PVFINANCING

D2.6 Business Model Report

France

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Introduction

The current report presents simulations of business models in France for the application segments selected in PV Financing: single family houses, multi-occupancy housing, shopping centres, educational buildings and industrial parks.

Some simulations are based on existing schemes such as Feed-in Tariffs, while others are based on innovative schemes that have not yet been implemented such as net metering.

Prices of photovoltaic installations are given annually by ADEME and will be used for reference in the report. For cases based on a 100-kWp installation, the report uses the price of €0.168/W.

Type of Installation	Price (euro cents/W)
Residential, integrated 0-3 kW	3.50
Residential, roof mounted 0-3 kW	2.76
Residential, integrated 3-9 kW	2.57
Residential, roof mounted 3-9 kW	1.97
Large roof 36 - 100 kW	2.05
Large roof > 100 kW	1.68
Source: ADEME, Etude de la filière photovoltaïque française - "Bilan, Perspective et Stratégie"	

1. Single Family House

Segment environment

The residential market in France peaked in 2010 and 2011 thanks to high the feed-in-tariff (FiT). Unfortunately these FiTs were too high to prevent opportunistic behaviour. At the end of 2011, the government cut the FiT drastically by 20%. This decision threw the residential photovoltaic market into turmoil with a very small industry and consumers who became suspicious about this technology.

Since the beginning of 2015, consumers' trust of has trickled back. The residential market in France is still low with 46 MWp installed in the first six months of 2015. It is based on a twenty-year FiT contract.

Segment Drivers

Single family homeowners invest in photovoltaic because they consider it as an investment. They expect a financial return from this installation. Only a few are investing solely on environmental grounds.

Another major driver whose importance has risen over the past two years is energy independence. Many homeowners are interested in self-consumption. They would like to be able to produce their own electricity and gain some independence from the grid.

Business Models

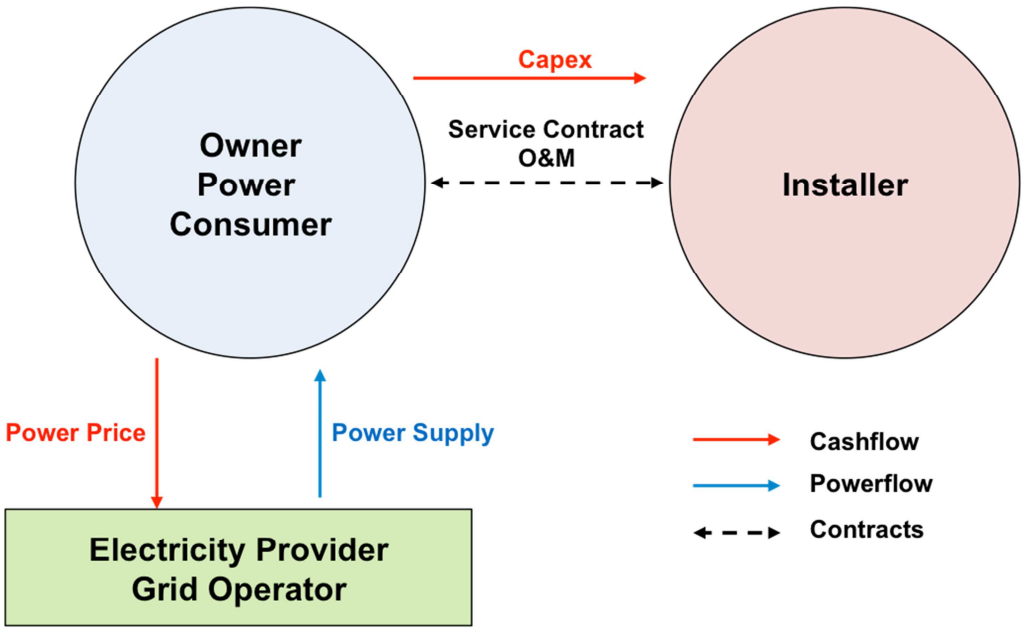
The following figure explains the business models based on the current Feed-In Tariff scheme. The second figure demonstrates a potential explanation of a mechanism based on net metering.

Business Model 1: Feed-in Tariff

Single family homeowners can buy a photovoltaic roof installation for an average price of €3 500/kWp, from a firm that will also install the structure on the roof and eventually provide O&M service during the installation's lifetime.

Photovoltaic installations' electricity is sold to EDF at a fixed FiT for twenty years. Homeowners buy the electricity for their own needs from an electricity provider through the grid. The electricity used by homeowners is not the electricity produced by their own panels.

Figure 1: Feed-in Tariff



Profitability Analysis

The case of a 3-kWp installation will be assessed for the purpose of analysing the profitability of a PV installation for single family houses with a FiT. The FiT for the third quarter of 2015 is €0.2578/kWh. The assumption is made that the owner of the house does not have to borrow money. Moreover, the house would be in the south of France with a high rate of irradiation: 1 500 kWh/sqm. p.a.

PV Project		
PV System Size	kWp	3
Specific System Cost	EUR/kWp	3 500
Total System Cost	EUR	10 500
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	10 500
Fixed Operation Costs	EUR p.a.	53
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1500
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 350
Degradation	% p.a.	0,50%

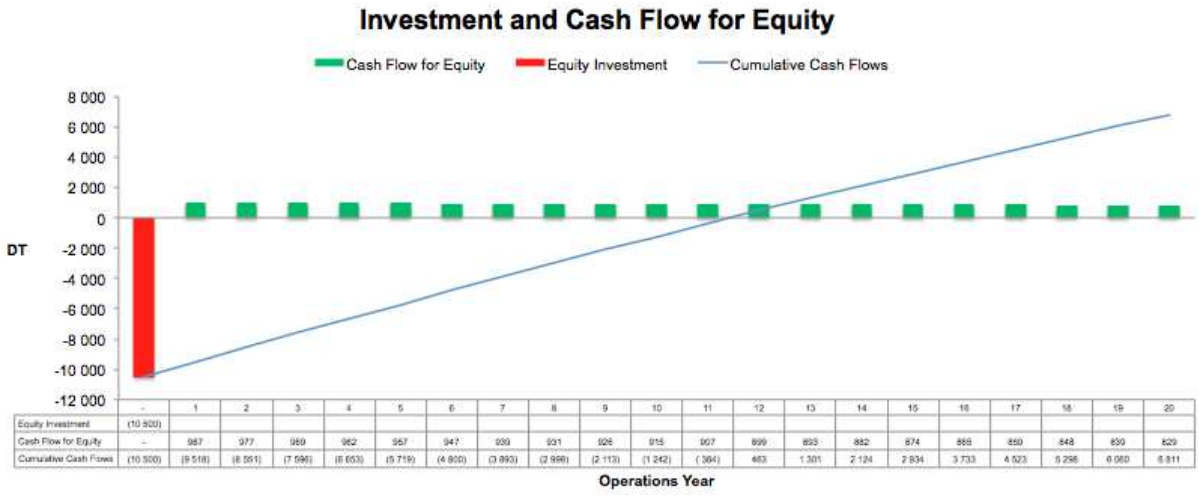
Investment			
Project Duration		Years	20
Equity		EUR	10 500
Debt (Gearing)	-	EUR	-
Loan Tenor		Years	5
Interest Rate		%	3,8%
Discount Rate		%	0,5%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	100%	EUR/kWh	0,2578
Self-consumption	-	EUR/kWh	-
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	-

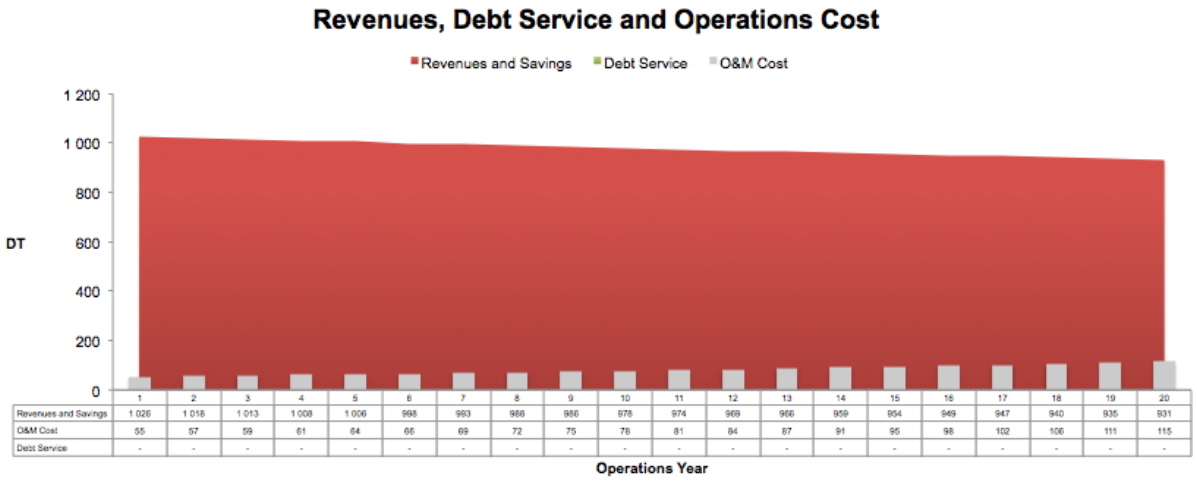
Results		
Net-Present Value	EUR	6 800
Project IRR	%	6,07%
Equity IRR	%	6,07%
Payback Period	Years	11,45
LCOE* (w/o subsidy)	EUR/kWh	0,16
LCOE (w subsidy)	EUR/kWh	0,16
Min DSCR**	x	-
Min LLCR***	x	-

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

With this scheme, the investment payback period would be eleven years. For a twenty-year project, the overall gain would be around € 8 000, undiscounted.



Once the initial investment is made, no more costs are included except O&M that is spread over time.

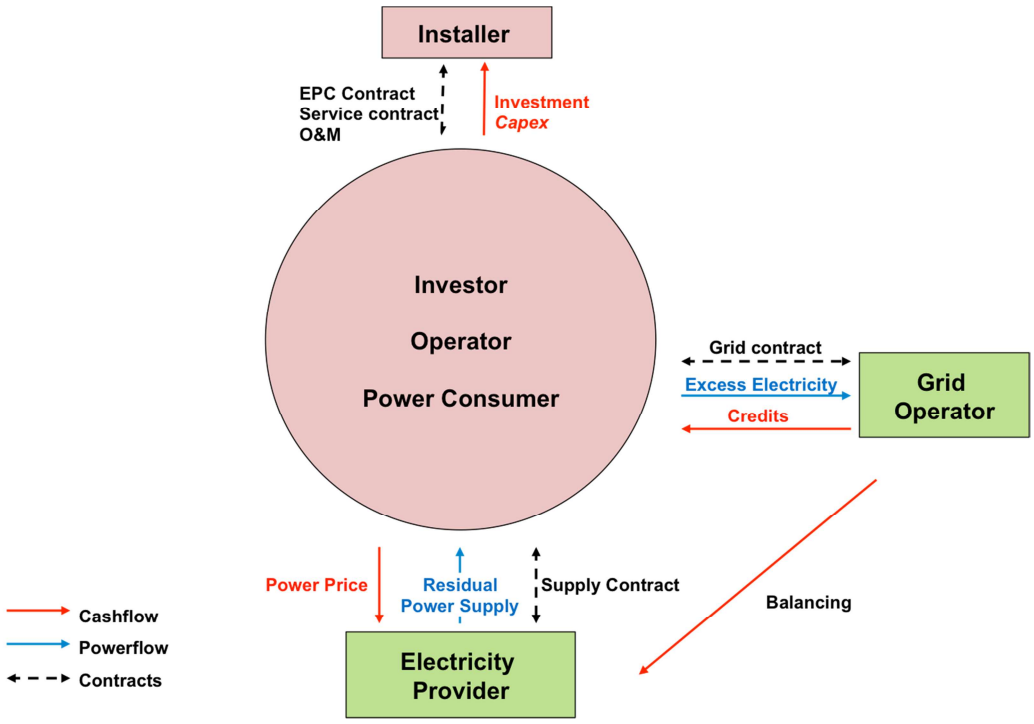


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Revenues and Savings	1 026	1 018	1 013	1 008	1 006	998	993	986	986	978	974	969	966	959	954	949	947	940	935	931
O&M Cost	55	57	59	61	64	66	69	72	75	78	81	84	87	91	95	98	102	106	111	115
Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Business Model 2: Net-metering

Net metering is not implemented in France but offers services that consumers seek. It includes a self-consumption aspect and allows the sale of unconsumed electricity produced during the day, when the house consumption rate is low.

Figure 2: Net-metering scheme



Profitability Analysis

The report presents another 3-kWp installation whose initial system price increases to a cost of € 4 000/kWp for the purpose of testing a net-metering scheme.

PV Project		
PV System Size	kWp	3
Specific System Cost	EUR/kWp	4 000
Total System Cost	EUR	12 000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	12 000
Fixed Operation Costs	EUR p.a.	60
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1500
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 350
Degradation	% p.a.	-

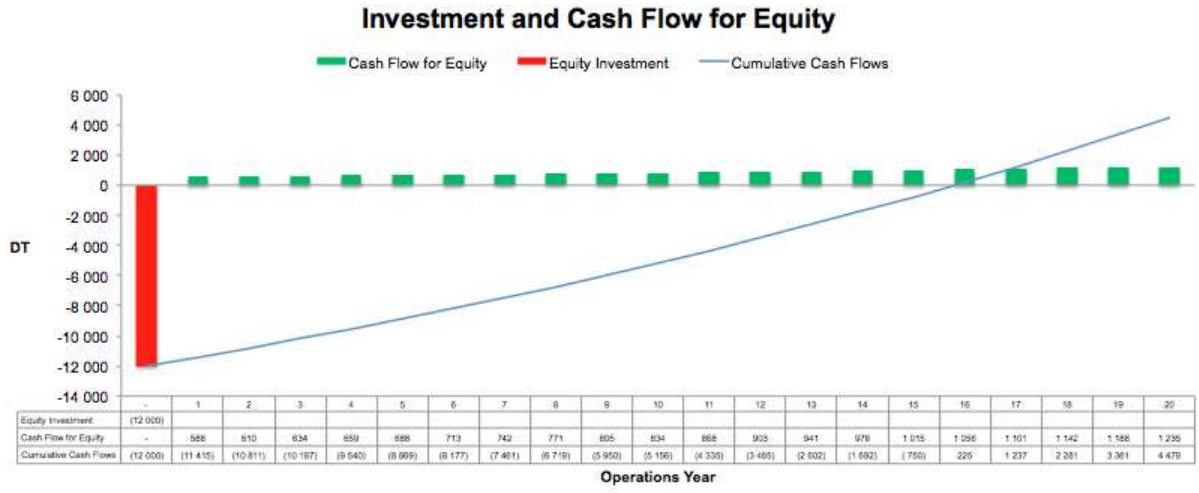
Investment		
Project Duration	Years	20
Equity	EUR	12 000
Debt (Gearing) -	EUR	-
Loan Tenor	Years	5
Interest Rate	%	4,3%
Discount Rate	%	0,5%

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

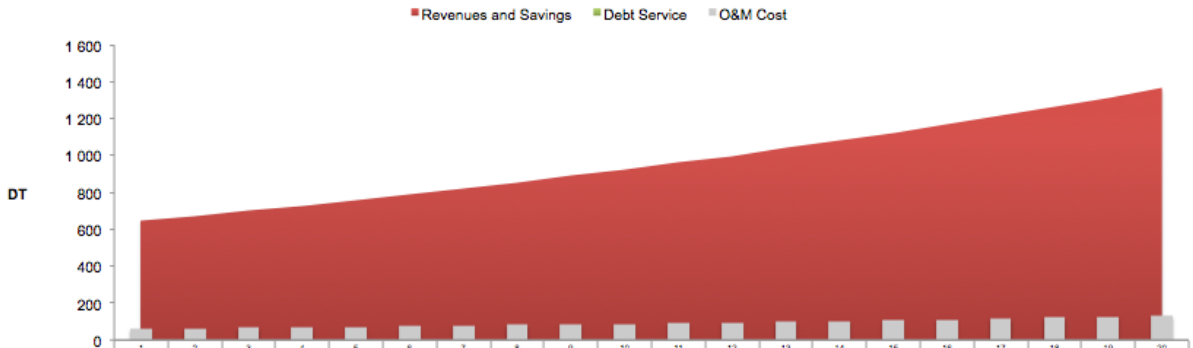
Results		
Net-Present Value	EUR	4 469
Project IRR	%	3,37%
Equity IRR	%	3,37%
Payback Period	Years	15,77
LCOE* (w/o subsidy)	EUR/kWh	0,18
LCOE (w subsidy)	EUR/kWh	0,18
Min DSCR**	x	-
Min LLCR***	x	-

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

At thirteen years this scheme's payback period is longer, but the annual gain increases every year leading to an overall higher gain. This is due to the self-consumed share of the electricity produced, while the average electricity price should rise by 5–6% p.a. in the coming years, making it more and more advantageous to consume one's own electricity.



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	650	675	702	730	761	789	821	854	890	923	960	999	1 041	1 080	1 123	1 168	1 218	1 264	1 314	1 367
O&M Cost	62	65	67	70	73	76	79	82	85	89	92	96	100	104	108	112	117	122	126	131
Debt Service	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Operations Year

2. Multi-occupancy housing

Segment environment

France has many multi-occupancy buildings especially in the social housing market. These buildings are major energy consumers, either for heating or for electricity. Therefore photovoltaic could be a solution for them, especially for renovation projects.

Building owners are not allowed to sell the electricity that they can produce directly to the building's tenants. Therefore the electricity produced by a photovoltaic installation on a social multi-occupancy building can only be sent to the grid against payment of an FiT, or used in the communal parts of the building.

The business model will be examined as currently encountered, when the electricity is self-consumed for the communal parts. The case of multi-occupancy housing with higher electricity production sold directly to the tenants will be analysed.

Segment Drivers

In the social housing market, the first reason for investing in a photovoltaic installation would be to follow government directions. Most installations are made during major renovation projects. It is important for owners to keep the price to tenants stable and low.

Business Models

The business models for the multi-occupancy housing segment in France are presented below.

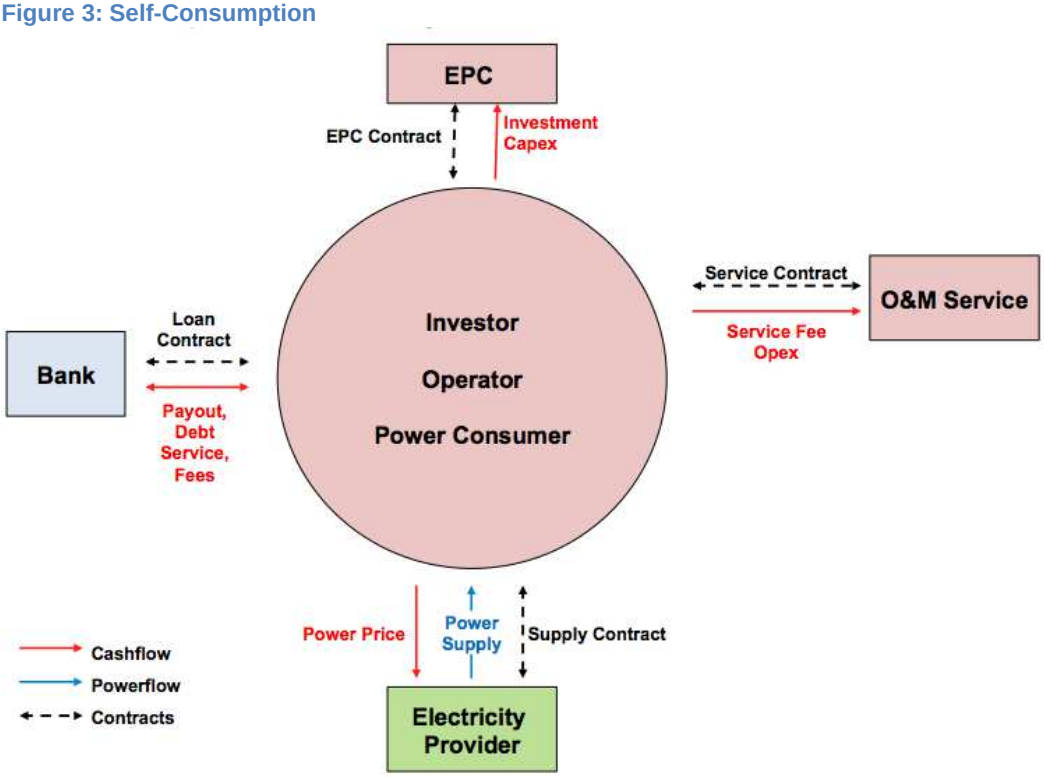
Business Model 1: Self-Consumption for the communal parts

In this scheme the investor is the building owner, and may be a private or public entity. The owner will be the electricity operator and also the consumer. The installation will be made by a contracted EPC company. It is important to include an O&M company that may differ from the EPC company. Finally, if the installation is not large enough, an electricity provider can also top up the transmission electricity through the grid.

The operator will subscribe to an electricity contract with a supplier to complete the production.

As the initial investment can be significant, a bank may participate in the project financing.

Figure 3: Self-Consumption



Profitability Analysis

The hypothesis of a consumption of 700 kWh/family/year dedicated to the communal parts was taken, based on a study from La Croix Rouge – Insertion. This consumption has been halved to reflect the consumption that could be covered by a photovoltaic installation.

An irradiation rate of 1 500 kWh/sqm. p.a. is used, which is representative of the south of France. Moreover it was assumed that for such a project, debt could be used with a gearing of 60%.

The report first looks at a building with one hundred families. This kind of building exists but new buildings are smaller. The report later looks at smaller buildings. One hundred families represent an installation of 36 kW. Buildings of this size in France were constructed in the second-half of the twentieth century but are not standard for new buildings.

PV Project		
PV System Size	kWp	36
Specific System Cost	EUR/kWp	2 050
Total System Cost	EUR	73 800
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	73 800
Fixed Operation Costs	EUR p.a.	369
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1500
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 350
Degradation	% p.a.	0,50%

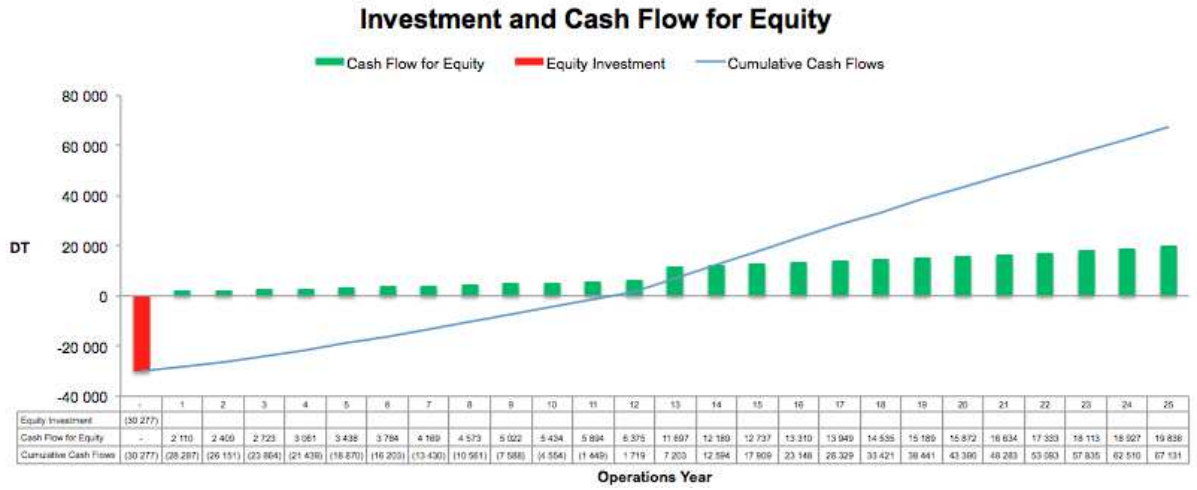
Investment			
Project Duration		Years	25
Equity		EUR	30 277
Debt (Gearing)	60%	EUR	44 280
Loan Tenor		Years	12
Interest Rate		%	4,3%
Discount Rate		%	6,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	100%	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	-

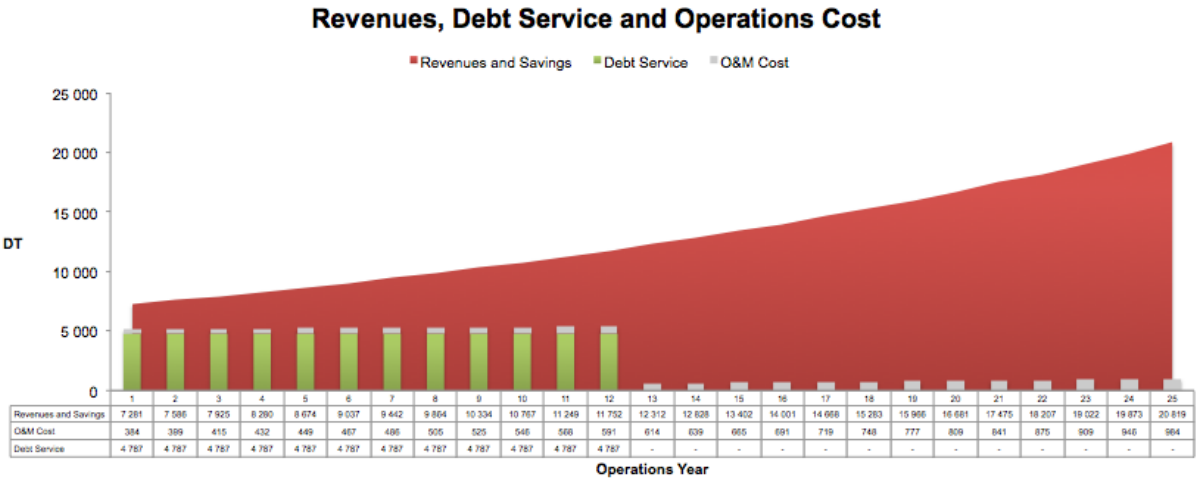
Results		
Net-Present Value	EUR	65 810
Project IRR	%	11,93%
Equity IRR	%	15,83%
Payback Period	Years	11,46
LCOE* (w/o subsidy)	EUR/kWh	0,13
LCOE (w subsidy)	EUR/kWh	0,13
Min DSCR**	x	1,44 x
Min LLCR***	x	1,81 x

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

The payback period for such projects is twelve years. The price of electricity in France is expected to rise every year by 5–6%. Therefore, self-consumption creates a gain that increases each year. Moreover, once the debt is paid back, the gains increase further.



		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	(30 277)																									
Cash Flow for Equity	-	2 110	2 409	2 723	3 051	3 438	3 784	4 189	4 573	5 022	5 434	5 894	6 375	11 697	12 189	12 737	13 310	13 949	14 535	15 189	15 872	16 634	17 333	18 113	18 927	19 836
Cumulative Cash Flows	(30 277)	(28 287)	(26 151)	(23 864)	(21 439)	(18 870)	(16 203)	(13 430)	(10 561)	(7 588)	(4 554)	(1 449)	1 719	7 203	12 594	17 909	23 148	28 329	33 421	38 441	43 390	48 283	53 083	57 835	62 510	67 131



	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	7 281	7 586	7 925	8 280	8 674	9 037	9 442	9 864	10 334	10 767	11 249	11 752	12 312	12 828	13 402	14 001	14 668	15 283	15 966	16 681	17 475	18 207	19 022	19 873	20 819
O&M Cost	384	399	415	432	449	467	486	505	525	546	568	591	614	639	665	691	719	748	777	809	841	875	909	946	984
Debt Service	4 787	4 787	4 787	4 787	4 787	4 787	4 787	4 787	4 787	4 787	4 787	4 787	-	-	-	-	-	-	-	-	-	-	-	-	-

For a smaller building, the installation needed is also smaller. The report looks at the example of a twenty five-family building, whose necessary installation size decreases to 9 kWp, while system cost decreases to € 1 970/kWp.

PV Project		
PV System Size	kWp	9
Specific System Cost	EUR/kWp	1 970
Total System Cost	EUR	17 238
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	17 238
Fixed Operation Costs	EUR p.a.	86
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1500
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 350
Degradation	% p.a.	0,50%

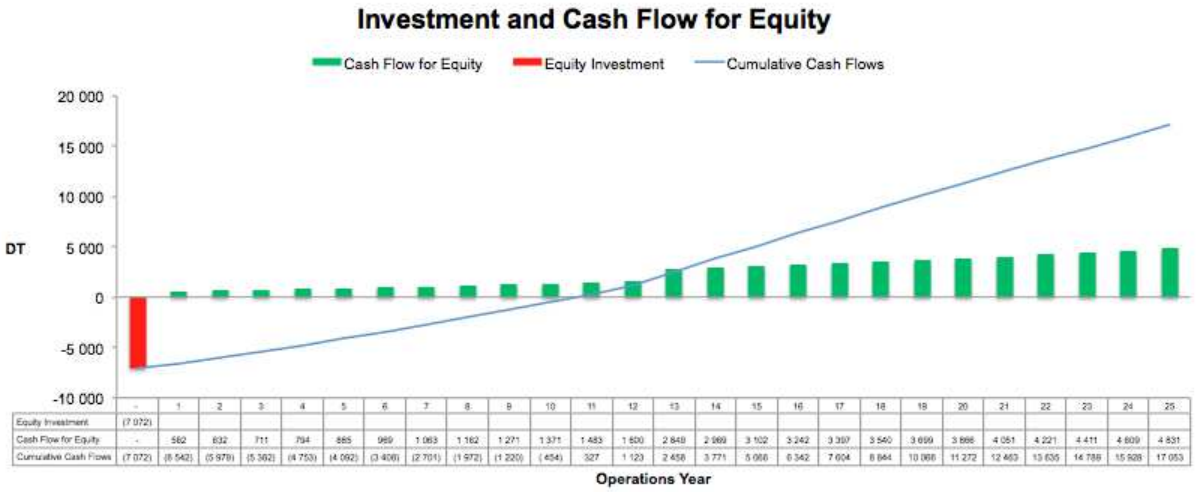
Investment			
Project Duration		Years	25
Equity		EUR	7 072
Debt (Gearing)	60%	EUR	10 343
Loan Tenor		Years	12
Interest Rate		%	4,3%
Discount Rate		%	6,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	100%	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	-
Oversupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

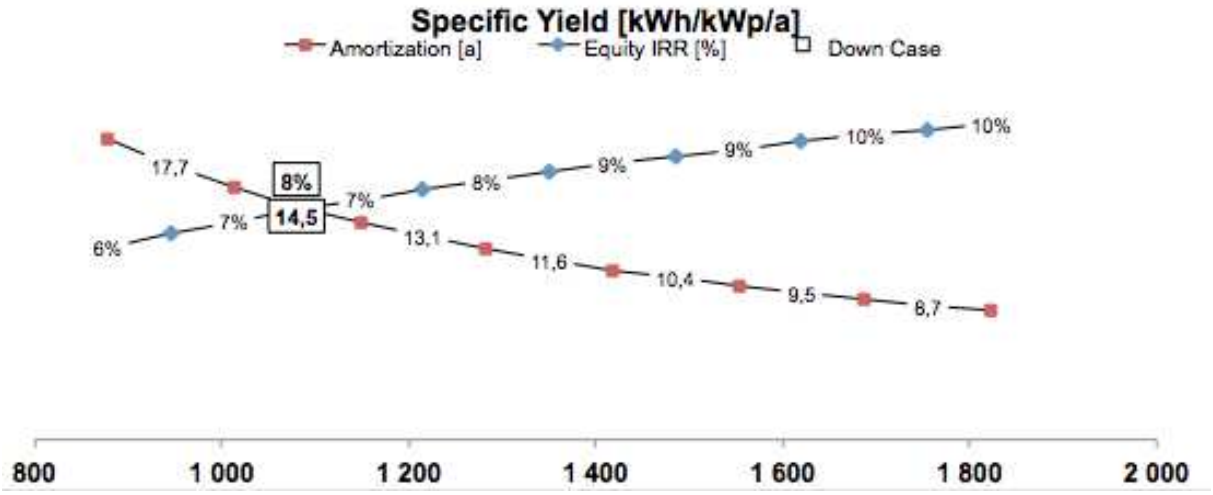
Results		
Net-Present Value	EUR	16 724
Project IRR	%	12,41%
Equity IRR	%	16,64%
Payback Period	Years	10,58
LCOE* (w/o subsidy)	EUR/kWh	0,12
LCOE (w subsidy)	EUR/kWh	0,12
Min DSCR**	x	1,50 x
Min LLCR***	x	1,89 x

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

The cash-flow model profile does not change but the amounts involved are smaller which makes the investment easier for building owners. The small decrease in the per kWp price does not make a drastic impact on the payback period.



In the north of France, where the irradiation is around 1 100 kWh/sqm. p.a., the payback period would be fifteen years.



Business Model 2: self-consumption & PPA

Another option for this model is to use the PV electricity to cover not only the consumption of the communal parts but also the tenants' consumption. This implies a dual scheme: not only a self-consumption scheme for the communal parts but also a Power Purchase Agreement scheme for the tenants.

Compared to the previous scheme, it implies the addition of a supply contract between the building and PV installation owner and the tenants. Without storage, the electricity produced by the photovoltaic installation cannot meet the evening and night-time demands. Therefore the tenants need power supply contracts with an electricity provider.

This scheme is not legal in France and building owners cannot sell electricity to the tenants. This scheme is a design for the future.

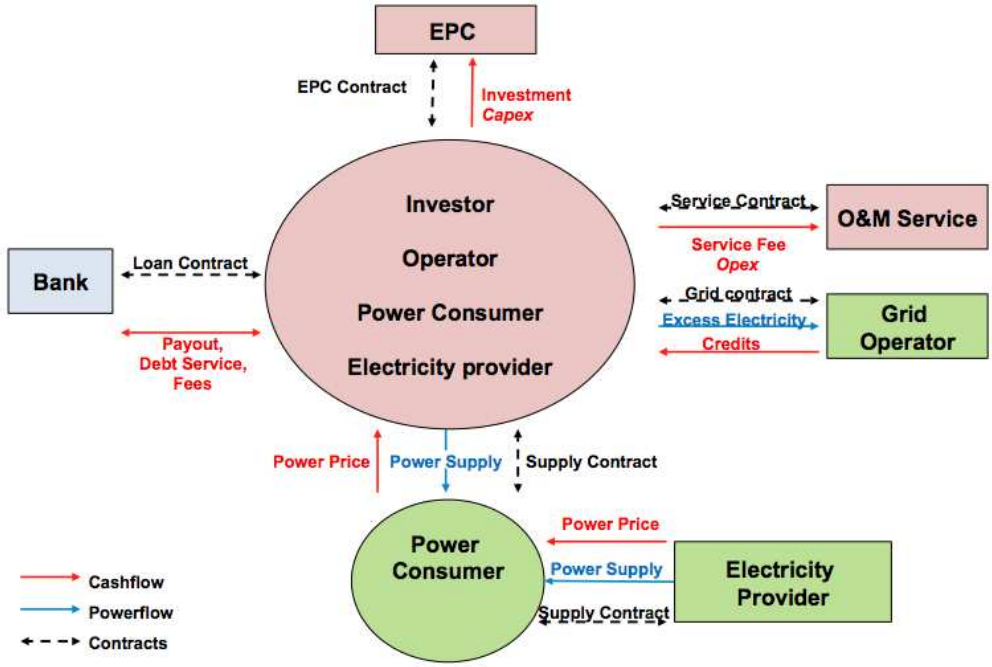


Figure 4: PPA & self-consumption

Profitability Analysis

The report looks at a twenty five-family building. It is assumed that 50% of the consumption of the communal parts and 25% of the families' consumption would be covered by a photovoltaic installation. The PPA tariff would be €0.14/kWh, which is the current household tariff in France. A small increase of 2% p.a. would apply to the PPA price.

PV Project			
PV System Size		kWp	24
Specific System Cost		EUR/kWp	2 050
Total System Cost		EUR	49 969
Investment Subsidy		EUR	-
Total System Cost incl. Subsidy		EUR	49 969
Fixed Operation Costs		EUR p.a.	250
Variable Operation Costs		EUR/kWh	-

PV Generation			
Specific Yield		kWh/qm/a	1500
Performance Factor		%	90%
Specific System Performance		kWh/kWp/a	1 350
Degradation		% p.a.	0,50%

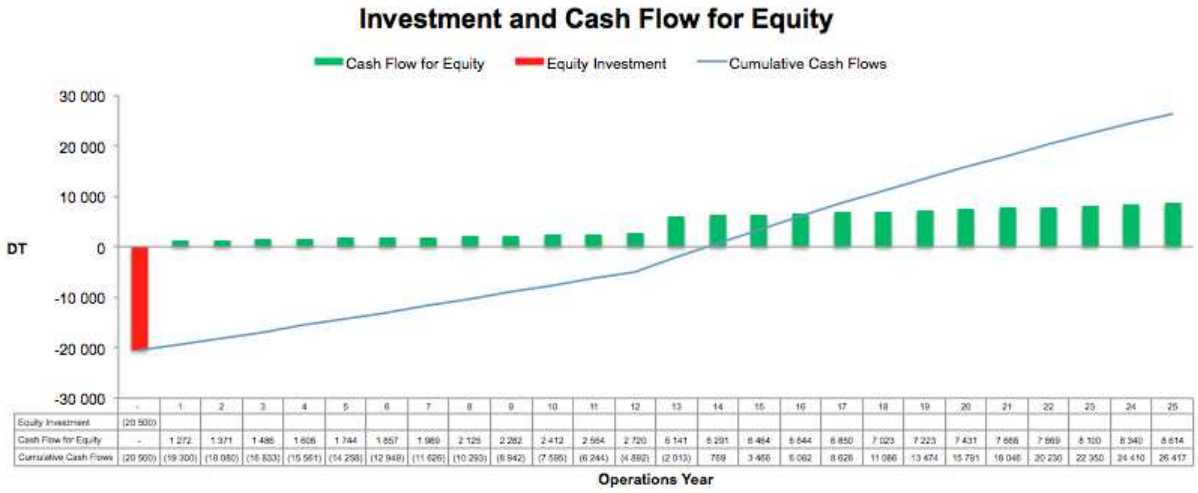
Investment			
Project Duration		Years	25
Equity		EUR	20 500
Debt (Gearing)	60%	EUR	29 981
Loan Tenor		Years	12
Interest Rate		%	4,3%
Discount Rate		%	6,0%

PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	35%	EUR/kWh	0,1300
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	65%	EUR/kWh	0,1400
Fees		EUR/kWh	0,0250
Overysupply Price		EUR/kWh	0,1000
Undersupply Penalty		EUR/kWh	0,0500

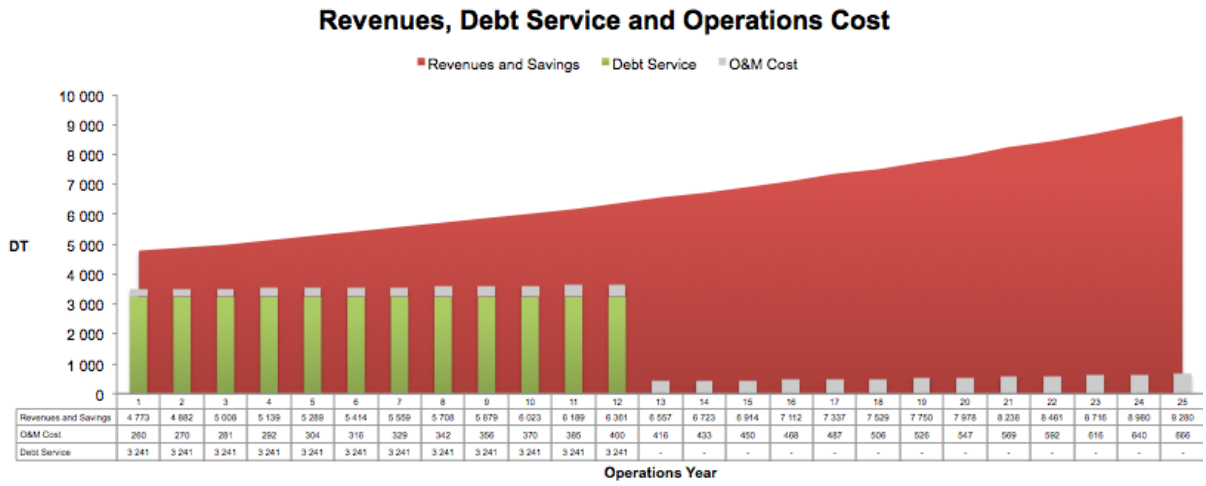
Results		
Net-Present Value	EUR	25 810
Project IRR	%	9,77%
Equity IRR	%	12,69%
Payback Period	Years	13,72
LCOE* (w/o subsidy)	EUR/kWh	0,13
LCOE (w subsidy)	EUR/kWh	0,13
Min DSCR**	x	1,39 x
Min LLCR***	x	1,58 x

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

In this scheme the payback period is fourteen years. Once the debt is paid off, the annual amount of cash for equity also rises. There is no economic advantage over the first scheme. Nevertheless, there may be a social advantage, as the electricity price paid by tenant would be more secure.



	-	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	(20 500)																									
Cash Flow for Equity	-	1 272	1 371	1 486	1 606	1 744	1 857	1 989	2 125	2 282	2 412	2 564	2 720	6 141	6 291	6 464	6 644	6 850	7 023	7 223	7 431	7 666	7 969	8 100	8 340	8 614
Cumulative Cash Flows	(20 500)	(19 300)	(18 080)	(16 833)	(15 561)	(14 256)	(12 948)	(11 626)	(10 293)	(8 942)	(7 585)	(6 244)	(4 682)	(2 013)	769	3 466	6 062	8 626	11 086	13 474	15 791	18 046	20 230	22 350	24 410	26 417



	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	4 773	4 882	5 008	5 139	5 288	5 414	5 559	5 708	5 879	6 023	6 189	6 361	6 557	6 723	6 914	7 112	7 337	7 529	7 750	7 978	8 238	8 461	8 716	8 980	9 280
O&M Cost	260	270	281	292	304	316	329	342	356	370	385	400	416	433	450	468	487	506	526	547	569	592	616	640	666
Debt Service	3 241	3 241	3 241	3 241	3 241	3 241	3 241	3 241	3 241	3 241	3 241	3 241	-	-	-	-	-	-	-	-	-	-	-	-	-

3. Shopping centres

Segment environment

Photovoltaic is a great opportunity for shopping centres. Sector professionals are interested in self-consumption schemes as the electricity production from a photovoltaic installation coincides with shopping centres' peak consumption.

Moreover, when a new commercial centre opens, which is rare, it often has a photovoltaic installation on its roof or its roof is built with provision for installing photovoltaic panels. It is harder to install photovoltaic on an existing building, as most roofs are not sufficiently robust to take the weight of the installation.

Segment Drivers

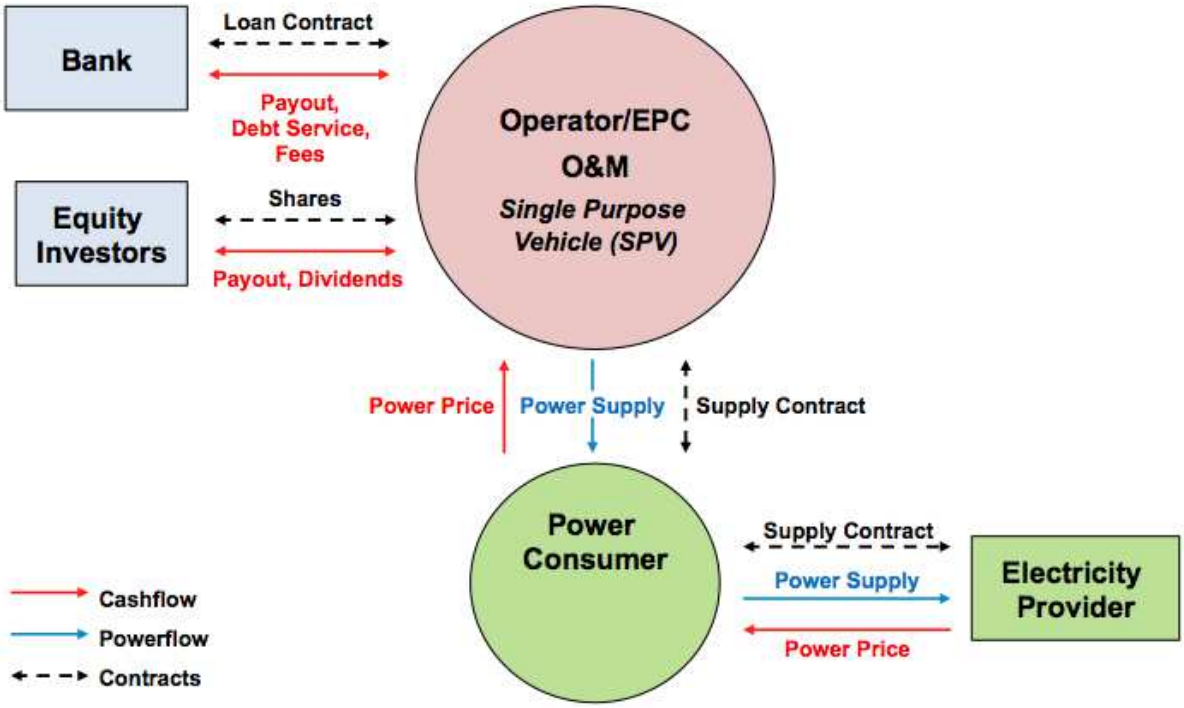
Many shopping centres and supermarkets invest in photovoltaic in anticipation of rising electricity prices for the coming years. With a photovoltaic installation they can either set a price for twenty years with a FiT or avoid spending too much money on electricity through self-consumption. This is why many cases on this market have been observed for building business models. The report presents a first reference scenario that has been tested and implemented. The second scheme draws the lines that will help replicate the first model.

Business Models

Business Model 1: Power Purchase Agreement

In this existing business model, an EPC company installs a photovoltaic installation on the roof of a supermarket. The same company sets up a Single Purpose Vehicle (SPV) to carry the project and it will be the owner and operator of the installation. The SPV sells the electricity to the supermarket through a Power Purchase Agreement (PPA) for a negotiated price. The installation size is calculated not to be excessive, so that there is no electricity oversupply and no grid injection. The supermarket tops up its electricity supply with a second contract with an electricity provider. The operation is financed through debt and equity. The operator rents out the roof of the centre; therefore a small rent is allocated to the owner.

Figure 5: Power Purchase Agreement



Profitability Analysis

The report looks at an installation of 250 kWp with a cost of 1 667 EUR/kWp. As the case is based on the aggregation of real projects in France, the yield is 1 150 kWh/sqm. p.a. The electricity price set in the PPA is €0.1750/kWh for the project duration, which is high compared to current market prices. Half of the project cost is carried by debt.

PV Project		
PV System Size	kWp	250
Specific System Cost	EUR/kWp	1 667
Total System Cost	EUR	416 750
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	416 750
Fixed Operation Costs	EUR p.a.	3 084
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1150
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 035
Degradation	% p.a.	0,90%

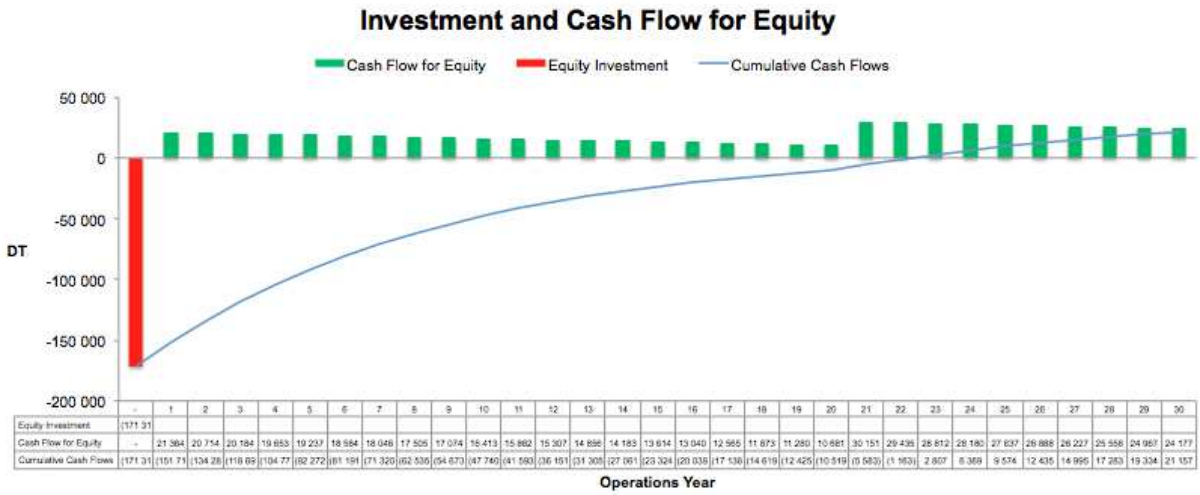
Investment			
Project Duration		Years	30
Equity		EUR	171 318
Debt (Gearing)	60%	EUR	250 000
Loan Tenor		Years	20
Interest Rate		%	5,0%
Discount Rate		%	9,0%

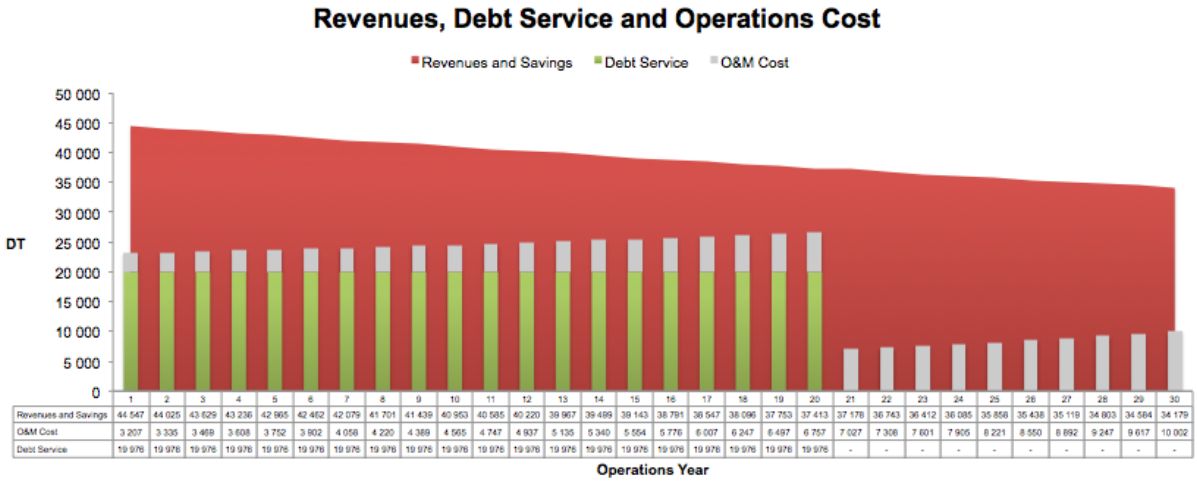
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	100%	EUR/kWh	0,1750
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	18 169
Project IRR	%	7,47%
Equity IRR	%	10,16%
Payback Period	Years	22,29
LCOE* (w/o subsidy)	EUR/kWh	0,16
LCOE (w subsidy)	EUR/kWh	0,16
Min DSCR**	x	1,53 x
Min LLCR***	x	1,53 x

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

The payback period of this business model is twenty-two years and the Net Present Value (NPV) is positive, therefore the scheme presents a rational investment.





	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	26	27	28	29	30
Revenues and Savings	44 547	44 025	43 629	43 236	42 965	42 462	42 079	41 701	41 439	40 953	40 585	40 220	39 967	39 499	39 143	38 791	38 547	38 096	37 753	37 413	37 178	36 743	36 412	36 085	35 858	35 438	35 118	34 803	34 584	34 179
O&M Cost	3 207	3 335	3 469	3 608	3 752	3 902	4 058	4 220	4 389	4 565	4 747	4 937	5 135	5 340	5 554	5 776	6 007	6 247	6 497	6 757	7 027	7 308	7 601	7 905	8 221	8 550	8 892	9 247	9 617	10 002
Debt Service	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	19 976	-	-	-	-	-	-	-	-	-	-

Business Model 2: PPA with stressed market conditions

The second business model uses the same scheme and the same case. The installation size is 250 kWp and the yield is 1 150 kWh/sqm. p.a. This second case takes a lower PPA price of €0.16/kWh because it will be closer to the market price and more acceptable for centres' managements, without escalation.

PV Project		
PV System Size	kWp	250
Specific System Cost	EUR/kWp	1 667
Total System Cost	EUR	416 750
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	416 750
Fixed Operation Costs	EUR p.a.	3 084
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1150
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 035
Degradation	% p.a.	0,90%

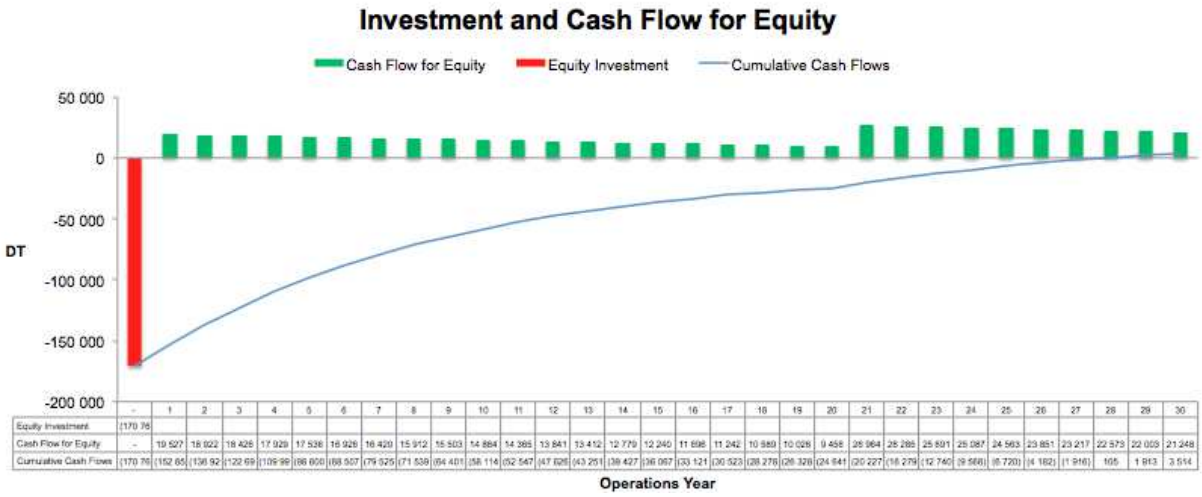
Investment			
Project Duration		Years	30
Equity		EUR	170 768
Debt (Gearing)	60%	EUR	250 050
Loan Tenor		Years	20
Interest Rate		%	3,8%
Discount Rate		%	9,0%

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	0,1600
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

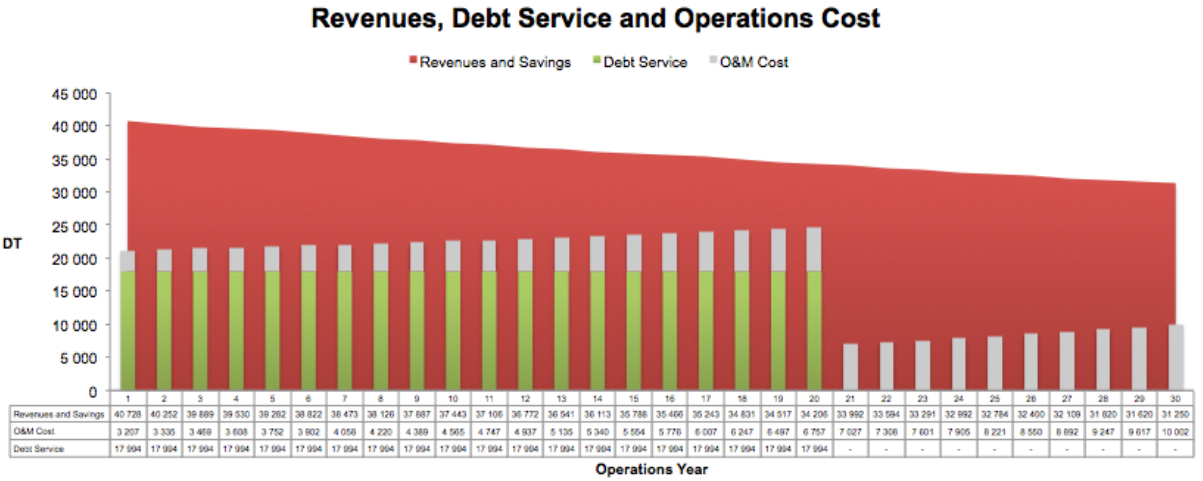
Results		
Net-Present Value	EUR	917
Project IRR	%	6,38%
Equity IRR	%	9,06%
Payback Period	Years	27,95
LCOE* (w/o subsidy)	EUR/kWh	0,15
LCOE (w subsidy)	EUR/kWh	0,15
Min DSCR**	x	1,53 x
Min LLCR***	x	1,53 x

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

In this case the NPV is still positive but the payback period increases to twenty eight years.



		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	26	27	28	29	30
Equity Investment	(170 76																														
Cash Flow for Equity	-	19 527	18 822	18 426	17 929	17 526	16 926	16 420	15 912	15 503	14 884	14 385	13 841	13 412	12 779	12 240	11 696	11 242	10 589	10 026	9 458	26 964	26 285	25 691	25 087	24 563	23 851	23 217	22 573	22 003	21 248
Cumulative Cash Flows	(170 76	(152 65	(136 92	(122 69	(109 99	(98 609	(88 507	(79 925	(71 539	(64 401	(58 114	(52 547	(47 826	(43 251	(38 427	(36 067	(33 121	(30 523	(28 276	(26 328	(24 641	(20 227	(16 279	(12 740	(9 566)	(6 720)	(4 182)	(1 916)	105	1 913	3 514



	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	26	27	28	29	30
Revenues and Savings	40 728	40 252	39 889	39 530	39 282	38 822	38 473	38 126	37 887	37 443	37 106	36 772	36 541	36 113	35 788	35 466	35 243	34 831	34 517	34 206	33 992	33 594	33 291	32 992	32 784	32 400	32 109	31 820	31 620	31 250
O&M Cost	3 207	3 335	3 469	3 608	3 752	3 902	4 058	4 220	4 389	4 565	4 747	4 937	5 135	5 340	5 554	5 776	6 007	6 247	6 497	6 757	7 027	7 308	7 601	7 905	8 221	8 550	8 892	9 247	9 617	10 002
Debt Service	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	17 994	-	-	-	-	-	-	-	-	-	-

In the first business model the discount rate was set at 9%. The case took the same discount rate to build the profitability analysis of the second scheme. But if the implementation of the first scheme is a success, the learning curve will improve and risk will be lower for replication. Therefore the discount rate could be lower. In the case of a project with a PPA price of €0.16/kWh and a discount rate of 7%, the payback period is 20 years.

PV Project		
PV System Size	kWp	250
Specific System Cost	EUR/kWp	1 667
Total System Cost	EUR	416 750
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	416 750
Fixed Operation Costs	EUR p.a.	3 084
Variable Operation Costs	EUR/kWh	-

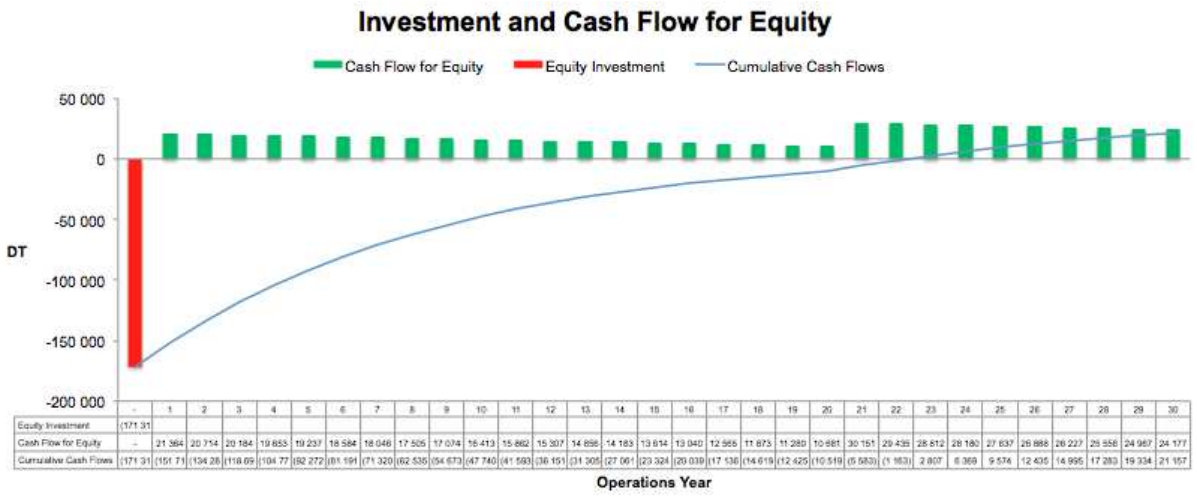
PV Generation		
Specific Yield	kWh/qm/a	1150
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 035
Degradation	% p.a.	0,90%

Investment			
Project Duration		Years	30
Equity		EUR	171 318
Debt (Gearing)	60%	EUR	250 000
Loan Tenor		Years	20
Interest Rate		%	5,0%
Discount Rate		%	9,0%

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	0,1750
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	18 169
Project IRR	%	7,47%
Equity IRR	%	10,16%
Payback Period	Years	22,29
LCOE* (w/o subsidy)	EUR/kWh	0,16
LCOE (w subsidy)	EUR/kWh	0,16
Min DSCR**	x	1,53 x
Min LLCR***	x	1,53 x

* 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	21	22	23	24	25	26	27	28	29	30
Equity Investment	(171 31																														
Cash Flow for Equity	-	21 364	20 714	20 184	19 853	19 237	18 584	18 046	17 505	17 074	16 413	15 862	15 307	14 856	14 183	13 614	13 040	12 565	11 873	11 280	10 681	30 151	29 435	28 812	28 180	27 637	26 888	26 227	25 556	24 967	24 177
Cumulative Cash Flows	(171 31	(151 71	(134 26	(118 09	(104 77	(92 272	(81 191	(71 320	(62 535	(54 673	(47 740	(41 593	(36 151	(31 305	(27 061	(23 324	(20 039	(17 136	(14 619	(12 425	(10 519	(5 583)	(1 163)	2 807	6 369	9 574	12 435	14 995	17 283	19 334	21 157

4. Office Buildings

Segment environment

Very few office buildings are equipped with photovoltaic panels in France. PV solutions could represent an opportunity for small and medium enterprises, which own their own office buildings, which is rarely the case. As for large groups, existing buildings are not necessarily PV-ready, so installation would come with new building projects.

Segment Drivers

Building managers invest in photovoltaic installations for new buildings, prior to the construction phase. A photovoltaic investment makes sense when it is part of a bigger investment regarding the entire building or, in some cases during its renovation. Promotors include photovoltaic when they want to construct a building with high energy efficiency standards. In these cases, photovoltaic is part of a package with other renewable energy sources and powerful heating and cooling control. Therefore photovoltaic in office buildings is often implemented using latest forms of integration, such as vertical integration in the walls or transparent cells.

The electricity produced can be used for the communal parts. The report looks at two cases that for the time being are not authorised in France, but would make economic sense – Power Purchase Agreement (PPA) and Net-metering.

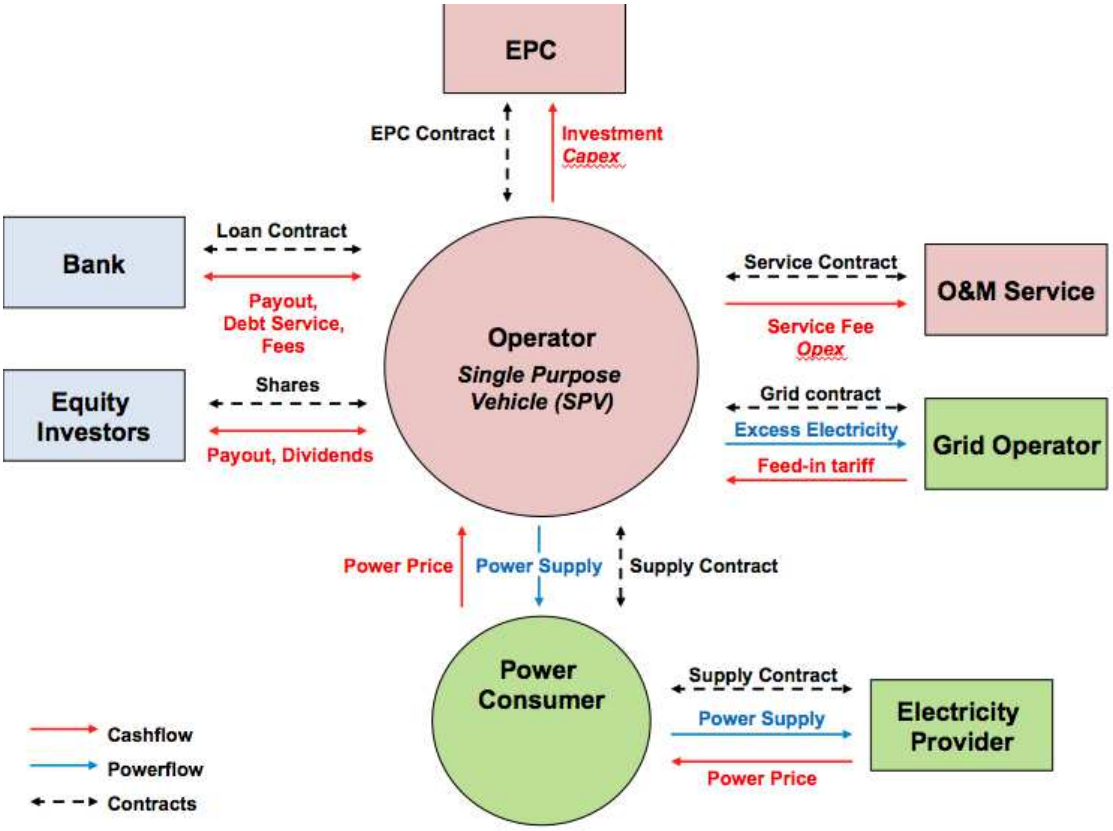
Business Models

Business Model 1: Power Purchase Agreement (PPA)

A power purchase agreement is a contract between a power consumer and an operator. In the case of an office building, the operator could sell the electricity to the companies that installed offices in the building. To do so, the operator would create a Single Purpose Vehicle (SPV) in charge of the project: selling electricity to the consumer, which consumes the electricity produced on the spot, injecting any excess electricity into the grid and mandating an operation and maintenance company.

Power consumers can top up their electricity needs by signing a second contract with another electricity provider.

Figure 6: Power Purchase Agreement



Profitability Analysis

The report presents the theoretical case of a building based in the South of France (irradiation at 1 500 kWh/sqm. p.a.) that installs 100 kWp of photovoltaic panels and sells the production to the companies it hosts through a PPA. Based on ADEME prices, the total cost of the project is € 168k, supported by debt with a gearing of 70%.

The report assumes that the PPA tariff in the first year is €0.10/kWh, with annual escalation of 3%.

PV Project		
PV System Size	kWp	100
Specific System Cost	EUR/kWp	1 680
Additional CapEx (e.g. Batterie)	EUR	-
Investment Subsidy	EUR	-
Total System Cost	EUR	168 000
Fixed Operation Costs	EUR p.a.	2 520
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1500
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 350
Degradation	% p.a.	0,90%

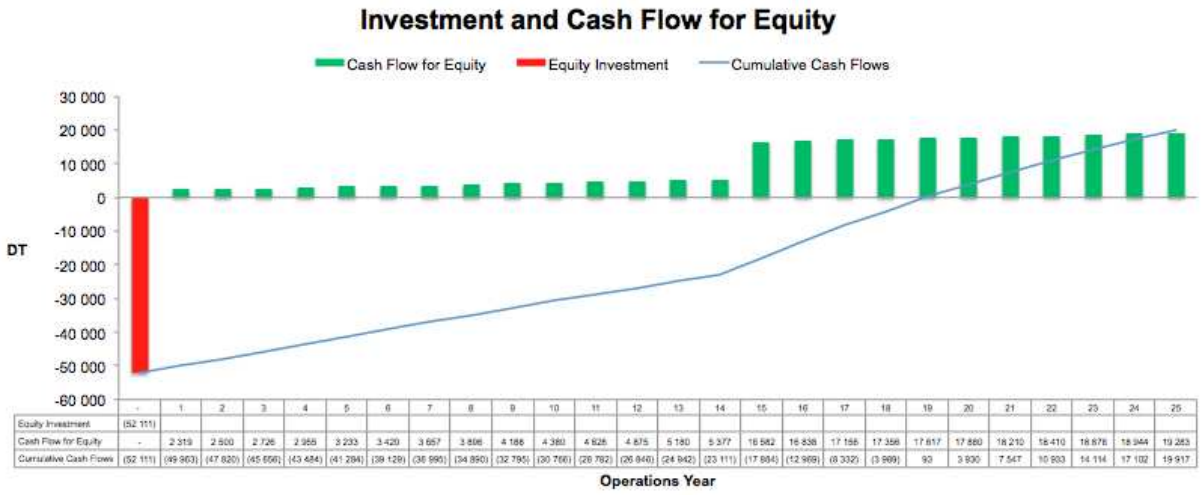
Investment			
Project Duration		Years	25
Equity		EUR	52 111
Debt (Gearing)	70%	EUR	117 600
Loan Tenor		Years	14
Interest Rate		%	3,8%
Discount Rate		%	8,0%

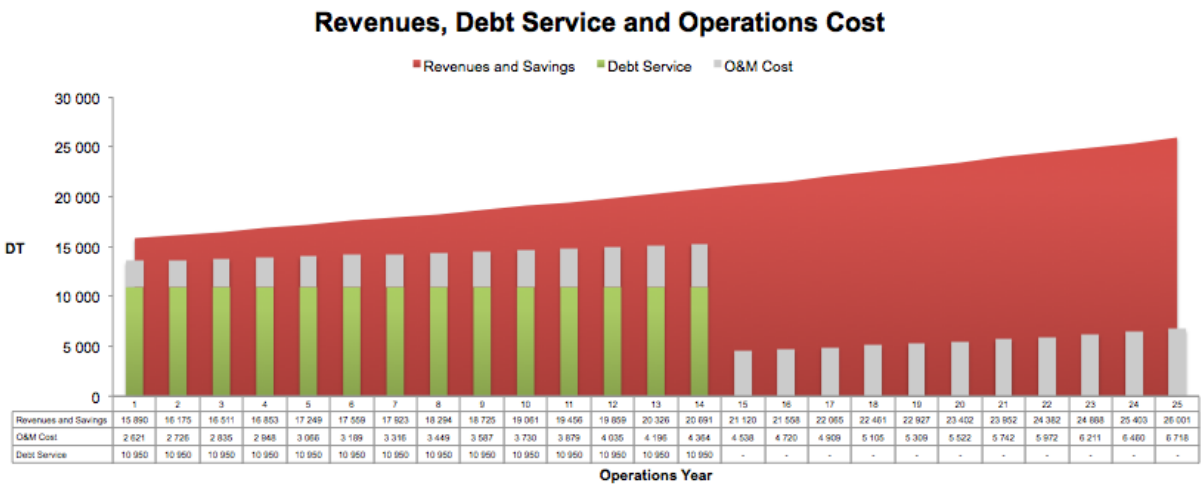
PV Business Model				
Category		Share	Unit	Price
Feed-in Tariff		-	EUR/kWh	-
Self-consumption		-	EUR/kWh	-
	Fees		EUR/kWh	-
Net-metering		-	EUR/kWh	-
	Fees		EUR/kWh	-
	Excess Electricty		EUR/kWh	-
PPA Tariff		100%	EUR/kWh	0,1000
	Fees		EUR/kWh	-
	Overysupply Price		EUR/kWh	0,0600
	Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	18 839
Project IRR	%	7,41%
Equity IRR	%	10,39%
Payback Period	Years	18,98
LCOE* (w/o subsidy)	EUR/kWh	0,13
LCOE (w subsidy)	EUR/kWh	0,13
Min DSCR**	x	1,21 x
Min LLCR***	x	1,33 x

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

On the basis of this hypothesis, the Net Present Value (NPV) of the project is positive but the payback period is up to nineteen years long.



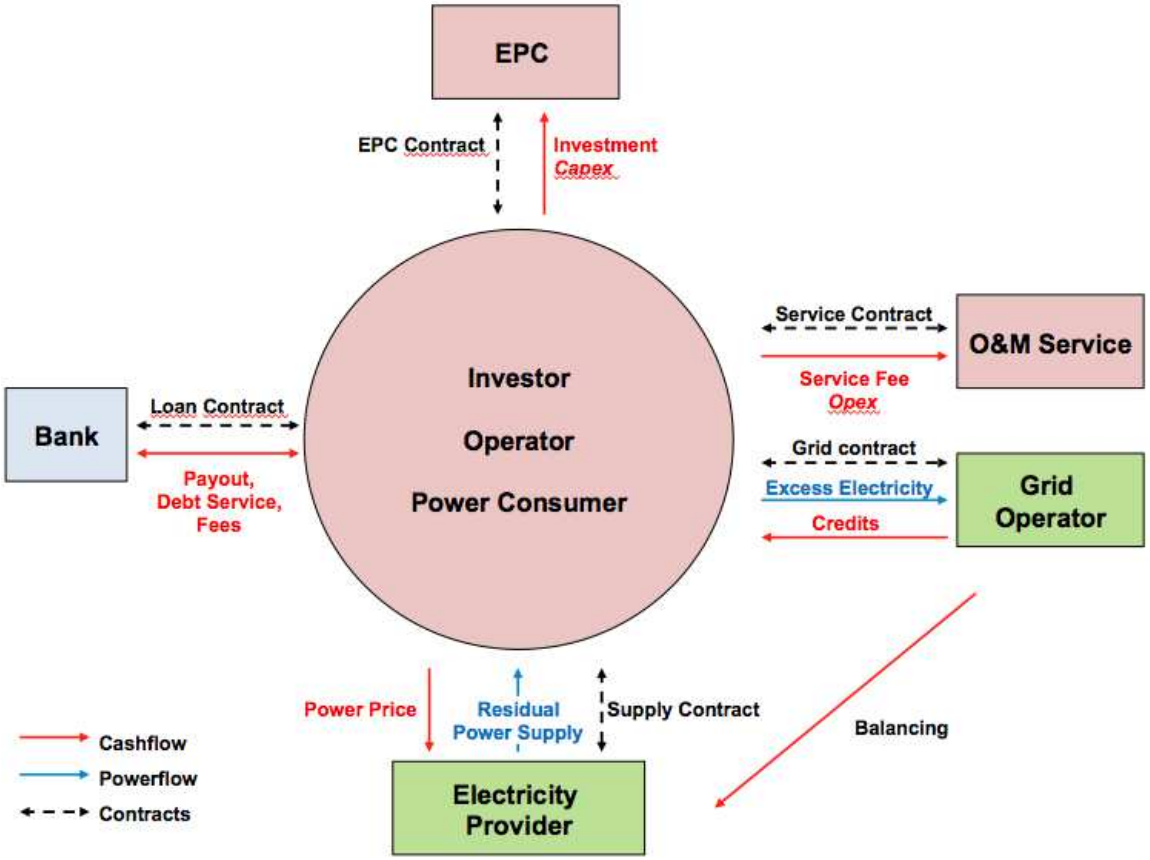


	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
Revenues and Savings	15 890	16 175	16 511	16 853	17 249	17 559	17 923	18 294	18 725	19 061	19 456	19 859	20 326	20 691	21 120	21 558	22 065	22 461	22 927	23 402	23 952	24 382	24 888	25 403	26 001
O&M Cost	2 621	2 726	2 835	2 948	3 066	3 189	3 316	3 449	3 587	3 730	3 879	4 035	4 195	4 364	4 538	4 720	4 909	5 105	5 309	5 522	5 742	5 972	6 211	6 460	6 718
Debt Service	10 950	10 950	10 950	10 950	10 950	10 950	10 950	10 950	10 950	10 950	10 950	10 950	10 950	10 950	-	-	-	-	-	-	-	-	-	-	-

Business Model 2: Net Metering

In the second business model, the building management installs a photovoltaic installation that produces electricity used for the communal parts of the building. The rest of the electricity is sent to the grid in exchange for credits for this electricity. In case of an electricity shortage, the building will use electricity from the grid paying the market price despite the use of accumulated credits.

Figure 7: Net-metering



Profitability Analysis

The report presents the theoretical case of a 36-kWp installation on an office building in the South of France with irradiation of 1 500 kWh/sqm. p.a. The total project cost is € 73 800 that can be supported by debt with a gearing of 70%.

The hypothesis is that 80% of the produced electricity is consumed and 20% is sent and sold in the grid.

PV Project			
PV System Size		kWp	36
Specific System Cost		EUR/kWp	2 050
Total System Cost		EUR	73 800
Investment Subsidy		EUR	-
Total System Cost incl. Subsidy		EUR	73 800
Fixed Operation Costs		EUR p.a.	1 107
Variable Operation Costs		EUR/kWh	-

PV Generation			
Specific Yield		kWh/qm/a	1500
Performance Factor		%	90%
Specific System Performance		kWh/kWp/a	1 350
Degradation		% p.a.	0,90%

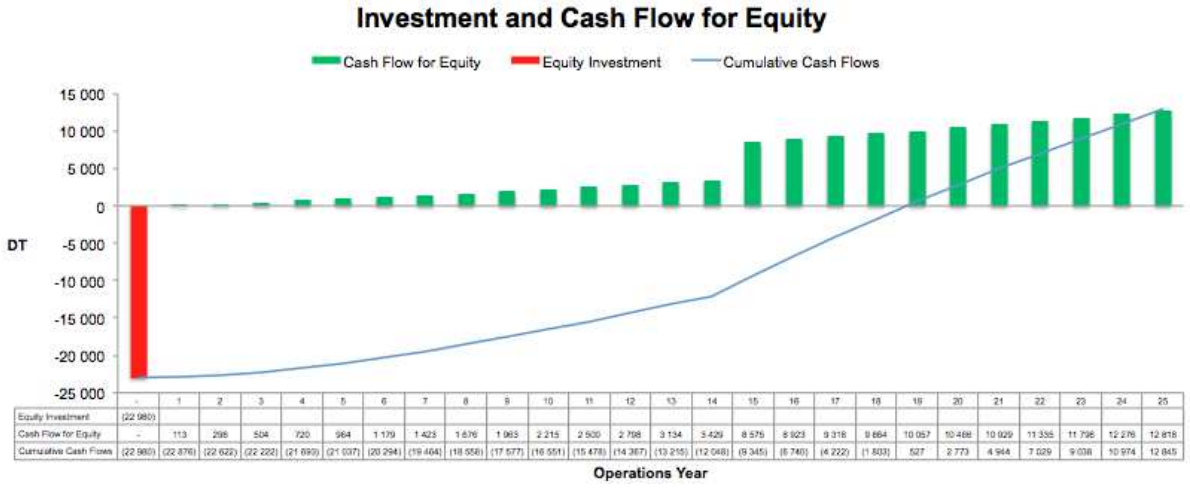
Investment			
Project Duration		Years	25
Equity		EUR	22 980
Debt (Gearing)	70%	EUR	51 660
Loan Tenor		Years	14
Interest Rate		%	3,8%
Discount Rate		%	8,0%

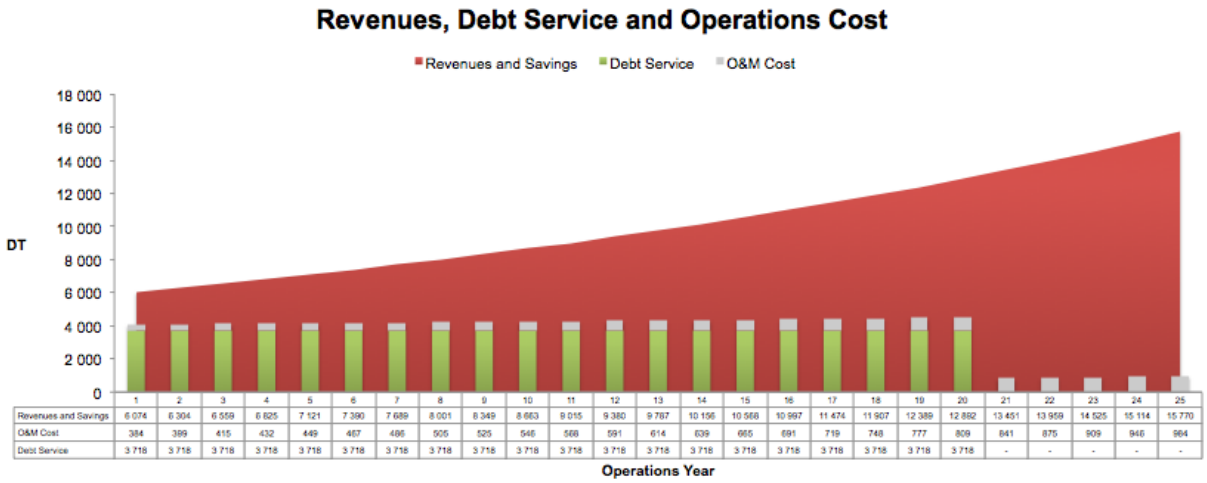
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	100%	EUR/kWh	0,1100
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	-	EUR/kWh	-
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	12 279
Project IRR	%	7,98%
Equity IRR	%	10,92%
Payback Period	Years	18,77
LCOE* (w/o subsidy)	EUR/kWh	0,16
LCOE (w subsidy)	EUR/kWh	0,16
Min DSCR**	x	1,02 x
Min LLCR***	x	1,31 x

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

This case is similar to the previous one with positive NPV and a payback period of up to nineteen years.





	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	6 074	6 304	6 559	6 825	7 121	7 390	7 689	8 001	8 349	8 663	9 015	9 380	9 787	10 156	10 568	10 997	11 474	11 907	12 389	12 882	13 451	13 959	14 525	15 114	15 770
O&M Cost	384	399	415	432	449	467	486	505	525	546	568	591	614	639	665	691	719	748	777	809	841	875	909	946	984
Debt Service	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	3 718	-	-	-	-	-

5. Educational buildings

Segment environment

The French administration is responsible for the management of public education but the referring authority depends on the level of the school: municipalities are responsible for primary schools, departments for middle schools, regions for high schools and the State for universities.

The administration is responsible for electricity management and investments, which means it is paying for the electricity and will be the financial beneficiary of any investment.

Segment Drivers

The main driver for a local authority to install photovoltaic panels on a school roof is to fulfil a political commitment towards green energy.

The economic advantage of a photovoltaic installation is low for local authorities, even when the electricity is paid with a Feed-in Tariff (FiT), as the report shows in the first business model. Moreover, business models based on self-consumption are hardly accurate for schools as they are closed for several weeks every year during holidays and also at the weekend. In the second part, the report shows the profitability level of an installation with a net-metering scheme.

Business Models

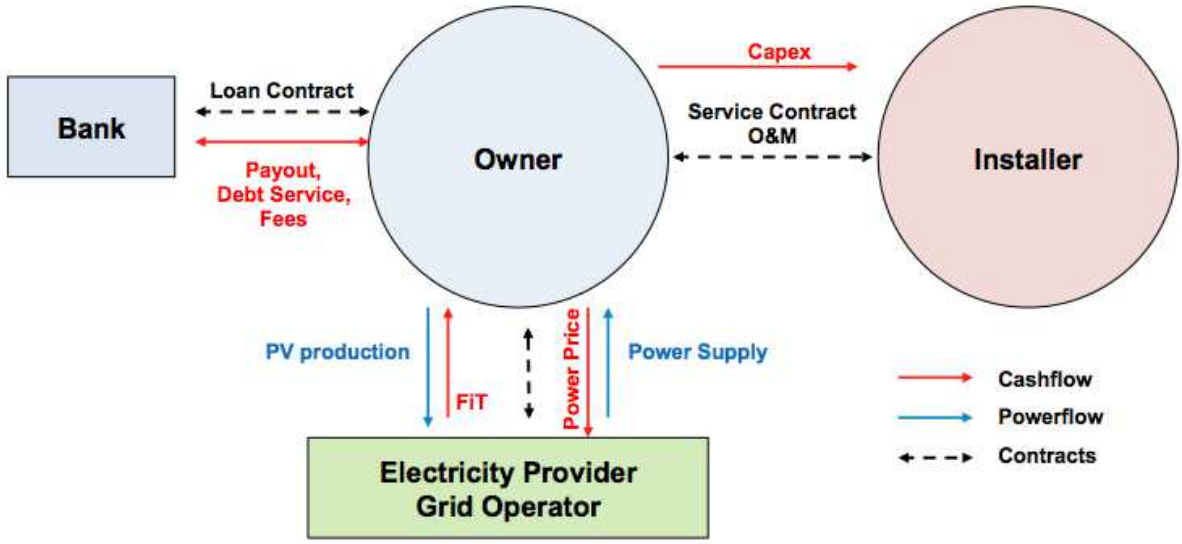
The business models of educational buildings in France are represented below.

Business Model 9: Feed-in Tariff (FiT)

In the model presented in this report, a professional installs the panels, which are bought by the local authority. The same installer can provide O&M services during the installation's lifetime. Depending on the installation size and cost, part of the financing can be covered through debt.

In the case of a FiT, the electricity produced is sent to the grid and bought by the grid operator at a fixed price. The electricity consumed by the building comes from the grid and is bought from an electricity producer.

Figure 8: Feed-in Tariff



Profitability Analysis

The report presents the case of a 100 kWp installation that would be implemented in the south of France where irradiation is 1 500 kWh/sqm. p.a. In the third quarter of 2015, the FiT for such an installation is € 13.96/kWh. The cost of the installation is € 168 000 of which 50% is covered through debt.

PV Project		
PV System Size	kWp	100
Specific System Cost	EUR/kWp	1 680
Total System Cost	EUR	168 000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	168 000
Fixed Operation Costs	EUR p.a.	2 520
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1500
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 350
Degradation	% p.a.	0,90%

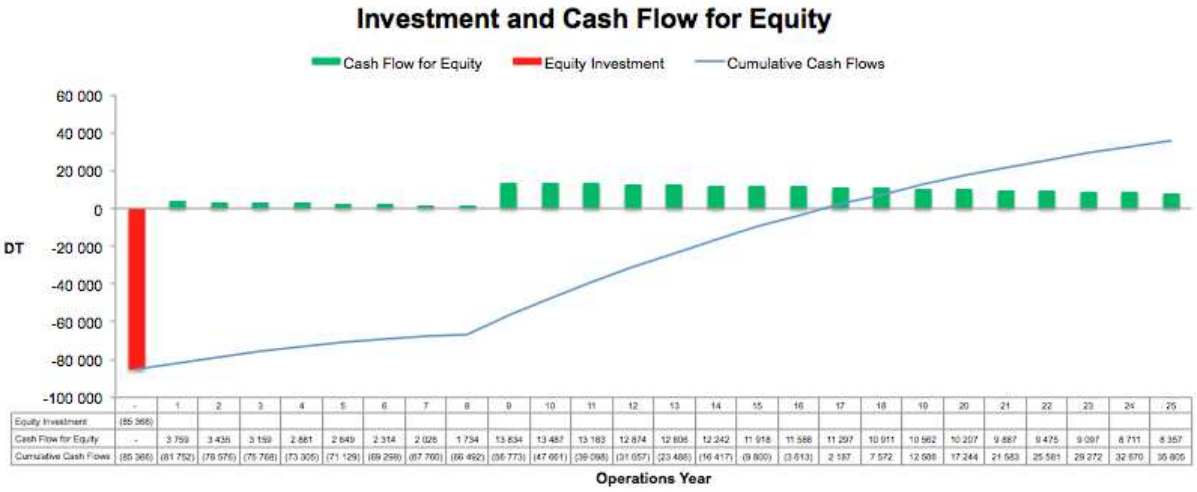
Investment			
Project Duration		Years	25
Equity		EUR	85 366
Debt (Gearing)	50%	EUR	84 000
Loan Tenor		Years	8
Interest Rate		%	3,8%
Discount Rate		%	4,0%

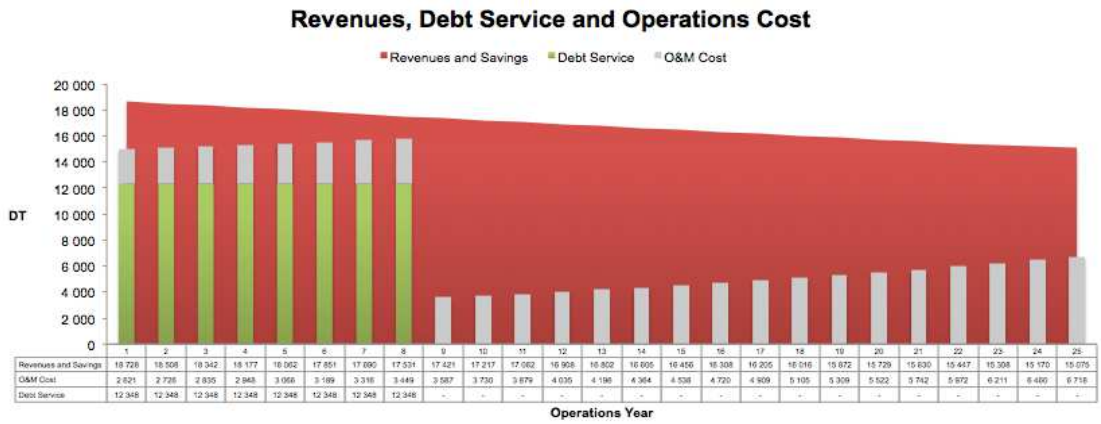
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	100%	EUR/kWh	0,1396
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	-	EUR/kWh	-
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	34 854
Project IRR	%	5,99%
Equity IRR	%	6,73%
Payback Period	Years	16,62
LCOE* (w/o subsidy)	EUR/kWh	0,12
LCOE (w subsidy)	EUR/kWh	0,12
Min DSCR**	x	1,14 x
Min LLCR***	x	1,14 x

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

The investment has a positive net present value but its payback period is long… as much as seventeen years, and thus be a barrier to such an investment.



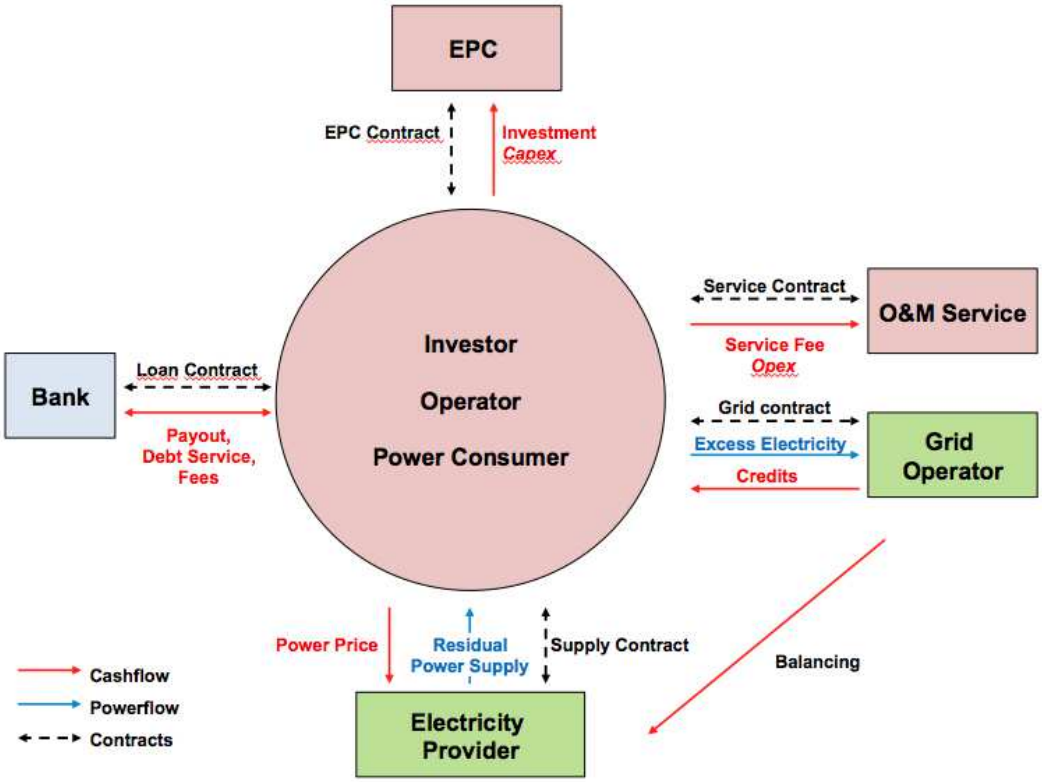


Business Model 2: Net Metering

A net-metering scheme could be an alternative scenario for educational buildings. In this scheme, part of the electricity produced by the panels is self-consumed. This can be the electricity produced during the days of the week, excluding the holidays. The rest of the electricity is injected in the grid and bought for a fixed price negotiated prior to the photovoltaic installation.

The local administration is still the owner of the panels and still requires the services of an EPC company and an O&M company. The cost of the project can partly be carried by debt.

Figure 9: Net-metering



Profitability analysis

The report looks at an installation similar to the one presented in the first part: a 100-kWp project that costs € 1 680/kWp. The irradiation is the same: 1 500 kWh/sqm. p.a.

It is assumed that 40% of the produced electricity is consumed by the school. The other 60% is sold to the grid at a price of € 0.11/kWh.

PV Project		
PV System Size	kWp	100
Specific System Cost	EUR/kWp	1 680
Total System Cost	EUR	168 000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	168 000
Fixed Operation Costs	EUR p.a.	2 520
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1500
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 350
Degradation	% p.a.	0,90%

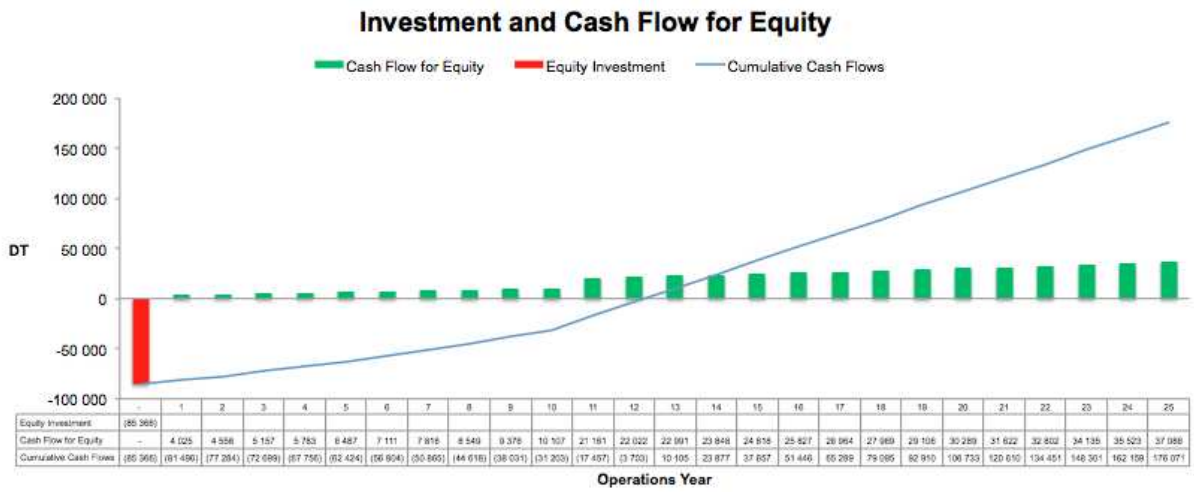
Investment			
Project Duration		Years	25
Equity		EUR	85 366
Debt (Gearing)	50%	EUR	84 000
Loan Tenor		Years	10
Interest Rate		%	3,8%
Discount Rate		%	4,0%

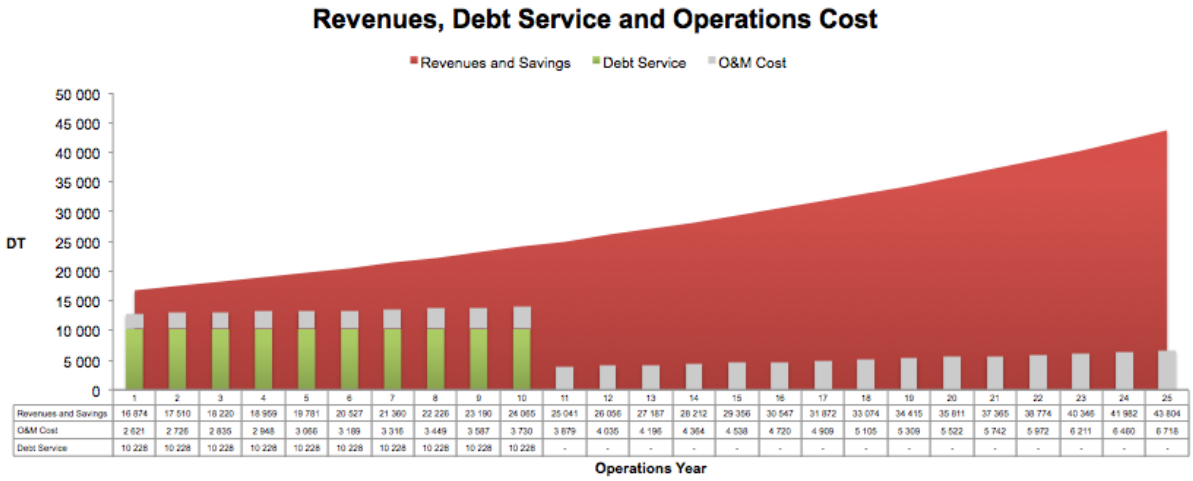
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	100%	EUR/kWh	0,1100
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	-	EUR/kWh	-
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	173 685
Project IRR	%	10,46%
Equity IRR	%	12,58%
Payback Period	Years	12,27
LCOE* (w/o subsidy)	EUR/kWh	0,12
LCOE (w subsidy)	EUR/kWh	0,12
Min DSCR**	x	1,39 x
Min LLCR***	x	1,65 x

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

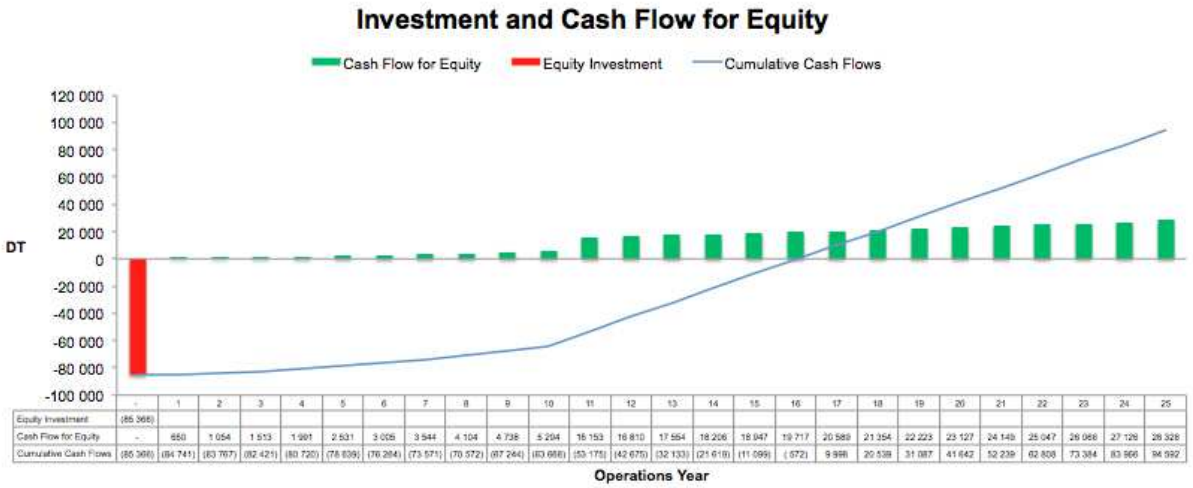
In this project the Net Present Value of the installation is still positive and the payback period is twelve years, which is closer to an acceptable level for such an investment.





	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	16 874	17 510	18 220	18 959	19 781	20 527	21 360	22 226	23 190	24 065	25 041	26 056	27 187	28 212	29 356	30 547	31 872	33 074	34 415	35 811	37 365	38 774	40 346	41 982	43 804
O&M Cost	2 621	2 726	2 835	2 948	3 066	3 189	3 316	3 449	3 587	3 730	3 879	4 035	4 196	4 364	4 538	4 720	4 909	5 105	5 309	5 522	5 742	5 972	6 211	6 460	6 718
Debt Service	10 228	10 228	10 228	10 228	10 228	10 228	10 228	10 228	10 228	10 228	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

As the latter scenario is based on a price escalation of 5% per year, the report shows the results when this escalation is 2% per year. In this case, the payback period is sixteen years.



	-	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	(85 366)																									
Cash Flow for Equity	-	650	1 054	1 513	1 991	2 531	3 005	3 544	4 104	4 738	5 294	16 153	16 810	17 554	18 206	18 947	19 717	20 589	21 354	22 223	23 127	24 149	25 047	26 066	27 126	28 328
Cumulative Cash Flows	(85 366)	(84 741)	(83 767)	(82 421)	(80 720)	(78 639)	(76 284)	(73 571)	(70 572)	(67 244)	(63 666)	(53 175)	(42 675)	(32 133)	(21 618)	(11 099)	(572)	9 998	20 538	31 087	41 642	52 239	62 808	73 384	83 966	94 992

6. Industrial parks

Segment environment

France has many industrial parks and technology clusters that could benefit from photovoltaic installations. Among the most innovative business schemes, Power Purchase Agreements (PPA) could be the most interesting, as they could be established between two entities based in the same park. As it stands PPAs are not authorised in France, therefore photovoltaic installations are mostly based on Feed-in Tariff (FiT), presented as first business model in this report.

Segment Drivers

The main driver for industrial parks to install photovoltaic panels is to create an eco-responsible environment to attract companies that want to have a positive impact on the environment.

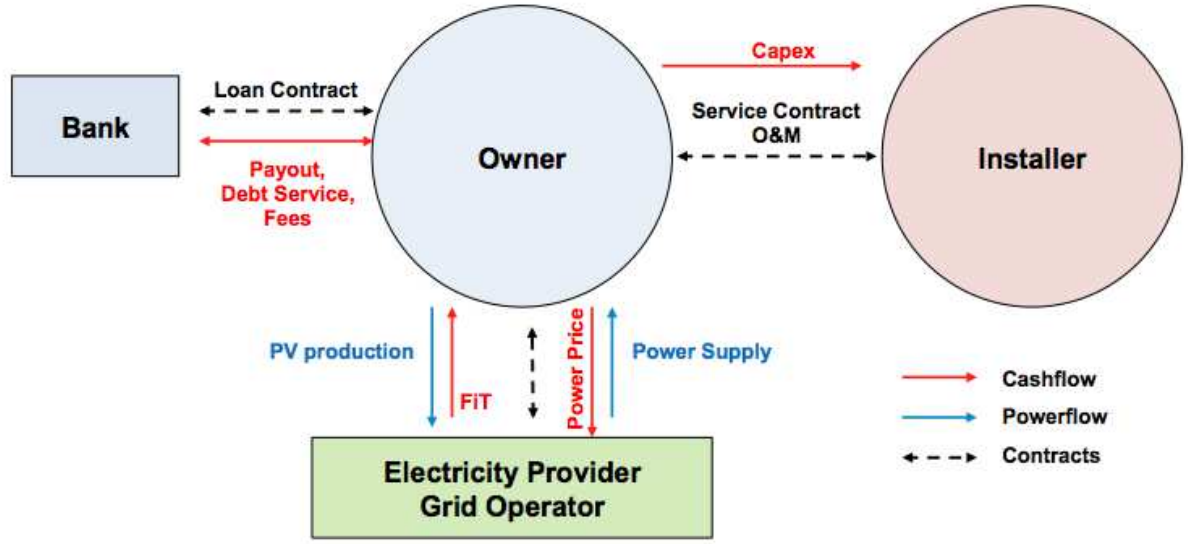
Business Models

Business Model 1: Feed-in Tariff (FiT)

The FiT is the model that can be used in industrial parks in France. An entity contracts the installation of PV panels with an installer that may possibly provide the operation and maintenance of the installation. The owner of the PV panels can use the financial services of a bank to finance the project.

The produced electricity is sold to a grid operator, at a fixed price for twenty years. The owner of the panels buys electricity from an electricity provider at the retail price offered by the provider for the building’s consumption.

Figure 10: Feed-In Tariff (FiT).



Profitability Analysis

The report looks at an installation 100 kWp with a total cost of €168k, based in the south of France where irradiation is 1 500 kWh/sqm. p.a. In the third quarter of 2015 the FiT for this installation is €0.1396/kWh.

PV Project		
PV System Size	kWp	100
Specific System Cost	EUR/kWp	1 680
Total System Cost	EUR	168 000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	168 000
Fixed Operation Costs	EUR p.a.	2 520
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1500
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 350
Degradation	% p.a.	0,90%

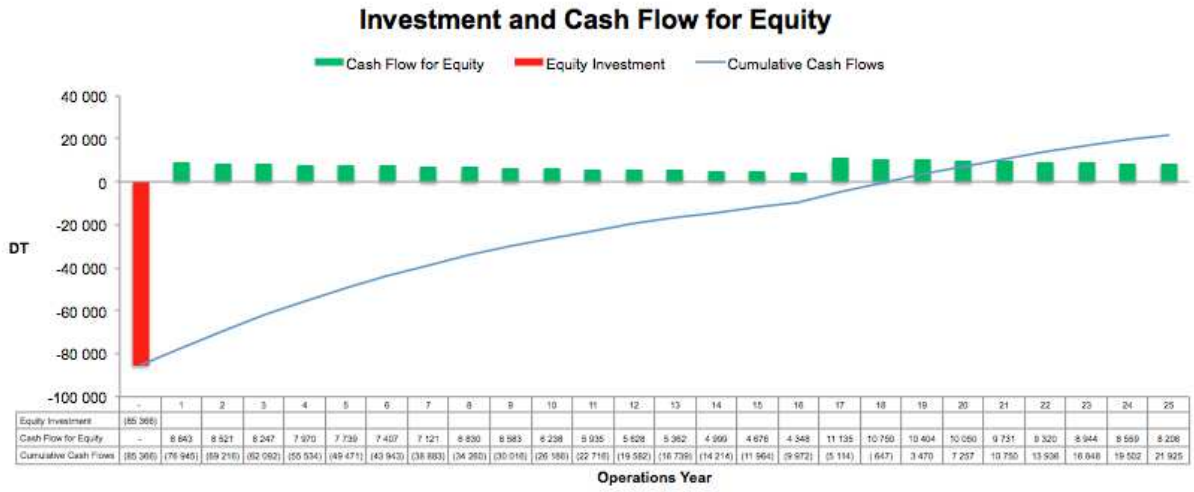
Investment			
Project Duration		Years	25
Equity		EUR	85 366
Debt (Gearing)	50%	EUR	84 000
Loan Tenor		Years	16
Interest Rate		%	3,8%
Discount Rate		%	5,0%

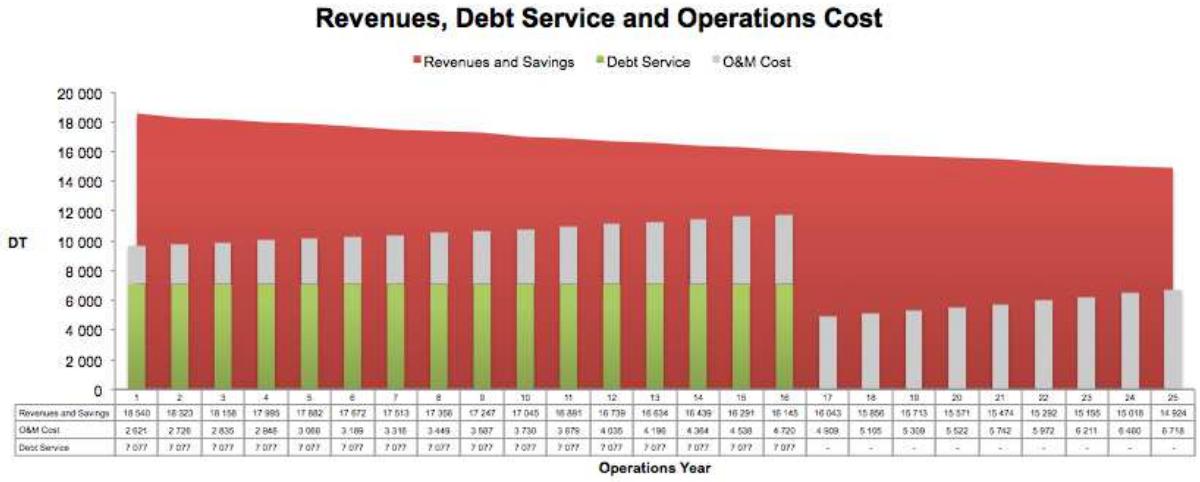
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	100%	EUR/kWh	0,1396
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	-	EUR/kWh	-
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	20 929
Project IRR	%	5,84%
Equity IRR	%	7,27%
Payback Period	Years	18,16
LCOE* (w/o subsidy)	EUR/kWh	0,13
LCOE (w subsidy)	EUR/kWh	0,13
Min DSCR**	x	1,61 x
Min LLCR***	x	1,61 x

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

The project is sound because the Net Present Value (NPV) is positive. At eighteen years, the payback period of such an investment would long.





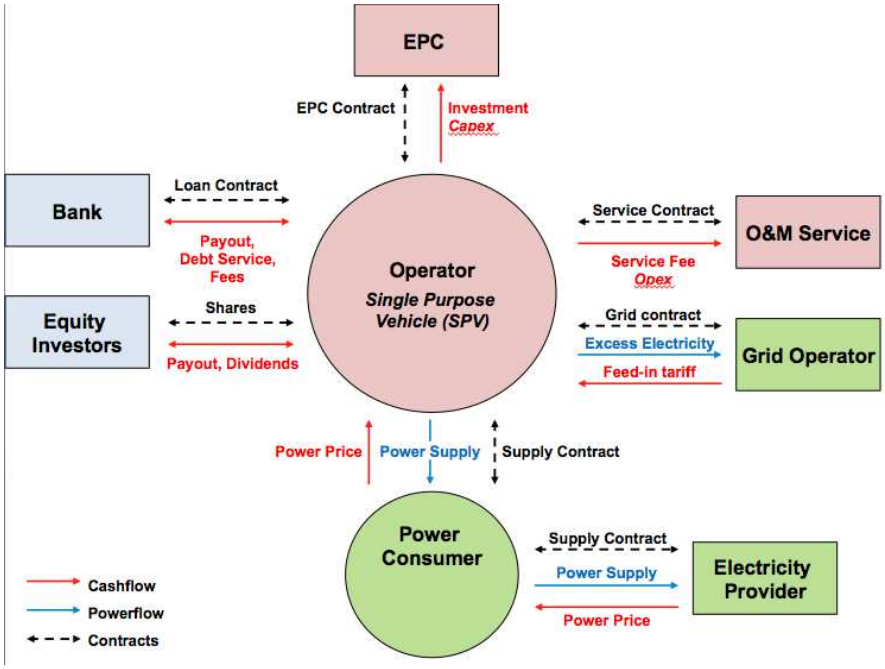
Business Model 2: Power Purchase Agreement

A PPA could be a good alternative on industrial parks, as it would allow one company to sell its electricity to neighbouring companies. This could lead to a local grid development.

A PPA is a contract between a power consumer and an operator. In the case of an office building, the operator could sell the electricity to the companies that installed offices in the building. To do so, the operator would create a Single Purpose Vehicle (SPV) to run the project: selling electricity to the consumer, injecting any excess electricity into the grid and mandating an operation and maintenance company.

Power consumers can source the rest of their electricity through a second contract with another electricity provider.

Figure 11: Power Purchase Agreement



Profitability Analysis

The report looks at an installation with the same parameters as the latter: a 100-kWp installation that costs €168k, based in the South of France. The PPA price is set up at €0.13/kWh with a price escalation of 3% over the years compared to the market price of electricity that should rise by 5–6% p.a. The discount rate is set at 8% to reflect a higher risk than a FiT-based project.

PV Project		
PV System Size	kWp	100
Specific System Cost	EUR/kWp	1 680
Total System Cost	EUR	168 000
Investment Subsidy	EUR	-
Total System Cost incl. Subsidy	EUR	168 000
Fixed Operation Costs	EUR p.a.	2 520
Variable Operation Costs	EUR/kWh	-

PV Generation		
Specific Yield	kWh/qm/a	1500
Performance Factor	%	90%
Specific System Performance	kWh/kWp/a	1 350
Degradation	% p.a.	0,90%

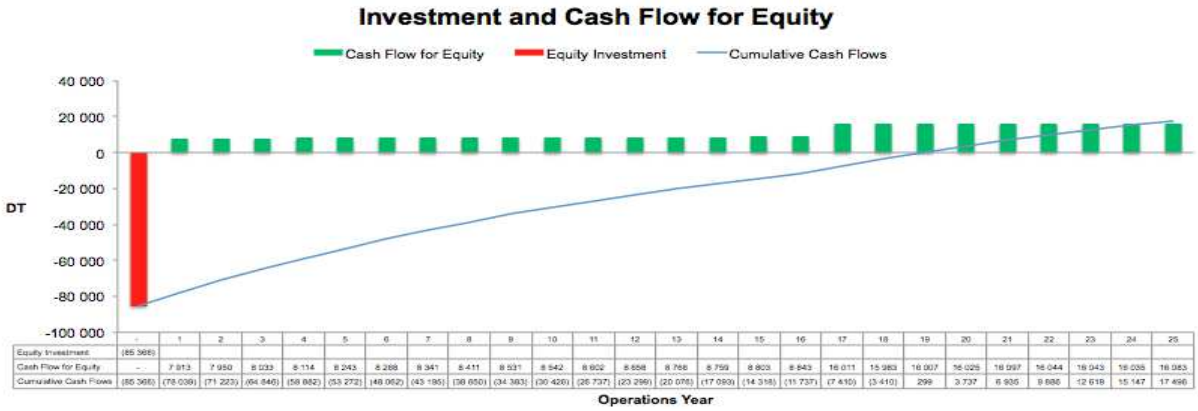
Investment			
Project Duration		Years	25
Equity		EUR	85 366
Debt (Gearing)	50%	EUR	84 000
Loan Tenor		Years	16
Interest Rate		%	3,8%
Discount Rate		%	8,0%

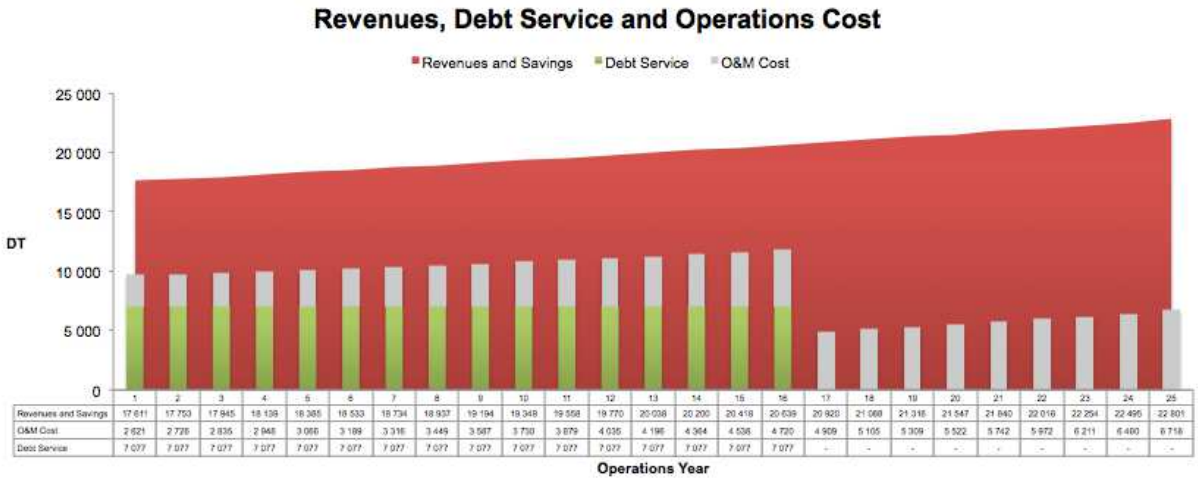
PV Business Model			
Category	Share	Unit	Price
Feed-in Tariff	-	EUR/kWh	-
Self-consumption	-	EUR/kWh	-
Fees		EUR/kWh	-
Net-metering	-	EUR/kWh	-
Fees		EUR/kWh	-
Excess Electricty		EUR/kWh	-
PPA Tariff	100%	EUR/kWh	0,1300
Fees		EUR/kWh	-
Overysupply Price		EUR/kWh	-
Undersupply Penalty		EUR/kWh	-

Results		
Net-Present Value	EUR	16 018
Project IRR	%	7,59%
Equity IRR	%	9,77%
Payback Period	Years	18,92
LCOE* (w/o subsidy)	EUR/kWh	0,14
LCOE (w subsidy)	EUR/kWh	0,14
Min DSCR**	x	2,12 x
Min LLCR***	x	2,18 x

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

In this project the Net Present Value (NPV) is positive and the payback period is seventeen years, which is long.





The graph below shows that this payback period would be improved if the PPA price escalation were 3%. The payback period would then be sixteen years.