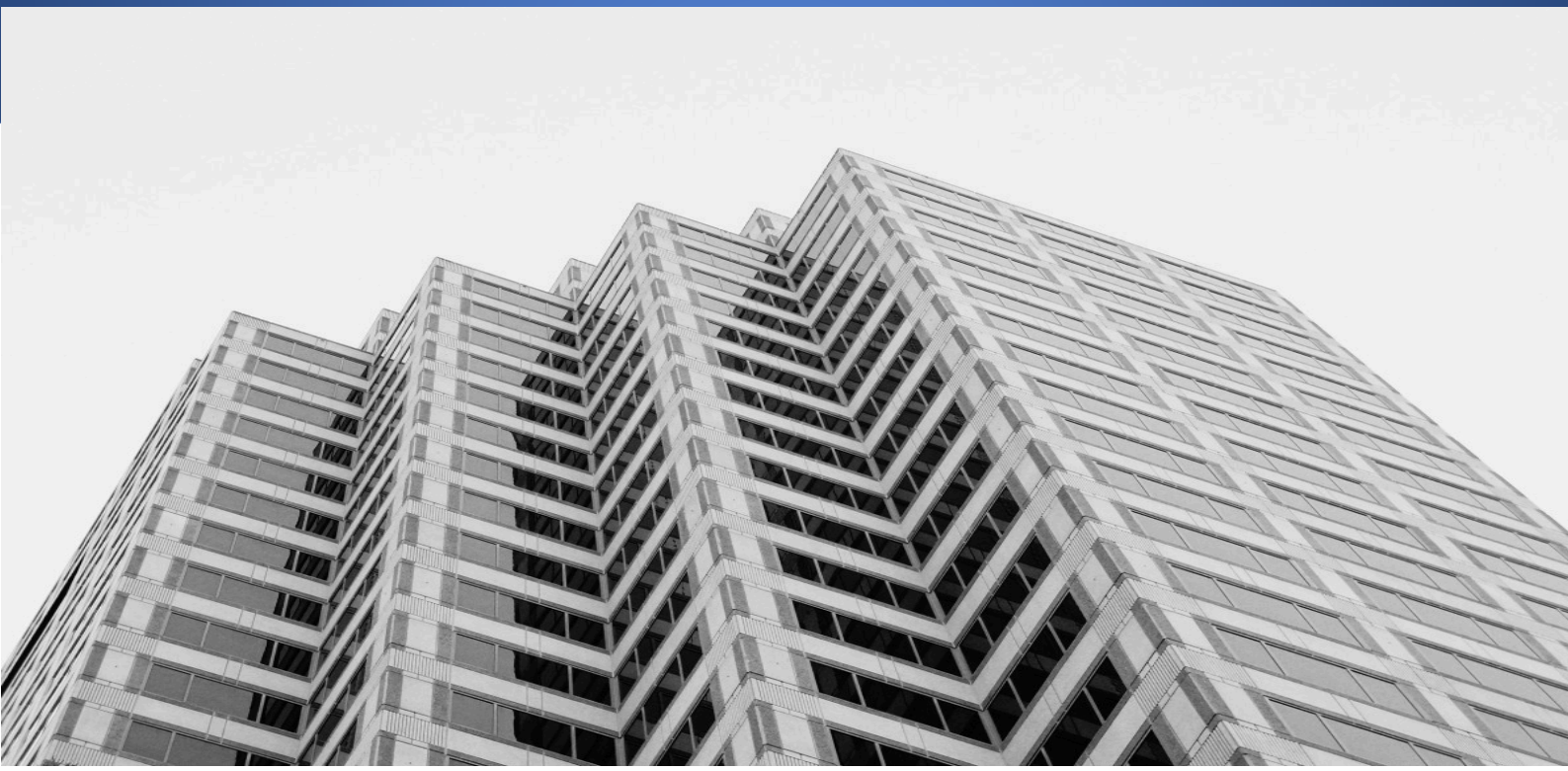
Gruppo Professione Energia

THE ENERGY PROFESSIONALS

APARTMENT BUILDINGS ENERGY SYSTEMS

Possible evolutions of energy in condominiums



Short paper
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Gruppo Professione Energia - The Energy Professionals (GPE) is the integrated consulting firm founded and managed by Marco Pezzaglia, a graduate in electrical engineering from the Polytechnic of Milan in 1993, began his career in the field of modeling and studies of electrical systems in a liberalized environment at the Italian Experimental Electrotechnical Centre (CESI www.cesi.it). In 2001 he joined the Authority for Electricity and Gas (now Regulatory Authority for Energy, Networks and the Environment – ARERA www.arera.it) where, in 2003, he was appointed Head of the Electricity Networks unit, dealing in particular with the terms and conditions for accessing to the electricity networks of production and consumption plants (connection and rules for dispatching) and the use of the interconnection network with foreign countries. On 1st January 2007, he took up the position of Head of the Renewable Sources, Energy Production and Environmental Impact Unit within the Markets Department, where he was actively involved in issues relating to assessments of the development of renewable sources, production and consumption systems and access to the system and the electricity market for electricity production and self-production/self-consumption systems. Since the beginning of 2010, he has been providing strategic consultancy and services in the energy sector both to private customers and to numerous sector associations, with particular reference to technical-regulatory and market issues. Expert in Energy Management certified EN 11339.

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The information contained in this document is purely reconnaissance: to this end, some technical details for the benefit of the narrative have been omitted. The author does not assume responsibility for any choices and actions that market operators may make on the basis of the information contained in the document. It should be noted that the application of the regulations on user systems must be duly analysed in relation to each specific case.

Preface by the author

The topic of user systems is one of the most debated topics in the world of the electrical system in recent years. The tariff benefits associated with these systems so far have made me a very important vehicle for the development of forms of distributed electricity production. The regulation of these systems, the definition of various models and, more generally, the underlying elements of the subject have been dealt with in another general report published on the website www.enusyst.eu , to which reference should be made for further information. In the field of user systems, the question of condominiums has always been a subject of particular interest because, according to the definitions in force, it is not possible to allocate the possible production of electricity carried out internally in a condominium (whether it is a service of common parts or a service of private housing units) to other real estate units other than those to which it refers. The purpose of this study is to develop a model that, starting from the current prevailing condominium configurations, allows the management of self-consumption in condominium buildings beyond the constraints currently in force, while maintaining the principles of free access to the market for individual end customers and minimising the impact on the plant configurations that must be adopted to allow self-consumption at a general level. All this shows a real and effective possibility to manage the self-consumption in the condominium at extended level without the need for significant investment and in compliance with the principles that guide the development of the internal market for electricity.

Marco Pezzaglia

Apartment buildings energy systems
Possible evolutions of energy in condominiums

1. Preface

This report intends to explore the possible evolution of the condominium towards a system of users within which it is possible to produce, exchange and consume energy according to new canons and models. As is well known, in the Italian system, such a possibility is today denied by the fact that the only models of user system that can be realized are limited to those that respond to precise norms and definitions. In particular, for the condominium there is no possibility to use the energy produced using common or in private areas in favor of all the condominiums for their individual consumption, the energy produced in this way can only be used for the power supply in consumption of common services or for single private purposes.
In reality, the condominium could represent the first energy community readily available if properly managed. Some questions arise in this regard to which this report attempts to give an answer. What is the potential for electricity production at the condominium level in the national system and how large can the self-consumption of electricity at the condominium level reach? How can individual condominiums enjoy the energy produced centrally within the condominium, or how can individual condominiums exchange with others any energy produced at the level of a single housing unit? Can this model be compatible with the current regulation on market settlement? Which type of regulation must be put in place in order for this to be achieved? What are the aspects of the authorization paths and procedures for the development of electricity production at local level and within the condominium so that this energy community can effectively develop?

The problem is also solved by the regulatory aspects that need to be developed in relation to the current state, as well as the compatibility of the development of self-consumption in a logic of social sustainability. These issues have already been dealt with at a general level in a previous study[1].

Although the treatment in this report refers to the specific Italian situation, it can be drawn from many points of interest at general level.

2. Apartment buildings definition

For the benefit of the present discussion, reference is made to the definitions of condominium and common parts in order to provide the basic tools for understanding the considerations set out below.

In fact, the Italian legal framework does not give a specific definition of condominium. The fact that the rules concerning the condominium are set out in Book III on ownership and, more specifically, in Chapter II of Title VII on communion of the Civil Code , helps to understand that the condominium is nothing more than a particular form of communion on immovable property. The peculiarity with respect to the more general discipline of communion is to be found in the fact that in the condominium there are parts of exclusive property alongside parts of common property. If the real estate units are the exclusive property of several parties, the rules of the condominium will apply. This is because next to the parts of individual property (the apartments) there will be those parts that by law must be considered common property. It is clear, then, that the distinctive feature of the two cases (commune and condominium) must be identified in the different conformation of the property rights of individuals compared to the real estate. It can, therefore, be affirmed that the condominium is a particular form of communion in which parts of exclusive property and parts of common property coexist. What therefore qualifies the condominium and the existence of common parts and it is of these that the civil code provides an exact definition.

More precisely, Article 1117 of the Civil Code states that they are the object of common ownership of the owners of the individual building units, even if they are entitled to periodic enjoyment and if any specific internal regulation does not indicate otherwise:

- all parts of the building necessary for common use, such as the ground on which the building stands, the foundations, the master walls, the pillars and beams, the roofs and the solar pavers, the stairs, the entrance doors, the vestibules, the hallways, the porches, the courtyards and the facades;

[1] http://www.enusyst.eu/documents/Sistemi-di-utenza-V.0.pdf

- parking areas and premises for shared services, such as the concierge, including the concierge's quarters, the laundry room, the drying racks and the attics, which, because of their structural and functional characteristics, are intended for shared use;
- works, installations and all kinds of products for common use, such as lifts, wells, cisterns, water and sewerage systems, centralised distribution and transmission systems for gas, electricity, heating and air-conditioning, for radio and television reception and for access to any other type of information flow, including from satellite or cable, and the relative connections up to the branch point to the premises owned by the individual condominiums, or, in the case of unitary systems, up to the point of use, without prejudice to the provisions of the sector regulations on public network.

3. Potentials of electricity production at the condominium level

In assessing the potential for electricity production at the condominium level at the national level, we limit ourselves to evaluating two possible types of production: photovoltaic production and the production of electricity through cogeneration plants installed mainly to meet the thermal needs of the homes that make up the condominium.

Photovoltaic potential

Based on publicly available sources and a 2002 study by the International Energy Agency - Photovoltaic Power Systems Programme (IEA-PVPS, Task 7), an attempt was made to determine the potential of integrated photovoltaics in buildings in some OECD countries. For Italy, an area of roofs potentially available for PV inclusion was estimated at 763.53 km^2 (about 410 km^2 for residential buildings and the remainder in agricultural, industrial and commercial buildings) and a facade area of 286.32 km^2 (for a total per capita value of about 18 m^2).
Considering that 14 million families live in about one million condominium buildings and that the typical Italian condominium has 30 real estate units with an average family composition of 2.4 units, a photovoltaic potential at condominium level of about 88 TWhe is obtained for a total installed power of about 70,000 MW and an average installable power per condominium of about 70 kWp.

PV potential estimation at condominiums level	
1.000.000	Number of buildings
14	Millions of families
30	Average number of apartment in each buiding
18	m^2 availbale for inhabitant
2,4	Area ratio (mq/kWp)
2,4	Average number inhabitants per family
34	Millions of inhabitants in apartment buildings
605	Total area available for PV in apartment buildings (millions m^2)
70.560	(MW) Potential power
70,56	Average power per apartment building (kWp)
1.250	Production ratio (hours)
88,2	Total production (TWh/year)
88.200	Total production per apartment buildings (kWh/year)

Calculation of production potential from photovoltaics in the condominium home - GPE evaluations

The potential value obtained must be compared with the potentially corresponding electricity demand. Considering an average consumption of about 3,000 kWh per household and an average contractual power of 3 kW, the electricity consumption associated with all the housing units in a condominium would be about 42 TWh (90,000 kWh/year per condominium), while the average connection power of a condominium considered as a whole (housing units plus common parts) would be around 100 kW.
These evaluations are obviously of an average nature and serve only to provide an order of magnitude of the phenomenon.

Potential of electricity that can be produced by cogeneration in the domestic/residential sector

Based on the report prepared by the GSE pursuant to Legislative Decree 102/2014[2] it is possible to estimate the potential of the thermal and electrical energy that can be produced by condominium domestic cogeneration. The assessments of the potential estimated by the GSE takes into account several limiting assumptions and more precisely:

- only the coldest climate zones (climate zones E and F) were considered, where the number of winter operating hours of the heating equipment may justify the installation of a cogeneration plant;
- it was considered realistic to consider for the purpose of estimating the technical potential only the condominium users with central heating; the most recently built dwellings were excluded, both because of a lower thermal demand due to the greater insulation and efficiency of the dwellings and because of a lower propensity for requalification on the part of the residents;
- the size of the CAR[3] is carried out in such a way that it must in any case be accompanied by reserve boilers.

In addition, the GSE estimates start from the impossibility of using the electricity that can be produced on a self-consumption basis in the individual houses that make up the condominium (as specified in the preface).

On the basis of the above limiting hypotheses, the estimate of the technical potential carried out by the GSE would lead to a total production of 42,3 TWht and 10,6 TWhe of thermal and electrical energy that can be produced by CAR.

If we want to overcome some of the hypotheses formulated by the GSE, even if we consider reasonable those of considering only climate zones E and F, taking into account the consumption of medium and large condominiums, but considering a criterion of thermal operation follows on the total thermal consumption for the groups considered (see table below) and not only for the configurations of a centralized system, we obtain production potentials of 76,9 TWht and 34,6 TWhe of thermal energy and electricity produced by cogeneration.

Estimation of thermal needs (GWht)													
Climate zone	Tyoe	N. apartments	Before 1919	1919-1945	1946-1961	1962-1981	1982-1991	1992-2001	2002-2013	TOTAL		Apartment buildings (AB)	
B	Single house	1	89	172	228	401	105	43	27	1.065	3.730		
	Terraced house	2-4	58	113	199	579	108	49	22	1.128			
	Average AB	5-15	69	150	220	412	81	31	14	977		1.537	41%
	Big AB	16 and more	12	40	102	324	64	14	4	560			
C	Single house	1	1.013	1.227	1.759	3.154	896	382	228	8.659	28.411		
	Terraced house	2-4	814	827	1.608	4.482	881	392	182	9.186			
	Average AB	5-15	623	558	1.442	3.185	700	288	160	6.956		10.566	37%
	Big AB	16 and more	246	305	509	1.940	429	127	54	3.610			
D	Single house	1	3.244	1.960	2.101	4.498	1.267	647	425	14.142	67.179		
	Terraced house	2-4	3.544	2.049	3.069	10.275	1.792	684	417	21.830			
	Average AB	5-15	2.175	1.473	4.539	8.950	1.768	658	496	20.059		31.207	46%
	Big AB	16 and more	627	1.300	1.364	6.022	1.171	373	291	11.148			
E	Single house	1	10.164	5.759	6.193	13.531	2.877	1.515	1.284	41.323	176.792		
	Terraced house	2-4	10.731	6.490	8.299	29.838	3.902	2.018	1.555	62.833			
	Average AB	5-15	6.622	4.165	8.606	20.846	3.662	2.228	2.459	48.588		72.636	41%
	Big AB	16 and more	1.342	1.960	3.124	13.370	2.045	1.148	1.059	24.048			
F	Single house	1	1.383	527	377	875	213	148	118	3.641	13.487		
	Terraced house	2-4	1.591	659	659	2.100	275	157	106	5.547			
	Average AB	5-15	751	285	395	1.281	230	157	136	3.235		4.299	32%
	Big AB	16 and more	82	72	141	552	103	63	51	1.064			
										289.599		120.245	42%

Heat consumption (GWh) for the residential sector to 2013 (MF: single-family house; VS: terraced house or small condominium; MC: medium condominium; GC: large condominium) - GPE processing on GSE data

[2] https://ec.europa.eu/energy/sites/ener/files/documents/it_potenziale_car_tlr_nazionale_e_regionale_dic_2016.pdf

[3] CAR is the Italian acronym of high efficiency cogeneration.

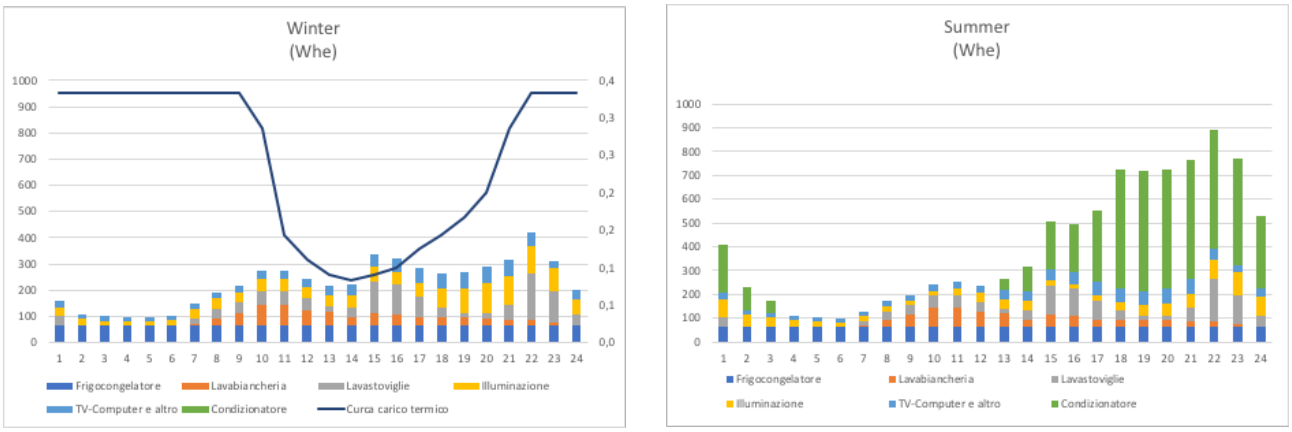
Thermal and electricity needs - Production potential estimates					
		Single family	Average AB	Big AB	Total
	N. of apartments	*1*	10	30	
	Type	*Autonomous*			
Needs (MWh)	Heating	*19,4*	115,3	442,8	
	Hot water (10% of heating)	*1,94*	11,53	44,28	
	Thermal total	*21,34*	126,83	487,08	
	Elettricity (only common servcies)	*3*	9	15	
	Elettricity (total consumption)	*3*	39	105	
	CHP dimensioning				
	CHP thermal power (kWt)		35	137	
	Production ratio (hours)		3.500	3.500	
	Thermal production (MWht)		122,5	479,5	
	Electrical power (kWe)		16	62	
	Electricity production (MWhe)		55	216	
	CHP potentials				
	Thermal need = CHP potential (GWht)		51.823	25.112	76.935
	Proportional electicity need (GWhe)		17.529	5.955	23.484
	CHP electriciy potential (GWhe)		23.320	11.300	34.621

Calculation of production potential from cogeneration in the condominium home - GPE processing on GSE data

Again, the evaluations are of a medium nature and serve only to provide general information, although they are considered significant for the purposes of this study.

General considerations on the electrical producible in the condominium area

Evaluating how much of the above calculated potentials can be used in self-consumption mode can be a very complicated goal. On the basis of studies developed in the past (MICENE project [4]) the typical curves of consumption per average condominium housing unit can be obtained (average housing area of 100 m²).



Electric load curves typical of the winter and summer season for a condominium housing unit - GPE elaborations on MICENE project data

In the calculation of the potential of self-consumption come into play numerous variables at this time unpredictable such as the introduction of techniques for active management of demand (load management / demand side management), the use of storage, the introduction of the possibility of exchange surplus / deficit between different subjects making up the single condominium[5]. What is certain is that with a view to creating a new market model, only actual self-consumption should be promoted, understood as contextual self-consumption of the production carried out. In order to encourage the exchange of energy between different users towards the creation of an effective energy community, it is necessary to promote the availability of

[4] http://www.eerg.it/resource/pages/it/Progetti_-_MICENE/compendio_misure_consumi_elettrici.pdf

[5] This presupposes that the model of energy community considered is that of the condominium level: this is not a constraint but only a hypothesis.

electricity in relation to such a mechanism: in this sense, the phenomenon of exchange on the spot should be progressively reduced or eliminated.

4. The production of electricity in the condominium

The electricity production of the condominium must be distinguished according to whether it is serving the common parts, or is installed in the service of private real estate units.

Electricity production plants serving the common parts

The installation of an electricity generation plant serving the common parts is counted among the innovations.

ART. 1120. INNOVATIONS
The condominiums, with the majority indicated by the fifth paragraph of Article 1136, can dispose of all the innovations directed to the improvement or the more comfortable use or the greater yield of the common things.
The condominiums, with the majority indicated by the second paragraph of article 1136, can dispose of the innovations that, in respect of the regulations of the sector, have as object:
[....]
the works and interventions [...] for the production of energy through the use of cogeneration plants, wind, solar or otherwise renewable sources by the condominium or third parties who obtain for consideration a right in rem or personal enjoyment of the solar slab or other suitable common surface;
[....]
The administrator is required to convene the meeting within thirty days from the request even of a single owner interested in the adoption of the resolutions referred to in the preceding paragraph. The request must contain an indication of the specific content and methods of execution of the proposed interventions. If this is not the case, the director must immediately send the proposing owner to provide the necessary additions. Innovations that could prejudice the stability or safety of the building, alter its architectural decor or make certain common parts of the building unusable for the use or enjoyment of even a single condominium are prohibited.

It is then art. 1123 of the Italian Civil Code, which dictates the rules according to which the expenses are to be distributed among the individual condominiums, on the basis of three main criteria: the first, general, of the distribution in proportion to the value of the property and the other two, particular, according to the use that each condominium can make of the common parts and the enjoyment that it can make of them.
In fact, the first paragraph of Article 1123 of the Italian Civil Code, similarly to the principle of proportionality of the rights of the co-owners over the common things on the basis of the value of the property of each, intended to establish the general criterion of distribution of the "expenses necessary for the conservation and enjoyment of the common parts of the building for the provision of services in the common interest and for the innovations decided by the majority" which are to be supported by all the condominiums "in proportion to the value of the property of each, unless otherwise agreed". This is, of course, a formula that tends to specify which expenses are to be divided in proportion to the value of the individual property of each condominium.

It is important to underline that no condominum can escape the obligations of maintenance, whether this is ordinary or extraordinary. So much so that the Civil Code, through article 1118, establishes that "the right of each owner on the common parts, unless the internal regulation provides otherwise, is proportional to the value of the property unit that belongs to him" and the same "can not escape the obligation to contribute to the expenses for the conservation of the common parts, even by changing the intended use of their property unit, except as provided by special laws".
For the following considerations of particular interest also the case in which a joint production plant generates an income. In fact, the proceeds that derive from a condominium production plant can be subject to taxation. And the condominium, in cases where the plant is configured as a commercial activity, becomes a de facto company and as such must be taxed: it will have to invoice with the application of VAT the energy sold to and any incentive tariff received must be subject to the withholding of 4 percent pursuant to Article 28 of Presidential Decree 600 of 1973.
All this is clarified by the Revenue Agency in a resolution in response to a request for clarification. In general, in cases where the common structures are used for purposes other than those strictly condominium, the performance of a commercial activity takes place. In this sense, the Agency has clarified, first of all, when photovoltaics is considered a commercial activity: it is a commercial activity the production of energy from plants with a power of up to 20 kW not placed at the service of the house or the headquarters of the entity when the energy produced is transferred in whole or in part to the network, as well as the production of energy

from plants with a power of more than 20 kW. In these cases, the condominium can be identified as a de facto company of which the condominiums that have passed resolutions with the required majority and that take economic advantage of the plant are considered partners. The company that manages a photovoltaic system is in fact a commercial one and must issue an invoice in relation to the energy it feeds into the grid; on any incentive tariff, the withholding tax referred to in art. 28 of Presidential Decree no. 600 of 1973 on the tariff relating to the part of energy fed into the grid is applied to the company. Unlike the case of plants under 20 kW placed at the service of the house or headquarters of the institution does not identify a usual commercial activity, when the energy produced is used essentially for domestic purposes and the surplus, which is not self-consumed, is fed into the network through the service of exchange on the spot. In this case, it is clear that this is not a commercial activity but, specifies the Energy Authority, that any income from the sale of energy produced and not consumed is taxable to individual owners as a different income under Article. 67, paragraph 1, letter. i) of the TUIR, in proportion to the thousandths of ownership.

Plants for the production of electricity for the individual condominium

Law no. 220 of 11 December 2012 grants individual condominiums the right to install a photovoltaic system, intended to serve individual units of the condominium, on the solar panel, on any other suitable common surface and on the parts of individual property of the person concerned.

ARTICLE 1122-BIS: NON-CENTRALISED INSTALLATIONS FOR THE RECEPTION OF RADIO AND TELEVISION SIGNALS AND THE PRODUCTION OF ENERGY FROM RENEWABLE SOURCES

"Installations of non-centralised installations for radio and television reception and for access to any other type of information flow, including from satellite or cable, and the relative connections up to the branch point for individual users, shall be carried out in such a way as to cause the least damage to the common parts and to the building units owned by the individual, while in any case preserving the architectural decoration of the building, except as provided for in the case of public networks. The installation of systems for the production of energy from renewable sources for the service of individual units of the condominium is allowed on the solar roof, on any other suitable common surface and on the parts of individual property of the person concerned. If modifications to the common parts are necessary, the interested party shall notify the administrator, indicating the specific content and the procedures for carrying out the interventions. The assembly may prescribe, by the majority referred to in the fifth paragraph of Article 1136, appropriate alternative methods of execution or impose precautions to safeguard the stability, safety or architectural decorum of the building and, for the purposes of installing the systems referred to in the second paragraph, provides, at the request of the interested parties, to share the use of the solar panel and other common surfaces, safeguarding the different forms of use provided for in the condominium regulations or otherwise in place. The assembly, with the same majority, may also subordinate the execution to the provision, by the interested party, of an appropriate guarantee for any possible damages. Access to individual property units must be allowed where necessary for the design and execution of the works. Installations for individual housing units are not subject to authorisation."

The condominium can, therefore, make a more intense use of the common thing, with the obligation, however, not to alterate its destination or prevent other condominiums from using it.

The Supreme Court, which has repeatedly intervened on the matter, has stated that those who participate in communion have the right to use the common goods for an exclusive purpose, allowing them the possibility of obtaining from the good a specific utility different from those obtained from other participants in communion, provided that such individual use does not alter the consistency and purpose of it, and does not prevent the equal use of others.
In this context, the notion of equal use of the common thing, to which art. 1102 of the Civil Code refers, is not to be understood in the sense of identical and contemporary use, since it must be considered that the law confers on each participant in communion the faculty of drawing the most intense use from the common thing, provided that this is compatible with the rights of others, since condominium relationships are informed of the principle of solidarity, which requires a constant balance between the needs and interests of all participants in communion (thus, among others, Cass. 5 October 2009, no. 21256).
With the judgment of 29 November 2017, no. 28628, the Court of Cassation then established the obligation for the condominium that intends to install photovoltaic panels on the roof of the building, to provide the condominium with the necessary elements to assess the feasibility of the work and compliance with Articles. 1120 and 1102 cc.

Ultimately, if the installation of a photovoltaic system requires changes to the common parts of the building, the owner must notify the administrator indicating the specific content and methods of execution of the interventions relating to the installation of the system or must provide all the elements necessary to qualify the intervention and assess its legitimacy. The assembly can prescribe, with the majority of the participants (attention: not of the condominiums, but of the 'participants') and at least two thirds of the value of the building, alternative ways of carrying out the installation or impose precautions to safeguard the stability, safety or architectural decorum of the building. The assembly can also provide for the distribution of the use of the solar slab and other common surfaces (so that it remains a space for the installation of photovoltaics for each condominium and to safeguard the possibility of using the common parts for other purposes); in addition, it can require the condominium concerned a guarantee for any damage.
Please note that the assembly has the right to deliberate on the installation of a photovoltaic system both if this is carried out by the condominium itself and if the installation concerns third parties.

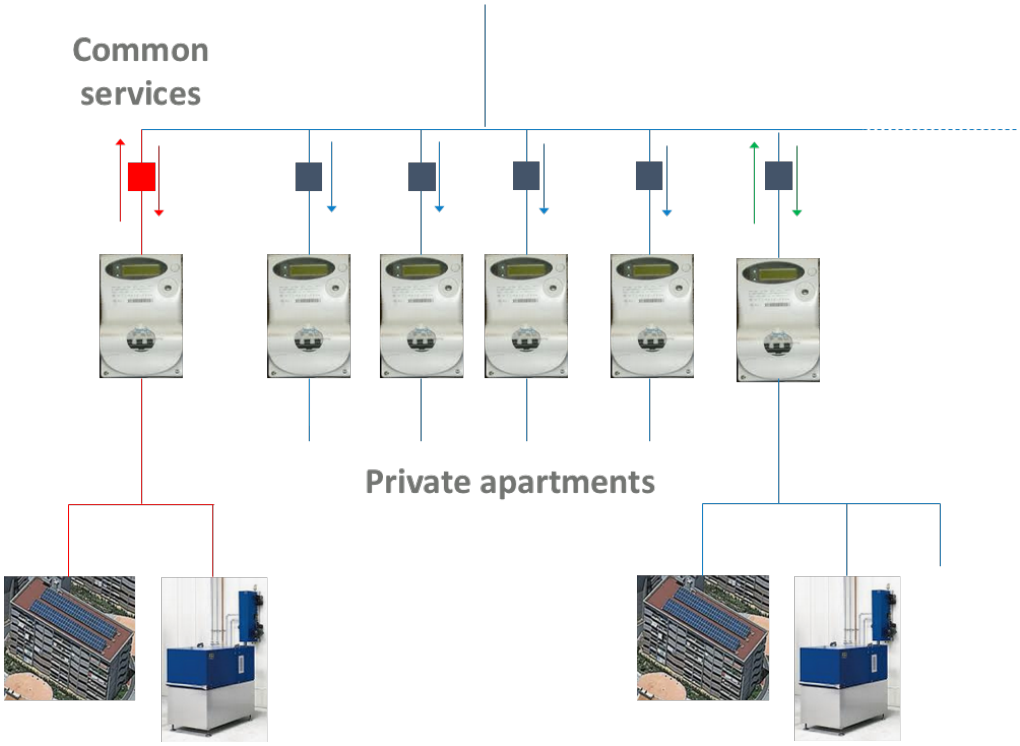
It 's quite clear that, being a personal system of the individual condominium, the electricity produced, given the current conditions, is for the exclusive use of the condominium, the costs of installation and management are borne entirely by the condominium and do not enter into the procedures of allocation of expenses.

5. Classification of a condominium energy system

For the purpose of this discussion we intend to study a configuration of an energy system condominium such that it is possible to account for any production of electricity within the condominium, whether common or private, as self-consumption in favor of individual condominiums as well as, for the only part of common production, consumption for the management of the common parts of the condominium. For the analysis that will follow we assume a plant configuration such as that indicated in the following figure that is considered representative of the vast majority of Italian condominiums. The analysis wants to provide a hypothesis of evolution of the current systems that is sufficiently simple to be able to be effectively applied; for this reason the hypothesis formulated uses as much as possible of configurations, modalities and conditions in force going to remove those constraints that currently prevent the self-consumption in multi-user systems at condominium level.

A condominium energy system can, therefore, be defined as the set of consumption units and production units located within the geographical perimeter of the condominium, usually belonging individually to a condominium electrical node on which the various circuits that connect the individual units from the condominium node are set. These circuits are developed in part in the common areas and possibly in the parts owned by the individual condominiums. All these elements form a private condominium network (PCN).[6]

[6] For the definition of private networks refers to http://www.enusyst.eu/documents/Energy_user_system_V.0.pdf



On the basis of the current legislative framework, with regard to the general definition of consumption units, the Authority can only continue to apply what is currently established by the Authority, considering that the entire regulatory framework defined with regard to the definition of consumption units serves to translate into practice the more general concept of the end customer as an entity that consumes electricity for its own use and which is granted the primary right to request access to the electricity grid in order to be able to freely access the market.

For the sake of simplicity, the current definition of consumption units is given below[7].

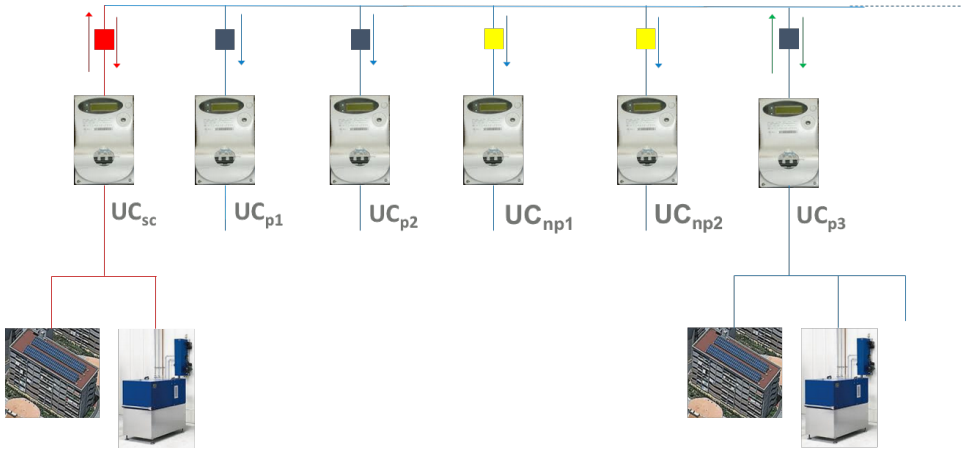
In order to identify the consumption unit CU, the current regulations use the following definition, as amended and supplemented by resolution 894/2017/R/eel, according to which the CU is the set of plants for the consumption of electricity connected to a public network, including through networks or private power lines, such that the total withdrawal of electricity relating to that set is used for a single use or production purposes. It normally coincides with the individual property unit. It is possible to group several building units into a single consumption unit in the following cases:
- real estate units in the full availability of the same natural or legal person linked by a bond of pertinence (main real estate unit and its appurtenances) and that insist on the same cadastral parcel or on contiguous parcels;
- pertinent real estate units (floors, garages, cellars), even in the availability of several natural or legal persons, forming part of a single condominium. The aforesaid set of pertinent real estate units can in turn be incorporated into the consumption unit relating to condominium users;
- real estate units in the full availability of the same legal entity, possibly made available by the latter to third parties, located on adjacent land parcels, within a single site and used for production activities of goods and / or services intended primarily for the construction, in that same site, a single end product and / or service.

The notions of private consumption units and networks as a whole give rise to the cases of users of a condominium energy system who may or may not be participants in the PCN.

- **UC_{sc}** consumption units of common services, including any consumption resulting from the application of the definition of consumption units set out in Resolution No. 894/2017/R/eel, second paragraph;
- **UC_{p}** User/participating consumption unit: it is a user holding a consumption unit that participates in the PCN and consequently can self-consume the electricity produced and fed into the PCN;

[7] For further considerations see http://www.enusyst.eu/documents/Energy_user_system_V.0.pdf

- **UC_{np}** Non-participating user/consumption unit: it is a user holding a consumption unit which is not participating in the PMC and consequently cannot self-consume the electricity produced and fed into the PNC. For the non-Participant user in the PNC, this is without prejudice to any benefits arising from self-consumption in the UCSC of the joint production only.



The following variables are also used:
F: energy flow during the reporting period [8] (kWh)
n: number of users participating in the PCN
m: number of non-participating users in the PCN

All the above consumption units can be passive or active:

- **Active consumption unit:** a consumption unit that includes one or more power generation units or one or more electrical storage systems;
- **Passive consumption unit:** a consumption unit that does not include any power generation unit and any type of electrical storage.

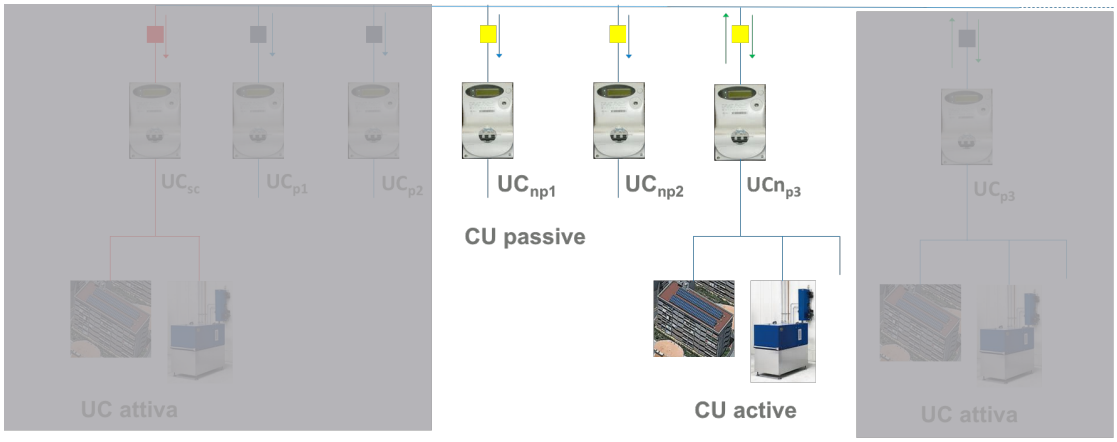
In line with current regulations, each CU can be associated with a connection point to the public network, which must be equipped with a special meter capable of treating the electrical energy exchanged according to the characteristics of the measuring systems defined by the current regulation for the voltage level and the value of the power available at the connection point. Each CU is therefore in any case associated with a POD[9] so that the corresponding user can exercise his right of free access to the electrical system.[10].

Modality of economic regulation of energy batches

Non-Participants in the PCN

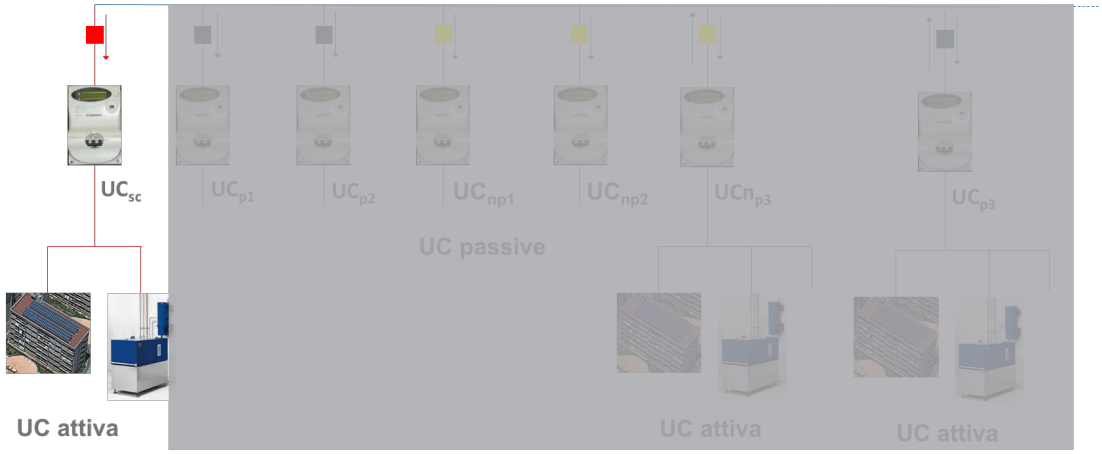
The non-participating parties regulate the purchase or sale of energy, including any exchange on site, in relation to the electricity exchanged with the network at the POD associated with them, as is already the case in practice (see figure below).

[8] Considerations about the reference period will be carried out later.
[9] POD: point of delivery
[10] This condition is normally found in existing condominiums. However, there are some where this condition is not met. Irrespective of the fact that the rules on the question of hidden customers should apply to them, if they have not yet been applied, the condition of the existence of a POD for each UC should be seen as indispensable in the case of the creation of a self-producing and self-consuming PCN.



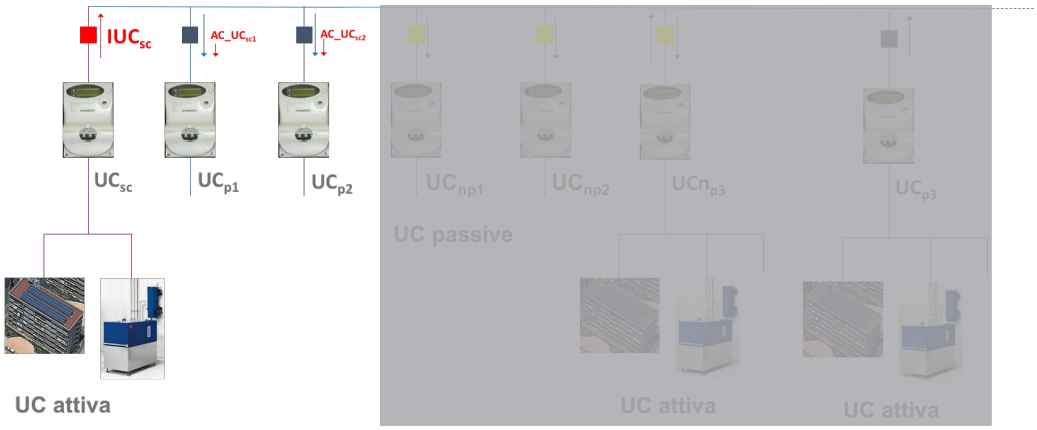
Common services

As far as common services are concerned (see figure below), the subdivision of the charge corresponding to the purchase of electricity to cover them is carried out according to the rules established by the Civil Code on condominium ownership and, more precisely, to this end, the provisions of art. 1123 of the Italian Civil Code apply, i.e. the economic charges for the purchase are subdivided on the basis of the thousandths of ownership of each condominium.[11]. The above implies that for the POD relating to the UCSC a contract for the purchase of electricity in relation to this individual POD must in any case be concluded in the same way as is currently the case. The effect of any self-consumption achieved at UCSC level is already included in the accounting for the purchase of electricity taken from this consumption unit. In this way, parties not participating in the PCN still participate in the benefit of joint production from the moment in which they participate in the condominium[12] and have contributed to the investment and contribute to the operating costs of the common installation.



In the event that UCSC feeds electricity into the grid (surplus achieved through the joint production plant), the establishment of the PCN means that this surplus can be allocated primarily to users participating in the PCN up to the amount of their consumption and, in the case of surplus energy remaining, it can be considered fed into the public grid and valued in terms of sales to the market, the proceeds of which are then divided among all the participants in the condominium according to the distribution resulting from the thousandths tables. Contrary to what happens with the UCSC levies, the creation of the PCN modifies the regime for the valorisation of any surplus of "common" energy compared to the current regime.
As regards the rules for the allocation of the common surplus between the PCN participants, a principle of proportionality can be adopted on the basis of the energy flows measured at the level of the individual PODs.[13] (see figure below).

[11] Without prejudice to other provisions deriving in practice from the Condominium Regulation.
[12] According to the law, participation in the condominium is essential.
[13] Which for passive users is the measure of electricity consumption.



$$AC\_UCscp_i = \min \{ I\,UC_{sc} * F\,UCpi / \Sigma_{i=1,n} F\,UC_{pi} ; F\,UC_{pi} \}$$

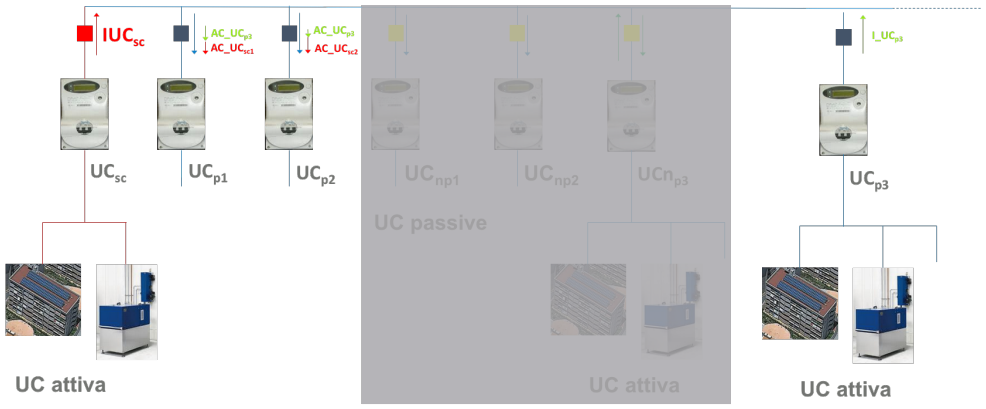
The measurement taken at each POD of the generic participating user must be modified by subtracting from the actual physical measurement the quantity corresponding to AC_UCscp_i

If $(I\,UC_{SC} - \Sigma_{i=1,n} AC\_UCscp_i) > 0$, this quantity of electricity shall be deemed to have been fed into the grid with the obligation to connect third parties. Operationally, what has been said is equivalent to attributing to the input measure of the POD corresponding to the quantity of electricity equal to:

$$I\,UCsc - \Sigma_{i=1,n} AC\_UCscp_i$$

Own consumption in the çCN from private production

In principle, it should also be possible to consume own energy within a PCN if there is a surplus of energy from private production in the same way as for the surplus of energy from joint production, as explained above. For each participant in the PCN, any additional share of own consumption quantifiable according to the already known proportionality test can be attributed, taking into account the levies already modified by the allocation of any surplus from joint production.[14] (see fig. below).



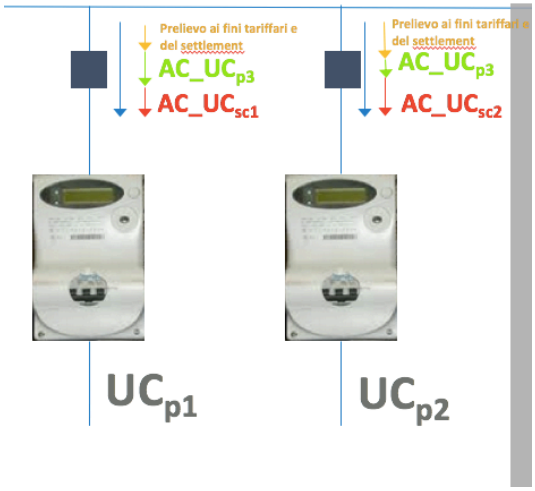
$$AC\_UCp_i = \min \{ I\,UC_{pa} * F\,UCpi_{\,mod} / \Sigma_{i=1,n} F\,UC_{pi\,mod} ; F\,UC_{pi\,mod} \}$$

Any surplus left over from the active private user is considered to have been fed into the grid by that user by changing the physical input measure recorded in the POD by deducting from the physical input measured the amount of surplus attributed to internal consumption within the PCN.

[14] In practice, in a PCN it is proposed that priority should be given to self-consumption resulting from joint production.

Measures for tariff and settlement purposes

The measures for tariff and settlement purposes will be the physical measures actually collected and amended on the basis of the above (see figure below).



In this way, it is possible for users participating in the PCN to enjoy the redeemable benefits attributable to own consumption in relation to electricity production within the PCN.

Relevant period and settlement

From the moment each user in the PCN is measured in relation to his own POD, the relevant period could be assumed to be the same as the month with the treatment of energy quantities by time slot.
For the energy balance with the public grid, each user is free to obtain individual supplies on the market, even if it is not to be excluded that the parties participating in the PCN may purchase the electricity integration in aggregate form (also through the operator of the PCN - see next point). As regards the use of indigenous energy in the PCN, this should be left to the free treatment of the parties within the PCN, in particular with regard to any indigenous consumption from private production.

PCN management

As seen above, in order to operate a PCN, it is necessary that the measures for market settlement are derived from the actual physical measures, if any, as amended. One possible process could be for the distribution companies to make the physical measures available to an operator in the PCN who has to prepare the final quantities and load them into the Single Buyer. For this purpose, the PCN operator is not a very different entity from a closed distribution system operator.
From the moment in which the management of the PCN may have modifying effects on the current methods of valorisation of the surplus energy of the common production and, in any case, for its intrinsic nature, it would be considered useful that the constitution of an RPC be the subject of a shareholders' resolution that sanctions the possibility of its realisation according to modalities and conditions that can be defined at a legislative and regulatory level.

Further considerations

A variant that makes the exchange of energy between users even more flexible could be that for which the allocation of private surpluses responds to specific rules also in a differentiated manner on the basis of internal agreements. However, such a mode would represent a very high level of complication to be managed and, for the purposes of this discussion, is not addressed. Moreover, a management model of the PCN according to pre-established terms and conditions favours the reduction of disputes, since the condominium is one of the main sources of disputes at national level. For this reason, it is preferable to manage the PCN as much as possible according to given rules, while remaining fully open to the market for the conditions of exploitation of the electricity component.

As far as on-spot trading is concerned, as the regulation of an PCN leads to an additional complication of the quantities of electricity involved, the PCN and on-spot trading schemes appear at first sight to be difficult to manage at the same time and therefore, on-spot trading should be considered as incompatible with the creation of an PCN.

6. Authorisation and procedural arrangements

With regard to authorisation and procedural schemes for the installation of production units, reference is made to the following.

Article 7-bis, paragraph 1, of Legislative Decree 28/2011 establishes that the communication for the construction, connection and operation of plants for the production of electricity from renewable sources, as well as the communication for the installation and operation of micro-cogeneration units, relating to activities in free construction, is carried out using a single model, to be approved by decree of the Minister of Economic Development, after hearing the Regulatory Authority for energy, networks and the environment. On the basis of these provisions:

- With the Decree of May 19, 2015, published in the Official Gazette no. 121 of May 27, 2015, the Ministry of Economic Development approved the model for interventions relating to small photovoltaic systems integrated on the roofs of buildings, which replaces those possibly adopted by municipalities, grid operators and the GSE. The aforementioned decree of 19/05/2015 applies to photovoltaic systems with the following characteristics:

- realization at end customers already equipped with active low-voltage collection points;
- power not greater than that already available for withdrawal;
- nominal power not exceeding 20 kW;
- simultaneous request for access to the exchange regime on site;
- construction on the roofs of buildings in accordance with the procedures set out in Article 7-bis, paragraph 5, of Legislative Decree 28/2011;
- absence of additional production plants on the same connection point;
- With the Decree of 16 March 2017, published in the Official Gazette no. 73 of 28 March 2017, the Ministry of Economic Development approved the model for interventions relating to high efficiency micro-cogeneration plants and micro-cogeneration plants powered by renewable sources. This decree applies to plants with the following characteristics:
- The decree applies to plants with the following characteristics: - construction at end customers already equipped with active low-voltage withdrawal points;
- power not exceeding that already available for withdrawal;
- feeding with biomass, biogas, bioliquids or methane gas or LPG;
- contextual request for access to the regime of exchange on the spot;
- not fall within the scope of Legislative Decree 42/2004;
- not to alter the state of the places and the external appearance of the buildings;
- generation capacity of less than 50 kWe.

As regards the treatment of the PCN, these decrees continue to be applicable also to condominium users in the event that they are merged into an PCN with the only observation that in the case of an PCN the request for access to the exchange system on the spot should be a mandatory condition.

7. Conclusions

The study demonstrates the feasibility of a general model for extending the mode of self-consumption of electricity produced in a condominium also to the consumption of all units. With a view to finding a model that can be readily used without the need for significant infrastructural investments, we have tried to make the most of the elements already present in the national regulations and regulations, such as, in particular, the presence of meters placed at the service of the consumption units of individual condominiums and managed by the distribution companies competent for the territorial area. In fact, the model requires the introduction of a manager of what can be defined, in general, a private network of condominium. The nature of the private network operator is not dissimilar of managing a closed distribution system. In order not to provide further elements that can feed the now extensive litigation that revolves around the condominium, it was considered appropriate to propose a model that meets the terms and conditions defined by law and regulation. For all the

other questions of a technical nature, reference should be made to subsequent in-depth studies; it is sufficient, for the purposes of this report, to have arrived at establishing a possible way of managing a private network of condominiums which, in its nature, already represents a first energy community.