

WIND POWER IN ITALY FROM THE LATE 1970s TO THE PRESENT

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ABSTRACT

This paper describes the development of the wind power industry in Italy over the past thirty years and the main factors that have encouraged or hindered its progress.

In particular, it examines the knowledge of available wind resources, the relevant technologies, the government incentives adopted to promote their use, and public reactions to the impact of wind-power plants on the environment and the landscape, and stresses the influence of the Kyoto protocol and European Union initiatives on Italian energy and environmental policies and consequently on the growth of wind-power use in this country.

The introduction also provides information on how wind energy was exploited in Italy in the more distant past.

1. INTRODUCTION

The foundations of Italy's modern wind power industry were laid at the end of the 1970s by a series of research, development and demonstration programs by the major national energy institutions. Several of these programs had the benefit of European Commission funding (1).

The industry's commercial success began in 1996, thanks to the Italian Vento Power Corporation (IVPC), a private-sector company founded in 1993. For the site studies needed in the startup phase, IVPC relied on know how available on the international market.

This recent development of wind power took place mainly in Puglia and Campania, regions known since antiquity for their windiness but certainly not for landscapes marked by old windmills or wind engines.

That kind of landscape was more common in the Maremma area of Tuscany and Latium, where, at the beginning of the

20th century, the Vivarelli Company installed numerous multi-blade windmills, a good part of which were used to run water pumps. The company prospered, building thousands of wind systems of this kind. About 10,000 windmills manufactured by Vivarelli and two other companies were operating in Italy in the 1950s and 60s. Almost the same number was exported to Africa.

The Vivarelli Company was founded between 1886 and 1890 in Tuscany, a region where, starting in the 16th century, a good number of windmills designed by Renaissance engineers had been erected. The Orsini family, for example, built two at their fortress in Sorano, to grind grain and gunpowder. Grand Duke Cosimo I built windmills in the city of Grosseto. According to documentary evidence, there were windmills on the island of Elba and near Pisa, including one situated partially offshore in the Orbetello lagoon.

In Sicily, the use of windmills goes back to ancient times. Starting in the 12th century, many were built at the saltworks on the Trapani coast, where they were used to turn large Archimedes screws that pumped water from one vat to another. Large salt-grinding windmills began to appear around 1500. The mechanism that turned the grindstones at the Ettore Inferna Saltworks was recently restored on the basis of a similar Tuscan design attributed to Leonardo da Vinci.

In the 19th century, the Industrial Revolution, which in other countries depended essentially on coal, forced coal-poor Italy to pay greater attention to local energy sources, such as hydro energy for electricity production (2). Incomplete research on the subject shows that wind power was also of interest towards the end of the 1800s. For example, the documents on the formation and the first general assembly of the Italian Meteorological Association (1882) give us an idea of the issues raised by meteorologists and mechanical engineers. The weather experts accused the

engineers of failing to take advantage of the fact that in certain areas of Italy winds blow at over 12.5 mph for more than three quarters of the year. The engineers objected that the winds were not reliable, but the meteorologists pointed to the centuries-old vestiges of windmills in central Italy and Sicily (3).

It is not clear from the Association's proceedings whether the advocates of wind power were thinking only of using them to operate machinery or whether they also foresaw using them to generate electricity. However that may be, the mechanical exploitation of wind power was widespread in the first half of the 20th century, not only in Tuscany and Latium but in other regions as well, such as those southern Italian areas that underwent land reform.

Uncommon applications were also to be found. One example was the wind engine built to run a sawmill in the mountain town of Capracotta, in central Italy (altitude: 4662 feet above sea level). The engine, though no longer operational, is still in place (4).



Fig. 1 - Wind engine built in Capracotta in the early 20th century to run a disk saw and an alternating saw (Photo dated 1936)

2. THE BIRTH OF ITALY'S MODERN WIND POWER INDUSTRY

2.1 Wind power before 1973

Vivarelli, Italy's first large wind power company, built thousands of wind engines between 1900 and 1960. After World War II, Vivarelli – following the examples set in countries such as Russia, Denmark, Germany, France and

the United States – also attempted to develop wind-powered electricity generating systems by coupling windmills and dynamos. But interest in wind power generation in Italy really began to grow only when electrical motors and appliances came into wide use.

The UN Conference on New Sources of Energy and Energy Development, held in Rome in August 1961, certainly helped raise interest in wind power generation in Italy. On that occasion, developments were reported from fifteen countries, ranging from small (10-15 kW) machines for water pumping and electricity generation to large (100-900 kW) grid-connected machines (5). Speaking for Italy, Arnaldo Maria Angelini reviewed the advantages and drawbacks of using geothermal, solar and wind power for electricity generation.

In 1962, Italy's National Research Council (CNR) launched solar thermal and solar desalinization programs, but there is no documented evidence of interest in wind power (6).

2.2 Start of wind power programs in the late 1970s

The 1973 oil crisis led to a thorough rethinking of Italian energy policy, but with a strong bias in favor of nuclear energy.

A National Energy Plan (7) was approved in 1975 and updated in 1977, but its implementation suffered serious delays, due to political tension, the 1978-79 oil crisis, and the 1979 accident at the Three Mile Island nuclear power plant.

All these circumstances prompted a review of the country's nuclear power development plans, and proposals for alternative energy-procurement solutions. This explains why it was only at the end of the 1970s that CNR, the National Committee for Nuclear Energy (CNEN), the national power utility (ENEL) and several industrial concerns (AERITALIA, Fiat Group, Agip Nuclear, CESEN and Riva Calzoni) joined forces to launch a series of research, development and demonstration programs aimed at promoting the use of wind power to generate electricity in Italy. Each program had its own priorities, but all of them meshed with those of the other programs.

Starting in 1979, the CNR was involved in the framework of Targeted Energy Plan 1, in collecting, classifying and processing wind pattern data supplied by the Air Force Weather Service's 136 monitoring stations.

That same year, ENEL started its Wind for Electricity Project (VELE), and CNEN received its first funds for renewable-sources research, promotion and development. In 1981, CNEN's name was changed to ENEA (National Agency for Alternative Energies), and the organization was

given a fundamental role in promoting wind power in Italy, developing the necessary technology, making the Italian wind industry competitive, and providing assistance to developing countries.

Industrial concerns were likewise starting to show more concrete interest in wind power, especially because their wind generator development programs were eligible for government funding.

In 1981, the CNR published the findings from its first investigation of wind resources in Italy. The report described the areas having the highest wind power potential, and major concentration in the south and on the islands. Generally speaking, windiness in mountainous areas turned out to be medium-high (8).

Prior to the CNR report, Italy's wind resources had been thought inadequate for cost-efficient electricity generation – an idea not backed by any systematic collection or processing of wind data – but at last it was clear that a good percentage of Italy's territory does not lack this energy source.

Once the nation's real wind resources had been identified and documented, the publicly funded CNR, ENEA and Enel programs started in on the construction, testing and qualification of small wind-driven generators. ENEA also engaged private-sector companies to conduct feasibility studies of medium-sized machines rated from 160 kW (vertical axis) to 200-225 kW (horizontal axis).

2.3 Government incentives for electricity generation from renewable resources; startup of the first commercial wind power plants

Law 308/1982, containing "Regulations regarding the limitation of energy consumption, the development of renewable energy sources and power plants operating with non-hydrocarbon fuels," introduced the possibility of government funding for projects aimed at generating electricity from renewables. But since the available grants amounted to only 30-40% of the starting investment, in reality the law enabled the construction of only a few wind-power plants in southern Italy. Generally speaking, it remained a dead letter, partly because the technology was still in its infancy and partly because of the paucity of the funds available for grants.

The 1988 National Energy Plan – rewritten in light of the Chernobyl accident and the referendum whereby Italy renounced nuclear power – specified for the first time the target capacity of wind-powered generators to be installed in Italy: 300 MW, or 600 MW if large-sized generators became available (9).

The relevant implementation laws (nos. 9 and 10) were passed in 1991. In 1992 the Interministerial Committee on Prices (CIP) approved Provision 6/92, which introduced a per-kWh price for energy produced from renewable sources. The price was made up of two elements, one related to costs avoided over the plant's entire lifetime, the other to the higher costs inherent in the specific type of plant. In 1992, when the measure was approved, the values of the two elements were taken to be 72 and 78 lire, respectively; by 1999 they had risen to 92 and 102 lire, and by 2004 they had reached 6.86 and 5.90 eurocents.

The energy price was decisive for the startup and rapid development of commercial wind power in Italy.

In 1996, IVPC built the country's first 7.2 MW wind power plant, operating with twelve 600-kW Vestas machines, in the southern town of Montefalcone, near Benevento. By 2001, the aggregate capacity of Italian wind power plants had reached 700 MW, compared with 22 MW in 1995. (The CIP/6 price incentive was discontinued in 1995, but its economic effects still apply for the first eight years of plant operation.)



Fig. 2 – The first IVPC wind farm in Montefalcone (BN)

The CIP/6 measure was widely criticized because its definition of "renewable energy sources" included so-called "equivalents" such as co-generation. These "equivalents" ended up absorbing a good part of the available funding, thus sidetracking funds needed to encourage the use of true renewables.

2.4 New incentive system adopted after the Kyoto Protocol and deregulation of the electricity market

The influence of international agreements and EU measures on Italy's energy and environment policies became more and more significant in the late 1990s.

In 1998, the Interministerial Committee on Economic Planning (CIPE) established the guidelines that Italy would have to follow and the actions it would have to take in order to comply with the Kyoto Protocol. The guidelines and

action plans regarding renewables were then translated into specific targets and strategies defined in a “National White Book on the Use of Renewable Sources“ approved by CIPE in August 1999.

That same year, EU Directive 96/92/CE on domestic electricity markets, was incorporated in Italian law with the approval of the decree n. 79/99. To encourage the use of renewable sources, this decree establishes that starting in 2001, producers and importers of electricity generated from conventional sources must feed a certain amount of electricity generated from renewables into the national electric grid, or else buy "green certificates" from plants that use renewable sources.

The value of the green certificate is determined by a reference value established by the grid operator (GRTN) and by the trend of prices in the electricity market. In this arrangement, the costs of developing renewables are no longer borne by the nation’s taxpayers, as was the case with CIP/6, but by conventional power producers. This change in the incentive system slowed the growth of installed wind power capacity in 2002-2003, as shown in Fig. 3 (10).

The slowdown was also partly due to opposition from some local movements that believed wind generators would have a negative impact on the environment and the landscape. This type of opposition has kept wind power development at a standstill in some Italian regions.

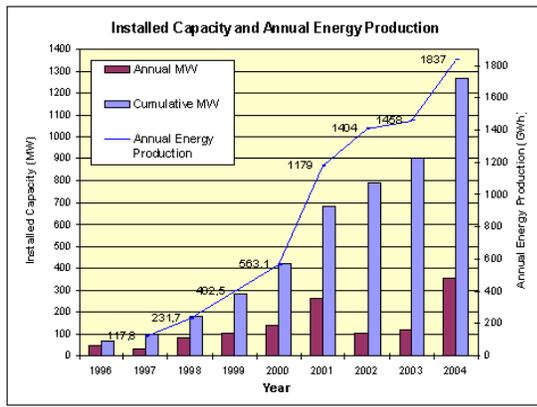


Fig. 3 – Installed capacity and annual electricity generation

In 2004, the plant installation rate started to rise again, due partly to EU directive 2001/77/CE, on electricity generation from renewable resources. This directive was incorporated into Italian law by Legislative Decree 387/2003, but has not yet been fully implemented.

The overall costs incurred since 1983 by Italian public agencies and private-sector enterprises for wind power research, development and demonstration programs alone are estimated at about 270 million US \$, as shown on a year-by-year basis in Fig. 4.

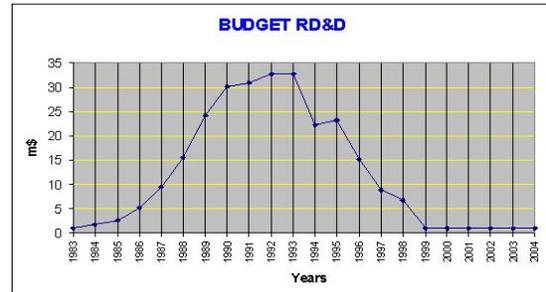


Fig. 4 – RD&D spending from 1983 to 2004

The total amount of money available since the approval of CIP/6 to promote electricity production from wind energy is estimated at 350 million US \$.

3. DEVELOPMENT OF WIND POWER TECHNOLOGIES IN ITALY

3.1 Early programs and their weaknesses

The earliest programs for cooperation between Italy's energy agencies and industrial concerns to develop wind technologies and compete with the northern European countries most advanced in this sector – especially Denmark – began in the late 1970s.

The positive synergy established in those countries among the academic world, research labs and industry was a valid example, but in Italy it could not be followed because the context was unsuitable; public institutions and industry lacked the determination and the division of roles that characterized their counterparts in northern Europe. The officers of the companies involved in designing and commercializing prototypes of wind-power generators were not firmly convinced that the market could be profitably developed.

The opinion that Italy was not a sufficiently windy country and that the potential market would never amount to much did not facilitate the birth of industrial interest. Moreover, the complexity of wind technology was underestimated. As a result, systems and components were often not designed carefully enough and tested rigorously in the laboratory and in field trials. Italian institutions and industries certainly worked on these aspects, but the synergies needed to come

up with the right solutions – for instance, for different sizes of wind generators – were missing.

Unlike the case in Denmark, Spain and other European countries, in Italy the development of wind generators jumped from small sizes (up to 70 kW) to medium sizes (200-320 kW) without solving certain technical problems that appeared during testing, which was sometimes carried out at sites where wind conditions were inadequate. Field demonstrations that revealed design errors were not systematically followed by component redesign and overall review. As a result, the technical problems remained unsolved and the Italian operators were unable to access the ever more competitive wind-power market.

Wind-generator development in Italy entered a difficult new phase when it was decided to focus on a large unit, the 1.5 MW GAMMA 60, a totally innovative configuration in which the power output would be yaw controlled. While the GAMMA 60 prototype was still being designed, in the late eighties and early nineties, some of its innovative aspects were transferred to a medium-size (600 kW) generator called the MK3.

In 1992 the GAMMA 60 was installed at an ENEL site in Sardinia, but, after a short test period and a fire in the shaft, the whole enterprise was abandoned with no practical results.

One of two medium-sized prototypes was the M30, a one-blade model developed jointly by Riva Calzoni and the German company MBB. Nearly 100 M30s have been installed in various parts of Italy; all of them are to be replaced in the near future by more competitive machines.

Another wind-technology development from this period was a 1540-kW hybrid plant consisting of three Ansaldo-WEST 320-kW MEDIT generators combined with a 600-kW photovoltaic installation.

It is worth recalling that during the eighties, both ENEA and ENEL had begun to independently test and qualify small wind-driven machines, including a water pump. In addition, the two agencies were studying interactions among 50-kW generators and the installation of small wind-power generators on islands and in mountain areas to provide electricity to isolated users.

3.2 Italy's wind power industry and Danish technology in the late 1990s

In the late nineties, when the worldwide wind power industry was already firmly established, Italy had no competitive model of its own, but the availability of commercial technologies on the one hand and of CIP/6

incentives (which many wind plants benefited from) on the other created positive "technology-market" synergy.

One operator that seized this opportunity was the Italian Vento Power Corporation (IVPC), which built the nation's first commercial wind-power plants. IVPC's example was soon followed by ENEL's Green Power Division and by Riva Calzoni (11), whose business was eventually taken over by Edison Energie Speciali (Edens).



Fig. 5 – GAMMA 60 at Alta Nurra (Sardinia) Enel's test site

The start of commercial operations was the necessary prerequisite for the birth of a new wind-power industry in Italy based on imported technologies.

In 1998 the Italian company WEST and Denmark's Vestas formed a joint venture called IWT, whose purpose was to manufacture medium-sized (600 kW) Vestas machines at the WEST plant in Taranto. A few years later Ansaldo-WEST gave up the wind business altogether, but in the meantime Vestas had raised the Taranto plant's manufacturing capacity.

In 2004 Vestas Wind System A/S, following the merger with NEG Micon and the consequent reorganization, modified its structure, creating 6 Sales Business Units (SBUs) and 4 Production Business Units (PBUs).

Its Italian subsidiary IWT, according to this strategy, now hosts the SBU Vestas Mediterranean East, which, through Vestas Italia and Vestas Hellas, has Sales and Service responsibilities for Italy, Greece and Eastern Mediterranean countries, as well as the two PBUs Vestas Nacelles Italy and Vestas Blades Italy.

The Vestas Group is very confident about the Italian market, which is why they have put one of their SBUs in Taranto

and made the two PBUs located here the sole agent for the entire world of the only kW-class wind turbine still included in the new product range, the V52 850-kW machine, thus underlining the great experience and competence reached by the Italo-Danish Company IWT.

Besides these activities of IWT's, two other projects that began in 2003 – Jonica Impianti's 20-kW prototype and Leiter's 1.2-MW prototype – are important from both the industrial and the technological standpoints. Both machines are based on highly innovative concepts that, considering the positive test results, should open attractive new prospects for the Italian wind industry.

4. CONCLUSIONS

The human and financial resources spent in RD&D, since 1983 to the early 1990s, to develop the wind power industry in Italy have produced scanty results. Despite all the efforts made over more than a decade to develop small, medium-sized and large generators, at the end of the nineties Italy had not come up with a model of its own that could compete with those offered by other countries.

Nonetheless, those activities carried out in Italy had the merit of increasing interest in wind power in this country, and thus constituted the basis for commercial development in the mid 1990s. Among the results was the start of manufacturing with Danish technologies at the Vestas-IWT plant in Taranto, and an increase in the development and manufacture of wind-power components in Italy.

5. REFERENCES

- (1) Casale, C. and Sesto, E., "Attivita' di ricerca e sviluppo condotte in Italia nel settore dell'eolico," conference on Cooperation Between Italy and Latin America in the Sector of New and Renewable Energy Sources, Rome, 17-20 October 1983
- (2) Silvi, C., "Can the History of Solar Energy Use and Technology Educate Us for a Solar Energy Future? The Italian Case," ISREE-9 (International Symposium on Renewable Energy Education), Göteborg, Sweden, 14-15 June 2003
- (3) Proceedings of the First General Assembly of the Italian Meteorological Association, Naples 1882
- (4) Personal communications from the Capracotta Environment Commissioner and Mr. Vincenzo Ianiro, February 2005
- (5) Report on the United Nations Conference on New Sources of Energy: Solar Energy, Wind Power, Geothermal Energy, Rome, 21-31 August 1961. New Sources of Energy and Energy Development. E/3577/Rev.1 ST/ECA/72

United Nations, New York 1962

- (6) Silvi, C., "History of ISES ITALIA 1964-1980," in Fifty-Year History of the International Solar Energy Society, American Solar Energy Society, August 2005
- (7) Italian National Nuclear Energy Committee (CNEN), "Delibera del CIPE del 23 dicembre 1977 e programma energetico nazionale," Doc. RES (78)22, June 1978
- (8) Italian National Research Council (CNR), "Investigation of Wind Energy Resources in Italy," Targeted Energy Project, Rome 1981
- (9) Full text of the National Energy Plan approved by the Council of Ministers on August 10, 1988, published in the ENEA review Energia e Innovazione 8-9, 1988
- (10) Pirazzi, L. and Casale, C., "Italy" in the IEA Wind Energy Annual Report, 2004
- (11) Pirazzi, L. and Vigotti, R., Le vie del vento, chapter 2.3, Franco Muzzio Editore, 2004