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Effectiveness of Public Financial Support in an Electricity Transmission Project between Iceland and the UK

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Abstract

The feasibility of the project called IceLink is now being examined, which entails laying 800–1,200 MW high-voltage direct current (HVDC) submarine cables over 1,000 km and transmitting over 5 TWh per annum. This project will meet the growing demand in Europe for electricity derived from renewable energy sources, though there exists a relatively high degree of potential risks (e.g., financial risk due to the lingering affect of the financial crisis). This study aims to examine the effectiveness of public financial support for the project by using a quantitative analysis as well as discussing public financial support as a possible measure to fill the viability gap. The simulation results imply that the project is unfeasible unless there is public financial support. In the light of the public nature of the project and its promotion of green power, public financial support may be acceptable. It can thus be said that public financial support will be effective for this project. Also, the sensitivity analysis results show break-even points for three major parameters:—WACC, wholesale power price, and CAPEX—to NPV. Furthermore, the corresponding public financial supports—concessional loans provided by public financial institutions, applying for the feed-in tariff (FiT) system in the UK, and receiving a government subsidy for initial investment—are discussed as potential measures to fill the viability gap. In order to have a feasible project, it is essential to introduce one or more effective measures of public financial support.

Keywords: renewable energy, electricity transmission, project viability, public financial support, IceLink

1. Introduction

1.1 Background

Attempts to transmit electricity from Iceland to other European countries have been studied for a long time (Hammons, Lee, Chew, & Chua, 1998). The average domestic, wholesale electricity price in Iceland is quite a bit lower than electricity prices in other, nearby European countries. Specifically, the price of electricity in Iceland was just above 20 USD/MWh in 2014, while the wholesale electricity price for the UK was 80–140 USD/MWh (Askja Energy, 2016). Additionally, almost all electricity in Iceland is generated by renewable energy sources (Statistics Iceland, 2015), which would help meet the growing demand for renewable energy in Europe that mainly stems from the EU's promotion of energy from renewable sources (European Union, 2009).

These conditions have accelerated a project called IceLink, which aims to transmit electricity from Iceland to the UK. The national power company Landsvirkjun (2016) is examining the feasibility of laying 800–1,200 MW high-voltage direct current (HVDC) submarine cables over 1,000 km and transmitting over 5 TWh per annum. The assumed electricity transmission route is shown in Figure 1 (Nakayama, Sasaki, & Ito, 2015).

While the IceLink project seems very appealing, there is a relatively high degree of potential risk. Sasaki and Nakayama (2016) illustrated some of the major potential risks of the IceLink project, which included regulatory risks, political risks, and financial risks. Considering the current financial climate in Iceland, financial risk may be the most influential factor with regard to this project. In other words, it will be quite difficult to raise long-term and stable funds. The necessity of public financial support is obvious when considering this context. (One should also keep in mind that the expected rate of return for public finance can be set relatively low in order to make a project feasible.)

Figure 1. Planned trade of electricity from Iceland to the UK in the IceLink project.

Source: Nakayama et al. (2015)

1.2 Previous Research

Criscuolo and Menon (2015) advocated for the importance of public support in the green sector using fiscal incentives such as public investment, loans, or financing as their examples. They also described cases in the USA as well as the UK where these policy measures have been adopted.

Frisari and Stadelmann (2015) examined the financial model of two large-scale, concentrated solar power plants in India and Morocco, exploring the role of policies and public finance in reducing financial risk. According to these two case studies, public financial support, such as concessional loans provided by public financial institutions, can contribute to a cost reduction in public budgets.

Jones (2015) analyzed the barriers perceived by private investors regarding investment in clean energy infrastructure. As a result, Jones identified five categories of barriers, including general financial barriers, and subsequently proposed five policy principles for investment solutions. One of these policies mentioned that national governments should actively promote public financial support in order to mobilize private finance.

Suzuki (2015) analyzed the barriers pertaining to technology diffusion in developing countries. Consequently, financial barriers, as well as technological and institutional barriers, were recognized as key obstacles to investment. Moreover, Suzuki proposed that the problem with such financial barriers included high capital costs and the low priority of finance and also that public financial support (such as the Green Climate Fund) was essential in order to overcome these obstacles.

Ondraczek, Komendantova, and Patt (2015) examined the effect of financing costs on the leveled cost of solar PV power, focusing on differences in the weighted average cost of capital (WACC). Furthermore, this study demonstrated that policies introducing low cost finance could be effective when promoting PV installation in developing countries near the equator.

Sasaki and Nakayama (2015) conducted analyses of the Central Asia South Asia Electricity Transmission and Trade Project (CASA-1000) from both a qualitative and quantitative perspective. They focused on the change of net present value (NPV) to WACC and suggested that the project might be feasible if the WACC was $\leq$10.0% and the volatility was below a certain value, even when the hedge cost of the project's risks were taken into consideration.

1.3 Objectives and Research Questions

This study aims to examine the effectiveness of public financial support in an electricity transmission project between Iceland and the UK using a quantitative analysis. Due to the lingering impact of the financial crisis, it seems very difficult to raise long-term and stable funds privately unless the project's internal rate of return (PIRR) is relatively high. Thus, our research questions are as follows:

- Is public financial support effective in an electricity transmission project between Iceland and the UK according a numerical simulation?
- If yes, what kind of public financial support can be considered as funding options?

2. Method

This study adopts the discounted cash flow (DCF) method in order to examine the viability of an electricity transmission project between Iceland and the UK. First, we define NPV as

$$\mathrm{NPV} = \sum_t (FCF)_t \exp^{-rt} - I \tag{1}$$

where $(FCF)_t$, r, and I are free cash flows at time t, discount rate, and the amount of the initial capital expenditure, respectively. In general, the WACC is adopted as a discount rate. In this method, the viability of a project is judged by the sign of the NPV. That is to say, if the NPV is positive, the project is considered feasible, and vice versa. The discount rate where NPV becomes zero is called PIRR. In other words, when the discount rate is set to PIRR, the present value of future free cash flows becomes equal to that of the initial capital expenditure as follows:

$$\sum_t (FCF)_t \exp^{-PIRR \cdot t} = I \tag{2}$$

When we focus on PIRR, the viability of a project is judged by the magnitude of the relationship between PIRR and WACC. That is, if PIRR is greater than WACC, the project is feasible, and vice versa. Obviously, these two approaches are essentially identical, and we thus examine the viability of this project using the former approach, namely evaluation by NPV.

3. Prerequisites

In addition to literature survey (i.e., Landsvirkjun, 2016; Ondraczek et al., 2015; and Ofgem, 2015), we assume the parameters needed for running a numerical simulation including Project Life and Construction Period based on interviews with relevant experts, shown in Table 1. We also set a range of sensitivity analysis—as shown in Table 2—for the purpose of determining the effect of changes within major parameters on NPV.

Table 1. Simulation parameters.

WACC	(%)	5.0
Wholesale Power Price	(USD/MWh)	80.00
CAPEX	(USD Billion)	2.2
OPEX	(USD/MWh)	40.00
Trade Volume	(TWh)	3.25
Project Life	(years)	25 (including construction period)
Construction Period	(years)	5 (five equal disbursement)

Table 2. Sensitivity analysis.

WACC	From 0.5 to 5.0%
Wholesale Power Price	From 80.00 to 170.00 USD/MWh
CAPEX	From 1.3 to 2.2 USD Billion

4. Results and Discussion

4.1 Simulation Results

The simulation results are shown in Table 3, and according to these results, the project shall be judged unfeasible because the NPV is negative. However, it can be said that public financial support would be an effective way to fill the viability gap so that the project can proceed.

Table 3. Simulation results.

Elapsed Years	(years)	0	1	2	3	4	5	6	7	…	24	25
Cash Inflow	(USD Million)							260.00	260.00		260.00	260.00
Cash Outflow	(USD Million)							130.00	130.00		130.00	130.00
Investment	(USD Million)		440.00	440.00	440.00	440.00	440.00					
NPV	(USD Million)	–650.06										

4.2 Sensitivity Analysis Results

4.2.1 WACC

The sensitivity analysis results of WACC are shown in Table 4 and Figure 2. Based on this, we can see that the break-even point for WACC to NPV exists between 1.0% and 1.5%. Note that the assumed WACC for this simulation is 5.0% because it may be necessary to fill a gap of about 3.5% to 4.0% points. Being provided with concessional loans by public financial institutions would be an effective measure to counteract the viability gap. That is to say, the low cost of interest on loans can lower WACC simultaneously. Incidentally, Sasaki and Nakayama (2016) have also suggested that the Icelandic pension fund (the Pension Fund for State Employees [LSR]) might be a candidate for financing the project.

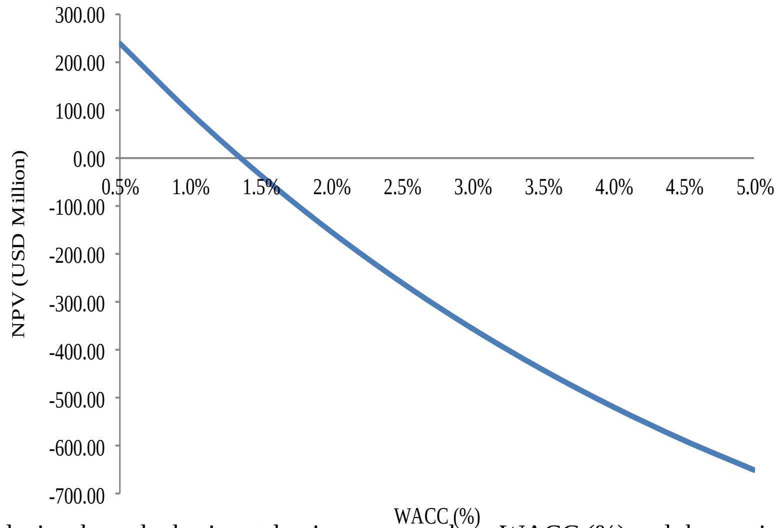

Figure 2. Sensitivity analysis where the horizontal axis corresponds to WACC (%) and the vertical axis corresponds to NPV (USD million)

Table 4. Sensitivity analysis of WACC.

WACC (%)	NPV (USD million)
0.5	239.81
1.0	95.19
1.5	–35.32
2.0	–153.04
2.5	–259.16
3.0	–354.76
3.5	–440.81
4.0	–518.19
4.5	–587.70
5.0	–650.06

4.2.2 Wholesale Power Price

The sensitivity analysis results of wholesale power price are shown in Table 5 and Figure 3. According to this, the break-even point for wholesale power price to NPV exists between 100.00 and 110.00 USD/MWh. Note that the assumed wholesale power price for this simulation is 80.00 USD/MWh because we believe that a gap of around 20.00 to 30.00 USD/MWh must be filled. Applying for the feed-in tariff (FiT) system in the UK may counteract this. That is, under the FiT system, electricity derived from renewable sources can be set at a higher purchase price. Incidentally, the role of a FiT for non-UK renewable electricity projects is under discussion at this stage (Department of Energy & Climate Change, 2014).

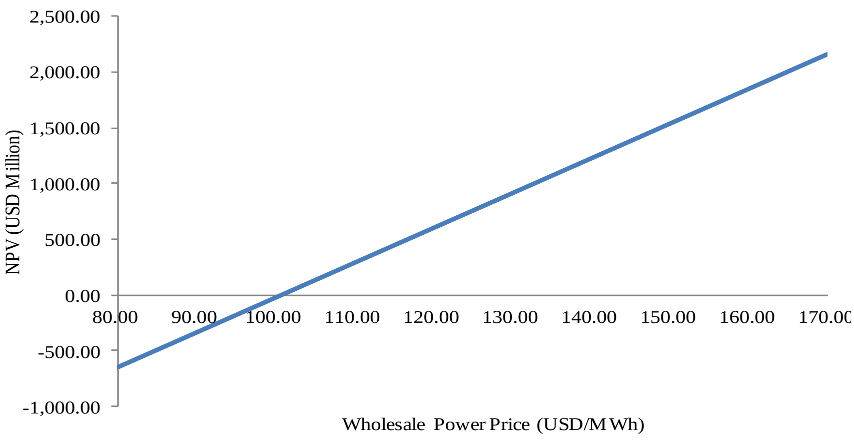

Figure 3. Sensitivity analysis where the horizontal axis corresponds to Wholesale Power Price (WPP) and the vertical axis corresponds to NPV (USD million)

Table 5. Sensitivity analysis of wholesale power price.

Wholesale Power Price (USD/MWh)	NPV (USD million)
80.00	–650.06
90.00	–338.00
100.00	–25.94
110.00	286.12
120.00	598.18
130.00	910.24
140.00	1,222.30
150.00	1,534.36
160.00	1,846.42
170.00	2,158.48

4.2.3 CAPEX

The sensitivity analysis results of CAPEX are shown in Table 6 and Figure 4. Based on this, we can see that the break-even point for CAPEX to NPV exists between 1.4 and 1.5 billion USD. Note that the assumed CAPEX for this simulation is 2.2 billion USD because we believe that a gap of around 0.7 to 0.8 billion USD must be filled. One of the potential measures to fill this gap is to receive a governmental subsidy for the initial investment. However, it would be difficult to fill a gap that amounts to about one third of the entire CAPEX solely with a government subsidy.

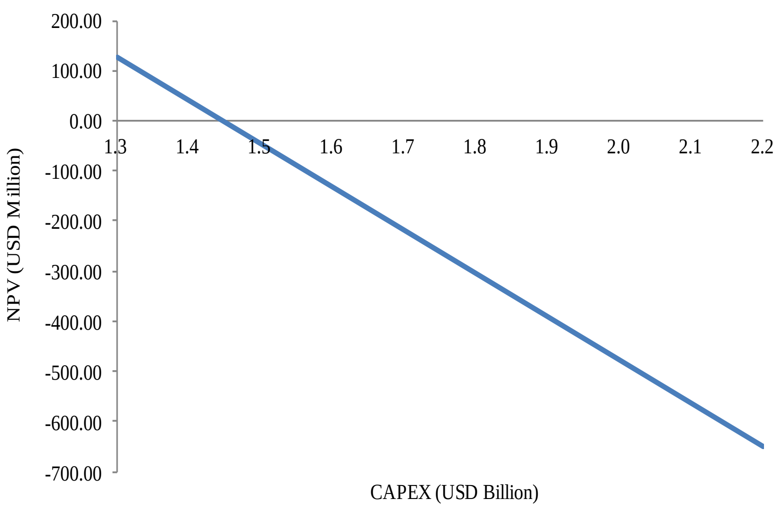

Figure 4. Sensitivity analysis where the horizontal axis corresponds to CAPEX (USD million) and the vertical axis corresponds to NPV (USD million)

Table 6. Sensitivity analysis of CAPEX.

CAPEX (USD Billion)	NPV (USD million)
1.3	126.52
1.4	40.23
1.5	–46.05
1.6	–132.34
1.7	–218.63
1.8	–304.91
1.9	–391.20
2.0	–477.49
2.1	–563.77
2.2	–650.06

4.3 Summary

The simulation results imply that the project seems unfeasible because the NPV is negative. The summary of the sensitivity analysis thus far is shown in Table 7.

Table 7. Summary of sensitivity analysis

Parameters	Analysis Results	Public Financial Support as Measures
WACC	The break-even point for WACC to NPV exists between 1.0% and 1.5%. Therefore, the viability gap is estimated at around 3.5% to 4.0% points.	It would be effective for public financial institutions to provide concessional loans. The Icelandic pension fund may be a suitable candidate for financing this project.
Wholesale Power Price	The break-even point for wholesale power price to NPV exists between 100.00 and 110.00 USD/MWh. Therefore, the viability gap is estimated at around 20.00 to 30.00 USD/MWh.	Applying for the FiT system in the UK would be an effective way to fill this gap, although the role of FiT in non-UK renewable electricity projects is currently under discussion.
CAPEX	The break-even point for CAPEX to NPV exists between 1.4 and 1.5 billion USD. Therefore, the viability gap is estimated at around 0.7 to 0.8 billion USD.	One way to fill this gap may be to receive a government subsidy for the initial investment. However, it would be difficult to fill the gap solely with a government subsidy.

5. Conclusions

The simulation results have implied that the project would be unfeasible unless there was public financial support. In light of the public nature of this project and its promotion of green power, public financial support may be acceptable. Thus, it can be said that public financial support would be effective in this project. The sensitivity analysis results have shown the break-even points of each of the parameters to NPV, and moreover, we have discussed each of the corresponding public financial supports that might fill the viability gap. In order to make the project feasible, it will be essential to introduce one or more of these measures.

The future challenges of this study are two-fold: a) analyzing the superiority of public financial support as a means of filling the viability gap, and b) reflecting on the uncertainty of the future of the analysis. With regard to the former, we can introduce a cost-benefit analysis in order to evaluate the efficiency of public expenditure. This approach may also be effective in ensuring accountability to taxpayers. With respect to the latter, it is quite significant for the project to consider the uncertainty of the future—the life of this project is too long to reflect on all the factors that might crop up. Incidentally, the real-options approach would be an effective method of addressing this issue.

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