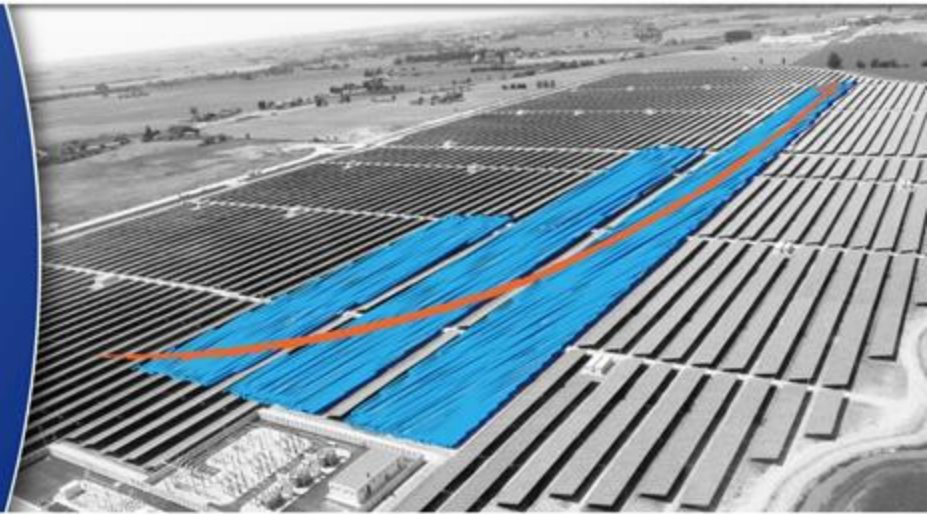


Development limited by regulation – self- consumption in Spain

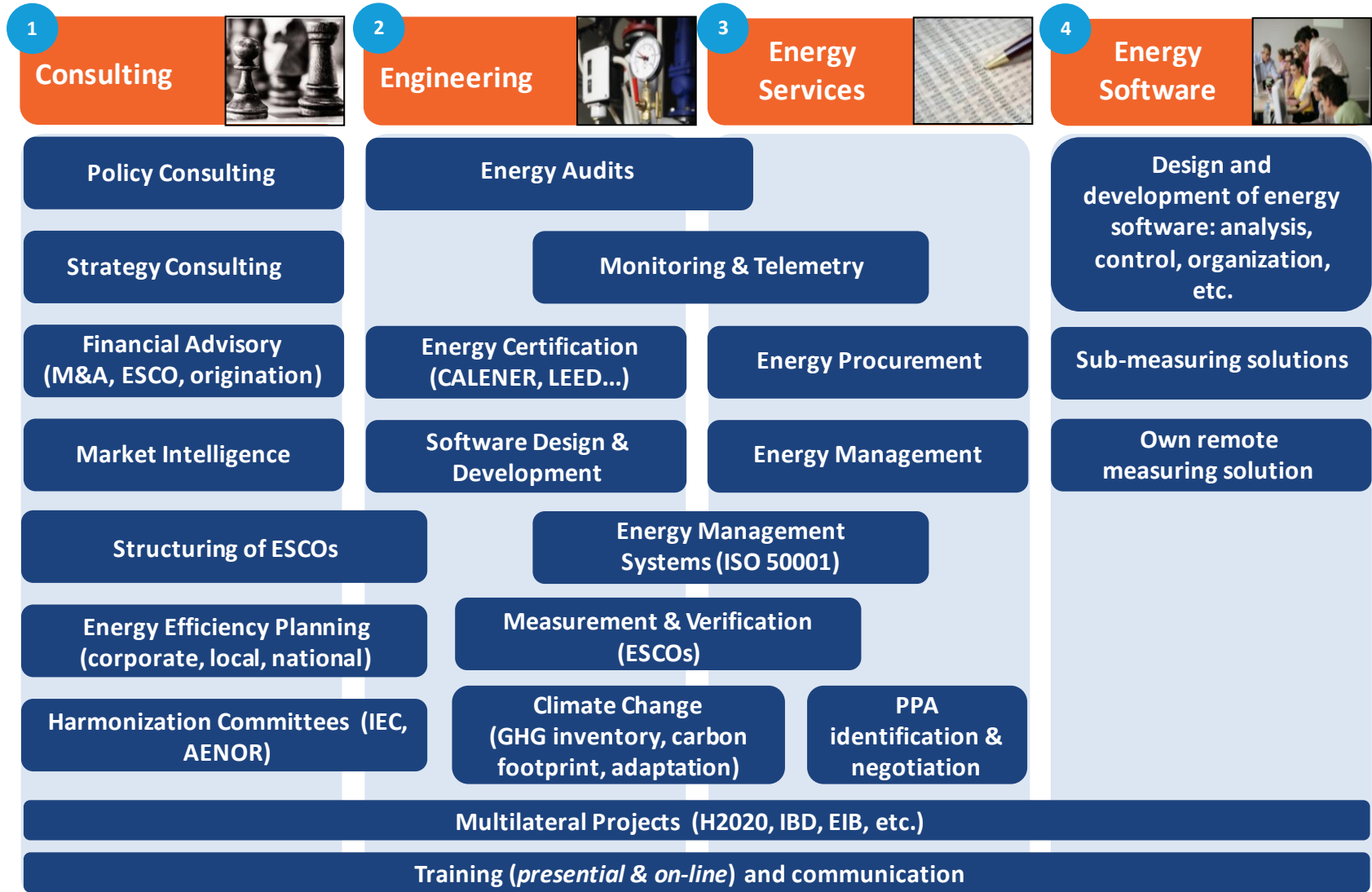


Workshop 18th October 2016 - CREARA



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Creara - Sustainable energy services



Creara - Markets & Clients

MARKETS



- **Renewable Energy**
 - Biomass and biofuels
 - Cogeneration
 - Geothermal
 - Marine
 - Photovoltaic
 - Solar Thermal Electric
 - Wind



- **Smart Grids**
 - Smart communities & cities
 - T&D
 - Power electronics (LV, MV, HV)
 - Automation and control
 - Electric Vehicle
 - Energy Storage
 - RES integration



- **Energy Efficiency**
 - ESCOs
 - Hotels & Hospitality
 - Hospitals
 - Industrial
 - Municipalities
 - Oil & Gas
 - Retail chains



- **Climate Change & Adaptation**
 - Local
 - National
 - Regional

CLIENTS

- **Entire market value chain**
 - Equipment & component manufacturers
 - Wholesalers
 - Integrators
 - Project developers
 - ESCOs
 - Utilities (DSOs & TSOs)
 - Independent energy retailers
 - Industry associations

- **Public entities**
 - Regulators
 - Energy agencies
 - Multilateral agencies
 - Local, national & regional governments

- **Final consumer**
 - Private consumers
 - Communities (cities, etc.)
 - Public consumers

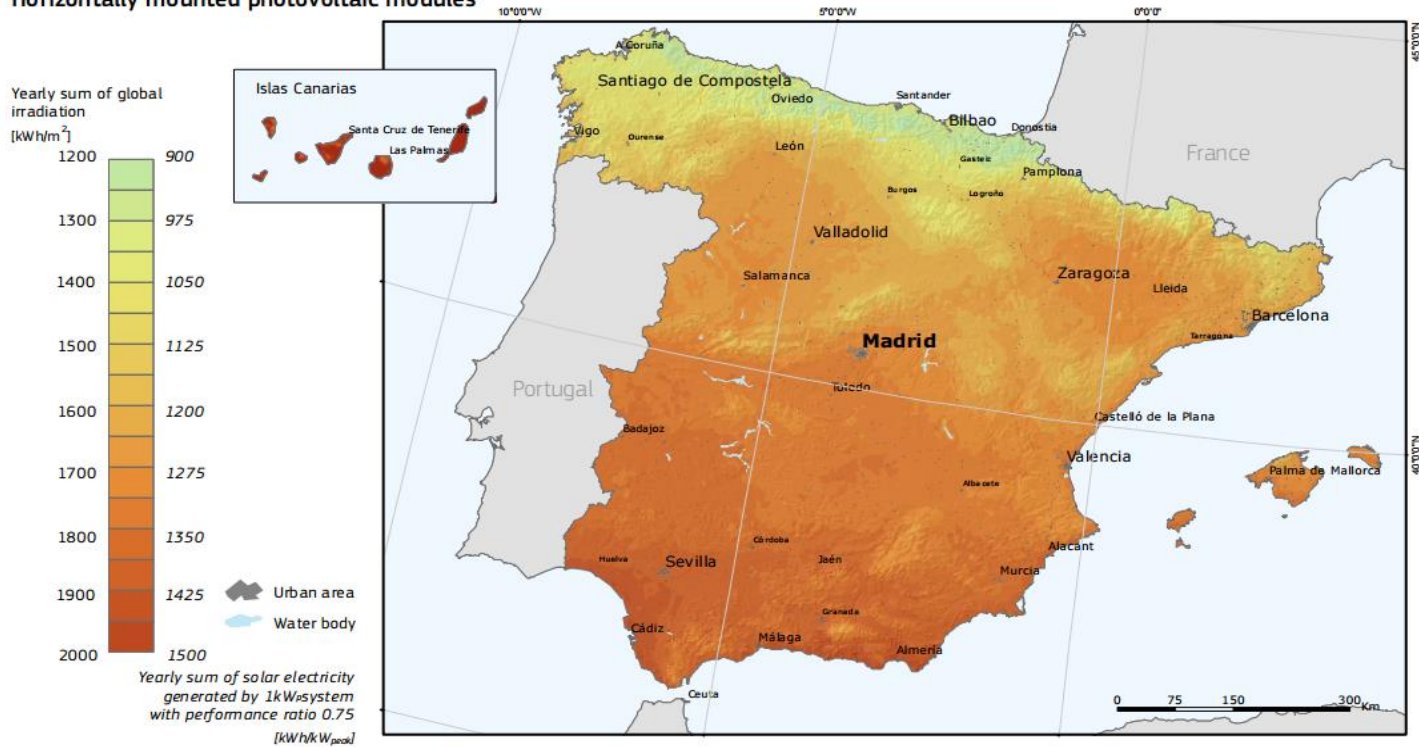
- **Financial & legal sector**
 - Law firms
 - Private equity
 - Venture capital
 - Banks
 - Investment funds
 - Family offices
 - Soft loans

Photovoltaics in Spain

Global irradiation and solar electricity potential

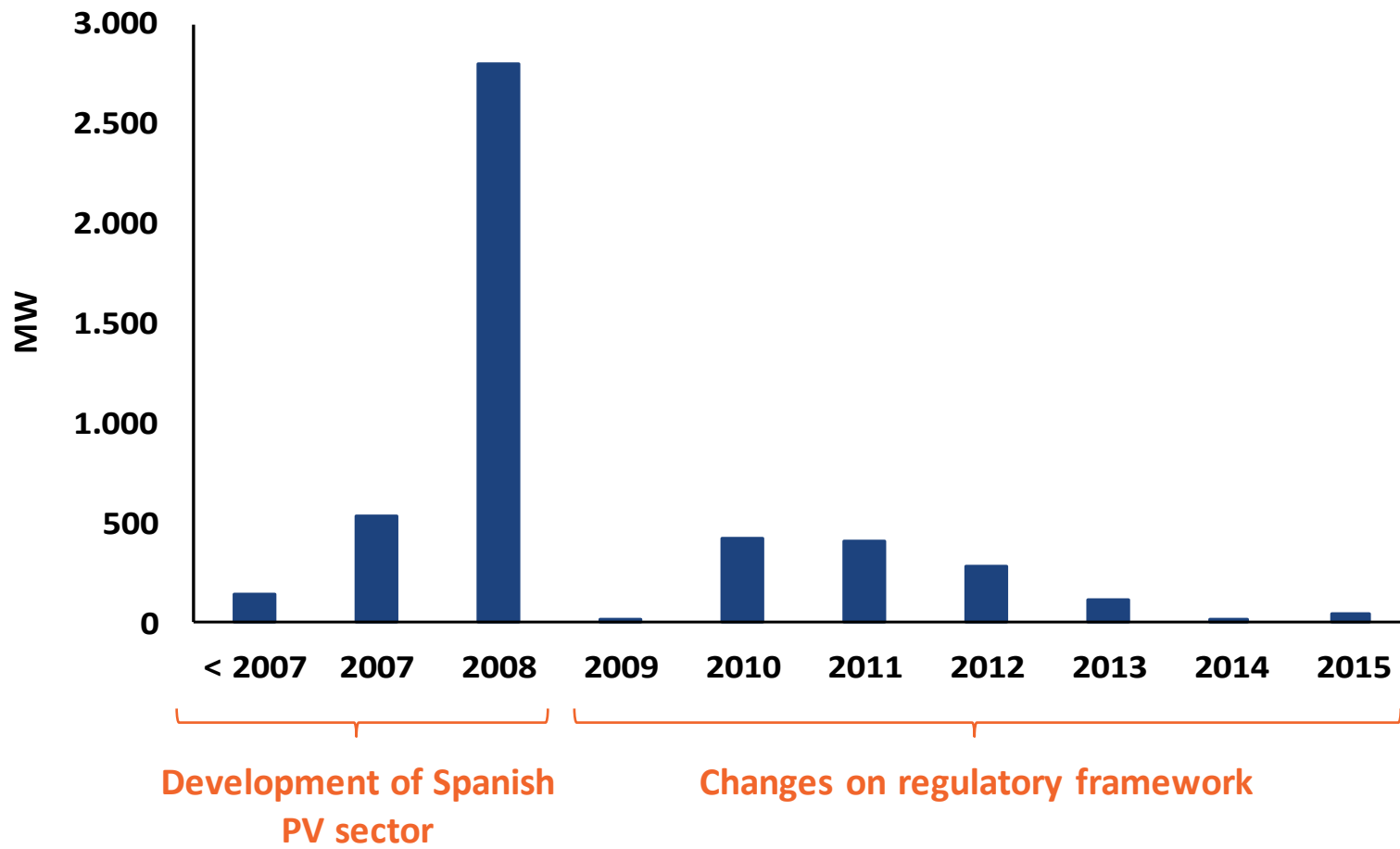
Horizontally mounted photovoltaic modules

SPAIN / ESPAÑA



Photovoltaics in Spain

Annual PV installed capacity in Spain



Source: UNEF, annual report 2015

Self-consumption in Spain

Main characteristics of self-consumption in Spain

	Self-consumption 1 (just for self-consumption)	Self-consumption 2 (self-consumption and selling)
Consumer	<ul style="list-style-type: none"> • One consumer party for the installation 	<ul style="list-style-type: none"> • There might be a consumer and a producer for the same installation
Owner	<ul style="list-style-type: none"> • Owner of system must be the same as owner of supply point 	<ul style="list-style-type: none"> • Owner of system may differ from owner of supply point
Registration	<ul style="list-style-type: none"> • Not necessary to register generation facility • Necessary to enlist in the self-consumption register (RD 24/2013) 	<ul style="list-style-type: none"> • Necessary to register generation facility as an electricity production facility (RD 413/2014)
Contracted Power	<ul style="list-style-type: none"> • Contracted power of consumer/ supply point can be up to a maximum of 100 kW • System's capacity cannot exceed supply point's contracted power 	<ul style="list-style-type: none"> • System's capacity shall not exceed the supply point's contracted power • No limit as in self-consumption 1
Excess Electricity	<ul style="list-style-type: none"> • Consumer does not receive payment for excess electricity injected into the grid 	<ul style="list-style-type: none"> • Consumer may receive compensation for excess electricity injected to grid by selling electricity to pool and paying generation tax
Measuring Equipment	<ul style="list-style-type: none"> • Mandatory to install measuring equipment to register net generation 	<ul style="list-style-type: none"> • Mandatory to install bidirectional measuring equipment to register net generation as well as measurement equipment at associated consumption point

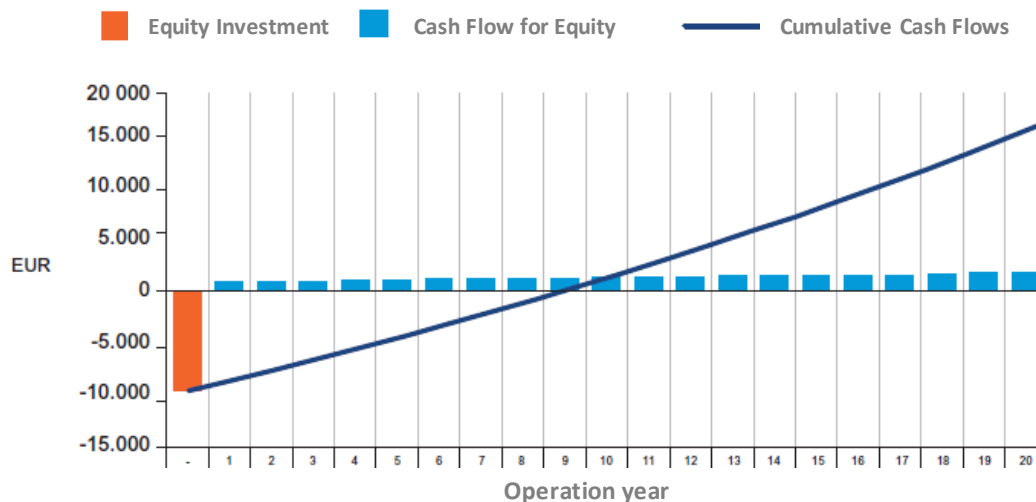
Self-consumption in Spain

- **Fixed charges, based on capacity**
 - PV systems up to 100 kW with neither a meter which measures the overall consumption of the consumer (not legally required) nor a battery system are exempt from paying the fixed charges
- **Variable charges for self-consumed electricity (kWh), based on the contracted electricity tariff**
 - Consumers whose contracted power is less than or equal to 10 kW are exempt from paying the variable charges for self-consumption
 - Mallorca and Menorca have reductions in the variable charges for self-consumption and the Canary Islands, Ceuta and Melilla and Ibiza-Formentera's electrical systems have total exemptions of these payments

Results for Spain

Residential self-consumption

Case study results for residential single family applications (self-consumption type 1)
 Example of a 4 kWp PV system placed in Madrid¹



Barriers for implementation

- If customer's demand curve does not match PV generation there is an electricity surplus which is not remunerated in self-consumption type 1
- The loss of excess electricity could be solved by installing a storage system
 - Storage implies additional charges
- Customer and owner of the PV system must be the same legal entity and electricity can only be consumed by one consumer
 - Multi-family buildings can only use the PV electricity for common spaces

PV system information	
CAPEX	9.883 Eur
Lifetime	20 years
Electricity Price	0,1504 Eur/kWh

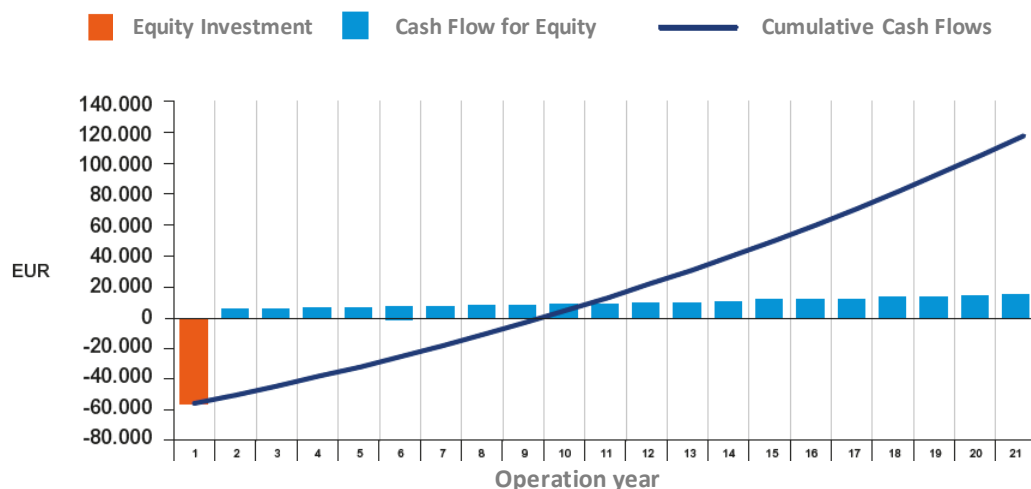
Results	
Payback Period	8,57 years
LCOE ²	0,090 Eur/kWh

Notes: ¹ Theoretical case which considers 100% of self-consumption; ² LCOE = Levelized Cost of Electricity
 Source: interviews; PV Financing model; CREARA analysis

Results for Spain

Commercial self-consumption

Case study results for commercial segment applications (self-consumption type 1)
 Example of a 30 kWp PV system placed in an office building Madrid¹



Barriers for implementation

- **Customers have to pay fees**
- **Laborious legal procedures (around 7 months) which are the same for every system**
 - This implies higher costs for smaller systems
- **Same problem as with multi-family buildings for office buildings with more than one company**
 - Consumer and owner of system have to be the same legal entity
 - Only option for commercial businesses is to use the PV electricity for common spaces or to use self-consumption type 2 for one of the tenants

PV system information	
CAPEX	56.100 Eur
Lifetime	20 years
Electricity Price	0,1306 Eur/kWh
Fees	0,0179 Eur/kWh

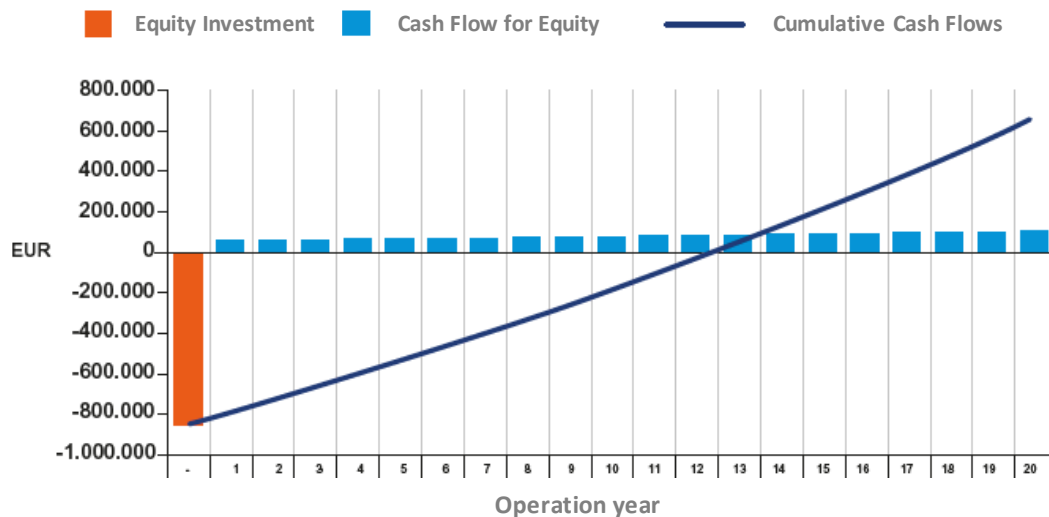
Results	
Payback Period	8,36 years
LCOE ²	0,070 Eur/kWh

Notes: ¹ Theoretical case which considers 100% of self-consumption; ² LCOE = Levelized Cost of Electricity
 Source: interviews; PV Financing model; CREARA analysis

Results for Spain

Industrial self-consumption

Case study results for industrial sector applications (self-consumption type 2)
 Example of a 500 kWp PV system placed in Madrid¹



Barriers for implementation

- **Self-consumption type 2 allows receiving remuneration for excess electricity but requires selling electricity in spot market**
 - Need for obtaining license of energy trader or need for involving a third party (representative)
- **Estimation of remuneration for excess electricity is complex due to pool prices variation (variable income)**
- **Industrial applications would have to choose self-consumption type 2 if they want to install an adequately dimensioned system (capacity limit in type 1)**

PV system information	
CAPEX	850.000 Eur
Lifetime	20 years
Electricity Price	0,0957 Eur/kWh

Results	
Payback Period	12,56 years
LCOE ²	0,080 Eur/kWh

Notes: ¹ Theoretical case which considers 80% of self-consumption; ² LCOE = Levelized Cost of Electricity
 Source: interviews; PV Financing model; CREARA analysis

Barriers for self-consumption in Spain

	Barrier	Consequences
Remuneration	Loss of excess electricity	Reduces the attractiveness of the installation for consumers whose demand curve does not match with PV generation (self-consumption 1)
	Remuneration for excess electricity	Pool prices are volatile, so it is complex to estimate the income obtained (self-consumption 2)
	Energy trader for selling excess electricity	In self-consumption type 2 either a license or contracting a third-party is needed to obtain the remuneration
	Electricity production facilities register	Payment of generation tax is required and laborious procedures have to be completed which are the same for large or small systems, so relatively costs for small systems becomes higher
Fees	Payment of fees	Payment of fixed and variable fees reduces system's profitability; they have only been set for 2 years for now
	Storage is indirectly penalized	Due to the additional charges that storage imply for small PV systems, consumers are not willing to install them
Others	Ownership of PV system	Current limitations reduce the options for consumers that cannot or do not want to rely for self-funding or loans
	Legalization of system	Different procedures which are time intensive

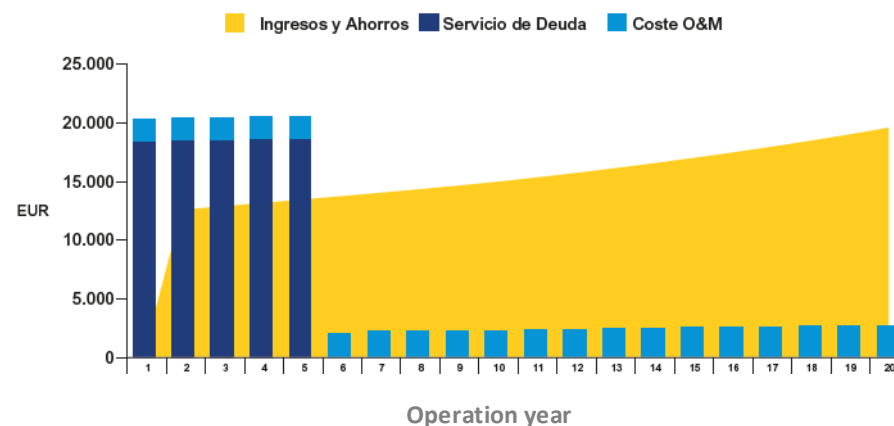
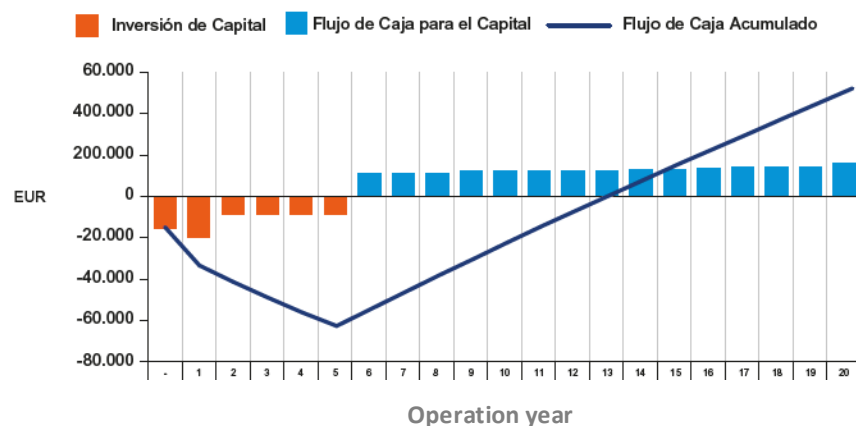
Barriers for PV sector in Spain

Barrier	Consequences
Legal insecurity	The insecurity created by the regulatory changes have displayed signs of uncertainty regarding the PV market in Spain. This uncertainty has led to great decrease of implementation projects
Supply contracts	The signing of more than one supply contract is not legally permitted, which makes signing PPAs between different consumers not a viable option and reduces the different options of financing PV installations
No net-metering regulation	A net-metering regulation would attract new investors to the PV market. As there is no net-metering mechanism, installing a PV system is only attractive for consumers with certain demand curves
Difficulty in obtaining grid access	PV developers might not be able to implement their PV because of difficulties in obtaining grid access permits (dependence on distribution system operators)

Results for Spain

Green energy cooperative

Case study results for green energy cooperative model - Example of cooperative with a 60 kWp PV power generation system (Madrid) for commercial and residential users



PV system information	
CAPEX	80.000 Eur
Lifetime	20 years
Leveraging	85%

Results	
Payback Period	12,83 years
Project IRR ²	9,91%
Equity IRR ²	10,51%

Notes: ¹ Internal Rate of Return

Sources: interviews; PV Financing model; CREARA analysis

Outlook and conclusions

- **The regulatory changes introduced in recent years have led to uncertainty for PV systems and their investment in Spain**
- **The only regulated, viable and profitable business model is self-consumption, although green cooperatives are emerging as another feasible option**
- **Demand in Spanish PV market can be encouraged with the modification of the regulatory framework in case there is a change of government**
 - **Recognition of the right to self-consume without additional charges**, considering that instant self-consumption does not imply the use of the grid
 - **Possibility to share** a PV installation for self-consumption
 - **Simplify administrative procedures** in order to install a PV system
- **If the PV demand increases, some identified financial mechanisms such as leasing, renting, crowdfunding, schemes that involve utilities and banks, etc... could be activated**

Visit **PV** Financing website

<http://www.pv-financing.eu/>

Thank you for your attention!

Dina Löper

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