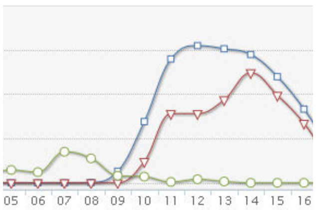
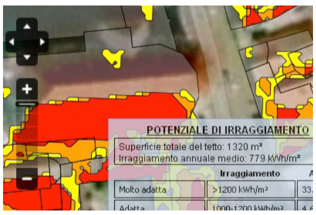
ENERBUILD

Result 7.1-4

Synthesis on producing energy on buildings in the Alpine Space

March 2012





ESAP
Energy Saving and Producing Buildings

Alpine SPACE
EUROPEAN TERRITORIAL COOPERATION
THIS PROJECT IS CO-FUNDED BY THE EUROPEAN REGIONAL DEVELOPMENT FUND
investing in your future

Synthesis on producing energy on buildings in the Alpine Space

Introduction

This work package in the ENERBUILD project was focused on the production of energy in buildings. The aim of the tasks was to understand better what an Energy Saving and Producing Building can look like and to work on some technical and financial tools to develop energy production systems on buildings. The work mainly focused on solar photovoltaic energy except from the Piemont Italian partner, who also worked on biomass energy.

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The NENA network is an association of organizations involved in the project. The network provides experts in connection with the demand for talks, lectures and individual consultations. For more information: http://www.nena-network.eu

Note on further results of ENERBUILD

Education

- Overview of education programs and vocational trainings for energy saving and producing buildings in the Alpine Space

Examination

- Summarizing survey on existing buildings on healthy living with new and advanced construction technology
- Killer arguments and opportunities for energy-efficient construction and the passive house
- User habits, impact on energy consumption in passive houses - results of a comprehensive long-term measurement

Efficiency

- Certification of energy-efficient public buildings Summary of instruments in the Alpine Space
- Transnational comparison of instruments according to ecological evaluation of public buildings
- ENERBUILD Tool: Transnational Pilot Testing on 46 Buildings and Experiences on Advisory Services

E-Producing

- Synthesis on producing energy on buildings in the Alpine Space
- Green Electricity? - Yes, please! 100% local Green Electricity in combination with private funding for the development of power plants on buildings using the example of Vorarlberg
- Eco Power Stock Exchange – In-depth information for monitoring offices

Innovation

- The Alpine World of Innovation - A collection of innovative examples in planning processes, pilot initiatives and stimulation of innovation

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ESAP building definition

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Description

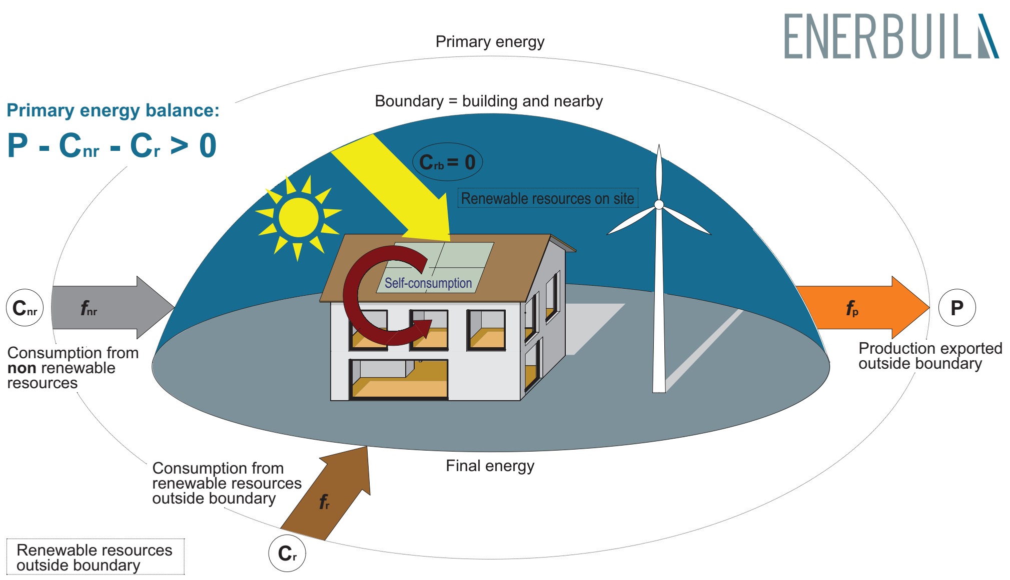
ENERBUILD partners worked out a common definition of Energy Saving and Producing buildings in order to help people understand better what a positive energy balance for a building is and how it can be assessed. The resulting common definition is suitable for different European countries and can help to compare different projects.

An ESAP building is described as:

- A PassivHaus building, respecting the PassivHaus standard according to PHPP calculation (Specific space heat demand < 15 kWhpe/m^2tfa/yr, Specific primary energy demand (including HVAC, DHW, lighting, auxiliary and appliances) < 120 kWhpe/m^2tfa/yr and air tightness n50 < 0,6 h-1)
- which produces at least as much primary energy as it consumes during one year for heating, cooling, lighting, hot water, ventilation and all electric appliances, thanks to production plants located on top of the building which export heat or electric energy through a grid and thanks to production plants located on top of the build-ing or nearby which serve for the building's energy needs,
- and respects the following requirements:
  - Transportation of the users has been taken into account for the building localization and does not generate too much extra energy consumption (see criteria A1 (Access to public transport network) of the ENERBUILD tool)
  - The impact of users' behavior is controlled best possible and some training is made to explain how to use the building in an efficient way.
  - The embodied energy has been calculated and some efforts have been made to minimize it by an adequate choice of materials (see criteria E1 (Ecological Index) of the ENERBUILD tool).

Illustration and results

As an illustration to the previous definition, the energy fluxes on a building can be represented by the scheme below. The building has a positive energy balance if P – Cnr – Cr –Crb > 0 where



- P represents all the energy which is produced on the building or nearby and which is exported outside this boundary (that's to say on electricity or heat grid). A conversion factor fp is used to convert this production into primary energy (according to the energy mix of the grid).
- Cnr (Consumption of nonrenewable primary energy resources) accounts for all the thermal and electrical energy which is consumed from the (electrical or thermal) grids and comes from nonrenewable resources. fnr represents the primary energy conversion factor of the grid's energy mix.
- Cr (Consumption of renewable primary energy resources outside boundary) accounts for the consumption of primary energy resources which are neither available on the building nor nearby. fr represents the primary energy conversion factor of this resource since some energy has been spent to bring the resource on the building's site.
- Crb (consumption of renewable primary energy resources inside boundary) represents the consumption of renewable primary energy resources on the building or nearby. The conversion factor is 0 (no energy needed to bring the resource on the site) and Crb = 0.

All the energy consumptions of the building are considered. The extra-energy produced and exported to a grid is counted in the building energy balance only if the production plant is located on or inside the building. For instance, a ground solar plant that sells electricity to a grid is not considered in the energy balance, even if it's located in the building's garden. On the contrary, self-consumption is taken into consideration if the production plants are located on the building or nearby.

Application to other regions, Capitalization

The definition is shared by partners of different regions from Italy, Austria and France.

Contacts, publications, dissemination, references

The definition has been translated into English, French, Italian and German.
They can be downloaded from www.enerbuild.eu.

Energy potential analysis

Editor: EURAC & FBK

Description of methodology for PV

Solar technology is one of the natural choices for on-site generation as the energy coming from the sun is captured by solar panels and transformed into heating or, by means of photovoltaic (PV) systems, into electricity. The identification of suitable surfaces in urban areas plays an important role for the private investor as well as the public local community. One of the most influencing factors is a correct estimation of the incoming solar radiation. It is crucial to consider shadowing effects due to topography (presence of hills/mountains) or shadows cast by nearby buildings, vegetation or other objects found in urban areas. Due to the complexity of this task, quality of solar radiation predictive models, as well as quality and quantity of their input data are pivotal to optimally exploit the advantages of solar panel systems.

The used methodology tries to combine and unify in general PVGIS[1,2], and LiDAR[3] approaches and to establish a so-called „solar cadastre" for the PV potential of the roofs in a given urban area. Four steps are identified.

Modelling of the buildings' roofs - to compute and quantify the incoming solar radiation, a 3D model of the town is required which represents the geometric properties of each building and its position inside the city and – if possible – in the surrounding environment.

Computation of the solar potential is based on the Astronomic Calculations, which consider the incoming radiation according to the sun position with respect to latitude, longitude and altitude.

Radiation distribution for the buildings is based on the calculations of clear sky irradiance through Geographic Information System (GIS) instruments by considering topographical and geometrical effects. A radiation transfer model (RTM) to compute the spectral components is used. The RTM receives inputs from both ground based instruments and from satellite data.

The calculation of the roof PV potential is the last step. The most common approach is to calculate the annual solar potential for the total roof area, and then PV potential is obtained as a pro-duct of this value and the efficiency of the corresponding PV module technology.

[1] www.hamburgenergiesolar.de (Last visit: 29 June 2011)

[2] Ludwig, D., McKinley L., 2010: Solar Atlas of Berlin - Airborne Lidar in Renewable Energy Applications. In: GIM International, Vol. 243/2010, pp.17-22.

[3] Jochem, A., Höfle, B., Hollaus, M., Rutzinger, M., 2009: Object detection in airborne LIDAR data for im-proved solar radiation modeling in urban areas. In: International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences. Paris, Vol. 38 (part 3/W8), pp. 1-6.

Illustration with results

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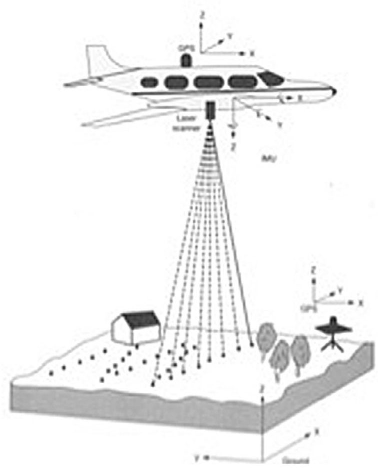
Modelling of the buildings' roofs.

Starting from LiDAR data and using GPS (Global Positioning System) and INS (Inertial Navigation System) instrumentation for georeferencing purposes, a DTM (Digital Terrain Model) is obtained, up to one meter resolution. By means of further filtering operations, only the building roof's geometry can be obtained. The case of Bressanone, Italy, is shown in figure 1a,b.



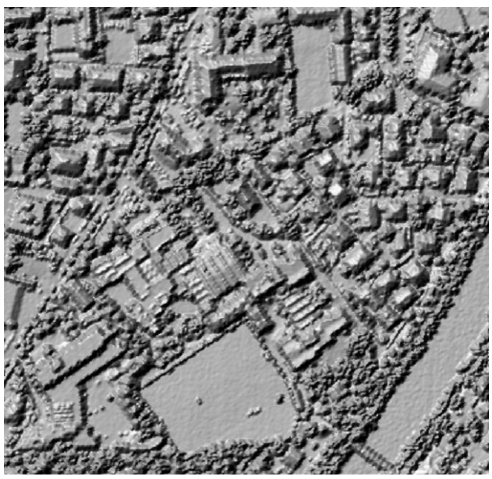


Fig.1a: LiDAR system and the resulting mapping of the terrain topology

Fig.1b: Filtering the DSM to obtain information only for the roofs

In addition, combination and integration of the data from the LiDAR-based DTM with cadastral data as well as models obtained from automatic and manual image matching could be made. This has been tested in Mattarello (Trento), Italy. In this case, a sufficiently large DTM at 1 m resolution is used to model the surrounding cast-shadowing mountains, while for the roofs de-tailed models from photogrammetry are created and integrated, with a resolution up to 25 cm. Figure 2 shows an example of the different models obtained from different modelling strategies for a group of buildings in Mattarello.

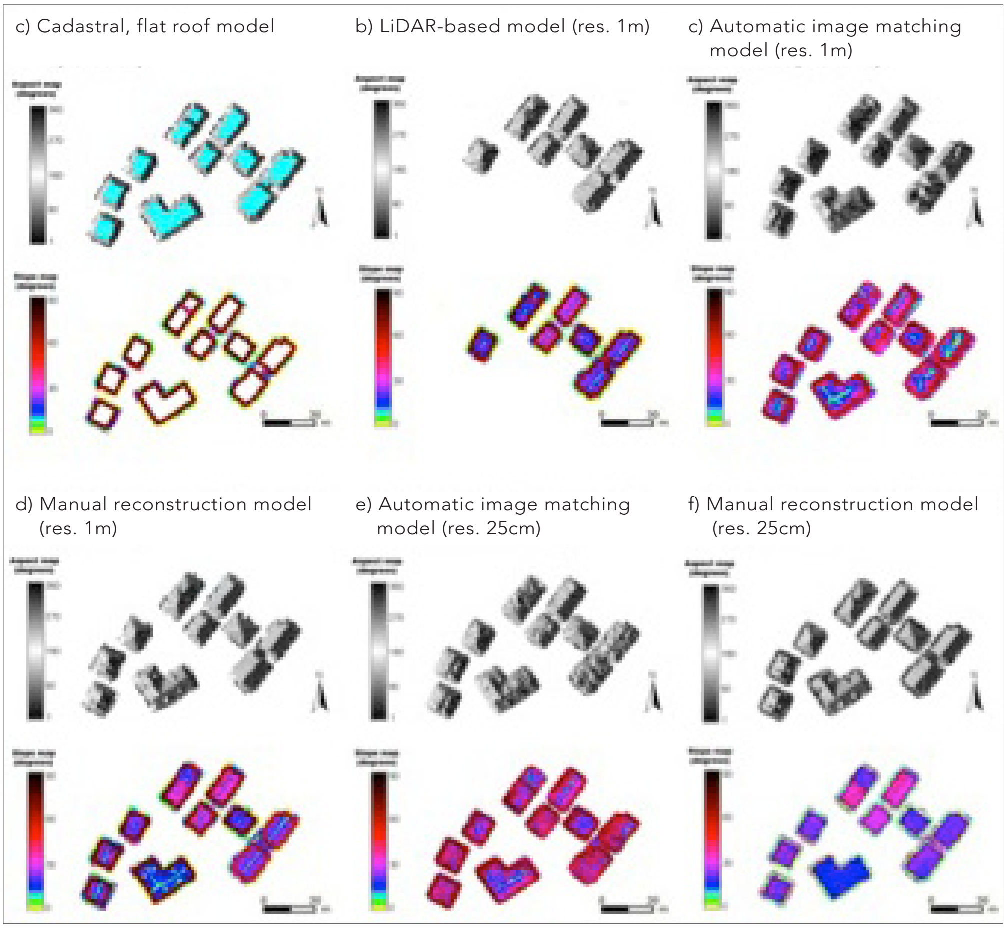


Fig. 2: Raster maps obtained from different data for building roofs. Aspect and slope maps of a group of buildings, obtained from: a) cadastral maps (flat roofs), b) LiDAR-based DSM, c) automatic matching of aerial images, d) manual reconstruction from aerial images, e) automatic matching of aerial images (rasterised at grid resolution 25 cm), f) manual reconstruction from aerial images (rasterised at grid resolution 25 cm). Aspect maps are classified starting from east, counter clockwise (north=90°, west=180°, south=270°), areas in cyan are horizontal. Some roofs are missing in b) since they have not been built yet at the time of the LiDAR flight. Terrain data (except a thin buffer zone) has been masked out in order to facilitate visualisation.

Energy potential analysis

Editor: EURAC & FBK

Computation of the solar potential

In the case of mountain area an important parameter is also the far shading produced by the surrounding mountains (horizon line). The other parameter taken into consideration is the near shading produced by close objects typical for an urban area (trees, buildings, etc.). In order to account the effect of cloudiness a monthly correction to the cumulative radiation obtained through on-site measurements (pyranometers, average on long term period, decades) is done.

Average value for example for all roofs in Bressanone (various inclinations) is ~1.100kWh/m².

Radiation distribution for the buildings

The obtained result can be subdivided into main annual radiation levels. An example for Bressanone is presented in the table 1 below. According to these levels, the description of the roof can be classified as very suitable (red), suitable (orange), medium suitable (yellow) and non-suitable without colour.

Level	Annual Radiation	Color	Description
1	> 1.200 kWh/m²		Very Suitable
2	1.000 - 1.200 kWh/m²		Suitable
3	800 - 1.000 kWh/m²		Medium Suitable
4	< 800 kWh/m²	no color	Non Suitable

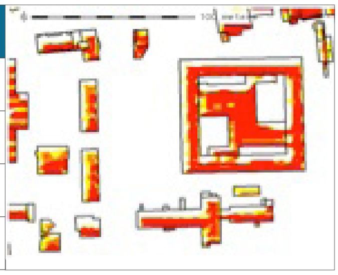
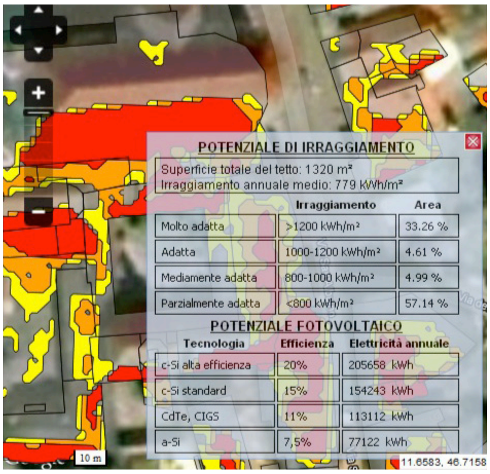


Table 1: Building classification with respect to solar potential



Calculation of the roof PV potential

The calculation is made for four different PV module technologies. One is for the c-Si high efficient technology; the others are for the standard crystalline Si and the following thin films CdTe, CIGS and a-Si PV modules. Results presented on the figure 3 show the calculated PV roof potential for the city Bressanone, Italy.

Application to other regions, Capitalization

The above described methodology is a general approach. It is applicable for different locations and regions. The main important databases here are the cadastre map for a given municipality, LiDAR, radiation and PV data.

Contacts, publications, dissemination, references

In order to disseminate the results a workshop „Solar Plants on Buildings: Energy Potential Assessment and Monitoring" has been organized in Bolzano, Italy the 17th October 2011

Acknowledgment – The result presented for the solar cadastre map for the city Bressanone has been founded by the European Regional Development Found (ERDF) under the project PV-Initiative N 2-1a-97.

Assessment of biomass energy potential - complementary approach **Editor: Regione Piemonte**

Description and synthesis of the work

Aim of the work was to investigate on biomass utilization and potential in Social Housing. This task was led together with the social housing agency of the province of Turin ATC (Agenzia Territoriale casa) which gave a list of 5.230 addresses corresponding to 31.388 apartments, among which:

- 18.705 apartments are owned directly by ATC and the rest is owned by other subjects, as municipalities or public bodies.
- 18.803 apartments are situated in the municipality of Torino, where major investigation about the feasibility of a biomass plant must be done, particularly related to flue gas emissions.
- 2.358 buildings, that are 12.585 apartments, are situated in an extra urban area, where constraints for biomass utilization are less strong.

These buildings were built between 1900 and 2011.

Data about installed plants are available for only 751 addresses and energy consumptions are available for only 270 of them. At present, it is not clear if the motivation for the difference in the number of apartments and records managed by ATC and the ones of which the energy consumption is available. The total annual expense for energy is reported at 12.600.000 Euro.

150 addresses (the related number of apartments is not clear), equivalent to 1.000.000 heated mc are located outside the municipality of Torino, and the related annual energy expense is 5.900.000 Euro/y. The price for heated volume varies from 4 to 11 Euro/mc y (and a strange 21 Euro/mc y in Pinerolo); the average price is 6,1 Euro/mc year. With an estimated cost of 0,85 Euro/Nmc of natural gas, the total gas consumption is around 6.000.000 mc, and this corresponds to 53.530 MWh. The estimated consumption for heated surface (hypothesis of an internal height of apartments of 3m) varies from 350 to 110 kWh/mq year (with a strange 40 kWh/mq year in Volvera); the simple average is 190 kWh/mq year.

In the theoretical case of complete utilization of biomass for these apartments, using biomass from forestry management, with 50% of humidity and a heating value of 2.200 kWh/t, the total annual use is 28.000 t. If the cost of biomass is 65Euro/t, the total expense for annual heating of the entire volume will be 1.800.000 Euro, that means 3.900.000 Euro of savings that can be used for dealing with the investment cost of the biomass systems.

This analysis shows a huge potential for biomass application in the Province of Torino than will be further investigated.


wood chip furnace – mobile grate


wood boiler and heat storage


wood chip production @IPLA


wood chip storage

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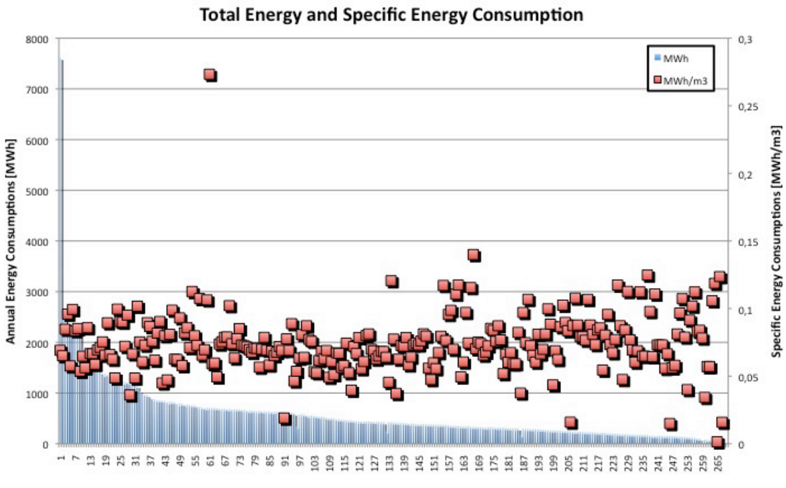
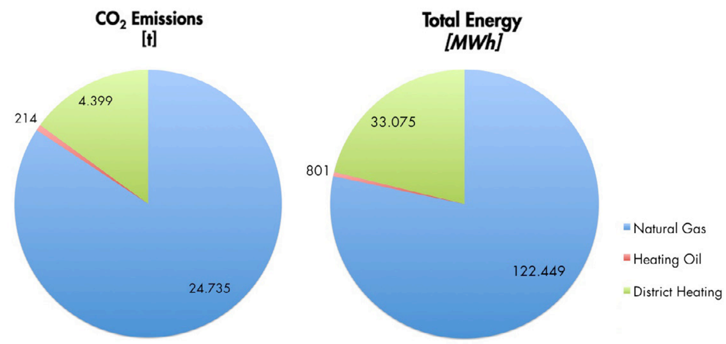
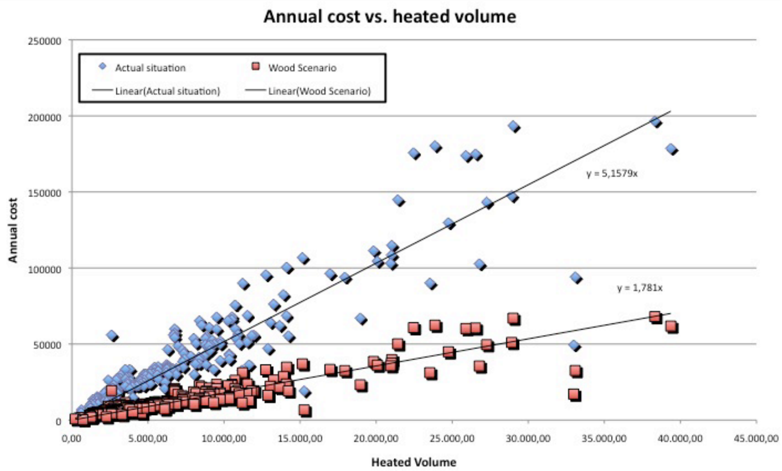
Illustration, results

All buildings with available data were analyzed, depending on their actual energy system (Natural Gas, Heating Oil, District Heating).





Graph 1+2: Global result of the total actual energy consumption and the potential reduction of CO_2 emissions.



Graph 3: Comparison of the actual situation and the planned scenario with respect to annual cost and heated volume.

The total energy consumption and the specific energy requirement are analyzed in the plot. The specific values seem to be in a specific range, with some differences probably due to geographic distribution of the apartments, building qualities and difference of operation times.

The main goal was to assess the total actual energy consumption and the potential reduction of CO_2 emissions. The global results are shown in the two graphs on the left side.

The cost savings are strictly related to the energy consumption, while CO_2 emissions are slightly different because of the lower emission factor associated with district heating.

The substitution of heating oil and natural gas fueled systems appears more convenient than district heating because of a larger decrease of emissions and other aspects linked to infrastructure, components substitutions and system maintenance.

Hence only oil and natural gas fueled system were analyzed to assess the potential energy and emission savings associated with the conversion to biomass systems. Using a cost of 60 Euro/ton for biomass from forestry management and a heating value of 2,2 kWh/kg, the annual consumption of biomass is about 52.000 t/y for the selected systems. The corresponding CO2 emissions reduction is about 25.000 t/y.

The action will be focused firstly on buildings with high specific and total consumption, resulting in major energy savings.

The third graph on the left shows the comparison of the actual situation and the planned scenario with respect to annual cost and heated volume. A linear interpolation on available data provide a price decrease from 5,2 Euro/m³ to 1,8 Euro/m³ switching to biomass fueled systems (not considering investment and maintenance costs).

Monitoring PV plants

Producing energy on ESAP buildings implies, most of the time, to develop PV plants on the roof. Such systems are almost standard now. An important point in this context is the investment security and reliability. The aim is to protect energy producers from negative surprises, such as disturbances to production failures. Experiences show that failures have to be expected. Actually, according to surveys and discussions collected in the preparation of the project in Vorarlberg, production losses occur in the order of 10-20%. The failures occur because of damage caused by marten bites, by shadows, by failures of individual modules and by disturbances in the rectifier. Since the plant owners usually have no possibility of comparison, the creeping partial failures are hardly recognized. The total failures are detected sooner, because the plant owners, not every day, but with opportunity (monthly or semi-annually) check the system display. Partial failures or partial blackouts are only recognized with the year-end accounting. Usually, the damage is already very large then. Also, annual comparisons are sometimes difficult, especially as the weather conditions are different over the years, so with a creeping deterioration it is difficult for the operator to draw conclusions about technical flaws. What he is missing here is the direct comparison system. Without a direct comparison system such errors cannot be truly determined.

Vorarlberg

Description

Context of the work on monitoring

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The development of a pilot monitoring tool in Vorarlberg was motivated by several reasons:

- Existing monitoring devices of PV are mainly proposed by manufacturers, meaning it's hardly possible to compare plants established by different companies. Only 2% of the plant operators monitor their plant by the manufacturer.
- Web integration of data from monitoring systems is complex and technically not easy to handle for small private producers. Different technologies and standards make a re-liable data transmission difficult.
- Due to the lack of independent and comparative measurement, it is hardly possible to pursue manufacturers in terms of performance. Whereas big failures can be easily identified, gradual deterioration or poor modules are hardly detectable.
- In the total of all plants production losses, 10-20%. exist because of damage caused by marten bites, by shadows, by failures of individual modules and by disturbances in the rectifier.
- There is the need to increase producers' reliability in electricity production. In Vorarlberg it is therefore desirable that the monitoring system will be part of the founding scheme.
- The implementation of a monitoring concept supports the creation of a „producer community". The producers should be able to mutually compare their plants. By comparison, the systems should raise playful competition between plant operators and raise awareness for the maintenance of plants. More generally, communicating on the system performances and preventing more accurately their failures contributes to encourage people to invest more in RES plants.
- Another aim would be to get more members to the ARGE Erneuerbare Energie Vorarlberg through the development of new services
- The monitoring of PV plants is also an added value for the Eco-Power Stock Exchange Example Vorarlberg http://www.oekostrombo-erse.at

Objectives within ENERBUILD project

In Vorarlberg, 1.100 photovoltaic systems are mounted, 30 systems were installed more than 10 years ago. They benefit from a feed-in tariff that is either signed with the Austrian public company OeMAG or directly with regional electricity distributors. The average size of plants is 4,9 kW. These are often small or micro-plants, built of small businesses and homeowners.

There is a huge potential to improve the running of PV systems. It can be assumed that the improvement in the context of Vorarlberg could represent no less than 560.000 Euros. In the frame of ENERBUILD, not all of the potential can be achieved but in the long term, at least 50% of the potential should be reached by avoiding failures. The objective is to increase productivity by at least 280.000 Euro per year. The investment in improvement measures should not be more than 15% of the total improvement potential. 10% of existing plants in Vorarlberg should be connected with the monitoring system during the project period. Subsequently, during the period of 5 years, 30% of all plants should be reached. In addition, 90% of all new upcoming plants should be connected to the monitoring system.

Monitoring PV plants

Illustration with results

Independent technology from suppliers of PV

To realize a technical concept independent from the manufacturer it was made possible to compare different plants with each other during operation in a standardized way. For the monitoring a data logger (counters, pulse converter) including a data transmission device was installed at each plant.

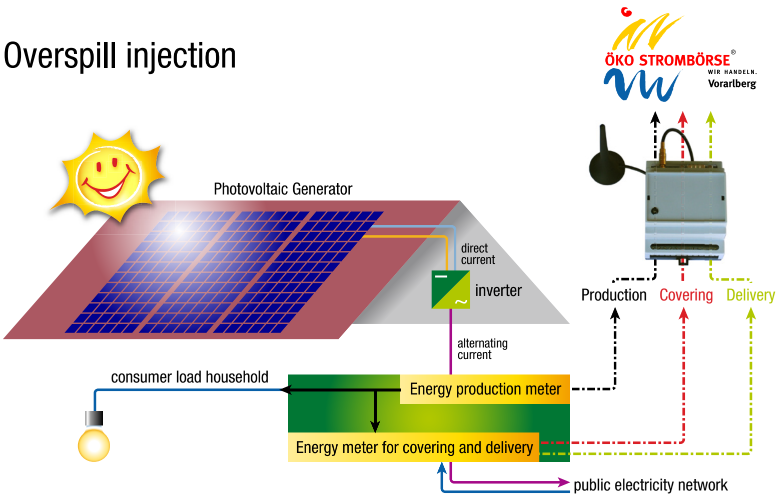

Figure 2 Scheme for overspill injection

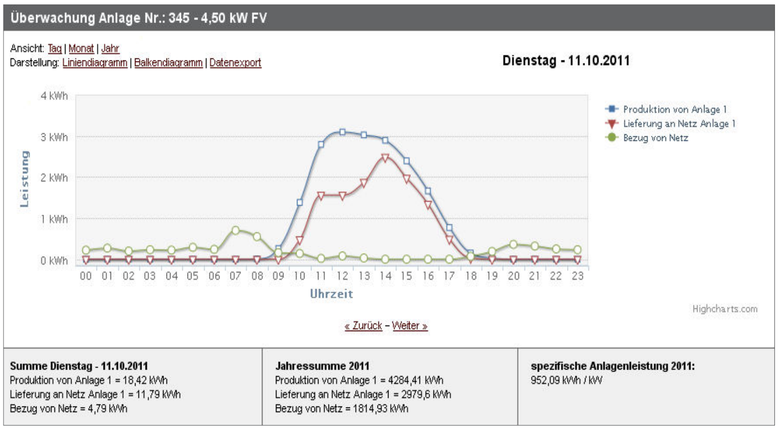

Figure 3: Monitoring Graph of a overspill injection plant

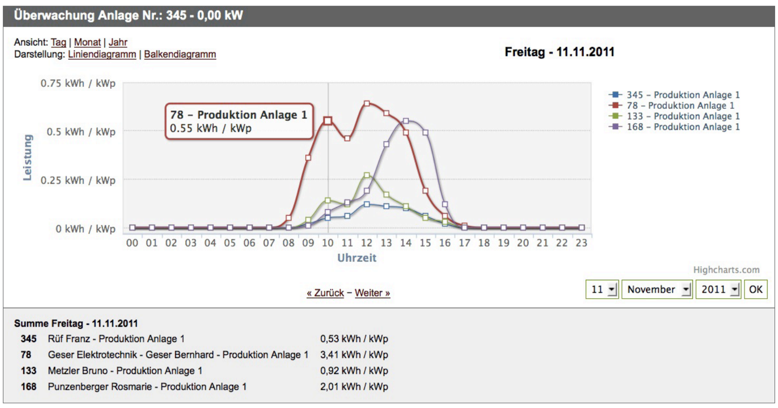

Figure 4: Comparison of Plants

Uniform data collection and transmission technology

Consistent data collection and transmission is a particular concern of the concept, from past experience especially this caused most disorders. The standard is implemented starting from the power meter. Up to four different counters can be recorded and transmitted, e.g. Electricity supply and delivery of electricity, domestic power consumption and others. The transmission technology is based on cooperation with a national mobile phone operator using a standard data GSM SIM card. The transmission takes place every hour with 1kB data volume (100 to 2.000 pulses per kWh). The web based monitoring (cloud-computing) makes the installation of additional software at producer or consumer side needless.

Photovoltaic benchmarks as monitoring principle

The benchmark is a reliable comparison of performance under the same conditions (calculated and harmonized on kWh per 1kWp). This enables to compare up to four PV systems from various constructions and dimensions. Discrepancies over time can be reliably identified as technical performance deviations. Weather conditions do not matter, since the systems were compared under identical conditions. For example, the nearest plant concluding weather-related deviations and plants with similar orientation give information about the relative performance of the plant itself. Sudden deviations to the compared plant clearly indicate damage.

Coupled with the Eco-Power Stock Exchange

The realized concept is deliberately coupled with the Eco-Power Stock exchange. The green power market is an existing internet-based system that lists the eco-power plants for the direct promotion offer of green power. Due to the fact that the data is already collected in the system, the monitoring concept refers to it.

Application to other regions - Capitalization

The monitoring as a technical system is vendor independent and can be operated without installing any software. In combination with the funding scheme of the Eco-Power Stock-Exchange, the 100% web-based solution allows an active development of a „consumer and producer community.„ A transfer of results to other regions and countries is possible without problems.

Service Offer
Cost to participate in the monitoring system

Investment (net)	Euro
Acquisition data logger:	390,-
Installation in new plants	40,-
For existing plants around	250,-
Data transmission, SIM card	20,-
Operating contributions / membership fees - listing in the system	15,-

Benefit for the plant operator Additional funding from the green electricity market per year	Euro
Community support accounts (1/4 of all communities are already green sponsor)	20.-
From direct-steering (2 households)	64.-
Avoidance of system failures: (10% estimated)	190.-

Average plant output 4.9 kW/h
Annual power: 4,9 kW/h * 1.300 (max service hours/year) = max solar radiation 6.370 kW/year. Estim.: 4.900 * 30 cents = 1.911,- * 10% = 190,-
It may be argued that the payback period for the investment in the monitoring will be less than 1.5-2 years.

Alessandria

Description

In Provincia of Alessandria's land in these last years many PV plants were built. The monitoring done by Provincia of Alessandria was conducted on 6 plants, and each of them differed from the others by size, by type of installation and by kind of users. The plants were monitored under direct inspection at the installation site.

The second step was to acquire data for monthly production of electricity. The data for the production of electrical energy on a monthly basis are presented in reports that indicate the production of electricity during the year. These data are comparable for the different types, both for performance throughout the year, and for specific production (kWh/kWp).

n.	Plant	Place	Capacity kWp	Type	Production kWh/kWp
01	RAL Srl	Alessandria	7.300	On ground	1.210,19
02	Portalupi Spa	Ticineto	61,54	On roof	1.014,27
03	SRT	Bosco Marengo	99		
04	SFIAL Srl	Alessandria	59,4	On roof	1.189,55
05	Liceo Scientifico "B.Pascal"	Ovada	14,52	On plan roof	
06	UNI Capi Scrl	Alessandria	20	On roof	1.177,96
				On face of building	735,13

Illustration with results

As sample we present the largest PV plant visited - RAL s.r.l. located in Alessandria – and the plant conducted directly by Provincia of Alessandria – Scientific Lyceum located in Ovada.

During the monitoring we tried to detect possible information regarding component costs of PV systems and their installation, for improving the system method to other realities on territory.

The costs are usually expressed in terms of Euro / Wp, referring to a „type-plant" (electrical and electronic components, mechanical support), net of preparatory construction work and working conditions required by any specific details; this to facilitate comparability among different types of plants (mono-multicrystalline; inverter with or without transformer, fixed or with solar-tracker).

From information obtained a reduction in costs due to the strong increase in installations has been found since the years of the incentive scheme called „CONTO ENERGIA, restored in Italy in this last years and also developed for next years.

Monitoring PV plants

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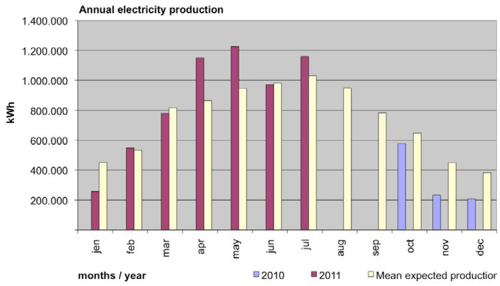
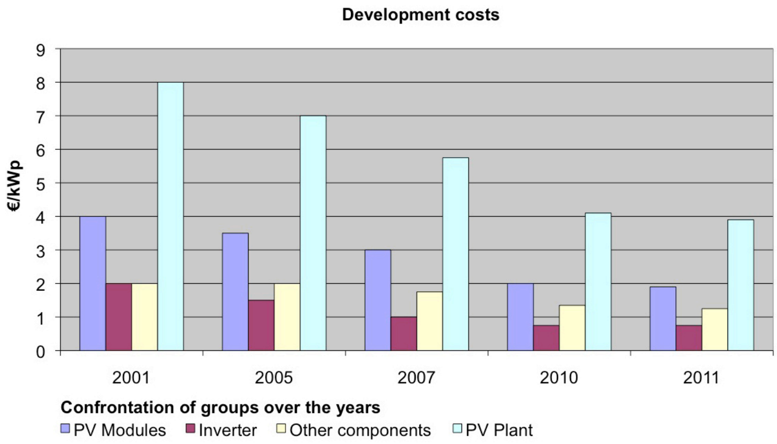
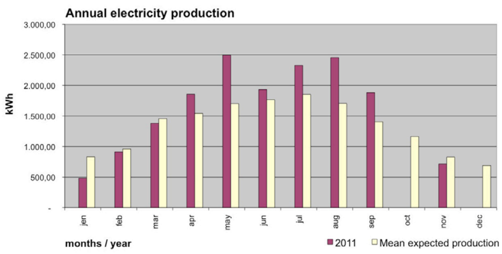
For other applications we must remind that he cost of installing the PV system depends mainly on the electrical and electronic components, mechanical structures of support and preparatory constructions are specific, variables and related to the real operating conditions:

- roof installation does not require high support works, if the structure is efficient; however it requires the prior realization of structures for protection against falls from a height that, in certain situations, may be an important factor;
- installation on the ground is the most immediate but supporting structures solidly anchored to the ground are required, and the mechanical characteristics are variable and depend on the nature of the soil (agricultural soils, landfills, etc.);
- wall installation to integrate architectural façade (mostly vertical) of building involves very different costs depending on whether panels hang directly on the wall (type RVF) or outdoors (structural) for the different incidence of structural steel supports and anchors consequently requested.



Largest PV plant - RAL s.r.l. located in Alessandria





Plant conducted directly by Provincia of Alessandria – Scientific Lyceum located in Ovada

In general, no particular critical issue was found.

For other applications it should be pointed out that the incentive system in action („Energy Account„) pushes constructors and those plant managers to plan the construction of plants through high-profile quality standards very carefully in order to minimize potential economic losses; all this for the final benefit of the producibility and reliability.

Special attention of the plant managers was given to modules steals, a problem present in the monitored area.

This resulted in a widespread application of protection systems also of various types:

- high-tech security systems, perimeter sensors, supplemented by video surveillance (camera unit and transmission cable IP solution and / or wireless);
- protection systems with optical fiber cables;
- protection plants (mostly mechanical) with systems of locking bolts.

Financial Tools

The aim of this task was to study financing methods for realizing photovoltaic plants. In order to achieve this topic, the WP partners made an investigation in their own region or country on existing systems to finance photovoltaic plants, with a special attention on collective actions.

The expert groups involved in this WP were VLBG - Regionalentwicklung Vorarlberg, TIS - Techno Innovation South Tyrol, RAEE - Rhônalpénergie-Environnement and EAO-Styria - Energieagentur Obersteiermark.

Different methods or approaches to finance photovoltaic plants with public participation were found and are presented in the following chapter.

Northern Italy

Description

The TIS innovation park of Bolzano, a center for innovation, cooperation and technology transfer for companies in the region, investigated about legitimate financing methods of photovoltaic plants in Italy and in the region of South Tirol. The most interesting approaches were selected and are going to be presented in the results (8.2).

Illustration with results

Bank loan from ethical bank of Bolzano

An affiliate from the bank Raiffeisen called Ethical Banking is investing, according to customer's mandate in economic activities related to sustainability, biologic and fare trade markets. Among these branches, Ethical Banking is investing also in photovoltaic plants, especially to realize small photovoltaic plants for domestic use. The rate of interest of this bank loan is very low, it is usually 2 – 3% lower than the rate of interest of a conventional bank loan. In the End of February 2011 the rate of interest was at 2,079%. This rate is being actualized every 6 months and is calculated as the average rate of interest of all ethical banking saving deposits and increased of 1%.

Everyone who wants to realize a small pv-plant for home consumption can ask for this loan, logical until the saving deposits are exhausted. The upper investment limits are following:

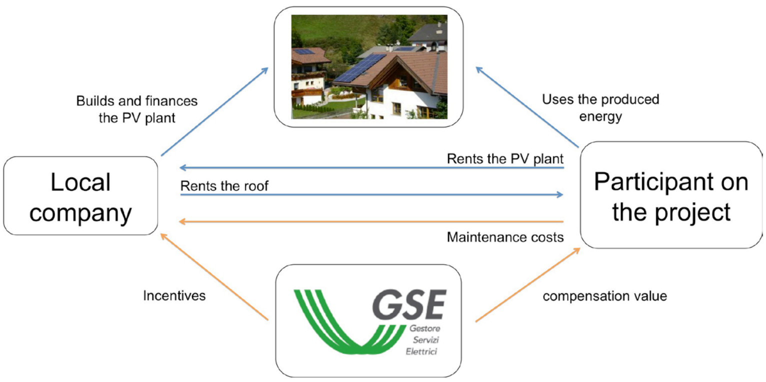
- One family (detached) house up to 15.000 Euro;
- Two family (semidetached) house up to 30.000 Euro;
- Companies up to 35.000 Euro.

Photovoltaic roofs for free

A municipality in the region of South Tirol started the project called „20 photovoltaic roofs", which gives municipality citizens the opportunity to install a photovoltaic plant on the roof of their own houses without investing any own money. The goal was to realize at least 20 PV plants on family houses.

The project is managed and realized by a local photovoltaic company, which means that it plans, installs and finances the plant and therefore it is also the owner of the plant. For this reason, the local photovoltaic company is going to receive the national incentives for producing electricity (from GSE) for all the incentive period of 20 years.

On the other side, the participants to this project, or the person whose roof is going welcome a small photovoltaic plant, can use the produced energy for internal consumption.



The figure shows the functional principle of the project „20 photovoltaic roofs".

The participant in the project has the big advantage that he doesn't have to invest private capital, because all the costs for realizing the pv-plant are paid by the local photovoltaic company. Furthermore, the participant in the project can use the produced energy for internal consumptions and therefore he saves energy costs. The legal relations between the local photovoltaic company and the participant of the project are regulated in a roof rental contract, in a pvplant rental contract and in a compulsory maintenance contract over a period of twenty years.

The only costs the participant has to support are:

- 1.000 Euro for notary and taxes
- 200 Euro/year for maintenance with the photovoltaic company.

Financial Tools

At the end of the twenty years the pv-plant goes directly without paying any amount of money from the company to the project participant. The project participant can also buy the pv-plant after a period of ten years.

Public participation to finance PV plants

Suitable corporate structures for public participation in photovoltaic plants are stock corporations or limited companies. The advantages of stock corporations are that they can collect financial resources from a wide public in shares and/or bonds. Both can be easily transferred.

The stock corporation called „Belvedere" is a company, whose core business is the waste management in the municipality of Peccioli (PI). In 2008 the company realized a 1.000 kWp pv-plant and gave citizens the possibility to participate by buying corporate bonds.

The project is called „one hectare of sky" („un ettaro di cielo"). The produced energy from the pv-plant is going to be injected into the electrical grid and sold to the GSE. The plant produces 1.300.000 kWh per year, which corresponds to the consumption of about 450 families.

The project „one hectare of sky" („un ettaro di cielo").

The corporate bonds have a nominal value of 50 Euro and can be acquired in batch of 60 for a total value of 3.000 Euro.

The bond loan is issued in two tranches with different loan period and different rate of interest:

a) The first tranche is for a period of 7 years (from 2008 – 2015) with a rate of interest about 5,5% per year;

b) The second tranche is for a period of 12 years (2008 – 2020) with a rate of interest about 6,5 % per year.

Both the first and the second tranches are going to be reimbursed in the end of the loan period. The interests are going to be disbursed in the end of every business year.

In order to present the project to the citizens and to find possible investors for promoting a campaign for the project was done. This campaign consisted in:

- two public meetings to present the project;
- sending of promoting flyers to citizens of the region with detailed information about the characteristics of the bond loan;
- publishing posters over all the territory;
- press release;
- advertising spots on the local TV;
- participation on different conferences and meetings to export the project.

During this campaign more than 300 people have invested in bond loans for this project.

The campaigns methods to search for investors among citizens are regulated by the public authority responsible for regulating the Italian securities market Consob (Commissione Nazion-ale per le Società e la Borsa). Therefore before starting a campaign, an authorization from Con-sob is needed.

Electricity cooperatives

To share the advantage of producing renewable electric power with a large group of citizens, it is possible to use another company model: the electricity-cooperative company. Electricity-cooperatives can supply their members with the so called system „auto-production and auto-consumption", which means that all the members can be supplied with the energy produced from cooperative plants. Cooperatives don't need to adhere the normal market structure (un-bundling), but can operate within all the sectors, that means that the cooperative can be producer, distributor and seller at the same time.

One big advantage is that the cooperatives can determine the electricity price on their own. In particular and in contrast to the normal rules of the electricity market, cooperatives can define for their members the energy producing and the energy transmission price.

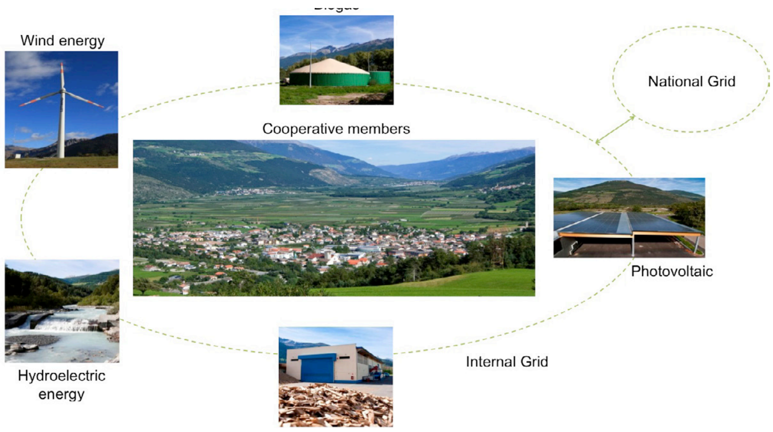
Another advantage is that members of the cooperative have to pay less tax for the consumed energy.

In the province of Bolzano, there are a lot of small electric cooperatives who supply their members with electricity and in some cases also with thermal energy trough a district heating grid, produced locally from renewable energy sources. A best practice example in the province of Bolzano is the electric cooperative E-Werk-Prad that won the „champions league of renewable energy" in 2010.

This cooperative produces electricity using different local renewable energy sources. The electric energy producing plants are the following:

- four small and medium hydroelectric plants (from 250 till 2.600 kVA);
- four cogeneration plants (2 are supplied with biogas and two with a mix of heating oil and vegetable oil);
- two wind turbines (1,2 and 1,5 MW);
- several photovoltaic plants.

Contemporary to the electric energy production the, cooperative is also operator of a district heating grid which 85% of the citizens actually are connected with. The thermal energy is produced in two power plants, half is produced with two heat pumps. The recovered thermal energy forms the four cogeneration modules. The rest is produced with a boiler supplied with wood chips.



The figure shows the working principle of the electric cooperative E-Werk-Prad.

Application to other regions, Capitalization solutions

Many solutions to finance photovoltaic plants that have been found and investigated in this WP can be applied to other regions in Europe. A solution that cannot be easily applied in other nations is the creation of electric cooperatives, since it is too strictly connected to Italian legal framework of cooperative companies (the European cooperative law isn't a strong framework because it does not cover fiscal aspects) and in particular to the regulation made by the Italian authority for electric energy and gas. The detailed report about possible financing instruments for photovoltaic plants in Italy can be downloaded from the homepage of the TIS innovation park (www.tis.bz.it). For further information, please contact:

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Rhone-Alps

Description

In France, PV projects suffered from numerous changes in the regulatory framework during the last few years. New feed-in tariffs were finally settled in March 2011, but since that time, due to a national limitation of the annual PV capacity installed, fewer companies are trying to develop projects. Moreover, banks have increased their requirements to finance the projects and loan rates became higher.

Consequently, there is an increasing interest in projects which are based on citizens' funding, since they may gather more own funding, require lower remuneration rates and lower loan amounts.

Aim of the task was then to work out a financial tool for collective investments in PV plants, considering two different types of society that are adapted to welcome citizens' funds. The most relevant are „cooperative companies of collective interest".

This kind of society is generally chosen when people want to share funds for collective actions, but without researching an important profitability. It is quite adapted for renewable energy projects when they are proposed by people that are willing to develop innovative RES projects. Several experiences already exist in France, using this model.

The other kind of society that is also adapted is a „Society with Simplified Shares" which is the most flexible structure that exists: nearly all the functioning can be described in the status. In contrast to the cooperative, no public funds can be integrated in the capital and the objective is more lucrative.

Illustration with results

In the ENERBUILD project, the work consisted in building a business plan model for PV projects supported by this type of society. Starting from a usual business plan, several specificities had to be integrated:

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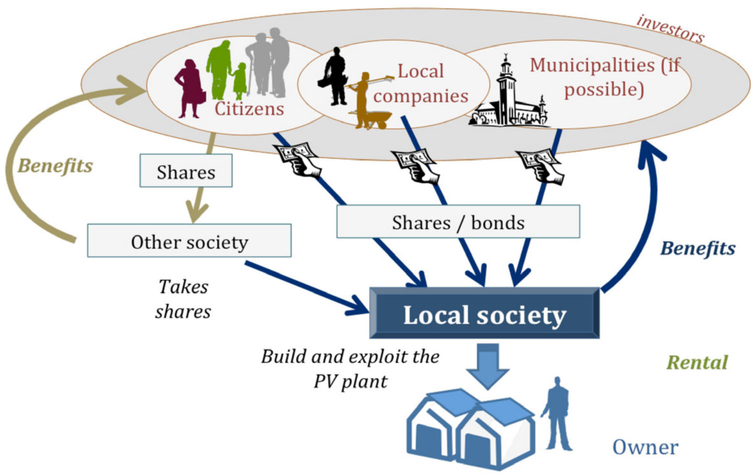
Financial Tools



The scheme explains the model that is used when realizing a PV project with citizen collective investment.

- The fact that citizens can buy and sell shares at any time
- The fact that municipalities can take shares up to 20% of the capital in a cooperative society
- The fact that more than 57,5% of the benefits have to be kept into indivisible reserves and must be reused for other collective activities
- The fact that this type of society has to have an employee

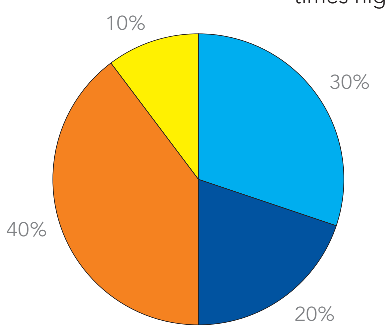
Two tools were developed: an exhaustive one and a simplified model which is shown below.

Results show that cooperative societies can provide a profitability rate of about 3%, whereas commercial societies provide rates that are 3 times higher. Anyway, many parameters can modify these results, and it is necessary to be very cautious about the interpretation.

Looking at the detailed financial balance, we can assess the results on a period lasting 20 years. We find out that if several PV projects are planned, the approach is different and on an economical point of view, cooperative societies are also interesting (reserves are reused for new projects and contribute to decrease the debt).

Application to other regions, Capitalization

The financial tool can be spread in other French countries but it can hardly be used by other EU countries since it is built for specific French societies, whose running is different from foreign ones.



Project	100	kW
Productivity	1.000	kWh/kW
Production	100.000	kWh/year
Feed-in tariff	0,3	Euro/kWh
Receipts	30.000	Euro/year

Figure: Hypothesis on society:

Annual forecast (Euro/year)	SCIC	SAS
Recettes (électricité)	30.000	30.000
Charges	11.400	7.900
Provision onduleurs	2.000	2.000
Abonnement réseau (TURPE)	600	600
Assuarances	2.000	2.000
Divers	900	900
CAC	2.000	0
Loyer toiture	2.400	2.400
Employé	1.500	0
Dotation aux amortissements	10.000	10.000
Frais bancaires et obligataires	1.400	1.400
Résultat avant impots	7.200	10.700
Réserves impartageables	4.140	535
Impot sur les sociétés	459	1.525
Résultat après impots	6.741	9.175

Réparitition du résultat (Euro/year)	Euro	Euro
Réserves	4.140	535
Total dividendes	2.601	8.640
CSG	320	1.063
Total dividendes	2.281	7.577
Citoyens	1.369	4.546
Entreprises locales	912	3.031
Dividende par part	2,28	7,58

Figure: Financial simplified balance

Styria

Description

In the course of the ENERBUILD-Project, the EAO was searching for a financing tool to promote the implementation of photovoltaic plants in the target region, Upper Styria West. The customer participation model was identified as the most suitable for the needs, as it supports the involvement of committed private enterprises and interested citizens by providing the appropriate financial means.

The model is based on the cooperation with a regional private company that plans to invest in a photovoltaic plant within its facility. The company sells for the financing of said plant participation certificates. The offer has existing and potential costumers of the company as target group. In the repayment method, the participants receive for each certificate annual product vouchers in the value of their original investment plus a convenient interest. This benefits the customers for the favorable return of their investment and also promotes the goods of the company, as the distribution of profits increases the loyalty of the customers.

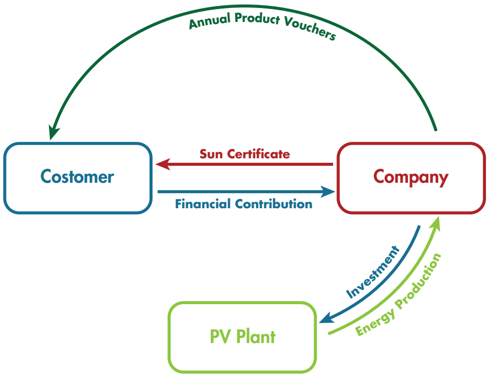


Illustration with results

The regional shoe company „Waldviertler" in the neighboring province Lower Austria has successfully financed its photovoltaic plant with this tool. It sold participation certificates with a value of Euro 200 each and offered 11 coupons over ten years with a total value of Euro 330 as pay-back. This accounts for an interest rate of 6,5%. As an incentive, participants also state their preference for green electricity and the contribution to regional development, since the shoe company is dedicated to the preservation of local SMEs.

The concept has already been duplicated within the region, as the local beer brewery „Schrems" offers participation certificates of Euro 200 value each for the installation of a photovoltaic plant on their roof. The repayment takes the form of annual product vouchers for Euro 60 over 5 years. The project has been planned and implemented by a new founded association of regional companies, the „Waldviertler Energiestammtisch", the regular's table of energy of the Waldviertel.

The EAO plans to implement a similar participation model on its home site, the Holzinnovationszentrum, HIZ (wood innovation center), together with an adjacent company, a local wood pel-lets producer. At the HIZ, we have several thousand square meters of available rooftop surface which are perfectly suited for a photovoltaic plant. The concept behind the participation offer includes the support of regional development and the contribution to environmental protection. In particular, the participation certificate will be an offer for increasing energy self-sufficiency as the money is invested in green electricity generation and will be paid back in wood pellets from regional forestry.

Application to other regions, Capitalization

With the described pilot financing model, we will be able not only to realize a PV plant but also to involve local companies and interested citizens in the process. The project increases energy awareness in the region through its implementation process and as a plainly visible landmark of the region. The participation model enables people to actively contribute to the regional energy balance and to experience the interactions of energy consumption and energy demand on a personal basis.

For its synergetic effects, the model has great economic feasibility. The company realizes a photovoltaic plant on its premise that improves the energy balance of the enterprise sustainably. Ultimately, the installation contributes to the creation of a decentralized energy generation and distribution network. The pilot financing model can be duplicated several times in and outside of the region.

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Contribution from other partners (Vorarlberg)

Eco-Power Stock Exchange Vorarlberg

Green Electricity PLUS is a product name for 100% regional green electricity from Vorarlberg. The product was developed and brought to market within the ENERBUILD project. It consists of a green electricity product of VKW Ökostrom GmbH that was founded for this specific purpose, and the Ökostrombörse, an initiative of the Association of Renewable Energy Vorarlberg. The special characteristic of this common product is that the amount of electricity consumed by the customer is green by 100% and stems from local green electricity power plants (small hydro- power plants, photovoltaic systems and biomass). The „PLUS" is the funding product of the Ökostrombörse. This is a support by means of extra-payment that is invested in the powerplants which got selected by the customers.

You can find more information in the appropriate ENERBUILD publication: „Green Electricity? – Yes please!"

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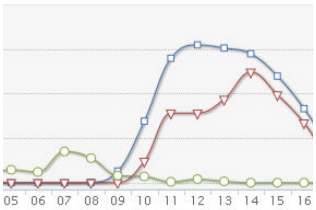

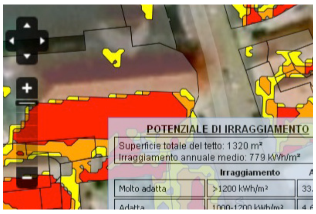

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