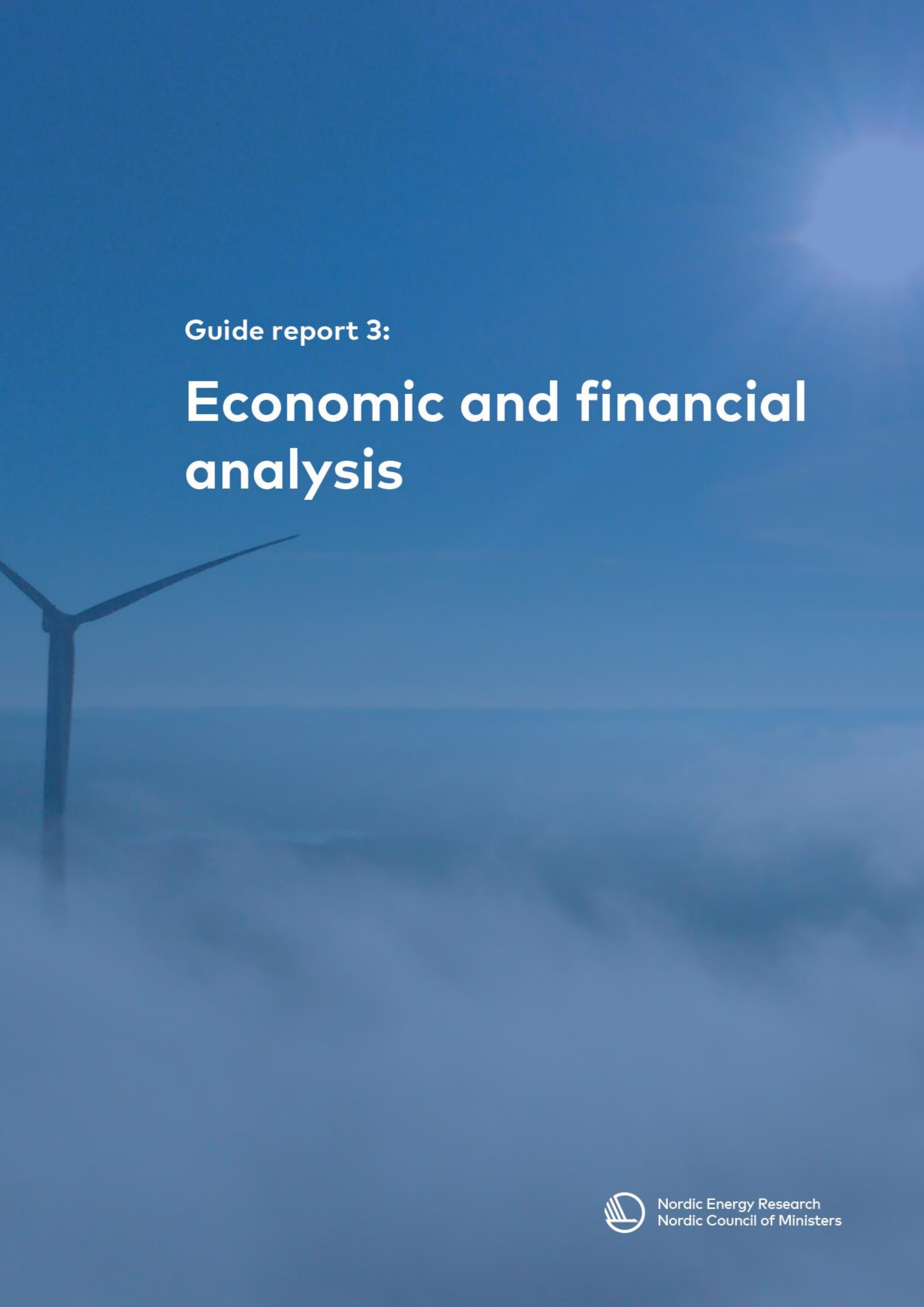

Guide report 3:

Economic and financial analysis

Nordic Energy Research
Nordic Council of Ministers

Guide report 3:

Economic and financial analysis

Peter Bode Nielsen, Morten Hørmann, Jakob Nymann Rud and Frederik Møller Lauge

COWI A/S

November 30, 2016

ISBN 978-82-92874-36-3 (PDF)

Layout: Misha Jemsek
Cover photo: COWI A/S

Nordic co-operation
Nordic co-operation is one of the world's most extensive forms of regional collaboration, involving Denmark, Finland, Iceland, Norway, Sweden, the Faroe Islands, Greenland, and Åland.

Nordic co-operation has firm traditions in politics, the economy, and culture. It plays an important role in European and international collaboration, and aims at creating a strong Nordic community in a strong Europe.

Nordic co-operation seeks to safeguard Nordic and regional interests and principles in the global community. Shared Nordic values help the region solidify its position as one of the world's most innovative and competitive.

Contents

List of abbreviations		4
1	Introduction	5
1.1	Basic definition	6
2	Central economic concepts	6
2.1	Interest rates	6
2.2	Discounting and annuities	7
2.3	Key Indicators	8
3	Financial analysis	9
4	Economic analysis	10
5	Sensitivity analysis	11

List of abbreviations

COP: Coefficient Of Performance. The rate of conversion of energy into heat – most notably used in relation to heat pumps.

CAPEX: CAPital Expenditure

DSCR: Debt Service Coverage Ratio

EIA: Environmental Impact Assessment

EPC: Engineering, Procurement and Contracting

FID: Final Investment Decision

FS: Feasibility Study

IFC: International Finance Corporation (part of the World Bank Group)

IRR: Internal Rate of Return

NPV: Net Present Value

O&M: Operations and maintenance

OPEX: Operational EXpenditure

PFS: Pre-Feasibility Study

RE: Renewable Energy.

RES: Renewable Energy Source

RES share: Renewable Energy Source share. The share of renewable energy used out of the total energy used.

SIA: Social Impact Assessment

WACC: Weighted Average Cost of Capital

1 Introduction

This report is a part of the guideline for project developers and planners of renewable energy projects. The guide is specifically aimed at supporting the implementation of 100% renewable energy heating and electricity production in sparsely populated areas in the Nordic countries. This report is aimed at providing the reader with a basic understanding of the concepts and definitions governing financial and economic analyses.

The types of renewable energy projects addressed by the guide relate to electrification of heating and production of electricity. In communities connected to a national power grid (on-grid), there is very little economic incentive to invest in local renewable electricity production. The investment will be local but the benefits are spread to the entire national grid. In communities that are not connected to a national power grid (off-grid) the incentive to invest in renewable electricity production is much greater, as the entire benefit is incurred locally.

Electricity production projects and electrification projects can be very different in regards to stakeholders and structure of the business case(s).

Energy production projects:

- One facility to invest in
- One project owner in search for external investors
- One business case to mind

Electrification projects:

- Electrification implemented at household level (many small facilities and investors)
- One large investor in infrastructure
- Many business cases to mind, all with different preferences and capacity

For both types of projects, the main activities of the project developers or owners lies within concept identification, and technical prefeasibility studies. However, when reaching feasibility study phase of the project development, the developers or owners will have to identify sources of finance wether it is external finance, own equity or a combination. The technical complexity of a project can often take much of the initial focus for project developer, but the difficulties of assuring the necessary financing should not be underestimated.

The contents of this report is generic, in the sense that it is not specifically targeted at 100% renewable energy projects. Regardless of the project type, the tools needed to complete a financial or economic analysis remain the same. In Guide Report 1: Leirvík Case, you will find an example of a financial and economic analysis of a renewable energy project on the Faroe Islands.

Over the past 2 years, the International Finance Corporation (IFC) has commissioned and published two separate guidelines for project development of renewable energy projects[1].

---

[1] IFC (2016): Converting Biomass to Energy - A Guide to Developers and Investors. Pending publication ultimo 2016.

IFC (2015): Hydroelectric Power - A Guide for Developers and Investors.
http://www.ifc.org/wps/wcm/connect/topics_ext_content/ifc_external_corporate_site/ifc+sustainability/learning+and+adapting/knowledge+products/publications/hydroelectric_power_a_guide_for_developers_and_investors

These guidelines are great source for additional information. We have chosen to refer directly to these guides for definitions of key concepts in order to provide consistency and transparency. Whenever we quote the IFC guides, the quoted material will be encased in blue boxes with the source indicated beneath.

1.1 Basic definition

Financial and economic analyses serve two different purposes. The financial analysis is used to document a reasonable expected return on investment to prospective investors. The economic analysis is used to document that the project is a net benefit to society as a whole – this is especially interesting in relation to public investments.

The main traits of the financial and economic analysis respectively are:

Financial Analysis:
- Investor's perspective
- Based on market prices
- Including taxes, tariffs, subsidies etc.
- Does not include externalities

Economic Analysis:
- Society's economic perspective
- Applies economic prices excluding taxes, tariffs, subsidies etc. to reflect the value of the project to society.
- Externalities (positive and negative) are included and quantified in monetary terms (such as reduction in GHG emissions).

2 Central economic concepts

In this section, we briefly introduce the central economic concepts which are essential to understanding financial and economic feasibility studies. Where possible, the definitions of these concepts are quoted directly from the IFC guidelines, IFC (2016) and IFC (2015).

2.1 Interest rates

Interest rates are a central element in financial and economic analyses. The interest rate is the opportunity cost of capital, i.e. what is the expected return on investment of your capital if you had invested it elsewhere.

WACC

The return of a project shall be compared to the alternative return, given the money is invested elsewhere. Therefore, the appropriate discount rate for a financial assessment is the **weighted average cost of capital** often referred to as the WACC.

The WACC is calculated using the following formula:

$$WACC = Share\ of\ Equity \times Costs\ of\ Equity + Share\ of\ Debt \times After\ tax\ Costs\ of\ Debt$$

where the corporate tax shield is deducted from the cost of debt.

Economic/Social Discount Rate

The appropriate discount rate, when performing an economic analysis is the rate of return of the entire economy, i.e., the national opportunity cost of capital. In comparison, the WACC applied in the financial analysis is only relevant to a specific investor, as the WACC calculation is based on a single investor's cost of equity and debt. The economic discount rate is typically lower than the WACC.

Source: IFC (2016)

Interest rates are very important to economic and financial feasibility studies, as they enable the comparison of costs and revenues at different points in time.

2.2 Discounting and annuities

Interest rates are used to compare payment streams today with payment streams tomorrow. Such a comparison can employ one of two main methods:

- Net Present Value
- Total Annual Net Cost

These methods each have their strengths and weaknesses. The Net Present Value method is good for keeping track of cash flow and variations in costs and revenues over time. The Total Annual Net Cost method is good for managing complex projects with many technical components with different technical life spans.

Net Present Value

On some projects, revenues and costs vary over time, e.g. up front investments and revenues that fluctuate (in real terms) over time. In that case you will need to use the Net Present Value method to calculate the difference between the present value of all future costs and the present value of all future revenues.

This method will also allow you to keep track of cash flow, as the method requires you to plot all costs and revenues over time.

NPV: The **Net Present Value** is a measure of profitability used in corporate budgeting to assess a given project's potential return on investment. The NVP is the difference between the present value of cash inflows and the present value of cash outflows. Due to the value of time, the NPV takes into account the discount rate (here the WACC) over the lifetime of the project, thus presenting the annual cash flows in present values.

The interest rate applied for calculating the NPV is either the WACC or the economic discount rate. The NPV is calculated using the following formula:

$$NPV\ (i, N) = \sum_{t=0}^{N} \frac{C_t}{(1+i)^t}$$

where **i** is the financial discount rate (WACC), **Ct** the net cash flow at time t and **N** the total number of time periods.

A NPV of zero (0) implies that the return on the investment equals the WACC. Therefore, a negative NPV can be found for a project with a positive return, but where this return is lower than the investor's required return.

Source: IFC (2016)

Total Annual Net Cost

On project where revenues and operating costs are constant over time it may be an advantage to use a simpler approach than NPV. The Total Annual Net Cost method annualizes all capital costs into annual payments on a loan with either WACC or the Economic Discount Rate as the interest rate. Since operating costs and revenues are identical from one year to the next it will be sufficient to calculate the sum of the annual payment on the capital investment, the annual operating cost and the annual revenue for a single year. This Total Annual Net Cost is directly comparable to other alternatives calculated in the same manner.

This method is especially effective when you have a project that includes many technical components with different technical life spans. You simply calculate the annual payment on each component separately, and base the payment calculation on a loan with the same duration as the technical life span.

2.3 Key Indicators

When you compare one or more alternatives, it is usually sufficient to directly match the Net Present Value or the Total Annual Net Cost in order to assess which project is the better alternative. However, in many cases you will also want to directly assess whether the preferred alternative is economically and financially feasible. The primary indicator of this is simply the value of the Net Present Value or the Total Annual Net Cost. A positive value means the project yields a net surplus – and a negative value means a net loss.

In addition to this direct assessment of the value exists several ways to extract more detailed information on the profitability of a project.

IRR: The **internal rate of return** is a measure used for assessing the profitability of potential investments. The internal rate of return is the discount rate that makes the net present value of all cash flows equal to zero.

DSCR: The **debt service coverage ratio** is the ratio of cash available for debt servicing to interest, principal and lease payments. The DSCR is a measurement of an entity's ability to earn enough cash to cover its debt payments.

$$DSCR = \frac{Net\ operating\ income}{Total\ debt\ service}$$

The higher this ratio is, the lower the risk of the lender. To be confident that the investor or project owner can repay his debt, financial institutions (lenders) will demand that the DSCR is larger than one (1) by a certain margin.

Payback period: This is the period necessary to earn back the initial capital investments. The shorter the payback period, the stronger is the financial viability of the project.

The case example in the text box below presents the methodology approach and the results of a financial analysis.

Source: IFC (2016)

3 Financial analysis

A financial analysis estimates the profitability of a project, from an investor's perspective. In a financial analysis you compare the costs of the project to the expected revenue over the project lifespan. This includes costs of financing and taxes/subsidies. Figure 3-1 illustrates the elements in a financial analysis.

Figure 3-1 Approach to financial analysis

Source: IFC (2016)

The financial analysis must consider the market demand for the products, how tariff regimes function for each product, and how this will affect the cash flow. The revenue consist of sale of one or more of the following production outputs, depending on whether the project is on-grid or off-grid:

On-grid:
- Heat

Off-grid:
- Heat
- Electricity

The goal of the financial analysis is to demonstrate the ability of the project to generate a sufficient return on investment to be interesting for investors. The results of the financial analysis are typically presented as the Net Present Value and the Internal Rate of Return. Investors will also be interested in the Debt Service Coverage Ratio to assess the financial risk of the project.

4 Economic analysis

An economic analysis takes a broader view of the profitability of the project. In an economic analysis, you include external effects such as environmental impacts and health impacts. The value of external effects is typically assigned using economic opportunity costs or shadow prices. An economic analysis does not include taxes, tariffs, subsidies, etc. These costs do not add to economic productivity and are merely transactions between entities within the economy.

An economic analysis is always a comparison between a base case (or reference scenario) – the expected present and future situation without the project – and the project alternative. Without this comparison, it would be impossible to assess whether the external effects are an improvement or not. Whenever the term "benefit" is used in an economic analysis it refers to the change in external effects that can be attributed to the project.

Figure 4-1 illustrates the elements in an economic analysis.

Figure 4-1 Approach to economic analysis.

The goal of the economic analysis is to demonstrate that the project is a net gain for society. This is typically mandatory whenever there is an element of public financing or regulation, e.g. tariffs. Economic analysis is also more and more frequently being used to brand private investments as being socially responsible. The importance of this type of analysis varies significantly with the project size.

- Smaller energy projects, decoupled from the national grid, will mainly have a local economic impact. The social and environmental impacts are furthermore of local scale.

- Larger energy project, connected to national energy grids, will have bigger economic impact on society as a whole. The larger projects the larger environmental and potential social impacts.

Typically, there is a greater variation in how the results of the economic analysis are reported – as opposed to the financial analysis. The financial analysis serves a very specific purpose, whereas the economic analysis is used to communicate the benefits of the project to many different stakeholders. As an example, external benefits are often reported in physical units, e.g. $kgCO_2$, as well as in monetary terms.

5 Sensitivity analysis

A sensitivity analysis assesses the impacts of uncertainty/risk by varying one or more uncertain parameters at a time. By observing the impact these variations have on the results of the financial and economic analyses, you will be able to identify the greatest sources of risk in your project.

Typical parameters exposed to sensitivity analyses are the following:

- Investment costs
- Operating costs
- Energy prices

Reports and materials in this series

- Renewable energy supply and storage: Guide for planners and developers in sparsely populated areas.
- Guide report 1: Heat supply in Leirvík - Case Study
- Guide report 2: Technology catalogue
- Guide report 3: Economic and financial analysis
- Guide report 4: The project development process
- Fornybar energy og lagring i spredtbyge områder (an Excel based screening tool: Include data for your own local community and analyse the feasibility of optional solutions for renewable energy systems.)

All reports available for download at www.nordicenergy.org/publications