EIP-AGRI Focus Group

Enhancing the production and the use of renewable energy on the farm

MINIPAPER: Business Models and Financial Alternatives for On-Farm Renewable Energy Projects

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Abstract

The introduction of renewable energy and energy efficiency systems (RES) on European farms on a mass scale depends on the availability of business models (BM) and financial instruments (FI) that suit the needs of farmers but also the requirements of the technology and finance providers. In recent years across the EU, a number of different BM and FI for on-farm RES have been introduced or tested with different levels of success, meaning that a valuable repertoire of experience has already been obtained. Nevertheless, a comparative analysis of the different solutions and BM and FI alternatives for on-farm RES is not so straightforward. Furthermore, the complexity and cross-national variability among the different EU countries and especially their administrative and regulatory RES framework is not helpful in order to carry out such a comparative analysis. In this document, we analyse three relevant promotions of on-farm RES that took place in recent years in Europe. We use a tailored methodology to classify and compare the different technological solutions, BM and FI for on-farm RES. This methodology can be helpful for those stakeholders who are interested in promoting, investing, analysing or regulating on-farm RES including researchers, investors, public authorities and the farmers themselves. The analysis carried out allows for the identification of a number of features that should be considered while designing on-farm RES promotion schemes. Among other best practice features we have identified the need to ensure independent assessment, the creation of economies of scale, the convenience of focusing on mature technologies and assisting farmers during the planning process, installation and operation of on-farm RES.

1. Introduction

European farms are directly responsible for energy consumption of 23.4 MTOE in 2015 (Eurostat), the equivalent to 2.2% of the European Union´s total consumption. In that year, the energy mix for agriculture was primarily composed of fossil fuels, accounting for up to 70% of the total, and the energy intensity of the sector is on the rise (Martinho, 2016). As a result, agricultural activities in the EU-28 generated 436.7 million tonnes of CO_2 equivalent in 2015, corresponding to about 10 % of total greenhouse gas emissions of the EU. There is a huge potential in agriculture to contribute to the numerous strategic objectives of the EU related to adopting a more sustainable energy model for the member states. Effective change must be based on a broad use of renewable energy systems and energy efficiency solutions (RES) as well as suitable business models. Furthermore, the sheer size of investments required to change the energy model of the agrarian sector requires the development of suitable financial instruments in order to provide capital at a sufficient scale and with the required characteristics.

In this minipaper we analyse three business models (BM) and related financial instruments (FI) that are considered especially relevant for the introduction of on-farm renewable energy systems in the European farming sector. The analysis of these experiences has been carried out using a tailor-made methodology to analyse on-farm RES, BM and FI. This methodology can facilitate the assessment and comparison of existing and potential solutions for on-farm RES. The ultimate goal of this minipaper is to provide relevant information and tools to on-farm promoters, investors and policy makers in order to facilitate the analysis of the projects and the design of promotion schemes.

The suggested methodology is an adaptation of the "business model configurator" to the case of on-farm RES. This was developed in the framework of the Horizon 2 project "Solar Bankability" to present alternatives for RES (Graf von Armansperg & Oechslin, 2015) and based on the results of the analysis of different alternatives for on-farm RES developed in the project "RESFARM". The model presents the different dimensions of a RES project in a structured manner, including the different elements that define a business model for a determined technology and application.

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2. Methodology

The business model configurator presents four main dimensions that allow a complete description of a given business model for RES. The first dimension of the business model configurator is “Consumption/off take” and this is determined by the manner in which the energy/savings produced by the system are transformed into economic value. So, for example, the energy produced by a PV system can be “monetarised”, among other ways, by being self-consumed by the producer and alternatively and/or complementarily being sold to other consumers under a power purchase agreement.

The second dimension of the business configurator presents how the energy is distributed from the production system to the consumption centre. Among other alternatives for energy distribution, this can be done by using the general electricity grid for distributing electricity or instead by connecting the systems directly to the consumers, using a mini-grid. The third dimension of the business model configurator is “ownership/financing” that is determined by who the owner of the system is and how the systems are financed. This dimension is determined in a first level by whether the systems are being directly owned (DO) by the farmers or alternatively third party ownership models (TPO) are used. A second level of this dimension shows how the owners are funding the systems. Among the alternatives observed in business models that can be used for on-farm RES are DO systems funded directly by the farmers or using special bank loans, systems owned by investors who are including them as assets in their balance sheets and systems owned by capital market investors through the use of securitizations and green bonds issuances.

Finally, the fourth dimension of the business configurator is determined by the “installation/operation” specification. This includes details of how the system is planned, operated, maintained and serviced. Among those elements are the contractually binding agreements among the different stakeholders that perform each task including the installation of the systems, the operation and maintenance services, the different provisions that must be included to deal with any incidence during the lifespan of the system, etc. The four dimensions that are represented in Figure 1 below, allow a complete description of a specific business model for RES.

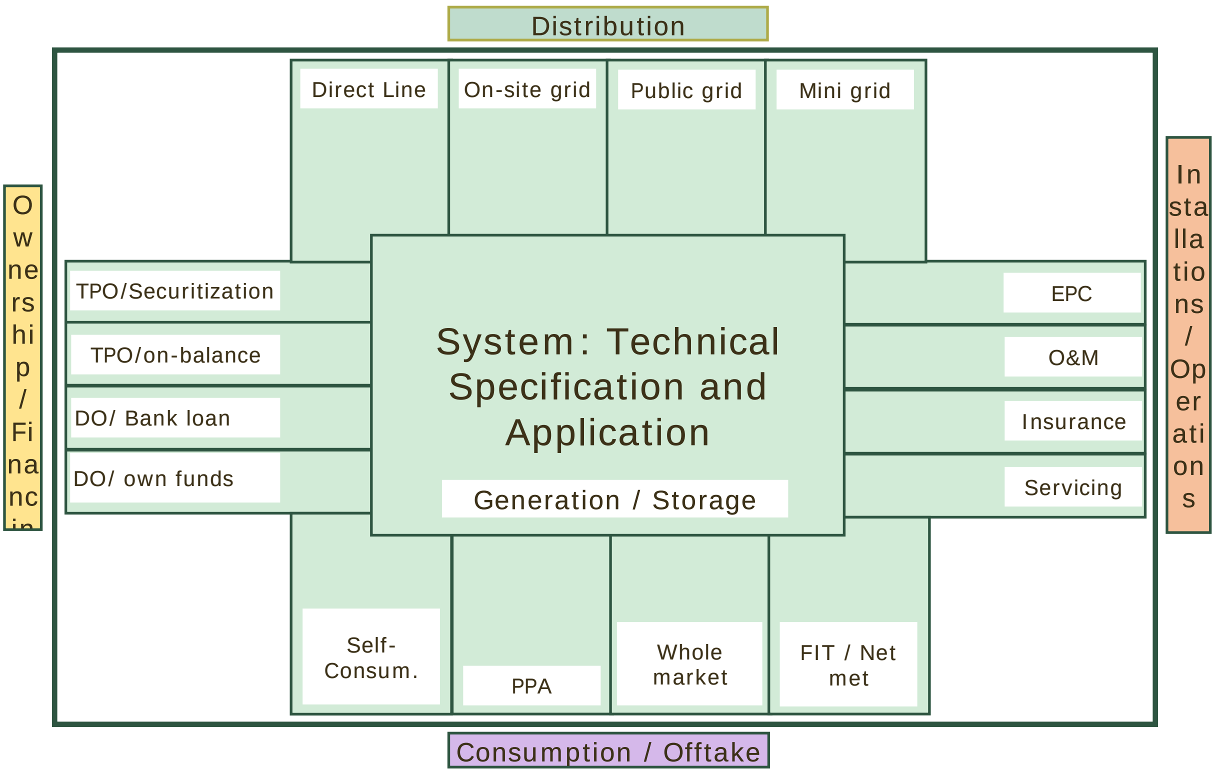

Figure 1: Business model configuration of RES. It shows the different dimensions that determine a specific business model, and the interrelations between the technical, legal and financial aspects.

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3. Selected business models and financial alternatives

In order to identify best practice for on-farm RES promotions, we apply the proposed methodology to describe and assess three different BM and FI that have been successfully used to introduce on-farm RES in Europe. The presented experiences and their features are not necessarily the optimal ones to introduce on-farm RES, but are considered by the authors as sufficiently successful so as to allow for the extraction of relevant information and lessons. By describing each of these alternatives in their corresponding business model configurators, it is possible to identify all the elements which must be considered in order to replicate or improve these business models in different countries, using different technologies or financial and promotion instruments.

3.1 Experience 1: Green bonds for on-farm RES in Southern Europe

The evolution of the technologies related to renewable energy and efficiency solutions have been remarkable over the past few decades. There are systems that can produce clean energy from a variety of sources including solar radiation, tides and waves, wind, etc (Stout, 2012). Nevertheless, not all of these alternatives can be considered to be suitable for installation on a farm in an economic way (del Río & Burguillo, 2009; OECD, 2012). This is not the case of photovoltaic systems (PVS) that allow the production of electricity from solar radiation. Practically all farms and agribusinesses are suitable for PV systems; Illumination, coolant pumps, conditioning, and the house itself all consume electricity. The main limitation of photovoltaic systems is the availability of sufficient space, which is not an issue for most farms that tend to have space available either on the land or on the roofs of the different buildings. Furthermore, in recent years, the price of photovoltaic systems has become considerably cheaper. As a result, PVS technology is already cost efficient for many applications, especially in the case where the consumption and the production of energy is simultaneous, like PVS for irrigation and for ventilation of barns. In the case of a net metering scheme being available, prosumers can use the grid as a "bank" were energy is notionally accumulated, otherwise batteries are required, an element that negatively affects the technical and economic viability of the projects.

PVS systems can produce electricity for self-consumption and/or for selling the energy through the public electricity grid. In most cases, PVS without batteries produce surplus energy that must be sold to the grid or lost, so consumption/off take models that allow for self-consumption plus selling surpluses are especially well suited for farms. A potential limitation of such off take options is the complex regulatory and administrative framework that affects the commercialization of electricity. Also, the cost of connecting the PVS to the public grid may also be high. These factors can discourage many farmers from installing PVS and increase the uncertainty over results. These barriers can be overcome by using energy service companies (ESCOs) business models (Bertoldi & Boza-Kiss, 2017), by virtue of which the ESCO take over the investment and necessary work to install and operate the RES and offer a guaranteed amount of energy or savings to the customer. In return, the farmer agrees to buy such energy at the price agreed over a period of time, enough to repay the investment. Normally, the farmer can exercise a purchase option so that he/she can access the facility's property at an agreed time. This model, called "third-party ownership" (TPO), presents a number of advantages and guarantees for the consumer, in such a way that it is the most used procedure for installing distributed renewable energy systems in the United States (Drury et al., 2012). Even though the TPO model has important and notable advantages, its viability depends on the ESCO being able to adequately fund its investments at competitive prices, normally by accessing capital markets directly.

Capital markets are similar to any other type of market, only that the product sold and purchased is "promises" of future payment, usually in the form of bonds. Bond buyers (the investors) will receive payments from the seller (the borrower, also called "Issuer") for the duration of the bond, usually including the refund of the price paid for the bond plus an interest rate. This interest is the price of money, the interest required by investors being higher, the higher the risk of default and the less the liquidity of the bond.

Renewable energy securitization: The lessons from California

The introduction of solar energy in California has been particularly successful due to the favourable combination of resource availability, policy schemes and innovative business models. As a result, California reported an installed solar capacity of more than 20 GW by 2017 which produced almost 20% of total electricity consumption with peaks of more than 50%. It also created an industry that employs more than 100,000 people. Most of this development took place in the last few years and coincided with the introduction of solar leases and power purchase agreements (PPAs) by companies such as SolarCity or Sunnova. These types of business models allow households and enterprises to install solar systems for self-consumption without facing up-front payments or technical and administrative planning difficulties. Under the PPA model, a family or an enterprise agrees to purchase a certain amount of energy provided by a photovoltaic system at a specific price. Then, the company responsible for providing that energy installs the photovoltaic system with the required characteristics on a suitable roof or plot of land. After an agreed period, the consumer can purchase the system at a reduced price. This business model presents several benefits, both for the consumer and for the provider. As mentioned, the consumer is not required to pay the up-front cost of the system, nor to be involved in the planning and construction activities. Consumers also have a "guarantee" of performance and results, a feature that is not offered in direct-ownership models. Even more relevant are the advantages for the provider, related to access to affordable finance for its operation. By a process known as securitization, Solar PPAs and leases can be used as "collateral" for capital market financial instruments such as asset backed securities (ABS). By issuing solar ABS, a type of green bond, solar developers "recycle" the capital invested in installing solar systems, allowing them to expand their operations and to offer their clients lower prices. The described business models and related financial instrument have been used by more than 65% of total new solar installations in California, attracting billions of dollars in private funds to this asset class. In the European agricultural sector some developers are starting to use these business models in order to introduce renewable energy systems. In the UK, Lumicity has developed more than £145 million in projects for the agricultural sector including solar and biomass systems, partly funded by green bonds. In Spain, firms like Opengy are offering solar PPAs for farmers including those with irrigation needs. The model is attracting a lot of interest among consumers, developers and investors so a Californian-style virtuous circle could soon be taking place in the European farming sector.

RES is known for requiring high investment at the beginning, when planning and building the facilities and for low operating costs as they do not need fuel or intensive maintenance to produce energy. RES also has a long useful life which in the case of PV exceeds 25 years and if they have been installed following proper protocols for best practice and quality, suffers few technical incidents throughout that time. Due to these circumstances, the cost of the capital used to undertake the initial investments greatly affects the price of the RES energy produced (Ondraczek, Komendantova, & Patt, 2015). The success of the TPO in the USA is largely due to the development of finance mechanisms which are suitably appropriate for RES projects, particularly securitisation for supply contracts (Power Purchase Agreements-PPA) (Mendelsohn, Urdanick, & Joshi, 2015). 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 it is possible to issue bonds[5] and therefore access a broader range of investors. Bond buyers are fundamentally institutional investors who are by far the main repository of capital available at an international level. Specifically, these investors manage funds to the value of more than €70 trillion. In comparison, global investment in renewable energy and energy efficiency in 2015 was €0.5 trillion. In order to access institutional investors, in this business model configuration, the ownership/financing option that has been selected is one which is suitable for institutional investors which involves TPO, securitization and bonding.

The type of bond that can be produced with PPAs is called "Asset Backed Security" (ABS) and is one of the most in demand financial instruments, as long as it is considered of sufficient quality ("investment grade") by the rating agencies and the investors. In order to obtain a sufficient credit rating, the PVS must meet certain technical and operational standards, thus a specific configuration of the relevant dimensions of the business model configuration is required. For example, all the PVS that are collateral for a specific ABS must be jointly monitored to allow investors to assess their performance.

The use of the combination of PPA and ABS is at the centre of the collective promotion of PV for

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irrigation developed by RESFARM, an initiative led by several farmers´ organizations in Spain, Italy and Greece. Farmers interested in being part of the initiative were assessed by independent experts in order to identify the suitability of their farms for the inclusion in a “pool” of projects. Each of the projects in the pool must be developed using common technical specifications and contracts, so investors can evaluate the pool easily and affordably. Once the promotion is considered to be of interest to both the farmers and the promoters, the price and length of the PPA is calculated and agreed. Typically, this offer consists of a price for the electricity that is between 15% and 30% below conventional offers and a commitment to buy energy from the system for 15 years. The farmer also receives a purchase option over the systems so at the end of the 15th year, the farmer can become the owner of the system which at that point, is still only halfway through its life span.

For the length of the contract, an ESCO is responsible for operating the system, including the commercialization of excess production and compliance with the complex regulation of energy production plants. Thus the farmers can access RES technology without facing the main barriers that have been identified for its use; the high up-front costs of the systems and uncertainty over their performance and results.

In order to offer competitive energy prices to farmers, this business model relies on access to long-term, low-cost financing because the cost of financing the systems has a very large impact on the cost of energy for the farmers. For example, an increase of 5 percentage points in the cost of financing means that the cost of a 15 year PPA must be increased by 30 percentage points in order to keep the business model economically viable. Debt markets are especially suitable for the provision of cheap financing but debt investors require specific financial instruments such as bonds in order to invest in projects. Furthermore, in order to produce a viable bond, the underlying projects must add-up to a sufficient size, in the order of tens or hundreds of millions of euros.

Very briefly, the description of the RESFARM model in the business configurator is the following one:

1st dimension: Consumption/offtake

- ⇨ Self-consumption plus whole market commercialization (excess production): The energy produced by the PVs is used for self-consumption on the farm and the excess energy produced is sold through the public grid. In the case of Spain, the introduction of an ESCO is required in order to manage the administrative complexities of commercializing energy through the public grid. In countries other than Spain, with a less challenging framework, the need for intermediaries can be avoided.

2nd dimension: Distribution

- ⇨ The electricity used on the farm itself is distributed through an on-site grid and the excess production is distributed to the whole market using the public electricity grid.

3rd dimension: Ownership/Financing

- ⇨ The configuration of this BM is designed to attract institutional investors by issuing bonds based on the PPA contracts of the ESCOs. By doing this, the financial cost of the business model should be reduced considerably, in the order of 50% over other alternatives. It also requires the creation of sufficient volume by aggregating many systems into a single pool. The ownership of the systems should be TPO in order to allow for the securitization of the PPAs.

4th dimension: Installation, Operation and Maintenance

- ⇨ The production of a viable pool for the selected ownership/financial configuration requires that all the systems follow a very specific set of installation and operation and maintenance guidelines. These guidelines determine that the specifications of the installation and O&M dimension are those which are demanded by the credit rating agencies in order to provide an investment grade rating for the resulting bond.

Figure 2 below presents the described business model configuration.

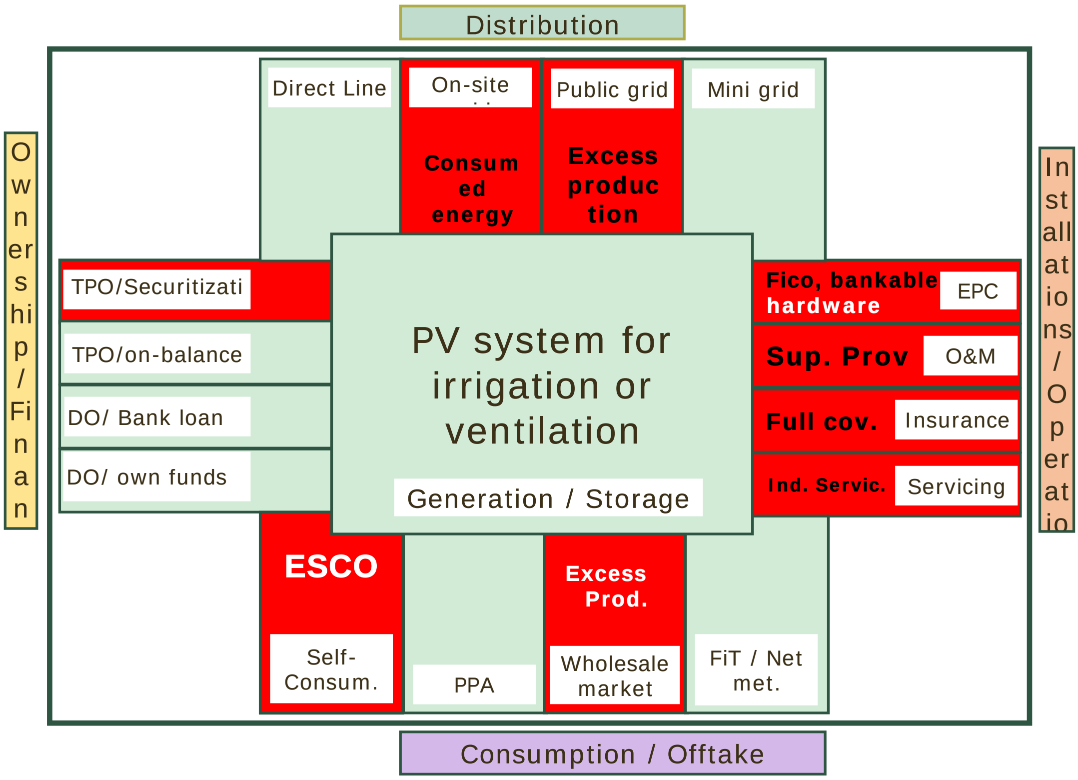

Figure 2: Business model configuration of Experience 1: ESCO based promotions of PV systems for self-consumption with surpluses commercialized in the wholesale electricity market. The related financial instrument would be an asset-backed security.

3.2 Experience 2: Public-Private Partnership to promote on-farm biogas production in France

The second example refers to an initiative that is currently being developed in France in order to facilitate the production and distribution of biogas. The equipment and technical expertise required to install and operate a commercially oriented biogas plant require important investments that may exceed the capacities of many farmers. In order to allow more of these projects to be executed, the regional authorities of Brittany, a French region, have established a company named ELAN which includes private investors alongside public funding in its capital.

By being provided with technical and financial support by independent advisers and specialized entities, the interested farmers can access biogas systems and produce gas to be injected into the grid and to obtain a feed-in-tariff compensation that allows for the amortization of the investments. Furthermore, the tariff is calculated to produce a commercial margin for both the farmer and his financial and technical providers.

In terms of the business model configuration the description of this alternative is the following one:

1st dimension: Consumption/offtake

- Feed-in tariff: The energy is commercialized through the public grid at a premium over the market price, as a result of a supporting scheme for renewable energy. This is formalized in a long term contract that involves the upgrading company and other relevant stakeholders.

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2nd dimension: Distribution

⇨ Public grid: In this case, the produced gas is distributed entirely through the public gas grid. No self-consumption of energy is considered to take place on the farm.

3rd dimension: Ownership/financing

⇨ Under this scheme, the farmers, the public investment fund and private investors co-own and co-finance the systems. This facilitates the attraction of sufficient funds for the investments at an affordable cost by leveraging different sources of capital. In some cases the technology provider also facilitates finance to be repaid by the revenues generated by the systems. In order to access capital markets the investment fund can issue bonds based on the future revenues resulting from the FiT. If the farmer or the investors receive loans to obtain the necessary finance, the financial provider, such as a bank, could create a warehouse facility in order to commercialize the loans to specialized institutional investors or even to use them as collateral for money market operations (repo).

4th dimension: Installation, Operation and Maintenance

⇨ In order to ensure the proper operation of the systems, all farmers must have a maintenance contract with the provider of methanization equipment (biogas digester, pumps, mixers etc.). This contract includes detailed technical provisions for issues such as the replacement of some equipment during the duration of the biogas contract. The provider of the equipment, which could be also the investor for this part of the plant, has to maintain this equipment to make it as efficient as possible and has to foresee any contingency that may affect the performance of the system during its lifespan.

The resulting business model configuration of Experience 2 is presented in Figure 3.

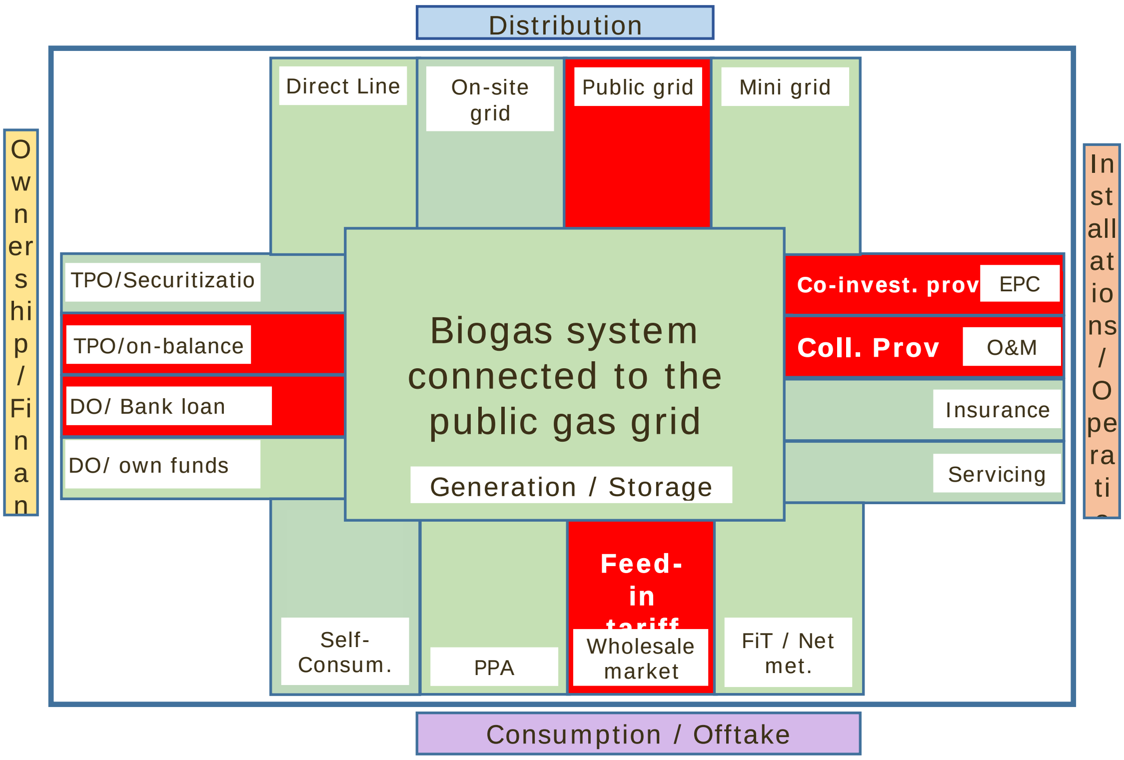

Figure 3: Experience 2: Business configuration for biogas systems promoted by PPP in order to produce gas for the public distribution grid

3.3 Experience 3: Farming the sun in Greece

Greek farmers face similar economic problems to the rest of their countrymen, including a shortage of financial resources and burdensome bureaucratic processes. Nevertheless, they also enjoy one of the best solar resources in Europe and a strong and supportive associative network. In order to alleviate the former and to take advantage of the latter, the Union of Agricultural Cooperatives of Agrinio (UACA), in western Greece, developed a project for farmers. This involved facilitating the installation of photovoltaic systems in order to produce electricity for the public grid and to obtain a feed-in tariff (FiT) in exchange. The development of such installations was very attractive financially due to the generous FiT, but it also required the availability of sufficient economic resources to pay for the required investments, more than €220,000 per installation. It also addressed the problem of navigating the extremely complicated administrative procedures necessary in order to install and operate the systems in Greece.

In order to assist the interested farmers with the installation of these systems, UACA established a comprehensive programme that included financial support, if required and technical and administrative assessment. A tailored loan programme was negotiated with a bank so farmers only had to provide a small part of the total investment. The assessors were responsible for dealing with the more than 10 different public agencies and bodies whose permits were needed to set up the installations. The entire process took more than two years on average, however only two weeks of this time was needed to build the actual systems themselves. Securing the connection to the public distribution grid has been reported as especially difficult and lengthy, due to particularly tricky processes demanded by the transmission system operator. Furthermore, significant reductions of the FiT initially offered by the government reduced the profitability of the investments.

According to a follow-up survey (Pombo-Romero & Fernández-Redondo, 2017), all the farmers involved in the programme are satisfied with the results and would increase their production if they could, as they consider producing clean energy to be a sustainable activity that is compatible with farming. These farmers recognize that the most important factor that allowed them to get involved in producing RES was the UACA initiative. Without the UACA's assessment and support, none of these systems would have been installed. This experience indicates the high importance of properly designing collective promotion initiatives in order to overcome the barriers that farmers interested in RES technologies are facing. UACA's experience also shows the importance of offering a multi-dimensional approach covering the technical, financial and legal issues related to on farm RES.. In terms of the business model configuration the description of this alternative is the following:

1st dimension: Consumption/offtake

- ⇨ Feed-in tariff: The electricity produced by the systems is sold to the wholesale electricity market at a pre-established price higher than the market price. The FiT has been established in order to allow an attractive return on the investment.

2nd dimension: Distribution

- ⇨ Public grid: The systems are connected to the public electricity grid in order to allow for the distribution of the energy to consumers.

3rd dimension: Ownership/Financing

- ⇨ Direct ownership plus special loans: The systems are directly owned by the farmers. Complementary, a special bank loan was negotiated on behalf of the farmers.

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4th dimension: Installation Operation and Maintenance

⇨ The promoting organization, UACA, has negotiated service contracts with specialized companies on behalf of the farmers in order to provide operation and maintenance services in optimal quality and cost conditions.

The business model that has been used in the described initiative can be graphically presented and analysed by the business configurator below.

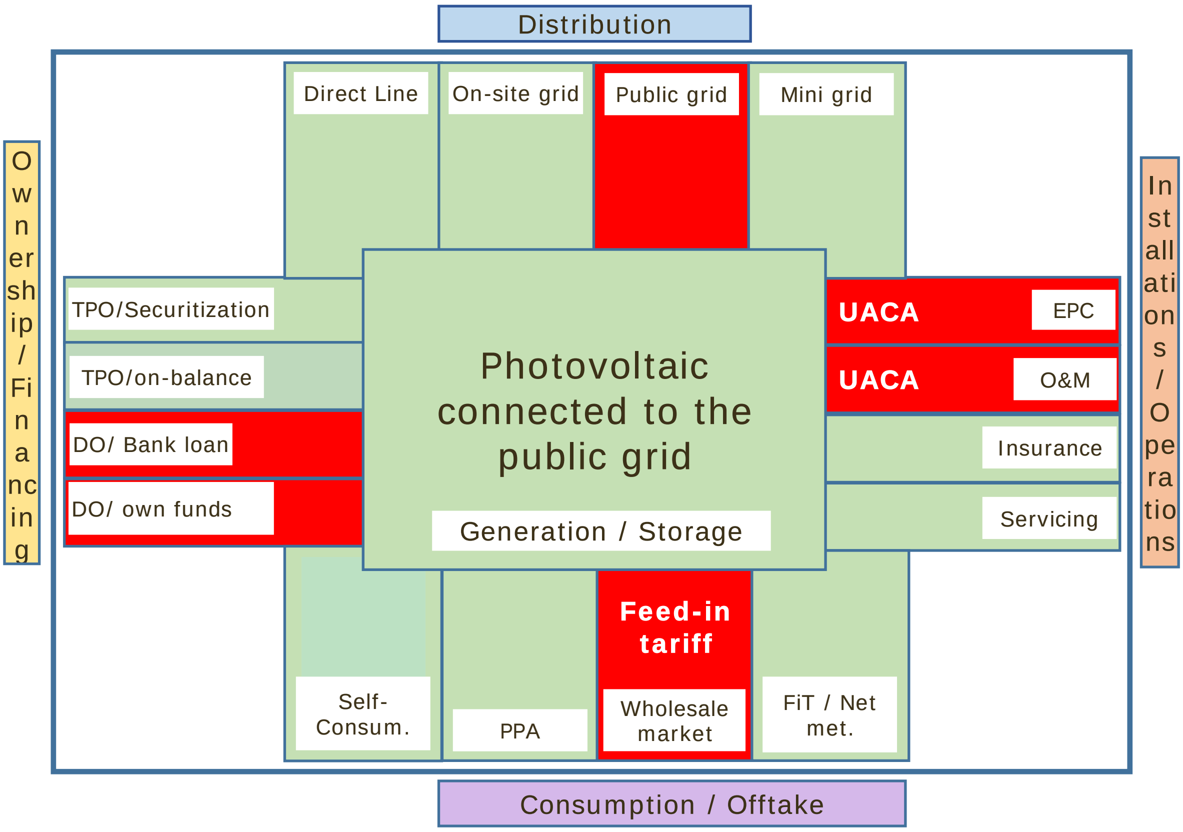

Figure 4: Experience 3: UACA´s solar initiative business configurator shows a commercialization oriented business model based on TPO and accessing soft bank loans.

UACA´s solar initiative business model configurator is especially well suited for the introduction of RES systems in order to increase the income of farmers. It is based on an off-take model where the proceeds of the systems are obtained by selling the electricity at a pre-established price, in this case, above the market price of electricity.

The distribution of the electricity necessarily requires access to the public grid. As aforementioned, UACA's experience shows the need to include, in advance, specialised assessment in order to negotiate and agree a fast and hassle-free connection process with the transmission system operator. An important key to the success of this experience is the availability of a dedicated financial facility for the investments, in this case, a bank loan programme. Finally, it is also relevant to point out that UACA also assisted the farmers in EPC and O&M activities, increasing the attractiveness of the programme.

4. Conclusions

The production of clean and affordable energy on European farms is central to the energy transition that is taking place on the continent. Nevertheless, the wide variety of available technologies, business models and regulations often introduce a high degree of complexity in the decision-making process to introduce and promote on-farm RES. It also creates difficulties in the design and assessment of policies to promote it. Furthermore, the regulatory and legal framework is not always aligned with the potential and characteristics of on-farm RES, as it is mainly developed to deal with a centralized utility-based model for producing and distributing energy, and it is not always easy to identify where the barriers lie.

In order to facilitate the analysis, comparison and discussion of the alternatives that exist for on-farm RES, we use a tailor-made methodology to qualitatively and quantitatively describe three relevant business models that have been successfully implemented in Europe. The proposed methodology can be systematically used to describe and analyse all the alternatives available and to assess innovative business models that can be developed to overcome existing barriers or to take advantage of new technologies and solutions. It can also be used to identify best practice and to compare different legal frameworks and policies with the level of introduction of on-farm RES in specific regions or sectors.

The business models analysed have been used to introduce photovoltaic and biogas systems on European farms, two of the most relevant alternatives available for on-farm RES. Farmers involved in these experiences showed a high degree of satisfaction, due to the support provided by organizations used to work in the sector, among other factors. The analysis of those experiences allows for the identification of a number of recommendations on how to design and implement successful business models for on-farm RES. Among these recommendations, the following are considered to be especially relevant:

- **Develop collective promotion schemes focused on particular technologies and types of farms in order to obtain economies of scale in planning, financing, installing and operating on-farm RES.**

- **Focus on technologies and consumption/uptake models that are mature and reliable. Innovation in collective on-farm promotions can be introduced in ownership/financing models that are attractive to investors and policy makers and that can reduce the cost of financing.**

- **Create sufficient knowledge and capacities of on farm RES technologies and business models among the institutions that are considered to be primary sources of information by the farmers in order to allow them to obtain reliable and independent assessment and support when considering the introduction of on-farm RE**

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