PVFINANCING

D2.6 Business Model Report

Italy

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1. Business model report: Residential sector – Single-family houses

Segment environment

Though still representing the major of the Italian PV market, the sector of single-family houses is still seriously slowed down by a number of major barriers:

1) Uncertainty on the stability of legislation and incentives, highly depending on the national policies. Unfortunately not many actions can be taken to overcome this problem, except for lobbying activities.

2) Need to invest money in a phase where it would be better to store it. On this topic it is hard to give any possible solution.

3) Access to debt financing; banks should develop specific tools suitable for the post feed-in tariff era.

4) Doubts on real maintenance costs and on the stability of plant yield. This can be solved through specific insurances and correct information given to the user, for instance through a specific independent information campaign.

5) Lack of trust towards companies which sell turn-key solution in a not well-known sector. Collective purchase group where technical staff from the Municipalities is checking the offers can be a possible solution.

6) Uncertainty on the legislation and future taxes that may arise (and they probably will) on self-consumption.

7) Weird visual restrictions due to landscape protection laws. Most of the times they are really not reasonable and justifiable (e.g. proximity to the rail tracks!). The project should be submitted to the Heritage Institute with a waiting time of about three months and almost 1,000 € of additional costs.

8) Too complex bureaucracy. Installing a PV plant needs 2 days' work but the customer then has to wait about 2 months for the plant to be operating.

Segment Drivers

The main driver for single-family houses owners to go for PV is out of doubt the savings on the electricity bill, combined with the possibility of making their electricity price not dependant on possible future rises. However, due to the current Italian legislation, relevant savings can be obtained only when a high share of self-consumption of PV electricity is possible, usually above 50%.

Secondary drivers of the decision are the commitment towards the environmental cause and the hi-tech image of the house. Therefore combination with heat pump and electrification the uses (charging electric vehicles, induction cooking, etc.) are for sure a good way to introduce also PV in the houses.

The average cost of small systems (1÷20 kW_p) is about 2,200 EUR/kW_p (VAT included). VAT for PV plant investment is 10% compared to the conventional value of 22%.

Usually users are willing and able to invest 30-50% of equity on the total investment, talking about 3÷6 kW_p systems, corresponding to a turnkey price of 7,000÷15,000 €. Therefore the available equity could be 3,000÷7,000 €. The savings expected by the user could range between 50% and 70%.

A really interesting opportunity is the tax reduction of 50% on the investment cost, with annual instalments for 10 years, which is available for small PV plants (< 20 kW_p) until the end of 2015 but it is likely to be extended also for 2016.

With such a relevant tax reduction and a 40% self-consumption rate, customers can thus reach payback times of 5÷7 years. The risks on the business plan are not very relevant because the self-consumption rate usually does not decrease and the tax reduction, once acquired, has no risks. The only risk is the possibility of future taxes on self-consumed PV electricity.

Business Models

Below you find the business models of Italy in the residential sector for single-family houses. For both the models, calculations have been done for a 3 kW_p system with a specific price of 2,200 €/kW_p and a specific solar radiation on the horizontal surface of 1,660 kWh/kW_p (site in central Italy).

Business Model 1: Self-consumption

Self-consumption business model is a very simple one and it is the most effective given the legislation and incentive situation in the Italian PV sector.

This is due to the relatively high electricity tariffs paid by the single user in the residential sector and also to a dramatic change in the net-metering regulation: the excess electricity fed to the grid is not anymore compensated with the consumption but a tariff is given for each kWh sold to the grid (mechanism of the “scambio sul posto”). However, this tariff, whose calculation is very complicated and depending on many specific factors is always much lower (even ¼ of the price of consumed electricity).

Furthermore, no taxes, at least so far, are applied to self-consumption of PV electricity.

The scheme below reports the typical configuration of the model. The bank has not been included because, given the high tax reduction, a more common solution is to operate in full equity. However, since taxes are dependent on the single user, the tax reduction option has not been included in the calculation model.

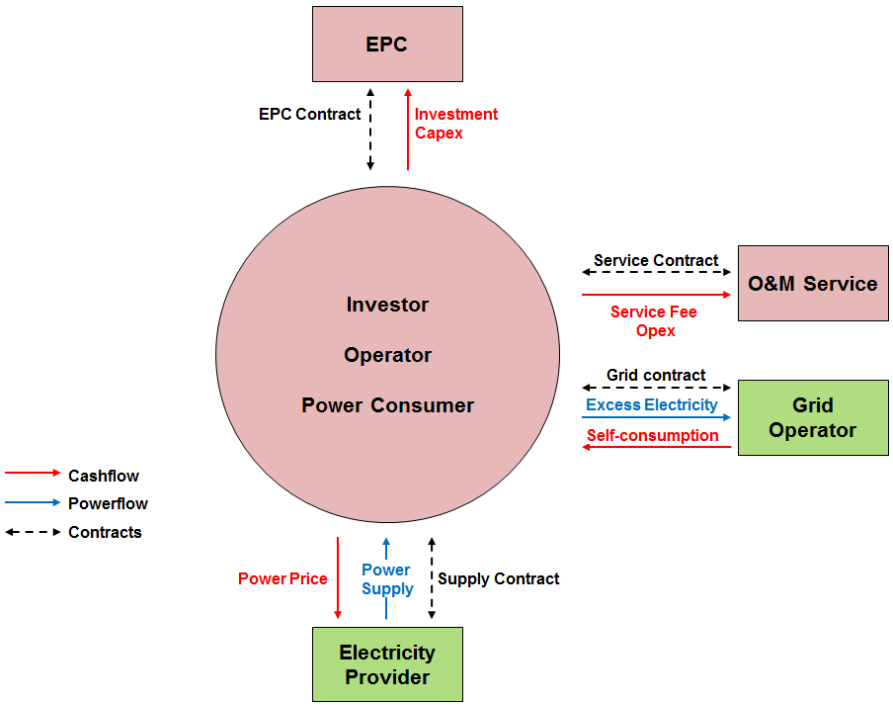


Figure 1: Self-consumption.

Profitability Analysis

Self-consumption rate has been assumed to be 40% and grid electricity price to be 0.23 €/kWh.

Project Overview

PV Project			
PV System Size	kWp		3
Specific System Cost	EUR/kWp		2.200
Total System Cost	EUR		6.600
Investment Subsidy	EUR		-
Total System Cost incl. Subsidy	EUR		6.600
Fixed Operation Costs	EUR p.a.		99
Variable Operation Costs	EUR/kWh		-

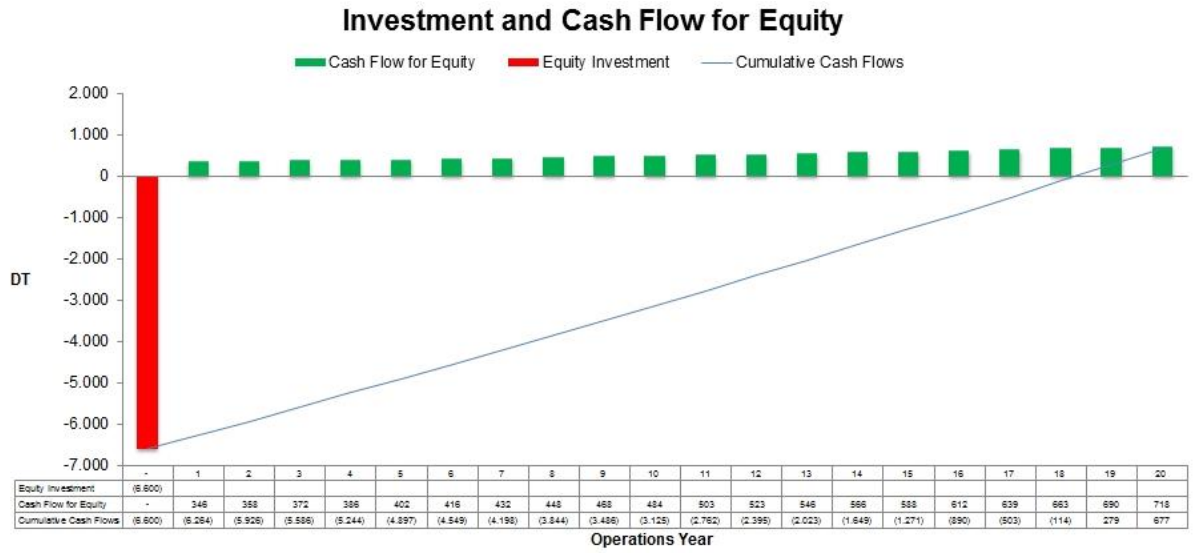
PV Generation		
Specific Yield	kWh/qm/a	1660
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.411
Degradation	% p.a.	0,70%

Investment			
Project Duration		Years	20
Equity		EUR	6.600
Debt (Gearing)	-	EUR	-
Loan Tenor		Years	7
Interest Rate		%	5,8%
Discount Rate		%	3,0%

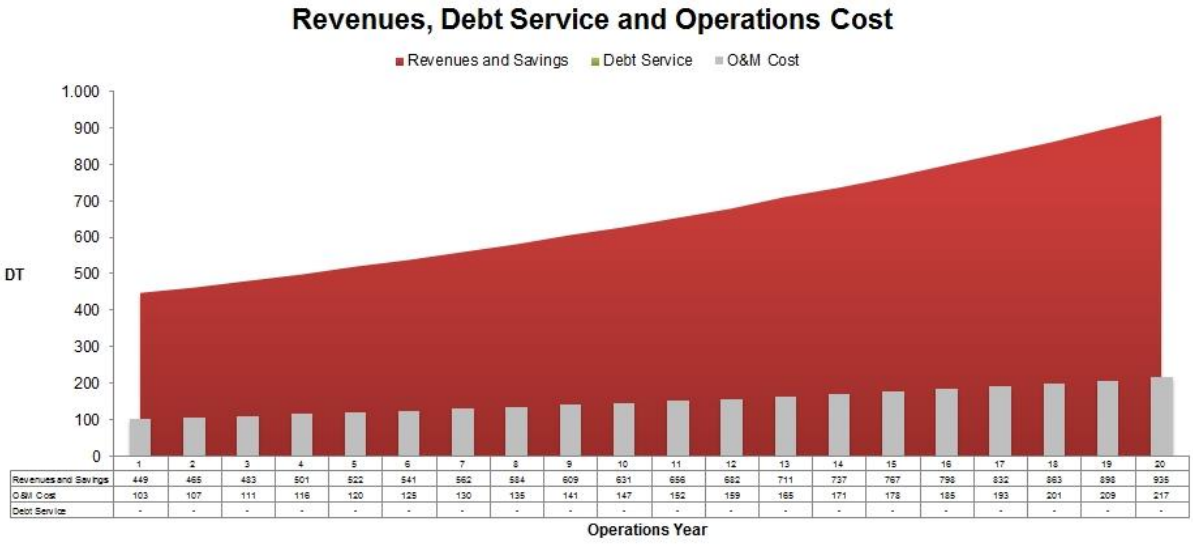
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	40%	EUR/kWh	0,2300
Fees		EUR/kWh	0,0500
Net-metering	60%	EUR/kWh	0,2300
Fees		EUR/kWh	-
Excess Electricity		EUR/kWh	0,0500
PPA Tariff	-	EUR/kWh	-
Fees		EUR/kWh	-
Oversupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	644
Project IRR	%	3,90%
Equity IRR	%	3,90%
Payback Period	Years	18,29
LCOE* (w/o subsidy)	EUR/kWh	0,15
LCOE (w subsidy)	EUR/kWh	0,15
Min DSCR**	x	-
Min LLCR***	x	-

The project IRR is around 4%, which can be acceptable for a single residential user. The payback time of the investment is quite high but this is clearly depending on the absence of the tax reduction option in the calculation model.

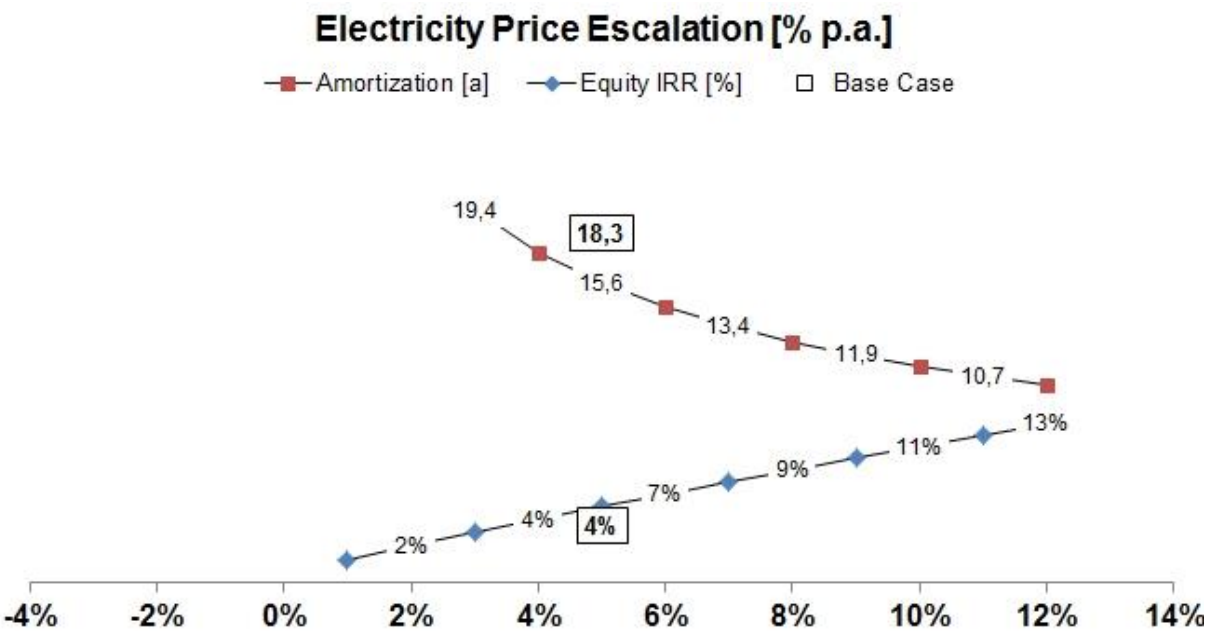


	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(6.600)																				
Cash Flow for Equity	-	346	358	372	386	402	416	432	448	468	484	503	523	546	566	588	612	639	663	690	718
Cumulative Cash Flows	(6.600)	(6.254)	(5.926)	(5.586)	(5.244)	(4.897)	(4.549)	(4.198)	(3.844)	(3.486)	(3.125)	(2.762)	(2.395)	(2.023)	(1.649)	(1.271)	(890)	(503)	(114)	279	677



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	449	465	483	501	522	541	562	584	609	631	656	682	711	737	767	798	832	863	898	935
O&M Cost	103	107	111	116	120	125	130	135	141	147	152	159	165	171	178	185	193	201	209	217
Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

An interesting sensitivity analysis, reported in the following page, is the one regarding electricity price increase. Since the model substantially depends on the self-consumption, this price can have a stunning effect on the project IRR.


Electricity Price Escalation [% p.a.]
Amortization [a]
Equity IRR [%]
Base Case
19,4
18,3
15,6
13,4
11,9
10,7
2%
4%
4%
7%
9%
11%
13%
-4%
-2%
0%
2%
4%
6%
8%
10%
12%
14%

Business Model 2: Power Purchase Agreement

This model is not commonly applied in this segment, due both to bureaucratic complications and to the fact that residential users do not like the idea of third parties operating their PV system and the additional burden of another electricity contract.

However, especially with the legislation regarding “SEU” (“Sistemi Efficienti di Utenza”), the Italian version of the PPA, will improve and become easier and clearer, also the small residential sector could see some examples of such models. The model can also be of interest in case the owner wants to lower its electricity costs but does not have the necessary equity and does not want to go into debt financing.

The scheme below reports the possible configuration of the model. The bank has not been included because, given the low investment needed, a more credible solution is to operate in full equity.

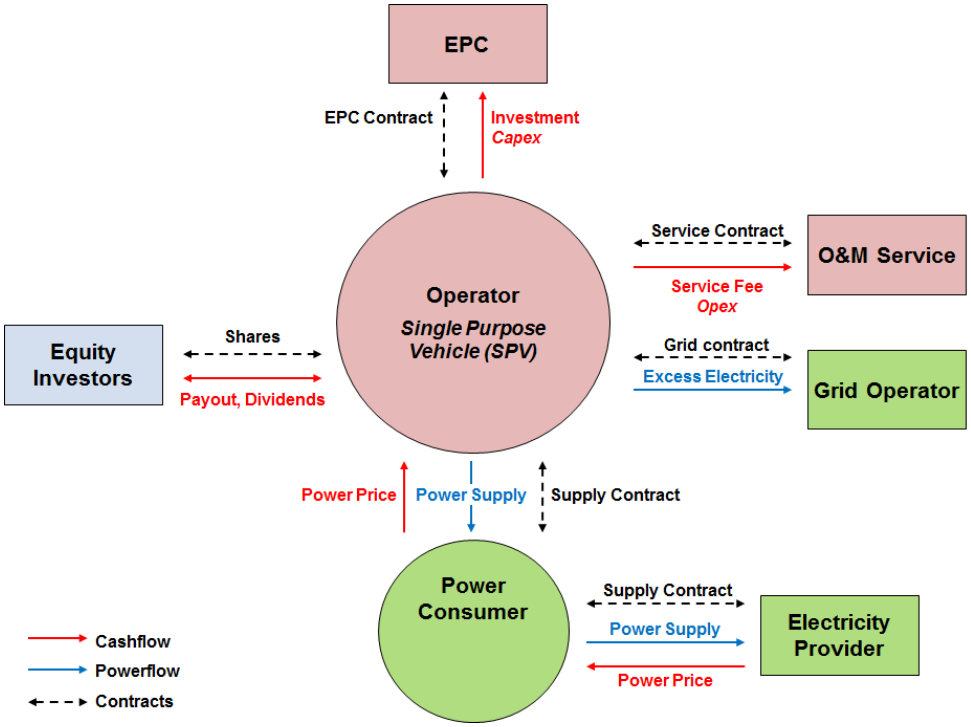


Figure 2: Power Purchase Agreement.

Profitability Analysis

A 15% saving with respect to the residential grid price (0.23 €/kWh) has been assumed. Therefore a price of 0.185 €/kWh for the PV electricity has been used in the calculation. As in model 1, tax reduction has not been included.

Furthermore, a self-consumption rate of 70% has been assumed, due to smart load management and home automation.

Project Overview

PV Project		
PV System Size	kWp	3
Specific System Cost	EUR/kWp	2.200
Total System Cost	EUR	6.600
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	6.600
Fixed Operation Costs	EUR p.a.	99
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1660
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.411
Degradation	% p.a.	0,70%

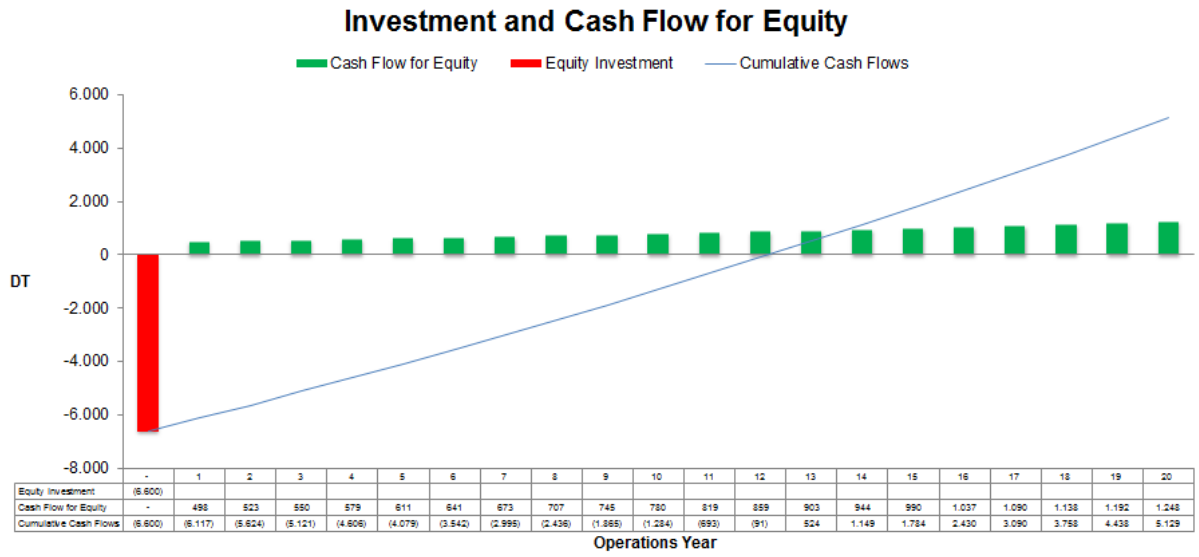
Investment		
Project Duration	Years	20
Equity	EUR	6.600
Debt (Gearing) -	EUR	-
Loan Tenor	Years	7
Interest Rate	%	5,8%
Discount Rate	%	3,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricity		EUR/kWh	-
PPA Tariff	100%	EUR/kWh	0,1850
Fees		EUR/kWh	0,0250
Oversupply Price		EUR/kWh	0,1000
Undersupply Penalty		EUR/kWh	-

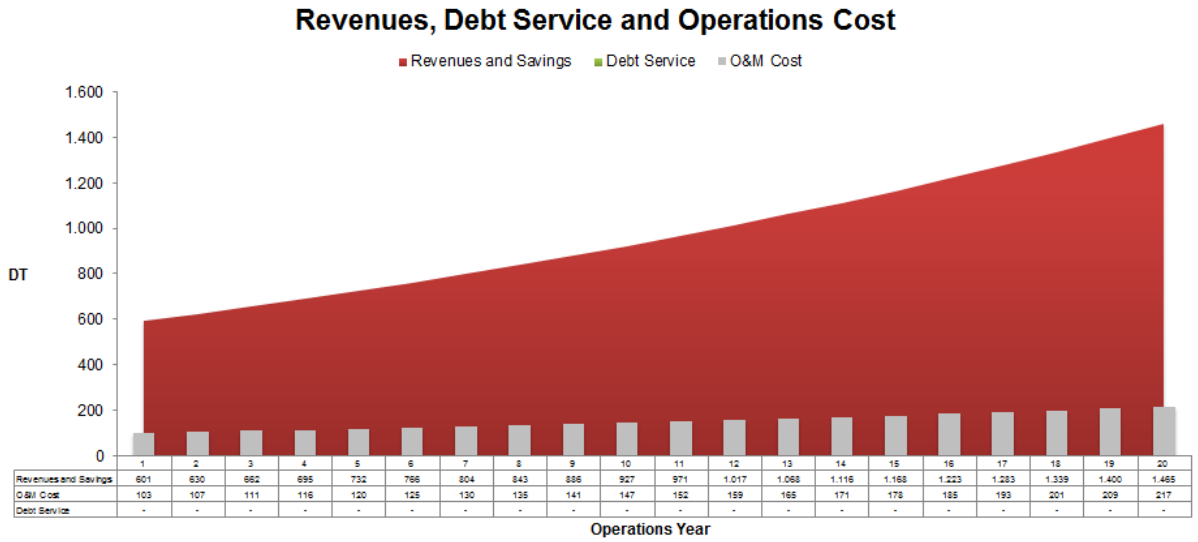
Results		
Net-Present Value	EUR	5.062
Project IRR	%	8,84%
Equity IRR	%	8,84%
Payback Period	Years	12,15
LCOE* (w/o subsidy)	EUR/kWh	0,15
LCOE (w subsidy)	EUR/kWh	0,15
Min DSCR**	x	-
Min LLCR***	x	-

* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

Thanks to such high self-consumption rate, the IRR can go to about 10% and the payback time to about 12 years, though without considering the tax reduction.



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(6.600)																				
Cash Flow for Equity	-	498	523	550	579	611	641	673	707	745	780	819	859	903	944	990	1.037	1.090	1.138	1.192	1.248
Cumulative Cash Flows	(6.600)	(6.117)	(5.624)	(5.121)	(4.606)	(4.079)	(3.542)	(2.995)	(2.436)	(1.865)	(1.284)	(693)	(91)	524	1.149	1.784	2.430	3.090	3.758	4.438	5.129



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	601	630	662	695	732	766	804	843	886	927	971	1.017	1.068	1.116	1.168	1.223	1.283	1.339	1.400	1.465
O&M Cost	103	107	111	116	120	125	130	135	141	147	152	159	165	171	178	185	193	201	209	217
Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

2. Business model report: Residential sector – Multi-family houses

Segment environment

In Italy, the large majority of people living in a flat is also owning it, thus making it easier, at least theoretically, to go for a PV plant.

In spite of that, regulation issues are still limiting the use of PV in multi-family houses. The major barrier is that, according to the legislation currently in place, it is not possible to sign a PPA of a PV electricity provider towards many different users. Therefore, at the moment, in multi-family houses, a PV plant can only feed either a single user or the common electrical uses in the building (lift, common lighting, etc.).

Regarding main barriers for diffusion, additional points which should be highlighted:

- A change in the regulation is needed in order to allow the possibility of PPA to multi-users.
- Bureaucracy of multi-family houses is very heavy in Italy, so the decision process is slow and uncertain.
- Available space on the roof could be an issue and that is the reason why cogeneration is a more successful solution at the moment.

Segment Drivers

For multi-family houses, the main driver for PV installations is lowering the electricity bill as well as the protection against rising electricity prices. Green image plays for sure a secondary role, even though it could be a driver for building companies wanting to sell their new houses to “green buyers”. As a matter of fact, the presence of PV causes a potentially higher property value for both the technology and the green image and, therefore, an increased possibility of selling or renting the house. The main economic targets for building owners could be an IRR higher than 10% and a payback time lower than 5-6 years.

The specific price for such applications, which range from 20 to 200 kW_p, could go from 1,500 to 2,000 €/kW_p.

Business Models

Below you find the business models of Italy in the residential sector for multi-family houses. For both the models, calculations have been done for a specific solar radiation on a horizontal surface of 1,660 kWh/kW$_p$ (site in central Italy). The size of the plant is 20 kW$_p$ for the first model and 60 kW$_p$ for the second one, both with a specific price of 1,500 €/kW$_p$.

Business Model 1: Self-consumption (for common electrical uses)

As outlined above, self-consumption of PV electricity in multi-family buildings is possible only when the energy is fed to the common uses such as lighting, automatic gates, lifts, etc.

As for single-family houses, a 50% tax reduction is possible also in this case, if we keep the limit of 20 kW$_p$ for the system size. However, this has not been included in the calculation.

The scheme reports the configuration of the model. The bank has not been included because, given the high tax reduction and the high number of buyers, a common solution is to operate in full equity and include the investment in the multi-family house budget.

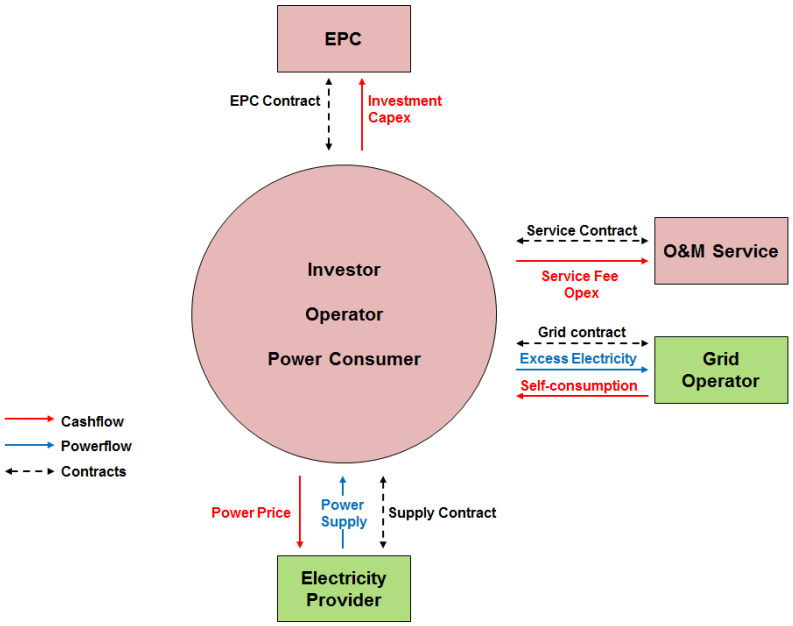


Figure 2: Self-consumption.

Profitability Analysis

Self-consumption of PV electricity has been assumed to be 60%, due to the fact that almost all uses (lighting, lift, automatic gate) cannot be concentrated during the daytime.

Project Overview

PV Project		
PV System Size	kWp	20
Specific System Cost	EUR/kWp	1.500
Total System Cost	EUR	30.000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	30.000
Fixed Operation Costs	EUR p.a.	450
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1660
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.411
Degradation	% p.a.	0,70%

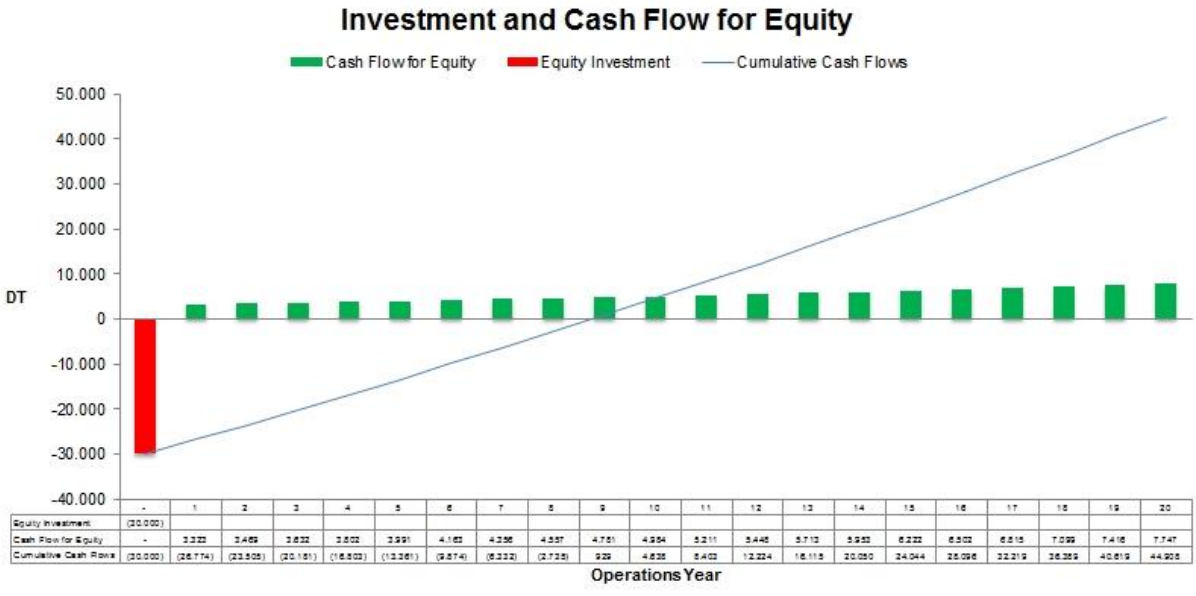
Investment			
Project Duration		Years	20
Equity		EUR	30.000
Debt (Gearing)	-	EUR	-
Loan Tenor		Years	7
Interest Rate		%	5,8%
Discount Rate		%	3,0%

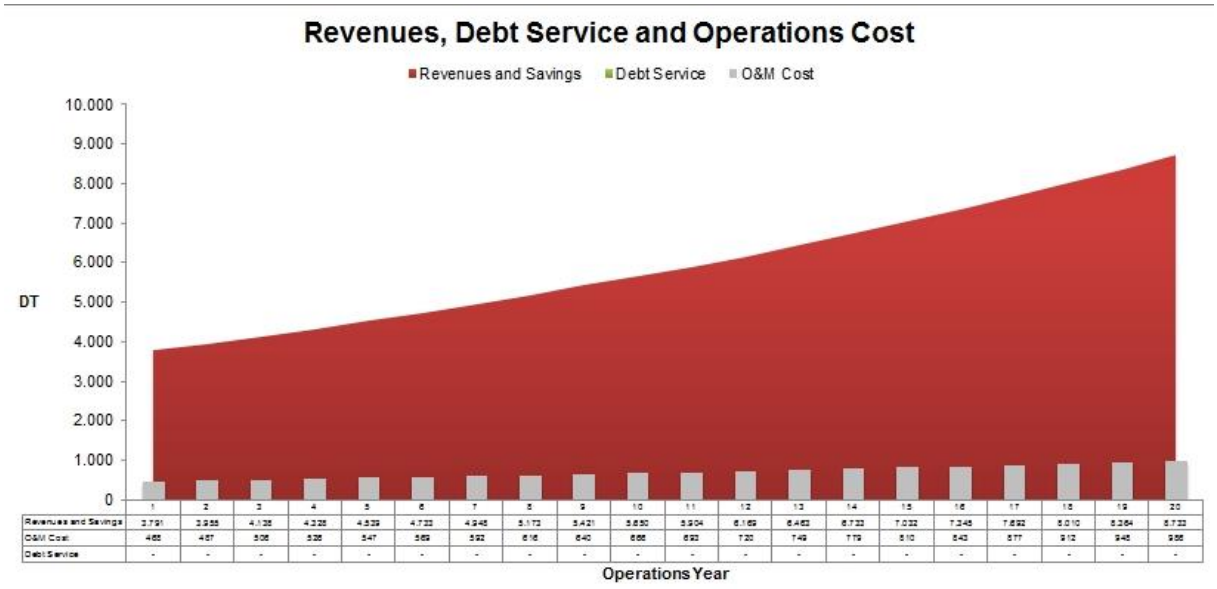
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	60%	EUR/kWh	0,2300
Fees		EUR/kWh	0,0500
Net-metering	40%	EUR/kWh	0,2300
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	0,0500
PPA Tariff	-	EUR/kWh	-
Fees		EUR/kWh	-
Oversupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	44.442
Project IRR	%	13,27%
Equity IRR	%	13,27%
Payback Period	Years	8,75
LCOE* (w/o subsidy)	EUR/kWh	0,10
LCOE (w subsidy)	EUR/kWh	0,10
Min DSCR**	x	-
Min LLCR***	x	-

* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

Interesting values of both IRR and payback times can be obtained in this case, thanks to the combination of several favourable parameters: High solar radiation, good self-consumption rate and high prices for the grid electricity.





	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	3.791	3.955	4.126	4.305	4.539	4.733	4.946	5.172	5.421	5.650	5.904	6.169	6.462	6.732	7.032	7.345	7.692	8.010	8.364	8.732
O&M Cost	465	487	508	528	547	569	592	616	640	666	693	720	749	779	810	843	877	913	945	986
Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Business Model 2: Power Purchase Agreement

As already reported in the introduction, this model is at the moment only theoretically applicable to this segment, but lobbying activities are going on towards a change in legislation. Such a change would regard the legislation on "SEU" ("Sistemi Efficienti di Utenza"), the Italian version of the PPA, which should be broadened to include the possibility for an investor / plant operator to sell PV electricity to multiple users.

Given the size of the system (60 kW_p), the tax reduction is not possible in this case.

The scheme below reports the possible configuration of the model. The bank has not been included because, given the low investment needed, a more credible solution is to operate in full equity.

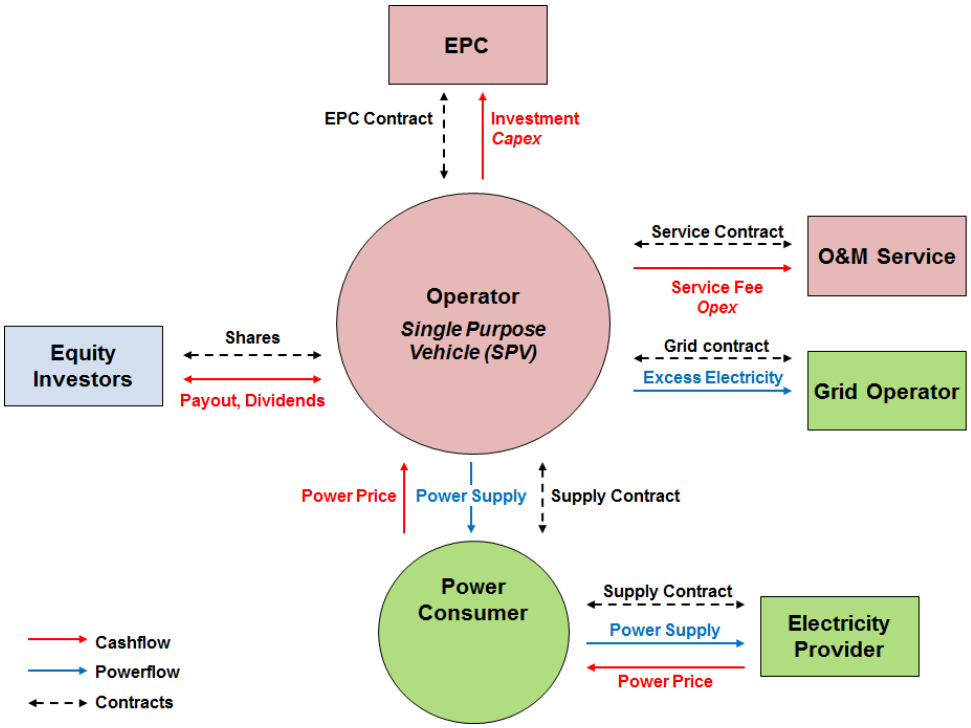


Figure 2: Power Purchase Agreement.

Profitability Analysis

The assumption for the PPA are that a price of 0.185 €/kWh can be offered by the PV plant operator and that, thanks to a smart load management (possibly introduced by the operator itself, together with the PV plant), a 70% self-consumption rate can be obtained.

Project Overview

PV Project		
PV System Size	kWp	60
Specific System Cost	EUR/kWp	1.500
Total System Cost	EUR	90.000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	90.000
Fixed Operation Costs	EUR p.a.	1.350
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1660
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.411
Degradation	% p.a.	0,70%

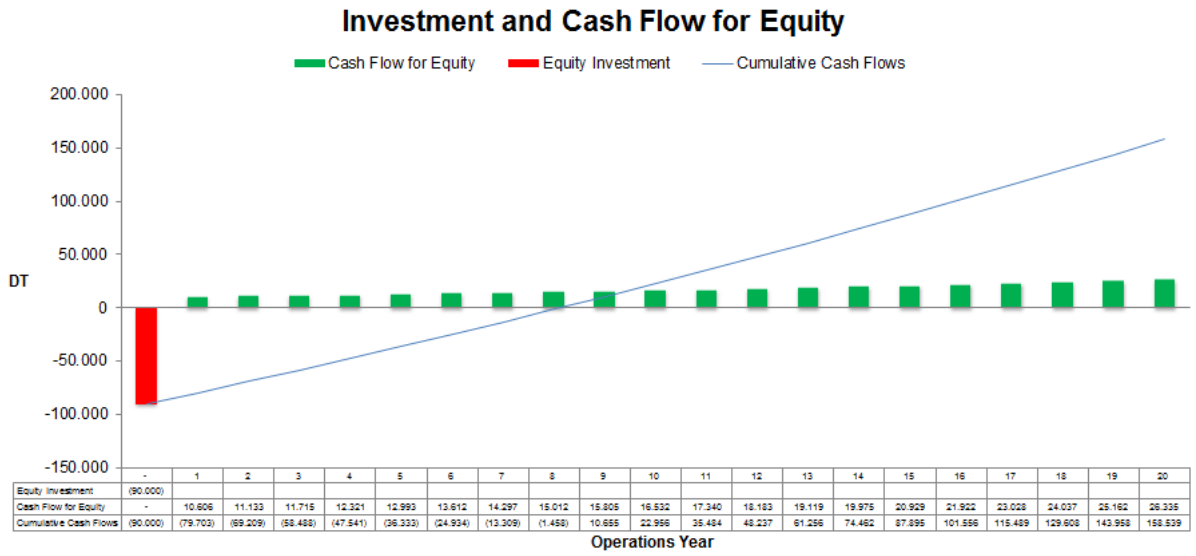
Investment			
Project Duration		Years	20
Equity		EUR	90.000
Debt (Gearing)	-	EUR	-
Loan Tenor		Years	7
Interest Rate		%	5,8%
Discount Rate		%	3,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricity		EUR/kWh	-
PPA Tariff	100%	EUR/kWh	0,1850
Fees		EUR/kWh	0,0250
Oversupply Price		EUR/kWh	0,1000
Undersupply Penalty		EUR/kWh	-

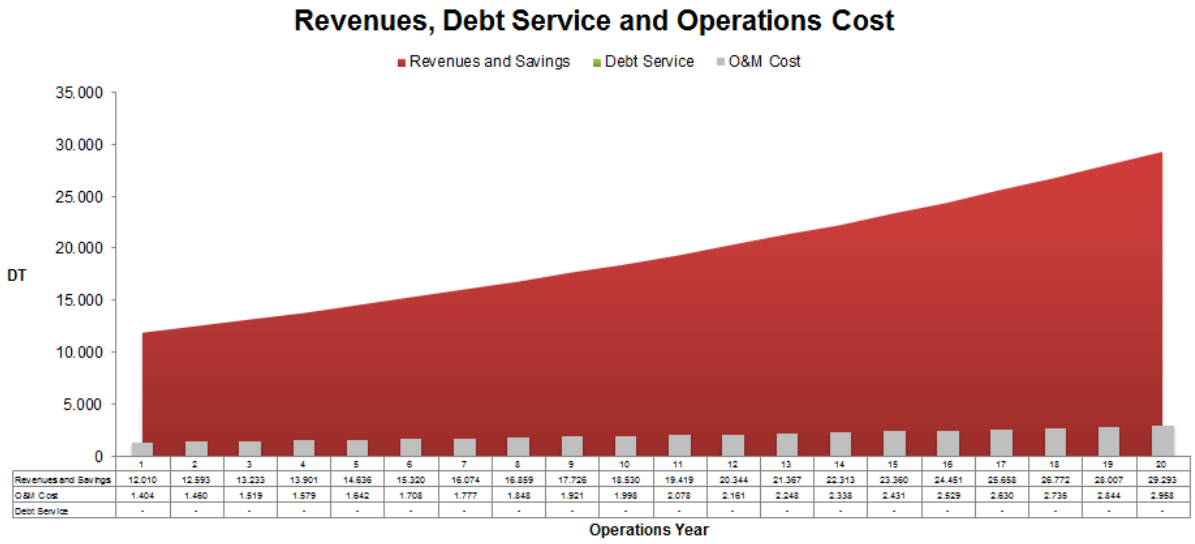
Results		
Net-Present Value	EUR	156.958
Project IRR	%	14,55%
Equity IRR	%	14,55%
Payback Period	Years	8,12
LCOE* (w/o subsidy)	EUR/kWh	0,10
LCOE (w subsidy)	EUR/kWh	0,10
Min DSCR**	x	-
Min LLCR***	x	-

* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

Results show that this model is very promising, thanks to the high self-consumption rate and to the possibility of selling PV electricity to multiple users.



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(90.000)																				
Cash Flow for Equity	-	10.606	11.133	11.715	12.321	12.993	13.612	14.297	15.012	15.805	16.532	17.340	18.183	19.119	19.975	20.929	21.922	23.028	24.037	25.162	26.336
Cumulative Cash Flows	(90.000)	(79.703)	(69.209)	(58.488)	(47.541)	(36.333)	(24.934)	(13.309)	(1.458)	10.655	22.956	35.484	48.237	61.256	74.462	87.895	101.556	115.489	129.608	143.958	158.539



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	12.010	12.593	13.233	13.901	14.636	15.320	16.074	16.859	17.726	18.530	19.419	20.344	21.367	22.313	23.360	24.451	25.658	26.772	28.007	29.293
O&M Cost	1.404	1.460	1.519	1.579	1.642	1.708	1.777	1.848	1.921	1.998	2.078	2.161	2.248	2.338	2.431	2.529	2.630	2.735	2.844	2.958
Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

3. Business model report: Commercial sector – Office buildings

Segment environment

Office buildings are an application segment which, for many reasons, is quite similar to the one of the shopping centres. The first promising feature is that, since offices are used during daytime, high rates of self-consumption for PV electricity are possible. However, usually office buildings, unless very large ones, do not need very large scale plants (as in the case of shopping centres) and, therefore, the specific turnkey cost is higher.

As outlined also for the shopping centres, the big hurdle here is the restrictive legislation about Power Purchase Agreements which limits their application to a single user only. If, as asked for by many PV stakeholder groups, the legislation will open to such solutions, a PPA towards multiple users in office buildings will probably become the most interesting business model for this segment.

Another possible solution could be that tenants accept to cover PPA costs as part of the tenancy agreement or via service charges but it seems that no such examples have been implemented in Italy so far.

Finally, besides the already described uncertainty of the legislation, additional barriers are: the possible default of the owner, the roof cover which is already occupied by many technical plants and, for offices located in the cities, the visual requirements which usually imply definitely much more expensive architecturally integrated PV plants.

Segment Drivers

Savings with respect to grid price and, maybe even more, the price stability of PV electricity are the main drivers for office buildings tenants and owners, while the “green image” can still play a role especially for large groups.

One of the highest concern for tenants is the complication of contracts, therefore having a second contract for PV electricity in parallel to the grid supply is a possible solution, but it is often seen as too complicated and not appealing enough. A combined offer including a number of different technologies and measures is surely more attractive as far as the whole issue of electricity supply is managed by one actor only, once again in order to avoid too complicated and not clear management.

Business Models

Below you find the business models of Italy in the commercial sector for office buildings. The first one is a self-consumption model where the PV plant is bought by the owner (30 kW_p plant with a specific price of 1,500 €/kW_p) and the second model, though not yet applicable, is a PPA towards multiple users sharing the same office building (100 kW_p plant with a specific price of 1,300 €/kW_p).

For both the models, calculations have been done for a specific solar radiation on a horizontal surface of 1,660 kWh/kW_p (site in central Italy).

Business Model 1: Self-consumption

Given the high electricity uses during the day, it is assumed that 70% of the PV production can be self-consumed. The scheme reports the configuration of the model.

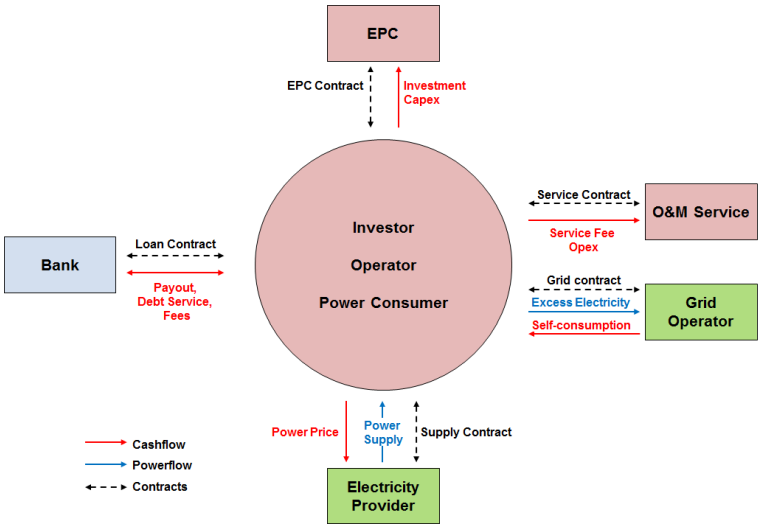


Figure 3: Self-consumption.

Profitability Analysis

A self-consumption rate of 70% has been assumed for the profitability calculation. The remaining 30% is managed through “scambio sul posto”, which is a sort of net-metering scheme.

Project Overview

PV Project		
PV System Size	kWp	30
Specific System Cost	EUR/kWp	1.500
Total System Cost	EUR	45.000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	45.000
Fixed Operation Costs	EUR p.a.	825
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1660
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.411
Degradation	% p.a.	0,70%

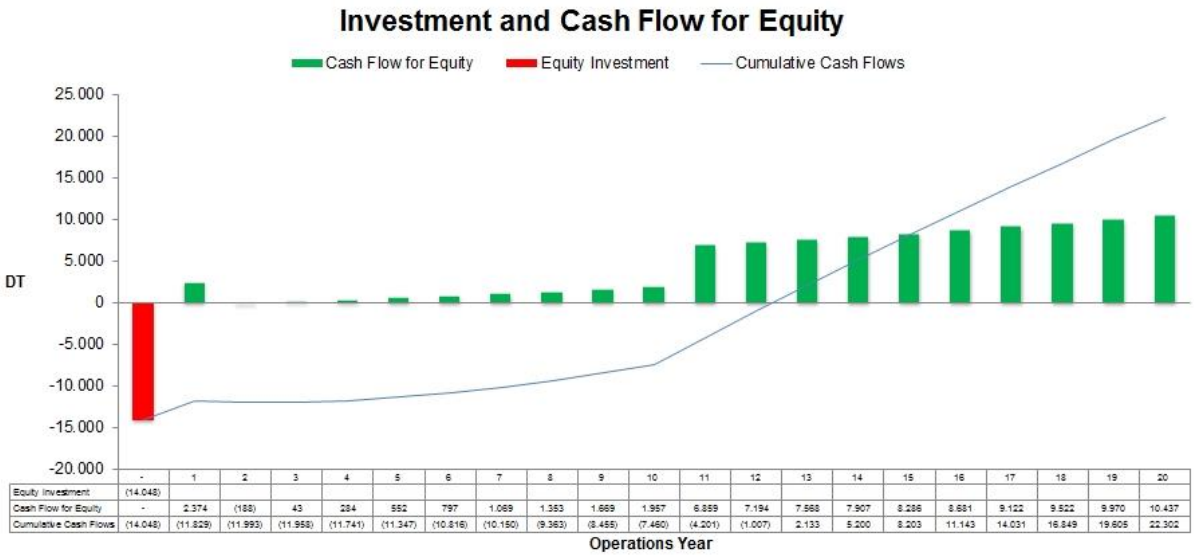
Investment			
Project Duration		Years	20
Equity		EUR	14.048
Debt (Gearing)	70%	EUR	31.500
Loan Tenor		Years	10
Interest Rate		%	5,8%
Discount Rate		%	7,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	70%	EUR/kWh	0,1900
Fees		EUR/kWh	0,0500
Net-metering	30%	EUR/kWh	0,2000
Fees		EUR/kWh	0,0500
Excess Electricity		EUR/kWh	0,0500
PPA Tariff	-	EUR/kWh	-
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

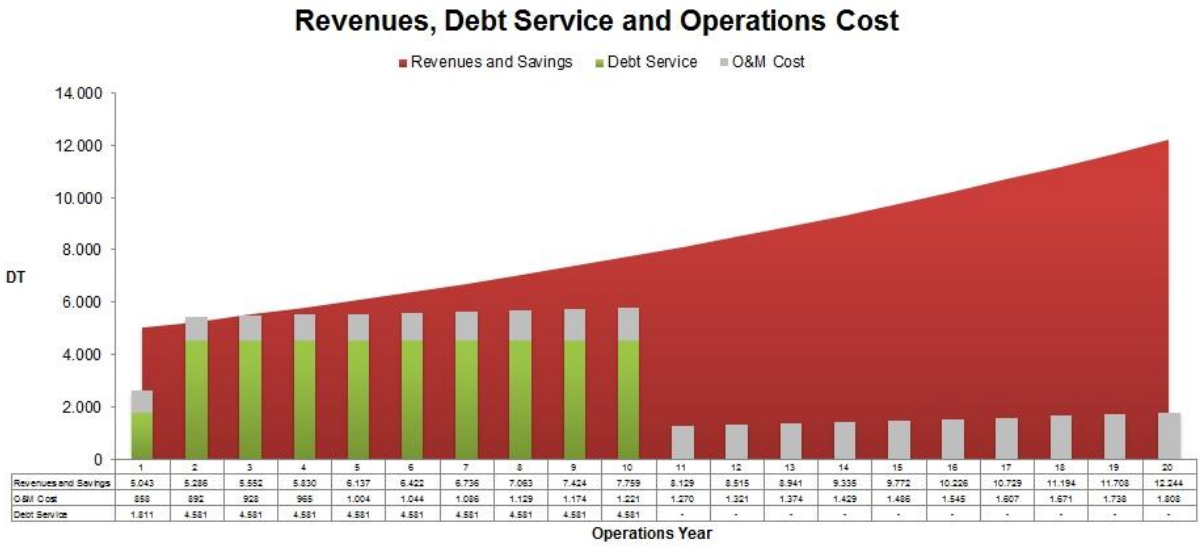
Results		
Net-Present Value	EUR	21.754
Project IRR	%	11,19%
Equity IRR	%	15,15%
Payback Period	Years	12,32
LCOE* (w/o subsidy)	EUR/kWh	0,13
LCOE (w subsidy)	EUR/kWh	0,13
Min DSCR**	x	0,96 x
Min LLCR***	x	1,16 x

*LCOE: Levelized Cost of Electricity
**DSCR: Debt Service Coverage Ratio
***LLCR: Loan Life Coverage Ratio

A payback time of more than 10 years is thus obtained and the cash flows are shown in the graphs below.

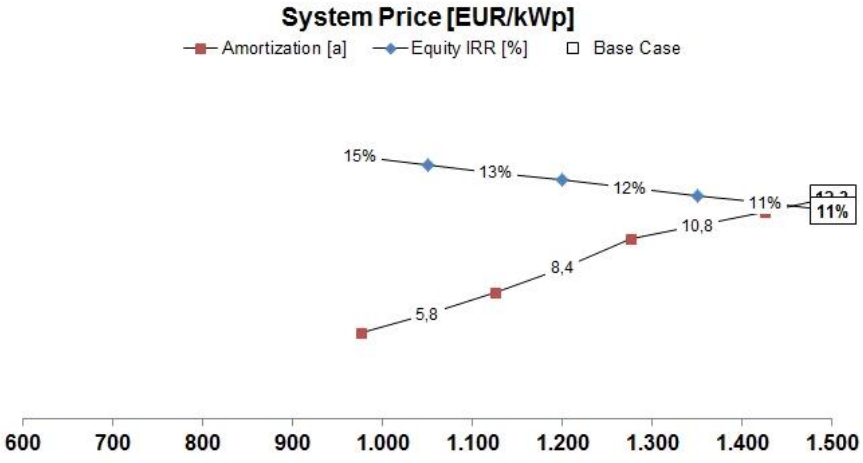


	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(14.048)																				
Cash Flow for Equity	-	2.374	(188)	43	284	552	797	1.069	1.353	1.669	1.957	6.859	7.194	7.568	7.907	8.286	8.681	9.122	9.522	9.970	10.437
Cumulative Cash Flows	(14.048)	(11.829)	(11.993)	(11.958)	(11.741)	(11.347)	(10.816)	(10.150)	(9.363)	(8.455)	(7.460)	(4.201)	(1.007)	2.133	5.200	8.203	11.143	14.031	16.849	19.605	22.302



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	5.043	5.286	5.552	5.830	6.137	6.422	6.736	7.063	7.424	7.759	8.129	8.515	8.941	9.335	9.772	10.226	10.729	11.194	11.708	12.244
O&M Cost	858	892	928	965	1.004	1.044	1.086	1.129	1.174	1.221	1.270	1.321	1.374	1.429	1.486	1.545	1.607	1.671	1.738	1.808
Debt Service	1.811	4.581	4.581	4.581	4.581	4.581	4.581	4.581	4.581	4.581	-	-	-	-	-	-	-	-	-	-

It is also interesting to show, as reported in the following sensitivity analysis, how the system price is a key parameter: Being able to go down to about 1,000 €/kWp would mean lowering payback time to about 8 years.



Business Model 2: Power Purchase Agreement

As already reported in the introduction, this model is at the moment only theoretically applicable to this segment, but lobbying activities are going on towards a change in legislation. Such a change would regard the legislation on "SEU" ("Sistemi Efficienti di Utenza"), the Italian version of the PPA, which should be broadened to include the possibility for an investor / plant operator to sell PV electricity to multiple users.

The scheme below reports the possible configuration of the model.

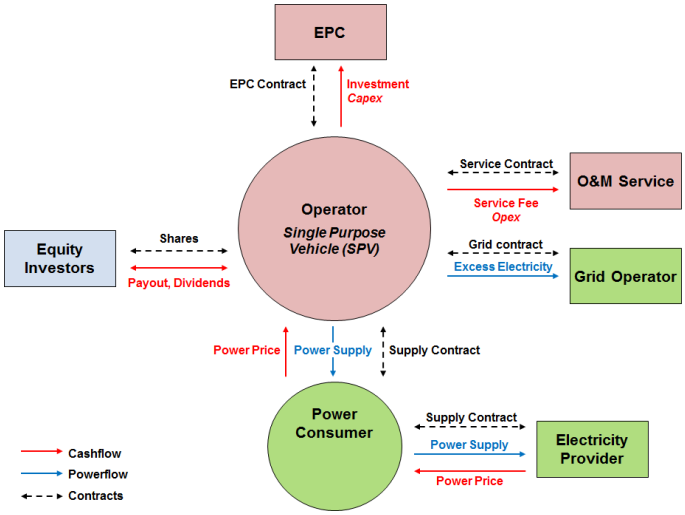


Figure 2: Power Purchase Agreement.

Profitability Analysis

A self-consumption of 100% has been assumed, which means the possibility for the investor to sell all the produced PV electricity to the multiple users in a shared office building.

The negotiated price has been assumed to be 0.15 €/kWh, thus obtaining a 20% reduction with respect to the grid electricity price.

Project Overview

PV Project		
PV System Size	kWp	100
Specific System Cost	EUR/kWp	1.300
Total System Cost	EUR	130.000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	130.000
Fixed Operation Costs	EUR p.a.	2.100
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1660
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.411
Degradation	% p.a.	0,70%

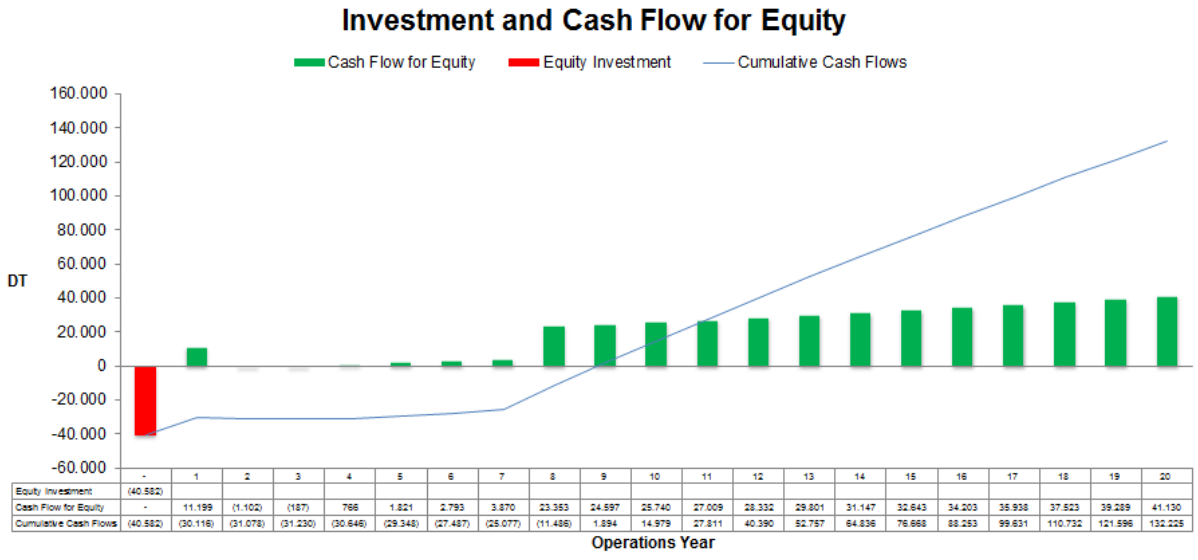
Investment			
Project Duration		Years	20
Equity		EUR	40.582
Debt (Gearing)	70%	EUR	91.000
Loan Tenor		Years	7
Interest Rate		%	5,8%
Discount Rate		%	7,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	100%	EUR/kWh	0,1500
Fees		EUR/kWh	0,0250
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

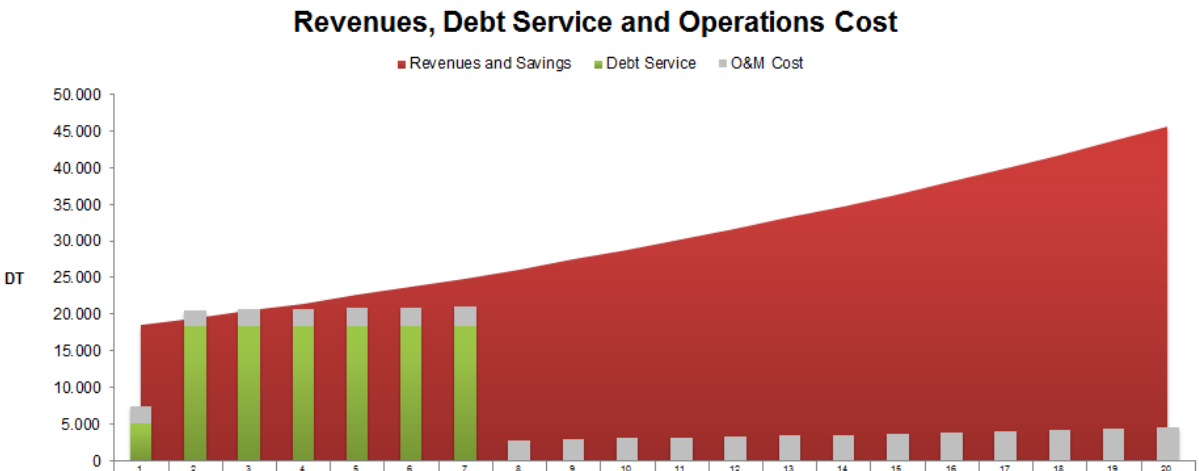
Results		
Net-Present Value	EUR	129.465
Project IRR	%	15,46%
Equity IRR	%	21,51%
Payback Period	Years	8,86
LCOE* (w/o subsidy)	EUR/kWh	0,11
LCOE (w subsidy)	EUR/kWh	0,11
Min DSCR**	x	0,94 x
Min LLCR***	x	1,06 x

* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

This business model shows much better results than the previous one, due to the high self-consumption rate and to the lower specific plant cost, due to the larger system size.



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(40.582)																				
Cash Flow for Equity	-	11.199	(1.102)	(187)	766	1.821	2.793	3.870	23.353	24.597	25.740	27.009	28.332	29.801	31.147	32.643	34.203	35.938	37.523	39.289	41.130
Cumulative Cash Flows	(40.582)	(30.116)	(31.078)	(31.230)	(30.646)	(29.348)	(27.487)	(25.077)	(11.486)	1.894	14.979	27.811	40.390	52.757	64.836	76.668	88.253	99.631	110.732	121.596	132.225



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	18.616	19.531	20.536	21.584	22.737	23.811	24.994	26.227	27.586	28.849	30.242	31.694	33.298	34.783	36.425	38.137	40.029	41.778	43.714	45.731
O&M Cost	2.184	2.271	2.362	2.457	2.555	2.657	2.763	2.874	2.989	3.109	3.233	3.362	3.497	3.637	3.782	3.933	4.091	4.254	4.424	4.601
Debt Service	5.233	18.361	18.361	18.361	18.361	18.361	18.361	-	-	-	-	-	-	-	-	-	-	-	-	-

4. Business model report: Commercial sector – Shopping centres

Segment environment

The application segment of the shopping centres is, at least theoretically, really promising in Italy. This is due especially to the very high rates of self-consumption that can be obtained for PV electricity, as well as to the possibility of building large scale plants (hundreds of kW_p or even some MW_p) which have a lower specific turnkey cost.

Unfortunately the diffusion in such a segment is still hampered by a very restrictive legislation about Power Purchase Agreements which forbids their application to multi-users, as is almost always the case with shopping centres, where the different shops pay their separate electricity bills. If, as expected and asked for by many PV stakeholder groups, the legislation will open to such solutions, a PPA towards multiple users in shopping centres will probably become the most interesting business model for this segment.

Another possible solution could be that tenants accept to cover PPA costs as part of the tenancy agreement or via service charges but it seems that no such examples have been implemented in Italy so far.

Segment Drivers

The main driver for shopping centre tenants to buy PV electricity would be of course too get savings on the electricity bill, which range between 15% and 20% with respect to the grid price.

From the point of view of the owners, investing in a PV system can make sense if the Internal Rate of Return is close to 10%. A secondary driver can be the “green image” of the structure, also including the possible increased property value.

The specific price for such applications, which are assumed as ranging from 200 kW_p up, could go from 1,000 to 1,200 €/kW_p.

Business Models

Below you find the business models of Italy in the commercial sector for shopping centres. For both the models, calculations have been done for a specific solar radiation on a horizontal surface of 1,660 kWh/kW$_p$ (site in central Italy). The size of the plant is 200 kW$_p$ for the first model and 1 MW$_p$ for the second one. The specific price is 1,200 €/kW$_p$ for the first model and 1,000 €/kW$_p$ for the second one.

Business Model 1: Self-consumption (for common electrical uses)

As outlined above, self-consumption of PV electricity in shopping centres with multiple users is possible only when the energy is fed to the common uses such as lighting, automatic gates, lifts, etc.

The scheme reports the configuration of the model.

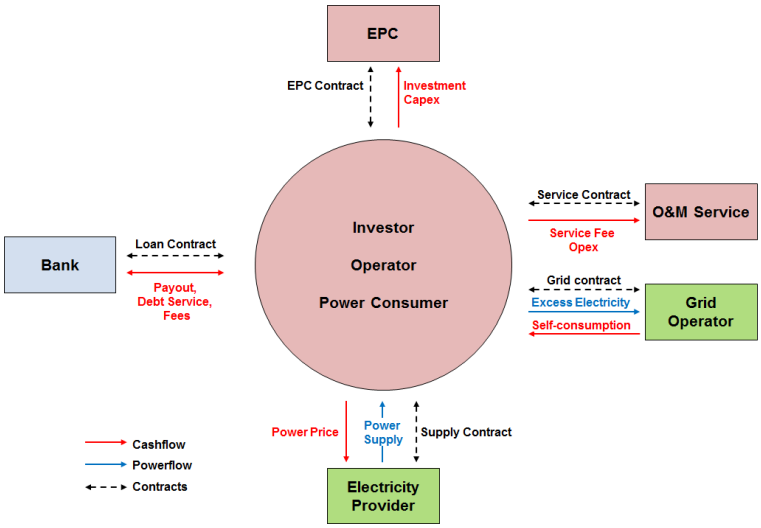


Figure 4: Self-consumption.

Profitability Analysis

A self-consumption rate of 80% has been assumed for the profitability calculation. The remaining 20% is managed through “scambio sul posto”, which is a sort of net-metering scheme.

Project Overview

PV Project		
PV System Size	kWp	200
Specific System Cost	EUR/kWp	1.200
Total System Cost	EUR	240.000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	240.000
Fixed Operation Costs	EUR p.a.	3.750
Variable Operation Costs	EUR/kWh	-

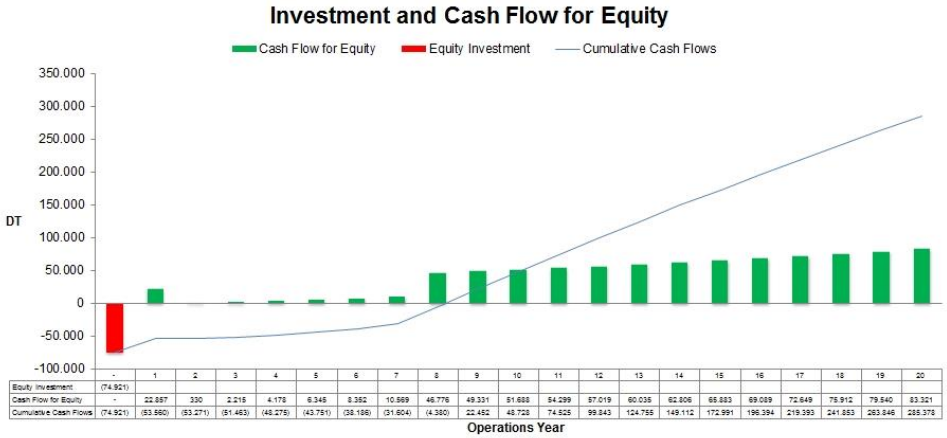
PV Generation		
Specific Yield	kWh/qm/a	1660
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.411
Degradation	% p.a.	0,70%

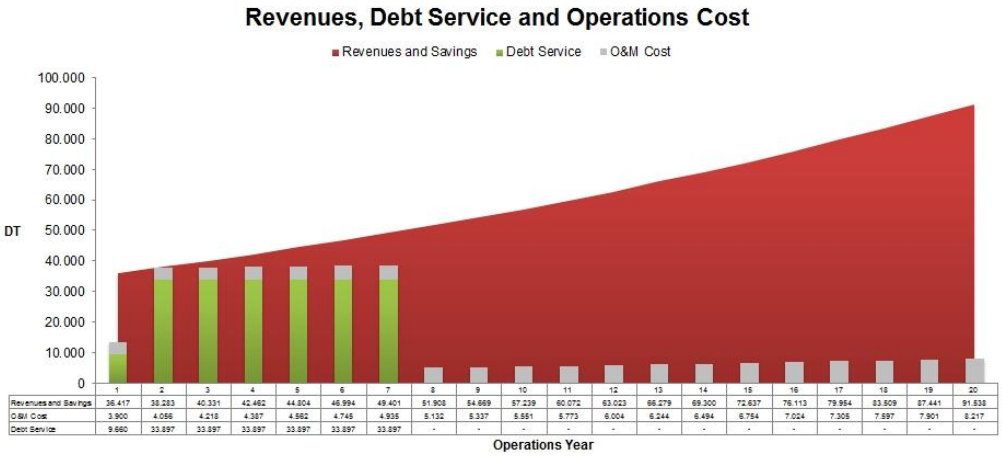
Investment			
Project Duration		Years	20
Equity		EUR	74.921
Debt (Gearing)	70%	EUR	168.000
Loan Tenor		Years	7
Interest Rate		%	5,8%
Discount Rate		%	7,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	80%	EUR/kWh	0,1900
Fees		EUR/kWh	0,0500
Net-metering	20%	EUR/kWh	0,2000
Fees		EUR/kWh	0,0500
Excess Electricty		EUR/kWh	0,0500
PPA Tariff	-	EUR/kWh	-
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	279.570
Project IRR	%	16,69%
Equity IRR	%	23,84%
Payback Period	Years	8,16
LCOE* (w/o subsidy)	EUR/kWh	0,10
LCOE (w subsidy)	EUR/kWh	0,10
Min DSCR**	x	1,01x
Min LLCR***	x	1,15x

* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

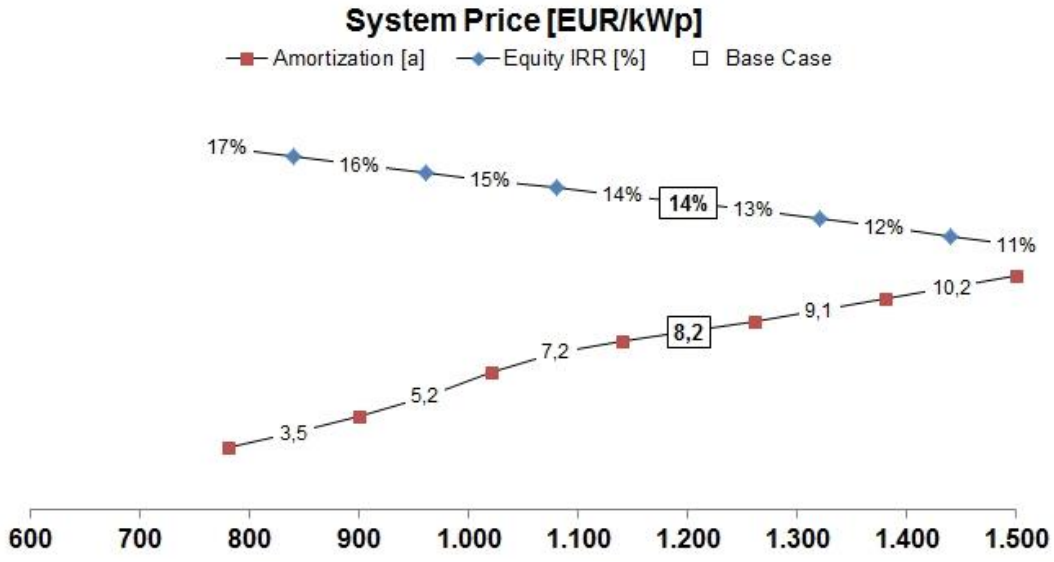


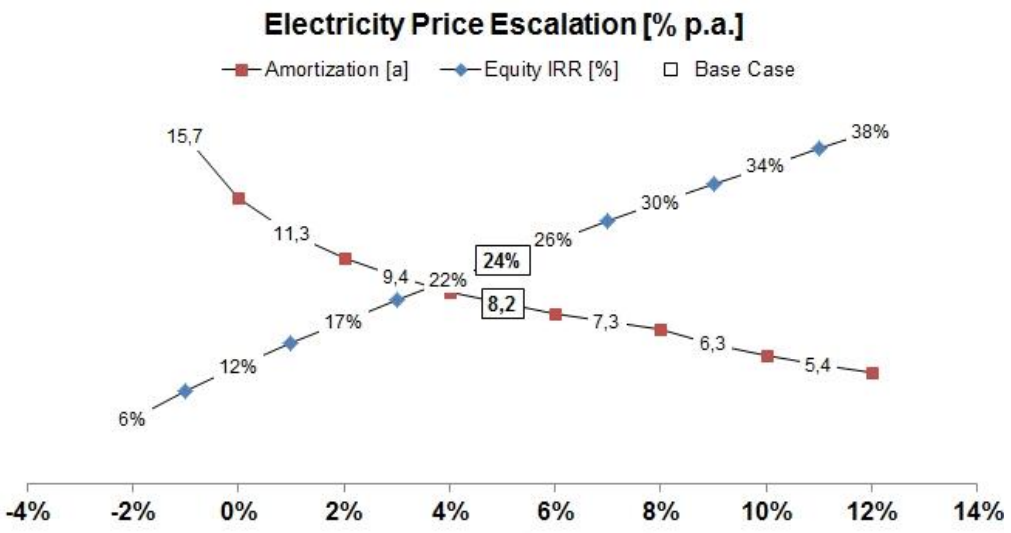


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	36.417	38.283	40.331	42.462	44.804	46.994	49.401	51.908	54.669	57.239	60.072	63.023	66.279	69.300	72.637	76.113	79.954	83.509	87.441	91.538
O&M Cost	3.900	4.056	4.218	4.387	4.562	4.745	4.935	5.132	5.337	5.551	5.773	6.004	6.244	6.494	6.754	7.024	7.305	7.597	7.901	8.217
Debt Service	9.660	33.897	33.897	33.897	33.897	33.897	33.897	-	-	-	-	-	-	-	-	-	-	-	-	-

The results look very promising, thanks to the high self-consumption rate, combined with a relatively high price for the grid electricity. Payback times of less than 10 years can thus be reached.

Two sensitivity analysis carried out with relevant parameters, namely the specific system price (€/kW$_p$) and the increase of the grid electricity price, show that the profitability could be even higher, provided better conditions are in place.




Electricity Price Escalation [% p.a.]
Amortization [a]
Equity IRR [%]
Base Case
15,7
11,3
9,4
8,2
7,3
6,3
5,4
6%
12%
17%
22%
24%
26%
30%
34%
38%
-4%
-2%
0%
2%
4%
6%
8%
10%
12%
14%

Business Model 2: Power Purchase Agreement

This model is at the moment only theoretically applicable to this segment, but lobbying activities are going on towards a change in legislation. Such a change would regard the legislation on “SEU”, the Italian version of the PPA, which should be broadened to include the possibility for an investor / plant operator to sell PV electricity to multiple users.

The scheme below reports the possible configuration of the model.

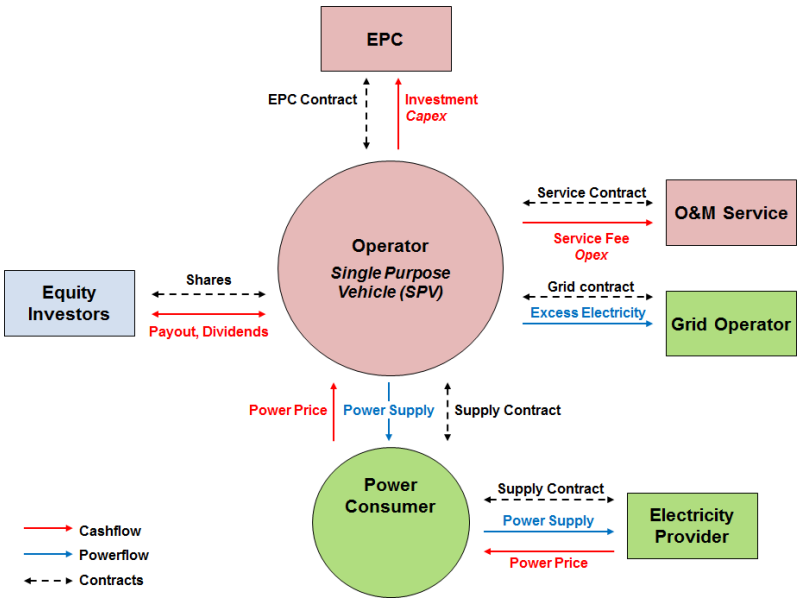


Figure 2: Power Purchase Agreement.

Profitability Analysis

A self-consumption of 100% has been assumed, which means the possibility for the investor to sell all the produced PV electricity to the multiple users in the shopping centre.

The negotiated price has been assumed to be 0.15 €/kWh, thus obtaining a 20% reduction with respect to the grid electricity price.

Project Overview

PV Project		
PV System Size	kWp	1.000
Specific System Cost	EUR/kWp	1.000
Total System Cost	EUR	1.000.000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	1.000.000
Fixed Operation Costs	EUR p.a.	15.150
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1660
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.411
Degradation	% p.a.	0,70%

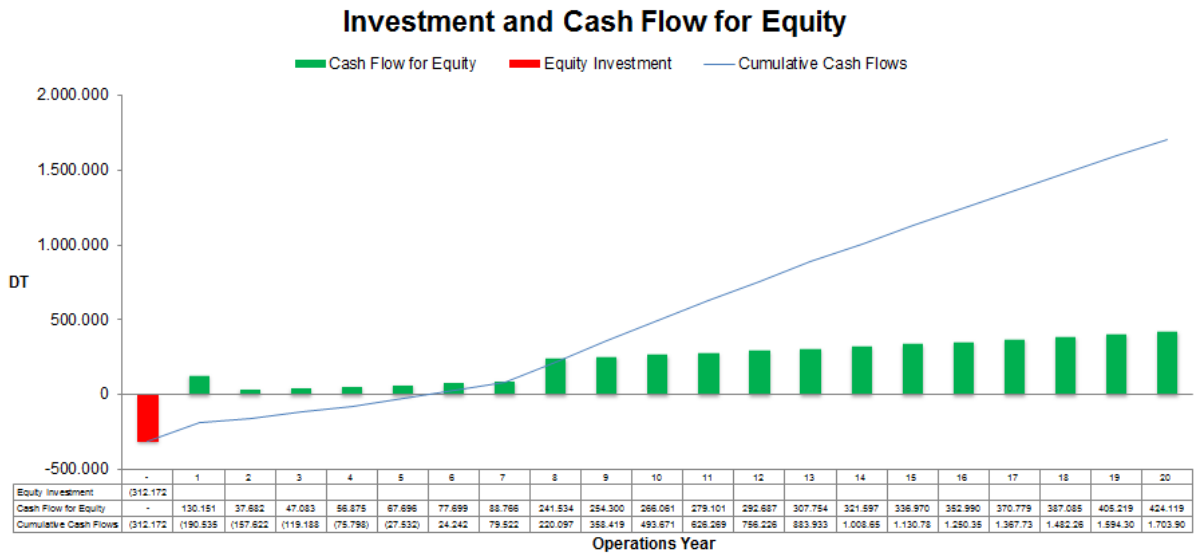
Investment			
Project Duration		Years	20
Equity		EUR	312.172
Debt (Gearing)	70%	EUR	700.000
Loan Tenor		Years	7
Interest Rate		%	5,8%
Discount Rate		%	7,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	100%	EUR/kWh	0,1500
Fees		EUR/kWh	0,0250
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

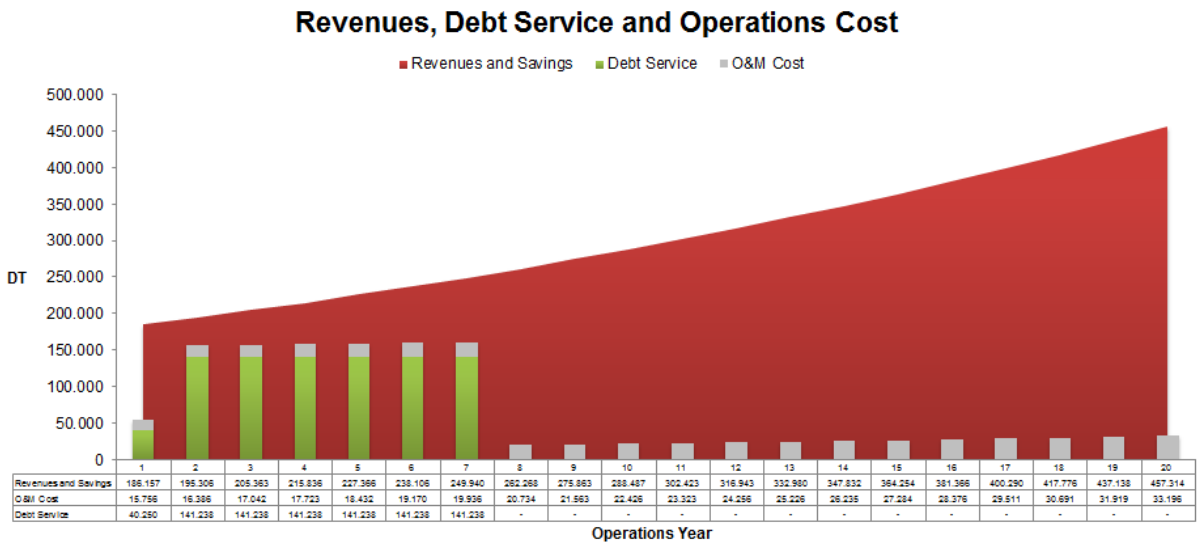
Results		
Net-Present Value	EUR	1.670.835
Project IRR	%	20,39%
Equity IRR	%	31,87%
Payback Period	Years	5,53
LCOE* (w/o subsidy)	EUR/kWh	0,08
LCOE (w subsidy)	EUR/kWh	0,08
Min DSCR**	x	1,27 x
Min LLCR***	x	1,43 x

*LCOE: Levelized Cost of Electricity
**DSCR: Debt Service Coverage Ratio

The huge potential of this model, unfortunately not applicable at the moment, is clear from the results: A combination of a 100% self-consumption and a very low specific price for the PV plant gives low values of payback times as well as relevant values for IRR.



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(312.172)																				
Cash Flow for Equity	-	130.151	37.682	47.083	56.875	67.696	77.699	88.766	241.534	254.300	266.061	279.101	292.687	307.754	321.597	336.970	352.990	370.779	387.085	405.219	424.119
Cumulative Cash Flows	(312.172)	(190.535)	(157.622)	(119.188)	(75.798)	(27.532)	24.242	79.522	220.097	358.419	493.671	626.269	756.226	883.933	1.008.65	1.130.78	1.250.35	1.367.73	1.482.26	1.594.30	1.703.90



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	186.157	195.306	205.363	215.836	227.366	238.106	249.940	262.268	275.863	288.487	302.423	316.943	332.980	347.832	364.254	381.366	400.290	417.776	437.138	457.314
O&M Cost	15.756	16.386	17.042	17.723	18.432	19.170	19.936	20.734	21.563	22.426	23.323	24.256	25.226	26.235	27.284	28.376	29.511	30.691	31.919	33.196
Debt Service	40.250	141.238	141.238	141.238	141.238	141.238	141.238	-	-	-	-	-	-	-	-	-	-	-	-	-

Given the very positive results, it makes no sense to explore it further through sensitivity analysis, especially since its application is not possible at the moment, due to the legislation currently in place in Italy for PPAs.

5. Business model report: Industrial sector

Segment environment

As in the commercial sector, also this segment can offer very high rates of self-consumption for PV electricity and the possibility of large scale plants (hundreds of kW_p or even some MW_p) with lower specific turnkey cost.

Differently from what was happening during the feed-in tariff period, where industrial companies just asked for PV, now PV is only one of the many possible measures (and not always economically viable) of a more general energy efficiency plan including, for instance, lighting efficiency, pressurized air distribution, building envelope, electric motors, etc.

According to the Italian legislation, industrial park companies cannot sell excess PV production to other companies in the area and, anyway, due to the economic conditions, the higher benefits come from self-consumption, therefore PV plants are sized according to this need. Moreover, as outlined also for other application segment, a PPA towards multiple users, for instance different industries in the same park, is not possible at the moment.

Some barriers should be highlighted:

- the available roof space and the roof conditions;
- authorization (visual impact), which gives problems with the Municipalities, even in case of installations on the roof; different authorizations are needed/requested for each plant;
- if the company invest but publish a tender for delivering the PV plant, the complication of the tender and possible risks of companies filing an appeal, is quite a risky point.

Segment Drivers

For tenants of industrial parks the main driver for PV installation is lowering the bill by increasing self-consumption. From this point of view, energy intensive companies have higher possible share of self-consumption though available roof space should be checked. Green image, especially in the case of large groups, can also play a relevant role.

If they have a medium and long term horizon for their activity and for their presence in the park, companies could be willing to invest themselves in PV, under the condition that the

activity has no stop in weekends. The required IRR is usually 10% or higher, unless green image, as reported above, is of some importance for the company.

Regarding PPAs, an industrial company could accept to buy PV electricity if it generates savings of 10-20% on the current tariff.

Business Models

Below you find the business models of Italy in the industrial sector: Self-consumption and PPA for a single industrial customer. For both the models, calculations have been done for a specific solar radiation on a horizontal surface of 1,660 kWh/kW$_p$ (site in central Italy). The size of the plant is 1 MW$_p$ with a specific price of 1,000 €/kW$_p$.

Business Model 1: Self-consumption

Self-consumption of PV electricity can reach 100% in such applications.

The scheme reports the configuration of the model.

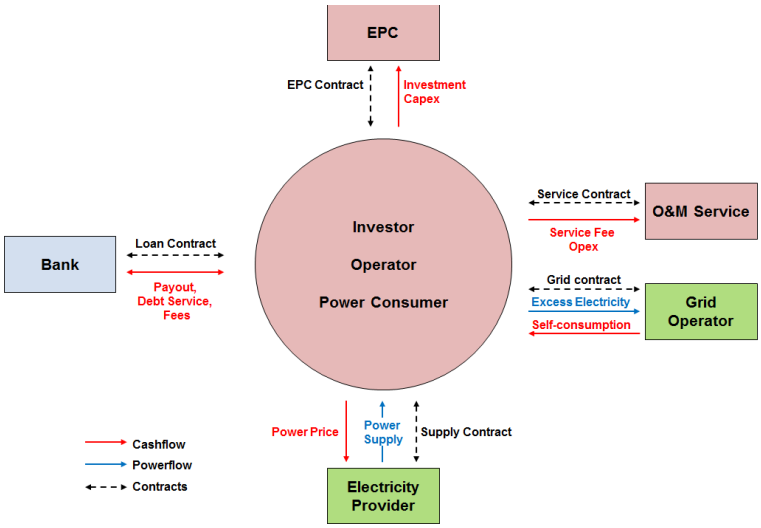


Figure 5: Self-consumption.

Profitability Analysis

To estimate the saving due to the complete self-consumption of PV electricity, a grid price of 0.17 €/kWh has been used.

Project Overview

PV Project		
PV System Size	kWp	1.000
Specific System Cost	EUR/kWp	1.000
Total System Cost	EUR	1.000.000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	1.000.000
Fixed Operation Costs	EUR p.a.	15.150
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1660
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.411
Degradation	% p.a.	0,70%

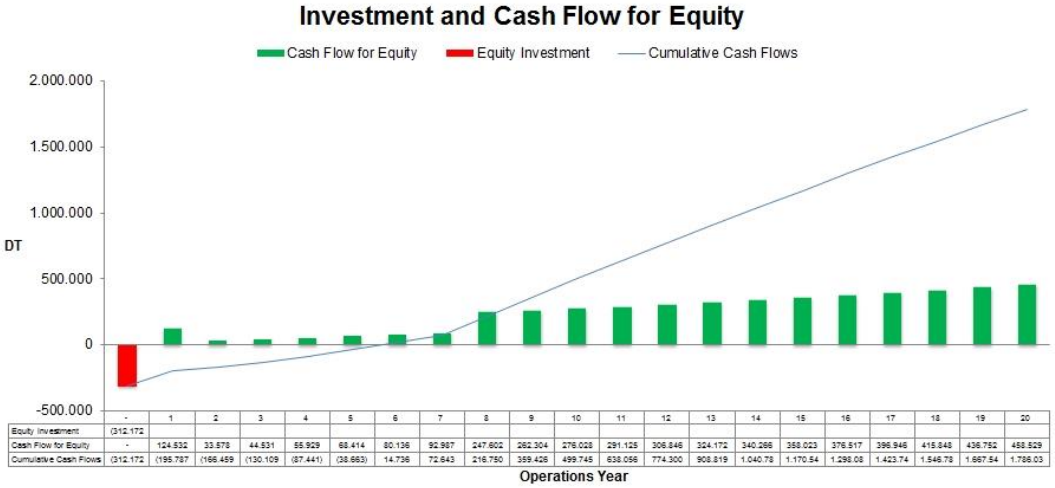
Investment			
Project Duration		Years	20
Equity		EUR	312.172
Debt (Gearing)	70%	EUR	700.000
Loan Tenor		Years	7
Interest Rate		%	5,8%
Discount Rate		%	7,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	100%	EUR/kWh	0,1700
Fees		EUR/kWh	0,0500
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	-	EUR/kWh	-
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

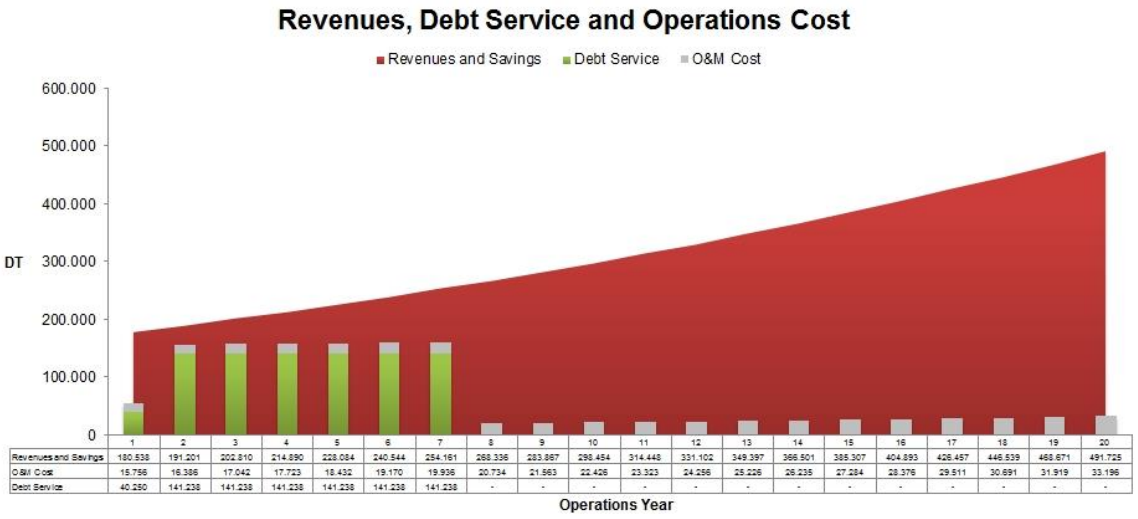
Results		
Net-Present Value	EUR	1.751.527
Project IRR	%	20,56%
Equity IRR	%	31,77%
Payback Period	Years	5,72
LCOE* (w/o subsidy)	EUR/kWh	0,08
LCOE (w subsidy)	EUR/kWh	0,08
Min DSCR**	x	1,24 x
Min LLCR***	x	1,43 x

*LCOE: Levelized Cost of Electricity
**DSCR: Debt Service Coverage Ratio

Such price, combined with a low specific turnkey cost and the possibility of self-consuming the whole PV output, gives a very low payback time of less than 6 years.

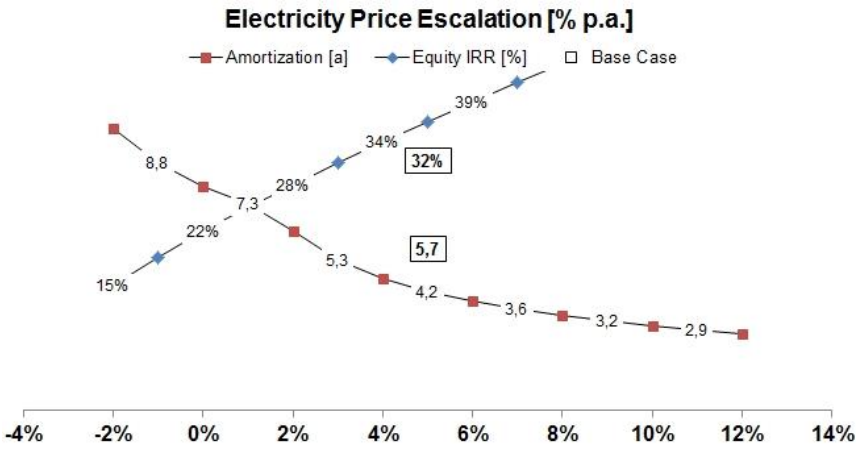


	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(312.172)																				
Cash Flow for Equity	-	124.532	33.578	44.831	56.929	68.414	80.136	92.987	247.602	262.304	276.028	291.125	306.846	324.172	340.266	358.023	376.817	396.946	415.848	436.752	458.829
Cumulative Cash Flows	(312.172)	(195.787)	(166.459)	(130.109)	(87.441)	(38.663)	14.736	72.843	216.750	359.426	499.745	638.056	774.300	908.819	1.040.78	1.170.54	1.298.08	1.423.74	1.546.78	1.667.54	1.786.03



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	180.538	191.201	202.810	214.890	228.084	240.544	254.161	268.336	283.867	298.454	314.448	331.102	349.397	366.501	385.307	404.893	426.457	446.539	468.671	491.725
O&M Cost	15.756	16.386	17.042	17.723	18.432	19.170	19.936	20.734	21.563	22.426	23.323	24.256	25.226	26.235	27.284	28.376	29.511	30.691	31.919	33.196
Debt Service	40.250	141.238	141.238	141.238	141.238	141.238	141.238	-	-	-	-	-	-	-	-	-	-	-	-	-

An interesting sensitivity analysis can be carried out basing on different scenarios for electricity grid price escalation, as reported in the graph below.



Business Model 2: Power Purchase Agreement

"SEU" ("Sistemi Efficienti di Utenza"), the Italian version of the PPA, can be applied to a single industrial customer.

The scheme below reports the possible configuration of the model.

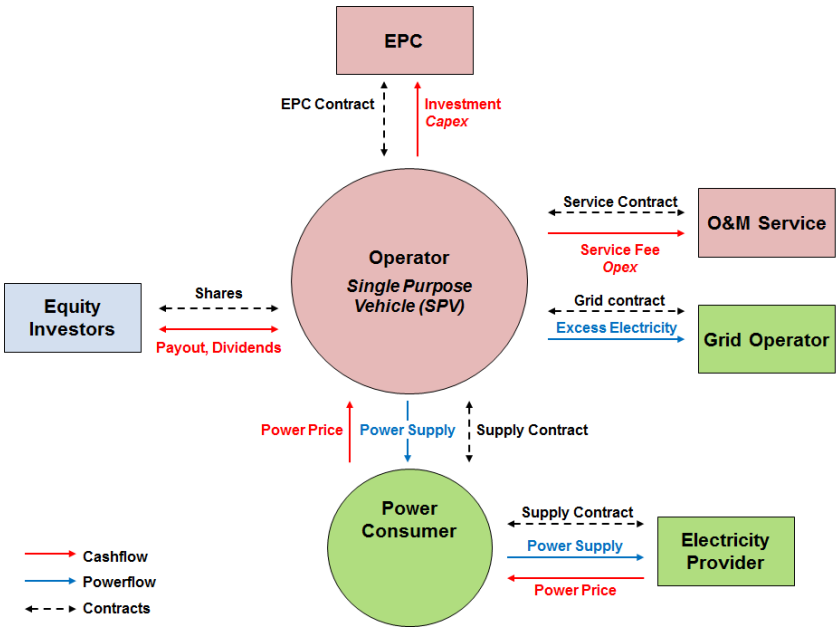


Figure 2: Power Purchase Agreement.

Profitability Analysis

Given a grid price of 0.17 €/kWh, a selling price of 0.14 €/kWh through the PPA has been assumed, thus meaning a reduction between 15% and 20%.

A low payback time can be thus obtained, as reported in the summary results below.

Project Overview

PV Project		
PV System Size	kWp	1.000
Specific System Cost	EUR/kWp	1.000
Total System Cost	EUR	1.000.000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	1.000.000
Fixed Operation Costs	EUR p.a.	15.150
Variable Operation Costs	EUR/kWh	-

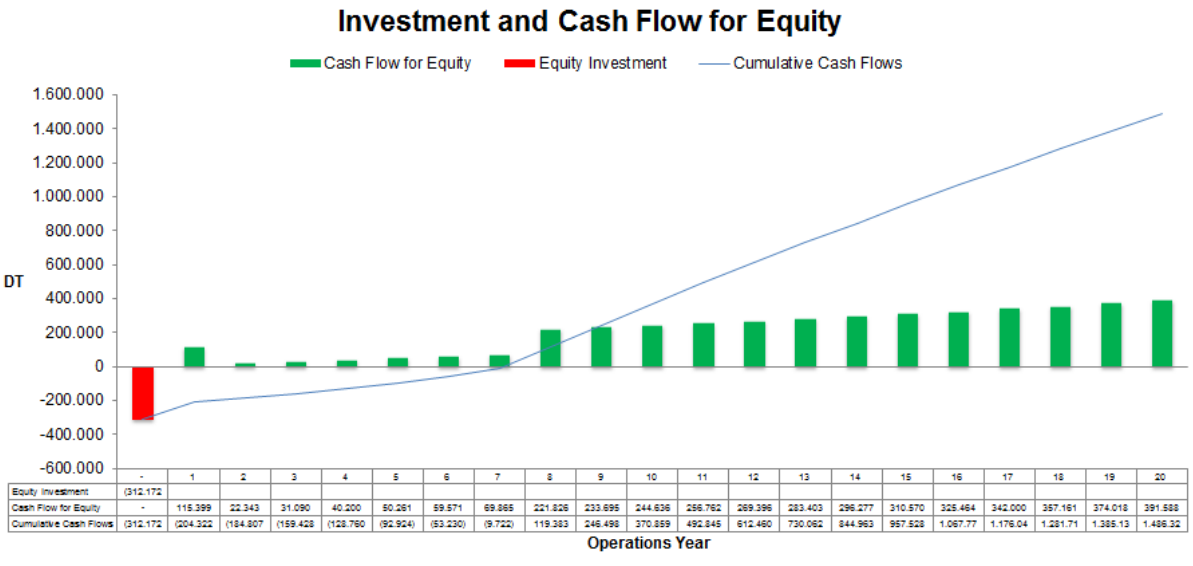
PV Generation		
Specific Yield	kWh/qm/a	1660
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.411
Degradation	% p.a.	0,70%

Investment			
Project Duration		Years	20
Equity		EUR	312.172
Debt (Gearing)	70%	EUR	700.000
Loan Tenor		Years	7
Interest Rate		%	5,8%
Discount Rate		%	7,0%

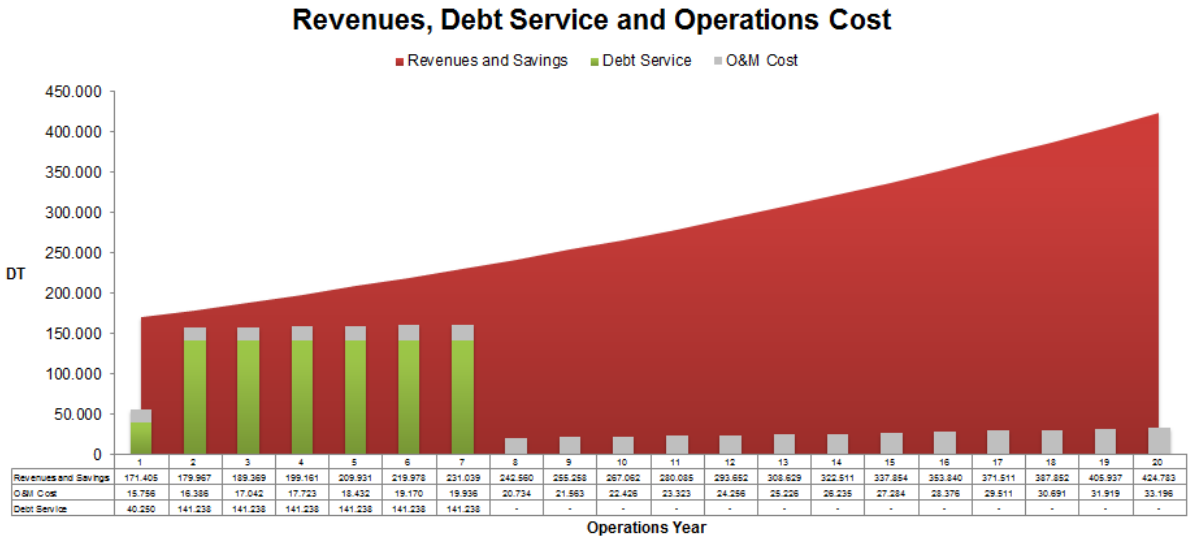
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	100%	EUR/kWh	0,1400
Fees		EUR/kWh	0,0250
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	1.457.004
Project IRR	%	18,85%
Equity IRR	%	28,39%
Payback Period	Years	7,08
LCOE* (w/o subsidy)	EUR/kWh	0,08
LCOE (w subsidy)	EUR/kWh	0,08
Min DSCR**	x	1,16 x
Min LLCR***	x	1,31 x

*LCOE: Levelized Cost of Electricity
**DSCR: Debt Service Coverage Ratio

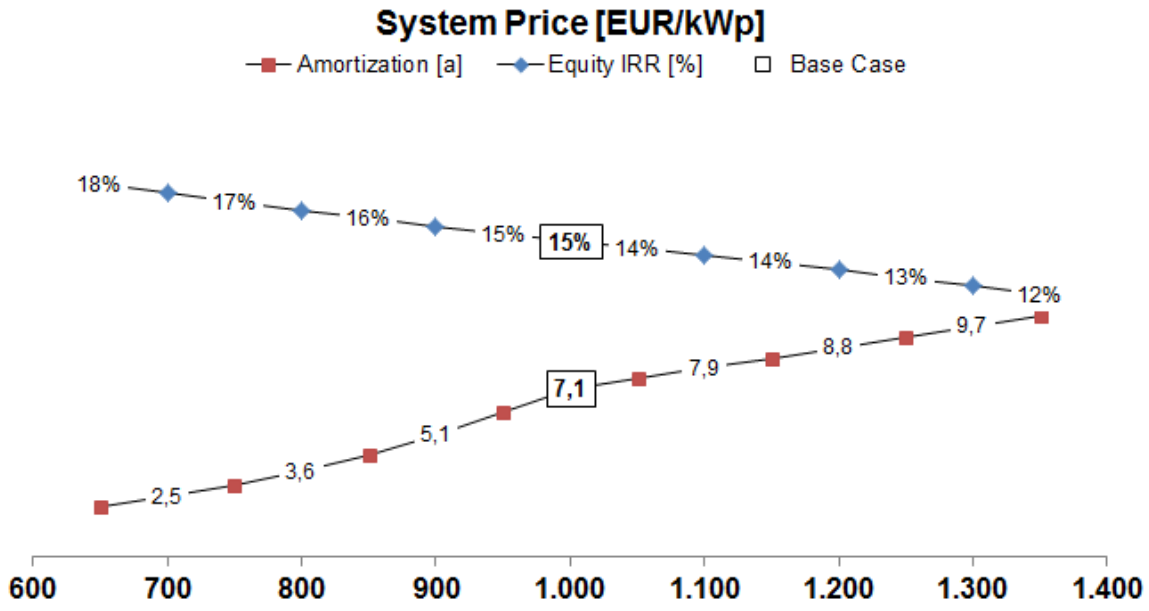


	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(312.172)																				
Cash Flow for Equity	-	115.399	22.343	31.090	40.200	50.261	59.571	69.865	221.826	233.695	244.636	256.762	269.396	283.403	296.277	310.570	325.464	342.000	357.161	374.018	391.588
Cumulative Cash Flows	(312.172)	(204.322)	(184.807)	(159.428)	(128.760)	(92.924)	(53.230)	(9.722)	119.383	246.498	370.859	492.845	612.460	730.062	844.963	957.528	1.067.77	1.176.04	1.281.71	1.385.13	1.486.32



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	171.405	179.967	189.369	199.161	209.931	219.978	231.039	242.560	255.258	267.062	280.085	293.652	308.629	322.511	337.854	353.840	371.511	387.852	405.937	424.783
O&M Cost	15.756	16.386	17.042	17.723	18.432	19.170	19.936	20.734	21.563	22.426	23.323	24.256	25.226	26.235	27.284	28.376	29.511	30.691	31.919	33.196
Debt Service	40.250	141.238	141.238	141.238	141.238	141.238	141.238	-	-	-	-	-	-	-	-	-	-	-	-	-

One more relevant output is that, even with higher plant costs (see graph below), the payback time still shows acceptable values.



6. Business model report: Educational sector

Segment environment

In Italy, buildings belonging to the educational sector (e.g. school) could have different owners, such as the Municipality, the former Province or even the State. Therefore the first step for each potential project development is to identify that owner and understand what could be the main driver for going towards a PV solution.

PPA could be a good business model for this segment since the school does not have to tackle the plant O&M and at the same time, on the developer and plant operator side, debt financing can be obtained more easily thanks to the fact that the buyer of electricity, and so the cash flow generator, is a public body.

The school management could also be interested in a leasing solution, for duration between 10 and 20 years, but with the condition to negotiate with a serious and reliable partner company. Furthermore the technical issues linked to the plant maintenance should be solved, especially regarding the possible future measures of energy renovation. A leasing should go through a third party financing because a pure leasing could go against the balance sheet stability rules. Therefore PPA would be the preferable solution to avoid any risks, as usual with a price advantage not lower than 10%.

The main sector-specific barriers are:

- Equity barrier: The Municipalities should be helped in finding low interest loans from the banks.
- It is hard for the Municipality to evaluate and compare the technical and economic offers received by the companies, also due to the complexity of the public tenders. The technical staff of the Municipality should be adequately training or an external help desk should support them.
- Contract details should be developed so to manage all problems, also the ones related to the management of the roof in case problems occur, for instance structural stability and future leakages.
- Self-consumption rates could be rather small due to the summer closing; therefore the PV plant should be carefully sized, possibly preferring schools which also have summer activities.

Segment Drivers

Electricity savings could be for sure a main driver in this segment, as well as the “green image” is, especially when more general projects, for instance involving a large number of schools at the same time, are developed. An example of such projects has been carried out during the feed-in tariff times by the former Province of Rome.

Being property of public bodies, PV investments in schools cannot benefit of the 50% tax reduction and, furthermore, as any investment in the public sector, should meet the strict requirements of the public body balance sheet.

Business Models

Below you find the business models of Italy in the educational sector for school buildings. The first one is a self-consumption model where the PV plant is bought by the owner through a bank loan and the second model is a PPA (SEU in Italy) through a third party.

For both the models, calculations have been done for a 20 kW_p plant with a specific price of 1,800 €/kW_p and for a specific solar radiation on a horizontal surface of 1,660 kWh/kW_p (site in central Italy).

Business Model 1: Self-consumption

Assuming that some activities are performed in summer also, a self-consumption rate of 40%, similar to what happens in the residential sector, has been introduced in the calculation.

The scheme reports the configuration of the model.

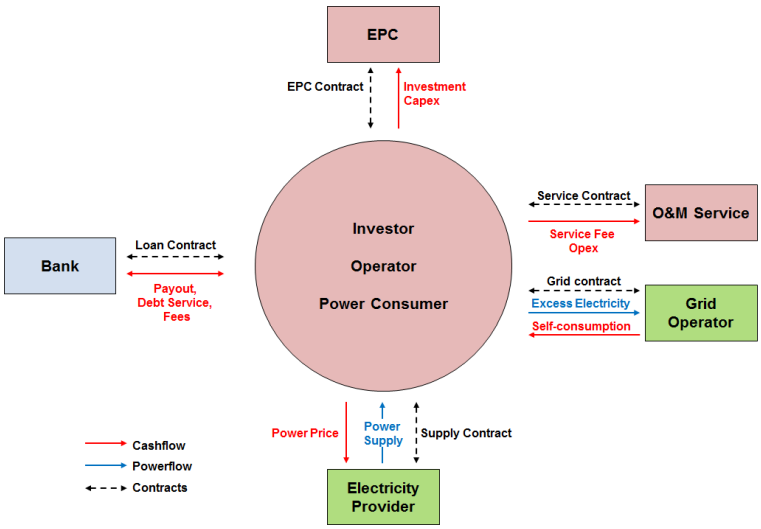


Figure 6: Self-consumption.

Profitability Analysis

60% of the PV production, which is not self-consumed, is valorised through the “scambio sul posto” mechanism.

Project Overview

PV Project			
PV System Size		kWp	20
Specific System Cost		EUR/kWp	1.800
Total System Cost		EUR	36.000
Investment Subsidy		EUR	-
Total System Cost incl. Subsidy		EUR	36.000
Fixed Operation Costs		EUR p.a.	690
Variable Operation Costs		EUR/kWh	-

PV Generation			
Specific Yield		kWh/qm/a	1660
Performance Factor		%	85%
Specific System Performance		kWh/kWp/a	1.411
Degradation		% p.a.	0,70%

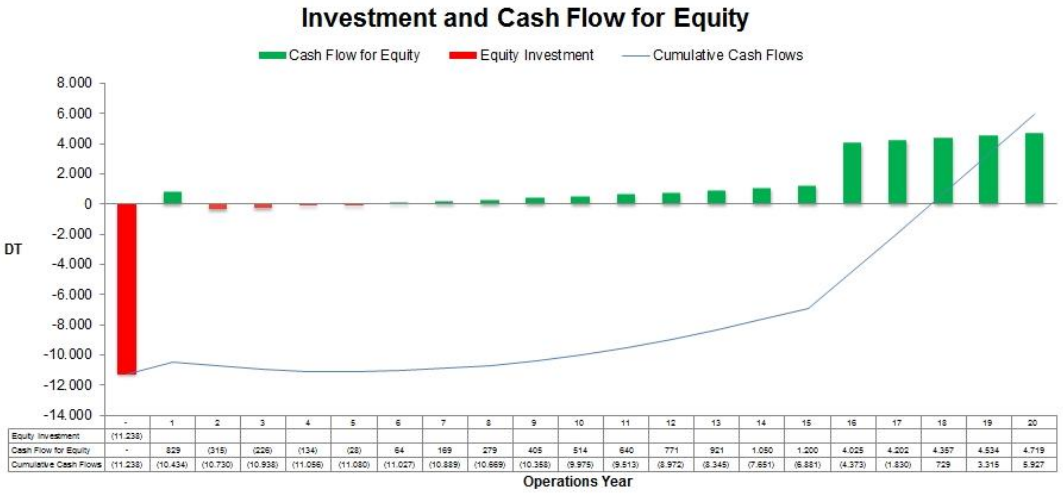
Investment			
Project Duration		Years	20
Equity		EUR	11.238
Debt (Gearing)	70%	EUR	25.200
Loan Tenor		Years	15
Interest Rate		%	5,8%
Discount Rate		%	3,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	40%	EUR/kWh	0,2300
Fees		EUR/kWh	0,0500
Net-metering	60%	EUR/kWh	0,2300
Fees		EUR/kWh	0,0500
Excess Electricity		EUR/kWh	0,0500
PPA Tariff	-	EUR/kWh	-
Fees		EUR/kWh	-
Oversupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

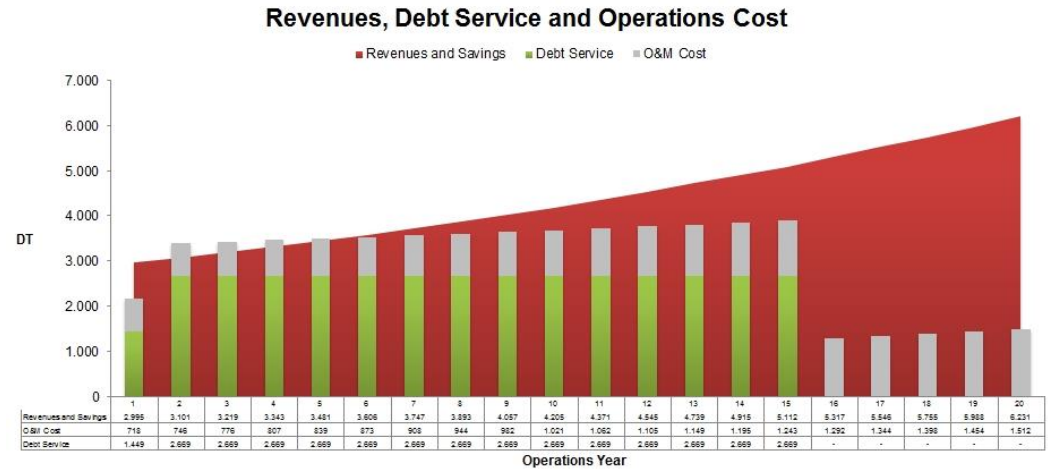
Results		
Net-Present Value	EUR	5.825
Project IRR	%	5,66%
Equity IRR	%	5,67%
Payback Period	Years	17,72
LCOE* (w/o subsidy)	EUR/kWh	0,15
LCOE (w subsidy)	EUR/kWh	0,15
Min DSCR**	x	0,88 x
Min LLCR***	x	1,10 x

* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

The results, summarised through the table above, are not very positive, due to the low self-consumption rate that can be obtained and to the small size of the system, which implies a quite high specific cost for the system.

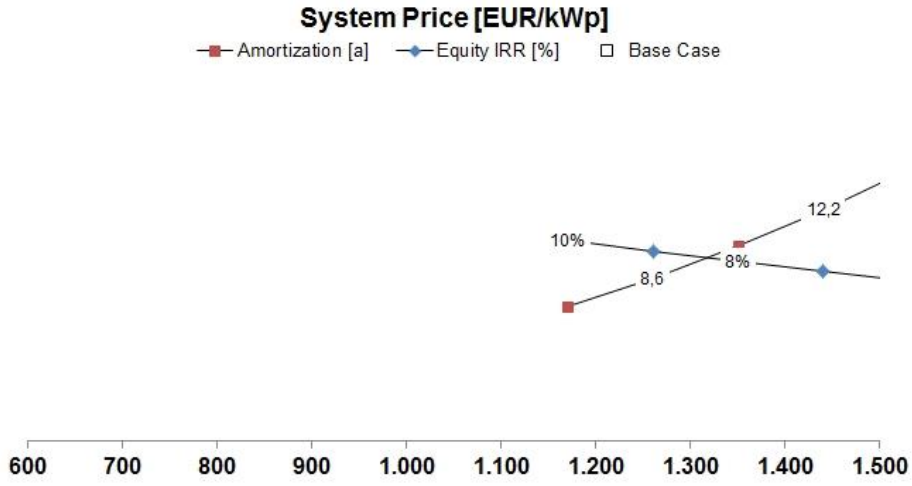


	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(11.238)																				
Cash Flow for Equity	-	829	(315)	(228)	(134)	(28)	64	169	279	405	514	640	771	921	1.090	1.200	4.025	4.202	4.367	4.534	4.719
Cumulative Cash Flows	(11.238)	(10.434)	(10.730)	(10.958)	(11.056)	(11.080)	(11.027)	(10.889)	(10.669)	(10.368)	(9.975)	(9.513)	(8.972)	(8.345)	(7.651)	(6.881)	(4.373)	(1.830)	729	3.315	5.927



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	2.995	3.101	3.219	3.343	3.481	3.606	3.747	3.893	4.057	4.205	4.371	4.545	4.739	4.915	5.112	5.317	5.546	5.755	5.988	6.231
O&M Cost	718	746	776	807	839	873	908	944	982	1.021	1.062	1.105	1.149	1.195	1.243	1.292	1.344	1.398	1.454	1.512
Debt Service	1.449	2.669	2.669	2.669	2.669	2.669	2.669	2.669	2.669	2.669	2.669	2.669	2.669	2.669	2.669	-	-	-	-	-

A scenario analysis shows (see graph below) that, with a lower specific system cost, payback times of about 10 years can be reached.



Business Model 2: Power Purchase Agreement

Calculations have been done with PV electricity at 0.19 €/kWh, about 15% lower than the grid price. The scheme below reports the possible configuration of the model.

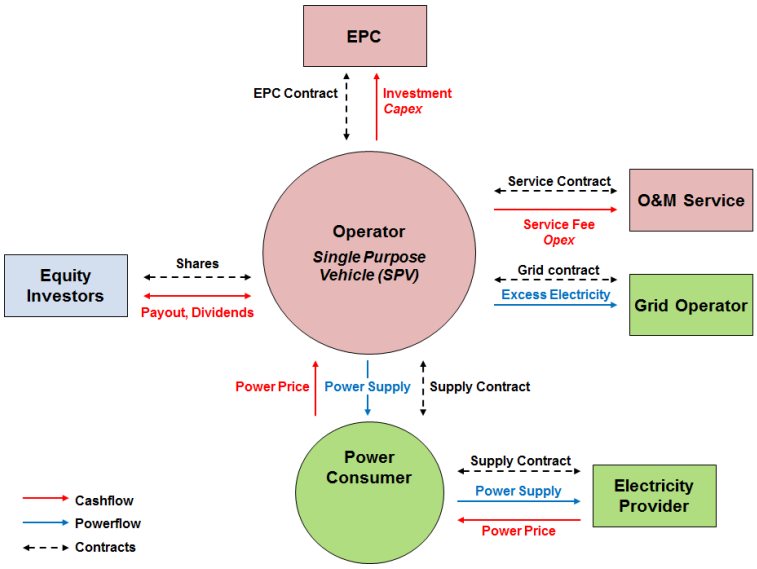


Figure 2: Power Purchase Agreement.

Profitability Analysis

Due to the low consumption rate (40%), the PPA refers only to less than half of the PV production, while the rest should be treated as excess electricity. Results are moderately positive in terms of payback time and IRR.

Project Overview

PV Project			
PV System Size		kWp	20
Specific System Cost		EUR/kWp	1.800
Total System Cost		EUR	36.000
Investment Subsidy		EUR	-
Total System Cost incl. Subsidy		EUR	36.000
Fixed Operation Costs		EUR p.a.	690
Variable Operation Costs		EUR/kWh	-

PV Generation			
Specific Yield		kWh/qm/a	1660
Performance Factor		%	85%
Specific System Performance		kWh/kWp/a	1.411
Degradation		% p.a.	0,70%

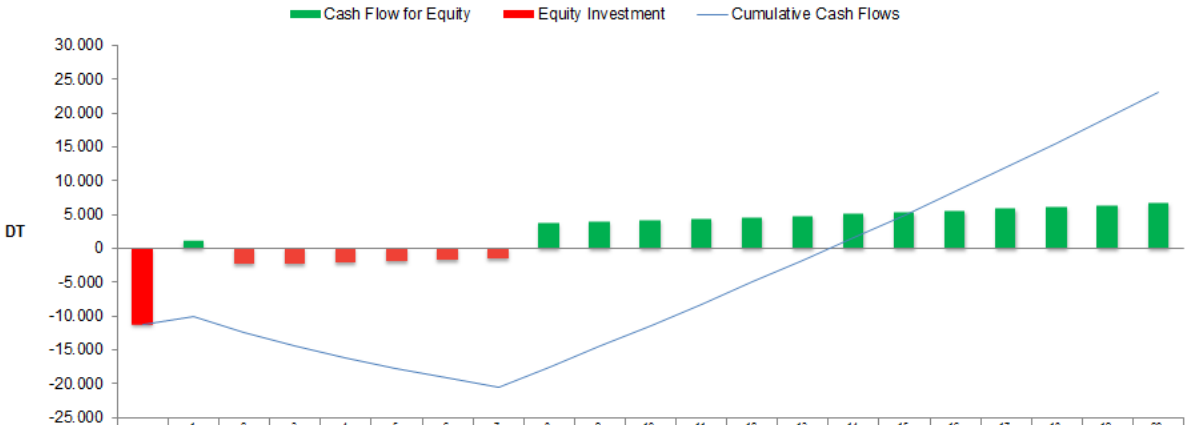
Investment			
Project Duration		Years	20
Equity		EUR	11.238
Debt (Gearing)	70%	EUR	25.200
Loan Tenor		Years	7
Interest Rate		%	5,8%
Discount Rate		%	3,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricity		EUR/kWh	-
PPA Tariff	100%	EUR/kWh	0,1900
Fees		EUR/kWh	0,0250
Oversupply Price		EUR/kWh	0,1000
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	22.780
Project IRR	%	8,38%
Equity IRR	%	9,61%
Payback Period	Years	13,51
LCOE* (w/o subsidy)	EUR/kWh	0,15
LCOE (w subsidy)	EUR/kWh	0,15
Min DSCR**	x	0,54 x
Min LLCR***	x	0,61 x

* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

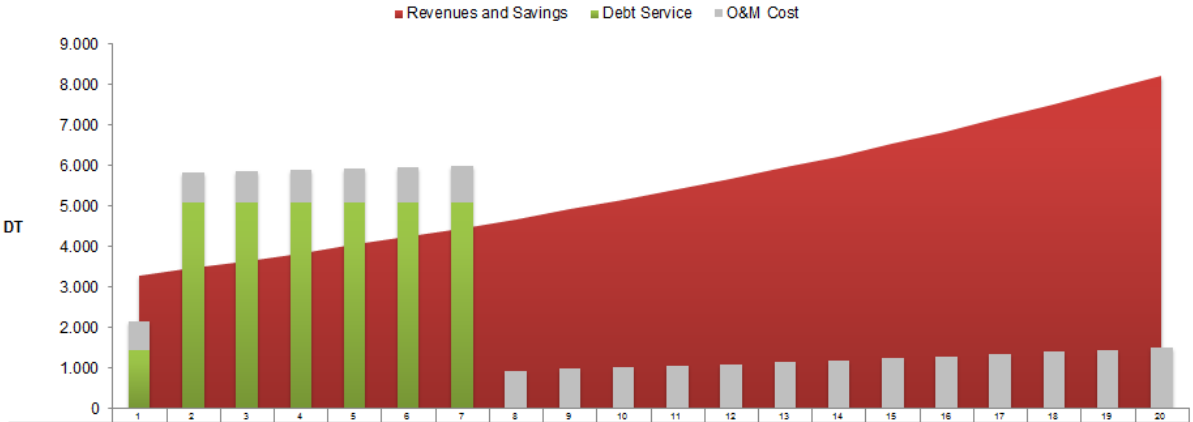
Investment and Cash Flow for Equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(11.238)																				
Cash Flow for Equity	-	1.143	(2.354)	(2.201)	(2.042)	(1.865)	(1.703)	(1.523)	3.749	3.958	4.148	4.361	4.582	4.829	5.053	5.303	5.564	5.856	6.120	6.415	6.724
Cumulative Cash Flows	(11.238)	(10.128)	(12.347)	(14.362)	(16.176)	(17.784)	(19.211)	(20.449)	(17.489)	(14.456)	(11.369)	(8.219)	(5.005)	(1.717)	1.624	5.028	8.495	12.038	15.633	19.292	23.014

Operations Year

Revenues, Debt Service and Operations Cost



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	3.310	3.477	3.659	3.850	4.059	4.255	4.470	4.694	4.940	5.170	5.423	5.687	5.978	6.248	6.546	6.857	7.200	7.518	7.869	8.235
O&M Cost	718	746	776	807	839	873	908	944	982	1.021	1.062	1.105	1.149	1.195	1.243	1.292	1.344	1.398	1.454	1.512
Debt Service	1.449	5.085	5.085	5.085	5.085	5.085	5.085	-	-	-	-	-	-	-	-	-	-	-	-	-

Operations Year