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Ente per le Nuove tecnologie, l'Energia e l'Ambiente

Ministero dello Sviluppo Economico

RICERCA SISTEMA ELETTRICO

IEA Wind Energy Annual Report 2008

Italy Chapter

Luciano Pirazzi, Claudio Casale

Report RSE/2009/17

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IEA WIND ENERGY ANNUAL REPORT 2008 - ITALY CHAPTER

Luciano Pirazzi (ENEA)

Claudio Casale (CESI RICERCA)

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Area: Usi finali
Tema: Determinazione dei fabbisogni e dei consumi energetici dei sistemi edificio-impianto, in particolare nella stagione estiva e per uso terziario e abitativo e loro razionalizzazione. Interazione condizionamento e illuminazione
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Italy Chapter 2008

1.0 Introduction

Italy, more than many other European countries, is very poor in indigenous resources, and so is highly dependent on foreign countries for its energy needs. The development of an energy policy for the exploitation of renewable sources is aimed at the achievement of two main objectives: a significant contribution from RES to satisfy energy demand,--even though in 2008, for the first time ever, the domestic electricity demand was slightly less than in 2007 (-0.7%)-- and an improvement of environmental indicators, by reducing air and water pollution through the replacement of older conventional generating plants.

In 2008 the electric energy generation from RES was quite good and much better than previous years. This was mainly due to a strong increase of electricity production from hydropower and also, but to a much smaller extent, from wind, taking into account the different relative weights of these two clean sources. In fact, the production from wind grew by 63% in comparison to 2007, according to 2008 provisional electricity statistics provided by Terna (Italian Transmission System Operator), while that from hydro increased by only 18%. However, in absolute terms the production from hydro was 45,511 GWh (albeit including also the output of some pumped-storage plants), with growth in 2008 of some 7,000 GWh, while production from wind was 6,637 GWh with growth of around 2,500 GWh.

Hydro, with about the same installed capacity as 2007, had a substantial production growth as a consequence of favourable climate conditions, mainly thanks to more rainfall and snow in the last months of the year. Wind energy also enjoyed a particularly windy year, but its substantial growth in energy contribution was mainly the result of a massive increase in power capacity. More than 1,000 MW was put into operation in 2008, thus establishing a new annual record (Table 1).Wind power capacity rose in 2008 by a surprising 37%, also because many wind farms, totalling around 370 MW, were connected to the grid in December.

Table 1 Key Statistics 2008: Italy

Total installed wind generation capacity	3,736 MW
New wind generation capacity installed	1,010 MW
Total electrical output from wind	6,637 GWh*
Wind generation as % of national electric demand	1.9%*
Formal wind target according to the 1999 RES White Paper:	2,500 MW or 5 TWh by 2008–2012
RES target according to Directive 2001/77/EC and Legislative Decree 387/2003:	22% (76 TWh) of gross electricity consumption from RES by 2010
Maximum wind potential according to the 2007 Position Paper of the Italian Government:	12,000 MW or 22.6 TWh by 2020
*Provisional data	

As to the whole electricity system, according to Terna's provisional data, the 2008 electrical demand on the domestic grid (including both customer loads and grid losses) was about 337 TWh, 0.7% less than 2007, corresponding to the same demand as 2006. The balance between imported and exported electricity improved, as it was almost 40 TWh, 14.5% less than 2007. Italy's 2008 gross domestic electricity consumption (i.e. 318 TWh of gross domestic production plus the balance between import and export) can therefore be considered about 358 TWh.

Altogether, hydropower (taking off an estimated 5.5 TWh from pumped-storage plants, which cannot be considered as a RES output), wind energy and geothermal energy (the last one with the same production as 2007), totalled some 52.1 TWh, to which should be added the biomass contribution, estimated according to GSE (Gestore dei Servizi Elettrici) at about 7.2 TWh.

Therefore, the total electricity contribution from RES in 2008 could be estimated at nearly 60 TWh, 10 TWh more than 2007, corresponding to a percentage increase of 20%.
Wind-generated energy, as a percentage of national electricity demand, amounted to 1.9% in 2008, about 60% more than in 2007.
In spite of that, a stronger involvement of central and local administrations, as well as of the national Transmission System Operator Terna, is still required for achieving, if not exceeding, the maximum wind potential of 12,000 MW estimated for 2020 according to the 2007 Position Paper of the Italian government. Such wind development would contribute to reaching Italy's 17% quota of primary energy from RES by 2020, in accordance with the so-called European Directive 20/20/20 (this Directive, before becoming operational, must be implemented at the national level).

2.0 Progress toward National Objectives
So far the formal objective for wind energy is still 2,500 MW, which must be achieved in the 2008-2012 period, according to the national White Paper of 1999. This goal has, by now been widely exceeded. However, taking into account the aforementioned Position Paper issued by the Italian Government in September 2007 as a response to the new 2020 RES targets set by the Plan of Action "An Energy Policy for Europe" of the European Council, the actual wind capacity objective should now be considered 12,000 MW, of which 2,000 MW offshore, by 2020, corresponding to an annual production of 22.6 TWh.
Through the new wind power capacity introduced into the electric system in 2008, equal to 1,010 MW, the cumulative wind power in Italy was 3,736 MW at the end of December 2008 (Figure 1), well above the former official target and in line with national commitments on a growing role for RES in accordance with the forthcoming European Directive. The total number of online turbines was 3,588, with an increase of 645 units in 2008.

2.1 Commercial Deployment
Wind energy, through the very good results achieved in 2008, both in terms of new power capacity and, according to provisional data, also electricity generation, is confirming its important role in the national electricity system. It is now positioned as the third renewable source following hydro and biomass. Hydro remains by far the most important clean energy source in Italy. Geothermal energy has now become the fourth renewable source, in terms of electricity generated; it is still close to wind energy, but, considering the different prospects of these two energy sources, its position is likely to remain behind wind energy for a long time.
The average capacity factor of wind plants in the year 2008, according to figures computed by Garrad Hassan Italia S.r.l. from data acquired by Terna and ENEA, was as high as 0.24, appreciably higher than in 2007 (Figure 2).
Good wind conditions in 2008 and the increased power capacity on line led to a share of wind generation of 1.9%, as a percentage of domestic electricity demand. Italy is getting a growing but still low contribution from wind energy (in 2007 the share was 1.23%), but much more must be done to reach a possible but very ambitious share of 6-7%, of electric demand. As mentioned, this would help achieve a RES quota of 17% of the overall primary energy consumption (i.e. total energy needs, including heating, cooling and transportation).
With 1,010 MW of new wind power capacity installed in 2008, the previous estimate of a maximum 3,500 MW of total capacity by 2008 (see the 2007 Report) has actually demonstrated to be reductive, and now the nearest target, which should be reached very shortly, is the threshold of 4,000 MW. By the end of 2009, taking into account works in progress, the cumulative installed capacity is now estimated to be some 4,600 MW.
Despite the usual difficulties faced by developers, like administrative bureaucracy, opposition of a minority of environmentalist associations, and the lengthy procedures for connection to the grid--which are becoming a real bottleneck-- wind energy deployment has been growing at a very brisk pace. An annual growth rate for installed wind power ranging from 800 to 1,000 MW in the period

2009-2012 can be anticipated. Moreover, this growth rate could even be confirmed as annual average until 2020, if a contribution were to be made also by offshore installations.
The Apulia and Sicily regions were the most active in 2008, respectively with 260 and 211 MW installed, followed by Campania, Sardinia, Calabria and Molise (Figure 3). Worthy of mention is the region Sardinia, where, some 100 MW were installed last year despite the fact wind energy had not been favoured by the regional government .
In 2007, International Power plc (IP), a leading independent electricity generating company with interests in over 30,000 MW (gross) of power generating capacity, located in 20 countries, entered the Italian wind market. It acquired some 550 MW and gained the position as the leading player in Italy in wind generation. In total International Power owns 1199 MW of wind energy plants all around the world and its share in Italy of total wind power installed corresponded to almost 15% at the end of 2008.
In the Italian wind market five other energy producers, of which two utilities (Enel and Edison) plus the wind developers IVPC, Fri-EL and E.ON Italia, have capacity shares ranging between 7.5% and 10.5%. They are followed by several minor investors with a share below 3% (Figure 4).
The IVPC Group, Italian Vento Power Corporation, is one of the leading national operators in the production and sale of electricity from wind. Since 1993, when it was set up, the IVPC Group has expanded its range of services also by offering them to third party operators. Since its establishment, IVPC has developed and installed approximately 1,000 MW of wind capacity, which are totally managed by itself, and of which 324 MW are directly owned, distributed over seven Italian regions.
The IVPC Group has currently 166 MW under construction. Furthermore, through the company IVPC Gestione S.r.l. and its other service companies, it carries out the management and maintenance of wind farms, not only for itself but also for third parties. In particular, with regard to the sourcing of financial resources, the IVPC Group is today considered a lead player in obtaining bank loans or so-called *project financing.* In the years 2006/2008 alone, the IVPC Group negotiated and executed *project financing* bank loan agreements of approximately € 696 million. As regards intermediation in the sale of electricity and green certificates, the IVPC Group looks after the sale of the electricity produced from the group's wind farms and those belonging to third parties too. The same activity is also carried out for the sale of green certificates belonging to group companies. Intermediation activities for the sale of electricity and green certificates are carried out by its own structure based in Rome, which operates in the sector of electricity trading with the aim of maximising the objectives of the companies owning production plants, seeing to the care and fulfilment of all the associated operations and activities (management of contracts, analysis and checking of data, monitoring of stock markets, examining integrated commercial proposals, etc.) and acting as interface in the relations with institutions of the electricity sector.
Among wind manufacturers, Vestas is still leading the Italian market, with a total capacity share close to 50%, and more than 340 MW installed in 2008, just one third of the total capacity put into operation in the year. Gamesa, with a share of 20% and new installations for 164 MW, maintains the second position.
Enercon had quite a good result in the year, with 125 MW installed, bringing its cumulative capacity to 473 MW, corresponding to a share of 12.67%. After these three major manufacturers, some other ones have entered the Italian market with shares ranging from 3.2 to 5.3%. In particular, REpower in 2008 performed the best result with 146 MW located in the Apulia and Sicily regions, bringing its total capacity nearly 200 MW. It was followed by Nordex, which installed 109 MW, and Ecotecnia with 104 MW. GE Wind put into operation only 13.5 MW, but should significantly increase its capacity in 2009 (Figure 5).
The average unit power of wind turbines installed in 2008 was 1,566 kW, slightly less than the previous year, but the average unit power of all on-line turbines at cumulative level still increased from 926 to 1,041 kW, mainly thanks to a large contribution provided by 2 MW turbines and a number of other machines ranging from 1.35 to 3 MW (Figure 6).

So far, no producers with a single wind turbine have yet entered the wind market in Italy. However, considering the new incentive scheme introduced in the 2008 Financial Law for wind plants not exceeding 200 kW, which has at last become fully operational (see below), and some new rules at regional level, it is likely that new small private investors, mainly farmers and landowners, will start to install single machines with capacity up to 1 MW.

3.0 Benefits to the National Economy

The economic turnover of the wind sector in the last two years, through the increasing growth rate of annual wind power capacity, rose to more than 1 billion euro, including turbines and components delivered to foreign countries. The most positive effect of this progress is the growing number of employees involved in the sector, which at end-2008, according to ANEV (National Wind Energy Association) amounted to 18,309 units, of which 5,353 directly occupied. The total personnel involved is subdivided in the following sectors: feasibility studies 2,240, manufacturing of turbines and related industry 3,033, development and civil works 5,246, installation 1,421, management O&M 6,369.

Regarding future prospects, according to a study jointly carried out by ANEV and UIL (a national trade union), it has been estimated that by 2020, in the case of full exploitation of an Italian wind potential of 16,200 MW, and an energy production of 27.2 TWh, some 66,000 people would be employed (including indirect employment).

In addition, some other economic and employment benefits are related to the replacement of the main components of old medium-sized wind turbines, carried out by IVPC.

Another positive aspect ensuing from the rising wind power capacity and its being scattered in rural areas is the increase of investments to upgrade electrical grid infrastructures, mainly planned and implemented by the TSO Terna.

3.1 Market characteristics

With the consciousness of the environmental and economic benefits from wind energy, and the full knowledge of the new chances offered by the changing incentive mechanism, steadily growing interest has been shown by local municipalities, entrepreneurs, investors (also foreigners) and common citizens to be involved in some way in new possible wind projects of every kind.

Finally, through the Ministerial Decree issued on 18 December 2008, the RES provisions in the 2008 Financial Law went into effect at the beginning of 2009. Among other measures, as an alternative to tradable green certificates (TGCs), this law has introduced a favourable fixed feed-in tariff for the electricity generated by RES plants up to 1 MW in capacity, for wind this limit being only 200 kW. This new incentive has prompted several entrepreneurs to build, commercialize and invest money also on small wind turbines, so far a niche market. This market now has the opportunity to grow significantly, owing to the great interest shown by people living in medium-high windy areas.

The owners of wind farms are mostly private medium-large companies, utilities and sometimes small local firms, jointly with larger ones. Neither single farmers nor citizens, including co-operatives, are yet owners of medium or large wind turbines. Only small turbines are currently owned, and to a lesser extent, managed by landowners. In the near future this tendency should change, with a growing number of single wind turbines up to 1 MW in capacity being located and run on private properties.

3.2 Industrial development and operational experience

Confirming the good results previously acquired in the Italian market, once again in 2008 Vestas was the leader both in annual and cumulative wind power capacity. The company is continuously increasing its presence in Italy, also by setting up three subsidiary companies. Specifically:

Vestas Italia S.r.l. is responsible for selling, installation, commissioning and maintenance of wind farms installed in Italy,in Switzerland,in East Mediterranean countries, such as Turkey, Cyprus,

Egypt, Tunisia, Libya and Lebanon, in South Balkan countries such as Bosnia, Macedonia, Albania and in all the Middle East countries.
Vestas Nacelle Italia S.r.l. is specialized in the assembly of V52-850 kW and V90-3 MW turbines. So far, more than 2,600 nacelles have been sent worldwide.
Vestas Blades S.r.l. is involved with the construction of blades for V52 units.
Vestas has now two commercial offices in Taranto and Rome. Moreover, in 2008, the company inaugurated the new production line of the V90-3 MW turbine and increased the number of employees in its two factories in Taranto to almost 700 people.
In 2008, Leitwind was set up as a company belonging to the Leitner group. In December 2008 the company installed its first wind farm in Italy with 4 LTW 77, 1.5 MW turbines (Figure 7). So far Leitwind's commercial products are two turbines, LTW 70 and LTW 77, respectively of 1.7 MW and 1.5 MW rated capacity, with different rotor diameters, 70 to77 m, as a function of the wind class of the site. Previously Leitwind had installed a few wind turbines in Italy, Austria, Bulgaria and India.
A new prototype, the LTW 80 rated at 1.5 MW, is under development and is likely to be installed in 2009.
It is quite interesting to mention the first wind farm installed in the Italian Alps by Nordex at the end of December 2008. Four 2.5 MW NM90 and one NM80 turbines were located about 1,000m a.s.l. close to the French border (Figure 8).
The Moncada Energy Group should soon begin producing the WPR 850/58, 850 kW direct-drive turbine, while further 2 MW, 20 kW and 1.5 kW wind turbine models should be designed and built in the near future in its factory in Sicily. Moncada has received approval to build a 500 MW, 400 kV merchant electrical line across the Adriatic from Albania to Italy. The line is being developed as part of a wider plan for an integrated energy hub in southern Europe and will also enable Moncada to export power from its planned and already authorized 500 MW wind farm in Albania. The interconnecting direct current cable between the Italian transmission grid and the Albanian grid will be 154 km long. Of these, 14 km will run on Italian ground (Brindisi), 10 km on Albanian ground and the remaining 130 km will be laid on the sea bed in the Channel of Otranto down to a maximum depth of 825 metres. The two ends of the cable will be connected to conversion stations (transforming AC to DC current and vice versa) which, in turn, will be connected to a 380 kV line at Brindisi Sud (Italy) and to a 220 kV line at Babica (Albania). This project has already been judged favourably by Terna and the Albanian TSO, and was also approved (9 January 2008) by the Albanian government. . The company has also developed a project for an interconnecting direct current cable between the Italian transmission grid and the Tunisian one, with a capacity of 600 MW and a voltage of 400 kV.
Lastly, as far as grid connection issues are concerned, mention should be made of Deliberation ARG/elt 99/08 issued by AEEG (the Regulatory Authority for Electricity and Gas) on 23 July 2008 to streamline further, and gather in a single document, the technical and economic conditions for connecting generating plants to electrical systems at all voltage levels. This deliberation, in effect from 1 January 2009, includes special provisions for RES plants, which should help clear and speed up the procedures for connecting wind plants to the grid and also better define the sharing of the relevant costs between wind investors and the grid operator.
On the other hand, AEEG Deliberation ARG/elt 98/08 of 23 July 2008 has allowed grid operators (such as Terna etc.) to require new wind plants to provide some ancillary services for the benefit of the electrical system, such as power output modulation, cut-in power ramp control, fault ride-through capability, and regulation of active and reactive power.
Terna, with the aim of allowing the connection of growing energy production from wind into the national transmission grid, has developed the "collecting plants method" (metodo dei collettori di potenza). This method allows to connect considerable amounts of power in the safest way with environmental and economic benefits. Its main objective is to favour the connection of more than 200 MW of generation capacity to each collecting plant of the 380 kV system.

Terna plans to invest € 550 million on the national transmission grid in order to support the development of RES, and in particular wind energy, through the repowering of existing lines, the construction of new ones and the construction of connecting plants, which represent the most significant part of planned investments.
Terna's plans for new connections, including the 500 kV d.c., 1,000 MW submarine cable between Sardinia and the mainland to be completed by the second quarter of 2010, and an enhanced connection to Sicily, will guarantee an increase of some 3,700 MW of transmissible energy from wind. .

3.3 Economic details

According to ANEV, the cost of installed wind turbines is substantially the same level as 2007. The average installed plant cost of a medium-sized wind farm (30 MW) at a site of medium complexity, with15 km of paths/roads and 12 km of electric line for the connection to the high voltage grid, is around 1,800 €/kW.
This cost is generally subdivided as follows:

- Turbines, installation and commissioning: 1,270 €/kW – 70.6%
- Development, namely site qualification, design, administrative procedures, etc.: 236 €/kW – 13.1%
- Interest on loans : 196 €/kW – 10.9%
- Connection to the grid: 73.8 €/kW - 4.1%
- Civil-engineering work: 23.4 €/kW - 1.3%
- Annual cost of operation and maintenance t has been estimated around 54 € /kW, leasing of terrain, insurance and guarantee included;
- Decommissioning cost has been estimated around 5 €/kW.

The income of wind plant owners is currently made up by the sum of two items, namely :

- the electricity price obtained by selling the energy produced; energy may be sold on the free wholesale market or, as an alternative, directly to GSE through a special contract by which the whole production is purchased by GSE at prices set in accordance with those of the free market; most wind plant owners choose the latter option; in 2008 the purchase price was extremely variable depending on many factors; on average it could be put at around 90 €/MWh;
- the price obtained from the sale of the tradable green certificates (TGC) assigned by GSE to electrical energy produced from RES; this price was also very variable in 2008, with an average value estimated around 75 €/MWh.

It is also worth recalling, for the sake of completeness, that a decreasing number of wind plants has still been entitled to sell energy to GSE at the premium "feed-in tariffs" granted by the old scheme of CIP Provision No. 6 of 29 April 1992. In 2008, the maximum CIP 6/92 tariff was, for wind plants, 151.8 €/MWh (preliminary price).

4. National Incentive Programs

As the old CIP 6/92 system based on feed-in tariffs is gradually expiring (incentives are granted for the first 8 years of plant operation), more and more wind plants are benefiting from the current RES support schemes.
The main scheme (and the only currently available to wind plants above 200 kW) is based on a RES quota obligation and the issuing of tradable green certificates (TGCs). Producers or importers of electricity generated from non-renewable sources must feed into the Italian grid a mandatory quota of RES electricity calculated as a percentage of the electricity produced from conventional sources in the previous year. At the beginning this percentage was 2%; in 2008, with reference to 2007, it had risen to 3.8%.
Operators subject to the RES requirement have to prove compliance by returning to GSE (Gestore dei Servizi Elettrici - the body in charge of running all RES support schemes), after the end of the

year, a corresponding number of TGCs. These can either come from one's own RES plants or be bought from other RES electricity producers. TGCs are granted by GSE to certified RES plants that began operating after 1 April 1999 (the so-called IAFR plants) for the first 12 years of operation (this term has now become 15 years for plants which began operations on or after 1 January 2008). TGCs are valid for 3 years.
TGCs can also be bought from GSE, at a price that is fixed every year in accordance with a given procedure. Unlike previous years when GSE's TGCs were needed to meet demand, from 2006 onwards the whole TGC demand has been covered by IAFR producers, mainly with hydro, wind, and geothermal plants. The ensuing competition pulled the TGC trading price well below that of GSE's TGCs, reportedly around 70-80 €/MWh in 2008 trading. These poor price conditions have been blamed, among other factors, on the RES obligation percentage rising at too slow a rate, which did not allow TGC demand to grow enough.
As anticipated in the 2007 Report, the rules of the RES quota/TGC scheme have recently been reshaped somewhat by the so-called 2008 Financial Law (Law 244 of 24 December 2007). The RES provisions of this law took quite some time to become effective as they required a further Ministerial Decree, which was issued only on 18 December 2008. However, the main changes brought in by these new provisions can be summarized as follows:

- the yearly increase of the mandatory quota of RES electricity has been raised from 0.35 to 0.75 percentage points in the period 2007-2012;
- the size of all TGCs has been reduced to 1 MWh;
- RES plants that have come online after 1 January 2008 will get TGCs for a period of 15 years (instead of 12 as older plants), in a number equaling the number of produced MWh multiplied by a coefficient, which is specific for each technology (e.g. 1 for onshore wind, 1.1 for offshore wind);
- from 2008 on, the price of TGCs bought from GSE will be calculated as the difference between 180 €/MWh and the annual average market price of electricity (e.g. the calculated price for 2008 was 112.88 €/MWh);
- the above reference values and coefficients may be updated every three years;
- until Italy has reached its RES electricity target according to Directive 2001/77/EC, GSE must buy all unsold TGCs before their expiration date (3 years from issue), at a price equaling the average TGC price of the previous year.

Another important feature is that the aforementioned Law 244/2007 and subsequent Decree of 18 December 2008 also set up or restructured other incentives available to RES plants up to 1 MW capacity.
Specifically, RES plant owners have been given the possibility to choose, as an alternative to electricity market price plus TGCs, a fixed comprehensive incentive price for the energy fed into the grid. This possibility has been allowed to RES plants up to 1 MW, but excluding solar plants (PV actually has its own special legislation and feed-in tariffs) and wind plants above 200 kW. The comprehensive price is available for 15 years to plants that have come into operation after 31 December 2007. For wind plants up to 200 kW capacity, it is currently 300 €/MWh
Additional new provisions have concerned another option available to RES plant owners, i.e. the option to choose, as trading mechanism, the on-the-spot exchange of their production with the energy they draw from the grid as customers. This possibility has now been extended to all RES plants up to 200 kW, provided they have come into operation after 31 December 2007 (formerly this limit was 20 kW);
Both these provisions, as said above, could well open new prospects for the deployment of small-sized wind turbines, or plants with a single turbine, up to an overall power of 200 kW.

Offshore

At the beginning of September 2008 a small 80 kW wind turbine was installed by the company Blue-H on a floating foundation about 20 km off the Apulian coast. The particular aspect of this

offshore application is related to the depth of the seabed of 111 m, where a counterweight was placed previously, and to the use of a submerged deepwater platform. The temporary concession for the location in the sea expired at the end of 2008 and the unit was subsequently decommissioned and brought safely back to shore. Blue H feels that it learned a tremendous amount from this experience and is confident that the know-how gained, along with its intellectual property already filed in the form of utility model and patents, will ensure continued leadership in the field of floating wind turbines.
Blue H is currently building the first operational 2.5MW unit in Brindisi, which it expects to deploy at the same site in the Southern Adriatic Sea in 2009, the first in the planned 90 MW Tricase offshore wind farm, located more than 20 kilometers from the beautiful coast line of Apulia.
Early in 2009, project GEOMA, a consortium led by Blue H, was selected as one of thirty recipients of Italian public funding under "Industria 2015" a program announced by the Minister of Economic development. The Blue H consortium is one of two wind energy projects selected by a panel of experts within Industria 2015. This Italian based project plans to develop a hybrid concrete/steel 3.5 MW floating wind turbine ideal for the deep waters of the Mediterranean Sea. The consortium, consisting of Ansaldo Sistemi Industriali, Blue H R&D, Blue H Sky Saver Srl, Cesi Ricerca, EADS Astrium, Progeco, Societa Gomma Antivibrante, TRE Tozzi Renewable Energy and the University Federico II of Naples, aims to create an integrated solution for a floating wind turbine able to bring down the overall cost of electricity generation to be in line with economics of onshore wind energy generation, but without the problem of negative visual impact.
Other initiatives aimed at setting up offshore wind farms on fixed foundations in shallow waters are running along the coasts of southern Italy and Sicily, but for the time being the investors are dealing with difficult permitting procedures, increasing costs and some adverse judgements expressed by local authorities.

5.0 R,D&D Activities

Since the introduction of a feed-in tariff for wind turbines up to 200 kW, several manufactures producing wind turbines up to 20 kW have begun up-scaling projects. To date, however, only one of them, Terom Wind Energy, has developed a turbine of 55 kW for low wind site applications. Blu Mini Power instead, through a venture with the French company Vergnet, is entering the Italian market with a 200 kW Vergnet turbine, in addition to its own smaller turbines.
In addition to the universities that have been working on wind energy for a long time, like those of Genoa, Bologna and Trento, and the Polytechnic of Milan, some other universities are now carrying on R&D activities on this subject: specifically, R&D on offshore wind power in Catania, on towers in Florence and Padua, and on small turbines in Naples.
Among R& D activities to note are those carried out by the aerospatial engineering department of the Polytechnic of Milan. They are mainly focused on:

- Advanced control laws for wind turbines, namely development of control laws for variable speed wind turbines for reducing fatigue damage and for gust load alleviation. Particular emphasis is placed on laws which include individual blade pitch control, which account for aeroelastic effects (tower and blade flexibility), and which can react to changes in the operating conditions (change in wind shear, presence of vertical and lateral wind components, operation in the wake of another turbine, etc.). Research activity has also lead to the development of a number of supporting technologies, including observers of the wind turbine structural flexible states from strain gages and accelerometers, and observers of the spatial distribution of the wind over the rotor disk. The control laws are tested both in a high-fidelity simulation environment based on the multibody finite element aero-servo-elastic code named Cp-Lambda (Code for Performance, Loads, Aeroelasticity by Multi-Body Dynamics Analysis), and in the field on a MW-class wind turbine.
- $(WT)^2$, i.e. the Wind Turbine in a Wind Tunnel project, whereby aero-elastic wind tunnel models of a multi-MW wind turbine are designed, to be tested in the large wind tunnel

facility of the Polytechnic of Milan. Scope of the models is the development, verification and comparison of control laws for wind turbines, as well as the testing of extreme operating conditions.

- Development of software for wind turbine design and optimization. This project aims at developing automated procedures for supporting all phases of the design process, including aero-servo-elastic analysis using the multibody finite element code Cp-Lambda, transfer of loads from aeroelastic simulations to detailed FEM models of sub-components for fatigue and ultimate analysis, and multi-objective optimization of the machine. The optimization procedures use the simulation capabilities provided by the Cp-Lambda code for performing: a) aerodynamic optimization of the rotor (e.g. twist and chord distribution for maximum Annual Energy Production (AEP), with noise constraints and maximum chord constraints); b) structural optimization of the blades (e.g. minimum weight configuration for given design load cases (IEC-61400 DLCs), placement of frequencies, stress/strain allowables, etc.); c) combined aerodynamic-structural optimization (e.g. for maximum AEP over weight).

The University of Genoa is still carrying on several activities on wind assessment, including the development of new models. One of them has recently been developed to study the intermittent character of wind energy and its consequences for electrical power systems. Since wind energy is not controllable because of its stochastic nature, a possible way to mitigate undesired fluctuations of wind energy output in the electrical system could be to identify the optimal allocation of wind power plants over an extended territory that can allow lower temporal variability of the aggregate wind power output and, therefore, also guarantee a significant contribution to base-load power supply. Specifically, this model has so far been applied to the case of optimal allocation of wind plants over the Corsica island. The model is based on the identification of anemological regions and wind regimes over the territory, and the calculation of the optimal spatial distribution of wind power plants, under given requirements of minimal variability of the overall wind energy input, i.e. the aggregate contribution of all anemological regions to the power supply system. By means of this optimisation, the wind energy fluctuation in the power supply system of Corsica has been reduced of about 58%, with an energy production loss of 23%.

CESI RICERCA has been working on wind power within the framework of its research program carried out under contract to the Italian government in the interest of Italy's electricity system. After completing its new Wind Atlas of Italy, CESI RICERCA is concentrating on better assessing Italy's actual offshore wind potential, taking into account all factors on which exploitation of this potential could depend (windiness, technology, costs etc.).

Since the most plentiful resources are found in waters too deep for the current offshore wind technology, CESI RICERCA has taken an interest in the feasibility of plants on floating foundations, with a consultant assisting on more specific marine issues.

Following a preliminary review of different concepts of floating platforms and their moorings, the dynamic behavior and stresses of a system comprising a large wind turbine mounted on floating structures of various types has been analyzed by a computational model under normal and extreme wind and wave conditions.

CESI Ricerca is also looking more deeply into the more practical aspects of construction, installation and operations of floating wind turbines, taking into account technical behaviour and costs over the whole operating lifetime. In this respect, a specific structure configuration has been selected and examined, calculating loads and stresses in normal operation and other critical phases including transportation and installation on site. At the same time, the costs of this structure have been estimated, to get an outlook of the overall investment and maintenance costs of a wind farm with floating wind turbines versus its expected energy performance.

Another activity, but not limited to offshore areas, has been undertaken by CESI RICERCA to supplement the Wind Atlas of Italy with a full Atlas of Environmental Compatibility providing, as far as possible, information on protected or restricted areas and other environmental constraints that

could hamper the setting-up of wind farms. Another software application has been developed to simulate wind farms for preliminary assessment of their visual impact on a given area.
Lastly, wind-measuring masts have been set up, both offshore (on a very small island in the Adriatic Sea) and in Tuscany, to fine-tune the Wind Atlas in some areas of Italy.

6.0 The Next Term

As mentioned above, in 2009the growth rate of wind capacity is expected to be similar to that seen in 2008 , and to be accompanied by increasing industrial activity and consequently also the creation of new job opportunities. This forecast is confirmed by the civil-engineering works already in progress in several regions for setting up many more hundreds of megawatts and by the previously mentioned approval, of the Ministerial Decree of 18 December 2008 on the incentives for electricity production from RES (implementing the 2008 Financial Law), which among other measures establishes a feed-in tariff for small wind turbines and also helps to support the commercial value of tradable green certificates.
Further development of R&D work can also be expected. Within the framework of Industry 2015, a new industrial policy law issued by the Italian government in 2006 and later implemented by the 2007 Financial Law, a call of the Ministry of Economic Development was published in 2008 with a view to granting funds to R&D programs aimed at industrial innovation for energy efficiency. The announcement raised very strong interest and many applications were submitted. Among them, three projects related directly to wind power have been approved, two involving offshore floating wind plants and development of a large wind turbine prototype, respectively, and the third dealing with a system with a very small vertical-axis wind turbine and a photovoltaic device.
The total eligible cost of these projects is some € 50 million, of which about € 20 million should be granted by the Ministry of Economic Development, with different shares of contribution as a function of their R&D content.

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