/ Perfect Welding / Solar Energy / Perfect Charging

Cost advantages of Fronius Tauro

in decentralised and centralised systems compared with competitors

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1 INTRODUCTION

This paper explains the cost structure of a commercial PV system and the main financial factors influencing the *total cost of ownership* (TCO). In addition, it takes a close look at some product features of Fronius Tauro commercial inverters and illustrates their impact on total system costs.
Another main thread of this paper carries out cost comparison calculations using a number of competitors' devices. Given a particular situation, these show which version or Fronius Tauro option would be the most economical choice for typical commercial PV systems. In addition, the technologies associated with service and maintenance are explained and their impact expressed in the system cost comparison.

2 COST STRUCTURE OF A PV SYSTEM

The levelised costs of energy (LCOE) provide information on how much the production of electricity costs and what it ultimately yields. These are regarded worldwide as a standard value when it comes to energy systems.

The LCOE or "levelised costs of energy" is the ratio between the total costs of the PV system and the expected yield. The total cost of ownership (TCO) covers all costs incurred, such as capital and investment costs, installation and labour costs, as well as the various costs for servicing, operating and maintaining the system over a certain period of time.

For PV systems, the levelised costs of energy are shown in EUROS per kilowatt or megawatt hour.

$$\boldsymbol{Levelised\ costs\ of\ energy}\ (\boldsymbol{LCOE}) = \frac{\boldsymbol{TCO}}{\boldsymbol{yield}}\ [\frac{\boldsymbol{€}}{\boldsymbol{kWh}}]$$

The lower the TCO and the higher the yield from the PV system, the lower and therefore better the value for the levelised costs of energy (see Fraunhofer ISE).

2.1 Total cost of ownership

The total cost of ownership (TCO) represents the total costs of a system. In addition to the acquisition costs, aspects of later use, such as repairs, maintenance, other running costs and, if necessary, disposal expenses, are deliberately taken into account (see Gabler Business Lexicon).

2.1.1 Capital expenditures

Capital expenditures (CAPEX) play an important role in the TCO. As well as the acquisition costs for the inverters, the acquisition costs for solar modules, labour and BOS costs (see Gabler Business Lexicon) are also included. In many cases, the initial costs are used as the sole decision-making criterion when selecting the inverters.

2.1.2 Balance of system costs

The balance of system costs (BOS costs) account for approximately one third of total CAPEX costs. They consist of the costs for the supports for the solar modules, the AC and DC cabling and various distributors. The BOS costs also include cable trays, elements for grid connection and other additional components and parts that make a significant contribution to the proper functioning of the PV system. Other components that can be included in the BOS costs are system monitoring, energy management software and various sensors (see Sinovoltaics).

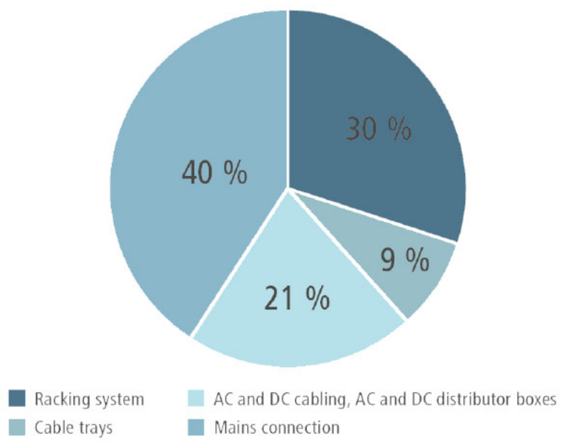

Figure 1: Composition of the balance of system costs. Source: Commercial PV system in northern Italy

To keep the initial costs of a PV project as low as possible, the BOS costs offer the best and greatest potential for savings. The Fronius Tauro offers several features whose only function is to save costs – especially BOS costs – in the project.
Even though CAPEX is sometimes the outgoing that is most closely examined by planners and investors, initial costs will not be the only factor if a PV system runs for 10, 15 or 20 years. Operational expenditures (OPEX) will accrue over these periods.

2.1.3 Operational expenditures

Operational expenditures (OPEX) represent the ongoing costs. These include all costs incurred as a result of operation, such as energy costs, repairs, maintenance and servicing, and together with the CAPEX, including BOS costs, give the total cost of ownership (TCO).
The product design of the Fronius Tauro offers a number of efficient ways of keeping these costs down. Refer to section 3 for more information.

Maintenance-free cooling system

The Fronius Tauro is equipped with an active cooling system. In addition to active cooling, the Fronius Tauro has double-wall insulation. This combination allows the interior temperature and the temperature of sensitive power electronics to be kept extremely low, even under extreme heat. Due to this innovative cooling system, the Fronius Tauro can deliver maximum performance at an ambient temperature of up to 50 °C. This in turn has a positive effect on the total yield of the PV system as well as the service life of the power electronics. Thanks to this unique cooling system, the Fronius Tauro can be installed in unsheltered outdoor locations. It also means that there is no need to spend money on shading and canopy/roofing for the inverters.
The active cooling system also has another positive effect on the TCO, as unlike some other cooling systems there are no prescribed maintenance intervals requiring the attention of specialist personnel.

Efficient technologies for service and maintenance

When developing the Fronius Tauro, the engineers focused above all on ease of use for servicing and maintenance. The intelligent product design with its generous interior space not only offers convenience during installation, but also enables the installer to carry out time-efficient servicing in the event of a problem. Here, Fronius relies on simple component replacement instead of the time-consuming replacement of the entire device. With the Fronius Tauro, the power unit can be easily replaced by just one person. In most cases, this procedure removes the need for a complete device replacement, which is what would be necessary with the other manufacturers’ devices. It also ensures that, in the event of a service callout, the error can be rectified quickly and that the long-term yield of the system is secured.

2.2 Yield

In principle, the yield of a PV system should be considered over a longer period of time. In the case of systems for self-consumption, a period of 20 years would be suitable. Depending on whether the PV system is a long-term or short-term investment, this value can be adjusted.
Many factors in a PV system have an influence on the yield of the entire system. In addition to local weather conditions, insolation, orientation, module inclination, shading, contamination and module temperature, the inverter also has a significant impact on yield.
Furthermore, the energy produced by the modules passes via DC cables to the inverter, where it is converted again and transported to the main distribution board via AC cables. However, these cable distances are rarely considered to be a factor influencing the yield of a PV system. Nonetheless, they affect it significantly, as losses occur that have an adverse effect on yield over the service life of the system, particularly at high currents and over long distances.

2.2.1 Power loss of cable

Power loss is caused by the physical characteristics of the cables and the environment. The amount of these losses is influenced by cable cross-section, material, length, temperature and the amperage conducted through the cable. These losses lead to a voltage drop, which in turn leads to a loss of power or a reduced yield in the PV system.
As a rule, PV systems are planned so that the average total power losses do not exceed 1.0%. However, this is not a legal or normative requirement, which is why PV systems with power losses of over 3% are sometimes planned.
A power loss of 1.0% may not seem much at first glance, but this small percentage can lead to losses in the thousands of euros over 20 years.
The following diagram illustrates the financial impact of power loss on cables in a 2 MWp system over a period of 20 years.

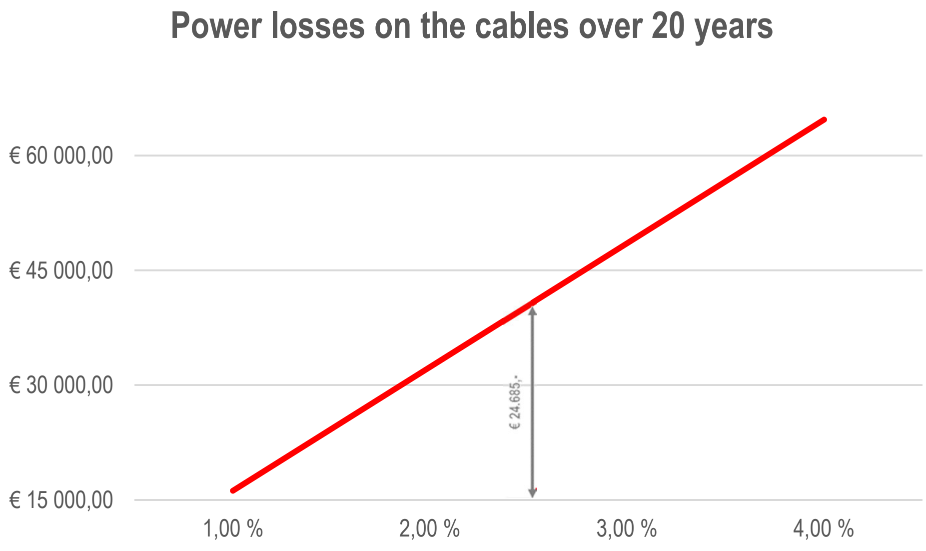

Figure 2: Power losses on the cables of a 2 MWp system over 20 years

Even a difference of 1.5% can lead to a significant monetary loss of more than €24,500. When considering the overall levelised cost of energy, this figure is a crucial factor.

These percentage cable losses can, depending on the amount of electricity being delivered, have a major financial impact, which is expressed by the following basic formula:

$$\mathbf{P = I^2 \times R}$$

Hence:

$$2 \times I = 4 \times P$$

P = power, I = current, R = electrical resistance

From this formula it follows that doubling the amount of electricity results in a four-fold increase in power loss.

Losses at cable level therefore deserve attention, as the lower the power losses within a PV system, the higher the yield. This in turn has a positive impact on the total cost of the PV system and hence the payback period.

3 TECHNOLOGIES FOR SERVICE AND MAINTENANCE

As described above in section 2.1.3, it is the maintenance and service callouts that have the greatest effect on the operational costs (OPEX). The more frequent and time-consuming they are, the higher the costs, and this in the end again affects the TCO.
Service callouts can have a variety of influences on the TCO depending on their type and frequency. This in turn depends on certain factors affecting the cost of the callout, such as:

/ Time spent on the callout
/ Number of persons deployed on the callout
/ Equipment required for the callout, e.g. a crane or scissor-lift platform
/ Any travelling expenses incurred

3.1 Replacing a Tauro power module

The Fronius Tauro ECO product design keeps down the cost of service callouts; instead of the time-consuming replacement of the entire device, it is possible to replace just the power module, leaving all the existing cabling in place.

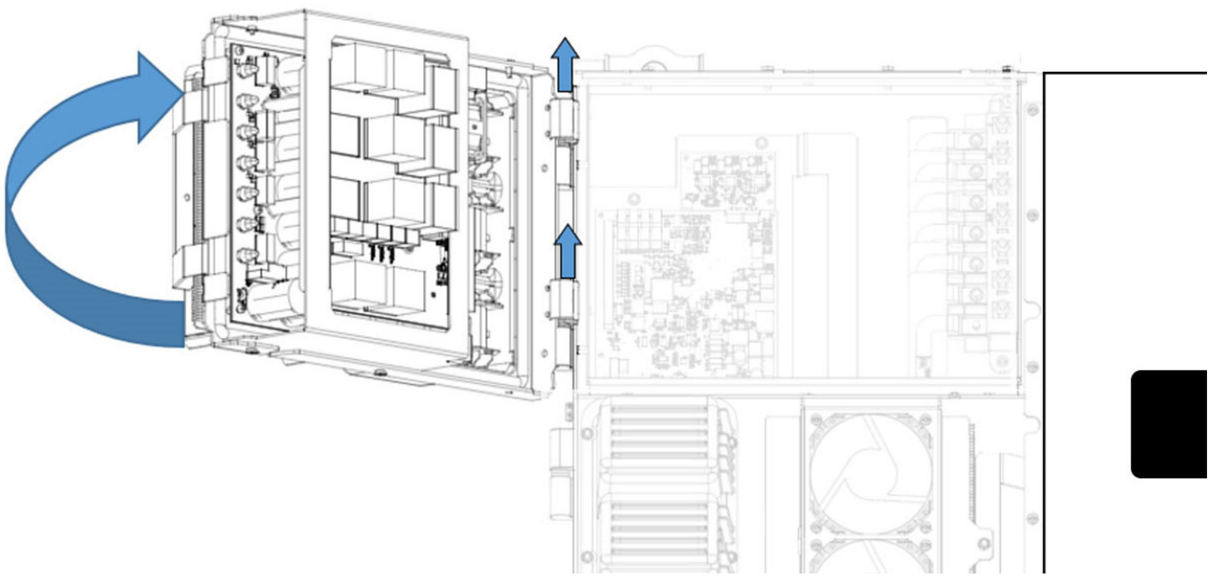

Figure 3: Replacing a power module on the Fronius Tauro

This process takes up much less time and above all requires very little in the way of personnel, since the power module can be replaced by one person.

3.2 Effect on OPEX costs

The process of replacing a power module has a positive impact on OPEX costs and consequently keeps the TCO down.
The following chart illustrates the effect of a service callout on OPEX costs. It is assumed that there will be 1 service callout per inverter over a 20-year service life. The duration of the callout or time taken to fix the

problem depends on the particular replacement process and the size and weight of the device. The number of persons deployed will also depend on the weight of the inverter. The equipment required will also vary according to the weight, shape and size of the inverter. In the following example, we have assumed that a scissor-lift platform will be hired if necessary.

The availability of spare parts, the shelf life of replacement parts, and shipping times have been ignored here and play no part in the calculation.

This example shows a service callout for a device installed in a roof-mounted system. The same problem scenario was used for the various manufacturers and the costs illustrated.

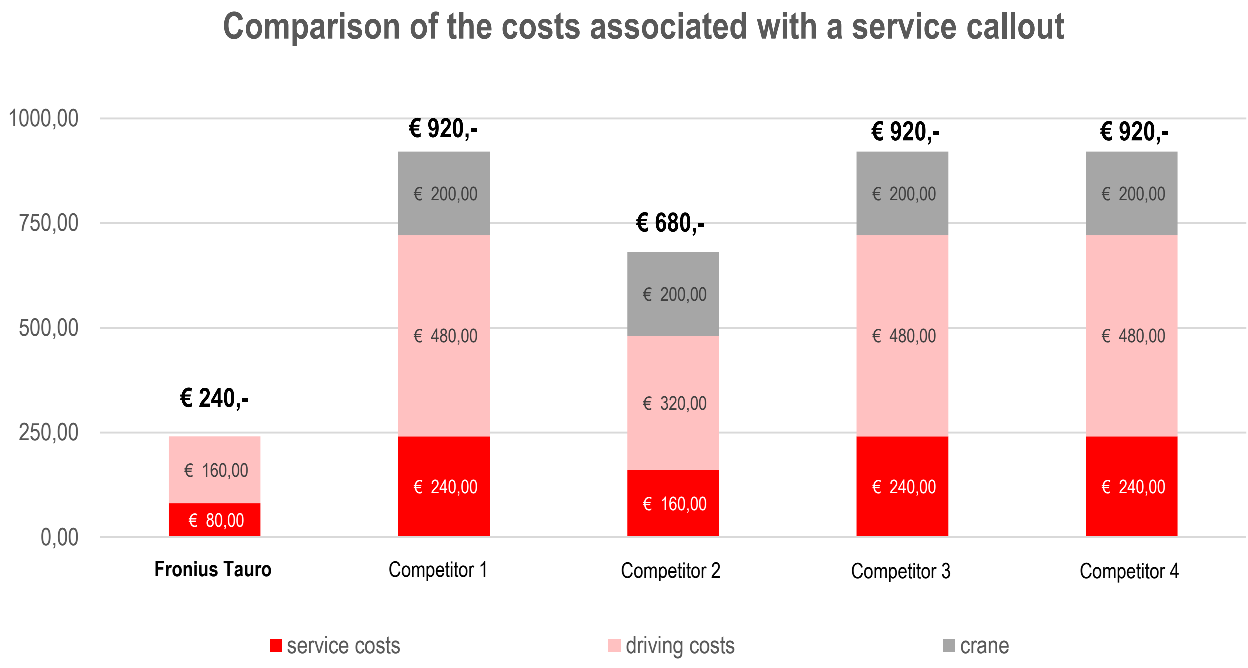

Figure 4: Comparison of the costs associated with a service callout for a faulty device

It is plain to see from the above chart that the costs of a service callout for the Fronius Tauro are considerably lower than for the other manufacturers. This is essentially due to the fact that the power module can simply be replaced. In this example, this operation was assumed to take the same amount of time as replacing the entire device, but it is worth noting that, in practice, replacing a power module can be done by one person in just a few minutes. Replacing the entire device, on the other hand, requires 2 or 3 people depending on the weight of the device and the manufacturer's instructions, thereby increasing service costs.

A power module for the Fronius Tauro weighs around 27 kg. It can therefore be replaced by one person without any problems and carried up and down from the roof via a fire ladder or similar means of access. Two or three people would be needed to replace a complete device installed on a roof. In addition, getting the replacement device up onto the roof and removing the defective one calls for additional equipment. In the case of competitors 1-4, this means the hiring of a scissor-lift platform or crane, again increasing the costs of the service callout.

The cost savings for a service callout for a Fronius Tauro can have a major impact on TCO.

4 SYSTEM COMPARISONS BASED ON COST

As a large-scale PV system usually represents a significant investment, it follows that is has to be cost effective, not to mention profitable. The relationship between low TCO and high yields is therefore extremely important. As already discussed in detail in section 2.1, it is frequently the initial costs rather than the total system costs that are used as the purchasing criteria. The same applies to the acquisition costs of the inverter. As some of the features integrated into an inverter can result in cost savings in other aspects of its operation, judging a system solely on the initial price of the inverter does not appear to be good policy. The more sustainable and usually more economical approach is to look at total system costs over the entire service life of the system (TCO).

The following subsections compare the total system costs of different types of system with those of competitors' systems. The main focus is on CAPEX costs and the effects of power loss. Any savings arising from the fact that no shading or covering systems are required, which have a positive effect in the case of the Fronius Tauro, are ignored in the following example scenarios.

4.1 Roof-mounted systems, self-consumption situation

4.1.1 Mixed system comprising Fronius Tauro & Fronius Tauro ECO Direct

The use of Fronius inverters enables a profitable PV system to be installed even in scenarios with complex system requirements. The simple combination of the flexible Tauro and the cost-effective Tauro ECO means a total system can be designed and implemented in a cost-optimised manner without sacrificing anything in the way of flexibility in the design of the system.

This combination has a lot going for it, particularly with respect to the TCO of commercial PV systems, as generally speaking it is just small sections of the PV system that demand greater flexibility in their design. This usually arises as the result of partial shading, other equipment or module strings of varying lengths. Whereas the Fronius Tauro will cover these generally more complex strings, the Fronius Tauro ECO will provide cost-optimised control of the larger part of the PV array, providing a cost-effective total system.

The costs of this particular combination are examined in the following example scenarios.

Example[1]: A commercial enterprise in Austria installs on the roof of its premises a PV system to reduce the energy costs that accrue during the day. The roof offers enough space for 350 kW AC and a decentralised system design was chosen to take account of local conditions. Shorter strings are required in some locations due to the presence of skylights.

[1] ***The following parameters were used for the computations in this example:*** *20-year service life, 0.2 EUR/kWh, 35m from main distributor, 350 kW AC, 500 EUR DCCB, 1200 kWh/a, location Austria, 1 service callout per inverter over 20-year period*

Different inverter manufacturers and their system solutions were used for this starting situation. The following chart compares the varying total system costs for this example scenario.

The cost overview compares the combination of Fronius Tauro and Fronius Tauro ECO with four other inverter manufacturers. The aforementioned example scenario uses Direct versions of Fronius Tauro devices, as a decentralised system design is required and this represents the most cost-effective solution under these circumstances.

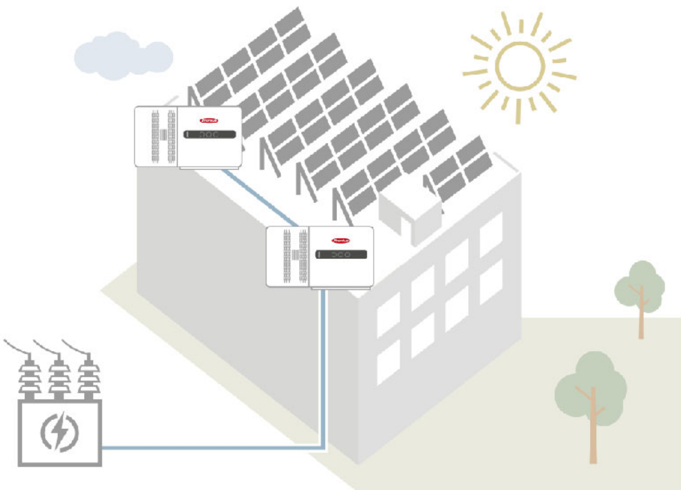

Figure 5: Roof-mounted installation of decentralised system with Tauro and Tauro ECO D

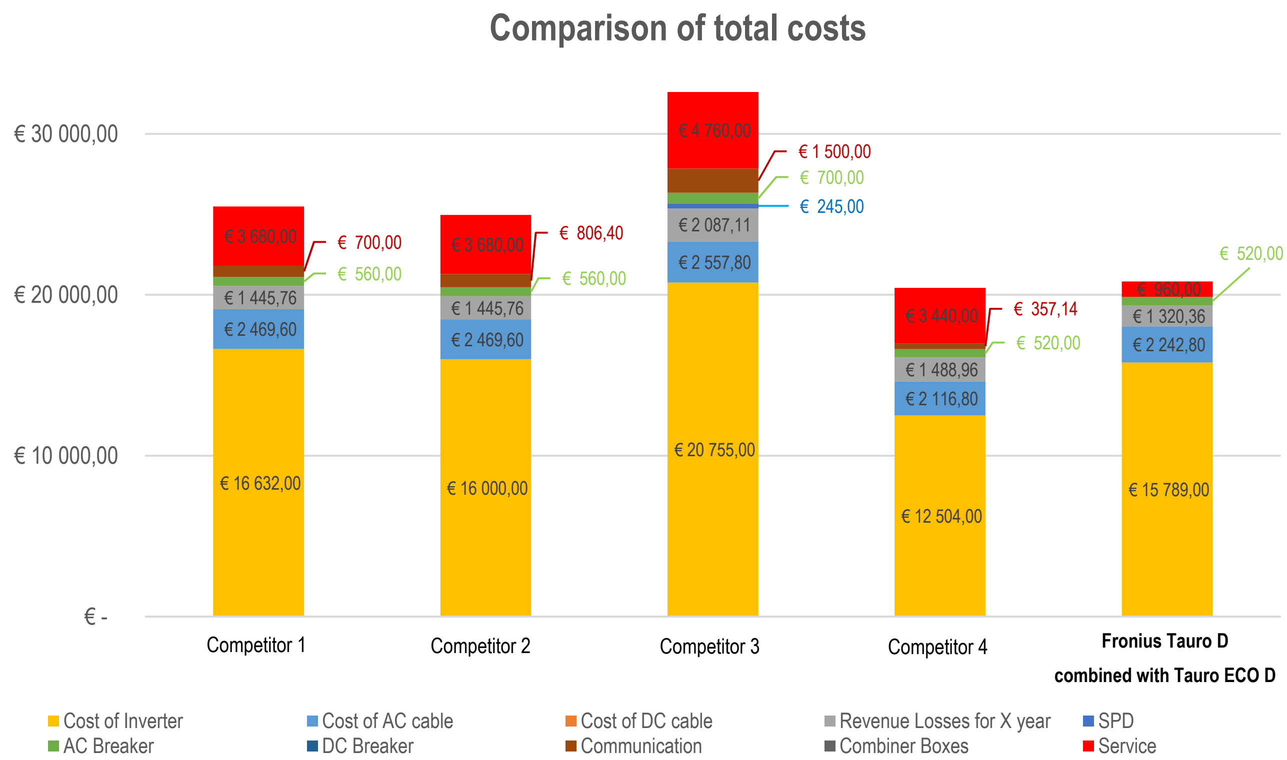

Figure 6: Roof-mounted installation of decentralised system with Tauro D and Tauro ECO D

As can be seen, the total system costs for the various manufacturers differ considerably. The price of the inverters for the Fronius Tauro & Tauro ECO system solution is about average. The total system costs, by comparison, are low. This is a clear indicator that looking at the price of the inverter in isolation when deciding which manufacturer to choose can be a false economy.

On the one hand, the low total system costs can be traced back to the cost-effective service function of the Fronius Tauro; on the other, to savings in BOS costs and the low level of cable losses. The Fronius Tauro system solution has the lowest costs, as shown in the following chart.

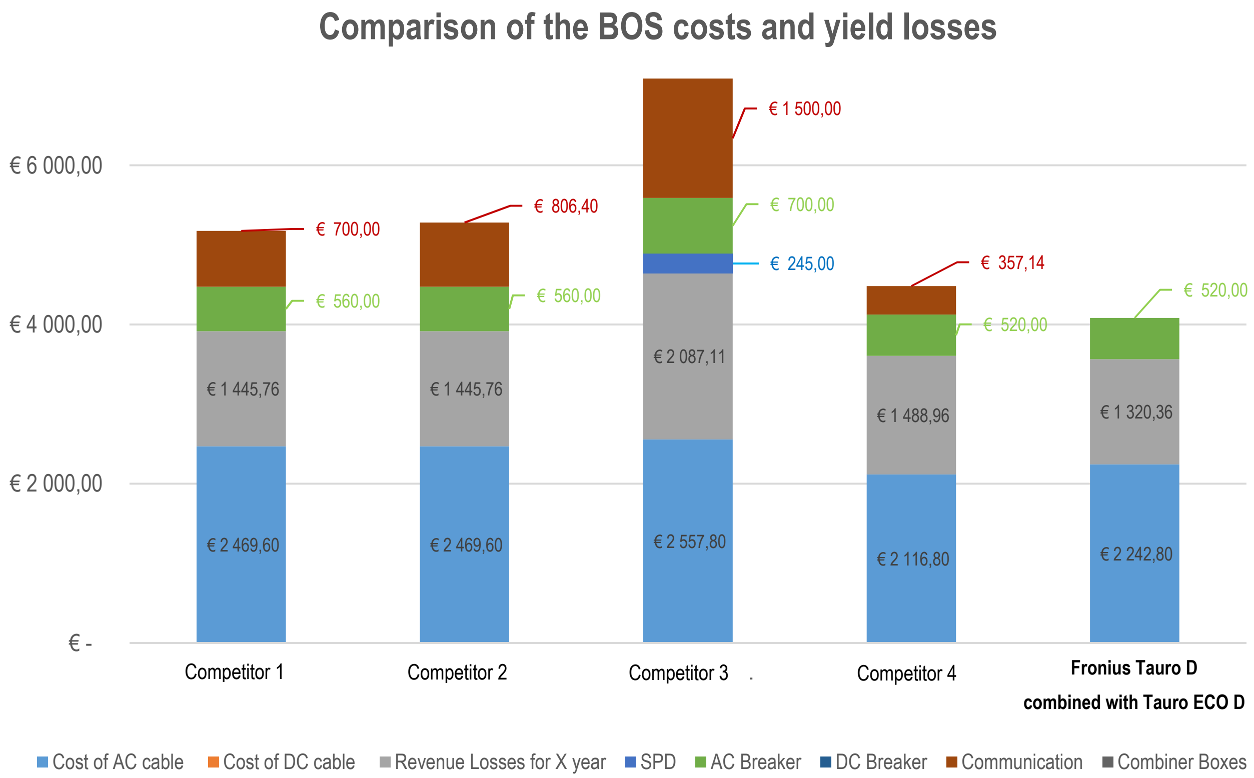

Figure 7: Comparison of the BOS costs and yield losses for an example 350 kW AC roof-mounted installation

Compared with the 4 other inverter manufacturers, various product features mean the BOS costs and power losses can be kept very low in a system using a Fronius Tauro. Specifically, system components such as monitoring hardware and communication interfaces are already built in as standard in the Fronius Tauro, resulting in significant savings. Even AC cable costs and power losses can be reduced thanks to the generous cable cross-sections of up to 240mm².

The result for this example scenario: choosing a Fronius Tauro reduces BOS costs by around 43% compared with the other manufacturers.

4.1.2 Tauro Direct for decentralised system design

Example[2]: A commercial enterprise in Austria installs on the roof of its premises a PV system to reduce the energy costs that accrue during the day. The roof offers enough space for 200 kW AC and a decentralised system design was chosen to take account of local conditions.

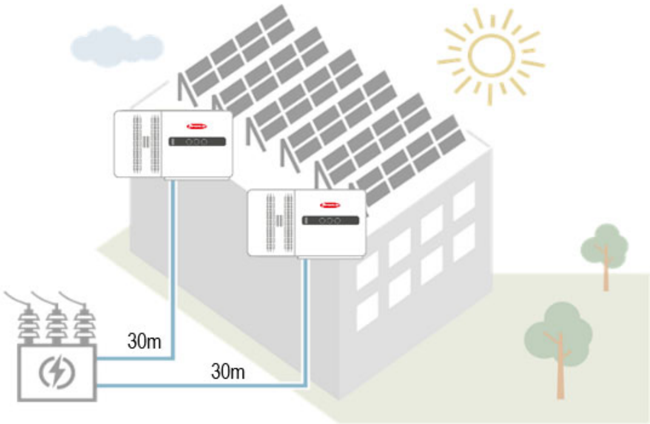

Figure 8: Roof-mounted installation of decentralised system with Tauro ECO D

Different inverter manufacturers and their system solutions were used for this starting situation. The following chart compares the varying total system costs for this example scenario. The subsequent cost overview compares the Fronius Tauro ECO with four other inverter manufacturers. The aforementioned example scenario uses Direct versions of Fronius Tauro ECO devices, as this represents the most cost-effective solution under these circumstances.

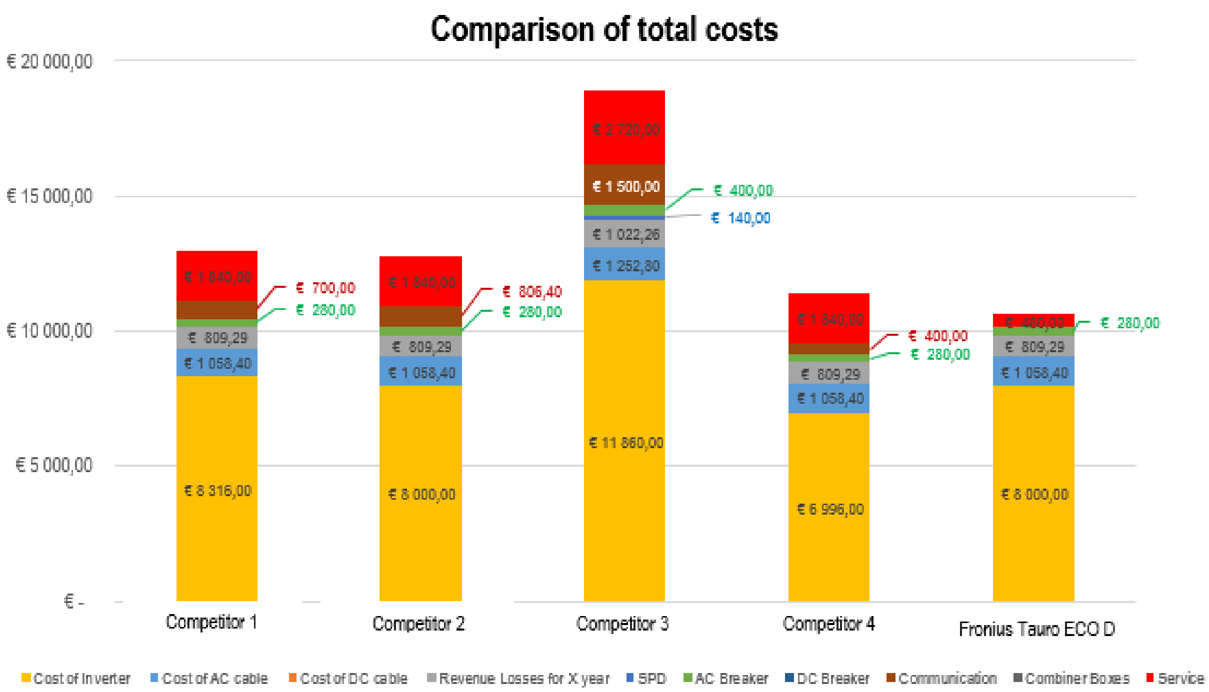

Figure 9: Comparison of total costs for an example 200 kW AC roof-mounted installation

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[2]***The following parameters were used for the computations in this example:*** *20-year service life, 0.2 EUR/kWh, 30m from main distributor, 200 kW AC, 1200 kWh/a, location Austria, 1 service callout per inverter over 20-year period*

As shown, the total system costs for the various manufacturers differ considerably. The price of the Fronius Tauro ECO inverters is about average. The total system costs, by comparison, are very low. This is a clear indicator that looking at the price of the inverter in isolation when deciding which manufacturer to choose can be a false economy.

On the one hand, the low total system costs can be traced back to the cost-effective service function of the Fronius Tauro. This example assumes that every inverter will have to be serviced once over its 20-year service life. This slashes service costs to just one seventh of that of the other inverter manufacturers.

The low total system costs of the Fronius Tauro ECO are on the one hand the result of the lower BOS cost as a consequence of the low cable losses; the comparison shows that the Fronius Tauro ECO boasts the lowest costs.

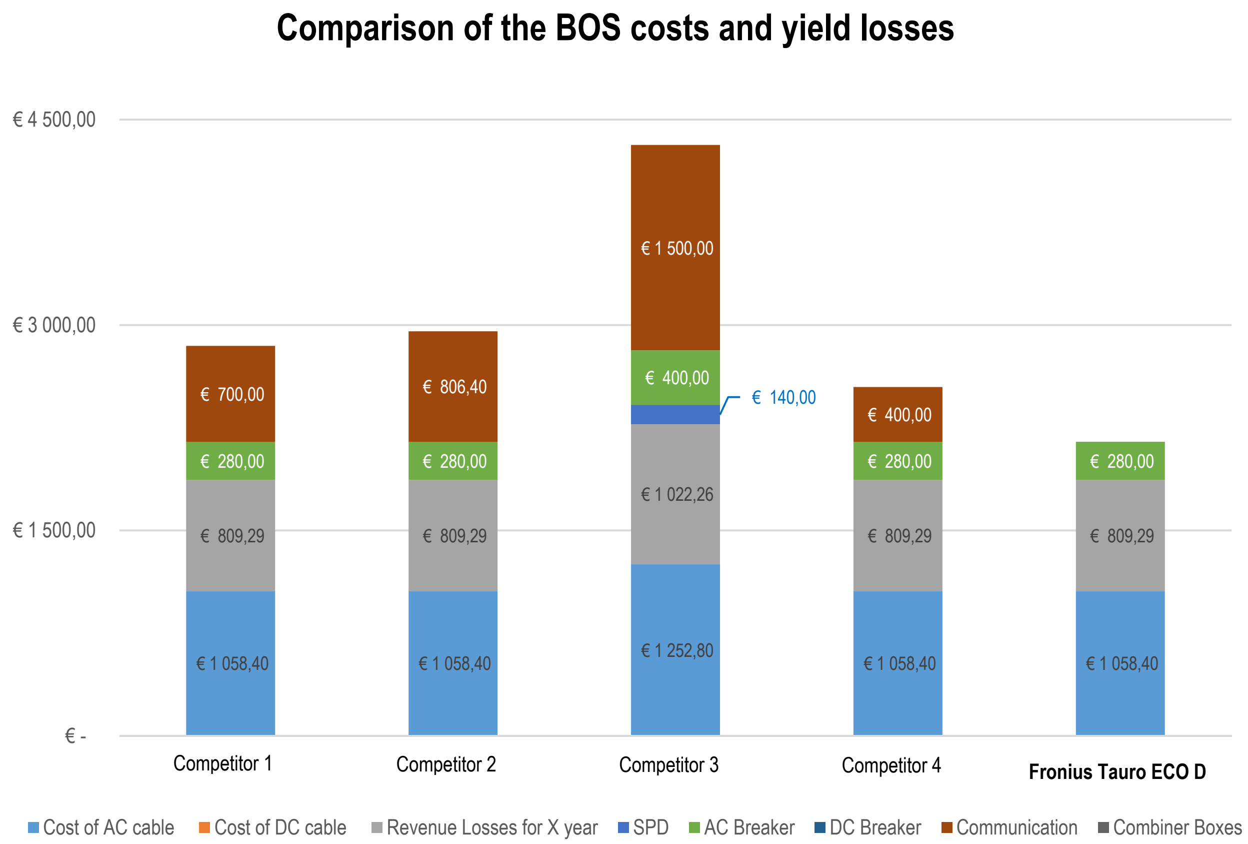

Figure 10: Comparison of the BOS costs and yield losses for an example 200 kW AC roof-mounted installation

Compared with the other 4 inverter manufacturers, the various features of the Fronius Tauro enable it to keep BOS costs and power losses very low. In particular, the permitted cable cross-sections reduce AC cabling costs and the power losses at cable level. In addition, system components such as monitoring hardware and communication interfaces are already integrated into the Fronius Tauro as standard, again achieving additional savings in BOS costs.

The result for this example scenario: a Fronius Tauro ECO has just half the BOS costs compared with the other manufacturers.

4.1.3 Tauro Precombined for centralised system design

Example[3]: A commercial SME in northern Italy installs on the roof of its premises a PV system to reduce the energy costs that accrue during the day. The roof offers enough space for 300 kW AC and a centralised system design was chosen to cater for local requirements.

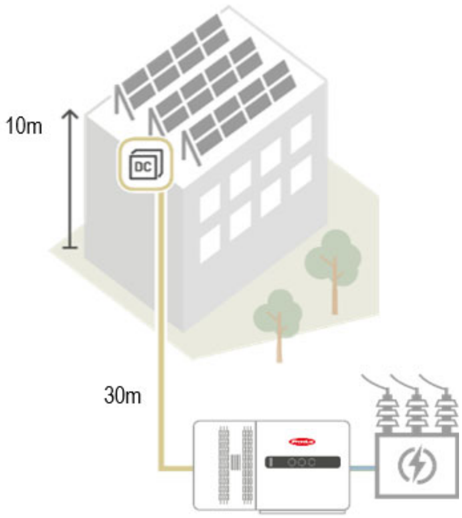

Figure 11: Centralised system design with Fronius Tauro ECO P, 300 kW AC

This cost overview includes two further inverter manufacturers that offer a system solution for the aforementioned scenario. A Precombined version of the Fronius Tauro ECO was used in this example scenario, as the circumstances demanded a centralised design, for which the Tauro ECO inverters are the most cost-effective option.

[3] ***Computation parameters:*** *20-year service life, 0.2 EUR/kWh, 30m from main distributor, 300 kW AC, 500 EUR DCCB, 1400 kWh/a, location northern Italy*

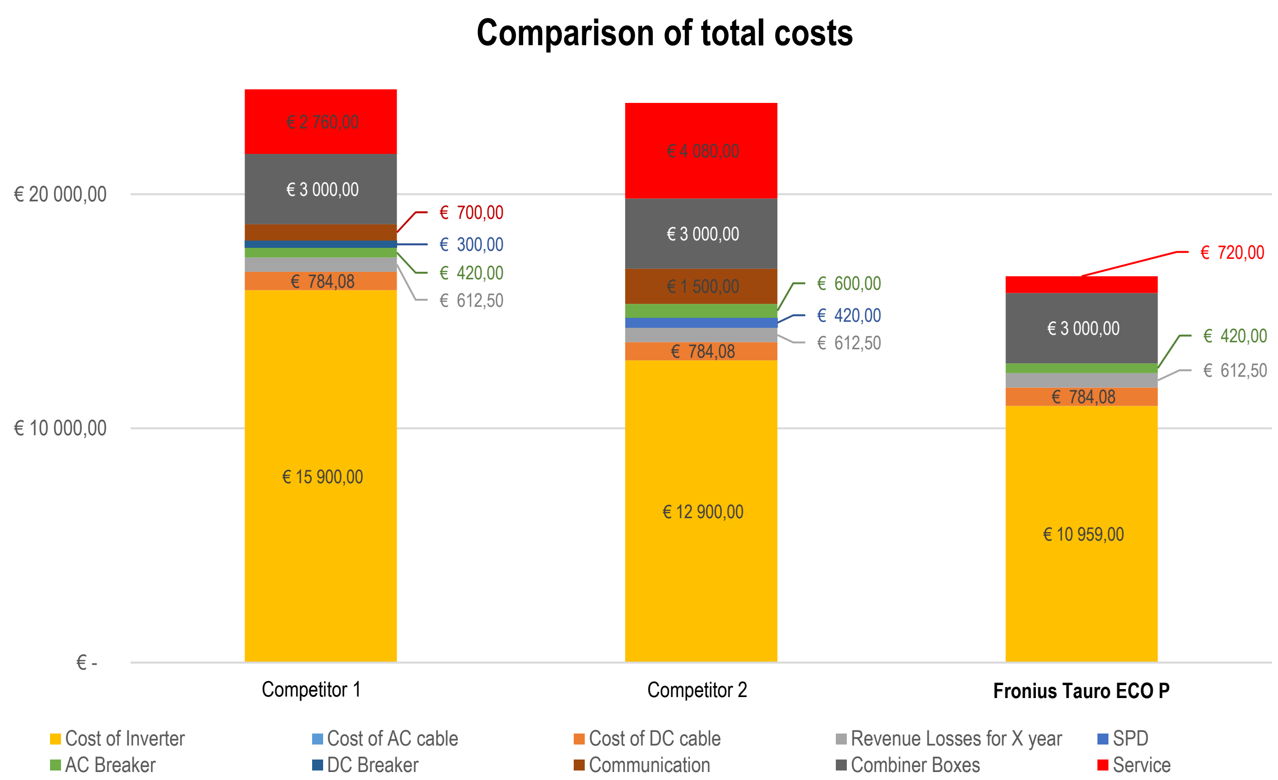

Figure 12: Comparison of total system costs for an example 300 kW AC roof-mounted installation

As can be seen, the Fronius Tauro is shown to be the most economical choice when comparing total system costs. This is due to the clear cost benefits in the BOS and service costs. Compared with the competition, a service callout to a Fronius Tauro ECO **is up to 82%** cheaper.

The savings in BOS costs were particularly high, as shown in the following chart.

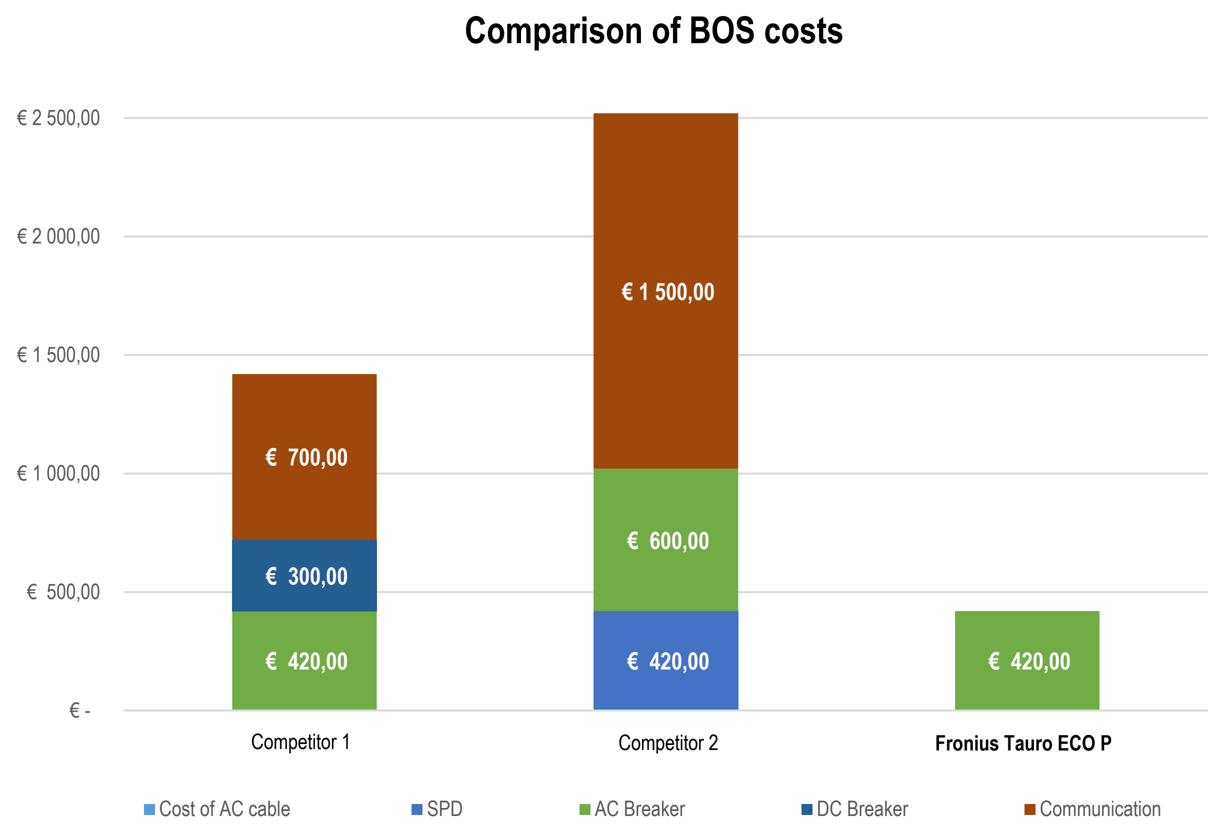

Figure 13: Comparison of BOS costs for an example 300 kW AC roof-mounted installation

The chart shows that the BOS costs of the Fronius Tauro are by far the lowest, as most of the system components required in the project, such as overvoltage protection, DC disconnector or communications unit, are already integrated into the device as standard. The BOS costs of the P version of the Fronius Tauro ECO are around **83%** lower than those of the competitors.

4.2 Outdoor systems, feed-in system, PPA

4.2.1 Tauro Direct for decentralised system design

Example[4]**:** A Greek investor installs a PV system on a plot of undeveloped land as an investment. The site offers space for 800 kW AC and a decentralised system was installed to take account of local conditions. The average distance to the transformer is 55 metres.

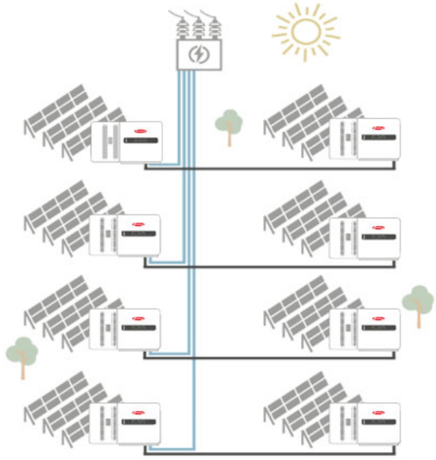

Figure 14: Outdoor installation of decentralised system design with Tauro Eco D with AC daisy-chaining option

This cost overview compares the Fronius Tauro with 4 other inverter manufacturers that offer a system solution for the aforementioned scenario. A Direct version of the Fronius Tauro ECO featuring the AC daisy-chaining option was used, as this represents the most cost-effective solution.

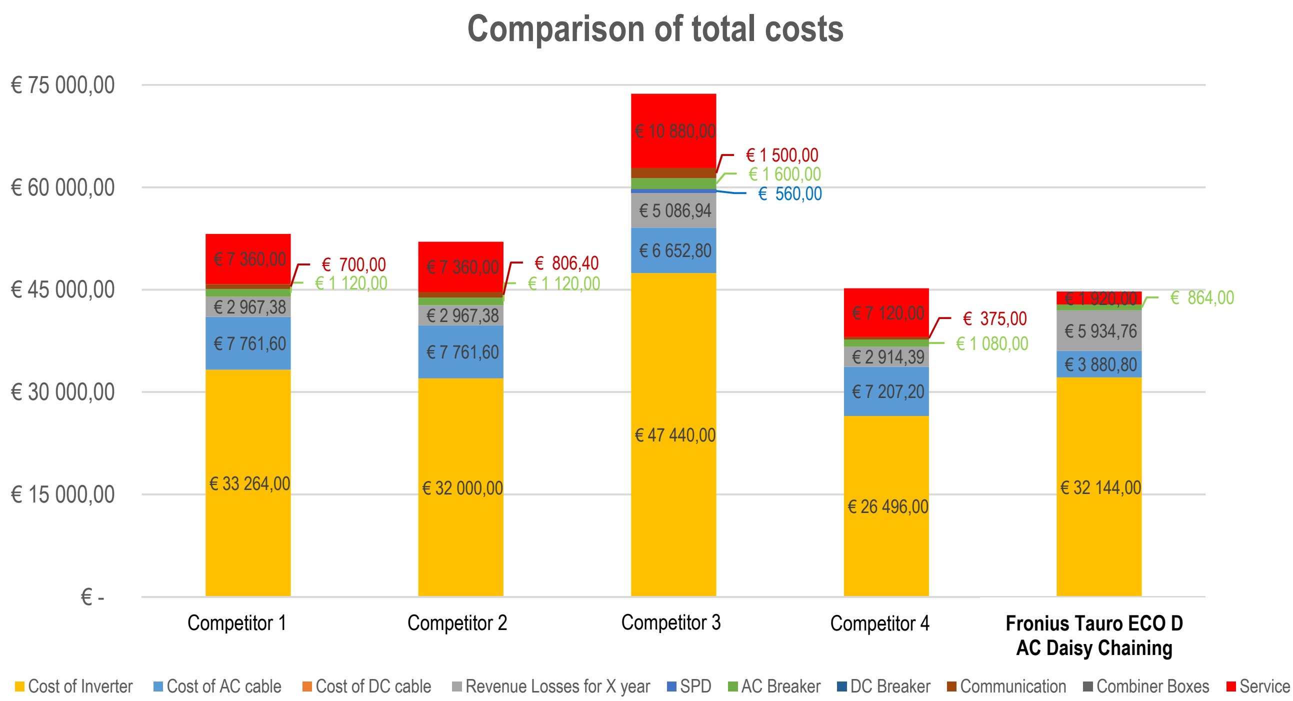

Figure 15: Comparison of total costs for an example 800 kW AC outdoor installation

[4] ***Computation parameters:** 20-year service life, 0.08 EUR/kWh, 55m from main distributor, 800 kW AC, 1500 kWh/a, location Greece*

As can be seen, the total system costs of the various manufacturers vary widely. Looking more closely at total system costs, the Fronius Tauro ECO with the AC daisy-chaining option is an attractive overall solution and offers the most cost-effective response for this scenario.
The strengths of system solutions in regards to service are clearly evident, as can be seen in the following chart.

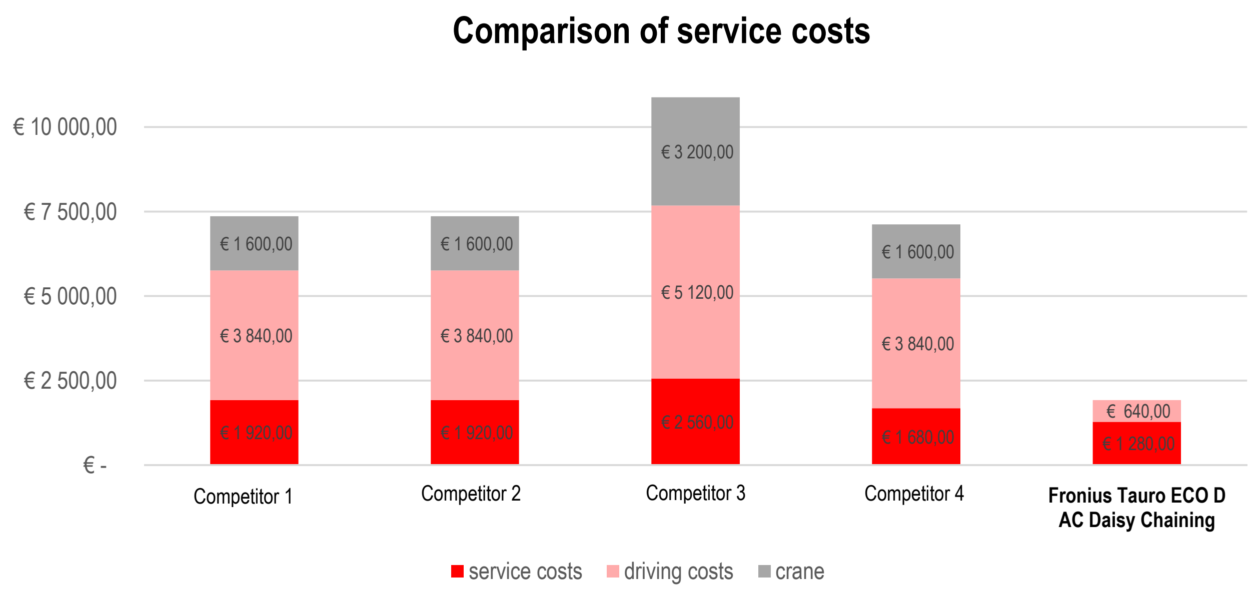

Figure 16: Comparison of service costs for an example 800 kW AC outdoor installation

A **saving of 82%** compared with the competitors is achieved using the Fronius Tauro ECO D.
A further clear benefit becomes apparent if we take an in-depth look at BOS costs.

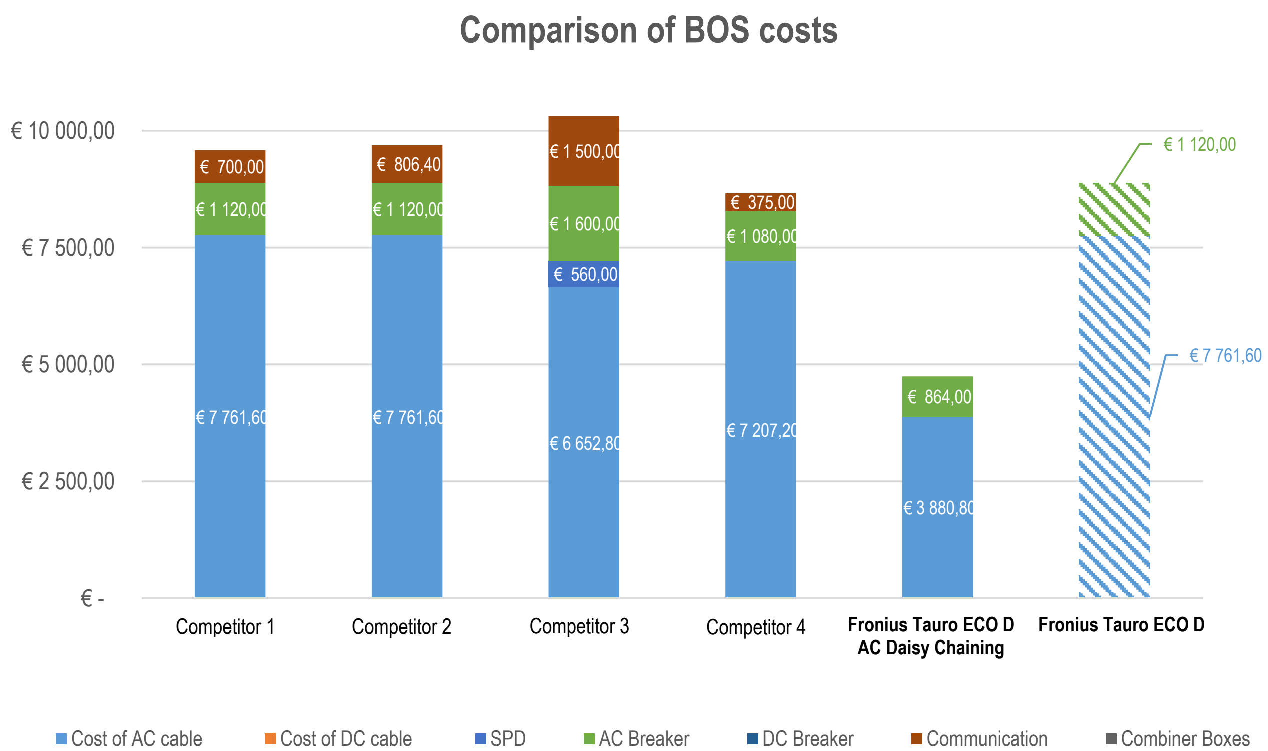

Figure 17: Comparison of BOS costs for an example 800 kW AC outdoor installation

Compared with the other inverter manufacturers, this shows that the Fronius Tauro ECO with the AC daisy-chaining option offers the greatest benefit in terms of BOS costs. This is due to the fact that components such as the communication unit and overvoltage protection are integrated as standard. The Fronius Tauro ECO solution with AC daisy-chaining also has financial benefits, particularly with regard to cable costs.
This beneficial financial impact of the AC daisy-chaining option on AC cabling costs becomes obvious if we compare the Tauro ECO D version without this option. This is shown in the chart as a hatched bar. It emphasises how using the AC daisy-chaining option in this scenario can reduce BOS costs by nearly 50%.

Compared with the other manufacturers, using the Fronius Tauro ECO with the AC daisy-chaining option saves **54%** of total BOS costs.

4.2.2 Tauro Precombined for centralised system design

Example[5]: A Sicilian businessman is installing a large-scale outdoor PV system as an investment. The site offers space for 2400 kW AC and the businessman prefers a centralised system design due to the conditions and local requirements. The average distance from the module array to the centrally located inverters next to the transformer is 100 metres.
For this illustrative cost overview, two further inverter manufacturers offering system solutions for the aforementioned outdoor scenario were included. A Precombined version of the Fronius Tauro ECO was used in this adopted example scenario. The total system costs of all three system solutions are shown in the

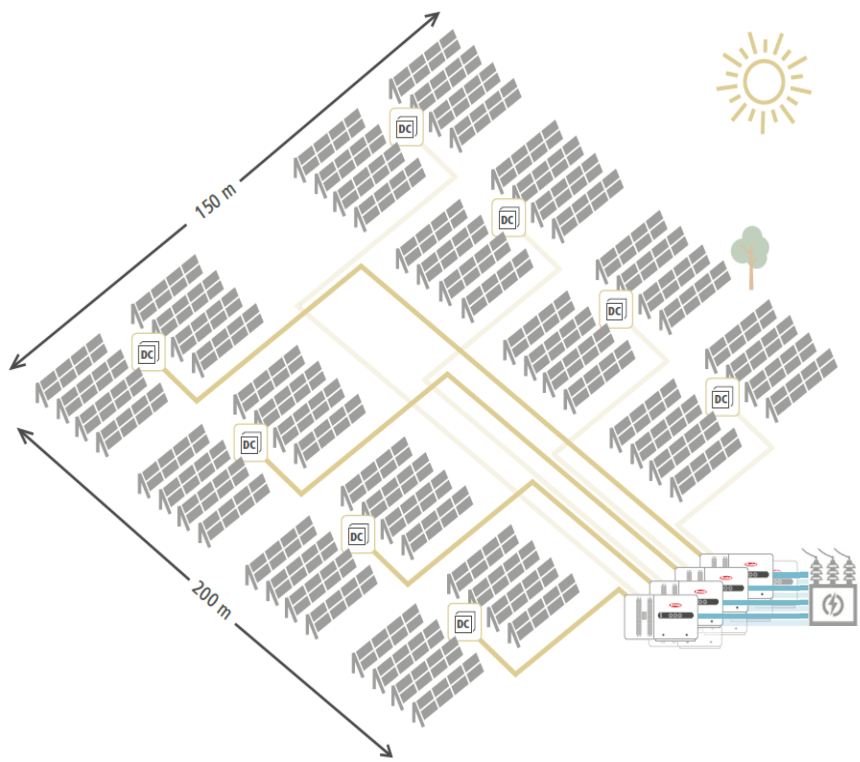

Figure 18: Centralised system design, outdoor, 2400 MW AC

5 ***Computation parameters:*** *20-year service life, 500EUR DCCB, 0.08 EUR/kWh, 100m from main distributor, 2400 kW AC, 1500 kWh/a, location Sicily*

following chart.

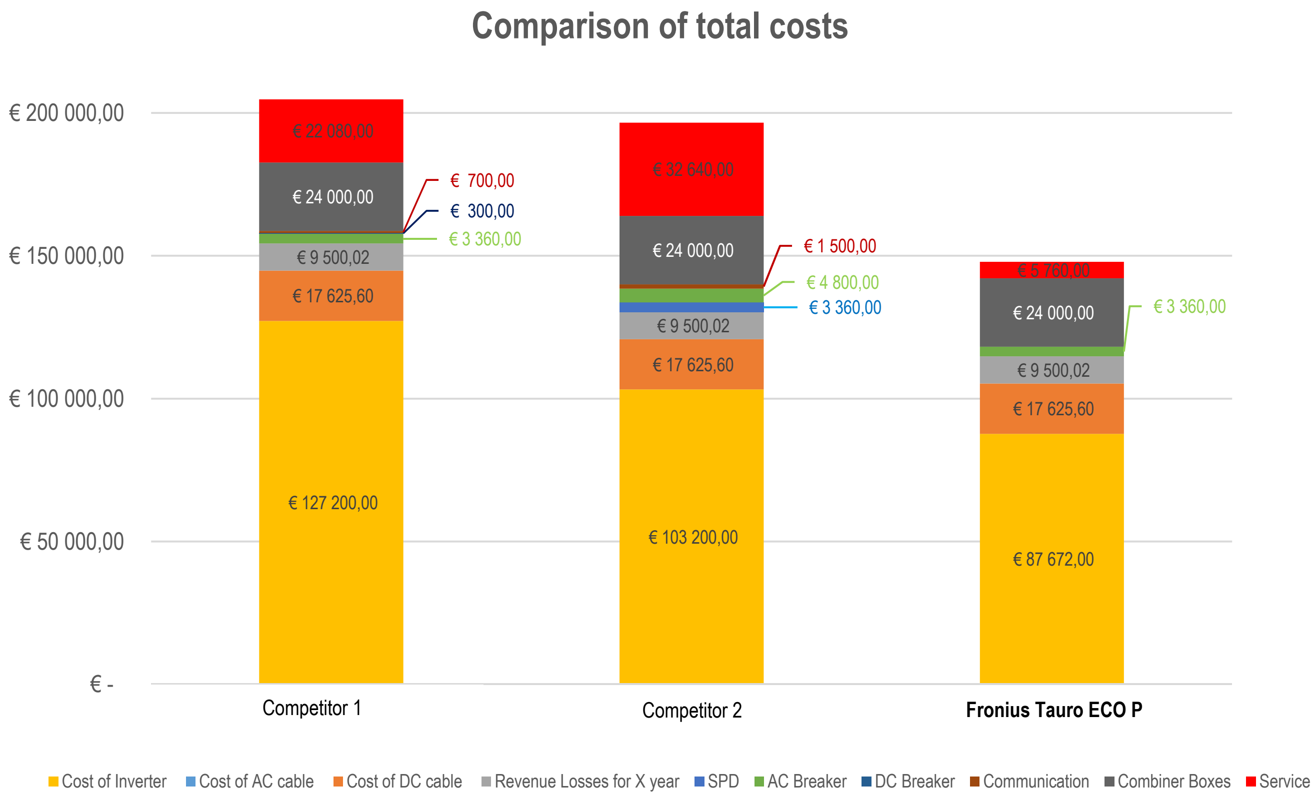

Figure 19: Comparison of total system costs for an example 2400 kW AC outdoor installation

As can be seen, even if we just compare total costs in this scenario, the Fronius Tauro ECO is the most cost-effective option as a result of its clear advantages in terms of service costs and BOS costs. The Fronius Tauro ECO P has a financial advantage, particularly in BOS costs.

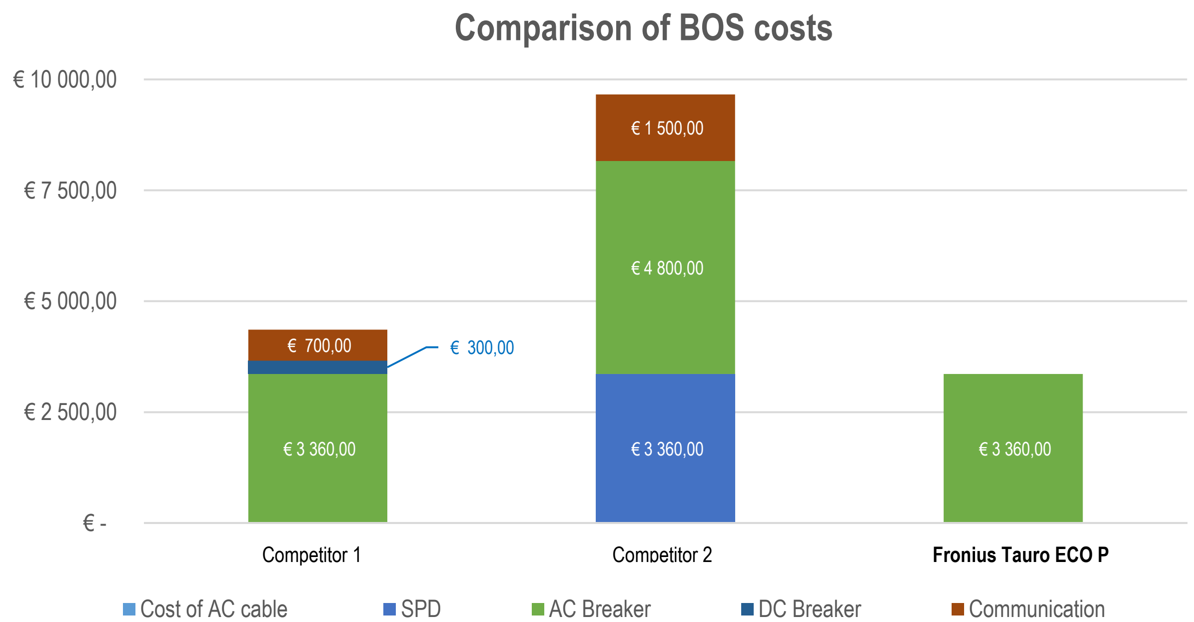

Figure 20: Comparison of BOS costs for an example 2400 kW AC outdoor installation

This chart clearly shows that BOS costs for the Fronius Tauro ECO P are markedly lower than for both the other manufacturers. This is because most of the system components required in the project, such as overvoltage protection, DC disconnector or communication unit, are already integrated into the Fronius

Tauro ECO as standard. BOS costs for a system solution with the Fronius Tauro will be around two thirds lower.

5 SUMMARY

A commercial PV system usually involves a major investment, so it follows that the system must be profitable. This can be achieved using a cost-efficient total system with a short payback period and maximum yield. The relationship between low TCO and high yields is therefore hugely significant.

The preceding sections have demonstrated that the CAPEX costs are an important factor and usually the main purchasing criterion when investing in a large-scale PV system. As we have seen, however, the initial prices of the chosen inverters are not the main consideration when it comes to total system costs. A closer look is recommended, particularly regarding the BOS costs, as this is where the largest savings potential in a commercial PV system will be found. The above cost comparison shows that the Fronius Tauro and its numerous product features generate savings in BOS costs of as much as 83%. The unique AC daisy-chaining option of the Fronius Tauro saves up to 50% of system components and AC cabling. Furthermore, the smart combination of the Fronius Tauro and Fronius Tauro ECO allows the commercial inverter series to deliver a total system that blends flexibility with cost-effectiveness.

The computations show that losses over time from cables throughout the system as a whole must not be disregarded. They play a crucial role in determining the payback period and are of particular significance for the total LCOE. Higher yield figures can be achieved thanks to the potentially large connection cross-sections and the various versions of the Fronius Tauro, leading to the realisation of a profitable large-scale PV system.

As discussed, it is not only CAPEX costs that have a major impact on TCO, as the OPEX costs also make a significant contribution. The maintenance-free cooling system of the Fronius Tauro protects the power electronics and lowers costs. The service technology of the Fronius Tauro provides a significant savings potential of up to 82%.

Its various versions and product features allow the Fronius Tauro to be incorporated into any system design. In addition, they also offer a number of options at the outset of the project, as well as the potential for ongoing cost savings and the development of a profitable commercial system.

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6 LIST OF FIGURES

7 SOURCES

Sources	*“Levelized cost of energy”, https://www.ise.fraunhofer.de/content/dam/ise/en/documents/publications/studies/EN2018_Fraunhofer-ISE_LCOE_Renewable_Energy_Technologies.pdf, 21.12.2020*
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APPENDIX

Appendix to comparison 4.1.1

Possible Inverter Options	Number of Inverters	Used cross section [mm²]	Number of MPP	Cost of Inverter	Cost of AC cable	Revenue Losses for X year	Service	SPD	AC Breaker	Communication	Total
Competitor 1	4	240	48	€ 16,632.00	€ 2,469.60	€ 1,445.76	€ 3,680.00	€ -	€ 560.00	€ 700.00	€ 25,487
Competitor 2	4	240	40	€ 16,000.00	€ 2,469.60	€ 1,445.76	€ 3,680.00	€ -	€ 560.00	€ 806.40	€ 24,962
Competitor 3	7	95	7	€ 20,755.00	€ 2,557.80	€ 2,087.11	€ 4,760.00	€ 245.00	€ 700.00	€ 1,500.00	€ 32,605
Tauro 100D + 50D + Booster D	3+0+1	240 & 240 & 120	6	€ 15,789.00	€ 2,242.80	€ 1,320.36	€ 960.00	€ -	€ 520.00	€ -	€ 20,832
Competitor 4	3+1	#NV	32	€ 12,504.00	€ 2,116.80	€ 1,488.96	€ 3,440.00	€ -	€ 520.00	€ 357.14	€ 20,427

Appendix to comparison 4.1.2

Possible Inverter Options	Number of Inverters	Used cross section [mm²]	Number of MPP	Cost of Inverter	Cost of AC cable	Revenue Losses for X year	Service	SPD	AC Breaker	Communication	Total
Competitor 1	2	240	24	€ 8,316.00	€ 1,058.40	€ 809.29	€ 1,840.00	€ -	€ 280.00	€ 700.00	€ 13,004
Competitor 2	2	240	20	€ 8,000.00	€ 1,058.40	€ 809.29	€ 1,840.00	€ -	€ 280.00	€ 806.40	€ 12,794
Competitor 3	4	95	4	€ 11,860.00	€ 1,252.80	€ 1,022.26	€ 2,720.00	€ 140.00	€ 400.00	€ 1,500.00	€ 18,895
Competitor 4	2+0	#NV	18	€ 6,996.00	€ 1,058.40	€ 809.29	€ 1,840.00	€ -	€ 280.00	€ 400.00	€ 11,384
Tauro 100D+Tauro 50D	2+0	240 & 120	2	€ 8,000.00	€ 1,058.40	€ 809.29	€ 480.00	€ -	€ 280.00	€ -	€ 10,628

Appendix to comparison 4.1.3

Possible Inverter Options	Number of Inverters	Used cross section [mm²]	Number of MPP	Cost of Inverter	Cost of DC cable	Revenue Losses for X year	Service	SPD	AC Breaker	DC Breaker	Communication	Combiner Boxes	Total
Competitor 1	3	95	3	€ 15,900.00	€ 784.08	€ 612.50	€ 2,760.00	€ -	€ 420.00	€ 300.00	€ 700.00	€ 3,000.00	€ 24,477
Competitor 2	6	95	6	€ 12,900.00	€ 784.08	€ 612.50	€ 4,080.00	€ 420.00	€ 600.00	€ -	€ 1,500.00	€ 3,000.00	€ 23,897
Tauro 100P+Tauro 50P	3+0	95 & 50	3	€ 10,959.00	€ 784.08	€ 612.50	€ 720.00	€ -	€ 420.00	€ -	€ -	€ 3,000.00	€ 16,496

Appendix to comparison 4.2.1

Possible Inverter Options	Number of Inverters	Used cross section [mm²]	Number of MPP	Cost of Inverter	Cost of AC cable	Revenue Losses for X year	Service	SPD	AC Breaker	Communication	Total
Competitor 1	8	240	96	€ 33,264.00	€ 7,761.60	€ 2,967.38	€ 7,360.00	€ -	€ 1,120.00	€ 700.00	€ 53,173
Competitor 2	8	240	80	€ 32,000.00	€ 7,761.60	€ 2,967.38	€ 7,360.00	€ -	€ 1,120.00	€ 806.40	€ 52,015
Competitor 3	16	70	16	€ 47,440.00	€ 6,652.80	€ 5,086.94	€ 10,880.00	€ 560.00	€ 1,600.00	€ 1,500.00	€ 73,720
Tauro 100 D Daisy Chain+100 D+50D	4+0+0	240 & 240 & 70	4	€ 32,144.00	€ 3,880.80	€ 5,934.76	€ 1,920.00	€ -	€ 864.00	€ -	€ 44,744
Competitor 4	7+1	#NV	68	€ 26,496.00	€ 7,207.20	€ 2,914.39	€ 7,120.00	€ -	€ 1,080.00	€ 375.00	€ 45,193
Tauro 100D+Tauro 50D	8+0	240 & 70	8	€ 32,000.00	€ 7,761.60	€ 2,967.38	€ 1,920.00	€ -	€ 1,120.00	€ -	€ 45,769

Appendix to comparison 4.2.2

Possible Inverter Options	Number of Inverters	Used cross section [mm²]	Number of MPP	Cost of Inverter	Cost of DC cable	Revenue Losses for X year	Service	SPD	AC Breaker	DC Breaker	Communication	Combiner Boxes	Total
Competitor 1	24	70	24	€ 127,200.00	€ 17,625.60	€ 9,500.02	€ 22,080.00	€ -	€ 3,360.00	€ 300.00	€ 700.00	€ 24,000.00	€ 204,766
Competitor 2	48	70	48	€ 103,200.00	€ 17,625.60	€ 9,500.02	€ 32,640.00	€ 3,360.00	€ 4,800.00	€ -	€ 1,500.00	€ 24,000.00	€ 196,626
Tauro 100P+Tauro 50P	24+0	70 & 35	24	€ 87,672.00	€ 17,625.60	€ 9,500.02	€ 5,760.00	€ -	€ 3,360.00	€ -	€ -	€ 24,000.00	€ 147,918