An exploratory analysis of decision-making of energy investment in industrial parks

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AN EXPLORATORY ANALYSIS OF DECISION-MAKING OF ENERGY INVESTMENT IN INDUSTRIAL PARKS

A report created in cooperation with Siemens AG
by

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1 INTRODUCTION & PROBLEM FORMULATION

"In the next few years, the most resource-efficient and sustainable location will be the most competitive, and that's why we are well advised to be very resource efficient, very energy efficient, very sustainable, because that can be a great advantages in international (or regional) competition if we set the framework right." [Machnig, 2017]. In this context, small scale local electricity production has lately been on the rise within the energy market in Germany. Thus, prosumers have been faced with lower investment cost for generation assets, incentive programs and a regulatory framework that allows them to act. In a similar manner, large industrial parks are considering to generate and store electricity on-site to self-supply their energy needs. This opens up new, however complex business opportunities for industrial parks since managing a small power plant connected to the electricity market requires in depth knowledge about electricity system and the market design. To enter the market and participate, a rightly 'sized' generation and storage asset must be locally placed. The evaluation to install and run carbon free generation assets includes two main things; first, an assessment of the regulatory framework of the envisaged technology setup. Second, the operating and capital expenditures for the assets and the revenue streams it generates in the future. A side note worth mentioning is that opportunity costs are not to be neglected. In that respect the challenge is to accurately reflect potential cost savings through own consumption since electricity can simply be bought from the connected market at prevailing prices. Agents acting within this framework can be described as follows:

- **Investors**, here the industrial park owners, have the key action to decide on whether or not to invest in assets given the alternatives (self-generated electricity versus grid supply) and the regulatory framework. They have in particular three key interests: a) the fulfillment of CO_2 requirements/reductions at plant level b) the avoidance of grid charges through own generation c) the option to sell excess electricity to the connected market.

- **Regulator** has the key action to formulate policies with respect to green technology adoption including storage's, setup rules in order to grant access to market for power plants, amendments to grid charging schemes. The regulator sits in between the market and the investor.

Within this context, the results of this report will shed light on the investment decision to self-supply the industrial's park power demand with a technology setup consisting of an on-site renewable generation technology (in particular wind turbines) and a storage solution (in particular an ETES storages). The decision-making process of investors within industrial parks can be influenced by multiple factors such as geographical location, load, market price. Moreover, the investment decision "can only be taken as a result of animal spirits – of a spontaneous urge to action rather than inaction, and not as the outcome of a weighted average of quantified benefits... Thus if the animal spirits are dimmed and spontaneous optimism falters, leaving us to depend on nothing but a mathematical expectation, enterprise will fade and die" [Keynes, 1937]. These "spontaneous" investment is influenced by the action/inaction of other investors. As such an agent-based model is a prerequisite to address the following research questions:

What drives investors of industrial parks to make a positive investment decision in wind parks to self-supply their power demand?

The remainder of the report is structured as follows. In chapter 2, the system identification and decomposition is done to set the boundaries of the model. Moreover, the system and their agents with properties are described. In chapter 3, the properties, states, relationships, behaviours and interactions of the agents and objects within the systems is formalized. Moreover, it is explicitly defined which agent/object does what and when. This is illustrated in form of an UML sequence diagram. Following this chapter, the computed model is verified whether the conceptual model was correctly translated into the model code. In chapter 5, the set of experiments are elucidated and the outcomes of those experiments are analyzed and discussed accordingly. The model validation is realized in cooperation with the experts of Siemens AG in chapter 6. In the last chapter, some of the practical aspects of using models is discussed to answer the research question.

2 SYSTEM IDENTIFICATION AND DECOMPOSITION

In this chapter, the realm of the model is identified and the boundaries are set. Therefore, this chapter will focus on the description of actions as well as limitations and the attributes of each agent within the model. One can find the assumptions made throughout the consultation and modelling process in Appendix B.

As mentioned earlier, our system comprises of two agent breeds, namely, investors and regulator. These agents are placed within the geographic and political boundaries of Germany. Therefore, the model consists of one regulator entity representing the interest of the current ruling government. During the model run, the regulator can switch every four years its strategy in altering the existing EEG subsidy based on the characteristics of the ruling government for the specified term. A short literature review displayed that the political landscape is largely supporting the Renewable Energy Sources Act and thus are in favor of the "Energiewende" [Tagesschau, 2017; Allmendinger et al., 2013]. However, there are discrepancies between the different parties on how to achieve the carbon emission level. In simple words, their approach to "Energiewende" differs in the level of commitment. Within the model, the political landscape is summarized into two potential attitude towards energy transition:

- **Green Regulator**: If the majority of the parliament in Germany consist of *green* and *progressive* members, the regulator will have a very strong sense in achieving the energy target in time and therefore it will generously increase the current EEG subsidy.

- **Conservative Regulator**: If the majority of the parliament in Germany consist of *conservative* and *liberal* members, the regulator won't make any major changes in their energy policy and therefore it won't or will just sparsely increase the current EEG subsidy.

To understand whether an action from regulator point of view is necessary, the regulator predicts whether the current actions are sufficient to satisfy the EU emission targets of 2020, 2030 and 2050. Since the model is limited to industrial parks in Germany, the emission level is calculated only for the certain number of industrial parks and their load in the system. As such also the EU emission targets in the model are broken down to the 1990 emission level of the system. If the linear forecasting of the emission levels shows that the respective next target can not be achieved, the regulator will increase the EEG subsidies pursuant to the ruling government at the time. However, if the target can be achieved, the regulator won't take any actions.

The investors are the "owner" of the industrial parks. As such their main goal is to be profitable. In this model, investors are considering yearly the possibility to invest into wind park to self supply the load of their industrial parks. Thus, during a model run, they are calculating yearly the return of investment (ROI). Thus, first, the net present value (NPV) of the renewable energy source is calculated by the following equation:

$$NPV = \sum_{t \in T} \frac{AEC(t)\ p_{eff}(t) - CAPEX - OPEX + AES(t)\ (p_{market}(t) + EEG)}{(1+i)^t} \tag{2.1}$$

where:

AEC = annual load capacity of the industrial parks

AES = annual energy sale

EEG = rate of remuneration by state for the investment into wind-park

p_{market} = average annual market price

p_{eff} = average annual market price

$CAPEX$ = capital expenditure of the possible wind-park capacity

$OPEX$ = operational expenditure of the possible wind-park capacity

i = discount rate

And subsequently the ROI is calculated via the following equation:

$$ROI = \frac{NPV}{TI} \tag{2.2}$$

where:

NPV = net present value

TI = total investment for the possible wind-park

However, the accepted positive ROI differs from investor to investor. Thus, the outcome of any given agent can vary drastically although many of the external factors are exactly the same. In the model each investor has its own unique ROI threshold based on their agent class. Investors are classified into three types according to the social milieus concept by Bourdieu 1984. The concept of milieus offers not only an elegant solution to model the richness of the individual investors understanding of a positive ROI but also the influence of peer effect on the investment decision. The three identified types of investors in the model are *"leader"*, *"follower"* and *"traditionalist"* [Kahneman et al., 1991; Engel and Gigerenzer, 2006; Bourdieu et al., 1984]:

Table 2.1: Investor agent types and their character traits based on the social milieus concept by Bourdieu (1984).

Agent Types	*Leader*	*Follower*	*Traditionalist*
ROI threshold	Low	Medium	High
Peer Effect	Low	High	Low

The investor type leader is always willing to experiment and to take calculated risks. It is also willing to expect lower return of investment than necessary if the investment is innovative, have a good image and/or believes that there is potential to become the new standard. Thus, the decision making of the leaders are not effected by the investment decision of their peers.

The investor type follower has an affinity towards innovation, but are very careful if it comes to bigger investment decision. Moreover, they distinctly observe the investment decision of their peers and thus are highly affected in their own decision making by it.

The investor type traditionalist are very frugal. If the return does not outweigh the initial investment by far, the traditionalist prefers to stay with the status quo [Kahneman et al., 1991]. As such traditionalists won't allow themselves to be misled from their ideals by their peers.

During the model run, each investor agent has full information about the percentile of transitioned industrial parks. After the calculation of the ROI and the effect of peers on the ROI, investors will compare it with their individual minimum ROI threshold. If it is above the threshold, investors will invest. The same mechanism also applies for an investment decision of a wind-park with storage capacity.

Next to the agents, the model consist of external parameters. The most important external factors for the investment decision of wind-parks is the geographical wind speed. The model is divided into the 16 states, where each state consist of an average wind speed. Moreover, the electricity market prices are fed into the model from the data provided by Siemens. Lastly, the technology information such as capacity factor, CAPEX and OPEX are also provided and can be found in the Appendix A.

3 | CONCEPT & MODEL FORMALIZATION

In this section, a UML class diagram is used to trace agent relationships in an object orientation manner. Figure 3.1, below shows the UML class diagram of the model. Here, the regulator and investors, global variables are defined as class objects. The global variables consist of external parameters such as the data for the electricity market or the average wind speed for the states in Germany. These data are read and processed by the regulator and the investor for their internal use. The regulator is setting the EEG policy based on the carbon footprint of the industrial parks. The investors on the other side are using the EEG policy from the regulator to calculate the viability of an investment into wind-parks and storages to self-supply their own load.

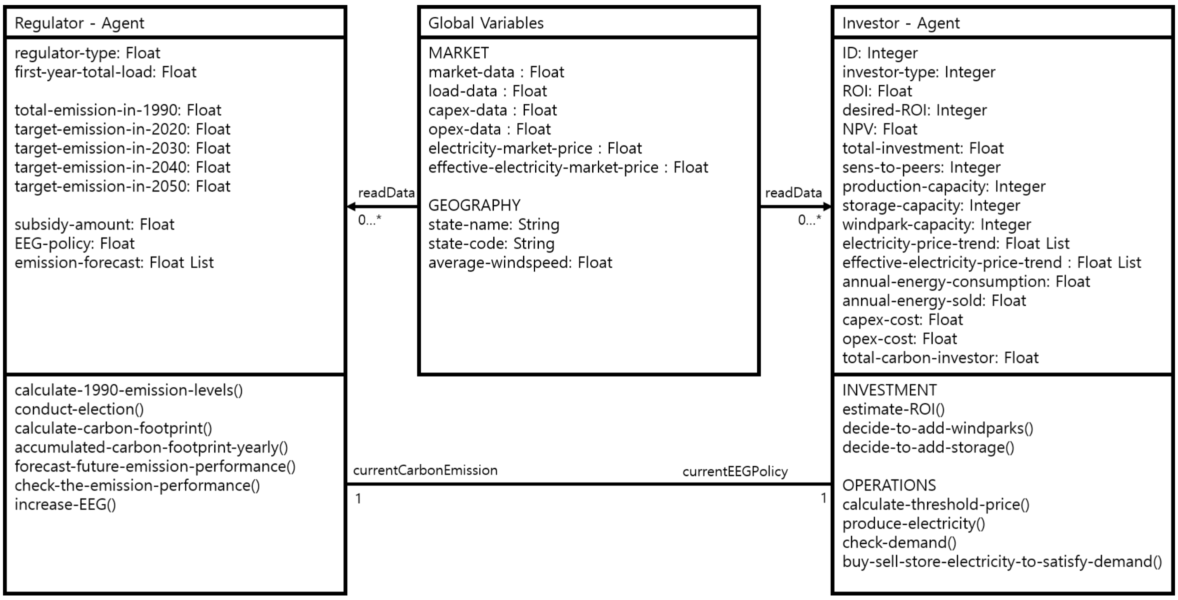

Figure 3.1: UML diagram of the investment model

Furthermore, the behaviour narrative consists of "which agent does what to whom and when", therefore interactions among the agents will be considered [Van Dam et al., 2012]. The narrative is given based on what happens in every tick. Figure 3.2 illustrates the narrative in an UML sequence diagram. Each vertical line represents an agent or object in the system which interacts or affiliated with something else. The horizontal arrows show the sequence. Time ticks as the diagram is followed from top to bottom, while it can be understood that the actions happen simultaneously if they are horizontally aligned.

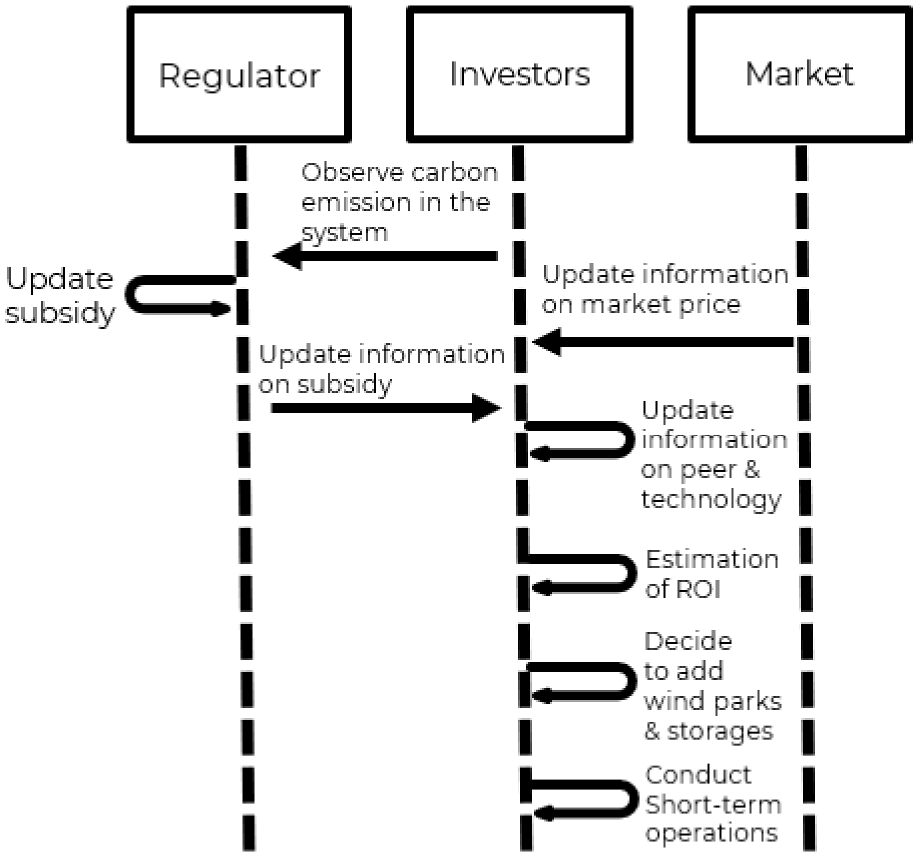

Figure 3.2: UML sequence diagram of the investment model

4 MODEL VERIFICATION

In this chapter, the model is checked whether it does what it is intended to do. For this purpose, certain scenarios are designed in which the model parameters are adjusted in a way that the outcome of the model can be anticipated. Then, the model is run under the designed scenarios and actual outcomes are compared to the anticipated outcomes. If these two have a match, it increases the confidence for the model that runs with respect to the initial intentions.

Two different types of checking the model are designed. In the first type, it is checked whether the intended properties of the model entities are actually attributed in the model itself. While the second type is about checking the behaviours by evaluating the model with respect to certain scenarios. These checks can be found below in table 4.1.

Table 4.1: Verification checks.

Description	*Result*
FirstTypeChecks :	
Different provinces in Germany have different average wind-speed	✓
Different investors have changing investor types, and their properties change with respect to the attributed investor type	✓
Regulator evaluates the future emission targets based on 1990's value	✓
While checking the system's emission, regulator checks the contribution of all agents	✓
Average desired ROI of leaders is smaller than followers'	✓
Average desired ROI of followers is smaller than traditionalists'	✓
The regulator elections are conducted in every 4 years	✓
SecondTypeChecks :	
As the future emission targets get more ambitious, regulator sets more ambitious targets for the modelled system	✓
As the electricity production capacity of investors increases, the amount of generated electricity increases	✓
As the electricity production capacity of the investors increases, the carbon emission of the industrial parks decreases	✓
When the future targets are put less ambitious and the performance of the system is in line with the identified targets, the regulators do not increase the subsidies	✓
As the frequency of green party to be elected increases, the amount of subsidies increases	✓

As the CAPEX and OPEX values increase, number of investing industrial parks decreases	✓
As the wind speed values increase, number of investing industrial parks increases	✓
As sensitivity to peers increases, more industrial parks invest in wind turbines	✓
If there is no industrial park, the system emission is 0	✓
If there is an investment decision, it happens only once for each industrial park	✓
As the fraction of traditionalists increases, the overall investment behavior slows down	✓

5 EXPERIMENTATION & DATA ANALYSIS

In this section, first the experimental setting will be explained to specify what kinds of inputs are associated with which outcomes. And then, their relation will be shown in next subsection, Data Analysis.

5.1 SIMULATION EXPERIMENT

A set of simulation experiments was conducted to better understand the behavior of each individual agent. In particular, The main focus under our research interest is what drives their investment. In overall, one hundred experiments were conducted to collect data of 5,000 respective agents, given that a single run of the model generates the behavior of 50 investors between 2020 and 2050. Each agent is labeled with following independent variables (i.e. the input parameters of the predictive model).

- `type`: either one of leader, follower or traditionalist. It determines the factors: `sensitivity, return-on-investment threshold`
- `windspeed`: average windspeed of the certain region (meter / second)
- `capacity`: the expected capacity of installment given their annual demand (MW). The unit increment is 3.5MW.
- `subsidy`: amount of subsidy at the moment when the agent makes investment

Likewise, their dependent variables (i.e. the outcomes of the model) are given when the model run ends.

- `invested`: either True of False
- `year of investment`: Since it is the moment when the agent decides to invest, the value is between 2019 and 2050. If the agent does not invest until its end, then a random number around 2060 is assigned due to the uncertain future.

A whole single run requires 30 seconds, 100 runs took approximately 10 minutes by parallel runs with 12-cores multiple processing. It is expected to produce a result with higher confidence if more experiments are conducted.

5.2 DATA ANALYSIS

5.2.1 Overall behavior – Macro level

To capture the whole picture of the result, the Regulator's viewpoint is selected. (See figure 5.1.) As the time advances from 2020 to 2050, the emission level (orange bar) is adjusted to the target (blue bar) by raising subsidy (blue dashed-line). Not only the technology becomes cheaper but also the subsidy increases, more agents make investments. And thereby, it may further accelerate the trend as the interaction plays a bigger role as time goes by.

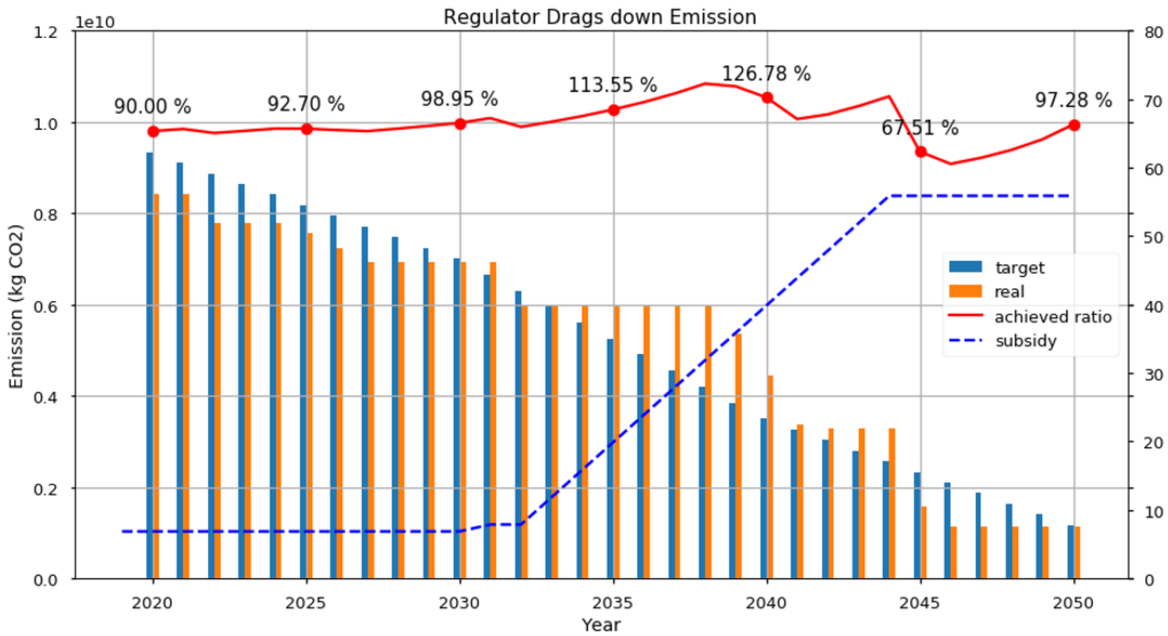

Figure 5.1: Overall behavior (single run)

The first thing to look at is what common features are shared among the group under the interest, namely invested group.

`windspeed`	**year of investment**	**subsidy**
6.8 meter / seconds	Year 2036	27 cents/KWh

Table 5.1: The average value of conditions for those who made investments

It can be inferred that `windspeed` is likely to play a great role given the large difference from the average windspeed (6.17 meter / seconds) of the non-invested group. Note that the other two factors are not applicable the non-invested group. Additionally, the two-divided distribution of `year of investment` and `subsidy` (See figure 5.2.) indicates that the investment is not made unless the time reaches to a certain moment.

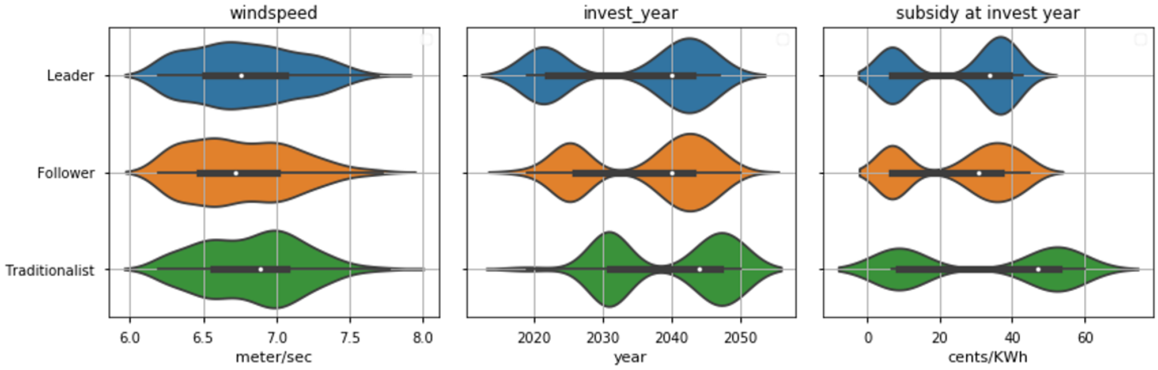

Figure 5.2: Unlike `windspeed`, the other two factors show a distribution which is highly divided into two.

In the next section, it will be analyzed why such differences occur by investigating on individual level.

5.2.2 Individual behavior - Micro level

Briefly, it is concluded from the experiment result that `windspeed` is the strongest force driving the investors and `subsidy` follows the next. Other factors such as `capacity`, `sensitivity` and `threshold` showed a weak or limited association to the outcome.

Windspeed

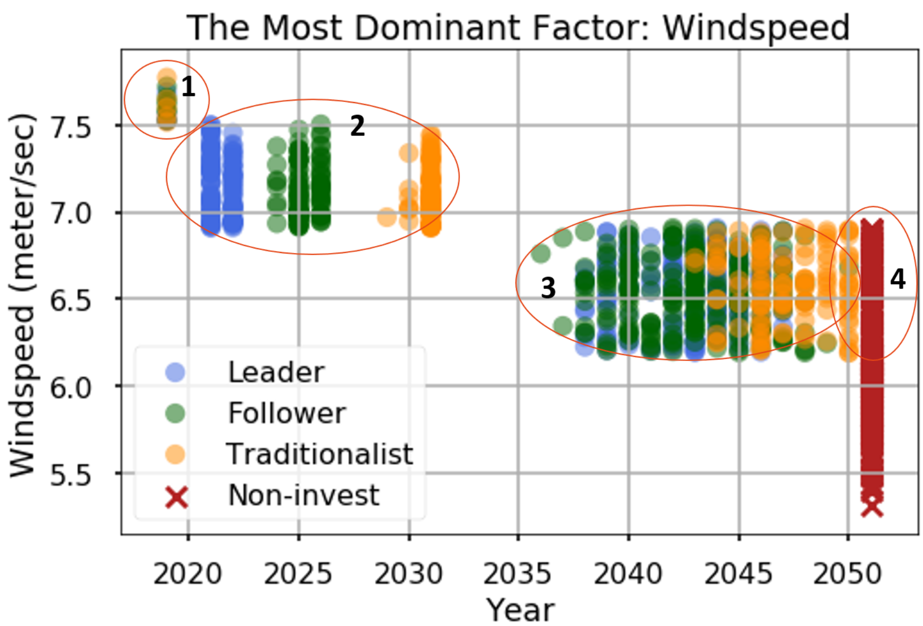

Figure 5.3: The higher `windspeed` leads the earlier investment.

As it is shown in figure 5.3, the investment is greatly determined by `windspeed`. The first group (denoted by "1") who has `windspeed` above 7.5 immediately makes investment based on NPV calculation. The second group joins after a while in Leader-Follower-Traditionalist order and finally, so does the third group although it exhibits a slightly mixed behavior.

One interesting thing is the behavior of the fourth group. It has a seemingly sufficient `windspeed` which is same as the third group, nevertheless it does not make an investment. To identify this interesting phenomena, this group is particularly inspected. (See figure 5.4. Note that the minimum condition of `windspeed` (6.2 m/s) is also displayed as any investment is not made under this value.)

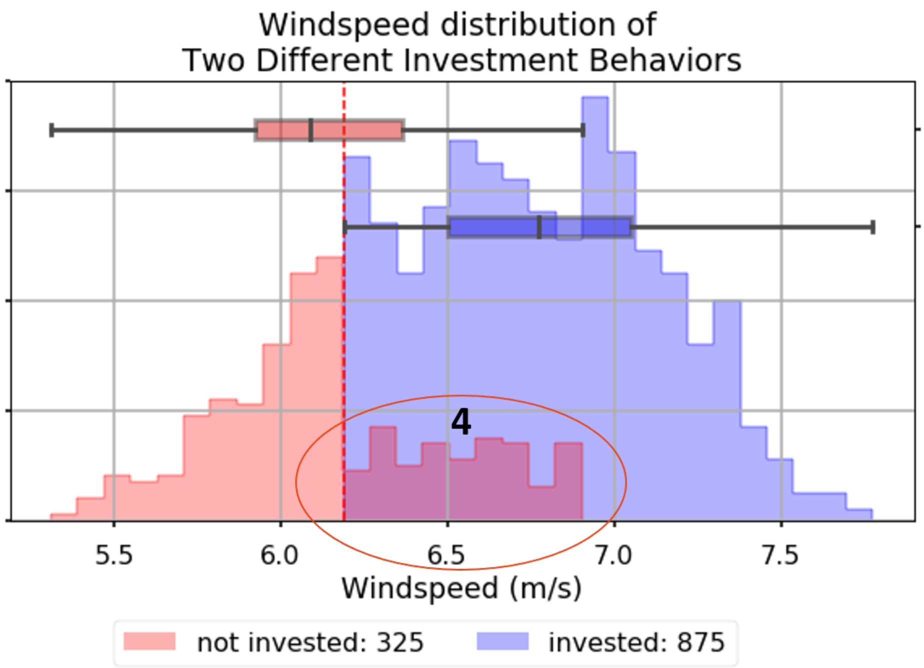

Figure 5.4: Distribution of Two groups regarding to `windspeed`

Subsidy

What is the second strongest factor which hinders the investment despite the sufficient `Windspeed`? It turns out that `subsidy` is the second key factor by plotting two groups with different inputs in multiple dimensions. In figure 5.5, it is not visible when all types of investors are aggregated, and yet it becomes clearly visible that `subsidy` is what makes difference when they are separated. (See figure 5.6.)

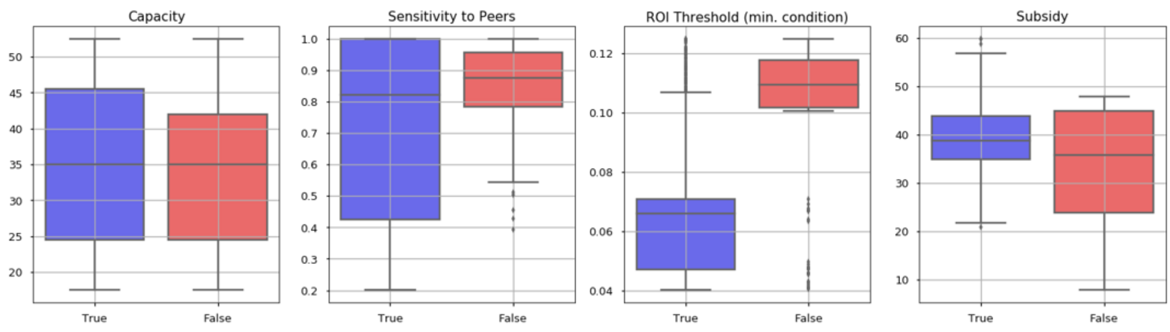

Figure 5.5: The impact of `subsidy` is not clearly visible when all types are aggregated.

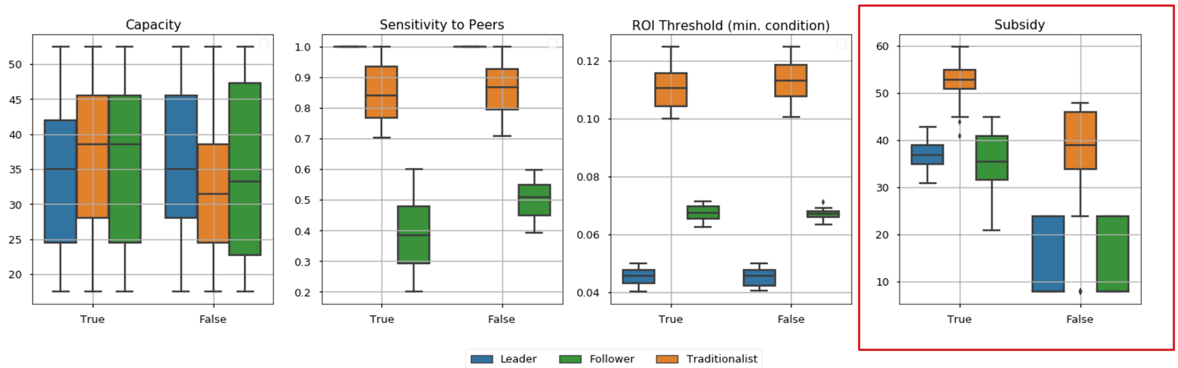

Figure 5.6: `subsidy` is the difference what makes difference.

The above result is interpreted as `subsidy` does play a certain, but limited role. In other words, the investors are primarily affected by their own `windspeed`, but can be restricted by the low `subsidy`. However, the same is not true in reverse as the investment will never be made for those who have insufficient `windspeed` regardless of high `subsidy`.

Lastly, the relation of other factors - `capacity`, `threshold` and `sensitivity` - are shown in figure 5.7

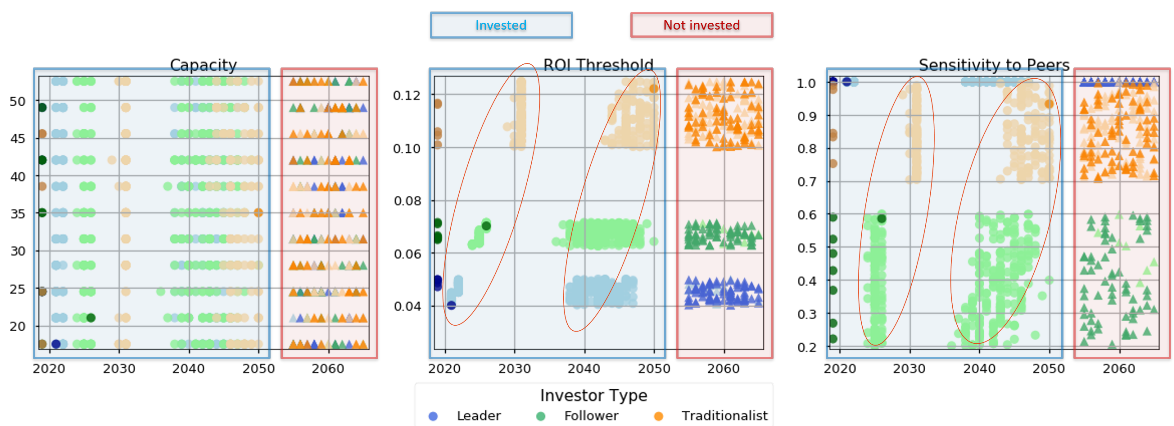

Figure 5.7: Other factors do not display a strong relation compared to `windspeed` and `subsidy`.

Interactions – Peer effect

The final question is how significant the interactions among agents are, namely the peer effect. We concluded that the interaction effects are only active between those who have sufficient wind speed. For those who cannot be benefited from the investment from the first place due to the low `windspeed` are not significantly affected by other agents. Note the red circles in the right panel in figure 5.7. Only for these limited groups, the more sensitive investors move towards the earlier investment.

6 MODEL VALIDATION

As mentioned earlier, the research is about understanding the fundamental drivers behind the investment decision to build wind turbines in industrial parks. In order to conduct such a study, the hypothetical industrial parks are designed in the model with hypothetical features. Therefore, we do not have a real system, or case application where we can actually compare the model results with the reality and validate respectively. Therefore, in this chapter, the focus is on the capabilities of the designed model, the points which is added to have a sense of reality, the main notions which are excluded for the sake of simplicity and resulting drawbacks of this study.

The model is capable of indicating the main determinants of an investment decision to construct wind turbines in industrial parks with the purpose of satisfying the electricity demand of a park on its own. This system is represented in a dynamic way where the multiple actors involved in this process have their role in the model, too. Having industrial parks as well as a regulator expands the scope of the model and lets us be able to understand the investment decisions from multiple angles. The power of agent-based modelling comes to the table at this point, since the use of this modelling technique makes it easier to include the interactions between the actors, as well as the feedback mechanisms which yield non-linear and difficult to detect behaviours at the end. An example from the model for such mechanisms is the chain reaction of regulator's system evaluation and subsidy adjustment, then these actions' effects on the investment decision of industrial parks, then decreasing emission levels with respect to the investing industrial parks, and the reflection of this decrease on the regulator's next evaluation. Also, instead of forming competition between the parties, examining a kind of collaboration which is included by identifying peer effects in the system makes our approach to the problem have a different point of view.

On the other hand, like every model, this model has its limitations as well. The market is included quite statically in our design. There is no interaction between the entities in the model and the electricity market. One way to handle this drawback may be connecting external market models to the existing design. However, importance of short-term changes increases enormously for the models with high renewable penetration. This makes it difficult to run a model for long-term strategical decision making with high numbers of experiments and specific techniques to overcome such computational issues are used. These points are explained further in the upcoming future work section.

As another limitation of the model, the short-term operations are decided sub-optimally. A heuristic approach gives the model a sense of control over the electricity buying, selling, or storing actions. However, this control is definitely not as extensive as the control in the LP models, and by having this approach we consent to have some sub-optimal decisions in the model. Again, by connecting external optimization tools to the existing model to have a better operational decision scheme can improve the quality of the modelling practice and enrich the possible outputs.

As stated before, there is not a real set of industrial parks which is used as a case study, and so it is not possible to compare the model outputs to check whether it projects the right system in an understandably realistic way. However, by having these remarks in mind, the level of reality of this model can be evaluated more accurately by using an expert opinion, and also knowing about the drawbacks opens the room for improvement for more decent understanding of the model's use and possible the future works.

7 DISCUSSION

In the first chapter, we identify the research problem of this study as "What drives investors of industrial parks to make a positive investment decision in wind parks to self-supply their power demand?". Then during our studies, the model is created with the purpose of answering this research question, and the experiments we share in the fifth chapter are designed respectively. Also, the interpretation of the experiment results is shared in the fifth chapter with a certain level of detail. This chapter concludes the discussion by providing with the summary of the results and also the possible directions for this model's improvement are shared here to guide the reader through the candidate future studies on top of this study.

As it is shared in the data analysis section, the most significant determinant of the investment decision is detected as the "wind speed" which is a geographical condition rather than a behavioural one we describe within our model. Of course, this result is in a way intuitive since it would be logical to expect the investment decision for wind turbines requires a certain wind speed value which is basically the energy source of the turbines. By knowing this, the second most effective determinant is identified as the subsidy values. It can be considered that the amount of subsidies is also a natural determinant of an investment decision. However, this one is not that intuitive when it comes to the degree of significance. Although it is possible to indicate that both are effective at the beginning, one cannot simply tell whether the subsidy levels or the peer effect is more effective on the investment decision. Our model shows that the effect of peer relations the third significant factor to make an investment decision. The model shows that the investment decision can be affected by the peer effect or regulatory action if there is sufficiently strong wind speed. Although the reached subsidy levels are unrealistically high in the model especially for the future years, this can be interpreted as the effect of an external decrease in the costs for the investors. Of course, it is always possible to use different model settings to examine different system structures. We think of these as variations of the same model rather than possible future work on top of our model, while in the next section we share our ideas for the directions where we consider as possible future applications.

7.1 FUTURE WORK

The model's most prominent drawback is the statically modelled parts which are the electricity market and the short-term operations. Very first step to improve the current study would focus on this point. The electricity market is fixed in our model and we have a heuristic based approach for buying selling and storing electricity in our system. However, this behaviour can be connected to an optimization model in which the agents evaluate their situation respectively and decide optimally. The constraint we had for such an application was the restrictions due to required computational power. Since the model has two different time scopes at simultaneously, yearly and daily respectively, it becomes too heavy to calculate the daily operations and long term strategical decisions simultaneously.

For such an integrated modelling practice where the conventional MILP models are connected to the agent-based modelling environment, approaches like the use of representative days while maintaining a kind of chronological order, or system states approach can be used. Although it is not included in this research's scope, there is a vast literature about the abovementioned approaches and more. The study of D.A. Tejada-Arango, M. Domeshek, S. Wogrin and E. Centeno constitutes an example for such studies 2018. Implementation of such practices can reduce the required computational power drastically and it can lead more sophisticated models to be created.

Appendices

A CAPEX AND OPEX VALUES

Weighted Average Net CF (%)	Weighted Average CAPEX ($/kW)					Weighted Average OPEX ($/kW/yr)					Weighted Average Wind Speed (m/s)
	2016	2020	2030	2040	2050	2016	2020	2030	2040	2050	
47.4%	1529	1450	1304	1227	1219	51.331	49.854	46.161	42.468	38.775	8.7
46.2%	1549	1472	1327	1251	1244	51.331	49.854	46.161	42.468	38.775	8.4
45.0%	1559	1490	1360	1294	1292	51.331	49.854	46.161	42.468	38.775	8.2
43.5%	1567	1502	1381	1320	1320	51.331	49.854	46.161	42.468	38.775	7.9
40.7%	1585	1534	1442	1400	1407	51.331	49.854	46.161	42.468	38.775	7.5
36.4%	1622	1596	1553	1542	1563	51.331	49.854	46.161	42.468	38.775	6.9
30.8%	1669	1664	1665	1682	1715	51.331	49.854	46.161	42.468	38.775	6.2
24.6%	1705	1715	1743	1777	1817	51.331	49.854	46.161	42.468	38.775	5.5
18.3%	1735	1797	1931	2033	2103	51.331	49.854	46.161	42.468	38.775	4.8
11.1%	1751	1849	2054	2201	2290	51.331	49.854	46.161	42.468	38.775	4.0

Figure A.1: CAPEX and OPEX costs for the wind-parks provided by Siemens AG

B ASSUMPTIONS

Investor assumptions:

- There is no differentiation between industrial park owner, tenant, and investor.
- The amount of electricity generated in the industrial parks is not effective on the electricity market prices.
- The demand data is processed daily.
- The demand is fixed over the years.
- All the short-term operations, "generating, buying, selling, storing electricity", are assumed to be done daily.
- The short-term operations are assumed to be done with a step-wise approach. First the generation part takes place, then the available electricity is checked, and then it is decided to sell or store with respect to the introduced measures within the model.
- "Investment decision" and "getting affected by peers" are assumed to happen only once. Possible accumulations are kept out of the scope.
- Carbon emission of an industrial park is solely related to the amount of electricity it buys. The industrial activities within the park and their emissions are kept out of scope.
- Carbon emission of industrial parks is assumed to be linearly correlated to Germany's energy sector carbon emission values over the years.
- The ratio of Germany's 1990 emission levels and 2018 emission levels is used to calculate the relative value of industrial parks' 1990 emission levels. Then the targets are introduced within the model.

Regulator assumptions:

- There is no upper value for subsidies.
- Germany closely follows EU emission targets. Any national target is not introduced within the model.
- Either the green party, or a center party wins the elections with 50% chance. Realistic election patterns and ratios are kept out of scope.

- The regulator focuses on the nearest emission target. It does not take the longer period emission targets into account (e.g. if year is 2024, the regulator targets 2030, but not 2040 or 2050).
- The regulator regards all industries homogeneously and pursues the emission targets by achieving the same reduction percentages in each entity.
- The emission targets identified for the country are reflected directly on the industrial parks by adjusting the scale.

Environmental assumptions:

- Wind speed is assumed to be distributed homogeneously in a province.
- Carbon emission of energy sector in Germany is assumed to be fixed at 560 gr CO_2 per kWh electricity. (This can be adjusted easily by using the sliders on user-interface)

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