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A MODEL APPROACH TO FINANCE INDUSTRIAL ENERGY EFFICIENCY PROJECTS

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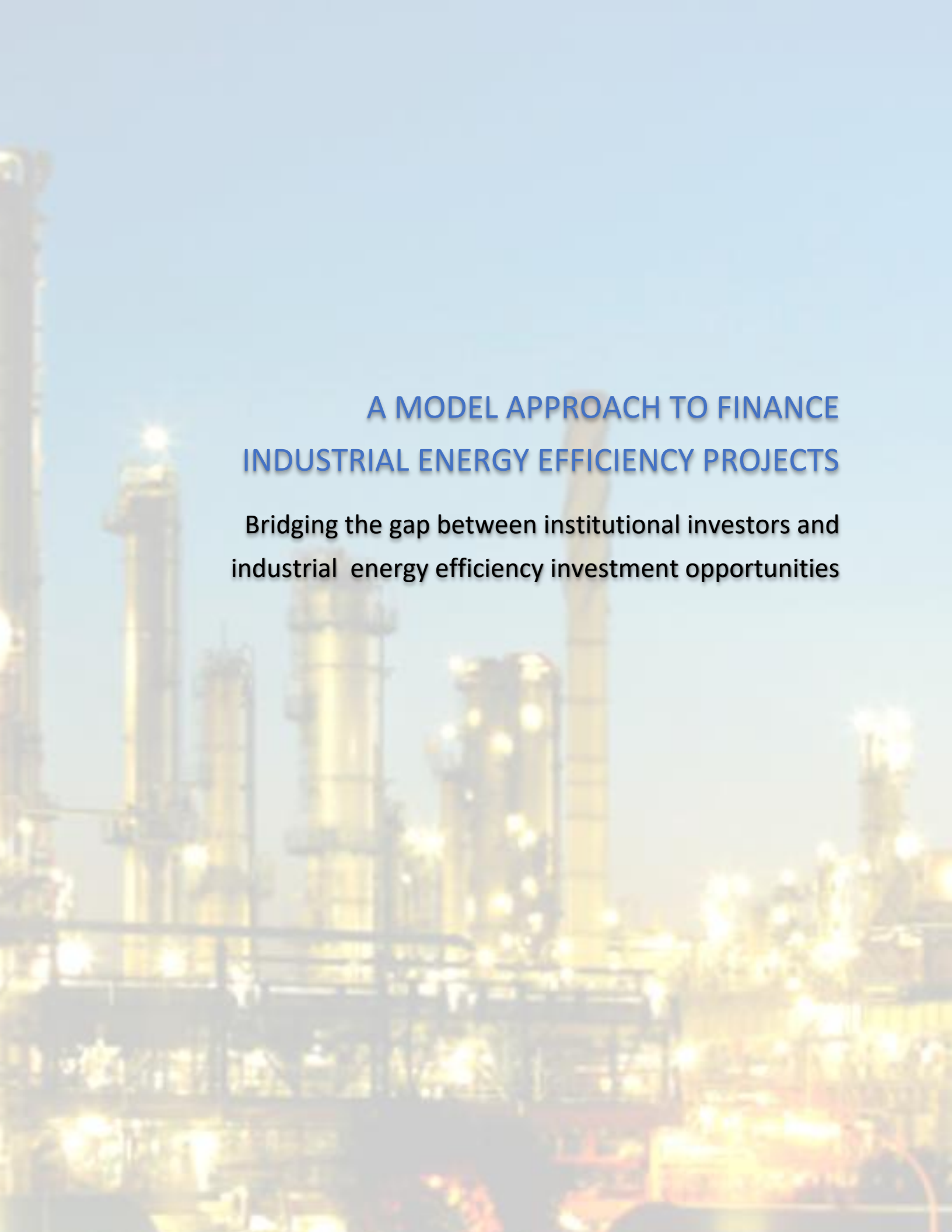

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Bridging the gap between institutional investors and industrial energy efficiency investment opportunities

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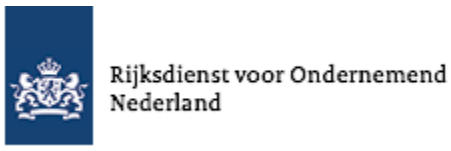

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EXECUTIVE SUMMARY

This study has been commissioned by the Dutch Government Organization RVO[1] under number TSE1706012 named "Modelaanpak voor financiering van grootschalige energie-efficiency". The proposal was originally submitted by the Dutch Branch Organization of Technology Suppliers FME[2] to TKI Energy & Industry [3]at the Top-sector Energy.

FME's request was based on the observation that many Dutch SME[4]'s struggle to grow in the industrial market with their energy efficiency products. Kimberly Tjon a Kie, Master student at Delft University, during a traineeship at FME in 2016 investigated investments in Energy Efficiency for industrial end-users both SME and Large Enterprise. The Master Thesis reveals that energy intensive companies have a relatively small CAPEX budget available for energy efficiency improvements through in-process application, and that such investments face a very high hurdle rate for execution. It is common that investments with a pay-back period longer than 2,5 years are rarely executed. The consequence is that novel energy efficiency technologies do not reach mass market scale, and product innovation and cost reduction of technologies is not achieved due to the lack of investments.

The energy transition from the current system towards to the long term decarbonization goal of the Paris Agreement will require a significant increase in capital investments. This triggered the current investigation and search for solutions by novel business models and financing instruments that would enable more industrial energy efficiency investments to be executed.

This research identified novel business models, policies and financial instruments that can increase the amount of private capital from institutional investors to increase energy efficiency investments particularly in energy intensive industry. The result will lead to positive market outlook for innovative energy efficiency products and increase competitiveness of the energy intensive industry. The first focus of this report was to improve the interaction between SME technology suppliers, energy intensive industries, government policies and institutional investors in order to create an mutually beneficial eco-system. This Eco-system has been analyzed in the report with a focus on ESCO[5] as a missing link for project development and project financing for Energy Efficiency projects in industry.

Institutional investors are increasingly seeking diversification in their portfolio, beyond stocks, low interest bonds and private equity, which can be illiquid long term infrastructure investments with predictable cashflows that are called alternatives. They have several billions of euros cash available that might be invested in such alternatives. Energy intensive industry holds in their hands several energy efficiency investment project opportunities with sufficient return of investment and they do not allocate capital sufficiently to implement those opportunities. Several of these projects might qualify as alternative investments.

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[1] RVO is Rijksdienst voor Ondernemend Nederland, Netherlands Enterprise Agency
[2] FME is De ondernemersorganisatie voor de technologische industrie
[3] TKI Energy & Industry is the public-private organization which contributes to the sustainability goals of the process industry by generating and applying new knowledge in partnerships and demonstration programs.
[4] SME: Small and Medium sized Enterprise
[5] ESCO: Energy Service Company

With their long term horizon and appetite for investments with predictable cashflows, institutional investors are potential partners for such industrial energy efficiency projects, and this report aims to bridge the gap between capital investors and industrial business opportunities.

At first sight it may seem simple to bridge the gap as many projects have relatively low risk and high returns. The reality is that it is hard to achieve due to several reasons. The main reason is the gap between the operational realities faced in industrial production plants and the strategic high level financial drivers. The financial world of investors is a very different world than the industrial world and they need to understand each-others language. This research through the Steering group tried to translate the need of the different parties involved in order to create synergies between the parties.

The report has been developed in 4 parts:

- Analysis of the Italian and Dutch energy efficiency policies.
- Analysis of ESCO experience in the Italian market and possible translation of this experience in the Dutch market.
- Analysis of a potential market size and structure in energy efficiency in the Netherlands and estimation of the size of investments via the RVO database EEP[6] [2017-2020].
- Analysis of novel financial instruments and investment funds to finance energy efficiency projects including the novel IFRS accountancy rules, and a new methodology and risk assessment to develop and bundle these projects in an investment fund.

The energy efficiency policies of Italy and the Netherlands are compared and specific attention is given to the Italian policy and the Italian ESCO's. Italy is a frontrunner in Europe in energy efficiency and in the use of ESCO's to develop and finance energy efficiency projects. The ESCO approach can be applied in the Netherlands and many other countries to develop more industrial energy efficiency projects. The methodology used in Analysis of ESCO experience in the Italian market is based on interviews and online surveys with ESCO companies. The market structure for industrial energy efficiency investments has been investigated by a statistical data analysis on the anonymized data of the Dutch Energy Efficiency Plan (so-called EEP's) submitted by industrial companies to the RVO government database for the Long Term Energy Agreements.

Government policies and novel financial instruments have been explored and investigated based on public sources and interviews with experts in the government and the financial sector. The consequences of the ESCO business model with respect to leasing and off-balance financing on financial reporting rules have been checked with the Dutch Accountancy Organization NBA.

At the end of every chapter there are summarized conclusions, recommendations and lessons learnt for each topic. The main conclusions reached are:

1. The overwhelming majority of energy efficiency project plans submitted by industry in The Netherlands to RVO are too small (< 10 million euro investment) to justify a tailor made business development and due diligence process for each project by external investors. A standardized methodology and risk assessment, in line with novel IFRS leasing rules, is required to develop and

[6] EEP: Energy Efficiency Plan

subsequently bundle many of these projects into an investment fund as a vehicle for institutional investors. This approach has been outlined in the report and requires testing on real projects.

2. The overall investment volume of all submitted Dutch energy efficiency projects is 2,2 billion euro and has been analyzed in different categories of investment size, pay-back period and type of company. This analysis provides the basis for investors to judge the potential market.
3. The current market for industrial energy efficiency investments in the Netherlands, not financed by industry, would allow for at least 3 equity based investment funds of each 200 million euro for external financing by institutional investors using the ESCO business model.
4. The average cost effectiveness of all submitted energy efficiency projects to RVO is 7,2 million euro investment for 1 PJ fossil energy reduction over 15 years, which is 4 times more cost effective than the investment for offshore wind in The North Sea (29,9 million euro) in 1 PJ renewable energy generation over the same period of 15 years.
   This confirms that industrial energy efficiency investments are a more cost effective category to reduce CO_2 emissions.

We developed several recommendations directed towards government policies, energy management & project development in energy intensive industries. As well as financial instruments for SME's, and structuring investment funds and Energy Service Companies.

1. Develop a standardized methodology

It is recommended to translate the proposed risk assessment and project development proposal into a standardized and agreed methodology together with partners from industry, investors, project/technology developers and an accountancy representative (to evaluate consequences of the new ISRS rules). This requires several specific project opportunities to be used as a test case. Depending on the size and nature of the project there may be different versions of the final approach as it is unlikely there will be one size that fits all. These project opportunities may be bundled together and financed by a specific energy efficiency investment fund.

2. Establish and equip an independent body for energy efficiency audits

A key factor in the success of energy efficiency measures is the presence of an independent auditor, to advise, support and supervise government decisions. In Italy this role is fulfilled by ENEA. In the Netherlands, RVO, ECN, and PBL are responsible for parts of this. However, none of these bodies is fully equipped for this task. A more focussed assignment and allocation of budget for energy efficiency audits and expert advice is recommended.

3. Make the size of the energy efficiency market clear and transparent

We highly recommend that the Dutch government follow the Italian governments example to report each year the size and structure of the national energy efficiency market. This would create transparency and attract more investments in this area. Enforcement of rules and more deployment of the EED, leading to more ISO50001 certified companies, will also stimulate the market.

4. Apply the learning on energy efficiency for CO_2 reduction investments in general

This report is focussed on energy efficiency and not directly on CO_2 emission reduction. However even for solely CO_2 emission reduction the recommendations are equally valid. Any successful change in industrial

production processes requires a strong alignment between strategic and operational priorities. This includes not only allocation of capital, but also a management system that stimulates and enforces deployment of opportunities whether this is energy efficiency, CO_2 reduction, electrification or innovation in general. The European Energy Efficiency Directive provides the foundation for such a management system and the ISO 50001 certification. Enforcing deployment of this energy management system will enable significantly more project opportunities to be identified and implemented.

5. Use the Italian ESCO learnings in energy efficiency investments for Dutch SME's and industry

The Italian experience with ESCO's should be applied to stimulate the development of energy efficiency projects in the Netherlands via ESCO's. This is especially important when industrial projects require different partners, customers or expertise, and do not have one single owner that develops, finances and operates them. An example is an industrial waste heat utilization project that has several customers and/or suppliers. The ESCO might be the linking pin as project developer between large industry, technology developers, and financers.

6. Apply novel financing instruments for financing technology supplier SME's

There is a strong growth in financing instruments like subordinated loans via peer to peer lending platforms. The awareness in industrial SME's about these novel financial instruments appears to be very limited and dedicated seminars with both financers and industrial SME's could stimulate the growth of these SME's, innovation, and further deployment of energy efficiency in industry.

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GENERAL INTRODUCTION

The Dutch industry is responsible for approximately one third of the total national energy consumption. In view of the Paris agreement the Dutch government has established an intermediate long term goal of 49 % CO_2 reduction by 2030 in order to reach 80-95 % CO_2 reduction by 2050.

The implementation of industrial energy efficiency measures is crucial in achieving national goals in reduction of CO_2 emissions. Besides this national climate goal there is also an economic goal as more investments in industrial energy efficiency will increase competitiveness in the industrial sector and stimulate innovation by enlarging the market for energy efficiency products and services developed and sold by many (SME) technology suppliers. Last but not least there is also a geo-political objective for stimulating industrial energy efficiency as Europe is a growing nett importer of energy like natural gas and oil. The production of oil & gas decreases due to the fact that natural depletion of its current oil and gas reserves (roughly 5 % per year) is much larger than the gain in energy efficiency (at best 2 % per year). On top of this The Netherlands will over a number of years change from a nett gas exporter to a nett gas importer due to the decreasing production for Groningen gas, that will cease production in 2030. As a consequence energy efficiency has besides national climate goals, also economic and geopolitical dimensions.

Industrial energy efficiency is globally acknowledged by the IEA as the largest contributor to CO_2 emission reduction and also the most cost effective solution for CO_2 reduction. Dr Fatih Birol, the Executive Director of the International Energy Agency, was in The Hague for an official visit on the 26th of March 2018 and led an energy roundtable with a group of Members of the Dutch Parliament and CEOs of leading energy companies operating in the country. He noted that the petrochemicals and energy cluster in the Port of Rotterdam was a leading global example of how energy efficiency and process integration combined with technology innovation could boost competitiveness.

As a consequence mobilizing investment capital, stimulating government policies and the applications of novel business models are crucial to achieve these goals via industrial energy efficiency, which is the focus of this report.

GENERAL OVERVIEW DUTCH POLICY

The European Energy Efficiency Directive 2012/27/EU provides Member states the choice to set their own national energy efficiency target within certain boundaries.

The Netherlands has chosen to increase Energy Efficiency via a final energy consumption target to be reduced with 482 PJ before 2020.This corresponds to yearly energy savings of 1,5%. The Dutch Energy Efficiency Policy systems contains several Voluntary Long Term Agreement between the Dutch government and the companies. Companies that signed the agreement commit themselves to develop and submit an Energy Efficiency Plan (EEP) to implement the measure to improve their efficiency in supply chain, process or in generation of renewables. More detailed information is available in Estimation of investment in energy efficiency in the Netherlands (Chapter 3)

There are agreements (covenants) for two different type of industries:

- MEE[7] covenant , Long Term Voluntary agreement between national government and Large Enterprises with energy consumption > 0.5 PJ per year which includes the EU-ETS companies.
- MJA3[8] covenant, Long Term Voluntary Agreement between national government, provinces, municipalities, branch organization and No EU-ETS companies.

In order to meet the EU Directive 2012/27/EU the Netherlands has chosen to implement additional policies with the "WET Implementatie EU-richtlijn energie-efficientie" (Energy Efficiency Directive Implementation Act) for the companies which are not covered by the Long Terms Agreements. Those companies were obliged to perform an Energy Audit before the 5th December 2015. Companies participating in these agreements are required to submit Energy Efficiency Plan every 4 years with their primary energy saving indication. According to this current policy, all projects within MJA3 companies with a Payback period less than 5 years should be implemented.

Table 1 Overview Dutch Energy Efficiency Policy

Energy Efficiency Directive EU/27/2012			
Dutch Energy Efficiency Policy Overview			
Final saving consumption goal 482 PJ by 2020			
SER Energieakkoord voor duurzame groei (Energy Agreement for Sustainable Growth)	40 organization (financial institution ,industries, environmental organization,etc.)	100PJ extra saving each year, where 9 PJ for the industry. 1,5% increase energy efficiency every year.	Voluntary collaboration with over 40 organizations with middle and long term agreements on energy-efficiency, generating sustainable energy and employment opportunities.
Long terms Agreements-MJA3 covenants	No- ETS companies	8% energy-efficiency every 4 years . Total goal for LTA is 30% energy efficiency (including supply chain) in 2020 compared to 2005.	Voluntary Energy Audit Energy Efficiency Plan (EEP) every 4 years with measures leading to 8% energy-efficiency. MJA3 companies should implement all projects with a payback time less than 5 years.
Long Terms Agreement- MEE covenants	Mostly ETS companies	Total cumulative energy saving of 9 PJ	Voluntary Energy Audit (EEP). Energy Efficiency Plan (EEP) every 4 years with sure cost-effective measures MEE companies should implement the most important projects with a PBP<5 yr. There is no

[7] Multiyear Agreement on Energy Efficiency

[8] Multi Year Agreements, Long term Agreement 3

			specific enforcement for MEE.
Wet Milieubeheer / Activiteitenbesluit art. 2.15	Companies not in covenants of EED, with certain energy usage*		Obligation to comply and perform Energy Audit

The Netherlands has in place several fiscal instruments to promote Energy Efficiency which are listed below. More detailed info on the matter can be found on the report *Verkenning energiebesparing en verduurzaming Deltalinqs.* Rotterdam (Noordende, 2018)

Table 2 General overview RVO subsidies for Energy Efficiency industrial project.

Subsidies	Explanation	Benefit
EIA-Energy Investment Allowance	Tax instrument, Tax deduction to promote Energy Efficiency Measure	On average the EIA, commissioned by the Ministry of Economic Affairs and Climate Policy, gives you a 13.5% tax advantage. More info are available in Link EIA
MIA -Environmental investment rebate	MIA scheme, offering a tax refund on environmental investment.	The MIA scheme allows Tax deduction up to 36% of the cost of an environmentally friendly investment. More info are available in the Link MIA
VAMIL- Arbitrary depreciation of environmental investments	Vamil scheme is a voluntary depreciation on environmental investment.	Vamil scheme lets you decide for yourself when to write off 75% of your investment costs. You determine how fast or slow that will be. That in turn offers you an advantage in terms of liquidity and interest. For the other 25% of your investment costs you follow the regular investment rebate. More info are available in the Link VAMIL

WBSO-R&D tax credit	With the WBSO, companies can lower the wage costs for R&D and other R&D costs and expenditures, such as prototypes or research equipment. You can deduct the tax benefit in your tax return to the Netherlands Tax and Customs Administration. Companies pay less wage tax and lower national insurance contributions, and self-employed individuals can make use of a fixed deduction	This deduction from the payroll tax to be paid is referred to as the 'R&D withholding tax credit'. In 2018 this deduction amounts to 32% of the first € 350,000 of the total underlying R&D cost and 14% of the remaining costs. More info are available in the link WBSO

ANALYSIS OF THE ITALIAN POLICY AND ENERGY EFFICIENCY MARKET IN ITALY

ITALIAN LEGISLATION FRAMEWORK IN ENERGY EFFICIENCY

This chapter will give an overview of the Italian Legislation in Energy Efficiency, Subsidies available and Energy Efficiency Market in terms of investment, Technologies and ESCO market. Italy has set up a yearly monitoring tool and aligned its legislation framework with European policies. On 31st December 2016, 15.154 audits were reported, corresponding to 8.130 enterprises. Thanks to this result, Italy is positioned at the top of the list of more virtuous EU member states in implementing article 8 of EED and its obligation to energy-intensive and large industries. In the rest of EU, indeed, at the end of the first obligation period on December 2015, 13.000 audits were executed. 7.000 of which were executed by the companies themselves. (ENEA, Analysis and Results of Energy Efficiency Policies in Italy, 2017). This fact and the successful Italian experience with the business model of ESCO's has prompted us to investigate the Italian policy for industrial energy efficiency in more detail

In the Italian policy the Directive on Energy Efficiency (2012/27/UE Directive) has been enforced by Legislative Decree 102 of July 4, 2014 establishing a framework of measures for the promotion and improvement of energy efficiency in many areas. The national goal is to reach 20 MToe[9] in primary energy saving which is equivalent to 837,36 PJ by 2020. Energy audits for non-SMEs are mandatory under art.8 of D.Lgs.102/2014 while for SMEs it is voluntary in cooperation with the regional governments. Special funds are assigned to promote Energy Efficiency in SME. All non-SME enterprises as indicated in Table 3 have to provide information on energy consumption per energy source with a breakdown among main processes, process services (e.g. compressed air, steam production, etc.) and general services (e.g. offices, warehouses, etc.). The Energy Audit needs to follow the technical guideline requirements of UNI EN 16247.

Table 3 Obliged enterprise definition under D Lgs. 102/2014

Obliged Enterprise	Definition	Deadline 5th December 2015	Deadline 5th December 2019
Large Enterprise	Number of employees >250 or Turnover >50 M€/year and Annual Budget > 43 M€	Submission energy audit report performed by internal or external auditor based on technical guideline requirements of EN 16247.	Submission energy audit report performed by internal or external auditor based on real energy data monitoring
Large Intensive Enterprise	Cost of energy >3% Total cost Annual Energy consumption at least of 2,4GWh The companies belonging to this category are listed in the CSEA – Cassa per i	Submission energy audit report performed by internal or external auditor based on technical guideline requirements of EN 16247.	Submission energy audit report performed by internal or external auditor based on real energy data monitoring

[9] million tonnes of oil equivalent

	servizi energetici e ambientali. (CSEA, 2017)		

An Energy audit must comply with minimum requirements set up by Annex 2 to the Legislative Decree 102/2014. An energy audit shall be considered as fulfilling the above mentioned requirements when it is carried out on the basis of minimum standards set up by the norm UNI CEI EN 16247 (parts from 1 to 4).

Energy audits have been part of the energy management process for many years. However, one of the challenges has been that audits could be carried out in different ways - from a quick walk around to a very detailed investment-based study. Now that the Energy Efficiency Directive requires large companies to execute energy audits, the EN 16247 series of European Standards will be very useful in providing a clear framework for implementing these audits. Standardization contributes to reaching these EU objectives by promoting best practices, supporting the introduction of new technologies, and providing companies, organizations and authorities with the tools they need to comply with relevant legislation, develop sound policies and improve energy efficiency.

Monitoring and verification process is requested by the Italian Ministry of Economic Development and ENEA, the Italian agency for new technologies, energy and economic sustainable development, is in charge of the verifications. The verification checks cover at least 3% of the energy audits performed by external auditors and 100% of the audits performed by internal auditors. Non-compliant enterprises are reported to the Ministry of Economic Development that issues the appropriate fines. The Italian legislation developed a uniform accreditation national system that regulate the parties involved in the Energy Efficiency sector. The accreditation is based on legal and technical requirements. Those accredited parties are eligible to perform an Energy Audit.

Table 4 Legal Accreditation Parties

Parties	Legal Accreditation	Number of certified parties
ESCO	UNI CEI 11352	The number of ESCO certified by 31st October 2017 is 337 http://www.fire-italia.org/elenco-ESCO-certificate-11352/
E.G.E.[10] **(Energy Management Expert)**	UNI CEI 11339	The number of EGE certified SECEM in the industrial sector by 2016 is 167 http://www.secem.eu/registro-ege-industriali/
Energy Auditor	UNI EN 16247-5	

[10] Esperto in gestione dell'energia

Every year by the 31st of March both the enterprises that have an obligation to audit and the enterprises certified under ISO 50001 have to communicate to the ENEA portal about the energy saving achieved during the previous year.

ENEA:ITALIAN NATIONAL AGENCY FOR NEW TECHNOLOGIES,ENERGY AND SUSTAINABLE ECONOMIC DEVELOPMENT

ENEA officially operates as "National Energy Agency" through its Technical Unit for Energy Efficiency (UTEE), in accordance with the implementation of the EU Directive EC/2006/32. ENEA-UTEE activities are aimed at accelerating the adoption of key technologies for a more efficient use of energy in order to increase the innovation capability and enterprises competitiveness related to energy saving and efficiency.

ENEA-UTEE have 120 employees -scientists, engineers and administrative staff. In *R&D advanced technologies activities in Energy Efficiency Energy and Industry employ more than 30 more engineers and scientist which focus on developing new advanced technologies for wide-range of industrial applications. The focus of the research is in designing and setting-up plants and experimental facilities for the process industry, designing and building sensors and systems dedicated to the building of robots for wide-range industrial applications – terrestrial, naval, marine, space, environmental. More information are available on the ENEA website , Advanced Technologies for Energy and Industry.* ENEA developed a Three Years Plan to recruit 30 % extra staff (572 people) between 2017 and 2019. Energy Efficiency with focus on circular economy, industrial symbiosis and new efficient technology is one of the sector expected to grow in terms of employment. The main activities that ENEA carry out in energy efficiency are:

- technical and scientific support and consultancy services to the State in order to achieve the national energy saving objectives;
- support to the Ministry for Economic Development (MSE) and Regions to ensure the general control and supervision for the implementation of the energy efficiency provision stipulated in the Legislation framework;
- final verification and monitoring of projects and provisions implemented for energy saving and efficiency;
- information and training.

The Italian Ministry of Economic Development has assigned a specific role to the communication and training as key drivers in generating and strengthening the attention given to energy savings and efficiency. ENEA has developed a Three-Year Training and Information Program, involving key stakeholders such as Regions, consumers' associations, ESCO associations and energy services suppliers. ENEA proposed an innovative scheme to analyze the energy structure of the audited production site called tree scheme. It is a procedure that defines the energy performance of a plant or production site, for each energy vector (electric, thermal, steam, hot water, etc.) purchased and used in the examined site, distinguishing annual consumption by the different users in the site itself. ENEA provided operational advice to auditors, in order to standardize reporting and accounting. ENEA developed the guidelines which helps to fully comply with article 8 of Legislative Decree 102/2014, in particular for multi-site enterprises. (ENEA, Energy Efficiency Annual Report -Data 2016, 2017).

Through the analysis of the audits received by ENEA Energy Performance Indices are determined for each sector. According to ENEA a total of 15.154 audit from 8.130 companies were received as of December 2016, increased by 8% from the 2015 data. The audit received shows a potential cumulative saving of 1,5 MToe ≈ 63PJ (see Table 5). Over the next years a significant increase in energy efficiency projects realized by enterprises is expected, as a result of the audits performed by energy-intensive and large firms and of the promotion of energy audits in SMEs. (ENEA, Energy Efficiency Annual Report -Data 2016, 2017).

A similar data analysis and estimation of investment has been carried-out in our research for the Dutch EEP database 2017-2020 and the results are available in Chapter 3.

Table 5 Interventions, investments (€) and savings (toe) of energy efficiency interventions identified in energy audits performed according to article 8 of D.Lgs. 102/2014 by payback time, cumulated values

Pay back period	Number projects	Investments (€)	Saving in TEP	Saving in PJ
≤3	8364	646,335,323	779,560	33
≤5	14,193	1,631,881,852	1,168,814	49
≤10	21,923	2,657,662,287	1,414,719	59
≤20	25,698	3,341,674,298	1,501,881	63

In our research the role of ENEA is considered one of the key factors to the success of the implementation of energy efficiency measures by the Italian policy.

WHITE CERTIFICATE MECHANISM

The Italian White Certificate scheme is one of the most complete examples of baseline and trade incentive schemes existing in Europe, created with the aim of promoting energy efficiency measures on final energy use. It acts both as an energy efficiency obligation (EEO[11]) scheme and as an incentive. The system is based on the obligation, imposed on electricity and natural gas distributors (DSO[12]) with more than 50,000 customers, to meet specific targets, expressed as primary energy savings. These targets are increasing over the years. The White certificate mechanism is addressed as the main policy instrument to reach the national goal, covering 60% of the target. The upcoming target for the next years up to 2020 are mentioned in Table 6 (GSE, 2017).

Table 6 White certificate Target 2017-2020

Year	National goal achieved by the WhC[13]
2017	7,14 MTeo equivalent to 299 PJ
2018	8,32 MTeo equivalent to 348 PJ
2019	9,71 MTeo equivalent to 407 PJ
2020	11,19 MTeo equivalent to 469 PJ

The DSOs can reach their target either by implementing energy efficiency solutions among end-users or by buying white certificates from other DSOs, ESCOs or companies that have an energy manager. The white certificate are tradable and they certify the achievement of end-use energy saving through an energy efficiency improvement initiative and project. One white certificate is equivalent to a 1 Ton equivalent of oil of reduction of the energy consumptions certified. Almost every project involving an improved efficiency in the final consumption of energy is eligible under the scheme and it is expected to issue white certificates for a period of five years (eight years for specific projects). *The savings are determined on the basis of special benchmarks defined by ARERA. In this case (deemed savings – with no on-field measurement – and engineering estimates – with on-field measurement) it is easy to evaluate the savings on the basis of the installed units or the produced kWh (e.g. solar heating, windows replacement, CHP and district heating, etc). In the other cases, when a simplified file is not available, the proponent must get a prior approval for the procedure of measurement and evaluation of the savings he intends to use. These are calculated on the basis of measured quantities in an energy monitoring plan* (Santo, 2015). Based on the savings different kind of white certificate can be issued as indicated in Table 7.

Table 7 Type White Certificate

White certificate	Explanation
TIPO I	Energy saving in electricity
TIPO II	Energy saving in gas
TIPO III	Savings of other fuels (LPG, diesel oil, etc) for other purposes than transportation

[11] Energy Efficiency Obligation
[12] Distribution System Operator
[13] White certificate

TIPO IV	Energy saving in transportation

The parties obliged to submit projects for the certification of the additional savings are:

- Distributor System Operator for gas and electricity with more than 50,000 final customers. In total there are 61 obliged DSO, 13 for the electricity and 48 for Natural Gas.

The parties eligible to obtain the White certificates are:

- Not obliged DSO for gas and electricity
- Energy Service Companies certified UNI 11352
- Companies with an Energy Manager
- Companies certified ISO 50001:2011

The parties and institution involved to regulate the White Certificate Mechanism are:

- GSE, public owned Italian energy service operator. GSE promotes the development of renewable energy sources and energy efficiency in Italy, by granting economic incentives and supporting the policy makers.
- GME, public owned Italian energy service operator that manages incentives for renewable energy and energy efficiency. They manage the spot market of the mechanism in electricity, natural gas and environmental markets.
- ENEA, Italian Energy Agency for new technologies, energy and environment, which covers the role of the technical evaluation of the project.
- ARERA, Ex AEEG (Regulatory Authority for Electricity, Gas and Water) which has a regulatory role in the mechanism. Issues the white certificate for the eligible parties and then decide upon the WhC obligation based on a trading system every year for the obliged parties DSO.

Figure 1 shows how the scheme works. An obliged or a voluntary subject may apply for WhC by presenting an energy efficiency project according to the rules set by GSE.

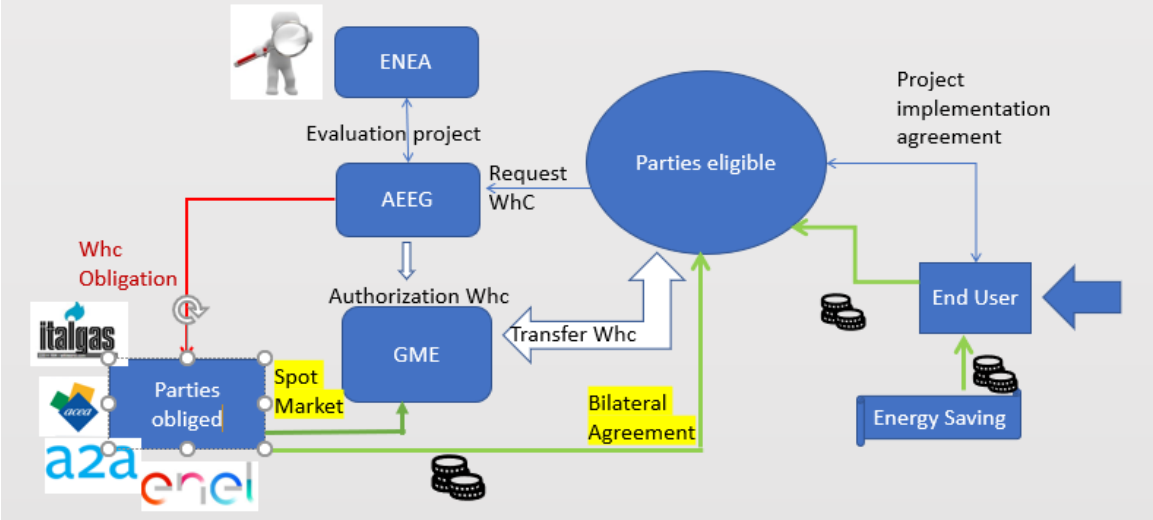


Figure 1 White Certificate Mechanism

The project can be presented via parties eligible to request the White certificates in the system. If the project is approved after the technical evaluation from ENEA, the parties receives from GME a number of WhC corresponding to the recognized savings on its account. The DSO can fulfil their obligation of WhC either obtaining the WhC via GSE implementing Energy efficiency project or purchasing the WhC via third parties in the GME market or via bilateral agreement with eligible parties. All parties with WhC on their account can then trade the certificates either on the real time GME market, in a spot market which usually is held once a week, or over the counter through bilateral contracts registered on the GME's platform. The price of the WhC are transparent and public and can be found on the GME website. The average price was around 100-120 euro/WhC from 2009 to 2016. Due to some changes in the regulation of the mechanism the Italian white certificate price went up by 150 % in 2017.

The white certificate in figure 1 are indicated in green and are considered as additional cashflow in the project on top of the additional cash flow coming from the energy saving. As a result this mechanism decrease the payback time of the investment in energy efficiency making the investment more appealing. One of the success factor of the White certificate mechanism has been the evolution of consultants and Energy service companies in the industrial sector. This evolution is related to the need to present the project with expertise in term of operation, required meters, algorithm and baseline. The Energy service companies gradually acquired expertise in the industrial processes, which can be replicated on other companies diffusing the best practices in energy efficiency. Clearly the diffusion created benefits for the market in energy efficiency. (Santo, 2015)

OTHER INCENTIVES : PIANO INDUSTRIA 4.0

Within the portfolio of energy efficiency plans the enterprise can use some other incentives to subsidize the investment. "Industria 4.0" National Plan represents a major opportunity for all companies that are ready to take advantage of the unprecedented incentives offered by the Fourth Industrial Revolution. The Plan provides for a wide array of consistent and complementary measures promoting investment in innovation and competitiveness by supporting investments, the digitalization of industrial processes, improvement in workers' productivity and development of new skills, new products and new processes.

(Economico, 2017). Table 8 summarize the incentives available up until today under the Industria 4.0 National Plan in Innovation that can be used as incentives for energy efficiency project. (Economico, 2017)

Table 8 Piano Industria 4.0 Efficienza Energetica

INCENTIVES	EXPLANATION	BENEFIT
IPER & SUPER AMMORTAMENTO	Supporting and offering incentives to companies that invest in new capital goods, tangible assets and intangible assets (software and IT systems) for the technological and digital transformation of their production processes. (i.e. monitoring system, process automation, robotic).	Hyper-depreciation: for depreciation purposes, investments in new tangible assets, devices and technologies enabling companies' transformation to "Industria 4.0" standards will be valued at 250% of the investment value. Applies for outright purchases and lease purchase agreements. Super-depreciation: for depreciation purposes, investments will be valued at 140% of the investment value. Applies for outright purchases and lease purchase agreements. Those benefiting from hyper-depreciation may in the future also apply the benefits to investments in intangible assets such as software and IT systems.
NUOVA SABATINI	Supporting businesses requesting bank loans to invest in new capital goods, machinery, plant, factory equipment for use in production and digital technologies (hardware and software).	Contribution partially covering interest paid by business on bank loans of between 20,000 and 2,000,000 euros, granted by banks approved by the Ministry of Economic Development, drawing either on a specific credit line of the Savings and Loans Fund (Cassa Depositi e Prestiti) or on ordinary reserves. The contribution is calculated on the basis of a conventional 5-year depreciation plan with an annual interest rate of 2.75% and is increased by 30% in the case of investment in "Industria 4.0" technologies. Priority access to the Central Guarantee Fund, for a maximum of up to 80%.
CREDITO IMPOSTA R&S	Encouraging private investment in Research and Development for product and process innovation to ensure the competitiveness of enterprises in the future.	50% tax credit on increases in Research and Development costs up to an annual ceiling of €20 million a year per beneficiary, calculated on the basis of the average expenditure on Research and Development in the years 2012-2014. The tax credit can be used to cover a wide range of different taxes and contributions, even if companies report losses. Applies to all expenditure on basic research, industrial research and experimental development: hiring of highly qualified and technically specialized employees, research agreements with universities, research institutes, enterprises, innovative startups and SMEs, depreciation on laboratory equipment and instrumentation, technical know-how and industrial property rights.

ENERGY EFFICIENCY INVESTMENTS IN ITALY

The Energy and Strategy Group of the Business School in the Polytechnic of Milan is responsible for the Energy Efficiency Report every year since 2011. The report investigates and describes strategic business, energy efficiency market size, ESCO market and technological application solutions used.

The Total investment in energy efficiency in Italy in 2016 was 6,13 billion euros. The Compound Annual Growth Rate – CAGR in the last 5 years is 12.5% (+8 % from 2015 to 2016).

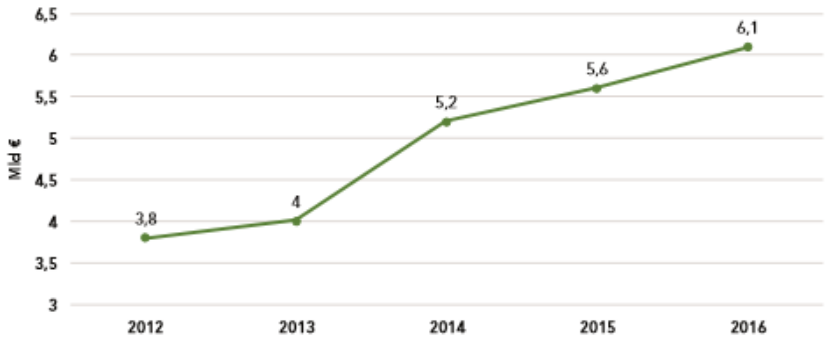


Figure 2 Total investment in Energy Efficiency in Italy between 2012 and 2016

Table 9 below shows the distribution of the energy efficiency investments in 2016 between the different sectors. The industrial sectors cover 33% of the total investment in energy efficiency.

Table 9 Distribution size of energy efficiency investments in 2016

Total Investments	Residential Buildings	Tertiary sector (Hotels and Banks)	Industrial sector
Percentage	53%	14%	33%
Millions euro	3,250	870	2,010

Heavy industry is the leader in energy efficiency investments with Steel companies as front runner. Their investments reach 342 Million euro in 2016. Following Pulp &Paper with 261 Million euro and Chemical and Petrochemical investing 221 million euro. In 2016 the industrial sector invested in efficient technologies to reach the energy saving measures. The distribution of investments per type of application are indicated in the graphic below (Figure 3).

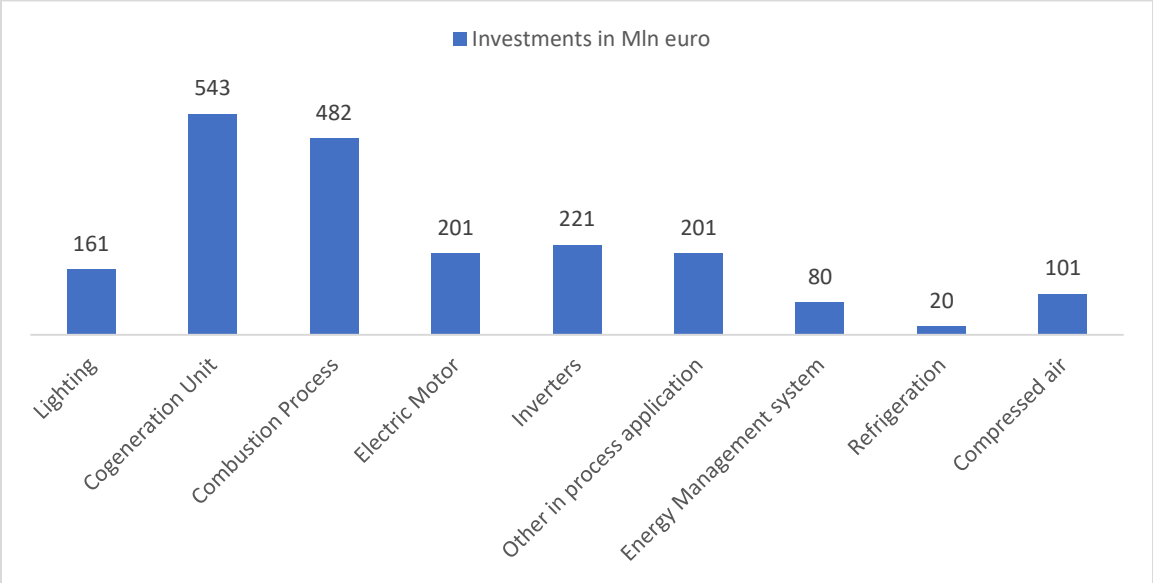


Figure 3 Distribution of investments by type of application in 2016

The main actors in the Energy Efficiency market are energy service companies (ESCOs) and energy utilities. Especially thanks to the white certificate mechanism, the energy savings generated by ESCOs and other utilities can be traded. In the industrial sector 26% of the total size of investments is accounted to ESCO's with a total of 523 Million euro. The Total number of ESCO certified UNI CEI 11352 in 2016 is 272 which it is an increase of 20% in comparison with 2012. This resulted in an increase of 10% employment within the ESCO business. The ESCO investments in energy efficiency are strictly correlated to the technology used or the specific technical solutions adopted.

There are four type of Applications correlated to the profit margin of the related technologies.

1. *ESCO only application*: ESCO are the leader in the market with a low margin of investment. The technologies & Others application associated are : Energy Management System ISO 50001, Energy Efficiency in Refrigeration System, Energy Efficiency in Compressed Air System.
2. *ESCO Killer Application*: ESCO are the leader in the market with a high margin of investment. Cogeneration (CHP) applications are the technologies associated.
3. *ESCO Common Application*: ESCO are not the leader in the market and with a low margin of investment. Building automation system, inverter, electric motor, efficient combustion system are the associated applications.
4. *ESCO Trap-Application*: ESCO are not the leader in the market, it is a high margin of investment. An example of this application is the LED-application.

If we look only at the technologies for the industry, the graph below displays the distribution and relevance in leadership and margin of investment.

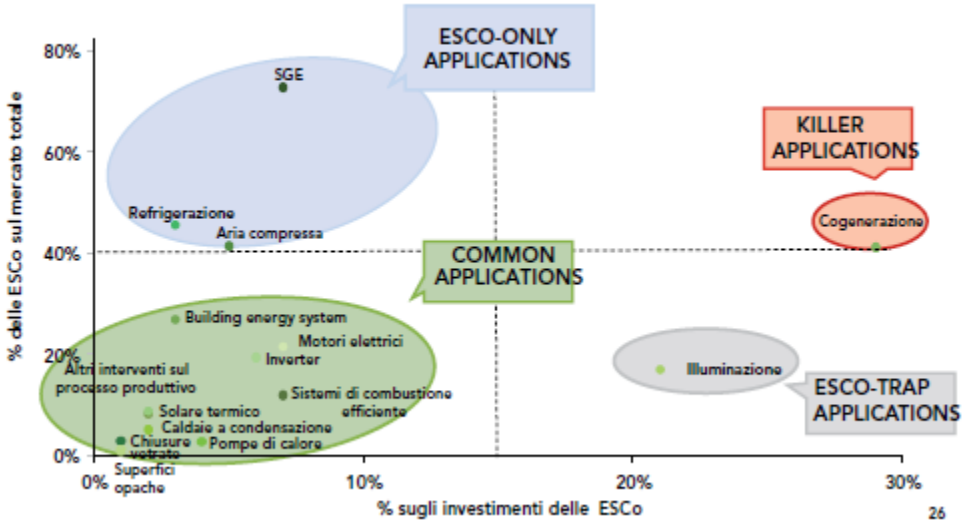


Figure 4 Distribution ESCO type of application and investments

Despite the increase of ESCO's and employees in the sector the revenue decreased by -10 % between 2012 and 2016 from 3.4 billion euro in 2012 to 3 billion euro in 2016. EBITDA [14]decreased also by -9% in the last 5 years, but the EBIT [15]increased by +15%. The +15% EBIT is related to the fact that ESCO's are investing less in energy efficiency with their own capital. The dissonance between the increased energy efficiency investment and decrease of total revenue of the ESCO's has to be appointed to the fact that the ESCO's are having trouble getting to grips with the business due to their fragmentary structure. There are too many small ESCOs present in the Italian market with low profit margin. Two third of the ESCO companies has a turnover lower than 11 million euro and EBIT of 625 thousands euro. The competition in the market is too high especially with the increasing presence of the Energy Efficiency business unit of the utilities which have more capital available. This general information about the Italian ESCO market is derived from a general study which includes ESCO building, ESCO industrial and ESCO Full scope.

In Chapter 2 we have been selecting specific ESCO's with industrial expertise and with 10 years of successful experience in the market with industrial end-users. ESCO industrial is the core of our research. An interesting trend is the increasing activity of Energy Efficiency Business Units in Utilities. The entrance of big energy utilities in the market have raised the competition for the ESCO. So far ESCOs are still leader in the market thanks to the expertise and know-how. On the other hand the utilities hold the capital available to invest and the network of energy trading. Their competition is expected to become more aggressive in the near future and it is forecasted to see a large number of acquisitions of ESCOs by the Utilities.An example is HERA, an Italian utility that finances many cogeneration projects via green bonds. Their technical and operational expertise is restricted to utility type measures in energy efficiency and excludes core process efficiency in complex processes like in chemicals or refining. More information are available in the link below.

[14] Earnings Before Income Tax, Depreciation and Amortization
[15] Earnings Before Interest and Tax(es)

https://energyindemand.com/2018/03/17/blog-from-silvia-zinetti-the-hera-group-experience-with-green-bonds-energy-efficiency-is-the-top-financed-category/

The Energy Efficiency Report (Milano, 2017) focused one chapter of their research on the cost-benefit analysis of the white certificate mechanism responsible for a total of 5.64 MToe/year (equivalent to 236 PJ/year) in primary energy saving between 2005-2016. (ENEA, Energy Efficiency Annual Report -Data 2016, 2017). Based on the Cost-Benefit Analysis in a Macro-Scale prospective for the Italian system, it is clear that the end-users and the main parties involved in the Energy Efficiency Business Chain (ESCOs, technology supplier) are the ones that benefit from the White Certificate mechanism with 3.7 billion euro and 4.5 billion euro.

Utilities are penalized from this mechanism and they have been contributing with around 5 billion euro in the past 10 years. However as previously mentioned they are looking at opportunities in expanding their business creating EE[16] business unit, becoming ESCO and operating in the EE market in order to increase their benefit and have a share in the market. The 'investor' in the white certificate mechanism is the Italian Government which has spent so far 1.3 billion of euro. (Milano, 2017) Based on the cumulated achieved saving by 2016 the average investment of the Italian state in the white certificate mechanism is equivalent to 5.73 Million euro per PJ. Overall the total system of the White Certificate is beneficial for the Italian system and has generated around 2 billion euro in the past 10 years.

In Italy Banks and special funds have been raising capital in the past years with tailor made service to be used for investment in Energy Efficiency. Green banks have an important role in funding energy efficiency and clean energy projects. To give some of the example of Banks with specific Green bonds in Italy are : Unicredit, Mediocredito, Credite Agricole, etc. The banks provide structured funds and in the last couple of years new alternatives are available for accommodating the requirement of the energy efficiency market. Green Funds are playing an increasing role for financing. Listed below two examples of funds currently available in the Italian market:

- Foresight Italian Green Bond Fund. Foresight target small and medium projects in renewable energy generation and energy efficiency. Those projects typically have a debt capacity in the range of 5 million to 15 million euro. It is a niche Italian market not currently served by banks or other sources. The fund underwrite investments grade bonds listed on the Milan stock exchange and it is aiming to raise a total of 200 Million euro. The first investment in projects is expected before the end of the first quarter of 2018.
- Italian Fund dedicated to Energy Efficiency, 16% belonging to the EIB[17]. The fund is an equity fund and it was established in July 2016. Their mission is to be an investor and partner in the energy efficiency sector by providing risk capital and specific industrial competences.

[16] Energy Efficiency
[17] European Investment Banks

LESSONS LEARNED, CONCLUSIONS AND RECOMMENDATIONS

The Italian and the Dutch system have a completely different approach in energy efficiency policy measures. Italy is based on legal obligations, audits and verification and a strong incentives system like the white certificate. Subsequently, the Italian system has via legislation created a large contribution of ESCOs for financing and developing energy efficiency projects. The white certificates in Italy is a successful mechanism which has been developed in the last 10 years. The Dutch system instead is based on Long term agreements and on the voluntary measure of the companies to implement energy efficiency plans. Taking in consideration the differences policy measures adopted by the Italian government and the Dutch the research highlighted four points that can be implemented in the Dutch system.

1. There is a strong policy regulation in the Italian system with a uniform system of professional accreditation which gives a guarantee of the professional level of the parties involved. The ESCOs and consultants in energy management need to have professional qualification and certification in order to be able to work in the sector.
2. There is a uniform methodology used to perform an Energy Audit- UNI EN 16247. ENEA oversees the technical ingredients for performing the Energy audit via Permanent technical tables, Standardized Accountability systems and develops sectorial guidelines with specific procedure for Multi-site companies.
3. The role of ENEA and GSE with technical experts in the verification and monitoring of the energy efficiency measures has an impact on the authority level of the Energy Efficiency obligation. Also the requirement of energy managers has a positive impact.
4. Due to the low cost of power especially for large industries in the Netherlands, implementation of incentives that can decrease the pay-back period of investments might be beneficial. Interesting incentives in Italy, besides the White Certificate mechanism, are the Hyper and Super depreciation incentive that could be implemented for specific innovative technologies that promote advanced energy efficiency technologies and Industry 4.0.
5. Italian policy instruments promote cogeneration that is a major source of industrial energy efficiency. The contribution of cogeneration in The Netherlands has been strongly decreasing over the last few years. This is due to the elimination of the cogeneration subsidies but also due to the lower power prices. The business case for cogeneration is therefore much more attractive in Italy than in the Netherlands.

The fiscal measures in The Netherlands like EIA, VAMIL and MIA have also a stimulating effect that could be aligned with the EEP's using a system with audits and verification in order to attract more investments. Such a system might contribute to innovation and energy efficiency which lead to the reduction of CO2 emissions. In the short term a specific training and information program involving industry, and Research centres in energy efficiency and environmental protection agencies could be developed to increase the awareness of people with respect to energy management and its implementation according to the EED leading to ISO 50001 certification. Subsequently the recruiting of much more technically skilled and certified employees in energy management can reinforce expertise in government, environmental- and research agencies.

ANALYSIS OF ESCO EXPERIENCE IN THE ITALIAN MARKET

ESCOs can be an important institutional mechanism for the delivery of EE investments.
The global energy service company (ESCO) market expanded by 12% to $26.8 billion in 2016. China has by far the largest market, making up over 60% of global revenues, thanks to strong government incentives. The United States (20%) and Europe (10%) are the other two major ESCO markets. Over 1 million people are now employed by ESCOs around the world. (EIA, Energy Efficiency Report, 2017)

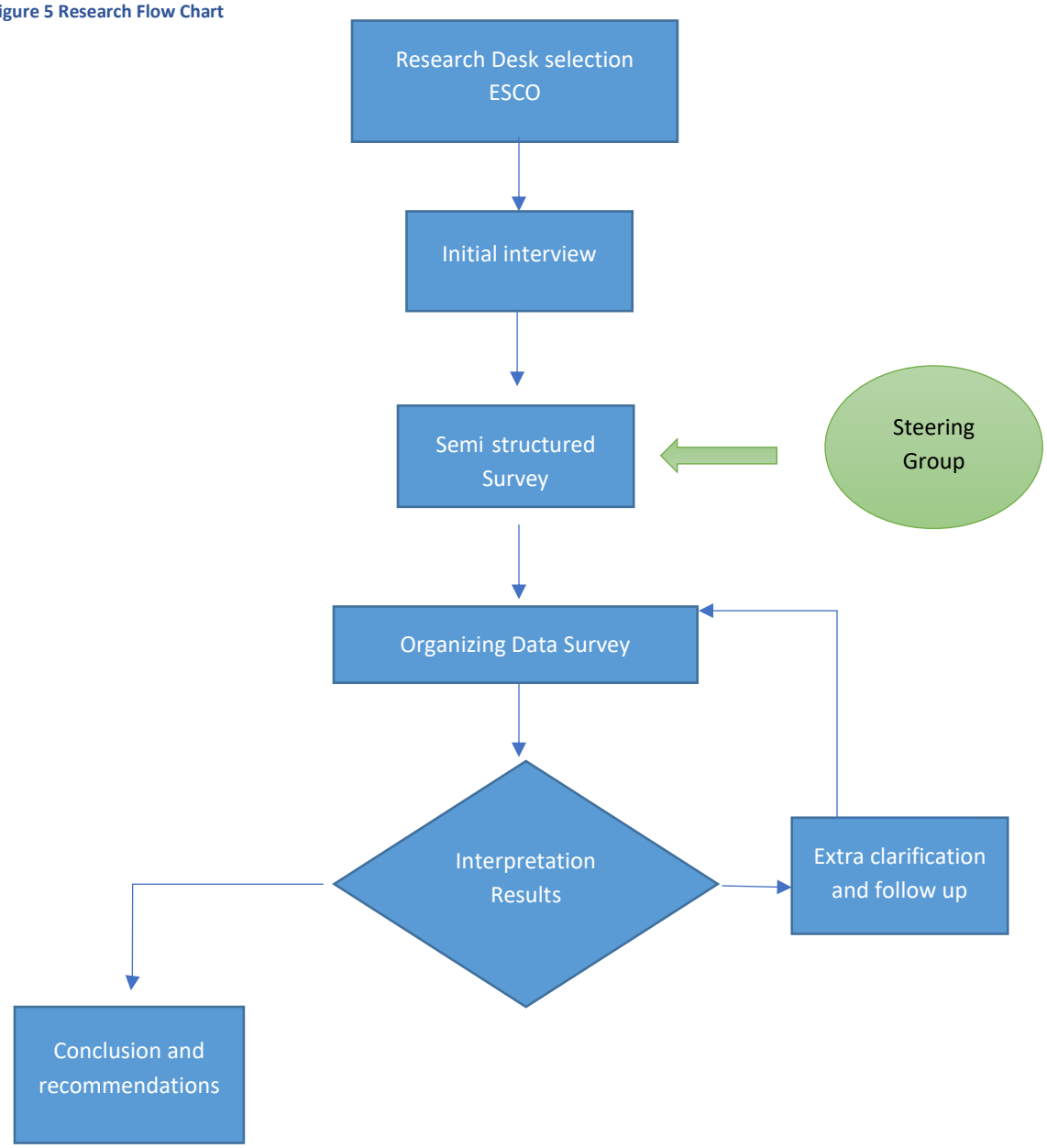
Dutch government programs support energy efficiency, mainly via tax deduction, and there is a large potential for the development of the ESCO market in the Netherlands. Due to the very limited experience with successful ESCO projects, there is not yet a good credibility with energy users in the Dutch industrial sector.

One of the main conclusions of the previous chapter of this report is the extensive experience in the industrial process by the Italian ESCO supported by the white certificate mechanism. Their 10 years of experience with industrial customers and with energy efficiency measures and policies is considered valuable application in other markets.

The following investigation is therefore based on the evaluation of an on-line survey submitted to five Italian ESCO's and one Dutch ESCO in order to get insight in their experience on the field.

RESEARCH DESIGN FLOW CHART

Figure 5 Research Flow Chart



RESEARCH DESK SELECTION ESCO AND INITIAL INTERVIEWS

Extensive preliminary research have been done to select the ESCO sample for the interviews.
In Italy the number of ESCO's certified UNI CEI:11352 by 31st October 2017 is 337 in total.
The purpose of this research is to consider only ESCO's with several years of experience in the industrial sectors and experienced with Large intensive energy companies. Based on the Energy Efficiency Report-July 2017 , Strategic Group of the Polytechnic University of Milan and further research the following ESCO have been selected:

- **Bartucci Spa** it is an integrated ESCO with experience and cross-sectorial competences in the industrial sector. Operative as ESCO from 2005.
  Bartucci Spa was awarded by the IEA in the Energy Efficiency Report in 2013 for a best practice in the industrial process efficiency in Cement manufacturing. (EIA, Energy Provider-Delivered Energy Efficiency, 2013)
- **Avvenia** is an ESCO with experience in strategic consultancy especially for Large Enterprise and cross-sectorial experience. Working with 25 Italian industrial sectors and big customers' portfolio, composed by more than 100 large enterprises.
- **Innowatio** with 20 Meuro of investments as an ESCO and 100 Million euro of investment planned by 2020, it is present in Italy but also in Argentina and Germany.
- **Kairos engineering consultants** , through a careful analysis of energy use will be able to suggest energy efficiency measures , aimed at rationalizing consumption , and to find solutions based on the use of efficient technologies.
- **EDF Fenice**, 100% subsidiary of Edison SpA in EDF Group, provides its clients with tailor-made energy efficiency solutions and environmental services to reduce their energy consumption and environmental impact.
  The comprehensive range of services provided goes from audit to management of energy assets built through own-financing and turnkey realization securing safe and optimized operation.
- **ENGIE Nederland**, partner in the Steering Group which has been working as an ESCO for industrial Dutch companies providing in-process and auxiliary application.

The ESCO's have been contacted at the beginning of October and via skype meeting and conference call they have been asked to collaborate with the research project.
All the ESCO's mentioned above have been participating at the survey meeting the deadline of the 4th of December 2017 with interesting insight and information in their business.
The ESCO's contacted have been always available to give clarification and additional extensive information.

SEMI-STRUCTURED SURVEY

In this research it has been decided to carry-out an on-line survey. The survey is semi-structured leaving room for open answers and using a standardised format with multiple choices which increases data reliability and a better structure in the research. The complete template is available in Appendix A.

The survey structure can be divided in 4 parts:

1. Size of investment and industrial customer (Q1,Q2,Q3,Q4,Q5,Q22,Q25)
2. ESCO service (Q6,Q7,Q8,Q9)
3. Execution project and performance guarantee (Q10,Q11,Q12,Q13,Q14,Q15,Q16,Q17,Q18,Q22,Q24)
4. Project Financing (Q19,Q20,Q21)

The first part related to size of the investment and industrial customer is a double check of the Research Desk selection. The questions investigate the type of the industrial customer served by the selected ESCO , the average size of the investment and the average reduction of the annual energy bill related to the implementation of Energy efficiency project for 5 representative sectors : Food & Beverage, Metal, Chemical, Construction and Pulp & Paper. The selection of those five sectors aligns with the Master Thesis carried out by Kimberley Tjon-Ka-Jie. As indicated in the Executive summary the thesis explored the barriers in energy efficiency interviewing energy end-users, companies that take part in the long-term agreements between industry and government (MJA3/MEE).

The second part of the survey explore the ESCO prevalent service offered to industrial customer, the reason of the end-user to choose an ESCO to carry out EE project and the critical factors for future success of the ESCO business. The third part explore in more detail contract structure, performance guarantee, sharing and mitigation of the risks. The last part of the survey in focused on specific question in project financing. At the end of the survey has been requested to the ESCO to voluntary share information on a specific real business case containing energy saving results, technology used, white certificates generated or draft of the contract. Two of the selected ESCO's provided those information and the results will be shared in Appendix B.

ORGANIZING DATA SURVEY AND INTERPRETATION OF THE RESULTS

The survey has been completed by the six selected ESCO within the time frame requested. The response rate of the survey is 100%.

PART I

During the first part of the survey Kairos Engineering does not satisfy the selection criteria of the focus of our research due to their focus on SME's. The Kairos' survey has been valuable insight information and can be used for further research, but for the purpose of this research has been evaluated separately in order to preserve the consistency of the benchmark of the survey. Bartucci, Avvenia, Innowatio, EDF Fenice and Engie Nederland confirmed the main focus on Large Enterprise and Large energy intensive companies as indicated in Table 10.

Table 10 Percentage type of customer

Classification	Percentage
Large Enterprise EU ETS	20-30%
Large Companies	20-30%
Large Intensive companies	20-30%
SME	0- 10 %

All the interviewed ESCO's have experience in projects in the process application and not only with auxiliary systems. Their professional experience is extended in several industrial processes and they developed knowledge in good and best practices for each sectors. In Question 23 ESCO showed the interest in developing a business in the Netherlands with in-process application using Energy performance contracts.

The average investment size for Large Enterprise are between 500,000 and 1 Million euro of the investment for Chemical and Metal sector. In case of Large Energy Intensive companies the size of the investment in those 2 sectors can reach investments of 5 Million euro. The result on question 4 and question 5 of the survey shown in Table 11 brings to the attention that the selected ESCO's carry-out relatively small size project in EE.

Table 11 Q4 & Q5 Average Size Investment ESCO

Range of Investment	Large Enterprise	Large Energy Intensive
0-100k euro	Construction	Construction
100k-500k euro	Food& Beverage, Pulp& Paper, Other	Construction, Food & Beverage , Pulp & Paper
500k-1M euro	Metal, Chemical	Metal, Chemical, , Food & Beverage , Pulp & Paper
1M-5M euro	-	Metal, Chemical

The average reduction of the annual energy bill is really low in the construction sector, which confirm also the reason of the smallest size of the investment in the sector. Interesting percentage of reduction are in the Metallurgic , Chemical and Food & Beverage sector with saving between 15% and 20% of the total annual energy bill. Further results are shown in Table 8. Good performance is reached in the Metal sector and Other sectors, which indicate the automotive sector for the Italian industries.

Table 12 Q2 & Q3 Average Energy saving

Average reduction annual energy bill	Large Enterprise	Large Energy Intensive
0-5%	Construction	Construction
5-10%	Pulp& Paper	Pulp & Paper
10-15%	Pulp & Paper, Metal, Chemical	Metal, Chemical, , Food & Beverage , Pulp & Paper
15-20%	Metal, Chemical, , Food & Beverage , Pulp & Paper	Metal, Food & Beverage
>20%	Metal, Others	

PART II

Moving on to the second part of the survey the research analysed the ESCO service and the reasons that motivate the industrial customer to implement Energy Efficiency Plan with an ESCO. The main reasons that drives industrial customers to implement Energy Efficiency measures are the renovation of the aging equipment with consequently reduction of energy cost. The legal obligation has a strong leverage and it is valid only for Italian industrial companies. The company policy is rated not important among the reasons.

One of the main findings of the survey is that the industrial customer choose an ESCO to execute EE project for the service quality and technical expertise with a strong attention on the performance guarantee. Table 13 shows ESCO's are not only a project financing vehicle but also a guarantee of technical expertise in energy efficiency. This is a good resolution of the research highlighting the importance of the technical expertise and professional certification system which was previously mentioned in the Italian legislation framework section.

Table 13 Q7 Ranking of the reasons that motivate industrial customer to choose an ESCO

Performance guarantee	★ ★ ★ ★ ★
Service Quality and technical expertise	★ ★ ★ ★ ☆
Project Financing	★ ★ ★ ☆ ☆
Less administration burden	★ ★ ☆ ☆ ☆

As a consequence to the customer need ESCO's service have to cover the whole portfolio from consultancy to design and operation and project financing. The critical factors for the success of the ESCO's business has a distinct correlation with legislation and the incentives stability for the Italian ESCO, which confirms the strict relationship between the development of the ESCO market as consequence of the white certificate mechanism. The volatility of the energy price is not considered a relevant factor for the success of the ESCO business and it is a well mitigated in the contracts. The company policy is not considered relevant which confirms the low leverage in the decision driver for the energy efficiency from the end-users.

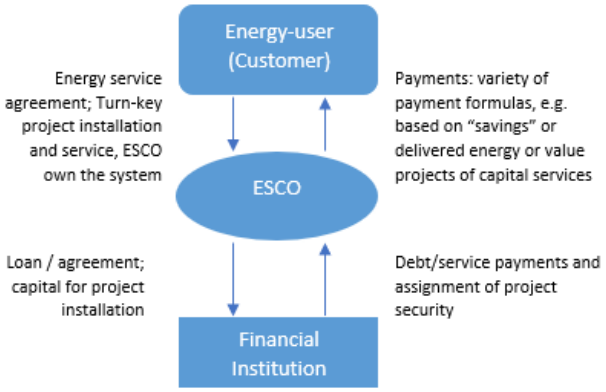
Two of the six ESCO indicated other critical factors which are related to the demand availability, quality and future integrity. The forecast of the flexibility of the energy demand and the energy generation can have a strong impact. For instance the availability of a device for thermal and electricity energy storage to a competitive price or the technology for the monitoring energy system available at accessible price is necessary in order to maintain profitable investments in EE.

PART III

ESCO is an important institutional mechanism for delivering EE investment. According to the European directive CE/32/06 the contractual mechanism developed to deliver EE projects is the Energy Performance contract. ESCO develops, implements and finances or arranges third party financing for an EE project under EPC, using the stream of income from the cost saving to repay the cost of the project, including the cost of the investment.

The third part of the survey in this research investigated the kind of contract the selected ESCO used in their projects in relationship with the risk sharing, project financing and pay-out of the investment. In Table 14 there is an overview of the type contracts available and used in the EE projects according to the survey and the main characteristic of the contract

Table 14 Type of Contract used by ESCOs and ranking of the survey

Contract & Energy Service Agreement	Ranking	Project financing	ESCO risk	Duration contract and investment	Business model	Owner system
Shared Saving Model	Most used ★ ★ ★ ★ ★	ESCO capital or Third party financing	Technical risk Financial risk	Short term (5-10 years), small size investment	Figure 3	ESCO own the system until the end of the contract. Afterwards the ownership will be transferred to the customer.
Energy Service Agreement Shared Saving Model	EPC[18] specify the sharing of the cost saving between ESCO and the host facility over the duration of the contract. The savings are split in accordance with a pre-arranged percentage.  Figure 6 EPC shared saving Business Model					
Energy Supply Contract or Chauffage	★ ★ ★ ★ ☆	Customer capital	O&M Risk Technical Risk	Long term (10-30) years, big size investment	Figure 4	Customer
Energy Service Agreement Energy Supply contract or Chauffage	ESCO takes over operations and maintenance of the energy-using equipment in the customer's facility and sells the energy output (*e.g.*, steam, heating/cooling, lighting) to the customer at an agreed price .This model represents a form of "outsourcing", where the costs for all equipment upgrades, repairs, etc. are borne by the ESCO, but the ownership remains with the customer. The fee paid by the client under a *chauffage* arrangement is calculated on the basis of its existing energy bill minus a percentage savings (often in the range of 3%-10%), or a fee may be charged per square meter of conditioned space					

[18] Energy Performance Contract

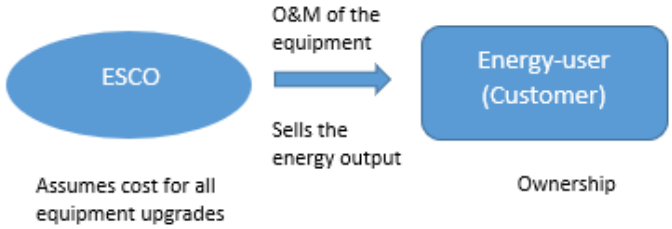


Figure 7 ESC Business Model

Guaranteed savings Model	Sometimes ★ ★ ★ ☆ ☆	Only Third party financing	Technical Risk	Short term(4-8 years) and small size investment	Figure 5	Customer takes the loans on its balance sheet and is the owner of the system.

Energy Service Agreement guaranteed Saving model

ESCO guarantees certain performance parameters and payments are made once the parameter performance has been confirmed. If the saving are less than the guaranteed level, the ESCO covers the shortfall. If the savings exceed the guaranteed level, the additional savings are shared between the ESCO and the customer.

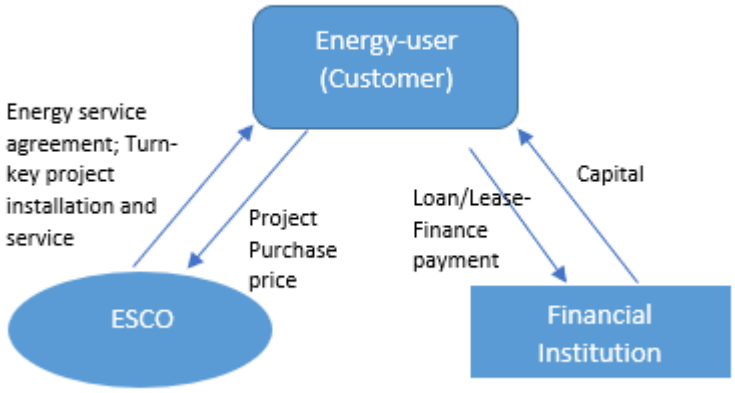
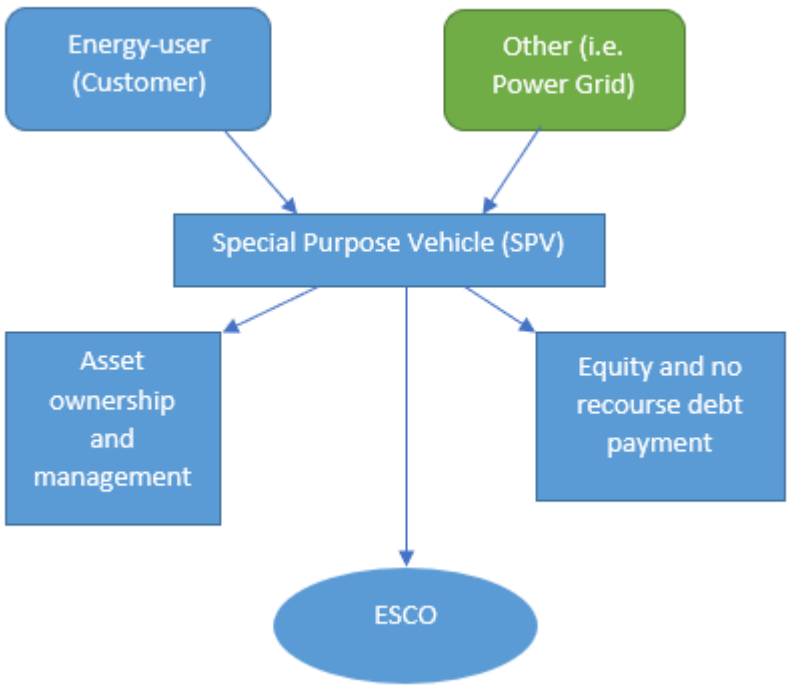


Figure 8 EPC Guaranteed Saving Model

Build-Own Operate & Transfer (BOOT[19])	Sometimes ★ ★ ★ ★ ☆	Only Third parties financing	Technical risk Financial risk	Long term (10-30 years) and big size of investments	Figure 6	ESCO owns the system until the end of the contract. Afterwards the ownership will be transferred to the customer.
Energy service agreement BOOT	It is a form of project financing, where an ESCO receives a concession from the private or public customer to finance, design, construct, own, and operate a facility for a defined period of time stated in the concession contract. This enables the project proponent to recover its investment, operating and maintenance expenses in the project during the duration of the contract. Customer enters into a long term supply contract and are charged according to the service delivered. The service charge includes capital and operating cost recovery and project profit  **Figure 9 BOOT Business Model**					

[19] Build-Own Operate & Transfer

First-Out EPC	Never ★ ☆ ☆ ☆ ☆	ESCO capital or Third party financing	Technical risk Financial risk	Short term (3-5 years)and small size investment	Similar shared saving	ESCO owns the system until the end of the contract. Afterwards ownership is transferred to the customer.
Energy service agreement First-Out EPC	The ESCO is paid 100 % of the energy savings until the project costs – including the ESCO profit – are fully paid. The exact duration of the contract will actually depend on the level of savings achieved: the greater the savings, the shorter the contract.					
Leasing Contract	Sometimes - Italy ★ ☆ ☆ ☆ ☆ Sometimes-NL ★ ★ ☆ ☆ ☆	ESCO capital or Third party financing	ESCO take Technical risk Financial risk	Short term (3-5 years)and small size investment		ESCO owns the system until the end of the contract. Afterwards the ownership will be transferred to the customer.
Energy service agreement Leasing Contract	Leasing can be an attractive alternative to borrowing because the lease payments tend to be lower than the loan payments; it is commonly used for industrial equipment. The stream of income from the cost savings covers the lease payment. The ESCO can bid out and arrange an equipment lease-purchase agreement with a financing institution. If the ESCO is not affiliated to an equipment manufacturer or supplier, it can bid out, make suppliers competitive analysis and arrange the equipment. There are two major types of leases: financial and operating. Financial leases are installment purchases of equipment. In financial lease, the client (lessee) owns and depreciates the equipment and may benefit from associated tax benefits. A capital asset and associated liability appears on the balance sheet. In operating lease the owner of the asset (lessor – the ESCO) owns the equipment and essentially rents it to the lessee for a fixed monthly fee; this is off-balance sheet financing source. It shifts the risk from the lessee to the lessor, but tends to be more expensive to the lessor. Unlike in financial lease, the lessor claims any tax benefits associated with the depreciation of the equipment. The non-appropriation clause means that the financing is not seen as debt. (Team E3P)[20]					

The survey outcome highlight a difference between the contractual approach used by the Italian ESCOs and the selected Dutch ESCO. Italian ESCO's most of the time choose to provide Shared Saving EPC taking 100% of the technical risk and the credit risk. Under current accounting rules both in the United States (US GAAP) and internationally (IFRS), leases are off-balance-sheet financing. New IFRS accountancy rules are more strict w.r.t. leasing. On-/off-balance is a decisive element when making an investment decision.

[20] https://e3p.jrc.ec.europa.eu/articles/energy-performance-contracting

Although companies prefer off-balance, these arrangements (e.g. operational lease, ESCO construction) are challenging to establish and to maintain as it is dependent on the ownership of equipment and risk. Furthermore is it expected to be more complex in the near future due to changing accounting standards from 2019 onwards. One of the interviewed Italian ESCO's which uses the EPC shared saving business model claim to have an EPC scheme tailormade to overcome the barrier. This solution is strictly linked to the risk sharing. Under investigation are the adjustments in the contractual scheme in order to manage the upcoming IFRS rules in 2019.

Most used contract to overcome the financial barrier is the Energy Supply contract. This kind of formula is used in case of CHP application and the solution is related to the energy generation. All the risks between End-user and ESCO are shared. To overcome the balance sheet issue in case of Cogeneration Unit the energy generated is injected in the grid and not sold to the customer.

In case of third party financing the Guaranteed Saving Business Model is chosen by an ESCO to guarantee the technical performance in relationship to the energy saving. Value of energy saved is guaranteed to meet debt service obligations down to a floor price. ESCO in this case carry-out only performance guarantee and take only technical risk. The energy user in this case take the investment on its balance sheet and take the credit risk, IFRS is not a concern. So far the interviewed Dutch ESCO used the Build-Own Operate & Transfer (BOOT) business model. All the risks between End-user and ESCO are shared. To overcome the balance sheet issue the costumer accountant agrees with a fixed service fee for the ESCO. At the end of the contract the residual value is determined and it will be off-set. It is now clear that the sharing and mitigation of the risk is directly correlate to the contract used to regulate the business model. The out-come of the survey clearly highlight a different approach between the two countries. Table 15 summarize sharing of the risk and the options in place to mitigate them.

Table 15 Risk Sharing and Mitigation

Risk	Sharing option Italy	Sharing option NL	Mitigation option
Technical Risk	NOT shared	Shared	Technical Know-How, Subcontractors
O&M Risk	Depends on the service energy agreement	Shared	Know-how
Performance Risk	Shared	Shared	Technical Know-How, Subcontractors
Credit Risk	NOT shared	Shared	Bank guarantee, other
Energy Price Risk	Shared	Shared	Internal Trading, contractual agreement with the end-user

The Italian ESCO's take all the technical risk and they mitigate this from their know-how and split among the sub-contractors. Operation and maintenance risk depends from the business model used. The ESCO takes 100% of the O&M risk in case of Energy Supply contract. Credit risk in case of EPC is not shared with the end -user and the mitigation indicated by an ESCO is a bank guarantee. The Energy price risk is shared with the end-user and the mitigation indicated can be internal trading or mitigation via the con-

tractual agreement with the customer. According to the answer on Question 13 one of the main legal requirement from the end-user are the performance guarantee and the technical certification and reference of the ESCO based on their track record. This point confirms the importance of know-how and technical expertise for the success of an ESCO.

ESCO's guarantee energy savings and/or provision of the same level of energy service at lower cost. A performance guarantee can take several forms. It can revolve around the actual flow of energy savings from a project, can stipulate that the energy savings will be sufficient to repay monthly debt service costs, or that the same level of energy service is provided for less money. Performance guarantees are not standard, but customized to the project. The standard procedure follow the IPMVP[21] protocol. ESCO's guarantee the performance of the whole system and mitigate the performance guarantee of each equipment with the technology supplier. An EPC contract is also customized to the specific project and the duration indicated in the survey is fluctuating between 5 and 8 years for an investment with Pay-back period of 4 years.

The typical total lead time indicated since a Kick-off meeting with the client and first audit and the signature of the EPC contract is indicated to be between 36 weeks and up to 52 weeks. A long process with more than 40% of the man-hours applied in Engineering , 20-30% in contract development and negotiation. The results of Question 22 demonstrate how the ESCO is predominately a performance guarantee vehicle and not only a project financing tool. Project financing man hours covers only 10-20% of the total process of the project. Question 24 investigate in this regard the relationship with technological innovations. The ESCOs interviewed have a specific R&D team, proprietary of technological solution in some cases and involved in market scouting for innovative technologies.

PART IV

ESCOs can finance, or assist in arranging financing for the operation of an energy system by providing a savings guarantee. Therefore ESCOs accept some degree of risk for the achievement of improved energy efficiency in a user's facility and have their payment for the services delivered based (either in whole or at least in part) on the achievement of those energy efficiency improvements.

The survey shows that the selected ESCO finance their project in Energy efficiency with ESCO internal capital. In the same case ESCO's have financial institutions, banks or special green funds from third parties financing. The different option in project financing has also an impact on the choice of the business model and EPC contract to be used. The typical average weight of capital cost used from the ESCO is under 10%. It varies between 4.5% and 8 %. In case of Third parties financing the percentage of loans and the percentage of equity for the investment is very different between the different ESCOs and depends on the size of investments. In case of bankruptcy of the industrial client the ESCO has the ownership of the asset. However, a specific asset dedicated for the project might have a much smaller sales value in the market than the original investment. The ESCO usually stipulates in the contract that they are the first in line to get money from the industrial client to cover their losses compared to other creditors.

[21] https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp

CONCLUSION AND RECOMMENDATION

Energy Service Companies (ESCOs) can offer a range of services to the customer, such as energy auditing, project identification and design, equipment procurement, installation and commissioning, measurement and verification, training, operation and maintenance. ESCO's can also finance or arrange financing for the investments in assets. In this way specific technical and operational expertise and private capital can be deployed, allowing technical risk to be transferred away from the customer, facilitating equipment procurement and offering flexible financing options.

An ESCO is an institution that improves and extend the energy efficiency market. The survey shows that most ESCO's have little capital available and take a small size of the total investment in energy efficiency. Besides the small investment, ESCO's open the opportunity to have financing at a relatively low WACC[22]. External financing institutes like energy funds need creditworthy enterprises before they step in.

ESCO's technical expertise in project development for EE project has a crucial role for the end -users in term of performance guarantee. ESCO will outsource the energy management with dedicated technical experts (turnkey solutions) focused on identifying and delivering energy savings results. An ESCO helps the customers understand their energy use and energy saving opportunities creating more awareness of the benefit of Energy Efficiency investments. Since the total benefit is collected coordinating different department in the same company, ESCO will lead the coordination and the project management. The service will be guaranteed via an effective contractual agreement based in the performance.

It can be concluded that the ESCO model might provide a crucial role in delivering more energy efficiency for industrial companies. End-users often have restrictions in term of budget, and available staff not allocated in energy efficiency, therefore ESCO is a way to outsource and facilitate energy efficiency in the industrial sector. The current interviewed independent Italian ESCO's are now too small to do major projects (> 2 million euro CAPEX) in energy intensive industries without external financing. This may change when they get access to more capital when they are taken over by utilities, which is the last trend in the ESCO market.

[22] Weighted Average Cost of Capital

APPENDIX A- SURVEY TEMPLATE

1. Please provide the % of companies you had as customers?

	0-5%	5-10%	10-20%	20-30%	30-50%	>50%
Large Enterprise EU- ETS	❍	❍	❍	❍	❍	❍
Large Enterprise	❍	❍	❍	❍	❍	❍
Large In-tensive compa-nies	❍	❍	❍	❍	❍	❍
SME	❍	❍	❍	❍	❍	❍

2. What is the average reduction of the annual energy bill related to the implementation of EE measures for Large Intensive Companies?

	0-5%	5-10%	10-15%	15-20%	>20%
Food & Beverage	❍	❍	❍	❍	❍
Metal	❍	❍	❍	❍	❍
Chemical	❍	❍	❍	❍	❍
Construc-tion	❍	❍	❍	❍	❍
Pulp & Pa-per	❍	❍	❍	❍	❍
Other, please specify	❍	❍	❍	❍	❍

3. What is the average reduction of the annual energy bill related to the implementation of EE measures for Large Enterprise?

	0-5%	5-10%	10-15%	15-20%	>20%
Food & Beverage	❍	❍	❍	❍	❍
Metal	❍	❍	❍	❍	❍
Chemical	❍	❍	❍	❍	❍

Construc-tion	❍	❍	❍	❍	❍
Pulp & Pa-per	❍	❍	❍	❍	❍
Other, please specify	❍	❍	❍	❍	❍

4. What are the average size of investment in EE for a Large Enterprise?

	0-100k euro	100k-500k euro	500k-1M euro	1M-5 M euro	>5 M euro
Food & Beverage	❍	❍	❍	❍	❍
Metal	❍	❍	❍	❍	❍
Chemical Construc-tion	❍	❍	❍	❍	❍
Pulp & Pa-per	❍	❍	❍	❍	❍
Other, please specify					

5. What are the average size of investment in EE for a Large Intensive Companies?

	0-100k euro	100k-500k euro	500k-1M euro	1M-5 M euro	>5 M euro
Food & Beverage	❍	❍	❍	❍	❍
Metal	❍	❍	❍	❍	❍
Chemical Construc-tion	❍	❍	❍	❍	❍
Pulp & Pa-per	❍	❍	❍	❍	❍

Other, please specify					

6. Can you indicate and rank the main reasons for an industrial customer to choose an ESCO to execute an EE project?

	1	2	3	4	5
Service Quality &Technical Expertise	❍	❍	❍	❍	❍
Project Financing	❍	❍	❍	❍	❍
Performance Guarantee	❍	❍	❍	❍	❍
Less administration burden	❍	❍	❍	❍	❍
Other, please specify	❍	❍	❍	❍	❍

7. Can you indicate and rank the main reasons that motivate an industrial customer to execute an EE project?

	1	2	3	4	5
Upgrading aging equipment	❍	❍	❍	❍	❍
Reduction energy cost	❍	❍	❍	❍	❍
Legal Obligation	❍	❍	❍	❍	❍
Company policy	❍	❍	❍	❍	❍
Other, please specify	❍	❍	❍	❍	❍

8. What is the prevalent service provided by your ESCo?2

	1	2	3	4	5
Consultancy	❍	❍	❍	❍	❍
Design, operation and start-	❍	❍	❍	❍	❍

up					
Project financ-ing	❍	❍	❍	❍	❍
All	❍	❍	❍	❍	❍

9. What are the critical factors for future success of your business?

	1	2	3	4	5
Volatility energy price	❍	❍	❍	❍	❍
Legislation sta-bility	❍	❍	❍	❍	❍
Incentive stabil-ity	❍	❍	❍	❍	❍
Company policy	❍	❍	❍	❍	❍
Other, please specify	❍	❍	❍	❍	❍

10. What kind of contract does your ESCO use?

	Never	Sometime	Most of the time
First Out EPC	❍	❍	❍
Shared sav-ing EPC	❍	❍	❍
Guaranteed saving EPC	❍	❍	❍
Build Own Operate and transfer EPC	❍	❍	❍
First in EPC	❍	❍	❍
Leasing con-tract	❍	❍	❍
Other	❍	❍	❍

11. How do you share and mitigate the risks?

	Share	Mitigation

Technical Risk		
O&M Risk		
Performance		
Credit Risk		
Energy Price risk		
Other		

12. Does your ESCO have a special insurance that covers the performance risk? What kind of insurance?
13. What are the major legal requirements requested by the customer in the contract?
14. How do you manage Performance Guarantee in EPC? Do you have a standard performance guarantee?
15. What is the total duration for an EPC contract for an investment with PBT= 4 years?
16. What is the typical Lead time (in weeks) of an EE project, since the Kick-Off meeting with the customer to the sign up of the contract?
17. One of the barrier that we face with Dutch customer are the strict accountancy rules (IFRS). Those rules do not allow the off balance for ESCo. How do you overcome this barrier?
18. Do you experience or foresee problems with the new upcoming accountancy rules IFRS in 2019 that are going to be more restrictive for off balance financing?
19. How do you finance the EE project?

	1	2	3	4	5
Internal capital by end-user	❍	❍	❍	❍	❍
Project partner	❍	❍	❍	❍	❍
Banks	❍	❍	❍	❍	❍
ESCO capital	❍	❍	❍	❍	❍
Other, please specify	❍	❍	❍	❍	❍

20. What is the typical weight average capital cost in your ESCo?
21. What is the percentage loans and the percentage of equity for the investments?
22. Could you please estimate % man/hours you spend for the different phase of an EE project?

	0-10%	10-20%	20-30%	30-40%	>40%	Out-sourced
Engi-neering	❍	❍	❍	❍	❍	❍
Project financing	❍	❍	❍	❍	❍	❍
Contract	❍	❍	❍	❍	❍	❍

develop-ment and ne-gotiation						
Audit	❍	❍	❍	❍	❍	❍
Admin-istration (White Certifi-cate)	❍	❍	❍	❍	❍	❍

23. Would you like to set up an ESCo in the NL? If so, what kind of project are you interested in?

24. How your ESCo deals with technology innovation that leads to a less energy intensive process?

25. Have you had experience in In-Process application?

First Name Last Name

Submit

APPENDIX B- REAL BUSINESS CASE

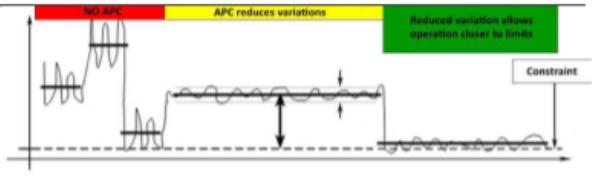
20171011_Case_study_Bartucci.pdf

BARTUCCI

Energy Performance Contract

Technology: A.P.C.

An Advanced Process Control (A.P.C.) is a supervision system designed and realized in order to manage automatically more production units or the whole plant. The systems are conducted trough predictive algorithms that permit to minimize consumptions and costs, respecting all the constraints. It is based on the synergy among monitoring, advanced modelling and multivariable control.



Project: Reheating Furnace

Fuel consumption optimization of a reheating furnace, in accordance with the target of the billets exit temperature and keeping the most critical process variables within their constraints.

PATENTED

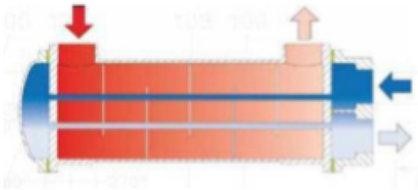
Sector: Steel

BARTUCCI

Energy Performance Contract

Technology: Economizer

Peculiar heat exchanger installed on the exhaust gas piping of a boiler which uses thermal energy to preheat the boiler feed water.
It permits to recover the heating energy that is usually dispersed in the atmosphere, reducing the specific consumption of natural gas needed by the boiler to heat water.



Project: Process boiler

416 kW economizer that minimizes the specific consumption of natural gas of a 7 MW boiler producing vapour to heat reactors and strips volatile components of the chemical plant.

- 5.7 % CH_4
- 150,000 Sm^3/y

Results

Lower NO_x emissions

Lower CO_2 emissions

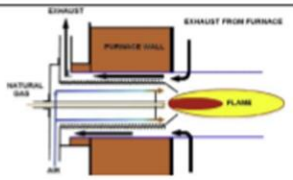
Sector: Chemical

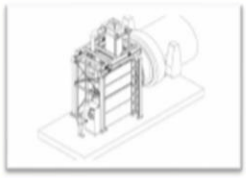
BARTUCCI

Energy Performance Contract

Technology: Recuperative burner

Self-Recuperative Burners include a recuperator that is integrated with the burner that preheats the incoming combustion air. The exhaust gases are 'pulled back' through the burner by an eductor which is located upstream of the burner. This design arrangement leads to a high air preheat temperature and excellent thermal efficiencies.





Project: Horizontal ladle

Installation of a 2 MW recuperative burner applied to a horizontal ladle heating plant.
This allows the minimization of natural gas consumption.

Sector: Steel

ESTIMATION OF INVESTMENT IN ENERGY EFFICIENCY IN THE NETHERLANDS

RVO DATABASE OF ENERGY EFFICIENCY PLAN 2017-2020

Since 1992, the Dutch government has long-term agreements with a wide range of sectors with the clear goal to improve energy efficiency. There are currently two types of long-term agreements, the MJA3 and MEE covenants. The first generation of MJA covenants ended in 2000 and was followed by MJA2 (2001-2012) and the Benchmarking covenant (2001-2012). In 2008, the government decided to extend and widen the scope of the MJA3 covenant, resulting in the current MJA3 covenant (2017-2020) applicable for non-ETS businesses. In the same time, the Benchmarking covenant has been converted to the current MEE-covenant (2017-2020) intended for ETS covered businesses. Companies participating in the Dutch Long term voluntary agreement are required to declare their energy efficiency projects planned for the specific period between 2017 and 2020 which are planned to be implemented.

The RVO database containing the Energy Efficiency Plans (EEP's) have been used to estimate the market size of investments in Energy Efficiency in the Netherlands. The EEPs presented in the RVO database covers more than 80% of industrial use in the Netherlands. (Christiaan Abeelen, 2015). There is not an official definition of a project. The range of project ideas goes from a monitoring energy system to a completely new efficient plant and there is not a limitation in the number of projects proposed by the companies. A specific Energy Efficiency Investment report for the Netherlands, like in Italy, is not available. Only limited information on investments related to the Energy investment allowance (EIA) scheme are available. (RVO, 2017) The following data analysis on the EEP in this research extrapolated a rough estimation of the size of investment in the Netherlands expected by 2017-2020. Due to the confidentiality and sensitive information of the EEP, the data have been anonymized by RVO before analysis.

DATA AND METHODOLOGY

The EEP database 2017-2020 provided by RVO contains 20,887 projects presented by 1081 companies (117 MEE and 964 MJA). Many companies have several production sites therefore the number of sites is much larger of the number of companies. The total amount of energy primary saving planned is 121 PJ to be implemented by 2020. Further explanation about the RVO database is given in Appendix C. The core of the following research is to estimate the size of the investments in energy efficiency for in-process applications therefore only the Process Efficiency Category is analyzed. Process Efficiency cover 50% of the total primary energy saving in TJ equivalent to 60,7 PJ as shown in Figure 10.

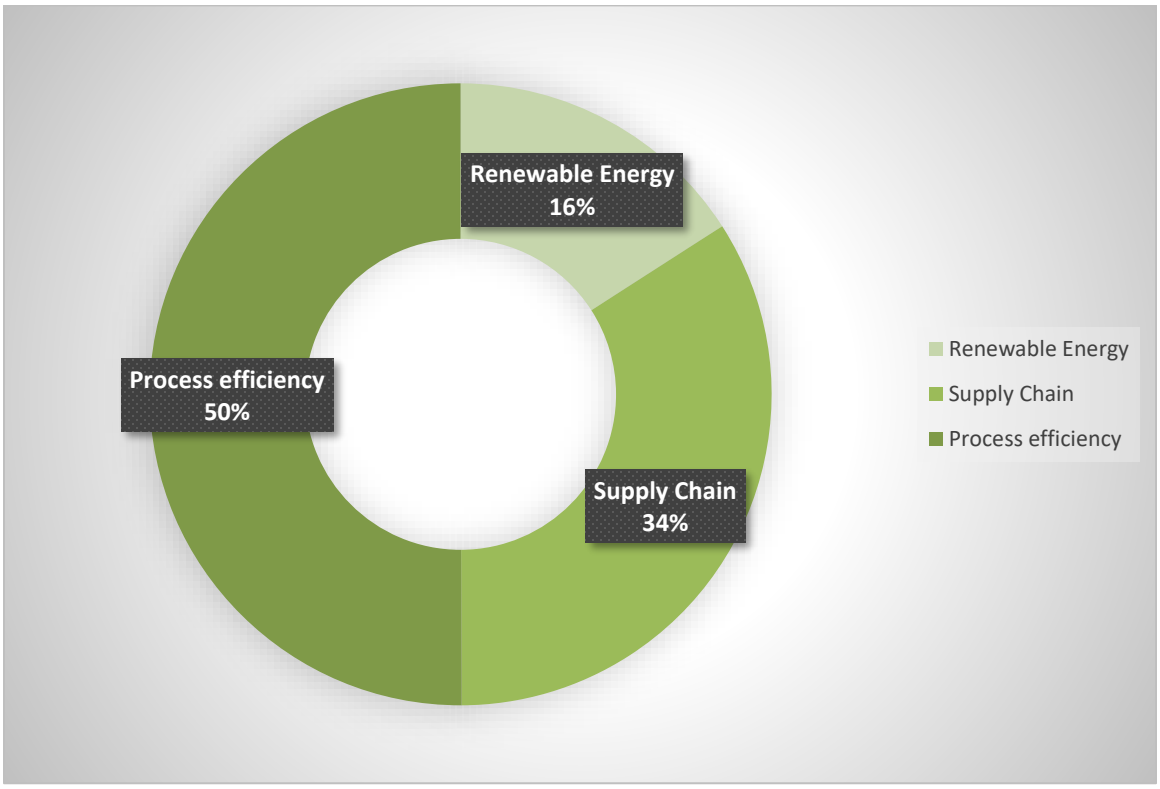


Figure 10 Distribution project by category

There are many projects with no PBP [23]value indication or no reliable data (i.e. PBP>25 years). All non-reliable data have been filtered out from the dataset. The sample data with pay-back period indication covers the implementation of project with saving in Gas, Electricity, Primary energy and Heat recovery as indicated in Figure 11. In order to overcome the lack of energy price data used by the industrial companies to calculate the energy saving, the research is going to consider only the projects in Gas and Electricity. The reason is that gas price and electricity price data are public available via the ICE-ENDEX website. The total saving related to Gas and Electricity in the sample data covers 68% of the Total Primary Saving.

[23] pay-back period

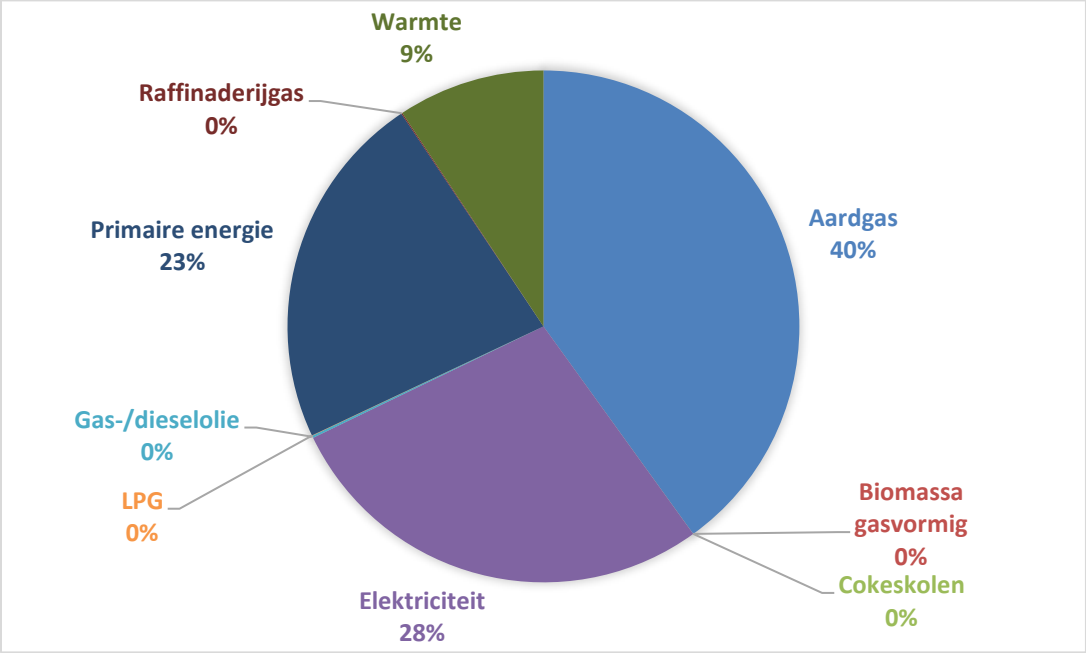


Figure 11 Distribution Energy source in the planned process efficiency energy saving project

It is important to discuss the first assumption of this research which is related to the energy price used in the calculation. There are remarkable large different between the prices that the companies have to pay for their electricity and natural gas. On average larger companies (MEE) pay less for their energy then small MJA3 energy users. The RVO database does not contain the unit energy price used by the companies for their calculation and there is no guideline in place that can be used to estimate the average value.

The average price used in this report for natural gas and electricity is 18€/MWh per natural gas and 40€/MWh per electricity, The value are based on the future prices listed on the ICE-ENDEX website for the Dutch market during December 2017 excluding taxes. This assumption is an underestimation for small energy users (MJA3) companies but reasonable accurate for the MEE companies.

It is recommended to implement a consistent methodology for the companies to report their energy prices that takes taxes into account. The energy saving indication for natural gas in the database are expressed in normal cubic meters and the price for natural gas refer to MWh. Prices per volume has been calculated using the gross calorific value presented in the conversion factor based on IEA energy balances methodology (IEA, 4th Quarter 2017). The indication for the Netherlands is equivalent to 35,194 KJ/m3 and 9,776 KWh/m3. Most of the companies (>95%) have used the Simple Pay-back Period Method in their calculation. Following the guideline issued by RVO in December 2015 (Nederland, 2015) the cash-flow revenue of the energy saving is calculated according to the excel sheet indicated in Appendix D. The estimation of investments is the result of the Cash flow revenue multiplied by the pay-back period indicated in the data-base.

The estimation of the market size and structure of the energy efficiency market in the Netherlands was a request of The steering Group during the Kick- Off Meeting of the project in October. The Dutch government has not yet in place a reporting system that measures the energy efficiency investments and it is becoming increasingly clear that the size and structure of the industrial energy efficiency market has to be estimated in order to attract investors in financing Energy efficiency projects. The investments are calculated based on the assumption previously explained by analyzing the energy efficiency market data. Table 16 below shows the sample data used as representative sample. The number of projects covers 17% of the total number of projects which covers 11% of the Total primary energy saving equivalent to 6,9 PJ.

Table 16 Sample data

Covenant	Number Projects	Annual Energy Saving in TJ	Total annual energy saving in euro	Total estimation investment in euro	Annual CO2 emission reductions in Tons
MEE	337	2,957	15,563,330	120,651,945	184,768
MJA	2037	3,992	20,110,707	134,070,668	259,310

The total amount of energy efficiency investments calculated for the sample data is 254 Million euro. Total Annual Revenue from the energy savings is calculated to be 48 Million euro. Therefore the average pay-back period (not weighted per project size of investment) is 5,2 years. In the analysis an important element is the 'certainty level' which is the probability for the implementation of the project. The conditional label is allowed in case of a specific condition has to be reached before the implementation of the project. The condition can be technical or financial and the companies have to provide a valid explanation. For process efficiency projects the financial conditions are indicated as budget availability, project profitability and availability of project funding. Therefore the financial conditions are linked to the availability of resources and allocation of capital. (Masselink, 2018)

The technical conditions are related to the positive outcome of a pilot test project. Sometimes potential product or process changes have to be verified before the implementation in order to avoid negative effect on the core process. Under the covenant rules, a company is allowed to replace the planned project indicated as certain with another project that reach at least the same amount of energy saving.

Table 17 below shows the certainty level in the sample data analyzed.

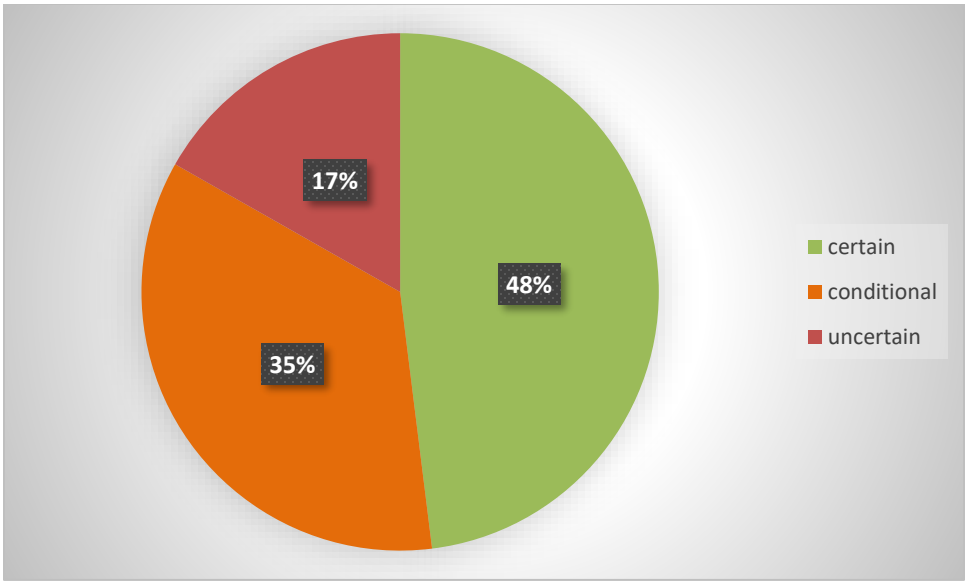
Table 17 Conditional level EE investment- sample data

Covenant	Number of Projects	Primary Energy Saving in TJ	Total annual Energy Saving in euro	Total estimation EE Investment	Total annual Cash Flow Revenue
MEE- Certain	184	1,261	6,549,835	46,218,686	8,842,277
MEE- Conditional	110	919	4,928,271	33,685,528	6,653,166

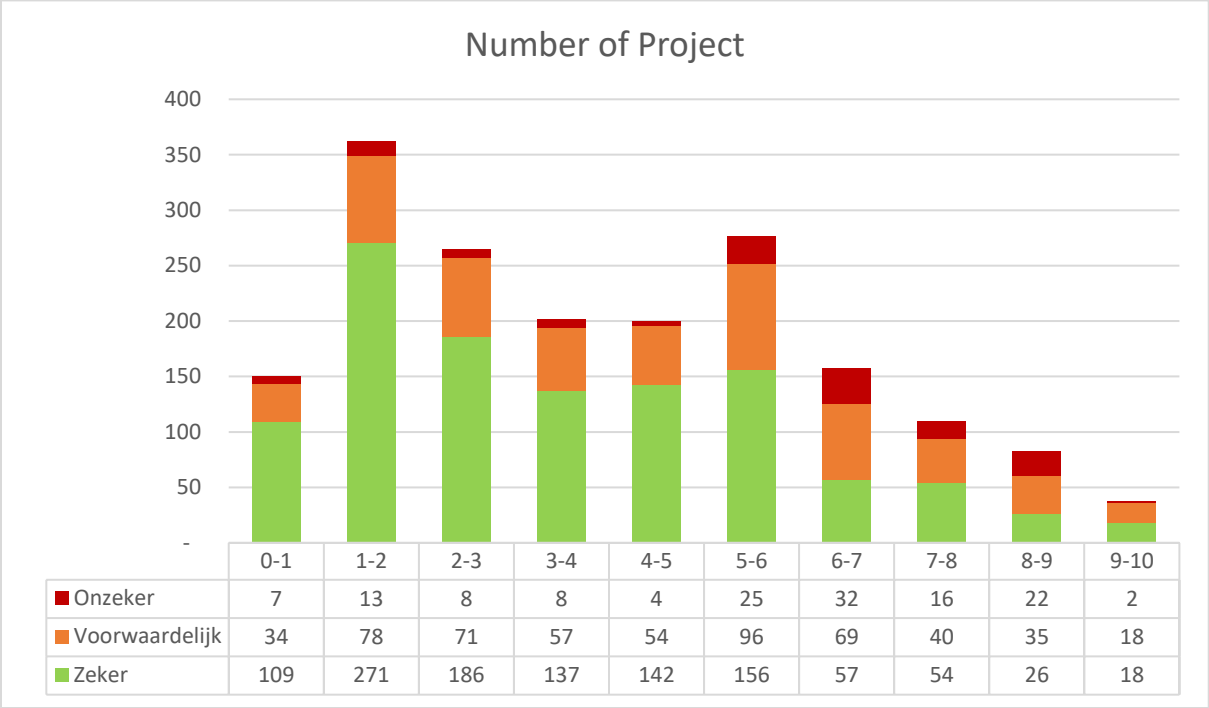
MEE- Uncertain	43	777	4,085,224	28,483,698	5,515,052
MJA- Certain	1,244	2,076	10,181,506	76,120,118	13,745,033
MJA- Conditional	590	1,526	8,018,854	55,942,111	10,825,453
MJA- Uncertain	203	389	1,910,347	14,272,479	2,578,969

Based on the analysis of the sample data 60% of the total number of projects are labelled as Certain. This implies that 48% of the Total Primary Energy Savings are guaranteed with 50% of the total reduction of CO2 emissions. 30% of the number of projects are labelled as conditional and their implementation depends from other variables (financial, technical or company organization). The conditional projects are responsible of 35% of the total primary energy saving. The uncertain projects, only 10% of the total number of projects, are unlikely to be implemented and the Energy primary saving related to them covers 17% of the planned Total Energy Primary saving.

Figure 12 Energy Primary Saving percentage based on the 'certainty level' of the project.



The distribution of number of projects with the pay-back period is shown in Figure 13. Most project are concentrated in the range of investments with pay-back period less than 2 years, where the certainty level of the project covers 75% (see Figure 15) This finding is in line with other studies. (Christiaan Abeelen, 2015)



	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10
Onzeker	7	13	8	8	4	25	32	16	22	2
Voorwaardelijk	34	78	71	57	54	96	69	40	35	18
Zeker	109	271	186	137	142	156	57	54	26	18

Figure 13 Distribution number of project per pay-back period MEE and MJA covenant

The assessment of the projects with high CAPEX investment which are uncertain to be implemented due to financial conditions are crucial to get insight in the investment market. The graph in Figure 14 shows a peak in the number of projects for investments for pay-back period between 5 and 7 years. Large individual projects with high CAPEX can be attractive for external investors. Small CAPEX projects can be attractive as well when they can be combined in a portfolio.

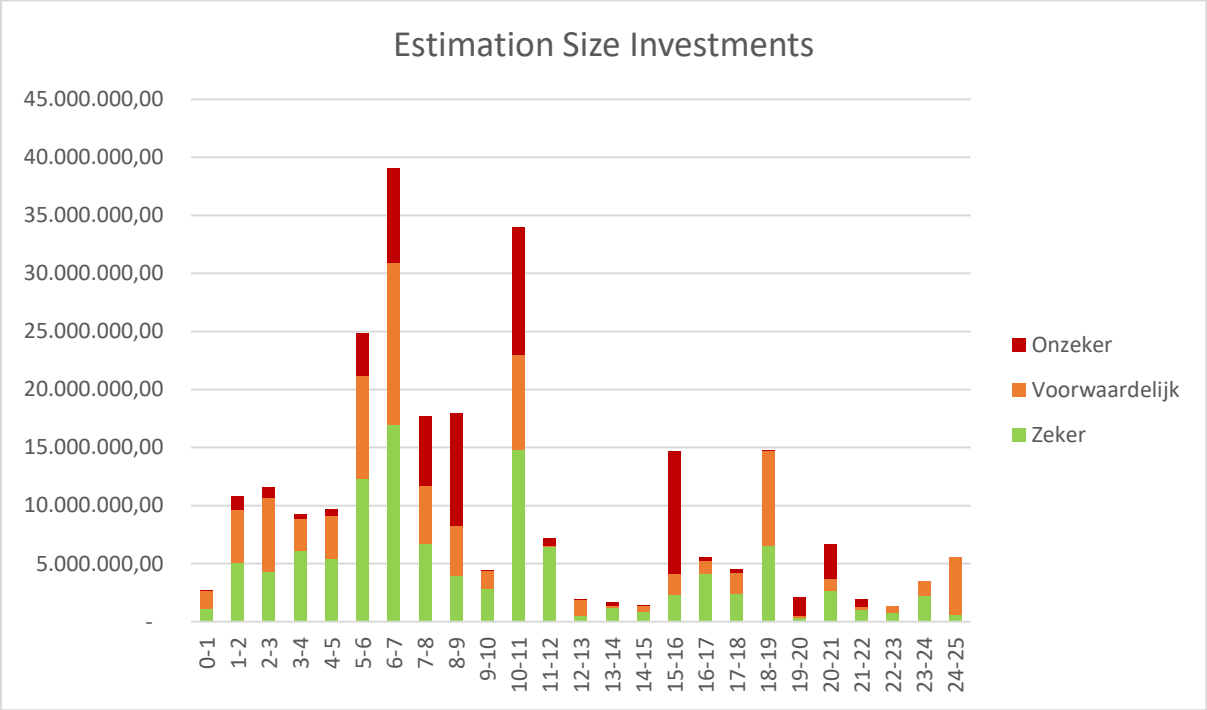
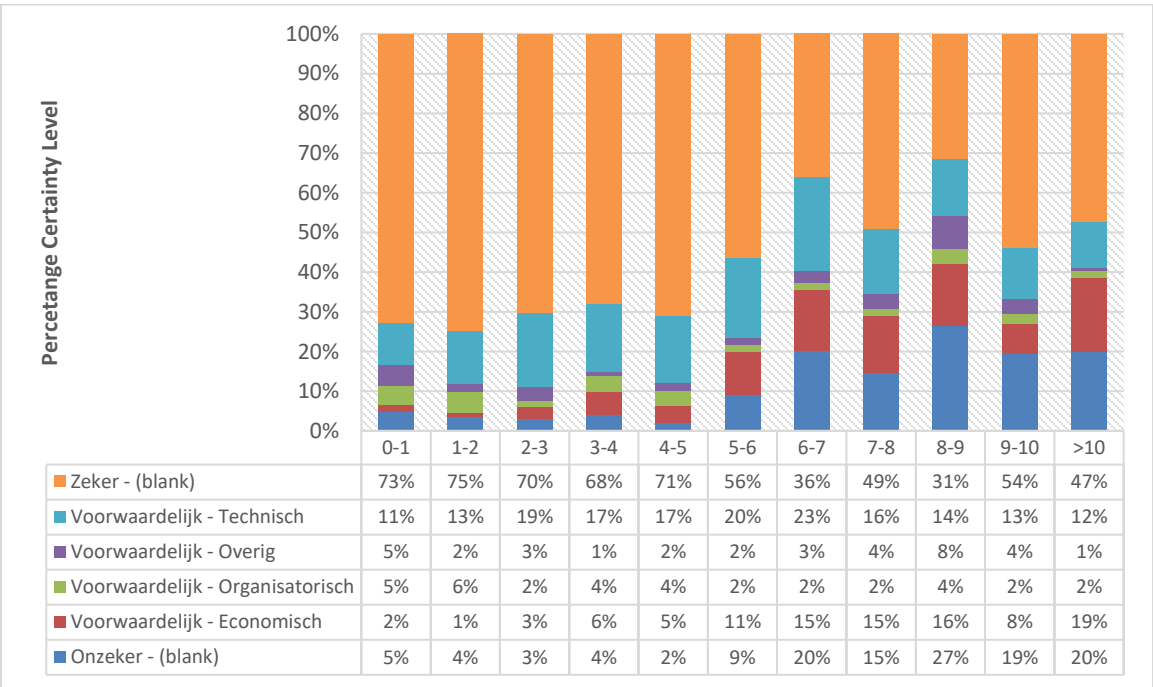


Figure 14 Distribution EE investment per pay-back period MEE and MJA Covenant

Figure 15 shows the uncertainty level and total CAPEX as function of pay-back period for the projects. The uncertainty for pay-back period larger than 5 years increases likely due to the financial conditionality related to the allocation of capital priority.



	0-1	1-2	2-3	3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10
Zeker - (blank)	73%	75%	70%	68%	71%	56%	36%	49%	31%	54%	47%
Voorwaardelijk - Technisch	11%	13%	19%	17%	17%	20%	23%	16%	14%	13%	12%
Voorwaardelijk - Overig	5%	2%	3%	1%	2%	2%	3%	4%	8%	4%	1%
Voorwaardelijk - Organisatorisch	5%	6%	2%	4%	4%	2%	2%	2%	4%	2%	2%
Voorwaardelijk - Economisch	2%	1%	3%	6%	5%	11%	15%	15%	16%	8%	19%
Onzeker - (blank)	5%	4%	3%	4%	2%	9%	20%	15%	27%	19%	20%

Figure 15 Certainty Level distribution per pay-back period

Table 18 below shows the total number of projects, planned Annual Primary Energy saving in TJ, Annual Energy saving estimation in euro, and the calculation of Investment per pay-back period.

Table 18 Distribution data sample per pay-back period

PBP	Number Projects	Annual Energy saving in TJ	Annual Cash Flow due to Energy Saving in euro	Total Investment in euro
0-1	150	749	5,355,094	2,679,724
1-2	362	1,230	8,681,241	10,801,572
2-5	667	1,478	10,312,167	30,505,712
5-7	435	1,589	10,916,682	63,908,550
7-10	529	1,218	8,212,873	70,759,624
>10	231	684	4,681,893	76,067,431

The cumulative energy saving in TJ of the sample data (Figure 16) shows that cumulative Investments with pay-back time longer than 2 years are necessary to reach at least 50% of energy savings and implies a CO2 emission reduction equivalent to 49% of the total as shown in Figure 17 .

Cumulative Investments for pay-back period up to 7 years can reach 73% of the total planned cumulative Primary Energy savings. From an investor and society point of view the implement of these projects are interesting due to their CAPEX size and return on capital. Projects with a pay-back of more than 7 years are difficult to finance due to their lower return on capital.

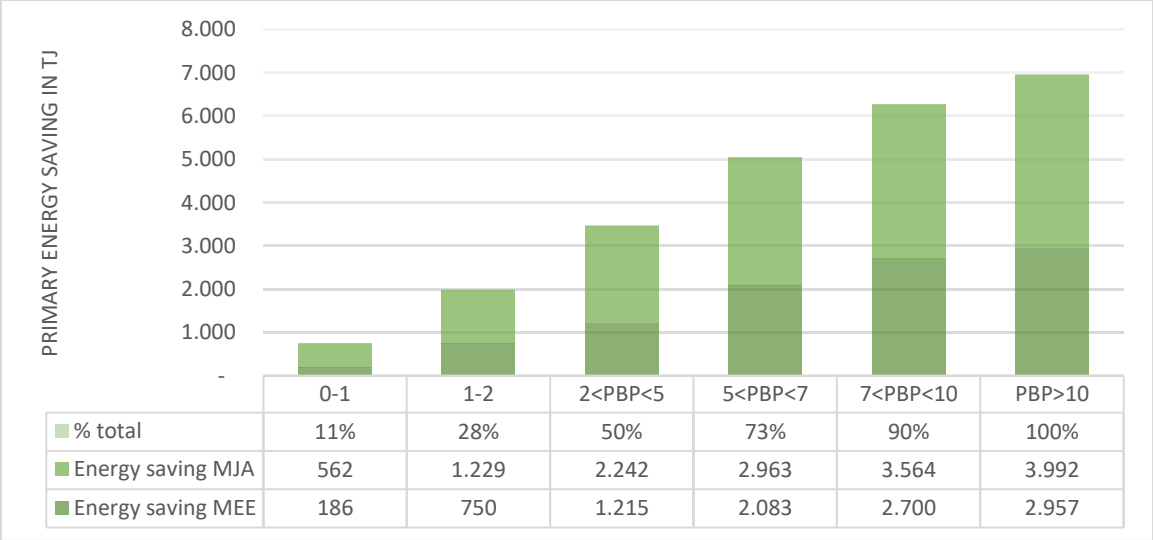
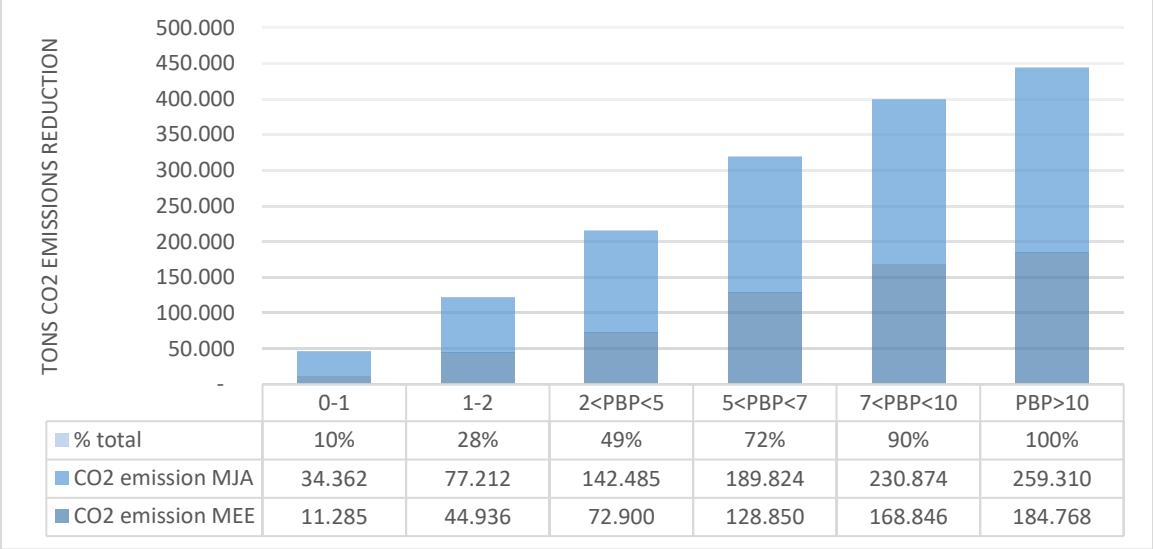


Figure 16 Cumulative Energy saving in TJ per pay-back period



	0-1	1-2	2<PBP<5	5<PBP<7	7<PBP<10	PBP>10
% total	10%	28%	49%	72%	90%	100%
CO2 emission MJA	34.362	77.212	142.485	189.824	230.874	259.310
CO2 emission MEE	11.285	44.936	72.900	128.850	168.846	184.768

Figure 17 Cumulative Tons of CO2 emission reduction per pay-back period

If we consider the sample data analyzed as a representative sample the data can be extrapolated to the total number of projects presented in the EEP database 2017-2020 in Process Efficiency. In order to reach the planned Total Primary Energy Savings from the EEP database in process efficiency of 60 PJ (saved over 3 years) , the Estimated cumulative investment are represented in Figure 18.

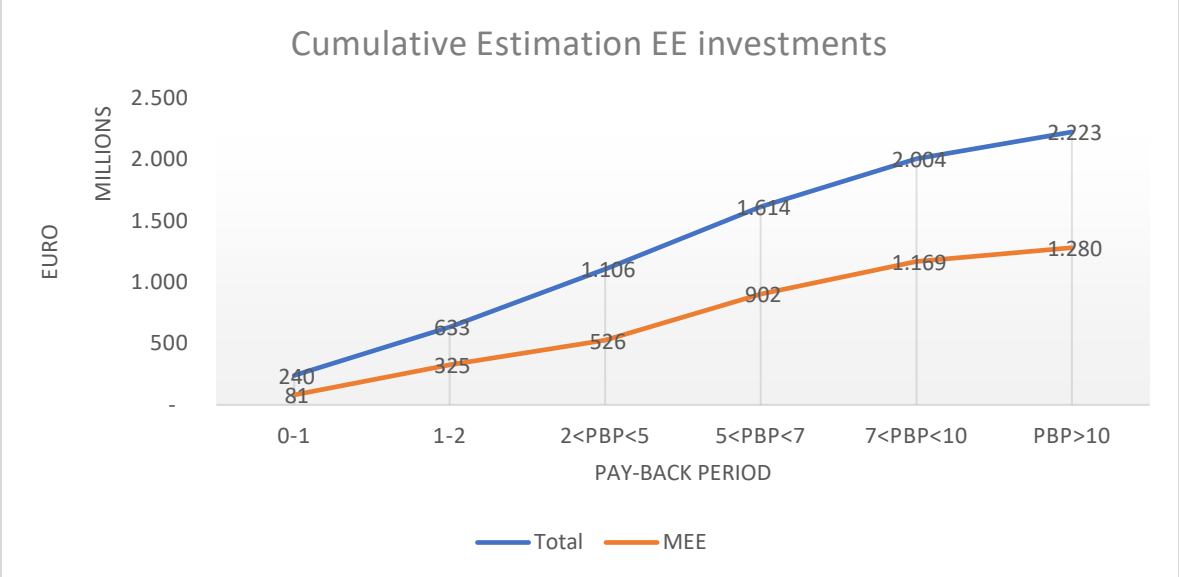


Figure 18 Cumulative Estimation Energy Efficiency Investments.

In conclusion the average estimation of the investment size per PJ is 36,7 million euro. The MEE companies have an average size of investment of 40 Million euro per PJ and the MJA3 give their contribution with 33,5 Million euro per PJ. Please note that these investments are based on the energy savings during a limited period of 3 years (2017-2020) while the assets could be in operation for at least 15 years. Thus the cumulative energy savings per million euro are 5 times higher. Note that the average energy price for

gas and electricity paid by MEE companies is far lower than for MJA3 companies because the largest energy consumers pay relatively little energy tax. Thus although the average investment per PJ saved for MJA3 companies is lower it is likely that corrected for energy tax there is more PJ's of energy to be saved for each investment euro in MEE companies. It is recommended that the impact of tax on capital effectiveness (PJ's saved per million euro invested) is taken into account in the future analysis of submitted projects.

In order to cover 60,7 PJ Primary Energy Saving in process efficiency the investments are estimated to be 2,2 Billions euro with an estimation of CO2 emission reductions of 2,6 million Tons of CO2 by 2020. Thus the energy saved over 15 years (a typical asset lifetime) is 5 times higher and equates to 303,5 PJ primary energy leading to a CO_2 emission reduction of 13 million ton.

To reach more than 28 % of the total energy savings (and potential CO_2 reduction) the implementation of projects with investment with a payback period of more than 2 years is necessary. From an external investor and society point of view the implementation of EE measures between 5 years and 7 years pay-back period can be very effective and important assuming that all investments with a pay-back period less than 5 years are financed and implemented by the companies themselves.

APPENDIX C- DATABASE EEP

For each energy-saving project the following data are available because of the mandatory field in the form available on the RVO website:

- Sector name and sector reference number
- Company reference (company #)
- Covenant (MJA/MEE)
- Category (process efficiency, supply chain efficiency or renewable energy)
- Type of application
- Certainty level ('certain', 'conditional' or 'uncertain')
- Conditional reason, available only in case of conditional project.
- Planned year of implementation
- Energy carrier or energy source
- Metric Unit of measure
- Energy saving in metric unit of measure

The energy saving indicate in metric unit of measure are directly converted to primary energy saving in TJ with a standard conversion factor. The database contains also the CO_2 emission factor [kg/GJ], that can be used to calculate the kg of CO_2 saved by project.

Fields available in the database but not mandatory are :

- Pay-back period [year]
- Pay-back period method (Simple pay-back period- TVT method, Discounted pay-back period NCW-method)

Fields not available in the database:

- Energy price and taxes
- CAPEX investment.

The different type of applications in the Process Efficiency section covered by the sample data are listed below:

- Drive System
- Compressor
- Dry-Process applications
- General Sustainable Buildings
- Energy Monitoring System
- Peel Insulation
- Insulations of pipes, channels, equipment and fittings
- Insulation heating or cooling systems
- Climate treatment measure
- Cooling/Freezing
- Cold Distribution
- Cold Generation
- Delivery Residual cold
- Mixing Process applications
- Ovens
- Compressed air systems
- Pump Systems
- Process control and automation
- Process Fans
- Separation Process
- Strategic Projects
- Energy Management Systems (i.e. ISO 50001)
- Vacuum System
- Combustions Process
- Lighting
- Transport (part of the business assets of the company itself)
- Heat Distribution
- Heat Generation (including Heat pump)
- Heat Exchangers
- Water treatment / waste water / water distribution

The distribution of sample data by sector in relationship to the primary energy saving indication is indicated in Table 19. The sample data has not the pay-back period available the for Cacao industry (MJA3) and Rail Sector (MJA3). The missing information related to this sector is however not relevant for the conclusions of our work.

Table 19 Sample Data by Sector

Sectors	Totale Primary energy saving Process efficiency	PBP reliable data Process efficiency	Selection only Gas and Electricity saving	Total estimation investments	% total
	[TJ]	[TJ]	[TJ]	euro	%
MEE					
MEE Bierbrouwerijen	151.79	63.85	63.23	2,633,416.28	42%
MEE Chemische industrie	18,481.37	2,948.71	1,049.58	42,705,455.38	6%
MEE Glasindustrie	844.26	256.49	256.49	7,348,895.78	30%
MEE Metallurgische industrie	3,229.94	98.67	98.67	3,195,564.21	3%
MEE Overige industrie	2,463.50	479.06	236.69	8,810,116.00	10%
MEE Papier- en kartonindust	2,490.61	1,135.54	822.78	43,081,775.24	33%
MEE Raffinaderijen	7,248.52	602.08	429.08	11,362,994.28	6%
MEE Total	**34,909.98**	**5,584.40**	**2,956.53**	**119,138,217.16**	**8%**
MJA					
Aardappelenverwerkende ir	514.41	86.43	81.58	4,100,767.67	16%
Asfaltindustrie	149.38	13.05	13.00	786,389.00	9%
Cacao-industrie	156.27	-	-	-	0%
Chemische industrie	2,925.15	424.70	229.74	6,376,537.04	8%
Diervoederindustrie	441.63	0.86	0.86	45,363.54	0%
Fijnkeramische industrie	57.58	8.49	8.49	494,463.22	15%
Financiële dienstverleners	844.83	46.45	44.88	642,878.62	5%
Frisdranken, Waters en Sapp	150.43	38.99	38.99	1,718,754.68	26%
Gieterijen	232.10	45.34	44.78	1,786,885.38	19%
Groenten- en fruitverwerker	224.09	107.56	107.56	3,621,657.86	48%
Grofkeramische industrie	336.56	13.30	13.30	410,624.56	4%
Hoger beroepsonderwijs	212.67	46.57	40.53	1,188,127.15	19%
ICT	2,467.68	521.89	521.50	22,526,819.32	21%
Kalkzandsteen- en cellenbet	66.49	24.81	23.03	635,424.31	35%
Koel- en vrieshuizen	373.36	1.67	1.67	43,264.31	0%
Koffiebranderijen	92.72	28.27	24.69	1,221,252.90	27%
Margarine-, vetten- en oliën	1,589.81	638.11	563.52	15,258,461.63	35%
Meelfabrikanten	62.34	10.57	10.57	228,444.68	17%
Metallurgische industrie	328.28	46.89	44.20	6,287,300.76	13%
Nederlandse olie- en gaspro	4,877.26	575.99	575.99	10,806,132.36	12%
Oppervlaktebehandelende i	115.77	49.57	48.17	1,130,118.07	42%
Overige industrie	1,480.75	274.11	263.90	11,055,412.10	18%
Railsector	1,797.92	12.30	-	-	0%
Rubber- en kunststofindustri	762.23	207.97	173.18	5,742,479.19	23%
Tankopslag en -overslagbedr	371.09	124.14	105.21	3,111,320.37	28%
Tapijtindustrie	33.04	17.81	17.81	409,110.78	54%
Textielindustrie	109.17	15.19	15.19	610,134.33	14%
Textielservicebedrijven	129.28	1.56	1.45	31,616.93	1%
Universitair Medische Centra	773.61	304.80	254.33	5,565,393.92	33%
Vleesverwerkende industrie	395.30	43.08	27.40	879,248.70	7%
Wetenschappelijk onderwijs	614.47	67.53	60.06	1,680,538.68	10%
Zuivelindustrie	2,507.07	655.37	493.44	14,331,048.67	20%
Zuiveringsbeheer	625.69	206.35	142.60	10,042,775.64	23%
MJA Total	**25,818.41**	**4,659.72**	**3,991.62**	**132,768,746.39**	**15%**
Grand Total	**60,728.39**	**10,244.12**	**6,948.15**	**251,906,963.55**	**11%**

APPENDIX D- CASH FLOW METHODOLOGY

The calculation of cash-flow revenue follow the Methodology indicated in Figure 19 Cash Flow TVT- Methodology. (Nederland, 2015) .

Figure 19 Cash Flow TVT- Methodology

Cashflow berekening

Besparingen		Besparing € x 1000	Kosten € x 1000	Totaal € x 1000	
1. Energie					
Energiebesparing:	GJ				
Energietarief:	€/GJ				
2. Onderhoud					
3. Afval					
4. Bediening					
5. Extra productie					
6. Overig					
7. Afschrijving*					
8. Resultaat voor belasting					
9. Belasting					
10. Resultaat na belasting					
11. Afschrijving (correctie)					
Totale jaarlijkse Cash Flow					C

Investeringen		Besparing € x 1000	Kosten € x 1000	Totaal € x 1000	
1. Aanschaf nieuwe installatie					
2. Engineering & Ontwikkeling					
3. Bouw & installatie					
4. Subsidie					
5. Opbrengst oude installatie					
Totaal					I
Overige projectgegevens					
1. Levensduur nieuwe installatie			Jaar		

1. Energy Saving in euro (Annual Energy Saving in GJ and Energy price in euro/GJ)

Non-energy benefits from energy efficiency improvements are indicated below and they should be properly incorporated into the business case analysis as they can significantly impact the implementation of the technology and result in a more favorable evaluation of the investments.

Non-energy benefit analysis includes:

2. Operation and maintenance costs (i.e. Reduction engineering controls, Reductions in labor requirements)
3. Waste (i.e. Use of waste fuels, heat, gas , Reduction product waste, Reduction waste water and Reduction hazardous waste)
4. Working environment and service
5. Extra productivity (i.e. Increased product output/yields, Improvements in equipment performance, Shorter process cycle times, Improvements product quality/purity, Increased reliability in production)
6. Other (i.e. Decreasing liability, Improvements public image, Delaying or Reducing capital expenditures, Additional space, Improved worker motivation)

The effect of productivity benefits versus the cost assessments could determine whether or not a project is undertaken. From a macro perspective those beneficial cost reductions and the evaluation of productivity benefits influence the assessment of the energy efficiency potential and should be included in the business case calculation.

As these non-energy benefits are not available in the RVO database the cash flow revenue is calculated considering only Energy saving (Point 1). Additional Cash Flow is 35% coming from the tax authority (Point 9) according to the Procedure from RVO (Nederland, 2015) . The omission of productivity benefits, O&M operational cost, Waste operation costs and other benefits results in an underestimation of the total benefits of the investments in Energy efficiency.

CONCLUSION AND RECOMMENDATIONS

In order to achieve more investments in Process Energy Efficiency and therefore reach climate goals, economic goals and geo-political goals it is necessary to have an insight in the market size of Energy Efficiency Investments. To reach more than 28 % of the planned Total energy saving the implementation of projects with pay-back period time longer than 2 years is necessary. In reality industrial companies rarely invested in projects with a pay-back period of more than 2,5 years. In order to achieve 50% of the planned total saving it is required to invest in projects with pay-back period up to 5 years. Up to 7 years pay-back time of the cumulative achievement of energy saving will reach 73% of the total goal. The certainty level distribution per pay-back period shows that the financial limitations increase for projects with PBP above 3 years. There is a potential market for external Investments for PBP between 3 and 7 years that can be stimulated using an ESCO financial business model and from an investor point of view can be attractive.

The Average Estimation EE investment is 36,6 million euro per PJ. In order to cover the Total Process Efficiency Primary Energy saving indicated in the data-base equivalent to 60 PJ the Total Estimation of the investments is 2,2 Billions euro. The average annual cashflow is estimated to generate 7 Million euro per PJ. According to Appendix D the profitability consider only the energy cost saving, therefore it is an underestimation of the real cost benefit analysis that the investment in energy efficiency can generate. It is important to highlight that this estimation is a rough estimation based on the assumption that the investigated data are representative for the total dataset. This assumption is statistically justified if the variation of data is not excessive. RVO checked several estimates versus the real data presented by the industrial company who submitted the EEP. In some cases, the estimate is within 10% but in other cases the difference is more than 50%, sometimes more than 100%. One of the reasons for variation are the energy prices which also vary in time and for which no guideline is given. The high energy price tax for the small MJA3 companies is not taken into account.

The simple pay-back period methodology used to calculate the profitability of the project does not take into account the discount rate of the money value and it is considered a poor indicator for projects with longer lifetime. Rather one should compare projects on basis of Return On Investment (ROI) as to have a fair comparison with the ROI on other investments outside the production plant environment.

We can conclude that the current estimation of investments is an underestimation of the size of the investments in energy efficiency and further research is recommended to refine the analysis. In order to refine the study a quality check on the data related to the pay-back period is highly recommended. The implementation of additional mandatory data fields likewise energy price used by the end-users and CAPEX of the projects are essential indicators.

Other suggestions to improve and double check the estimation of the investment is to perform a data analysis in correlation with the EIA[24] data, in order to cross check the investment and find the overlap between the two database. Implementing all these recommendations would enable to publish a yearly investment report that provides investors the information needed to finance energy efficiency investments either via an ESCO model, directly to industrial companies or via an alternative mechanism.

[24] https://www.rvo.nl/subsidies-regelingen/energie-investeringsaftrek-eia

IMPACT OF THE GLOBAL FINANCIAL MARKET AND NEW ACCOUNTANCY RULES ON SME S AND LARGE INDUSTRY FOR A NEW FINANCING PROCESS AND TOOL

GLOBAL ACCOUNTANCY RULES AND THEIR IMPACT ON PROJECT AND COMPANY FINANCING

The purpose of Accountancy rules is to give a standardized methodology for reporting financial performance of companies in quarterly or annual reports. If the rules change this will likely impact investment priorities in for instance energy efficiency projects and therefore it is important to analyse the impact of recent changes in legislation. Another reason is that although the rules are clear, there is still a lot of uncertainty on the interpretation of the rules in practice.

The international legislative framework for financial reporting of companies and thereby the accountancy rules for companies listed at the stock exchange have 2 broad categories: namely IFRS and US-GAAP. IFRS stands for International Financial Reporting Standards. GAAP stands for Generally Accepted Accountancy Principles and US GAAP is adopted by the US Securities and Exchange Commission (SEC). It is important to make the distinction as the same operational results will lead to different financial statements for the 2 categories. After a long consultation process that took several years the IASB (International Accountancy Standards Board) has formalized new accountancy rules for IFRS leasing that will be in force at January 1 of 2019.
The Dutch accountancy organization NBA is indirectly involved in this IFRS consultation process via the RJ[25]. One of the major changes in the new IFRS rules is the treatment of off-balance financing.

Previously, if a company used assets that were financed (leased) by a third party , these assets could be kept off-the balance sheet and the cost of the lease would be included in the operating cash flows. Therefore, it was able to develop more activities without effect on the company's financing structure (leverage) and solvency. However, the cost of these assets (the lease) is in fact a liability and the company is more leveraged without showing it on the balance sheet. This was often the case in the past for e.g. cogeneration units that were used at industrial sites and were financed by utilities.

- Under the new IFRS rules this has been corrected, and now the value of the contractual obligation of the leased asset needs to be reported on the balance sheet of the industrial company if the purpose is solely financing.
- The expected credit loss (chance on default times the lease amount) should be reported on the balance sheet as well

The background of this measure is that all financial obligations like loans and also lease contracts are now visible in the balance sheet of the financial report and that this gives a better reflection of the financial situation of the company. Although there are no direct operational changes the regulatory impact on the financial report of companies who use many costly leased assets is large (e.g. airplane companies that lease their airplanes or oil companies that lease oil tankers for transport of oil from production platforms to their customers). One may argue that in the long run everybody is used to the new interpretation and the appraisal of financial company performance will return to its original valuation. Likely however, investment priorities and contractual structures will change.

[25] Raad voor de Jaarverslaggeving

A recent analysis of PwC[26] shows that due to these new rules the total (reported) debt of major companies listed at the Dutch stock exchanges AEX and AMX (excluding banks and insurance companies) grows with 45 billion euro. That is 15 % of their current reported total debt. However, as a result of the same rules their EBITDA grows with 19 %. Globally, companies listed at stock exchanges have 3000 billion euro worth of leasing contracts, of which 85 % is kept off-balance[27].

For example an industrial company may decide to enter into a long term lease contract with an energy service company for an asset that improves its energy efficiency. The following criteria should be applied to judge the impact of leasing:

- The service company should take technical and/or operational risks for the operation of the asset during the contract period (in other words not just a financial lease)
- The asset is used for more than 1 customer
- The control of the asset is with the energy service company

If the latter 3 criteria apply it is allowed under the new rules to enter into the contract without listing the asset contract value on the balance sheet. The consequence of these rules is that the services companies need to put more effort in supplying services like managing technical/operational risks and/or selling their services to more customers e.g. like a utility platform. Whether technical/operational risks can be properly managed by the service company strongly depends on the integration of the asset in the production process of the customer. End-of-pipe solutions like processing of residual heat or CO_2 will be much easier to manage than equipment that fulfils a crucial role in the core of the production process. Also the issue of "who is in control of the asset?" is not always easy to answer in complex production processes. Generally speaking the required service of the industrial company changes from pure financing to outsourcing of technical and operational services.

OVERVIEW OF FINANCERS AND THEIR FINANCING PRODUCTS, CRITERIA AND CUSTOMERS

Generally speaking one can distinguish between 2 basic types of capital financing namely equity (stocks) and debt (loans or bonds). A company wants the lowest capital cost, which is the weighted average capital cost (WACC) of the interest rate on the debt and the required return on equity. The cost of equity exceeds the cost of debt, due to the higher risk that equity providers face: if a company should enter bankruptcy, all creditors and lenders are paid first, and equity providers (shareholders) will be reimbursed last. Banks are very risk averse, and therefore, the riskier the company is perceived a larger portion of equity is required to attract debt. As a result the company's cost of capital is higher. This is also true for projects. Note that providers of equity and debt are usually different. On top of this there are several forms of debt; normal loans which require collateral and subordinated loans which require less or no collateral and can in some circumstances be converted to equity. The overall optimal financing is thus strongly dependent on the structuring of these different forms of debt and equity.

Banks and SME's

[26] https://www.pwc.com/

[27] https://fd.nl/ondernemen/1243613/explosie-van-schulden-door-nieuwe-regels-voor-lease

There are major changes which have occurred in the financing of debt since the financial crisis in 2008 that impact funding of companies and thus of projects like energy efficiency. In the Netherlands SME's have traditionally always been very dependent on financing via banks in contrast to the US where there is a much more developed capital market. Government and regulators have imposed much more regulation on banks to reduce the risks they can take and thereby prevent a potential second financial crisis. Three major developments have impacted banks to a large extent and thereby the financing of their clients:

1) Basel 3
2) Elimination of distribution fees
3) MIFID 2

Basel 3 requires banks to have a minimum percentage of equity capital (tier one capital) relative to the loans. Banks who were relatively large in mortgages, like Dutch banks, had to increase their tier one capital or to reduce the value of outstanding loans much more than other banks. This reduces their risk profile but decreases their profitability and potential growth in loans, at least at short term. Secondly, hidden costs for customers in mutual funds, the so-called distribution fees, that provided income to banks were no longer allowed. At last MIFID 2 came into force at January 3 of 2018 that created more transparency but also higher compliance costs for banks. Thus, the traditional business model of banks has become less profitable over the last 10 years. For the borrowers it became more difficult to get a loan as a result of these circumstances although the quantitative easing (buying of state bonds) by both FED and ECB has drastically reduced the interest rate on loans since 2012. Thus, it became harder to get a loan but the interest rate is much lower compared to the period before 2008, at least when the risk is perceived low by the bank. [28]

SME's were specifically impacted. First of all, assessment of a small loan is roughly the same amount of work as assessment of a large loan (economy of scale). Thus, the nett margin for a bank on a large loan is higher than on a small loan. Large companies, especially if they are listed on a stock exchange can easily issue bonds on the capital market and are therefore much less reliant on banks than SME's. Several attempts have been made to set up an exchange, the NPEX, for listing of SME bonds.[29]

However, secondary trading had to stop in November 2017 to adapt to new regulation. In the past the Dutch NIBC bank had the role of financer for SME's and the more riskier loans. Currently, such a bank does not exist in The Netherlands. Many countries have a bank which is specialised in this category. Germany has for instance KFW that also finances energy efficiency projects. Germany also has a more liquid capital market for SME bonds. On the whole SME's in The Netherlands seem to have less favourable financing conditions than SME's in our neighbour countries.

It is hard to obtain objective quantitative information on the access of SME's to debt funding. Many SME's complain that banks do not give them a loan and thereby restrict the growth of their company (and its

[28] https://www.afm.nl/nl-nl/professionals/veelgestelde-vragen/provisieverbod-beleggingsondernemingen-distributievergoedingen

[29] https://www.npex.nl/over-npex/secundaire-handel.

potential contribution to the energy transition). On the other hand, CEO of ING Ralph Hamers said recently that Dutch companies were spoiled with low interest rates and that ING would expand in Italy and Turkey were successful entrepreneurs had more growth ambitions and accepted the higher interest rate. Fact is that the assessment of tailor made loans for SME's like novel and small technology suppliers is a costly process that requires a lot of expertise. For small loans this is not compatible with the current business model of banks that tend to standardization via digitization of their business processes.

In France and Germany companies could use their account receivables as collateral for loans. Until recently this was not possible in the Netherlands as banks would not allow it. Recently, minister Dekker from the Dutch government announced that he would end this prohibition. This would give Dutch SME's about 1 billion euro more credit facilities.[30]

Recently an analysis of the status of SME's in the Netherlands showed that the past year 30 billion euro more turnover was generated by all SME's together (a growth of 3,4 %) while they created 92.000 jobs (a growth of 2,9 %). However, this growth was mainly realised by 10 % of the SME's. For the remaining 90 % lack of financing and a shortage of available staff on the labour market limited their growth. [31]

Peer-to-peer lending platforms and SME's

Over the last few years several initiatives have been developed to digitize traditional financial processes like payments (by Pay-Pal and Ayden) and lending via peer to peer platforms. The latter is basically a digital platform that connects suppliers of capital (investors) and with SME's/borrowers using a business model that takes a fixed percentage fee from the loan (actually a commission, about 1 %). This is the same business model as Airbnb, Uber, Facebook etc. The previously time-consuming appraisal of loans is to a large extent replaced by automatically gathering and analysing digital data from different open sources to establish cashflow, credit rating, risks, historical performance etc. A subset of the peer to peer lending platforms are the crowdfunding platforms where the investors are private investors instead of institutional investors. Peer to peer platforms operate in a potentially very lucrative market. They are not (yet) subject to regulation like banks and therefore do not need to have much own capital available as banks do. They also do not need a bank permit. The variable costs are low because the processes are automated, investments are modest (an IT system acting as platform) and income grows quickly with size.

An example of a large peer to peer platform is Funding Circle who started in the UK and is now also active in Germany, USA and the last 2 years in The Netherlands, where they more than double their turnover per year. Over 7 years in the UK they have become the largest lending source for SME's replacing banks with sometimes 200 years of history and experience. It turns out that their digital appraisal process for small loans (maximum size now in NL is 250.000 euro) has practically the same default rate as the much more costly expert appraisal process in banks namely 2,5 %. Interest rates vary between 2,78 % and up to 10 %

[30] https://fd.nl/economie-politiek/1240994/kabinet-maakt-einde-aan-verpandingsverbod-om-kredietverlening-aan-het-mkb-te-stimuleren

[31] https://fd.nl/economie-politiek/1227623/economisch-herstel-gaat-aan-meeste-mkbers-voorbij

depending on the risk classification and lending period (between a half and 5 years). In this market, especially the early post crisis risky sectors like retail, Horeca, building sector SME's have hardly an alternative financing mechanism and this leads to a high growth for these platforms. The lending requirements for SME's are also less severe than for banks.

Another (Dutch) lending platform is Caple. The French bank BNP Paribas has taken a taken a 10 % interest in this platform. Caple has a focus on larger loans; between 0,5 and 5 million euro and will focus on the following countries: The Netherlands, Germany, and the UK.[32]

A lending platform that via crowdfunding has a focus on sustainable companies or projects is One planet crowd[33] developed by Start-green in 2012 that issues loans up to 2,5 million euro. Also innovative start-ups with high growth potential are entitled via One planet crowd to get financing via subordinated loans that can be converted to certificates of shares.

Subordinated debt funds

A number of specialised subordinated debt fund for SME's have been launched in the last 2-3 years. Examples are FundIQ[34] and the NLIII Achtergestelde Leningen Fonds (ALF) managed by Aegon. These funds use a traditional (meaning not purely digital) appraisal of the company requesting the loan. Therefore the size of the loans is often larger than for the peer to peer lending platforms.[35]

The ALF offers subordinated loans up to 50 % of the total financing requirement. This is often in combination with senior debt financing from a bank (ING, ABN AMRO and RABO bank) or an investment from equity suppliers. In case of the combination bank with ALF, the bank will approach ALF because the project solvability is too low to finance the project completely with senior debt. The reasons for the combination equity with ALF are:

- if company has too low solvability for senior debt
- if senior leverage company becomes too high

ALF is available for SME's up with a proven product till 500 employees which are in the growth phase (no start-ups). Companies from financial sector, real estate, housing cooperatives, agriculture, fishery and aquaculture are excluded. Financing is given on basis of cashflow. Cashflow needs to be sufficient also when business is under stress. Duration of the loan is up till 8 years. The interest rate is between 6 % and 15 % depending on risk profile and loan duration. On average the time of the process to get a contract for the loan is 6 weeks.

[32] https://fd.nl/ondernemen/1227688/bnp-paribas-neemt-belang-in-nederlands-leningenplatform-caple

[33] http://www.startgreen.nl/nl/crowdfunding/

[34] https://fundiq.nl/

[35] https://www.aegonassetmanagement.com/en/netherlands/fund-overview/nlii-alf/

FundIQ issues loans varying from EUR 250.000 till EUR 2,5 million and NLII ALF loans range from EUR 150.000 to EUR 10 million. These funds therefore nicely complements the size range of peer to peer lending platforms.

Both funds do not lend to financial institutions, a sector of which leasing-companies are considered to be part. Currently, these is no information about the usage of such funding mechanisms by SME technology suppliers. On the whole one might expect that this is a very positive development for technology supplier SME's to finance further growth.

Private equity and SME's

Start-ups and novel technology companies that want to grow quickly have often a negative cashflow and can therefore not rely on loans as often a positive cashflow is a prerequisite from the lender. Such companies need either financing from other companies, private equity funds and/or government subsidies like the Dutch WBSO for technology development. The Dutch branch organisation for private equity funds NVP[36] lists all the participations from its members in a spreadsheet. [37]

Typically private equity companies that want to invest in novel technology search for SME's that have high growth potential over the holding period (usually till a maximum of 5 years), have a low capital intensity and high return on capital. To achieve a diversified portfolio of SME's with a modest amount of capital employed private equity seeks for low capital intensive companies. The overwhelming majority of these SME's in the database are in area of biotechnology and ICT (as enabler for fintech, telecommunication services, cloud solutions, data processing, e-commerce, retail, mobility). Energy (both oil and gas, waste as well renewables) is a small minority in the database mainly represented by services that require little or no capital. The SME selection for hardware energy technology (either for energy generation, conversion and energy efficiency) is much smaller. Assuming that the same amount of early stage innovation takes place for software as for hardware energy solutions the smaller number of hardware SME's must be explained by their higher capital intensity, their longer development period and consequently their higher risk profile. For example a novel reactor or other type of production/processing equipment like a heat pump has often unknown scale effects due to the complex interaction between chemical reactions and transport phenomena like heat transfer and mass transfer. Thus the trajectory from a successful lab scale unit to a successful industrial unit can be very costly and time consuming.

Out of the 4802 funded initiatives over time by VNP members varying in categories from early stage, start-up, growth till buy-out there are roughly 35 industrial energy hardware solutions. Solar PV was skipped as this is more of a retail application than industrial. The majority within this group is based on renewable energy generation and prior processing techniques like biomass torrefaction and wind power technology. Likely, the government subsidies like feed-in tariffs for renewable power reduce the risk profile for these technologies and their private equity financers as one can rely on a positive cashflow for a long period (8 years for biomass and 15 years for wind energy) and therefore the early stage investors face a positive market outlook. These 2 technologies categories can be found in both early stage, start-up, growth as

[36] Nederlandse Vereniging van Participatie maatschappijen

[37] http://www.nvp.nl/pagina/ondernemend%20vermogen/#!lang=en

buy-out categories. Note however, that not all investments in the VNP database are completely described. It may therefore be possible that there actually more energy efficiency investments. We assume that the current data are representative.

When focussing on industrial energy efficiency one can find 8 examples in the VNP database as listed below:

1. Improvement production processes
2. Efficiency electric powered machines
3. Heat to energy conversion
4. Peltier cooling motor
5. Energy efficiency technology
6. Geo-heat pumps
7. Self-cleaning heat exchangers
8. Heat pumps

These are all, but one, early stage technologies. Thus we can conclude that roughly one out of 500 investments is focussed on industrial energy efficiency hardware solutions with no one in the growth or buy-out phase. This is a very small number given the ambitions of the Dutch goals and the Paris agreements in general. The fact that there are roughly 4 times more investments in the renewable energy generation than in energy efficiency that also extends to the growth and buy-out phase suggests that government funding via feed-in tariffs is a very successful mechanism to promote innovation (more specifically crossing the valley of death) in the area for industrial energy applications.

Note, that although early stage private equity firms focus on investments in start-up companies that have low capital intensity, this does not imply that they are short in cash. A recent investigation by Bain & Company shows that the amount of not-invested capital present in all private equity firms has grown till US$ 633 billion end of 2017 globally. Note that the majority of this private equity capital is for buying large companies and not for investment in start-ups and SME's. The published investigation in FD of Bain & company does not differentiate between the start-ups, SME's and large buy-outs but it is expected that with such a large growth all sectors benefit. The last 5 years the average growth of not-invested capital was 12 % per year globally. The 10 largest private equity firms attracted more capital in 2017 than they could invest. This is partly due to the competition of multinationals that want to take over the same companies. Never in history had private equity so much capital available as in 2017 namely US$ 977,9 billion while the percentage that was not invested was also historically high. This global trend is also seen in The Netherlands where the growth in private equity is large from 1 billion euro influx in 2014 till 10 billion euro in 2017.[38]

Similarly, one might expect that subsidy mechanisms like feed-in tariffs (OPEX subsidies for a long period of time enough to amortize the investment) for industrial energy efficiency will also mobilize private equity for industrial energy efficiency and energy conversion techniques that lead to CO_2 reduction.

[38] https://fd.nl/ondernemen/1235374/populariteit-remt-rendement-van-private-equity

Alternative investments and project financing

Institutional investors like pension funds invest the majority of their capital in stocks and bonds that are listed on a stock exchange. A small percentage is allocated to private equity, which has a higher risk profile but also a higher expected return than stocks (2,5 % higher on average). Besides private equity there is an increasing interest for alternative investments for 2 reasons:

1) The effective interest rate on bonds is very low due to quantitative easing over the last few years by ECB and FED and as consequence the income stream from these investments is low.
2) Alternative investments might provide a long term steady income higher than bonds and are hardly correlated with the stock market and thus reduce portfolio risk

Alternative investments could be investments in projects for infrastructure like toll roads and renewable energy production. These investments are called illiquid as, in contrast to stock exchange listed stocks, one cannot easily sell the project in a very short timeframe. Therefore they are very suitable for investors with a long time horizon. A portfolio of energy efficiency projects might also qualify as alternative investment. Current recommendation is that large institutional investment funds like pension funds should invest 10 % in alternative investments while the percentage of energy project investments is currently very low. Thus, there is plenty of scope to enlarge this contribution.

Government funding and energy innovation

There is substantial amount of Dutch subsidies and fiscal instruments available to promote investments in energy innovation. Some support technology development at low TRL level like the WBSO, others like SDE+ (feed-in tariff subsidy) support technology development indirectly at very high TRL level. Topsector energy innovation policy targets technology development at medium TRL levels. Then there are more generic fiscal instruments like EIA, VAMIL and MIA. Deltalinqs has made an overview of all these instruments in a report written by Hans van't Noordende. (Noordende, 2018)

These instruments are designed to implement government policy and its ambitions. Essential for energy innovation is the vision and strategy of the national government. Economist Mariana Mazzucato argues in her book "The entrepreneurial state" that all major (disruptive) innovations originate from state funding. Innovations like Internet TCP/IP protocol, Internet HTML protocol, Google search algorithm, GPS, electric cars (Tesla and BYD), electric vehicle charging stations, CO_2 enhanced oil recovery, solar PV, offshore wind energy and many other major developments could only take off at large scale because of major government funding in the early most risky phase of development. Countries like the USA, China and to a lesser extent Germany are famous for this approach. By contrast to what many believe, private funding plays only a minor role in these large early stage developments as explained by Mazzucato in her TEDTalk.[39]

The Dutch feed-in tariff system (SDE+) has been very successful in driving down financing costs for large scale offshore wind energy and has also enabled private funded innovations in wind energy. Thus, optimal financing is not just a choice between government funding and private funding. Instead, one should

[39] https://www.ted.com/talks/mariana_mazzucato_government_investor_risk_taker_innovator

treat financing as an ecosystem where government funding and private funding both can reinforce each other.

The Dutch government has set up the NIA[40] that is supposed to fund large projects with subordinated debt in immature markets (that are more risky than the "commodity" projects like offshore windfarms, biomass projects or solar farms). Therefore they require at least 30 % equity for financing. An example is their ETFF [41]that is able to fund projects from 750.000 euro till 25 million euro during 15 years. At least 50 % of the equity must be financed by the project sponsor. ETTF will fund at maximum 50 % of the equity, thus 15 % of the total capital requirement if the ration of equity and debt is 30/70.[42]

https://www.nederlandsinvesteringsagentschap.nl/actueel/nieuws/2016/oktober/14/energietransitie-financieringsfaciliteit-100-miljoen-euro-risicodragend-vermogen-voor-de-energietransitie-in-nederland

During 2018 the Dutch government will set up the investment fund Invest NL (2,5 billion euro in size) [43]that will incorporate the role of NIA and also offers other financing products. ETTF will maintain the channel for which companies can get financing. FMO and NL Invest will work together to form NL Business to target countries that FMO can currently not serve because the market there is not mature enough.

The purpose of this fund to is to stimulate investments in sustainable energy projects that will then, when the market matures, lead to lower cost financing mechanisms and thus stimulate innovation. A suitable candidate might be geothermal energy.

Provinces have also set up investment funds with the purpose to stimulate employment and economic activity in their own region. Sometimes they are managed by the government themselves and sometimes this management activity is outsourced e.g. the funds from respectively provinces of Overijssel and Noord-Holland are managed by StartGreen while Innovation quarter (Zuid Holland) is managed by IQ capital.

Large industry and financing

Most energy intensive industry multinationals, whether part of the Dutch MJA3 or MEE convenants, use only internal financing as investment priorities are determined by the corporate headquarters of the company. Operating companies like production plants are usually not allowed to seek major external funding for projects on site. The new IFRS accountancy rules will enforce this trend. For energy intensive companies the available capital budget for energy efficiency investment projects in production plants is usually limited to projects with a pay-back period of maximum 2,5 years. In exceptional cases when there are multiple benefits beyond energy efficiency or when consumers are willing to pay a premium (only in B2C markets) longer pay-back periods are allowed internally. As companies grow in the number of operating units all over the world while the decision process becomes more centralized, internal competition for

[40] Nederlands Investerings Agentschap
[41] Energie Transitie Financierings Faciliteit

[42] https://www.bngbank.nl/financiering/etff

[43] https://www.nederlandsinvesteringsagentschap.nl/project

project funding increases. In general at plant level there are much more high return energy efficiency investment opportunities than the available budget allows to implement. At company level their published ROI levels are usually much lower than the ROI of typical energy efficiency projects at plant level. Due to several agency problems there is often a lack of alignment between the financial drivers at the top and the project opportunities in e.g. energy efficiency at plant level. This has been addressed by Stijn Santen in his TEDx talk in 2014.

https://www.youtube.com/watch?v=oj8QOSwRM9s

In specific cases the funding capacity of the company is limiting the investments in energy efficiency projects. However, in most cases funding capacity is sufficient but investment priorities are not geared to operational efficiency but to volume growth of the company through buying competitors and increasing dividend by share buy-backs. Thus internal competition for project funding increases while the available capital budget for operational efficiency decreases. Naturally, there is an interdependence between funding capacity and investment priorities. A cash rich company might leverage it financing capacity by lending to the maximum in order to buy a large company and subsequently needs to reduce the capital budget for its operating companies to maintain its credit rating. In such situations additional external debt for energy efficiency projects will be hard to justify. However, if the new accountancy rules are met, ESCO constructions might alleviate this problem. Also, if Dutch government wants to pass legislation regarding CO_2 emissions or energy efficiency (or enforce existing laws), the budget would be for compliance rather than for operational efficiency. Compliance budget is usually easier to secure.

PROPOSED FINANCING PROCESS AND TOOL FOR ENERGY EFFICIENCY PROJECT

To develop the market for industrial energy efficiency projects one needs to integrate the beforementioned financial products and instruments into a coherent process and structure. Due to the strong interdependency of all elements this is by definition a co-creation process of different parties like the industrial client, the project developer, the technology supplier, the financer and possibly a grid owner/operator when infrastructure is involved. The following list of steps might help in this development process which consists of two phases: A (exploratory and expanding) and B (defining and focussing).

1. Make a shortlist of all project opportunities that match the strategic drivers and priorities of the company without excluding project opportunities that do not match the current operational budget, acceptable payback time, or operational criteria of the production plant
2. What is the nature of the energy efficiency opportunities? (e.g. waste heat utilization)
3. Is there a specific window of opportunity required to implement this opportunity ? (for instance a maintenance turnaround)?
4. Which potential clients or stakeholders might benefit beyond the industrial site itself? This could be neighbour industrial sites, utility buildings like hospitals, swimming pools, offices and schools, and or residential area's with a predictable energy offtake. This would involve extra Capex and complexity but would increase the overall value and would enable off balance financing opportunities.
5. Might the project opportunity be integrated with other potential projects on site or elsewhere? (e.g. replacement of equipment in a turnaround at the site of other neighbouring sites or setting up a fund or a business that executes a portfolio of likewise projects)
6. Can other multiple non-energy benefits be defined that would increase the impact and priority of the project? (e.g. improved safety, reduced maintenance, improved product quality,

increased production capacity, waste reduction, leverage the application at other production sites, flexing the power demand etc.)
7. Might "novel" technologies (novel defined as novel for the industrial customer) increase the benefits or scope of the opportunity? (e.g. heat pumps integrated with pinch technology)
8. Which combination of potential partners might create the optimum collective value?
9. Would the overall business case likely meet the drivers of each potential partner? (if so, approach each partner for phase B)
10. Get agreement on this approach with crucial internal stakeholders

After evaluating the answers to these questions one can with the chosen potential partners go to the same process to analyse whether this group arrives at the same or other solutions taking into account all their specific company criteria. Note, this is a very unusual process as commonly projects are first scoped and defined within the decision parameters of the local production plant. Likely, the commonly used project development process excludes many valuable projects which with other partners create much more value and raise the strategic priority. After finalizing this first phase one can continue the project/business development process with the chosen group of partners formalized in to a letter of intent. This will be the 2nd phase B.

1. Define the roles of each partners into the project based on their strategic drivers and optimal allocation of competences, experience and capital
2. Carry out a risk assessment of the opportunity and assign each risk to the party who is best placed to manage and minimalize
3. Develop and structure the business case with a financial model that is aligned with the roles of the partners and the risk assessment
4. Develop and structure the project planning based on the business case

The risk assessment is a crucial part of the process B and can be viewed as a due diligence process. This assessment should incorporate the following risks:

1. Credit risk (crucial for the financer and usually well defined by agencies like Fitch, Moody's etc.). It involves long term cashflow stability, dependencies on performance and scope of responsibility (ESCO). Basically this answers the question "Do I get my money back?"
2. Technology risk (crucial for the industrial client and can be partly mitigated by the project developed and technology developer). Not well defined as this risk can be differently perceived by experienced developers compared to industrial clients. Question: Is the TRL level high enough? At a higher level: might future disruptive technologies outperform the project?
3. Operational risk (crucial for the industrial client and can be partly mitigated by him and the project developer). Not well defined as this depends on the production process as well. Question: Will it work reliably enough?
4. Commercial risk (crucial for all partners). Can be well defined and contractually mitigated. Question: how will the relevant energy price and potentially equipment price vary over time?
5. System risk. Perfect technology and equipment operation might still have unforeseen consequences for the production process as a whole. This involves issues like (future) integrity, flexibility of the process. Not well defined as this depends on the production process as well.
6. Organizational risk. Not well defined. How stable is the partnership and its common strategic drivers over time?

The credit risk can become a risk on bankruptcy. Current arrangements, like the "Groeifaciliteit" from RVO do sometimes not offer sufficient protection while covering those risks with an insurance will directly benefit the credit rating for project financing. Clearly, the more standardized the risk assessment and/or due diligence is, the easier it will become to attract financing as costs will go down. There are several European initiatives that address these issues. One of them is the Investor Confidence Project[44]. This has a history in the application for buildings but its application for industry is relatively new.

It is obvious that the development of this process requires testing on real projects to validate the methodology. An investment fund for let's say industrial energy efficiency projects would typically have a size of at least 200 million euro. A number of small likewise projects might be bundled in a lot that is described by one contract. Contract lot's may be about 5 to 10% of the fund size: about 20 million euro. Many projects are much smaller (less than a few million euro) and thus cannot justify the development of a contract lot. Integrating a number of smaller projects in one contract lot using a standardized methodology including a risk assessment as described before might solve this problem. Risks decrease due to the portfolio effect of diversification while the development costs of the projects decrease due to the use of the standardized methodology.

On basis of the LTA database analysis we can conclude that the average EEP project is very small. The average project size for all certain MJA3 projects is 61.000 euro (1244 projects for 76,1 million euro) while it is, although much more, still only 251.000 euro (184 projects for 46,2 million euro) for all certain MEE projects. These numbers are the average for all pay-back periods. When zooming in on the pay-back period 5 till 7 years the average investment for certain projects (average of MJA3 and MEE) is 300.000 euro based on 213 projects for 63,9 million euro. Likely there will be a large variation in project investment size. However, these examples show that it is essential to develop a standardized methodology for both risk assessment and project development as many projects are too small to justify a tailor made due diligence process. Thus going forward with an investment fund implies collecting and analysing a large number of project opportunities that comply with the financial terms of the lot. The alternative approach is to implement specific projects one by one, seeking small scale dedicated funding from a financial supplier , preferably in a simplified standard contract. In both approaches a standardized methodology including the risk assessment is essential.

PROPOSED FINANCING PRODUCT FOR ENERGY EFFICIENCY PROJECTS

The formerly described process should ultimately lead to a standardized risk assessment and thereby a standardized financial methodology that enables the use of external capital. The use of the methodology will make it easier for partners to work together irrespective whether the final construction is an ESCO or another financial construction. The Italian experience with ESCO's shows that often additional financing by ESCO's is not required by the industrial clients. The driver to work with ESCO's is then their operational and technology expertise and thereby being able to absorb operational risks that the industrial clients does not want to take. The ESCO-industry relationship is then based on outsourcing of operations and

[44] http://www.eeperformance.org/

maintenance while also reducing operational and commercial risks. In order to understand when financing is required the market size of industrial energy efficiency needs to be estimated. The estimation of this market size is based on the following criteria:

- Industry will currently finance all energy efficiency investment opportunities with a pay-back of less than 2 years themselves
- Industry and ESCO's will strike contracts with a minimum duration of 10 years
- Projects with a pay- back time between 2 years and 5 years will be selected for financing in an ESCO construction assuming that these projects can be "ringfenced" from the core production process

The combination of a contract duration of minimum 10 years (preferably 15 years) with a pay-back period between 2 and 5 years will allow the ESCO and its financer to make sufficient return on capital provided that their cost of capital is low enough. The cost of capital is again a function of a proper risk assessment, portfolio diversification of projects and an optimal financial structuring of equity, subordinated debt and normal debt.

The following table indicates the current market size based on the analysis of proposed energy efficiency projects (EEP's) in the LTA database RVO for projects with a payback period between 2 and 5 years. The CAPEX associated with projects which are labelled as "financial conditional" is relatively small (27 million euro) compared to the total market size (250 million euro). As expected the amount is much smaller for the MJA3 companies which are legally obliged to implement all projects with a pay-back period less than 5 years. The CAPEX for technically conditional projects is larger: 79 million euro. Thus, in the ideal situation that an ESCO can remove the technical and financial conditionality for all these EEP's their market size in the Netherlands for MEE and MJA3 companies would be 106 million euro for these high return projects.

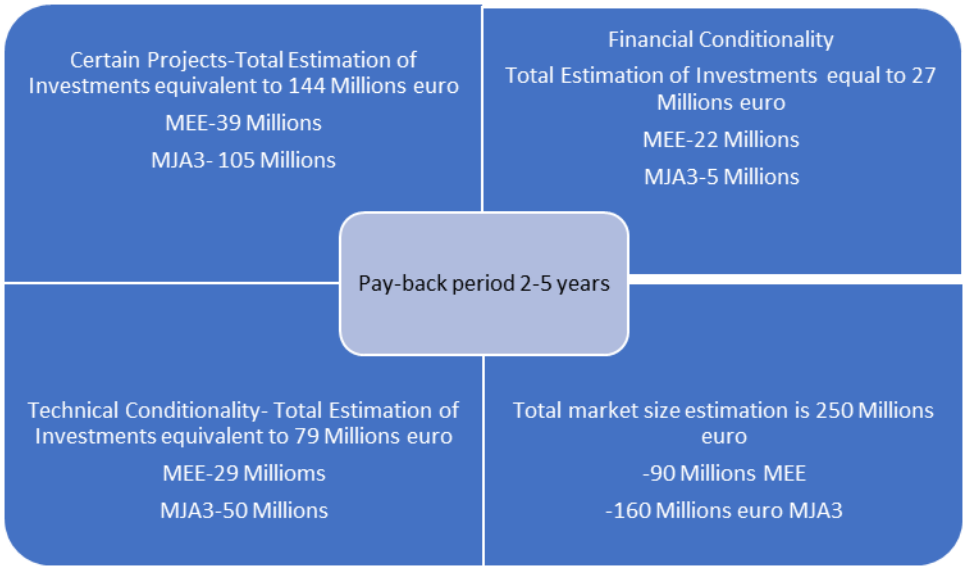


Figure 20 Market size estimation of investment with PBP between 2 and 5 years

The next table shows the market size and technical and financial conditionality for project with a pay-back between 5 and 7 years. This will be the section which might be most suitable for external financers as they are more capital intensive and the core process projects (less suited for external financing) are likely to have lower pay-back periods than 5 years. If the government would enforce by law the implementation of EE projects up to a pay-back period of 5 years for both MJA3 and MEE companies their appetite for external financing is also likely to be higher. In order to allow the ESCO and its financer to make enough margin to cover the costs of capital and other expenses the contractual period must be much longer than the payback period; 10 years is a minimum for a payback period of 7 years. If possible 15 years is preferred. For the ESCO's that can solve the financial conditional and technical conditional projects the market size is 186 million euro.

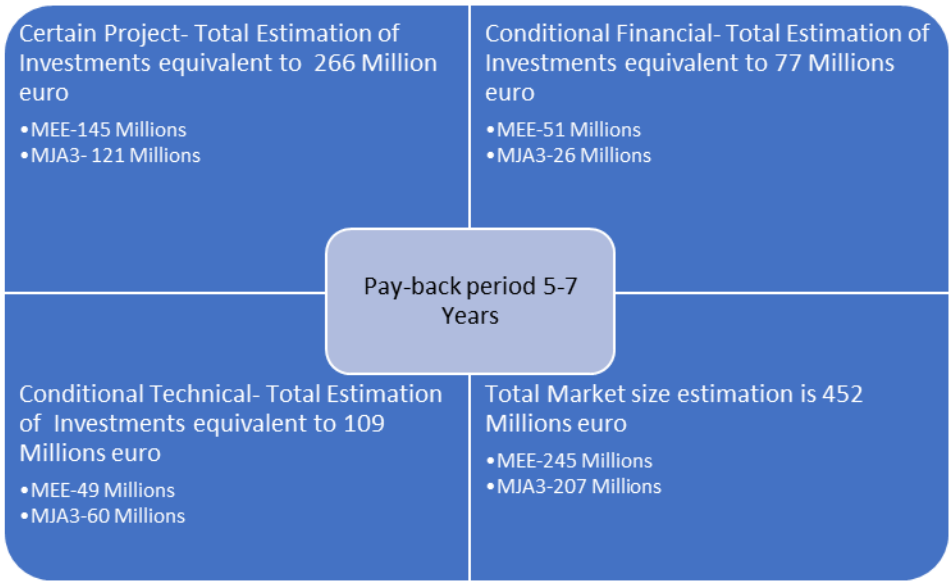


Figure 21 Market size estimation of investment with PBP between 5 and 7 years

These CAPEX numbers are relatively small and that is due to the limited dataset from the LTA database that could be used for this analysis. In addition there are much more energy efficiency investment opportunities then there are listed in the EEP database and this number is expected to grow when all industrial companies will give more priority to energy efficiency and implement the ISO50001 energy management system. Also the awareness of ESCO's in industry is low and industry still needs to cope with the consequences of the new IFRS rules. Therefore it is useful to evaluate the investment cost-effectiveness of industrial efficiency compared to energy production.

As previously calculated on basis of the LTA database of RVO the total investment size of all submitted projects is 2,2 billion euro leading over 15 years to an energy reduction of 303,5 PJ. The investment segment with a pay-back period between 2 and 5 years is 12 % of the total CAPEX hence 264 million euro but provide 21,2 % of the energy savings (64,5 PJ). Thus the investment cost-effectiveness is 4,09 million euro per PJ. The offshore Gemini wind park was an investment of 2,8 billion euro. It will potentially produce over 15 years 93,6 PJ. Thus, the average cost-effectiveness of the investments in offshore wind power

production for this park is EUR 29,9 million per PJ energy produced. It can be concluded that the investments in energy efficiency with pay-back period 2 till 5 years are 7 times more effective. For all industrial EE investments the average investment cost effectiveness is with 7,2 million euro per PJ still 4 times more effective than for offshore wind power. This is based on a comparison of private investments thus excluding subsidies. This shows why the IEA labels energy efficiency as the first fuel and that energy efficiency investments have a very high impact.

Besides analysis of the impact it also useful to estimate what the typical market size could be in The Netherlands for external energy efficiency investment funds using the following assumptions:

- The fund only delivers equity capital to the project and equity will be 1/3 of the total capital requirement (thus 2/3 supplied by debt)
- The cooperation of the industrial customer, the investment fund and possibly a technology provider will resolve all technical and financial conditionalities as mentioned in the LTA database from RVO
- The fund will invest in all projects with a pay-back period between 5 and 7 years, where industrial customers will finance all projects themselves with a pay-back period shorter than 5 years
- The cooperation of the industrial customer and the investment fund will be designed in such a way that the new IFRS leasing rules pose no objections for financing by the fund
- The market size is based on a period of 10 years with the same progression in energy efficiency investments per year compared to the EEP's submitted to the LTA database for 3 years (2017-2020)
- The market size is based on energy efficiency only and thus excludes projects that reduce CO_2 emissions but might increase energy usage like CCS and electrification

Under these assumptions the equity fund market size is 615 million euro. If we assume that investment funds must have a minimum size of 200 million euro from the viewpoint of portfolio diversification and manageable overhead, the Dutch market using these assumptions would be large enough for 3 funds.

CONCLUSIONS

There is abundantly capital available from institutional investors or other financers. High return energy efficiency project opportunities are also abundantly available. However, these two groups do not seem to meet. To unleash this potential market of energy efficiency investments in projects in production plants of energy intensive industries requires a standardized methodology. This would include a holistic risk assessment to reduce development time and costs for both financers and project partners. This is not a trivial exercise as project opportunities typically emerge in a plant environment with professionals experienced in the production process while the financial decision making process takes place by financial experts in the headquarter of the company using often different criteria. Thus, the project has to bridge the experience and priorities at production level with the strategic financial drivers at board level. An energy management process as a results of the European Energy efficiency directive leading to ISO 50001 is a first step to get a better alignment between operational and strategic priorities within the industrial company.

A project assessment methodology including a holistic risk assessment co-developed by financers and industrial parties is a crucial step to expand and de-risk the energy efficiency market. Most likely, this approach is best used for projects at plants that have an interface with other plants or facilities outside the plant battery limit to avoid conflicts with internal accountancy rules. These projects, with partners, require long term commitments (10 years or more) and therefore become a strategic decision within the energy intensive industry companies.

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