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RENEWABLE ENERGY CSOPS: AN UPDATED ANALYSIS FOR WIND POWER APPLICATIONS

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In this paper we show an up-to-date analysis of the economic feasibility of Energy CSOPs (Consumer Stock Ownership Plan). CSOPs are instruments for low-threshold community investment projects and have shown to be competitive tools for distributed investments. Applied to the renewable energy sector (in this instance, wind power), CSOPs can help fostering the decentralized power production landscape as well as busting possibly present prevalent monopolies. We analyze the financial and economic feasibility of a set of model projects and discuss the most important investment parameters.

Keywords: CSOP, Kelso, Investment, Renewable Energy, Wind Power
JEL Classification: L12, L26, O13, Q21

1. INTRODUCTION

Renewable power has gained increasing importance during the last two decades, at least. Dependent on their natural prerequisites such as landscape or the climate, but also based on their predominant energy supply structure, countries all over the world focus on different kinds of renewable power production. Areas with heavy insolation tend to invest into solar power (either solar heat and/or photovoltaics, PV), while countries that possess convenient wind conditions invest into wind turbines. Also, there are countries that exhibit good conditions for hydro power or geothermal power.

In contrast to "conventional" forms of energy production, renewable energy comprises both advantages and challenges: While conventional power requires fuel, most renewable power systems do not, and as such, usually possess very low or even zero marginal costs. That is, once the facility (e.g. a solar park or a wind turbine) is installed, it requires little maintenance. However, many countries' power supply structure is arranged in a centralized way, due to monolithic coal and/or nuclear power plants. This oftentimes led to natural monopolies in the past, with all its advantages and disadvantages. Contrary, most renewable forms of energy production require a

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decentralized arrangement, which poses difficulties for the energy distribution system, but also has the potential to reface the traditional, monopolistic scheme of energy production.

This is where the kelsonian CSOP (Consumer Stock Ownership Plan) idea comes into place: CSOPs, as discussed by Kelso and Adler (1958) and Kelso and Kelso (1986), provide a legal construct that is specifically designed to enable consumers to participate in productive capital and helps to cracking prevalent monopolies. Kelso (1989) describes the CSOP's mode of operation in great detail and also discusses the successful first CSOP implementation of "Valley Nitrogen Producers Inc." in 1958, busting a prevalent local monopoly in the fertilizer industry, decreasing the fertilizer prices drastically and bringing allocations back to more economically efficient levels.

Today, the CSOP can be seen as an alternative to the cooperative model of decentralized production facilities, especially for (but not limited to) renewable power production. Lowitzsch and Goebel (2013) argue that in comparison, the CSOP is a more flexible, low-overhead and low-threshold approach for consumers investing into power production projects. In this paper we analyze whether CSOP-financed wind power production can be profitable under certain conditions: We compare two wind potential regimes, each at two roll-out scenarios and two scenarios for the economic climate. In total, we have eight scenarios. These scenarios are set-up to work as a sensitivity test for each other: As such, for example they show how the system will react if there are changes to the interest rates or to the wind conditions. Comparing the right selection of two scenarios will allow for a brief sensitivity analysis, keeping all other factors constant (comparative static analysis). For each of the scenarios, we discuss the amortization time, the free cash flow development, the repayment interests and the returns paths, as well as other indicators. The simulation of CSOP implementations takes place for wind power plants in Germany, since the CSOP concept is already adapted for the German company law structure. Also, Germany possesses attractive wind power sites and a guaranteed feed-in tariff. Furthermore, there are governmental subsidies for renewable power in the form of low interest loans. In conclusion, we find that the concept usually comes to profitable solutions and provides rewarding investments.

The paper is structured as follows: Section 2 provides a brief overview of the CSOP implementation. Afterward, Section 3 discusses the proposed investment projects in general. In Section 4 we present the financial indicators used. Results are shown in Section 5 and Section 6 concludes.

2. CSOP IMPLEMENTATION

Lowitzsch and Goebel (2013) discuss the CSOP implementation in greater detail. Here, we briefly sum up just the major points.

The CSOP concept is based on a trust company administrating the shares, the payments and the facility's operation. As the CSOP is designed to operate on low-threshold levels as seen from the investor's point of view, the private equity share should be small. Thus, the project at hand is to be financed by using a long-term loan. Of course, the loan should be at lowest possible interest rates. As investments into renewable energy power plants are politically favored in Germany, the state bank subsidizes these kinds of investments. State loans are wound up by using financial intermediaries, i.e., commercial banks, see stage (1) in Figure 1. This procedure is usually nontransparent to the investor/the CSOP trust. The loan is then transferred to the trust (2), which itself secures the repayment by a pledge of portfolio stocks and/or assets (3). Note that at this point, the trust usually does not possess appreciable amounts of assets, which has to be considered in the loan contract. However, the state bank programme does cover for this downside. As seen from the commercial bank's point of view, the default risk of the loan is rather small, as first, the state collateralizes the loan and second, the investment project itself (the actual wind turbine) is rather reliable to refund.

The trust starts by investing into the power plant (4). Over time, the CSOP trust then repays the loan (principal and interest) by its income (5). First, the trust issues individual stocks to its participants, the private households (6). The share amount is calculated based on the households' energy consumption (e.g. families consume more and thus, receive a larger share than singles). On a monthly basis, the participating households pay their bills for delivered energy (7) to the trust, which amount to market-type energy prices, even though the own production of energy may be much cheaper (8). Therefore, the trust's assets increase rather quickly. These assets are used to repay the loan to the commercial bank (5).

In addition, there may be times at which the wind turbine may produce more energy than required within the group of CSOP participants. Then, the CSOP trust manages to sell the excess energy at the market (9). Finally, if desired, a municipality can joint the project as an external investor (10). Note that for a) the case of the CSOP actually selling energy to the market as well as for b) the participants paying their bills directly to the CSOP, market prices for energy come into place. Today, these market prices are still subject to conventional energy production, and as such, depend on oil and natural gas prices. Whenever energy market prices are up, the earnings of the trust selling to the market increase, which is in favor of the CSOP financing scheme (and vice versa). However, if these prices are up, participant would have to pay higher prices if they would have to buy energy at the market, instead of from the trust. Therefore, the trust has some opportunity cost, which comes into favor of the participants (they save money by buying from the trust instead of from the market).

To sum up, the CSOP trust handles the following tasks:

- Apply for loan from state bank over a commercial bank, setup the contract etc.
- Invest into power plant.
- Issue stocks to participants. Manage these shares in cases of moving participants or other kinds of entries/exits from the group.

- Supply energy to the households.
- Sell excess energy at the market.
- Collect payments from excess energy trades and monthly payments from the participants.
- Repay the loan to the commercial bank.

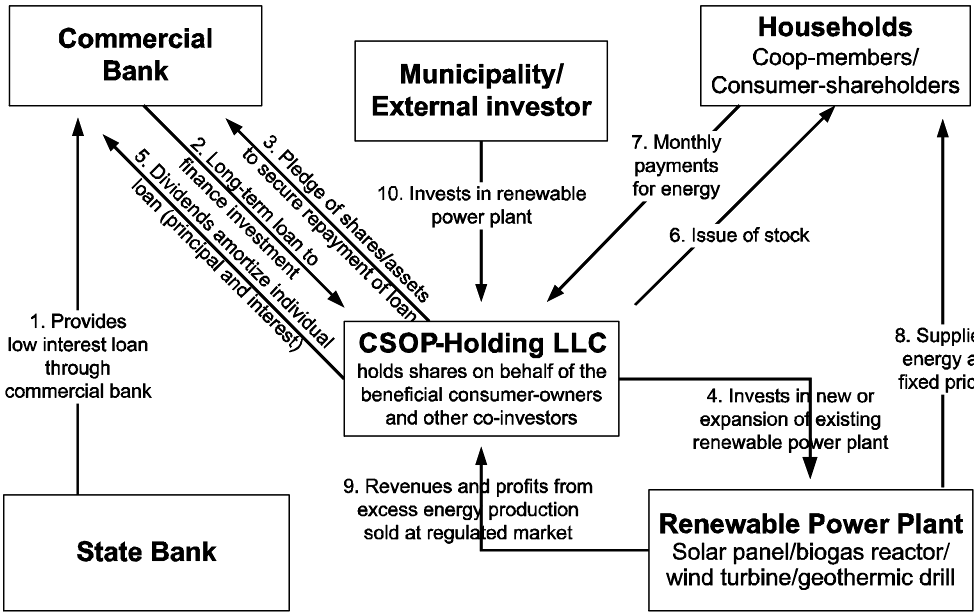

Figure 1. CSOP Structure

3. INVESTMENT PROJECTS

Given a set of private households in a village or town, each of these households is assumed to consume electricity from a monopolistic electricity supply company. In general, electricity supply contracts are non-negotiable ("take it or leave it"), and prices may be economically inefficient (too high, as seen from the consumers' point of view). The principle CSOP idea is that locally bounded consumers decide to make a joint investment into production facilities whose products they themselves consume. Instead of buying electricity, they produce it on their own. In this case, the local production facility to be installed is a wind power production turbine.[1]

[1] Constellations may also suggest a small solar park, a geothermal installation, a hydro or biogas power plant and/or others.

The location of the town under investigation may vary: There are locations in Germany at which the wind power potential is great. In that situation, a strong wind turbine should be installed. For this scenario, we select a Vestas V90 2.0 MW type turbine. If the setting is only a weak wind scenario, the selected turbine type is a Vestas V112 3.0 MW. Table 1 presents the selected scenarios, including expected full load hours (as provided by Fürstenwerth *et al*., 2013) and reference yield as provided by the German EEG (2014) [Erneuerbare-Energien-Gesetz, Renewable Energy Sources Act] in its most recent version from 2014.

The strong wind turbine (V90) is smaller and cheaper. The turbine itself costs about € 2,000,000, but together with costs for planning, allotment, grid connection, baseplate and others, we calculate installation costs of € 2,768,000. Operational costs for the turbine consist of maintenance and repairs, lease of land, insurance, business operation, capital surplus and other and sum up to € 106,040 per year during the first ten years. As we assume higher costs for maintenance after ten years, we calculate operational costs of € 117,920 per year after the first ten years of operation.

The weak wind turbine (V112) is larger and more expensive, but is capable of providing a good energy harvest even on suboptimal wind conditions. It costs € 3,450,000, its installation costs sum up to € 4,572,000. Operational costs are calculated to be € 198,825 in the first ten years of operation and € 221,100 afterward.[2]

Together with the rated power of the turbine, the full load hours determine the energy output and therefore, the earnings of the project. In the CSOP, the earnings are split up into two components: One part of the energy output can be sold to the participants at € 0.0839 per kWh (see Doerr and Lange, 2012) or at higher prices, due to the financing scheme (see below). The residual energy is fed into the grid and gets merchandized. For the feed-in, a minimum starting value of € 0.089 per kWh is guaranteed by the EEG during the first five years of operation. Dependent on the actual wind conditions (in comparison to the reference yield of the turbine), this guarantee will either stand after the first five years, or it will be reduced to the base value of € 0.0495 per kWh (§ 49 I and II EEG).

As for the economic climate, we assume a crisis and a non-crisis scenario. In a crisis, we set the inflation rate to 1% and the nominal base rate to 3%. In a non-crisis scenario, we assume an inflation rate of 3% and a base rate of 6%. Table 2 summarizes. For the roll-out scenarios, finally, we assume a normal speed scenario and a quick scenario. The scenarios discriminate between a) yearly average annex and b) average degression of EEG compensation. The normal scenario assumes an average yearly annex of 2,400 to 2,600 MW and an average degression of 0.4%, while the quick scenario is at a yearly annex of 2,900 to 3,100 MW and a degression of 0.8% (§ 29 I EEG). Table 3 shows an overview. To sum up, Table 4 provides unique and distinct labels for all of our eight scenarios. For each of them, a set of economic indicators is to be evaluated.

[2] Note that all these values are expert estimations based on Wallasch *et al*. (2013).

Table 1. Description of the Turbine Scenarios

Scenario	Rated Power	Hub Height	Rotor Aperture	Reference Yield	Full Load Hours
Vestas V90	2,000 kW	95 m	90 m	29,868,622 kWh	2,200 h
Vestas V112	3,000 kW	119 m	112 m	48,817,688 kWh	2,750 h

Table 2. Description of the Economic Climate Scenarios

Scenario	Inflation Rate	Nominal Base Rate
Crisis	1%	3%
Non-Crisis	3%	6%

Table 3. Description of the Roll-out Scenarios

Scenario	Yearly Average Annex	Average Degression of EEG Compensation
Normal	2,400 to 2,600 MW	0.4%
Quick	2,900 to 3,100 MW	0.8%

Table 4. All Scenarios Combined.

Scenario	Vestas V90	Vestas V112
Crisis, normal roll-out speed	1.1a	1.1b
Crisis, quicker roll-out speed	1.2a	1.2b
Non-crisis, normal roll-out speed	2.1a	2.1b
Non-crisis, quicker roll-out speed	2.2a	2.2b

4. INDICATORS AND ASSUMPTIONS

We assume that once the wind scenario for the location at hand is determined and the decision for one of the two types of turbines is made, the turbine is installed in the year of 2015. Thus, we can consider the subsidy conditions for that year, as given by the most recent version of the EEG. As for the CSOP structure, the necessary holding is founded. Since we assume that the citizens at a local village or town form the joint CSOP, these citizens formerly bought electricity from their utility. As the turbine produces electricity, these citizens now consume the electricity from their turbine. As the turbine produces more electricity than consumed by the citizens, the surplus is fed into the grid and is repaid by the utility.[3] At times where the citizens consume electricity and the local turbine does not generate (enough) power to cover the consumption, the remaining electricity gap is bought in addition from the utility.

Each CSOP group household pays a small amount of money in order to participate (entrance fee). In addition, during amortization time, all households continue to pay their "old" electricity prices as if they still bought from the utility. As the electricity their own turbine produces is much cheaper, the difference between actual costs and payments is used to repay the loan, in addition to cash flows generated by the feed-in tariff. Once the loan is payed off, participants can switch to paying the electricity productions costs only and participate in the feed-in tariff, so in general, they may generate profits instead of paying. This, however, depends on their own power consumption. In the following, we assume that a two-person household consumes 3,140 kWh of electricity per year, which is the average consumption in Germany, as determined by co2online gGmbH (2015).

We assume that 1,000 two-person households participate in such a way that the annual total electricity consumption of all participants is 3,140,000 kWh. The entrance fee which each of the households has to pay depends on the equity ratio. The German KfW (Kreditanstalt für Wiederaufbau, Development Loan Corporation) has a program setup called "Renewable Energy Standard (no. 270)" at which renewable energy investments are supported. It provides earmarked funds at low interest rates (currently, 3% of nominal interest rate).[4] Since the KfW program requires a considerable equity ratio, we target at an equity ratio of 22%, such that the amount of money each participant has to pay is calculated by

$$\mathrm{EF} = \frac{\mathrm{TIC} \cdot 0.22}{\mathrm{NOP}},$$

where EF refers to the entrance fee, TIC is the total installation costs (dependent on the turbine type) and NOP is the number of participants. Considering 1,000 participants, for the V90 (at which TIC = € 2,768,000), EF = € 608.96. For the V112, TIC = € 4,572,000, such that EF = € 1,005.84, provided that the yearly energy output of the V112 is greater than the energy consumption of 1,000 households. If not, it could be conceivable to raise the total number of participants in order to reduce the individual EF.

To sum up, the questions at hand, as seen from a possible investor's point of view, are 1) amortization time, 2) free cash flow and, of course, 3) the time structure of repayment and return. Since we consider an operation time of 20 years for the turbine, the investment project ends in 2035.

[3] In Germany, the utility is obligated by law to buy the electricity and to pay for it, as determined by § 49 I and II, EEG.

[4] Additional information are available at KfW (2015).

5. RESULTS

The renewable energy investment is redeemed within the turbine's operation time in all considered scenarios. Not surprisingly, investing into the larger (and more expensive) V112 results in longer times of amortization, especially during non-crisis times and at quicker roll-out speeds. Scenario 2.2b (V112, non-crisis and quick roll-out) is the only one that tends to being critical, showing an amortization time of 13 years. Figure 2 visualizes the times of amortization for all scenarios.

Figure 3 shows the time-dependent structure of discounted free cash flow for the V90 projects, while Figure 4 presents the development for the V112 projects. Caused by the great loan amount and its consequential heavy interest of borrowed capital, in the non-crisis scenarios, the free cash flows are much lower during the amortization time for the V112 projects. In scenario 2.2b, this effect is intensified once more due to the strong degression of the feed-in tariffs. Thereby, the impact on interest constitutes the main reason for the longer amortization time of the scenarios 2.1b and 2.2b. This impact is so profound that in the non-crisis and quick roll-out speed scenario, the total revenue of the lower investment into a V90 is higher than the revenue of the more powerful V112. Generally, the cash flows increase during the first years due to the diminishing interest amount of borrowed capital.

The development of the tax burden is shown in the upper panel of Figure 5, while the lower panels show the average values. Between the years 2020 to 2023, the first curve buckle represents an enhanced tax burden because of the exhaustion of the accumulated deficit, which was generated by the high interest payments. The second curve buckle in 2031 mirrors the end of the depreciation time and a repeated increase of tax burden. The last curve buckles (which are only seen in the V112 scenarios) are caused by the assumed local conditions: In 2034, the subsidy of high feed-in tariffs ends and is replaced by lower feed-in tariffs (§ 49 I and II EEG). In 2035, the free cash flow will continue to decrease: The high feed-in tariff will be replaced by the lower one, entirely. In the following years, the cash flows would stand, but this is not relevant in our time frame.

In Figure 6 we depict the repayments and return structure. Again, as can be seen, most projects are fully repayed after around 10 years. After that, significant returns are generated. To provide a more detailed insight, we summarize the investment plan for the example 1.1b (V112, crisis, normal roll-out speed):

Total loan amount:	3,676,454.00 €
Sum of interests (borrowed capital):	677,596.00 €
Brought equity per household:	1,005.84 €
Return after 20 years (total):	2,488,636.00 €
Return after 20 years (per household):	2,489.00 €

After all, the discounted yield per household amounts to

$$2{,}489 = 1{,}005.84 \cdot (1+i)^{20}$$
$$\Leftrightarrow i = 4.63\%,$$

where i denotes the internal rate of return (IRR). Tables 5 and 6 show the IRRs for all scenarios. In all cases, the IRR is positive. Dependent on the crisis/non-crisis scenarios, the nominal IRRs are greater that the inflation rates, except for scenario 2.2b. Seen that way, all projects return a positive real IRR, except for 2.2b (V112, non-crisis, quick roll-out speed). Other ratios support the results: The leverage costs of energy (LCOE) of all scenarios reside within a range between € 0.059 and € 0.075 per kWh. As Kost et al. (213) point out, LCOE are considered to be competitive below € 0.073 per kWh. Figure 7 shows that scenario 2.2b does not satisfy this value.

Finally, the net present values (NPV) of the projects verify the predicated statements, see Figure 8. The NPV is the sum of all discounted cash flows which are triggered by the investment. It indicates that the scenarios with low inflation rates possess better conditions for implementing a CSOP-financed project. Again, we advise against an implementation of a Vestas V112 under the conditions of scenario 2.2b.

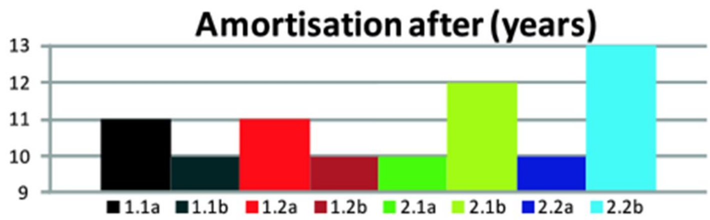

Figure 2. Amortization Time

Table 5. Internal Rates of Return, Vestas V90.

1.1a	1.2a	2.1a	2.2a
4.76%	4.04%	6.63%	5.81%

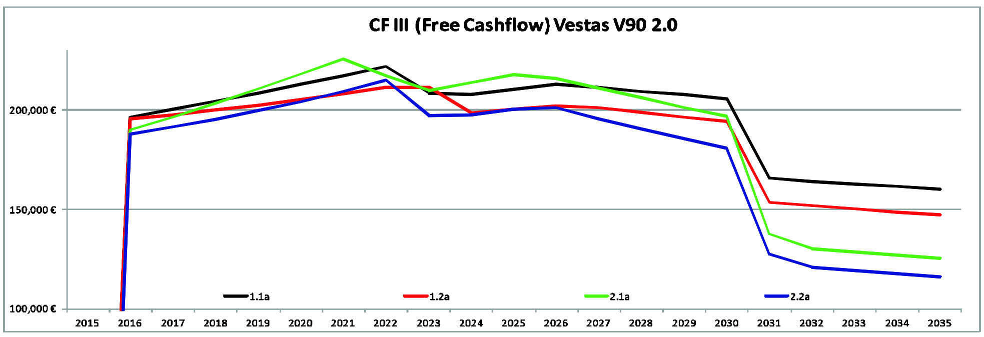

Figure 3. Discounted Free Cash Flow V90

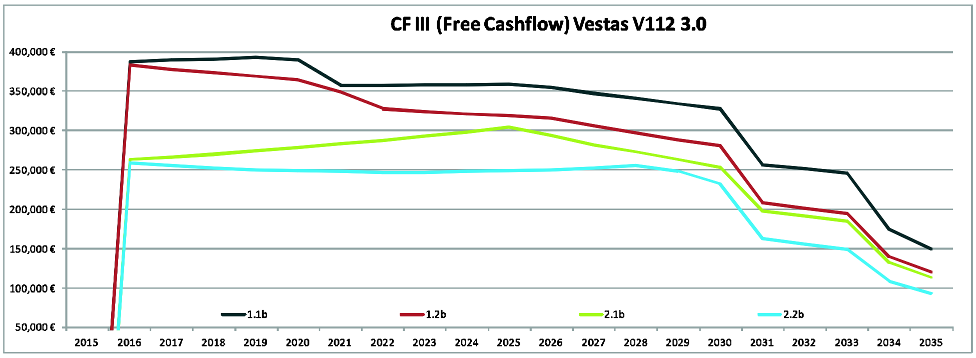

Figure 4. Discounted Free Cash Flow V112

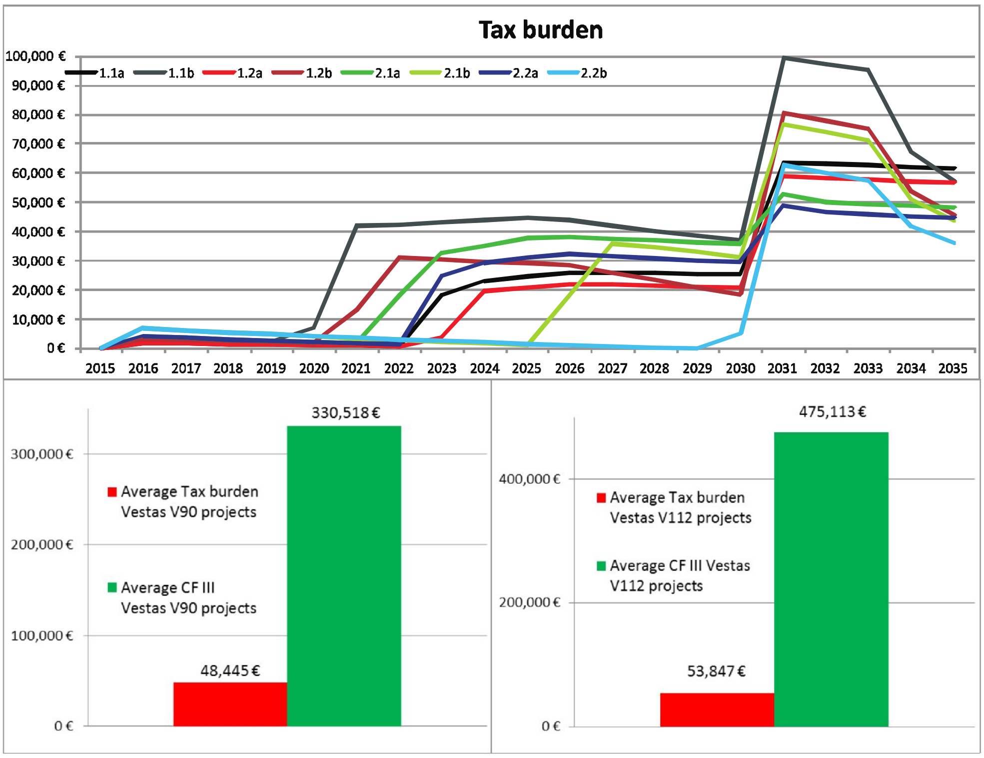

Figure 5. Average Tax Burden and Free Cash Flow (CF III), V90 and V112 Projects.

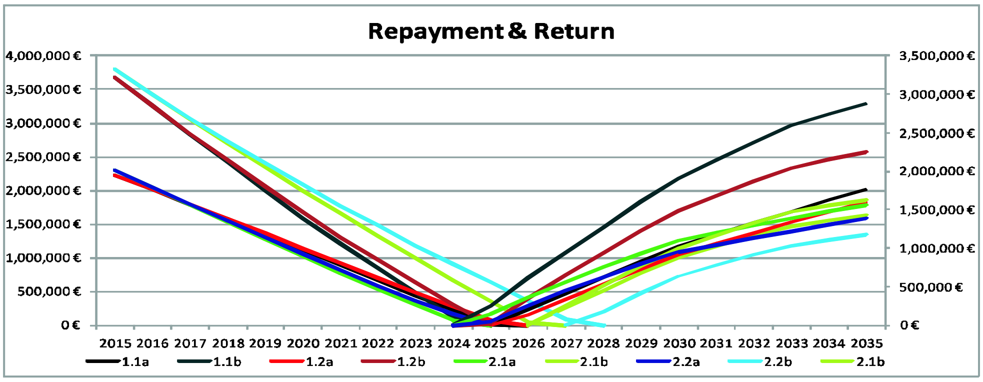

Figure 6. Repayments (Left Scale) and Returns (Right Scale).

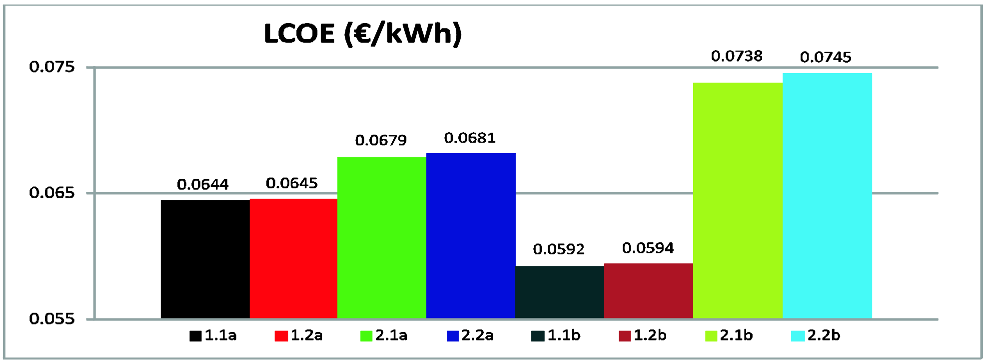

Figure 7. Leverage Costs of Energy (LCOE) for all Projects

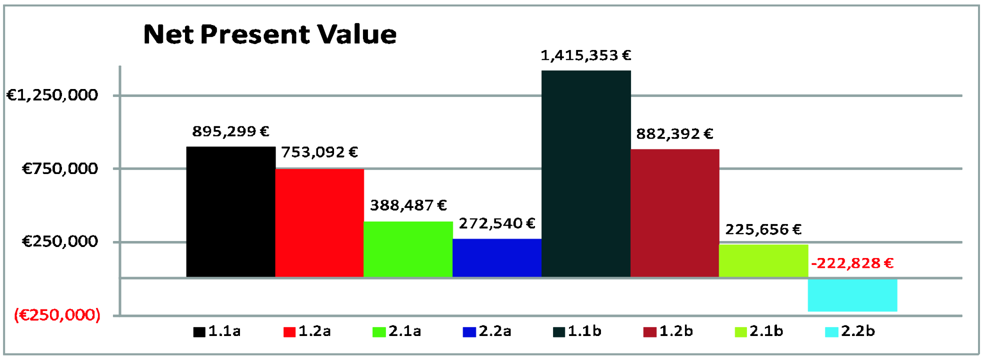

Figure 8. Net Present Value (NPV) for all Projects.

Table 6. Internal Rates of Return, Vestas V112

1.1b	1.2b	2.1b	2.2b
4.63%	2.78%	3.31%	0.47%

6. CONCLUSION

In this paper we analyze the profitability of direct renewable energy (wind power) investments under certain given scenarios. Here, we take the special conditions necessary for CSOP investment into account. We find that in seven of the eight scenarios, the investment projects are profitable and should be competitive to many alternative investments. Only for the scenario „weak wind, non-crisis, quick roll-out speed“, the real IRR is negative. However, although that project possesses the longest amortization time, it is still redeemed way within the turbine's operation lifetime.

To sum up, the CSOP investment scheme turns out to be a competitive way to implement renewable energy projects. Not only do participants benefit financially, but the scheme helps customers to gain participation in productive capital, fosters the decentralized energy supply landscape necessary for a renewable energy grid and may even increase the consumers' awareness regarding sustainable behavior, such as responsible energy saving. The localized power supply also poses an incentive to implement a small smart-grid installation, while incentives on larger-scale smart power supply are still expected to show up, eventually.

The analysis shown here is however limited to the scenarios we present. Whenever the conditions considered are exceeded, the results are not reliable. In our future research, we will provide a more detailed analysis of extreme value scenarios that are not limited to conditions that are expected to come up in Germany, but in other regions of the world as well. Here, we will also analyze the conditions of PV investments instead of wind power plants.

One policy implication to be derived from our results would be to have the state keep up or even intensify the state loan subsidy programme. Rather than simply subsidizing the feed-in tariff (from which, in most cases, in the end, monopolistic energy companies take most of the benefit), the state should intensify the incentives for small investors to support small-scale local power production facilities. This does not only crack economically inefficient monopolies, but also disburdens the energy grid to a severe degree, which is a big problem in many states. Future energy policy should aim at increased incentives to privately invest into small-scale local energy production, for which renewable sources provide ideal technical conditions.

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