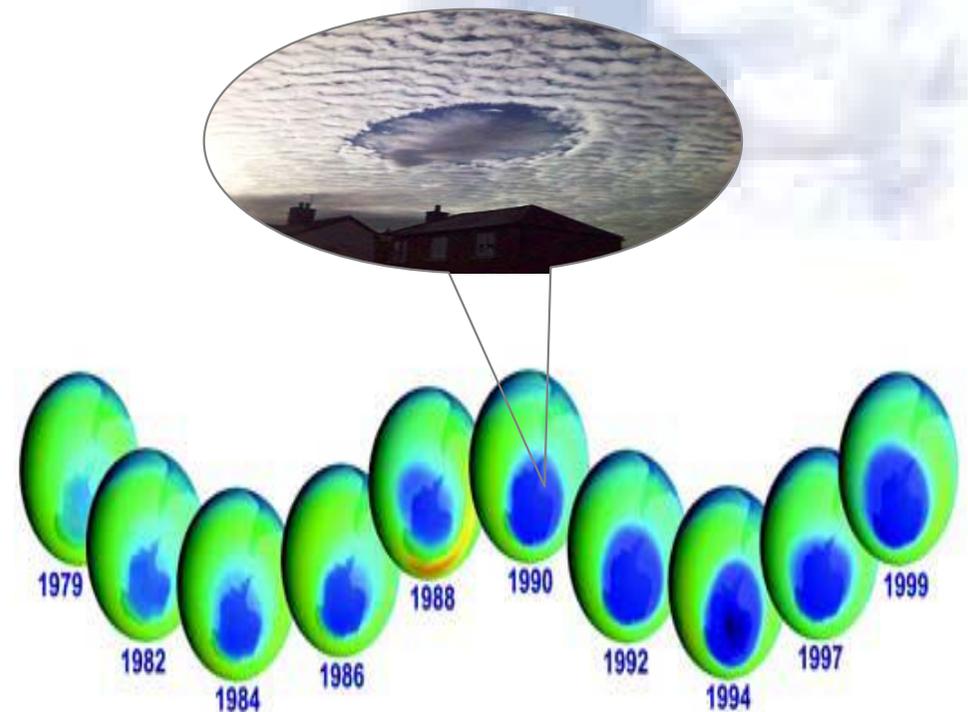
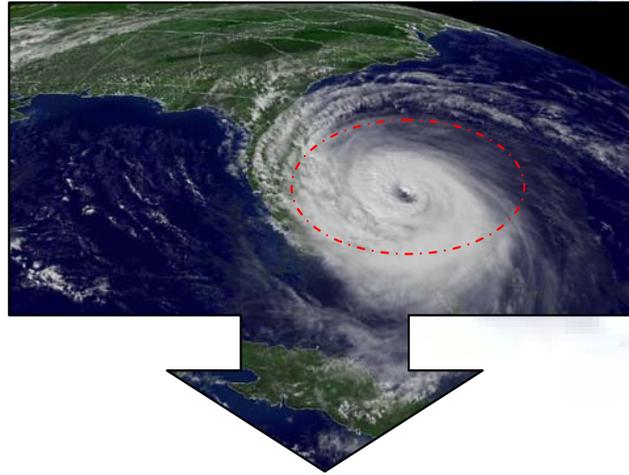


# Acceleration of global warming

In 1974, two California chemists, Mario J. Molina  and F. S. Roland  announced that chlorofluorocarbons (CFCs) being added to the atmosphere might decrease the ozone layer surrounding the earth .

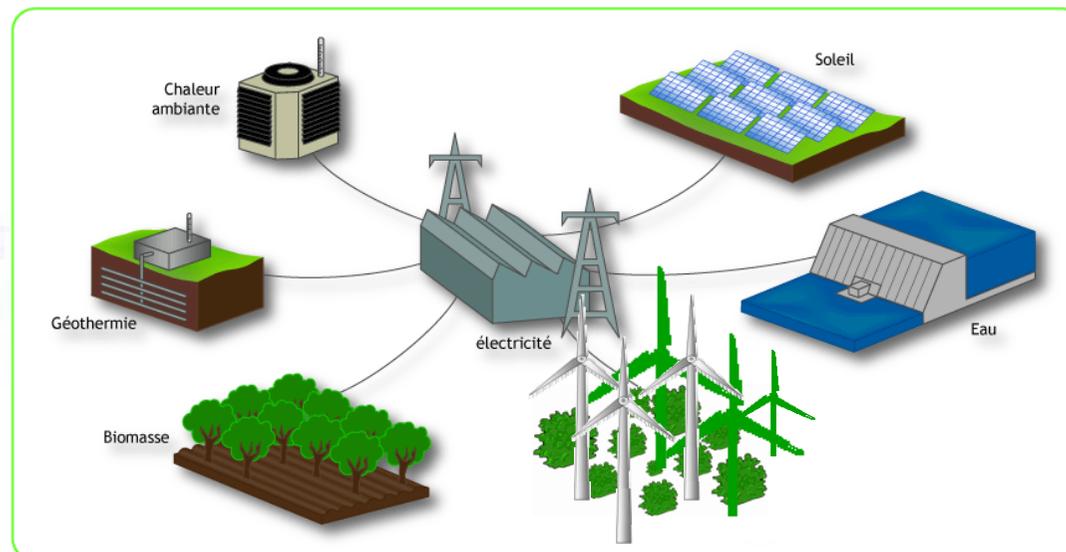
Then, in 1985, a large “ozone hole” was discovered above the continent of Antarctica during the spring time by  Joe Farman, Brian Gardiner & Jonathan Shanklin at the British Antarctic Survey.





**While energy demand is growing  
fossil fuel reserves are being depleted**

*The remedy for these problems is to use Renewable Energy*



*CONCEPTION ET MODELISATION  
D'UNE STATION EOLIENNE AU SUD OUEST DE L'ALGERIE*

*Assessing Wind Energy in South West Algeria*



*Dr. Youcef HIMRI*

# OBJECTIVE

**This study presents the wind data analysis and available wind energy potential at three locations namely Adrar, Timimoun and Tindouf in Algeria.**

**The energy yield was calculated using the RETScreen software and finally the plant capacity factors and economical parameters were estimated and reported.**

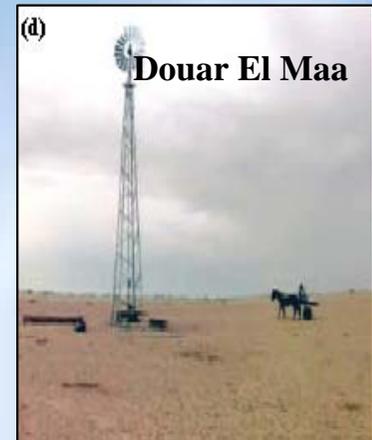
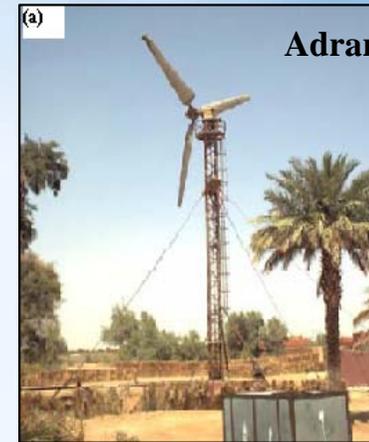
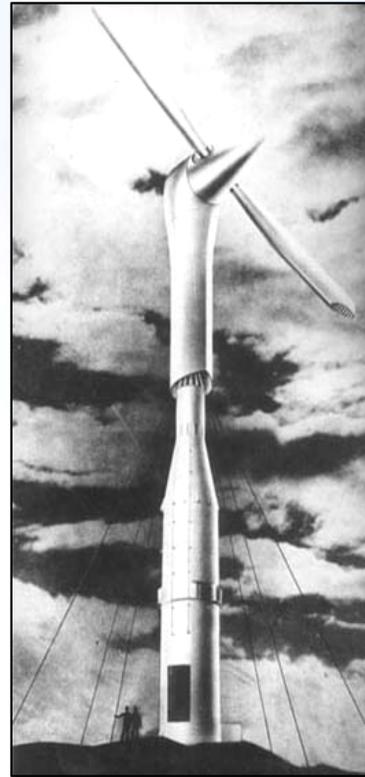


# Wind Energy potential of Algeria

According to Helimax, Algeria is among 15 African countries



Good potential of wind energy



**In collaboration with Prof. S.Rehman, Center for Engineering Research, K. F. U. of Petroleum and Minerals, we have treated Wind power potential assessment for three locations in Algeria.**

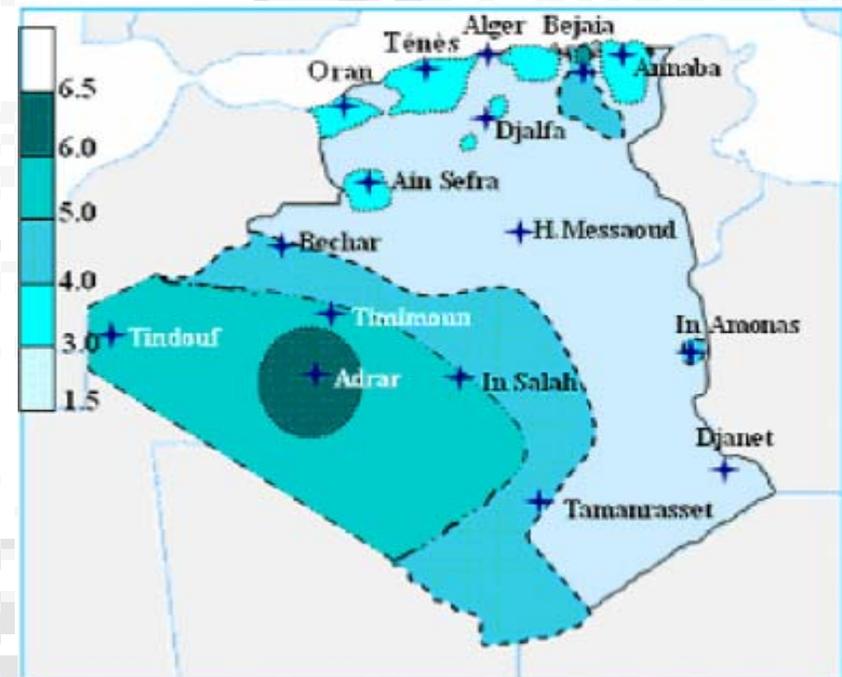
# Wind data and site description (1/2)

**Tab1: Geographical coordinates of the data collection stations used in the study**

Location	Latitude	Longitude	Altitude (m)	Duration (years)
Adrar	27°49'N	00°17'E	263	11
Timimoun	29°15'N	00°17'E	312	11
Tindouf	27°40'N	08°06'W	401	8

**The wind speed data were collected over a period of 8-11 years at three sites used in this study.**

**The wind speed measurements were made 10m AGL and recorded every 3h interval at all the stations.**



07/14

**Fig1: Map showing the locations of the wind measurement stations.**

# Wind data and site description (2/2)

This indicates that higher electricity could be produced during 09:00-18:00 h, which also coincide with higher electricity demand time.

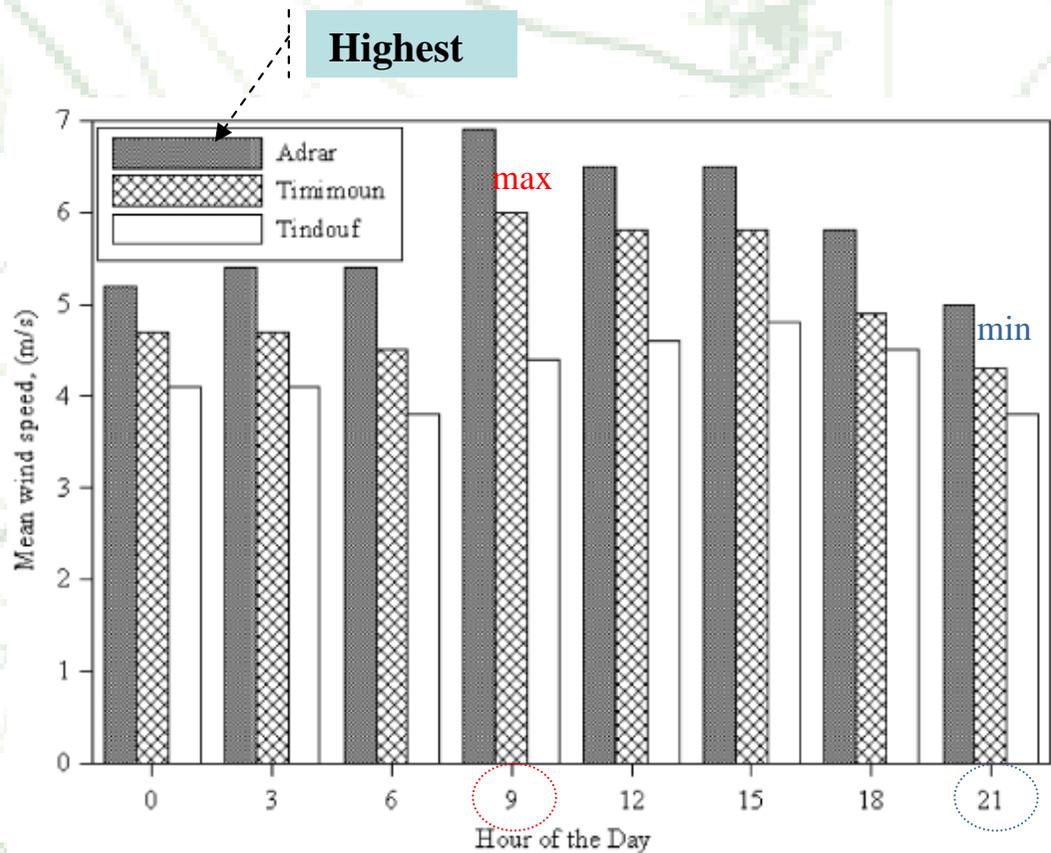


Fig2: Diurnal variation of long-term mean wind speed.

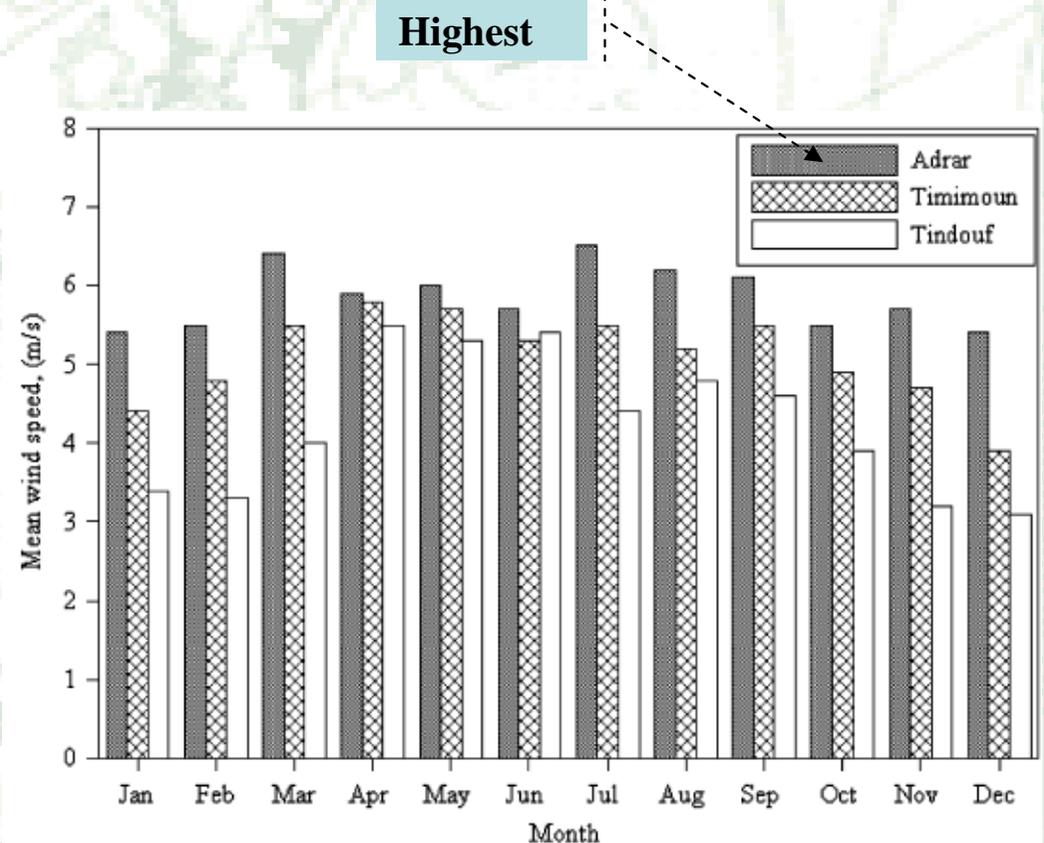
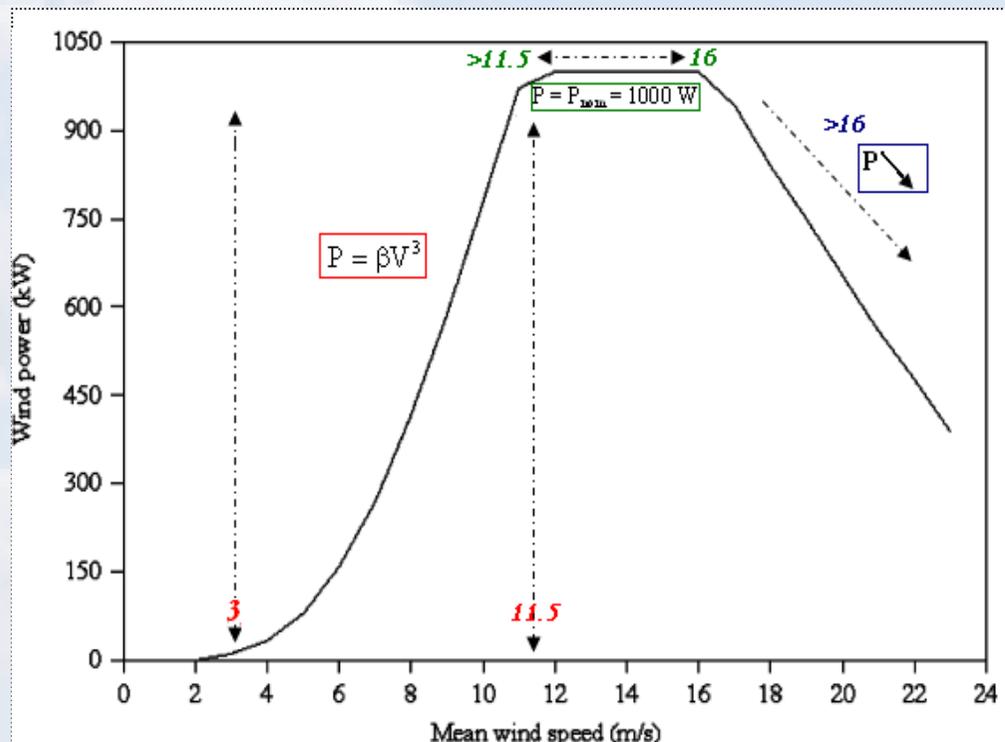


Fig3: Seasonal variation of long-term mean wind speed.

# Wind Turbine Parameters

The energy yield from hypothetical wind farm of 30 MW installed capacity is obtained from RETScreen software.



Tab2:Summarizes wind turbine parameters.

Item	value
Model	DEWIND 62
Rated power (kW)	1000
Rotor diameter (m)	62
Hub height (m)	68.5
Swept area of rotor (m <sup>2</sup> )	3019
Cut in wind speed (m/s)	3
Rated wind speed (m/s)	11.5
Cut out wind speed (m/s)	23
Rotor speed (rpm)	12.1 -25.2
Tower type	Tubular

Fig4:Wind power curve of DEWIND 62 turbine

# Results (1/2)

**Tab3: Summary of Energy yield and related output from wind farm of 30MW**

Item	Adrar	Timimoun	Tindouf
Annual mean wind speed (m/s)	5.9	5.1	4.3
<b>Specific yield (kWh/m<sup>2</sup>)</b>	<b>1091</b>	<b>863</b>	<b>619</b>
<b>Gross energy yield (MWh/year)</b>	<b>109,371</b>	<b>86,470</b>	<b>62,015</b>
Wind energy delivered (MWh/year)	98,832	78,138	56,040
Plant capacity factor (PCF) (%)	38	30	21
Green house gases (GHG) (tons/year)	48,577	38,406	27,544

**Furthermore the usage of wind energy at these sites will avoid 48,577 tons of green house gases (GHG) from entering into the local atmosphere of Adrar each year and about 1,214,425 tons of GHG over the lifetime of the wind power plant. Similarly at Timimoun and Tindouf a total of 960,150 and 681,500 tons of GHG could be avoided from entering into the local atmosphere of these stations.**

# Results (2/2)

**Tab4: Cost of Wind Farm Development**

Cost item	Amount (\$)	Percent of total cost (%)
Feasibility study	245,200	0.6
Development	835,500	2.0
Engineering	610,500	1.4
Energy equipment	31,890,000	74.7
Balance of plant	5,868,000	13.8
Miscellaneous	3,215,110	7.5
Initial costs- total	42,664,310	100

The details of the cost of various items involved in the development of a wind farm are assumed to be valid for three locations in Algeria, are summarized in

**Tab5: Summary of economical feasibility indicators for a 30MW installed cap. wind farm at 3 locations**

Item	Value		
	Adrar	Timimoun	Tindouf
Pre-tax IRR and ROI (%)	61.7	42.1	22.8
After-tax IRR and ROI (%)	61.7	42.1	22.8
Simple pay back (year)	3.8 ↘	4.8	7.0 ↗
Year to positive cash flow (year)	1.8 ↘	2.7	5.7 ↗
Net present value-NPV (\$)	76,125,725	48,843,997	19,712,439
Annual life cycle saving (\$)	9,706,028	6,227,608	2,513,335
Benefit cost(B-C) ratio	6.95	4.82	2.54
Cost of energy COE (\$/kWh)	0.0309	0.0430	0.0657

# Conclusion (1/2)

- **The higher wind speeds were observed in the day time between 09:00 and 18:00h and relatively smaller during the rest of the period.**
- **The long term mean wind speed at Adrar, Timimoun and Tindouf was 5.9, 5.1 and 4.3 m/s at 10 m above ground level (AGL).**
- **The long term seasonal wind speeds were found to be relatively higher during March – September compared to the other months.**
- **Wind farms of 30 MW installed capacity at Adrar, Timimoun and Tindouf if developed could produce 98,832- 78,138 and 56,040 MWh of electricity annually taking into consideration the temperature and pressure adjustment coefficients of about 6% and all other losses of about 10%, respectively.**

## Conclusion (2/2)

➤ The plant capacity factors at Adrar, Timimoun and Tindouf were found to be 38%, 30% and 21%, respectively. The corresponding cost of energy at these three sites was found to be 3.1, 4.3 and 6.6 US Cents/kWh.

➤ Such a development at these sites could result into avoidance of 48,577- 38,406 and 27,544 tons /years of CO<sub>2</sub> equivalents GHG from entering into the local atmosphere thus creating a clean and healthy atmosphere for local inhabitants.

➤ The economical feasibility study made based on the assumed economical parameters from the literature, showed that the positive cash flow could be obtained in 1.8, 2.7 and 5.7 years at Adrar, Timimoun and Tindouf respectively with corresponding benefit cost ratio (B-C) of 6.95, 4.82 and 2.54.



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