Accessible, reliable and affordable solar irrigation for Europe and beyond

Deliverable 2.8

Photovoltaic Irrigation Financial Instrument for Institutional Investors

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Acronyms

ABS	Asset Backed Security
CAPEX	Capital Expenditure
CAPM	Capital Asset Pricing Model
DCF	Discounted Cash Flows
DeFi	Decentralized Finance
EPC	Engineering, Procurement and Construction
ESCO	Energy Services Company
EU	European Union
FI	Financial Instrument
GHG	Greenhouse gases
IRR	Internal Rate of Return
ISINPA	Irrigators, SMEs, Investors and Public Authorities
KEMT	Key Enabling Materials and Tools
kWh	Kilowatt hour
LCOE	Levelized Cost of Energy
MW	Megawatt
NPV	Net Present Value
O&M	Operation and Maintenance
OPEX	Operational Expenditure
PPA	Power Purchase Agreement
PV	Photovoltaic
PVI	Photovoltaic irrigation
QC	Quality Control
RE	Renewable Energy
SME	Small and Medium Enterprise
SPV	Special Purpose Vehicle
TPO	Third Party Ownership
Twh	Terawatt hour
WACC	Weighted Average Cost of Capital

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Introduction

SolaQua in a nutshell

SolaQua's overall objective is to increase the share of **renewable energy (RE)** consumption in Europe by facilitating the market uptake of **photovoltaic irrigation systems (PVIS)** in the farming sector. A PVIS is based on a combination of **photovoltaic (PV)** technology, hydraulic engineering, and high-efficiency water management techniques to optimize irrigated farming.

The consortium of SolaQua, which represents more than 70% of European irrigators, is aware of the potential of PVIS to decisively improve the sustainability of farming and rural communities in Europe. Nevertheless, to fulfil this potential, it is necessary to overcome the existing barriers to the market uptake of SI. To do this, SolaQua will accelerate the clean energy transition in European agriculture by facilitating the development of a well-functioning market for SI. This will be done by producing and exploiting a set of 7 **Key Enabling Materials and Tools (KEMT)** and by creating awareness, skills, action, engagement, and commitment (ASAEC) opportunities among more than 150,000 farmers, 70 local SMEs, and 40 Public Administrations in Europe.

The execution of SolaQua will result not only in a reduction of the cost of PVIS for farmers but also in the availability of effective standards for consumers and environmental protection, more efficient policies and supporting schemes, and new business opportunities for SMEs. Furthermore, to exploit the project's results and to trigger the PVIS market, SolaQua will facilitate a joint promotion of more than 100 MW of reliable and affordable PVIS led by the end-users themselves: the farmers.

To achieve the overall objective of increasing the share of RE in the European farming sector by facilitating PVIS market uptake, SolaQua has established the following 5 specific objectives:

1. **Produce and disseminate a set of 7 KEMT**, designed to solve technical, economic, and legal issues which are acting as barriers for the market uptake of SI.
2. **Produce awareness and skills of PVIS among the target groups in six countries** (France, Italy, Spain, Romania, Portugal, and Morocco). At least 150,000 potential end-users will be reached, 70 SMEs will be trained, and 38 Public Authorities will be able to produce more informed policies and supporting schemes.
3. **Trigger the European PVIS market by facilitating a joint promotion of at least 100 MW of PVIS**, exploiting SolaQua's KEMT and led by the target audiences engaged in PVIS because of the project's dissemination and communication actions.
4. **Increase the effectiveness of public supporting schemes for on-farm investments for the promotion of PVIS**: SolaQua will produce a new European Agrarian Fund for Rural Development (EAFDR) financial instrument that will be implemented in 3 European regions and will support more than 40 MW of new PVIS capacity.
5. **Facilitate market uptake of reliable and affordable PVIS in markets outside the EU** that will result not only in increased cooperation but also in business opportunities for European SME´s and investors.

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Financing PVIs

Mediterranean agriculture relies in irrigation in order to water crops during the long dry season. This water has to be pumped to the fields with a total annual energy cost of more than 24 TWh at European level and related GHG emissions of more than 4 million tons. For example, in Spain pumping water into irrigation systems accounts for 25% of the total energy consumption of the agriculture and up to 40% of total costs of farming[1]. Photovoltaic irrigation (PVI) represents a suitable, zero-carbon alternative to the current fossil fuel-based energy model of irrigated agriculture (Lorenzo et al, 2018). Nevertheless, PVI requires high up-front investment in order to plan and build the facilities. This investment can pay off because of PVI´s low operating costs as it does not need fuel or intensive maintenance to produce energy. Thereof, the economic return of PVI is obtained over the lifespan of the system, typically 25 years of more, so uncertainty over the results and the time value of money plays an important part to stablish the profitability of PVI. As a result, the cost of the capital used to undertake the initial investments greatly affects the price of the energy produced by PVI and its reduction is a key element to facilitate its competitiveness over incumbent solutions and, consequently its market uptake.

Furthermore, the large investment required to decarbonise irrigation, estimated at more than € 20 bn in Europe, means that access to wholesale financial markets will be needed. In other words, PVI projects must have access as direct as possible to capital markets, eliminating as many intermediaries as possible. This means that PVI assets must serve as the building blocks (the collateral) to produce mainstream financial instruments (FI) oriented to institutional investors. In particular, issuing so called “green bonds” to attract funding from capital markets is an increasingly common practice to fund large renewable energy projects as it minimizes capital costs. The international experience shows that, properly addressing a number of issues, FIs can also be used to fund self-consumption-oriented projects such as PVI. A common element of such experiences is to focus on the securitisation of long-term supply contracts (Power Purchase Agreements-PPA). Securitisation is a financial technique consisting of grouping cash flows from collection rights and issuing fixed-income securities backed by these collection rights. In this way, many advantages are obtained from the point of view of access to financial resources because securitization transform illiquid assets (PVI systems) into liquid ones (bonds) and therefore allows access to a much broader range of investors, including institutional investors who hold most of the world's available capital.

The securitization process of any asset undertakes three phases. In the first phase, a sufficient number of suitable assets (systems/contacts) are added to generate a stream of cash flows, as predictable as possible. Once this cash flow stream is available, its amount, schedule and riskiness must be carefully stablished. Based on this analysis it will be possible to determine if securitization if possible and, in that case, the type, structure and price of the FI. Finally, the FI is materialized in securities that promise investors a number of future payments backed by the underlying assets. These payments are conditional to the performance of the underlying assets so investors are “betting” on the capacity of those assets to produce sufficient cash flows. Later, in the denominated secondary market, the securities are traded among investors, at a price that reflects to what extent the evolution of the underlying assets is according the initial expectative. Securitization is at the heart of modern finance as it provides liquidity to many different asset classes. By allowing investors to invest in FIs instead of on individual projects, securitization

[1]https://www.idae.es/uploads/documentos/documentos_10330_Agricultura_de_regadio_05_c325ffde.pdf

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streamlines the process of assessing, valuing, acquiring and selling assets vastly increasing the availability of funds for the underlying assets.

Furthermore, producing PVI assets in a manner that allows their use as collateral for FI, will not only improve access to long-term, low-cost capital for new projects, but will also enhance irrigators´ access to reliable providers and contractors. This is because, in order to be suited for securitization, underlying assets must comply with quality standards in design, production and maintenance. This compliance is certified by independent entities such as credit rating agencies, so all the stakeholders involving have incentives to focus on quality. Finally, the existence of PVI backed FIs will allow to increase the efficiency of public resources when supporting the decarbonization of the agriculture. In particular, special FIs such as those established by the European Agricultural Fund for Rural Development (EAFRD) (Wieliczko, 2018) could be complemented with the PVI FI to support PVI deployment, as a complement or even as a substitute of project-level grants.

As a result of the aforementioned reasons, the partners of SolAqua project are committed to facilitate the production of a PVI-FI as part of its activities. SolAqua is an initiative led by the Polytechnical University of Madrid aimed to facilitate the market uptake of PVI in Europe and beyond. The consortium of SolAqua, which represents more than 70% of European irrigators, includes all the relevant expertise and networking necessary to produce and disseminate the relevant information and solutions that are needed to unleash the potential of PVI. The members of Solaqua understand that, in order to fulfil the potential of PVI, it is necessary to overcome the existing barriers to its the market uptake. In this regard, facilitating the production of an FI backed by PVI is considering as a strategic action. In order to achieve this goal, SolAqua organized a multidisciplinary working group that was responsible to produce the framework of such FI. The result is one of the 7 Key Enabling Materials and Tools (KEMT) produced by SolAqua to support potential users in dealing with the technical, legal and economic aspects of planning, building and operating reliable and competitive PVI.

Purpose and scope

PVI has proved to be a suitable alternative to the incumbent energy solutions of the irrigators, particularly in terms of environmental impact and price stability. Nevertheless, the introduction of PVI has to be also reflected in economic gains for the irrigators, otherwise most of them will stick to existing alternatives. In the case of PVI, that require high upfront costs, the existence of affordable funding is key as a large amount of capital has to be allocated into the project over many years. In the case of PVI, a higher cost of capital will impact in a higher cost of energy, reducing its competitiveness with incumbent solutions. Thus, cost of capital reductions for PVI must be part of a comprehensive strategy to facilitate its market uptake. The cost of capital depends on many factors, being among the most relevant the liquidity of the asset and the pool of investors that are suited to invest on it. The more liquid and the largest the pool, the lower the resulting cost of capital. In this regard the purpose of this document is to stablish the framework to achieve reductions in the cost of capital of PVI projects by increasing its liquidity with FIs.

The goal of reducing the cost of PVI energy for irrigators must also be compatible with another goal of SolAqua: to facilitate the participation of local SMEs in the development of the PVI

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market. Opening this market to local SMEs is necessary in order to introduce competition and to facilitate a positive impact in the local economies of irrigated areas. Nevertheless, capital market-oriented FIs are normally reserved to large companies or to financial intermediaries, so building a FI which can benefit SMEs has its own challenges. In particular it involves that all the SMEs agreed in common standards, introducing advanced monitoring and ensuring a high level of coordination between the stakeholders during all the process. In this regard this document is also aimed to stablish specific features on a PVI FI that facilitate the participation of local SMEs in the introduction of the technology.

The FI here described is based and complements the rest of the KEMT, including the technical specifications for PVI and the power purchase agreement (PPA) contracts. These KEMT, alongside the diffusion activities to the different stakeholders, are designed to facilitate the production of PVI systems within the next few years. These systems and the design here exposed will allow for the existence of a flagship issuance of the FI which will serve as a reference for investors and regulators and to achieve sustainable reductions in the cost of PVI.

About this document

After this introduction, Chapter 1 presents the underlying assets that can support a PPA-PVI based FI including the type of systems that are suited and the contracts that must be present. Chapter 2 focuses on how PVI assets can be bundled in order to create a “coherent” collateral composed by many PVI systems produced by different SMEs under a standardized PPA model. The chapter also presents details of the legal entity that must be stablished to contain such assets and the process that must be followed to transfer PVI-PPA from the SMEs that produced them into the container that will support the FI. Chapter 3 is about describing a securitization process applied to the case of PPA-PVI. Securitization is a highly standardized technique so a PPA-PVI FI must stick to the existing practices, in particular if it aims to obtain an investment degree credit rating. Chapter 4 presents the description of the resulting FI and the structure that must be stablished to support its operation. Finally, Chapter 5 includes a methodology to assess the value of a PPA-PVI FI from the perspective of investors. This facilitates the identification of the critical elements that must be considered during the production of the assets to facilitate the securitization process later on.

- Chapter 1 is about the underlying assets that can support a PVI-based FI.
- Chapter 2 is focused on the process of bundling and transfer such assets.
- Chapter 3 deals with the securitization process of PVI-PPA.
- Chapter 4 presents the main details of the resulting FI and the market to which it will be addressed.
- Chapter 5 is a valuation methodology for a PVI-PPA based FI.

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1. The underlying assets

FIs are created to channel funds from investors that own those funds to projects that need the funds to be executed. On this regard investors demand a return in exchange for its funds. The higher the demanded return by the investor, the higher the cost of capital for the projects. On the contrary, high quality FIs can offer lower returns to investors as they are more demanded. In order to produce a high quality FI, the underlying assets must be predictable in their performance, in particular the amount and schedule of cash flows and the riskiness that can affect the original prevision. In the case of the FI being backed by distributed PVI projects, their technical and legal characteristics must allow for the assets to be easily bundled, managed, monitored and assessed by the different stakeholders. The predictability of the assets requires the identification of the related risks and, eventually, its mitigation.

Thus, in order to be suited for securitization, an asset must be capable of producing periodic receivables which are normally paid by end users of the asset, for example leases on equipment or repayments on credit cards. Also, in order to allow for an efficient management, monitoring and reporting of the assets, a common framework for standardization is necessary, both in technical and legal terms. Finally, a fundamental difference between a traditional financing model and one based on direct access to capital markets is the need to provide investors with an easily enforceable claim over the assets in order to reduce credit and commercial risks. Those risks are related to the eventuality of end users or intermediaries defaulting in their obligations to pay the scheduled payments. In order to minimize this risk that assets must be isolated and the senior claim has to be for investors. The described requirements implies that the underlying assets of a PVI FI must be produced under certain specifications, including the business models in which they are commercialized to irrigators and the contracts that stablish the rights and obligations of each party.

The aforementioned conditions can only be met on the basis of third-party ownership models (TPO) which allow project aggregation, pooled management of the assets and “true sale” when transferring to the investors. In the case of PVI, the production of a related FI will require the existence of contractual relationships that fulfils the aforementioned requirements while allowing access to the farm-based assets and conflict resolution mechanisms that could be easily enforced if needed. Only by introducing these elements at the moment of the creation (origination) of the PVI, they can be used as collateral for FI throughout a securitization process (Pawłowski, 2018). For this reason, it is relevant to create consensus, commitments and coordination among different stakeholders in advance, one of the objectives of the SolAqua project.

In short, the existence of a high quality FI based on PVI depends on the following two factors:

1) the existence of a pool of systems with the sufficient technical quality as to produce the energy required with a high level of reliability and
2) the existence of a standardized PPA business model to introduce PVI which allows for bundling, managing, operating and monitoring many systems in an efficient manner. On this regard the underlying assets of the proposed FI are not the PVI, but the PPAs based on them that include the payment obligations of the irrigators which will produce cash flows for the investors. In this Chapter 1 both components will be described in the framework of producing a high quality FI.

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1.1. Producing photovoltaic irrigation systems suited as collateral for financial instruments

PVI is suited to most irrigation infrastructures, providing that the design and construction specifications and execution meets the necessary quality standards (Carrêlo et al, 2020). Nevertheless, the use of TPO business models (needed to produce FIs) is more adequate for medium to large scale systems (>100kWp). The principal reason is that this type of systems presents a higher level of risks related to issues such as the high pressures involved of the systems and the difficult to provide backups in case of malfunction. In order to mitigate such risks, it is more adequate that specialized stakeholders take responsibility of the EPC, O&M. Small PVI systems malfunctions or ill design are normally easier to fix and less damaging, so direct ownership can be a suitable option in most cases. Furthermore, TPO business models require a number of tasks that, albeit provide guarantees over the results, imply costs that have a bigger impact on small systems.

TPO business models require the existence of suppliers of the goods and services related and investors willing to fund projects. The model works better if such stakeholders are available at local level as they can leverage their existing knowledge and networks. In particular PVI-specialized firms can take advantage of accumulated know-how and economies of scale in issues such as hardware acquisition or O&M. Although the number of PVI specialized firms is still limited, it is possible to increase its number by providing irrigation and energy related SMEs with specific training on PVI. These firms, provided with the technical capacities and financial support, can in turn act as originators of the FI by offering to their current customers PVI compatible with the FI. In order to comply with the FI requirements the PVIs offered by the SMEs must present, at least, the following elements:

- Originators must have been technically certified by an independent entity to ensure that they can produce high quality PVI. In particular, the relevant staff must have attended and passed the specific training courses to acquire such capacities.
- The planning of the PVI systems must be produced in order to guarantee the adequacy of the specifications to the needs and characteristics of the irrigation infrastructure. The planning must pass the corresponding quality control.
- Specific PVI engineering must be included in order to ensure the adequate integration between the PV systems and the hydraulic part of the infrastructure. The specific PVI engineering guideline is presented in KEMT 1.
- During the construction phase the contractors must apply best practices and dedicated protocols to minimize well-known potential failures and to improve the performance of the system. A specific QC must be passed to verify compliance.
- The PVI systems and related infrastructure must be monitored 24/7 in order to identify any malfunction at an early stage and to facilitate the execution and verification of the O&M plan.
- The PVI system and related elements must fully comply with the legal and administrative requirements for its construction and operation.
- Customers, key suppliers and servicers must pass a credit assessment. The results and documents of such credit assessments must be available for third parties, in particular rating agencies and underwriters.
- The economic conditions of all the relevant elements of the PVI must be transparent and sustainable, based on validated economic assessment methodologies and in

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positive financial indicators. This includes a competitive price of the energy, a reasonable cost of the systems and of the O&M and any other relevant issue.

The aforementioned characteristics must be presented in the PVI systems at project level in order to allow the stakeholders to qualify them as valid collateral for FI.

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1.2. A power purchase agreement for a PVI-FI

European irrigators rely on a network of local technology suppliers that can rapidly develop skills and expertise in PVI-related issues. In particular it is possible to train local SMEs that are already familiar with energy and irrigation EPC to include PVI within their portfolio of products. Nevertheless, the business models and the types of offers usually presented by such companies to their customers are limited. The typical local supplier is focused in offering products and services to irrigators based in a one-off selling of the demanded good, but most of these SMEs do not guarantee results or provide tailored funding for the investment. In the case of energy-related technology suppliers, including those already offering PVI, the offers usually consist of selling facilities and operating and maintenance services. In this way, the risks and uncertainties for investment are fully undertaken by the farmer that must also assume the high up-front payment necessary to install the systems. This circumstance, is a barrier to the market uptake of PVI and is especially relevant in the case of large systems where upfront payments in the order of € millions are needed. An alternative to the existing business models of PV-self consumption is the third-party ownership (TPO) business model (Drury et al., 2012). These business models have the advantage of the installation not being implemented or operated with the resources of the farmers themselves as it is a specialized company who is responsible for financing and operating it during the agreed period, thus undertaking the operational risk. In the case of PVI the irrigator can obtain the energy required and pays

Using PPA to introduce PVI: A case study.

A farmer is looking for alternatives to reduce water-energy costs for irrigation. The local SME offers a 100 kWp PVIS for €100k that will produce 170 MWh/year for irrigation. The bank offers the farmer a loan for 70% of the initial investment with a typical interest of 3.5% over 5 years. This results in a payback of 11 years, IRR= 5% and VAN= €9k. The farmer does not proceed with the project due to the high initial investment, an IRR below its WACC and uncertainty of the PVIS performance. In order to attract the client, a specialized SME offers a PPA that will release the farmer from upfront payments and operational risk. To finance its PPA business line, the SME has secured a €600k credit line with a bank at cost of 5%, 4-year maturity and presenting real guarantees over the assets of the company. This allows the SME to finance just 5 projects every 10 years and to assume transaction costs every 4 years to rollover the loans. This severely constrains the capacity of the SME to promote PVI projects, regardless of its expertise, quality of service and product demand. If the PPAs of all the SMEs can be transferred to a specialized vehicle and used as collateral for FI, the SMEs will have access to cheaper and wider (untangled of its balance sheet) financing for projects, without presenting guarantees over the assets of the company but only on the basis of producing standardized PPAs. This will allow local SMEs to offer competitive PVIS to farmers, who avoid the initial investment, the uncertainty over the results and buy energy at a cheaper price than grid or diesel-based sources (savings of between 60%-80%) through a PPA. In the presented case, with an exposed risk of € 600k the formula will allow the SME to install 6 PVIS/year instead of 5 every 10 years, powering its growth. To access this solution, the SME must meet the technical and legal requirements demanded to qualify the PVI-PPAs as collateral for FIs. SolaAqua provides SMEs with the required tools (smart contracts, installation protocols for PVIS, quality control, monitoring and BC reporting) to match these requirements and allow investors their efficient verification.

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regular fees for it, as it would be if he/she were buying that energy from a traditional electricity utility company, for instance. In addition, if the contract stablished between the irrigator and the PVI provider includes a purchase option on the installation, the farmer can access the system's whole property once amortised. An important advantage of this model, called Power Purchase Agreement (PPA), is that the provider guarantees the proper functioning of the PVI and the provision of the necessary energy to, so that the farmer has the expected result assured and has not to bear the operational risks.

In order to facilitate the use of PPAs as collateral for FIs, they must present certain characteristics. In first place the PPAs must be standardized, meaning that all the assets to be used as collateral of a specific FI must have the same contracts, including technical specifications, clauses and conflict resolution mechanisms (Davidson et al, 2015). Otherwise, it will not be possible to bundle and jointly managing them and the credit qualification as a pool will not be granted. The different clauses of the standardized contracts must also introduce guarantees for investors and facilitate the securitization process. For example, the contracts must be easily transferred to investment vehicles without the need of specific consent of the customer. In order to facilitate valuations and assessment from asset managers and investors, the systems must be closely monitored and periodic reporting must also be possible. Also, in order to reduce the riskiness of the assets, very streamlined conflict resolution mechanisms must be included in the PPAs. The aforementioned characteristics have been included in a PPA produced by SolAqua (see deliverable D2.7). The PPA can be used for securitization and will be the collateral for the related FI. Finally, Figure 1 presents how a PPA-PVI works.

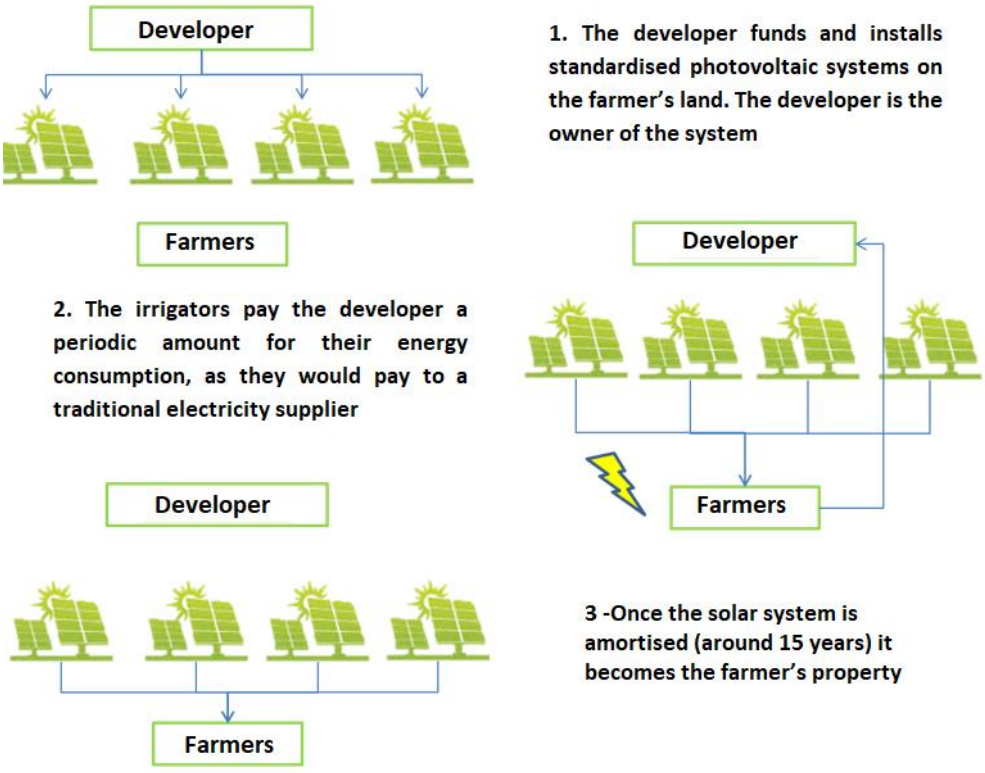

Figure 1. The PPA-based business model for PVI consists of offering irrigators long-term energy supply contracts at preestablished prices. In order to produce the contracted energy, the developer must build and operate PVI systems on-site. The model has the advantage that the irrigator does not have to make high-up front costs to build the systems and has a guarantee of the results in the long term. As the technical and financial risks are located in specialized stakeholders, the PPA model is particularly well suited for medium and large scale PVI systems.

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1.3. The customers and suppliers of PVI

The FI is intended to facilitate the introduction of PVI by improving the attractive of the solution both for irrigators and for local SMEs that can supply the related goods and services. In this regard the definition of both groups in the context of the production of a FI is relevant as the FI will be designed in order to ensure that both stakeholders are directly benefited from the FI. This bottom-up approach is particularly important as it is understood by the partners of Solaqua as the best manner to ensure that irrigators and SMEs maximize their share of the economic advantages that issuing a PVI backed FI can bring.

The customers of PVI

Most of the irrigation energy needs in Europe are centralized by irrigator´s associations or cooperatives (the customers). Typically, they manage the irrigation needs of hundreds or even thousands of farmers of a specific area charging them a fee to pay for their share of the expenses. The customers are responsible to manage the infrastructure and to obtain the energy required for its operation on behalf of the farmers. In this regard the customers with medium to large irrigation infrastructure, that are the target of SolAqua, have expertise in managing the energy consumption and have even specific staff for this purpose. In most cases these consumers have special agreements with existing energy providers in order to obtain the better possible prices. PVI

The potential PVI market: more than enough to sustain a new asset class for FI

In the EU-27 there are 11.6 million farms that utilise around 40% of the total available land (160 million ha). The Mediterranean region accounts for over a third of the farms with more than 4.2M registered and that cultivate over 47% of the total EU-27 farmland (70 million ha). More than half of the output is produced in the 10.2 million of irrigated crops. Spain and Italy have the largest irrigated areas (3.7 million and 2.0 million ha respectively), over 50% of the total irrigable area. These countries, together with France, Greece and Portugal make up over 82% of the total irrigable area within the EU while having 42% of the total utilized agricultural area. Southern European countries use the largest percentages of abstracted water for agriculture too. This generally accounts for more than two-thirds of total abstraction: irrigation requires water consumption of 70 billion m3/year and electricity consumption of 24 TWh/year to pump it. On average, 44 % of total water abstraction in Europe is used for irrigation. Reducing this consumption without affecting the output requires modernization and automation of pressurized irrigation systems that, in turn, requires greater energy availability in quantity and time: although pressurized systems have achieved a 21% water consumption reduction in the last 50 years, energy requirements have increased up to 657%, becoming 40%-50% of total irrigation costs. PVI is therefore a big business. In Europe it is a new market niche for renewables with extremely high potential to reach a big trading volume in the short-term. In Spain alone there is a potential market for PVI over € 4 bn. In Southern Europe the estimated market volume of €15 billion, Northern African fast-growing farming sector represents a PVI market potential of €15 billion. Mediterranean market alone excess €30 billion that can be naturally addressed through European technology and SME installers if suited business models and finance is available, a potential positive result of the Green Deal. Globally, the potential market is immense as well: the irrigation sector claims about 70% of the world's total water withdrawals, currently providing 40% of the world's food from approximately 20% of all agricultural land. Overall, worldwide, the Total Addressable Market (TAM) of PVI worldwide exceeds € 200 billion, which represents 150 GW, a huge niche market. Regarding market growth, estimations can be made based on solar pump market analysis, as PVI is expected to be a market driver. This huge number of potential customers represents a sufficient base to support PVI as an asset class on its own.

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customers are increasingly receptive to PVI as a mean to control their energy costs and to reduce the environmental impact of its activities.

Nevertheless, irrigators are facing the dilemma of changing incumbent solutions such as grid connections, that are familiar to them, with PVI which is not. In this regard there is a high level of uncertainty on the results, that added to the need of paying high up-front investments, is a major barrier for the customers. As presented, a PPA can provide the guarantees that irrigators demand while eliminating the need of large upfront payments. The solution has the potential to suit the needs of many large irrigators so it is expected that, if complemented with competitive prices of the energy, can have a good acceptance.

The originators of PVI

Despite their multiple advantages, PPAs for PVI are not often available and result in a cost of energy higher than incumbent solutions. The main reason it that the few large companies that can offer PPAs for PVI have to include the assets into its own balance sheet over the 20 or more years of lifespan of the PPA. This situation can be overcome if companies could offer PVI-PPAs without having to secure the long-term finance requirement. In this situation companies, including local SMEs, would be able to focus in producing high quality PVI meeting the quality requirements of the FI. They would be able to offer the irrigators PPAs without having to secure first the funding. These suppliers are the originators of the FI and are described below.

In the jargon of securitization, the originators are the entities that produce or “originate” the assets that will be used as collateral for the FI. In the case of the PVI-FI, the potential originators are the network of local SMEs that supplies irrigators with specialized equipment and services including irrigation infrastructures like pumps and industrial sprinklers, diesel generators or electricity maintenance. These SMEs have normally a close relationship with the customers based on common trust and knowledge. Furthermore, the local SMEs are an important agent to support rural communities and incomes as they provide jobs and opportunities. Nevertheless, to act as originators, local SMEs must be equipped to supply PVI with the required technical standards, in particular for medium and large systems.

Once the SMEs would be certified as technically capable to produce PVI with the required standards which, they will have access to tools and resources, including funding, to support their operations. Dedicated credit lines will be available on condition to the approval of the PVI project (see Chapter 2), in a streamlined review and QC process. Once the project if approved, the local SME will be able to offer the customer a PPA suited to its needs, always in compliance with the standard. If the customer agrees with the offer, the local SME will access the financial resources to execute the project without needing upfront payments or bank loans. This business model, similar to those used in consumer finance, will ensure the quality of the system (otherwise the SMEs will not have access to funding) and the standardization of the technical, legal and economic characteristics of the assets. Therefore, it will be possible to produce the pools of underlying assets that are required to issue the FI. The process of bundling assets of PVI is presented in Chapter 2 next.

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2. Bundling PVI assets

Apart from the suitability of the assets, the most relevant issue that a pool of assets must address to be suitable for securitization is size. A minimum size must be achieved so the fixed costs associated with credit ratings, transactions, legal advice and, particularly, underwriting are outweighed by the reduction in the cost of capital (Gorton & Metrick, 2013). As the fixed costs of a securitization are estimated in over €1M, the minimum size of an asset securitization is considered to be at least € 50 million, while optimal size is around € 500 million. To achieve such size by pooling PVI-PPA projects averaging less than €500 k, a large number of them must be put together (bundled) into a "container". This container is normally a legal entity established ad hoc, which is called a "special purpose vehicle" (SPV). The SPV incorporates the assets to be securitized in order to allow for a joint management and to guarantee that they are not affected by potential claims over the originators (the SPV is bankruptcy remote).

As mentioned before, in order to support the activity of local SMEs, one of the special characteristics of Solaqua´s FI is that it will be backed by assets from different originators, meaning that many PVI-trained and certified SMEs can be involved in producing a pipeline of standardized PVI projects of sufficient size as to develop the pool. Creating a pool with PVI projects produced by many different originators has its own challenges, especially regarding the fact that credit rating processes are often focused on the originators rather than on the assets. To overcome this barrier, it must be possible to focus the credit analysis on the assets (the PPA-PVI) rather than on the originators (the SMEs) so an asset-class specific credit rating must be possible to be produced (Lowder & Mendelsohn, 2013). To allow that the credit rating can focus on the assets rather than in the many originators, all of the originators must stick to standardized contractual, technical and commercial practices, a rigorous compliance verification system must be involved to ensure that the resulting pool is coherent and tractable independently of the originators and a bankruptcy remote structure must be put in place to isolate the assets from the originators.

Thus, bundling PVI assets in the framework of a securitization requires:

1) a specific quality control to ensure the suitability of the assets,
2) a dedicated process to transfer the assets to the pool and
3) a specific asset management practice tailored to PVI and oriented to obtain a good credit rating. Each element is described below.

2.1 Quality control

There are many events that can negatively affect the performance of a PVI-PPA over the 20 years or more of its lifespan. These events can range from technical failures that reduce the production of the systems to credit events such as customers not attending the due bills. Some of these events cannot be anticipated and are intrinsic to the business but many are the result of inadequate design, insufficient quality of the EPC or the O&M or inappropriate assessment of the client riskiness. Such events can therefore be avoided or minimized by implementing best practices such as those produced for PPA-PVI projects in the context of Solaqua. These best

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practices have been identified based on existing track records of PVI performance and relevant legal and financial standards which have been proved reliable and efficient in similar contexts. The use of the best practices introduces in PPA-PVI origination the level of quality which is required to be used as collateral for FI. In this regard, a quality control (QC) must be implemented in order to verify that the PVIs comply with the required quality standards of the FI. This QC must be carried out by an independent entity on behalf of investors and must include not only technical aspects of the infrastructure, but also the details of the PPA. QC must also be applied to ensure that the economic terms are sustainable and that the customer and key suppliers are creditworthy.

In order to produce a high quality FI, the QC of the PPA-PVI will be implemented starting at the moment that the originator produces a preliminary planning for the customer. The originator will carry out a protocol to obtain and verify relevant data regarding the PVI project. This information will be passed to the QC entity for its analysis. The QC entity will inform the results of the assessment to the aggregator that will use that information to give or not the go of the project to the originator.

If the project is accepted for further development, a detailed planning, budgeting and economic assessment will be carried out by the originator in collaboration, at least in the initial projects, with the aggregator. Also, a final version of the PPA will be produced. The results will be object of a new QC that will be used to take a final decision on the funding of the project. During the construction phase QC will also be carried out to ensure compliance with best practices. If the originator is not complying with the quality standards, the aggregator will have the option to suspend its participation and claim the capital invested until that point or to directly assume its execution in substitution of the originator.

The final QC will be carried out after a certain period of operation of the PVI system and, in any case, once the PPA has been signed by the customers and compliance has been certified. At that point the systems will be ready to be transferred to the pool.

2.2 Transferring the assets

Once the QC stablishes the suitability of the PVIs to be used as collateral of FIs, they must be allocated into an independent entity in order to ensure that they are bankruptcy remote. This is important as the PPAs will last 20 years or more and loses will occur in case of anticipated termination. In particular, if the PPAs were not transferred from the originators to the independent entity, any difficulty occurring to the originator during the life of the PPA would negatively affect its value and, consequently, that of the FI. This level of uncertainty is not compatible with obtaining an investment degree credit rating for the FI that requires bond holders having priority on any claim over the PPA-PVI. Nevertheless, in the case of the described FI, the local SMEs that originated the PVI-PPA will retain part of the ownership/risks of each project in order to align the incentives (avoiding the moral hazard inherent to the originate-to-distribute model) at least until the systems have been operating over 12-24 months. In most cases it is also expected that the SME-originator will keep the O&M activities related to the systems that it has built, even after transferring it to the SPV, acting as a contractor of the new owner (the asset manager).

The SPV or SPVs that will be used to pool the PVI will be commercial entities with its balance sheet composed exclusively by PPA-PVIs. The SPV will be initially financed by equity investors

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and debt. Ideally, financial partners will establish a dedicated credit line for such SPVs in order to provide the debt. The equity will be provided by specialized investors including infrastructure companies and the local SMEs themselves. The equity and debt of these SPVs can be efficiently leveraged by the support of public entities such as development banks or investment agencies. Once the SPV is funded, it will act as a financial supplier of the local SMEs during the initial stages in order to support the origination of PPA-PVI. The transferring of the PPA-PVI will be conditional to the accomplishment of the last QC protocol. It is expected that this transferring will be carried out by the SME selling the PPA to the SPV under preestablished conditions (true sale).

2.3 Managing the SPV

By buying the PVI-PPA, the managers of the SPV become responsible for its operation and to fulfil the related obligations towards the customers. For this reason, the asset managers will be expert in the field and will count on a suited infrastructure to jointly manage a large number of distributed PVI and a variety of clients and suppliers. The asset managers must ensure constant, efficient monitoring of all the systems and clear, easy to adopt provisions in case of events that could affect the normal functioning of the assets. Specifically, the management of the SPV will establish a transferring protocol to deal with non-compliance or defaults of service providers, including the SMEs that originated the assets. The necessary provisions will be included in the PPA to facilitate such interventions.

In the context of a SPV stablished to facilitate PVI-PPA securitizations, it is relevant to note that there are a number of differences among the strategies that maximize asset managers´ return and those strategies preferred by institutional investors and market regulators. For example, active portfolio management, including leveraging projects and churning, may improve returns, but increase risk and distort underlying cash flows. The optimal time frame of the vehicle may also differ from the point of view of the managers, the investors and the underlying projects themselves. This can cause conflicts particularly during the first issuances of the FI as no reference of previous transaction can be used to indicate the pros and cons of the securitization.

Asset managers of renewable energy projects in the targeted countries are normally used to develop and manage portfolios of projects oriented to non-institutional investors such as equity funds, individuals or family offices (Prol, 2018). The typical financing model of such projects starts with a specialized promoter designing, planning and starting the operation of the system on behalf of investors. This “green field” phase is riskier, as a number of technical and legal risks may appear, and consequently the cost of capital is relatively high. After the systems are in operation the riskiness of the assets decreases significantly as the project enters the “brown field phase”. At that point the assets are suited for a broader set of investors with a lower targeted yield and longer tenures such as utility companies. The initial investors then can sell the assets to these low-risk investors and obtain a profit. The described prevalent business model does not introduced incentives to design portfolios/pools targeted to directly address capital markets and much less to finance the activity of local SMEs.

Thus, pools of RES projects are currently managed as relatively small portfolios traded privately as a whole instead of being transformed into collateral for publicly traded instruments. This reduces significantly the funds available for PVI and means that each project must seek funding, a process that is particularly costly. Therefore, the managers of the SPV will change the traditional focus from specialized investment funds to bond holders. Broadly speaking, this means that the asset managers must seek to build and run a pool of assets larger and more

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homogenous than the normal practice. The pools must have a simple, plain vanilla structure, with a buy and hold to maturity strategy, high level of bankruptcy remoteness and very clear and standardized protocols to acquire, by true sale, exclusively PPA-PVI that can themselves be easily monitored and valuated by credit agencies and non-specialized institutional investors.

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3. PVI securitization

Introducing quality standards in planning, building and operating PVI is key to increase confidence in the solution but they do not necessarily reduce the cost of PVI energy to competitive levels, which is a requisite for its market uptake. For this to be possible, the cost of capital of PVI must be considerably reduced and access to it substantially increased. This can be done by applying to PVI project finance concepts leveraged with transforming the resulting assets into liquid FIs. Because of its advantages in terms of cost and risk allocation for long-term funding, project finance is the default option to fund large infrastructure projects (Mohamadi, 2021) but this cannot be directly applied to smaller ones such as PVIs. This is because project finance´s costs are less than proportional to the size of the project so the larger the project, the cheaper it is to fund each € invested. Apart from size, the other key element to reduce the cost of capital is to increase liquidity of the resulting assets. As liquidity increases, so does the price that investors are willing to pay for the assets, further reducing financing costs per € invested in the underlying assets for a given level of risk and return. In the case of FIs, increased size and liquidity triggers a financial virtuous circle as the larger the size of an FI is, the more liquid and valued it is. Thus, as the pool of PVIS assets increases, larger and more liquid FIs can be produced increasing its valuation and the confidence in the asset class, stimulating further demand and allowing for the reduction of the cost of producing new PVIS. The described process can have a large positive impact in the reduction of the cost of energy from PVI and, consequently in fostering its market uptake.

The financial technology that allows to transform illiquid assets such as PVI systems into liquid assets such as green bonds is securitization. As presented, it offers a number of advantages but it also come at a cost and it is only available for assets classes that meet the requirements in terms of size, nature of cash flows, legal status and standardization. PVI can met those requirements if proper origination practices and coordination among stakeholders is put in place. At that moment the securitization process described below will be possible resulting in the production of a PPA-PVI high-quality capital market-oriented FI.

3.1 Asset securitization

Securitisation is a financial technique consisting of grouping cash flows from collection rights (such as PPAs from PVIs) and issuing fixed-income securities backed by these collection rights (they are the collateral of the FI). The process essentially consists of three phases. In the first phase, a sufficient number of systems/contacts are added (bundled) to generate cash flows needed to create a financial instrument for the capital market. Once this pool is available, the amount and the risk of this cash flow are analysed and then the type, structure and price of the FIs that can be created from this collateral are established. Finally, the issuance and placement of the securities can be carried out in order to obtain upfront income in exchange for future payments. This process generally includes the intermediation of financial institutions which acquire all or part of the issuance for themselves and/or their customers (underwriters) at a pre-determined price. The lower the price, the higher the yield demanded by investors and the lower the amount of money obtained by the issuer. After the issuance, in the denominated secondary market, the securities are sold at market price that will reflect changes in the FI´s valuation, depending on the assets' evolution and the economic environment. The funds obtained by selling the FIs to investors can be used to pay-off the investment of the originators. In the case

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of PVI, the securitization will allow SMEs offering PVI under the PPA option to remove such assets from its balance and to obtain funds for further expansion.

The securitization of PVI will have economic viability if the resulting FI have a high price (low yield) that can only be achieved it the issuance obtains an investment grade credit rating. Otherwise, the market of the FI will be very limited and the resulting cost of capital will be high and the cost of energy from PVI will not be competitive. Once there is a reasonable expectative that an investment grade credit rating can be obtained the securitization process can take place. Below the obtention of a credit rating for PVI and the subsequent securitization process are described.

3.2 Credit rating

Issuing FIs as a conduit to obtain debt finance is a relatively easy process from the legal perspective. In the simplest version any entity can issue "IOUs" (I Owe You) in exchange of cash from investors. In practical terms the use of FIs is limited by the availability of investors willing to buy them at yields lower than banking finance, including issuing cost. In this regard, FIs (bond) markets are divided in high yield and investment grade, reflecting the credit rating of the assets. High yield bonds (BB+ or less in S&P notation) are considered as riskier than investment grade (BBB- or more in S&P notation) and consequently investors demand higher yields. As explained before if the FI has to pay a higher yield to investors the result is that the cost of funding PVI is higher and consequently the cost of energy for irrigators will be higher. As PVI require long-term funding to match its lifespan (20 years or more), the impact of increased yield on the value of PVI-backed FIs is very high. As an example, Table 1 presents the value of 2 bonds with the same cash flows associated but different yields corresponding to their credit rating:

	Bond A (A-)	Bond B (BB+)
Face value	100 €	100 €
Maturity (years)	20	20
Coupon (annual)	2%	2%
Yield	2.5%	5.5%
Price	**92.21 €**	**58.17 €**

Table 1. The value of a bond with a long maturity is very sensitive to its yield. A bond with low valuations means that the underlying assets must pay more for the finance, which in the case of PVI will negatively affect its competitiveness. For this reason, a PVI FI must obtain an investment grade credit rating that guarantees a low yield.

As shown in Table 1, three percentual points increase in the yield required by investors to acquire bond B means that its value is 37% less than that of bond A. This reflects the key importance of obtaining an investment grade credit rating for a PPA-PVI backed FI in order to effectively reduce the cost of energy for irrigators.

In order to obtain a credit rating for PVI-PPA it will be necessary to build and operate a minimum amount of systems in order to create a track record (Mohamadi, 2021). Nevertheless, it is also possible to speed up the process by building simulation models reflecting the expected performance of the assets. In any case the services of a credit qualification agency will be required so it is important to anticipate the type of information that will be necessary to provide and to introduce in the origination of the assets elements that will improve its credit assessment. On this regard the following Table 2 summarizes the elements that are expected to be presented in the credit analysis of a PPA-PVI and possible mitigation measures:

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Risk	Description of the risk	Mitigation measure
Long contractual terms	The PPAs last 20 years or more, introducing a lot of uncertainty.	Securitized debt can be structured at shorter maturities, for example by leaving the assets in the SPV for longer time.
Lack of track record	There are not previous data on the performance of PVI-PPA.	Produce data based on the existing systems (demonstrators) and the data existing on the irrigators and SMEs data bases.
Quality of the O&M	Rating agencies often examine also O&M providers. This could be difficult as it is expected to involve many local SMEs in the operations.	Introduce O&M best practices and measures to ensure compliance.
Warranties and replacements	Warranties of the equipment and availability of replacements can be assessed by the credit rating agency.	Stablish a reserve fund in the SPVs to cover unexpected expenses without need to find new finance.
Insufficient cash-flow to attend payments	The FIs will be backed exclusively by the cash flows of the SPV, any shortfall will mean that the bonds are in default.	Introduce credit enhancement elements including overcollateralization and junior tranches.

Table 2. Investors in a PVI-PPA FI will be exposed to a number of risks that are specific to the asset class. In order to produce a credit rating, these risks will be analysed and quantified. In order to improve the credit qualification, and consequently to reduce the cost of PVI for irrigators, these risks must be mitigated including actions such as the described.

3.3 The securitization process

The sequence which can result in a PVI-PPA backed PVI will start with the commercial contact between a PVI-PPA provider and a potential customer. The customers are irrigators interested in introducing PVI under the PPA model. At that point a preliminary planning will be carried out in order to determine the suitability of the project and the main elements of the offer, including price of the energy and length of the PPA. If the preliminary planning is accepted by the customer, the provider will contact with the managers of the SPV in order to approve the project and to receive a credit line for its execution. To assess the suitability of the project, an initial QC of the preliminary project will be carried out by an independent contractor. If the result is positive, a detailed planning of the system will be carried out and a firm offer will be presented to the customer. After the acceptance of the terms of the PPA by the customer, the promoter will have access to financial and technical support from the SPV in order to facilitate the execution of the project and the compliance with the quality criteria. These activities will be funded by greenfield investors and, eventually, by the revenues resulting of issuing FIs.

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Once the PVI systems´ construction is completed and the systems are fully operational, a second quality control will take place in order to verify that the PVI-PPA meets all the requirements to be included in the pool. If that is the case the assets will be totally transferred from the original promoter to the SPV. From then on, the assets will be jointly managed and monitored with the objective of producing a high quality FI. Once the pool achieves sufficient size and track record of its performance is available, the securitization process can be considered. As mentioned, obtaining an investment grade credit rating is a requisite to access capital market funding at affordable costs. In order to improve the risk assessment of PVI-PPA, credit enhancements can be introduced, for example by providing investors guarantees in case of the default. These guarantees can be provided from institutions seeking to support the development of PVI, such as national governments or the EU whose policies include foster investment on farming and decarbonizing food production.

Once the details of the FI are determined, the assets can be transferred from the SPV to securitization fund. At that point it will be necessary to introduce an *Underwriter*, usually an investment bank, to support the issuance. The underwriter will acquire the issuance in its entirety or in large part at the agreed price. Later the underwriter can keep the securities in its balance sheet up to maturity or sell them to other investors in the denominated secondary market. At this stage, the bonds would already be in the balance sheets of institutional investors, who would require periodic information for their investments to be assessed. Figure 2 schematically shows the different components, stakeholders and stages of the described securitization process of PVI-PPA.

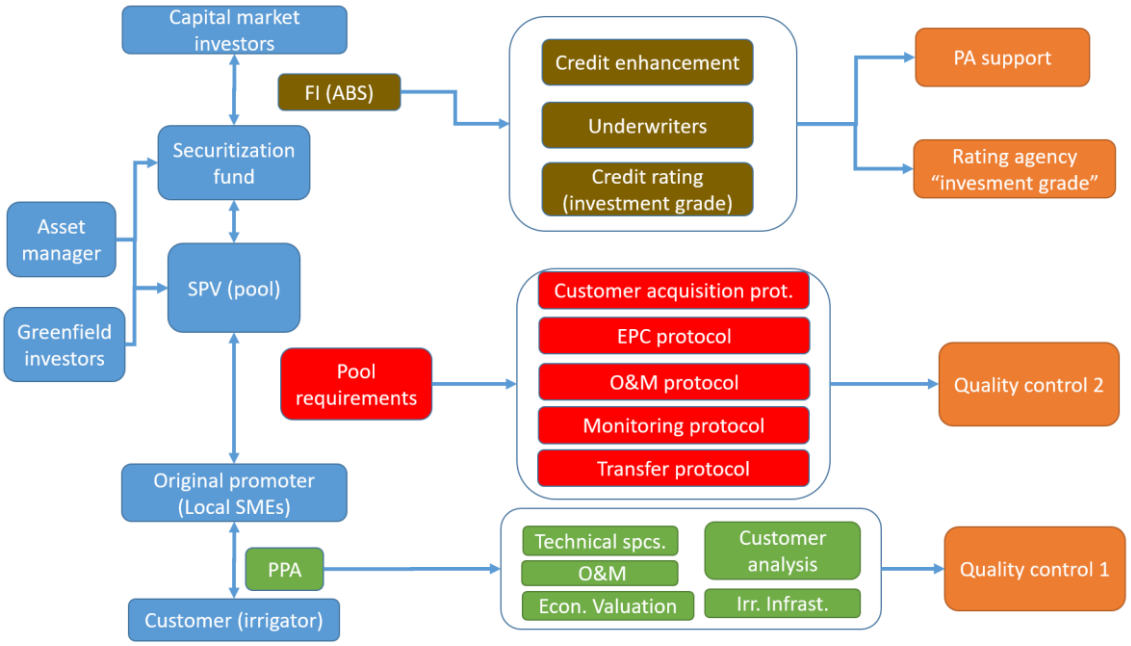

Figure 2. The sequence which will result into a PVI-PPA based FI will be initiated by the agreement of a PPA between an irrigator and a promoter. If the resulting assets meets the requirements of the pool, it will be transferred to an SPV and jointly managed during a period. Once the resulting pool achieves sufficient size and a track record of its performance is available, the details of the securitization can be determined. On that basis a credit rating can be obtained and, if the result indicates the suitability of the FI, the PVI-PPA can be transferred to a securitization fund. In collaboration with underwriters and other potential partners, the fund will be ready to issue FIs in order to finance PVI-PPA.

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4. The financial instrument

The described securitization process will allow to produce a specific type of FI denominated "Asset-Backed Security" (ABS). ABSs are fixed income securities (bonds) which are guaranteed (collateralized) by assets other than loans or mortgages. When buying an ABS, an investor obtains a "promise" of being paid periodically a preestablished interest (the coupon) over a period of time (the maturity). At the end of that period the investor will be repaid a preestablished amount of money (the face value). In this regard a bond is similar to a loan with the difference that this loan can be easily sold in the market by the lender, so, as an asset it is much more liquid than a normal loan. Bonds are therefore the building blocks of the financial system and the bond market oversize all the other markets by far.

ABS is well suited to PVI as is the mainstream technology to securitize cash flows from receivables, such as payments for electricity from irrigators. Rating agencies, regulators and investors are used to deal with ABSs and the demand of investment grade ABS from institutional investors is huge. Although the initial price of the FI, and consequently the amount of money that the SPV obtains to repay and/or fund new PVIs, is determined before issuance, the value of the FI after that moment will heavily depend on the performance of the underlying assets. In that regard it is possible that the first issuance will be penalized because of no refence is available, but its existence is necessary precisely to allow for the market a reference of the asset class PPA-PVI. Subsequent issuances will take advantage of this and will likely obtain higher valuations allowing for reductions in the cost of energy for irrigators.

4.1 Structure and management of a PVI-PPA based FI

After the issuance, in the so called "secondary market" the FI will be traded at market prices. If the FI performs well, its value will rise accordingly. In order to stablish the performance of the bond that the underlying assets are producing the expected cash flows and that the "promises" of payment to bond holders are likely to be met. In order to allow investors and other stakeholders to evaluate the performance of the collateral after bond issuance, they must have access to relevant information. Furthermore, investment grade ABSs are required to present a very specific structure and payment sequence to reduce the risk of defaulting on the bonds.

The structure that must be in place to back an PVI-PPA FI after issuance includes elements to ensure the appropriate performance of the underlying assets and the transfer of cash flows to the stakeholders involved. Thus, in order to avoid that any part of the chain defaulting affects the flow of cash from customers to investors, an independent party will be in charge of collecting the proceeds of the asset directly from the irrigators. This independent party (normally a commercial bank) will deposit the money into a special account (lockbox) that will be used to attend payments using a preestablished sequence known as "payment waterfall".

The first claim to be attended with the proceeds of the assets will be to pay the servicer as it is required to start the whole sequence. Then, those claims related with the operation of the securitization fund will be paid, as this is the entity that relates the assets with the investors and must be operating even in case of default. Then, the fees related with the management of the assets will be attended in order to ensure that this key task is available even under very stressed scenarios. Following this, the insurance policies and credit enhancement instruments will be paid to facilitate the obtention of such hedging. The next in seniority are those claims related

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with monitoring the assets and disclosing information, as they are required to be active in case of default. Then the O&M expenses of the PVI will be paid in order to ensure the proper functioning of the systems.

After paying the different expenses related with the operation of the assets and the structure that supports the FI, the paying agents will proceed to pay to investors. If the issuance is structured, meaning that different FIs have been offered backed by the same collateral, the bondholders with the most senior note will be paid in full first. If there is still money left in the lockbox it will be used to repay first to mezzanine note holders and equity investors. Failing to attend payments to these junior investors is not a cause of default for the bond, but will have negative consequences on its valuation. Finally, if after attending all this claims there is still money in the lockbox it will be deposited in the reserve accounts. Figure 3 presents this structure.

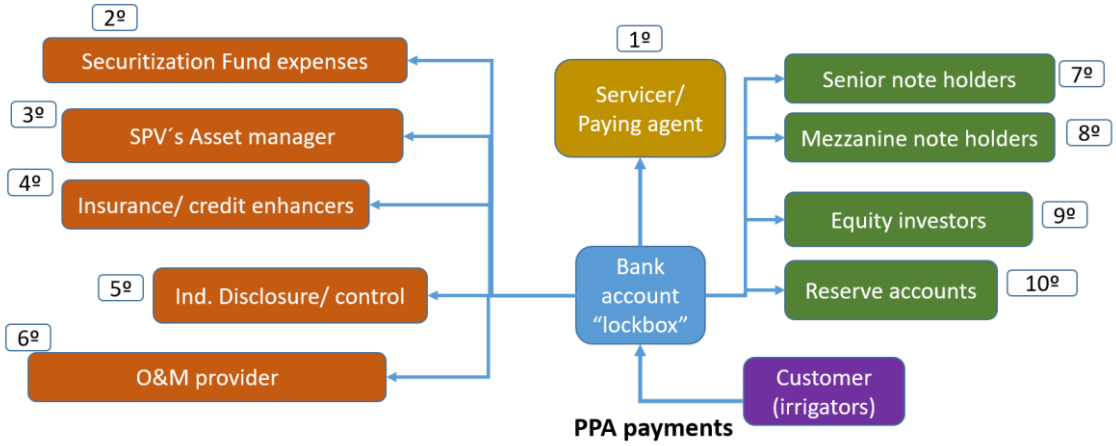

Figure 3. The structure supporting the PVI-PPA FI must provide investors guarantees that the proceeds from the irrigators will be used exclusively to maintain the operation of the assets and to attend the payment structure. In order to provide guarantees over this issue, an independent paying agent will be responsible to collect the money and to attend the different claims following a preestablished payment sequence.

4.2 The market of a PVI-PPA FI

The described FI, providing that an investment grade credit rating is obtained, will be oriented to institutional investors, such as pension funds and insurance companies. These types of investors buy FIs, especially bonds, in order to allocate savings and polices of households, companies and governments. The resulting global bond market is huge, with total outstanding bonds amounting more than $ 128 tn in 2020 (in comparation global GDP in 2020 was $ 84 tn). The FI here described will fall into the green bond category, a class of FIs that is backed by investments with a positive environmental impact. The market of green bonds is growing at a fast speed and has exceed in Europe the level of € 400 bn by May 2021[2]. Green bonds demand is growing as socially-responsible investors can include them into their portfolios to meet their commitments. In particular, new generations are showing an interest in green based investments. This indicates an increased demand for green bonds as total disposable income of millennials is expected to exceed the income of all other generations by 2029. As a result, green

[2] https://www.climatebonds.net/files/reports/cbi_pricing_h1_2021_03b.pdf

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bonds have often a premium in terms of valuation which can result in lower cost of capital for the underlying assets.

When an institutional investor decides to include a particular FI in its portfolio, it requires a minimum amount of them, normally in the order of tens of € million at least. Considering that the initial issuance of the FI is expected to range between € 40 M and € 80 M, it can be fully purchased by one or two clients. Nevertheless, it is estimated that the PVI-PPA asset class has the potential to support in Europe FIs outstanding up to € 10 bn so an active secondary market can eventually be developed.

A particularly relevant market trend for a PVI-PPA FI is decentralized finance (DeFi). While traditional finance relay in centralized financial intermediaries such as banks and traditional financial instruments such as bonds, DeFi utilizes cryptographic technologies, in particular the Ethereum blockchain, to validate and execute transactions. The central concept is that many decentralized participants in a network can produce the level of trust required to validate financial transactions. One of the tools of DeFi are the smart contracts which are self-executing agreements in which a chain of actions take place automatically when certain conditions are met. Smart contacts are automatically enforced so no party can manipulate or modify them. For example, a smart contract can be established to reproduce the structure presented in Figure 3 in order to execute the payment waterflow without the need of a paying agent. DeFi also introduces “tokens” which are digital representations of assets. Thus, tokenization is the DeFi version of securitization with the difference that no lawyers or underwriters are required.

DeFi is still in its infancy but it is evolving fast and has the potential to completely disrupt the financial industry. A reliable alternative to securitization based on DeFi could drastically reduce the cost of providing PVI-PPA with liquidity, for example by producing and selling tokens instead of securitized bonds. In any case the value of the token will also depend on the value of the underlying assets so introducing quality standards in the origination of PVI-PPA will be necessary.

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5. Valuing a PVI-PPA

As previously indicated, obtaining an investment degree credit rating is essential to ensure that an FI can reduce the cost of PVI for irrigators. This means that different stakeholders, in particular credit rating agencies, must be able to produce related assessments. In order to facilitate the assessment of PVI-PPA it is relevant to anticipate a valuation framework and the type of information that will be necessary to obtain relevant valuations. This Chapter 5 presents a framework for such assessments that can serve as a reference to produce track records on the performance of the assets and to facilitate the securitization process.

In order to stablish the value (price) of a bond, there are two main elements that must be estimated. First, one must estimate the value of the cash flows that the underlying assets will produce during each period of their lifetime. Then, a discount rate must be calculated to adjust those cash flows by its riskiness and the time-value of money.

5.1 Estimating the cash flows of a PVI-PPA pool

PPAs are particularly well suited as collateral for FIs because they allow to stablish a well-defined stream of cash flows. The PPAs for PVI stablish not only the price of the energy during the entire duration of the contract, but also the amount of energy that will be billed to the customer within a narrow interval. In this regard the main variable that can cause that cash flows differ from the preestablished amount is the possibility that some irrigators will end up not complying with the PPA terms agreed upon. This can happen because they are insolvent or refuse to pay for any reason. Preliminary credit analysis can reduce this risk but it cannot be completely eliminated. This commercial risk is expressly undertaken by the FI investor, so its estimation is essential to assess the credit rating and, consequently, the value of the FI. The estimation of commercial risks is normally produced by models that use past observed delinquency rates and relate their value to relevant variables. In the case of a new asset classes such as PVI, it is expected that the evaluation of the commercial risk will be initially focused on the customers, so financial information from them must be collected at the moment of subscribing PPAs.

The value of a given stream of cash flows can vary depending on who is carrying out the assessment. This is due to two main elements that must be taken into consideration. The first element is the different discount rates that each stakeholder must apply. Thus, the more layers or intermediaries are between the source of the cash flows and the stakeholder, the higher is the discount rate, as it must include the increased level of risk. The second element is the existence of fees or taxes related to services that must be put in place to allow the cash flows to reach a specific stakeholder.

Modelling the value of a pool of PVI-PPA from the perspective of the originator

As one of the conditions for the inclusion of a PVI-PPA in the securitization pool is that it must not be in default, we can assume that, at the initial stage $t = 0$, the m number of PVI-PPA included in the pool produce revenues for the average contracted energy of e per year. Each PVI-PPA will

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have a price for the energy established at origination that will be updated annually based on the evolution of the general price consumer index. Thus, assuming that the initially agreed price per kWh (t = 0) is p_0 and the anticipated price evolution is γ, the expected price of the energy in year *t* is given by eq.1:

$$p_t = (1+\gamma)^{t-1} p_0 \qquad \text{eq. 1}$$

For reasons of simplification, it can be assumed that γ is a constant. This constant can be replaced by any other model for price updating to produce more detailed estimations. In the absence of breaches of contract, the number of PPA-PVIs in compliance (paying the agreed price) would be constant and equal to *m*. However, there is a degree of probability *β* that a contract enters into default. This decreases the number of contracts generating cash flow in such a way that, at the time *t,* the number of PVI-PPA in the pool backing the FI is given by eq.(2):

$$m_t = (1-\beta)^{t-1} m_0 \qquad \text{eq. 2}$$

The establishment of the value of *β* is a fundamental component to set the future value of cash flows and, thus, the value of the FI backed by such cash flows. There are several methodologies to estimate the default rate based both on individual characteristics of the debtor, the macroeconomic conditions and their interaction with different segments and sectors of the economy. However, to simplify we will undertake that *β* is a constant, so the annual cash flows c_T generated by the pool is given by eq.(3):

$$c_t = p_t \cdot E_t = [(1+\gamma)^{t-1} p_0] \cdot e \cdot [(1-\beta)^{t-1} m_0] \qquad \text{eq. 3}$$

And, considering δ as the risk-free interest rate, the total value of the PVI-PPA for the originator (at this stage the SPV), C shall be:

$$\boldsymbol{C = \sum_{1}^{T=t} \left(\frac{c_t}{(1+\delta)^t}\right)} \qquad \text{eq. 4}$$

5.2 Valuing a PPA-PVI FI

The value of the resulting pool backing the FI, C_{FI} , shall correspond to the actual value of the cash flows to be originated by the assets in the pool, from the perspective of FI´s investors. This value differs from the value of these same cash flows from the originator's perspective due to the inherent costs of the securitisation process and, most notably, the credit improvements needed to make the resulting bond safe enough to obtain an investment degree credit rating. It is very likely that a first-of-its-class PPA-PVI backed FI will require credit enhancement through over-collateralisation. Over-collateralisation consist in allocating more collateral to the securitisation of that which appears in the issue's par value. So, assuming that *ϑ* is the level of over-collateralisation required to securitise the PVI-PPA pool, there will have to be an increase in *ϑ* for the PVI-PPA number initially assigned to the bond to cover possible defaults. In normal circumstances the level of defaults that eventually occur with a probability *β* should be less than *ϑ*. So, there will be an excess of over-collateralisation of size *σ*. The cost of capital that ends up as an excess of over-collateralisation is different (superior) to the cost of capital obtained in ABS, because it must be funded with equity or junior debt, so to determine the final cost of capital

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for the originator it is necessary to establish the relationship between all these variables and market conditions. It can be incorporated ϑ in the model by the assuming the equivalence $\vartheta=\beta-\sigma$ so the annual cash flow included in the securitisation c_t^s is eq.(5):

$$c_t^s = p_t \cdot E_t = \left[(1+\gamma)^{t-1} p_0\right] \cdot e \cdot \left[(1-(\beta+\sigma))^{t-1} m_0\right] \qquad \text{eq. 5}$$

In the case of securitisations, asset managers usually charge a percentage η of annual flows for their services, so this cost F_t must be included in the model by the expression eq.(6)

$$F_t = \eta \cdot c_t^s \qquad \text{eq. 6}$$

To determine the actual value of the pool assets backing the C_{FI} we use eq.(7):

$$C_{FI} = \sum_1^{T=t} \left[\frac{(1-\eta)\cdot c_s^t}{(1+\delta)^t}\right] \qquad \text{eq. 7}$$

In this regard investors will demand that the FI offers a return higher than the risk-free return δ as they are accepting a certain level or risk. This risk premium μ is a function of the difference of the value of the collateral C_{FI} and the actual value of the payments promised to the bond holders D_{FI} can be calculated using eq.(8):

$$D_{FI} = \sum_1^{T=t} \left[\frac{i_t}{(1+\delta)^t}\right] + \frac{FV}{(1+\delta)^T} \qquad \text{eq. 8}$$

Where i_t is the coupon of the FI to be paid at time t, and FV is the face value of the issuance. Thus, the return r demanded by investors to purchase the PVI-PPA based FI is higher, the higher the probability that D_{FI} is higher than C_{FI}:

$$r = \delta + \mu \approx P(D_{FI} > C_{FI}) \qquad \text{eq. 9}$$

The value of r, and thus the probability than the cash flows produced by the pool of PVI are not sufficient to meet the payments to the bondholders, is established by the market on the basis of the information available and the expectative of investors. In this regard the objective value of the bond V is the value of the promised payments discounted at r and is given by eq.(10):

$$V = \sum_1^{T=t} \left[\frac{i_t}{(1+r)^t}\right] + \frac{FV}{(1+r)^T} \qquad \text{eq. 10}$$

5.2 Resulting cost of capital for PVI projects

Once the pool's value is established for the institutional investors C_{FI} it is possible to identify the cost of capital resulting for the PVI by calculating the internal rate of return (IRR). IRR is defined as the discount rate that updates a future flow stream to a net current value of 0, so in this case it would be given by eq.(11):

$$0 = C_{FI} - \sum_1^{T=t} \frac{c_t}{(1+IRR)^t} + \frac{\sum_1^{T=t}[c_t - c_t^s]}{(1+IRR)^T} \qquad \text{eq. 11}$$

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Eq.(11) collects the inflows and outflows of capital on the part of the originator. In the first period the originator receives the amount C_{FI} from the investors in exchange for the flows c_t over the next *T* years. In the last period, the originator also receives any remaining funds resulting from a hypothetical excess of over-collateralisation or reserve accounts that have not been used. Of all the variables considered in the model, it can be seen that, in order to assess the value of the bond it is particularly relevant to establish the credit quality of collateral β, so an effort must be done to properly stablish and document the creditworthiness of the irrigators. Another relevant element is to anticipate the excess of over-collateralisation σ that will be required by rating agencies to determine that the FI is in the investment grade area. As it is very likely that the value of σ will be high, it is expected that only a relatively small part of the initial pool will be funded by the securitization. This indicates the need to create a large pool of PVI previously to consider the securitization and/or to obtain other type of credit enhancement such as first loss-facilities at competitive cost, for example by securing support from institutional partners.

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