TRIPLE-A

Enhancing at an Early Stage the Investment Value Chain of Energy Efficiency Projects

Deliverable 3.3: Report on the Cost of Capital Estimation of Energy Efficiency Projects across Member State Countries

February 2021

The Triple-A project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 846569.

Enhancing at an Early Stage the Investment Value Chain of Energy Efficiency Projects

GA#:846569

Topic: LC-SC3-EE-10-2018-2019-2020

Funding Scheme: CSA

Start Date: September 2019

Duration: 30 Months

Project Coordinator: NTUA

Deliverable Number (relative in WP)	3.3
Deliverable Title	Report on the Cost of Capital Estimation of Energy Efficiency Projects across Member State Countries
Work Package Number	3
Task Number	3.2
Date of Delivery	February 2021
Dissemination Level	Public
Work Package Leader	UPRC
Task Leader	UPRC
Lead Beneficiary	UPRC
Author(s) (Organisation)	Diamantis Koutsandreas (NTUA), Nikos Kleanthis (UPRC), Filippos Dimitrios Mexis (NTUA), Alexandros Flamos (UPRC)
Keywords	Energy Efficiency Investments; Financial Performance; Risk Assessment; Cost of Capital; Cost of Equity; Profitability; Member States

Preface

Triple-A has a very practical result-oriented approach, seeking to provide reliable information answering on three questions:

- How to ***assess*** the financing instruments and risks at an early stage?
- How to ***agree*** on the Triple-A investments, based on selected key performance indicators?
- How to ***assign*** the identified investment ideas with possible financing schemes?

The Triple-A scheme comprises three critical steps:

- ***Step 1 - Assess:*** Based on Member States (MS) risk profiles and mitigation policies, including a Web based database, enabling national and sectoral comparability, market maturity identification, good practices experiences exchange, reducing thus uncertainty for investors.
- ***Step 2 - Agree:*** Based on standardised Triple-A tools, efficient benchmarks, and guidelines, translated in consortium partners' languages, accelerating and scaling up investments.
- ***Step 3 - Assign:*** Based on in-country demonstrations, replicability and overall exploitation, including recommendations on realistic and feasible investments in the national and sectoral context, as well as on short and medium term financing.

Who We Are

	Participant Name	Short Name	Country Code	Logo
1	National Technical University of Athens	NTUA	GR	EPU NTUA
2	ABN AMRO Bank N.V.	ABN AMRO	NL	ABN·AMRO
3	Institute for European Energy and Climate Policy Stichting	IEECP	NL	IEECP
4	JRC Capital Management Consultancy & Research GmbH	JRC	DE	jrc CAPITAL MANAGEMENT
5	GFT Italy srl	GFT Italy	IT	GFT
6	CREARA Consulting SL	CREARA	ES	creara
7	Adelphi Research Gemeinnützige GMBH	adelphi	DE	adelphi
8	Piraeus Bank SA	PB	GR	
9	University of Piraeus Research Center	UPRC	GR	TEESlab University of Piraeus Research Center
10	SEVEn, The Energy Efficiency Center	SEVEn	CZ	SEVEn7
11	Public Investment Development Agency	VIPA	LT	VIPA NATIONAL PROMOTIONAL INSTITUTION
12	National Trust Ecofund	NTEF	BG	NATIONAL TRUST ECO FUND

The Triple-A project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 846569.

Disclaimer

Copyright Message

Table of Contents

1 Introduction 1
2 Overview 3
3 Energy Efficiency Projects Data 5
4 Risk Assessment 14
5 Cost of Capital Estimation 21
5.1 Approach 21
5.2 Stakeholders Consultation 22
5.3 Estimation 26
5.4 Profitable EE Projects Identification 29
6 Conclusions 38
7 References 40
Appendix A 43
Literature sources used for the rebound effect evaluation 43
Appendix B 44
Questionnaire for investors' preferences 44

Figures

Figure 1: Flowchart of the methodology followed 4

Figure 2: Project IRR (equity=100%) curves for Building Fabric Measures and HVAC Plant in Germany 6

Figure 3: Project IRR (equity=100%) curves for Lighting and Compressed Air in Germany 7

Figure 4: Project IRR (equity=100%) curves for Cooling and Heating in Germany 7

Figure 5: Project IRR (equity=100%) curves for Motors and Pumps in Germany 8

Figure 6: Project IRR (equity=100%) curve for Waste Heat without power generation in Germany 8

Figure 7: Project IRR (equity=100%) curves for Lighting and Building Fabric Measures in Bulgaria 9

Figure 8: Project IRR (equity=100%) curve for Integrated Renovation in Bulgaria 9

Figure 9: Project IRR (equity=100%) curves for Refrigeration and Motors in Italy 10

Figure 10: Project IRR (equity=100%) curves for Heating and Compressed Air in Italy 10

Figure 11: Project IRR (equity=100%) curve for Integrated Renovation in Lithuania 11

Figure 12: Project IRR (equity=100%) curve for HVAC Plant in Spain 11

Figure 13: Project IRR (equity=100%) curve for Integrated Renovation in the Netherlands 12

Figure 14: Risk of Building Fabric Measures, Refrigeration and HVAC Plant across Triple-A's case study countries 19

Figure 15: Risk of Integrated renovation, Cooling, Heating and Lighting across Triple-A's case study countries 19

Figure 16: Risk of Motors, Compressed Air, Waste Heat and Pumps across Triple-A's case study countries 20

Figure 17: Investors profiles participated in the stakeholder consultation process 22

Figure 18: Distribution of responses (%) per country 23

Figure 19: Distribution of the answers at the low-risk class 24

Figure 20: Distribution of the answers at the medium-risk class 25

Figure 21: Distribution of the answers at the high-risk class 25

Figure 22: Distribution of the answers about the holding period (years) 26

Figure 23: Project IRR acceptance curves for the Institutional and Retail investor profiles 28

Figure 24: Project IRR acceptance curves for the Impact investor and ESCO 28

Figure 25: Project IRR acceptance curve for the Fund investor profile 29

Tables

Table 1: Evaluated Risk Categories and Factors 14

Table 2: Rebound Effect Classification 15

Table 3: Rebound effect risk and risk value per project type 15
Table 4: Technical Complexity Classification 16
Table 5: Technical complexity risk and risk value per project type 16
Table 6: Energy prices and taxes volatility risks per Triple-A's case study country 17
Table 7: Weak economic environment risk per Triple-A's case study country 18
Table 8: Summary of the investor's preferences 27
Table 9: Eligible project types for Institutional investors 30
Table 10: Eligible project types for Retail investors 31
Table 11: Eligible project types for ESCOs 32
Table 12: Eligible project types for Impact investors 33
Table 13: Eligible project types for Funds 34
Table 14: Summary of non-eligible project types per investor profile 35
Table 15: Summary of high profitability project types (above 30%) 35
Table 16: Summary of low profitability project types (below 10%) 36

Glossary

APT:	Arbitrage Pricing Theory
CAPM:	Capital Asset Pricing Model
CPI:	Consumer Price Index
CSR:	Country Specific Risk
CV:	Coefficient of Variation
DCF:	Discounted Cash Flow
DEEP:	De-risking Energy Efficiency Platform
EE:	Energy Efficiency
EEMs:	Energy Efficiency Measures
ESCO:	Energy Service Company
HVAC:	Heating, ventilation, and air conditioning
IRR:	Internal Rate of Return
NPV:	Net Present Value
OECD:	Organisation for Economic Co-operation and Development
PSRS:	Project and Sector-Specific Risk
WACC:	Weighted Average Cost of Capital
CoC:	Cost of Capital
IRR:	Internal Rate of Return
SDR:	Social Discount Rate
O&M:	Operation and Maintenance

Executive Summary

In the field of Energy Efficiency (EE) investments, plenty project ideas exist of which only a fraction is being financed, mainly either because project developers are not experienced enough in the respective procedures or they do not have the capacity or resources to persuade investors. Investors, on the other hand, lack a set of reliable EE-based criteria for the assessment and identification of the most attractive EE projects. This is the second fundamental challenge that hinders the implementation of EE projects. The Triple-A scheme tries to cover such gaps by making EE investments more transparent, less risky and, thus, more attractive for investors and financing players.

Cost of capital is a key indicator affecting investment decisions, signifying the investors' desired rate of return at different risk levels. The higher the implied risks are, the higher the cost of capital is, and thus the less profitable the investments become. In addition, the cost of capital is a crucial parameter for financing institutions in the decision-making process of investment selection. A high cost of capital indicates a high risk associated with a firm's operations, and, thus, investors tend to require an additional return to neutralise the additional risk. This is the case especially during an economic crisis, such as the current one triggered by the COVID-19 pandemic, with investors asking for higher returns to be compensated for the additional uncertainty.

The current report aims to estimate the cost of capital of EE investments from the investor's point of view, overcoming the difficulties in estimating the cost of capital from the project's side due to the shortage of information on critical parameters and subjectivity. It also aims to identify the project types at case study countries that serve the investors' preferences.

EE projects performance presents a turning point related to the entailed EE technology, from which it starts to improve at a slow rate for every additional year of investment, where investors could regard this point as their optimal holding period. Moreover, the macroeconomic risk has a significant influence on the total risk of an EE project. The investor profiles analysed in the context of the current report present different preferences at each risk class, as well as a different attitude towards taking higher risk, something that can be observed from the project IRR acceptance curves constructed per investor profile in the presented report. EE project types of the Industrial sector financially outperform the Building sector's corresponding ones, producing greater profitability for investors.

The findings of this report will be enhanced by the ongoing stakeholder's consultation and incorporated in the Triple-A methodology. In particular, they will be incorporated into the Triple-A Tools[1] for benchmarking the performance of the examined EE projects, as well as reported by the Triple-A Web-based Database[2].

[1] Standardised Triple-A Toolbox: http://toolbox.aaa-h2020.eu/

[2] Web-based Database on Energy Efficiency Financing: https://aaa-h2020.eu/database

1 Introduction

The 'gap' that the Triple-A scheme tries to cover lays in the development phase of Energy Efficiency (EE) investments, where plenty of project ideas exist. Unfortunately, many of them tend never to get financed for various reasons. In fact, too often, project developers do not have the right expertise or resources to make a convincing financing case for investors, not to mention that most of the banking sector does not adopt energy-efficiency-based criteria for financing the most attractive projects.

Triple-A, trying to address this challenge, has adopted a very practical result-oriented approach which is incorporated in the Standardised Triple-A Tools[3]. The Tools have been designed to support project developers, bankers, and financers, enabling them to check the European Union Taxonomy compliance, assess the actual risk and benchmark their EE projects' estimated performance. The Tools could be used not only to benchmark projects, but also to receive a suggested portfolio of already benchmarked Triple-A projects parameterised to each user's needs.

In addition to the Triple-A Tools, the Triple-A Interactive Web-based Database[4] is available, providing interactive maps and graphs that display the results of the Triple-A risks assessment on EE investments in the following eight case study countries: Bulgaria, Czech Republic, Germany, Greece, Italy, Lithuania, Spain and the Netherlands.

Access to capital is critical to support energy investments (IEA, 2019). However, countries with less developed financial systems face difficulties in attracting investors' capital. In particular, in 2018, one-third of energy investments were concentrated in areas with well-developed financial systems and easy access to foreign capital. The quality of a financial system could be evaluated through capital availability from private institutions, liquidity of capital markets, and access to domestic and foreign sources, complemented by limited public finance (IEA, 2019). Moreover, in advanced economies, the cost of capital ranges to lower rates due to the favourable monetary conditions, improved technology maturity and policies supporting reliable cash flows (IEA, 2020).

The assessment of EE projects' entailed risks, which can endanger their successful implementation, comprises an essential step towards creating a safer environment for investors. Cost of capital, being closely related to the risk that EE projects present, is a key indicator affecting investment decisions (European Commission, 2018). From the investor's side, it signifies the investors' desired rate of return and subsequently how risk-averse they are, while its main use is in discounting the future cash flows (Deloitte, 2014). Higher risks lead to higher required returns by investors and thus lower profitability for projects (KPMG, 2018).

The cost of capital could be classified into the financial discount rate and the social discount rate (European Commission, 2018). The financial discount depicts the opportunity cost of capital, i.e., what is the loss of selecting to invest in one project over another? On the other hand, the social discount rate (SDR) reflects society's view regarding the present value of potential future benefits and costs that may arise in the context of an EE project. The presented study focuses on the financial discount rate, which is the one that signifies the investors' preferences. Investors usually evaluate the profitability of an EE project and subsequently whether they will provide their capital or not considering one or more financial indicators, such as the Internal Rate of Return (IRR), Payback period (PBP), Net Present Value (NPV), benefit / cost ratio (BCR), etc. The discounted value of the future net cash flows indicates their present value, being a measure of the market value of a business or asset. In that way, various present values

[3] Standardised Triple-A Toolbox: http://toolbox.aaa-h2020.eu/

[4] Web-based Database on Energy Efficiency Financing: https://aaa-h2020.eu/database

could be compared to one another to identify the most profitable business or asset, including the alternative of "doing nothing" (EY, 2016).

Considering the crucial role that investors could play in upscaling EE investments, and the degree to which cost of capital affects their decisions, it is of paramount importance to analyse the values that cost of capital could take, as well as the factors that affect it, such as technical and macroeconomic risks. However, cost of capital calculation is considered a rather difficult exercise, mainly since subjectivity is implied in the Cost of Equity estimation (PWC, 2020). In addition, the current macroeconomic environment presents extreme particularities, such as the historical lows of interest rates (EY, 2018).

Under this context, the present document's primary goal is to report the Triple-A methodology on Cost of Capital estimation of EE projects across case study countries. Specifically, this report aims to estimate the cost of capital of EE investments based on investors' preferences, overcoming difficulties related to the cost of capital's estimation from the project's point of view and incorporating innovative means of financing. Moreover, the current report aims to shed some light on which project types across the Member States could be regarded as eligible for investors to provide their capital. In particular, the research questions that the current report answers could be summarised as follows:

- What is the minimum required return per investor profile and across different risk levels?
- What project types achieve better performance than the minimum one required by investors to provide their capital?

In particular, the analysis begins with constructing IRR curves that depict how the IRR varies over different time horizons of investments using successfully implemented EE projects from the DEEP platform as an input, as well as EE projects gathered during Triple-A implementation. As a next step, the risks of the EE project types in the case study countries are assessed and classified based on their total risk over three classes: (i) low-risk projects, (ii) medium-risk projects, and (iii) high-risk projects, enabling their linkage with the investors' preferences. The investors' preferences are collected via a stakeholder's consultation, mainly targeting EE experts and investors. In this way, the investors' preferences in terms of expected rates of return at different risk levels (low, medium, and high) and holding period of investment are collected. Finally, the performance of successfully implemented project types across case study countries is compared to the investors preferences to identify the profitable ones. The results of the presented study will be incorporated into the Triple-A methodology for benchmarking the performance of the examined EE projects, as well as will be included in the Triple-A database.

Apart from this introductory section, the rest of the report is organised across five sections. Section 2 presents the overview of the methodology followed within the context of the current report. Section 3 presents the data of successfully implemented EE projects across case study countries, along with their financial performance in terms of project IRR. Section 4 describes the methodology followed for the risk assessment of the project types analysed in Section 2, while Section 5 presents the approach used for the calculation of the cost of capital of EE investments across Triple-A case study countries, as well as the results arisen. Finally, Section 6 concludes the report and presents future ways that the outcomes of the current report could be utilised in the context of Triple-A.

2 Overview

In the above context, Figure 1 depicts the flowchart of the whole methodology adopted within the presented report to estimate the cost of capital of EE projects across case study countries for the case that all the capital is leverage by investors and identify the profitable EE projects that serve the investors' requirements. In particular, it shows the basic steps conducted, as well as the key inputs and outputs of each step.

The first step of the current report is the analysis of the successfully implemented EE projects across case study countries (step **A**). The data are extracted from the De-risking Energy Efficiency Platform (DEEP), and the EE projects gathered in the context of Triple-A. This analysis's output is the construction of the project IRR (equity=100%) curves that depict how the project IRR varies over different time horizons of investments. The risks of these project types are assessed and classified (step **B**) to connect them with the investor's preferences in terms of the minimum required return, since different returns are required at different risk classes. The risk assessment is based on the **Deliverables 3.2: "Final Report on Risks of Energy Efficiency Financing and Mitigation Strategies Typology"**[5], **4.1: "Draft Standardised Triple-A Tools"15**[5] and **4.2: "Final Standardised Triple-A Tools"**[5], while also is adapted to the particularities of the current study. The minimum required return and the holding period per investor profile are estimated through stakeholder consultation, implemented via an online questionnaire (step **C**, **D**). The minimum required returns account for the case that debt is not involved, being by that way equivalent to the cost of capital and comparable with the project IRRs (debt=0%). Then, the minimum required returns arisen are compared to the project's IRR for each investor profile's holding period to identify the profitable investments across case study countries (step **E**). The primary input of this step is the IRR curves (output of step **A**), the risk assessment (output of step **B**) and the investors' preferences in terms of required return and holding period (outputs of **steps C, D**). In the case that the project IRR is greater than the minimum accepted project IRR required by the investor at the holding period, the project is considered as eligible, while on the contrary, when the project IRR is lower than the minimum accepted project IRR by the investor, the project is classified to the rejected projects.

[5] Available online at https://www.aaa-h2020.eu/results

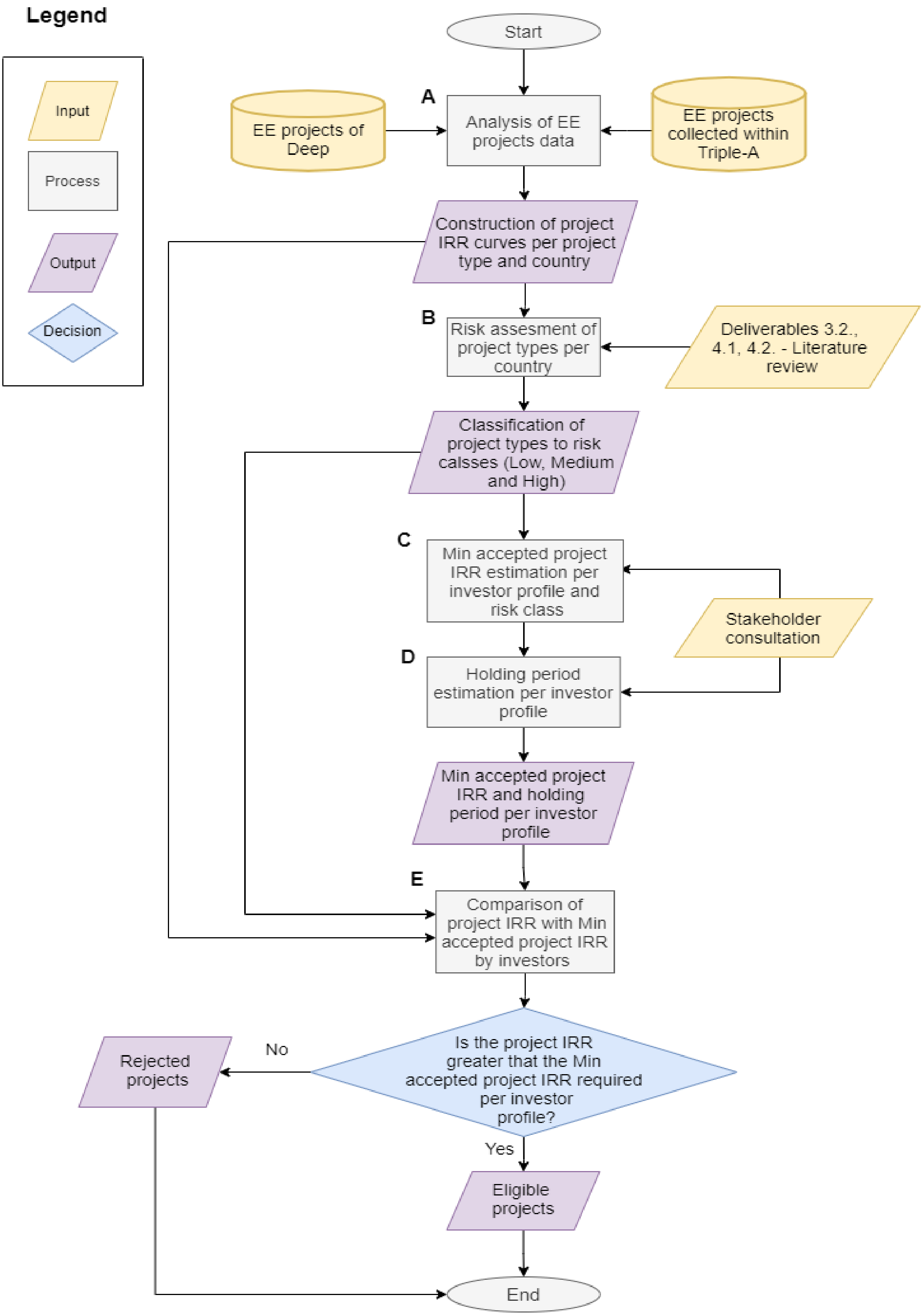


Figure 1: Flowchart of the methodology followed

3 Energy Efficiency Projects Data

The data of successfully implemented EE projects in the under-examination countries are analysed, in order to evaluate their performance and subsequently identify the project types which achieve performance greater than the cost of capital, i.e., the eligible project types for investors to provide their capital, based on the minimum accepted project IRRs per investor profile that will be arisen. The EE projects' data are extracted from the DEEP [6] database, while also some additional projects collected in the context of Triple-A are utilised. As a result, the data of 4860 EE projects in total are analysed.

The DEEP is an open-source database for EE investments performance monitoring and benchmarking, and it contains data about EE projects that belong either to the Building (7767 projects) or Industry (9421 projects) sector. The project types of the Building sector include the (i) Building Fabric Measures, (ii) Heating, Ventilation, and Air Conditioning (HVAC) plant, (iii) Lighting, and (iv) Integrated Renovation, while the corresponding ones of the Industry sector are composed of the (i) Compressed Air, (ii) Cooling, (iii) Heating, (iv) Motors, (v) Pumps, (vi) Waste Heat (without power generation), and (vii) Refrigeration. Moreover, the projects are classified based on the country that they took place, while for our analysis, only the case study countries are examined. The DEEP reports the performance of EE projects in terms of PBP (years), avoidance cost (Eurocent/ kWh), total investment cost (EUR), annual cost savings (EUR/ (m^2*year), IRR, NPV, and CO_2 savings. The projects' financial performance could be captured through the IRR, indicating the project's profitability, depicting the annual rate of growth. In particular, the IRR is the discount rate that makes the NPV equal to zero (United Nations, 2015):

$$NPV = 0 = \sum_t \frac{CF_t}{(1+IRR)^t} = -I_o + \sum_{t=1}^{n} \frac{R_t - O\&M_t - T_t}{(1+IRR)^t} \quad (1),$$

where:

- CF_t corresponds to the project's annual cash flows,
- I_o corresponds to the project's total investment cost,
- R_t corresponds to the project's annual cost savings,
- $O\&M_t$ corresponds to the project's annual operation and maintenance costs,
- T_t corresponds to the project's annual corporate taxes.

For the calculation of IRR, the total investment cost and annual cost savings available in DEEP are used since O & M costs and corporate taxes are not provided in DEEP. Thus, the presented IRR results indicate somewhat optimistic profitability of the analysed EE projects, since in case that the O & M costs and corporate taxes were incorporated in the calculations, then the projects' profitability would be decreased. It has to be noted that none interest payments are included in the projects' cash flows. Therefore, the calculated IRR accounts for the project IRR, i.e., the IRR for the case that the whole capital is leveraged by equity (i.e., investors). This fact motivates the methodology adopted towards calculating the cost of capital of EE projects (Section 5).

The DEEP calculates the projects' IRR based on the average life of the measure implemented in each case. However, what is crucial for capital providers is the holding period of the investment, i.e., the years that the investors accept to hold their money on an investment before earning the required return (Netherlands Enterprise Agency, 2018). Different holding periods of investment imply a distinct required

[6] The De-risking Energy Efficiency Platform (DEEP) can be accessed online at http://deep.eefig.eu

return by investors, who may not accept holding their money for the whole horizon of an EE project, irrespective of the return achieved, and reject it.

For the EE project types analysed, the IRR curves are constructed, depicting how the project IRRs vary over the different time horizons of the investments. Each curve presented starts from the year that the investment becomes profitable (IRR>0), i.e., from the time the project cash flows surpass the investment's initial cost. In each curve, the type of measure and the country that the project is implemented in is shown at the top of the diagram, while the number of projects from which each curve has been derived is shown in parenthesis. The median operator is used to aggregate each project type's data at a specific country to handle the outliers that exist in the data.

It should be noted that for some case study countries, no data about EE projects implemented were available, such as for Greece. As a result, these countries are not covered in this section. Moreover, for other case study countries, such as the Czech Republic, only a negligible or small amount of data was available. For the first case, the data were excluded from this analysis to ensure the results' reliability. For the latter case, the data were compared with project types for which a significant amount of data is available, such as with project types from Germany, to inspect the data quality and assure that the data can be considered interpretable and reliable. In case that this requirement was not served, the data were excluded from the analysis. However, in the future, the current analysis is going to be expanded, incorporating project types from all the case study countries, while they will be reported at the Triple-A database.

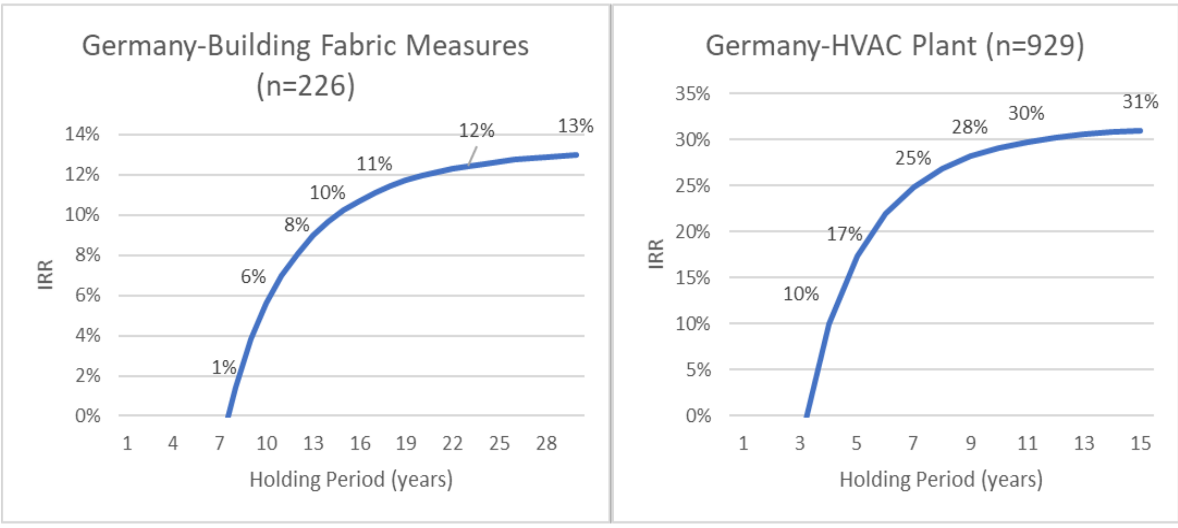


Figure 2: Project IRR (equity=100%) curves for Building Fabric Measures and HVAC Plant in Germany

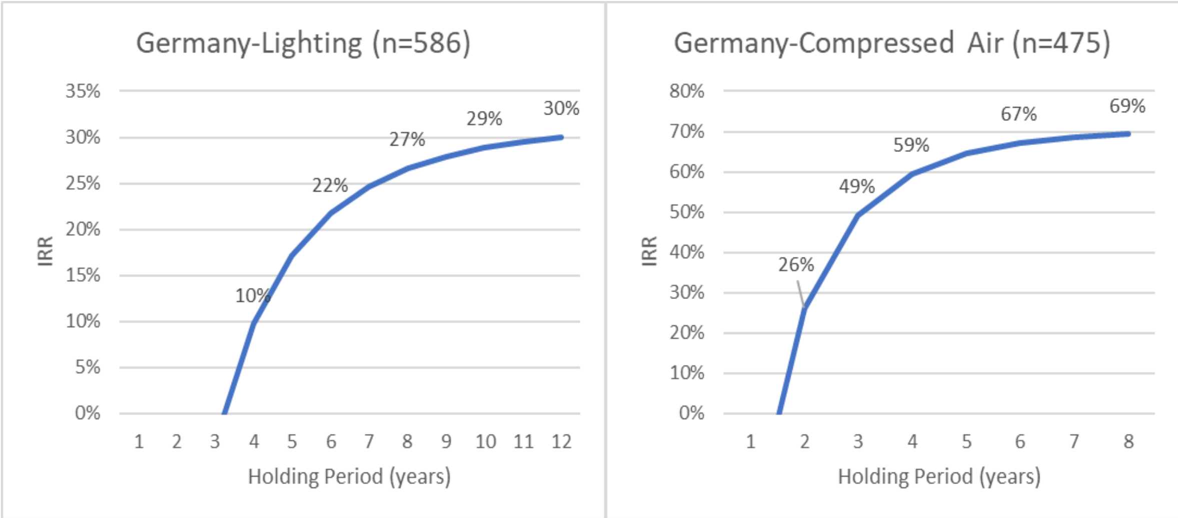


Figure 3: Project IRR (equity=100%) curves for Lighting and Compressed Air in Germany

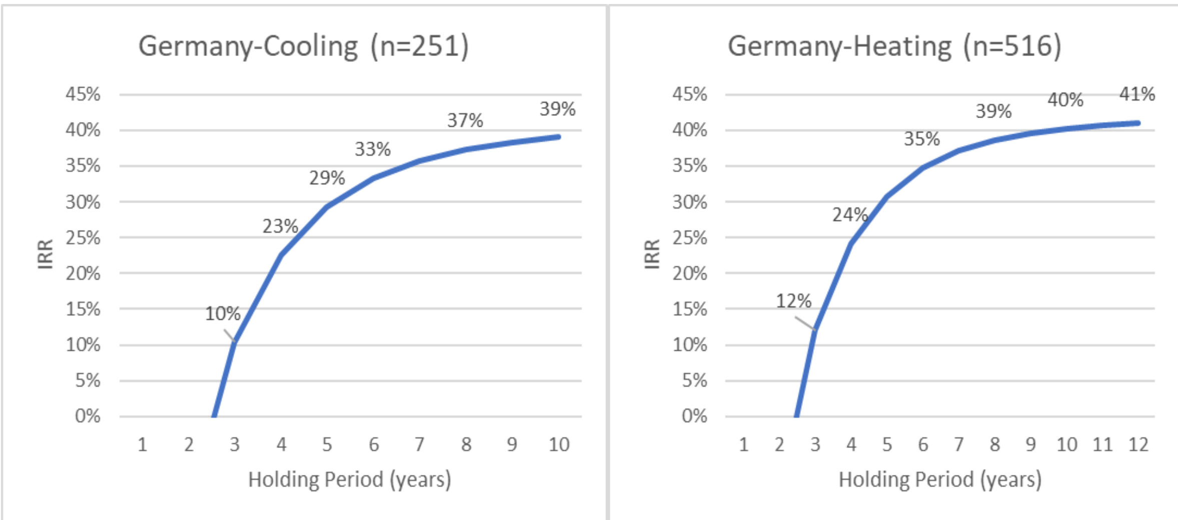
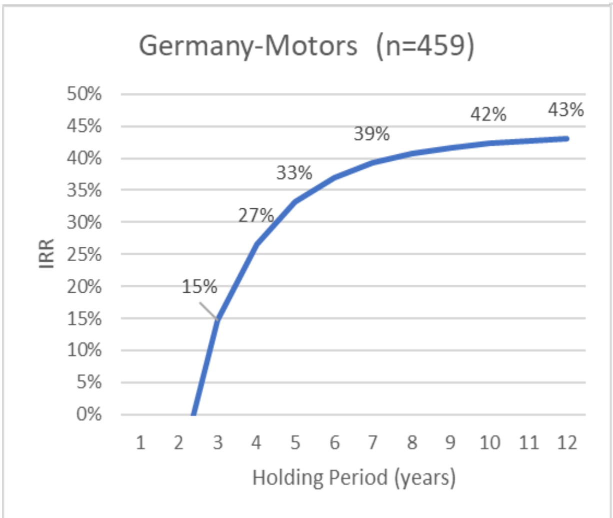


Figure 4: Project IRR (equity=100%) curves for Cooling and Heating in Germany



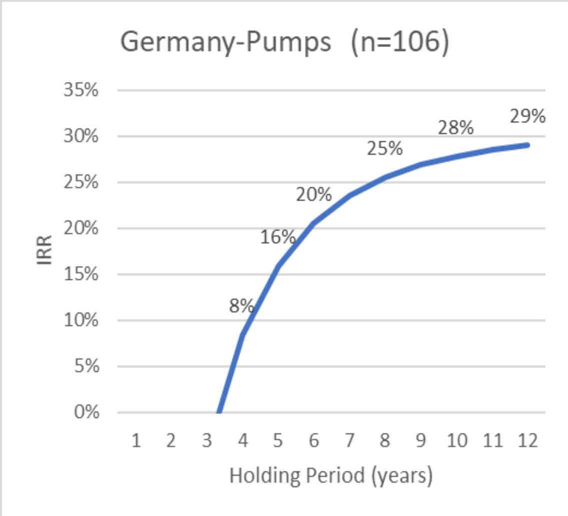


Figure 5: Project IRR (equity=100%) curves for Motors and Pumps in Germany

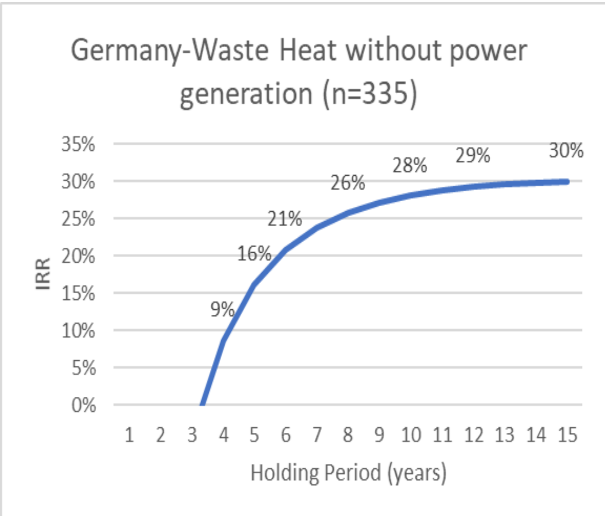


Figure 6: Project IRR (equity=100%) curve for Waste Heat without power generation in Germany

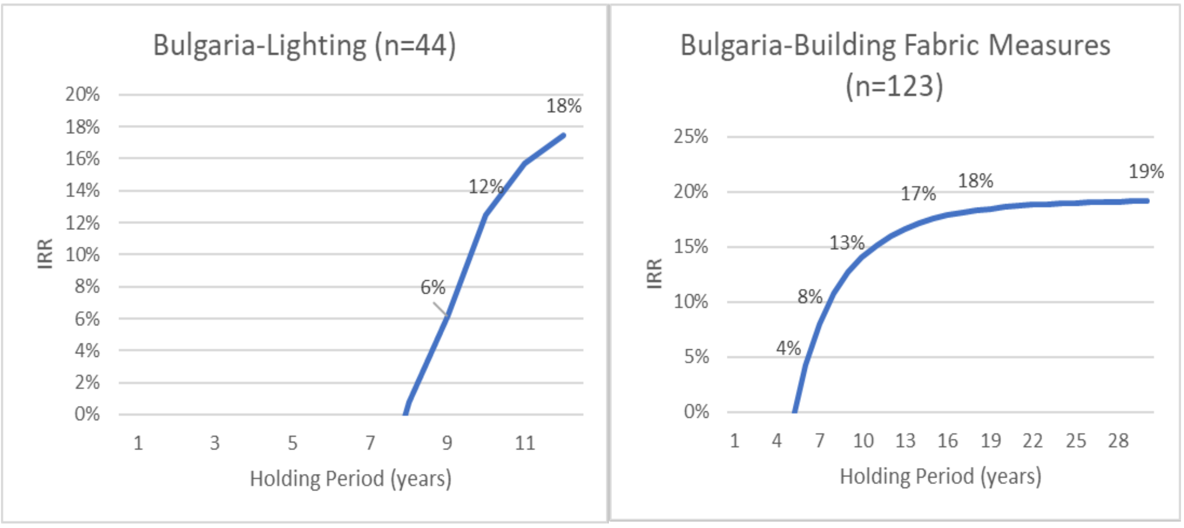


Figure 7: Project IRR (equity=100%) curves for Lighting and Building Fabric Measures in Bulgaria

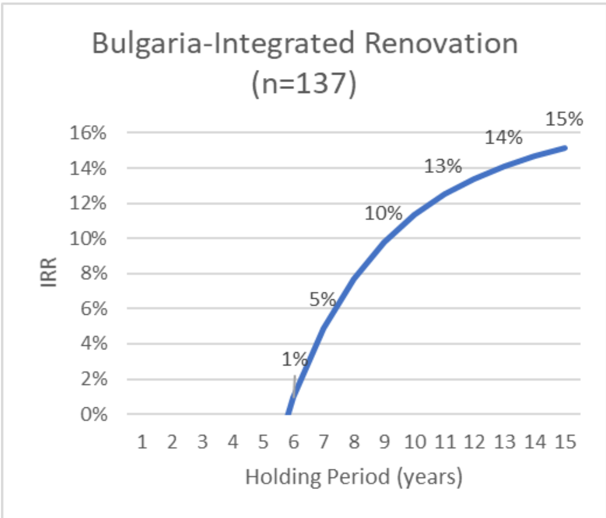


Figure 8: Project IRR (equity=100%) curve for Integrated Renovation in Bulgaria

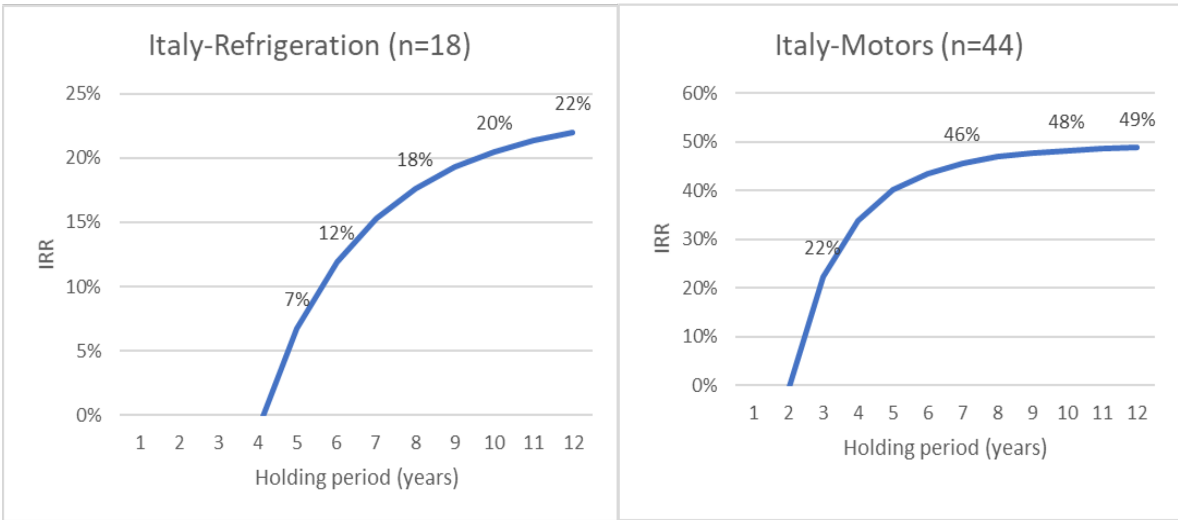


Figure 9: Project IRR (equity=100%) curves for Refrigeration and Motors in Italy

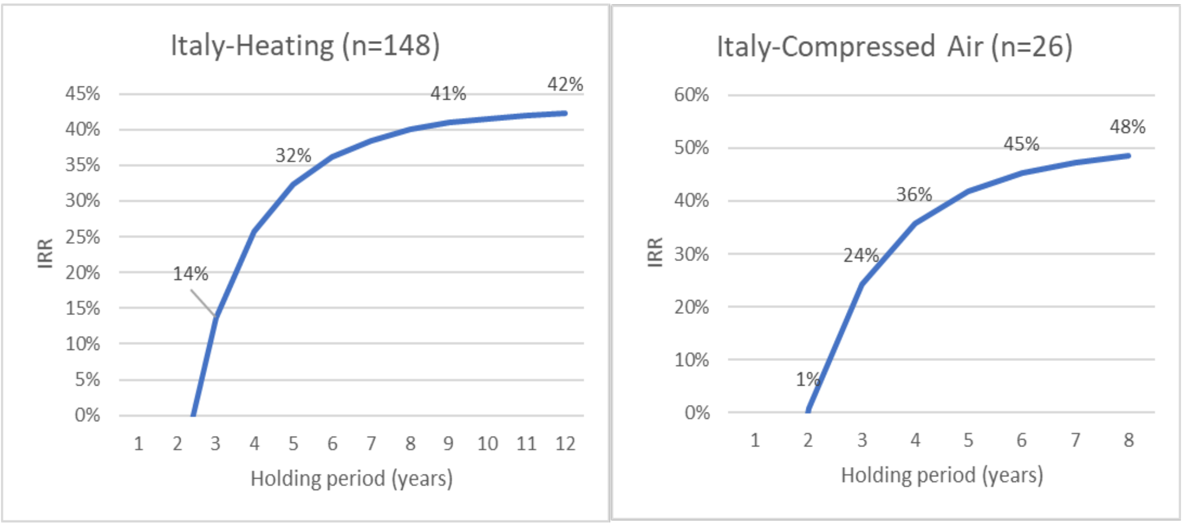


Figure 10: Project IRR (equity=100%) curves for Heating and Compressed Air in Italy

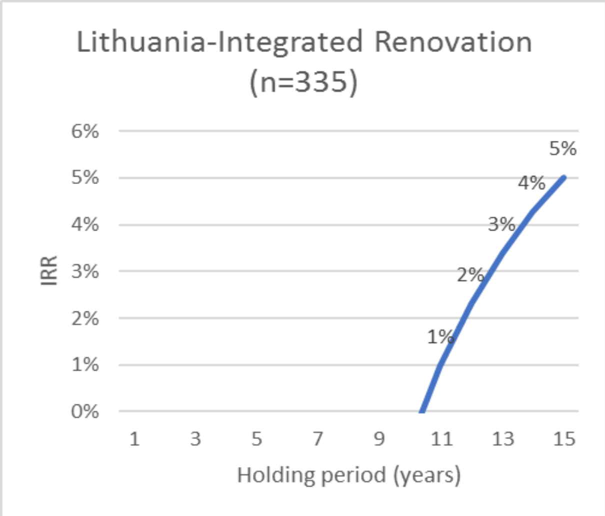


Figure 11: Project IRR (equity=100%) curve for Integrated Renovation in Lithuania

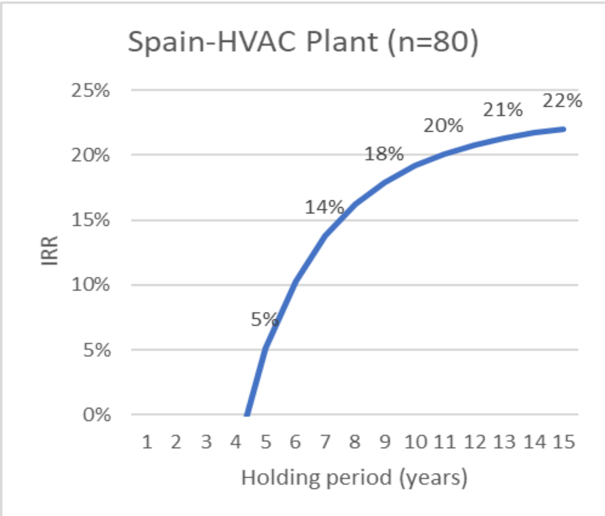


Figure 12: Project IRR (equity=100%) curve for HVAC Plant in Spain

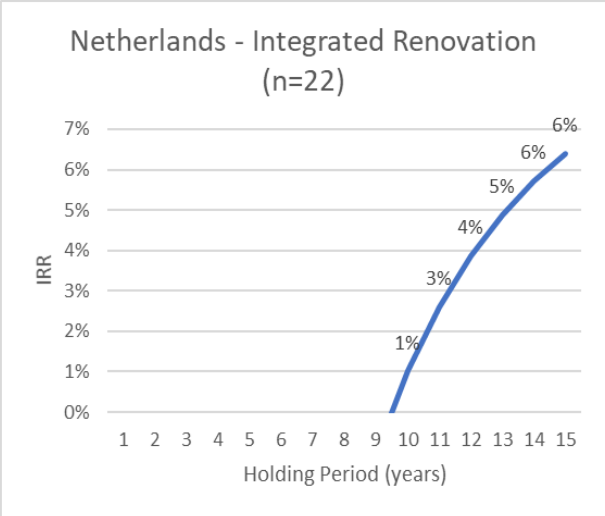


Figure 13: Project IRR (equity=100%) curve for Integrated Renovation in the Netherlands

As it could be noticed, EE projects of better financial performance in terms of IRR, start being profitable in the first years of the project, becoming by that way more attractive for investors. On the other hand, projects of worse financial performance, delay generating profitability for investors and thus may be rejected. For example, Compressed Air in Germany, as it stands for 475 successfully implemented projects on average, becomes profitable only after the first year of the project, achieving an IRR of 69% at the end of the project's life (8 years). On the other hand, Integrated Renovation in Lithuania, becomes profitable after the ninth year of the project, achieving an IRR of only 5% at the end of the project (15 years). In general, Industrial project types financially outperform the project types of the Building sector, achieving profitability earlier on the project life cycle.

An important outcome that could be derived from the above curves, is that the majority of project IRR curves present a turning point, from which the project's financial performance starts to hardly improve, closely connected to the EE technologies implemented within the project. At projects of bigger project life (such as Building Fabric Measures), the period after the turning point is longer, with the curve becoming particularly static and achieving a negligible improvement for an additional year of investment. Thus, investors should withdraw their capital at the project IRR curves' turning point even though their accepted maximum holding period may be served and the projects still being profitable for them, since an opportunity cost is probably incurred. That said, it would be more profitable for investors to direct their money to other EE projects rather than keeping their money on the investment. The only curves that do not present turning points are the projects that delay to present profitability, such as the Integrated Renovation in Netherlands. Therefore, the turning points of the project IRRs could be regarded as the optimal holding period for investors.

Moreover, another point of interest could be to inspect how the financial performance of projects is affected at projects that their life duration exceeds the life of the entailed technology. In these cases, a reinvestment on the entailed EE technology is required. However, based on the available information at the presented report such an analysis is not possible, since more information is required, such as which specific measures each project type involves, since the reported categories of the project types analysed are rather general and the specific technology life cannot be estimated. Thus, it remains a subject for future examination.

Finally, the differences presented between the same technologies across case studies can be explained either from the different energy prices, the different climatic conditions, especially for the measures of the Building sector, and from aspects related to the technology implemented, such as the availability of the required technology, its quality, the skills and experience of the involved technical staff etc. The latter especially applies for the projects of the Industry sector where their implementation entails the utilisation of more advanced technology compared to the projects of the Building sector.

4 Risk Assessment

Since the required returns by investors are risk dependent, higher rates of return are required for projects of higher entailed risk (Deloitte, 2014). Thus, the profitability of investments can differ dramatically across energy sectors, due to the different implied risks (IEA, 2019). In order to connect the minimum required project IRRs that will be derived to the EE project types analysed, their total risk of failure is calculated, i.e., the risk of failing to meet their projected performance, due to the technical risks associated to the project type implemented and the macroeconomic risk connected to the country that the project takes place.

The risk factors considered to evaluate the EE project types analysed in the current report are presented in the **Deliverable 3.2: "Final Report on Risks of Energy Efficiency Financing and Mitigation Strategies Typology"**[7]. In order to assess these risk factors, the Triple-A "Assess" methodology presented in the **Deliverable 4.1: "Draft Standardised Triple-A Tools"**[7] and **Deliverable 4.2: "Final Standardised Triple-A Tools"**[7] is employed after making the necessary modifications in order to adapt it to the particularities of the current study.

In the above context, the risks taken into consideration are the Sector and Project-category specific ***(PSRS)*** and the Country-specific ***(CSR)*** ones. ***PSRS*** risk factors depend on the sector of the project type and the EEMs implemented within its context, while ***CSR*** risk factors depend only on the country where the project takes place. The other risk factors are eliminated since they depend on the particularities that each project presents, i.e., they are evaluated at a project-level by receiving information from the persons in charge of managing them. Therefore, given that each project type considered in this study is aggregated over a number of projects of the same type implemented in the same country, this information is not available, and these risk factors are not applicable for the present analysis. The risks considered are presented in Table 1, along with the category that they belong to.

Table 1: Evaluated Risk Categories and Factors

	Risk Categories			
Risk Factors	**Behavioural**	**Energy Market & Regulatory**	**Economic**	**Technological, Planning and Operational**
Rebound effect ***(PSRS)***	✓			
Energy prices and energy taxes volatility ***(CSR)***		✓		
Weak economic environment ***(CSR)***			✓	
Technical Complexity ***(PSRS)***				✓

PSRS: *Project and Sector-specific risk,* ***CSR:*** *Country-specific risk*

[7] Available online at https://www.aaa-h2020.eu/results

Rebound Effect

This risk factor describes a specific behavioural bias, and it emerges when the implementation of an EE project leads to lower costs for energy services combined with an increase in the demand for such services (European Commission DG ENV, 2011).

To estimate the rebound effect, the values that it usually takes have been identified by reviewing several literature sources (see also Appendix A). Therefore, five risk classes have been constructed, as listed in Table 2. These classes have been linked to distinct risk levels, where a higher rebound effect value corresponds to a higher risk.

Table 2: Rebound Effect Classification

Rebound effect scale	Risk - Risk value
< 12,5%	Insignificant – 0
≥ 12,5% & < 25%	Low – 0.25
≥ 25% & < 37,5%	Medium – 0.5
≥ 37,5% & < 50%	High – 0.75
≥ 50%	Very high – 1

Next, each project type considered in this analysis is assigned to one of these classes, based on the rebound effect that is usually presented within its context. In that regard, Table 3 presents the rebound effect risks assigned to the project types considered in our analysis. At the "Integrated Renovation" project type which could contain all the other project types of the Building sector, the highest value presented in the individual project types of the Building sector (i.e., Building Fabric Measures, HVAC Plant and Lighting) has been assigned, since the whole project could fail if one of the entailed project types failed.

Table 3: Rebound effect risk and risk value per project type

Project types	Risk - Risk value
Building Fabric Measures	Insignificant-0
HVAC Plant	Low-0.25
Lighting	Insignificant-0
Integrated Renovation	Low-0.25
Compressed Air	Insignificant-0
Cooling	Low-0.25
Heating	Low-0.25
Refrigeration	Insignificant-0
Motors	Insignificant-0

Pumps	Insignificant-0
Waste Heat	Insignificant-0

Technical complexity of the project

This risk factor is related to the complexity of the EEMs implemented from a technological point of view, and it could affect the chances for successful project implementation by increasing the possibility that the expected energy savings will not be achieved. A list of technical complexity scores per EE project type was used for assigning risk values at scale [0-1] (Table 4) to each one after reviewing the respective literature, such as (Andreosatos & Tourkolias, 2019). Moreover, the methodology is based on stakeholder validation conducted in the context of the **Deliverables 4.1: "Draft Standardised Triple-A Tools" and 4.2.: "Final Standardised Triple-A Tools".**

Table 4: Technical Complexity Classification

Technical complexity scale	Risk - Risk value
Low complexity	Low – 0
Medium complexity	Medium - 0.5
High complexity	High – 1

Table 5 contains the technical complexity risk of the project types considered in this analysis. For the "Integrated Renovation" project type, similarly to the rebound effect, the highest technical complexity risk presented in the individual project types of the Building sector is assigned.

Table 5: Technical complexity risk and risk value per project type

Project types	Risk - Risk value
Building Fabric Measures	Medium-0.5
HVAC Plant	Low-0
Lighting	Low-0
Integrated Renovation	Medium-0.5
Compressed Air	High-1
Cooling	Medium-0.5
Heating	Medium-0.5
Refrigeration	Medium-0.5
Motors	High-1
Pumps	High-1

Waste Heat	High-1

Energy prices and taxes volatility

This risk factor is associated with the price risk in EE investments. The uncertainty about energy prices influences the decision to undertake an EE investment, as it may lead to unexpected monetary savings, and therefore, the return of the EE investment may differ from the initial estimation (Sardianou, 2008). Moreover, energy taxes are considered critical, affecting the end-use price and the EE investments' monetary savings (Hill, 2019).

In order to evaluate energy prices and taxes volatility, the methodology employed in the Triple-A “Assess” component is utilised. Based on this, the consumer price index (CPI) of the energy sector that involves both energy prices and taxes is utilised, thus enabling the evaluation of both risk factors simultaneously. The volatility of the CPI of the energy sector for each of the examined countries is measured with the coefficient of variation (CV) of monthly values (Sardianou, 2008; Mills, 2006) for the last fifteen years (01/2005-12/2019), as reported by the OECD (OECD, 2021). CV is defined as the ratio of the standard deviation σ to the mean μ, and it can be expressed as follows:

$$CV = \frac{\sigma}{\mu} \text{ (2).}$$

In order to allow for aggregation, the *CV* values arisen are converted to risk ones [0-1], as follows:

$$\frac{CV\_CPI(country) - CV\_CPI(country\_min)}{CV\_CPI(country\_max) - CV\_CPI(country\_min)} \text{ (3),}$$

where $CV\_CPI(\text{country\_max})$ and $CV\_CPI(\text{country\_min})$ are set nearly (0.01 deviation) to the coefficients of variation of the countries that present the highest and lowest volatility (Greece and Netherlands), respectively. Thus, the lowest and highest risk values tend to be, but are not equal to 0 and 1, respectively, which is more realistic from a risk analysis point of view.

Table 6 depicts the Triple-A case study countries' energy prices and tax risks by applying the methodology mentioned above.

Table 6: Energy prices and taxes volatility risks per Triple-A’s case study country

Country	Energy prices & taxes risk value
Netherlands	0.06
Germany	0.12
Italy	0.23
Czech Republic	0.27
Republic of Bulgaria	0.29
Spain	0.43

Lithuania	0.64
Greece	0.94

Weak economic environment

This risk factor is related to the poor economic conditions that may exist in the country that the EE investment takes place, incorporating all the macroeconomic risk factors that can affect the country risk, such as interest rates, inflation, availability of finance etc. (Pettinger, 2019). It can negatively influence investment in many ways, affecting the investment's profitability through inflation or KPIs through interest rates.

We evaluate this risk factor via the countries' credit ratings, as provided by Standard & Poor's (S&Ps), following the methodology employed in the Triple-A "Assess" component. A country's credit rating is an evaluation of its credit risk or probability of default (CHEN, 2020; S&P, 2020). This index is selected because S&P considers all the macroeconomic aspects of the economy for assigning the credit ratings, while also investors consider this index when deciding what country they will invest in.

The possible credit rating values that can be assigned to a country by S&Ps are the following: AAA, AA+, AA, AA-, A+, A, A-, BBB+, BBB, BBB-, BB+, BB, BB-, B+, B, B-, CCC, CC, C, D. The risk is scaled so that the risk of countries with the highest credit ratings tends to zero and the risk of the countries with the lowest credit ratings tends to 1 (for more information see the **Deliverables 4.1: "Draft Standardised Triple-A Tools"** and **4.2: "Final Standardised Triple-A Tools"**).

Table 7 contains the weak environment risks arisen for the Triple-A case study countries by implementing the approach mentioned above.

Table 7: Weak economic environment risk per Triple-A's case study country

Country	Credit rating	Risk value
Netherlands	AAA	0.05
Germany	AAA	0.05
Italy	BBB	0.47
Czech Republic	AA-	0.21
Republic of Bulgaria	BBB	0.47
Spain	A	0.32
Lithuania	A+	0.26
Greece	BB-	0.68

After calculating the risk factor values, the total risk of each project type considered is calculated by using the arithmetic mean, as follows:

$$Project\ type\ risk = mean(r_i) \quad (4),$$

where r_i: $i = 1, \ldots, 4$, are the values of the risk factors considered.

The risks of the project types considered across the Triple-A case study countries are presented in the following figures. A risk value of 0% accounts for the lowest possible risk, while a risk value of 100% for the highest one.

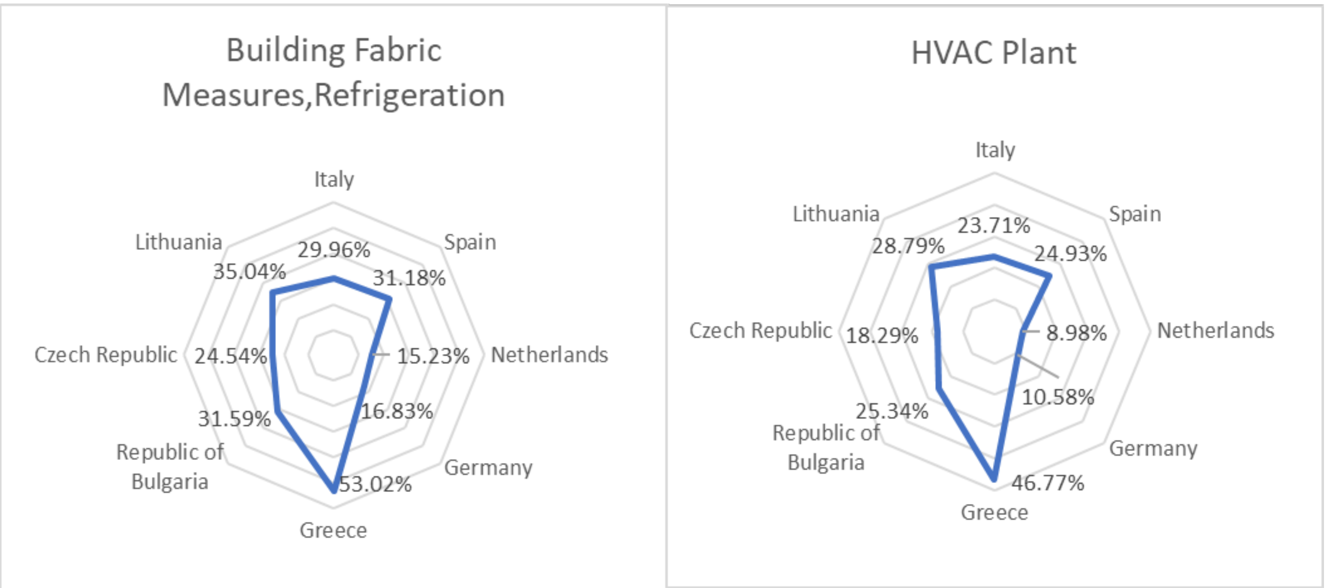


Figure 14: Risk of Building Fabric Measures, Refrigeration and HVAC Plant across Triple-A's case study countries

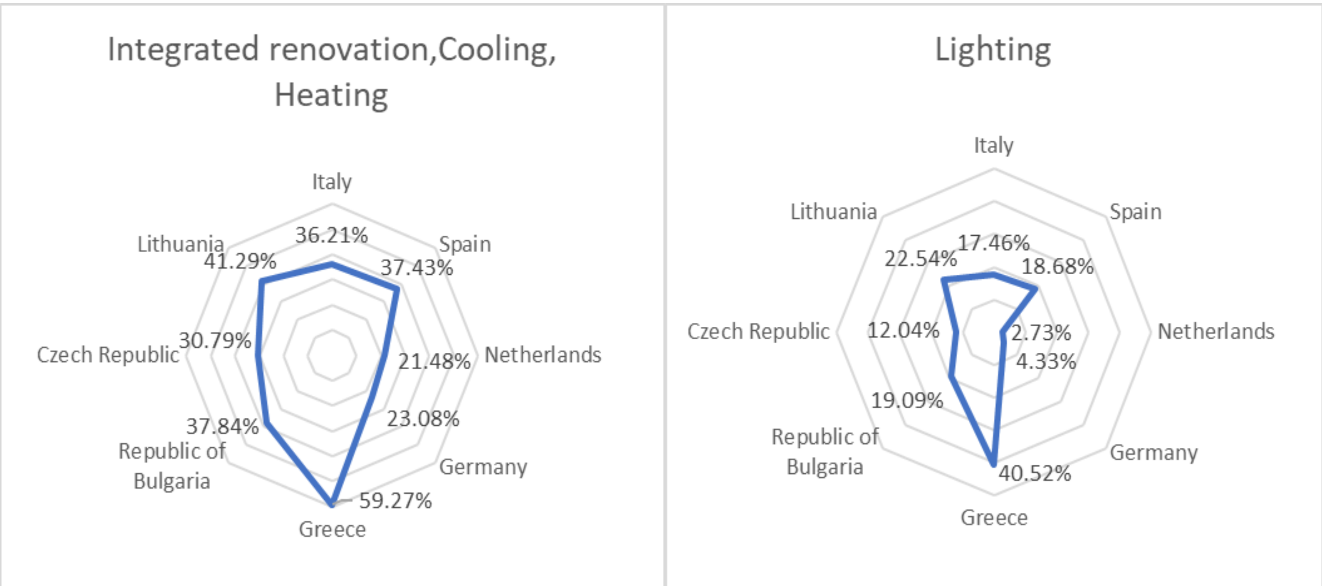


Figure 15: Risk of Integrated renovation, Cooling, Heating and Lighting across Triple-A's case study countries

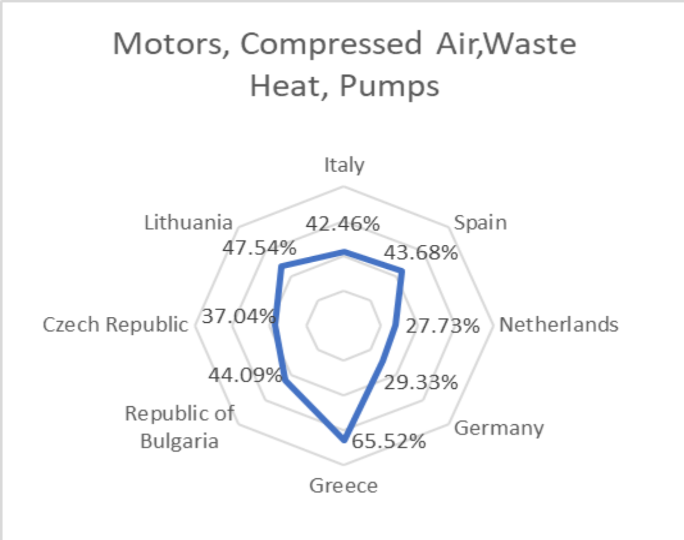


Figure 16: Risk of Motors, Compressed Air, Waste Heat and Pumps across Triple-A's case study countries

As could be observed from the graphs above, the country's macroeconomic risk in which each project is implemented plays a crucial role in the project's total risk. Countries with high macroeconomic risk (e.g., Greece), irrespective of the technical risk of the project type in question, never present low risk rates. On the other hand, in countries with low macroeconomic risk, the project risks range between low to medium rates, such as in the Czech Republic, or present low rates of risk, such as in Germany. The effect of the macroeconomic risk on the total risk of the project becomes bigger at the project types of low risk, such as in Lighting, something that can be clearly observed in Figure 15, where the divergences between the case study countries become even bigger.

In order to allow for comparisons between the project types with the required return per investor profile derived, they are classified based on their total risk into three classes: (i) the low-risk project types, (ii) the medium-risk ones, and (iii) the high-risk ones. The class of the low-risk projects accounts for risk values that belong to the [0%,33.33%) range, while the one of the medium-risk projects includes risk values that lie in the [33.33%-66.66%) range. Finally, the class of the high-risk projects accounts for risk values in the [66.66%-100%] range.

5 Cost of Capital Estimation

5.1 Approach

The common approach for calculating the cost of capital is the computation of the WACC. According to this approach, the cost of capital is calculated as the weighted average of the estimated cost of debt and cost of equity, as follows (World Bank, 2005; EY, 2020; Moreno, 2008):

$$WACC = \frac{D}{D+E} \times Cost\ of\ debt \times (1-t) + \frac{E}{D+E} \times Cost\ of\ equity \quad (5),$$

where D is the market value of debt, E is the market value of equity, and t is the corporate tax rate.

The cost of debt is usually estimated as the sum of the risk-free rate of return (r_f) and a company-specific risk premium, as follows (Deloitte, 2014; Moreno, 2008):

$$Cost\ of\ debt = r_f + Risk\ premium \quad (6).$$

According to CAPM, the cost of equity of a given company is the sum of the risk-free rate and the market risk premium ($r_m - r_f$), multiplied by b, which indicates the riskiness of a given company relative to the market, as follows (Dülk, 2012; PWC, 2008):

$$Cost\ of\ equity = r_f + b \times (r_m - r_f) \quad (7),$$

where r_m is the market return.

According to the Arbitrage Pricing Theory (APT), the cost of equity is calculated based on a multi-factor model in which the stock's return is explained by several macroeconomic factors which are considered as systematic (e.g., GDP and inflation), i.e., a risk that is inherent to the entire market reflecting the impact of economic, geo-political and financial factors, and thus cannot be diversified across sectors (Evan, 2021; CFI, 2021). The formula can be depicted as follows (IMF, 1996):

$$E(Re) = r_f + b_{i1} * F_1 + b_{i2} * F_2 + \ldots + b_{ik} * F_k + e_i \quad (8),$$

where b_{ik} is the sensitivity of the stock's return to the change of the risk factor k, and F_k is a common set of factors that influence the returns of all stocks.

Given the above definitions, it becomes evident that in order for the cost of equity of an EE project to be calculated, there must be information about its riskiness relative to the market (b parameter), while also information about the specific period of its implementation must be acquired to compare the project's performance with the market's one for the period of implementation. The first limitation of this approach is that this information is usually not available for EE projects. Moreover, the cost of equity of a project is equivalent to the cost of capital coming from investors. However, another limitation of the APT and CAPM approaches is that they do not distinguish between different investor types. Thus, given the above limitations, the computation of cost of equity with CAPM or APT methodology is considered out of scope and inappropriate for our analysis.

In contrast, in the current report, the cost of capital is calculated from the investor's side. Based on this approach, the cost of capital is the minimum required return desired by investors (Deloitte, 2014). In this way, the particularities of each type of investor are taken into consideration. Since the methodology is applied on the projects of DEEP, which do not involve any financing costs at their cash flows and thus depict the project IRR (equity=100%), banks are not involved in the investor options of the analysis presented in this report. Therefore, the minimum required return by each investor type is estimated for the case that the project is financed only by equity. Usually, EE projects are financed via a mix of debt and equity, especially those of a larger scale. However, by making this assumption that investors leverage all the capital, our results can be directly compared with the performance of the projects types analysed within the current report, for which data about their project IRR (100% equity) is available. Thus, the profitable EE projects for each investor type can be identified.

In that regard, the investors' minimum required return accounts for the minimum accepted project IRR by them to provide their capital, which is also the cost of capital of the projects if each type of investor will leverage all the capital. It is important to refer that the comparison between the investor's minimum accepted project IRR and the project IRR must take place for the maximum accepted holding period required by investors, which is usually the horizon that each investor will hold their money on an investment.

5.2 Stakeholders Consultation

A stakeholders' consultation process was implemented in order to gather investors' preferences. In particular, a dedicated for this scope online questionnaire was developed and circulated to EE experts and investors from Triple-A's case study countries. With this questionnaire, the investors' preferences in terms of the minimum required return at different risk levels (low, medium, and high) and holding period (years) of investment are gathered. These answers are given for the case that the whole project's capital is provided by equity (i.e., investors), thus allowing direct comparison with the project IRR, which does not include any financing costs. Moreover, the investor profile that would be more relevant to the answers provided by the stakeholders is asked, given that each investor type has their own preferences. The content of this questionnaire is shown in Appendix B.

In total fifty-two (52) responses were received by stakeholders, mainly investors and EE experts. The distribution of these answers with respect to the investor profiles, is presented in Figure 17.

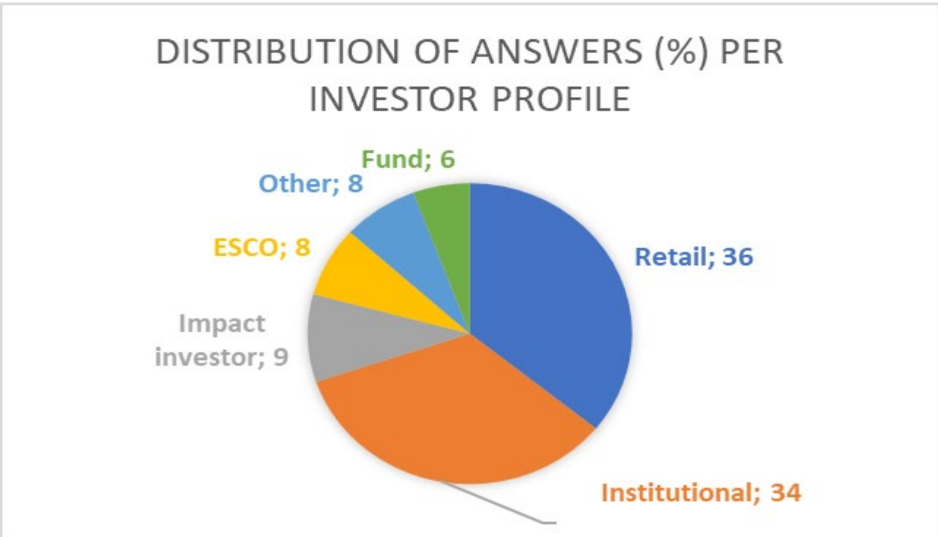


Figure 17: Investors profiles participated in the stakeholder consultation process

As indicated also in the figure above, the main investor profiles arisen include the Retail investor (36%), Institutional investor (34%), Impact investor (9%), ESCO (8%), and Fund (6%). The "other" category involves some investor categories for which only one answer was provided, such as Real estate investor and National promotional institution. These profiles are not included in the final sample to ensure the robustness of the results arisen. The majority of answers were provided for the Retail and Institutional investor profiles, suggesting confidence about the reliability of the results arisen about these two profiles.

Retail investors are individual investors who invest for themselves (non-professional investors) or have a professional take the decisions for them (Frankel, 2020; Mackintosh, 2020). On the other hand, Institutional investors comprise companies or organisations that invest money on behalf of other people (KPMG, 2021; CFI, 2021). Investments funds, pension funds, and insurance companies could be characterised as traditional Institutional investors, while hedge funds, private equity funds, sovereign wealth funds, and exchange-traded funds could be characterised as alternative profiles. Investment Funds collect capital from numerous investors to collectively purchase securities while each investor retains ownership and control of their own shares (Capital.com, 2020). Although this profile could be classified as Institutional investor profile, it was considered a distinct investor profile by stakeholders and remained a distinct category in the presented report. Impact investor profile presents the particularity compared to other profiles that it aims to achieve both social or environmental and financial targets (GIIN, 2021). A wide range of investors can belong to this profile, such as banks, pension funds, financial advisors, government investors, etc. Impact investors can be classified into two distinct categories: (i) those that have as their first priority to maximise their profit, and (ii) those that their main scope is to maximise the achieved social or environmental Impact and secondarily their profit (GIIN, 2021). ESCOs are companies that offer energy services such as implementing EE projects, while their remuneration is directly connected to the energy savings achieved within the project under implementation. ESCOs can directly finance an EE project or assist in its financing by providing a savings guarantee, for example, to a financial institution (EC, 2021).

The distribution of answers collected with respect to the country of the stakeholders is shown in Figure 18.

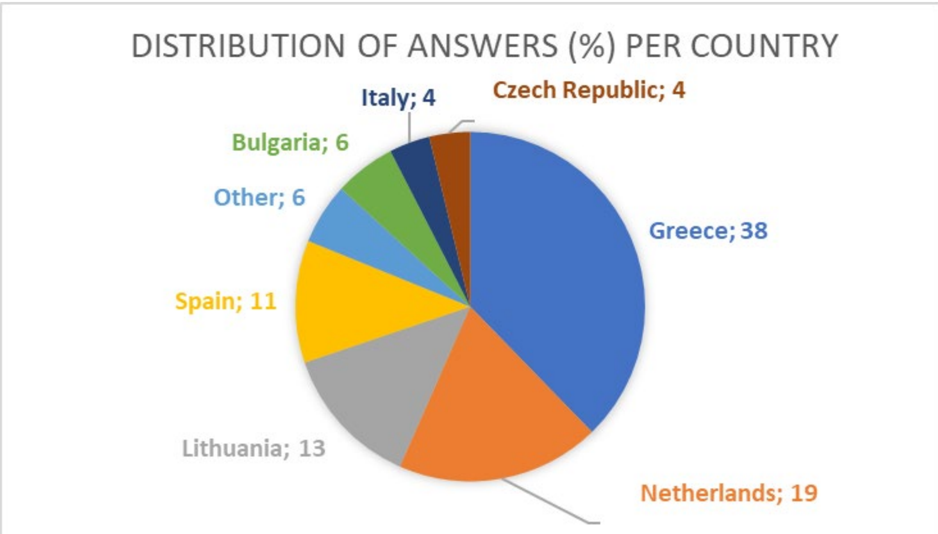


Figure 18: Distribution of responses (%) per country

Most of the answers emerged from stakeholders from Greece and the Netherlands, covering more than half of the total sample (57%). Next comes Lithuania, Spain, Bulgaria, Italy and the Czech Republic in terms of the number of stakeholders. Also, some answers were collected by stakeholders from other countries apart from the Triple-A's case study ones, such as Ireland and Switzerland. The collection of answers from most of the Triple-A's case study countries indicates the pluralism of the answers collected, decreasing by that way the sample bias of the results.

Figure 19 presents the distribution of the stakeholders' answers in terms of the minimum required return per investor profile at the low-risk level. The upper bound of the range accounts for the 75th quartile of the answers given for each profile, the 75% of the answers are below this number, and the bottom bound for the 25th quartile of the answers given for each profile, i.e., the 25% of the answers are below this number, indicating the dispersion of the answers collected.

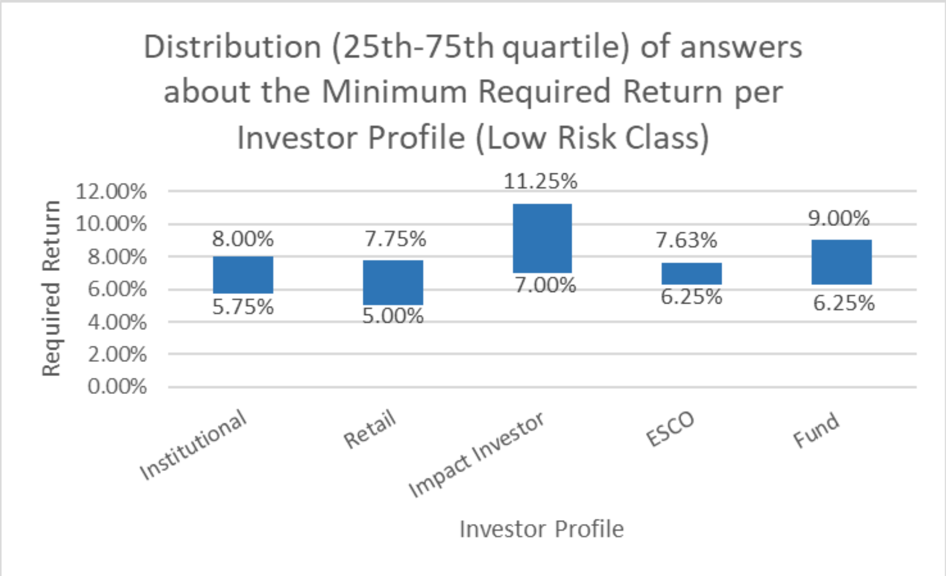


Figure 19: Distribution of the answers at the low-risk class

As seen, at the low-risk class, the Impact investor profile is the one for which stakeholders provided the highest returns, also presenting the most extensive distribution between the different answers collected. On the contrary, ESCO is the profile that presents the shortest distribution between the different values assigned to it at the low-risk class, with the other three profiles (Institutional, Retail and Fund) to present almost the same distribution of a relatively moderate level.

Figure 20 presents the distribution of the corresponding answers given by the stakeholders at the medium-risk class.

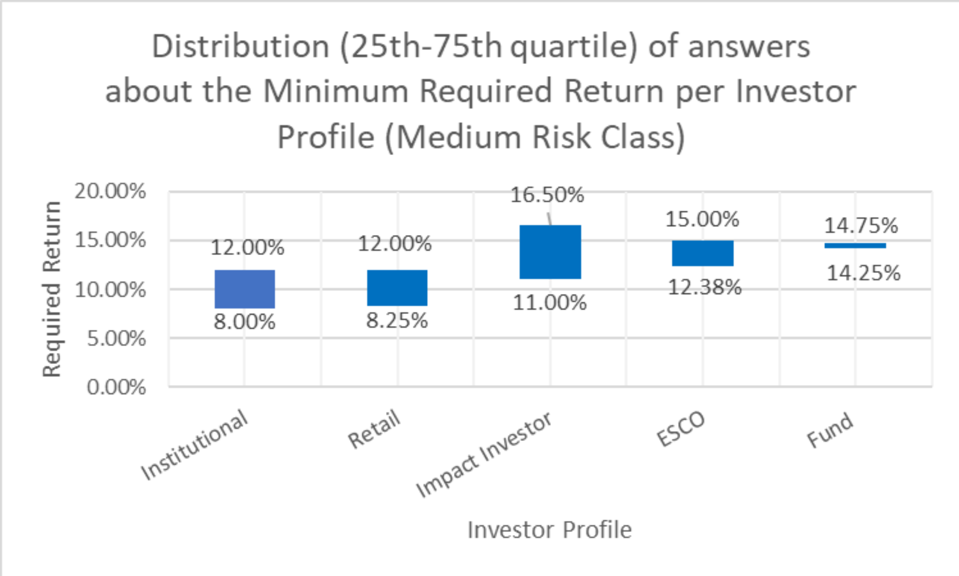


Figure 20: Distribution of the answers at the medium-risk class

Impact investors are again those who have the largest distribution of answers provided (Q3-Q1=5.5%) across the diverse investor profiles, while the Fund profile has the shortest distribution (Q3-Q1<1%). Compared to the low-risk class, the required returns have significantly increased, e.g., for the ESCOs, the bottom and the upper bounds of the range have increased by more than 90%, indicating the sensitivity of the investor profiles to risk.

Figure 21 present the distribution of the corresponding answers given by the stakeholders at the high-risk class.

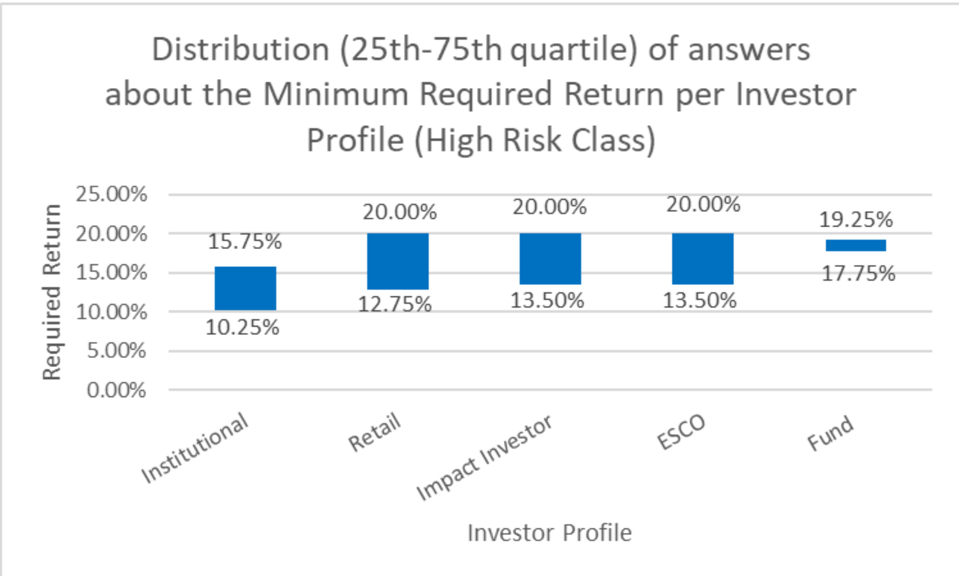


Figure 21: Distribution of the answers at the high-risk class

In the high-risk class, the answers provided for the Institutional, Retail, Impact investor, and ESCO present almost the same distribution of a rather large scale, which may indicate the dispersion of investors preferences at high risks, even of those belonging to the same profile. On the other hand, the answers provided for Funds at this risk class present the shortest distribution, something that again may relate to the smaller sample of answers provided for this profile.

Furthermore, examining the investment holding period is of crucial importance, and each investor category resulted in different holding periods. Figure 22 indicates the distribution of the answers given regarding the maximum holding period accepted by each investor type.

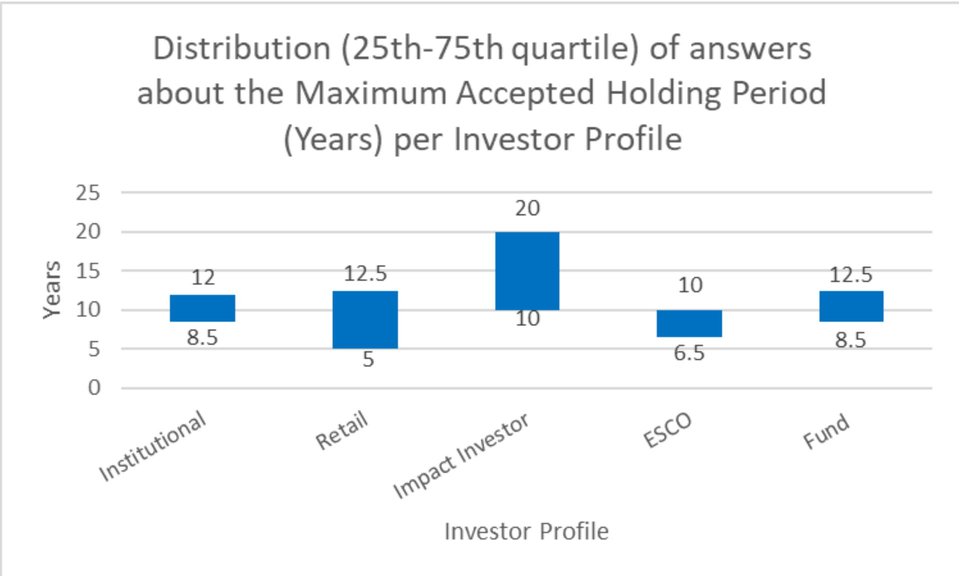


Figure 22: Distribution of the answers about the holding period (years)

As far as the maximum accepted holding period is concerned, i.e., the maximum period that each investor type accepts to hold their money on an investment, the answers provided for Impact investors present the most considerable dispersion, with the Retail investor profile coming next in terms of dispersion of answers. The high distribution of answers about the Impact investor may relate to the various categories that lie in this profile, as can be derived from its definition provided above, since some investors of this category first aim at maximising their profit and others at maximising the social or environmental Impact. The results about the other profiles present a relatively short distribution, except for Retail investors, where Q3-Q1=7.5. This also may relate to the fact that it comprises a general category including many diverge individual investor profiles.

5.3 Estimation

In order to estimate the point results about the minimum acceptable return and maximum accepted holding period desired by investors, the answers are aggregated using the median operator to handle outliers. Table 8 presents a summary of the results arisen by applying this approach.

Table 8: Summary of the investor's preferences

Investors profiles	Minimum accepted project IRR			Holding Period (years)
	Low risk	Medium Risk	High Risk	
Institutional	6%	10%	14%	10
Retail	7%	10%	18%	8
Impact Investors	9%	12%	15%	19
ESCO	7%	14%	25%	8
Fund	7%	15%	19%	10

As presented in the table above, in the low-risk class, Impact investors ask for the highest return (9%), with Retail investors, ESCOs, and Funds requiring the same return of 7%, and Institutional investor asking for the lowest return of 6%. Note that as presented in Section 4, most of the inspected EE projects lie at this risk class. Thus, the returns of this class are of particular importance. At the medium-risk class, the Institutional and Retail investors ask for the lowest return of 10%, with Funds asking the highest one (15%). The other two profiles lie in the middle of these two profiles, with Impact investors asking for 12% and ESCOs for a return of 14%. At the high-risk class, ESCOs ask for the highest return (25%), with Institutional investors asking for the lowest one (14%). The other investor profiles' required returns are between of these values with Impact investors, Retail investors, and Funds asking for 15%, 18% and 19% respectively. However, since none of the EE project types analyzed belongs to the high-risk class, the returns of this class don't present a significant interest for our analysis.

As regards the maximum accepted holding period per investor profile, Impact investors are the ones that accept to hold their money for the highest time, something that is in line with their objectives, which are not pure financial ones. Institutional investors and Funds have a holding period of 10 years, while Retail investors and ESCOs hold their money on average for 8 years. It should be noted that the holding period of ESCOs is found to be 8.5 years after aggregating values with median, thus was rounded to the lower integer.

Based on the results of Table 8, the project IRR acceptance curves are constructed, showing how the minimum accepted project IRR by each investor profile varies across the different risk levels, or in other words indicating the minimum project IRR that an EE project must achieve in order to be regarded as eligible by each investor profile. To do so, the assumption that the point results presented above are linked to a linear fashion was made.

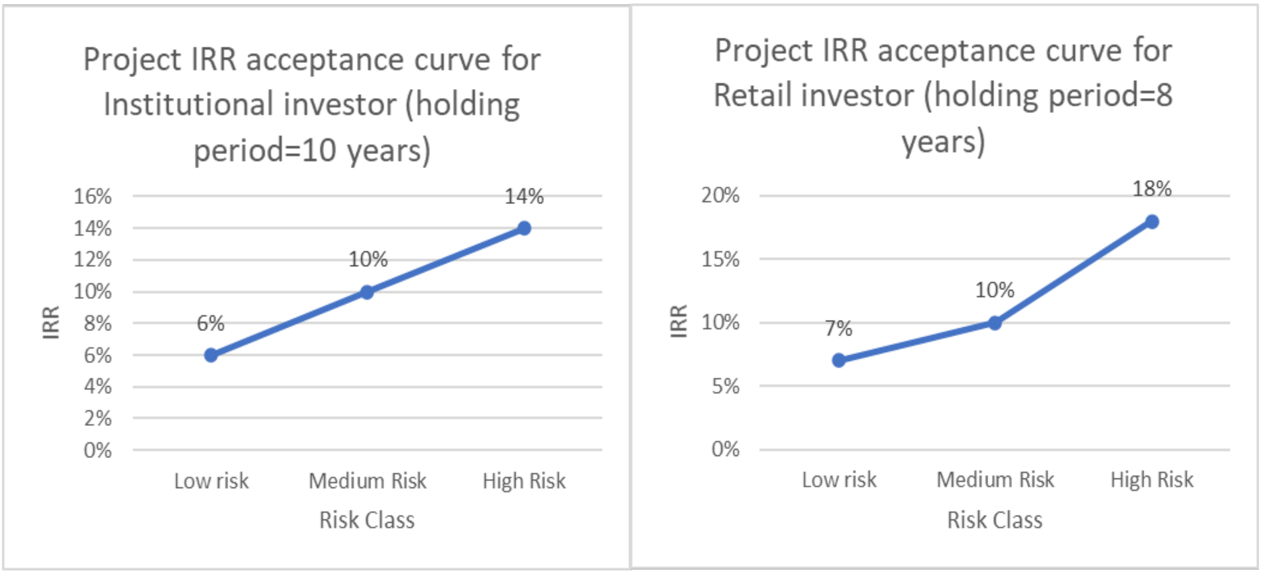


Figure 23: Project IRR acceptance curves for the Institutional and Retail investor profiles

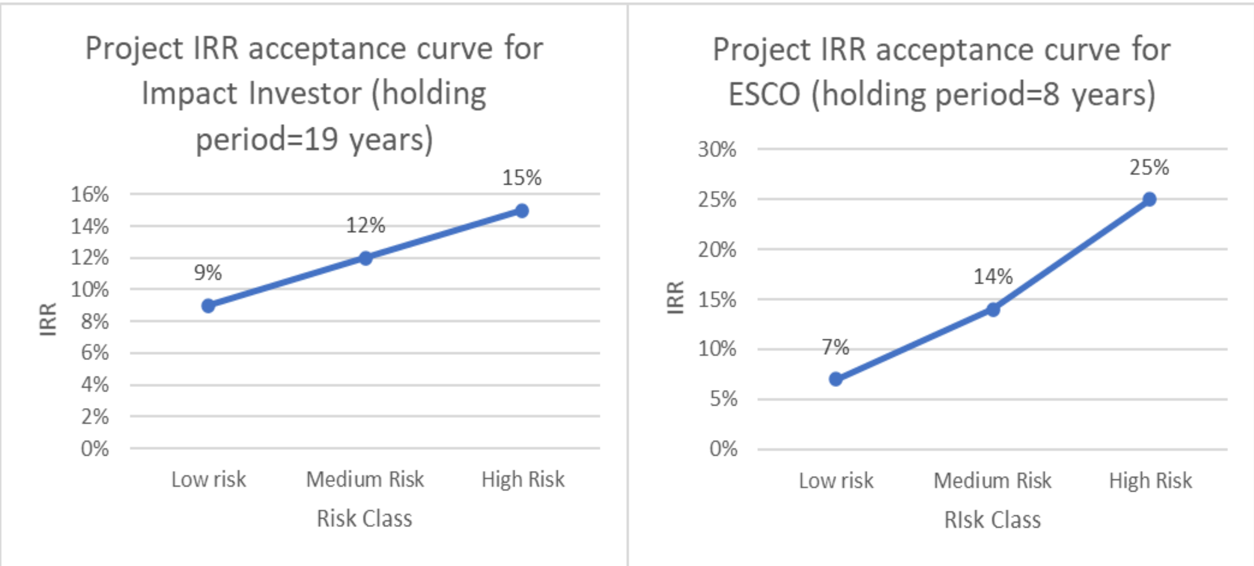


Figure 24: Project IRR acceptance curves for the Impact investor and ESCO

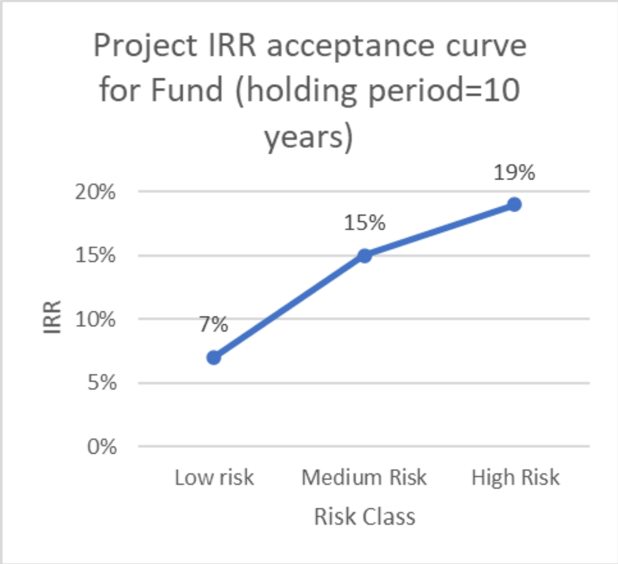


Figure 25: Project IRR acceptance curve for the Fund investor profile

As observed from the above curves, the different investor profiles show a different attitude at how they vary their requirements at different risk levels. The project IRR acceptance curves of the Institutional and Impact investors are perfectly straight, i.e., a constant increase takes place from low- to medium-risk class and from the medium- to the high-risk class, thus meaning that the requirements have diverged in a symmetric way across the various risk classes. On the contrary, the requirements of the Retail investors and ESCOs increase at a higher rate in the range between the medium-risk to the high-risk class compared to the range from the low-risk to medium-risk class. Finally, the requirements of the Funds increase at a lower rate in rising risk levels. Therefore, although all the risk profiles analysed are risk takers, since they accept to invest in projects of high risk, comparatively, Fund profile can be considered as more risk-taker, showing a higher appetite for investing in projects of high risk. On the contrary, Retail investors and ESCOs can be regarded as more risk-averse investor profiles, and Institutional and Impact investors as more risk neutral compared to the other profiles examined.

5.4 Profitable EE Projects Identification

Given the above-presented investors' requirements in terms of minimum accepted project IRR and maximum accepted holding period, the project types at the Triple-A's case study countries that serve the investors' requirements can be identified. A project is considered as profitable when it achieves an annual rate of return above the cost of capital, i.e., project IRR > cost of capital (EMTF, 2020). In our analysis, based on the assumption that all the capital is leveraged by investors, the cost of capital will be the minimum required return by each investor type if the investor type in question covers all the capital needs of a project. Thus, in order a project to be regarded as profitable it must achieve a return in excess of the minimum one required by the investor, i.e., project IRR > minimum accepted project IRR by investor. In this case, the project is profitable, and its NPV positive. The comparison is conducted for the holding period that each investor type requires. For instance, for Institutional investors, the required cost of capital, i.e., minimum accepted IRR, is compared with the IRR that the project types produce, i.e., project IRR, for a 10-year investment's horizon. The comparison is conducted using the IRR curves presented in Section 3.

Table 9 presents the project types that can be considered eligible for Institutional investors based on their performance and entailed risk (see Sections 3 and 4). In the last column, the excess return, calculated as the difference between the project IRR and the minimum accepted IRR by Institutional investor, is presented, indicating the degree of profitability that each eligible project type achieves.

Table 9: Eligible project types for Institutional investors

Project IRR vs Min accepted project IRR by Institutional investor (holding period =10 years)				
Eligible projects	Project risk	Project IRR	Min Accepted IRR	Excess return
HVAC Plant – Germany	Low	29.10%	6%	23.10%
Lighting – Germany	Low	28.87%	6%	22.87%
Compressed Air - Germany	Low	69.30%[8]	6%	63.30%
Cooling – Germany	Low	39.00%	6%	33.00%
Heating – Germany	Low	40.25%	6%	34.25%
Motors – Germany	Low	42.31%	6%	36.31%
Pumps – Germany	Low	27.82%	6%	21.82%
Waste heat (without power generation) – Germany	Low	28.01%	6%	22.01%
Building Fabric Measures – Bulgaria	Low	14.08%	6%	8.08%
Integrated Renovation – Bulgaria	Medium	11.32%	10%	1.32%
Heating – Italy	Medium	41.55%	10%	31.55%
Motors – Italy	Medium	48.20%	10%	38.20%
Refrigeration – Italy	Low	19.18%	6%	13.18%
Compressed Air – Italy	Medium	48.50%[8]	10%	38.50%
HVAC Plant – Spain	Low	19.10%	6%	13.10%
Lighting – Bulgaria	Low	12.45%	6%	6.45%

For Institutional investors, sixteen (16) out of the nineteen (19) projects analysed are considered eligible. The non-eligible projects are: (i) Building Fabric Measures – Germany, (ii) Integrated Renovation – Lithuania, and (iii) Integrated Renovation – Netherlands. The projects with excess return higher than 30% are (from higher to lower order): (i) Compressed Air – Germany with profitability above 60%, (ii) Compressed Air – Italy, (iii) Motors – Italy, (iv) Motors – Germany, (v) Heating – Germany, (vi) Cooling

[8] The comparison takes place for a holding period of 8 years since the lifetime of the entailed measure is less than the holding period

– Germany, and (vii) Heating – Italy. All these projects belong to the Industrial sector. The projects with excess return lower than 10% are (from higher to lower order): (i) Building Fabric Measures – Bulgaria, (ii) Lighting – Bulgaria, (iii) Integrated Renovation – Bulgaria with profitability lower than 2%. These three (3) projects belong to the Buildings sector.

Table 10 presents the project types that serve the Retail investors' preferences.

Table 10: Eligible project types for Retail investors

Project IRR vs Min accepted project IRR by Retail investor (holding period = 8 years)				
Eligible projects	**Project risk**	**Project IRR**	**Min Accepted IRR**	**Excess return**
HVAC Plant – Germany	Low	26.85%	7%	19.85%
Lighting – Germany	Low	26.60%	7%	19.60%
Compressed Air – Germany	Low	69.30%	7%	62.30%
Cooling - Germany	Low	37.29%	7%	30.29%
Heating - Germany	Low	38.61%	7%	31.61%
Motors - Germany	Low	40.76%	7%	33.76%
Pumps - Germany	Low	25.49%	7%	18.49%
Waste heat (without power generation) - Germany	Low	25.68%	7%	18.68%
Building Fabric Measures - Bulgaria	Low	10.71%	7%	3.71%
Heating - Italy	Medium	39.97%	10%	29.97%
Motors - Italy	Medium	46.90%	10%	36.90%
Refrigeration - Italy	Low	16.22%	7%	9.22%
Compressed Air – Italy	Medium	48.50%	10%	38.50%
HVAC Plant – Spain	Low	16.20%	7%	9.20%

Regarding Retail investors, fourteen (14) out of the nineteen (19) projects analysed are profitable. Those that provide no profits but imply damages for this investor profile are: (i) Building Fabric Measures – Germany, (ii) Integrated Renovation – Bulgaria, (iii) Lighting – Bulgaria, (iv) Integrated Renovation – Lithuania, and (v) Integrated Renovation – Netherlands. The projects with profitability higher than 30% are (from higher to lower order): (i) Compressed Air – Germany with profitability above 60%, (ii) Compressed Air – Italy, (iii) Motors – Italy, (iv) Motors – Germany, (v) Heating – Germany, and (vi) Cooling – Germany. Similarly, to the eligible projects for Institutional investors, these projects belong to the Industrial sector. The projects with profitability lower than 10% are (from higher to lower order): (i) Refrigeration - Italy, (ii) HVAC Plant – Spain, and (iii) Building Fabric Measures – Bulgaria.

Table 11 presents the project types that achieve performance over what ESCOs require.

Table 11: Eligible project types for ESCOs

Eligible projects	Project risk	Project IRR vs Min accepted IRR by ESCO (holding period=8 years) Project IRR	Min Accepted IRR	Excess return
HVAC Plant - Germany	Low	26.85%	7%	19.85%
Lighting - Germany	Low	26.60%	7%	19.90%
Compressed Air - Germany	Low	69.30%	7%	62.30%
Cooling - Germany	Low	37.29%	7%	30.29%
Heating - Germany	Low	38.61%	7%	38.61%
Motors - Germany	Low	40.76%	7%	33.76%
Pumps - Germany	Low	25.49%	7%	18.49%
Waste heat (without power generation) - Germany	Low	25.68%	7%	18.68%
Building Fabric Measures - Bulgaria	Low	10.71%	7%	3.71%
Heating - Italy	Medium	39.97%	14%	25.97%
Motors - Italy	Medium	46.90%	14%	32.90%
Refrigeration - Italy	Low	16.22%	7%	9.22%
Compressed Air – Italy	Medium	48.50%	10%	38.50%
HVAC Plant – Spain	Low	16.20%	7%	9.20%

As far as ESCOs are concerned, fourteen (14) out of the nineteen (19) projects of our analysis were proven eligible. Those considered as non-eligible for ESCOs are: (i) Building Fabric Measures – Germany, (ii) Lighting – Bulgaria, (iii) Integrated Renovation - Bulgaria, (iv) Integrated Renovation – Lithuania, and (v) Integrated Renovation – Netherlands. The projects with profitability higher than 30% are (from higher to lower order): (i) Compressed Air – Germany with profitability above 60%, (ii) Heating – Germany, (iii) Compressed Air – Italy, (iv) Motors – Germany, (v) Motors – Italy, and (vi) Cooling – Germany, all from the Industrial sector. The projects with profitability lower than 10% are (from higher to lower order): (i) Refrigeration - Italy, (ii) HVAC Plant – Spain, and (iii) Building Fabric Measures – Bulgaria.

Table 12 includes the project types that it would be profitable for Impact investors to invest in.

Table 12: Eligible project types for Impact investors

Project IRR vs Min accepted IRR by Impact investor (holding period=19 years)				
Eligible projects	**Project risk**	**Project IRR**	**Min Accepted IRR**	**Excess return**
Building Fabric Measures - Germany	Low	11.70%	9%	2.7%
HVAC Plant - Germany	Low	31%[9]	9%	22%
Lighting - Germany	Low	30%[10]	9%	21%
Compressed Air - Germany	Low	69.30%[11]	9%	60.30%
Cooling - Germany	Low	39%[12]	9%	30%
Heating - Germany	Low	41%[10]	9%	32%
Motors - Germany	Low	43%[10]	9%	34%
Pumps - Germany	Low	29%[10]	9%	20%
Waste heat (without power generation) - Germany	Low	30%[9]	9%	21%
Building Fabric Measures - Bulgaria	Low	18.46%	9%	9.46%
Integrated Renovation - Bulgaria	Medium	15%[9]	12%	3 %
Heating - Italy	Medium	42.25[10]	12%	30.25%
Motors - Italy	Medium	48.75%[10]	12%	36.75%
Refrigeration - Italy	Low	22%[10]	9%	13%
Compressed Air – Italy	Medium	48.50%[11]	10%	38.50%
HVAC Plant – Spain	Low	22 %[9]	7%	13%

Sixteen (16) out of the nineteen (19) projects analysed are considered profitable for Impact investors. The non-eligible projects are: (i) Lighting – Bulgaria, (ii) Integrated Renovation – Lithuania, and (iii) Integrated Renovation – Netherlands. The projects with profitability higher than 30% are (from higher to lower order): (i) Compressed Air – Germany with profitability above 60%, (ii) Compressed Air – Italy, (iii) Motors – Italy, (iv) Motors – Germany, (v) Heating – Germany, (vi) Heating – Italy, and (vii) Cooling – Germany. The projects with profitability lower than 10% are (from higher to lower order): (i) Building Fabric Measures – Germany (lower than 3%) and (ii) Integrated Renovation – Bulgaria (lower than 2%), belonging to the Building sector. The higher number of eligible project types for Impact investors is related to the higher holding period that enables projects to achieve higher performance rates.

[9] The comparison takes place at 15 years since the lifetime of the entailed measure is less than the holding period.
[10] The comparison takes place at 12 years since the lifetime of the entailed measure is less than the holding period.
[11] The comparison takes place at 8 years since the lifetime of the entailed measure is less than the holding period.
[12] The comparison takes place at 10 years since the lifetime of the entailed measure is less than the holding period.

Finally, Table 13 contains profitable EE project investments for Funds.

Table 13: Eligible project types for Funds

Project IRR vs Min accepted project IRR by Fund (holding period=10 years)				
Eligible projects	Project risk	Project IRR	Min Accepted IRR	Excess return
HVAC Plant - Germany	Low	29.10%	7%	22.10%
Lighting - Germany	Low	28.87%	7%	21.87%
Compressed Air - Germany	Low	69.30%[13]	7%	62.30%
Cooling - Germany	Low	39.00%	7%	32.00%
Heating - Germany	Low	40.25%	7%	33.25%
Motors - Germany	Low	42.31%	7%	35.31%
Pumps - Germany	Low	27.82%	7%	20.82%
Waste heat (without power generation) - Germany	Low	28.01%	7%	21.01%
Building Fabric Measures - Bulgaria	Low	14.08%	7%	7.08%
Heating - Italy	Medium	41.55%	15%	26.55%
Motors - Italy	Medium	48.20%	15%	33.20%
Refrigeration - Italy	Low	19.18%	7%	12.18%
Compressed Air – Italy	Medium	48.50%[13]	10%	38.50%
HVAC Plant – Spain	Low	19.10%	6%	13.10%
Lighting - Bulgaria	Low	12.45%	7%	5.45%

For Funds, fifteen (15) out of the nineteen (19) projects lead to excess return. The projects that do not produce excess return are: (i) Building Fabric Measures – Germany, (ii) Integrated Renovation – Lithuania, (iii) Integrated Renovation - Bulgaria, and (iv) Integrated Renovation – Netherlands. The projects with profitability higher than 30% are (from higher to lower order): (i) Compressed Air – Germany with profitability above 60%, (ii) Compressed Air – Italy, (iii) Motors – Germany, (iv) Heating – Germany, (v) Motors – Italy, and (vi) Cooling – Germany, all implemented in the Industrial sector. The projects with profitability lower than 10% are (from higher to lower order): (i) Building Fabric Measures – Bulgaria and (ii) Lighting – Bulgaria.

Table 14 summarizes the non-eligible projects per investor profile. Building Fabric Measures, Lighting, and Integrated Renovation projects seem to be often not profitable for at least three of the five investor profiles each and thus can be less attractive to them. A significant finding is that all projects included in Table 14 have been implemented in the Building sector.

[13] The comparison takes place at 8 years, since the lifetime of the entailed measure is less than the holding period.

Table 14: Summary of non-eligible project types per investor profile

Investor profiles	Non-eligible project types
Institutional Investors	Building Fabric Measures – Germany Integrated Renovation – Lithuania Integrated Renovation – Netherlands
Retail Investors	Building Fabric Measures – Germany Integrated Renovation – Bulgaria Lighting – Bulgaria Integrated Renovation – Lithuania Integrated Renovation – Netherlands
ESCOs	Building Fabric Measures – Germany Lighting – Bulgaria Integrated Renovation – Lithuania Integrated Renovation – Netherlands
Impact Investors	Lighting – Bulgaria Integrated Renovation – Lithuania Integrated Renovation – Netherlands
Funds	Building Fabric Measures – Germany Integrated Renovation – Lithuania Integrated Renovation – Bulgaria Integrated Renovation – Netherlands

Table 15 includes the highly profitable projects per investor profile. According to the analysis, Compressed Air projects have been the most profitable projects, with more than 60% excess return in Germany across different investor profiles. Furthermore, Motors, Heating, and Cooling projects were proven to be also very profitable, achieving rates higher than 30% in all investor profiles.

Table 15: Summary of high profitability project types (above 30%)

Investor profiles	Project types
Institutional Investors	Compressed Air – Germany Compressed Air – Italy Motors – Italy Motors – Germany Heating – Germany Cooling – Germany Heating – Italy
Retail Investors	Compressed Air – Germany Compressed Air – Italy Motors – Italy

	Motors – Germany Heating – Germany Cooling – Germany
ESCOs	Compressed Air – Germany Heating – Germany Compressed Air – Italy Motors – Germany Motors – Italy Cooling – Germany
Impact Investors	Compressed Air – Germany Compressed Air – Italy Motors – Italy Motors – Germany Heating – Germany Heating – Italy Cooling – Germany
Funds	Compressed Air – Germany Compressed Air – Italy Motors – Germany Heating – Germany Motors – Italy Cooling – Germany

Table 16 contains the projects that have the lowest profitability per investor profile. Building Fabric Measures projects are among the less profitable projects across all different investor profiles. Integrated Renovation, Lighting, HVAC Plant, and Refrigeration projects have low profitability in two investor profiles each. Apart from Refrigeration projects, all the other projects have been implemented in the Building sector. An important finding is that Retail investors and ESCOs have similar results regarding low profitability projects.

Table 16: Summary of low profitability project types (below 10%)

Investor profiles	Project types
Institutional Investors	Building Fabric Measures – Bulgaria Lighting – Bulgaria Integrated Renovation – Bulgaria
Retail Investors, ESCOs	Refrigeration – Italy HVAC Plant – Spain Building Fabric Measures – Bulgaria
Impact Investors	Building Fabric Measures – Germany Integrated Renovation – Bulgaria

Funds	Building Fabric Measures – Bulgaria Lighting – Bulgaria

6 Conclusions

In the context of the current report, the cost of capital of EE projects is calculated from the investor's side, while also the methodology is applied to the data of EE projects successfully implemented across Triple-A case study countries. First, the IRR curves of the project types analysed in the presented study are constructed, depicting how their project IRRs vary across the different investment horizons. Following, the total risk of failure of these project types is calculated and connected to the investors' preferences. In doing so, the projects are split into three classes, i.e., low-, medium-, and high-risk projects. The minimum required return per investor profile considered in our analysis is estimated for the case that the whole capital is leveraged by investors (equity=100%) via a stakeholder consultation that focuses on investors, in which fifty-two (52) stakeholders participated, mainly from Greece, Netherlands, Lithuania and Spain. Moreover, the project types that serve each investor profile's preferences are identified**.** The minimum accepted project IRR required per investor profile for the case that all the capital is leverage by investors (100% equity) is compared to the project IRR for the entailed holding period of each investor profile. In this case (100% equity), the minimum accepted project IRR by investors is also the cost of capital of the project, given that the project produces a greater return than the one asked by investors and thus being eligible.

The key findings can be summarised in the following points:

- Investors must adjust their holding period based on the turning point of EE technologies, directing their capital to other more profitable EE projects after that point. To identify this point, the project IRR curves must be considered.
- The macroeconomic country risk has a significant influence on the total risk of the projects. Specifically, all project types implemented in countries with high macroeconomic risk are never classified at the low-risk class, irrespective of the EE measures implemented.
- Five main different investor profiles emerged by stakeholder consultation on investors preferences: Institutional investors, Retail investors, Impact investors, ESCOs and Funds. Each of these profiles has its own distinct preferences regarding the required return, varying across the risk levels. Funds could be considered as more risk-takers compared to the other profiles analysed, while Retail investors and ESCOs as more risk averse, and Institutional and Impact investors as more risk neutral.
- With regards to the maximum holding period accepted by each investor type, Impact investors accept to hold their money for a longer period (19 years), something that may relate to the fact that their targets are not only of financial nature. The other profiles have rather similar requirements in terms of the maximum accepted holding period, ranging from 8 to 10 years.
- EE projects of the Industrial sector financially outperform the Buildings sector's projects, serving the investors requirements most of the times. In that regard, from the eligible project types for each investor profile, only Industrial projects achieved performance over the required return by investors in the order of 30% or higher. In comparison, all of the Building sector's eligible projects achieved profitability lower than 30% and, in many cases, lower than 10%.
- Based on our analysis, Germany and Italy seem to be the most attractive countries to invest in since all the high profitability projects that were found were implemented in these countries. However, it should be mentioned that more data regarding EE projects have been available from these two countries, something that affects the results.

The findings of this report are going to be incorporated in the Triple-A methodology, as implemented through the Triple-A Tools, and specifically in the Agree Tool. At this stage, this report's outcomes will be utilised for benchmarking the inspected EE projects by using the costs of capital arisen. For example, they could be used for calculating the NPV of the projects based on the type of investor engaged within their context. Moreover, the IRR curves constructed in the context of this report could be utilised for benchmarking the performance of the projects based on the measures implemented within their context. In addition, the Triple-A database will incorporate this report's results, such as the risks of the EE projects from DEEP and the costs of capital. The stakeholder consultation conducted in the context of this report will be enhanced, so as to receive more feedback from EE experts and investors, thus making the results of the presented study more robust.

7 References

Andreosatos, C., & Tourkolias, C. (2019). *Proposed standardized process for energy efficiency projects' assessment.* Retrieved from https://ec.europa.eu/info/sites/info/files/energy_climate_change_environment/events/presentations/010_charis_andreosatos_seif_athens_07-03-2019.pdf

Capital.com. (2020). *Investment Fund*. Retrieved from https://capital.com/investment-fund-definition

Çelik, S. a. (2013). *Institutional Investors as Owners: Who Are They and What Do They Do?* Paris: OECD Corporate Governance Working Papers. Retrieved from https://doi.org/10.1787/22230939

CFI. (2021). *Institutional Investor: A legal entity that gathers funds from several investors to invest in various financial instruments*. Retrieved from https://corporatefinanceinstitute.com/resources/knowledge/trading-investing/institutional-investor/

CFI. (2021). *Systematic Risk: Risk caused by factors beyond the control of a company or individual*. Retrieved from https://corporatefinanceinstitute.com/resources/knowledge/finance/systematic-risk/

CHEN, J. (2020). *Sovereign Credit Rating*. Retrieved from https://www.investopedia.com/.

Deloitte. (2014). *Some common mistakes to avoid in estimating and applying discount rates.* Retrieved from https://www2.deloitte.com/content/dam/Deloitte/xe/Documents/About-Deloitte/mepovdocuments/mepov13/dtme_mepov13_Discount%20rates.pdf

Dülk, M. (2012). Cost of capital of energy efficiency projects: The case of space heating and cooling. *periodica polytechnica, Social and Management Sciences*.

EC. (2021). *Energy Service Companies (ESCOs)*. Retrieved from https://e3p.jrc.ec.europa.eu/communities/energy-service-companies

EMTF. (2020). *A GUIDE FOR THE SELECTION OF ENERGY EFFICIENT TECHNOLOGIES.* Energy Management Task Forces. Retrieved from https://www.emtfsask.ca/pdfs/gdenefftech.pdf

European Commission. (2018). *JRC SCIENCE FOR POLICY REPORT, Energy efficiency, the value of buildings and the payment default risk.* Retrieved from https://publications.jrc.ec.europa.eu/repository/bitstream/JRC113215/jrc113215_kjna29471enn_v2_ipo_final.pdf

European Commission DG ENV. (2011). *Addressing the Rebound Effect.* Retrieved from https://www.ecologic.eu/sites/files/project/2013/2670_03_rebound_effect_report.pdf

Evan, J. D. (2021). EVALUATING SENSITIVITY OF MACROECONOMIC FACTORS TO STOCK RETURN USING ARBITRAGE PRICING THEORY FRAMEWORK: EVIDENCE FROM INDONESIA STOCK MARKET. *International Journal of Research Publications*.

EY. (2016). *Market evidence on the cost of equity.* Retrieved from http://qcaprod.australiaeast.cloudapp.azure.com/wp-content/uploads/2019/05/31159_Market-evidence-on-the-cost-of-equity-Ernst-Young-1.pdf

EY. (2018). *WACC in the context of Risk, Return and Resilience at PR19: Ernst & Young report.* Retrieved from https://www.unitedutilities.com/globalassets/z_corporate-site/pr19/third-party/t7002_wacc_in_the_context_of_risk_return_and_resilience.pdf

EY. (2020). *Practitioner's guide to cost of capital & WACC calculation.* Retrieved from https://www.eycom.ch/en/Publications/20200227-Practitioners-guide-to-cost-of-capital-And-WACC-calculation/download

Frankel, M. (2020). *What Is a Retail Investor?* Retrieved from https://www.fool.com/millionacres/real-estate-investing/commercial-real-estate/what-is-a-retail-investor/

GIIN. (2021). *What is impact investing?* Retrieved from https://thegiin.org/impact-investing/need-to-know/

Greening, L. (2000). Energy efficiency and consumption – the rebound effect – a survey. *Energy Policy*.

Hill, D. R. (2019). Energy Efficiency Financing: A review of risks and uncertainties. *16th IAEE European Conference* (p. 16th IAEE European Conference). International Association for Energy Economics.

IEA. (2018). *Energy Service Companies (ESCOs): At the heart of innovative financing models for efficiency.* Retrieved from https://www.iea.org/reports/energy-service-companies-escos-2/esco-contracts

IEA. (2019, May). *World Energy Investment 2019*. Retrieved from https://www.iea.org/reports/world-energy-investment-2019/financing-and-funding-trends

IEA. (2020). *Investment estimates for 2020 continue to point to a record slump in spending*. Retrieved from https://www.iea.org/articles/investment-estimates-for-2020-continue-to-point-to-a-record-slump-in-spending

IMF. (1996). *Institutional Investors and Asset Pricing in Emerging Markets.* Retrieved from https://www.elibrary.imf.org/view/IMF001/03605-9781451841718/03605-9781451841718/03605-9781451841718_A001.xml?lang=en&language=en&redirect=true

KPMG. (2018). *Cost of Capital Study, New Business Models - Risks and rewards.* Retrieved from https://assets.kpmg/content/dam/kpmg/ch/pdf/cost-of-capital-study-2018.pdf

KPMG. (2021). *Institutional investors today: A very different animal*. Retrieved from https://home.kpmg/xx/en/home/insights/2019/05/institutional-investors-today-a-very-different-animal-fs.html

Mackintosh, P. (2020). *Who Counts as a Retail Investor?* Retrieved from https://www.nasdaq.com/articles/who-counts-as-a-retail-investor-2020-12-17

Mills, E. K. (2006). From volatility to value: analysing and managing financial and performance risk in energy savings projects. *Energy Policy*, 188-199.

Moreno, D. G. (2008). *COST OF CAPITAL INDICATOR FOR EU MEMBER STATES - METHODOLOGY.* European Commission, Joint Research Centre. Retrieved from https://publications.jrc.ec.europa.eu/repository/bitstream/JRC49398/reqno_jrc49398_cost_of_capital_-_methodology_final.doc_1_%5B1%5D.pdf

Nair, G. ,. (2010). Factors influencing energy efficiency investments in existing Swedish residential buildings. *Energy Policy*, 2956–2963.

Netherlands Enterprise Agency. (2018). *A MODEL APPROACH TO FINANCE INDUSTRIAL ENERGY EFFICIENCY PROJECTS.* Retrieved from https://www.topsectorenergie.nl/sites/default/files/uploads/Model%20to%20finance%20large%20scale%20industrial%20project%20in%20Energy%20Efficiency%20-%20S.._.pdf

OECD. (2021). *Inflation (CPI)*. Retrieved from https://data.oecd.org/price/inflation-cpi.htm

Peretz, N. (2009). *GROWING THE ENERGY EFFICIENCY MARKET THROUGH THIRD-PARTY FINANCING.*

Pettinger, T. (2019). *Factors affecting investment*. Retrieved from https://www.economicshelp.org/blog/136672/economics/factors-affecting-investment/

Proctor, C. (2021, January 16). *Impact investing finances companies that aim to do good in the world — here's how it works and how to get involved*. Retrieved from https://www.businessinsider.com/: https://www.businessinsider.com/what-is-impact-investing

PWC. (2008). *Valuation Methodology Survey.* Retrieved from https://www.pwc.co.za/en/assets/pdf/valuation-methodology-survey-2008.pdf

PWC. (2020). *Assessing your Cost of Capital in a COVID-19 world.* Retrieved from https://www.pwc.co.nz/issues/covid-19/pwc-cost-of-capital-in-the-current-climate.html

S&P. (2020). *Sovereign Risk Indicators 2020 Estimates*. Retrieved from https://www.spratings.com/sri/

Sardianou, E. (2008). Barriers to industrial energy efficiency investments in Greece. *Journal of Cleaner Production*, 1416-1423.

United Nations. (2015). *PROMOTING ENERGY EFFICIENCY INVESTMENTS FOR CLIMATE CHANGE MITIGATION AND SUSTAINABLE DEVELOPMENT, A Guidebook for Project Developers for Preparing Energy.* Retrieved from https://digitallibrary.un.org/record/3797226?ln=en

Weber, L. (1997). Some reflections on barriers to the efficient use of energy. *Energy Policy*, 833-835.

World Bank. (2005). *How Profitable Are Infrastructure Concessions in Latin America? Empirical Evidence and Regulatory Implications.* Retrieved from https://ppiaf.org/documents/2146/download

Appendix A

Literature sources used for the rebound effect evaluation

Ai, H., Wu, X., and Li, K. (2019). Differentiated effects of diversified technological sources on China's electricity consumption: Evidence from the perspective of rebound effect. Energy Policy.

Borenstein, S. (2015). A microeconomic framework for evaluating energy efficiency rebound and some implications. The Energy Journal, 36(1).

Farese, P., Gelman, R., and Hendron, R. (2012). A Tool to Prioritise Energy Efficiency Investments. National Renewable Energy Laboratory (NREL).

Greening, A. L., Greene, L. D., and Difiglio, C. (2000). Energy efficiency and consumption – the rebound effect – a survey. Energy Policy, 28, 389-401.

Hens, H., Parijs, W., and Deurinck, M. (2010). Energy consumption for heating and rebound effects. Energy and Buildings, 42, 105-110.

Jaegerbrand K. A., Dickinson, J., Mellin, A., Viklund, M., and Dahlberg, S. (2014). Rebound effects of energy efficiency measures in the transport sector in Sweden. VTI.

Naessen, J., and Holmberg, J. (2009). Quantifying the rebound effects of energy efficiency improvements and energy conserving behaviour in Sweden. Energy Efficiency. 2, 221-231.

Nair, G., Gustavsson, L., and Mahapatra, K. (2010). Factors influencing energy efficiency investments in existing Swedish residential buildings. Energy Policy, 38(6), 2956-2963.

Sorrell, S. (2007). The Rebound Effect: an assessment of the evidence for economy-wide energy savings from improved energy efficiency. UK Energy Research Centre (UKERC).

Stevens, D., Fuerst, F., Adan, H., Brounen, D., Kavarnou, D., and Singh, R. (2018). Risks and Uncertainties Associated with Residential Energy Efficiency Investments, SSRN Electron. J., vol. 35, no. 4, pp. 1–14.

Appendix B

Questionnaire for investors' preferences

1) Please insert your country

2) Based on your experience, what is the minimum return that an investor asks for a low-, medium- and high-risk energy efficiency project (Please provide three answers, one per risk-class)?
   - Low Risk:
   - Medium Risk:
   - High Risk:

3) Based on your experience in energy efficiency investments, what is the maximum acceptable holding period (years) by investors?

4) Based on your experience, what is usually the capital structure of an Energy Efficiency project (Please provide the Debt-to-Equity (D/E) ratio)?

5) The answers that you provided, to what investor's category would be more relevant?
   - Institutional investor
   - Retail investor
   - Other (Please clarify)

6) If there are any comments that you would like to highlight regarding this questionnaire, please leave them below.

TRIPLE-A

Questionnaire for investors' preferences

Questionnaire for investors' preferences

Please insert your country

Η απάντησή σας

Based on your experience, what is the minimum return that an investor asks for a low-, medium- and high-risk energy efficiency project (Please provide three answers, one per risk-class)?

Low Risk:

Η απάντησή σας

Medium Risk:

Η απάντησή σας

High Risk:

Η απάντησή σας

Based on your experience in energy efficiency investments, what is the maximum acceptable holding period (years) by investors?

Η απάντησή σας

Based on your experience, what is usually the capital structure of an energy efficiency project (Please provide the Debt-to-Equity (D/E) ratio)?

Η απάντησή σας

The answers that you provided, to what investor's profile would be more relevant?

- ◯ Institutional investor
- ◯ Retail investor
- ◯ Άλλο: ____

If there are any comments that you would like to highlight regarding this questionnaire, please leave them below.

Η απάντησή σας

Πίσω | Υποβολή | Σελίδα 2 από 2