

Green Energies: Abruzzo Towards an Eco-sustainable Future

The energy issue can be schematically summarized as follows: satisfying the energy service needs of an increasingly numerous humanity in a fair and sustainable manner, in a context characterized by the scarcity of fossil resources and the need for climate protection. Renewable energies are developing all over the world. In some industrialized countries, such as in Germany, non-negligible sections of the economy are beginning to move towards the production of the technologies necessary for the development of clean energy. On the other hand, it must be taken into account that alternative sources have not yet reached a degree of diffusion such as to allow effective cost reductions due to factors of production scale. The diffusion of renewable and energy saving technologies would allow to continuously improve the technical and economic yields, favoring cost reductions. Abruzzo is called the «green region of Europe». In order to secure concrete help for the development and protection of its territories, Abruzzo has become a pioneering region for clean energy such as windpower. In recent years, in Abruzzo, we have witnessed the spread of initiatives for renewable energy sources. This growth is due to both the growing environmental awareness and because in Italy these forms of green renewable energy enjoy an advantageous public incentive mechanism. As Abruzzo is characterized by a great variety of environmentally sensitive landscapes – which are rich in historical, cultural, and architectural value – wind farms (as well as photovoltaic apparatus) often risk compromising the natural beauty of the region. Thus, we are also witnessing strong criticism towards renewable energy sources. Despite the many acts of violence Abruzzo has already suffered, it is still characterized by landscapes of high value and great beauty, which if correctly managed and enhanced, can constitute the raw materials for sustainable tourism development which can translate into a resource rich innovative economy for the local populations.

Energie verdi: l'Abruzzo verso un futuro ecosostenibile

La questione energetica può essere schematicamente riassunta come segue: soddisfare in modo equo e sostenibile il fabbisogno di servizi energetici di un'umanità sempre più numerosa, in un contesto caratterizzato dalla rarefazione delle risorse fossili e dalle necessità di protezione del clima. Le energie rinnovabili si stanno sviluppando in tutto il mondo. In alcuni paesi industrializzati, come in Germania, sezioni non trascurabili dell'economia cominciano a orientarsi verso la produzione delle tecnologie necessarie allo sviluppo dell'energia pulita. Dall'altro lato, si deve tener conto che le fonti alternative non hanno ancora raggiunto un grado di diffusione tale da permettere efficaci abbattimenti di costo dovuti a fattori di scala di produzione. La diffusione di tecnologie rinnovabili e di risparmio energetico permetterebbe di migliorare in modo continuo i rendimenti tecnici ed economici, favorendo abbattimenti di costo. L'Abruzzo, considerata la «regione verde d'Europa», nell'intento di confermare e fornire aiuto concreto allo sviluppo e alla salvaguardia del proprio territorio, è una regione all'avanguardia per le energie pulite, in particolare l'eolico. Negli ultimi anni, in Abruzzo, assistiamo al diffondersi di iniziative per fonti energetiche rinnovabili dovuto sia alla crescente sensibilità ambientale sia al fatto che queste forme di produzione di energia godono in Italia di un vantaggioso meccanismo di incentivazione pubblica. Di contro assistiamo anche a una forte critica nei confronti delle fonti rinnovabili, in quanto l'Abruzzo è caratterizzato da una grande varietà di ambienti di valore paesaggistico, storico, culturale e architettonico, che gli impianti eolici (come pure il fotovoltaico) rischiano spesso di compromettere. Un territorio che, malgrado le tante violenze che ha già subito, costituisce ancora un complesso armonico caratterizzato da paesaggi di grande bellezza e di elevato pregio, che se correttamente gestito e valorizzato, può essere la materia prima per lo sviluppo turistico sostenibile e costituire la risorsa economica innovativa per le popolazioni locali.

Énergies vertes : Abruzzes vers un avenir Éco-durable

La problématique énergétique peut se résumer schématiquement comme suit : satisfaire de manière équitable et durable les besoins en services énergétiques d'une humanité de plus en plus nombreuse, dans un contexte caractérisé par la rarefaction des ressources fossiles et la nécessité de protéger le climat. Les énergies renouvelables se développent partout dans le monde. Dans certains pays industrialisés, comme en Allemagne, des segments non négligeables de l'économie commencent à s'orienter vers la production des technologies nécessaires au développement de l'énergie propre. D'autre part, il faut tenir compte du fait que les sources alternatives n'ont pas encore atteint un degré de diffusion tel qu'il permette des réductions de coûts efficaces en raison de facteurs d'échelle de production. La diffusion de technologies renouvelables et économes en énergie permettrait d'améliorer en permanence les rendements techniques et économiques, favorisant les économies de coûts. Les Abruzzes, considérées comme la « région verte de l'Europe », afin de confirmer et d'apporter une aide concrète au développement et à la protection de son territoire, est une région à la pointe de l'énergie propre, notamment éolienne. Au cours des dernières années, dans les Abruzzes, nous avons assisté à la propagation d'initiatives pour les sources d'énergie renouvelables en raison à la fois de la sensibilité environnementale croissante et du fait que ces formes de production d'énergie bénéficient

d'un mécanisme d'incitation public avantageux en Italie. D'autre part, nous assistons également à une forte critique des sources renouvelables, car les Abruzzes se caractérisent par une grande variété d'environnements paysagers, historiques, culturels et architecturaux, que les parcs éoliens (ainsi que le photovoltaïque) risquent souvent compromettre un territoire qui, malgré les nombreuses violences qu'il a déjà subies, constitue toujours un complexe harmonieux caractérisé par des paysages d'une grande beauté et de grande valeur qui, s'ils sont correctement gérés et mis en valeur, peuvent être la matière première d'un développement touristique durable et constituer la ressource l'innovation économique pour les populations locales.

Keywords: green energies, Abruzzo, sustainable future, renewable sources

Parole chiave: energie verdi, Abruzzo, futuro sostenibile, fonti rinnovabili

Mots-clés : énergie verte, Abruzzes, avenir durable, sources renouvelables

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1. National and International Economic Scenario

Globally, the conversion of United States and China to renewable energy sources has contributed to cutting technology costs, so the gap is shortening and the time to take concrete action has come; so, it is necessary to redesign the system of electricity to make the production distributed by renewable sources ever more efficient and effective.

The data analysis in Italy, at an international level, has shown a particular weakness compared to the other main EU countries – principally Germany – in the energy sectors and in renewable sources.

With an EU-27 average of 55%, the dependency rate of our country – measured as the ratio between the energy import/export balance and gross consumption – is equal to around 83%. This figure is compared to 52.1% in France, 62.7% in Germany and 79.8% in Spain. Our production *mix* is heavily biased toward the more expensive sources: around 54% of electricity is produced with natural gas, more than double the EU-27 average, which is equal to 22% with 10% produced by oil. The aforementioned is compared to 3% of the European average.

Italy is scarcely endowed with traditional energy resources, but it is strongly dependent on imported energies – in particular on natural gas from North Africa. For this reason, it is highly interested in the development of energy integration due to its natural role of «Suspension bridge» that Southern Italy plays in the Mediterranean basin. There is no doubt that renewable energy sources could become fundamental in the economic growth of Italy. Starting virtuous development processes in the fields of research, innovation, new advanced manufacturing, and tertiary specializations, Italy could lead the way forward.

The focus on the development of renewable energies is crucial not only for Southern Italy, but it can also be a chance to synchronise the local area interests with the national interests. Because of its geographical position as an energy exchange hub in the Mediterranean basin, Southern Italy can play a central role both nationally and internationally – in the field of transmission as its significant supply of renewable resources contributes to the achievement of energetic objectives that are strategic for the whole country's infrastructure (Gestore dei Servizi Energetici SPA, 2019).

At a national level, especially in relation to the «new» renewable (wind, solar, biomass, and biogas) The South is ahead of The Centre-North. This surprising revelation is because of the South's abundance in renewable energy resources, which derive from solar radiation, wind, and biomass; this positive trend continues right up until present day. In 2010, about 66% of all the energy generated by these three sources in Italy was produced in this area. The development of renewable sources in Southern Italy can significantly contribute to the achievement of national *targets*, which are set under international agreements. Those pacts commit our country to increase the amount of energy produced with renewable resources and to decrease the polluting emissions. In addition, this expansion can lead to the spread of the newest sectors of the green economy, which is booming worldwide. This type of alternative energy expansion in Italy contributes to the completion of the entire national chain of renewable energy. The South produces, according to the historical data analysis of Southern Italy, more than 60% of the energy generated by wind, solar, and biomass in our country. About the development of geothermal energy, there may be new initiatives for the South, and for the entire country as a whole. These renewable areas are still really un-



Tab. 1. Main energy and climate targets of the EU and Italy for 2020 and 2030

	2020 target		2030 target	
	EU	ITALY	EU	ITALY (INECP)
Renewable Energies Sources (RES)				
Percentage of energy derived from RES in final gross energy consumption	20%	17%	32%	30%
Percentage of energy derived from RES in final gross energy consumption in transport	10%	10%	14%	21.60%
Percentage of energy derived from RES in final gross energy consumption for heating and cooling			> 1.30% per year	> 1.30% per year
Energy Efficiency				
Reduction of primary energy consumption compared to the PRIMES 2017 scenario	-20%	-24%	-32.50%	-43%
Final consumption savings through mandatory energy efficiency models	< 1.5% per year (without transport)	< 1.5% per year (without transport)	< 0.8% per year (with transport)	< 0.8% per year (with transport)
Greenhouse Gas Emissions				
GHG vs 2005 reduction for all plants bound to ETS legislation	-21%		-43%	
GHG vs 2005 reduction for all non-ETS sectors	-10%	-13%	-30%	-33%
Total GHG reduction compared to 1990 level	-20%		-40%	

Data source: MISE-MIT-MATTM

dervalued in Italy. Beyond Tuscany and Lazio, the Italian areas with the most relevant presence of geothermal energy are located along the Southern Tyrrhenian Sea, in the regions of Campania and Sicily and in a huge off-shore area – that goes from Campania coast to Aeolian Islands. Geothermal energy can be found in smaller measures in Apulia and Sardinia.

1.1. The Geothermal Resource

Italy has the greatest geothermal resources in all of Europe and this fact is equalled only by Iceland. Geothermal sources can be used for both the production of heat (heating and cooling) and electricity. The use of geothermal energy to generate electricity is a longer – term project, as this procedure needs experimentation to take place by using innovative technologies, which are capable of reaching very high temperatures at great depths, with minimal environmental impact. In Italy, for over 100 years, geothermal energy has been used only in Tuscany, where there are 33 geothermal plants. These geothermal plants provide around 800 MW, 1.8% of installed power. This figure meets some of the national demand and about 25% of the Tuscan demand. The installed power

in those areas puts Italy in fifth place among the geothermal electricity producing countries in the world; the other countries are the United States, the Philippines, Indonesia, and Mexico; however, Italy is in first place in Europe. The Tuscan geothermal power plants are still based on traditional technologies, as well as those technologies created in other parts of the world at the end of 1950s. At that time, they were created to economically compete with other electricity generational systems, in particular hydroelectric and thermoelectric from fossil fuels (ENEA, 2010).

Today, geothermal energy enjoys strong interest for its renewable qualities; it is also, inexhaustible, is constantly available, and it is independent of climate conditions and has a low impact footprint on the environment.

Considering the South, the geothermal resource is considered strategic for Italy as it can be found largely on the national territory in the Central-Southern Tyrrhenian Sea area; geothermal technologies are exploitable with technologies that are widely spread in our country; thus, it is a resource that helps Italy avoid foreign imports. The development of geothermal energy may be a valid alternative to the nuclear plan. Italy rejected the nuclear plan by Referendum in June

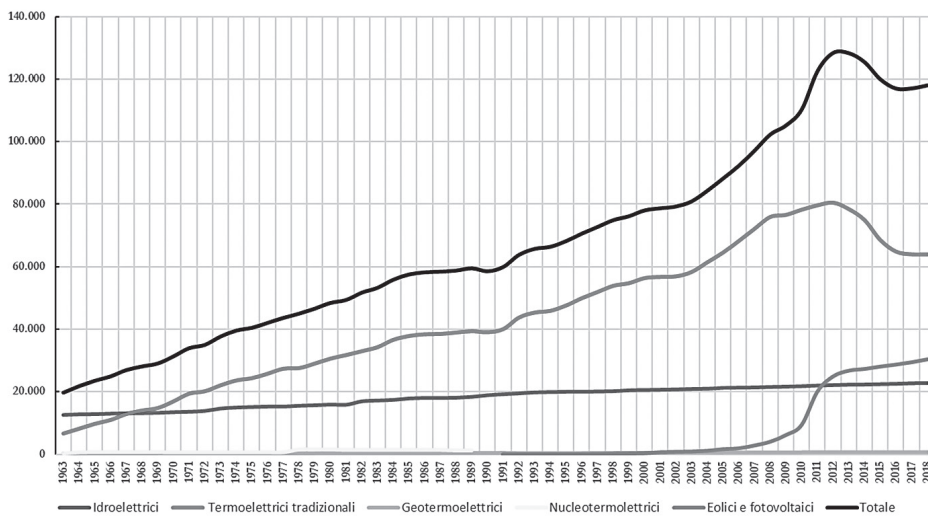


Fig 1. Evolution of plants by source technology. Colour legend: blue: Hydroelectric; red: Traditional Thermolectric; light green: Geothermal Electric; yellow: Nuclear Thermolectric; green: Wind and Photovoltaic; black: Total
Source: data elaboration on *Terna*

2011. The geothermal possibility holds the promise of great advantages represented by the strong likelihood of independence from fuel-producing countries – not to mention vastly lowering any detrimental risk to the environment. In the next 15 years, the estimated increase of electricity production from geothermal sources will be around 10% of the national demand. The South has a strong competitive advantage compared to the rest of the country; as afore stated, Southern Italy possesses the main geothermic resources. The first quantitative analysis has recently demonstrated that Campania has the greatest geothermal potential in Italy; indeed, its geothermic potential is greater than that of Tuscany – especially in the areas of the Phlegraean Fields and Ischia. Those locations contain high temperature geothermal resources that can be found at very low depths; therefore, the resource can be extracted with modest drilling costs; this factor is crucial in any geothermal project, and it may influence the convenience or inconvenience of exploitation.

1.2. Solar Photovoltaic

Over a four-year period – between 2007 and 2018, the number of solar photovoltaic plants has grown exponentially, and the same has happened for the installed power. In terms of quantity, Southern Regions have shown major increases, while, in 2010, North East area showed the highest development percentage (+154%). Recently, Italy has improved the renewable energy capacity de-

rived from solar-photovoltaic sources. At the end of 2018, Italy ranked fourth in the world behind Germany, Spain, and Japan, in terms of installed power (+20 million kW). Looking at the territorial division of the installed power, the North stands at almost 9,000 MW, the Centre holds 15% while the South stands at 35% of the total MW. Regarding the number of plants, of the 822 thousand working in 2018, more than half are in Northern regions, one third in Southern regions, and the remaining in Central regions. The photovoltaic distribution shows a prevalence in Apulia, Sicily, Sardinia, and Campania. In the macro-area, two thirds of the total plants are concentrated in Apulia, in Sicily, and Sardinia. Considering Apulia alone, there is more than 56% of the total installed power. The growth of the Italian photovoltaic market was encouraged by incentives, as the production of energy through photovoltaic technology is still not entirely economically convenient. According to Germany's experience, the market can continue to grow, despite reductions in incentives. To guarantee the achievement of the targets set for the development of renewable energy, the incentives must be stable over time, economically sustainable and take into account the evolution of technology.

1.3. Wind

Wind power is a growing reality. In Italy, there are 198 active plants, located mainly in the South, which cover 4.2% of the national electricity con-



sumption. It is clear that something is changing, and that there is a growing sensitivity towards renewable resources, demonstrated by a great number of wind farms installed in recent years. In Italy, wind power has grown at a rapid pace until it had reached an installed capacity of 9,766 MW in 2018, with a production of 17.7 TWH, an increase of about 40%. Over time, wind power has had a central role in the diversification process of the Italian energy supply. Southern Italy – because of its territorial features – has a considerable potential that has yet to be exploited. The level and consistency of prevailing winds, the orography and accessibility are all factors that influence the choice of the installation of turbines, and this is the reason why 84% of the plants and 98% of the installed power are in the Southern regions. The South is at the forefront of the development of this sector; in just three southern regions alone – Apulia, Campania and Sicily – there is the 56% of the national total number of plants installed. Apulia is first for the number of wind plants (134) but second for installed power; behind

Apulia is Sicily. These two regions together have an installed capacity of over 2,700 MW on their territories, almost half of the national amount. Nonetheless, the sector has suffered a slowdown in investments compared to previous years, due to the uncertainty that affected not only wind power but also the renewable energy sector in general. In Italy, the wind power chain – in which about 30 thousand people currently work – can create good prospects for the future, by completing the planned installations, which would double the number of employees. This advancement in the renewable sector will only be possible by overcoming those critical issues that impede the full development of the sector. Its uncertainty is strictly linked to some impediments that actually inhibit the spread of wind power in our country. In the renewable energy market, incentives have represented not only a great boost to investment, but they also support of clean sources; in the price competition with fossil fuels – consider that renewables are penalized by technologies that are not yet ready.

Tab. 2. Power development targets (MW) from renewable sources

Source	2016	2017	2025	2030
Water	18,641	18,863	19,140	19,200
Geothermal	815	813	919	950
Wind	9,410	9,766	15,690	18,400
<i>Off-shore wind</i>	0	0	300	900
Bioenergy	4,124	4,135	3,570	3,764
Solar	19,269	19,682	26,840	50,880
Total	52,259	53,259	66,459	94,094

Data source: MISE-MIT-MATTM

Tab. 3. 2030 development targets for renewable energy production (TWH)

	2016	2017	2025	2030
Renewable production	110.5	113.1	139.3	186.8
Water (effective)	42.4	36.2		
Water (normalized)	46.2	46	49	49.3
Wind (effective)	17.7	17.7		
Wind (normalized)	16.5	17.2	31	40.1
Geothermal	6.3	6.2	6.9	7.1
Bioenergy	19.4	19.3	16	15.7
Solar	22.1	24.4	36.4	74.5
Gross domestic consumption of electricity	325	331.8	331.8	337.3
FER-E Percentage (%)	34.00%	34.10%	42.00%	55.40%

Data source: MISE-MIT-MATTM



For the importance of biomass in national energy production and for the achievement of the Community targets established for 2030, the above-mentioned data trace the development of this sector, aligning the research with the past and future expectations.

During last five years, the trends have been constantly increasing in reference to both the number of plants and the installed power: in fact, the recorded development rates were respectively equal to +120% and +87% compared to 2006.

However, unlike other types of renewable sources, biomass production is closely connected to the availability of raw materials and the sustainability of the production processes. Therefore, both the size of the plants and the availability of supply sources in the local area should be taken into account to avoid importation and diseconomies; hence, the importance of local supply chains.

Further issues relate to both the incentives system, that needs a clearer definition, and the underground locations, that make it both difficult to monitor the traceability of the supply chain and to produce punctual data and statistics. It would be appropriate to do an in-depth regulatory analysis: as it has already been said, a check on the reception of the National Guidelines – concerning the permissions of renewable energy plants – by regional governments has shown that among all regions, only Apulia and the Province of Bolzano have defined a framework introducing biomass plants¹.

2. Renewable Sources in Abruzzo

Abruzzo is considered «the green region of Europe». It is at the forefront of clean energy in order to provide the region with concrete help for the development and protection of the territory – in particular with wind energy. Recently, in Abruzzo there has been an explosion of initiatives for renewable energy sources. This increase in attention to this sector in Abruzzo is due to both the growing environmental sensitivity and to the advantageous Italian incentive system for these forms of energy production. In spite of this, there has also been criticism about renewable sources; the reason is that Abruzzo has a huge variety of environments with great landscapes, which have historical, cultural and architectural value; however, wind and photovoltaic plants may compromise these natural landscapes. This territory constitutes a harmonious complex, characterized by beautiful and valuable landscapes. If properly managed and enhanced, it can be a resource for the local population towards the proper development of sustainable tourism and economic innovation. The sharp drop after the financial crisis, which started in United States in 2007 and affected throughout the world in the second quarter of 2008, is also reflected in consumption in Abruzzo.

In Abruzzo, consumption went from 6,916 Gwh in 2006 to 6,252 Gwh in 2009; after a little recovery in 2010-2011, consumption fell again to a minimum of 6,240 Gwh recorded in 2013, with slow growth in the five-year period 2014-2018. From 2006 to 2013, the decrease in consumption, and consequently in demand, affected all the prov-

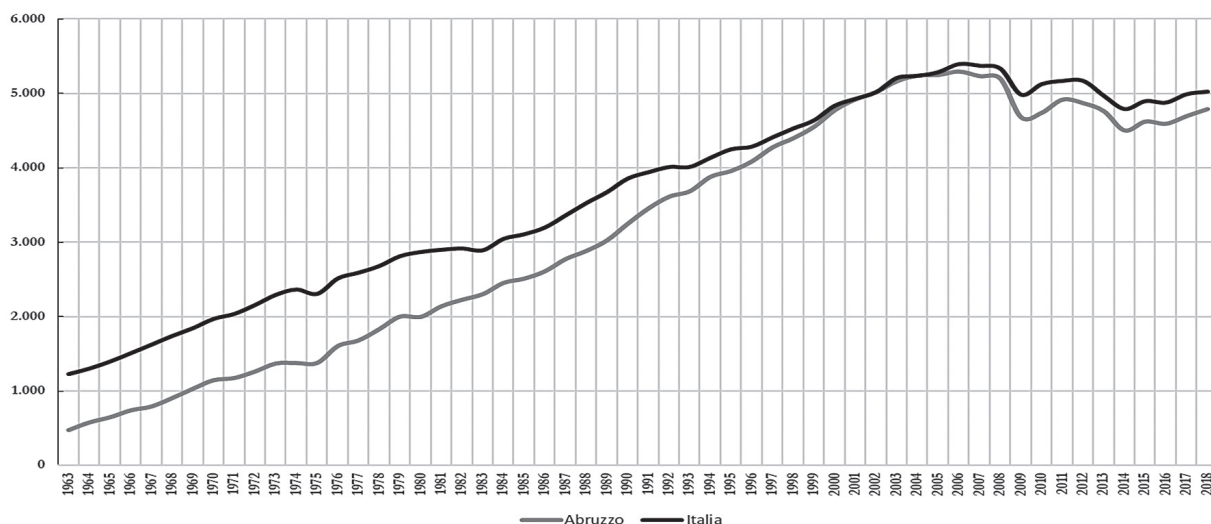


Fig. 2. Consumption per inhabitant in Abruzzo and in Italy

Source: data elaboration on *Terna*



Tab. 4. The distribution of renewable energy plants. Abruzzo-Italy comparison

Plants	Abruzzo		Southern regions and Islands		Italy	
	2008	2018	2008	2018	2008	2018
Hydroelectric	45	65	172	283	2,022	4,248
Thermoelectric	9	49	141	543	682	4,612
Renewable Water	51	71	175	286	2,184	4,331
Wind	16	47	220	5,205	242	5,642
Photovoltaic	608	20,138	7,604	226,533	32,018	822,301
Bioenergy	4	38	74	375	352	2,924
Geothermal	-	-	-	-	31	34

Source: data elaboration on *Terna*

Tab. 5. The installed power of renewable energy plants. Abruzzo-Italy comparison

Plants	Abruzzo		Southern regions and Islands		Italy	
	2008	2018	2008	2018	2008	2018
Hydroelectric	1,163	1,182	4,914	5,010	23,383	24,548
Thermoelectric	1,136	1,310	24,572	22,711	71,722	60,195
Renewable Water	1,002	1,014	2,887	2,976	17,624	18,936
Wind	155	255	3,481	9,931	3,538	10,265
Photovoltaic	10	732	135	7,439	432	20,108
Bioenergy	5	31	410	1,134	1,555	4,180
Geothermal	-	-	-	-	711	813

Source: data elaboration on *Terna*

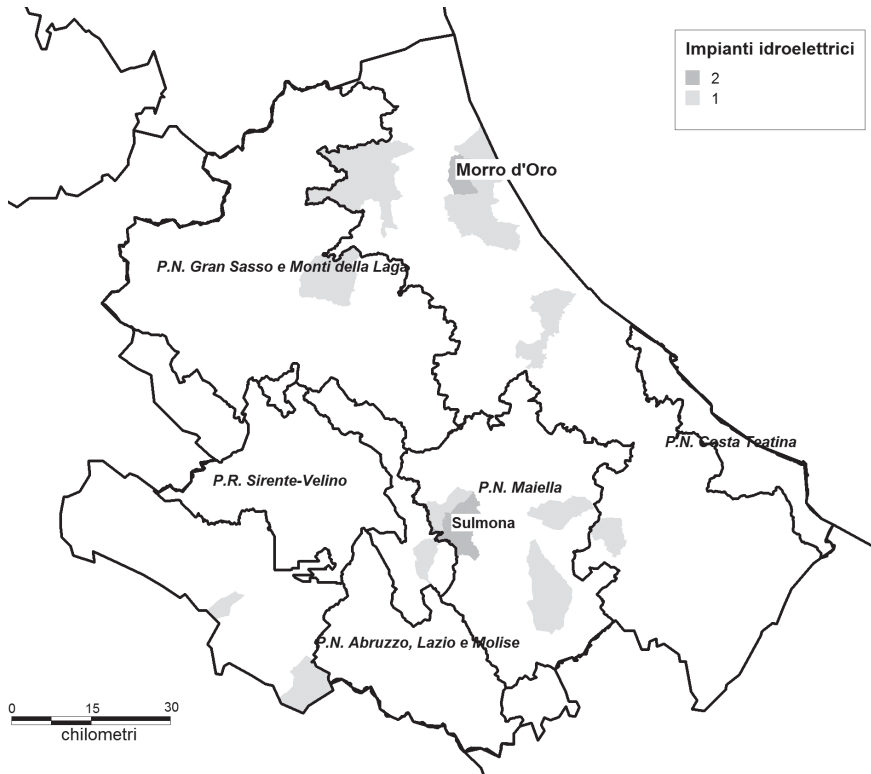


Fig. 3. Location of hydroelectric plants in Abruzzo

Source: data elaborated from Regione Abruzzo

inces of the region, even if with some differences. The Province of Chieti had consumption that went from 2,111.2 Gwh in 2006 to 2,070.0 Gwh in 2013; the Province of L'Aquila from 1,717.4 Gwh in 2006 to 1,478.3 Gwh in 2013; Pescara from 1,465.8 Gwh in 2006 to 1,148.8 Gwh in 2013; Teramo from 1,530.6 Gwh in 2006 to 1,440.3 Gwh in 2013.

The trend of consumption in Abruzzo follows the national trend: a sharp drop in 2009, after the world crisis, with partial recovery in the following years, followed by a further decrease (2013) and a limited growth in the last period. The Province of Pescara had suffered the main reduction, followed by the Province of L'Aquila and the Province of Teramo; instead, the Province of Chieti recorded the lowest reduction. The high level of consumption in the Province of Chieti is due to the industry sector with 995.9 Gwh (almost 40% of the total regional consumption) and the tertiary sector with 659.8 Gwh (3.4% of the total). If compared to the other provinces, Pescara has the lowest consumption in all sectors, except in the domestic sector. The energy from renewable sources produced within the regional territory is mostly hydroelectric, wind, photovoltaic, and bioenergy. This shows their boost compared to traditional sources and a growing trend to use over 50% of renewable sources, by 2030 (Regione Abruzzo Energy Plan 2020-2030). In 2018, the comparison with the Southern regions and with

the whole of Italy shows that Abruzzo had a significant increase in all renewable sources; indeed, there has been a particularly marked spread in Abruzzo of bioenergy and power plants (from 4 in 2008 to 38 in 2018).

2.1. Hydroelectric Energy in Abruzzo

Given its positive hydrogeological condition, Italy has developed hydroelectricity for the national production of electricity. Among the Italian regions, Abruzzo stands out for its number of hydroelectric plants on the territory; its richness in water represents a relevant resource, as many springs – located in areas that are inadequate for the anthropic process – are still intact. This precious natural resource is mainly used for regional water supply and for electricity production. Abruzzo exploits the hydroelectric potential of the territory; there are 65 plants in the region and the total hydroelectric production in 2018 was 1,182 Gwh, with a considerable increase during the last decade. The Province of Teramo gives the greatest contribution to hydroelectric production (37% of the total amount), followed by Chieti and L'Aquila, which respectively contribute with 24% and 22% of the total amount; the Province of Pescara generates the remaining 17% of the total hydroelectric production (Regione Abruzzo Energy Plan 2005-2010).

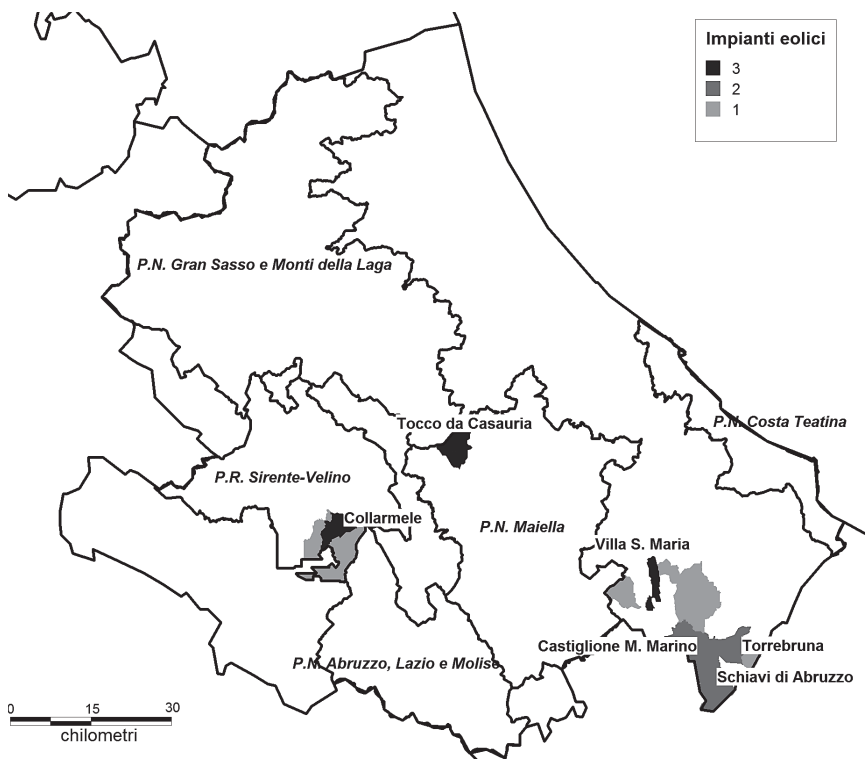


Fig. 4. Location of wind farms in Abruzzo
Source: data elaboration Regione Abruzzo



2.2. Wind Energy in Abruzzo

Wind energy is, among other renewable sources, the most technologically mature and economically competitive resource. During the last 15 years, the cost of wind kWh has decreased by 70% and, according to the EWEA (European Wind Energy Association), a large-scale production of wind turbines could allow a further reduction of at least 25% in the future. In Abruzzo, wind farms produce about 225 MW of energy, and some of those farms started their wind farm projects at the end of 1980s, reaping the benefits today. Abruzzo and wind energy come from far away and those in the branch are looking to increase this renewable sector. It makes good investment sense in the renewable sector, with the money deriving from the rent of the areas where the structures are built continue to expand; investors are looking forward to the revamping and the modernization of the plants to also revisit also the administration percentages. The wind farm sector, in accordance with regional traditions, does not interrupt the life flow, as it has remained the same as it was before innovation. Abruzzo approved the Guidelines that regulate the industrial plants integration for the production of wind energy within the regional territory by DGR 754 of 30 July 2007.

Wind farms have been noticeably spreading around Italy during the last decade. These wind

farms are principally located in the Central-Southern regions of Italy; they are also located on some Italian islands and in hilly or mountainous areas characterized by the availability of good wind-power resources. In Abruzzo, wind farms are located below 1,300 meters above sea level – according to Wind Charter – and they fall into two categories, according to their position; that is, they are placed on the highlands or on cliffs. The plants placed on highlands are mostly in the Province of L'Aquila, where they occupy large areas but with small lateral linear extensions; the others wind farms are located on the cliffs in the Province of Chieti, where there are some visibility problems due to their large linear extension. The wind farms in the internal areas of the territory affect the areas of parks, reserves, oases, migratory routes, brown bears. It is hoped that technology will coexist in harmony with wild Nature, without threatening it, as «She is the hostess».

In 2004, Abruzzo signed an Agreement Plan with the Ministry for the Environment, in cooperation with the Department of Agriculture, Forests and Rural Development Hunting and Fishing; this agreement was released in 2008 because there was a call to agricultural entrepreneurs to spearhead the development of self-production methods and for the use of a short chain supply. Since that moment, Abruzzo has started the development of biomass as an energy source. Currently, the use of

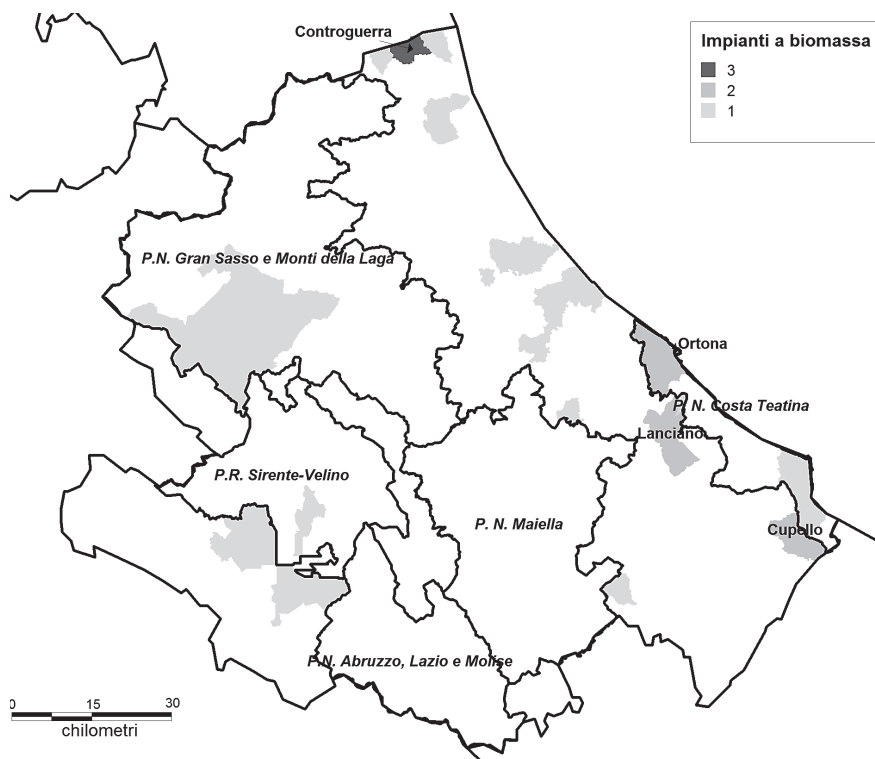


Fig. 5. Location of Biomass plants in Abruzzo
Source: data elaboration Regione Abruzzo

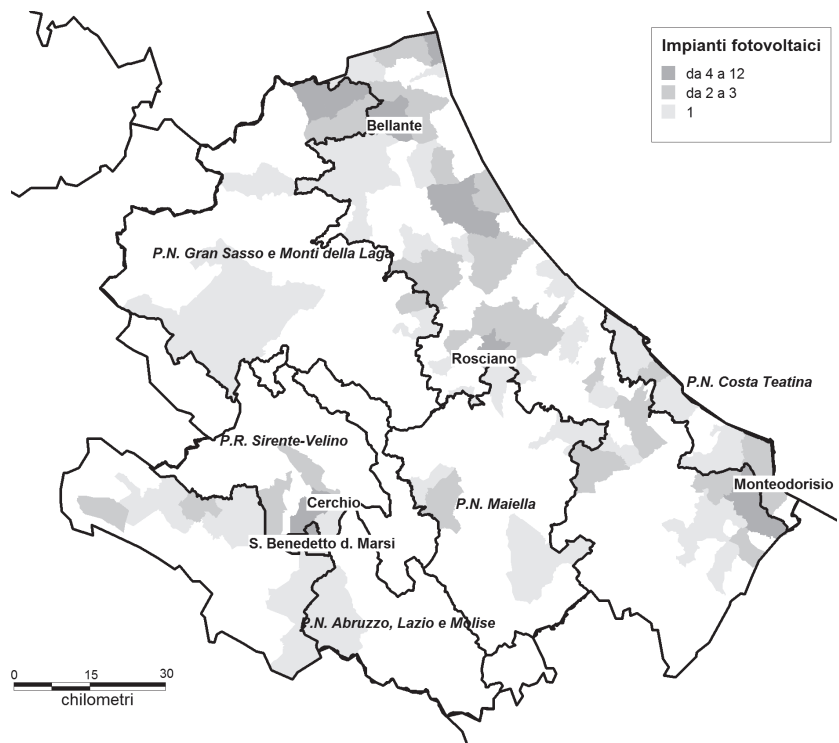


Fig. 6. Location of photovoltaic systems in Abruzzo
 Source: data elaboration Regione Abruzzo

combustible biomass for thermal energy production for domestic users is common, especially for the internal areas of the region.

Regarding Bioenergy renewable energy derived from biological sources, such as plant matter or animal waste, in Italy, the situation was quite good at the end of 2018. Considering the number of plants, if compared to the global renewable plant system, according to figure 5, in Abruzzo there are 38 plants with 31.4 MW of power, the regional bioenergy production was equal to 150.4 Gwh (in 2018), corresponding to 3% of the national total production. The electricity generated by the bioenergy plants was produced in very small plants, with power less than 1MW. At a provincial level, the plants are mainly powered by biogas and their electricity production covers 0.9% of the national energy generation. In particular, the best equipped is the Province of L'Aquila (with 0.4% on a national basis), while the other three are ranked low, with numbers hovering around 0.2%. The situation of energy production from plants powered by bioliquid is improving, both at the regional level (1.5%) and at the provincial level – even if there is an anomaly: in the Provinces of Teramo and Pescara alone is there a significant production (1.2%). Regarding the consumption in the residential and non-residential sectors (+5.2%), in Abruzzo there was a very positive trend in the period 2013-2018, (with +17.6% between 2017/2018),

this trend gained traction because of plants which were powered by solid biomass, with a power of 31.4 MW (GSE, 2019).

Aimed at encouraging photovoltaic technology, Abruzzo has promoted its renewable energy since 1998, through calls for public and private users, who are connected to the electricity grid and parts of building structures. In the early months of 2001, the Ministry for the Environment and the Protection of the Territory launched the «Photovoltaic Roofs» program, which gives contributions to promote the construction of small power photovoltaic systems (from 1 to 50 kW), connected to the electricity grid and part of building structures such as roofs, terraces, facades, street furniture, etc. At the same time, the regional promotion has continued, aiming at the development of renewable energy sources for small and medium-sized public and private users. As part of the «Photovoltaic Roofs» program, a series of projects have been approved to install photovoltaic devices in some municipal and provincial areas of Abruzzo. At the end of 2018, the photovoltaic systems installed in the region amounted to 20.138 (2.4% on national basis), with a power of 713 MW (3.6%) and a production of 857 Gwh (3.8% on national basis), an increase of 1.046 new plants in comparison to the year 2017 (see figure 6). Recently, Abruzzo ranks among the top southern regions for the growth in plants number and power. The best in



number of plants is the Province of Chieti (0.8%), followed by Teramo (0.7%), L'Aquila (0.6%) and Pescara (0.5%). Teramo is the highly ranked in power engaged (245.0 MW) (GSE, 2019).

3. Sustainable Development in Abruzzo. A Glimpse into the Future

With lower carbon emissions to fight climate change, Abruzzo, following the European priority aimed at «sustainable development», guides its policies towards measures capable of developing an efficient and competitive economy in terms of resources².

The regional strategies elaborated to achieve this macro priority follows two main directions: the first is towards the environmental dimension, which is accomplished by measures that concern energy policy, limitation of climate change effects, management of natural and anthropic risks, and sustainable management of soil, water and waste. The second direction is towards the biodiversity protection and natural and cultural resource enhancement, by strengthening the model of sustainable regional tourism use.

In recent years, Abruzzo has advanced in energy planning through the launch of important initiatives, strengthening also interregional cooperation. With reference to energy policies defined by the Regional Energy Plan (2009-2018), the cohesion policy in the 2020-2030 will be directed at the reduction of final gross energy consumption.

Those actions will be aimed at increasing the energy efficiency and the reduction of waste, following the Covenant of Mayors on the energy policy of sustainability and efficiency, by also creating a management system of certification processes; the Region signed such an agreement with ENEA – Italian agency for New Technologies, Energy and Environment in 2012.

In this context, there are various measures to be undertaken: the modernization and energy efficiency of the public property or of public use, the reduction of energy consumption in cycles and structures of production, the implementation of intelligent remote control networks, and the regulation and management of energy consumption in the urban sector. Upstream, it is appropriate to start a systematic action to evaluate the current efficiency of individual buildings, in order to identify the appropriate intervention methods and techniques to increase their performance and to optimise and reduce consumption.

These systematic actions will give priority to ur-

ban areas, historic villages, and crisis areas – in which interventions are made through territorial and integrated planning tools to maximise synergies and environmental benefits. The rise in regional renewable energy production is a priority that the Region intends to pursue, in accordance with the 2030 Union targets. New actions will be encouraged in collaboration with the agricultural sector to promote supply chains for energy re-use, heat production from a vegetable biomass origin (short supply chain-wood, production waste, etc.) and bio methane re-use in the companies, which could also be used outside their production sector. Interventions will take place firstly in the main urban centres, the coastlines subject to serious congestion, and the main areas where there is a relevant movement of people and goods (Programming service, Development and Community Activities, Secretariat Booth of Ex Ex DGR 388/2013).

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Note

¹ The size of medium plants has continuously decreased since 2009, in particular because of the installation of new plants powered with biogas, characterised by an installed power lower than 1MW; they have been created to be able to use comprehensive incentives, set by D.M. 18/12/2008.

² «In order to achieve the EU's binding target of at least 32% of renewable energy by 2030, which is referred to in Article 3 of Directive (EU) 2018/2001, States must make a concerted effort to meet the set EU gradually programmed targets. From 2021, the contributions of Member State's must follow a precise indicative trajectory. By 2030, this trajectory will consider the share of renewable source energies and gross final energy consumption of the Member State. Starting in 2022, the indicative trajectory is projected to reach a reference point of at least 18% of the total increase in the share of renewable source energy. Both the national binding target of the Member State for 2020 and its contribution to the 2030 target will be under scrutiny. By 2025, the indicative trajectory is projected to reach a benchmark of at least 43% of the total increase in the share of renewable source energy. Both the national binding target of the Member State for 2020 and its contribution to the 2030 target will be considered. By 2027, the indicative trajectory is projected to reach a reference point of at least 65% of the total increase in the share of renewable source energies. Both the national binding target of the Member State for 2020 and its contribution to the 2030 target will be examined. By 2030, the indicative trajectory must reach at least the expected contribution of the Member State. If a Member State expects to exceed its national binding 2020 target, its indicative trajectory may start at the level it expects to reach. All the indicative trajectories of the Member States must contribute to the achievement of the Union's reference points for 2022, 2025 and 2027. They must also contribute to the Union's binding target of at least 32% of renewable energy by 2030. Regardless of its contribution to the Union's objective and its indicative trajectory for the purposes of this Regulation, a Member State is free to set targets that are more ambitious for its national policy purposes» (Direttiva Unione Europea 2018/2001 del Parlamento Europeo e del Consiglio, dicembre 2018).

