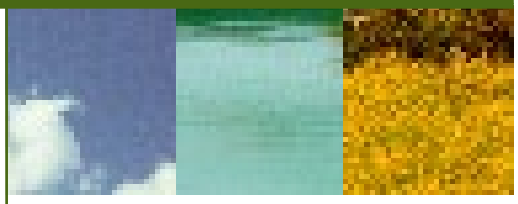
MOLINS DE VENT

TARRAGÓ®

Info-Memorandum



Molins de Vent TARRAGÓ®

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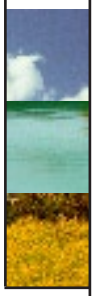


1 **Executive Summary,** *page 4*

2 **Company Background,** *page 4*

3 **Windmill Operation,** *page 8*

4 **Parts of a Windmill,** *page 8*

5 **Calculation of an Installation,** *page 9*

6 **Windmill Special Characteristics,** *page 10*

6.1 Automatic Brake System, *page 10*
6.2 Feed Water Pump Valve, *page 10*
6.3 Regulating System, *page 10*
6.4 Grease System, *page 10*
6.5 Model Characteristics, *page 11*
6.6 Model Yields, *page 12*

7 **Applications of the Windmills,** *page 14*

7.1 Water supply for small towns, *page 14*
7.2 Water supply for the agriculture and farms, *page 14*
7.2.1 Multi installation in big premises, *page 14*
7.2.2 Single Installation in Small Premises, *page 15*
7.3 Water Quality, *page 15*
7.4 Other Applications, *page 15*

8 **Contact,** *page 16*

1. Executive Summary

This info-memorandum is a presentation of *Molins de Vent TARRAGÓ®*, the company, its products and the water pumping systems that use renewable energy.

2. Company Background

Molins de Vent TARRAGÓ® is a company that produces, commercialises and installs windmills for pumping water. Additionally, *Molins de Vent TARRAGÓ®* offers consulting and administration services for applications that use the wind energy to pump water. The main product of *Molins de Vent TARRAGÓ®* are multi-showel windmills.

Molins de Vent TARRAGÓ® has been founded in 1984, although the origins of the company go back to the year 1964. In 1964, the founder Josep Tarragó i Vilarrubí, at the age of 16, built up its first windmill for the personal use.

In 1984 *Molins de Vent TARRAGÓ®* starts the commercial activity. The company initially was regionally orientated and only installed windmills in the denominated district La Conca de Barberà *(see Picture 2)*. La Conca de Barberà has a total surface of 648,80 km², with a population density of 27,96 h/km².(1)

Molins de Vent TARRAGÓ® expanded its activities very soon to the rest of Catalonia, the

Figure 1: Assembly in the outside part of the headquaters of Molins de Vent TARRAGÓ®

(1): *www.pradesmontsant.com*

Picture 2: Base of Molins de Vent TARRAGÓ®.

peninsula and Balearic Islands *(see Picture 3)*. Apart from Catalonia, the regions where Molins de *Molins de Vent TARRAGÓ®* mainly has settled windmills are Andalusia, Aragon, Catalonia, Extremadura, La Rioja, Navarra and Portugal.

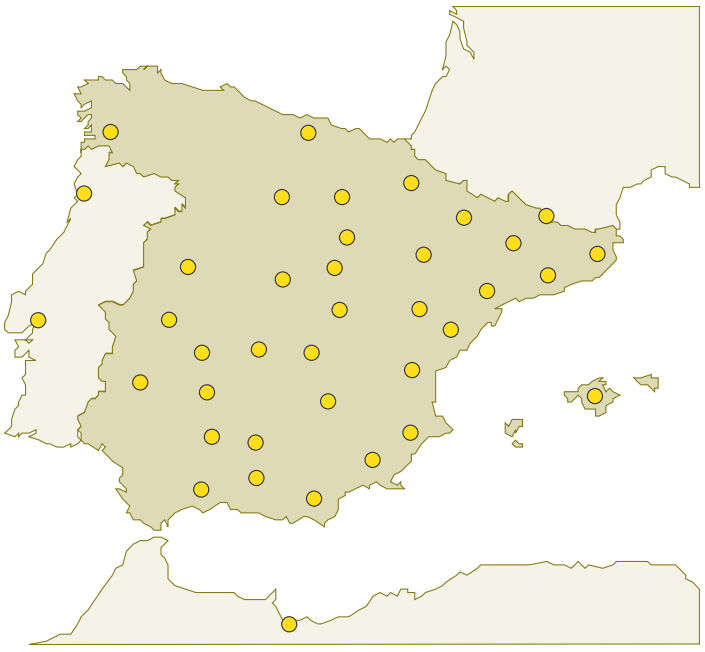


Figure 3: Molins de Vent TARRAGÓ® in Spain (regions), Portugal, Andorra and Marocco.

Moreover, *Molins de Vent TARRAGÓ®* exports to the markets of Andorra, Brazil, Germany, Marocco, Panamá and Portugal.

In terms of international markets, *Molins de Vent TARRAGÓ®* has carried out a study about the opportunities of internationalization into South America and Mexico. The variables of decision in this study are in *Table 1*.

Variable	Influence
Political Situation of the Country	The bigger the political stability, the higher the security in the commercial treatment.
Population Density	The lower the population density, the higher the number of rural areas, the higher the market acceptance of the windmills.
Purchasing Power	The purchasing power indicates the capacity of the final consumer's purchase. As much as more big, more favo rable. The final customer is an important client for *Molins de Vent TARRAGÓ®*, together with the institutional client.
Electrification Rates	1) it is an important variable, because evaluates the penetration grade to he market of competitive systems as the electrical bombs. 2) to value a future penetration to the market with a second range of products like the windmills to generate electricity.
Energy Market Liberalization	The experience in Europa demonstrates that in energy liberalized markets, utilities invest in respectful products with the environment, fact that also favours *Molins de Vent TARRAGÓ®*
Intellectual Property Rights	Its existence is necessary to protect the product property.
Participation in International Trade Organizations	This participation motivates international trade.
Other	Existence of Grants, Bilateral Treaties of Help to the Economic and Sustainable Development...

Table 1: Variables to determinate an initial study about internationalization

Each of these variables received a value (of 1 at 3) depending on their grade of importance and at the same time, this value was pondered by the occurrence grade in each country (value from 1 to 3). For example, the variable protection of intellectual and industrial property rights took the value of 3 to have maximum importance and in Argentina this variable took the value in turn of 3 to be a country with appropriate international legislation. Total: 3 x 3 = 9. The maximum value that a country can reach is 45. Argentina and Brazil reached the maximum values with 42 points.

The preliminary results of the study are picked up in the following *Picture 4*.

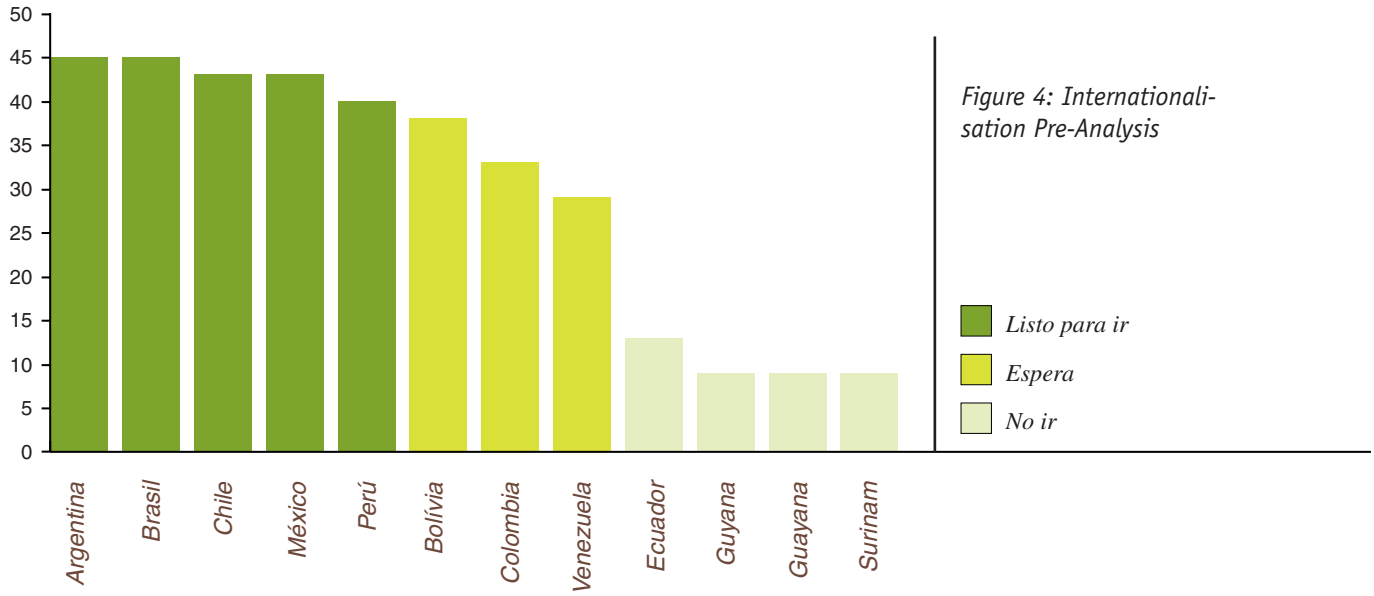


Figure 4: Internationalisation Pre-Analysis

The objective of *Molins de Vent TARRAGÓ®* is to enlarge the business to international markets where the systems of pumping water by means of windmills not only represent an economic alternative for the country, but also an ecological one. *Molins de Vent TARRAGÓ®* provides a technical solution for pumping water that allow the client to be energetically self-sufficient using a free, renewable and environmental friendly energy: the wind energy.

The products of *Molins de Vent TARRAGÓ®* guarantee the following effects:

- Respectful treatment of the environment
- Reduce costs
- Facilitation of energy autonomy
- Use of a renewable and free energy
- Reduce contamination

One of the factors that have guaranteed the success of *Molins de Vent TARRAGÓ®* has been the exceptionally motivated team of the company, and the quality of service (QoS).

3. Windmill Operation

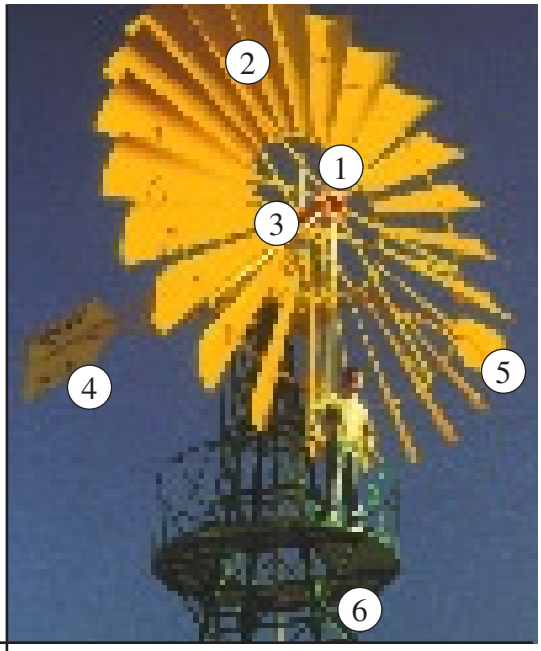
The windmill starts to pump water at a wind speed of 4 m/sec. The wind-wheel begins to rotate and makes the piston pump work, which is located in the bottom of the groundwater. The pump is driven by connecting rods from the wind-wheel, which go through the interior of galvanized tubes into the pump at the bottom of the groundwater.

The pump has a piston and a system of valves that impell the water into the tubes to the surface into a pool. One of the main characteristics of the piston bombs is that the bomb would continue pumping water and air without being harmed in case the groundwater capacity is lower than what was foreseen.

The windmill transports the water and, if necessary, rises the water above the height of the tower. Thus, it is also necesarry to install a press-tows at the end of the tubes of the tower, to avoid water losses.

The TARRAGÓ windmills are protected against strong winds thanks to its automatic brake system. Apart from the automatic brake system, the windmill has a manual brake system at the bottom of the tower that allows to stop it easily at any moment.

4. Parts of a Windmill



Picture 5: Parts of a Windmill

1. Axle of the wind-wheel: transforms the circular movement of the wind-wheel into a vertical movement to the piston rods.

2. Wind-wheel: transforms the wind energy into a mechanical movement.

3. Head Plate: contains the mechanical parts of the windmill.

4. Orienting Tail: guides the wind-wheel to the wind direction.

5. Oriented Tail: guides the wind-wheel against the wind direction in case of too strong winds or when it is necessary to stop the windmill.

6. Tower: allows to reach winds of more speed. The higher the tower, the stronger the wind and also the higher the possibility to avoid obstacles that impede the impact of the wind.

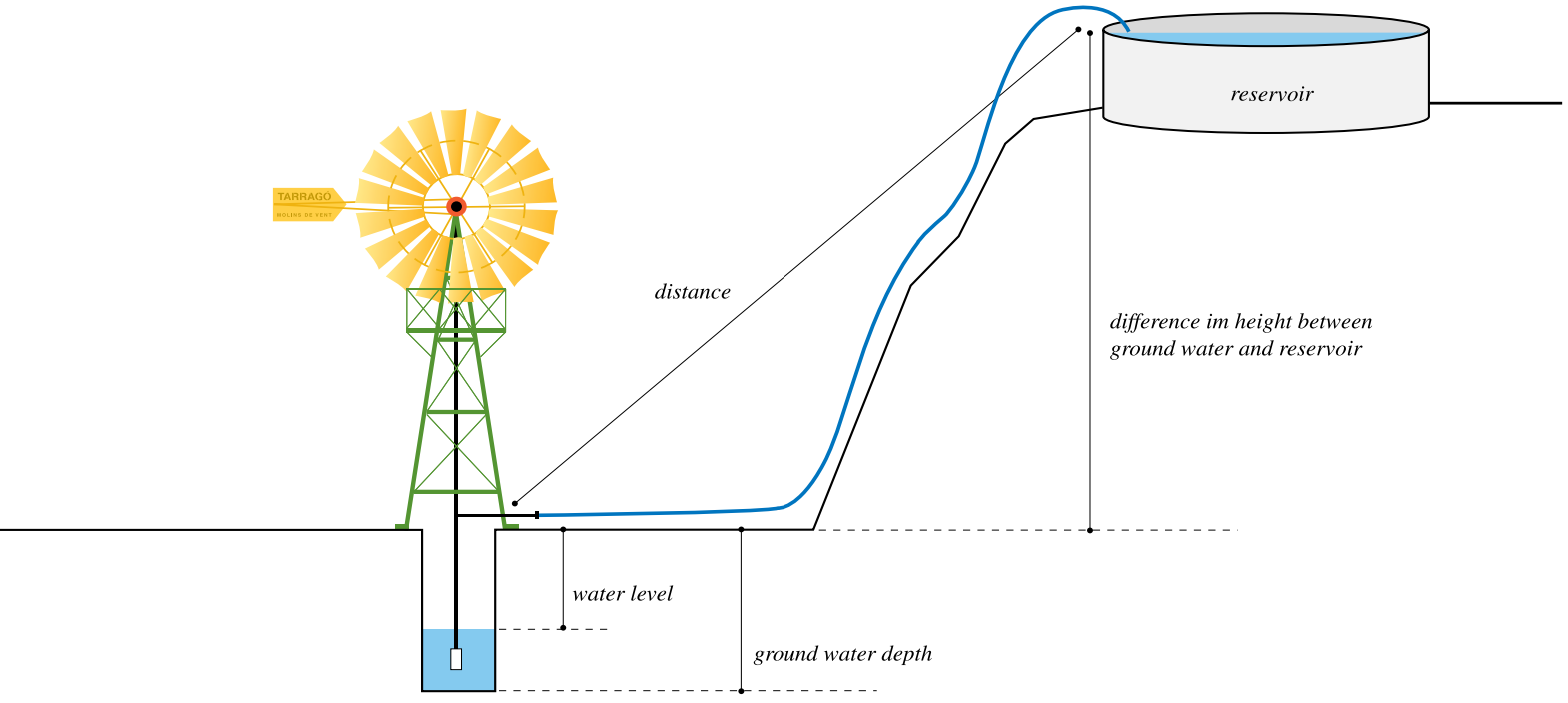
5. Calculation of an installation

Molins de Vent TARRAGÓ® currently offers 6 different models of windmills to pump water. The most suitable model is always determinated according to the following variables:

- Wind speed in the region / area
- Kind of groundwater (small lake, groundwater, perforation...)
- Static level of the water
- Distance of elevation of the water
- Transport distance
- Environmental impact
- Type of exploitation and/or water needs
- Irregularities of the landscape

The pumped flow of water is strongly dependent on the diameter of the wind-wheel. The yield of a multiblade windmill increases exponentially with the diameter of the wind-wheel. The bigger the diameter, the higher the nominal power and therefore the higher pumped flow of water.

The tower of the windmill has to be high enough in order to reach a continuous wind flow free of and to avoid influence of obstacles like trees, small hills... close to place of installation.



Picture 6: Shema of an installation

6. *Windmill Special Characteristics*

Molins de Vent TARRAGÓ" joins a traditional image with the advantages of new materials and technologies: use of design software, production with strict quality controls, high precision production technology, new materials of high resistance, among others. The elements that make the *Molins de Vent TARRAGÓ®* windmills a product of high yield that is superior to old windmills, are the Automatic Brake System *(see Section 6.1)*, the System of Feed Water Pump Valves *(see Section 6.2)*, the System of Regulation *(see Section 6.3)* and the Grease System *(see Section 6.4)*.

6.1 Automatic Brake System

The orienting and oriented tails together with several supports form a mechanism that allows the windmill to detect excessive winds, being braked progressively with increasing wind speed and working again in case wind speed slows down.

6.2 Feed Water Pump Valves

The feed water pump valves are designed to work under very hard conditions, even pumping water that is impossible to pump for other types of pumps. Neither they are affected by the decrease of the level of the water, pumping in this case the water together with air.

6.3 System of Regulation

This System allows the user of the windmill to decide the wind speed in that the windmill will begin to brake automatically, adjusting this limit to the local conditions and the time of the year.

6.4 Grease System

All the parts exposed to mud can be greased efficiently in order to resist bigger efforts, supported by small cushions of maximum quality being and it releases duration. The windmills, *Molins de Vent TARRAGÓ®*, are designed to reduce to the minimum the maintenance. We recommend to grease the windmill once or twice a year.

6.5 Model Characteristics

Characteristics	M-1018
Diameter of the wind-wheel	10 m.
Height of the tower	18 m.
Platform	2 with stairs and banisters
Base of the tower	Square with 4,37 m. per side

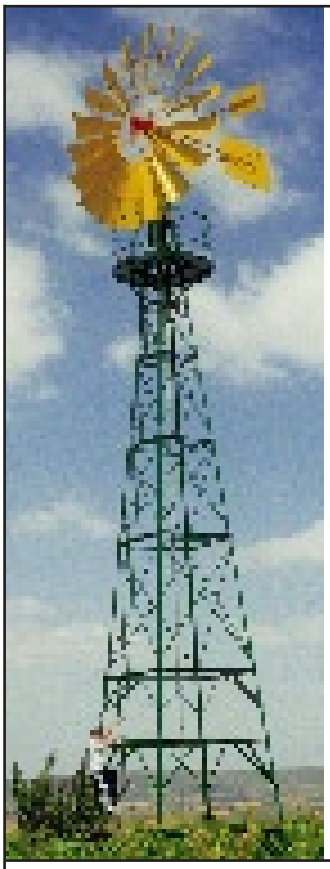
Characteristics	M-7015
Diameter of the wind-wheel	7 m.
Height of the tower	15 m.
Platform	2 with stairs and banisters
Base of the tower	Square with 3,02 m. per side

Characteristics	M-5015
Diameter of the wind-wheel	5 m.
Height of the tower	15 m.
Platform	2,23 Ø m. with banisters & stairs to access to the top
Base of the tower	Square with 3,02 m. per side

Characteristics	M-4012
Diameter of the wind-wheel	4 m.
Height of the tower	12 m.
Platform	2,20 Ø m. with banisters & stairs to access to the top
Base of the tower	Square with 2,46 m. per side
Tower Supplement	3 m. (possible to adapt)

Characteristics	M-3009
Diameter of the wind-wheel	3 m.
Height of the tower	9 m.
Platform	2,20 Ø m. with banisters & stairs to access to the top
Base of the tower	Square with 1,90 m. per side

Characteristics	M-1806
Diameter of the wind-wheel	1,80 m.
Height of the tower	6 m.
Base of the tower	Square with 1,50 m. per side
Tower Supplement	2 m. (possible to adapt)



Picture 7: M-4012

Picture 8: M-1806

6.6 Models Yields

☐ YIELDS M-1018

Pump	Ground-water (m)	Max. Water Amount (l/h)	Min. Water Amount (l/h)	D.T. P. galvanised
B-20040	90	11.600	6.000	3″
B-25040	66	16.000	8.500	4″
B-26040	42	40.500	18.000	5″
B-30040	18	60.000	24.000	8″

☐ YIELDS M-7015

Pump	Ground-water (m)	Max. Water Amount (l/h)	Min. Water Amount (l/h)	D.T. P. galvanised
B-15030	90	9.000	5.000	2″ 1/2
B-20022	72	11.600	6.000	3″
B-20040	48	16.200	8.500	4″
B-26040	18	40.500	18.000	5″

☐ YIELDS M-5015

Pump	Ground-water (m)	Max. Water Amount (l/h)	Min. Water Amount (l/h)	D.T. P. galvanised
B-8522	90	4.000	2.300	2″
B-10022	72	5.300	3.100	2″
B-12022	48	7.800	5.000	2″ 1/2
B-15030	36	11.500	7.100	3″
B-20022	18	16.200	8.500	4″

☐ YIELDS M-4012

Pump	Ground-water (m)	Max. Water Amount (l/h)	Min. Water Amount (l/h)	D.T. P. galvanised
B-7022	90	2.800	1.500	1″ 1/2
B-8522	72	4.200	2.300	2“
B-10022	48	5.700	3.100	2″
B-12022	36	8.200	5.000	2″ 1/2
B-15022	18	13.000	7.100	3″

☐ YIELDS M-3009

Pump	Ground-water (m)	Max. Water Amount (l/h)	Min. Water Amount (l/h)	D.T. P. galvanised
B-5015	90	1.200	500	1″ 1/4
B-6215	72	1.800	800	1″ 1/2
B-7015	48	2.400	1.100	1″ 1/2
B-8515	36	3.500	1.500	2″
B-10022	24	5.000	2.100	2″
B-12022	18	7.100	3.000	2″ 1/2

☐ YIELDS M-1806

Pump	Ground-water (m)	Max. Water Amount (l/h)	Min. Water Amount (l/h)	D.T. P. galvanised
B-6012	18	1.000	375	1″ 1/4
B-7007	15	1.400	525	1″ 1/4
B-8515	10	1.800	775	1″ 1/2

The water amounts are expressed in liter per hour in order to create comparable data to other pumping systems. Nevertheless the water amount pumped per day is more significant because the wind speed changes during the day.

The maximum water amounts are refered to wind speeds of 12 m/sec and the minimal pumped water amount is pumped with a wind speed of 4 m/sec. It is always recomended to install the piston pump that functions in hours of low wind speed, too.

7. Applications of the Windmills

7.1 Water Supply for Small Towns

More and more windmills are installed to supply water to small villages. *Table 2* shows the installations carried out up to now to supply water to such villages.

Village	Province	No. of Habitants	Model	Year of Installation
Vilanova de Prades	Tarragona	157 (1998)	M-4012	1987
Blancafort	Tarragona	395 (1999)	M-4012	1988
Vic	Barcelona	30.397 (1999)	M-3009	1998
			M-4515	1999
			M-4515	2001
St. Feliu Llobregat	Barcelona	37.849 (1981)	M-4015	1997
Villarquemado	Teruel	1.176 (1983)	M-3009	1996
Vilamalla	Girona	606 (1996)	M-3009	2001

Table 2: Major towns with windmills

7.2 Water Supply for the Agriculture and Farms

Windmills are adequate for small properties as well as for large premises and farms.

7.2.1 Multi installation in big premises

In case of large premises, it is recommended to install more than one windmill (multi installation). The advantage of a multi installation is the possibility to extract water from all points of the premise.

7.2.2 Single Installation in Small Premises

In case of small premises (greengrocer fields, small farms...), the installation of a medium sized windmill (M-3009 and M-4012) is sufficient to ensure the coverage of water needs.

7.3 Water Quality

Windmills pump water into reservoirs to ensure appropriate levels of dissolved oxygen in tailwaters. In many instances the water released from the reservoir will have lower concentrations of dissolved oxygen, at times totally devoid of it, causing mortality of aquatic organisms in downstream reaches. Windmills are installed to provide a suitable quality and temperature for the downstream aquatic communities. An example of such an installation is in the natural park of Delta de l'Ebre (Tarragona, Spain).

Recently, studies have been carried out to consider the utilization of windmills in clean water systems and water desalinization.

7.4 Other Applications

Some other special applications of the windmill are:

- Water transfer among pools in different levels.
- Drain of areas.
- Water supply to small sees, public gardens and fountains.
- Water supply in natural parks.
- Water supply to industries.
- Water cleaning and water recycling installations.

8. Contact

You will find further information about us:

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