pvs in bloom

Supported by INTELLIGENT ENERGY EUROPE

PVS IN BLOOM : FINAL PROJECT REPORT

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Venice, November 2011

This publication has been developed in the framework of the ***Project PVs in Bloom -Farming photovoltaic flowers: a new challenge for land valorisation within a strategic eco-sustainable approach to local development***, Contract number IEE/07/762/SI2.499457, financed within the Intelligent Energy Europe Programme (CIP Framework Programme) of the European Commission.

Coordinator: Unioncamere del Veneto (Italy)

Energy Agency of Sassari Province (Italy)

Development Company of Municipality of Milies (Greece)

University of Jaén (Spain)

Chamber of Commerce, Industry and Shipping of Valencia (Spain)

Institute of Physics of the Lublin University of Technology (Poland)

Innovation Region Styria (Austria)

Italian-Slovak Chamber of Commerce (Slovakia).

Foreword

This document represents the Final Publishable Report of the IEE PVS in BLOOM Project, a 36 month initiative supported by the Intelligent Energy Europe programme of the European Commission and managed by EACI (The Executive Agency for Competitiveness and Innovation). The project, entitled “PVs in BLOOM - Farming Photovoltaic Flowers: a new challenge for land valorisation within a strategic eco-sustainable approach to local development” was created with the aim of supporting the installation by public and private investors of ground photovoltaic plants of small and medium dimension, with a power size ranging from 50 KWp to 2-3 MWp (Photovoltaic Panel Plantations – PVPPs) in areas characterized by intrinsic, induced or latent marginality (terrains that are no longer able to answer positively to investments or that have exhausted their primary and exclusive function).

Project Title:
Farming

Photovoltaic Flowers:
a new challenge for land valorisation within a strategic eco-sustainable approach to local development.

Acronym:
PVs IN BLOOM

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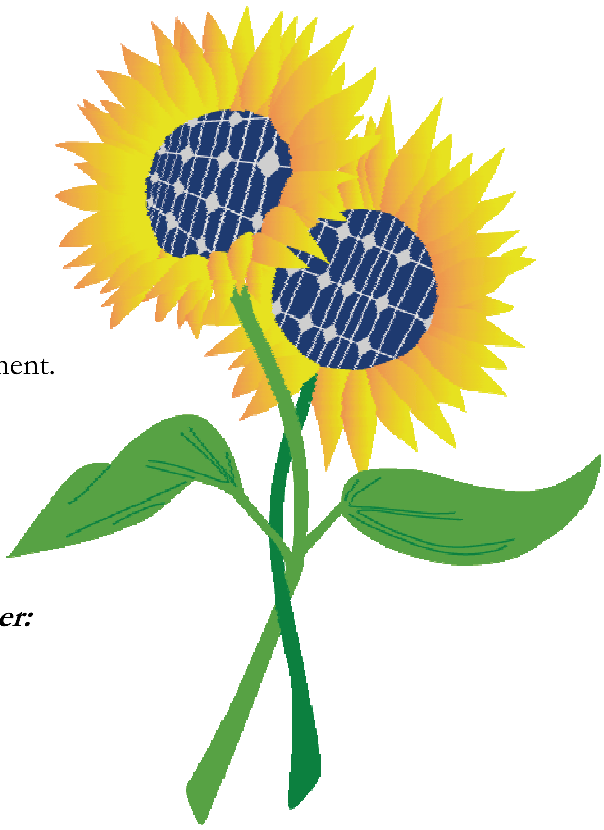

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1. Executive Summary

The PVs in Bloom project ran from the 1st of October 2008 until the 30th of September 2011.
The Project is managed by an international consortium, led by Unioncamere del Veneto (the Regional Union of Chambers of Commerce of Veneto, North-East Italy) and including 8 partners from 6 EU countries: the Energy Agency of the Sassari Province (Italy), the Chamber of Commerce Development Company of Central Macedonia (Greece), the Development Company of Municipality of Milies (Greece), the University of Jaén (Spain), the Chamber of Commerce, Industry and Shipping of Valencia (Spain), the Institute of Physics of the Lublin University of Technology (Poland), Innovation Region Styria (Austria), and the Italian-Slovak Chamber of Commerce (Slovakia).
The PVs in Bloom Project was born to promote the intelligent diffusion of small and medium dimensions PV plants in marginal areas (Photovoltaic Panel Plantations – PVPPs) across Europe according to functional and environment-friendly criteria. One of the most important particularities of this project is its unique and simple-minded approach, which original idea was born by asksing oneself why not to tackle the current shortage of resources in Europe (energy resources, land resources, financial resources for local public administrations) in a synergic way.
Promoting the increase of energy yield from Renewable Energy Sources in fact, can be done in a way that produces income for local public administrations and small investors, while at the same time giving back value to neglected, abandoned or useless marginal terrains. This kind of approach, that aims at giving new life to that kind of areas, is a good compromise between the need for financial and energy resources and the valorisation of the territory.
The PVs inLOOM Project has identified more than 50 European Best Practices and models for recovering low/zero value terrains through ground PV plants (PVPPs) ranging from 50 kWp to 2-3 MWp; involved 60 local public administrations across Europe in its activities and produced pilot pre-feasibility studies for spurring the start-up of new PVPPs on landfills and quarries. The PVs in Bloom Project intends to promote the intelligent diffusion of PVPPs across Europe according to functional and environment-friendly criteria.

The mission of the project during these 36 months has been:

- Promoting the recovering of zero/low value terrains owned by public/private stakeholders trough ground PV plants.
- Disseminating tools for promoting market transformation, abating administrative barriers and enabling of policies and strategies.
- Identifying new solutions for public administrations and investors for boosting investments in PVPPs.
- Creating a EU wide network for the vast promotion and diffusion of PVPP skills and experience.

2. Why should we use Photovoltaics in marginal areas?

2.1 General overview

European economies depend on natural resources. These include raw materials and ground surfaces (land resources). Given the current unprecedented world economic conditions, a change in the exploitation and optimization of resources must occur. If new additional resources cannot be found in old Europe, the present resources must be exploited completely. Land is a resource that European public administrations can no longer afford to neglect. In each European region, as in each European municipality, marginal areas determined by different distinctive causes share a common feature: they are under valorised. Where "green plants" cannot grow or have big difficulties in surviving (e.g. abandoned quarries, not irrigable barren lands, areas within/near industrial locations or near technology parks/schools, etc.), or where terrains must be maintained segregated or in limited-controlled access (e.g. waste dumps, water cleaning areas, sewage treatment areas, abandoned military sites, contaminated sites,…), there is an **"unexploited richness": unused land. PVPPs (Photovoltaic Panel Plantations) represent a recovering solution** for such underdeveloped resources, and have the power of re-delivering social consideration to "zero value" areas while conferring them new economic utility. Ground photovoltaic plants are currently present in Europe under the form of big plants (bigger than 3-5 MWp). The smaller ones, owned generally by private land owners or small municipalities, have developed up to now more with more difficulty. The point is that the European territory has all the needed resources for becoming the scenery of an environmental and energetic revolution centred on Renewable Energy Sources. Yet to do this it is necessary to pass from a logic of big centralized investments to one that recognizes the features and resources of each territory, thus valorising each small yet relevant piece of land

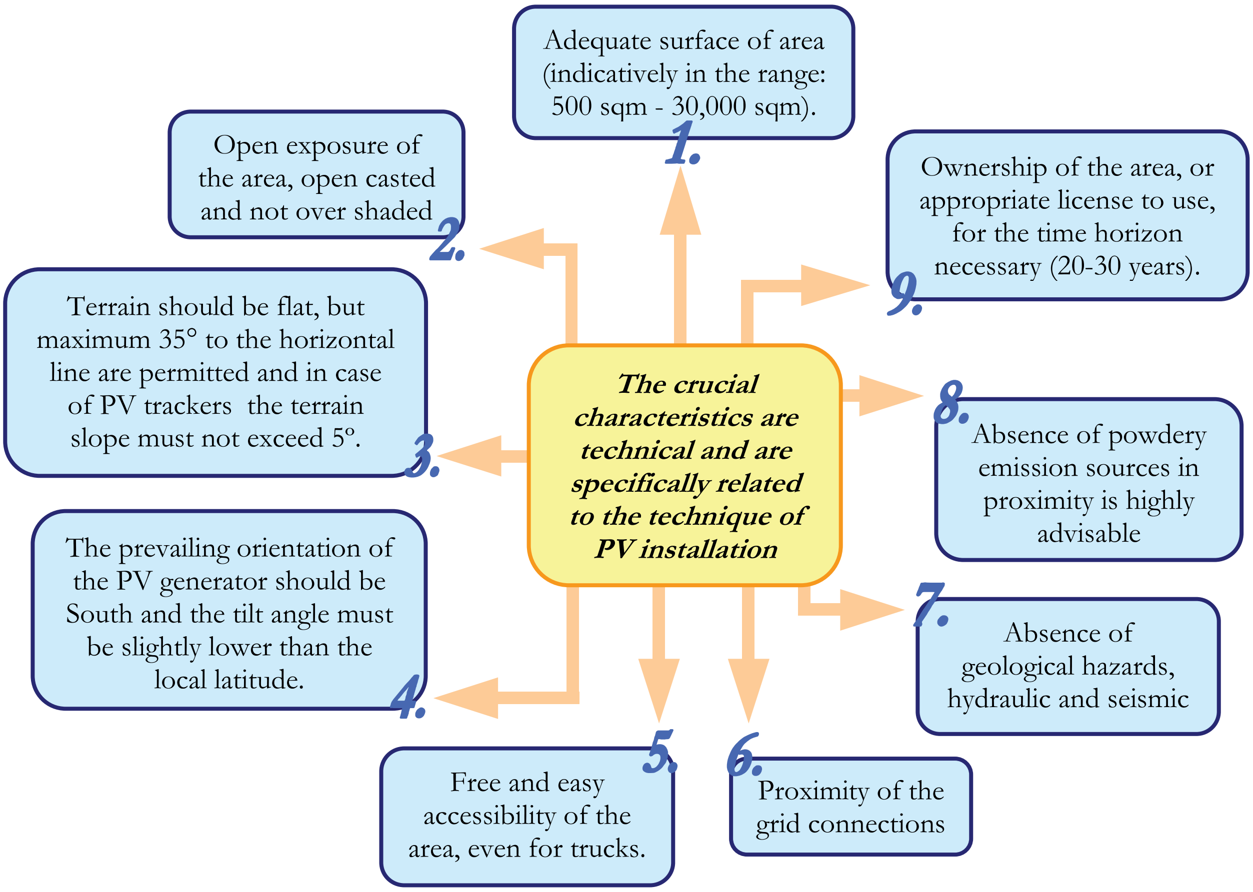
2.2 What are marginal areas?

Marginal Areas refers to areas where there are conditions, intrinsic, induced or latent, which result in the delay or impossibility in their development compared to the normal context in which they are inserted. The condition for becoming a marginal area can be either intrinsic (when coming from previous uses of the same area) or induced (when there are political and administrative constraints).
It is important to underline that the term *"marginal area"* is not a synonymous of *"remote area"*, as often marginal areas are closed to inhabited or commercial or productive areas.

The main factors that determine the marginality of an area are easily recognizable and can be divided into three categories:

- The lack of features necessary for social-economic exploitation.
- The previous intense exploitation of the area, which has resulted in a depletion of the terrain capacity for future utilization.
- A particular previous use of the area, which introduced restrictions or other administrative/legal constraints.

To be considered for a PV installation, these areas must be free from landscape, archaeological and environmental constraints, or, depending on the type of area, there must be an ad hoc authorization by the respective Competent Authority (Municipalities, Provinces, Regions, Ministries, etc.., or combination of them) for changing the destination of use of the area. Each of these types of marginal areas must have certain characteristics for evaluating the possibility to build a PVPP. A lot of these characteristics are essential, while others can be considered preferential.



It is important to analyze additional characteristics because they express factors that may be preferable and favourable and can lead to have a lower initial investments or special guarantees for lower operating costs in the future.

Landfills or waste dumps: The presence of biogas power plants (CHP) could be an advantage as determines the presence of electric delivery point. Then the systems of exploitation of biogas from landfill accelerate the process of terrain consolidation, therefore after 2 or 3 years after the ending of exploitation of landfill (post-operative management that could be longer than thirty years), we could be in the presence of contextual favourable elements:

- Reduction of geological risks and no variation of surface inclination as a result of quicker terrain consolidation;
- Power delivery point close to the area and therefore the investment necessary to build the PVPP could decrease;
- In case of overcoming the peak of electricity production from biogas, it is possible to extend the life of the power point of delivery using the additional power produced by the PVPP.

Industrial wasteland: The presence of electrical substations could have favorably affected in the determination of the initial investment. It is also possible to exploit the possibility to reclaim the asbestos roofing of industrial building. In this case the eventual FIT could be higher and this is important to be considered into the feasibility study

Contaminated or non-arable areas: These areas have the advantage of latent conditions of marginality, for which the purchase price of the surface before the assessment in key PV installation, is extremely low. If the purchase is expected as a function of the Minutes of the settlement, the condition element is to contain the initial disbursement.

Restricted areas, precluded or prevented: These areas may offer the advantage of containing costs of the PV installation, in fact, the prohibition or the problematic nature of access, may result in lower premiums for insurance coverage to damage and theft.

Airport areas or military, active or abandoned: In areas active military we could have the same advantage that we had in the case of denied access areas.

Areas of respect: they are areas located that do not overlap, but in the immediate closeness of roads, railways, high voltage power lines, pipelines, cemeteries, wastewater treatment plants, airports, telecommunications masts, landfills and treatment plants waste.

"Unfavourable" elements for setting PVs: On the other hand, a common problem of all "green" marginal areas (i.e. which have grassy vegetation that provides the accommodation capacity of rainfall), is that an installation may result in a decrease of PV capacity itself. Also high concentrations/conveyance of rainfalls in the area must be taken in

consideration, for the adoption of preventive measures against landslides and mudslides.
This effect is worst if marginal areas are " brown" (no herbaceous vegetation), as the carrying capacity of rainfall is limited in advance. Regarding PV technologies we can split them in two main categories:

- Crystalline silicon solar cells (poly-crystalline or mono-crystalline)
- Thin film solar cells

Both these categories have advantages and disadvantages and their utilization could be various. The crystalline silicon solar cells have high conversion efficiency and save their performance for long time. For this reason these type of cells could be used when the surface is not big and it is necessary a high efficiency to produce enough energy. Unfortunately crystalline silicon solar cells work very well with direct irradiation, and have a sensible decreasing of their performances in case of shadow and low solar radiation. This means that the area exposure became crucial in order to not compromise the investment profit. Thin film solar cells have medium/low conversion efficiency for direct irradiation, but they preserve a high efficiency with diffuse and low radiation. Furthermore they perform better at high temperatures than crystalline cells do. These aspects are crucial in case marginal area selected is in a slope or it is over showed. There is a considerable lack of experience – when compared to crystalline silicon-regarding their on-field mid and long term performance: in fact the thin film degradation process is not fully predictable yet.

2.3 The EU methodology for mapping marginal areas

The PVs in BLOOM Project moves from the consideration that valuable and fertile terrains are vital not only for agricultural purposes but also for many other activities and for territorial development in general. Yet, alongside productive terrains, another reality exists: that of unfertile, barren or non-used land, that the PVs in BLOOM Project has called "marginal areas" and accurately classified in order to enhance the identification of its most diffused typologies. Preserving valuable and fertile terrains and finding ways to exploit marginal areas is a strategy that not only allows the optimization of existing resources, but also pursues sustainability by marrying profitability with environment-friendly solutions. Moreover, this approach generally allows recovering and giving back value to terrains that would have otherwise irreparably lost it. To open successfully the way to an easier identification and assessment of existing marginal terrains, a shared European classification and methodology for identifying and quantifying marginal terrains has been created. The methodology allows operating at different administrative levels (municipal, provincial, regional), and was produced in collaboration with the Faculty of Architecture of the University of Venice (IUAV).

Categories of marginal areas:

1.	Open air extractive areas that are not in function any more		
2.	Open air extractive areas that are near to exhaustion		
3.	Landfills of any type that are not in function any more		
4.	Landfills of any type that are near to exhaustion		
5.	Degraded areas, where degrade is due to the absence of vegetation or to the exclusion from existing land classifications, including the urban area or transformation area classes		
6.	Dismissed industrial areas		
7.	Polluted areas to be recovered or other areas enrolled in the register of polluted areas		
8.	Sowable terrains that have never vegetated (barren agricultural areas)		
9.	Agricultural areas that are not fit for agro-forestry and pastoral use		
10.	Buffer zones (Clear areas):		
		10.1	Buffer zones around linear infrastructures (roads, railways, long distance power lines, long distance gas lines/oil lines,etc.)
		10.2	Cemetery buffer zones
		10.3	Depuration plant buffer zones
		10.4	Airport buffer zones
		10.5	Radio antennas buffer zones
		10.6	Buffer zones around areas with high risk of relevant accidents
		10.7	Buffer zones of plants for the recovering and disposal of waste
11.	Militar areas:		
		11.1	Not functioning any more
		11.2	Being dismissed
12.	State-owned areas		

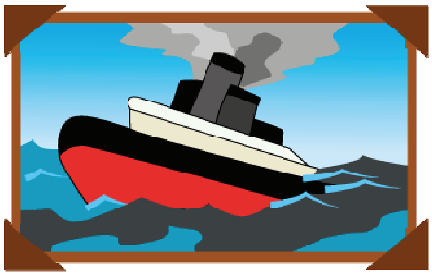
All these areas are to be taken in consideration when free from landscape, archaeological or environmental restrictions.
The methodology for the geographic identification of marginal areas and for assessing their number at the municipal, provincial or regional level, foresees the application of a four-step procedure. This procedure envisages the application of the criteria described below.

STEP 1: *Identification criteria.*

An area is to be considered "marginal" according to its function. A terrain which has no possibility of being used has good chances of being tagged as "marginal". The marginality of an area can refer to different cases: intrinsic, induced or latent marginality. Marginality is intrinsic when it is indivisible from the area itself, it can is induced when the area's use or value is erased by political/legal/city planning or by other administrative choices. It is instead latent when an area, sometimes even a

vast surface, is completely abandoned due to the specific legal bounds pending on it.
Several territorial elements characterizing potential "marginality" are identifiable when considering the general urban/landscape planning tools in force in European countries. A simple list of urban categories is not enough to state the marginality of an area: it can be the result of a combination of factors. That's the reason why starting from the first level analysis mentioned above, the marginality status must be linked to the negative or positive evaluation of some further features, which can determine a high or low level of potential marginality, as described in the following point.

The water-impermeability of a terrain contributes to marginality since it system. For the same reasons the areas jeopardized from a geological point of view can be considered marginal as well. If the modification of the geological conditions due to geological interventions involves the deeper layer of the terrain, this has to be considered irreparably damaged, so giving it a characteristic in favour of the attribution of marginality. The modifications of the geological horizons must be evaluated especially in the case of landfills and extractions activities.

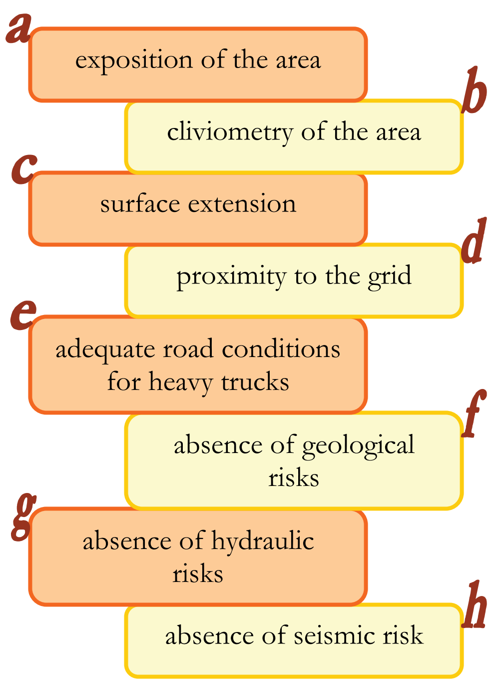


The presence of pollutants is another element which contributes to the attribution of marginality because of the expensive and time-consuming land reclamation needed. In agricultural areas, this means having to immediately cease all the agricultural activity, while in areas fallen into disuse, the reclamation must be all the same carried out before any future use is possible. In order to determine the presence of pollution it is necessary to verify that in the analyzed terrain there are no areas registered in the public register of polluted sites. Also other analysis by the public utility dealing with such issues must be taken in consideration. This will the presence of conditions favouring the attribution of marginality. The presence of economic activities excludes marginality and can be inferred from urban planning tools. If the urban planning tools envisage future economic activities on a specific area, a marginality evaluation is to be also definitively excluded.

A preservation order is of course an undoubted signal of non- marginality due to the high values of the area generally from the landscape point-of-view, and therefore the area will be excluded from our marginality evaluation being not disposable. The presence of clear areas/anthropic constraints represents instead a potential marginality feature as it is usually just a matter of hygienic, sanitary or security problems, that don't exclude other uses such as the installation of a PV plant. Once the marginal areas are located through the 2 steps above, a third step is needed for verifying functional and technical criteria to confirm the suitability of actually installing a PVPP.

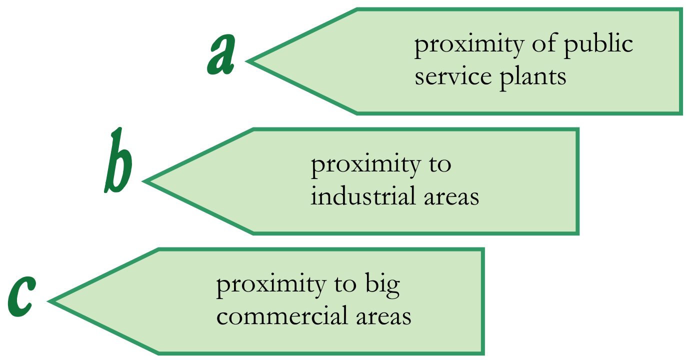
STEP 2: *The technical and functional criteria.*

Technical and functional criteria are needed in order to verify if the chosen area has all the necessary requirements for the installation of the Photovoltaic Plantation, such as accessibility to the needed facilities for building and maintenance of the plant or the availability of connections to electrical distribution points that rationalize the investment cutting down costs. The identified functional criteria may be defined as:



The last set of criteria, listed in point 4 below, allows us to favour areas that allow the positioning of the PVPP in areas that absorb high levels of electrical energy and of course in proximity of the electrical grid.

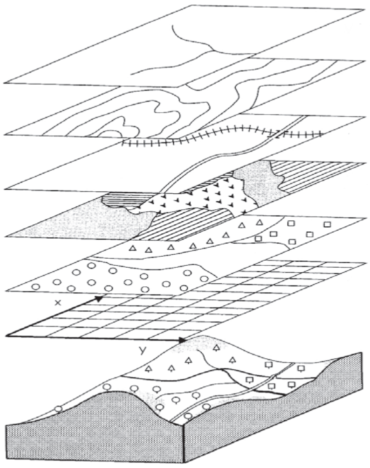
STEP 3: *Localization criteria*



2.4 How to apply the selection criteria following a repeatable methodology?

The cartographic identification of marginal areas is possible through the use of GIS softwares and by overlapping different maps reproducing the different criteria. In a first phase the non-marginal areas at the local scale must be excluded by overlapping the local and urban/landscape planning tools. In a following step the listed categories will be selected on the remaining areas in order to verify the presence of potential marginal areas. At the end it will be verified if and to what extent these areas meet all the technical-functional and localization criteria.

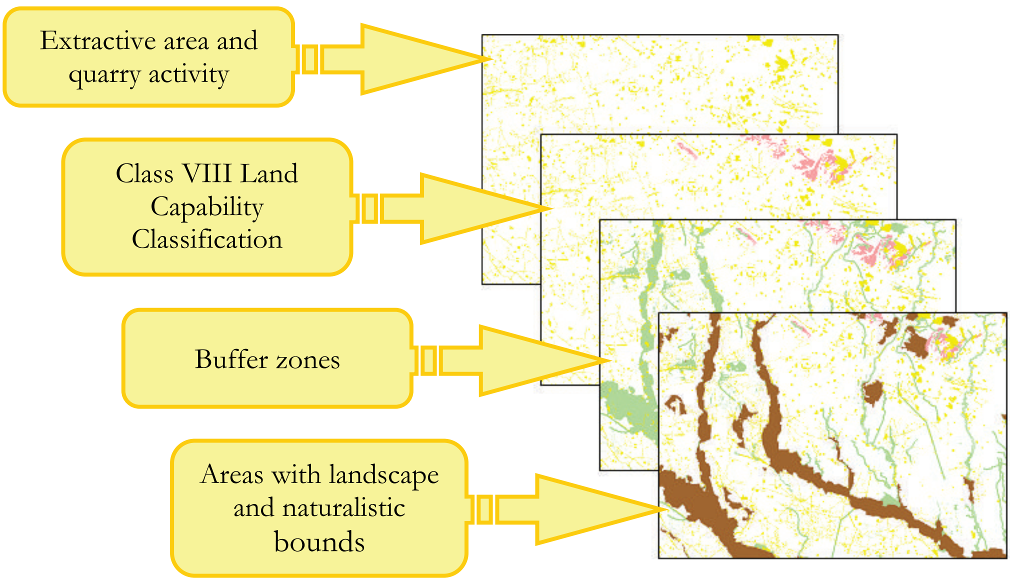
Once having defined marginal areas and a methodology for their identification, it is useful also to have a basic knowledge concerning different



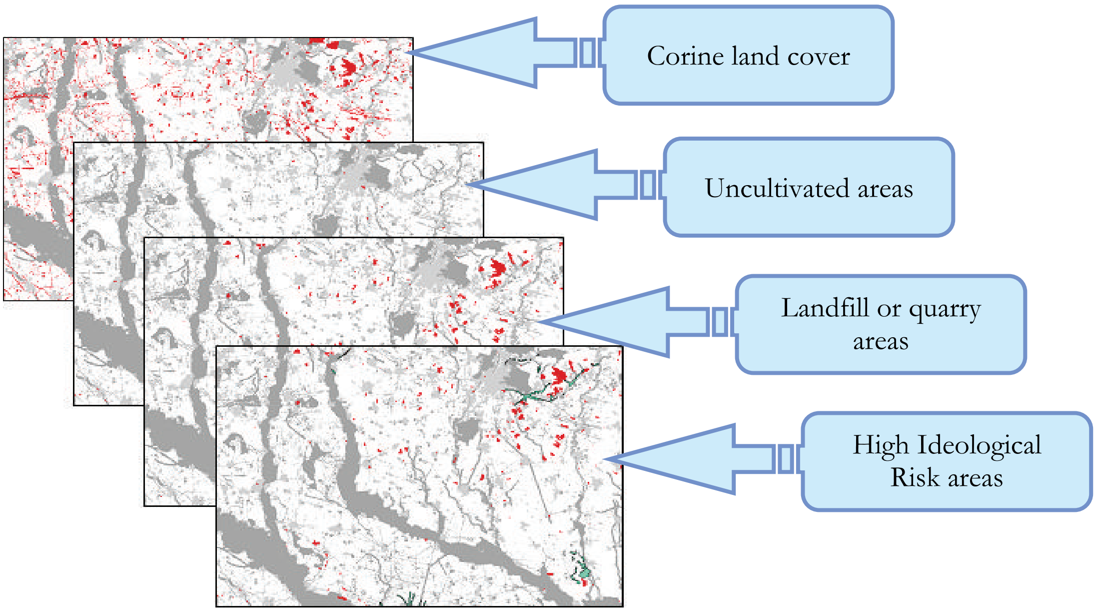
PVPP system typologies and their implementation, with a special focus on those located on, or in proximity of, a marginal terrains. The following paragraphs examine and codify in practical descriptive tables the existing PVPP systems, creating an inventory of the different existing technologies for PV modules and ground implementation systems. Moreover, grid tables for judging quickly the most suitable systems with reference to specific marginal terrains have been developed, for a first easy broad evaluation.

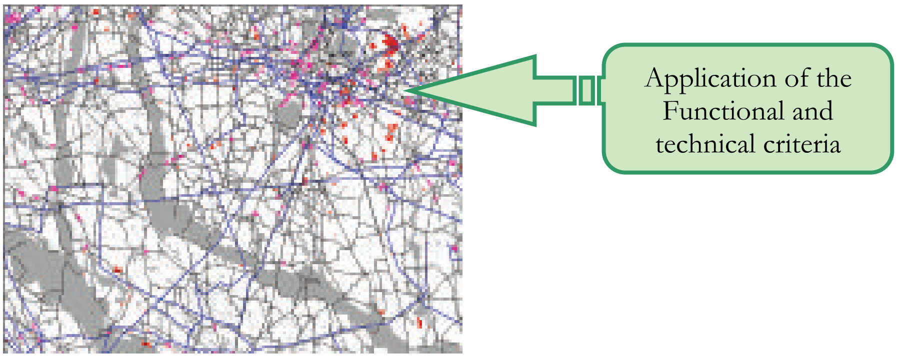
An example is given by the following sequence of images.

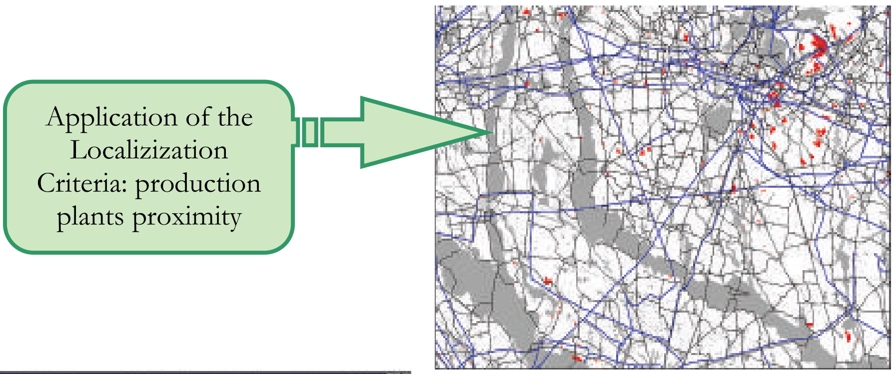
Identification and classification of marginal areas

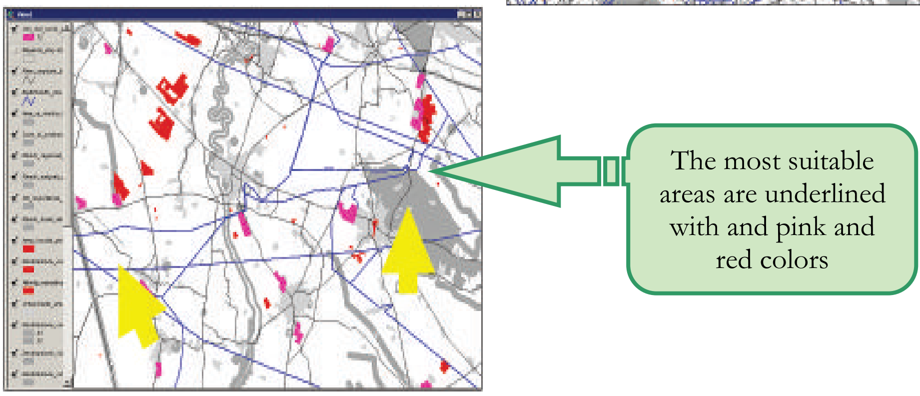


The marginal areas are highlited in red





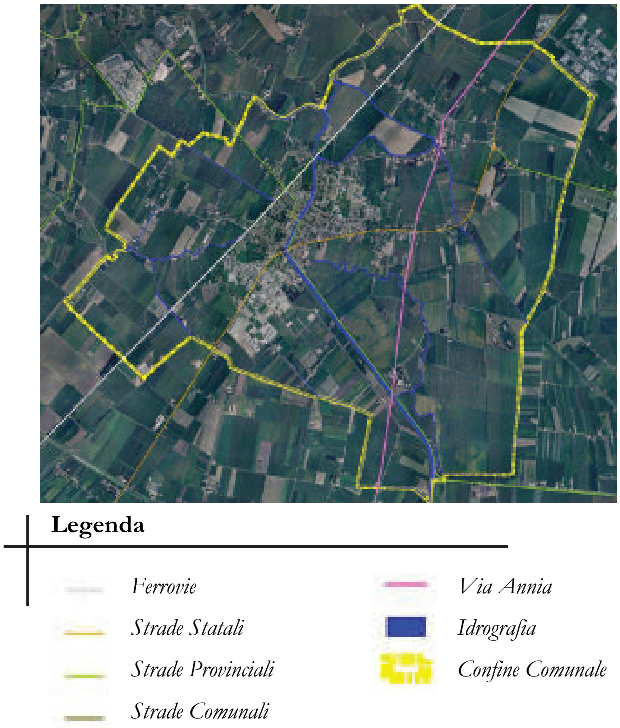




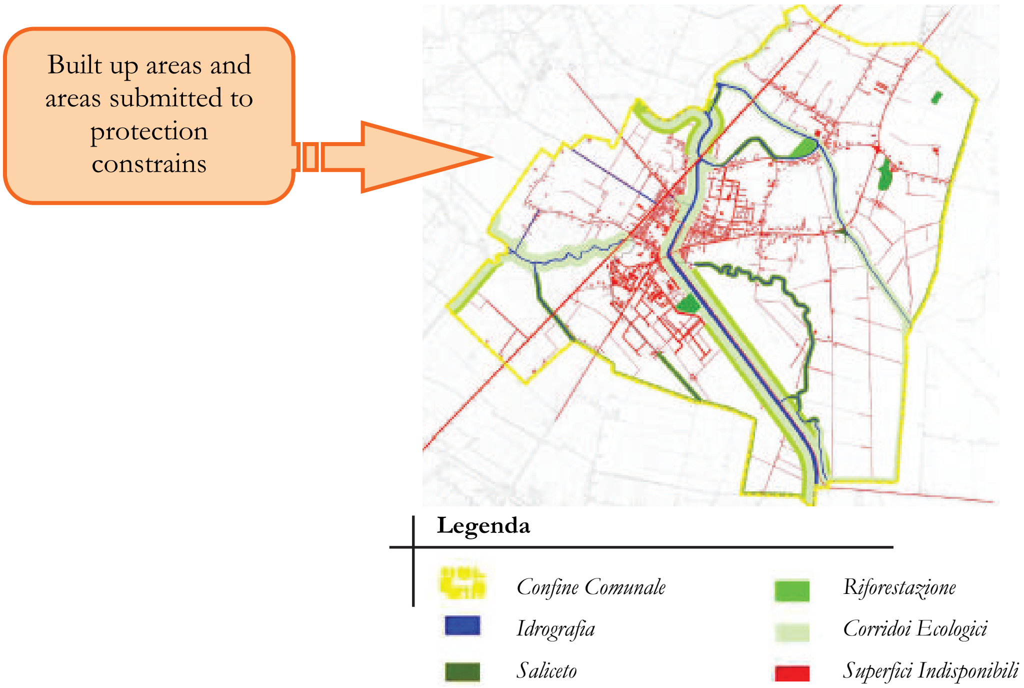
2.5 A real application of the marginal area mapping methodology: the case of Ceggia, Italy

2.5.1 The cartographic layer assessment

The data used to apply the methodology for mapping marginal areas on the Ceggia case study have been recovered through its Municipality website. Thanks to an efficient webgis all the materials regarding the P.R.G (Municipality Urban Planning Tool) have been downloaded. Other cartographic data have been downloaded from the National Cartographic Website of the Environmental Department.
The software GIS ArcMAP has been used in order to find out and identify the marginal areas of the Ceggia Municipality.
The basic idea is that of removing the unavailable areas in order to leave on the map those with marginality features. The first table below is that regarding the presentation of the municipality territory through the orthophotographs taken during the flights of 2006.



You can see how the historical centre is compact and near a productive area of almost the same size in the south direction. The cartography allows to underline the absence of potentially suitable grounds for "PVs in Bloom" as they were always in use in the years of the survey, with the exception of 2 landfills; one positioned in open country and the other inside the inhabited centre.
Afterwards the presence of constrains have been analysed as they actually make the areas unavailable. The protection constrains which have been considered are those of a non residential zoning, and in this specific case those ones provided for the Galasso Law and the river clear zone. The following images shows all the step to obtain the final map.


Built up areas and areas submitted to protection constrains
Legenda
Confine Comunale
Idrografia
Saliceto
Riforestazione
Corridoi Ecologici
Superfici Indisponibili


Available areas
Legenda
Confine Comunale
Idrografia
Superfici Indisponibili

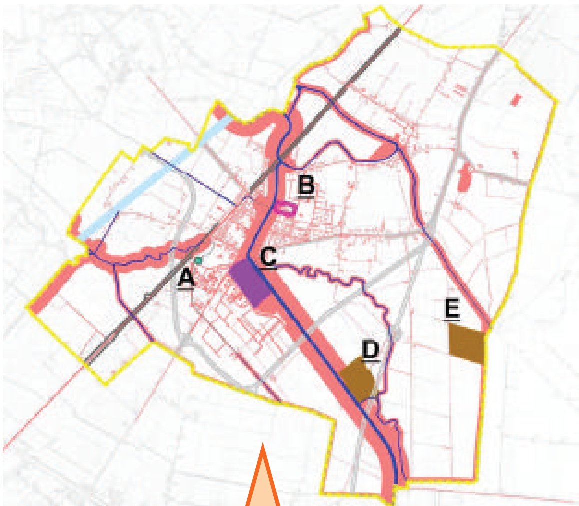
Zooning

Legenda

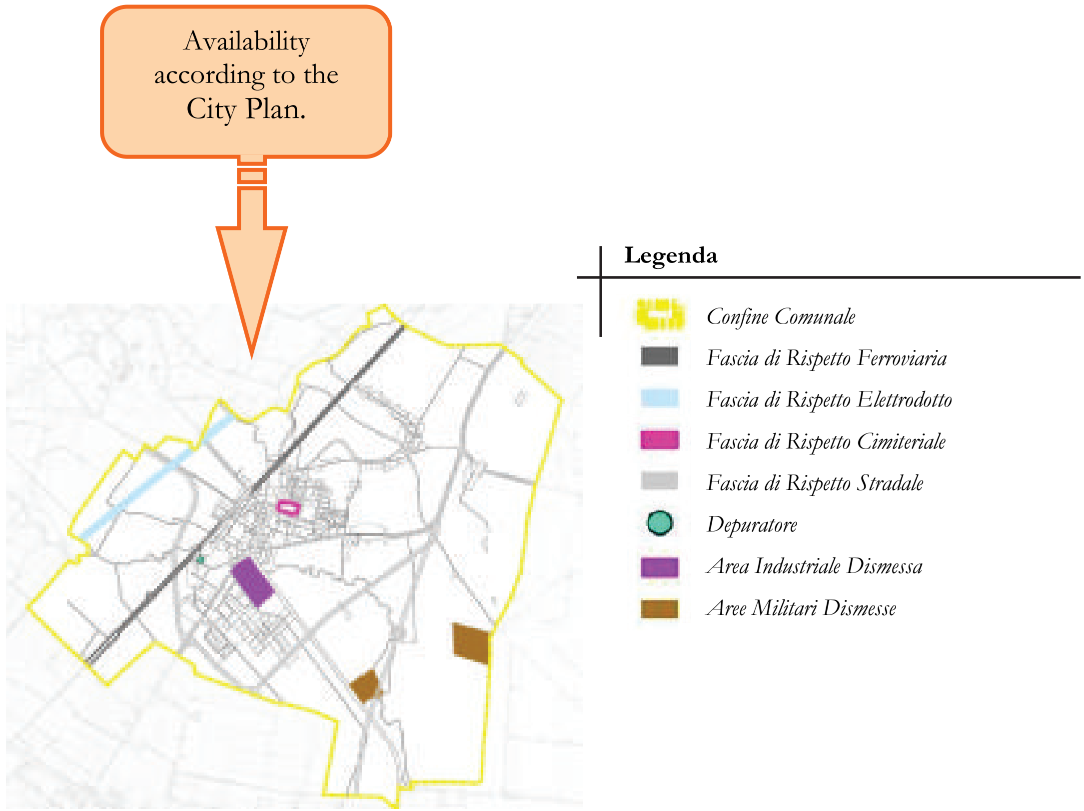
- *Confine Comunale*
- *Ferrovia*
- *Viabilità*
- *Viabilità di progetto*
- *Idrografia*
- *Residenziale Zona Insediamenti storici- A*
- *Residenziale Zona Edificata Satura – B1*
- *Residenziale Zona Edificata di Completamento – B2*
- *Residenziale Intervento Diretto – C1*
- *Residenziale Zona di Espansione Sottoposta a SUA – C2*
- *Industriale Esistente o Completamento –D1*
- *Industriale Soggetto a SUA – D3*
- *Industriale dismessa*
- *Militare dismessa*
- *Zona Servizi e Attrezzature Pubbliche – F1 F2*
- *Impianti tecnologici*
- *Parcheggi*
- *Agricola Non Caratterizzata – E2.1*
- *Agricola Caratterizzata – E2.2*
- *Agricola da Bonifica – E2.3*
- *Espansione Boschiva – E2.4*
- *Verde Tutelato*

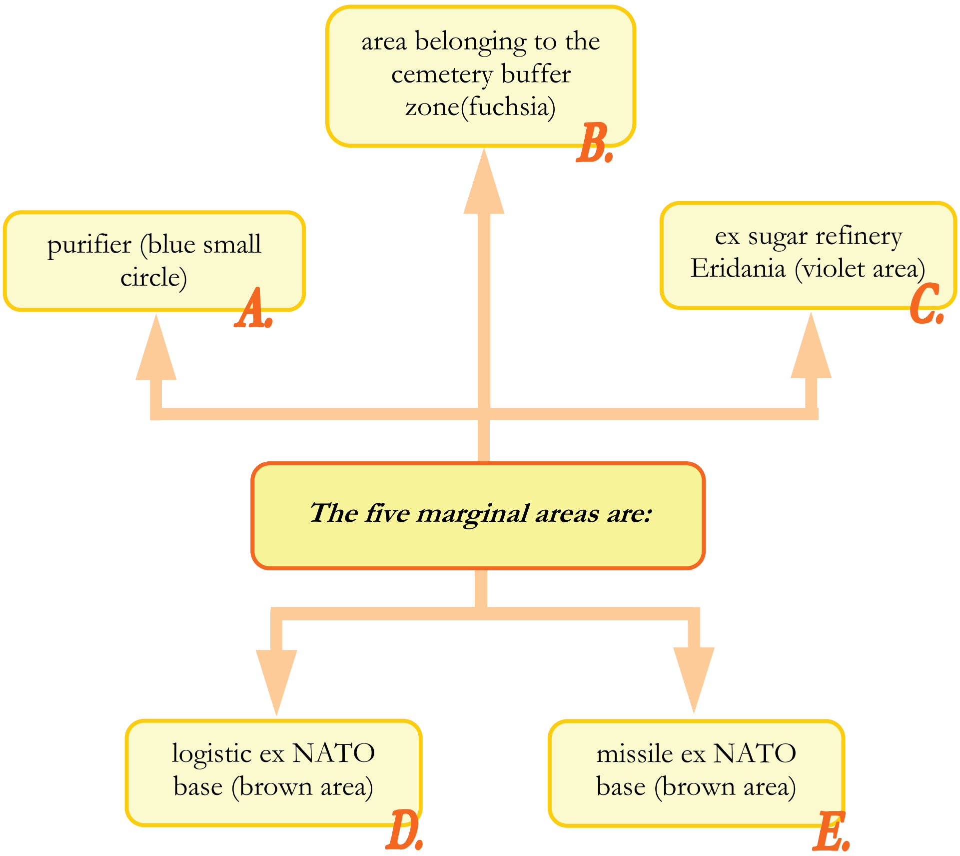
Legenda

- *Confine Comunale*
- *Idrografia*
- *Fascia di Rispetto Ferroviaria*
- *Fascia di Rispetto Elettrodotto*
- *Fascia di Rispetto Cimiteriale*
- *Fascia di Rispetto Stradale*
- *Depuratore*
- *Area Industriale Dismessa*
- *Aree Militari Dismesse*
- *Superfici Indisponibili*



Available and unavailable areas





Then we proceed with the analysis of each single highlighted element taking into account the hydro geologic risk according to the PAI cartography of the Veneto Region. From this analysis Ceggia seems to be interested to the hydro geologic risk, even if with a medium risk. The next step is to fill the so called "marginality grid" in order to underline the presence of the features which characterize the marginality of an area: this grid means to be just an

instrument for decision making and not one for the final choice. In fact the grid is able to compare many areas at the same time thanks to the quick view of the specific features.
To get the final choice it is necessary then to compare the areas identified as potentially marginal with well defined technical –functional parameters.

Table 1: *SEQ Tabella * ARABIC 2: marginality verification*

MARGINALITY FEATURES		A	B	C	D	E
Impermeability of the ground				√	√	√
Modified Geo-soil horizon	*Mines and landfills others*			√		√
Pollution presence		?			?	√
Absence of economic activities			√	√	√	√
Absence of future uses expectations						√
Absence of protection constrains		√	√			√
Presence of buffer zones/ anthropic restrictions		√	√			

From the grid and analysis of the potentially marginal areas we can see the following results:

A. *Purifier*

According to the analysis of CORINE cartography, the area embracing the purification system's clear zone seems to be an area of permanent cultivation, so that its potential marginality is reduced. Besides it is possible to note that this area has only two marginality's features.

B. *Area belonging to the cemetery buffer zone*

The urban growth concerning Ceggia's built up area expanded in all the area belonging to the cemetery buffer zone, which is now used as equipped urban park without any plans of changing. Consequently the area loses its potential marginality and that's also confirmed by the analysis in the grid which highlighted very few specific marginality features.

C. *Ex sugar refinery Eridania*

The disused industrial area of the ex sugar refinery Eridania cannot be considered a marginal area as it is submitted to an Integrated Programm of Urban, Building and Environmental Requalification (PIRUEA) adopted in February 28, 2008 and then approved on June 29, 2006. These administrative steps are subsequent to the urban regulation in force for the territorial analysis. It is important to underline that the industrial park is placed in the historical-cultural Heritage, ex d.lgs. 42/2004.

D. *Logistic Base ex NATO*

The area belonging to the ex logistic base NATO has only 2 marginality's features, which are actually not sufficient to acknowledge it as a marginal area. The canal Piavon, on a side, represents a restriction and on the other side is crossed instead from a new viability infrastructure which is not properly sufficient for the PVs in Bloom purposes. At the end, in the preliminary document of the new urban regulation (PAT) the area shows a possible tourist use, which completely nullifies the possible marginality.

E.	*Ex NATO base – missile launching area*
	Observing the marginality grid it is possible to note how the ex NATO area for the missile launching is lacking only 1 feature to obtain the full score: so we can definitely say that this is a marginal area. The marginality of the area is confirmed even if it is in a zone which PAI considers of moderate and medium risk. The average life of a photovoltaic system, in fact, is widely expected to fall within the interval periods of such flood phenomena. For the above mentioned area however a reclamation is necessary or a specific analysis of the chemical-physical and environmental features, as its function for the missiles launching is supposed to have used some fuels, which we don't know the chemical composition, the concentration, but overall the quality phases of their utilisation.

2.5.2 Verifying the technical-functional and location criteria

All the technical-functional criteria necessary for the execution of the Project "PVs in Bloom" are present while qualifying the area:

1.	The irradiation exposure is excellent thanks to the lack of structures that could screen with direct shadows
2.	The cliviometry is characterized for being completely leveled except for the embankment works which are functional for the military activities and that could be used in order to support photovoltaic panels
3.	The area presents itself as easily accessible thanks to the relevant roads and to the close medium voltage electric network

The area spreads for 186.000 square meters which, theoretically, could be enough for a system that can take advantage of 90.000 square meters of panels and, in this way, produce 9MWp right beyond the limit which the "PVs in Bloom" is looking for.

Area exposure	Full sun	√
Clivometria of the area	Flat	√
Sufficient area extension for the requested sizing	186000mq (of which 90000 coverable with panels, corresponding to about 9 MWp)	√
Distribution network proximity: Media tensione or cabina primaria Enel lines	Medium voltage line	√
Presence of appropriate viability for heavy vehicles	Relevant roads	√
Absence of geological risk	Absent	√
Absence of hydraulic risk	Moderated risk (from PAI)	√

Table 2: *Verifying of technical-functional for area "E"*

A further step will lead us to verify how the mentioned area reacts. These criteria are not binding but they are thought in order to increase the awareness of the area potentialities for installing "photovoltaic plantations" and in order to achieve the consciousness that an energy production close to

industrial or commercial activities which do need that energy, could be nothing but an amazing benefit.
In fact, knowing the right location according to big energy consumers or to structures and systems that definitely need a huge amount of energy, give the chance to highlight the benefits arising from the energy self-production and without any insurmountable barriers, disproving the common belief that is only reserved to the households.
Following, then, the table number 4 shows the location criteria, that is the peculiar characteristics of the area, which allows to increase the potential marginality value.

Table 3:
Location criteria.

Closeness to public service plants	
Closeness to industrial zones	
Closeness to commercial zones of big distribustion	

2.5.3 Final identification of the area marginality

From the location criteria table, we can see as the area doesn't answer to any criteria. Nevertheless, the area is by the way suitable to the "PVs in Bloom" project, overall, because the difficulty of its restoration to agricultural activity.
The presence of an medium voltage line guarantees however the energy carriage without the necessity of building a new distribution infrastructure.
The absence of big industrial and commercial activities on the municipality territory (with the exception of the municipality industrial area south of the sugar factory area), it does not substantially limit the marginality of the selected area, as the energy which would be produced from a photovoltaic plant localized in this area could have widespread function and public benefits.
For the Ceggia council, the positive effects resulting form the installation of a photovoltaic plant could be, both environmental (reduction of pollutant emissions, increase of the energy production from renewable sources, in line with the Kyoto Protocol indications) both economic (reduction of the energetic costs for the public buildings).
The electricity production could contribute, also, representing a new available source for the manage of the drainage system, because of the produced energy could contribute supporting the energy requirements necessary for the operation of the pumping stations located throughout the drainage territory.

2.6 Benefits of going marginal

It is interesting to point out some of the existing positive outcomes that a investment on a disused terrain can bring about, both from the environmental and business development point of view.
Among the environmental benefits linked with the installation of a PV device there are the following:

- Electrical energy produced through photovoltaic systems does not produce any polluting emission. The functioning of a PVPP is zeroemission in case of grid connected systems and minimum in the case of stand-alone systems, linked exclusively to the substituting of the accumulation batteries.
- Each kWh produced by a PV plant allows saving the emission in the atmosphere of roughly 540 grams of CO_2 (keeping in consideration the current energy mix of the Italian market)7. This means, in the example of the 500 kWp plant of Carano mentioned in paragraph 2, currently producing on average 675,000 kilowatt hours a year of clean energy, that during its 30 year life-span it will allow to avoid the release of approximately 10,935 tons of CO_2 emissions in the atmosphere.
- The production of PV panels requires non negligible energy consumption, yet the positive energy balance of a PV plant over its minimum lifespan (usually 20-25 guaranteed years) has been demonstrated since long time by various scientific sources. If one considers that the real life-span of silicon panels can be much longer than the usual 20 years (satellites demonstrate that after 40 years the energy production is still
  acceptable, with average reductions limited to 30%), one can think that, in actual terms, the balance can be even more positive in the long period. Moreover a PVPP, once installed, can be renewed after the life-span of its panels with new and more promising technologies. Where the area is already predisposed, the framework and electricity connection are already available, the authorization path has already proven successful,
  refurbishing of pre-existing plants cuts down costs for continuing the production of renewable energy.
- Investing in a PV plantation on specific marginal areas such as landfills or other areas actively producing CO_2 emissions has a special value, since it can qualify the site as “zero-emissions”. The investment moreover can also lead to take in consideration further interventions producing the reduction of CO_2, such as biogas capitation plants or other devices.
- Marginal areas such as no longer in use industrial sites or polluted terrains, which have heavy reclamation costs, or areas which require long biological or chemical regeneration periods, through a PVPP can start producing income straight away, allowing the terrain to re-establish its natural conditions during its non productive years..
- Former military sites and other State-owned sites are also not easy to reclaim, and sometimes cover vast surface extensions of land. These environmental and landscape wounds can be medicated through the

development of a low-visual impact PVPPs (also with modern greenmimetic geomembrane covers), reintegrating such location into the original landscape.

- The use of marginal areas does not subtract terrain to agricultural land, exploiting instead land made useless by atrophic action. This is particularly valuable for countries in old Europe that cannot afford to use up large valuable-land surface extensions.

Figure 1:
Le Vigne Solar Park- Arezzo, San Sepolcro, Italy - Environmentally integrated PVPP in natural hill Landscape (http://no-nuke-no-ogm.blogspot.com/2008/06/arezzo-parco-solare-le-vigne.html)

Alongside with unquestionable benefits for the environment, land valorisation through PVPPs brings about many development opportunities for local economies. Among such opportunities, we can list the following points:

- Local companies of the PV supply chain and linked industry develop and grow.
- The PV industry is currently a strategic business sector: the EuropeanPV market is growing by 39% a year8 and represents an opportunity that private companies and utilities can not step out of.
- Opportunities for strategic alliances between utilities, the PV industry and other companies are created.
- For utility companies, the possibility of attracting new customers occurs. This not considering that some attributes of photovoltaics could become crucially important for electricity suppliers or distributors in the future – e.g. PV as an opportunity for diversification and penetrating new markets or to improve the green image of utilities. Both points seem evident, considering the increasing amount of utilities offering green power products as a distinguishing element in liberalized and competitive markets.
- The contribution of PV energy to the reduction of peak conventional electricity demand is also an important value to be taken inconsideration.
- Infrastructure development is strictly intertwined with the realization of new PV plants.
- The interaction with other RES sources will be enhanced giving way to a positive spiral of growth in the other sectors of the RES market..
- The reclamation of marginal areas with PVPP investments will give additional value to the same marginal terrains and surrounding area,

and positive spirals of growth towed by the recovering/reusing of the degraded/marginal areas will start-off (think of the creation of Solar parks, RES Parks, RES Platforms, and many other solutions).

- Synergies with agricultural/commercial/industrial or other energyconsuming activities can occur.
- Photovoltaic systems allow electricity rates to be locked at current prices. With fossil fuels likely to become more expensive in the future, purchasing a PV system today can reveal to be an intelligent economic move for private companies and citizens.
- Independence can be achieved by the local industry with reference to power supply and the linked price developments. In the Appendix, further indications are given also on the scale of the potential economic return on investment of a PV plant, through a threecase analysis. Considering all the direct and indirect advantages linked in the paragraph above, outcomes will reveal even more positive when installing a PVplant on a marginal terrain.

Figure 2:
PVPP Double "S" snc – Brentonico TN - Less fertile mountain terrain (http://www.doubles.it/?action=fotovoltaico)

2.7 A real case of marginal area re-valorization by a Local Public Authority

Several local realities in Europe are already projected in a modern, desirable, and economically advantageous future, being now able to answer to the demand of energy from local industry and citizens as well as ensuring environmental protection and producing economic income for the public administration's needs. Many local administration's best practices in fact demonstrate that concrete results are possible both at the economic and at the environmental and energetic level, thanks to the re-valorisation of zero-value marginal areas through PVPPs. One of these real cases have been inserted below for demonstrating that investing in PVPPS is not only possible, but can also be a far-sighted and convenient choice. One for all, is the experience of the Municipality of Carano, (Trento, Italy), .
The plant of “I Corozi” – Municipality of Carano, Val di Fiemme (TN), Italy, is an example of successful landscape integration. The plant, covering 15,000 square meters, is embedded in a forest of trees and covers an area first interested by the extractive activity of a porphyry quarry.

The plant was installed by a private company (CPL Concordia), which won the tender launched by the Municipality of Carano. The choice of the place made it possible to exploit an already empty and historically characterized by an artificial landscape, and did not involve cutting of any tree. To further reduce the impact, efforts to contain the height of the panels, which do not exceed 165 cm, and, at the request of the Municipality, was planted a row of trees along the perimeter road. For building elements local stone materials were used left over in the porphyry quarry. In Carano, we are at 1,200 meters above sea level. This has led to the choice of a particular type of panel, with the possibility of adjusting manually the angle of inclination (the so-called "angle of tilt").
The angle of inclination is changed seasonally: in winter an acute angle (between 45 and 55 degrees) prevents the deposition of snow and makes it so the panels do not shadow each other, while in the summer the angle from the ground is reduced to 25 degrees in order to increase the incidence of sunlight. The previsions of CPL Concordia were winning, even in consideration of two design choices: the support structure of the panels (some of them are mobile) and the anti-theft system, the first alarm installation in Italy applied to photovoltaics. If a panel is detached from the structure, a signal is communicated to the system of supervision which forwards it to the company delegated to the monitoring and maintenance of the plant, and even to the police.

a.	Covers the energy demand of three quarters of the Carano municipality's population;
b.	The PVPP is composed by 3000 solar panels (of which 90% fixed and 10% mobile), installed in 2007, and now the plant produces an average of 625,000 kilowatt hours a year (for 500 kWp of nominal power);
c.	The total investment amounted to 3.2 million euro, and will be amortized by the municipality in ten years
d.	The 60% of the income produced (approximately 300,000 euro per year) is used to repay the mortgage, while the remaining 40% goes into the coffers of the municipality allowing it to supply free-of charge services to citizens and to carry out supplementary investments for the development of the local community
e.	Has avoided the high environmental reclamation costs of the area due to the former extractive activity;
f.	Guarantees a return to the Municipality of approximately 300,000 euro per year net after maintenance costs (the National Authority for Electric Energy and Gas grants, through the feed-in tariff system, 0.47 euro per kilowatt-hour produced), which allows the Municipality of Carano to maintain its balance in the black, to supply free services to citizens, to carry out supplementary investments for the growth and development of the local community.The return is guaranteed for 20 years;
g.	Assures significant abatement in CO_2 production;
h.	Confers new social value to a dismissed extractive area with ongoing didactic activities for scholarships and citizens;
i.	Guarantees energy security and self-sufficiency to a consistent part of the municipality's population and business tissue;

Effective income for public administrations, real savings for families, social value for the community, positive impacts on employment with multiplier effects for the local economy are all achievable goals connected with the valorisation of zero-value terrains such as areas degraded by marginality. Local policy makers and governments have the duty of contributing to increase societal welfare. Societal welfare includes among others mediating the negative environmental consequences of land use, sustaining the production of essential resources, and safeguarding the competitive advantages of the sites which are degrading. The responsibility of local public administrations in territorial planning is decisive for the future development of local environments and economies. This responsibility can be used as an opportunity when including specific measures for enhancing the reclamation of marginal areas through PVPPs. The tools already available are many: favourable regulatory conditions, normative special terms, tax breaks, incentives, simplified administrative procedures, guidelines for reclamation through RES applications, directing European or regional/national funds to aid this kind of interventions, pilot initiatives. Each one of these measures contributes to channel investments in the direction of sustainable and qualified growth

Figure 3:
Source:
http://www.cpl.it/casi_di_successo/energia/fonti_rinnovabili/fotovoltaico_a_carano_tn.

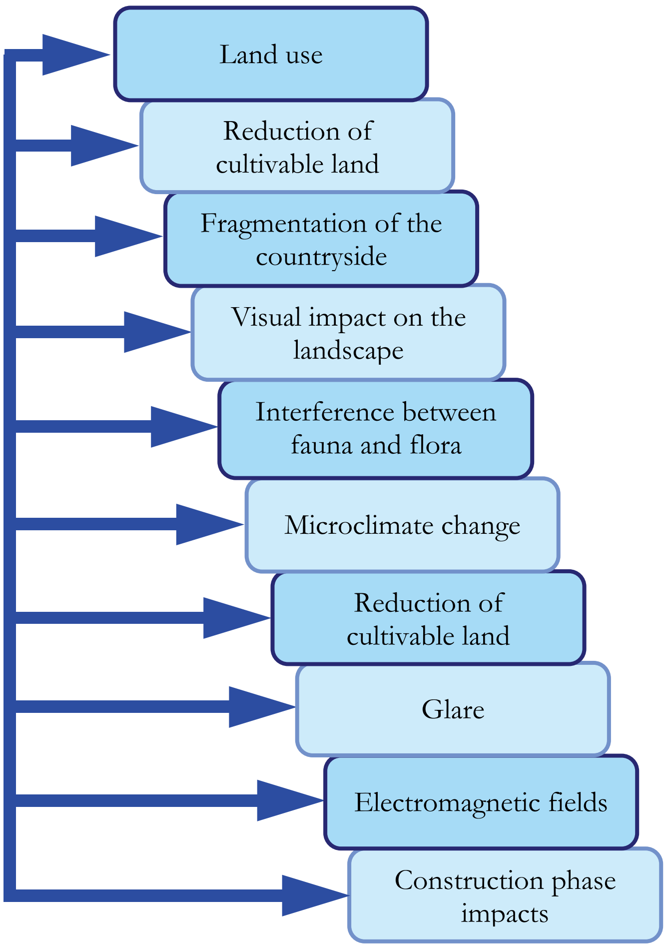
Figure 4 :
Source:
http://www.cpl.it/casi_di_successo/energia/fonti_rinnovabili/fotovoltaico_a_carano_tn.

3. What about locations, actors and authorizations?

3.1 Landscape impact & geographical location

Generally speaking, the installation and operations of a system that exploit solar energy through the photovoltaic conversion brings about an important form of landscape transformation.
In fact, in presence of a given level of solar radiation, the existing technologies offer a low level of conversion efficiency of the photovoltaic cells and thus a remarkable physical dimension of such systems is usually required (to give an idea a PV installation of 1MW that uses static structures might require up to 2 hectares of land depending on several factors such as the latitude of the area where the system is installed, the module tilt and so forth). This required area must be highly enlarged if tracking techniques are used.
Consequently, in approaching an investment in a PV system an investor should also analyze the strict requirements requested by the local authorities on the assessment of the environmental impact especially in the case of historic sites and rural or mountain villages and areas.

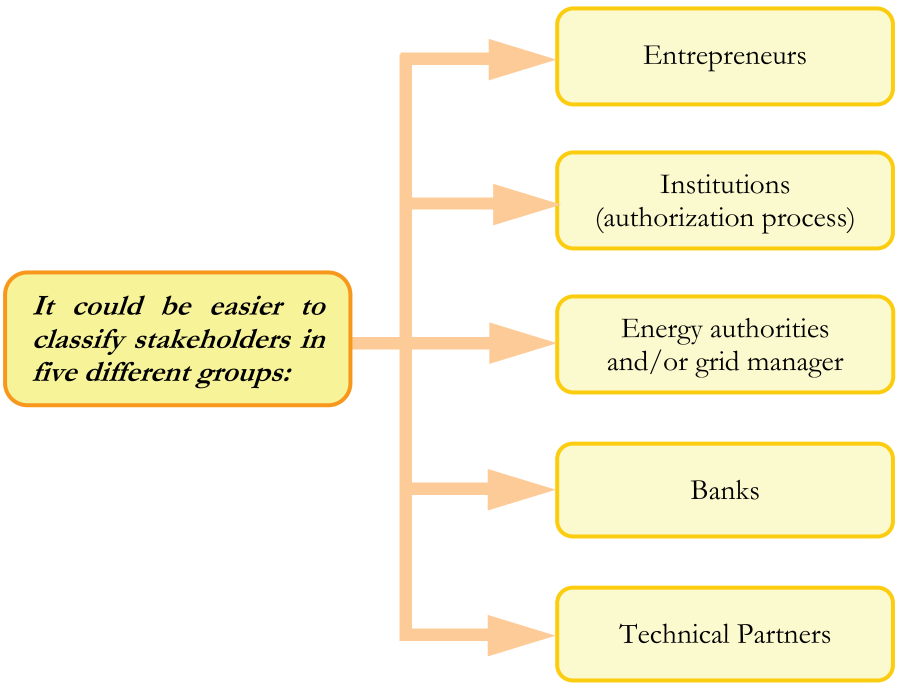
The main landscape impacts of photovoltaic system are as follows:



Marginal area is defined as a land whose productivity is scarce regardless of the fact that it is either rural or non-rural. Investments in a photovoltaic system to be built in marginal areas can benefit from a simplified system of rules set by the local government and authorities unless these areas are located in areas environmentally protected by the law. For instance, there are regional governments that have issued a special regulation for reconciling the production of energy from renewable sources with the safeguard of its regional territory encouraging the diffusion of renewable energy sources plants. Some examples have been observed - although with some differences- in some countries such as Italy and Spain. By contrast, the marginality in merely geographic terms may represent a factor of additional complexity for instance when a marginal area is located far away from the nearest power line and may be divided by a private land in the between.

3.2 Main stakeholders involved

The construction of a PVPP is a long process that involves a large numbers of stakeholders with different roles and level of interest. Authorizations required, technical aspects, project financing and building of PVPP are aspects that involve private companies, authorities and public institutions therefore a brief analysis about the value chain is necessary to perform, in accordance with the spirit of this guide.



Of course some stakeholders could change at partnership level and for this reason, even if they couldn't be the most important, we would analyze firstly the two groups Banks and Technical Partners. Photovoltaic, even if the power plant is located in a marginal area, is a capital intensive technology and, considering our Guide target, the building investments could be up to several million of Euros. For this reason banks and/or financiers (such as

private equity funds) are strictly necessary for obtaining the necessary venture capital to finance such type of projects.
PVPP's building and maintenance operations are technical aspects that need to be managed by specialized companies that become technical partner. PVPP's owner needs often to involve consultancy firms for managing the authorizations, bureaucratic paperwork and engineering processes. After these activities, construction of PVPP's requires high specialized construction companies with the role to build and connect to the power grid the photovoltaic installation. Furthermore additional partners are necessary for maintenance, insurance and accounting. Main stakeholders are surely entrepreneurs and taking into account that our focus is on marginal areas and assuming that marginal areas are property of municipalities and more in general public institution; these subjects represent mainly this type of stakeholder. Independently from the country, we could have three different categories of stakeholder:

- Public institution that wants build and manage PvPP in marginal area
- Joint venture between public institution and private companies
- Public institution that wants give land grant for exploiting marginal areas

It is important to note that in all partner countries, Public institution that have some right on marginal areas are very often local municipalities. This because marginal areas are often lands at "zero value" granted to private companies. These municipalities are sometimes (it depends on countries and PV installation size) involved in authorization processes as well, and this conflict of interests make them a stakeholder also when we speak about the institutional group of stakeholders. Institutions are important stakeholders because they are main actors in the authorization process. Municipalities,
Provinces, Regions and Ministries (with some departments) are the institutions that an "entrepreneur" needs to involve for building a PV installation in a marginal area. The number of institutions involved change at partnership level and level of involvement could depend of size of installation. This means that time to have all authorizations for going ahead with installation could changes a lot at partnership level. The last stakeholder group we are about to consider is Energy Authorities and/or grid managers. Grid manager and in particular distributors are responsible for connecting to the grid PV installations. It is crucial that they give appropriate assistance in this because marginal areas could be often located in regions that are hard to reach. In countries where there are incentives, Energy Authorities are usually in charge of verifying that all authoritative and installation process is correctly done in order to recognize a Feed in Tariff incentive. With exception of Poland this point is common to all partners.

3.3 Something about Authorizations and Administrations

Regarding the implementation of photovoltaics in marginal areas, it is important to consider the possibilities of application from an administrative point of view. In particular must be notice that a worsening in the economic conditions, and also in almost all cases an excessive bureaucratic burden, are perceived as major obstacles. However there are disparities between the situations in different countries. Analyzing the countries involved in the PVs in BLOOM project, the following considerations can be drawn:

Austria

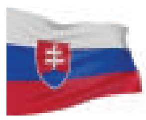
The level of radiation in Austria is medium, but enough for the use of solar energy. In fact the conditions are the same of southern Germany. The biggest barrier for the development of the Austrian photovoltaic market is administrative. There is a lack of regulations for the feed-in tariff. As a consequence the Federal States have used different ways to support photovoltaics. The discontinuity of the administrative and economic circumstances has caused an accumulation of authorized, but not built facilities. Regardless, the Austrian photovoltaic market in general has a great potential.

Greece

Has one of the most advantageous FIT, a very good level of radiation, and the duration of the administrative procedures is of medium level. The legal uncertainty, with a legal stage subjected to changes, and the economic crisis, has slowed the construction of new photovoltaic installations in Greece up to now. However it is a country with great potential for photovoltaic development in the coming years.

Italy

It is one of the countries with greater development of the PV market currently. The duration of administrative procedures is medium to high, with little difference between the minimum and maximum durations. This is an aspect that could be improved, particularly to facilitate the authorization of small installations for self-consumption of private stakeholders and municipalities. Italy has very good radiation levels, and has maintained for some years one of the most attractive FIT schemes in Europe, that ensured the economic viability of projects. On the 3rd of March 2011 however, the Italian Government approved a new Act on Renewable Energies, the so called “Decree Romani”. The measure isn’t a resolute cut of the Tariffs as feared, but of course it entails a reduction of the incentives and a certain degree of uncertainty. From the 1st of June 2011, the FIT system will be governed by an ad-hoc decree that has to be adopted by the government before the 30th of april 2011 and will determine among others an annual

	ceiling to the supportable electric power, the reduction of tariffs according to the reduction of costs of technologies and plants and of the FIT systems in force in the EU and different tariffs according to the type of areas interested by the installation.
	Poland
	In its territory the radiation level is relatively low, and the duration of the proceedings is low, but because the authorizations are punctual, and there are few installations in a system that is not properly regulated. It is a new market but it still lacks even a regulated FIT and still require a lot of work to have a basic structure for the development of the PV sector.
	Slovakia
	Radiation levels are not high. Until the end of 2010 an advantageous FIT and relatively rapid administrative procedures made Slovakia a country of great attractiveness for investment in photovoltaics. At the end of December 2010 the government changed the legislation concerning solar power plants: after 30 June 2011 only plants on the roof or wall integrated up to 100 kW will be permitted. All the ground mounted plants not connected by 30 June 2011 will not receive FIT and the price of the energy will be the market one. From February 2011 Municipalities in Slovakia are not permitted to release building permissions to ground installations.
	Spain
	Spain lives a special situation, with a virtually paralyzed photovoltaic market, and which probably will require adjustments in the next years. Despite its good levels of radiation the FIT is the lowest in all cases and is not flexible in proportion to the power of authorized installation. The duration of the proceedings is the highest and the authorization in small installations is almost as complex as in the case of the large ones. In addition in Spain the caps that set quaterly the power that can be installed, progressively benefit more installations on rooftops in front of the facilities on ground, and this makes PVPPs building even more difficult.

This situation is due to the adjustment suffered after a period of photovoltaic boom in 2008. The introduction of annual caps by a new regulation, caused an increase in the complexity of administrative procedures and, above all, long waiting periods for finally obtaining authorizations. The effects of the economic crisis on the possibilities of financing and the legal uncertainty, with policy changes that have affected retroactively the rates of installations already in service, have also helped to immobilize a market that will have to start a recovery process in the coming years.

Other important conclusions can be drawn. Currently the general trend is gradually decreasing the incentives for photovoltaic systems, which can be observed in all studied cases.

The decrease has been especially intense in Spain, is planned in Slovakia, and may occur soon in Italy. Furthermore this trend is more restrictive as in the case of installations on the ground, as seen especially in cases like those of Spain and Slovakia. The strategy to encourage power generation in urban environments and distributed generation is certainly very positive. However we must not forget that PVPPs can play an important role not only as an energy source, but as a means for the use of another resource: the marginal areas.

Only in the case of Italy there is a regulation (Conto III) which benefit the installation of PVPPs in degraded lands. There are also several examples of this in Spain, but limited to regional development policies. In a situation where new facilities are limited, especially on the ground, a good measure would be to take into account the exceptions that clearly involve additional benefits. If in this moment the tendency of the market is to lower the selling price of electricity of photovoltaic origin, perhaps for this reason this is a good time to foster measures to maintain higher prices in the case of installations which carry those additional benefits, such as the recovery of marginal areas. This can be beneficial in all countries but especially in those which the photovoltaic market is growing now and those where its implementation is incipient or virtually inexistent, where further growth is expected in coming years.

Along with the economic circumstances, the stronger factors in the construction of photovoltaic installations are the administrative difficulties and legal certainty. In general the duration of the formalities and bureaucratic burden is too high in all countries. However, the fact that there are improvements to carry out here is also an opportunity to incorporate procedures and practices to encourage the recovery of marginal lands.

Anyway what should not happen in any case is that the rules of the game are not clear. Legal certainty is essential for the proper functioning of any business because without it is not possible to stimulate the investments.

To incorporate renewable energy sources in general, and photovoltaic solar energy in particular is a need for all European countries, and so in the best possible way will imply regulatory changes and administrative good practices, and at the same time other environmental aspects and management of the territory, as the recovery of marginal lands.

3.4 European exemplary cases of administrative practices

3.4.1 Cases of business models based on collaboration between different socio-economic agents

Photovoltaic energy production allows different operators to form alliances to carry out initiatives. Municipalities, governments, financial institutions, photovoltaic industry, associations and citizens can work together to create PVPPs, according to various models.

Case of good practice

PVPP "La Villa", Villa de Don Fadrique, Toledo

Installation

- Power: 0.6 MW
- Details: 3,258 photovoltaic solar panels spread over 24 separate fixtures of various power ratings from 5 to 100 kWp
- Processing center 800 KVA.
- Processing center 50 KVA for auxiliary services.
- Annual production: 1,000,000 kWh / year
- Area: 21,700 m 2
- Location: low-productivity agricultural land
- Investment: 4 million euros
- Awards received: Solar Prize 2008 - Spanish Call, awarded by Eurosolar (European Association for Renewable Energy)

Source: www.construible.es

Description of good practice

A solar garden, or *huerto* solar in spanish, is a space in which **small photovoltaic systems of different operators share infrastructure and services**. The individual installations of small investors, produces small-scale energy to sell to the grid.
The *Huerta Solar La Villa II* was the first case in Spain where the collaboration between so disparate entities, like a bank, an environmental group and a company, joined to develop a photovoltaic power project.
The environmental group Ecologists in Action, the promotion, plant installation and sale of renewable energy generation company GEA Group, and Triodos Bank unveiled an agreement in 2008 to promote renewable energy and developing alternative and sustainable, socially responsible investment.

Huerta Solar La Villa II, located in low-productivity agricultural land is the result of this collaboration. There are 20 owners involved in the garden. Among them, besides other companies and individuals, is the organization Ecologists in Action, many of its members, and the bank Triodos Bank, who also funded much of the facility.

Case of good practice

The "Fanega Solar" de Ochánduri, La Rioja

Installation

- Owners: residents of the municipality (64 installations of 6.3 kWp), Town Council (100.8 kWp) and co-owners of the land (two plants and a 50.4 kWp of 100.8 kWp)
- Power: 700 kWp , Size: 21.000 m2
- Details: All facilities are equipped with structures of two-axis tracking and distributed in 28 trackers of 25 kW each.
- Location: low-productivity agricultural land
- Investment > 700,000 EUR
- Awards received: Sun and Peace Prize 2008 (Terra Foundation and the Science Park of Granada)

Source: Fanega Solar project description. Luis Narvaez.

Description of good practice

A municipality, despite its small size and not having a large volume of investment, may undertake the project to carry out the installation of a solar plant. On December 5, 2007 this PVPP in the Ochánduri village, of only about 80 inhabitants was put into service. The project had to overcome some administrative and financial obstacles, but finally was made possible through the collaboration of citizens.

Initially the project provided that each participant had his own followertracker, with its own meter and its contract with the electric company, but the power company did not accept the evacuation infrastructure to be loaned, because they were connected at medium voltage, and if the infrastructure was in the hands of the proprietors, the Autonomous Government only issued a registration of producers in the special regime for each processor (for every 5 kW), which involved the installation of 68 transformers, making the project unviable. The solution

was to package the facility in **units of 100 kW, participants in groups of 20 and four associations of participants were formed**. Each of these four associations installed the transformer, entered in the register of production, and contracted with the power company.
Funding for the project was carried out so that any resident, regardless of his economic status, could agree to participate. The financing was negotiated together, calling for a "contest" between the financial institutions that expressed their interest in participating. Finally the funding of two entities that offered not to ask for guarantees to the participants was accepted.
As for the land occupied by the facility, it is located in a low-productivity farmland near the town. Agreement was reached with the owners of the same pair to cede transfer it for free, in exchange for participation in the project with an installation (two plants and aof 50.4 kWp and one of 100.8 kWp).

3.4.2 Cases of normative regulations that favour the installation of PVPPs in marginal or protected from urban development areas:

The fact that the following rules set out the areas where the installation of photovoltaic plants is allowed, unravels many of the possible doubts about compliance with environmental regulations and urban planning, at the time of obtaining or granting permits for new facilities. In some cases these areas are set explicitly and in others not so explicitly, but in any case they set a framework in which investment in the above areas are carried out under conditions of legal certainty, this being useful for investors, public or private agencies to the licensing procedures.

Case of good practice

Guidelines for the installation of ground PV systems in the territory of Emilia Romagna

Standard Reference

Deliberation 6 December 2010, n°28 of the Emilia Romagna regional Government

Status

Activated in 2010 and still active

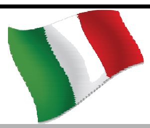
Description

In 2010, the regional government of Emilia Romagna published special regulation for reconciling the production of energy from Renewable Sources with the safeguard of the territory, agriculture and natural environment and landscape, favouring the diffusion of RES plants while limiting the consumption of soil.
The Regional Guidelines regulates the localization of biomass, wind, biogas, hydroelectric and PV plants on the regional territory. Concerning the installation of ground PV

plants, the deliberation identifies two typologies of areas, with different levels of protection.
In particular, **the regulation grants a simplified procedure for the installation of PV plants over marginal areas, where any dimension and peak power is admitted, while instead it limits installation over agricultural land** (only admitting plants of max 200 kWp - the limit within which the plant can be considered as device producing agricultural income for tax purposes - that covers a maximum of 10% of the available agricultural surface) **as well as landscape/environmentally protected areas** (as the Natura 2000 areas). Farmers will be allowed to complete the production of Dop, Igp, biologic, Doc and Igt products with the installation of ground PV plants within these limits. This will allow them to integrate the income from agriculture with the income from the production of RES energy.
In 2011, the regional government provided a complete and updated cartography of the areas suitable for the installation of ground PV plants over the regional territory.
The cartography, which reports the general localization criteria for PV plants is available to public on the website of the regional government (http://www.regione.emilia-romagna.it/wcm/geologia/canali/cartografia/cart_geotematica/cartogrfia_fotovoltaico.htm).
In every area the different levels of protection are indicated, according to natural, environmental, landscape regulations as well as the characteristics of the territory.

3.4.3 Cases of public grants for the installation of PVPPs

Direct grant or aids through favorable financing conditions are set out measures for promoting the incorporation of solar energy in countries where this market is mature and in some cases impulse of new technologies or support to good practice such as the recovery of degraded lands, in countries where this source of energy is already well represented.



Case of good practice

Incentives for investments in solar power out of landfills in the region of Piedmont

Description

In 2008, the region of Piedmont, in **the framework of the Structural Funds (ERDF Regional Operational Programme 2007-2013) issued a call for funding the installation of plants producing solar energy in areas that had been landfills**. The call for promoting investment in photovoltaic systems in closed landfills and dumps that were in the process of post-operational management, with the following characteristics:

- Areas used as landfills for inert waste or non-hazardous waste
- Areas with a minimum size of 10,000 square meters
- Areas located in the Piedmont region

In addition, projects to be funded, should take into account the need to minimize the impact of PV on the areas of action, while respecting their proper integration into the environment and landscape.

3.4.4 Cases of obtaining benefits through the division of the PVPP in lots less than 200 kWp owned by different municipalities

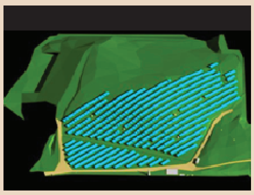
Many photovoltaic installations on land actually consist of several different plants that share common facilities such as safety devices, connections for the exchange of electricity, etc. Thus, besides saving on shared facilities, each of the facilities as part of a larger plant is capitalizing on the economic or administrative requirements to be met.

Case of good practice

The Campardo Investment model

Installation

- Developer and owner: CIT, a consortium of 44 municipalities in the area of Godega S. Urbano, Veneto, North-East Italy
- Total Power to be installed: 1 MWp
- Details: Orchard divided into 50 solar installations up 20kWp each to generate electricity at low voltage. A single transformer and a single injection to the grid.
- Technology: standard polycrystalline silicon
- Area: 39,549 m2
- Location: Exhausted landfill. South-facing panels arranged to allow access to the pumps and wells.



Source: The Campardo project

Description of good practice

In 2008, the region of Piedmont, in **the framework of the Structural Funds (ERDF Regional Operational Programme 2007-2013) issued a call for funding the installation of plants producing solar energy in areas that had been landfills**. The call for promoting investment in photovoltaic systems in closed landfills and dumps that

	were in the process of post-operational management, with the following characteristics: • Areas used as landfills for inert waste or non-hazardous waste • Areas with a minimum size of 10,000 square meters • Areas located in the Piedmont region In addition, projects to be funded, should take into account the need to minimize the impact of PV on the areas of action, while respecting their proper integration into the environment and landscape.

3.5 Conclusions

As a general conclusion it should be noted that the general trend is gradually decreasing the incentives for photovoltaic systems, which can be observed in all studied cases.
The decrease has been especially intense in Spain, is planned in Slovakia, and may occur soon in Italy. Furthermore this trend is more restrictive as in the case of installations on the ground, as seen especially in cases like those of Spain and Slovakia. The strategy to encourage power generation in urban environments and distributed generation is certainly very positive. However we must not forget that PVPPs can play an important role not only as an energy source, but as a means for the use of another resource: the marginal areas.
Only in the case of Italy there is a regulation (Conto III) which benefit the installation of PVPPs in degraded lands. There are also several examples of this in Spain, but limited to regional development policies. In a situation where new facilities are limited, especially on the ground, a good measure would be to take into account the exceptions that clearly involve additional benefits. If in this moment the tendency of the market is to lower the selling price of electricity of photovoltaic origin, perhaps for this reason this is a good time to foster measures to maintain higher prices in the case of installations which carry those additional benefits, such as the recovery of marginal areas. This can be beneficial in all countries but especially in those which the photovoltaic market is growing now and those where its implementation is incipient or virtually inexistent, where further growth is expected in coming years.
Along with the economic circumstances, the stronger factors in the construction of photovoltaic installations are the administrative difficulties and legal certainty. In general the duration of the formalities and bureaucratic burden is too high in all countries. However, the fact that there are improvements to carry out here is also an opportunity to incorporate procedures and practices to encourage the recovery of marginal lands.
Anyway what should not happen in any case is that the rules of the game are not clear. Legal certainty is essential for the proper functioning of any business because without it is not possible to stimulate the investments. The paragraph describing existing good administrative practices shows a series of exemplary experiences that can serve as a reference for public bodies and policy makers for tackling this aspect.

To incorporate renewable energy sources in general, and photovoltaic solar energy in particular is a need for all European countries, and so in the best possible way will imply regulatory changes and administrative good practices, and at the same time other environmental aspects and management of the territory, as the recovery of marginal lands.

4 Beyond landfill capping: thin film and pilot experiences

4.1 Overview

Nowadays, in Italy, waste landfill management is still one of the most widespread activities in the waste chain. Waste landfills, if not well managed, can cause serious environmental impacts to the soil and high costs especially in its post-mortem stage. To prevent and mitigate these impacts, and to contribute to the recovery of such degraded areas, there is a great need for innovative solutions, especially when capping the landfill for the post-mortem phase. The techniques currently used for final capping are expensive as well as not really so effective in preventing the unwanted environmental impacts.

Some pilot experiences existing in the USA and in Europe demonstrate that positive environmental impacts and financial return are achievable by providing landfills in the post mortem phase with an innovative kind of temporary capping, based on geomembrane covered with thin film solar PVs, and the additional advantages that can be achieved when the capping does not have to be decommissioned after its foreseen life-span (at least 20 years), becoming part of the final definitive capping that otherwise would have had to be installed at that date.

Unioncamere del Veneto, the coordinator of PVs in BLOOM, has promoted a pilot realization of this type in Italy, described in the following paragraphs, which could be relevant for fostering replication of solar capping in Italy and in the rest of Europe.

The final capping of an expired landfill and the insertion of the site in the surrounding environment is one of the most delicate aspects of waste management for local public administrations. The final capping of landfills is, generally, realized through a rivegetation of the final coverage (Directive 99/31/CE), which proves to be highly expensive.

Best Practices realizations in Texas (USA), Malagrotta (Rome) and Leppe (Germany), prove that other solutions are possible: geo-membrane textile covers integrated with thin film PV panels allow the local public administrations to abate the cost of capping while becoming a renewable energy producer giving functionality to an area which is destined to stay unused for a long period of time. Further developments are foreseen also through pilot cases in Italy through the PVs in BLOOM Project.

PV-applications unconnected to any building are usually considered to be ground mounted systems, build upon finally sealed landfills, old airports and former military areas. As landfills are normally only being used for such installations after the process of outgasing and its related moving of the ground has stopped, these landfills are considered unusable for upto 25 years. Only after this time of temporary closing (re-naturing,), the land is returned to the municipality. The land cannot be used for any alternative purpose during this time (that could be around 20-30 years).

One solution could be represented by flexible thin-film photovoltaic modules integrated into heavy duty roofing / geo membranes. This kind of coating provided advantages in eliminating the need for a costly substructure, as it is able to adapt to the moving ground. It could also be integrated completely into the landscape – making use of Solar Integrated's extensive know-how in building integrated photovoltaics.

Originally a fixed crystalline installation was considered the only way, but such system showed several problems compared to flexible thin-film photovoltaic solutions. If installed directly to the ground the risk of breakage of the modules was very high because of the still moving ground, which could lead to areas being shifted against each other. A substructure on the one hand would not have completely solved this problem and would not allow for a real integration into the landscape. Furthermore, a stiff substructure withstanding shifting within the landfill would have been very expensive and would have compromised on the economical viability of the system.

A flexible photovoltaic solution based on a roofing membrane, can provide advantages in eliminating the need for a costly substructure, as it is able to adapt to the moving ground. It could also be integrated completely into the landscape. Additionally, the thin-film modules have shown in some pilot plants to produce about 100 kWh/kWp more than crystalline silicon modules due to their better performance at high temperatures. This is due to the triple junction technology employed in the thin-film solar cells. Triple-junction means the thin-film layer is coated onto the base substrate in a way that three specific semiconductor layers are formed. Every layer collects the light in a specific range of the light spectrum – i.e. blue, green and red. Blue light is dominant in the morning and afternoon of the day as well as when it is cloudy or overcast.

This means, these PV-cells collect light over a longer time period of the day. Furthermore the triple junction technology makes these PV-cells less sensitive to orientation and tilt angle. Because the amorphous silicon cells have also a very low temperature coefficient, they are less affected by rising module temperatures, do not need ventilation or cooling and are hence ideally suited for integration into landfills and buildings. Finally, the use of a thin film covered geomembrane landfill capping would allow to avoid the cost of the realization of the typical traditional final capping in soil and grass illustrated below, at least for 10-15 (but possibly more) years – the life span of the geomembranes according to current technology – allowing the public administration that ownes the landfill to postpone a very high expence (the typical final capping) and, in the meantime, generate income from the PV plant that can be used for financing the costs that will be sustained at the end of the geomembrane life span with that money.

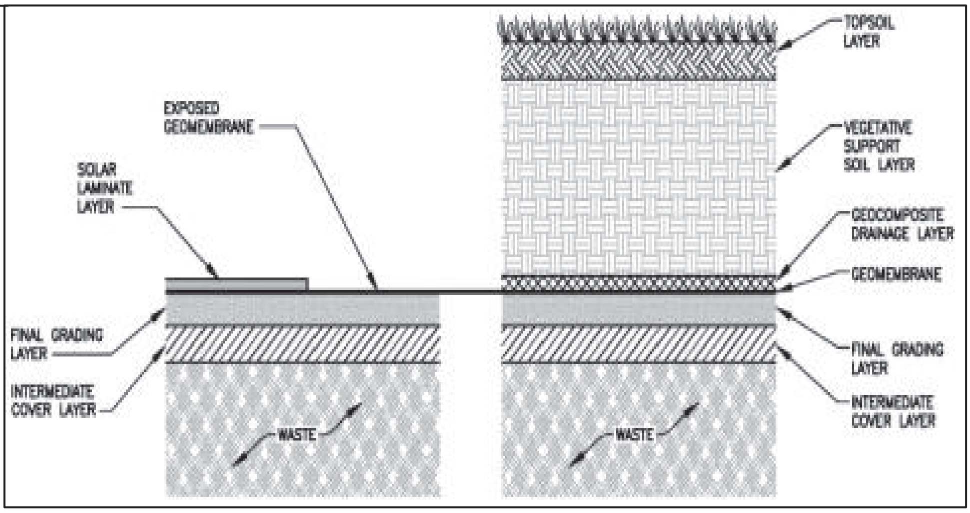


Figure 5:
Landfill Cover Sections Pilot Design and Typical Design

4.2 The case of Tessman Road Municipal

A First pilot and meaningful realization has been done only in the USA, where there seems to be considerable interest in going forward with this approach.
For the landfill solution in San Antonio (Texas) the realization of a thin film capping took part in three different steps. To cover the waste, as a first step approx. 61 cm of soil were put down, graded and compacted with a smooth drum roller.

Figure 6:
Detail and aerial view of the San Antonio landfill photovoltaic system

Figure 7:
Aerial view of San Antonio landfill prior to the installation of the photovoltaic system

Thereafter TPO geomembrane panels were positioned in place over the soil. The seams of the geomembrane panels were fusion welded, a method that allowed quick and easy installation. At approx. 18 m intervals, trenches were dug to anchor the geomembrane and to provide a secure place for the electrical conduit of the solar panels. After laying the cables of the solar panels, the trenches were filled with soil to keep the geomembrane from being blown away or shifting out of place. In a final step, the trenches were covered with a strip of the geomembrane, which was welded to the bottom sheet to produce a safe, dry environment for the wiring.

Figure 8:
Details of the preparation of the San Antonio landfill for the photovoltaic system's installation

As a third step, uni-solar flexible thin-film photovoltaic laminates were adhered to a prepared TPO geomembrane. These top-panels were heat welded around all edges to the base geomembrane.
Similar to the Malagrotta landfill the operators of the San Antonio landfill are also making use of the gas produced during the decomposing process for energy production. The solar system covers nearly 2.3 ha, with approx. 134.4 kWp installed power, saving annual CO_2- emissions of 109 tons.
A substructure on the one hand would not have completely solved this problem and would not allow for a real integration into the landscape. Furthermore, a stiff substructure withstanding shifting within the landfill would have been very expensive and would have compromised on the economical viability of the system.
Currently, the USA pilot, does not give a sufficient guarantee of life duration (from 20 to 30 years), in order to ensure the technical and economic significance of the investments in which they are involved.
This means that further pilot experiences are needed in order to ensure the technical and economic significance of the investments in which a public administration can be involved. Below other two existing experiences.

4.3 Leppe Landfill, Germany

An other example of thin film application is given by the Leppe landfill, Germany. In the Leppe landfill is used as a test site for a projected funded by the German Federal Environment Fund and operated by the Bergische Abfallwirtschaftsverband. In this case the project was realized by a combination of flexibile thin-film solar cells on roofing membranes bonded to accredited landfill PE-HD geomembranes. Additionally a reference field with conventional non-flexible solar modules was built.

Figure 9:
Installation of the SolarRoof Membrane via an adapter strip

Figure 10:
Crystalline silicon solar module reference field.

Figure 11:
various solar test systems on the Leppe landfill testsite

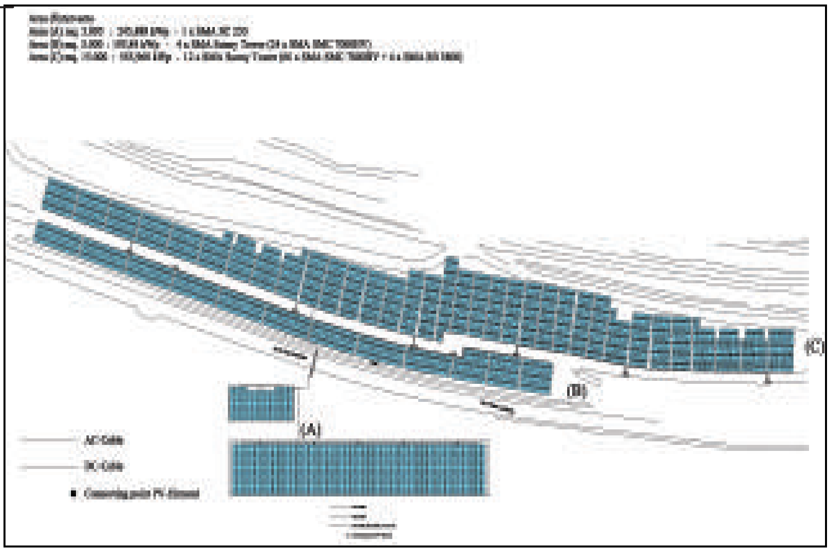
To ensure a lasting combination between the PE-HD geomembrane and products such as the solar roof membrane from Solar Integrated an adapter strip was used in between, which allowed bonding to the geomembrane on the one hand and hot air welding of the solar roof membrane on the other hand.

4.4 The case of Malagrotta

The new PV plantation realized in the former landfill area of Malagrotta (Rome) is the most significant example of recovering of a marginal area for the production of green energy currently available.
The main aim at the basis of the area's recovering was to enhance the waste recycling power (especially plastic and metallic waste) and to convert gasses deriving from waste's decomposition into electricity and fuel. Once reached the goal of becoming the main green energy supplier of the Region, the owners of the landfill (Colari Consorzo Laziale Rifiuti and Sorain Ceccini – public-private consortium) chose to add to the potential green energy production of the area the installation of PV system.
The PV plant was built by the Consorzio Laziale Rifiuti and Solare Integrated Technologies, which used uni-solar flexible thin film cells.
The adopted technology allowed to create a structure perfectly integrated with the environment; the use of flexible PV has been advantageous also in terms of costs' saving: there's no need for costly supporting structures and no risk of breaking due to natural ground subsidence.

Moreover, the uni-solar cells produce a high quantity of energy, thanks to amorphous silicon modules' efficiency, which allows capturing energy for a larger light spectrum during the day.
Considering now some data, during the first year of activity, the system, covering an area of 21,300 m2, produced 1,3550 MWh/year, avoiding CO_2 emissions equal to 1,250 tones. The new PV plantation realized in the former landfill.

Figure 12:
Parts composing the landfill of Malagrotta (Image courtesy of Enea-Ente Per Le Nuove Tecnologie L'Energia E L'Ambiente



To realize the Malagrotta installation, the landfill was covered by a thin concrete layer, separated by splices packed with wooden beams to allow for controlled movement of the area and breakage of the concrete plate. Attaching the flexible PV membrane as is done on a roof inhibits air being able to penetrate from underneath and causing wind-uplift. Additionally this fixation method prevents theft of modules. As no water coming from a landfill – even rainwater – may leave the landfill area, a solar Membrane on the landfill buttress serves and additional purpose, which is sealing of the ground and allowing for a controlled discharge of the water. Rainwater can also help to clean the PV-system and is recollected at the bottom of the installation. To ensure a low and easy to maintenance system, string inverters were used rather than a central inverter. On the one hand string inverters ensure that the voltage in each individual PV-field does not get too high. On the other hand string inverters allow maintenance and repair without shutting down the complete system but only the involved section.

Figures 13, 14:
String inverters at the Malagrotta landfill photovoltaic system are placed at regular intervals

The Malagrotta PV plant is realized on the buttress of the landfill, and not on its top. In Italy, it is not provided for the construction of new landfill cover using methods other than the provisions of Legislative Decree 36/2003. Unlike the case in which work is carried out on a site already in post-administration prior to 2003 and therefore not subject Legislative Decree 36/2003. In this case, nothing prevents, if properly authorized, to use camping geomebrane exposed above the previous one, but this site needs to return to be covered at the end with soil and grass suitable for vegetations.Currently, the realization of the final post-mortem shell membrane exposed is not very developed. This is why, the Coordinator of PVs in BLOOM triggered the realization of

4.5 A PVs in BLOOM success story: the Tiretta landfill pilot project

The Tiretta landfill is a long standing problem for our country. It has been inactive for about a decade, but in 1989 Veneto Region authorized a storage of 150 000 cubic meters of earth from a Vicenza foundry. Then, in 1995, Veneto Region allowed a disposal of 315 thousand cubic meters of dangerous waste: paint booths filters, inks, adhesives, drugs. Now it continues to be a source of pollution by leachate.
Since 2000 the Tiretta landfill is considered a polluted site to be reclaimed because it polluted the wells through percolation of a substance derived from bromacile. This product is used for agricultural herbicides, and it poisoned wells in Quinto di Treviso; those wells are still closed by union orders, but we are finalizing risk analysis of the landfill in a few months. This work is arranged with Treviso province and Arpav. In the meanwhile, Arpav analysis certificates are showing a worsening situation determined by release of contaminants found in wells downstream.
I remember that exceeding just one parameter it implies the prosecution of reclaim.
The Tiretta landfill, thanks to the support and action of Unioncamere del Veneto, will have a new future. Of course it will never become a place to bring our children to play, but at least, and it is not so bad, it will be "inoffensive" and for free. A project for safety and requalification of the Tiretta landfill was officially presented: by Paese city and will be partially

funded by the Veneto Region, and designed by Priula Consortium and by Aeneas.
The innovative aspects of the operation mainly concern technology and economic-financial self-sustainability of the operation.
Tiretta, considered one of the most polluted landfills in the Veneto region, will be covered by a new impermeable layer A photovoltaic park will be build on it, not using traditional panels, but a film with cells able to capture sun's rays. The film will always remain adherent to the waterproof surface, and will consequently change. This technology has been used for the first time in Texas, and it will debut in Italy only in Paese, in the Veneto region.

Figure 15:
The original Landfill Site of Tiretta di Padernello, Paese (TV)- Italy

According to the prefeasibility study drafted by Unioncamere del Veneto, keeping in account the urgency of carrying out a safety measure intervention on the landfill, and the need to reduce consistently the leakage of leachate, making the landfill safety is possible through an intervention with a temporary (20 years or similar) geomembrane capping, allowing to dilute the costs of the intervention by the municipality in possibly 20 years. This will allow the municipality to recover its coffers' condition putting away the income that will be created starting from the end of 2012 since the turn of the key of the PV plant saving the money for the definitive capping operations.
The technology used will be the one proposed by UNISOLAR, as in the case of the three pilot experiences of Tessman, leppe and Malagrotta monitored by PVs in BLOOM.

These are the average data for the "Unisolar PHotovoltaic Laminate" :

- Specific (STC) electric power for unit surface (w/sm)= **60**
- Weight (KG/sm) = **4**
- Colour: blue
- NOCT: = **46 °C**
- Temperature coefficient (TC) of Pmax: - **0,21%/ °C**

On the surface of landfill access to the main biogas production points will be foreseen.
The overall surface is about 30.000 square meters, for a plant of about 1 MWp.

The project will initially be funded by the Veneto Region. 7 million euros coming from the regional government will have to be repaid in 15 years at zero rate, and 388 thousand euros will be received in free grants. The City of Paese will give the money to Priula consortium that will manage the work. The photovoltaic system will produce the resources needed for the return of 7 million euros to the Region, through the sale of produced energy and with the FIT.
Furthermore, thanks to production, and adding income taxes, it will also be possible to support the final capping intervention in 2034, when a new vegetable soil will be put on the landfill. "The work is safe even if contributions will be cut. In that case, the waste rate would be increased slightly, but sharing among the municipalities managed by Priula, the raise will be about 0.46 cents each family".
Energy production could already start in 2012.

4.6 Conclusions

The legislation related to technology about exhausted landfills capping has been object of great interest in PVs in BLOOM.
This kind of coverage can cover portions of soon to be closed areas of active landfills with flexible, laminate-type photovoltaic (PV) solar collection strips. The flexible solar laminates, which capture the sun's rays for conversion into electricity, are adhered directly to a synthetic green or white coloured geomembrane. The problem is that currently, in Europe, such type of realization can only interest the buttresses of the landfill, and not the cover, that must be made of organic material and covered by grass.
Starting from the results achieved in America on solar capping, the approach can be further developed and the the American pilot experimentation can be adapted in order to demonstrate the validity of the application in Italy through a significant pilot project, that will bring to a new and/or alternative protocol for securing landfills in the post mortem phase and also in riskfull situations (see the case of leakages of leachate from the bottom of the landfill).
Unioncamere del Veneto, the project coordinator, is in fact collaborating with ENEA to promote the start of an experimental thin-film PVPP cover over one lot of those available in the landfill of the municipality of Tiretta (for which PP1 carried out a feasibility study). This Italian experimentation, could lead to a the spreading in Europe of a new EU legislation proposal concerning the substitution of landfill covers (which according to Directive 99/31/CE is supposed to be realized with a ground and grass layer with a determined thickness –at least some meters of organic material) with geo-membranes covered with thin film PV panels.
This development of EU legislation, could allow great savings in the cost for covering landfills produce renewable energy and give functionality to an area as a landfill in post-mortem phase which is destined to stay unused for a long period of time.

5 Lessons learnt

5.1 Introduction

The study concerning marginal areas carried out thanks to the PVs in BLOOM Project has revealed how many under-valorised or totally abandoned terrains actually exist that can be included within this macro-category. The majority of them are likely to remain for long time, and in some cases even forever, without any use or function, while other terrains are for various reasons included in local development plans or addressed by initiatives of private investors and therefore re-used and renovated through reclamation. The sample analysis carried out in some regions and countries such as Italy, Spain and Slovakia show impressive numbers regarding the mass of terrains that currently are abandoned and the potential green revolution that could revolve around them. A true green economy should turn its eyes on them, avoiding their destiny of unused resources in the general indifference. Photovoltaics is a RES technology which is hungry for land; rehabilitating marginal areas for converting solar energy on a large scale is particularly suitable contributing to sustainable development.

More than 645 MWp of solar energy easily achievable from landfills in Italy, 393 MWp from contaminated soils in Slovakia and nearly 1,2 GWp easily achievable from landfills and mines in Spain, are remarkable figures that depict all the potential of including the PVs in BLOOM approach in the urban and landscape planning and of the public and private investment schemes of old and new European countries.

The production of electricity from photovoltaics on marginal areas, as well as reducing the environmental impact of PV plant deployment would also spare hectares and hectares of arable land.

The photovoltaic exploitation of marginal terrains allows transforming abandoned sites from "non-lieus" to "lieus", giving originally unproductive lands the power of generating long-term income. The opportunity of exploiting some kinds of marginal lands (in particular landfills, open quarries, brownfields and former military areas) has been seized by some European and non European countries, yet in some cases without a clear reference within their strategic development policies. In particular, according to the monitoring carried out through the PVs in BLOOM Project, it was noticed that the re-use of marginal terrains through RES investments, in particular photovoltaics, is currently practiced in the United States and Japan, while among European countries, the one with the most interesting programs and realizations is Germany. Also Italy can be quoted, but only with reference to some virtuous practices of some regions such as Sardinia, Piedmont, Lombardy, Veneto and Tuscany.

Even if they are not very many, the experiences of the above-mentioned countries are significant, and demonstrate for example how deploying PVPPs on landfills may bring benefits such as:

- significant income for landfill owners and municipalities
- increased value of damaged terrains
- safekeeping of potentially dangerous lands
- aesthetic upgrading of the terrain and surrounding landscape
- opportunities for further larger scale installations
- energy independence and energy source diversification
- matching solar energy production with periods of peak demand
- avoiding carbon and other fossil-fuel air emissions
- providing green jobs linked to the plant installation and maintenance

Other cases demonstrate how airports can be a perfect showcase for a PV plant, when it is integrated on the airport's grounds and buildings. Finally, old military bases and old dismissed mines can be profitably converted to photovoltaic parks.

5.2 General Lessons Learnt on the experience of PVs in BLOOM

The experience of the PVs in BLOOM project has demonstrated that the general lessons to be learned are the following:

- Municipalities, public organizations for the management of land resources, utility companies, energy producers and distributors, consortia for the management of industrial areas and Sate Land authorities are the organizations who own or manage the greatest number of marginal areas (usually the degraded ones or those that are subject to particular constraints that require limited uses);
- If these organizations were empowered to give the priority to the reuse of marginal lands when investing, the restoration of such areas through renewable energy and in particular photovoltaics would be a strong leverage for the public administration for enabling sustainable virtuous behaviours with tangible returns for local economies and indirectly for the State itself;

- Developing Photovoltaic Power Plants provides the opportunity of attracting environmentally conscious investors that are interested in supporting green investments or locating their premises in more environmentally-friendly industrial areas. For example, the location of a solar module manufacturer on a brownfield could provide a great opportunity for the creation of new jobs and for boosting the local solar market;
- PVPPs provide environmental benefits that are particularly attractive for urban areas with air quality concerns. With their zero emissions, solar energy systems can offset emissions from other energy sources particularly during peak hours when utilities often rely on older systems that pollute more heavily.
- Local, regional and national public administrations could develop policies that protect sowable land from speculation and promote real sustainable development through the introduction of RES marginal area reclamation into their territorial development policies and programmes.
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5.3 Who sais what about the project's implementation

5.3.1 An insight on Poland

In Poland the use of photovoltaic based solutions as renewable energy source is not at all common, indeed the majority of stakeholders involved never knows enough about this kind of technology. For this reasons the biggest achievement of the polish partner and for Poland during the PVs in BLOOM experience is the successful realization of a PVPP in Wierzchoslawice. The photovoltaic power plant is situated in a buffer zone near the local water supply centre. At the moment the first stage of the project is being realized – a PVPP of 1 MWp nominal power.
In the near future they are planning to encourage lobbing actions to promote their experience and this approach during conferences and seminars.
For Poland the participation in the project has been an important experience.

Following the activities and the meeting organized during the implementation of the project many results has been achieved:

- Introduction in Poland and definition of the concept of marginal land
- Strategic Vision on phtovoltaic farms contribution to sustainable development in Europe

- Introduction to stakeholders to the technical vocabulary related to photovoltaic power plants (solar radiation, sunshine duration, etc.) and to the choice of technology due to the nature of the terrain (matching technology, photovoltaic power plants due to the characteristics of the marginal land)

Considering the polish situation, the introduction on the country's scenery of the points described above is not at all granted.
After this 3 year experience, it can be said that in order to encourage a real implementation of photovoltaic market in Poland it is essential to introduce a feed-in-tarrif.

5.3.2 An insight on Spain

In Spain, state and regional regulations has developed many tools for both regulating the activity of photovoltaic plants and to regulate the management of the territory. However, except in exceptional cases has not been contemplated the restoration of degraded lands using photovoltaic systems. The administrative procedures in many cases pose a major impediment to the construction of new facilities, but often the problems are not from the actual design of the procedures, but from the practical deficient application, which causes the failure of the deadlines.
The photovoltaic solar energy is a very well known technology in Spain. In the last two years, the Spanish PV sector has suffered a break due to the constant changes of the legal frame which have created a very high uncertainty and the commitment investments in this sector have been stopped. Instead of this situation and as consequence of the installation costs of PV Plants have decreased, last months the PV sector is recovering and the forecast are optimistic for the next years.
The realization of PVs in Bloom project has permitted to the municipalities to get a deeper knowledge, from the economic, environmental and social point of view, of the possibilities which offer the installation of PV Plants in marginal areas. This type of initiatives can be linked to get investments in the towns, economical benefits for the councils, people training at different levels, creation of small companies in the towns, creation of jobs, etc. So, it is worth pointing out that this action has showed new challenges in the normal tasks of the councils and has opened new possibilities to increase sustainable development. For all these reasons, the councils are very conscious of the importance to promote and make easier the installation of PV Plants in their marginal areas and so, the sustainability of the project is assured.
The PVs in Bloom project was launched when the installed PV power in Spain had experienced a formidable surge -2•5 GW were installed during 2008. Consequently, society was familiar –to some extent- with the PV technology and its benefits. This much had paved the way to the initial overwhelming positive reaction of most spanish municipalities to the objectives of the project. In fact, the municipalities interested to be involved in the project were many. Doubtlessly, the attractive idea of recovering degraded areas by means of installing PVPPs, so that these areas could be re-

qualified using this technology was a compelling argument to persuade the contacted municipalities to support the objectives of the project. Additionally, promoting local businesses related to PV technology –e.g.: operation and maintenance small firms- and the possibility of attending training seminars on PVPP –in order to provide the prospective attendants with useful knowledge to find a job, or a more qualified one- were appealing ideas given the high unemployment rate existing in Spain.
The identification of marginal terrains suitable for the installation of PVPPs and the pilot projects in these terrains shown to the municipalities together with some other project stakeholders have helped to make them aware of the potential of PVPPs. As PV technology improves, some research still remains to be carried out in this field.
The use of the marginal areas to install PV Plants opens a great number of possibilities to support the sustainable development of the towns.

5.3.3 An insight on Austria

In Austria, some clusters and RTD centres are interested to support ongoing initiatives for integrated approaches of RES including the findings of PVs in Bloom for their own domestic market as well as for transferring the identified good practices to joint new markets.
Also the information about the projects examples diffuses step by step to municipal and regional stakeholders who will foster a medium term impact especially the model of the participative approach for citizen owned PVPPs. For the long view PV as a part of an integrated RES system will get more interested in particular for industries and public utilities.
In detail additional lessons learnt came out during project work regarding the chosen technology, stakeholders´ behaviour model und role modelling within fields of administration and economy as well as the world of funding and financing.
The main point of learning project derives from the basic idea to use different marginal areas to increase a common public value for this kind of real estate. At the same time an ecological footprint is set in an improved manner. Thus buffer zones around highways, airports, public utilities and old industrial respective mining sites become more interesting for future investments.
The available funding scheme and an appropriate feed-in tariff are not an absolute must for pushing PVPPs but with a quite restrictive system like in Austria much more time and new smart solutions for e.g. energetic autarchic systems within public utilities, providing own electricity for industry a.o. are necessary. But therefore one single project just can contribute by opening the mind for these kinds of future applications.
The elaborated handbooks and documents support to approach the local and regional stakeholders whereby the demonstrated good practice cases within the own or a comparable region are more convincing than from other European regions. And influencing public stakeholders is a continuous process where a lot of selected stakeholders from different levels have to get integrated for a properly managed dissemination project, too.
Generally the methodology of PVs in Bloom initiates some impacts for the participating partners on municipal and regional level. But due to the not so

advanced PVs friendly environment in Austria the project work focuses more on co-operation regions in Slovenia and East Germany. Then step by step partners in Austria get more and more interested in particular for smaller investments and for smart solutions regarding integrated systems of RES and new models of financing as participative models with citizen.
To create the awareness for using PVPPs on marginal areas is a great idea but not that easy to convince stakeholders and other interest groups immediately. Thus the accompanying elaboration of different guidelines and handbooks are relevant for providing qualified information for an appropriate mind setting by decision makers and multipliers.
Especially the variety of all identified good practises cause an encouraging feedback from the involved stakeholders from cities, municipalities, public utilities and development agencies. One main request is the provision of turn-key solutions for all fields of expertise (renewable energy technologies, planning, engineering, financing) which is the opportunity for a private-public service development, too.

5.3.4 An insight on Greece

The main objective of the project was to promote policies and strategies to support the production of solar energy panels mainly in abandoned - marginal areas of Local Authorities. Through its implementation several issues were addressed, and Greece can be declared the country were PVs in BLOOM has been more successful, given the potential development of the PV market, sun conditions and FIT developments.
The project in fact opened in Greece a whole new branch of potential investments, linked to the requalification through PVPPs over abandoned or abusive landfills and waste dumps (there are in great number in Greece).
The benefits for the small municipalities in the near environment are very high. The citizens get a live example for green energy production in their municipality area. Furthermore local companies have taken part of the works during construction and jobs can be generated for the local operation and security of the photovoltaic park. The photovoltaic "MW free field park in Thiva" has thereby a positive effect on the local job situation.
The private investor in return, thanks to the benefits of the incentive program, can have a positive economic return on investment over the term of 20 years to be made available for further activities in order to continue the rehabilitation of the area.
The combination of the financial incentives and terms, the high feed-in tariff, the system cost and the solar radiation available are such, that the investment in tthis kind of systems is attractive even without an initial investment subsidy. Another important note is that in the past two years it has been observed, that operating PV systems in Greece produce about 10 to 15 % higher output than the estimated values due to the fact that in the recent years the annually available solar radiation is higher than the values used from databases.

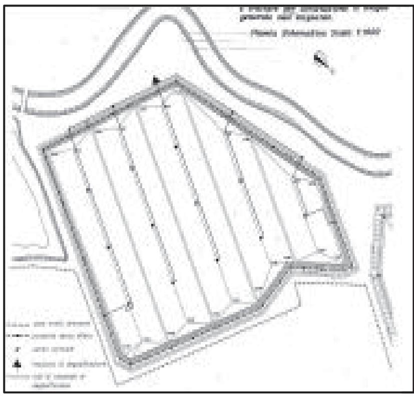
5.4 Conclusions

Unfortunately, European countries, and even those where Photovoltaics have had a remarkable development, have not set up yet organic policies that specifically address the assessment of existing marginal areas and the planning of incentive measures and other support schemes giving the priority to the development of RES sources over such areas.
Currently there are enough examples of good practices to allow any public or private organization wishing to promote this kind of initiative on one of its terrains to start from an advantaged point.
The success of the PVs in BLOOM aapproach in Greece shows that taking as a model the existing best practices EU countries, especially the ones where the PV market is not yet mature could avoid the hard speculation that has characterized the development phase of the PV market in recent years, saving thousands of grain crops and other cultivations from destruction.
Looking at PVs in BLOOM as a new way for approaching investments for real integrated and sustainable development represents an excellent chance for all European municipalities and citizens.

6. The PVs in BLOOM Success Stories

6.1 Noale landfill, Venice Province, Italy

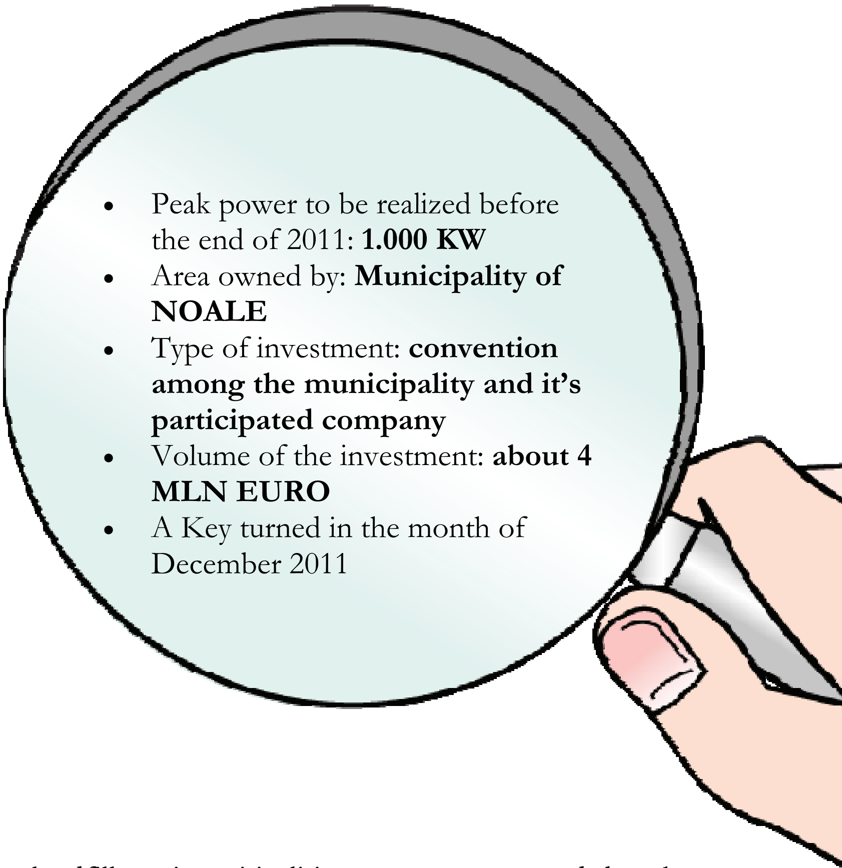
Thanks to the action of the coordinator of PVs in BLOOM, Unioncamere del Veneto, among others a 1 MW photovoltaic system will be built in Noale, Venice, on the former landfill called Cà Barbiero.
After delivering of prefeasibility study by Unioncamere del Veneto in collaboration with ENEA, the project was temporarily deadlocked because of financial shortages in the municipality.
The PVPP is being built and will be due by the end of 2011. It will have a megawatt of power and will be the largest plant in Italy made over a former landfill. The project, realized by the City of Noale in collaboration with Veritas (the local public utility), will be build with last generation photovoltaic modules of silicon that will occupy about 3 acres of former landfill. The panels fitted will not cause environmental pollution, nor emit electromagnetic radiation. The plant will save 5,500 tons of fossil fuel and to avoid emissions of 11,000 tons of greenhouse gases. The energy produced will satisfy the electricity needs of 350 families in Noale.



Figures 16,17:
Former landfill of Cà Barbiero, Strada Bigolo, Noale, VE Italy.

Noale's residents, in addition to environmental benefits, will receive a benefit of about 30,000 per year, which will be deducted from the hygiene enviromental bill. The management of post-mortem dump will be give to Veritas for the next 20 years. Veritas will invest approximately 3,500,000 euros in that construction, and the photovoltaic system will probably be in function within August 31, 2011. "It's substantial investment" stated a representative of Veritas "also because we are talking about landfills that cost even when they are closed, like the landfill in Noale. However, we are happy to invest in this project, which to our knowledge is the first in Italy. The industrial installations of waste treatment are our lifeline because fortunately in our area landfills are becoming less relevant therefore the management is for closed sites".

Estimated data:



Substantially, Noale's landfill main criticalities were represented by the missing of the grid medium voltage connection, and the need to clarify whether in the future it could become necessary to carry out further interventions on the landfill surface for further works that could be eventually asked for by the competent organizations.
It is also possible to say that an intervention with some difficulties was achieved notwithstanding delays and in favour of citizens and to public benefit.

6. 2 Arjona barren land, Jaén Province, Spain

Within the frame of the PVs in Bloom project, on early 2009, the project partner University of Jaén got in touch with the prospective investor, together with the firm 'Solar Jiennense, S.L.' whose main activities are focused on installing PVGCS. The project partner University of Jaén helped to persuade this prospective investor to install a PVPP, on grounds of how the community and he could benefit from this investment. Leaving aside environmental consciousness and some other important eco-sustainable issues which were properly detailed, profitability in economic terms was assessed. Thus, although the feed-in-tariff had been lowered in September 2008 when compared with the most favourable one existing until then, the costs of PV had also decreased in 2009 by some 40% when compared with 2007. Additionally, an important financial support –some 80%- could be provided by means of a bank loan.
Once a positive decision was made, the project partner University of Jaén got actively involved in the installation of the static part of the PVPP from a technical point of view. Apart from providing some technical advice when needed, the project partner University of Jaén carried out a quality control of

the modules of the static PVPP -1,2 MW- in order to check the real peak power of a module sample (Figure 19).
A 2,6-MW (inverter nominal power) Photovoltaic Panel Plantation (PVPP) was successfully put into commission in December 2009 in the surroundings of Arjona, a village within the province of Jaén). It is is located in a some 6-hectare land plot of non-productive agricultural land. This PVPP comprises a 1,3 MW sun tracking PV grid connected system (PVGCS) and a 1,2 static one. The PVPP as a whole is privately owned by an only investor.

Figure 18:
Arjona 2 ·6-MW PVPP's view. The static system -1 ·2 MW- is clearly different from the one that uses tracking techniques.

Figure 19:
Module sample of different nominal power that underwent a quality control carried out by PP5

- Location of the PVPP: **Arjona (Jaén)**
- Peak power: **1.2 MW**
- Area owned by: private owner
- Type of investment (private, public, leasing, mortgage…): **private (20%) and bank leverage (80%)**
- Volume of investment: **4.8 MEur**
- Key turned in the month of: **December 2009**
- Prevision of further RES investments around the area: **The high visual impact of the system, together with the dramatic PV cost decrease is surely creating a mimetic action in the surroundings of the area**

The Arjona PVPP has turned into an example of a successful action in the right direction. Owing to its large size and appealing aspect (nearly half static and half sun tracking), this PVPP has exerted an attraction on some other investors of the area who are pondering whether to invest or not on this technology.

6. 3 Thiva landfill, Viotia prefecture, Greece

The most success story of "PV's IN BLOOM" in Greece is the project in Thiva. The 2,0 MWp power station in Thiva has transformed abandoned land (waste dump area) into a highly profitable investment, paving the way in Greece to a whole branch of the investments: the abandoned landfill recovery PVPP.

Figure 20:

The project "MW free field park in Thiva" has been developed in close cooperation with the
RSEnergy – Hellas Solartechnik EPE and is perceived as a practice case for large photovoltaic plants in abandoned areas and potentially in the future for landfills.
The benefits for the small municipalities in the near environment are very high. The citizens get a live example for green energy production in their municipality area. Furthermore local companies have taken part of the works during construction and jobs have been generated for the local operation and security of the photovoltaic park. The photovoltaic "MW free field park in Thiva" has thereby a positive effect on the local job situation.
The private investor in return, thanks to the benefits of the incentive program, will have a positive economic return on investment over the term of 20 years to be made available for further activities in order to continue the rehabilitation of the area.
The combination of the financial incentives and terms, the high feed-in tariff, the system cost and the solar radiation available are such, that the investment in the 2 MWp system is attractive even without an initial investment subsidy. For the average estimated PV electricidty production of 1351 kWh/ kWp, and a yearly O&M cost taken as 100.000 EUR, in all cases the privately contributed capital is paid back in less than 8 years and the IRR calucalted at 20 years is equal more than 10,10 % for the worst case scenario.
Another important note is that in the past two years it has been observed, that operating PV systems in Greece produce about 10 to 15 % higher

output thatn the estimated values due to the fact that in the recent years the annually available solar radiation is higher than the values used from datbases.

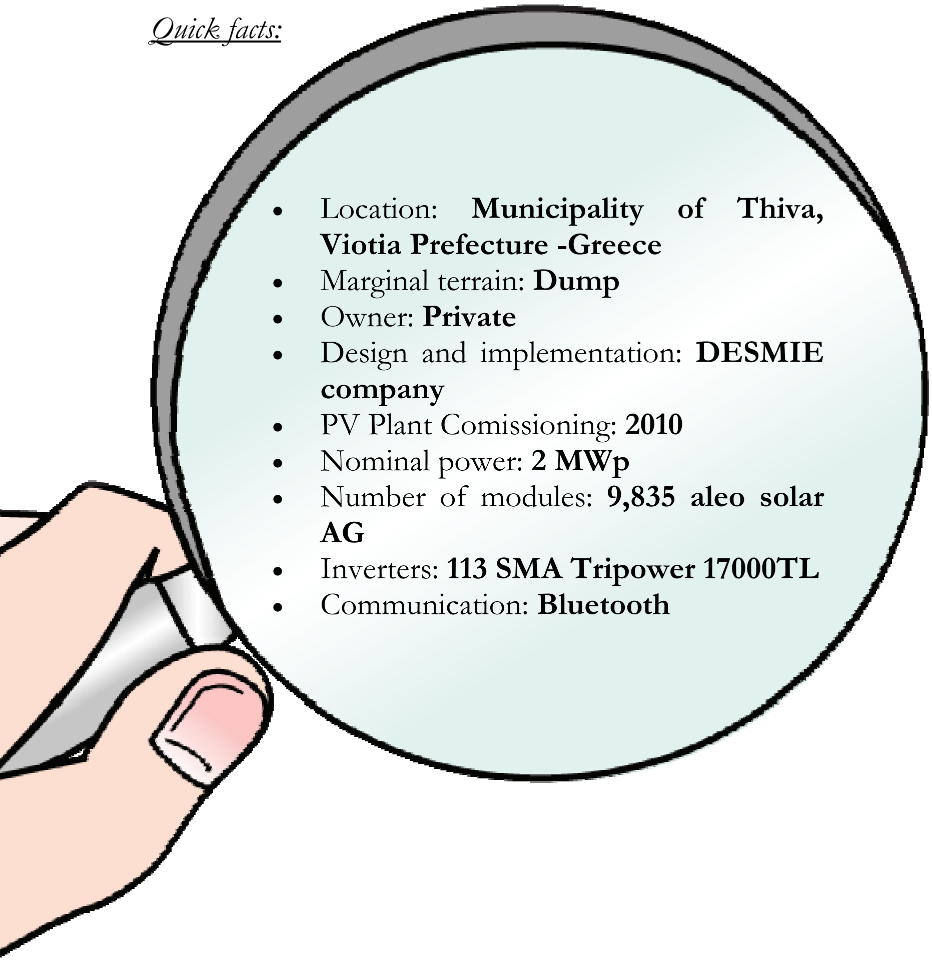
Description of the project

It all starts with the sun and Greece offers not only one of the highest irradiations in Europe but also one of the most attractive support schemes for photovoltaic installations. The 2,0 MWp power station in Thiva will transform abandoned land (waste dump area) into a highly profitable investment.

The photovoltaic park is located in the municipality of Thiva just one hour from the capital Athens. The park is based on quality components made in Germany: aleo solar AG modules, Schletter FS mounting system and SMA Solar Technology AG inverters. In the near future the park will be expanded by another 600 kWp to reach the total power of 2,6 MWp.

The following information was provided by AEM, the Development Company of the Municipality of Milies (the Greek partner of the project PVs in BLOOM).

Quick facts:



- Location: **Municipality of Thiva, Viotia Prefecture -Greece**
- Marginal terrain: **Dump**
- Owner: **Private**
- Design and implementation: **DESMIE company**
- PV Plant Comissioning: **2010**
- Nominal power: **2 MWp**
- Number of modules: **9,835 aleo solar AG**
- Inverters: **113 SMA Tripower 17000TL**
- Communication: **Bluetooth**

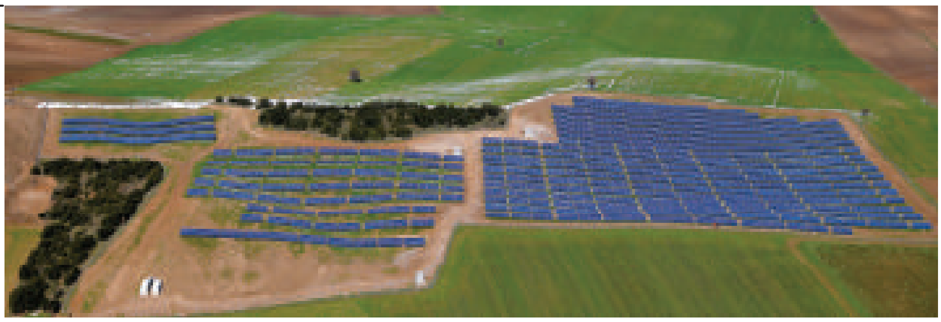
Marginal terrain reuse model

The project “MW free field park in Thiva” has been developed in close cooperation with the Municipal Development Company of Milies and is perceived as a practice case for large photovoltaic plants in abandoned areas and potentially in the future for landfills.

The benefits for the small municipalities in the near environment are very high. The citizens get a live example for green energy production in their municipality area. Furthermore local companies have taken part to the works during construction and jobs have been generated for the local operation and security of the photovoltaic park. The photovoltaic “MW free field park in Thiva” has thereby a positive effect on the local job situation.
The private investor in return, thanks to the benefits of the incentive program, will have a positive economic return on investment over the term of 20 years to be made available for further activities in order to continue the rehabilitation of the area.
It is a private land. Which was abandoned for many years and the neighbours used it as a waste dump area (this is very common in Greece). The municipality of the area uses its own waste dump area and not this one. The realization of the PVPP was during February 2011. The owner has signed contract with DESMIE based on support scheme for renewable energy sources and the FIT is guaranteed for 20 years. According the Greek legislation there is a possibility that the tariffs will be decreased (in a small percentage) after some years.

PVPP design and construction
The MW free field park in Thiva is designed in the most environmentally-friendly way. Ramming profiles are used for the free field photovoltaic mounting systems. The use of beton is limited to the minimum and the ramming profiles can be removed after the life time of the photovoltaic park returning the land into its original shape.

Figure 21:
rendering of the ground PV Plant



The MW free field park follows the shape of the land. Therefore large excavation works were avoided.
The status of the land was waste dump area for many years. The photovoltaic plant will turn the previously unused and abandoned area back into production. An additional positive effect is the reduction of fire threat during the summer time for abandoned land with high grass. The PV park is now cleaned and under constant check by the local personnel. Also a specific fire department license has been granted to the PV park verifying the safety of the installation.
RSEnergy Hellas Solartechnik Ltd is a qualified partner of many leading manufacturers. Working completely with quality components means the investor will benefit from the security for the investment. The Municipal Development Company of Milies team has a great interworking with RSEnergy planning and implementation experts.
The SMA Tripower inverters are equipped with latest technology such as two MPP trackers, high voltage input range and Bluetooth communication.

They offer highest flexibility in plant design and also over the 20 year lifetime of the PV investment.
The picture below shows the top view CAD plan of the photovoltaic system with the different rows of modules distributed in the field. Transformators, ISOBOXES and a service road are also shown in the CAD. The decentral inverters are installed behind the PV modules on the free field mounting system.

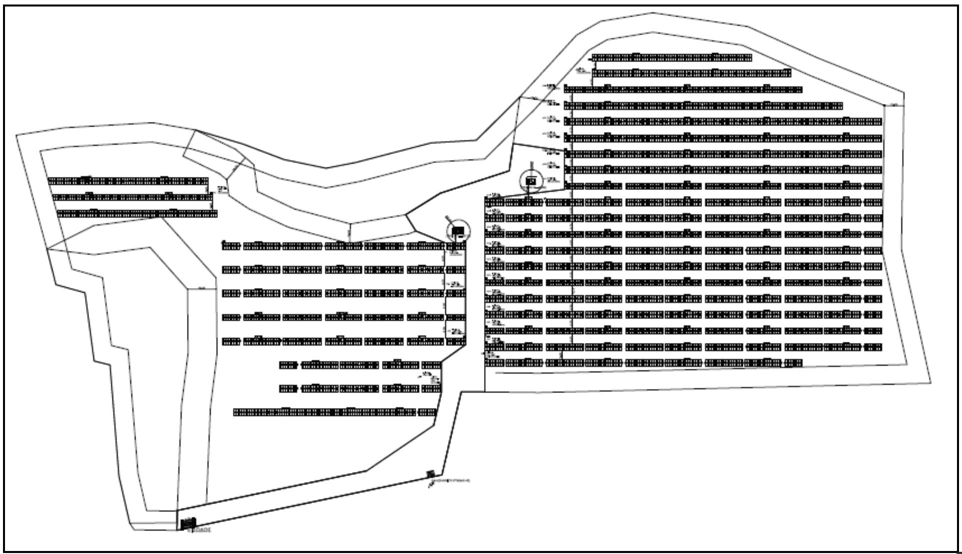


Figure 22:
Lay out of the PV Plant

<u>*FIT and additional benefits*</u>
The Greek government has taken bold initiatives for the development of photovoltaic energy, offering not only generous financial incentives but also simplifying the authorisation procedures as well. The table below provides an overview on the feed in tariff system in Greece for different sizes PV plants.

Feed-in-tariffs for PV in Greece					
Year of signing of contract	Rooftop systems <10 kWp (€/MWh)	Month	Mainland grid (€/MWh)		Autonomous island grids (€/MWh)
			> 100 kWp	≤100 kWp	
2009	550	February	400	450	450
		August			
2010		February			
		August	392.04	441.05	441.05
2011		February	372.83	419.43	419.43
		August	351.01	394.88	394.88
2012	522.5	February	333.81	375.53	375.53
		August	314.27	353.56	353.56
2013	496.38	February	298.38	336.23	336.23
		August	281.38	316.55	316.55
2014	471.56	February	268.94	302.56	302.56
		August	260.97	293.59	293.59
Tariff Payment	25 years		20 years		
Inflation adjustment	Adjusted partially (25% of last year's Consumer's Price Index) annually				
Other incentives	The residential PV system is no longer considered a business activity, and the income from the sale of electricity is tax free.				

Table 4:
Feed in Tariff

Business plan main topics and investment indicators

The business model is based on an official yield report performed by the Center of Renewable Energy Sources in Athens Greece (CRES). The report has been developed by this independent entity with input figures provided by RSEnergy Hellas Solartechnik. For monthly values of solar irradiation and temperatures the below figures have been considered.

Table 5:
Monthly values of solar irradiation and ambient temperature for the site.

	GLOBAL HORIZONTAL IRRADIATION MEAN VALUE (kWh/m²· day)	DIFFUSE HORIZONTAL IRRADIATION MEAN VALUE (kWh/m²· day)	GLOBAL HORIZONTAL IRRADIATION TOTAL VALUE (kWh/m²)	DIFFUSE HORIZONTAL IRRADIATION TOTAL VALUE (kWh/m²)	GLOBAL TILTED IRRADIATION TOTAL VALUE (kWh/m²)	AMBIENT TEMPERATURE MEAN VALUE (°C)
JAN	1.824	1.037	56.54	32.15	81.78	8.2
FEB	2.424	1.359	67.87	38.05	88.40	8.7
MAR	3.576	1.860	110.86	57.66	131.07	10.7
APR	5.128	2.209	153.84	66.27	165.69	14.5
MAY	6.124	2.541	189.84	78.77	186.74	19.3
JUN	6.878	2.539	206.34	76.17	193.44	23.7
JUL	6.726	2.470	208.51	76.57	199.27	26.2
AUG	6.026	2.251	186.81	69.78	193.81	25.8
SEP	4.878	1.803	146.34	54.09	172.50	22.4
OCT	3.174	1.493	98.39	46.28	129.15	17.3
NOV	1.974	1.115	59.22	33.45	83.19	13.3
DEC	1.526	0.933	47.31	28.92	68.01	10.0
YEAR	4.188	1.801	1531.87	658.17	1693.05	16.7

The table below shows the hourly values of solar irradiation at the photovoltaic site according to existing climate data.

Table 6:
Hourly values of solar irradiation at tilt of 30° and South orientation, of the mean daily profile per mouth, for the site of installation. (in kWh/m2)

Hour	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0.002	0.001	0	0	0	0	0
6	0	0	0	0.006	0.028	0.04	0.034	0.014	0	0	0	0
7	0	0.007	0.039	0.094	0.131	0.149	0.143	0.117	0.073	0.02	0	0
8	0.05	0.092	0.162	0.244	0.286	0.313	0.308	0.285	0.237	0.143	0.062	0.03
9	0.167	0.215	0.304	0.409	0.451	0.485	0.483	0.466	0.421	0.293	0.18	0.132
10	0.285	0.337	0.442	0.566	0.605	0.643	0.644	0.636	0.597	0.441	0.299	0.238
11	0.381	0.436	0.553	0.688	0.723	0.763	0.767	0.768	0.735	0.56	0.396	0.324
12	0.436	0.492	0.614	0.755	0.788	0.829	0.834	0.84	0.812	0.626	0.45	0.373
13	0.436	0.492	0.614	0.755	0.788	0.829	0.834	0.84	0.812	0.626	0.45	0.373
14	0.381	0.436	0.553	0.688	0.723	0.763	0.767	0.768	0.735	0.56	0.396	0.324
15	0.285	0.337	0.442	0.566	0.605	0.643	0.644	0.636	0.597	0.441	0.299	0.238
16	0.167	0.215	0.304	0.409	0.451	0.485	0.483	0.466	0.421	0.293	0.18	0.132
17	0.05	0.092	0.162	0.244	0.286	0.313	0.308	0.285	0.237	0.143	0.061	0.03
18	0	0.006	0.039	0.094	0.131	0.149	0.143	0.117	0.073	0.02	0	0
19	0	0	0	0.005	0.028	0.04	0.034	0.014	0	0	0	0
20	0	0	0	0	0	0.002	0.001	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0
0-24	2.638	3.158	4.228	5.522	6.024	6.448	6.429	6.249	5.75	4.164	2.771	2.194

The graph below shows the sun path at the selected PV site location over the year.

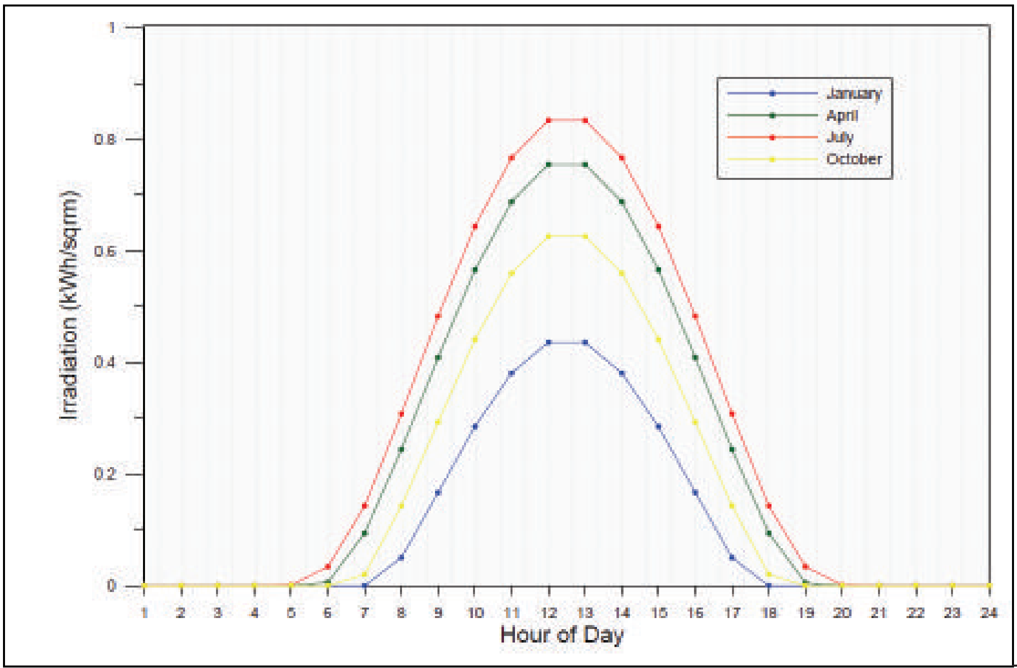


Figure 23: *Mean daily profiles for 4 months, for the size of installation*

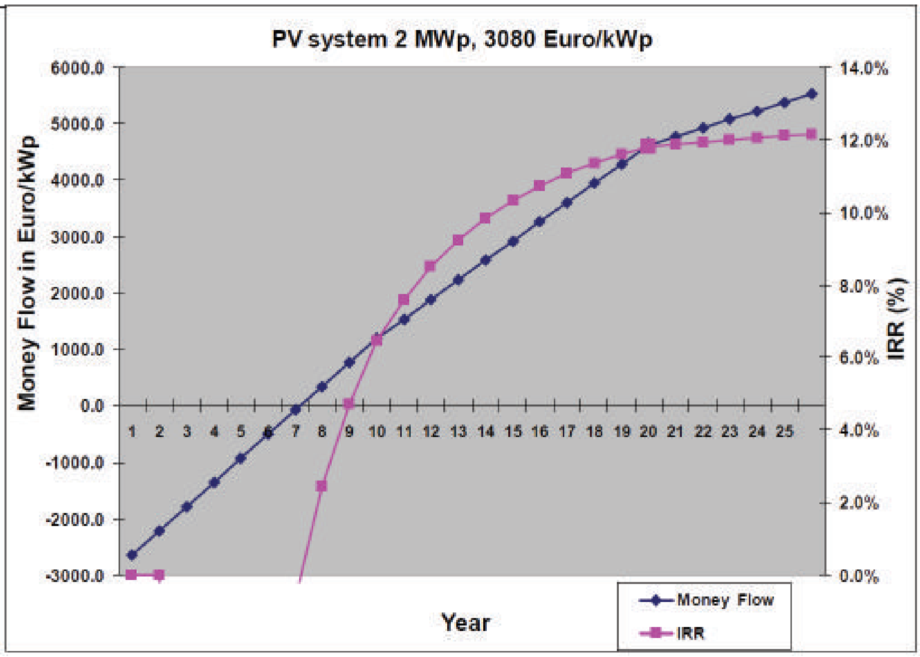
Taking all climate data and the technical configuration into consideration, the Center of Renewable Energy Sources calculates the below energy production over the year.

	Global tilted irradiation Total Value (in kWh/m^2)	Global tilted irradiation with Horizon Shading Total Value (in kWh/m^2)	Energy delivered by PV plant per kWp (in kWh/kWp)	Performance ratio	Total energy delivered by PV plant 1999.36 kWp (in kWh)
JAN	81.78	81.31	70.41	0.866	140778.61
FEB	88.40	88.26	76.27	0.864	152484.73
MAR	131.07	130.91	109.93	0.840	219788.81
APR	165.69	165.69	134.87	0.814	269649.33
MAY	186.74	186.74	146.82	0.786	293540.01
JUN	193.44	193.44	147.98	0.765	295860.65
JUL	199.27	199.26	150.19	0.754	300279.27
AUG	193.81	193.80	146.81	0.758	293519.13
SEP	172.50	172.41	134.39	0.779	268688.75
OCT	129.15	128.89	104.96	0.814	209850.59
NOV	83.19	82.75	70.28	0.849	140513.47
DEC	68.01	67.65	58.09	0.859	116151.70
YEAR	1693.05	1691.10	1350.98	0.799	2701105.04

Table 7: *Estimated annual electrical energy produced by the PV plant.*

Based on the by law defined feed in tariff the financial return of the system can be estimated as shown in the below graph.

Figure 24:
The development of the money flow and the IRR per kWp after tax deductions



Lessons learnt

The combination of the financial incentives and terms, the high feed-in tariff, the system cost and the solar radiation available are such, that the investment in the 2 MWp system is attractive even without an initial investment subsidy. For the average estimated PV electricity production of 1,351 kWh/kWp, and a yearly O&M cost taken as 100 kEuro, in all cases the privately contributed capital is paid back in less than 8 years and the IRR calculated at 20 years is equal more than 10.1 % for th worst case scenario. Another important note is that in the past two years it has been observed, that operating PV systems in Greece produce about 10 to 15 % higher output that the estimated values due to the fact that in the recent years the annually available solar radiation is higher than the values used from the databases.

6. 4 Conclusions

The examples of success stories of PVs in BLOOM reported here are cases in which through a trigger given by the availability of expertise, knowledge, the matching of competences and financial leverage it is possible to develop and carry out a successful development plan for a marginal area.
In the case in which a public body (i.e. a municipality) intends to build a new PV system - either directly or through the identification of a private investor chosen by a public tender - on its marginal area which is part of its property, the first evaluations will have to cover:
The identification of a suitable marginal area on which to install the system
The financial and economic aspects associated to the investment by preparing a business plan

With regards to the first point it will be useful to map the marginal areas available on the municipality's territory and classify them by using both general and economic criteria.

While assessing the general characteristics, among other things, it would be necessary to examine how easy is to get the new PV system connected to the grid as well as the attainability to the site. Further, a priority should be given to those areas presenting a low environmental impact and this evaluation should be carried out considering the type of investment to be made and the legislation applicable on the territory.
Likewise, the economic characteristics will have to be verified according to the applicable feed-in tariff system as stated by the national and regional legislation. Further, in some cases investments made on marginal areas may be rewarded more than other type of investments. For instance, although with some differences, in countries like Italy and Spain PV projects on marginal areas allow the investors to obtain an additional premium (in Italy this additional premium account for an additional 5% whilst in Spain it is limited to regional development policies).
Of course, the economic analysis will have to cover not only the marginal area characteristics but the entire project including the costs for the construction, maintenance, insurance and so forth. Such an analysis is useful not only in the case of direct investment made by a public body but also when the same public body prefers to assign the work to a qualified partner which will make the investment. An important theme under discussion is the internal stability and its constraints on the municipalities' budget which in some cases could make the investment not possible at least in financial terms.
Possible solutions could come from the exploration of all the financial instruments that public institutions may access to.
Another important aspect for the public body is the organization of the investment in a way that safeguards the public interest of its citizens and the community a s a whole.

Conclusions

The irrational use of land resources for industrial, commercial and in some cases agricultural activities has lead in many countries to the abandonment of vast terrains in degraded conditions. Land degradation is often the result of human activities leading to the impoverishment of the soil, the dispersion of pollutants, and the impossibility to use the terrain for other purposes. Landfills, quarries, former military sites/supply-storages, areas around major infrastructures such as airports, electrical substations, power plants are an examples.

Starting new activities using marginal terrains avoiding the sacrifice of terrains subtracted to agriculture or to the landscape is not only ethical, but also economically convenient with respect to leaving them abandoned.

The transformation of greenfields into brownfields, more noticeable in areas of high urbanization/industrialization continues inexorably and must be contained: little attention now will lead to big problems in the future.

The implementation of PVs in BLOOM has contributed to achieve some important results in order to promote the rational use of marginal areas. For example, the achieved result in figures could be summarize in: indirect involvement of 2.163 European Municipalities sensitized to the PVs in BLOOM philosophy, direct engagement of 67 Municipalities across Europe from the partners countries in RES, collection of 50 European best practices and models for recovering low/zero value terrains through ground PV plants and triggering of more than 19 MWp of PVPPs on marginal terrains in Europe thanks to the support of project partners.

The future development of the PV industry is linked to the degree to which in each country the development of a sustainable RES market.

This cannot be done through a unique solution, but by balanced combination of policy /financial instruments also considering country risk. Profitability (IRR) must be assessed by public actors on a regular basis and support levels must be adapted accordingly (in any case PV investments should represent a reasonable incentive compared with IRR of investments with similar risk level).

Important to the future development of the PV market are not only FITs but mostly the sensitivity and considerable attention from government to support installation of photovoltaic plants. According to latest data of EPIA the photovoltaic market of Europe represents 81% of the global share with 40GW, considering that the sun radiation of the earth in one year turned in electric energy, using currently available technology, overcomes the potential of all the other energy sources available. Between 2009 and 2010 the solar market grew by 132%.

The global top 10 in 2009 and 2010 (MW installed)

	2009		2010	
1	Germany	3.806	Germany	7.400
2	Italy	723	Italy	2.300
3	Japan	483	Czech Rep	1.490
4	USA	477	Japan	990
5	Czech Rep	398	USA	900
6	Belgium	285	France	719
7	China	160-228	Belgium	424
8	France	185	Spain	369
9	South Korea	167	Australia	320
10	Australia	79	China	300-520

Figure 24:
Source: EPIA, 2011

Building on the experience of mature European markets, what is at stake is to successfully develop PV market in the long term in the respect of the value for which RES sources were generated: the protection of the environment and human health.
The future growth of the sector depends on the adoption of two different scenarios. One is a moderate scenario ("Business-as-usual" market) with no major reinforcement of existing support mechanisms, and reasonable continuation of current FiTs aligned with PV systems prices. The other one foresees continuation of FiTs aligned with PV systems prices. However a policy driven scenario relies on a strong political will and minimizing administrative barriers. Obviously policy driven scenario offers almost double as fast growth as the moderate scenario. A 36-51% decrease of cost to generate solar power could be achieved on average by 2020.
The idea of looking at marginal areas as priority areas for the implementation of photovoltaic ground installations and of supporting municipalities and/or their controlled companies in primarily using these areas of land for renewable energy production, is the driving factor that led Unioncamere del Veneto and the other project partners to draft the PVs in Bloom Project and local stakeholders to rapidly find great interest in it.
If local municipalities would give the priority to the re-use of marginal lands when investing, the restoration of such areas through renewable energy plants, and in particular photovoltaic systems, could become a strong leverage for enabling virtuous sustainable behaviours with tangible returns for local economies (e.g. maintaining employment and creating new jobs) and indirectly for the States themselves.
The lessons learnt and strategic approach applied and tested through PVs in BLOOM could be expanded to countries representing a lot of possibilities and not yet experienced like Greece, Albania, Macedonia, Serbia or Turkey, bridging the gap between sustainable and feasible development.