WIND ENERGY – AN OPPORTUNITY FOR ALSO SMALL AND MEDIUM INVESTORS

Elena Condrea[1*], Adrian Condrea[2], Anca Cristina Stanciu[3]
[1), 3)]"Ovidius" University of Constanta, Romania
[2)]Elda Mec SRL Constanta, Romania

Abstract
In this paper, we aimed at highlighting the importance of renewable energy, particularly of wind energy, in reducing the impact of economic activities on the environment, in ensuring the quality of life, being aware that there are major concerns in this regard globally, and especially at European level. Not only did Romania, as an EU member country, adopt all the European regulations in the field, but it also followed closely their implementation, supported rulemaking and the projects aimed at helping the investors on the renewable energy market. In the second part of this paper, we presented a study on the installation of a double effect wind turbine at Elda Mec Company, in Constanta County, Romania. This wind turbine was installed through the implementation of a project funded by the Partnerships in priority areas Program, which aimed at informing small and medium investors that it is possible to obtain and use wind power even without a wind farm.

Keywords
Wind energy, renewable energy, environment, environmental protection.

JEL Classification
Q27, Q28, Q42, Q48,

Introduction

Currently, we are dealing more and more with the issue of ensuring the quality of life and sustainable development. We cannot talk about sustainable development without talking about environmental protection. Sustainable development policies include policies for environmental protection and the environmental protection conditions sustainable development.

Worldwide, a leading role in environmental protection and sustainable development was played, over the years, by the following events: United Nations Conference on Human Environment, Stockholm, 5-16 June 1972; UN World Conference on Environment and Development (Rio de Janeiro, 3-14 June 1992); the World Summit on Sustainable Development (Johannesburg, 26 August - 4 September 2002) and the Maastricht Treaty in

* Corresponding author, **Elena Condrea** – elenacondrea2003@yahoo.com

1992 (ADRC, 2012) and the Kyoto Protocol to the United Nations Framework Convention on Climate Change (December 1997). (Arion, Tabuleac)
Moreover, an important role in ensuring the quality of life in terms of environmental protection is played by the implementation of the environmental management system in all companies that want or need (as a result of their activities) to determine and, respectively, to control the impact of their activities on the surrounding environment. Thus, as specified by the ISO 14001: 2004 standard (SRAC, 2015), the senior staff/ managers appointed by the management in this regard must inform the relevant authorities about the activity of their company, about the impact of its products, services or processes on the environment. They must implement the declared environmental policy, record and monitor all the actions taken in order to protect the environment. On 15 September, 2015 the new ISO 14001:2015 standard was published in English, French and Spanish. The Romanian version will appear in October 2016.
Given that, in most cases, the economic growth has led to a decrease in many natural resources, to a massive increase in pollution and in greenhouse gas emissions; one of the main objectives of the environmental policy is to develop renewable energy sources as a clean global energy resource.
For this purpose, the European Commission prepared the White Paper "Energy for the Future: Renewable Energy Sources" (1997) and the Green Paper (November 2000) "Towards a European strategy for security of energy supply. (Bejan, Rusu and Balan)
This paper aims at highlighting the role and the benefits of wind energy as far as the quality of life is concerned, in the context of sustainable development, with reference to a case study that involves installing a wind turbine at Elda Mec Constanta company, at the premises from Topraisar, Constanta County, Romania.

1. Renewable energy - global priority

According to the policies presented in the documents mentioned above, one of the main objectives of the European Commission was to increase the share of renewable energy in the overall energy consumption from 6%, in 1997, to 12%, in 2010; this threshold was exceeded by many European countries, and by the UE28 average. (Eurostat, 2015)
In December 2008, the European Union adopted a package of regulations on "climate and energy", which obliges Member States to implement measures that aim at increasing the share of renewable energy to over 20% of Europe’s total energy production until 2020. (E.C., 2011)
It can be said that, at present, renewable energy demand for electricity reached a high level worldwide, particularly in Europe.
According to Eurostat (2015), the share of renewable energy in total energy consumption across Europe has increased from year to year, from 2005 to 2014 (Table 1); the best result among the EU countries was registered in Sweden.
On 1 January 2007, only slightly more than 1% of the global electricity was provided by wind generators (approx. 74,000 MW). (Duma, 2007)
As far as wind energy is concerned, which is an important renewable source of energy across Europe, in 2008, it represented approximately 4.8% of the total EU energy consumption (E.C., 2011). Based on these figures, it is expected that, by the end of 2020, this percentage will exceed 12 units, and more than 34% of the total electricity consumption will be provided by renewable energy sources.

Over the last decade, most of the wind energy produced in the EU is, in fact, the result of the operation of numerous wind farms in only some Member States (until the end of 2008, Germany, Spain, Denmark, Italy, France, Portugal, Netherlands, Sweden, Ireland, Greece, the United Kingdom installed over 1,000 MW of wind power on their territory). Also, in 2008, the largest share of wind power in electricity demand was registered by Denmark (20.30%), followed by Spain (12.30%), Portugal (11.40%), Ireland (9.30%) and Germany (6.90%). In the other countries, the share of wind energy in total energy consumption is much lower. (C.E., 2011)

Table no. 1 Eurostat Share of renewable energy in gross final energy consumption

Geo \ time	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2020 Target
EU 28	**9.00**	**9.50**	**10.4**	**11.0**	**12.4**	**12.8**	**13.1**	**14.3**	**15.0**	**16.0**	**20**
Norway	*59.8*	*60.3*	*60.2*	*61.8*	*64.9*	*61.2*	*64.8*	*65.9*	*66.7*	*69.2*	*67.5*
Iceland	*60.1*	*60.8*	*71.5*	*67.5*	*69.7*	*70.4*	*71.6*	*73.2*	*72.2*	*77.1*	*64*
Sweden	40.6	42.7	44.2	45.3	48.2	47.2	49	51.1	52	52.6	49
Latvia	32.3	31.1	29.6	29.8	34.3	30.4	33.5	35.7	37.1	38.7	40
Finland	28.8	30.0	29.6	31.4	31.4	32.4	32.8	34.4	36.7	38.7	38
Austria	23.8	25.3	27.3	28.2	30.2	30.6	30.8	31.6	32.3	33.1	34
Denmark	16.2	16.4	17.8	18.6	20.0	22.1	23.5	25.6	27.3	29.2	30
Portugal	19.5	20.8	21.9	23.0	24.4	24.2	24.7	25.0	25.7	27.0	31
Estonia	17.5	16.1	17.1	18.9	23.0	24.6	25.5	25.8	25.6	26.5	25
Slovenia	16.0	15.6	15.6	15.0	20.0	20.5	20.2	20.9	22.5	21.9	25
Romania	**17.6**	**17.1**	**18.3**	**20.5**	**22.7**	**23.4**	**21.4**	**22.8**	**23.9**	**24.9**	**24**
France	9.6	9.3	10.2	11.1	12.1	12.6	11.1	13.4	14.0	14.3	23
Lithuania	17	17	16.7	18.0	20.0	19.8	20.2	21.7	23.0	23.9	23
Spain	8.4	9.2	9.7	10.8	13.0	13.8	13.2	14.3	15.3	16.2	20
Croatia	23.8	22.7	22.2	22.0	23.6	25.1	25.4	26.8	28.1	27.9	20
Germania	6.7	7.7	9.1	8.6	9.9	10.5	11.4	12.1	12.4	13.8	18
Greece	7.0	7.2	8.2	8.0	8.5	9.8	10.9	13.4	15.0	15.3	18
Italia	7.5	8.4	9.8	11.5	12.8	13.0	12.9	15.4	16.7	17.1	17
Bulgaria	9.4	9.6	9.2	10.5	12.1	14.1	14.3	16.0	19.0	18.0	16
Ireland	2.9	3.1	3.6	4.1	5.1	5.6	6.6	7.1	7.7	8.6	16
United Kingdom	1.4	1.6	1.8	2.7	3.3	3.7	4.2	4.6	5.6	7.0	15
Poland	6.9	6.9	6.9	7.7	8.7	9.2	10.3	10.9	11.3	11.4	15
Hungary	4.5	5.1	5.9	6.5	8.0	8.6	9.1	9.6	9.5	9.5	14.65
Slovakia	6.4	6.6	7.8	7.7	9.4	9.1	10.3	10.4	10.1	11.6	14
Netherlands	2.5	2.8	3.3	3.6	4.3	3.9	4.5	4.7	4.8	5.5	14
Belgium	2.3	2.7	3.4	3.8	5.1	5.5	6.2	7.2	7.5	8.0	13
Czech Republic	6.0	6.4	7.4	7.6	8.5	9.5	9.5	11.4	12.4	13.4	13
Cyprus	3.1	3.3	4.0	5.1	5.6	6.0	6.0	6.8	8.1	9.0	13
Luxembourg	1.4	1.5	2.7	2.8	2.9	2.9	2.9	3.1	3.6	4.5	11
Malta	0.2	0.2	0.2	0.2	0.2	1.1	1.9	2.9	3.7	4.7	10

Source:[*http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_31&plugin=1*](http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode=t2020_31&plugin=1)

According to the statistics published by the European Association of Wind Energy, in early 2013, the world leaders in terms of the capacity of the wind turbines installed in 2012 are China (13,200 MW), USA (13,120 MW) and Germany (2,439 MW), countries closely followed by India (2,336 MW), UK (1,897 MW), Italy (1,273 MW), Spain (1122 MW), Brazil (1,077 MW), Canada (935 MW) and Romania (923 MW). (Petrescu, 2013)

These differences arise because of the fact that the wind resource, as well as any other type of resource, varies greatly from country to country. In recent years, there has been registered a certain development of the offshore wind energy, in the North Sea and the Baltic Sea, in areas with water depth less than 30 meters, at a distance of up to 40 km from the shore. Compared to onshore wind power, the offshore wind power represents only about 2% of the total installed capacity in Europe (C.E., 2011). This result is explained by the fact that, in offshore wind farms, plants are more complex, and, therefore, more expensive; the operating and maintenance costs are higher; the service personnel of these facilities is less numerous and the working conditions are difficult.
At the same time, we found significant differences in the capacity of the transmission networks of other electricity generation plants, which take over the produced wind energy.

2. Wind energy - an important element in the development programs of investors, in Romania

As evident from the statistics provided by Eurostat (2015) and by the European Wind Energy Association (Petrescu, 2013), we can state that, in our country, there are major concerns with renewable energy development, particularly with wind power.
According to a study conducted by PHARE (Lascu, 2011), Romania's wind potential is of approximately 14,000 MW of installed capacity, respectively 23,000 GWh of electricity production per year. Considering only the technical and the economic conversion potential of about 2,500 MW, the corresponding electricity production would be of approximately 6,000 GWh per year, which would mean 11% of the total electricity production of the country.
According to the data published on 01.04.2013 by Transelectrica, in Romania, at that time, there were 25 large wind farms under the responsibility of the energy dispatcher, with a total capacity of approximately 1,900 MW. Numerous other smaller wind farms, which did not fall under the control of the national energy dispatcher and whose aggregate capacity was 200 MW, were added. (Petrescu, 2013)
In 2013, the main wind market investors were CEZ, Enel and Energias de Portugal. (Petrescu, 2013)
The CEZ Group (2016) invested in Dobrogea 1.1 billion Euros in the construction of the biggest onshore wind farm in Europe, with a total installed power of 600 MW. The entire capacity of CEZ Wind Farms (139 wind turbines in Fantanele, with a capacity of 347.5 MW; 101 wind turbines in Cogealac and Gradina, with a capacity of 252.5 MW) was put into operation in late 2012.
Regarding the concerns of Enel Group (2016) with renewable energy, the wind projects of Enel Green Power Romania in Banat and Dobrogea regions became operational in late 2012, the net installed capacity being of about 500 MW.
Energias de Portugal Group operated several wind farms, both in Dobrogea (Pestera and Cernavoda - Constanta County; Sarichioi - Tulcea County) and Moldova (Vutcani – Vaslui County).
If we analyze the geographic areas where the above mentioned wind farms are installed, we notice that these are areas where the wind speed reaches over 6.5 m/s (Fig. 1), knowing that the wind speed is one of the decisive factors in installing wind turbines.
At the national level, taking into account all the wind farms installed and operated at the end of 2015, we can state that the leader in the production of wind energy is Constanta County, where there are wind turbines with a capacity of 1,636 MW. At the level of Tulcea

County, wind power amounts to 796 MW. Through the investments in wind energy, in those counties, at present, Dobrogea is seen as the area with the greatest potential in the Southeast of Europe. (Cernat, 2016)

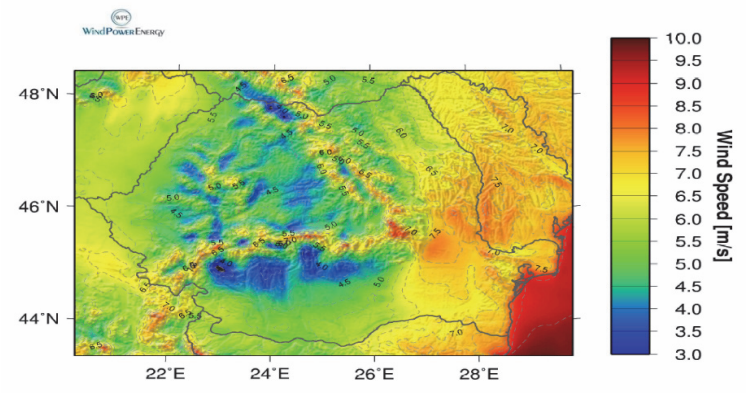

Fig. no. 1 Romania's wind resources at 50 m high, for different topographic conditions
Source: Lascu, M., 2011. Energia eoliană – harta de vânt a României, potențial de 14.000MW

According to Agerpres (Cernat, 2016), the national ranking continues with the following counties: Giurgiu (193 MW), Prahova (188 MW), Galati (166 MW), Brasov (152 MW), Ialomita (142 MW) and Braila (110 MW). In other counties, wind energy is worth less than 100W, the worst results being recorded in Salaj (4.7 MW), Covasna (6.4 MW) and Ilfov (6.5 MW).
The data presented by Transelectrica in early 2016 reveal that, by the end of 2015, there were signed contracts for the connection to the national electricity network for renewable energy projects totaling 10,789 MW, of which 7,521 MW was represented by the wind power.
In order to incentivize the production of renewable energy, the investors in this sector receive for free the so-called "green certificates"; these certificates are paid both by the natural and the legal persons in Romania, with the electricity bill. By their marketing on a specialized market, these certificates contribute to the increase in the revenue of renewable energy producers. For 2016, the mandatory quota of the electricity produced from renewable energy, benefiting from the promotion system through green certificates, is 12.15% of the gross final electricity consumption, higher by 0.6%, compared to 2015. (H.G. 1015, 2015)

3. Wind energy – a current concern of the management of Elda Mec Constanta Company

Elda Mec Company, located in Constanta, Romania, is a limited liability company with private capital, founded in 1996; its main activity is represented by the *Manufacture of dairy products and cheese*, as well as by their trade (since May 2000).

Throughout its activity, the company management was also concerned with the production and market delivery of top quality products, safe for consumption. Thus, in 2006, it began the construction and equipping works for a new factory of dairy and cheese production, by SAPARD European funds, at the premises in Topraisar, Constanta County. From July 2007 and until nowadays, the company undertook several actions in order to achieve, maintain and improve the quality of the products marketed under the brand ELDA. We highlight, among these, the implementation and certification, in January 2014, of the *Quality management system,* in accordance with the requirements of SR EN ISO 9001:2008 and of the *System of Food Safety Management,* in accordance with the requirements of SR EN ISO 22000:2005.

Being also concerned with ensuring environmental protection, in 2012, the company management decided to become a co-financing partner within the Project PN-II-PCCA No. 39/2012, entitled "Power Generation System which uses a Double - Effect Wind Turbine in Order to Ensure the Energy Autonomy in Specific. Applications (Double T-VAX)", the contractor being the National Institute for Research and Development in Electrical Engineering INCDIE ICPE-CA (Engineer Sergiu Nicolaie - project manager) and the contracting authority – the Executive Unit for Financing Higher Education, Research, Development and Innovation through Partnerships in priority areas.

As indicated in the project, this year, Elda Mec Company will take over the double-effect wind turbine prototype, made by the other partners in the project, and will put it into operation at the premises from Topraisar, Constanta County. Thus, it will ensure a high degree of autonomy and protection against the accidental interruption of power supply from the public network, which is particularly important, considering the company's objects of activity (both raw milk and other dairy products depreciate quite fast in the absence of an appropriate temperature throughout the production process).

The specialists involved in this project thought of making a double effect wind turbine (counter-rotating) for wind energy use, based on the idea that one can thus increase the maximum power that can be extracted from the air stream. For the mechanical-electrical energy conversion, the electric generator used in the double effect of wind energy plants must be placed in a dedicated building, with both mobile armatures (inductor and induced, respectively), each coupled to one of the two wind rotors. In phase 4 of the project (INCDIE ICPE-CA, 2015), the team began the construction of the permanent magnet electric generator, both armatures of the electrical machine being able to rotate independently. In case of accidental interruption of power supply from the national network, the wind plant should ensure the operation of two pumps from the technological equipment for minimum 15 minutes, time required to retrieve the raw materials/ intermediate products from the technological devices in operation and to store them safely. Thus, the counter-rotating wind power installation can operate in two modes, namely: either as a source of electricity, the wind generator debiting the electrical power to the national grid, or to provide the necessary electrical power for the recovery of raw materials/ intermediate products, as an ordinary "UPS".

Given the way in which the wind facility is to be used and the equipment which is to be supplied with electricity, the project team determined that the turbine will be made so as to operate at the following nominal parameters: nominal power = min. 10 kW and a nominal voltage = 3x400 V, under a wind speed of 10 m/s, to which there is estimated a relative speed between the two counter-rotating armatures of about 300 rev/min.

Also, in order to provide an enhanced operational safety, the wind facility equipped with two counter-rotating wind turbines will be connected to the national electrical network.
Among the main benefits to Elda Mec Company, brought by the commissioning of the wind turbine, are:

- ✓ Ensuring the electricity for intervention in case of power failures in the supply of electricity, leading to the avoidance of losses in raw materials, of locking the machines in operation and of other major property damage etc.;
- ✓ Providing electricity to the national power network, providing thus free electricity, which entails lower production costs.

Conclusions

After analyzing the impact that the installation and operation of wind facilities have on the environment, but also on the economic and daily life, worldwide, can say that the benefits of wind energy are undeniable. Of these, we mention the following (C.E., 2011; Duma, 2007):

- ✓ Zero emissions of pollutants and greenhouse gases;
- ✓ Reducing the consumption of cooling water, associated with many conventional energy production technologies;
- ✓ Waste is not generated in obtaining wind energy;
- ✓ Reduced costs per unit of energy produced; in recent years, following the application of various technologies for the production of wind turbines, their technical parameters have improved greatly, which led to lower prices of energy production to just 4 cents / 1 kW;
- ✓ Reduced costs for repairing, replacing parts/ sub-assemblies, if applicable;
- ✓ Reduced negative impact on the habitat of birds and animals, on the environment as a whole.

Starting from the results of the commissioning of a double effect wind turbine at Elda Mec Company, we can state the following:

- ✓ It is possible to produce a wind turbine prototype, which operates at wind speeds lower than those required to turbine generators in wind farms (these conditions are often encountered in practice);
- ✓ The wind turbine can be installed and operated in many remote areas, where, until now, wind generators could not be used due to the average wind speed lower than 10 m/s;
- ✓ The supporting pillar of the double effect wind turbine is only 12 m high, being thus easier to install and operate; moreover, the costs for these operations are lower;
- ✓ The propellers used in the double effect wind turbine are much smaller than those used in wind parks and do not vibrate at the time of their actuation by the wind, which results in lower manufacturing costs and in reduced installation and operating costs. Moreover, the surrounding habitat of residents, birds and animals is not affected.
- ✓ The double effect wind turbine installations can be the solution for the small and medium entrepreneurs (production units, hostels, irrigation facilities etc.) who wish to contribute to the environmental protection and, at the same time, to reduce their production costs;
- ✓ This type of wind turbine can represent the saving solution for those who cannot connect to the national electricity network and need electrical power of about 10-15 kW.

References/Bibliography

Agenția pentru Dezvoltare Regională Centru (A.D.R.C.), 2012. *Strategia de dezvoltare regională 2014-2020*. [online] Available at: <http://www.adrcentru.ro/Document_Files/strategia2014-2020/00001446/68dnr_Axa%20prioritara%203.%20Protectia%20mediului%20inconjurator,%20cresterea%20eficientei%20energetice,%20stimularea%20utilizarii%20surselor%20alternative%20de%20energie.pdf> [Accessed 28 February 2016].
Arion, V., Tabuleac, M. *Expunere de motive.* [online] Available at: <http://www.senat.ro/legis/PDF%5C2007%5C07L121EM.pdf> [Accessed 05 March 2016]
Bejan, M., Rusu, T., Bălan, I.. *Prezentul și viitorul energiei. Partea a II-a. Energii regenerabile. Perspective tehnologice*. [online] Available at: <www.agir.ro/buletine/817.pdf> [Accessed 03 March 2016].
Cernat, F., 2016. *Județul Constanța produce cea mai multă energie verde*. Available at: <http://www.agerpres.ro/economie/2016/01/06/judetul-constanta-produce-cea-mai-multa-energie-verde-iar-salajul-cea-mai-putina-14-29-11> [Accessed 26 March 2016].
CEZ, 2016. Available at: <http://www.cez.ro/ro/despre-noi/informatii-generale/companiile-cez/despre-grupul-cez-in-romania.html> [Accessed 26 March 2016].
Comisia Europeană (C.E.), 2011. *Orientare a UE privind dezvoltarea energiei eoliene în conformitate cu legislația UE privind natura*. Luxemburg: Oficiul pentru Publicații al U. E.
Duma, R., 2007. *Energia eoliană – Pariul pe aripile vântului*. [online] Available at: <http://www.marketwatch.ro/articol/2375/Energia_eoliana_-_Pariul_pe_aripile_vantului/> [Accessed 05 March 2016].
Enel, 2016. *Energii regenerabile*. [online] Available at: <http://www.enel.ro/ro/mediu-energii-regenerabile.html> [Accessed 26 March 2016].
Eurostat, 2015. *Share of renewable energy in gross final energy consumption.* [online] Available at: <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init=1&language=en&pcode= t2020_31&plugin=1> [Accessed 25 March 2016]
INCDIE ICPE-CA, 2015. *Proiectul "Sistem de generare a energiei electrice utilizând turbina eoliană cu dublu efect, pentru asigurarea autonomiei energetice în aplicații specifice (Double T-VAX)", Etapa de execuție nr.4/2015: Realizare nacelă de turbină eoliană cu dublu efect*
Lascu, M., 2011. *Energia eoliană – harta de vânt a României, potențial de 14.000 MW*. [online] Available at: <http://energielive.ro/energie-eoliana-harta-de-vant-a-romaniei-potential-de-14-000-mw/> [Accessed 26 March 2016].
Mănoiu, V., 2011. *Efectele energiei eoliene asupra mediului. Energia eoliană în România*. Greenly Magazine. [online] Available at <http://greenly.ro/invitati/efectele-energiei-eoliene-asupra-mediului-energia-eoliana-in-romania> [Accessed 01 March 2016].
Petrescu, R., 2013. *România, locul 10 în lume la capacitatea turbinelor eoliene instalate anul trecut. China și USA domină piața globală a vântului*. [online] Available at: <http://www.zf.ro/zf-24/romania-locul-10-in-lume-la-capacitatea-turbinelor-eoliene-instalate-anul-trecut-china-si-usa-domina-piata-globala-a-vantului-10845810> [Accessed 25 March 2016].
Societatea Română pentru Asigurarea Calității - SRAC, 2016. *Mediu – ISO 14001*. [online] Available at <http://www.srac.ro/ro/mediu-iso-14001> [Accessed 05 March 2016].
SUN CERT, 2015. Available at <http://www.suncert.ro/certificari/management-de-mediu-iso-140012015> [Accessed 05 March 2016].

***. *HG 1015/30.12.2015 pentru aprobarea cotei anuale obligatorii de energie electrică produsă din surse regenerabile de energie, care beneficiază de sistemul de promovare prin certificate verzi, pentru anul 2016*. [online] Available at <http://legislatie.just.ro/Public/DetaliiDocument/174541> [Accessed 05 March 2016].

Acknowledgements
Research was performed with the support of UEFISCDI, PNCDI II Program – Joint Applied Research Projects, Contract no. 39/2012, Power Generation System which use a Double-Effect Wind Turbine in Order to Ensure the Energy Autonomy in Specific Applications.