Management of Risks of Power-to-X Project

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Abstract

Supply chain risks have been studied for decades but rarely in the energy sector, and the financial effects of the realization of supply chain risks have received limited scholarly attention. The objective is to study the risks related to power-to-x fuel projects and examine how the risks affect the profitability of investments. This study uses life-cycle costing (LCC) to study the profitability of a project, and scenario analysis is connected to potential risks identification. The study also opens the discussion of pricing the business risk in the field of green transformation.

Keywords: supply chain risk management, risk pricing, power-to-x

Introduction

Background

The transition to fossil-free energy production has begun but it has been slow due to the significant capital-intensive investments they require. The technology for the energy transition is relatively old, but compared with fossil energy production, its economic feasibility on an industrial scale is uncertain. From the supply chain risk management point of view, the effects of energy transition on environmental, demand, process or supply chain operations have not been examined widely. The aim of supply chain risk management is to identify the potential sources of risk and implement appropriate actions in order to avoid or contain supply chain vulnerability. In this study, we examine the risks related to a power-to-x project/plant investment.

P2X (power-to-x) fuels refer to synthetic fuels produced with power-to-x technology. The production process of P2X technology based synthetic fuel is presented in Figure 1. P2X synthetic fuels are produced from carbon dioxide and hydrogen in synthesis. (Laaksonen et al. 2021) The product can be methane, methanol, and dimethyl ether. And for example, methanol can be further processed to gasoline, diesel, and kerosene, or possibly utilized in chemical industry products and the plastic industry. Used hydrogen can be waste hydrogen from industry or it can be produced with electrolysis. If hydrogen is produced with electrolysis, the process requires a lot of electricity. In order to produce green hydrogen, emission free electricity is needed.

In this paper, we consider the production process where methanol is produced in MeOH synthesis and methanol is further processed into gasoline (MTG synthesis). Thus, the end product is power-to-x technology based synthetic (drop-in) fuel.

These P2X based synthetic fuels can be used to replace fossil fuels. P2X fuels can compete with advanced biofuels but there are several obstacles that hinder their usage. The main issue that affects the demand of P2X fuels is regulation and its effects on the demand and price of these fuels. (EU RED II) The emission reduction target is ambitious, 55% below 1990 levels by 2030, and carbon neutrality by 2050 (EC 2023). To achieve these targets, different actions and solutions are needed. One potential option is P2X fuels but industry scale production of these fuels is lacking. At the beginning, promoting investments in P2X fuels requires subsidies or other support from the community. The key to success is also understanding the risks and critical factors in economic feasibility.

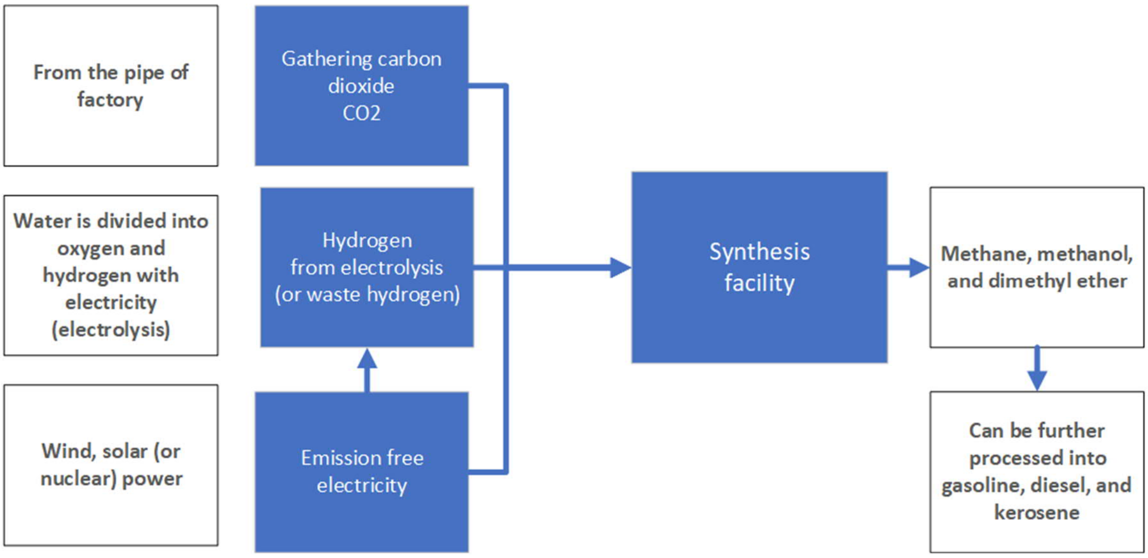

Figure 1: Production process of P2X technology based synthetic fuels

Aim of the study

The research gap can be justified from two different perspectives. Firstly, our approach starts with practical gap spotting, where we identified an empirical and a contextual gap from the literature. Supply chain risk management has been studied extensively in the past decades, but very rarely in the energy sector. Secondly, we can justify our study by managerial problems and practices; the financial effects of the realization of the supply chain risks have been ignored or have received limited scholarly attention. The valid profitability assessment approaches were not applied in supply chain risk management. The approaches in which profitability assessments are linked to supply chain risk management are incompletely presented. Subsequent to risk identification, an assessment of the risks concerning their probability of occurrence and the extent of their adverse effect on the entire supply chain should be carried out.

The aim of the study is to examine the risks related to a power-to-x project/plant investment. The research questions are:

1. What supply chain risks are related to power-to-x plant investments?
2. How do the changes in different risks affect the profitability of power-to-x plant investments?

Research is conducted as a case study, and it applies multiple methods, such as expert interviews, profitability modelling and scenario analysis. This study uses life-cycle costing (LCC) to study the profitability of a project. The case considers a power-to-x technology based synthetic fuel plant. Expert interviews are utilized to understand the studied context: power-to-x market, supply, demand, and prices. Profitability modelling utilizes the DCF method and includes components such as capital expenditures, operational expenses, and demand and price expectations. The DCF modelling includes different scenarios considering different end-products and different sources of supply, to demonstrate the risks and their effects on profitability. This research does not consider the risks related to the technology itself, nor the concrete risks of transportation, warehousing, distribution, etc. related to raw materials and finished products.

As a result, we present a list of supply risks and estimate the cost effect of supply risk occurring. The results show that supply risks relate to disruption, price escalation, technology, quality, scheduling, safety, and regulation. The profitability of a plant is most critical to the availability of hydrogen, the selling price of synthetic fuel, and the operation time.

Theoretical point of view

Supply chain vulnerabilities and risks

The importance of supply risk management has been understood for decades, and those risks have been studied extensively in the context of business risks. Sadgrove (1997), for example, emphasized the risks connected to suppliers and their delivery performance: defective planning and extended delivery chains cause problems in terms of delivery reliability.

Sources of vulnerability include different risks related to supply chains. According to Johnson (2001), risks in the supply chain fall into two categories: those associated withproduct demand (seasonality, volatility) and product supply (capacity limitations, supply disruptions). Chopra and Sodhi (2004) identified their categories and drivers of supply chain risks. Their risk categories include disruptions, delays, systems, forecasts, intellectual property, procurement, receivables, inventories, and capacity, each one ofwhich may have several variations with regard to their source and type of impact.

There are many different dimensions to consider in the risk management of supply chains. It is clear that benefits and risks vary according to the type of business relationship. According to the literature (Huttunen et al. 2000; Teece 1988; Williamson 1991), it is possible to appraise the main sources of risks that emerge in the network context. First of all, there are so-called asset-specificity-related “hold-up” risks, which could be explained as follows: the higher the asset specificity and uncertainty and the greater the danger of opportunism, the higher the “hold-up” risks related to outsourcing/loose networks and the better the options for in-house manufacturing/tight networks (e.g., strategic collaboration or joint ventures), and vice versa (Bensaou 1999). The second risk type includes competency and market-related “inefficiency” risks: the more competitive the markets for complementary competencies are, the more potential buyers/suppliers there are, and the lower the transaction-cost-related risks. The third type are knowledge-related, and they are called “spill-over” or “appropriability” risks: the more appropriable new knowledge is, the smaller are the risks related to outsourcing/loose network options, and vice versa. Finally, there may be time-horizon-related “timing” risks: the greater the differences in planning horizons between the buyer (typically more myopic) and the suppliers (typically more patient), the higher the risks of networking, and vice versa. Other relevant collaboration-related risk types include replaceability (cf. the above-mentioned “inefficiency” risk), loss of strategic flexibility, and dependency (Lonsdale and Cox 1998).

About Resiliency

According to Ponomarov and Holcomb (2009) the concept of resilience is directly related to important issues such as ecological and social vulnerability, the politics and psychology of disaster recovery, and risk management under increasing threats. Supply chain resilience and supply-related risk management cannot be viewed separately from each other. Supply chain resilience assumes significance in this regard. Resilience is defined in literature as the adaptive capability of a system to return to its original state or even better after being disturbed (Christopher and Peck 2004). Also, the ability to manage risks, i.e. being better positioned than competitors to deal with vulnerabilities, is the essence of supply chain resilience (Sheffi 2005).

Supply chain risk assessment is a central part of supply chain resilience, and it can be reduced and summed up to the following risk types: demand risks, supply risks, process risks, control risks, environmental risks, and furthermore vulnerability check as well. On the other hand, the price of risks has not been taken into account much in previous research.

Methodology

Economic feasibility is an important parameter regarding the possibility of P2X to practical applications. This study uses life-cycle costing (LCC) to study the profitability of a project. Various studies have been conducted on LCC calculations as a follow-up to earlier life-cycle assessment (LCA) reviews in the field of green transition (e.g. Fawzy et al. 2022; Miranda and Kulay 2023; Sollai et al. 2023).

In this study, the LCC is based on the initial outlay of technical installation, capital cost during construction phase, and yearly operating margin derived from technology modelling, market analysis and knowledge of interviewed experts. Expert interviews (13 experts in the fields of oil and energy industry) were utilized to get background understanding about the studied context: power-to-x market, supply, demand, and prices. The results of the expert interviews about market analysis are discussed in detail by Laaksonen et al. (2021). LCC is performed for a 20-year lifetime. The value of cash flow is determined on a yearly basis, and the present value (the value point in time 0) is the beginning of the first operating year. The yearly cash flows occur from year one to 20 (n). The present value (PV) of cash flow (Equation 1) is calculated as follows:

$$PV = \sum_{t=1}^{n} \frac{CIF_t - COF_t}{(1+i)^t} \qquad \text{Eq.1}$$

Where:

Where:	t	time index
	n	the last year cash flows take place
	i	yearly interest rate
	CIF_t	cash inflow
	COF_t	cash outflow

The initial investment cost (I) of technical installation, including engineering, occurs at the value point in time 0. NPV is the difference between the present value of cash inflows and the present value of cash outflows from year 1 to 20 (PV) less the present value of initial investment (I).

$$NPV = PV - I \qquad \text{Eq. 2}$$

The value of the company increases or decreases due to the positive or negative NPV, respectively. This surplus is considered as the cost of risk in this study. The company can deal with the financing costs of investment by the cash inflow without the surplus (i.e. NPV=0). The value of NPV reflects the loss of money to finance new projects primarily in this case.

Supply chain risk management is studied by means of scenarios. The NPVs of five scenarios are calculated. The scenarios vary by technology, source of hydrogen, price, and variety of end products (described in the next chapter). The risk analysis explores the profitability of scenarios 1, 3, 4 and 5 in detail, studying the NPV when a variable included in the LCC develops disadvantageously. In this study, sensitivity analysis of one variable was conducted. The sensitivity analysis answers two questions simultaneously: "How does the NPV change with any given variation of input data?" and "Which critical value must input data achieve to make the project profitable ($NPV \geq 0$)?" This article discusses mainly the latter question, the break-even point, but naturally all values above and below that point are possible. The results of this study show the maximum present value cost of risk that can occur without turning the project unprofitable.

Analysis

To examine supply chain risk management, five scenarios were created. Short descriptions of each scenario and the related risks are summarized in Table 1. The scenarios differ in end products (i.e. production process) or the source of supply (e.g.

source of hydrogen). Figure 2 visualizes how the scenarios are placed in relation to the production process.

Scenario 1 is the base case methanol-to-gasoline (MTG) process; scenario 2 is MTG plus electrolysis installed to fill the gap between waste hydrogen and demand hydrogen; scenario 3, MTG 2.0, is modified scenario 1: the income from sales is considered higher and some instruments have been added to initial investments that increase the value of I; scenario 4 is a methanol (MeOH) case; and scenario 5 describes the case where the variation of end products is widest because of technological selection, and methanol-to-olefins (MTO) being coupled with Mobil's olefins to gasoline and distillate (MOGD) synthesis. (Laaksonen et al. 2021). In general, risks related to power-to-x projects/investments can be as follows:

- Availability of green energy/electricity (supply disruption risk): Price development is uncertain and EU legislation may rule how the green electricity should be produced (e.g. own wind park or electricity from grid)
- Market and price of end products (synthetic fuels) are uncertain due to EU legislation (demand risk: synthetic fuels are drop-in products that can respond to the blending obligation)
- Uncertainty in raw material supply, availability, and options (supply risk)
- Technology is developing (hold-up risk), new investments are start-ups and pilot plants. Thus, real O&M costs and real operating times are not certain (process risk).
- No experience of industry scale production: Economy of scales can be achieved in large industry scale production (process risk, and knowledge and personal -related spill-over risk).
- Uncertainty of investment subsidies (environmental risk: political)
- Investment (high degree of asset specify) costs can be higher than expected (hold-up risk).
- The suitable timing is a remarkable issue since P2X is a capital-intensive industry.

These risks are common for each scenario, but there are some risks that are emphasized in certain scenarios. Next, the scenario specific risks are discussed.

Table 1 – Risks related to scenarios

Scenario / case	Description	Risks
Scenario 1: Base case MTG	• MTG process where the product is **gasoline** • Hydrogen is **waste hydrogen** (low-cost hydrogen) • CO_2 from cement industry (other possibilities as well)	• Waste hydrogen unavailable • Source of CO_2 defines the location of plant or transport of CO_2 (pipe) • Cost of electricity is not remarkable when hydrogen is supplied, not produced • Uncertainty of market and price: Legislation and regulations define the market, price (premium?) and competitors (advanced biofuels?) • No experience of industry scale production, pilot plant
Scenario 2: Base case MTG with electrolysis	The same as Scenario 1, but hydrogen is produced with **electrolysis**	• Production of hydrogen in electrolysis is expensive: investment costs and inefficient production process

	• MTG process where the product is **gasoline**
	  ◦ Self-sufficient in hydrogen production
	  ◦ CO_2 from cement industry (other possibilities as well)
		• A lot of electricity is needed: availability and price of electricity (own wind park or grid)
		• EU legislation: The requirements of green electricity?
		• Source of CO_2 defines the location of plant or transport of CO_2 (pipe)
		• Uncertainty of market and price: Legislation and regulations define the market, price (premium?) and competitors (advanced biofuels?)
		• No experience of industry scale production, pilot plant

Scenario 3: MTG 2.0	The same as Scenario 1, but some new parameters and some parameters are updated • MTG process where the product is **gasoline** • Hydrogen is **waste hydrogen** (low-cost hydrogen) • CO_2 from cement industry (other possibilities as well) • Optimistic product prices • Catalysts costs included	• Waste hydrogen unavailable • Source of CO_2 defines the location of plant or transport of CO_2 (pipe) • Cost of electricity is not remarkable when hydrogen is supplied, not produced • Uncertainty of market and price: Legislation and regulations define the market, price (premium?) and competitors (advanced biofuels?) • This case includes optimistic fuel prices • No experience of industry scale production, pilot plant
Scenario 4: MeOH	• MeOH process where the product is **methanol** • Lower investment costs because methanol is not refined further • Hydrogen is **waste hydrogen** (low-cost hydrogen) • CO_2 from cement industry (other possibilities as well)	• Waste hydrogen unavailable • Source of CO_2 defines the location of plant or transport of CO_2 (pipe) • Cost of electricity is not remarkable when hydrogen is supplied, not produced • The price of methanol is remarkably lower than gasoline/diesel/kerosene • Versatile use of methanol: marine, option to process further into gasoline/diesel/kerosene, chemical industry, plastic industry etc. • No experience of industry scale production, pilot plant
Scenario 5: MTO-MOGD	• MTO-MOGD process where the products are **gasoline, diesel and kerosene** • Hydrogen is **waste hydrogen** (low-cost hydrogen) • CO_2 from cement industry (other possibilities as well)	• High investment cost • Waste hydrogen unavailable • Source of CO_2 defines the location of plant or transport of CO_2 (pipe) • Cost of electricity is not remarkable when hydrogen is supplied, not produced • Uncertainty of market and price: Legislation and regulations define the market, price (premium?) and competitors (advanced biofuels?)

		• No experience of industry scale production, pilot plant • Versatile use of end products: road transportation, marine, aviation. Synthetic kerosene demand is expected to be high.

Regarding scenario 1, the essential risks are related to the availability of waste hydrogen (supply risk), uncertainty of market (demand risk), i.e. the actual demand and price of synthetic gasoline (depending on EU regulation), and no experience of industry scale production (process risk). In scenario 2, waste hydrogen is not available and, thus, hydrogen is produced with electrolysis. In addition to the demand and process risks, the main risk in this scenario is the availability and price of renewable electricity. The production of hydrogen with electrolysis requires a lot of low-cost electricity. The risks in scenario 3 are the same as in scenario 1. In scenario 4, the product is different from the previous scenarios, and there are risks and advantages related to the methanol produced. The price for synthetic methanol is much lower than for synthetic gasoline, but there are many purposes of use for methanol, and thus the market and demand are wider. The risks in scenario 5 are quite same as in scenarios 1 and 3, but the investment cost is higher due to the more expensive technology. However, the products are versatile and can be used in road transportation, marine, and aviation. The demand for synthetic kerosene is expected to be high.

In scenarios 1, 3, 4, and 5, where hydrogen is waste hydrogen, there are risks related to the supply price of waste hydrogen. The price for waste hydrogen is assumed to be low, but it is possible that there is competition for the waste hydrogen. The price for waste hydrogen can be regarded as a control risk. In all the scenarios, there is risk of whether the investment can get subsidies from the government. The risk related to subsidies can be regarded as an environmental risk.

For each scenario, the profitability is calculated with the DCF method. NPV for the scenarios is presented in Table 2. It can be noticed that with the starting values, scenarios 1, 3, 4, and 5 are profitable with a positive NPV. In scenario 2, where hydrogen is produced with electrolysis, the NPV is negative, and the scenario is unprofitable. Table 2 also demonstrates the size of the investment in different scenarios as well as the assumed amount of subsidy.

Table 2 – Profitability of scenarios

Scenario (M€)	Total investment	Investment subsidy	NPV
Scenario 1: Base case MTG	67,6	26,4	20,8
Scenario 2: MTG + electrolysis	117,5	40,1	-166,2
Scenario 3: MTG 2.0	82,8	28,6	53,0
Scenario 4: MeOH	62,0	21,4	7,2
Scenario 5: MTO-MOGD	99,3	34,6	56,9

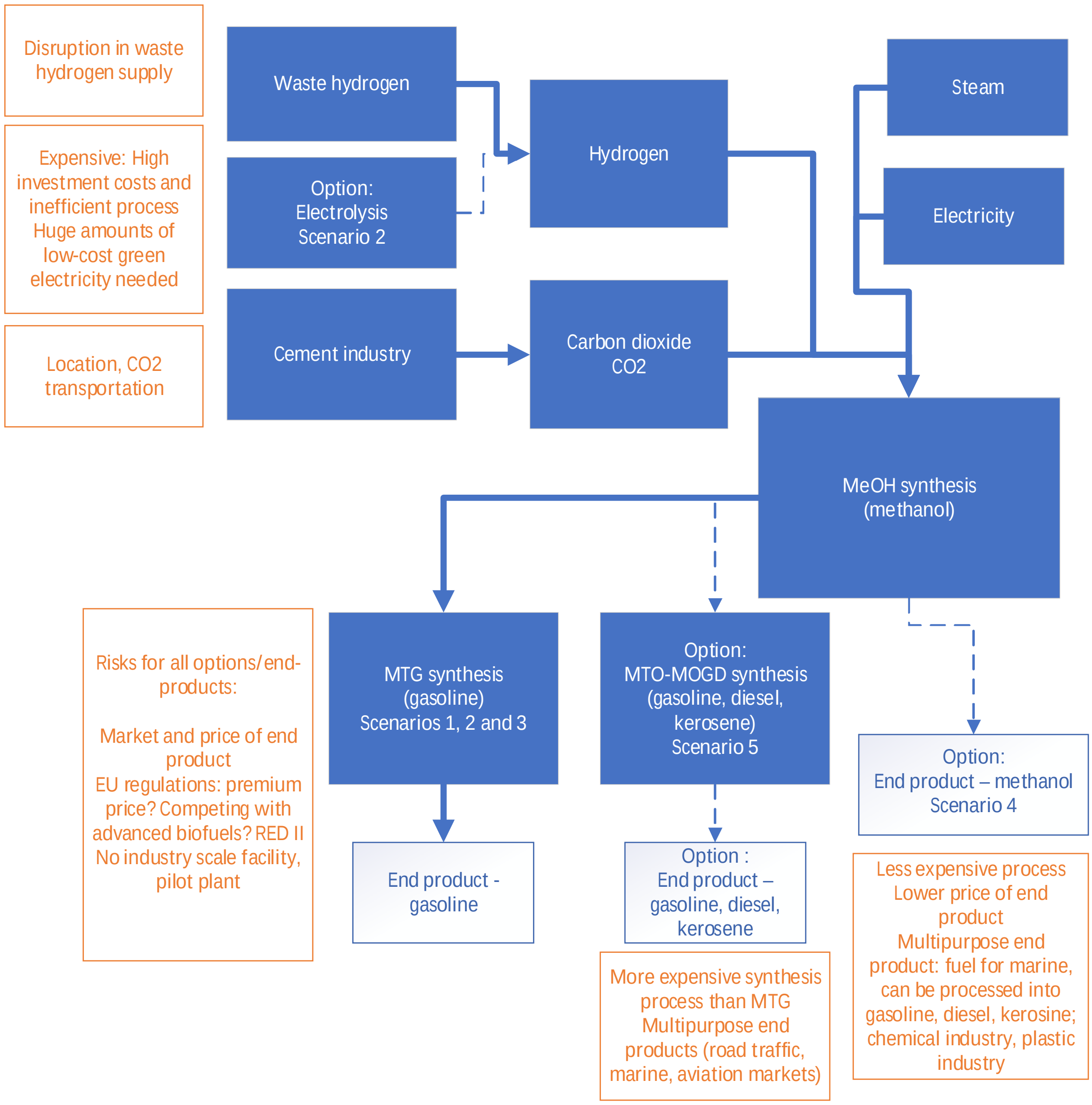

Figure 2 – Production processes of different scenarios and the related risks

As Table 2 showed the profitability of the scenarios with the assumed starting values, the profitability is then examined when different risks occur and how these risks affect the profitability of the investment. The risks and their categorization were discussed earlier, and the risks can be categorized as follows:

- Demand risk: The expected price for P2X fuel cannot be achieved.
- Process risk: Because there is no experience from industry scale production, there is a risk that the operation time is lower than expected.
- Control risk: Supplier raises the price of waste hydrogen.
- Environmental risk: For political reasons, no subsidy is received.
- Supply risk: Waste hydrogen is not available, and the hydrogen needs to be produced with electrolysis.

Table 3 shows the break-even points of different risks. In other words, how much the starting value can change in order for the NPV to gain value 0, which is the point when the investment becomes profitable or unprofitable.

Table 3 – Break-even points of different risks, NPV = 0

Scenario	Demand risk: Price change %	Process risk: Operation time change %	Control risk: Hydrogen price change %	Environmental risk: Subsidy change %
Scenario 1: Base case MTG	**-12,7**	**-20,7**	**53,3**	**-74,8**
Scenario 3: MTG 2.0	**-26,0**	**-37,3**	**140,0**	**NPV > 0 (subsidy 0€)**
Scenario 4: MeOH	**-5,3**	**-9,4**	**20,0**	**-31,6**
Scenario 5: MTO-MOGD	**-25,7**	**-34,9**	**146,7**	**NPV > 0 (subsidy 0€)**

Scenario 2 illustrates the supply risk, when waste hydrogen is not available and hydrogen needs to be produced with electrolysis. Scenario 2 is remarkably negative/unprofitable (see Table 2) with an NPV of -166,2 M€. Because the result would be the same in every scenario where waste hydrogen is not available, the supply risk is not presented in Table 3. All the scenarios would be remarkably negative if hydrogen were produced with electrolysis with current energy/electricity prices. Supply risk can be seen as the most critical risk for all the scenarios.

The results of sensitivity analysis show that demand risk is the second most critical for electric fuels (see Table 3). For example, in scenario 4, if the price of methanol decreases only -5,3%, the NPV is 0. In this case the price of risk is 7,2 M€ (Table 2). The end products of the scenarios are substitutes for fossil fuels. The competing products are typically cheaper and there are normally no problems in supply, production, delivery etc.

Discussion & Conclusion

This study opens the discussion on pricing the business risk in the field of green transformation. Previous research has scratched the surface of the topic of this research, but their main interest has been in risks related to technology or raw materials, e.g. hydrogen can easily ignite or/and explode (IEA 2021). The topic is relevant globally.

This study identified theory-based supply chain risk management models for the business risks of P2X projects. The results showed that the supply risk is the most remarkable because the technology of electrolysis is not competitive. The second remarkable risk is the demand risk especially in terms of the price of P2X fuels. The third is the process risk because the risk is that the real operation time is lower than expected. It must also be remembered that industrial scale production might differ from pilot plant. The fourth is the environmental risk which, in this case, is the investment support. The control risk is considered the least remarkable risk since the warehousing of hydrogen is difficult at the moment. The supplier of hydrogen must supply it to earn the highest revenue. This type of sole source situation can still be difficult for P2X plants.

The results of this study suggest that it is not profitable to produce P2X fuels using electrolysis at the current price of electricity. The results of Sollai et al. (2023) confirm the result. They conclude that the technology is far from competitive, and if e-methanol is sold at the same market price as fossil-derived methanol (demand risk), the projects are unprofitable. Technological innovations will overcome the challenge of intermittent renewable energy sources, like wind, however. IEA (2021) estimates that green hydrogen can be competitive by 2030. This type of progress would decrease the risks accrued by the unviability of waste hydrogen, especially if renewable energy sources are included in the initial investment; in that case the price and availability of electricity is low risk.

In this study, the role of regulator is studied through environmental risk, more specifically the subsidy available for this type of investment. More relevant from the risk point of view might be the acts of the regulator supporting creation of demand. Governments have served the carrots, but the time of sticks has not yet come. However, aviation companies are ready to buy. The use of sustainable fuels is less than 1% of the total at present. The problem seems to be on the supply side, and therefore the role of subsidies is central (Owens Thomsen 2023).

Many start-up companies have emerged in the area of green transition. Their business seems to be on a knife's edge at the moment, because the financiers are not ready to tie up their capital until it is clearer in which direction the technology and law will develop.

In this study, the volume, cost, and price of variables are fixed over the operating lifetime of a plant. In the future, the simulations would give more insight into analysis when combining the supply chain business risks with a profitability model. Further research is needed to analyse and model the financial effects of the realization of supply chain risks. On the other words, what is the cost and price of risks?

References

Bensaou, M. (1999) Portfolios of Buyer-Supplier Relationships. Sloan Management Review, 40, 35-44

Chopra and Sodhi (2004). Managing Risk to Avoid Supply-Chain Breakdown. MIT Sloan Management Review. September.

Christopher, M. and Peck, H. (2004), "Building the Resilient Supply Chain", The International Journal of Logistics Management, Vol. 15 No. 2, pp. 1-14.

European Commission (2023) Climate Action. Available at: https://climate.ec.europa.eu/index_en

Fawzy S., Osman A.I., Mehta N., Moran D., Al-Muhtaseb A.H., Rooney D.W (2022) Atmospheric carbon removal via industrial biochar systems: A techno-economic-environmental study. Journal of Cleaner Production, Vol. 271, 1333660

Huttunen, A., Kyläheiko, K. and Virolainen, V-M., 2000. Identifying and Avoiding Risk in the Advanced Internet Technology Partnership. Proceedings of the 5th International Symposium on Logistics. Japan.

IEA (2021) Global Hydrogen Review 2021. https://www.iea.org/reports/global-hydrogen-review-2021/executive-summary

Johnson (2001). Learning from Toys: Lessons in Managing Supply Chain Risk From the Toy Industry. California Management Review, Vol 43, No. 3, Spring.

Laaksonen, P., Karjunen, H., Ruokonen, J., Laari, A., Zhaurova, M., Kinnunen, S.K., Kosonen, A., Kärri, T., Sinkkonen, T., Rissanen, T., Tervonen, A., Varis, J., 2021. Feasibility Study for Industrial Pilot of Carbon-Neutral Fuel Production - P2X: Final Report. Lappeenranta-Lahti University of Technology LUT, Lappeenranta, ISBN 978-952-335-668-9 [pdf].

Lonsdale and Cox (1998). Outsourcing: A Business Guide to Risk Management Tools and Techniques. Earlsgate Press.

Miranda D.S., Kulay L. (2023) A prospective study on the environmental feasibility of supplying electricity to the Brazilian Amazon through biogas power generation. Sustainable Energy Technologies and Assessments, Vol. 55, 102962

Owens Thomsen M. (2023) Chief economist, IATA, 9.1.2023. https://yle.fi/a/74-20011443

Ponomarov S. and Holcomb M. (2009). Understanding the concept of supply chain resilience. The International Journal of Logistics Management.

Sadgrove, K. (1997). The complete guide to business risk management. Routledge.

Sheffi (2007). The Resilient Enterprise: Overcoming Vulnerability for Competitive Advantage. The MIT Press.
Sollai S., Porcu A., Tola V., Ferrara F., Pettinau A. (2023) Renewable methanol production from green hydrogen and captured CO2: A techno-economic assessment. Journal of CO2 Utilization, Vol. 68, 102345
Teece, D.J., 1988. Technological Change and the Nature of the Firm, in Dosi, G. et al (eds.). Technical Change and Economic Theory. Pinter Publishers. London, pp. 256-281.
Williamson, O.E., 1991. Strategizing, Economizing, and Economic Organization. Strategic Management Journal, Vol. 12, pp. 75-94.