PVFINANCING

D2.6 Business Model Report

Austria

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Index

1. Residential Single Houses

Segment environment

The installation of PV systems is most common in the residential sector. For a PV system to operate profitably in the residential sector it is necessary to maximize the share of self-consumption. Excess electricity is fed into the grid for which the system owner receives the market price of a few Euro cents.

Segment Drivers

For individual households there are several reasons to invest in a PV system such as independence, hedging against rising electricity prices, reduced electricity costs as well as a “green” lifestyle.

Investment subsidies are of course also import drivers for investment. PV systems with a capacity of up to 5 kWp, which is typical for residential buildings) are eligible to receive an investment grant of 275 EUR/kWp (rooftop or free-standing PV systems) or 375 EUR/kWp (PV system integrated into building).

Business Models

Below you find the business models of Austria in the single residential house segment.

Business Model 1: Self-consumption

This example shows the typical business model for the single residential house segment with the aim of as much self-consumption as possible and the excess electricity being fed into the grid at market price. Any electricity demand that cannot be met by the PV system is counter-balanced by the conventional grid.

Figure 1: Self-consumption

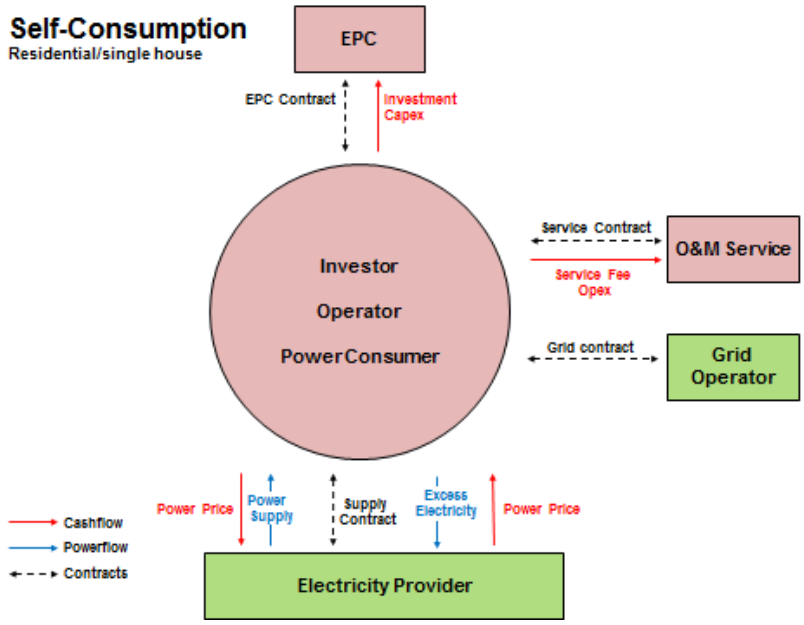


Figure 2: Project Overview

PV Project		
PV System Size	kWp	5
Specific System Cost	EUR/kWp	1.800
Total System Cost	EUR	9.000
Investment Subsidy	EUR	1.375
Total System Cost incl. Subsidy	EUR	7.625
Fixed Operation Costs	EUR p.a.	100
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1200
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.020
Degradation	% p.a.	0,75%

Investment			
Project Duration		Years	25
Equity		EUR	7.625
Debt (Gearing)	-	EUR	-
Loan Tenor		Years	-
Interest Rate		%	0,1%
Discount Rate		%	0,0%

PV Business Model				
Category		Share	Unit	Price
Feed-in Tariff		-	EUR/kWh	-
Self-consumption		35%	EUR/kWh	0,2000
	Fees		EUR/kWh	-
Net-metering		-	EUR/kWh	-
	Fees		EUR/kWh	-
	Excess Electricty		EUR/kWh	-
PPA Tariff		65%	EUR/kWh	0,0750
	Fees		EUR/kWh	-
	Overysupply Price		EUR/kWh	-
	Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	6.915
Project IRR	%	5,46%
Equity IRR	%	5,46%
Payback Period	Years	13,91
LCOE* (w/o subsidy)	EUR/kWh	0,11
LCOE (w subsidy)	EUR/kWh	0,09
Min DSCR**	x	-
Min LLCR***	x	-

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

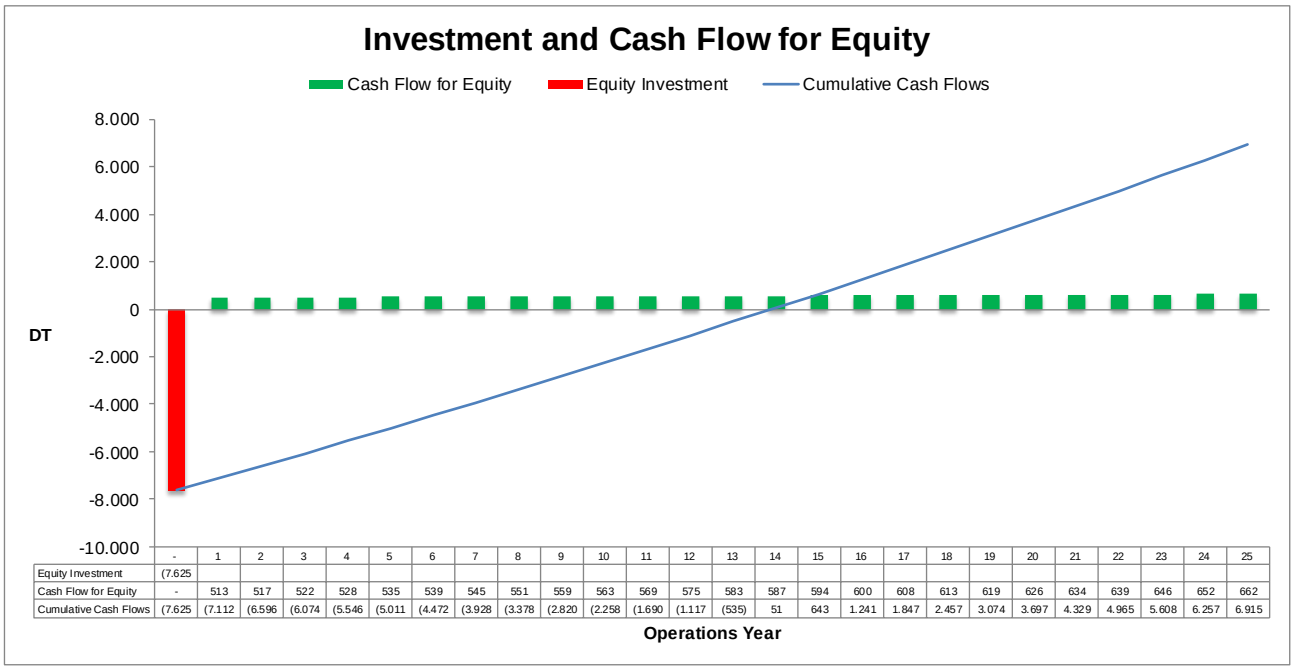
In this example the household invests in a PV system with a capacity of 5 kWp. The total system cost is 9,000 EUR reduced by an investment grant of 1,375 EUR.

The household consumes 35% of the produced PV electricity for its own needs, a rate which is rather typical for single-family houses. The excess electricity is fed into the grid at a PPA-price of 7.5 EUR cents, the electricity tariff is 20 EUR cents. Since the system is self-funded, no additional costs for debt services or bank fees occur. Electricity prices are predicted to grow moderately at an annual rate of 2%.

Profitability Analysis

Under the applied assumptions as listed in *Figure 2* the following cash flow scenario applies:

Figure 3: Project cash flows: Investment and cash flow for equity

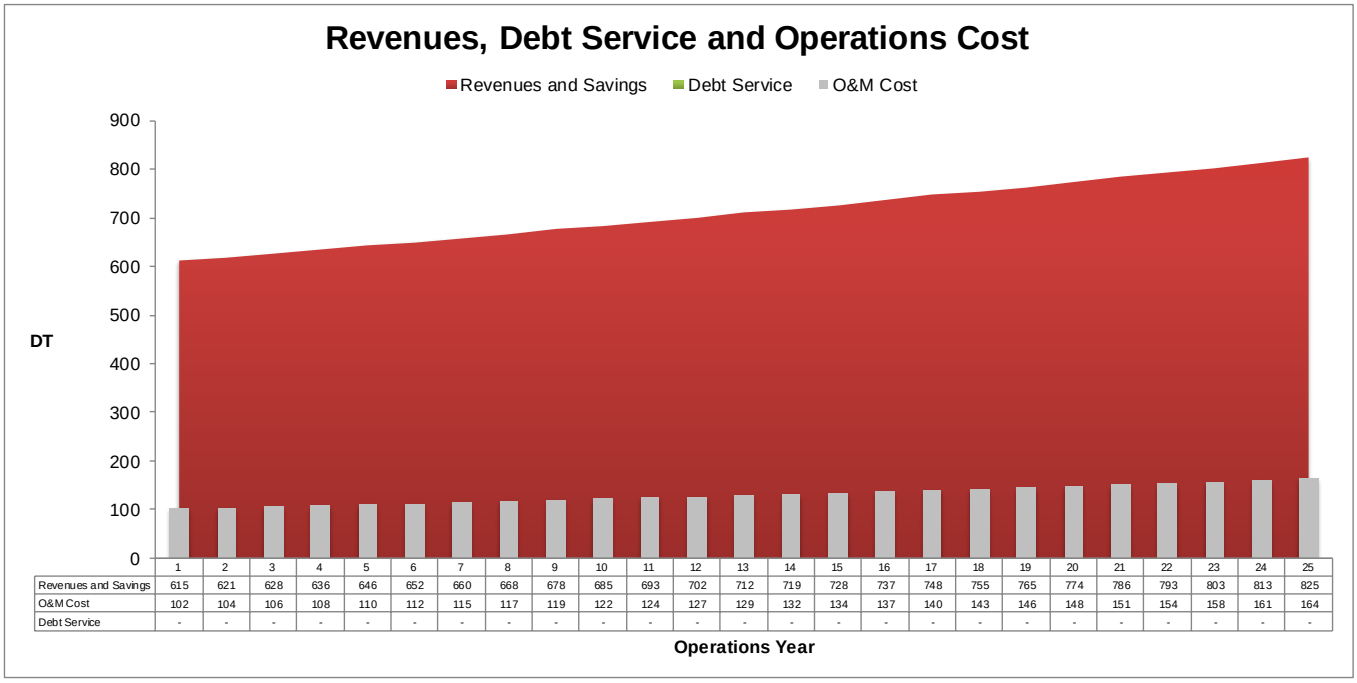


	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Equity Investment	(7.625																									
Cash Flow for Equity	-	513	517	522	528	535	539	545	551	559	563	569	575	583	587	594	600	608	613	619	626	634	639	646	652	662
Cumulative Cash Flows	(7.625	(7.112	(6.596	(6.074	(5.546	(5.011	(4.472	(3.928	(3.378	(2.820	(2.258	(1.690	(1.117	(535)	51	643	1.241	1.847	2.457	3.074	3.697	4.329	4.965	5.608	6.257	6.915

As the applied financing model is self-funding, expenses only occur in the year of installation with the cash flow for equity turning positive from the second year onwards.

Under the applied assumptions, the break-even point is reached at just under 14 years. Since the PV system is set to run for a period of 25 years, cumulative positive cash flows are achieved for the remaining nine years.

Figure 4: Project cash flows: Revenues, debt service and operation costs



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Revenues and Savings	615	621	628	636	646	652	660	668	678	685	693	702	712	719	728	737	748	755	765	774	786	793	803	813	825
O&M Cost	102	104	106	108	110	112	115	117	119	122	124	127	129	132	134	137	140	143	146	148	151	154	158	161	164
Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 4 shows the achieved revenues thanks to the PV system as well as the operation and maintenance costs (under the assumed price escalation of 2%). As depicted in the chart the system operator achieves revenues of 825 Euros at the end of the PV plant's life span.

Business Model 2: Self-consumption with a higher electricity tariff

More than 120 energy suppliers exist in Austria, each of them offering different energy prices. Therefore, in this business model a higher electricity tariff of 22 EUR cents is applied. The remaining assumptions were not altered.

Figure 5: Self-consumption

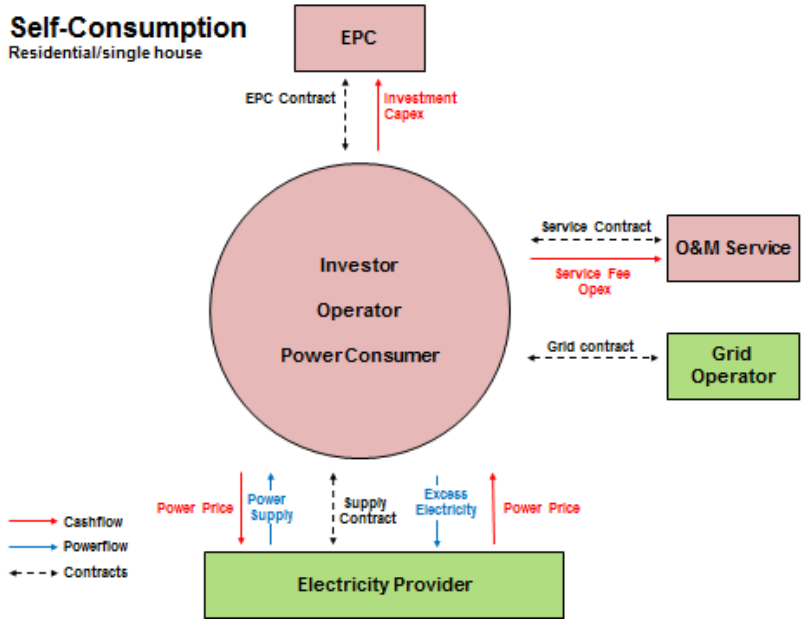


Figure 6: Project overview

PV Project		
PV System Size	kWp	5
Specific System Cost	EUR/kWp	1.800
Total System Cost	EUR	9.000
Investment Subsidy	EUR	1.375
Total System Cost incl. Subsidy	EUR	7.625
Fixed Operation Costs	EUR p.a.	100
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1200
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.020
Degradation	% p.a.	0,75%

Investment			
Project Duration		Years	25
Equity		EUR	7.625
Debt (Gearing)	-	EUR	-
Loan Tenor		Years	-
Interest Rate		%	0,1%
Discount Rate		%	0,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	35%	EUR/kWh	0,2200
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	65%	EUR/kWh	0,0750
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	7.964
Project IRR	%	6,15%
Equity IRR	%	6,15%
Payback Period	Years	13,05
LCOE* (w/o subsidy)	EUR/kWh	0,11
LCOE (w subsidy)	EUR/kWh	0,09
Min DSCR**	x	-
Min LLCR***	x	-

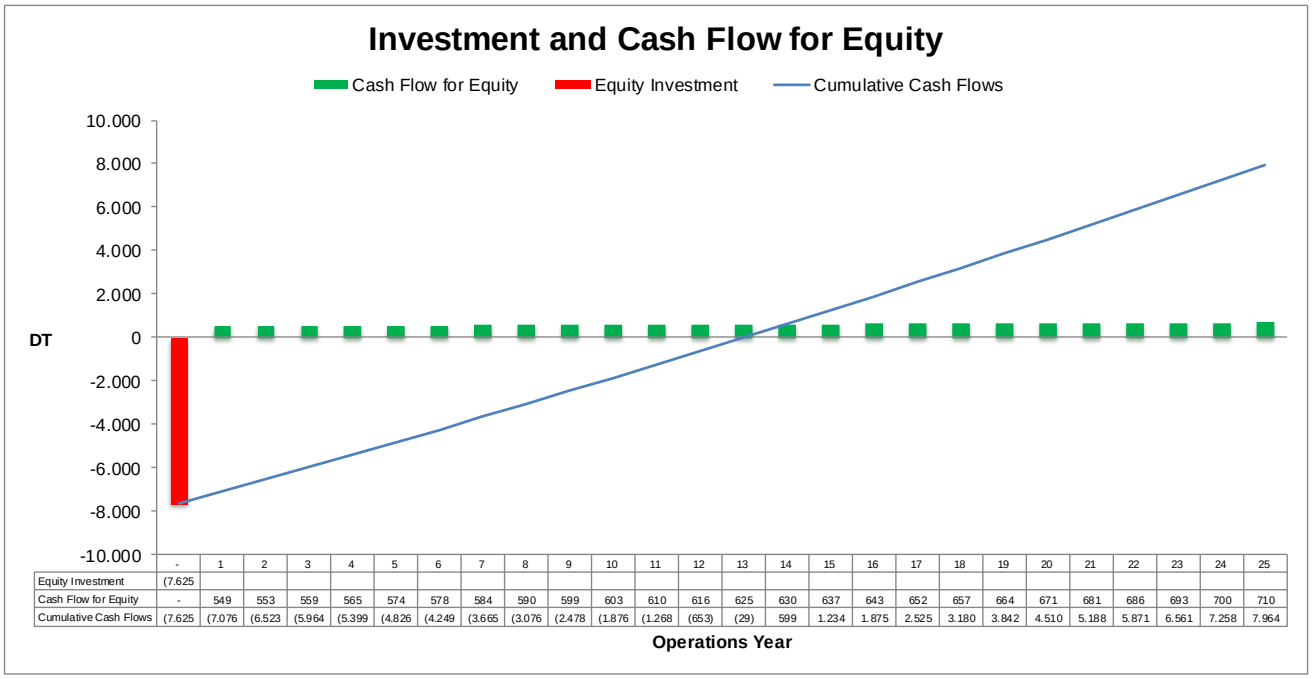
* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

The same assumptions as in business model 1 were applied. The system with a capacity of 5 kWp is completely self-funded. However, a higher electricity tariff of 22 EUR cents is assumed (compared to 20 EU cents in business model 1).

Profitability Analysis

Under the applied assumptions as listed in *Figure 6* the following cash flow scenario applies:

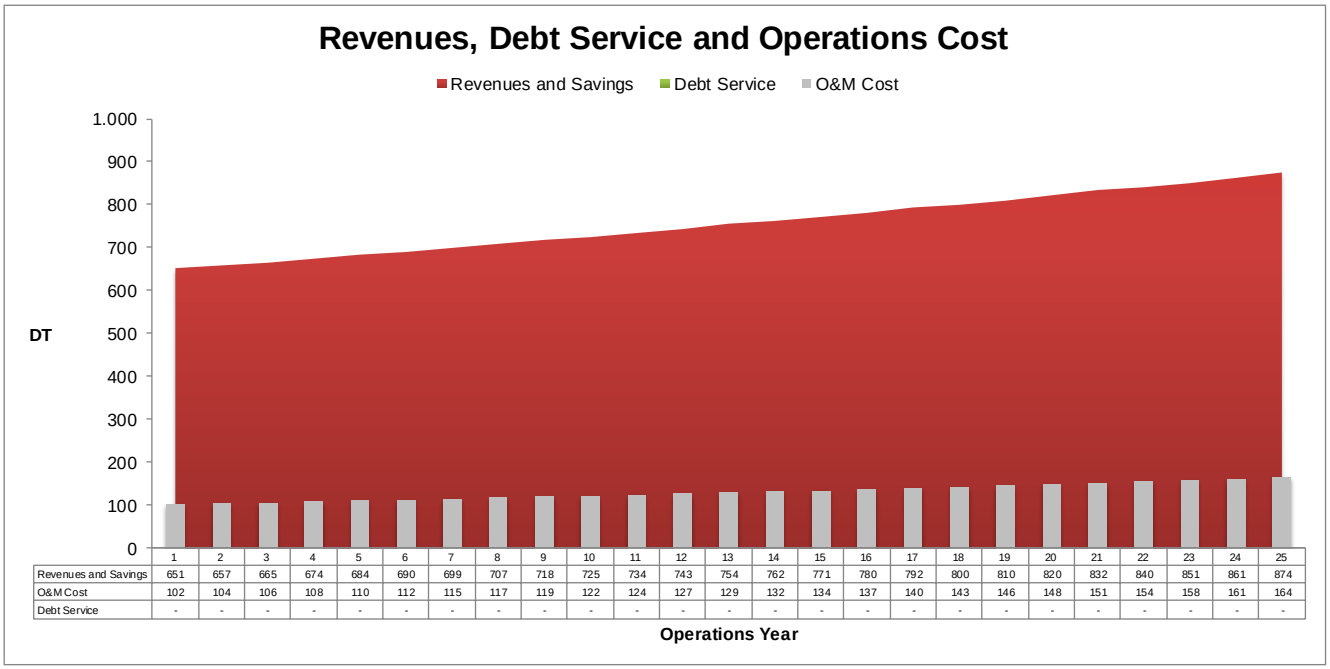
Figure 3: Project cash flows: Investment and cash flow for equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Equity Investment	(7.625																									
Cash Flow for Equity	-	549	553	559	565	574	578	584	590	599	603	610	616	625	630	637	643	652	657	664	671	681	686	693	700	710
Cumulative Cash Flows	(7.625	(7.076	(6.523	(5.964	(5.399	(4.826	(4.249	(3.665	(3.076	(2.478	(1.876	(1.268	(653)	(29)	599	1.234	1.875	2.525	3.180	3.842	4.510	5.188	5.871	6.561	7.258	7.964

Simply changing the electricity tariff makes small changes: the break-even point is in this case reached after 13 years (compared to just less than 14 years in business model 1).

Figure 4: Project cash flows: Revenue, 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	21	22	23	24	25
Revenues and Savings	651	657	665	674	684	690	699	707	718	725	734	743	754	762	771	780	792	800	810	820	832	840	851	861	874
O&M Cost	102	104	106	108	110	112	115	117	119	122	124	127	129	132	134	137	140	143	146	148	151	154	158	161	164
Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

While the period up to the break-even point is reduced under the assumption of a higher electricity tariff, revenues at the end of the PV plant's life span rise very slightly by 20 EUR to 874 EUR.

2. Residential Multi-Family Houses

Segment environment

The installation of PV systems is in Austria most common in the residential sector. However, in cases of multi-family residential buildings certain legal restrictions render the installation of PV systems far less attractive than in the case of single family houses.

Unfortunately, self-consumption of solar energy for multi-family buildings is limited to general services that are used by all tenants such as corridor lighting and elevators. This constraint is rooted in a specific national law that regulates the electricity sector (“Elektrizitätswirtschafts- und organisationsgesetz 2010). This law prohibits the direct sale of PV electricity to individual tenants for two reasons: firstly, supplying more than one tenant with PV electricity requires a license for the grid operation and secondly, every individual has a right to choose their own electricity supplier and cannot be compelled to use the PV electricity.

As this legal requirement seriously restricts the future development of photovoltaics in Austria, several interested parties and pressure groups have entered into dialogue with the responsible ministry to achieve a respective amendment.

Segment Drivers

Based on the described regulatory environment, three different modes of operation of PV systems located on multi-family residential buildings exist: full feed-in without any self-consumption, exclusive use of PV electricity via the existing electricity grid for general services and PV electricity for the supply of individual flats via installation of an individual grid.

Important segment drivers are of course available subsides. PV plants with a capacity of up to 5 kWp are eligible to an investment grant of 275 EUR/kWp, plants with a capacity of 5-200 kWp can receive 200 EUR/kWp as well as a subsidized FiT of 11.5 EUR cents/kWh (2015).

Full feed-in without self-consumption is usually chosen by energy supply companies for the production of eco-power (no other type of investors are currently known to follow this practice).

Other segment drivers are obtaining a green image and reducing general operating costs for the tenants.

Business Models

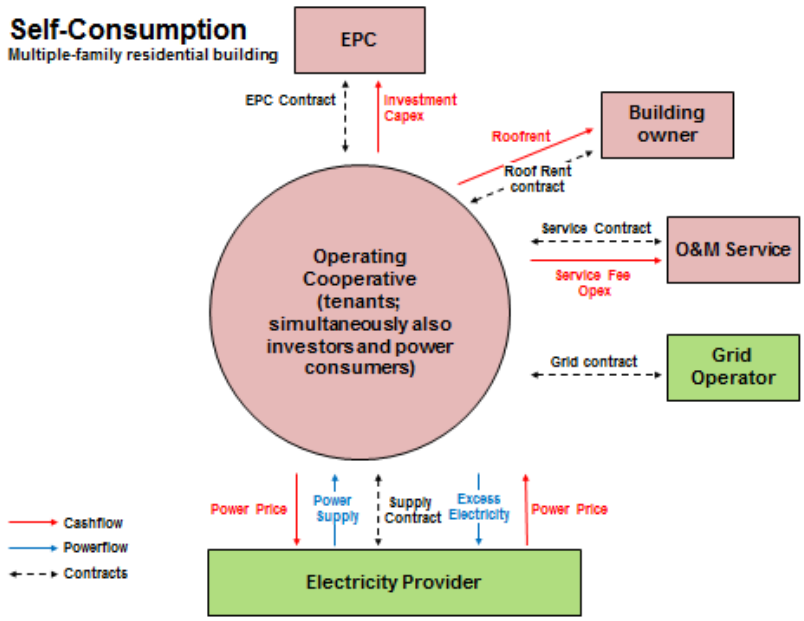
Below you find the business models of Austria in the multi-family residential segment.

Business Model 1: Self-consumption and Power Purchase Agreement (PPA)

Self-consumption in multiple-family residential buildings is legally only possible for general services that are consumed by all tenants (e.g. lighting in corridors and shared spaces, elevators). This example shows the case of a rather large multi-family residential building with a PV plant with a capacity of 10 kWp. In line with the respective national law, only general services in the building are powered by the PV electricity.

The example clearly shows how the electricity market regulation restricts the efficient use of PV electricity by multiple parties and that such an investment is not economically feasible.

Figure 2: Self-consumption



In the assumed case, the tenants form an operating cooperative, meaning that each tenant contributes to financing the system. The cooperative jointly invests in the PV plant, operates it and consumes the generated electricity.

Figure 2: Project Overview

PV Project		
PV System Size	kWp	10
Specific System Cost	EUR/kWp	1.700
Total System Cost	EUR	17.000
Investment Subsidy	EUR	2.750
Total System Cost incl. Subsidy	EUR	14.250
Fixed Operation Costs	EUR p.a.	214
Variable Operation Costs	EUR/kWh	0

PV Generation		
Specific Yield	kWh/qm/a	1200
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.020
Degradation	% p.a.	0,70%

Investment			
Project Duration		Years	25
Equity		EUR	14.250
Debt (Gearing)	-	EUR	-
Loan Tenor		Years	-
Interest Rate		%	3,0%
Discount Rate		%	1,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	20%	EUR/kWh	0,2000
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	80%	EUR/kWh	0,0750
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	2.204
Project IRR	%	2,19%
Equity IRR	%	2,19%
Payback Period	Years	21,05
LCOE* (w/o subsidy)	EUR/kWh	0,13
LCOE (w subsidy)	EUR/kWh	0,12
Min DSCR**	x	-
Min LLCR***	x	-

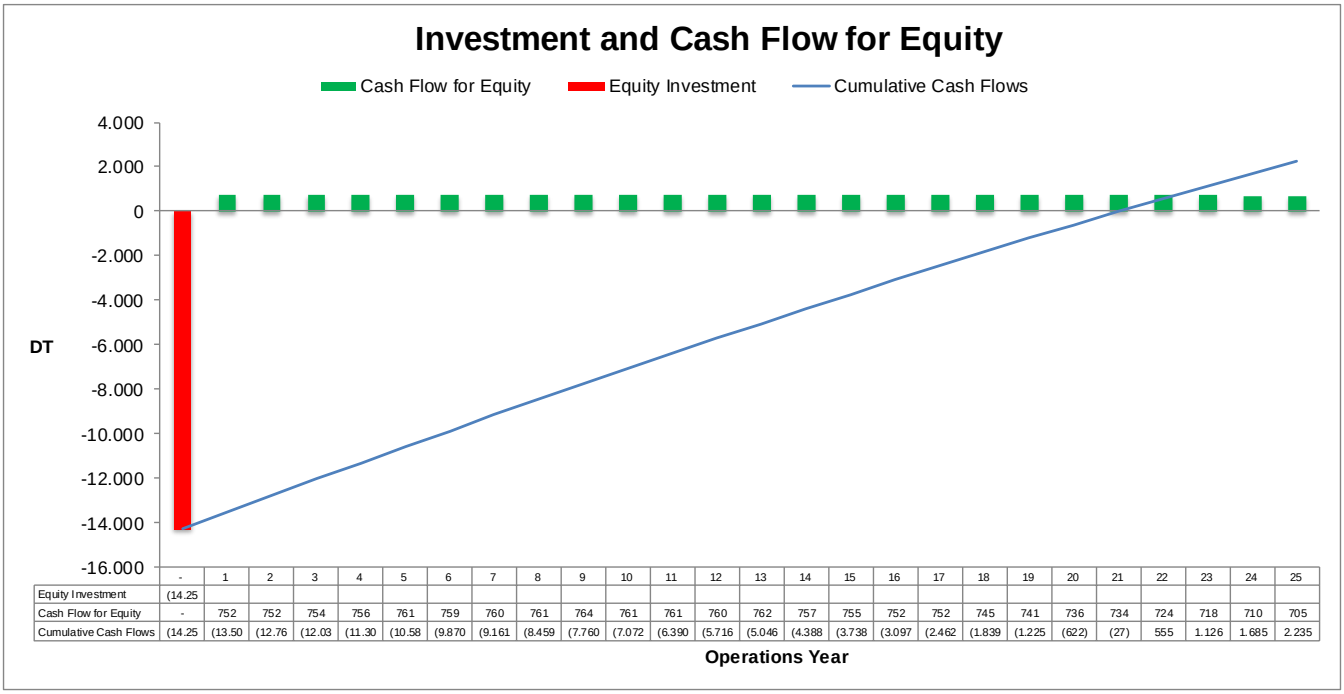
* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

The plant is completely self-funded and costs in total 14,250 EUR (after deduction of a 2,750 EUR subsidy). It is jointly financed by all tenants of the building. The rate of self-consumption is set at 20%, the remaining 80% is sold via a PPA at 7.5 EUR cents/kWh. A small roof rent that is paid to the building owner is included.

Profitability Analysis

Under the applied assumptions as listed in *Figure 2* the following cash flow scenario applies:

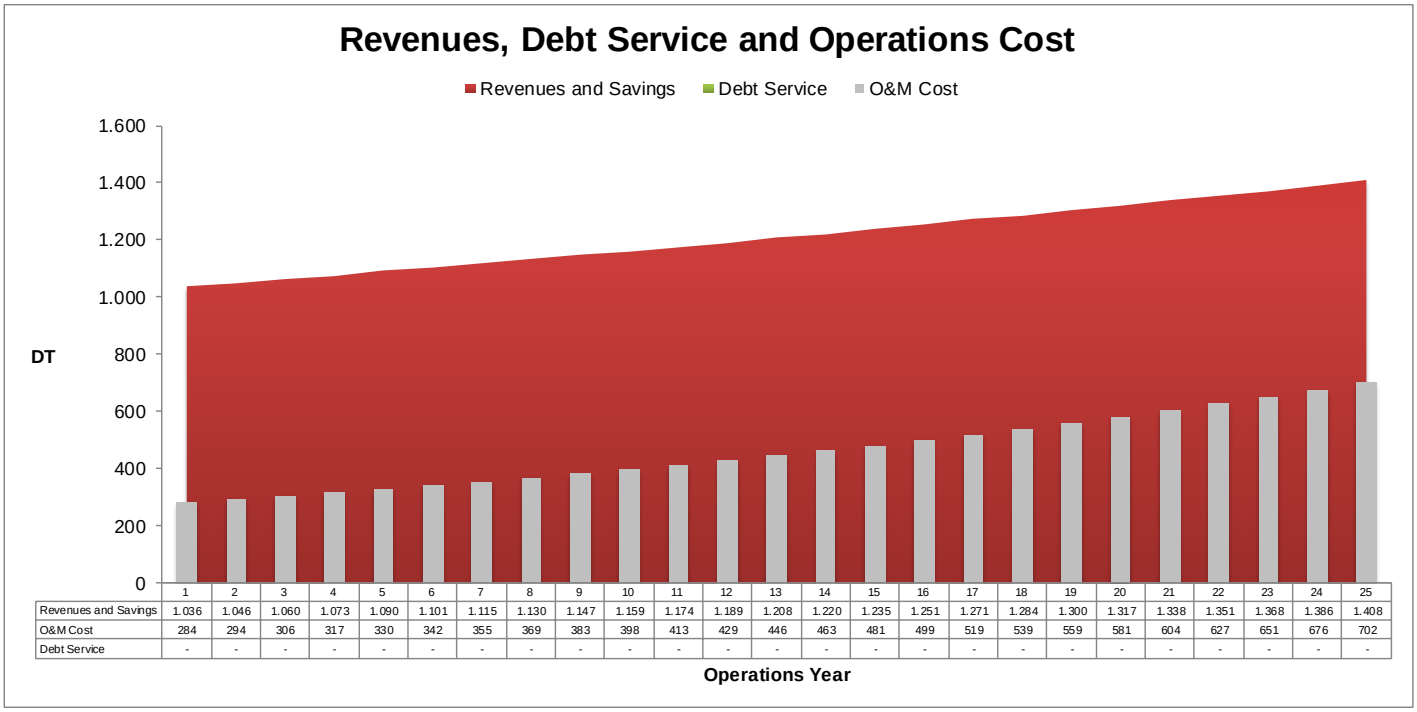
Figure 3: Project cash flows: Investment and cash flow for equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Equity Investment	(14.25																									
Cash Flow for Equity	-	752	752	754	756	761	759	760	761	764	761	761	760	762	757	755	752	752	745	741	736	734	724	718	710	705
Cumulative Cash Flows	(14.25	(13.50	(12.76	(12.03	(11.30	(10.58	(9.870	(9.161	(8.459	(7.760	(7.072	(6.390	(5.716	(5.046	(4.388	(3.738	(3.097	(2.462	(1.839	(1.225	(622)	(27)	555	1.126	1.685	2.235

The resulting cash flows show unfavourable outcomes, explaining why such a business model is not applied in reality. Amortisation of the PV system is only reached after more than 21 years. Considering the life span of 25 years, this result is economically not attractive.

Figure 4: Project cash flows: Revenues, debt service and operation cost



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Revenues and Savings	1.036	1.046	1.060	1.073	1.090	1.101	1.115	1.130	1.147	1.159	1.174	1.189	1.208	1.220	1.235	1.251	1.271	1.284	1.300	1.317	1.338	1.351	1.368	1.386	1.408
O&M Cost	284	294	306	317	330	342	355	369	383	398	413	429	446	463	481	499	519	539	559	581	604	627	651	676	702
Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 4 shows the achieved revenues thanks to the PV system as well as the debt service and the operation and maintenance costs (under the assumed price escalation of 2%). As depicted in the chart the system operator achieves revenues of only 1,408 EUR at the end of the PV plant's life span.

Another possible scenario could be that the cooperative takes out a loan to finance the system instead of completely self-funding it. Assuming a debt gearing of 50% (7,125 EUR), a loan tenor of 8 years and an interest rate of 3%, the outcome becomes even less attractive. In this scenario the break-even point is reached after more than 22 years with the debt service surpassing revenues and savings through the PV system.

Business Model 2: 80% self-consumption made possible by the necessary legal amendment, and Power Purchase Agreement (PPA)

This example was chosen to show the positive effects if the law requirement for the electricity market was amended to allow PV system operators to sell their produced electricity to several different consumers. In the case of a multi-family residential building this would mean that the PV system operator could offer the PV electricity to all tenants without having to acquire an expensive grid operator license and without the tenants each having to own individual PV-systems.

This case assumes a newly built apartment building with a PV system installed on the roof. The owner of the building is also the system operator who sells PV electricity to his tenants via PPA.

Figure 5: Power Purchase Agreement

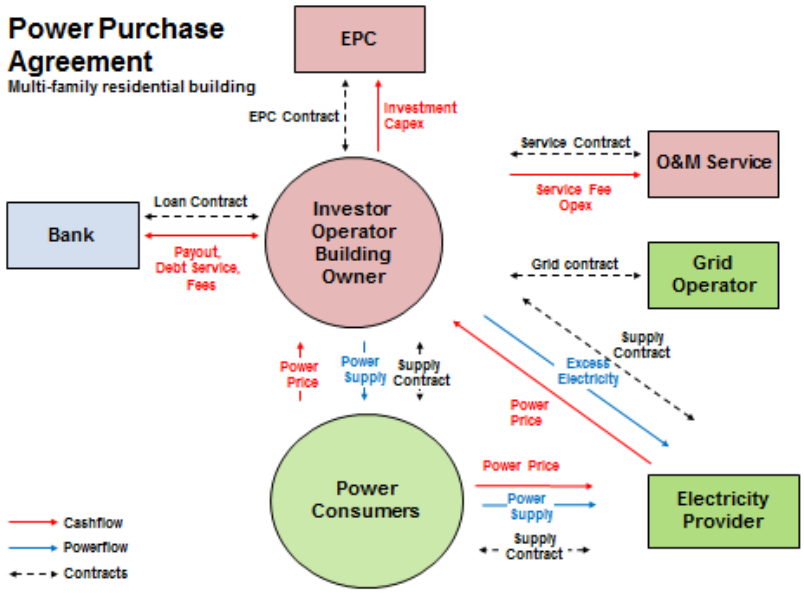


Figure 6: Project Overview

PV Project		
PV System Size	kWp	10
Specific System Cost	EUR/kWp	1.700
Total System Cost	EUR	17.000
Investment Subsidy	EUR	2.000
Total System Cost incl. Subsidy	EUR	15.000
Fixed Operation Costs	EUR p.a.	225
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1200
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.020
Degradation	% p.a.	0,70%

Investment			
Project Duration		Years	20
Equity		EUR	6.149
Debt (Gearing)	60%	EUR	9.000
Loan Tenor		Years	10
Interest Rate		%	3,1%
Discount Rate		%	1,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	20%	EUR/kWh	0,1150
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	80%	EUR/kWh	0,1500
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	6.704
Project IRR	%	5,41%
Equity IRR	%	6,86%
Payback Period	Years	13,80
LCOE* (w/o subsidy)	EUR/kWh	0,15
LCOE (w subsidy)	EUR/kWh	0,13
Min DSCR**	x	1,07 x
Min LLCR***	x	1,09 x

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

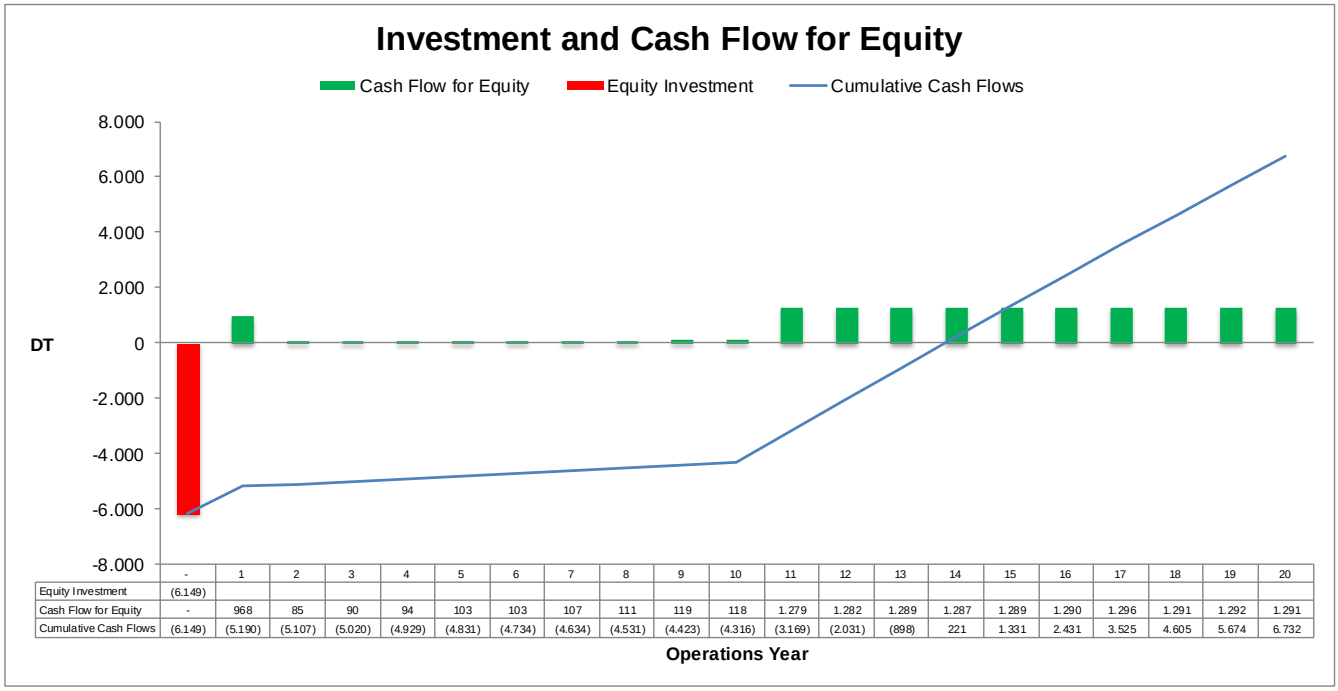
In this example the building owner invests in a PV plant with a capacity of 10 kWp. The total system cost is 17,000 EUR and he receives an investment grant of 2,000 EUR. He takes out a loan of 9,000 EUR with a tenor of 10 years (including a one-year grace period) to finance his investment.

The assumed business model is a mix of self-consumption (for general services in the building) and 80% of the produced electricity is passed on to the tenants via PPA at a price of 15 EUR cents.

Profitability Analysis

Under the applied assumptions as listed in *Figure 6* the following cash flow scenario applies:

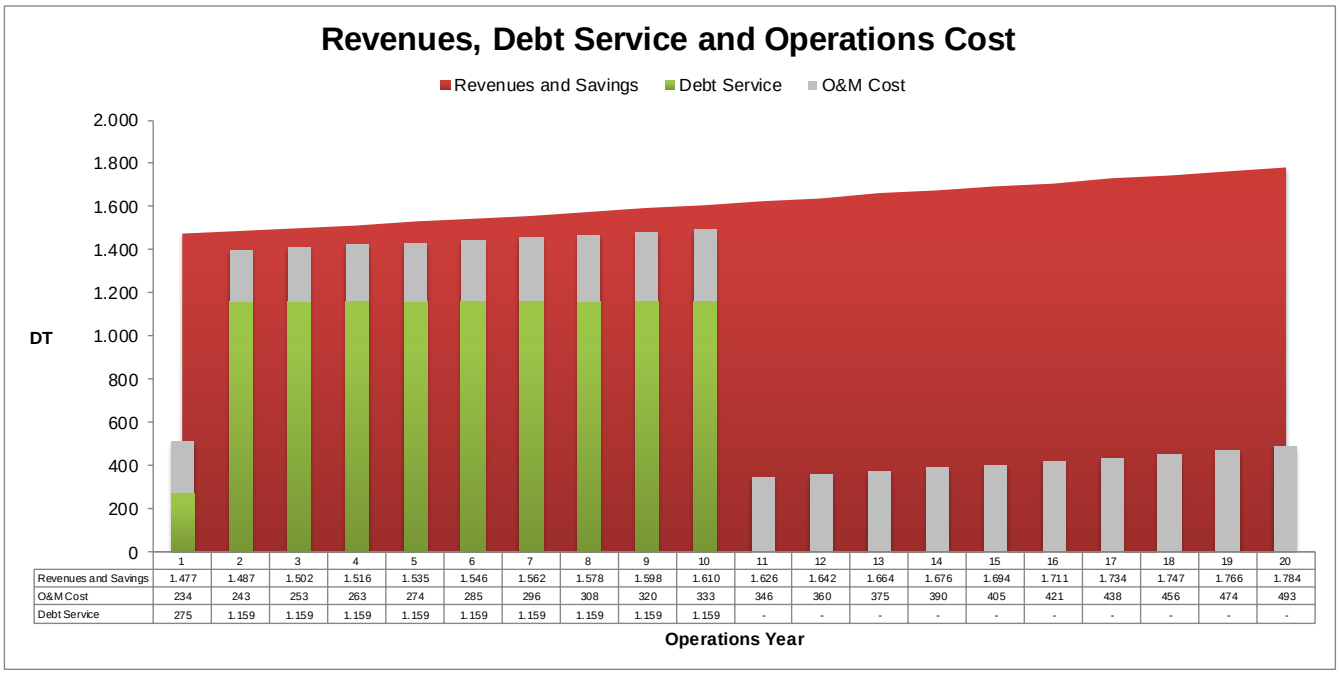
Figure 7: Project cash flows: Investment and cash flow for equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Equity Investment	(6.149)																				
Cash Flow for Equity	-	968	85	90	94	103	103	107	111	119	118	1.279	1.282	1.289	1.287	1.289	1.290	1.296	1.291	1.292	1.291
Cumulative Cash Flows	(6.149)	(5.190)	(5.107)	(5.020)	(4.929)	(4.831)	(4.734)	(4.634)	(4.531)	(4.423)	(4.316)	(3.169)	(2.031)	(898)	221	1.331	2.431	3.525	4.605	5.674	6.732

As is clearly visible in the above illustration, the possibility of selling 80% of the produced PV electricity to the tenants considerably reduces the payback period from more than 21 years in business model 1 to 13.8 years in this example.

Figure 8: Project cash flows: 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	1.477	1.487	1.502	1.516	1.535	1.546	1.562	1.578	1.598	1.610	1.626	1.642	1.664	1.676	1.694	1.711	1.734	1.747	1.766	1.784
O&M Cost	234	243	253	263	274	285	296	308	320	333	346	360	375	390	405	421	438	456	474	493
Debt Service	275	1.159	1.159	1.159	1.159	1.159	1.159	1.159	1.159	1.159	-	-	-	-	-	-	-	-	-	-

Another consequence of this fictitious legal amendment are the improved revenues and savings through the PV system. At the end of the PV system's life span revenues amount to 1,784 EUR.

This simulation clearly shows the advantages of the described legal change resulting in a shorter amortization period and higher savings.

3. Business model report: Office building

Segment environment

The segment environment is identical to that of multi-family residential buildings.

The operation of PV systems on office buildings with more than one tenant or owner wishing to use the PV electricity is limited by a national law which regulates the electricity sector ("Elektrizitätswirtschafts- und organisationsgesetz 2010). According to this law, it is only possible to sell PV electricity to various different users within the building if the system operator holds a special grid operating license. Hence the produced electricity can only be used for commonly used services (e.g. lighting in corridors, elevators).

Due to an amendment of the building regulations from 2013 Viennese building owners face certain solar requirements. Therefore, new office buildings must install a PV system with a capacity of 1,000 kWh per 100m^2 gross floor area. However, it must be noted that this regulation is not consistent with the regulation for PV usage, as it is not possible for various tenants of the office building to consume the produced electricity.

Segment Drivers

The main segment drivers are reduced electricity costs and marketing reasons and, in Vienna of course, the amended building regulation mentioned above.

Based on the described regulatory environment, three different modes of operation of PV systems exist: full feed-in without any self-consumption; exclusive use of PV electricity via the existing electricity grid for general services (e.g. lighting in corridors, elevator) with excess electricity being fed into the grid; PV electricity for the supply of individual tenants requiring the installation of an individual grid

Important segment drivers are of course also available subsides. PV plants with a capacity of up to 5 kWp are eligible to an investment grant of 275 EUR/kWp, plants with a capacity of 5-200 kWp can receive 200 EUR/kWp as well as a subsidized FiT of 11.5 EUR cents/kWh.

Business Models

Below you find the business models of Austria in the office building segment.

Business Model 1: Self-consumption and feed-in

This example shows the case of a large office building that is owned and used by just one company. Therefore, it is simple to maximize the share of self-consumption.

Figure 3: Self-consumption

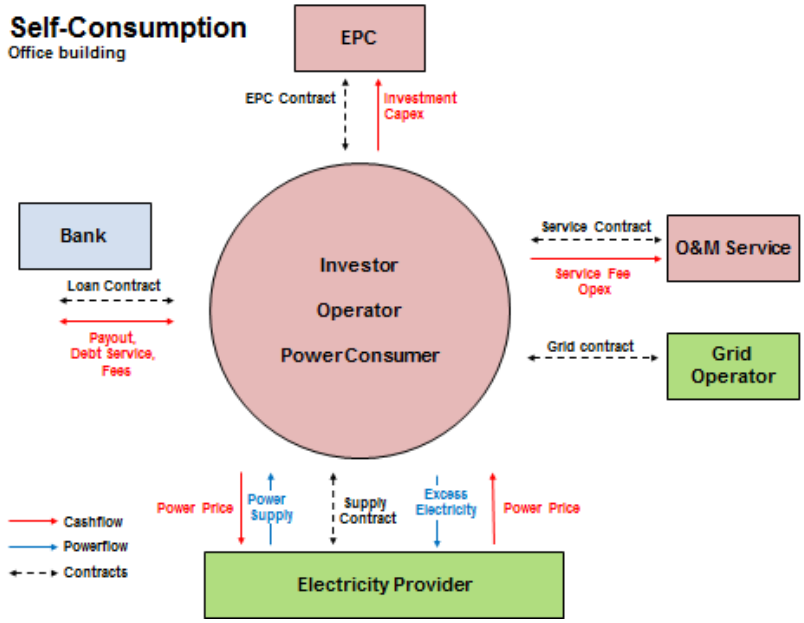


Figure 2: Project Overview

PV Project			
PV System Size		kWp	15
Specific System Cost		EUR/kWp	1.300
Total System Cost		EUR	19.500
Investment Subsidy		EUR	3.000
Total System Cost incl. Subsidy		EUR	16.500
Fixed Operation Costs		EUR p.a.	398
Variable Operation Costs		EUR/kWh	-

PV Generation			
Specific Yield		kWh/qm/a	1200
Performance Factor		%	85%
Specific System Performance		kWh/kWp/a	1.020
Degradation		% p.a.	0,70%

Investment			
Project Duration		Years	25
Equity		EUR	3.500
Debt (Gearing)	80%	EUR	13.200
Loan Tenor		Years	10
Interest Rate		%	2,4%
Discount Rate		%	4,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	35%	EUR/kWh	0,1150
Self-consumption	65%	EUR/kWh	0,1500
Fees		EUR/kWh	-
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	10.154
Project IRR	%	8,67%
Equity IRR	%	15,53%
Payback Period	Years	11,74
LCOE* (w/o subsidy)	EUR/kWh	0,12
LCOE (w subsidy)	EUR/kWh	0,11
Min DSCR**	x	1,01 x
Min LLCR***	x	1,01 x

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

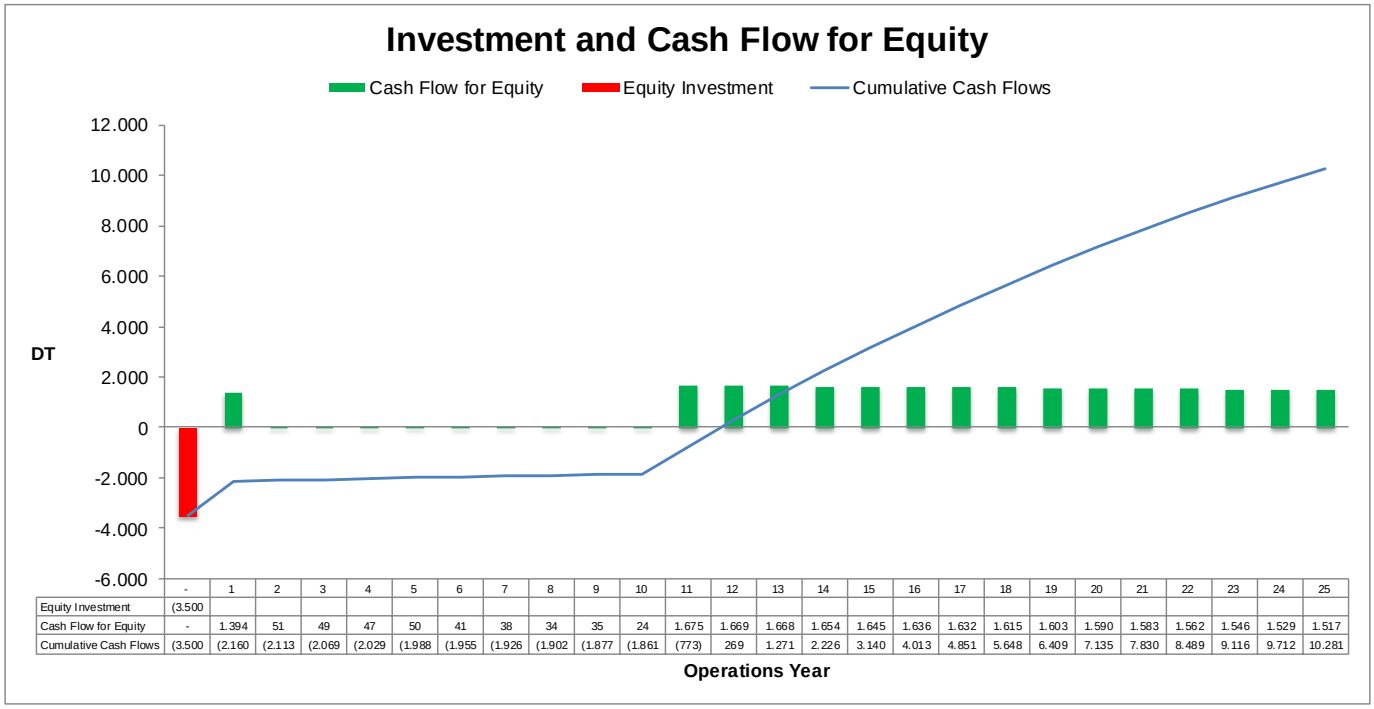
The office building owner invests in PV system with a capacity of 15 kWp and a total system cost of 19,500 EUR reduced by an investment grant of 3,000 EUR. To finance the investment, he takes out a loan of 13,200 EUR with a loan tenor of 10 years (including a one-year grace period).

As it is a large office building, self-consumption is considered to be high at 65%. Excess electricity is fed into the grid at a subsidized FiT of 11.5 EUR cents.

Profitability Analysis

Under the applied assumptions as listed in *Figure 2* the following cash flow scenario applies:

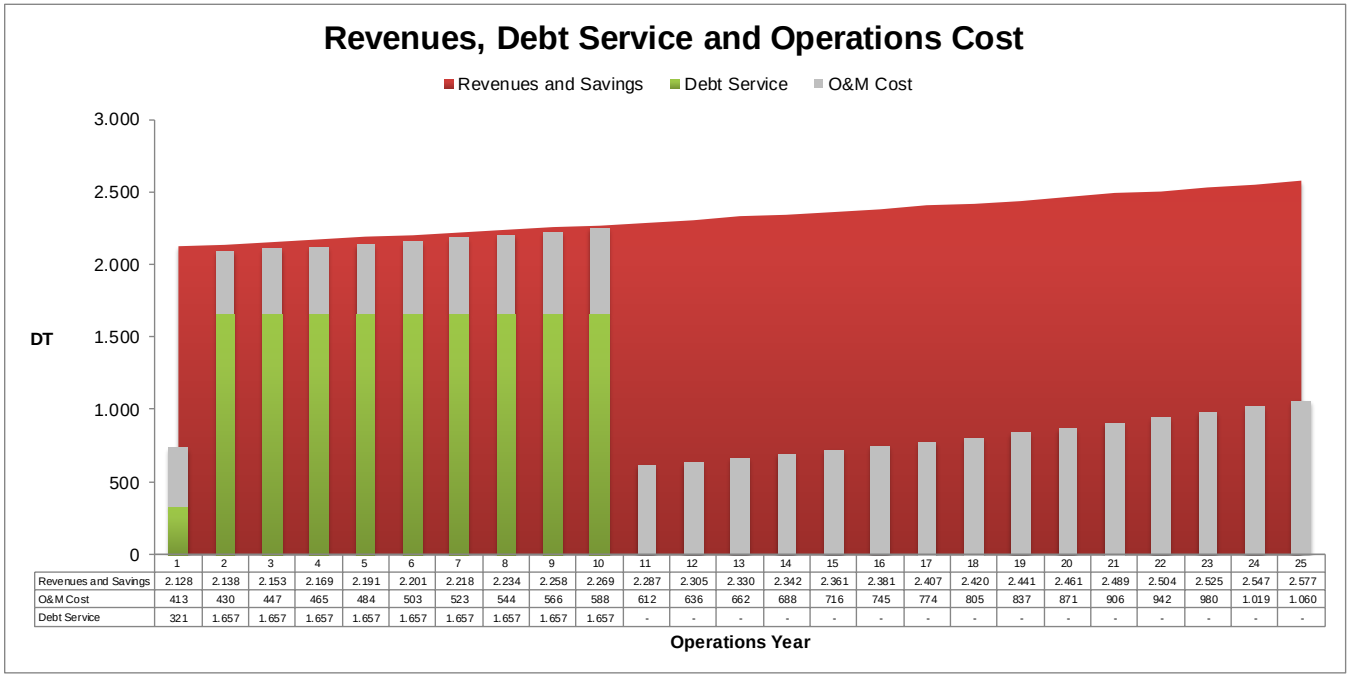
Figure 3: Project cash flows: Investment and cash flow for equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Equity Investment	(3.500																									
Cash Flow for Equity	-	1.394	51	49	47	50	41	38	34	35	24	1.675	1.669	1.668	1.654	1.645	1.636	1.632	1.615	1.603	1.590	1.583	1.562	1.546	1.529	1.517
Cumulative Cash Flows	(3.500	(2.160	(2.113	(2.069	(2.029	(1.988	(1.955	(1.926	(1.902	(1.877	(1.861	(773)	269	1.271	2.226	3.140	4.013	4.851	5.648	6.409	7.135	7.830	8.489	9.116	9.712	10.281

Debt gearing is assumed at 80% leaving an equity share of 3,500 EUR – depicted as the red bar in the year of investment. The loan tenor is 10 years including a one-year grace period, which is why the cash flow for equity rises considerably in year 11. The PV plant reaches the break-even point after a period less than 12 years.

Figure 4: Project cash flows: Revenues, debt service and operation cost



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Revenues and Savings	2.128	2.138	2.153	2.169	2.191	2.201	2.218	2.234	2.258	2.269	2.287	2.305	2.330	2.342	2.361	2.381	2.407	2.420	2.441	2.461	2.489	2.504	2.525	2.547	2.577
O&M Cost	413	430	447	465	484	503	523	544	566	588	612	636	662	688	716	745	774	805	837	871	906	942	980	1.019	1.060
Debt Service	321	1.657	1.657	1.657	1.657	1.657	1.657	1.657	1.657	1.657	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 4 shows the achieved revenues thanks to the PV system as well as the debt service and the operation and maintenance costs (under the assumed price escalation of 2%). As depicted in the chart the system operator achieves revenues of 2,377 EUR at the end of the PV plant's life span.

Business Model 2: 80% self-consumption made possible by the necessary legal amendment, and PPA

This example was chosen to show the positive effects if the law requirement for the electricity market was amended to allow PV system operators to sell their produced electricity to several different consumers. In the case of an office building this would mean that the PV system operator could offer the PV electricity to all tenants without having to acquire an expensive grid operator license and without the tenants each having to own individual PV-systems.

This case assumes a newly built office building with a PV system installed on the roof. The owner of the building is also the system operator who sells PV electricity to his tenants via PPA.

Figure 5: Power Purchase Agreement

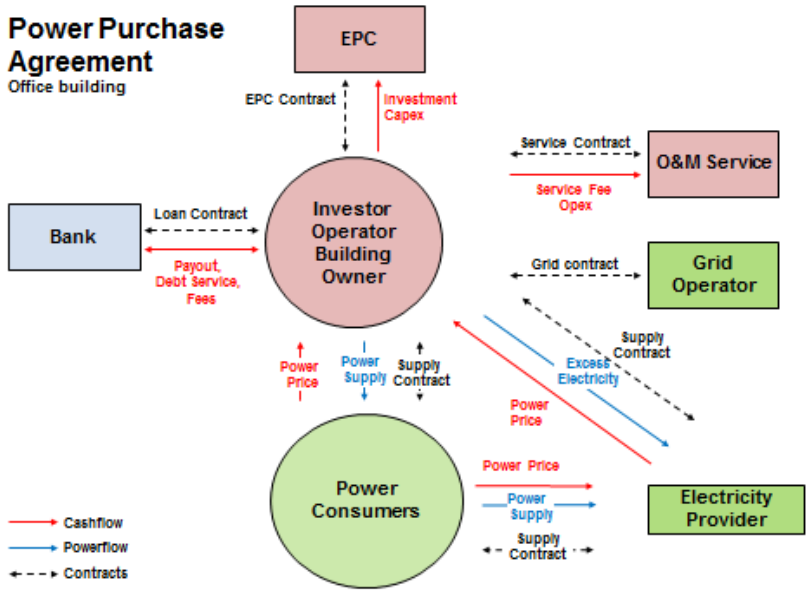


Figure 6: Project Overview

PV Project			
PV System Size		kWp	15
Specific System Cost		EUR/kWp	1.300
Total System Cost		EUR	19.500
Investment Subsidy		EUR	4.125
Total System Cost incl. Subsidy		EUR	15.375
Fixed Operation Costs		EUR p.a.	381
Variable Operation Costs		EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1200
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.020
Degradation	% p.a.	0,70%

Investment			
Project Duration		Years	25
Equity		EUR	5.532
Debt (Gearing)	65%	EUR	9.994
Loan Tenor		Years	8
Interest Rate		%	2,4%
Discount Rate		%	4,0%

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	0,1300
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

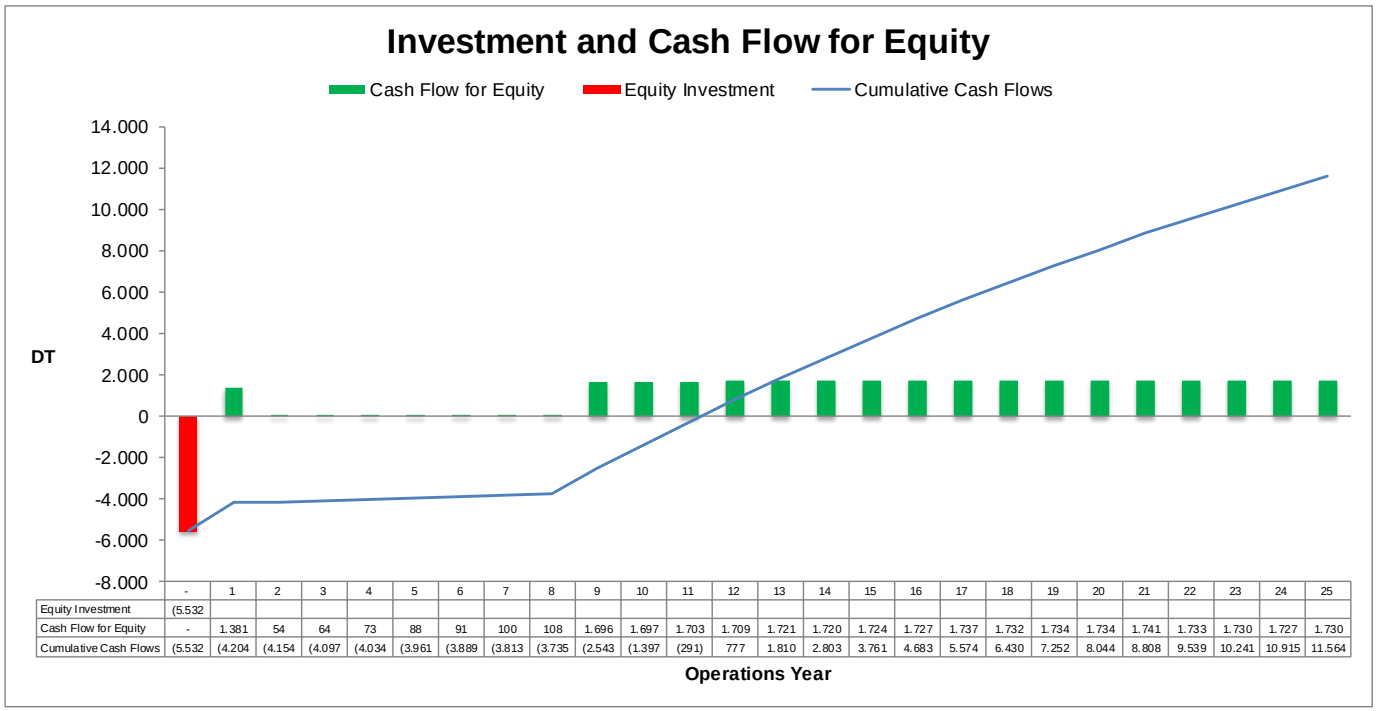
Results		
Net-Present Value	EUR	11.409
Project IRR	%	9,59%
Equity IRR	%	13,39%
Payback Period	Years	11,27
LCOE* (w/o subsidy)	EUR/kWh	0,12
LCOE (w subsidy)	EUR/kWh	0,11
Min DSCR**	x	1,03 x
Min LLCR***	x	1,05 x

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

The building owner invests in a PV system with a capacity of 15 kWp and a total system cost of 19,500 EUR. To finance the investment, he takes out a loan of 9,994 EUR with a tenor of 8 years (including a one-year grace period).

In the case of buildings with several tenants it is possible that each tenant applies for a separate investment grant. Therefore, it is possible for this investment to be subsidized with 275 EUR/kWp. The system operator sells 100% of the produced PV electricity via PPA at a price of 13 EUR cents to his tenants.

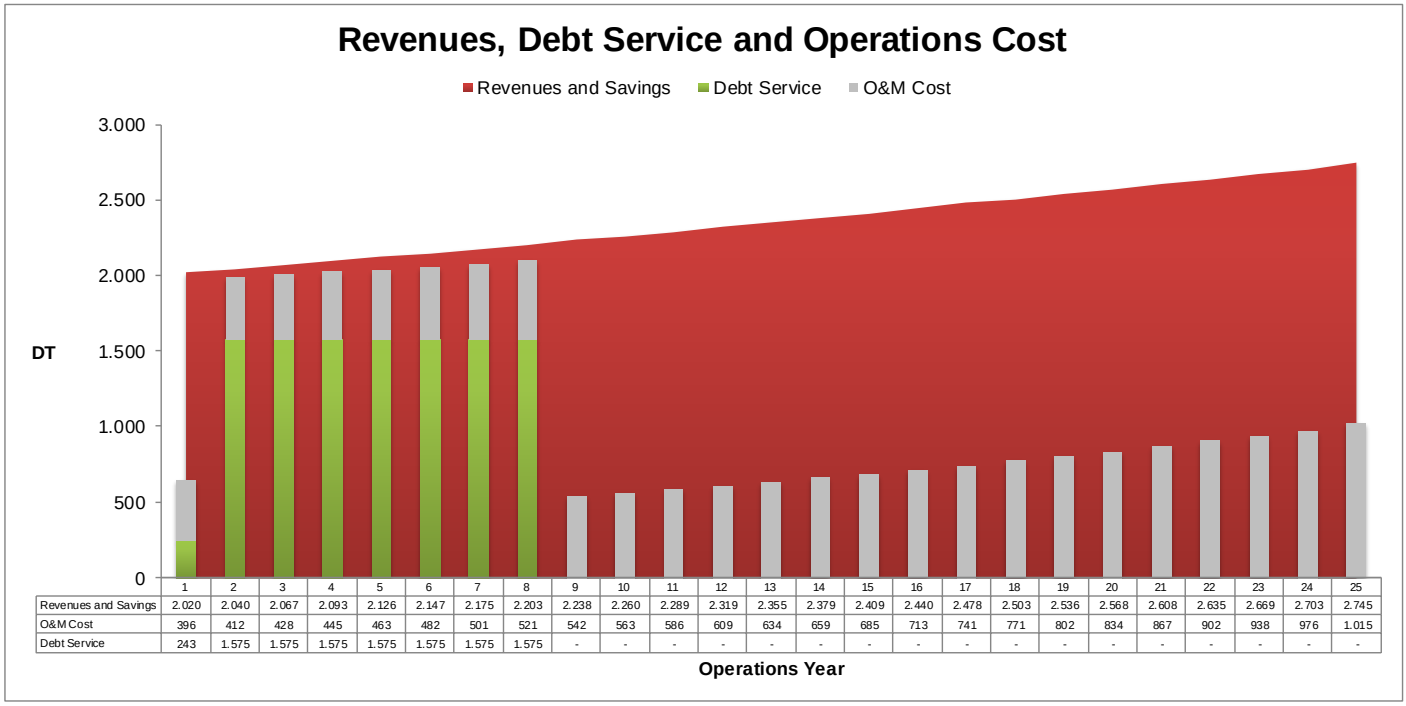
Figure 7: Project cash flows: Investment and cash flow for equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Equity Investment	(5.532																									
Cash Flow for Equity	-	1.381	54	64	73	88	91	100	108	1.696	1.697	1.703	1.709	1.721	1.720	1.724	1.727	1.737	1.732	1.734	1.734	1.741	1.733	1.730	1.727	1.730
Cumulative Cash Flows	(5.532	(4.204	(4.154	(4.097	(4.034	(3.961	(3.889	(3.813	(3.735	(2.543	(1.397	(291)	777	1.810	2.803	3.761	4.683	5.574	6.430	7.252	8.044	8.808	9.539	10.241	10.915	11.564

As is clearly visible in the above illustration, the possibility of selling 100% of the produced PV electricity to the tenants considerably reduces the payback period from almost 12 years in business model 1 to just above 11 years in this example.

Figure 8: Project cash flows: 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	21	22	23	24	25
Revenues and Savings	2.020	2.040	2.067	2.093	2.126	2.147	2.175	2.203	2.238	2.260	2.289	2.319	2.355	2.379	2.409	2.440	2.478	2.503	2.536	2.568	2.608	2.635	2.669	2.703	2.745
O&M Cost	396	412	428	445	463	482	501	521	542	563	586	609	634	659	685	713	741	771	802	834	867	902	938	976	1.015
Debt Service	243	1.575	1.575	1.575	1.575	1.575	1.575	1.575	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Another consequence of this fictitious legal amendment are the improved revenues through the PV system. At the end of the PV system's life span revenues amount to 2,745 EUR.

This simulation clearly shows the advantages of the described legal change resulting in a shorter amortization period and higher revenues.

4. Business model report: Shopping Center

Segment environment

Possibilities of running PV systems in shopping centers are restricted by a national law which regulates the electricity sector ("Elektrizitätswirtschafts- und organisationsgesetz 2010). This law limits self-consumption of solar energy to general services that are used by all tenants such as corridor lighting and elevators. Additionally, it prohibits direct sale of PV electricity to individual tenants for two reasons: firstly, supplying more than one tenant with PV electricity requires a license for the grid operation and secondly, every individual has a right to choose their own electricity supplier and cannot be compelled to use the PV electricity. Since acquiring the necessary license is a very cost- and time-intensive process, this scenario is very unlikely.

As this legal requirement seriously restricts the future development of photovoltaics in Austria, several interested parties and pressure groups have entered into dialogue with the responsible ministry to achieve a respective amendment (see Business Model 2).

Segment Drivers

Owners of shopping centers will most likely invest in PV system for marketing and image reasons as well as to reduce running costs for their tenants. Additionally, shopping centers usually have a large rooftop area, which makes it well suited for the installation of a PV system.

However, as it is not legally possible for the system operator to sell the produced PV electricity to the individual tenants without a grid operating license, the choice of business models is heavily restricted to: feed-in to the grid profiting from the subsidized FiT; self-consumption only for general services (e.g. lighting in common spaces, elevators, escalators; legally possible without a grid operating license); and installation of an additional grid (i.e. if multiple tenants want to use the PV electricity in their individual shops, they must own an individual PV system including meter and inverter).

Available subsidies are of course also important segment drivers: PV systems with a capacity of 5 – 200 kWp are eligible to receive a subsidized FiT. The FiT is adjusted annually (2015: 0,115 EUR) and is valid for 13 years. Additionally, these plants of this size can also receive an investment grant of 200 Euros/kWp.

Business Models

Below you find the business models of Austria in the shopping center segment.

Business Model 1: Self-consumption and feed in of excess electricity

Self-consumption in shopping centers is legally only possible for general services that are consumed by all tenants (e.g. lighting in corridors and shared spaces, elevators, escalators, parking area). But, since these general services have rather high electricity consumption, the installation of a PV-system paired with a subsidized FiT can still be economically attractive.

Figure 4: Self-consumption

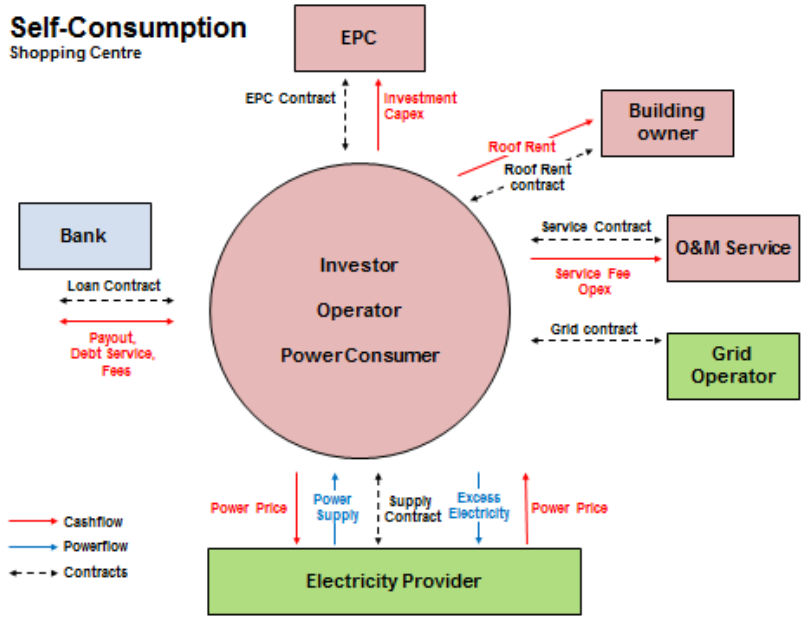


Figure 2: Project Overview

PV Project		
PV System Size	kWp	80
Specific System Cost	EUR/kWp	1.100
Total System Cost	EUR	88.000
Investment Subsidy	EUR	16.000
Total System Cost incl. Subsidy	EUR	72.000
Fixed Operation Costs	EUR p.a.	720
Variable Operation Costs	EUR/kWh	0

PV Generation		
Specific Yield	kWh/qm/a	1100
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	935
Degradation	% p.a.	0,75%

Investment			
Project Duration		Years	25
Equity		EUR	15.300
Debt (Gearing)	80%	EUR	57.600
Loan Tenor		Years	12
Interest Rate		%	3,1%
Discount Rate		%	6,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	60%	EUR/kWh	0,1150
Self-consumption	40%	EUR/kWh	0,1300
Fees		EUR/kWh	0,0013
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	35.044
Project IRR	%	9,53%
Equity IRR	%	17,33%
Payback Period	Years	10,43
LCOE* (w/o subsidy)	EUR/kWh	0,10
LCOE (w subsidy)	EUR/kWh	0,09
Min DSCR**	x	1,34 x
Min LLCR***	x	1,34 x

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

In this example the shopping center operator invests in PV plant with a capacity of 80 kWp. After deduction of an investment grant of 16.000 EUR, the applied system cost is 72.000 EUR. To finance this investment, the operator takes out a loan of 57.600 EUR and a tenor of 12 years (including a one-year grace period). Since the shopping center operator is usually not the owner of the building, a small amount of rent for the rooftop is included in the operation costs.

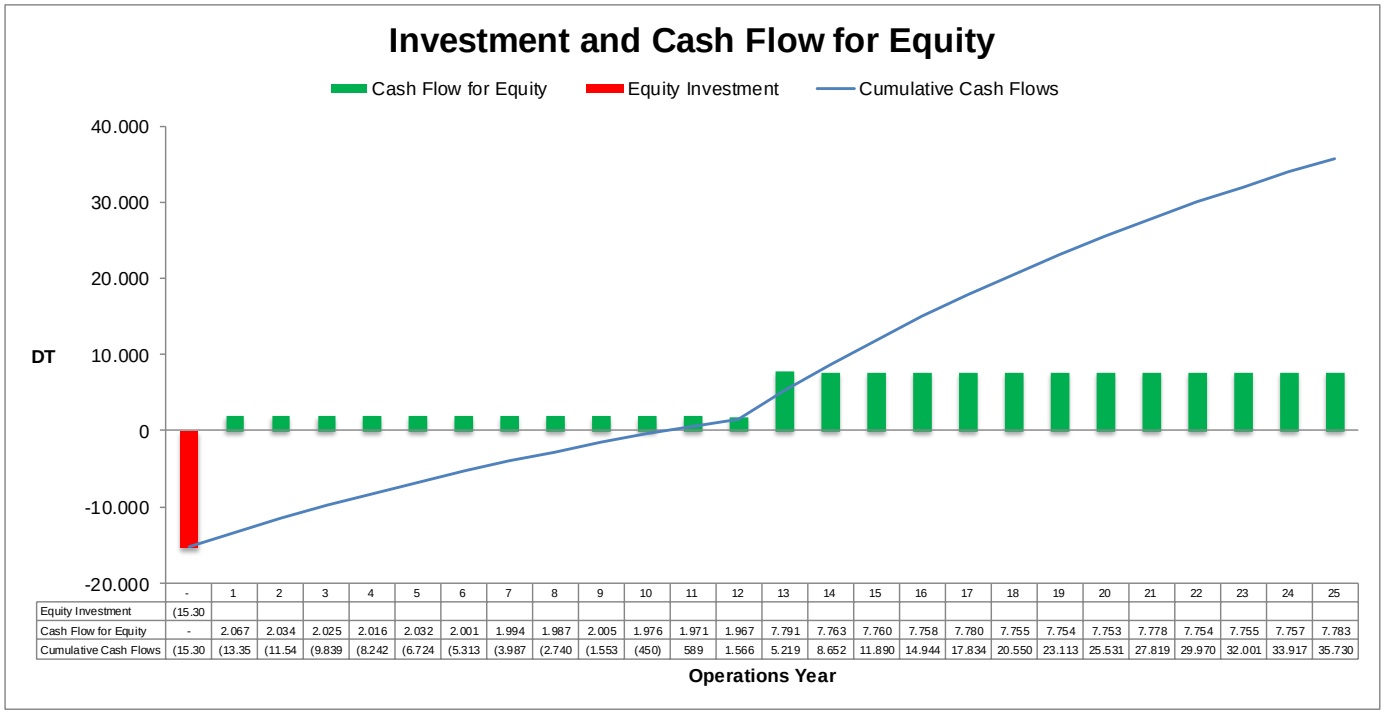
The assumed business model is a mix of self-consumption and feed-in of excess electricity into the grid: 40% self-consumption for general services and 60% is fed into the grid at a subsidized FiT of 11.5 Euro cents. The electricity tariff is at 13 EUR cents/kWh.

Note: Self-consumption above 25,000 kWh is subject to a fee of 1.5 EUR cents/kWh. Unfortunately the used calculation tool was not able to accurately depict this situation. Therefore, this fee was proportionately divided resulting in a rate of 0.0013 EUR as shown in Figure 1 under "Self-consumption fees".

Profitability Analysis

Under the applied assumptions as listed in *Figure 2* the following cash flow scenario applies:

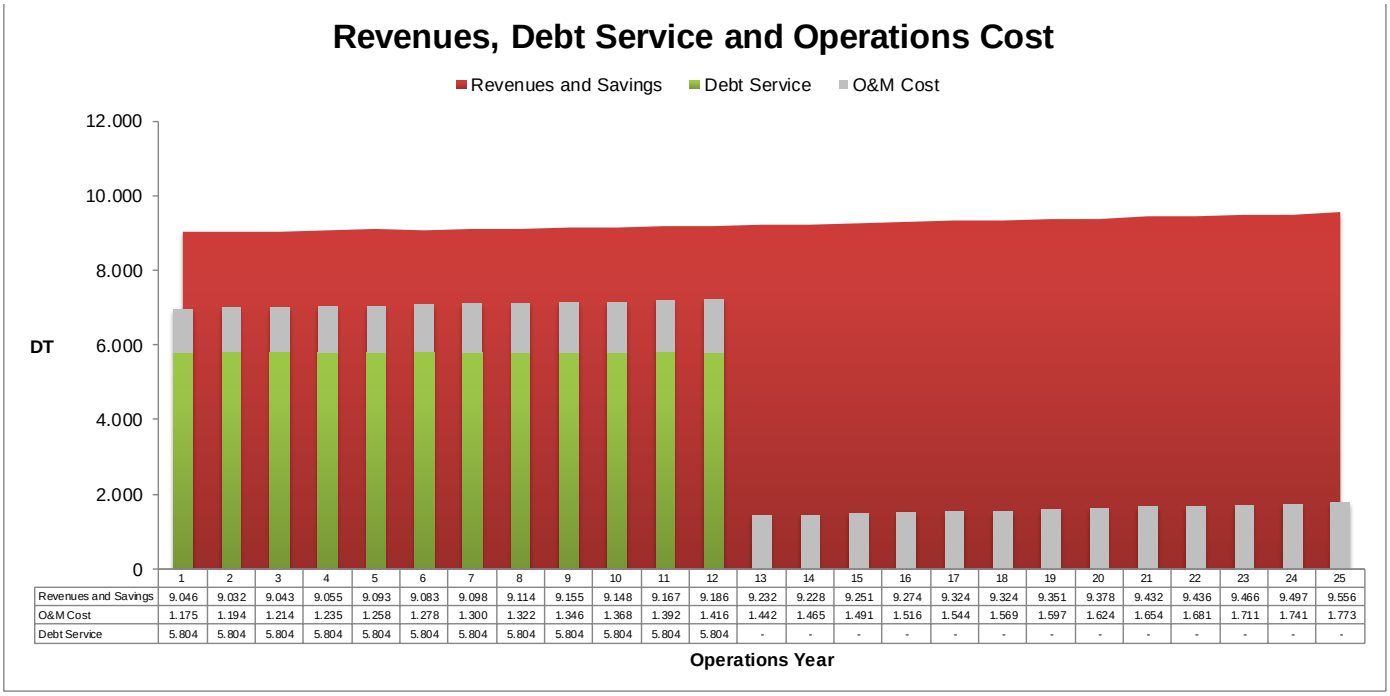
Figure 3: Project cash flows: Investment and cash flow for equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Equity Investment	(15.30																									
Cash Flow for Equity	-	2.067	2.034	2.025	2.016	2.032	2.001	1.994	1.987	2.005	1.976	1.971	1.967	7.791	7.763	7.760	7.758	7.780	7.755	7.754	7.753	7.778	7.754	7.755	7.757	7.783
Cumulative Cash Flows	(15.30	(13.35	(11.54	(9.839	(8.242	(6.724	(5.313	(3.987	(2.740	(1.553	(450)	589	1.566	5.219	8.652	11.890	14.944	17.834	20.550	23.113	25.531	27.819	29.970	32.001	33.917	35.730

Debt gearing is assumed at 80% leaving an equity share of 15,243 EUR – depicted as the red bar in the year of investment. The loan tenor is 12 years, which is why the cash flow for equity rises considerably in year 13. The PV plant reaches its break-even point after a period of 10.4 years.

Figure 4: Project cash flows: Revenues, debt service and operations cost



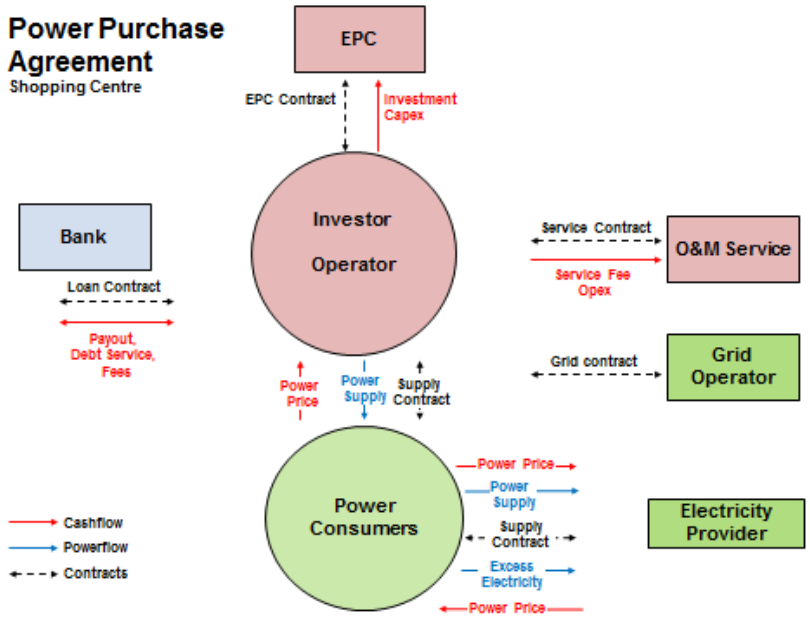
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Revenues and Savings	9.046	9.032	9.043	9.055	9.093	9.083	9.098	9.114	9.155	9.148	9.167	9.186	9.232	9.228	9.251	9.274	9.324	9.324	9.351	9.378	9.432	9.436	9.466	9.497	9.556
O&M Cost	1.175	1.194	1.214	1.235	1.258	1.278	1.300	1.322	1.346	1.368	1.392	1.416	1.442	1.465	1.491	1.516	1.544	1.569	1.597	1.624	1.654	1.681	1.711	1.741	1.773
Debt Service	5.804	5.804	5.804	5.804	5.804	5.804	5.804	5.804	5.804	5.804	5.804	5.804	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 4 shows the achieved revenues thanks to the PV system as well as the debt service and the operation and maintenance costs (under the assumed price escalation of 2%). As depicted in the chart, the project is self-sustaining since revenues and savings exceed the debt service and operations cost. The system operator achieves revenues of 9,556 EUR at the end of the PV plant's life span.

Business Model 2: Power Purchase Agreement with multiple tenants made possible by the necessary legal amendment

This example was chosen to show the positive effects if the law requirement for the electricity market was amended to allow PV system operators to sell their produced electricity to several different consumers. In the case of a shopping center this would mean that the PV system and shopping center operator could offer the PV electricity to all tenants without having to acquire an expensive grid operator license and without the tenants each having to own individual PV-systems.

Figure 5: Purchase Power Agreement



In this business model the shopping center operator invests in the PV plant and sells 100% of the electricity to the tenants via PPA at a price of 13 EUR cents/kWh.

Figure 5: Project Overview

PV Project			
PV System Size		kWp	80
Specific System Cost		EUR/kWp	1.100
Total System Cost		EUR	88.000
Investment Subsidy		EUR	16.000
Total System Cost incl. Subsidy		EUR	72.000
Fixed Operation Costs		EUR p.a.	720
Variable Operation Costs		EUR/kWh	0

PV Generation			
Specific Yield		kWh/qm/a	1100
Performance Factor		%	85%
Specific System Performance		kWh/kWp/a	935
Degradation		% p.a.	0,75%

Investment			
Project Duration		Years	25
Equity		EUR	15.300
Debt (Gearing)	80%	EUR	57.600
Loan Tenor		Years	12
Interest Rate		%	3,1%
Discount Rate		%	6,0%

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	0,1300
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	58.629
Project IRR	%	12,03%
Equity IRR	%	23,53%
Payback Period	Years	5,99
LCOE* (w/o subsidy)	EUR/kWh	0,10
LCOE (w subsidy)	EUR/kWh	0,09
Min DSCR**	x	1,50 x
Min LLCR***	x	1,59 x

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

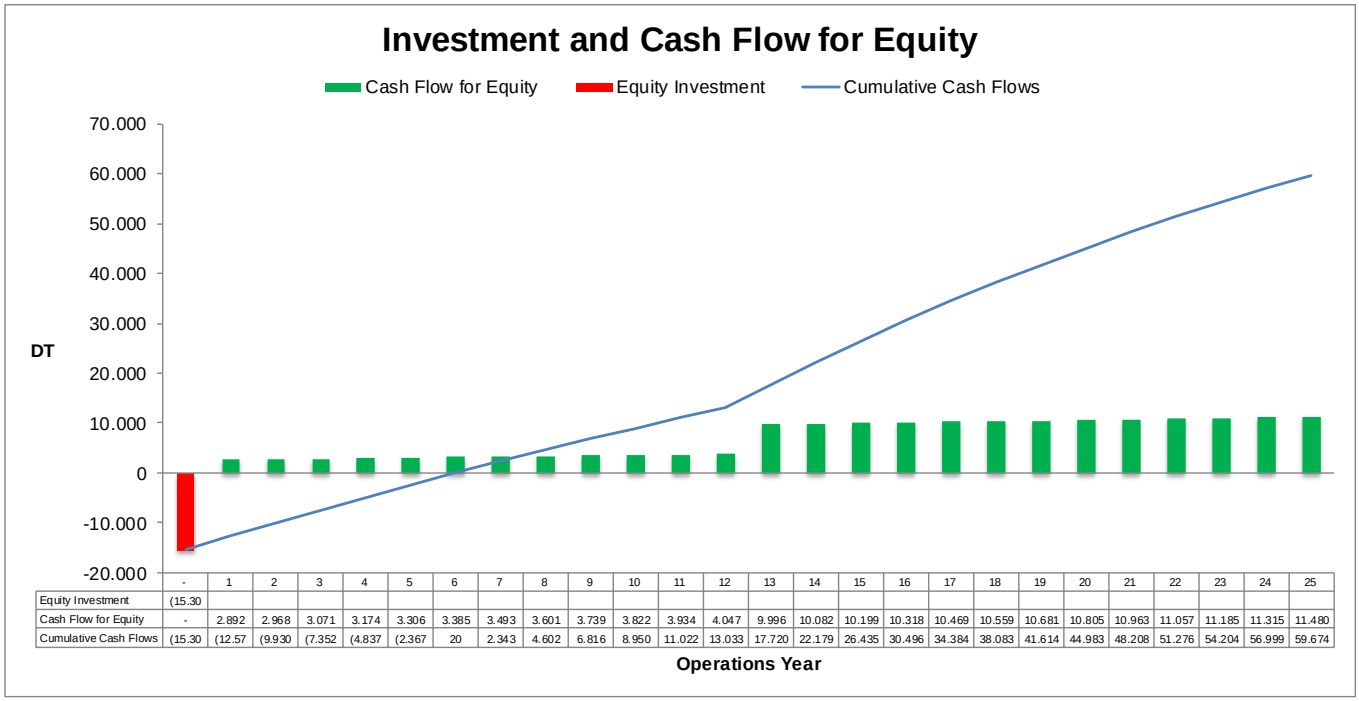
The shopping center operator invests in a PV plant with a capacity of 80 kWp at a total system cost of 88,000 Euro. He receives an investment grant of 16,000 Euro and takes out a loan to finance his investment.

Note: Self-consumption above 25,000 kWh is subject to a fee of 1.5 EUR cents/kWh. Unfortunately the used calculation tool was not able to accurately depict this situation. Therefore, this fee was proportionately divided resulting in a rate of 0.0103 EUR as shown in Figure 1 under "Self-consumption fees".

Profitability Analysis

Under the applied assumptions as listed in *Figure 6* the following cash flow scenario applies:

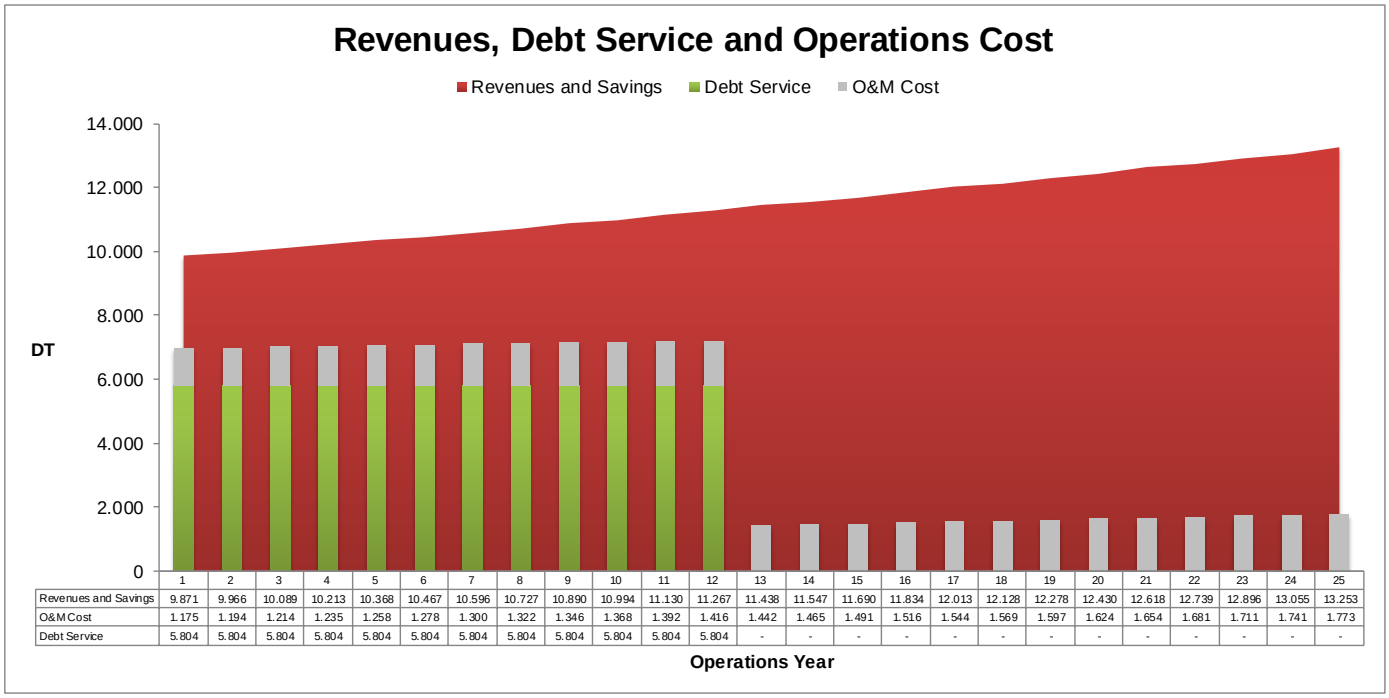
Figure 6: Project cash flows: Investment and cash flow for equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Equity Investment	(15.30																									
Cash Flow for Equity	-	2.892	2.968	3.071	3.174	3.306	3.385	3.493	3.601	3.739	3.822	3.934	4.047	9.996	10.082	10.199	10.318	10.469	10.559	10.681	10.805	10.963	11.057	11.185	11.315	11.480
Cumulative Cash Flows	(15.30	(12.57	(9.930	(7.352	(4.837	(2.367	20	2.343	4.602	6.816	8.950	11.022	13.033	17.720	22.179	26.435	30.496	34.384	38.083	41.614	44.983	48.208	51.276	54.204	56.999	59.674

As is clearly visible in the above illustration, the possibility of reaching a share of selling 100% of the PV electricity to the shop operators within the center considerably reduces the payback period from 10.4 years in business model 1 to 6 years in this example.

Figure 7: Project cash flows: 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	21	22	23	24	25
Revenues and Savings	9.871	9.966	10.089	10.213	10.368	10.467	10.596	10.727	10.890	10.994	11.130	11.267	11.438	11.547	11.690	11.834	12.013	12.128	12.278	12.430	12.618	12.739	12.896	13.055	13.253
O&M Cost	1.175	1.194	1.214	1.235	1.258	1.278	1.300	1.322	1.346	1.368	1.392	1.416	1.442	1.465	1.491	1.516	1.544	1.569	1.597	1.624	1.654	1.681	1.711	1.741	1.773
Debt Service	5.804	5.804	5.804	5.804	5.804	5.804	5.804	5.804	5.804	5.804	5.804	5.804	-	-	-	-	-	-	-	-	-	-	-	-	-

Another consequence of this fictitious legal amendment are the improved savings through the PV system. At the end of the PV system's life span savings amount to 13,253 EUR.

This simulation clearly shows the advantages of the described legal change resulting in a shorter amortization period and higher savings.

5. Business model report: Industrial parks

Segment environment

Possibilities of running PV systems in industrial parks are limited by a national law which regulates the electricity sector ("Elektrizitätswirtschafts- und organisationsgesetz 2010). This law prohibits the direct sale of electricity to multiple consumers unless the system operator acquires a special grid operating license. Since this a very cost- and time-intensive process, so far no system operator has acquired such a license.

Direct electricity supply to just one consumer is however possible.

As this legal requirement seriously restricts the future development of photovoltaics in Austria, several interested parties and pressure groups have entered into dialogue with the responsible ministry to achieve a respective amendment (see business model 2).

Segment Drivers

Based on the described regulatory environment, three different modes of operation of PV systems located on multi-family residential buildings exist: full feed-in without any self-consumption, electricity supplier operates a PV system on a third company's building and sells the electricity to just one company (PPA), and self-consumption.

Self-consumption is the most common mode of operation. Main drivers are reduced electricity costs and the favorable conditions for a high rate of self-consumption. With the falling FiT self-consumption is becoming more and more attractive.

Available subsidies are of course also important segment drivers: PV systems with a capacity of 5 – 200 kWp are eligible to receive a subsidized FiT. The FiT is adjusted annually (2015: 0,115 EUR) and is valid for 13 years. Additionally, these plants of this size can also receive an investment grant of 200 Euros/kWp.

Business Models

Below you find the business models of Austria in the industrial parks segment.

Business Model 1: Self-consumption and feed-in tariff

This case shows the common example of a company investing in a PV system and consuming as much as possible of the produced electricity. Excess power is fed into the grid at a subsidized FiT.

Figure 5: Self-consumption

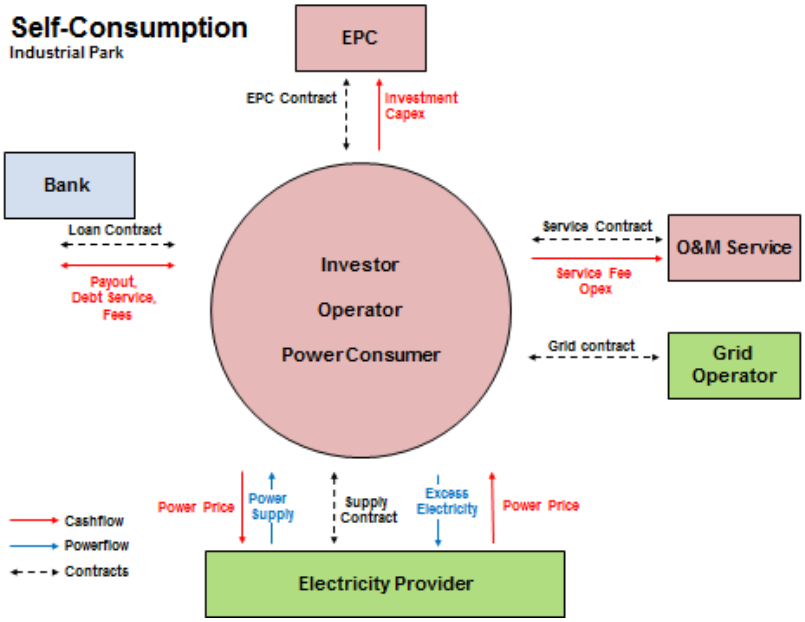


Figure 2: Project Overview

PV Project		
PV System Size	kWp	40
Specific System Cost	EUR/kWp	1.100
Total System Cost	EUR	44.000
Investment Subsidy	EUR	8.000
Total System Cost incl. Subsidy	EUR	36.000
Fixed Operation Costs	EUR p.a.	510
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1200
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.020
Degradation	% p.a.	0,70%

Investment			
Project Duration		Years	25
Equity		EUR	11.200
Debt (Gearing)	70%	EUR	25.200
Loan Tenor		Years	8
Interest Rate		%	2,9%
Discount Rate		%	5,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	40%	EUR/kWh	0,1150
Self-consumption	60%	EUR/kWh	0,1300
Fees		EUR/kWh	-
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	30.201
Project IRR	%	11,66%
Equity IRR	%	17,86%
Payback Period	Years	9,57
LCOE* (w/o subsidy)	EUR/kWh	0,09
LCOE (w subsidy)	EUR/kWh	0,08
Min DSCR**	x	1,13 x
Min LLCR***	x	1,13 x

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

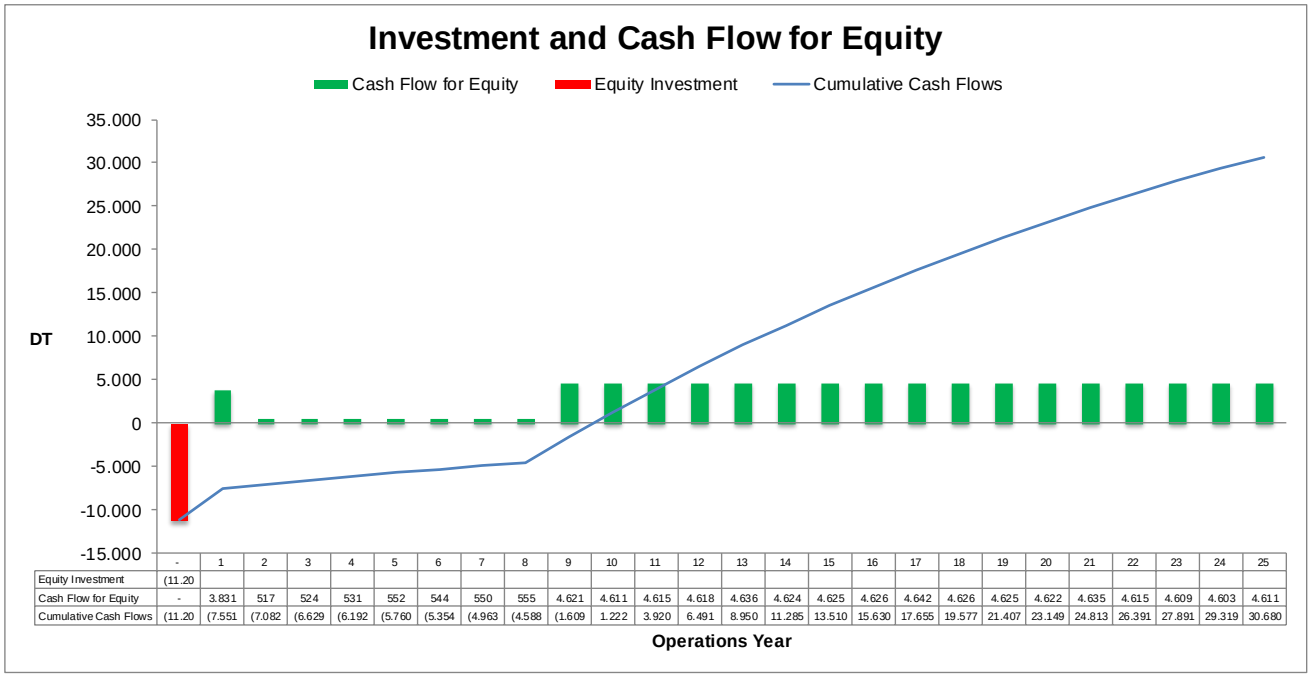
In this example a company invests in a PV plant with a capacity of 40 kWp at a total cost of 44,000 EUR and receives an investment grant of 8,000 EUR. To finance the investment, the company takes out a loan of 25,200 EUR with a loan tenor of 8 years.

Self-consumption is assumed at 60% and the remaining 40% is fed into the grid at a subsidized rate of 11.5 EUR cents.

Profitability Analysis

Under the applied assumptions as listed in *Figure 2* the following cash flow scenario applies:

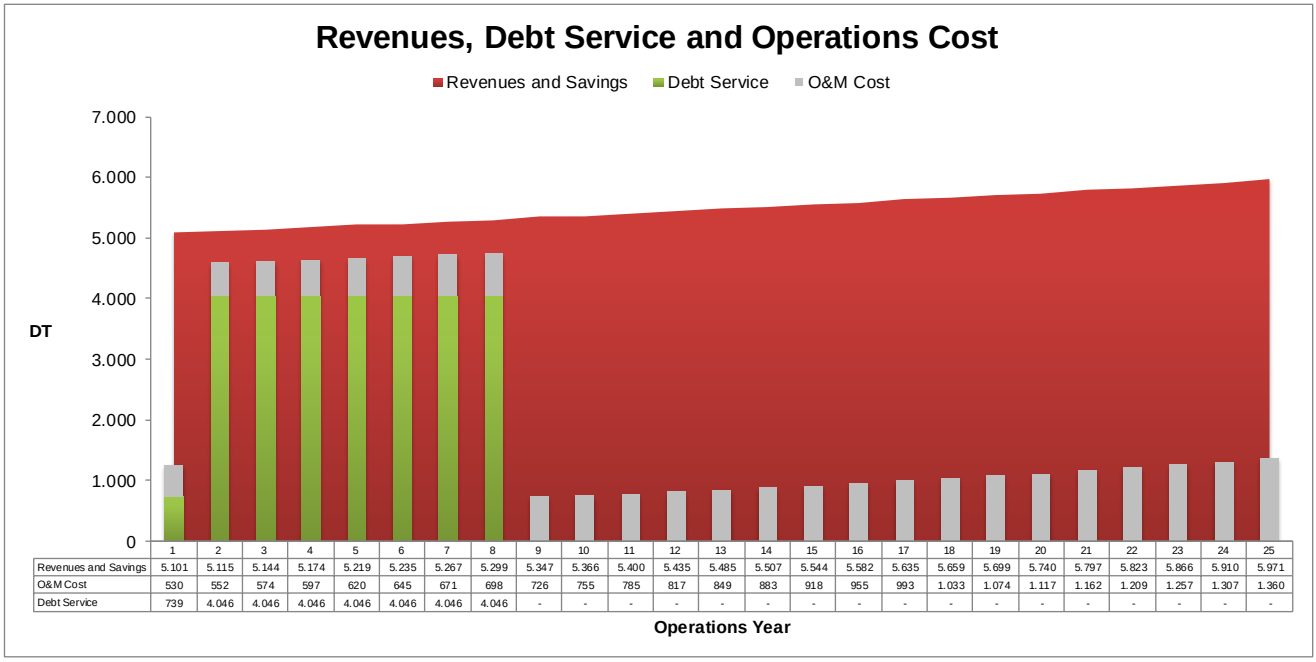
Figure 3: Project cash flows: Investment and cash flow for equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Equity Investment	(11.20																									
Cash Flow for Equity	-	3.831	517	524	531	552	544	550	555	4.621	4.611	4.615	4.618	4.636	4.624	4.625	4.626	4.642	4.626	4.625	4.622	4.635	4.615	4.609	4.603	4.611
Cumulative Cash Flows	(11.20	(7.551	(7.082	(6.629	(6.192	(5.760	(5.354	(4.963	(4.588	(1.609	1.222	3.920	6.491	8.950	11.285	13.510	15.630	17.655	19.577	21.407	23.149	24.813	26.391	27.891	29.319	30.680

Debt gearing is assumed at 70% leaving an equity share of 11,200 EUR – depicted as the red bar in the year of investment. The loan tenor is 8 years including a one-year grace period, which is why the cash flow for equity rises considerably in year 9. The PV plant reaches its break-even point after a period of 9.6 years.

Figure 4: Project cash flows: 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	21	22	23	24	25
Revenues and Savings	5.101	5.115	5.144	5.174	5.219	5.235	5.267	5.299	5.347	5.366	5.400	5.435	5.485	5.507	5.544	5.582	5.635	5.659	5.699	5.740	5.797	5.823	5.866	5.910	5.971
O&M Cost	530	552	574	597	620	645	671	698	726	755	785	817	849	883	918	955	993	1.033	1.074	1.117	1.162	1.209	1.257	1.307	1.360
Debt Service	739	4.046	4.046	4.046	4.046	4.046	4.046	4.046	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 4 shows the achieved revenues thanks to the PV system as well as the debt service and the operation and maintenance costs (under the assumed price escalation of 2%). As is clearly visible in the chart, the achieved revenues and savings exceed the debt service and operating costs throughout the PV system's life span, meaning that the project is self-sustaining.

Business Model 2: Power Purchase Agreement (PPA)

Business model 2 shows the case of an external investor, who is an energy supply company, installing a PV system on a commercial company's roof. The energy supply company sells the produced PV electricity to the company via PPA. Excess electricity that the company cannot consume itself is fed into the grid at market price.

Figure 5: Purchase Power Agreement

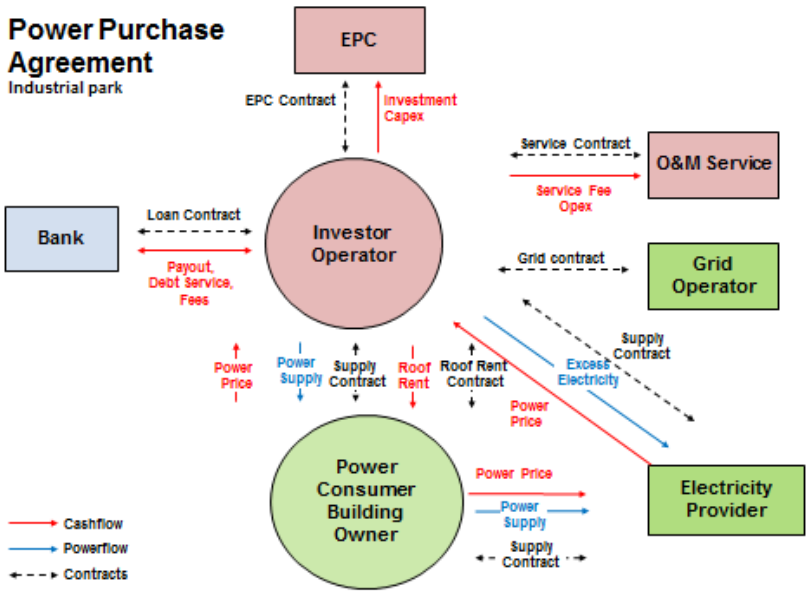


Figure 6: Project Overview

PV Project		
PV System Size	kWp	40
Specific System Cost	EUR/kWp	1.100
Total System Cost	EUR	44.000
Investment Subsidy	EUR	8.000
Total System Cost incl. Subsidy	EUR	36.000
Fixed Operation Costs	EUR p.a.	510
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1200
Performance Factor	%	85%
Specific System Performance	kWh/kWp/a	1.020
Degradation	% p.a.	0,70%

Investment			
Project Duration		Years	25
Equity		EUR	5.921
Debt (Gearing)	85%	EUR	30.600
Loan Tenor		Years	10
Interest Rate		%	3,4%
Discount Rate		%	5,0%

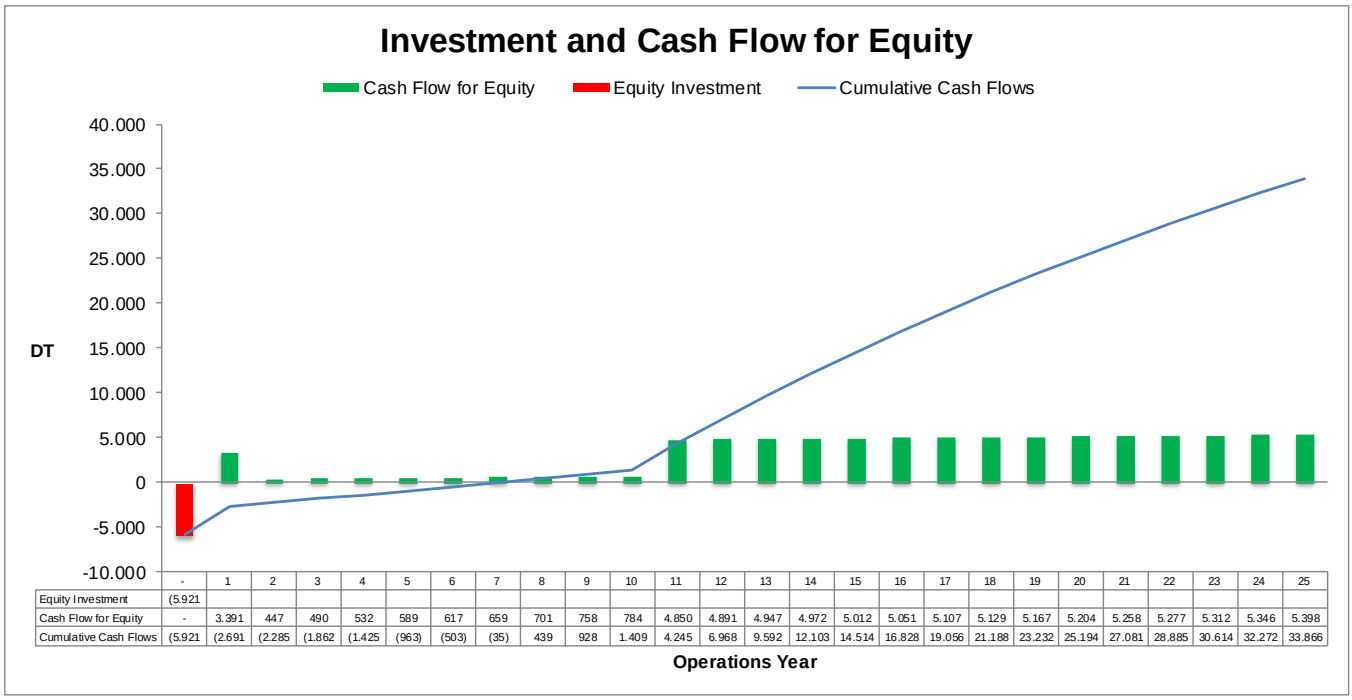
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	100%	EUR/kWh	0,1200
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	33.391
Project IRR	%	11,98%
Equity IRR	%	25,62%
Payback Period	Years	7,07
LCOE* (w/o subsidy)	EUR/kWh	0,09
LCOE (w subsidy)	EUR/kWh	0,08
Min DSCR**	x	1,11 x
Min LLCR***	x	1,15 x

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

The power supply company invests in a PV plant with a capacity of 40 kWp and total system costs of 44,000 EUR reduced by an investment grant of 8,000 EUR (as in business model 1). However, in this case the power supply company sells all of the produced PV electricity via PPA at a price of 13 EUR cents to the company. Additionally, the supplier has to pay rent for the roof space.

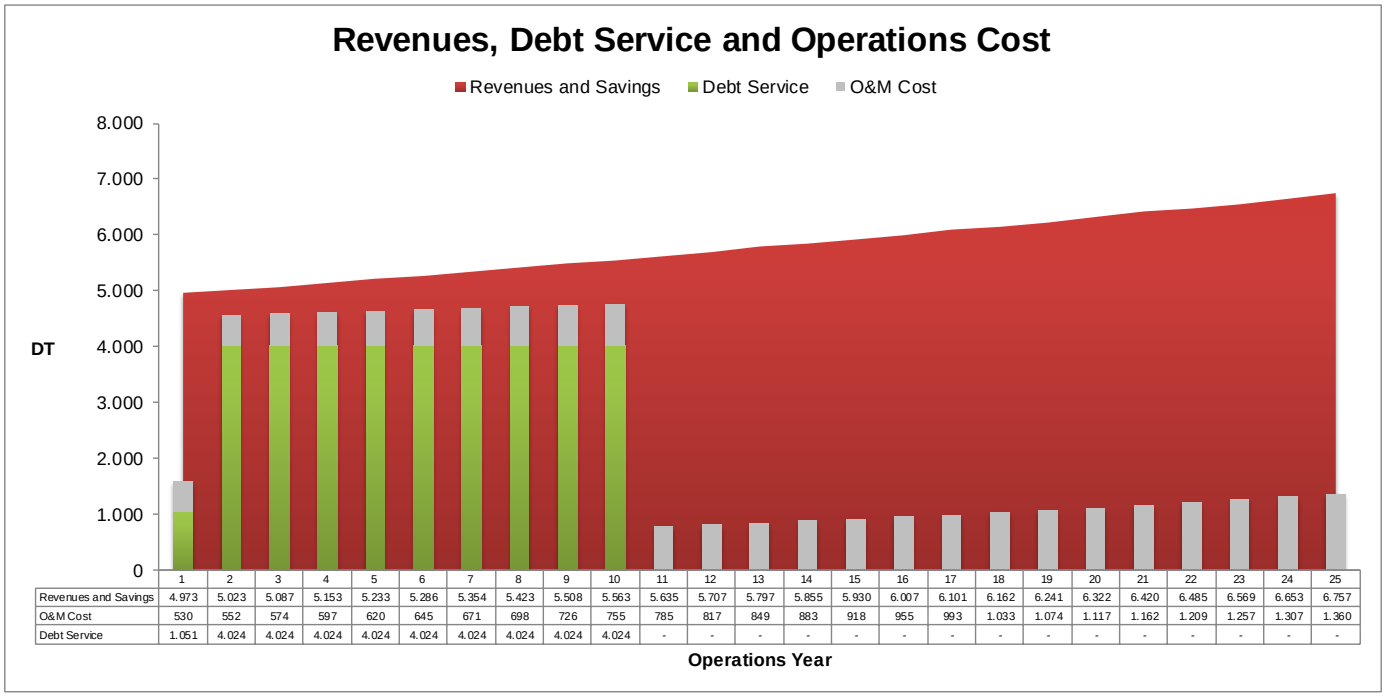
Figure 3: Project cash flows: Investment and cash flow for equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Equity Investment	(5.921																									
Cash Flow for Equity	-	3.391	447	490	532	589	617	659	701	758	784	4.850	4.891	4.947	4.972	5.012	5.051	5.107	5.129	5.167	5.204	5.258	5.277	5.312	5.346	5.398
Cumulative Cash Flows	(5.921	(2.691	(2.285	(1.862	(1.425	(963)	(503)	(35)	439	928	1.409	4.245	6.968	9.592	12.103	14.514	16.828	19.056	21.188	23.232	25.194	27.081	28.885	30.614	32.272	33.866

Debt gearing is again assumed at 85% leaving an equity share of 5,921 EUR – depicted as the red bar in the year of investment. The loan tenor is 10 years including a one-year grace period, which is why the cash flow for equity rises considerably in year 11. In the case of 100% PPA, the PV plant reaches its break-even point after a period of 7years (as compared to 9 years in business model 1)

Figure 4: Project cash flows: 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	21	22	23	24	25
Revenues and Savings	4.973	5.023	5.087	5.153	5.233	5.286	5.354	5.423	5.508	5.563	5.635	5.707	5.797	5.855	5.930	6.007	6.101	6.162	6.241	6.322	6.420	6.485	6.569	6.653	6.757
O&M Cost	530	552	574	597	620	645	671	698	726	755	785	817	849	883	918	955	993	1.033	1.074	1.117	1.162	1.209	1.257	1.307	1.360
Debt Service	1.051	4.024	4.024	4.024	4.024	4.024	4.024	4.024	4.024	4.024	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Another consequence of this fictitious legal amendment are the improved savings through the PV system. At the end of the PV system's life span savings amount to 6,757 EUR.

This simulation clearly shows the advantages of the described legal change resulting in a shorter amortization period and higher savings.

6. Business model report: Educational buildings

Segment environment

For PV installations on public buildings it is important to first clarify the ownership of the building. Schools are usually owned by the municipality which therefore also pays for the consumed electricity. In this case the business model is quite simple as the municipality can itself realize the installation of the PV system. In the case of higher schools or universities the building is usually owned and rented out by a real estate company, whose consent becomes necessary when planning a PV system.

Segment Drivers

The main driver for public educational facilities to invest in a PV system is typically to raise awareness among students and the local population for green energy. These PV systems cab be financed by the municipality or an external investor (typically an energy supply company). However, the most common financing model by far in this case is Crowdfunding, which allows for direct local participation and investment. Through the possibility of direct involvement in regional projects the local population is not only offered an investment opportunity, but also for contributing towards greening their municipality. For municipalities the construction of a PV system on a public school or university through Crowdfunding can represent an important first step to establish a direct relationship between energy production and consumption, thus raising awareness.

In case of larger PV systems (> 5 kWp) obtaining a subsidized FiT represents a precondition for an economically viable investment.

Business Models

Below you find the business models of Austria in the public education segment.

Business Model 1: Self-consumption and feed-in of excess electricity (FiT)

This example assumes the case of a university, which partly uses its own electricity and feeds the excess electricity into the grid at a subsidized FiT.

Figure 6: Self-consumption

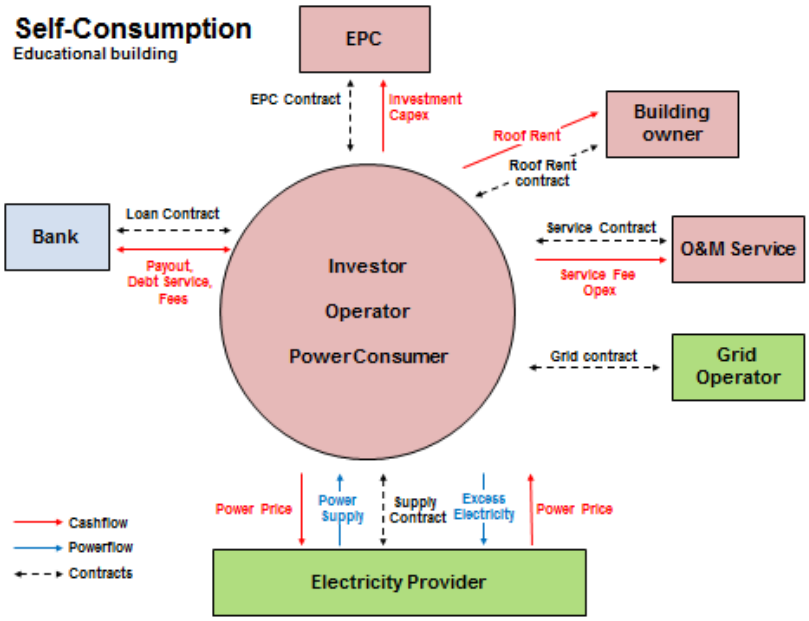


Figure 2: Project Overview

PV Project			
PV System Size		kWp	25
Specific System Cost		EUR/kWp	1.300
Total System Cost		EUR	32.500
Investment Subsidy		EUR	5.000
Total System Cost incl. Subsidy		EUR	27.500
Fixed Operation Costs		EUR p.a.	275
Variable Operation Costs		EUR/kWh	0

PV Generation			
Specific Yield		kWh/qm/a	1400
Performance Factor		%	85%
Specific System Performance		kWh/kWp/a	1.190
Degradation		% p.a.	0,70%

Investment			
Project Duration		Years	25
Equity		EUR	5.856
Debt (Gearing)	80%	EUR	22.000
Loan Tenor		Years	8
Interest Rate		%	3,0%
Discount Rate		%	3,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	60%	EUR/kWh	0,1150
Self-consumption	40%	EUR/kWh	0,1600
Fees		EUR/kWh	-
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	31.177
Project IRR	%	11,35%
Equity IRR	%	18,20%
Payback Period	Years	9,32
LCOE* (w/o subsidy)	EUR/kWh	0,09
LCOE (w subsidy)	EUR/kWh	0,08
Min DSCR**	x	1,10 x
Min LLCR***	x	1,10 x

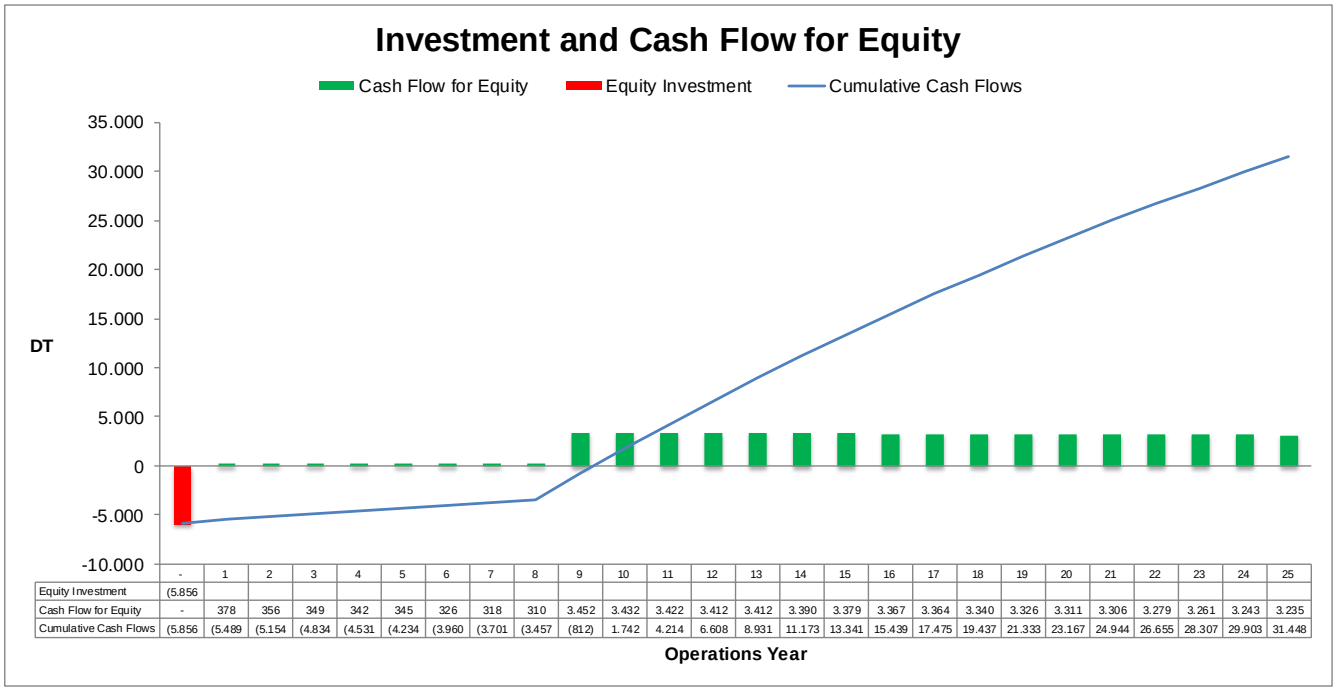
* LCOE: Levelized Cost of Electricity
** DSCR: Debt Service Coverage Ratio
*** LLCR: Loan Life Coverage Ratio

The university in this example invests in a PV system with a capacity of 25 kWp with a total system cost of 27,500 EUR after deduction of a 5,000 EUR investment grant. The university uses 40% of the produced PV electricity itself and feeds the excess electricity into the grid at a subsidized FiT of 11.5 EUR cents. The university takes out a loan to finance the plant (23,375 EUR, loan tenor of 8 years).

Profitability Analysis

Under the applied assumptions as shown in Figure 2, the following cash flow scenarios arise:

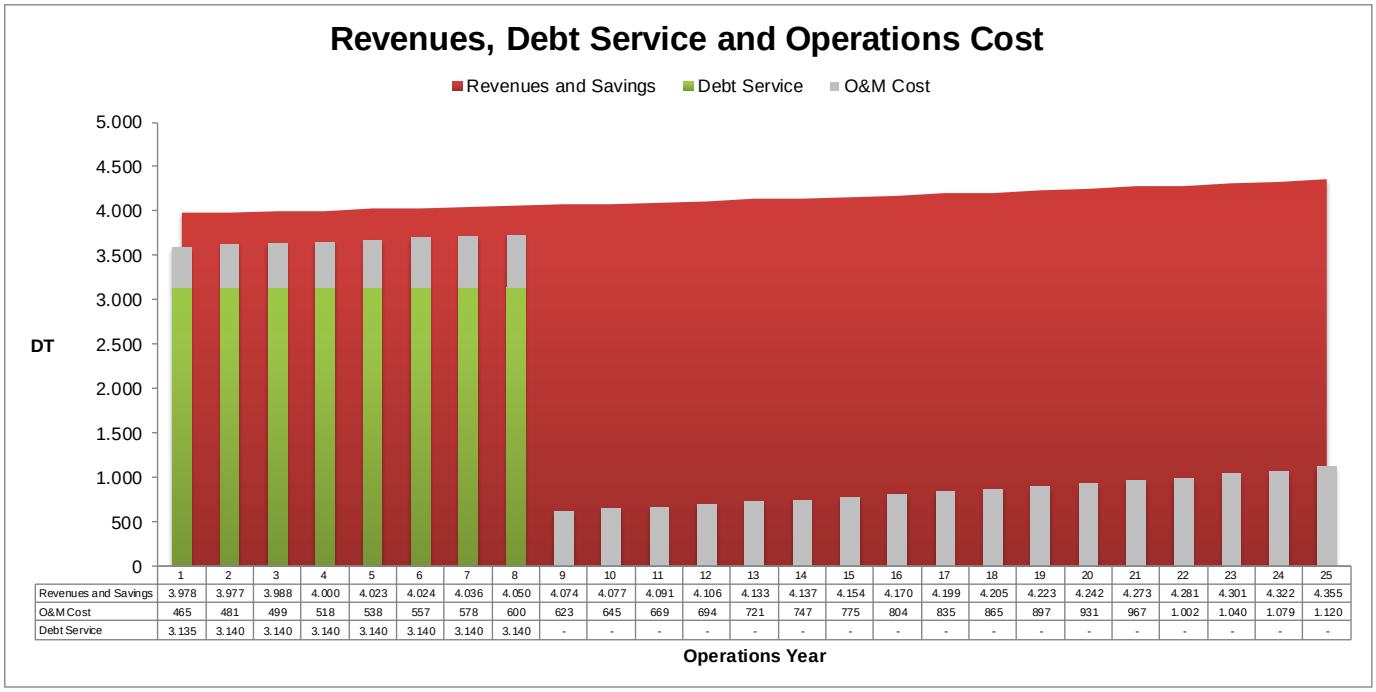
Figure 3:Project cash flows: Investment and cash flow for equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Equity Investment	(5.856																									
Cash Flow for Equity	-	378	356	349	342	345	326	318	310	3.452	3.432	3.422	3.412	3.412	3.390	3.379	3.367	3.364	3.340	3.326	3.311	3.306	3.279	3.261	3.243	3.235
Cumulative Cash Flows	(5.856	(5.489	(5.154	(4.834	(4.531	(4.234	(3.960	(3.701	(3.457	(812)	1.742	4.214	6.608	8.931	11.173	13.341	15.439	17.475	19.437	21.333	23.167	24.944	26.655	28.307	29.903	31.448

Debt gearing is assumed at 80% leaving an equity share of 5,856 EUR – depicted as the red bar in the year of investment. The loan tenor is 8 years, which is why the cash flow for equity rises considerably in year 9. The PV plant reaches the break-even after 9.3 years.

Figure 4:Project cash flows: 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	21	22	23	24	25
Revenues and Savings	3.978	3.977	3.988	4.000	4.023	4.024	4.036	4.050	4.074	4.077	4.091	4.106	4.133	4.137	4.154	4.170	4.199	4.205	4.223	4.242	4.273	4.281	4.301	4.322	4.355
O&M Cost	465	481	499	518	538	557	578	600	623	645	669	694	721	747	775	804	835	865	897	931	967	1.002	1.040	1.079	1.120
Debt Service	3.135	3.140	3.140	3.140	3.140	3.140	3.140	3.140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 4 shows the achieved revenues thanks to the PV system as well as the debt service and the operation and maintenance costs (under the assumed price escalation of 2%). Since savings and revenues exceed costs and debt service, the project is self-sustaining. As depicted in the chart the system operator achieves revenues of 4,355 EUR at the end of the PV plant's life span.

Business Model 2: Self-consumption and feed-in tariff, financed by Crowdfunding

Crowdfunding is a popular financing method for schools owned by municipalities, which is why this scenario was chosen. In this case a smaller PV system is funded by multiple private investors

Figure 5: Self-consumption

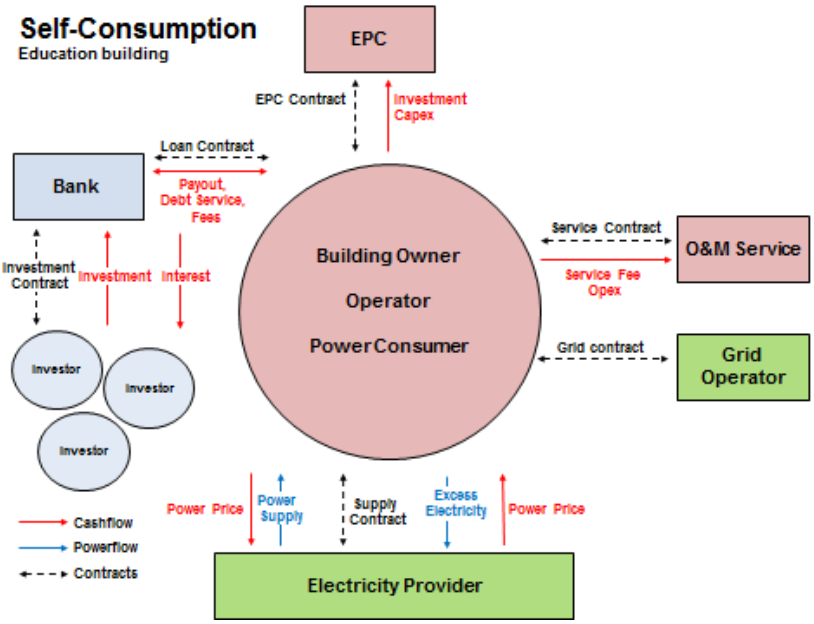


Figure 6: Project Overview

PV Project			
PV System Size		kWp	10
Specific System Cost		EUR/kWp	1.600
Total System Cost		EUR	16.000
Investment Subsidy		EUR	2.000
Total System Cost incl. Subsidy		EUR	14.000
Fixed Operation Costs		EUR p.a.	140
Variable Operation Costs		EUR/kWh	0

PV Generation			
Specific Yield		kWh/qm/a	1400
Performance Factor		%	85%
Specific System Performance		kWh/kWp/a	1.190
Degradation		% p.a.	0,70%

Investment			
Project Duration		Years	25
Equity		EUR	5.056
Debt (Gearing)	65%	EUR	9.100
Loan Tenor		Years	8
Interest Rate		%	3,5%
Discount Rate		%	3,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	50%	EUR/kWh	0,1150
Self-consumption	50%	EUR/kWh	0,1600
Fees		EUR/kWh	-
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	10.071
Project IRR	%	8,64%
Equity IRR	%	10,95%
Payback Period	Years	12,21
LCOE* (w/o subsidy)	EUR/kWh	0,12
LCOE (w subsidy)	EUR/kWh	0,11
Min DSCR**	x	1,07 x
Min LLCR***	x	1,07 x

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

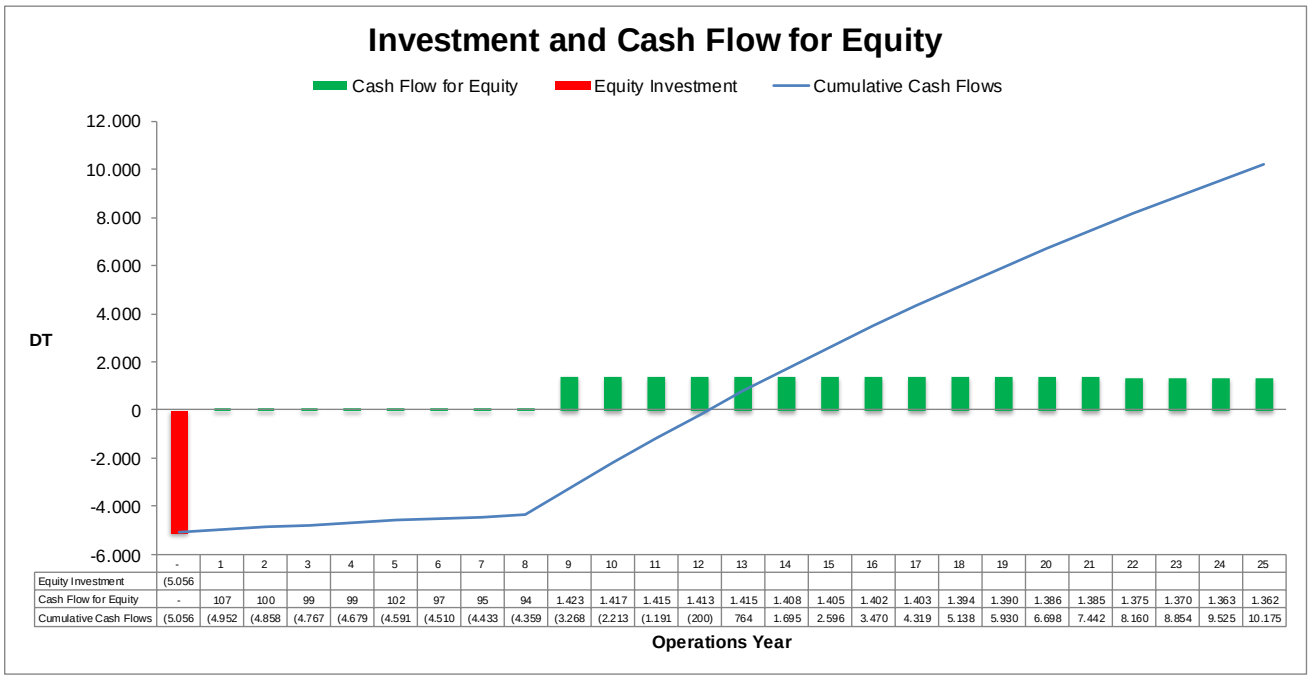
The private investors jointly fund a PV system with a capacity of 10 kWp and a total system cost of 16,000 EUR reduced by an investment grant of 2,000 EUR. Debt gearing is set at 65% leaving a loan amount of 9,100 EUR. Since the private investors earn an interest, the interest rate is set a little higher than in the first example.

The school reaches a rate of self-consumption of 50% with the remaining 50% being fed into the grid at a subsidized FiT of 11.5 EUR cents.

Profitability Analysis

Under the applied assumptions as listed in *Figure 6* the following cash flow scenario applies:

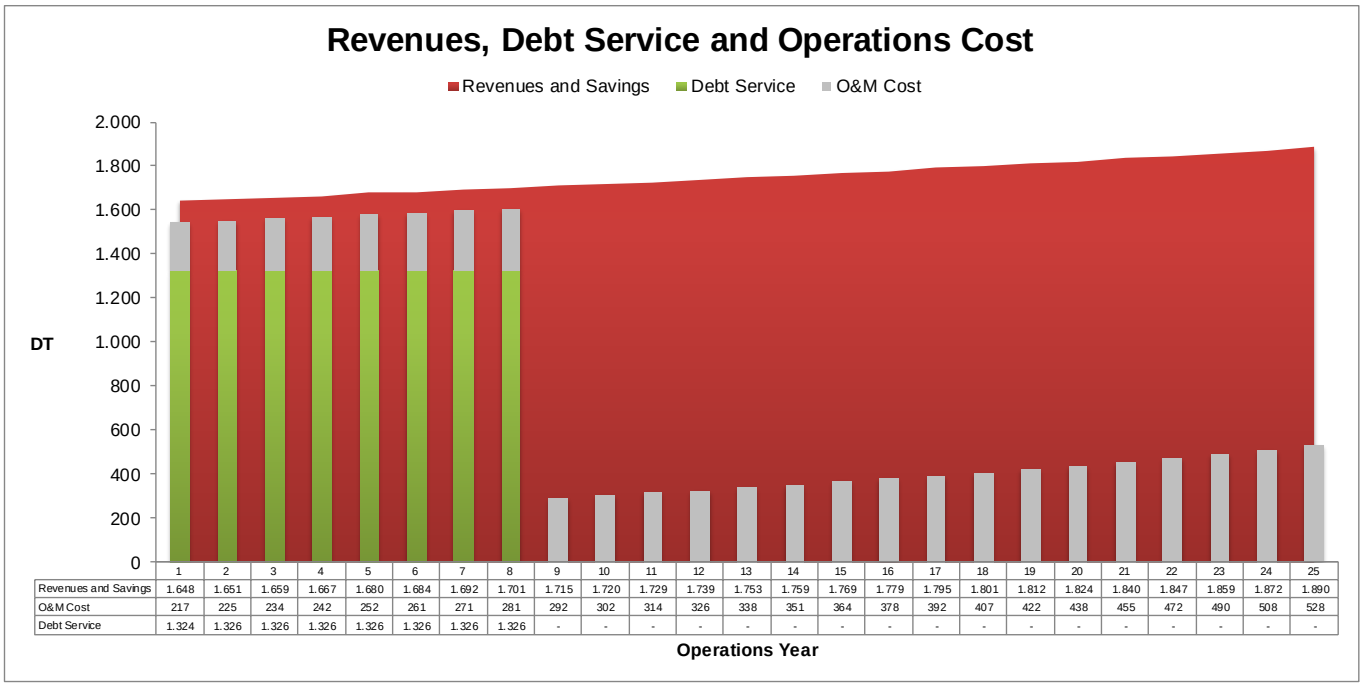
Figure 7: Project cash flows: Investment and cash flow for equity



	-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Equity Investment	(5.056																									
Cash Flow for Equity	-	107	100	99	99	102	97	95	94	1.423	1.417	1.415	1.413	1.415	1.408	1.405	1.402	1.403	1.394	1.390	1.386	1.385	1.375	1.370	1.363	1.362
Cumulative Cash Flows	(5.056	(4.952	(4.858	(4.767	(4.679	(4.591	(4.510	(4.433	(4.359	(3.268	(2.213	(1.191	(200)	764	1.695	2.596	3.470	4.319	5.138	5.930	6.698	7.442	8.160	8.854	9.525	10.175

The loan is repaid after 8 years after which the cumulative cash flow starts to rise. The PV plant reaches its break-even point after a little more than 12 years.

Figure 8: Project cash flows: Revenues, debt service and operation cost



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Revenues and Savings	1.648	1.651	1.659	1.667	1.680	1.684	1.692	1.701	1.715	1.720	1.729	1.739	1.753	1.759	1.769	1.779	1.795	1.801	1.812	1.824	1.840	1.847	1.859	1.872	1.890
O&M Cost	217	225	234	242	252	261	271	281	292	302	314	326	338	351	364	378	392	407	422	438	455	472	490	508	528
Debt Service	1.324	1.326	1.326	1.326	1.326	1.326	1.326	1.326	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Figure 8 shows the achieved revenues thanks to the PV system as well as the debt service and the operation and maintenance costs (under the assumed price escalation of 2%). As depicted in the chart the system operator achieves revenues of 1,890 EUR at the end of the PV plant's life span.