provide and what they have provided in the past. A quality label attached to these providers should be available, but a method to generate such a label is not supplied by the draft. Furthermore, member states should provide model contracts and clauses that may fit therein. Member states should publish regular market overviews including barriers and how to alleviate them. Suppliers are required to make consumers aware of this list of ES suppliers and the offers that they make.

To conclude, one may say that the recast has gained significant sharper teeth with requirements for concrete actions to be taken by the member states in the very near future; The directive should be implemented no longer than one year after its entry into force, which is expected to be somewhere in the fall of 2011. On the other hand, ambiguities remain. Analyses as to why the previous targets weren't being met and how this directive solves that issue are not present. Another ambiguity lies in the definition of the targets: 20% EE improvement in 2020 implies that Europeans will use 20% less energy than in 2005. Attempts to reach that target by 1.5% annual increments as required for Suppliers does not necessarily reduce energy consumption. Instead, it just dampens growth.

Ambiguities like these are a lost opportunity for a necessary stringent policy. The next reform opportunity is in 2013, when the Commission assesses progress. If they propose binding legislation one can expect a time-consuming process of trade-offs and so on, such that the earliest real measures would probably be introduced by 2015. Reaching the targets that are set out by then in only five years may be a greater challenge than the EU can achieve.

5.1.6 Flanking policy

Policy discussed here is not directly relevant to the ESCO business. However, it will be referred to when the Dutch policy implementation and motivations are discussed.

Directive 2009/28/EC (The European Parliament & The European Council, 2009) is Europe's effort to increase the share of renewable energy in the total gross energy mix to a mandatory 20% by 2020. Fuels used for transport should be at least 10% sustainable: Electrical, compressed air or biofuels that are sustainably obtained (i.e. not causing deforestation, food supply problems etc.). It explicitly addresses the built environment in the pre-amble. Member states are allowed to take into account renewable energy generated in or at buildings for their mandatory renewables share, by setting a minimum required renewable energy share to be used in buildings. Heat pumps as a means to save energy are mentioned, provided that the energy spent on these devices is subtracted from the savings, i.e., it counts as a fuel. Member states should furthermore take into account the contribution of renewable energy when planning for new structures, installations and industry. In addition, member states should encourage architects and technical building designers to properly consider renewable energy and highest efficiency methods when designing buildings. The majority of the text is meant to safeguard sustainability of biofuels, inspired by concerns of unsustainable biofuels supply.

The legally binding terms begin with stating that the effort to reach a 20% sustainable energy supply is divided among the member states, such that The Netherlands should achieve a 14% renewables share by 2020. This means an increase of 11.6 per cent points from 2005, which is the base year for renewable share measurements. For calculating the percentage of renewables, heat generated by passive heating systems in buildings is subtracted from the gross energy expense, such that the denominator decreases thereby increasing the share of renewables. Member states are required to recommend lower authorities to incorporate heating and cooling from renewable sources (such as geothermal) into their planning of city infrastructure. Member states shall as well introduce into building regulations measures to increase the share of renewable energy and suggest the use of cogeneration and passive cooling to reach (near) zero energy buildings. By 2014, member states shall require minimum levels of renewable energy used in buildings that are newly built or renovated, where appropriate. By 2012, member states shall ensure that new public buildings lead by example so as to implement the directive in their own buildings; they may for example provide that roof space of (semi) public buildings is made available to third parties to install renewable energy equipment. Heat pumps installed in buildings should meet 2007/742/EC requirements, and solar thermal equipment installed preferably meets European standards and requirements. Information on support measures and guiding to reach the objectives of this directive is required to be made available all relevant actors, most notably building architects and installers

The Effort Sharing Decision (406/2009/EC) (European Council, 2009) obliges European Member States to reduce their non-ETS greenhouse gas (GHG) emissions before 2020. The pre-amble states ambitious targets (-50% by 2050, -20% by 2020, both compared to 1990 baseline levels) to keep global warming below 2° celsius, however the legally binding terms are considerably less stringent.

Union wide emissions of ETS-GHGs should by 2020 be reduced by 21% compared to 2005 baseline levels generally, and 10% for non-ETS emissions. The effort to reach this reduction is assigned to Member States by a key most dependent on GDP per capita and economic growth. The Directive acknowledges the need for economic growth, union-wide and per member state, allowing for the Member States with lowest GDP levels to increase their GHG emissions with as much as 20%. More economically developed Member States with high GDP per capita should reduce their emissions, where Denmark, Luxembourg and Ireland have the highest target of -20%. The Netherlands has a reduction target of -16%. Furthermore, the directive provides rules for emissions trading, forwarding of emissions from previous years if the emissions allowance has not been met, and allowing member states to use emissions (up to 5%) from years to come. The emissions targets are for the period from 2013 until 2020.

5.2 Dutch Policy

We now have an understanding of what the European government desires from their member states. The policy requires The Netherlands to reduce GHG emissions by 16% and achieve a share of renewables in domestic energy generation of 14%, both by 2020. There is no EE target for any member state yet, but an indicative target of EE improvement for the year 2020 has been set, with mandatory EE regulations on the dawn if union-wide improvement is not satisfactory by the year 2013. What policy has the Dutch government installed over the years to achieve these targets ? Does the Dutch government set higher standards, or are they satisfied with compliance – or is compliance hard enough to achieve already ?

These questions will be answered by reviewing the most relevant policy that is currently in place. As a conclusion to this section, the most recent available results of Dutch policy will be discussed.

5.2.1 Aim and context

Analogous to the EU policy, the Dutch government has not set binding EE targets. They are committing to 16% GHG reduction and 14% renewables shares targets, and do strive to achieve the 20% indicative EU energy efficiency target (Kabinet Rutte I, 2010). The fuel price developments combined with depleting natural gas supplies are a motivator for serious energy policy. (EL&I, 2011a). This is because virtually all buildings in The Netherlands are connected to the national natural gas grid; Gas is the main fuel used for heating, cooking and hot water supply. It also has a big share (around 60%[16]) in the electricity fuel mix. The abundant supply of gas that The Netherlands have enjoyed since the 1960's is on the downfall, see

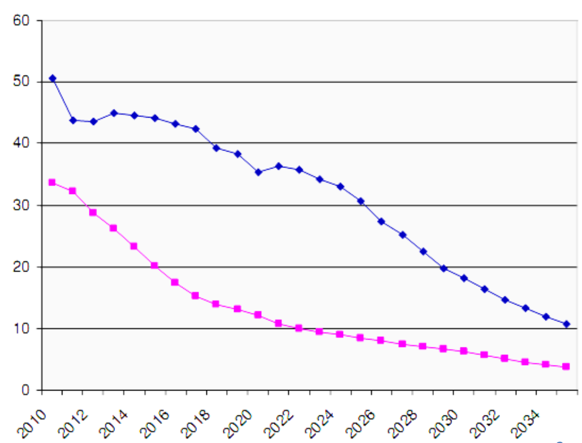

Figure 28: Dutch natural gas production in billion m^3 (groningen, blue and minor fields, pink)
(EL&I, 2011a)

The Dutch government thus has a lot to gain by rethinking energy use, since decreasing natural gas production would necessitate natural gas imports and all the spending and dependencies related to it.

Energy Efficiency as a policy target comes in to play in two factors. First, EE reduces absolute consumption or at least growth of consumption of energy in gross. This helps for reducing GHG emissions. Second, a reduced demand for energy leads to reduced demand for generation. If the total amount of generated energy is smaller with a stable or preferably growing absolute renewable energy production, this causes the share of renewables in total to rise since the denominator decreases. This last argument is endorsed by the Dutch government in its last energy report (EL&I, 2011a).

[16] http://iea.org/stats/electricitydata.asp?COUNTRY_CODE=NL

5.2.2 National Energy Efficiency Action Plans

This section will discuss the 2007 and 2011 national energy efficiency action plans. As with the recast of 2006/32/EC, only incremental changes of the 2011 plan over the 2007 will be discussed.

As required by the 2006/32/EC, the Netherlands have drawn up an energy efficiency plan for the period 2007-2020. To meet the requirements of the directive, the NLEEAP covers the residential, tertiary, non-ETS industry, transport and agriculture sectors. Of importance for this study are the residential and tertiary sectors.

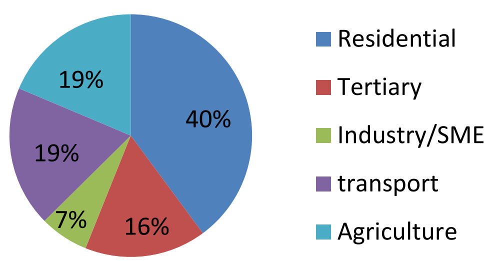

Figure 29: Origin of energy saving shares for NLEEAP 2011

The overall national target for energy savings 268 PJ annually for the year 2016, compared to a 2007 baseline. The division of savings between all sectors is given in Figure 29

The importance of the built environment (residential and tertiary sectors) can clearly be seen in this figure; they make up for more than half of expected savings. The small contribution of industry to these savings is because companies participating in carbon trading schemes (EU-ETS) are excluded.

Aside from sector specific measures, some cross-sectoral measures are taken as well. These are the Energy Tax and the Energy Investment Deduction, among others. The energy tax, by increasing energy prices, is expected to reduce energy consumption in the short term, and reduce payback times for energy efficiency investments, thereby also achieving a structural effect. For what concerns the residential sector, the measure with highest regulatory impact is the coupling of the building decree with an Energy Performance Standard (EPS)[17]. The EPS calculation method is typically calculated by engineering companies and difficult to grasp; a value of zero indicates a (nearly) zero energy building (EL&I, 2011b). However, it should reach a value of 0.4 in 2015, from 1.4 in 1995. This compares to 15 kWh/m^2 annually - close to the zero energy building concept - in 2015. The building decree is only applicable to new buildings however, such that renovations are still necessary. To aid energy efficiency arguments in the transfer of existing property and to internalize their monetary value, all buildings that change ownership or occupancy are required to have undergone an energy audit, attaching an energy label to houses. Great emphasis is being put on consumer education and information. Special tax rebates and incentives are being made available to property owners, specifically to those without access to capital. The tertiary sector is largely targeted with the same instruments.

Lastly, the Dutch Government aims to fulfill an exemplary role when it comes to the energy efficiency of public buildings. Newly built central government buildings will be climate neutral from 2012 on (excess emissions abated), whereas local and regional governments should reach at least 50% climate neutrality in new buildings.

The targets stated by the NLEEAP are clear, with a good effort to justify baselines and figures. When it concerns the built environment, the proposed measures seem weak. Although consumer education is an

[17] To avoid confusion with Energy Performance Contracting, the Dutch term of EPC (Energy Performance Coefficient) has been renamed

important factor in energy usage reduction, the impact is difficult to measure (The European Commission, 2009). This fact makes it difficult to justify so many measures involved with education. In addition, for most measures a clear statement of the expected savings per measure is not present. Another point of concern is the tax incentives and rebates part. The Netherlands have shown an unstable policy history (K V Organisatie-advies, 2010; Meijer, 2007) when it comes to tax incentives concerning environmental issues, scaring off investors. The only concrete measure seems to be the gradual tightening of the building codes. Lastly it does not "*try to capture the spirit of the Directive* [2006/32/EC] *in terms of creating a market for energy efficiency and energy services*". (The European Commission, 2009)

The 2011 revision of the NLEEAP is more detailed in general but introduces little news. The targets from the 2007 NLEEAP are reaffirmed. It makes more references to the EU EEP and states (how) to implement (parts of) the EPBD, RES and ESD directives. The NLEEAP starts off with an interesting table:

Table 5: NLEEAP parameters in GWh

	Target	Savings
2010	11.367	26.497
2016	51.190	74.620

It seems that the NLEEAP 2011 savings significantly overshoot the targets. However, a new methodology has been introduced to assess savings. First of all, savings that originate from autonomous EE developments are included in the 2011 plan. In the 2007 plan, only EE increases that were caused by policy were counted. Secondly, *electricity* savings that are achieved in ETS regulated companies are now also included in the savings figures. This introduces unnecessary confusion, and it makes it easier for the government to reacht the targets. However, it does harmonize the method of assessment union-wide, so that comparison between all member states becomes possible.

The economic turmoil since 2008 is said to have an effect. This can mean two things: The effect is a greater savings figure because of reduced production, or it had a negative impact on investments in more energy efficient technology. This is not explained. CHP has been on the rise in the agriculture sector – where the greenhouses have a significant share of the sector's revenue – and the high oil prices of 2008 were not foreseen in the 2007 modelling. It's safe to assume that this led to reduced oil and gas consumption, skewing the image towards higher savings.

The most important measures that are described in the NLEEAP and relevant to this study are described in separate sections below. Interesting measures that are not discussed in a separate policy section are:

Enforcement of the Law Environment Management Utility Buildings (Wet Milieubeheer). This requires utility building owners that use energy exceeding 50.000kWh electricity and/or 25.000 m^3 natural gas to take any and all energy savings measures that have a payback period of five years or less. This includes schools, offices and the healthcare sector. Users in excess of 200.000 kWh or 75.000 m^3 can be forced to have an energy savings assessment. This policy is to be enforced by municipalities but it has had little effect until now (Boonekamp & Vethman, 2009), since municipalities have not (yet) made energy efficiency a priority in permits and regulations enforcement.

The proposed "Block By Block" approach is intended to speed up the renovation pace of the Dutch (social) housing sector. This program entails 5 pilots to research how complete blocks of houses can be renovated at once towards higher energy efficiency. The project should produce knowledge on how to organize and finance these projects, where an important role is set aside for the municipalities and local governments.

The 2011 NLEEAP is the first Dutch policy document that explicitly mentions ESCOs. ESCOs are addressed as an interesting option for housing corporations, building owners, investors and complex managers. This is however little more than a description of the concept and a summary mentioning that "several dozens of ESCOs are active in The Netherlands". Additionally, the availability of a model EPC contract on the AgentschapNL website is mentioned.

5.2.3 Werkprogramma schoon en zuinig

"Schoon en Zuinig" (Clean and Efficient, SeZ), launched in 2007 by the cabinet Balkenende 4, was the umbrella program for the Dutch EE, renewables and GHG efforts. It set out the direction of future policy, which savings to achieve and by what means. The cabinet Rutte 1 has victimized the program, but much of it remains; The initiatives that were launched remain, while the targets have been lowered the EU minimum requirements.

Figure 30: SeZ Promotion content

The program was motivated by GHG emissions reductions, and stated the ambition to reduce emissions with approximately 30% by 2020, compared to 1990 baseline levels. This target has been abandoned. The program aimed to cover any energy related sector in the Netherlands.

As mentioned in the NLEEAP, the most direct measure to improve energy efficiency is to enforce stricter building codes. By 2015, all newly built dwellings should approach the "zero energy building" concept, requiring no more than 15 kWh/m2 annually. The desired effect is to have newly built dwellings 50% more efficient than before (baseline not mentioned). Buildings in use by governments should be at least one phase ahead of regulations required for private buildings. To ramp up improvement of existing buildings, possibilities are being examined to require buildings that change owner to have at least a certain minimum energy performance. Furthermore, the Dutch government has teamed up with housing corporations, energy, construction and installation companies to develop the program "*Meer met Minder*". This program entails a.o. setting up a revolving fund and government backed low interest loans to finance energy efficiency improvements for residential buildings. It is expected to enable the refurbishment of 500.000 buildings in the period between 2007 and 2011. After this period, 300.000 buildings should be renovated annually by means of this program. As a last key point, the (social) rented housing rating scheme – on which the legally allowed maximum rent is based – will be adapted to reflect the energy performance of buildings.

5.2.4 Housing sector

The covenant **Meer met Minder** (MmM, more with less) (Rijksoverheid, 2008) is set up and signed by the Dutch government and the branch organizations for construction, installation and energy retailing. The target is to save 100pJ from its initiation until 2020 by means of building improvements. From 2007 until 2011, at least 500.000 homes should be renovated to reach either energy label class B or an improvement of at least two classes. From 2012 on, an annual renovations target will be set for up to the year 2020. Additionally, the parties "should make an effort to equip at least 100.000 houses with renewable energy technology until 2011". To achieve these targets, the private parties in general "should take away hurdles that refrain investors from investing in energy efficiency in the built environment". This should entail at least (a.o.) consumer education, a central information point for consumers / investors, *the development of a market for energy efficiency measures*. Energy retailers are required to deploy smart grid meters for residential buildings, and supply consumers with monthly energy usage statistics.

"In overweging nemende dat alle partijen het belang van energiebesparing zien, vanwege het klimaat en de voorzieningszekerheid"

The government parties "make an effort to strive to" supply subsidies and fiscal schemes for energy related equipment used in non-industrial buildings to enable these buildings to achieve B-label status or improve with two classes.

Clear targets are mentioned, but constructions such as "make an effort to strive to" are generously vague. The evaluations of the MmM program that have been made will give an insight in how big the efforts actually were, and if their striving has been noble enough. Also noteworthy is the absence of the housing corporations as a signing party in this covenant, despite the desire for their inclusion that had been stated in the *"Schoon en Zuinig*" program.

Motivated by the MmM program, the **Convenant Energiebesparing Corporatiesector** (covenant energy savings corporation sector) with the Dutch housing corporations has been set up to intensify energy efficiency improvements in the existing housing supply owned by the housing corporations. The result should be a saving of 24Pj by 2020. Additionally, newly built houses by the corporations should be 25% and 50% (2011, 2015 targets respectively) more efficient than new houses built according to the 2007 baseline. The targeted energy source is specifically natural gas. This is not surprising, given the high penetration of gas fired space and water heating in The Netherlands. The measures taken by the housing corporations should be such that they immediately lead to lower net costs for tenants. Whether this means a nearly zero or a positive NPV of the projects is not discussed. The government commits to revising the rented housing crediting system. This means that the legally allowed price for renting a house will be tied to the energy performance of the house; a higher rent may be charged for better performing buildings. Operations should be financed using the corporation's own funds.

The **Spring Agreement** (VROM, 2008) between the Dutch government and the building and project development umbrella organizations aims to increase energy performance of newly built dwellings for residential as well as commercial purposes. Since the private parties in this agreement serve the housing corporations sector as well, the agreement overlaps with the "*Convenant Energiebesparing Corporatiesector*". For residential buildings, the targets are the same as in the aforementioned covenant. In case of underperformance, the Dutch government holds the right to unilaterally alter the building codes such that the targets of the covenant will be met. An interesting section covers the creation of experimental or demonstration areas where energy efficiency standards are at least 25% higher than the covenant's aim. These areas should gain a share of between 5 and 10 per cent of the annual building production. Outside these areas, municipalities are not allowed to require or enforce stricter standards. Lastly and most interestingly, "the efforts to reduce energy use in new buildings should not, as a consequence of higher costs, lead to deterioration of the competitive position compared to existing buildings". It seems that this statement neglects the effects of lower energy bills on the total cost of ownership of such a new building.

5.2.5 Commercial Sector

In the **Duurzaamheidakkoord** (*Sustainability Agreement*) (Rijksoverheid, 2007) of November 2007 with the Dutch government and the umbrella organizations of small and medium enterprises and the agricultural organization, the signees state their ambition to achieve in The Netherlands "One of the most sustainable and efficient energy supplies in Europe". The indicative target of 2% energy savings is mentioned again, as is the obligation to reach 20% GHG emissions reduction in 2020. The covenant leans heavily on the intentions to communicate best practices and boost (co-operative) innovations in energy usage. The parties commit to "applying the most cost efficient measures" as soon as possible. Innovation policy is directed towards energy technologies that are applicable before 2020 to reach the savings target. The government commits to facilitating demonstration projects, the SME parties commit to drafting more specific sectorial agreements concerning energy efficiency. The Dutch directing body for the energy transition (Regieorgaan Energietransitie) is given supervision of the tasks set out in the covenant, and should therefore develop a long term innovation strategy for until 2020. Interestingly, the organ should "safeguard a stable policy environment". In addition, the Dutch government aims to continue efforts to "green" the tax system to give desirable incentives towards reaching the GHG and EE targets. Specific attention is given to micro CHP to be applied in residential buildings. For SMEs, an information center on energy use is being installed to give advice and communicate best practice.

5.2.6 Government sector

The **Climate Agreement Municipalities and State** (Rijksoverheid & VNG, 2011) covers policy made by municipalities that influences the energy consumption of either the municipality itself or of their citizens and businesses. The built environment section mentions the demonstration projects named in the Lente Akkoord and an allocation of about € 260 M for these projects. Municipalities plea to conduct sustainable business and fulfill an exemplary role. The target of 50% climate neutrality for new buildings mentioned in the NLEEAP is not (re)affirmed. Municipalities and companies may voluntarily set higher building energy performance standards in mutual agreement. Lastly, innovation and information exchange programs are being set up to exchange best practices.

5.2.7 Taxes, tax incentives and subsidies

The **Energy Investment Deduction** (Energie Investerings Aftrek, EIA) has been called into existence to stimulate companies to invest in energy efficiency in their buildings or production processes. A list of qualified measures has been set up and is available to companies. Investments related to energy (efficiency) that are on this list can be deducted from corporate taxes for up to 44%. Because corporate taxes in The Netherlands average at around 25%, a 44% deduction leads to a net profit of 11% of the amount spent on energy (efficiency) measures.

The reasons as to why a certain strict list is used instead of assessing any measures are not clear. However, companies can suggest new measures to the list annually. Additionally, companies can file "generic" measures. For example, investments that yield savings of 0.2 to 1.0 m3 natural gas per euro spent are eligible. Another example is eligibility for EIA when (corporate) building's energy performance improves by two labels or reaches at least class B. It is interesting to see that in the years 2007 – 2009, the amount applied for the EIA has dropped from 2023 to 870, a decline of about 57%. Meanwhile, the fraction of applied investments that were eligible for EIA has risen from 72% to 77%.(Agentschap NL, 2010).

The MIA **(Milieu InvesteringsAftrek**, Environment Investment Deduction) and VAMIL (**Vrije Afschrijving MILieuinvesteringen**, Random Depreciation Environmental Investments) are two often combined measures to boost investments in environmentally friendly technologies that are used in commercial or industrial processes[18]. MIA allows companies to deduct 36% of environmentally friendly investments from the fiscal profit of a company. VAMIL allows companies to depreciate environmentally friendly technologies all at once, instead of spread over the economic lifetime of the equipment. It is an addition to the EIA which entails only energy-related environmentally friendly measures. For an investment to be eligible for MIA/VAMIL, it has to perform better than alternatives that perform the same function. Examples range from ammonia-reduced chicken stables to zinc. Some relevant measures for the ESCO business are: water-efficient toilet systems, rainwater reuse equipment, compressed air systems, low NOx heaters and afterburners[19].

The Energy Tax, introduced in 1996, is the Dutch government's effort to generate an incentive towards energy users to invest in energy efficiency or reduce energy consumption in general. The rates for this tax are displayed in Figure 31. The trend that larger users pay significantly less taxes is clearly visible. With its introduction, other non-energy related taxes were lowered so as to keep the net impact on purchasing power neutral. It is part of "greening" the Dutch tax system, following the adagium that the polluter pays. Since the revenue this tax generates compensates lost tax revenues from other sectors, only a fraction of it is reinvested in energy related issues.

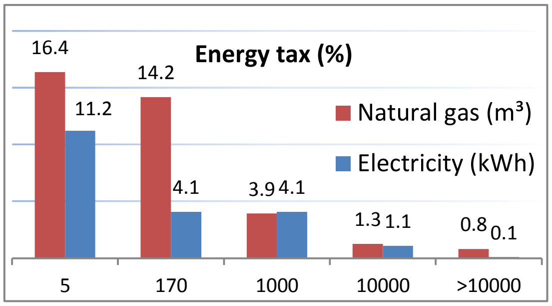

Figure 31: energy tax in NL. Figures in thousands

5.3 Results and evaluations

With the installation of a new cabinet in September 2010, the *Schoon en Zuinig* umbrella programme ceased to exist. However, the components relevant for this study are still being carried out: MmM, the Spring Agreement and the Covenant Energy Savings Corporate Sector are still up (Schneider & Jharap, 2010).

MmM has been successful in meeting the renovations target or is projected to do so for up to 2011 (Schneider & Jharap, 2010).It has been successful in generating (public) interest in energy savings in homes and has been able to unify the diverse players in the field, creating awareness among stakeholders. Some partakers in the covenant perceive increased demand for insulation and energy efficiency in general. There are considerable hurdles still to take. One of the key mechanisms through which MmM was supposed to work was to unburden and centralize energy efficiency measures for private parties such as home owners and private letters, envisioning a "single desk" approach. This has not happened yet, as combining a fragmented policy and incentives field with numerous parties as installers, consultants, housing owners and corporations, utilities companies and policy developers to

[18] http://www.belastingdienst.nl/zakelijk/investeringsregelingen/investeringsregelingen-04.html
[19] http://regelingen.agentschapnl.nl/sites/default/files/bijlagen/Index%20Milieulijst%202011.pdf

deliver one product has proven to be more complex than initially presumed. Interviews point out the complexity of the program as one of the biggest hurdles for smaller parties. The economic crisis of 2008 has also set back the efforts of the MmM program, delaying investments and increasing the cost of capital. A major setback for energy retailers was the disapproval in 2009 of the smart meters proposition from the parliament by the senate, fueled by privacy concerns[20]. To conclude, the Dutch government adheres the opinion that meeting the 2020 targets will be difficult considering the efforts thus far delivered. The government believes that this can be attributed to the implementation of the program rather than the design of it. On a positive end note, the parties involved in the covenant are positive about the feasibility of the program and are willing to show continued commitment.

The Spring Agreement, intended to cover the newly built housing and offices sector, has encountered heavy weather due to the financial and economic crisis. Although targets for efficiency are being met, and great trust in the technical feasibility of the stricter building codes is being displayed, the effect of this program is expected to fall below estimates. This is because the housing market has changed from a situation where demand was high – such that sellers could set the price and conditions – to a buyers' market, where the lowest direct cost of a building is more important. This is unfavorable for investments in energy efficiency as they add up to the sales price. To conclude, although the effectiveness of the covenant is lower than planned because of external factors, parties still show commitment to building more efficient buildings as specified by the building codes. Building according to higher standards as allowed per this agreement is probably not going to happen because of the higher costs involved, although demonstration projects are still being implemented with enthusiasm.

The Covenant Energy Savings Corporate Sector is reported to be on track. The initial goal was to let houses reach energy label class B or increase to label levels. However, the assessment of success in energy improvements by means of energy label increases had to be abandoned. This is because this method requires two energy efficiency assessments (or energy label determinations) to be made before such an increase can be perceived; one before and one after the energy efficiency improvements. This has proven to be too burdensome, and the criterion has changed to "installing at least two energy efficiency measures" in any home. The efficiency impact of two measures has been estimated to reach the same effect; a 20% efficiency increase. NL Agency has estimated, by means of a sample and using the abovementioned "two measures" estimate, that the targets set for 2007 – 2011 will be met. This comes down to improving efficiency by 20 – 30% (Gerdes, 2010) in 100,000 houses annually. Contributing factors to this success are the revision of the social housing crediting system, allowing corporations to generate more revenue from improved homes, and the change in perception of tenants towards energy efficiency, specifically in terms of added comfort, decreased housing (energy) expenses and the environment. Another positive notion is the fact that housing corporations are relatively immune to the economic crisis. This is because their large financial and physical reserves and continuous cash flow. However, if the crisis sustains, sales from the corporate housing supply and project development revenues will decline, impacting their financial situation and hence their ability to invest in energy efficiency. As a final note, the EIA tax incentive has had an interesting role in financing the renovations. Because of very detailed requirements to energy efficiency improvement measures, many

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[20] http://vorige.nrc.nl/binnenland/article2206601.ece/Eerste_Kamer_tegen_slimme_electriciteitsmeters

requests were denied or returned following incomplete or erroneous applications. This has been said to set back projects or even cancel them. A tight cooperation between the housing corporations and the NL Agency has resolved most of this issue. However, the incentive is now not available to housing corporations anymore and valuable time and opportunities have been lost.

In the meanwhile, the central government has kept to its promise of improving their buildings' energy performance(VROM, 2010c). Over 30 of their offices are currently being reviewed as a part to renew 4 out of 7 million m^2 "in the years to come". Measures – most of which in the housekeeping and climate controls tuning – are expected to deliver savings of up to 15% with a payback period of 3 to 5 years, amounting to gross savings of €7.5 million per year. These funds are redirected to improving efficiency of the rest of the building stock by at least 25%.

For an oversight of all policy currently in place in The Netherlands and the EU, see figure 29

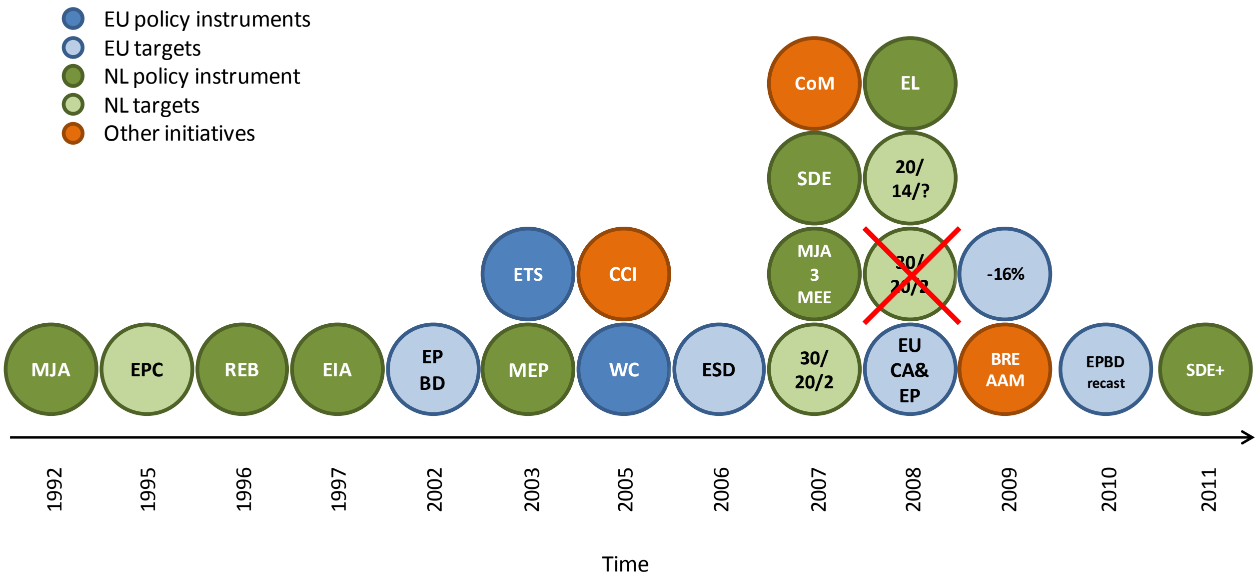

Figure 32: EU and NL policy and targets timetable (Sanne de Boer, Universiteit Utrecht, 2011, including glossary below)

MJA	Long-term Agreement (Meer Jaren Afspraak)
EPC	Energy Performance Coefficient (Energieprestatiecoëfficiënt)
REB	Regulerende EnergieBelasting (predecessor of MEP)
EIA	Energie-InvesteringsAftrek
EPBD	Energy Performance of Buildings Directive
MEP	Ministeriële regeling Milieukwaliteit Elektriciteitsproducite (predecessor of SDE)
ETS	Emission Trading System
WC	White Certificates
CCI	Clinton Climate Initiative
ESD	Energy Savings Directive
30/20/2	30% GHG emission reduction(1990-2020), 20% renewables in 2020 and 2% energy consumption reduction per year
EU CA&EP	EU Climate Action & Energy Package
MEE	Meerjarenafspraak Energie-efficiëntie ETS-ondernemingen

SDE	Stimuleringsregeling Duurzame Energieproductie
CoM	Covenant of Mayors
~~30/20/2~~	targets are released and changed into the EU targets for the Netherlands (20/14/?)
20/14/?	EU targets for the Netherlands: 20% overall GHG emission reduction in 2020-1990 and 14% renewables in 2020
EL	energy labels
BREEAM	Building Research Establishment Environmental Assessment Method
-0.16	Effort Sharing Decision presenting a *binding* GHG emission reduction target for the non-ETS sectors

5.4 Analysis

The NLEEAP states to deliver additional savings in tertiary sector, i.e. the built environment excluding residences, of up to 43 PJ annually in 2016. With Schneider and Steenbergen's (2011) figure of 0.86 PJ savings achievable by ESCOs annually, primarily in the tertiary sector, this means that ESCOs can deliver about two percent of the total demanded savings for the tertiary sector on an annual basis. On the grand total of energy savings however, the share that ESCOs can deliver is a mere 0.3 percent.

Still, it is interesting to see where the Dutch government focuses policy, and where the market potential for ESCOs lies. Both figures are displayed below:

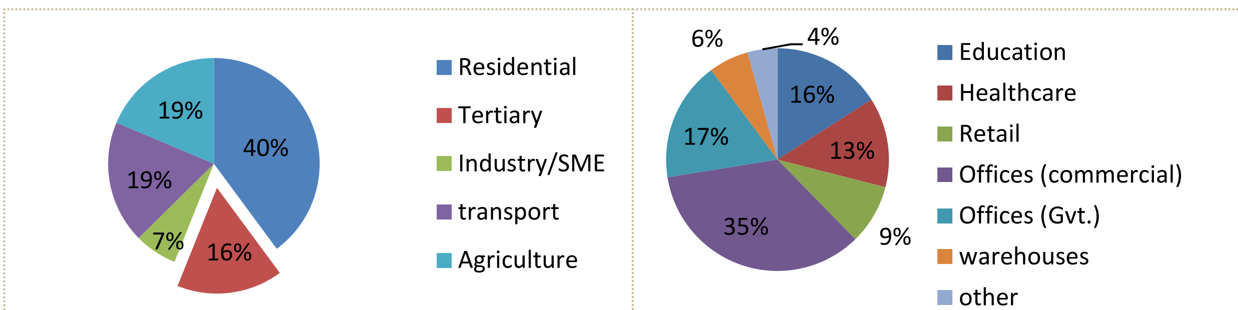

Figure 33: Origin of savings from NLEEAP 2011 (left) and estimated market shares (right)

Dutch policy makers expect the greatest part of energy savings to come from the residential sector, be it corporate social housing or privately owned homes and apartment complexes. These savings should come from increasingly more efficient new houses and a fixed annual renovation pace. For ESCOs however, there is little to gain in the residential sector as discussed in chapter 4. If the "Block by block" pilots envisioned in the 2011 NLEEAP work out well, an opportunity may be created for ESCOs: bundling a whole block of houses under one EPC may be viable for ESCO operations. However, since ESCO operations become feasible from utilities bills starting around €200.000 and average household spending on utilities is €2000[21], this would require bundling at least a hundred homes. This is a considerable project size, that would in any case rule out the oldest of homes that were built on smaller scales – assuming that the block by block approach works best with uniform houses.

The block by block approach for residential buildings may work for corporation owned houses: these are often uniform and built on larger scale. However, ESCO activity in social housing projects faces a couple of challenges. First of all, housing corporations have contracts with their tenants that do not include utilities rates. In addition, these contracts are very difficult to break up and the legally allowed annual

[21] Statline.cbs.nl

increase in rental rates may not be enough to cover the ESCO investments made. It is promising that the government announced that rental rates will increasingly be coupled to the energy performance of a house, but even then tenants have the right to terminate the contract if they do not agree with the new rental rates. It is interesting how this will play out in the future.

For what concerns private home owners, the MmM program combined with EE audits is a good effort to bring motivation, information and means together. The green loans that are provided through this scheme are a step in the right direction, but the interest rates are still high: borrowing € 15.000 over a period of 15 years still yields a net rate of interest of 45%[22]. In any case, privately owned homes will not become feasible for ESCOs for the foreseeable future.

The tertiary sector, i.e. the built environment excluding industry and residences is more promising. 30% of all savings in the built environment should come from this sector, while the government is involved in 46% of the potential market share for ESCOS if one includes hospitals, education and government offices in one chunk. Combined with the exemplary role the government is required to play in terms of energy efficiency in general, and the "launching customer" idea for ESCOs specifically, the government has an extremely important role to play for the future development of ESCOs in The Netherlands.

> *"the role of public spending in ESCO development is barely acknowledged in terms of policy that is set out for the near future"*

It is striking that this is barely acknowledged in terms of policy that is set out for the near future. The 2011 EEAP – the sole legislation mentioning ESCOs in the first place – only goes as far as mentioning the concept of ESCOs and referring to a model contract. Meanwhile, a significant portion of the government owned complexes is currently being recommissioned or renovated by the RGD without EPC, in a way that does not necessarily provide the best mix of measures. A valuable opportunity for creating ESCO demand as well as achieving significant savings is being lost here, for a number of reasons:

First, the government sector has a good financial situation. Either there is enough capital to fund operations privately, or a credit can be easily obtained because of excellent credit ratings. This greatly reduces the financing costs as expensive options such as lease and forfeiting will not be necessary. It is a safe case where ESCOs can be sure of continued operation of their costumer with very little risk. This "sandbox" can generate valuable learning in terms of contract design and M&V, which brings us to the second point:

The government is committed to communicating best practices and sharing knowledge on EE implementation nationwide. Instead of having to rely on external parties for supplying information, the government could create a knowledgebase in-house and instantly share it. This would greatly reduce the complexity of creating such a knowledgebase.

The commercial offices sector looks promising. It has a potential market share of 35% amounting to €24 m turnover annually starting this year. There are ample tax incentives and deductions available specifically for investing in environmental and efficient technology, bringing down the implementation costs by as much as 10% or more. An interesting situation presents itself with the large

[22] http://www.greenloans.nl/

fraction of vacant buildings. These can be refit without discomfort for the occupant, while the value of the building increases which is interesting for the building owner. Additionally, the added comfort and reduced utilities bills that refitted buildings offer are interesting for the prospective tenant as well as for the building owner that is able to charge a higher rental rate. A hurdle is that the building owner assumes a significant risk by refitting a building that is not occupied. It may very well be that the building is simply unattractive in terms of location or reachability.

A point of concern in the commercial offices sector is the following. The Dutch government puts great emphasis on CHP and TES. CHP has been installed en masse in the greenhouses sector, but is also common in the commercial offices sector. TES is taking off as well. Although these measures save great amounts of energy and can be lucrative on their own, the "per measure" approach that the Dutch government displays in this sector may hamper ESCO development. Payback periods for TES and CHP are among the lowest, such that they can be regarded low-hanging fruits. It is therefore very practical to include these measures in EPC packages such that the payback period of the EPC project can be brought down, while extra energy savings can be made. An important notion herein is with the RGD refurbishment projects. Additionally, TES is installed mostly in new buildings, since these measures require low-temperature heating and accompanying insulation measures that are easier to apply in new buildings. When TES is installed in existing buildings, retrofit projects approach a more "package like" approach because of the required insulation. This eases the pain a little, but measures as lighting retrofits would still be left out.

The financing options that are available combined with the tax incentives that are at companies' disposal leave room for interesting constructions. Commercial parties having difficulties finding a credit, or those that want their balance and credit ratings untouched can make use of lease constructions and forfeiting. This is interesting for public entities as well, because they may not always be able to deduct investments from their corporate taxes, or subtract VAT. The viability of such a construction has been shown in the Sittard case study. Another important example, and "one to watch" for the near future, is the Rotterdam Green Buildings Program. The bundled refurbishment of all public swimming pools at once is an interesting approach that may be copied to other cities or complex types.

As a general comment, the Dutch government has directed the greater share of efforts and strict targets towards *new* buildings. Examples are the gradually strictening of buildings codes for residential buildings as well as public and commercial offices; they should reach the "nearly zero" energy standards by 2015, 2018 and 2020 respectively. New buildings may however not be wise to target. The commercial office sector is saturated with 14% vacancy, while the residential market sector does not have good prospects for new houses, at least for the near future[23].

While there is large potential in renovating existing buildings, the residential sector is difficult for ESCOs, whereas stringent directives for existing commercial offices do not exist, other than buildings undergoing "major renovations" need to have installed "cost effective" measures. Whether these measures should be installed in the whole building or in the renovated part is unclear. In addition, the

[23] http://www.nieuwbouw-nederland.nl/publicatie/2270/CBS-Recordaantal-woningen-opgeleverd-in-2009-vooruitzichten-minder-positief.html

renovation pace of commercial property is not satisfactory, according to the European Commission (European Commission, 2010).

To conclude, the greatest potential and responsibility for launching ESCOs lies with the Dutch national and regional/local governments. The housing sector is an option when buildings can be bundled, while there is some revenue to be made in the commercial offices sector. While there are some excellent tax incentives in place, the greatest threat for ESCOs lies in a fragmented policy approach, stimulating specific installations or methods while leaving others untouched. Of course, the stability of the policy itself is also an issue. For example, the EIA availability for housing corporations lasted only two years, while a significant amount of this time was spent on administrative issues instead of implementation. Another example of instable policy is the launch of the SeZ program and discontinuation only three years later. A long-term and stable policy vision is essential, if it were only to reduce the risk perceived by investors.

6 The USA ESCO story

The reader now has a good sense of what the Dutch market looks like and what policy is in place that affects ESCOs or ESPs in general. We know that the Dutch market is strongly underdeveloped while much potential exists, and that policymakers do have a mention of the ESCO concept, although specific targeted policy is virtually non-existent. With all this knowledge in mind, it is instructive to study the mature and still growing ESCO market of the USA. Although it is beyond the scope of this thesis to pinpoint what developments led to the success of the US ESCO industry, an understanding of the context in which this industry developed at least gives us a valuable example. The similarities and differences between the USA and the Dutch ESCO market and related policy may hold important clues for the recommendations that follow in the final section of this thesis.

To understand this context, a brief review of the energy policy history will lead us into the currently most important policy that is in place. Special attention will be paid to the state of California, a frontrunner in energy policy since the oil crises in the early seventies. With the history and policy in mind, the reader is given an overview of the characteristics of this successful ESCO market. Having finished this section, the reader will understand in which context a successful market has been able to develop, and what characteristics this market has.

6.1 History and context

As in most OECD countries, the oil crises of the seventies and late eighties were a major motivation to rethink or even start with energy policy. In these early years, energy policy was motivated by security of supply, and it has been the top motivation in the USA up until now (Bang, 2010). The united states produced about 40% of domestic liquid fuel consumption and 82% of natural gas consumption as of 2007 (IEA, 2010). Electricity is generated from coal for about 50% and natural gas for 20% for at least until 2030 (Dixon, McGowan, Onysko, & Scheer, 2010). Renewables will reach a share of 16% in 2030, up from 8% in 2007.

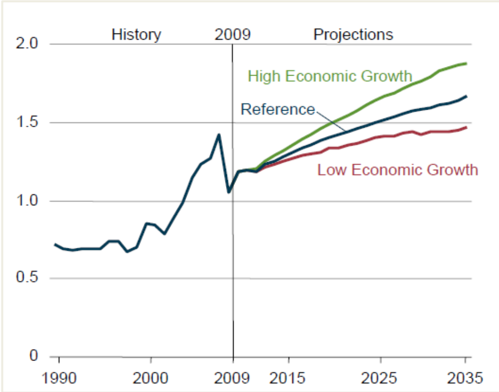

Figure 34 Energy expenditures in the USA, trillion 2009 dollars (IEA, 2010)

These figures show that the USA will be tied to fossil fuels for its energy supply for the foreseeable future, with imports fulfilling most of the liquid fuel needs. Meanwhile, fossil fuel prices are rising, while projections for fuel expenditures as a share of GDP are falling. This can only be the case when GDP is decoupling from energy use, and an indicator that this is currently happening is supplied by Dixon et al., stating that in the period 2002-2005, GHG emissions rose 2.8% while GDP rose over 12% (Dixon et al., 2010)

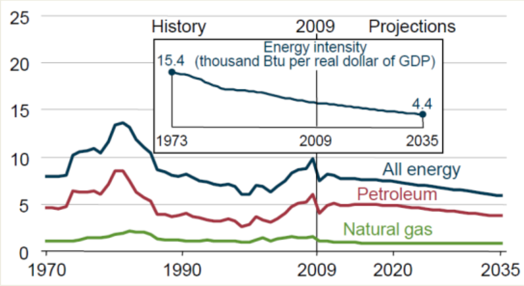

Figure 35 Energy expenditures as percentage of GDP (IEA, 2010)

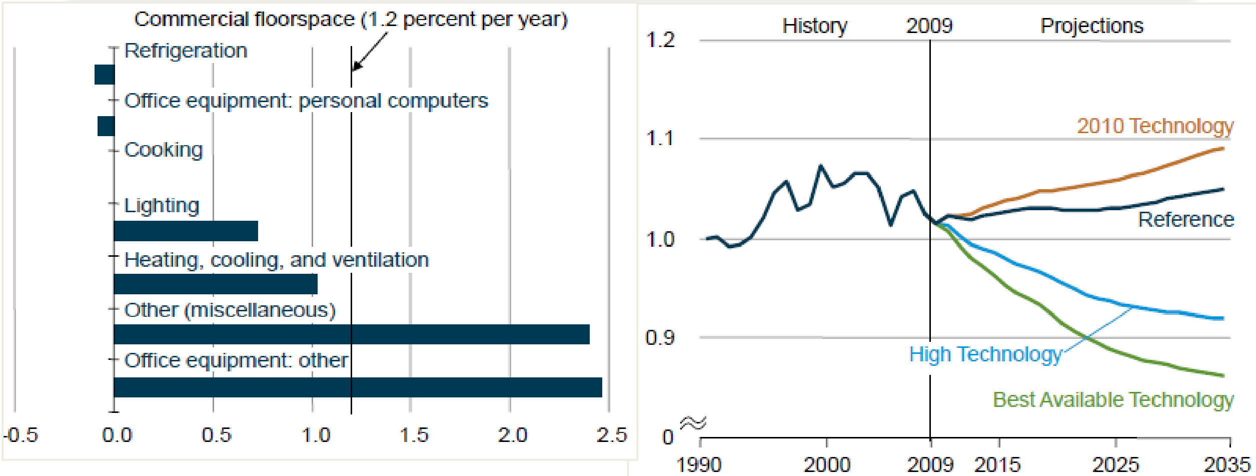

Figure 36 Avg. Annual energy demand growth rates (L) and energy demand index (R)(EIA, 2011)

Decoupling can take place in a number of ways, for example by reforming the economy from manufacturing to services, which has happened since 1990. Currently, 76% of GDP originates from the services sector while only 6% of GDP is generated by the industry sector. In addition, the prospects of energy use for the industry sector are a stable demand while the energy demands of the commercial sector are growing. This means that significant decoupling needs to take place in the services sector(EIA, 2011). See Figure 34 – Figure 36. Since the services sector is usually situated in office buildings, this means that the energy spent in these buildings needs to decrease: Currently, buildings consume 40% of US primary energy, breaking down to 72% of electricity and 36% of natural gas consumption(Doris, Cochran, & Vorum, 2009). In other words: there is a need for energy efficiency improvement in the built environment in the United States.

That this requires policy should be no surprise. EE policy has been in place since the early seventies, and has had considerable effects, for example in California. See Figure 37. In the next section, the outline and workings of the most important US federal policy will be discussed where it concerns building efficiency. Since building efficiency is usually a state affair, we will also look into Californian policy features; State policy has been adapted into federal policy several times throughout history (Bang, 2010), so it pays off to have a sense of what developments are currently taking place there.

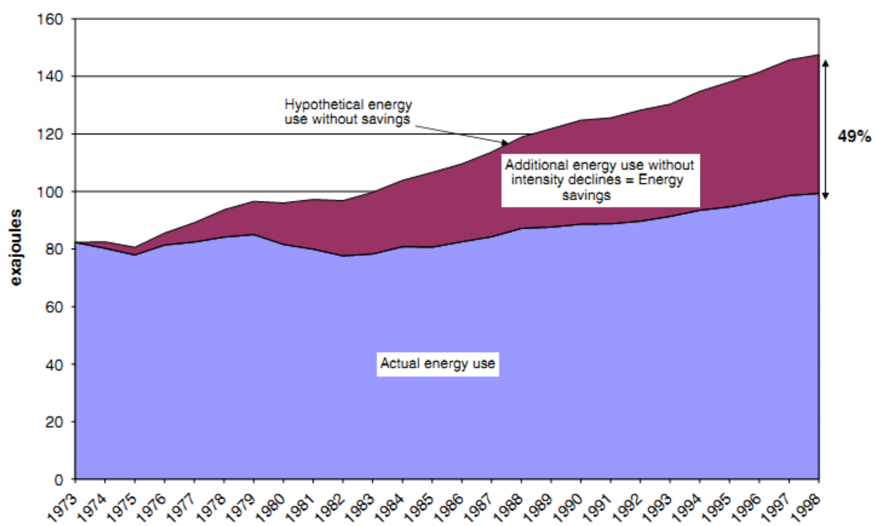

Figure 37 Electricity savings from utility programs, bldg. standards and appliances in California (Geller et al., 2006)

6.2 Current policy

Energy policy in the US is strongly decentralized. History has shown that it is up to the individual states to design their own policy concerning appliance efficiency, building codes or even GHG emissions(Byrne, Hughes, Rickerson, & Kurdgelashvili, 2007; Dixon et al., 2010; Doris et al., 2009; Geller et al., 2006).

US energy policy is aimed at market transformation, of which two primary features are (Doris et al., 2009):

Barrier reduction: Implementing widely applied performance criteria for buildings and appliances, thereby creating a level playing field for all parties in the market. Rebates on EE implementation costs are also present.

Technology accessibility: Rebates, grants and subsidies that favor equipment that is cost-efficient in the long term but has a higher price of acquisition

Important federal legislation is the Energy Policy Act (2005), the Energy Independence and Security Act (2007) and the Federal Energy Management Program (FEMP). In addition, the American Reinvestment and Recovery Act (ARRA, 2009) has released significant funds to EE improvement projects (Dixon et al., 2010; Satchwell, Goldman, Larsen, & Singer, 2010). Relevant combined features of the EISA and EPAct are the following:

- Technical assistance for the private sector promoting CHP
- Designing new building standards that lead to 30% EE improvement by 2030

No hard targets for EE in the built environment have been set at the federal level, except where it concerns federal agencies and/or buildings[24]. Instead, the federal government assists states in designing building codes, whereas considering implementation of these codes by the states is mandatory. The freedom that the federal government leaves states has led to an interesting patchwork of standards that vary per state and per sector; residential or commercial. See appendix B. Although some states barely apply or enforce energy efficiency standards, there is room for frontrunners as well. All states work with the regularly updated International Energy Conservation Codes (IECC) building codes or equivalents. The US Department of Energy (DOE) has set the target that the 2012 IECC should be 30% more efficient than the 2006 IECC baseline, and reports are that progress is on track(Dixon et al., 2010). However, commercial buildings need to comply with other standards or only parts of the IECC standards. A standard that commonly applies is the ANSI/ASHRAE/IESNA[25] 90.1. Buildings complying with the 2010 version are reported to be 25% more efficient than those complying with the 2004 version(US Department of Energy, 2010).

There are a few very important issues with this decentralized governance over building efficiency. First, states are free to adopt any version of the building codes, if at all. This led to only 2 states having adopted the most recent commercial building codes, and 13 states having adopted either no code at all or codes that lag more than three generations behind.

[24] http://www1.eere.energy.gov/femp/regulations/eo13514.html
[25] American National Standards Institute / American Society of Heating, Refrigerating and Air-Conditioning / Illuminating Engineering Society of North America

Second, code compliance is not federally enforceable. States have to hand over to the DOE a proof of compliance, request for extension or an explanation why they do not comply (Molina et al., 2010). Currently, IECC or commercial code compliance ranges between 40-60%, since states often lack the manpower or budget to enforce codes (Doris et al., 2009).

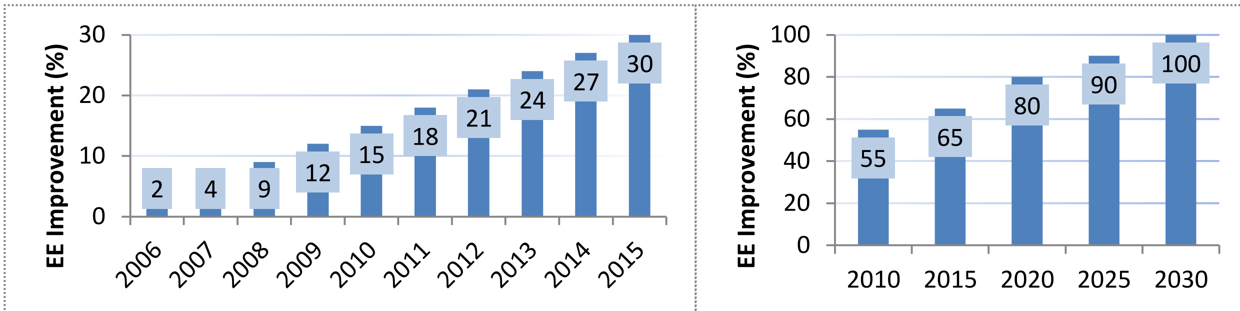

Figure 38: FEMP energy reduction targets (%) compared to 2003 baseline. Existing buildings (L) and new buildings (R)

The federal government does show good intentions and effort with the Federal Energy Management Program. See Figure 38. The FEMP is a program that requires Federal – not state or local government – buildings to lead by example. By 2015, all existing federal buildings must have reduced their energy use by 30% compared to a 2003 baseline level. New buildings should be "zero energy" buildings by 2030, where intermediate targets refer to the same 2003 baseline. The FEMP program has led to significant activity in the ESCO sector, which will be discussed in section 7.4.

6.3 California

The state of California has been committed to increasing energy efficiency since 1974 (Geller et al., 2006), and it was the first state to enact a state-wide building codes in 1978 (Molina et al., 2010). The state has been the number one on the ACEEE's energy efficiency scorecard for the last four consecutive years (Molina et al., 2010). Two bodies have been responsible for the greater part of California's energy efficiency program: The California Public Utilities Commission (CPUC) and the California Energy Commission (CEC). The CPUC issues regulatory policies to utilities operating in California, while the CEC oversees energy issues in more general terms, for example: EE in buildings and appliances, renewables and energy demand/supply forecasting.

The focus of Californian EE policy lies on permanent market change (Vine, 2002; Vine, Rhee, & Lee, 2006), such that measures implemented under EE programs will continue to deliver savings after a program is terminated. The bigger part of funding for EE programs comes from a surcharge on consumer energy bills, approximately 3% (Geller et al., 2006). These funds are redirected towards Research, Demonstration and Development (RD&D), rebates on energy efficient equipment, or retrofits for homes with low incomes. In 2002, utilities spent over $ 230 million in these programs, while in 2000 the net life-cycle benefits of spending in these programs amounted to $2.7 billion (Geller et al., 2006).

These funds are collected and redistributed by the utilities companies. In addition, utilities' disincentives towards investing in EE measures have been removed or greatly alleviated. The CPUC allows utilities to recover revenue that is lost due to improved EE that can be attributed to them by raising the utilities rates. This mechanism will at best result in a neutral position towards EE improvements. Therefore, since Californian utilities are privately owned, shareholder incentives towards investing in EE have been created. these are: (Hayes, Nadel, Kushler, & York, 2011; Satchwell, Cappers, & Goldman, 2011)

- Shared net benefits: allowing utilities to share in EE benefits
- Performance targets: a reward as a percentage of program costs if the target is met
- Rate of return adders: Spending on EE improvements is artificially given the same rate of return as spending on capital investments, where the regulator allows these funds to be recovered through increased utilities bills

Utilities have set up or are executing programs that fund a wide range of retrofits. Measures eligible include lighting and appliances, HVAC systems, motors and building retrofits/renovations[26].

Figure 39 suggests that the total mix of energy policy in California has had a considerable impact on electricity use in California, where about half of these savings originate from utilities public purpose programs.

In the next section, the impact of this system on the ESCO business case will be assessed.

As a last remark, it is interesting to see that states with high (building) efficiency standards tend to spend more dollars on ESCO investments. Compare with appendix B.

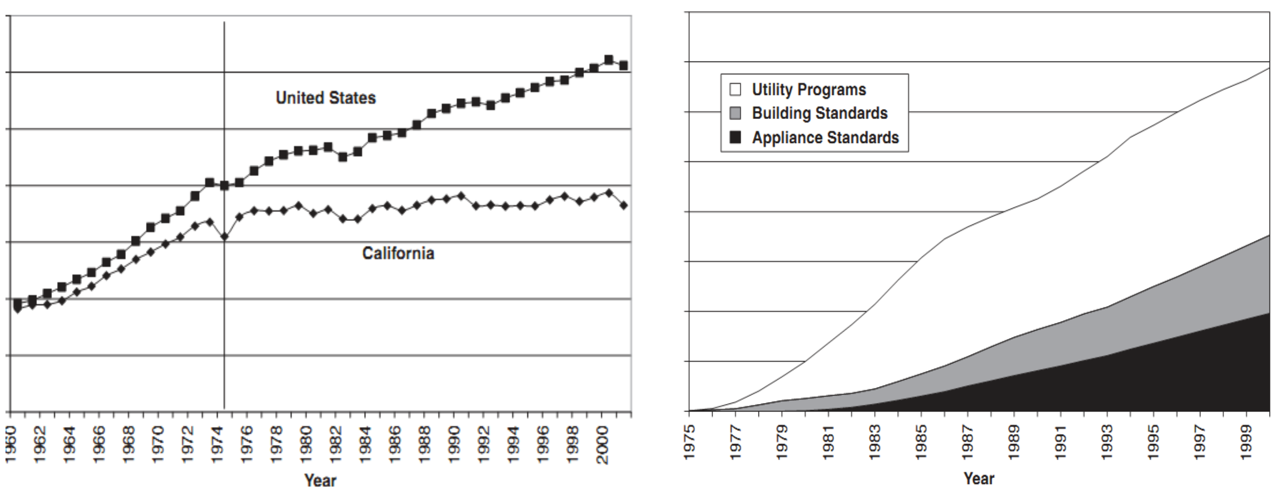

Figure 39: per capita electricity use (L) and electricity savings in California (R), aribitrary units (Geller et al., 2006)

[26] http://www.green.ca.gov/EnergyPrograms/rebates.htm#retro

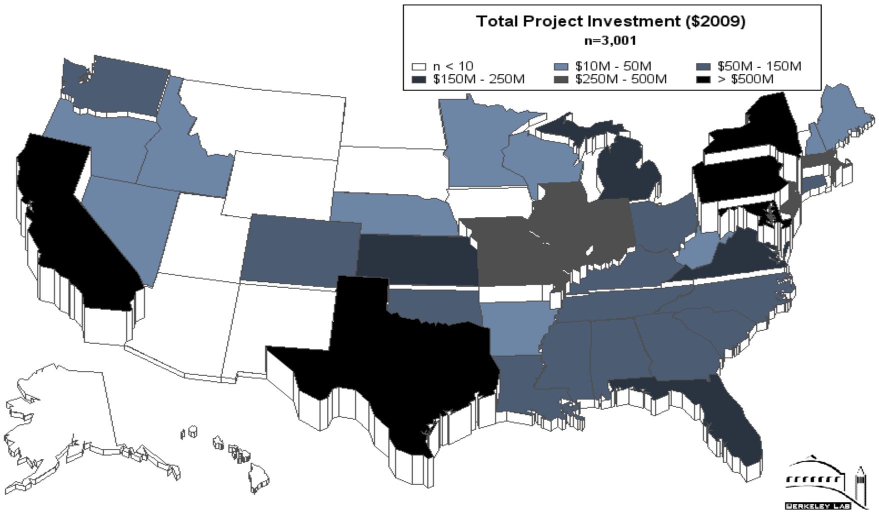

Figure 40: ESCO investment by state. Blacker/higher chunks represent higher values. Figure from LBL project database. For a description of data validity, see section 7.5

6.4 Policy impact

What does the policy environment described above mean for energy efficiency and ESCOs specifically in the United States ? Research demonstrating a causal link between ESCO developments and federal or state policy has not been found. However, there are important correlations worth discussing. Where it concerns energy services, the commercial sector is actually the smallest client in terms of generated revenue. The Municipalities, Universities, Schools and Hospitals (MUSH) sector generates about 2/3, of revenue, whereas revenue from the federal client is about 15%. Data on what share of federal spending is caused by the FEMP program is not available, but experts quote it as "significant'. See Figure 41.

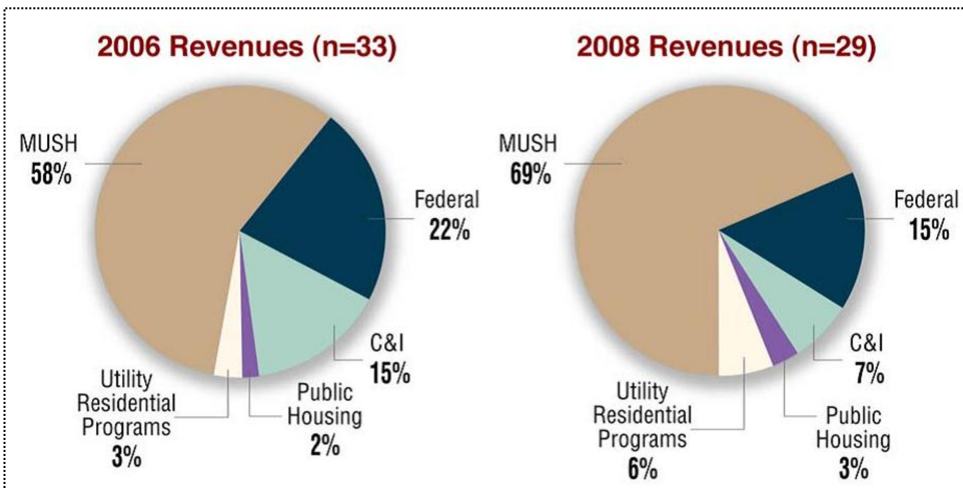

Figure 41: Energy services revenue in the US per market sector. C&I stands for Commercial & Industrial (Satchwell et al., 2010)

In addition, although government policy may or may not be focused on developing an ESCO industry, government institutions do spend considerable money on EE investments, and they can and do choose to send these funds to ESCOs, at least a share of it – and these decisions are policy in the very essence.

Policy also affects the mix of technologies employed by ESCOs. Onsite generation revenue market share – among which CHP – has risen from 10 to 14% between 2006 and 2008. ESCOs seem to reap the benefits of incentives offered by public funds and tax credits. They bundle onsite generation technologies with EE measures to improve economic project performance (Satchwell et al., 2010). Note that EPAct 05 and EISA (2007) include CHP promotion measures.

The big share of federal and MUSH sectors can be attributed to policy:

> *"It appears that "lead by example" programs established by state and local governments, the infusion of federal stimulus dollars, and the continued support by the federal government for performance contracting programs will continue to support ESCO market growth in the public/institutional sector."* (Satchwell et al., 2010)

To conclude, EE policy does have a significant impact on the development and operations of ESCOs. The most direct clues lie in the federal and state governments requiring utilities companies to deliver savings (Bhattacharjee et al., 2009). This finding is reaffirmed in the growth projections for the Energy Efficiency Services Sector of 2010 (Goldman et al., 2010). Government support, be it by legislation or implementation, is key to energy efficiency developments and very important for the ESCO industry.

6.5 Current market

Now that the reader has a sense of the energy outlook and policy context for ESCOs in the USA, it is time to discuss what the actual market looks like today. Statements in this section are backed by the Lawrence Berkeley National Laboratory ESCO project database and/or research, unless stated otherwise. Data supplied to LBL originates largely from the members of the National Association of Energy Service Companies (NAESCO), the American trade organization for ESCOS. NAESCO states to currently represent 38 ESCOs[27], whereas the LBL database with ESCOs contains almost the double amount of 78 ESCOs and around 4000 projects. NAESCO represents the interests of a broader range of energy related companies and authorities, spanning from related technology companies such as window film developers to utilities companies and municipalities. Their mission is to disseminate information, knowledge and best practices between members and to potential clients. The data and conclusions from this section may not necessarily stem from a representative sample. However, articles originating from this data have been accepted and cited in a large number of peer reviewed international publications such as Elsevier's *Energy* and *Energy Policy*. In addition, LBL publications are a key source of information on energy services for the USA's department of energy.

Having acknowledged the possible limitations of the validity of conclusions drawn on this data we proceed with the analysis. United States ESCO gross revenues have been increasing consistently over the past two decades. See Figure 42.

[27] http://www.naesco.org/organizations/companies.aspx?CatID=3

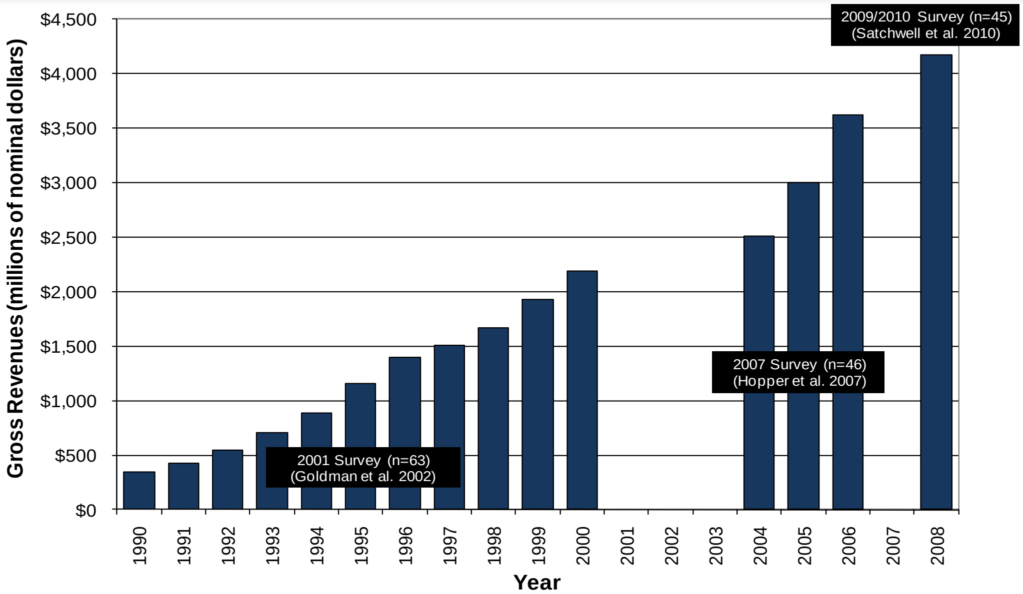

Figure 42: Gross ESCO revenues in the United States (Satchwell et al., 2010)

2008 gross revenues were about $ 4.5 billion, of which 7% or $ 315 million was spent in commercial and industry sectors; the rest is related to public spending, see also Figure 41.

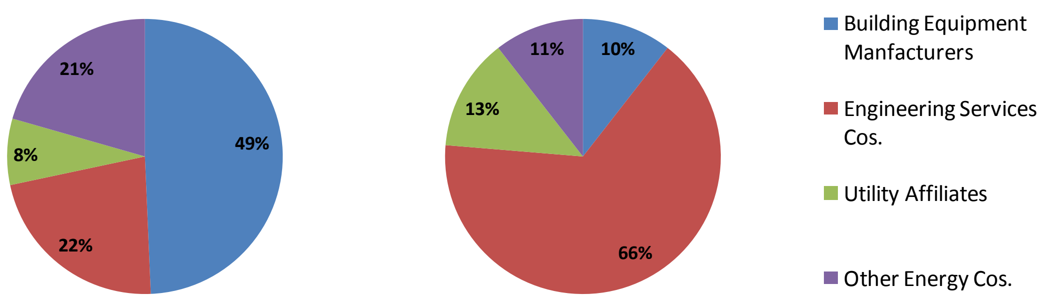

Figure 43: Industry ownership in 2008. Based on revenues (L) and on number of companies (R)

Figure 46 displays company ownership by sector. An interesting point is that utilities affiliates represent a small fraction in both revenues and number of companies, while the first ESCOs were founded primarily by utilities companies (Bhattacharjee et al., 2009). Second, building equipment manufacturers represent half of revenues but only 10% of ownership. This may suggest that these companies employ a large portfolio of technologies when implementing a project, focusing on sales of installations and integrating these, combined with their knowledge on their own technologies, into the project for maximum performance. This picture is in contrast with the engineering services sector. Engineering firms can be expected to have a broad spectrum of knowledge, but may have limited access to novelty technologies for low prices, such as the equipment manufacturers have.

Figure 44 shows that EE projects by far generate the most revenue. Notice that the large fraction of energy efficiency revenues may partly be due to the strong increase in EE requirements for federal buildings between 2007 and 2009 of 8 percent points (Figure 38).

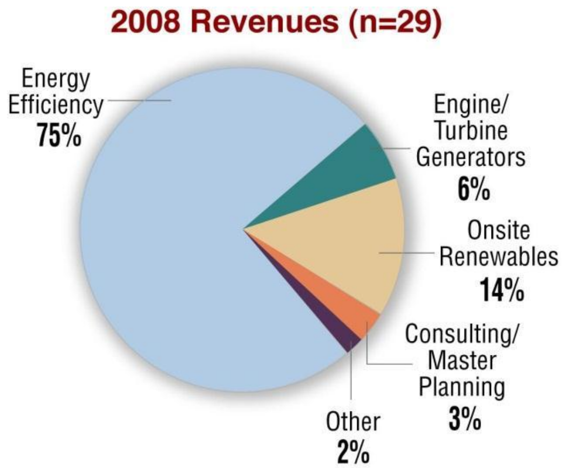

Figure 44: ESCO revenues per project type (Satchwell et al., 2010)

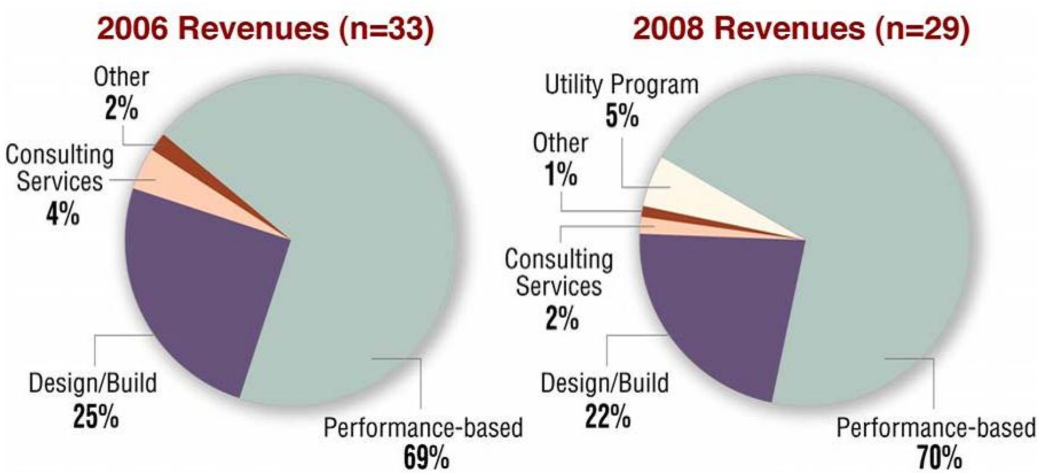

Figure 45: ESCO revenues by contract type (Satchwell et al., 2010)

Performance contracting has a big and stable share in revenue. This has been related to legislative and procurement requirements, where the EISA07 specifically authorized ESPC as a means to achieve EE improvements (Satchwell et al., 2010). Design/build projects have a stable share of around one quarter of revenues. A utilities program share of 5% again establishes the effect and importance of policy for ESCO revenues.

60% of ESCOs perceived an upward trend in project installation costs (i.e. the total investment made per project) over the past decade. Surveyed companies attribute this for the biggest part to rising costs of labor and materials, while transaction costs, contract rules and demand for more comprehensive retrofits share a second place. Note that transaction costs and contract rules include the cost of capital, which has been rising as a result of the financial and economic crises since 2008.

A last important characteristic is the effect on employment that the energy efficiency services sector has. Estimates yield a 2% figure of the total workforce involved in building construction and home remodeling being engaged in activities related to EE improvements. The firms generating this employment are usually very small with less than ten employees, the exception of a few very large firms that originate from the engineering sector noted (Goldman et al., 2010). The employment chain involved in EES is displayed in figure 49.

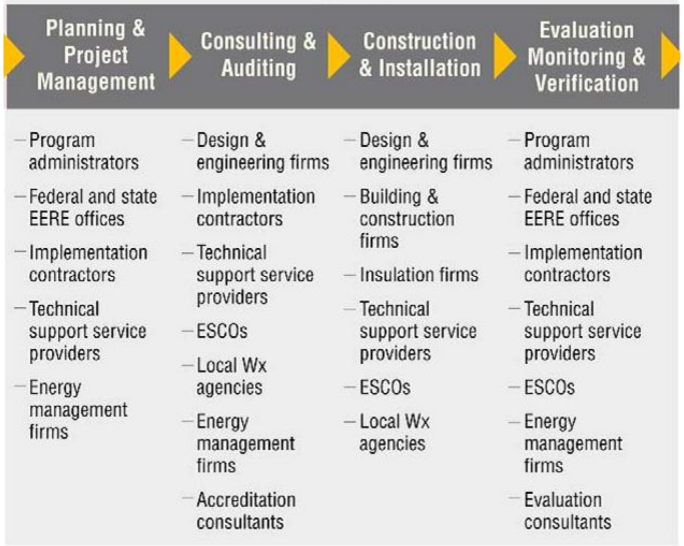

Figure 46: Employment chain for EES (Goldman et al., 2010)

Appendix C contains factsheets [28] with performance benchmarks of ESCO projects in the following USA market sectors: State / local government, Public housing, k-12 schools, healthcare, federal, universities. There are some important remarks to be made.

> *We report the 20th, 50th and 80th percentile value for each of the performance metrics based on installations that occurred from 1996 to 2008. Each bar is bounded at the bottom by the 20th percentile and at the top by the 80th percentile. The numerical value listed in the bar chart is the 50th percentile (the median value for all projects in that group). The bars represent the historic range for these performance indicators for projects installed by ESCOs in a similar climate zone (based on ASHREAE climate zones) or market segment*
>
> -LBL ESCO factsheets

Major HVAC operations, including boiler, chiller and cooling tower replacements, thermal energy distributions, controls and motor measures yield the highest efficiency gains in federal buildings. Accordingly, the costs of these operations are also the lowest per square foot in federal buildings. Objects in the federal portfolio include offices, but also military complexes and other large sites; large sites typically have a good cost per square foot ratio since the denominator is bigger.

Minor HVAC operations are similar to major HVAC operations except that they exclude the more capital extensive measures such as replacement of big installations. Focus is therefore more on controls and thermal energy distribution. These operations have the best cost/ft^2 performance in public housing projects, noting that the sample size relatively small. Second best performing in these operations is again the federal sector.

Onsite generation is best assessed in terms of avoided energy consumption. Avoided natural gas consumption caused by onsite generation is largest for the post-secondary education (universities, colleges) sector. This sector often occupies campuses with a greater number of smaller buildings. Onsite generation installations can be employed in a number of scenarios, but the most plausible is the

[28] http://eetd.lbl.gov/ea/emp/ee-pubs.html

following: one installation replaces many smaller installations, yielding a higher net efficiency by economy of scale. This does however introduce the need for heat distribution on campus. The highest avoided electricity consumption caused by onsite generation is found in the state/local government sector. The difference between these two sectors in terms of avoided kWh and kBTU is unclear, but may lie in the commissioning of generation equipment; they can be tuned to supply full heat demand or full electricity demand, or anything in between.

Lastly, smaller operations excluding large overhauls of major equipment yield the highest efficiency gains in federal complexes. Again, these have the lowest cost per unit floor area.

To conclude, different sectors have different buildings that justify different measures. This affects the technology mix installed at these buildings and therefore the total payback time of the project. It seems that large scale complexes yield best overall results, whereas sectors with smaller complexes display a great spread in benefits per measure per sector type, between different sectors.

6.6 Comparing Dutch and American buildings

A valid question to pose is whether EPC projects in the USA can actually be compared to EPC projects in the Netherlands. One may ask, for example, if the energy consumption of the US office sector wasn't already very high to begin with, so that efficiency improvements to a standard that is comparable between the USA and the Netherlands may yield higher energy and monetary savings for the USA project because there is just more to gain.

Statistics suggest that this is not the case, at least not for all sectors. Comparing data from the Buildings Energy Data Book[29] from the US DOE with data from the "Energie Data"[30] database from Agentschap NL yields the following:

Table 6: consumption breakdown into gas (yellow) and electricity (blue)

	kantoren
Space heating	500
Cooling	70
Warm tapwater	6
Humidifiers	2
Other	25
Food service	50
ICT-central	150
ICT-decentral	90
Pumps	15
Product manufacturing	0
Product cooling	0
Transport	15
Ventilation	40
Lighting indoor	260
Lighting outdoor	10
Lighting emergency	5
Total	1,238
Electricity	642
Gas	506
Sum of El. And Gas	1148
Share of sum vs. total	0.927302

Energy consumption measured in MJ/m^2 primary energy for the year 2008 yields 1243 MJ/m^2 for the USA commercial sector and 1238 MJ/m^2 for the Dutch "offices" sector. Energy consumption in federal complexes is difficult to assess since the variability in objects is high: from courthouses to military bases, from giants as the Pentagon to outposts in Alaska. However, dividing the gross primary energy consumption by gross federal floor space yields a figure of 3150MJ/m^2, while the department of defense weighs in with 63% of total floor space.

An attempt has been made to compare other, more detailed US and NL energy consumption per unit floor area per sector. There are a number of factors that have caused such a comparison to fall beyond the scope of this study:

- US Consumption data are mostly available in units of delivered energy per unit area, while Dutch data is primarily available in units of primary energy per unit area. Conversion is possible but should include estimates of gross generation efficiency and the fuels used per activity. See

[29] http://buildingsdatabook.eren.doe.gov/TableView.aspx?table=3.1.3
[30] http://senternovem.databank.nl/

table 5.

- Dutch and American data are divided in sectors that do not overlap.
- The number and diversity of sectors that are detailedly covered in terms of energy per unit floor area is limited.

This limited availability of data and the differences in calculation methods introduce the need for estimates of conversion and in-site energy use; buildings *may* use electricity for water heating. This introduces too much uncertainty to have meaningful figures. It is however a very interesting study in itself.

To conclude, energy consumption in office buildings in 2008 is comparable between the USA and the Netherlands, and the consumption is similar. Much to our demise, the commercial sector is the smallest client of ESCOs. Whether American ESCOs operate in a market where there is more profit to be made because of general higher energy consumption per building is a question that cannot be answered in this study.

6.7 Conclusion

The US ESCO study suggests that energy efficiency policy has an impact on energy consumption. The industry is still growing despite economic turmoil. Greatest revenue per company is gained by ESCOs affiliated with building equipment companies, whereas engineering companies seem to have founded a large number of smaller subsidiaries. The biggest and most important client for ESCOs in the US is the public sector, covering 84% of revenue in 2008. This shows that public spending is of vital importance for the ESCO industry. In addition, it was policy in the first place that got ESCOs started in the USA by requiring utilities companies to deliver and implement savings at their clients. The federal sector alone is responsible for 15% of ESCO revenues. This can be related to the ambitious building efficiency standards that they set themselves. This is an important lesson for the Dutch ESCO situation, as we will see in the final section of this thesis…

7 Recommendations and Conclusion

7.1 Review

We have seen that Dutch policymakers are actively working towards a more energy efficient economy. Every new building that is built ten years from now should be nearly energy neutral. GHG emissions reductions and renewable energy targets are mandatory, and there is policy and support in place to reach those targets. The EU has the mandate and the will to intervene if these targets aren't met.

Energy efficiency for existing buildings is a harder nut to crack. While an ambition of 20% improvement by 2020 relative to a 2005 baseline exists, there seems to be no all-encompassing strategy to achieve this. Instead, numerous sectoral agreements and separate smaller programs have been drafted and signed, most of them covering new buildings.

Renovation targets for the residential sector have been set and abandoned, while there were no consequences when these targets were not met. In addition, there is no uniform program for directing and evaluating renovation targets. This is an example of the lack of policy for existing buildings.

The commercial offices sector faces a similar problem: future buildings should be very efficient, but existing buildings are not at all regulated, not in terms of renovation targets nor efficiency targets. The only tangible measure seems to be the mandatory display of energy labels when ownership or tenancy is transferred. However, the labeling scheme has not yet taken off in The Netherlands in the way that it was envisioned by both EU and Dutch policymakers. Tax incentives do exist for the sector that may persuade owner-occupiers to invest in energy efficiency, sometimes tied to improving the energy label, but the split incentive is still present as strong as ever.

The figure of two percent EE improvement annually that ESCOs can deliver in the tertiary sector leads to the conclusion that ESCOs are not the silver bullet for Dutch EE ambitions in the built environment. It is a small step towards achieving the goals however, that can be autonomously made by entrepreneurs if Dutch policymakers are willing to generate demand.

Market research indicated that there is a large need for information and education about the ESCO concept. Potential customers are unaware or distrustful of the concept, whereas potential suppliers of ESPC perceive a great need for standardization of contracts, M&V and financial arrangements.

The public sector is a story in itself. This sector has the biggest potential for the ESCO market, be it for the national government or lower authorities and semi-public entities such as hospitals, schools and universities. Additionally, it is subject to strong and ambitious regulation. The Dutch national government buildings, new or existing, should all be "nearly zero" energy buildings by 2018. The RGD real estate program clearly shows that a big share of their buildings will not be zero-energy buildings by this time, and that only vacating the least efficient buildings significantly improvers *their* performance, but not that of the national building stock. A great demand for renovations may be generated by the fact that lower authorities should achieve zero-energy building targets in half of their building portfolio by 2020.

Also, the Dutch government has expressed interest in ESCOs recently, and the concept is mentioned in a large number of studies on how to achieve the Dutch EE targets. It is painful to see that these insights are not reflected in current or planned policy. Instead, the RGD has been and still is implementing partial

EE projects in their buildings. This activity can seriously damage the ESCO potential as is discussed in section 5.5. It is clear that although the national government is taking laudable action, the actual methods can be greatly improved; Especially in the light of the government's commitment to being a *launching customer* for ESCOs by EU regulation.

We have seen that in the USA, the vast majority of ESCO revenues originate from the public sector. This is most probably caused by policy that sets efficiency standards for public buildings. Most revenue is generated with performance contracts that deliver energy efficiency solutions. This indicates that the concept of a launching customer exists and is viable. Also, the American ESCO market is organized, at least partly, with the existence of NAESCO. In fact, most countries that have a successful ESCO market have an ESCO branch organization; the list includes Belgium, Austria, and Italy. These organizations greatly improve communication within and from the industry. Most notably, they supply their members with standard contracts and protocols or a knowledgebase in general. The macro-economic effects of an active private EE sector have been clearly identified in terms of employment and avoided consumption and thus imports.

The latter argument is very important for the Netherlands. With the current economic outlook, the construction sector has seen a clear decline in production. A welcome order would be massive overhauls of public buildings to begin with. Additionally, this would attract investments into the Dutch domestic economy. This is most welcome in a time where even the currency itself is at stake since it positively influences the trade deficit; in the short term with increased GDP by construction activities, in the long term by reduced fuel imports because of improved efficiency. It seems that European policy does not negatively affect ESCO development, since a number of EU member states do have a functioning ESCO market.

A misdirection of policy and means lies in the fact that Agentschap NL is targeting commercial parties with information on EPC[31], while the potential for EPC lies for the biggest part in public buildings. On the other hand, the RGD makes no mention of EPC in any of their reports and continues implementing programs that may not have an optimal package installed, while ambitions are not as high as could be delivered by ESCOs.

With all the above considerations in mind, it is of the author's conviction that the answer to the research question,

How can we stimulate the development of an energy services industry in The Netherlands?

Should be as follows:

[31] http://www.agentschapnl.nl/programmas-regelingen/escos

7.2 Recommendations

Whereas:

EE policy has a positive effect on energy efficiency in general, and over 80% of ESCO revenues in the USA originate from the public sector;

the Dutch government has committed to playing an exemplary role in building energy efficiency, while EU policy stresses the importance of member state governments to becoming a launching customer for ESCOs;

ESCOs could demonstrably help reaching the Dutch GHG, EE and renewables targets;

the Dutch government expects 56% of all EE efforts to be delivered by the non-industrial built environment while 46% of this market is under their jurisdiction;

the Dutch economy as a whole can benefit from the ESCO concept in terms of domestic investments, generated revenue, avoided costs and increased employment;

policy is currently fractured and unstable while policy stability is a crucial factor in reducing uncertainty;

the Dutch government's buildings EE improvement targets appear sub-optimal while a package approach for installing measures seems not to be pursued;

existing buildings are hardly covered by binding regulations or targets;

EPC by ESCOs has been shown to significantly reduce energy consumption in existing buildings;

The Dutch national government should develop long term consistent policy that requires building managers under their direct or indirect jurisdiction to pro-actively consider having their buildings serviced by energy service companies.

Important herein is that current and planned retrofitting projects need to be reconsidered in terms of the package of measures installed. Examples such as the private RGD initiative are damaging the potential ESCO market while these activities may not be cost optimal or achieve maximum energy savings.

A national program for the stimulation of energy services would give ESCO development in the Netherlands a necessary and desired impulse. This program should contain at least:

- A financing or loan guarantees program for ESCO projects
- Detailed mapping of energy use in all public buildings
- Public availability of this data
- Strict enforcement and regular updating of building codes for public buildings
- The creation of a knowledgebase with implemented and proposed projects, their financial arrangements and technical specifications
- A platform with stakeholders in the ESCO industry. Herein should be the Dutch government both as a client and a regulator, experts in financing and building technology, and representatives of the Dutch (prospective) ESCO industry as entrepreneurs. The platform should exchange perception of barriers and incentives and communicate best practices. It may very

well be under direction of Agentschap NL, since they at least know how to navigate current policy including incentives and rebates.

Notice that most of these recommendations are already part of the EU Energy Efficiency Plan (2011), the EPBD (2010/31/EU) and/or the ESD (2006/32/EC).

The biggest challenge for the supply side is getting their product “on the shelves”. The lack of information on energy services and trust in the outcome of energy service projects are major barriers. These can be greatly alleviated by founding a national association of energy service companies, such as has been done in the USA but also closer to home in Belgium, Italy and other European countries. The association could accredit prospective ESCOs, increasing the trust in the outcome of services they deliver. Additionally, a Dutch NAESCO should promote the cause of energy services by disseminating information and best practices. Practical assistance in contract drafting and financial arrangements would also be a key activity employed by the association.

Although finance is a major barrier, this does not play up as much with the prospective biggest client for the near future: public institutions. They have a great credit rating and even a private bank: The BNG (Bank Nederlandse Gemeenten, Dutch Municipalities Bank). This bank can not only provide great financial support for the ESCO initiative; Aiding in long-term development projects for municipalities is their main mission objective.

Finally, a recommendation for the national government that can be implemented as soon as possible is the following:

While Agentschap NL seems to be aware of the ESCO concept and is actively promoting it, they are not targeting the right market parties with the right emphasis. Agentschap NL needs to become aware that ESCOs are for the biggest part dependent on public investments.

On the other hand, the RGD is the prospective biggest client of ESCOs while they actively choose to pursue different contract forms; RGD-owned buildings are increasingly serviced by DBFMO contracts that span a very diverse range of services. Whether these contracts achieve maximum EE improvements is an important question; Focus seems not to lie on maximum EE improvement but rather on unburdening and cost management. The public tenders that attract ad-hoc consortia that implement DBFMO contracts may be harmful for the development of ESCOs that want to offer a more limited portfolio of services focused on energy efficiency.

If ESCOs are to thrive in the Netherlands while achieving maximum EE improvements, Agentschap NL and the RGD should be brought together to reconsider current RGD policy. These parties have the knowledge, the potential and the means to get implement performance contracts in The Netherlands, which has been shown by them implementing DBFMO contracts. The actual EE performance of DBFMO contracts should be investigated. Even if this performance is optimal, the RGD and Agentschap NL should remember that DBFMO services take revenue from prospective ESCOs. This means that ESCO development will be hampered, while DBFMO is not (yet) available or suitable for smaller parties that want to increase their building performance. A suggestion is to separate the energy-related parts of DBFMO performance contracts from other services. This way, prospective ESCOs can be a part of consortia that tender for DBFMO contracts, while their expertise as a separate company could more easily flow towards smaller clients or those demanding only EPC.

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This thesis was would have been impossible to write without the patience, support and freedom that my primary supervisor, dr. Robert Harmsen, gave me throughout the year. Robert was of great help drafting the research proposal and very supportive in getting me to Berkeley. Going there in the first place would have been impossible without prof. dr. Ernst Worrell's recommendation and endorsement to the Berkeley Lab. My e-mail with motivation and resume probably made a long and interesting journey as soon as it arrived there, but a few months later I received a reply for which I could have only hoped. Yes, I was welcome, on the condition that I was willing to spend six instead of three months there and if I was willing to devote half of my time to updating their ESCO project database. I was expected to manually copy & paste about 300 projects from Excel to Access. I refused, and proposed to write a VBA procedure. This enabled me to get back in touch with my quantitative side: Programming and learning VBA, and wrestling with Excel and Access in late night sessions with lots of coffee. As Pete told me numerous times, these skills will last a lifetime, and they had a nice side effect in Berkeley already: Without them I could not have budgeted in my nice trips – or even a loaf of bread in tougher times.

Andy (Andrew Satchwell) and Pete (Peter Larsen) gave me a working environment I could only have hoped for. Besides providing support for any questions I had, they encouraged me to take some time off and discover the great country that is the United States. The freedom they gave me enabled me to travel through most of California, from the mountains around Tahoe and Yosemite to Death Valley, up along the coast from LA back to the Bay Area. The data that Andy and Pete provided me with has been invaluable for writing the USA case study.

Mom & Dad can go to bed from now on with one worry less: Their son has finally graduated. I think I challenged their patience most of all. Their endless support and trust throughout my academic career has been comforting and motivating: who would want to disappoint such good, loving and caring parents ?

Inkscape deserves some credit as well. It generated the cover page and all figures that are not attributed – which means they were made by me. It is a Free[32] program that deserves a recommendation because it's versatile and clever. Its use of Scalable Vector Graphics (SVG) makes it very easy to produce figures at any size and resolution. Another feature is to have it trace a screenshot (using Bitmap Tracing) to upscale it to high DPI, which comes in handy with diagrams from low-res PDFs.

Finally, I thank ChillTrax, Jazz24 and ClassicFM for their endless streams of soothing music. No-one should have to write a thesis without the right tunes…

[32] en.wikipedia.org/wiki/Free_and_open_source_software

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All online sources have been verified to be active as of *Friday, August 26, 2011*

Footnote #	URL
1	http://ec.europa.eu/clima/policies/package/index_en.htm
5	belastingdienst.nl/zakelijk/omzetbelasting/btw_aftrekken/welke_btw_aftrekbaar/
6	ec.europa.eu/taxation_customs/taxation/vat/how_vat_works/index_en.htm
7	www.belastingdienst.nl/zakelijk/ondernemen_kosten/ondernemen_kosten-02.html
8	belastingdienst.nl/zakelijk/ondernemen_investeren/ondernemen_investeren-10.html#P103_12976
10	www.changebest.eu
13	www.rotterdam.nl/eCache/TER/10/95/654.html
14	www.clintonfoundation.org/what-we-do/clinton-climate-initiative/cities/building-retrofit
16	iea.org/stats/electricitydata.asp?COUNTRY_CODE=NL
18	www.belastingdienst.nl/zakelijk/investeringsregelingen/investeringsregelingen-04.html
19	regelingen.agentschapnl.nl/sites/default/files/bijlagen/Index%20Milieulijst%202011.pdf
20	vorige.nrc.nl/binnenland/article2206601.ece/Eerste_Kamer_tegen_slimme_electriciteits meters
21	Statline.cbs.nl
22	www.greenloans.nl/
23	www.nieuwbouw-nederland.nl/publicatie/2270/CBS-Recordaantal-woningen-opgeleverd-in-2009-vooruitzichten-minder-positief.html
24	http://www1.eere.energy.gov/femp/regulations/eo13514.html
26	www.green.ca.gov/EnergyPrograms/rebates.htm#retro
27	www.naesco.org/organizations/companies.aspx?CatID=3
28	eetd.lbl.gov/ea/emp/ee-pubs.html
29	buildingsdatabook.eren.doe.gov/TableView.aspx?table=3.1.3
30	senternovem.databank.nl/
31	www.agentschapnl.nl/programmas-regelingen/escos

Glossary and Acronyms

Agentschap NL	the Dutch agency for innovation, sustainability and international entrepreneurship by the ministry of Economic affairs, Agriculture and Innovation
CHP	Combined Heat and Power
CO_2	Carbon Dioxide
EC	European Commission
ECN	Energy research Center of the Netherlands
EE	Energy Efficiency
EEAP	Energy Efficiency Action Plan
EES	Energy Efficiency Service
EESC	Energy Efficiency Services involving risk taken by the ESCO
EIA	Energie Investerings Aftrek (Energy Investments Deduction)
EL&I	Economische zaken, Landbouw & Innovatie (ministry of Economic affairs, Agriculture and Innovation)
EPC	Energy Performance Contracting
ES	Energy Services
ESC	Energy Servies Contractin
ESCO	Energy Services Company
ESPC	Energy services Performance Contracting
ETS	Europen Trading System (for carbon/GHG credits)
EU	European Union
FI	Financial Institution
GDP	Gross Domestic Product
GHG	GreenHouse Gases
HVAC	Heating, Ventilation and Air Conditioning
IEA	International Energy Agency
IEADSM	the EIA's Demand Side Management program
IPMVP	International Performance Measurement and Verification Protocol
LBL	Lawrence Berkeley National Laboratory
M&V	Measurement and Verification
MIA	Milieu InvesteringsAftrek (Environment Investment Deduction)
MmM	Meer met Minder (more with less)
NAESCO	National Association of Energy Service Companies
NEEAP	National Energy Efficiency Action Plan
NL Agency	Agentschap NL
NLEEAP	Netherlands Energy Efficiency Action Plan
SeZ	Schoon en Zuinig (Clean and Efficient)
SME	Small and Medium Enterprises
TES	Thermal Energy Storage
TPF	Thrid Party Financing
VAMIL	Vrije Afschrijving MILieu-investering (Random Depreciation of Environmental Investments)
VAT	Value Added Tax
VROM	Volkshuisvesting, Ruimtelijke Ordening en Milieu (ministry of spatial planning, housing and environment)

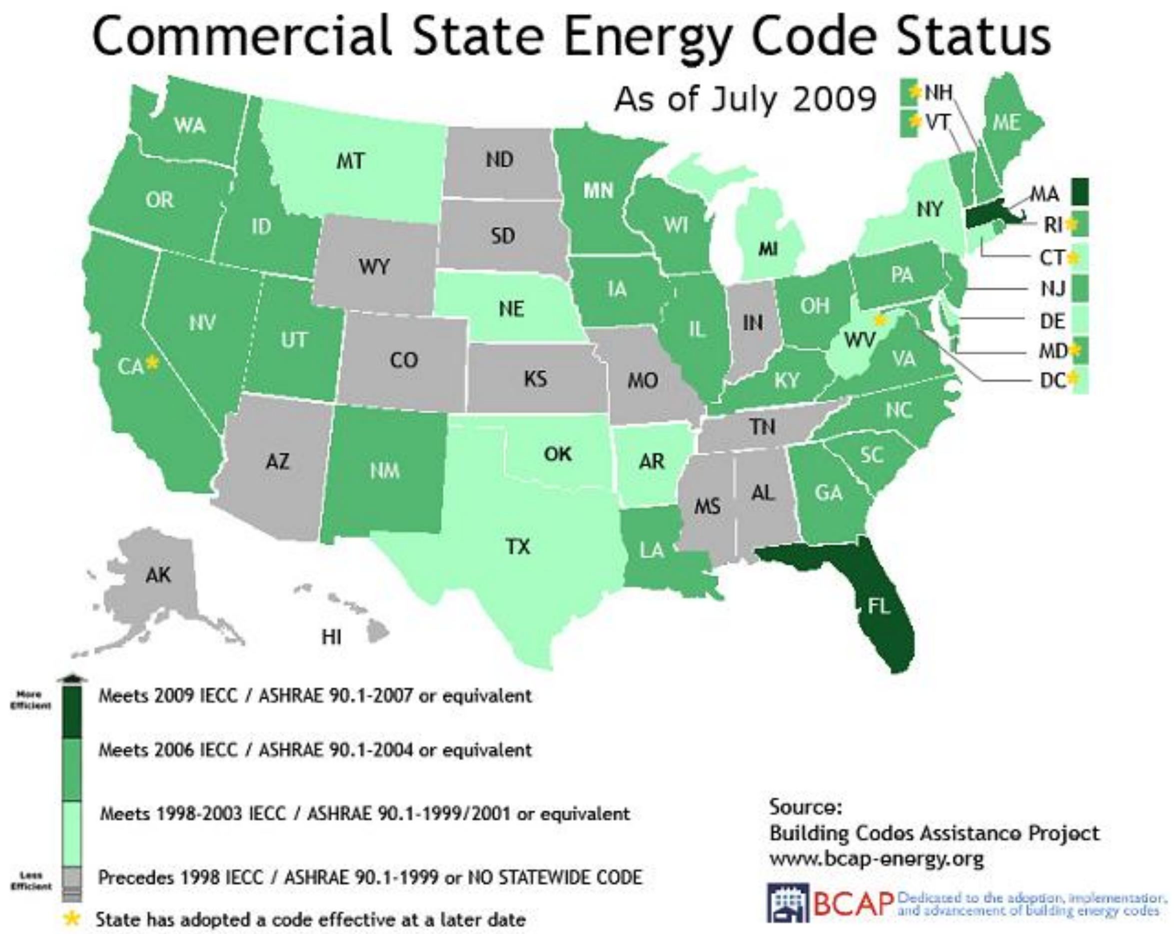
Appendix A: Oversight of M&V options in IPMVP

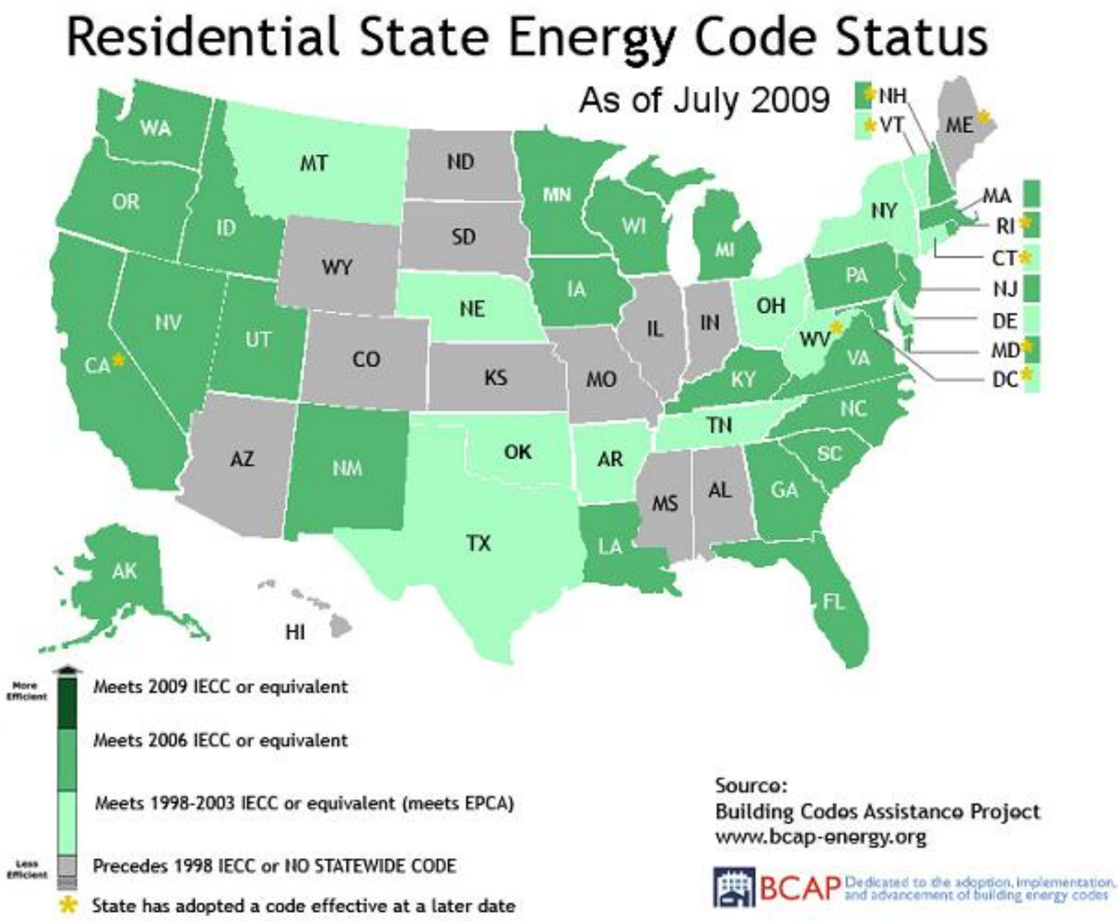
Table taken from Efficiency Valuation Organization, 2010

IPMVP Option	How Savings Are Calculated	Typical Applications
A. Retrofit Isolation: Key Parameter Measurement Savings are determined by field measurement of the key performance parameter(s) which define the energy use of the ECM's affected system(s) and/or the success of the project. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter, and the length of the reporting period. Parameters not selected for field measurement are estimated. Estimates can based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter is required. The plausible savings error arising from estimation rather than measurement is evaluated.	Engineering calculation of baseline and reporting period energy from: short-term or continuous measurements of key operating parameter(s); and estimated values. Routine and non-routine adjustments as required.	A lighting retrofit where power draw is the key performance parameter that is measured periodically. Estimate operating hours of the lights based on building schedules and occupant behavior.
B. Retrofit Isolation: All Parameter Measurement Savings are determined by field measurement of the energy use of the ECM-affected system. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the savings and the length of the reporting period.	Short-term or continuous measurements of baseline and reporting-period energy, and/or engineering computations using measurements of proxies of energy use. Routine and non-routine adjustments as required.	Application of a variable-speed drive and controls to a motor to adjust pump flow. Measure electric power with a kW meter installed on the electrical supply to the motor, which reads the power every minute. In the baseline period this meter is in place for a week to verify constant loading. The meter is in place throughout the reporting period to track variations in power use.
C. Whole Facility Savings are determined by measuring energy use at the whole facility or sub-facility level. Continuous measurements of the entire facility's energy use are taken throughout the reporting period.	Analysis of whole facility baseline and reporting period (utility) meter data. Routine adjustments as required, using techniques such as simple comparison or regression analysis. Non-routine adjustments as required.	Multifaceted energy management program affecting many systems in a facility. Measure energy use with the gas and electric utility meters for a twelve month baseline period and throughout the reporting period.

D. Calibrated Simulation Savings are determined through simulation of the energy use of the whole facility, or of a sub-facility. Simulation routines are demonstrated to adequately model actual energy performance measured in the facility. This Option usually requires considerable skill in calibrated simulation.	Energy use simulation, calibrated with hourly or monthly utility billing data. (Energy end use metering may be used to help refine input data.)	Multifaceted energy management program affecting many systems in a acility but where no meter existed in the baseline period. Energy use measurements, after installation of gas and electric meters, are used to calibrate a simulation. Baseline energy use, determined using the calibrated simulation, is compared to a simulation of reporting period energy use.

Appendix B: State Building codes in the USA





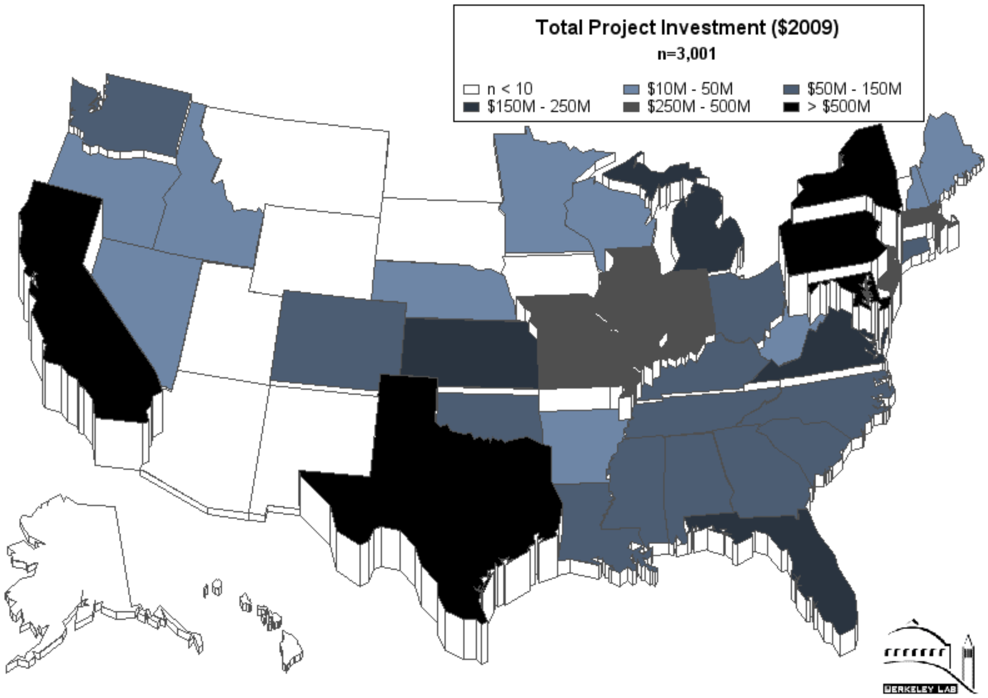


Figure 47: ESCO investment by state. Blacker/higher chunks represent higher values

Appendix C: USA Market sector factsheets

Technologies include:

[a] *Major HVAC equipment replacements (e.g., boilers, chillers, cooling towers), HVAC distribution improvements, and other control, lighting, and motors measures.*

[b] *Less capital-intensive HVAC measures and controls plus lighting and other measures.*

[c] *Onsite generation equipment with other energy efficiency measures (e.g., lighting).*

[d] *Domestic hot water, water conservation, other energy-efficient equipment and strategies such as vending machines, lighting, laundry/office equipment, refrigeration, industrial process improvements, staff training, and utility tariff negotiations.*

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