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Guidance for Feasibility Studies under the EE Incentive Scheme for energy intensive industries in Vietnam

Final Guideline, 29 February 2024

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draft

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Aim and context of a Feasibility study

This document is a guideline for feasibility studies (FS) for Energy Efficiency (EE) projects in industry under the EE Incentive Scheme (Voluntary Agreements) for energy intensive industries in Vietnam. The guideline is prepared in the context of the Energy Partnership Programme between Vietnam and Denmark and is aligned with the current regulation e.g., the construction law 2020, article 53 and 54.

An energy efficiency project usually starts with an energy audit or screening of possible energy efficiency projects. The most promising solutions are assessed in a pre-feasibility study, where the options are weighed against each other. After the pre-feasibility phase, the most promising solution undergoes a more detailed assessment in a feasibility study.

The approach precented in this Guideline can as well be applied on similar projects where the scope is to reduce CO_2-emissions, OPEX, improve yield, etc. For the simplicity this Guideline refers to the projects as Energy Efficiency (EE) projects.

EE project preparation and implementation follows the 5 steps:

1. An initial energy audit or screening identifies potentials to improve energy efficiency and/or reduce CO_2-emissions from the company's operations. In this step, the projects are often prioritized based on evaluation of which projects that supports the overall objective in the best way and on a simple payback analysis.

2. A pre-feasibility study is carried out if it is not obvious which technical solution is optimal. The pre-fs will define the project in more detail and identify relevant alternative solutions in terms of technical scope, investments (CAPEX) and operating costs (OPEX) etc. so as the management of the company can decide on a preferred solution forward.

   As such, a pre-feasibility study should look broadly into relevant project elements and solutions not only detailing the immediate obvious technical solution. The total cost of ownership (TCO) or Net Present Value (NPV) for alternative solutions over their lifetime should be assessed along with other decision criteria including CO_2-footprint, future capacity requirements and energy prices, non-energy benefits etc.

   A separate detailed Pre-feasibility Guideline for Energy Efficiency in industry has been developed in parallel with the present guideline and can be accessed at DEPP3 website.

3. A **feasibility study** of the preferred solution identified in the audit or the pre-fs is carried out if it is not obvious which concrete design, choice of supplier etc. that is most to the advantage of the investor. The fs will precisely define the preferred solution in terms of scope, technical solution, risks, non-energy benefits, social and environment aspects, implementation scheduling, investments (CAPEX) and operating costs (OPEX) so as the management of the company can finally decide on allocating funds for carrying out the project (Final Investment Decision – FID).

4. A specification and tendering phase, where the approved solution is specified to a level of detail that allows planned installations and related works to be tendered among preferred suppliers, and where final details of the technical solutions can be settled in cooperation with the preferred supplier.

5. A contracting phase, where contracts for installations and related works are signed and performance guarantees for the planned project are defined and settled in the contract(s).

The purpose of the feasibility study is to present a detailed business case and any identified non-financial benefits and risks to the company leadership and prospective financing institutions with the goal of making a final investment decision (FID).

If external financing from a financial institution is needed for the project, the feasibility study will be a part of the documentation underlying the loan application.

A separate loan application guidance has been developed in parallel with the present guideline and be accessed at DEPP3 website.

Content

Introduction to the Feasibility Study Guideline

The feasibility study is essential for evaluating the viability and potential success of an energy efficiency project. The feasibility study includes an assessment of both the technical and financial feasibility of the project.

While the pre-feasibility study weighs different energy efficiency solutions with the purpose of ruling out non-attractive investments, the feasibility study is a detailed study of the most attractive solution.

The aim of the feasibility phase is to carry out a pre-liminary solution design for the preferred solution and make a fairly accurate investment budget (CAPEX and OPEX) so as the management of the company can allocate funds for implementing the project.

Input and knowledge from suppliers are important and beneficial when carrying out the feasibility study and can also give new inspiration to the preferred solution. Further, suppliers can assist with more accurate budget estimates.

The feasibility study should include all considerations necessary to precisely define the preferred solution in terms of scope, technical solution, risks, non-energy benefits, social and environmental impacts, project scheduling, investments (CAPEX) and operating costs (OPEX) so that the management of the company can finally decide on allocating funds for carrying out the project (Final Investment Decision – FID).

The feasibility study is developing the project to a level of maturity between conceptual and detailed design. Therefore, the feasibility study will also serve as a basis for the subsequent detailed design and tendering process.

Specifically, the feasibility study should cover the following aspects:

1. Project scope and objectives
2. Technical specifications
3. Non-energy benefits
4. Procurement and contracting strategy
5. Financial analysis of the project
6. Sensitivity analysis
7. Social and environmental assessment
8. Risks and mitigation strategies
9. Time schedule of implementation
10. Conclusions of feasibility study

The outcome of the feasibility study is a report to be used both as basis for the management's decision on the investment.

If external financing from a financial institution is needed for the project, the feasibility study will be a part of the documentation underlying the loan application.

1 Project scope and objectives

Define the project's scope and objectives.

Project objective

The objective of the project should be aligned with the overall strategic direction of the company. As an example, if the company has a strategic goal of reducing energy consumption by 6% over a specified period, it should be clearly stated how the project supports that goal.

The project objective should as a minimum address the following:

- Is it solely an energy efficiency project?
- Is it a replacement of worn-out equipment?
- Is it a capacity expansion project?
- Is it a simple 1:1 replacement of already existing equipment?
- Or is the project an add-on to already existing equipment?
- Will the project comprise other installations, building works etc.?

Examples of strategic goals and supporting project objectives are listed below.

	Examples of strategic goals	Examples of project objectives
#1	Reduce unit cost [$/ton of product output] by year 20xx	The project is expected to increase automation and reduce manual labor, decreasing the company's operating expenditures.
#2	Reduce energy consumption by x% by year 20xx	The project replaces gas boilers with electric heat pumps with higher COP (coefficient of performance).
#3	Eliminate energy related carbon emissions at for all production sites by year 20xx	The project is expected to reduce carbon emissions from electricity and gas by 50% in 5 years and 100% in 10 years.
#4	Increasing the capacity of the energy system by xx % by year 20xx	Securing capacity expansion of the energy system, that supports the planned production expansion towards 2030.
#5	[…]	[…]

In the absence of guiding strategic goals, the project objective should as a minimum address energy savings, non-energy benefits and financial return expectations.

Project scope
Clearly outline the scope of the energy efficiency project, specifying the targeted areas or processes.

The project scope should be described at a high-level excluding detailed technical specification.

The project scope should as a minimum address the following

- What are the goals of the project?
- What are the deliverables?
- What tasks needs to be performed?
- What is the basis for the investment?
- What are the deadlines?
- Who should be involved?

The project scope should include a reference to the pre-feasibility study and any technical studies completed after the pre-feasibility study.

2 Technical specifications

The section should provide technical details of the proposed energy efficiency project.

2.1 Results of the Pre-feasibility Study

Description of the work done under the pre-FS and the conclusions must be developed in the FS.

If no Pre-Feasibility Study has been conducted (e.g. because the preferred solution is obvious), the work described in the separate Pre-FS guideline on the Design basis for the project, the Purpose and scope of project, and any alternative solutions considered should be included under the FS.

2.2 Analysis and studies during the Feasibility Study

Description of any further analysis and studies done under the FS leading to the proposed project. This should include reference to any recommendations in the Pre-FS on further clarification or studies.

2.3 The proposed project

The technical specifications of an energy efficiency project provide detailed information about the technologies, systems, and processes involved in the project. The technical specifications should be based on best available technologies (BAT) available on the market.

The technical description in the feasibility study is a further development of the design basis and solution strategy described in the pre-feasibility study, to reach a basis design of the project, including additional technical details, input from manufacturers, pricing and scheduling.

The technical specifications typically covered in an energy efficiency project are listed in the table below:

The technical specifications	
System requirements and compatibility/integration with existing infrastructure and technologies	[…]
Performance criteria and capacity	[…]
Energy consumption and efficiency	[…]
Technologies required to implement the solution (e.g., heat pump, piping, electrical installations etc.)	[…]
Technology readiness assessment of key components	[…]
Market availability of key technologies and infrastructure parts	[…]
Control and monitoring systems (sensors, meters, and automation control)	[…]
Maintenance and service requirements	[…]
Regulatory compliance (involves ensuring that the technology fulfils regulatory standards and requirements with respect to e.g., environmental impact and safety).	[…]
Warranty terms and conditions	[…]
Required engineering skills and resources to develop and operate the project.	[…]
Process Flow Diagrams (PFD) and Process Instrumentation Diagrams (PID)	[…]
[…]	[…]

Table 1 – Technical specifications for an energy efficiency project

By thoroughly examining these technical aspects, you can determine whether the energy efficiency solution is technically feasible and aligned with the goals of the organization.

2.4 Preferred suppliers

Dialogue with suppliers can be applied in some special cases, i.e. in the form of direct contracting (small scale of investment, only one supplier, supplier who has successfully implemented the similar projects, etc).

For large investment projects, FS consultants must determine accurate information based on similar projects that have been successfully implemented domestically and around the world by a number of suppliers.

For private enterprises, it is recommended to involve suppliers in the project development to an extent that a pre-liminary solution design can be presented with capacity data and drawings for all major equipment and installations.

State Owned Enterprises (SOEs) must carefully consider their ability to engage with suppliers in order not to violate the Bidding Law.

For SOEs, the parameters in the FS must be neutral so as not to exclude potential suppliers (do not present requirements/parameters where only one supplier is dominant).

In FS for SOEs, the consultant should only choose parameters publicly available on the market. For projects that require bidding, dialogue with suppliers may violate the Bidding Law. If there is only one supplier, the contractor appointment method according to the provisions of the Bidding Law shall be applied.

At this stage, potential suppliers are involved in the project development to an extent where the preferred solution can be presented. During a tendering process at a later stage the company will select the preferred supplier with the most advantageous solution.

For SOE projects subject to bidding, the participation of suppliers will violate the Bidding Law. Consulting on making FS for SOEs should therefore only refer to the Catalogues of suppliers.

2.5 Solution design

The content of the FS must comply with Article 54 of the Construction Law[1]. Article 54 of the Construction Law states: a basic design shall be made to achieve the project's objectives, suit construction works of the project, ensure synchronism between works when they are put into exploitation and use. It follows that the basic design must include explanations and drawings expressing the contents described in the table below:

Details in a basic design description in FS according to Article 54 in the Construction Law	
a)	The construction location, direction of the line of works, list, sizes, types, and grades of works on the whole construction ground.
b)	Selected technological, technical and equipment plans (if any).
c)	Architectural solutions, ground plan, cross-sections and vertical sections of construction works and their sizes and main structures.
d)	Construction solutions, major materials to be used, estimated construction cost of every work.
dd)	Plan on connection of technical infrastructures inside and outside the works, fire and explosion prevention and fighting solutions.
e)	Applied standards and technical regulations and construction survey results for making the basic design.

Table 2 – Required details in a basic design description in Feasibility Studies as stated in Article 54 in the Construction Law

Drawings comprising of layout, cross-sections and vertical sections and 3D-animations should be developed to present a visual solution design for the preferred solution. The level of detail required for the drawings is scaled according to the complexity of the project.

A description of how the system is integrated and controlled must be made, making sure that the solutions can be properly integrated and that the control can interact with existing system and support the expected outcome of the project.

Usually, a preferred solution will include a main scenario with relevant sub-scenarios to consider further to choose the most suitable solution for the specific company.

The main scenario and relevant sub-scenarios should be described in terms of investment costs and operating costs so the management of the company can decide on a preferred path forward.

[1] Microsoft Word - Vietnam Construction Law 2014.doc (ccoin.vn)

At this stage, potential suppliers are involved in the project development to an extent where the preferred solution can be presented. During a tendering process at a later stage the company must select the preferred supplier with the most advantageous solution.

3 Financial analysis of the project

This section shall clarify the key elements that form the foundation of the business case. This includes elements of uncertainty and sources of financial data. The project developer may use their own model or find inspiration in the "Financial Analysis Tool to Enable analysis of Financial Benefits to Enterprises of Participating in a Voluntary Agreement Scheme in Vietnam" (Output 2, November 2022).[2]

Technology catalogues, manufacturing catalogues and existing literature are sufficient sources of information in the pre-feasibility phase. In the feasibility study data quality must be higher as the purpose of the project is to make a final investment decision (FID). To obtain higher quality data, private enterprises (but not SOEs) may engage potential supplier and contractors to get more accurate price estimates. SOEs will have to rely on public information on the parameters and costs of similar investments already made.

3.1 CAPEX

Energy efficiency projects require capital investments (CAPEX) covering different phases of the project. CAPEX can be broken down into pre-construction and construction costs. Pre-construction costs are costs occurring before the final investment decision.

- Pre-construction/Development costs (DEVEX)
  - Development and planning
  - Permitting and logistics
- Construction costs
  - Piping and other equipment costs
  - Electrical installations
  - Civil works
  - Grid connection costs
- Soft expenditures
  - Investment costs (more information is provided in section 3.7)
  - Overhead costs
- Contingency for unexpected costs
  - At this stage in the project a certain percentage of the budget must be allocated for unforeseen expenses, which is related to uncertainties for the individual budget elements but also including unforeseen costs that can occur in any project at this stage. The size of the unforeseen cost allocation also depends on the complexity of the project and on how many project elements are within the control of the project. At the FS stage of the project, the unforeseen costs can account for 20-30% of the budget.

CAPEX should account for future price developments, particularly for capital-intensive components and materials.

Included in the CAPEX section is an evaluation of the robustness of the different components included in CAPEX. Typically, some expenditures are more uncertain than others. The robustness also depends on the expected time of investment and market conditions.

To gain more robust CAPEX estimates, the developer can request suppliers to provide budget quotes on some CAPEX elements, e.g., piping, and electrical installations.

[2] https://depp3.vn/Document/Detail/117

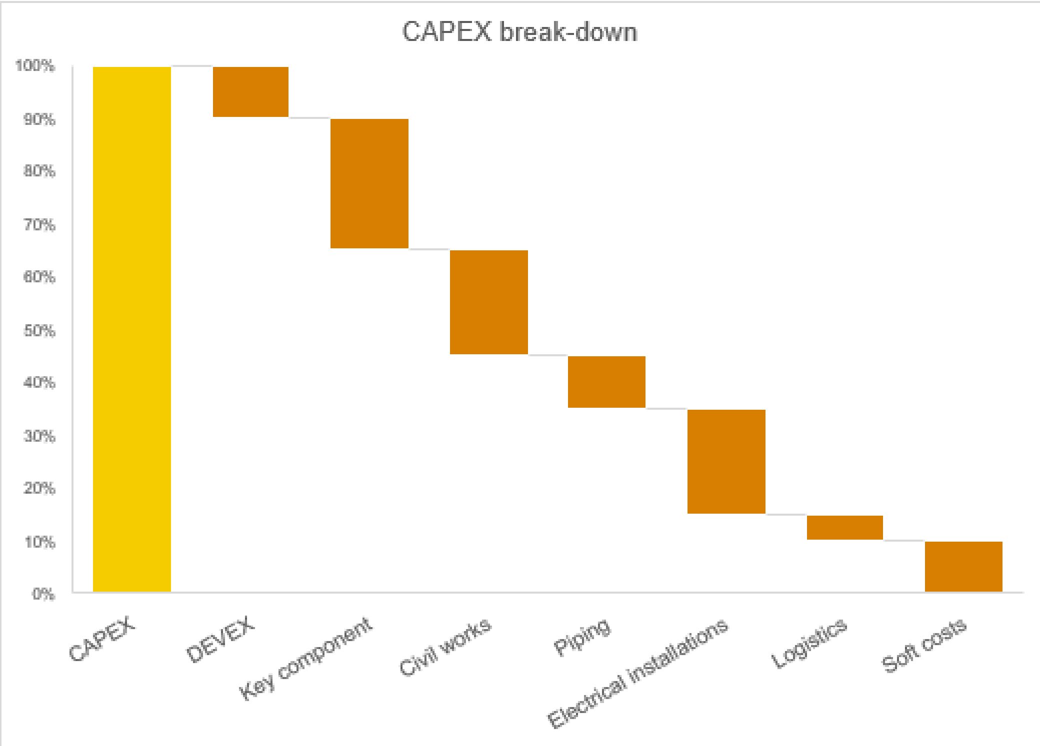

Figure 1: CAPEX waterfall diagram - exemplified.

3.2 OPEX

Implementation of energy efficiency projects typically results in changes in a company's operating expenditures.

Any additional operating expenses impact the financial viability of the project.

Changes in operating expenses from changes in energy expenses and other costs derived from the implementation of the project constitute OPEX in the business case. OPEX includes, for example:

- Wages and salaries for new staff within e.g., engineering
- Energy costs and other costs of operation with specific consumption (e.g. oil, water etc.)
- Taxes e.g. carbon
- Maintenance
- Deferred re-investment in existing technology (if the project involves replacement of existing technology)
- Annual service agreements
- …

Energy efficiency projects are designed to generate net energy savings. Meanwhile, installation of new equipment could bring increased utility expenses in one area and energy savings in other areas. For instance, installation of an electric heat pump with heat recovery will cause savings on the external delivery of heat while generate additional utility costs from electricity.

The impact of operating expenses on the overall financial viability of the project depends on the corresponding energy- and non-energy savings and the complexity of the project. It also depends on the level of automation of the chosen solution. Furthermore, some salary expenses are temporary and phased out over time as the company matures and gets familiar with the new solution.

There is a trade-off between wages and costs for annual service agreements. In some cases, the company has the capabilities to partly in-source service and maintenance.

Some EE providers operate with an energy-as-a-service business model, where all monitoring, service and maintenance is handled by the EE provider. This is sometimes the case for energy storage projects, which require more skilled competencies. If the chosen solution comes with a high degree of service, a discount on the upfront costs (CAPEX) should be expected.

3.3 Energy savings

Energy savings is a key component and should be carefully assessed in a feasibility study. Energy savings are savings in utility expenses for all energy sources used in the company.

Total energy savings over a project lifetime are derived by forecasting production volumes and the costs of energy.

Aspects to consider when forecasting annual production volumes include:

- Expected efficiencies in production
- Expected capacity expansions
- Competition in the market and demand for products
- Historical growth in production volumes

Forecasting future annual production volumes is normally challenging. Especially in high-growth markets with considerable competition.

Elements to consider when forecasting the future energy prices include:

- Forward prices on electricity and fuels (applicable in liberalised electricity markets)
- Historic development of electricity and fuel prices
- Transportation costs
- Taxes and fees
- …

Forecasting electricity and fuel prices is subject to high uncertainty in highly liberalised markets where electricity is purchased on the spot market.

3.4 GHG savings

Energy efficiency projects will often result in reduced greenhouse gas (GHG) emissions. From a project feasibility perspective, GHG savings is important as it can tip the balance of the business case and potentially turn non-attractive projects into financially feasible projects.

The FS must calculate emission reductions from the project as pre-project emissions minus post-project emissions. For projects using electricity, the annual emission coefficient of the national power grid must be applied[3]. For projects using other forms of energy, non-electricity emissions factors published through MONRE's home page should be applied.[4]

The value of GHG emissions savings depends on the regulatory framework the company operates in.

In countries where an Emissions Trading System (ETS) system is operating, there is a cap on carbon emissions. Companies that are covered by the ETS system receive a fixed number of quotas that represent a company's allowance measures in carbon emissions. If a polluter emits more than its allowance, the polluter must purchase additional quotas. The cost of quotas constitutes a benchmark for potential savings arrived from GHG savings.

[3] http://www.dcc.gov.vn/van-ban-phap-luat/1101/He-so-phat-thai-luoi-dien-Viet-Nam-2021.html
[4] http://www.dcc.gov.vn/van-ban-phap-luat/

Similarly, companies in some countries are subject to national carbon taxes, normally expressed as a price per ton of CO_{2e} emitted. A carbon tax is a regulatory measure to incentivise companies to reduce the carbon footprint of their operations in a given location.

There are currently no carbon taxes applicable in Vietnam, but in Vietnam, an ETS will be piloted by 2025 and fully operational in 2028 according to the Decree no. 6 of 2022.

Furthermore, the embedded CO_2 content in products is increasingly becoming a competitive parameter in export markets. Many international companies are already today working to reduce the GHG emissions in their supply chain (their so-called Scope 3 emissions) under the voluntary Science Based Targets initiative (SBTi). This is reflected in requirements to producers in their supply chain to account for and gradually reduce the CO_2 footprint of their products. If the enterprise operates in such markets, the potential market value of reducing CO_2 emissions should be carefully assessed together with the marketing division of the enterprise (or something like that).

Finally, from 2026 some export companies will be subject to the Carbon Border Adjustment Mechanism[5] (CBAM), which puts a carbon tax on certain carbon intensive goods such as cement, iron and steel, aluminium and fertilizers entering the EU.

In sum, costs savings from GHG reductions could constitute avoided carbon taxes or avoided costs associated with purchase of carbon quotas.

3.5 Corporate taxes and import duties

Tax considerations play a crucial role in assessing the financial viability of the project since it affects net profits and the financing strategy as debt is tax deductible.

The relevant corporate tax rate should therefore be identified and included in the financial analysis of the project.

Imported equipment for energy efficiency investments may in some cases be eligible for reduced import duties. It is important to reflect the actual costs incurred by the company in the financial analysis.

Similarly, the FS should identify whether there are any tax incentives for environmental projects which for which the project may be eligible.

3.6 Inflation rate

The inflation rate should be included in the business case. Inflation rate is normally forecasted by considering the historic inflation rates in a specific country and the risk of future political and economic instability.

Inflation is an important factor to consider when assessing financial viability since inflation can erode the real returns on investments. Assets that do not outpace inflation may result in a decrease in real value over time. This is particularly relevant for long-term investments.

3.7 Financing plan and cost of capital

The financing plan lays out the terms and conditions considering equity/loan ratios, financing cost and terms and conditions. In the feasibility phase, the considerations on financing are important since it impacts total financing costs. Meanwhile, financing costs depend on available financing options and lenders' terms and conditions.

In the FS phase, developers do not have the full overview of financing costs and conditions, however the project developer can provide indications from general market conditions such as market interest rates, tenors, and

[5] More information about the EU CBAM-mechanism can be accessed here: Carbon Border Adjustment Mechanism - European Commission (europa.eu)

preferred equity/loan ratios. The project developer may inform their assessment at the FS stage through engagement with the company's primary bank connection to obtain some preliminary indications about the costs and conditions related to external capital for the project.

The project developer should describe the following as input to the financial analysis in chapter 5:

- The Total Investment Cost
- The expected % shares of own financing (share of equity) and external financing (share of debt)
- The expected market rate for external financing (cost of debt)
- The expected tenure and collateral requirements related to the external financing
- The corporate tax rate applicable to the company[6]
- The company's required return on their own financing (cost of equity)
- The resulting Weighted Average Cost of Capital (WACC)

The cost of capital reflects the costs of financing and is essential for calculating the value of the project.

Financing typically consists of a combination of debt and equity, which is why the company specific Weighted Average Cost of Capital (WACC) should be applied in the financial analysis.

The WACC is the rate that a company is expected to pay on average to all its security holders to finance its assets.

WACC formula:

$$(Share\ of\ debt\ \times\ market\ rate) \times\ (1 -\ corporate\ tax\ rate) +\ Share\ of\ Equity \times\ Cost\ of\ equity$$

The cost of debt is adjusted for the corporate tax rate since debt is tax deductible.

For a project to be financially viable for the company, its Internal Rate of Return (IRR) must exceed the WACC.

3.8 Incentive schemes

Any available incentive schemes and public grants may be important for the financial viability of the project.

Depending on the structure of the national incentive scheme and the demand for funding, granting of incentives will be more or less likely. An assessment of how likely it is that incentive schemes will be available for the chosen project should be performed.

Name of incentive/grant	Regulation	Responsible agency	Grant size	Probability
-	§	-	(VND)	(%)
…	…	…	…	…

Table 3 – Overview of incentives

Evaluation criteria of the incentive scheme, such as net energy savings, should be included in the evaluation.

Examples of incentives are grants to reduce upfront investment costs and tax incentives tied to energy or GHG savings.

3.9 Assessment of the financial viability of the project

The results of the business case provide information on the financial viability and financial attractiveness of the project.

[6] It is noted that tax deductibility of interest on loans is capped at 30% of earnings before interest, taxes, depreciation, and amortisation (EBITDA) when a taxpayer has related-party transactions. Please refer to [Vietnam - Corporate - Deductions (pwc.com)]

The business case returns a number of financial KPIs, which are critical information when assessing financial viability. This includes net present value (NPV), internal rate of return (IRR) and payback time (PBT).

DCF	The Discounted Cash Flow (DCF) is a valuation method used to estimate the value of an investment based on its expected future cash flows
NPV	The Net Present Value (NPV) is what a project is worth today based on Discounted Cash Flows (DCF). NPV enables comparisons of projects with different timings and cash flow distributions over the project lifetime.
PBT	The payback time (PBT) is the number of years required to recover an initial investment based on cumulative cash flows.
IRR	The Internal Rate of Return (IRR) is a discount rate that makes the net present value (NPV) of all cash flows equal to zero in a discounted cash flow analysis.

3.9.1 Discounted Cash Flow (DCF)

The discounted cash flow (DCF) analysis is presented. The Discounted Cash Flow (DCF) is a valuation method used to estimate the value of an investment based on its expected future cash flows. DCF gives a full overview of the negative and positive cash flows in each year of the project lifetime. The DCF should inform on how the project cash flows impact the liquidity and financial position of the company including the company's obligations concerning debt repayment.

Discounted cash flow formula:

$$DCF = \frac{CF_1}{(1+r^1)} + \frac{CF_2}{(1+r^2)} + \cdots \frac{CF_n}{(1+r^n)}$$

DCF = Discounted cash flow
CF_1 = cash flow in year 1
CF_2 = cash flow in year 2
CF_n = cash flow in additional years
r = Discount rate
n = Time period

WACC is normally used as the discount factor.

A cumulative discounted cashflow diagram is useful when you want to know how long it takes to recover the investment (pay-back time, PBT). The example in **Error! Reference source not found.** has a pay-back time of 8 years.

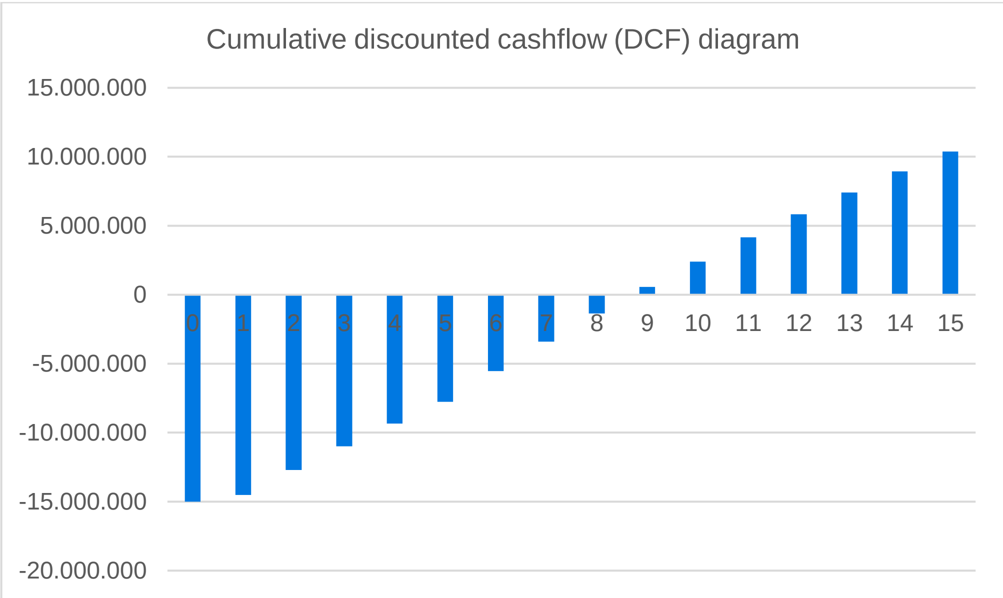

Figure 2 – Cumulative discounted cashflow diagram, CAPEX: 15 million., discount factor: 5%, project lifetime: 15 years.

3.9.2 Net Present Value (NPV)

Net Present Value (NPV) is a financial metric used to assess the profitability of a project. It represents the difference between the present value of cash inflows and the present value of cash outflows over a specified period of time.

Net Present Value (NPV) is derived by deducting the initial investment from the sum of future discounted cash flows.

$$NPV = -CF_0 + \frac{CF_1}{(1+r^1)} + \frac{CF_2}{(1+r^2)} + \cdots \frac{CF_n}{(1+r^n)}$$

NPV = Net present value
CF_1 = cash flow in year 1
CF_2 = cash flow in year 2
CF_n = cash flow in additional years
r = discount rate
n = Time period

At NPV = 0, the investment 'breaks even'.

3.9.3 Pay-back time (PBT)

Pay-back time (PBT) is the number of years required to recover an initial investment based on cumulative cash flows.

3.9.4 Internal Rate of Return (IRR)

When assessing the financial viability of a project, a key criterion is whether the project Internal Rate of Return (IRR) is equal to or above the Weighted Average Cost of Capital (WACC) for the Investor.

The project IRR is the interest rate at which the initial investment is equal to the discounted value of future cash flows from the project.

Hence, when IRR=WACC, the project investment "breaks even", when IRR>WACC the project investment returns more than the average cost of capital, and if IRR<WACC the project investment is not able to pay the full financing cost.

Investors have difference risk profiles and return expectations, which will impact how attractive the project is perceived.

3.10 Economic Analysis of projects

For projects planning to apply for funding through a financing facility funded by an International Financial Institutions (IFI) such as the World Bank and EIB, there will be separate requirements to supplement the financial analysis (assessing viability from a financial investment point of view) with an economic analysis (assessing socio-economic viability from a society point of view). The project developer should refer to the specific guidance available for the considered financing facility as these requirements will differ between different IFIs.

In general, the approach will take its point of departure in the financial analysis and perform a number of specific corrections:

1. Restatement of all prices to be excluding any taxes, duties, and subsidies.
2. Quantify key environmental externalities - in particular reduction in GHG emissions - and if a generally accepted shadow price (published by the government or an IFI) exists, or a local/regional market price (from an existing ETS) exists, then calculate the value of the externality and include it in the economic calculation.
3. Change the WACC in the calculation (reflecting the financing cost of the enterprise) to a social discount rate for Vietnam (e.g. 6.3% based on the OECD (2021b) working paper “Assessment of a Social Discount Rate and Financial Hurdle Rates for Energy System modelling in Viet Nam” which was prepared to support the Viet Nam Energy Outlook 2021).

On the basis of these changes, the economic NPV and IRR should then be calculated and compared with the financial NPV and IRR.
It is highly recommended to align with the specific requirements of the financing facility considered as the requirements will vary between them and no uniform approach exists.

4 Non-energy benefits (NEBs)

Non-energy benefits (NEBs) are potentially significant and should therefore be carefully assessed. NEBs might be equally important – or even more important – than the benefits from improved energy efficiency.

NEBs from the chosen energy efficiency solution might comprise a wide range of areas related to product quality, capacity gains, sustainability benefits etc.

Similarly, some projects may have Non-energy Costs, e.g. in terms of additional space requirements on-site that may impact future expansion opportunities.

The value of NEBs (and costs) should be assessed (and if possible quantified) from an economic perspective. As an example, improved product quality may generate additional demand for the product and increase sales by x% (see example in Table 4).

Non-energy benefits and costs		
NEB	**Description**	**Valuation**
Product quality	Does the chosen solution(s) lead to improvements in the product quality? Or does the chosen solution compromise product quality?	*Increased product quality is expected to improve the company’s market position and increase sales by x% compared to pre-implementation.*
Capacity gains	Does the chosen solution(s) enable the option for expanding production capacity?	The specific production costs decrease, as the plant can have a higher throughput. […]

Flexibility improvements	Does the chosen solution(s) lead to flexibility improvements?	Flexibility can be utilized to optimize the energy costs due to variable energy prices. Flexibility can also be for peak shaving, which will reduce the equipment capacity needed and therefore also the related investments. Flexibility can also be in terms of ability to vary the input products (e.g. types of wood) […]
Space requirements	Does the chosen solution(s) require additional – or reduced space or changed in building interior?	If additional space is needed then investment in additional buildings must be included, which can have a significant impact on the project's feasibility. […]
Production efficiency	Does the chosen solution(s) improve operational up-time?	This will give a higher throughput and therefore reduce the specific production costs. […]
Future expansion opportunities	Does the project yield future expansion opportunities?	This can support the production of new products or increase the existing, which all represent at value. […]
Sustainability	Will the chosen project improve the sustainability and carbon footprint of the company? Will this address current or expected customer demands and improve competitiveness?	This will help secure or increase a market share of the product if this is a requirement from the end customers or finally the end-user. […]

Table 4 – Non-energy benefits (NEBs) for an energy efficiency project

Besides from the NEBs listed in Table 4, a more extensive list is presented in Table 10 in Appendix 1. Here potentially relevant NEBs are presented, alongside an assessment of whether they might impact risks, costs, and the value proposition of the project.

Some of the questions raised in Table 4 are of "non-engineering" character and it is therefore important that the energy auditor and the company discuss involvement of sector- and product specialists, sales department, etc. to justify any benefit further – whether these come from the company's own organization, a main office or external consultants.

Sustainability benefits, such as GHG savings, are important to include in the FS study, as it improves the attractiveness of the project and increases the likelihood of securing financing. This is particularly important if the company seeks financing from institutional investors like the World Bank and The European Investment Bank (EIB), as these organizations add significant weight to sustainability impacts when prioritizing investment prospects. GHG savings occur if the project includes fuel switching whereby a more carbon intensive energy source (e.g., coal) is replaced with a less carbon intensive energy source (e.g., biomass). GHG savings may be quantified using national emission factors for the energy sources saved by the project (electricity, coal, gas, oil). For electricity the national GHG emission factors for grid-based electricity in Vietnam published by MONRE may be applied[7].

In some cases, financial investors may in their Cost Benefit Assessment of a project use a shadow carbon price (which is calculated to include environmental costs which are not priced in the market) to assess and rank investment options. In 2020, EIB updated their shadow carbon prices to reflect best available evidence to meet the Paris Agreement[8] (see Table 5).

EIB Shadow costs of carbon							
	2020	2025	2030	2035	2040	2045	2050

[7] http://www.dcc.gov.vn/van-ban-phap-luat/1101/He-so-phat-thai-luoi-dien-Viet-Nam-2021.html
[8] EIB (2023). The Economic Appraisal of Investment Projects at the EIB. 2nd edition. Report link: https://www.eib.org/en/publications/20220169-the-economic-appraisal-of-investment-projects-at-the-eib

Value (Eur./tCO_{2e})	80	165	250	390	390	525	800

Table 5 – EIB Shadow cost of carbon [9].

As a general principle, projects that can be achieved below EIB's shadow cost of carbon are considered more attractive and thus more likely to be considered for a loan. Meanwhile, when working outside EU countries EIB employs sensitivity analyses to account for local conditions and carbon markets.

5 Sensitivity analysis

The purpose of the sensitivity analysis is to account for how uncertainties related to, i.e. future energy prices, which could affect the overall feasibility of the project. Some risks and uncertainties cannot be quantified and should be discussed qualitatively, e.g. risks related to complexity and choice of technology.

…the sensitivity analysis should as a minimum consider the following uncertainties:

- CAPEX
- Energy prices and any applicable energy taxes
- Production volumes and production mix
- Financing costs
- Incentive schemes

The results of the sensitivity analysis are presented in a table to see the impact on key financial performance indicators (IRR, NPV and PBT)

		Scenario A	**Scenario B**	**Scenario C**
Investment	VND million	[………]	[………]	[………]
Lifetime	years	[………]	[………]	[………]
Net present value (NPV)	VND million	[………]	[………]	[………]
Internal rate of return (IRR)	%	[………]	[………]	[………]
Payback time (PBT)	Years	[………]	[………]	[………]

Table 6. Results from sensitivity analysis where IRR, NPV and PBT vary with CAPEX

Quantifying CAPEX uncertainties can be done by assessing uncertainties of the different components of CAPEX and assigning higher uncertainties to CAPEX elements, which are based on estimates and lower uncertainty to CAPEX elements, which are based on concrete budget codes (price lists) from suppliers. CAPEX uncertainty then becomes a weighted average as expressed in the formula below:

$$CAPEX\ uncertaintiy\ [\%] = (U_{installations} \times CAPEX_{installations}) + (U_{piping} \times CAPEX_{piping}) + \ldots\ldots.$$

A similar approach can be applied to other uncertainties such as funding costs and incentive schemes.

6 Social and environmental assessment

If funding for the project is sought from financial institutions through facilities that involve international financing, there may be separate requirements for social and environmental assessment of the project that goes beyond the national legal requirements. This will typically reflect the environmental and social procedures of the main financier

[9] EIB (2020). EIB Group climate bank roadmap 2021-2025. Report link: https://op.europa.eu/en/publication-detail/-/publication/98cc83ef-4f06-11eb-b59f-01aa75ed71a1/language-en

and be reflected in an elaborate Environmental and Social Management Framework for the specific financing facility[10].

The social and environmental assessment should account for legal and regulatory conditions impacting project implementation.

The table below should be used to describe the social and environmental implications of the project. Examples of general implications are provided. Meanwhile, in the FS study, social and environmental implications, and actions to enforce or remedy such implications should be thoroughly described.

Some implications are mostly temporary, only occurring during the construction phase while others are permanent occurring throughout the operation of the project.

Potential implications depend on the specific project, technology, and location.

Impact parameter	**Description**	**Temporary/permanent**	**Actions**
Job creation	The project has the potential to generate demand for highly skilled jobs during construction and operation phase.	Permanent	…Educating and upskilling of the local labor force
Public health	During construction, the large, concentrated workforce raises the demand for ensuring a healthy and safe working environment. After implementation the project may also result in permanent improvements in the working environment, e.g. through reduced particle emissions, noise etc.	Temporary or Permanent	…Plan work during hours where weather conditions are favorable. …install safety signs and manuals in the work environment
Labor safety	Lifting, transporting, loading, and unloading, electrical installations, hot installations can pose safety risks to workers during the construction phase. After implementation the project may also result in permanent improvements in safety, e.g. if a boiler is replaced by a heat pump.	Temporary or Permanent	…educate labor force in how to perform specific jobs in a safe manner. Introduce risk assessments procedures before any work operations are started.
Emissions of pollutants (e.g., NO_x/SO_x)	During the construction phase, exhaust gases from generators and engines release air pollutants such as NO_x, SO_x and CO_2.	Temporary or Permanent	…source engines and generators with filters to reduce release of air pollutants
Quality of life	The project has the potential to create a more interesting working environment, and it can also contribute to a feeling of being a part of contributing to the sustainability agenda.	Permanent	[…]
Education and awareness	[…]	[…]	[…]

[10] A good example for Vietnam is the Vietnam Scaling up Energy Efficiency Project (VSUEE), where the Environmental and Social Management Framework is available here: https://documents1.worldbank.org/curated/en/487091528452637075/pdf/Environmental-and-Social-Management-Framework.pdf

Local industry interests	[…]	[…]	[…]
Greenhouse gas emissions	[…]	[…]	[…]
Air and water quality	[…]	[…]	[…]
Resource conservation	[…]	[…]	[…]
Waste reduction	[…]	[…]	[…]
[…]	[…]	[…]	[…]

Table 7 – Social and environmental impact of the project during construction and operation phase

Further inspiration may be found in publicly available EIA screening checklists[11] and EIA templates[12].

The social and environmental assessment is part of the overall evaluation of project feasibility. It also informs project owners and prospective financiers of the general acceptance from the local community, which is critical in the implementation of the project.

In assessing the social and environmental impacts, the following stakeholders should be considered:

- Neighbours
- Staff
- Customers
- Supply chain
- Local and governmental authorities

[11] https://pnea.sprep.org/sites/default/files/2022-04/SPREP%20EIA%20Screening%20Checklist.pdf
[12] https://safetyculture.com/checklists/environmental-impact-assessment-template/

7 Risks and mitigation strategies

A project will have several risks, which must be identified in a feasibility study. A risk log of potential risks and actions (Table 8) and a risk matrix (

Impact	*5*	*Medium*	*High*	*Very High*	*Extreme*	*Extreme*
	4	*Medium*	*Medium*	*High*	*Very High*	*Extreme*
	3	*Low*	*Medium*	*Medium*	*High*	*Very High*
	2	*Very low*	*Low*	*Medium*	*Medium*	*High*
	1	*Very low*	*Very low*	*Low*	*Medium*	*Medium*
		1	*2*	*3*	*4*	*5*
		Likelihood				

Figure 3

), which rates risks according to impact and likelihood are necessary tools in a project.

Having a detailed risk mitigation strategy improves investor confidence as it improves the overall attractiveness of the investment. An example of a template for risk assessment is provided below.

ID	Category	Specific risk description	Impact	Likelihood	Action(s)
1	*Political risks*	1.1 Existing scheme for financial support for EE investments is discontinued	[…]	[…]	[…]
2	*Regulatory risk*	2.1 Delays in obtaining necessary permits and regulatory approval.	[…]	[…]	[…]
3	*Technical risk*	3.1. The technology does not deliver the expected product quality or production capacity.	[…]	[…]	[…]
4	*Risks of budget increase*	4.1 The tender outcome is higher than budget estimates.	[…]	[…]	[…]
5	*Risks of schedule delays*	5.1 The project implementation is delayed due to e.g. delayed subcontractors…	[…]	[…]	[…]
6	*Risks of reduced results*	6.1 The technology does not deliver the expected energy savings.	[…]	[…]	[…]

Table 8 – Risk register and action log

The risk matrix is a useful tool for creating an overview of most critical risks. Risks which have high impact on project implementation and a high likelihood of realisation (placed in the red area) should be closely monitored.

Impact	*5*	*Medium*	*High*	*Very High*	*Extreme*	*Extreme*
	4	*Medium*	*Medium*	*High*	*Very High*	*Extreme*
	3	*Low*	*Medium*	*Medium*	*High*	*Very High*
	2	*Very low*	*Low*	*Medium*	*Medium*	*High*
	1	*Very low*	*Very low*	*Low*	*Medium*	*Medium*
		1	*2*	*3*	*4*	*5*
		Likelihood				

Figure 3 - Risk matrix

The risks can be evaluated by using the following categories for each risk.

Likelihood

1: 0-15% The likelihood is very small
2: 16-30% The likelihood is small
3: 31-45% It is likely
4: 46-60% It is quite likely
5: 61-75% It is very likely

Impact:

1: The Impact is very small. It can be handled within the plan's buffer.
2: The Impact is small. It can be handled within the project manager's tolerance.
3: The Impact is medium. This will lead to a decision presentation to the management.
4: The Impact is great. This will result in a greater delay and/or increase in the cost of the project.
5: The Impact is very great. It will close the project (showstopper).

To mitigate and handle the risk, then each risk should be addresses with the following questions:

- How can the risk be prevented?
- At what stage in the project can the risk occurs?
- Will the risk influence other project elements?
- If the risk occurs what is the consequences?
- Which actions must be taken if the risk occurs?
- When is the risk no longer present?
- If the risk is mitigated, will it then have an effect on time, content, resources etc.?
- Who is responsible for the risk?

8 Implementation plan

A high-level timeline stating the individual phases of the project and key milestones is important since it gives investors and management the confidence that the project is realistic and manageable.

Project milestones, such as budget approval or securing financing, should be included in the time schedule.

This should also include any permits needed for implementation of the project.

	Month 1-3	Month 3-5	Month 5-7	Month 7-9	Month 9-11	Month 11-13	Month 13-15	Month 15-17	Month ...
Project initiation and planning	M								
Design and Engineering			M						
Financing and budget approval					M				
Permits needed					M				
Preparation of tender, tendering, contracting and stand still						M			
Implementation								M	
Commissioning and handover									M
Monitoring and optimization									M

M = Milestone

Table 9 – High level time schedule for project implementation

Challenges in realising the implementation plans and delay mitigation strategies should be described in chapter 8. Challenges may for instance includes the supply chain restraints and longer environmental approval processes causing delays in project implementation.

A list of critical stakeholders and their respective roles in the different phases of the project should be described.

9 Conclusions and recommendations

In the last chapter of the feasibility study, conclusions and recommendations are made. This includes summarizing the soundness of the project, key project benefits and recommendations for implementation and further actions.

9.1 The soundness of the project

In this section, the soundness of the project is summarized. This covers the technical, financial, and practical rationale of the project.

9.2 Key project benefits

In this section, key project benefits are highlighted. Examples of project benefits include:

- Energy savings
- GHG reductions
- Cost savings
- Improved product quality

9.3 Recommendations

The last step in the FS report is recommendations for further actions and next steps required for project implementation.

This may include actions related to environmental investigations needed for detailed planning and system design, or incorporations of management techniques to complete critical steps of the project successfully. It may also include paying attention to new political winds, which could have implications for the availability of public funding of tax incentives.

The scope of this section depends on the observations made in the FS phase, the complexity of the proposed solution, and risks and dependencies identified.

Appendix 1 – Non-energy benefits (NEBs)

A list of potential non-energy benefits in energy efficiency projects are provided in Table 10. The list is based on proven benefits of past projects in Europe and the U.S. [13]

BENEFITS OF ENERGY-EFFICIENCY PROJECTS	IMPACT ON RISKS	IMPACT ON COSTS	IMPACT ON VALUE PROPOSITION
Waste			
Reduced waste heat		X	
Reduced hazardous waste	X	X	
Reduced sewage volume	X	X	
Reduced sewage pollution level	X	X	
Reduced product waste	X	X	
Emissions			
Reduced dust emissions	X	X	X
Reduced CO, CO_2, NO_x, SO_x emissions	X	X	X
Reduction of refrigerant gases emissions	X	X	X
Production			
Reduced malfunction or breakdown of machinery and equipment	X	X	X
Improved equipment performance	X	X	X
Longer equipment life (due to reduced wear and tear)		X	
Improved product quality	X	X	X
Increased production reliability (due to better control)	X	X	X
Larger product range			X
Reduced customer service costs (due to better quality)		X	X
Improved flexibility of production	X	X	X
Improved temperature control	X	X	X
Improved air filtration system	X	X	X
Reduced raw material need	(X)	X	
Reduced water consumption	(X)	X	
Reduced consumables	(X)	X	
Shorter production cycle (shorter process cycle time)		X	X

[13] Killip, G., Cooremans, C. & Fawcett, T. (2018). M-Benefits: D2.2 Guidelines for Protocols, Interventions and Evaluations. Report link: https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5bd4f4af7&appId=PPGMS

Increased production yields		X	X
Operation and maintenance			
Reduced maintenance cost		X	
Reduced machinery and equipment wear and tear	X	X	
Reduced engineering control cost		X	
Working environment			
Reduced noise	X	X	X
Air quality improvement	X	X	X
Improved temperature control (thermal comfort)	X	X	X
Improved lighting (visual comfort)	X	X	X
Improved workforce comfort	X		X
Improved workforce productivity	X	X	X
Reduced absenteeism	X	X	X
Reduction of health costs		X	
Reduced need for protective equipment		X	
Risk reduction			
Reduced risk of accident and occupational disease	X	X	
Reduced CO_2 and energy price risks	X	X	
Reduced water price risk	X	X	
Reduced commercial risk	X	X	
Reduced legal risk	X	X	
Reduced disruption of energy supply risk	X	X	
Others			
Increased installation safety	X	X	X
Improved staff satisfaction and loyalty	X	X	X
Reduced staff turnover	X	X	X
Delayed or reduced capital expenditure		X	
Reduced insurance cost		X	
Additional space		X	X
Simplification and automation of customs procedures		X	X
Contribution to company's vision or strategy			X

Improved image or reputation	X		X

Table 10 - Non-energy benefits of energy of energy-efficiency projects (Long List).