

Biomass energy, agriculture and sustainability. A case study in the inside hill of Northern Campania¹

Abstract

Renewable sources of energy could promote local development providing that the planning is sustainable, respectful of issues concerning the environment, the landscape and society. At the same time the plan needs to evaluate the resources of the territory in order to create the basis for an economic development. The aim of this contribution is to offer an analysis based on quantity and quality and suggest a plan for generating energy from biomass in a hilly environment that helps to reveal the riches of the land left by man and time and assigns new values and functions to the territory which needs to be smarter, greener and more inclusive. In the light of the new planning trends and taking into account the European strategic directives, considering the assets of the hilly landscape and of the territorial vocations, this study looks at an area in the province of Caserta located in Northern Campania, where, alongside the potential production of energy from biomass the presence of the Roccamonfina Volcano offers the region outstanding environmental and territorial value. The move towards renewable sources of energy, if suitably planned in accordance with European standards could be the answer to the social and economic unbalance which still characterizes these realities, by making sure that the values of the ecosystems are preserved and by contributing to the innovation and attractiveness of these hilly areas in terms of occupation and economy.

Keywords: Energy planning, Biomass, Sustainable development.

Reference framework

The traditional energy sources (coal, gas and petrol), which have influenced the development in the past century, cannot successfully guarantee an energy supply, which is economically sustainable and in conformity with the process of the development (IEA, 2013).

The high cost, the limited resources (considering that they are non-renewable sources in due course), the increasing request of sources of traditional energy (even from developing-economy countries like China and India), the reliance on other States (which supply the main sources) politically unreliable and unstable, the highly polluting effects of combustion – in particular of the coal, in May 2013 the level of the carbon dioxide gathered in the atmosphere exceeded the parameter of 400 ppm (IEA, 2013) – the production of new technologies are the main causes that are determining a new energy transition process declined the sources of alternative energy, the efficiency, and the energy saving, processes that (for the above-mentioned reasons) cannot be minimized.

Our goal, therefore, keeping in mind the contribution of the economy and aware of the importance of the Geography – meant as the study

of space, of territory, of environment and of landscape – and in the energy-transition, and how its heuristic approach is binding in the matter of a new multilevel-economic planning, as confirmed in the studies and in the research conducted so far about the energy and geography (Bridge *et al.*, 2013; Blaschke 2013; Bradshaw, 2010; Solomon, Krishna 2010), aims to evaluate (through a quality-quantitative analysis) the possibility to combine the renewable biomass energy sources with an agricultural landscape – alias the totality of morphological, economical and social aspects of the agricultural business (Grillotti Di Giacomo, 1992), offering an energy plan of sustainable biomass. To demonstrate that it is possible to combine the biomass in an agricultural area, that we have identified for this specific case in the Town of Roccamonfina, which is located in the northern part of Campania, in the province of Caserta (Fig. 1), we will dwell on two aspects, as the literature concerning this sector states²: one, the theoretical type (which is intended to take into account the European, national and local information that is indispensable comparison tools for an energetic planning strategically effective) as well as it discovers in it useful territorial vocations, or dispositions, or inclinations, or invitations: more precisely of the potentialities

to furnish it certain productions or energies or facilitations (Gambi, 1972): «when a human society makes an environment its own, in some way, it does it because it recognizes, useful vocations [...] dispositions, or inclinations, or invitations: more precisely of the potentialities to furnish it some productions or energies or benefits». Once the biomass/territory, environment and landscape bond is clear, it will be focussed on the quantitative aspect that departing from the predispositions of the place, the potentiality territorial in energetic terms is defined.

PART ONE

The area of study and the normative context

The European Committee in the Communication known as «Planning Chart for energy 2050», (from now on «Energy 2050» where for a long term «the challenges to be faced to achieve the UE objective of the substitution of coal assuring at the same time the certainty of the energetic provisioning and the competitiveness is delineated», European Commission, 2011), it restates the im-

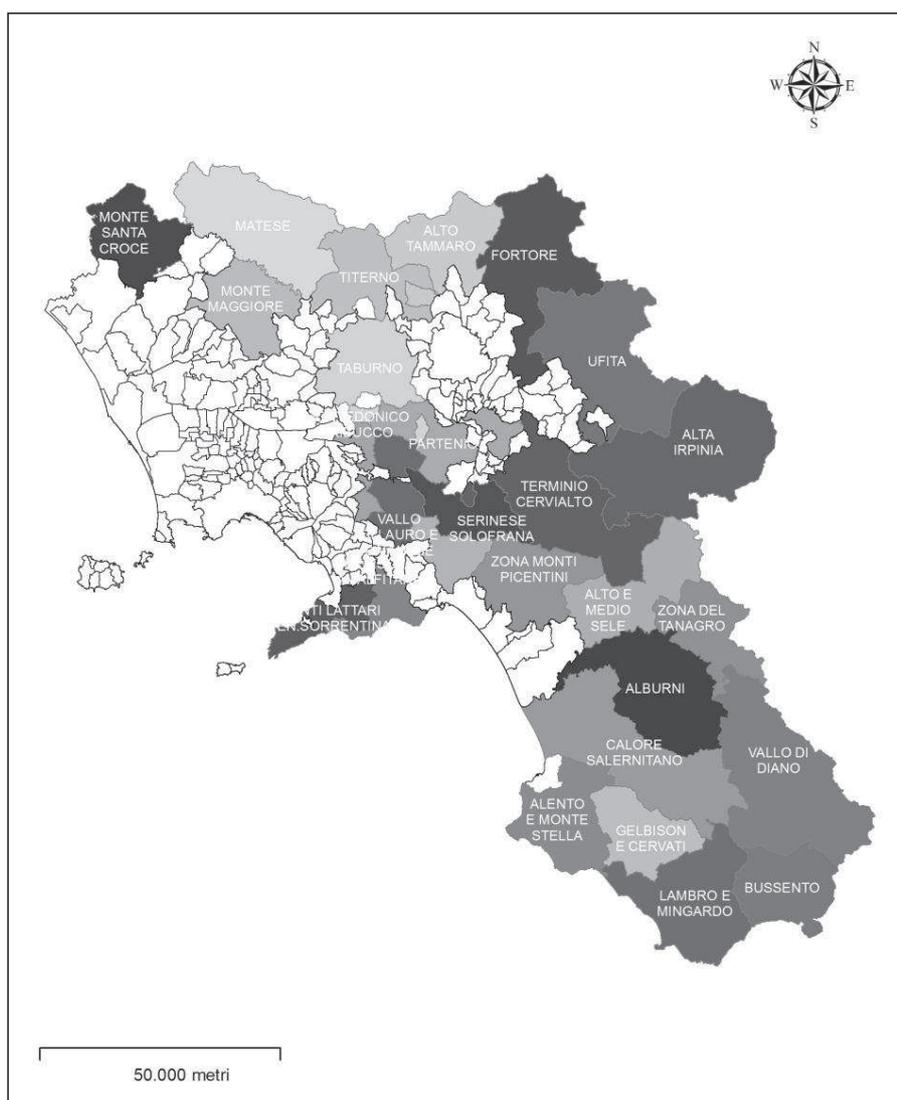


Fig. 1. The Mountain Communities of Campania (Source: Our elaboration on regional data). Roccamonfina is situated in the Northern part in the province of Caserta, in the Region of Campania. It is part of the "Comunità Montana" «Monte Santa Croce». According to ISTAT, the territory of the municipality of Roccamonfina is classified as an area of inland hills presenting a medium grade of urbanization. Considering the position of the Town of Roccamonfina, in taxonomic parameters, elaborated by the Ministry for the Cohesion for the defining of inland areas (see footnote 3), we can ascribe Roccamonfina in the internal towns of the South.



portance of energy as a motor of development to guarantee a good quality of life and an environmental and economic safety.

In order for this to happen, it is necessary to carry out an energetic planning, careful to the values of the territory and shaped to the new sources of renewable energy, as required by the environmental policies by the national legislative platform and by the economic conjuncture present at the moment.

In the National Energetic Strategy (from now on SEN, 2013) the decisive role for the economic and social development of the Nation, for the energetic sector through the reduction of the costs of provisioning of the energy, for the strengthening of the energetic safety of the Country, for the increase of production of energy from renewable sources and for the attainment of the environmental objectives pointed out from Europe is confirmed.

From this last strategy, through the Community Funds 2014-2020, important resources can be intercepted and destined to the social, economic and territorial cohesion, predisposing as the preliminary document and the method promoted by the Office of the Cohesion in December 2012 remind and known as «Methods and objectives for an effective use of the community funds 2014-2020»³ (from now on MOFC) actions aimed to intercept the aforesaid sources but above all to also get efficient and effective results in the energetic branch.

On a local scale the programmatic documents on energy recall and develop how much was promoted and strongly wanted by the top down planning.

The Regional Environmental Energetic Plan published in 2009 (from now on PEAR) outlines an energetic picture of a suffering Campania. The Energy's deficit for 2007 amounts to 60% in terms of necessary energy to the balance of the budget and 47% in terms of installed power⁴.

In order for the Campania region to be more independent from an energetic point of view significantly reducing imports outlined in PEAR, considering the European Directives, energy development strategies relying on renewable energy, the percentage of 35% for 2020, the regional electricity requirements. For this purpose, an increase of the general contribution of the renewable sources in the regional energetic budget of Campania from the actual 4% to 20% in 2020 is expected (PEAR 2009). A particular role is assumed by the biomasses of agro-forestry origin that have the assigned task, as stated in the of Rural Development Plan, 2009 (from now on PSR) of «to compete for the economic development of the rural areas and

to the diversification of the income of the agro-forestry businesses, also taking the opportunity for the reduction of several environmental (nitrates of agricultural origin) and forest (sustainable management) problem list».

In the regional energy planning, renewable energy represents a necessary action, also considered the set objectives (burden sharing) for each region which implement the European and national ones. Campania, in this regard, must achieve in terms of renewable energy equal to 16.7% in 2020 (Official Gazette, no. 78 of 04.02.2012).

In this regional horizon, characterized by energetic issues, the province of Caserta, of which Roccamonfina is administratively part of, covers an important role in the regional energetic requirement. As demanded by the Provincial Environmental Energetic Plan (from now on PEAP) around the 55% of energy produced in the region originates from the province of Caserta, despite the fact that the production is fundamentally carried out through conventional (hydroelectric and thermo electric) sources. Our research and study, strong on the European background, national and local indications, aware of the strategic role of energy, especially of the renewable one, in the territorial planning of economically and socially fragile reality like some areas of the Mezzogiorno (south), declines, as we have already anticipated in the introduction, on the synthesizable theme in the binomial renewable energies/agricultural internal areas⁵.

The choice has also been influenced by the supranational experience, where the application of the technologies to the renewable sources of energy and the actions of energetic efficiency had requested a territorial governance.

For this reason we can remember, and as an example, the experience promoted by the European Committee of the «The Covenant of Mayors» where the adhesion of many Municipalities (5716 to the date of May 25, 2013) of the twenty-seven European countries - in Italy 2736 Municipalities participated.

This study follows the innovative formulation of the governance quoted above and it experimentally applies it to a marginal Municipality of a poor agricultural internal area: the Municipality/Town of Roccamonfina. The latter, for its position and for its environmental, demographic and economic condition belongs in that taxonomy of the inside areas of the South (Mezzogiorno).

The selected Town, Roccamonfina, situated in the Northern part of the province of Caserta and which is part of the *Comunità Montana* «Monte San-



ta Croce» belongs to a climatic type “E” zone or to a class that, for atmospheric conditions, needs a great quantity of heat for the heating system (DPR 412 of the '93). It is therefore necessary to find energetic solutions that are sustainable with the environmental charts and at the same time advantageous for the local economy.

Therefore, the energy transition to new renewable energy sources can be, if properly conjugated with the territorial vocations, a driving economic and social development. To such intention, we quote a passage from the poet Arminio, a humanist of the landscape, who, on a conference on the internal areas, affirmed, in a writing titled «Ideas for the internal Mediterranean», that there should be a tax of thirty thousand euro a year for every windmill blade and to use these funds to improve services for the elderly. This, apparently simple statement, conceals within, a strong cultural semanteme that interprets a bond between the new technologies and local resources, among guardianship, safeguard and development, between innovation and conservation. These themes can rightly be considered as key words of the present contribution which will focus on the energy and on the energy potential, on local resources, on economic and social development, on safeguard and on the environmental protection. As the poet Arminio says «a plot of politics and poetry, economy and culture, scruples and utopia».

Energies from biomasses in the internal agricultural areas. A geographical analysis

In general, the FER and in particular, biomasses, for their nature, have an inseparable relationship with the territory because they are originated in the same environment. It is certainly not sufficient to appraise only the potential of the biomass resource, already on its own, a complex operation, but there are also a series of variables that need to be considered in order to opportunely conjugate the biomasses in the inside areas.

In the search of the best location for the biomasses, the analysis of the proximity between source and distribution also plays a fundamental role. It is not enough to know the potential of biomass of the territory to define it functional for the production of the FER. It needs to also keep in mind some organizational structures of the place, of the infrastructures in order to make the transformation, economically advantageous and sustainable (Stephen *et al.*, 2010). Transporting raw materials from a specific place to turn it

into something else, and having the vehicle that is destined to the transfers, fuelled with traditional fuels becomes non sustainable action from an environmental point of view – the transport sector is responsible for about 30% of carbon dioxide in developed countries (Anable, Bristow, 2007) – economically disadvantageous and, the place of the production of raw material, finally, won't have a true benefit in terms of occupation and local development (Ness, Brogaard, 2008).

The preferred form of distribution of the renewable energy from biomass would be from an energetic source connected directly to the distribution network, through a short supply chain, on a regional base (Puttilli 2009), provincial or also municipal, as in our operational hypothesis, guaranteeing a local economic development both in terms of occupation and in terms of energetic saving.

The biomass, as every FER, can generate conflicts with the territory, and particularly with the internal agricultural areas, that often introduce undeniable environmental values, therefore, for the biomasses, the pressure of the agricultural biodiversity, in a territory of merit and quality as that of the Municipality/Town of Roccamonfina, the deforestation, as well as the quality of the air and water need to be considered.

Bearing in mind the strong concern of FAO (2008) about food safety, it would be necessary to preserve the current extensive crops and to introduce cultivations for energetic purposes that have a low environmental pressure (EEA 2008) and are part of the local plant and animal life.

Besides the elements of conflicts, for the analysis of the biomass-territory relationship, it is surely important to consider the potential synergies between the resources and the internal areas.

Specifically, we remember, for example «the General Forest Plan 2008-2013», whose draft of document contains an action (10) to approach the increase of the production of combustible biomasses in Campania, taking this practice as a favourite and taking into consideration the good existing potentialities in the Region in terms of production of biomass and foreseeing the improvement of the existing woods and the amplification of the forest surfaces.

Also «Park Areas» and «SIC» can be finalized for obtaining biomasses for the production of renewable energy, provided that the intervention does not have remarkable effects on the objectives of maintenance of the same site. Therefore, it allowed the cultivation care to public and private woods, consisting in operations of thinning the



coppices and in the fustaies that allow the recovery of the branches.

In this way it would create a synergy among inside areas, resources and energy and the interest of the energetic policies of the local development and of the guardianship of the environment and the landscape would be safeguarded.

Finally it is important to consider the organization of the territory, in relationship to the source of renewable energy on a different scale. It becomes mandatory, therefore, to appraise the presence of businesses devoted to the production and the exploitation of elements destined to the biomass FER and of cooperatives that implement interventions aimed in improving the energetic efficiency.

Elements, these last, useful to estimate if the local territory is predisposed for a short supply. It needs to appraise the presence of the local policy maker, of the stakeholder able to set in relationship the central State with the community and with the local authorities to sensitize, to convey, to promote, to overcome possible conflicts and to create, at the same time a network of interdependencies (Reho 2009).

Holding in the due consideration the kaleidoscopic complexity of the production of biomass energy, as shortly recalled, and aware of the difficulty of the operation system of a short chain, it is necessary to recall, at this point, even though shortly, the strength and weakness of the territory through an analysis that keeps in mind the values and the environmental brittleness, cultural, social so that it is possible to conjugate in a sustainable way, overcoming conflicts and resistances, the internal agricultural inside energy/areas.

PART TWO

The town of Roccamonfina. Territorial analysis for a sustainable energy planning

According to ISTAT, the territory of the municipality of Roccamonfina⁶ is classified as an area of inland hills⁷ presenting a medium grade of urbanization⁸. Considering the position of the Town of Roccamonfina, in taxonomic parameters, elaborated by the Ministry for the Cohesion for the defining of inland areas (see footnote 4), we can ascribe Roccamonfina in the internal towns of the South because it does not present a number of basic facilities such as secondary schools, a hospital with emergency department, a type silver⁹ railway junction.

The MOFC in the citation which we have gathered in the inland areas (note 4), clearly speaks about resource endowment. The economical aspect of our discussion, of the internal agricultural areas defined energy as an engine of development. We believe that it is useful, even though briefly, to draw our attention on the environment, on the territory and on the landscape of Roccamonfina, on one hand because the action energy is sustainable and consistent with the territory and on the other hand because we want to confirm how many internal areas of our country represent a real patrimony to support, protect and at the same time to develop. For this reason, before looking at the *strictu sensu* of the energetic potentialities, it is useful to draw our attention and highlight the strengths and weaknesses of the town of Roccamonfina referring to three SWOT charts which show, in a synthetic way, as the economical contribution requires, the geographic picture of the municipality of Roccamonfina.

The biomass potential of the municipality of Roccamonfina. A theoretical analysis¹⁰

One of the problems in the analysis of the biomass potentiality is its evaluation of some variables which are not easily ponderable, such as the re-use of part of the biomass in the production business cycles, in the uses of energy, in the combustion for the production of thermal energy in fireplaces or stoves. In a specific ISTAT case study relating data was not only compared to the town of Roccamonfina for its relation to its site but, also for its location. For this reason, we have compared the census data of the other municipalities that are part of the unit of the Mountain Community "Monte Santa Croce" in which Roccamonfina is part of. Finally, this data was contrasted with the standard, provincial parametrics of Caserta. The choice of this multi scale analysis (Municipality, Province and the Mountain Community) lies in the fact that even though, an analysis that is conducted on a municipal scale (which is always necessary and which has to be declined to the values of sustainability), deals with a broader vision that certainly goes beyond the municipal limits. In addition to this date, many quantitative data are not available on a municipal scale and this creates many problems in the analysis of the potential. In this study, we have used a tool, that is a software known as AGRIRES destined to a quantification of the potentialities of residual type agricultural biomass, in order to hypothesize a further local



Strong Points	Presence of natural resources of great landscape and nature value Park Area Presence of cultural resources Strategic position	Low sustainable appreciation of the resources of high natural value. Inadequate infrastructural facilities. Poor dissemination of environmental awareness. Phenomena of illegal activities. High production of waste and low percentage of recycling. Deficit of production and supply of clean energy. Water stress epigeo. Little safeguard for biodiversity. No regard for natural resources for the creation of job opportunities. High dependence on energy from traditional sources.	Weak Points
Opportunities	Importance of territorial, environmental and landscape dimension for the strategies in the town's development Development of information for the society.	Loss of biodiversity due to human impact. Loss of competitiveness in the tourist- sector due to environmental and social degradation	Threats

Fig. 2. SWOT analysis relating to the environment, to the territory and the landscape of the town of Roccamonfina (*Source: Our elaboration*).

Strong Points	Unoccupied dwellings Valuable environment Increase in university and secondary school graduates Increase in the size of the family	High aging index High dependency ratio of the elderly Decreased fertility index values Negative demographic balance Lack of entrepreneurial function For professional positions	Weak Points
Opportunities	Unoccupied dwellings Valuable environment Increase in university and secondary school graduates Increase in the size of the family	Social discomfort Decline in birth rate in the absence of Social Welfare Economy is not developed	Threats

Fig. 3. SWOT analysis of the population of the Town of Roccamonfina (*Source: Our elaboration*).

energetic evaluation of the residual biomasses (Colonna, Regina, 2011; Colonna, Del Ciello and Petti, 2010).

Going into detail for the use of the woody crops areas, the following charts show data related to the following periods of investigation. Only some of the woody biomasses have been estimated, those mostly present in the territory and at the same time the most appropriate for the production of thermal energy.

Once the background is known, the hypothesis of an energetic planning starts from a local dimension, and therefore the following planning hypotheses are valued for elements of develop-

ment/change relevant only in the territory of the municipality of Roccamonfina for its position and climatic zone¹² needs a sustainable energetic action more than others. From the comparison of the reported data there is an obvious reduction of the SAU between 2000 and 2010. Such a reduction is compatible with the desertion of the land, in contrast to the agricultural development policy of the last period. Other forms of work activities, more profitable and more rewarding, attract the younger age groups that tend to split the traditional family farmer with a consequent reduction of cultivated areas. Furthermore, the reduction of the SAU is also due to, as the field research has



Strong Points	Tourism with untapped potential (religious tourism, rural, nature, sports). Abundance of local quality products (chestnuts).	High unemployment. Weakness of the business sector. Lack of use of the primary resource (Chestnuts). Low evaluation of resources and cultural sites. Lack of ability to boost natural tourism sector. Low presence of innovative financial tools. Low propensity to the aggregation and to the integration, in order to create clusters and supply chains. Poor diffusion of technology and innovation. Little inclination to entrepreneurship.	Weak Points
Opportunities	European, national and regional policies for sustainable tourism development	Decreased Regional competitiveness system. There is the risk that the competitive areas will adapt easily and quickly to the tourism evolution.	Threats

Fig. 4. SWOT analysis of the production system of the Town of Roccamonfina (*Source*: Our elaboration).

Tab. 1. Comparison BUSINESS AREA depending on the use of the land of the Municipalities which are part of the Comunità Montana Monte Santa Croce and of the town of Roccamonfina.

	SAU a arable	SAU a permanent cultivation	SAU permanent pastures and fields	Woods	Other Surfaces	Total Surfaces
Comunità Montana 2000	4049,10	5851,79	2155,28	5632,78	404,16	18987,67
Comunità Montana 2010	2340,54	5322,50	1860,44	2537,07	449,28	12754,33
Roccamonfina 2000	29,58	1930,19	0,32	276,32	35,04	2300,28
Roccamonfina 2010	18,85	1325,05	16,48	144,88	50,06	1574,83

Source. ISTAT, Agriculture Census, 2000 and 2010.

Tab. 2. Town areas occupied by woody crops agricultures land capable to produce woody biomasses for thermal uses.

Municipality (Town)	Grapevines (ha)	Olive Trees (ha)	Fruit trees (ha)	Woods (ha) ¹¹	Total
Conca della Campania	49,16	180,76	467,19	242,19	939,3
Galluccio	174,61	196,82	226,3	276,77	874,5
Marzano Appio	24,53	75,28	579,77	200,65	880,23
Mignano Monte Lungo	94,08	214,99	205,96	2447,74	2962,77
Presenzano	37,26	119,97	391,34	975,37	1523,94
Rocca d'Evandro	122,75	143,97	14,33	601,41	882,46
Roccamonfina	1,69	6,65	1921,85	276,32	2206,51
San Pietro Infine	14,37	332,09	1,98	348,21	696,65
Tora e Piccilli	45,85	71,12	107,05	264,12	488,14
Total	564,3	1341,65	3915,77	5632,78	11454,5

Source. ISTAT, Agriculture Census 2000.



Tab. 3. Town area occupied by crops woody agricultures and forest land capable to produce woody biomasses for thermal uses.

Municipality (Town)	Grapevines (ha)	Olive Trees (ha)	Fruit trees (ha)	Woods (ha)	Total
Conca della Campania	28,13	182,29	587,98	140,2	938,6
Galluccio	194,47	158,98	281,77	169,96	805,18
Marzano Appio	8,86	43,6	783,18	92,51	928,15
Mignano Monte Lungo	49,11	160,16	284,75	412,16	906,18
Presenzano	7,05	116	384,59	605,67	1113,31
Rocca d'Evandro	51,89	88,07	25,89	289,55	455,4
Roccamonfina	7,83	74,72	1250,33	144,88	1477,76
San Pietro Infine	4,93	226,94	0,91	351,02	583,8
Tora e Piccilli	12,27	62,92	244,88	331,12	651,19
Total	364,54	1113,68	3844,28	2537,07	7859,57

Source: ISTAT, Agriculture Census 2010.

confirmed, a strategy of the farmer to reduce the tax burden of their properties. On the basis of the elaborations and taking into account that most of the pruning and trimming of larger sizes have already a local energy use and also part of the branches and shoots have an alternative use, ISTAT estimated data in 2010, indicate that there is an additional potential including between 60 and 100 kilotons per year of pruning available from all vine, and Olive-bearing areas. For only the municipality of Roccamonfina the value of the potential gross settles on 23 ktonne/year for woody biomass type (Fig. 5).

A planning that tends to recover some aban-

doned land, with a new use of the SAU lost between 2000 and 2010 to build an energy chain, located in the town of Roccamonfina can be hypothesized. The assumptions and the consequent processing/simulations are made, as already mentioned, in order to protect the biodiversity of the landscape. The existing crops and focuses only the surface SAU lost in the period between the fifth and sixth ISTAT census of agriculture, preserving thus the landscape and its environmental importance is retained. Additional woody biomass were estimated on an annual basis, from the pruning of vineyards, olive groves and orchards, in the town of Roccamonfina derived from a reuse of 250 ha

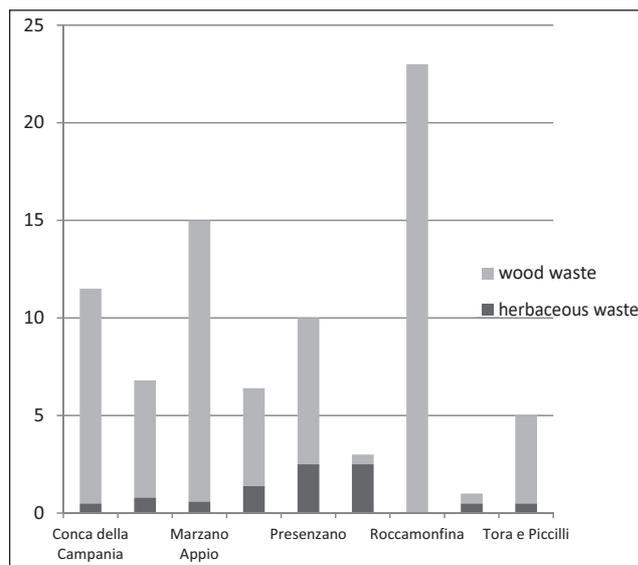


Fig. 5. Gross potential agricultural residues for the area of interest (Source: ISTAT data 2010, processed by ENEA).



of abandoned. On the basis of ISTAT data it is taken into account that the dynamics of permanent cultivations is usually very slow and residues were evaluated by both the annual pruning and that from the explants of the fruit trees based on the average parameters already used in other studies. The first hypothesis was made with a breakdown in the use of 100 ha of woods, 50 ha for vines, olive trees and 50 ha to 50 ha to more fruit trees. This allocation is distributed in percentage terms over the whole surface SAU investigated an increase of 3.9% of the woods, 13.7% for the vines, 4.5% for olives and finally 1.3% for fruit-bearing trees. The data processing was carried out with ENEA software for the evaluation of the potential of biomass from agricultural residues provides an increase estimated of 1000 tons/year (Fig. 6).

A second planning assumption, of course,

also linked to the conditions of energy-territorial planning, increases the total area in terms of component SAU and SAT introducing an increase/reuse on the initial surface not in absolute terms but as a percentage of the total, and quantifies the woods in +5%, +15% over the vineyards, +5% for olive groves and orchards, respectively, for a total of about 430 acres between SAT and SAU. This simulation produced a further increase in the gross potential resulting from agricultural waste for a total of 3.8 ktonne/year, of which 3.38 ktonne/year of potential income available to the territory.

The results shown in Fig. 7, give the gross biomass potentiality from agricultural remains. Subtracting the amount that already has a position/use the net potentiality for the territory is obtained, available and distributed on the entire

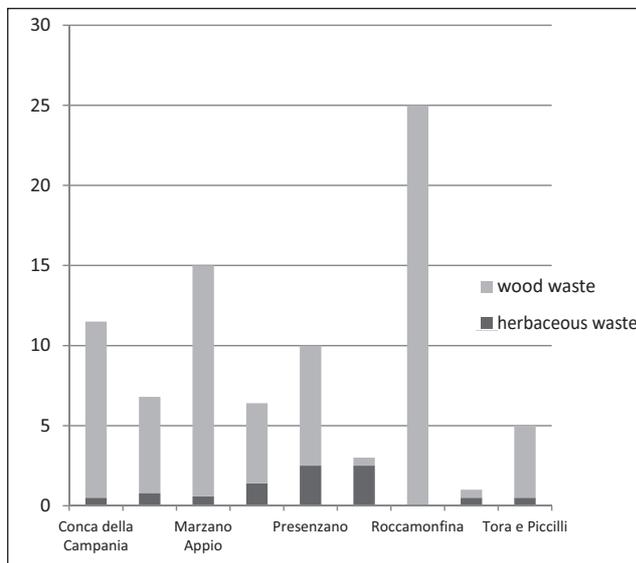
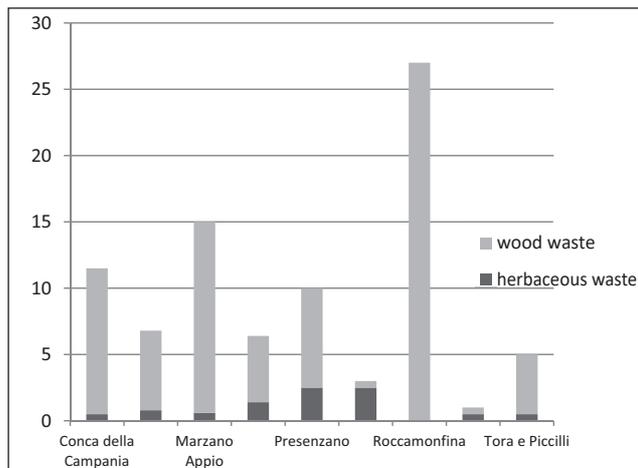


Fig. 6. Gross potential agricultural residues for the area of interest (Source: ISTAT data 2010, processed by ENEA from the first hypothesis of increase SAU).

Fig. 7. Potential gross agricultural residues for the interested area (Source: ISTAT data 2010, processed by ENEA from the second hypothesis of increase SAU).



municipality under analysis and, therefore, does not take into account the logistics for subsequent use. In fact, biomasses should be collected, transported and concentrated in sites close to processing plants taking into account the season when producing. These factors affect the technical and economic convenience in the use of agricultural remains. Evaluation which is necessary and interesting, but is not considered in this first phase. To obtain the amount of energy content in the biomass remains, (the type, size, composition and moisture of the harvested biomass should be taken into account), an average value of the energetic content was used, the PCI (lower calorific power) equals to 18.25 MJ/kg. The two hypotheses of increase of the area used have produced a net increase in the potential available to the territory of 0.9 kt and 3.3 kt, respectively, and therefore the total potential energy about 405 TJ in the first case and about 445 TJ in second hypothesis (Table 4).

Referring to the category regarding woods, only the woods in the internal part of the agricultural property were considered (tab. 1). It is specified that there are also woodlands with cutting cycles that are from about 20-25 years in which the level of maximum use is low and could be increased without affecting the equilibrium of the woodland. In addition, the use of branches left behind in situ in the cutting phase, can produce further quantities of residues that are useful for an energetic value, considering the prohibition of burning, in the place of production, plant residues and pruning from agricultural activities, as required by the legislation in force (185 del D. Lgs n. 152/2006). It is evident, therefore, that the quantities of biomass available in the area (and which could meet the heating requirements of farms/households of the Town) would be far more significant if also residues from the processing of chestnuts and hazelnuts as well as olive pomace (which has been deliberately neglected in this study) are considered.

Conclusions

The territorial analysis and quantitative assessment of the potential from biomass of the municipality of Roccamonfina and as suggested, national and European stated on renewable energy sources can lead us to assess, in a positive way, the theoretical and technical potentiality of this town with relation to biomass energy. The study theoretically showed that in this area the biomass energy planning can be practiced and can represent a sustainable practice as it would use, partially, agricultural wastes that are a problem for local farmers for the disposal, due to the recent rules/laws prohibiting burning on agricultural soils. In addition, the proposal to increase the SAU with crops already on site would ensure the quality of the landscape and at the same time the diversification of crops, avoiding those critical issues and conflicts that arise regarding energetic biomass cultivations. Our proposal would be in agreement with the local, national and European legislative platforms, and the realization of a biomass power plant in this area could represent a driving force for the local economy which is, at the moment, fragile. In order to obtain and in particular to assess the potential on a municipal scale, such as the one chosen, given the statistical data available, which is not enough, given the scale of the study, further investigation is needed on the ground and an analysis through geographic information systems that allow to integrate, implement and assess in great detail and in particular, the potential at a municipal scale. It is well aware that an energy planning in order to be sustainable, must also consider costs and management, as well as the monitoring of the consumption of biomass and their origin, the actual surfaces involved in the cultivation/production, more generally, the knowledge of the development of use and consumption of the ground and urbanized areas using other detection systems that also cover the uses of land provided by the municipal planning

Tab. 4. Potential gross and net energy for the municipality of Roccamonfina only for agricultural wood residues.

Town of Roccamonfina	Gross Potential (kt)	Net Potential (kt)	Potential energy (TJ) Agricultural wood residues (TJ)
Initial Situation	23,67	21,21	387
I hypothesis	24,78	22,19	405
II hypothesis	27,47	24,59	445

Source: ISTAT, 2010 processed by ENEA.



instruments. Sure enough, in the present study the reduction of agricultural land involved small/medium-scale is justified by the abandonment of the agricultural activity because of more profitable activities (feedback cross-demographic data feedback), while the larger surfaces covered a different intended use of the soil following of significant type human activities (decision-making and planning, creation and development of industrial areas, craft, PIP, with feedback on socio-economic elaboration). Whereas the inland areas and also the depressed can compete as long as they are based on a plan that uses tools of ex-ante evaluation of innovative and already on the market.

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Notes

- ¹ The work is the outcome of joint reflection. Andrea Riggio is the author of part one; Pierluigi De Felice is author of part two.
- ² In 2010 a study entitled *Biomass Energy Europe. Status of Biomass Resource Assessments*, was published, edited by Rettenmaier N., Schorb A., Köppen S., declined on the theme of the biomasses and on the studies to it devoted. It is read in the research that is necessary to appraise the theoretical potential for a coherent, effective and sustainable analysis of the biomasses, technical, economic and practicable (cfr. also Colonna, De Felice and Forni, 2013).
- ³ The document proposes a method to intercept and to use in effective and efficient way the funds coming from Europe and destined to the different thematic areas individualized by the European union. Of these last ones we remember, particularly, the one committed to the support towards a transition for a low emission of carbon. The anticipated actions for this thematic

area can be synthesized in the followings points: 1) to improve the energetic efficiency and to promote the use of intelligent energy; 2) to improve the sustainable exploitation of the biomasses in the rural areas; 3) to improve the energetic quality of the urban environments and to increase the electric mobility; 4) to consolidate eco-sustainable technology productivity chains and increase the required energetic quote covered by renewable sources.

⁴ In reality, calculating the producibility of the FER plants already authorized but not yet completed/realized, reaching an amount of 1485 MWps from renewable sources the deficit of power can be considered below this percentage, reaching the park of the sources renewable quota, 33% of the deficit would be covered in fact from FER plants (Regione Campania, 2009).

⁵ Considering the complexity of the definition of "internal areas" and keeping in the correct consideration the different institutional taxonomy and academic aspects (OCSE, MIPAF, EUROSTAT), in order to reach the goals we recall, also aware of the limits and of the natural impermanence, the declaration of internal areas data in the document already quoted MOFC: "that part of the Town, around three fifths of the territory and a little less than a quarter of the population – distant from centers of agglomeration and service and with unstable trajectories of development but at the same time endowed with resources that the central areas miss it, "rugged", with demographic problems but at the same time strongly polycentric and with an elevated potential of attraction".

⁶ The municipality of Roccamonfina, in the province of Caserta, has a land area equal to 30.94 square kilometers and a population density of 117 inhabitants/km² if we consider the resident population in 2011 numbered 3626 units (ISTAT, Census 2011). The population density of the province of Caserta stood, according to ISTAT census data (Census, 2011) to 342 inhabitants/km². This municipality is part of the taxonomy of the small towns of Italy, which represent 70.3% of the national municipalities (The Atlas of Small Towns, 2011).

⁷ ISTAT has divided the country into homogeneous areas resulting from the aggregation of contiguous municipalities based on threshold altimetry values. The maximum elevation spot of Roccamonfina amounted to 1006 m, while the minimum at 303 m. The elevation of the city is 612 m. See ISTAT, 2009.

⁸ ISTAT has based the degree of urbanization on population density and contiguity between areas by classifying the territory into three types of areas. An area is formed by a group of local contiguous areas.

⁹ According to the classification given by the Italian Railway, in the category of station SILVER, includes all other medium-small plants with an attendance average for metropolitan services-regional and long-distance less than that of GOLD category.

¹⁰ The data for these analyzes were drawn up together with the research department of ENEA from people, in particular, of Engineer Andrea Forni and Pasquale Regina where senses of gratitude must be confirmed.

¹¹ Resuming the ISTAT definition, it is specified that in Tables 2 and 3, the data for the column woods indicate the surface in the woods adjacent to farms.

¹² Taking into account the taxonomy of the municipalities according to climatic zones, as shown in Table A attached to the DPR 412/93 as of October 31, 2009, the City of Roccamonfina belongs to band E.

