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Analyse, Evaluate and Locate of Wind Farms for Power Supply in the Ramshar New City in Sistan Region

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Abstract: ***Lack of energy can be the biggest problem that the countries will be facing in near future and renewable energies are the best to solve this issue.Use of distributed renewable energy sources for domestic energy consumption will increase in the near future, due to its advantages as being clean and infinite energy generation possibility. This trend allows more efficient energy consumption because of reducing transmission loses and dependence of domestic appliances to grid distribution.Wind being a non-polluting and nontoxic energy source, will go a long way in solving our energy requirements. Wind energy can be utilized to windmills, which in turn drive a generator to produce electricity. HOMER, software for optimization of renewable based hybrid systems, has been used to find out the best technically viable renewable based energy efficient system for different numbers of households. This study investigates the possibility of using and developing electric power to supply reliable, affordable and sustainable electricity to RAMSHAR a new city in Sistano Baluchistan province in IRAN. Simulations are performed using the Hybrid Optimization Model for Electric Renewable. Finally the paper points out some major challenges that are facing the development of this technology in South Khorasan.***

Keywords— RAMSHAR, HOMER Software, Wind Turbine, Initial Capital (IC), Total Net Present Cost (NPC)

I. INTRODUCTION

Use the new plants cause depletion of fossil fuels, global warming, and pollution. The consumption of energy continues to grow as both the world population and the living standard increase [1]. The demand increases even though energy efficiency has largely been improved; the biggest demand today and in the future is for electrical power generation [2]. This will increase fuel prices causing that the world is looking for alternative sources of energy [3, 4]. Wind and PV are the most promising renewable sources, in addition to hydroelectric power sources which have been traditionally exploited [5]. The renewable energy sources such as wind, Photovoltaic system, small-hydro, biomass, geothermal are inexhaustible in nature and easily available in our country. Also remotely located villages, islands, hills, military equipment, and so forth are some of the areas which are mainly isolated from the power system grid and in these areas wind and hydro-energy are available abundantly. Thus for supplying energy in such areas, isolated system, micro or minigrid system, is an emerging concept and draws the attention of many researchers.The purpose of this article, the design of hybrid electric power supply system for the Ramshar city in Sistan region in IRAN. Ramshar city is Located on the south Khorasan of Iran, roughly between 30° , 42 N and 61° , 23 E and distance of approximately 35 km from Zabol and Zahedan is located 180 km and Elevation is 495 meters above sea and climate of the region is hot. Fig.1. shows the location of Ramshar city.

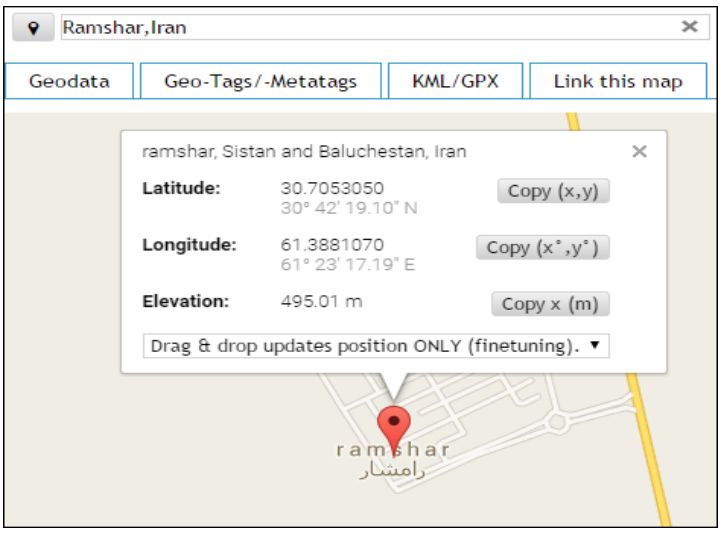


Fig. 1.The location of Ramshar city

Micro grid is the small scale energy system equipped with distributed energy resources, electronic equipment, loads, ancillary facilities, and so forth. A number of new technologies and innovative ideas are proposed now [6-8].Designing and establishing new towns in developed and developing countries is done with the intention of settling and absorbing extra population from other cities that cause civil problems. Also, these new cities are established due to the failure of developing countries in solving problems in metropolitan cities; for this reason these cities are established near the big cities to benefit from and utilize their facilities.

With regard to geopolitical position of Sistan region, encouraging the population to stay in this area, as the main factor in strengthening eastern borders, is crucially important. But, population changes during the past five years show that the majority of people emigrated from this region to areas outside Sistan. Moreover, the income of city activities is less invested in the region and most of people are willing to invest outside of the region such as Zahedan city. Furthermore, some environmental and regional conditions such as land salinity, lack of drainage, the precocious erosion of the buildings have caused reluctance of investment within the region. Under these circumstances, Ramshar new city project was designed as a center to absorb some of the region's population in order to solve the regional problems.

Recently Government has taken decision to formulate a master plan for development and protection of this city. In this city weather in the spring is very nice, summer is warm and in the winter weather be cool and dry.

II. SYSTEM DESCRIPTION AND WORKING

According to the load data, the peak load and average daily load demand of the Deym are 207 kW/h and 2.5MW/day, respectively. The daily load distribution profile of the Ramshar new city is indicated in fig.2.

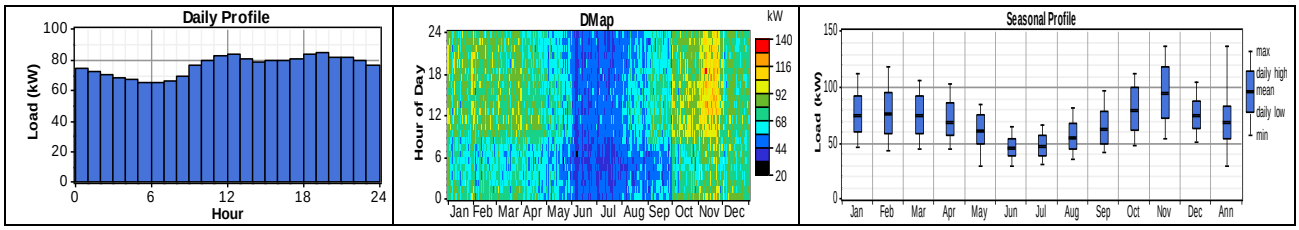


Fig.2. The daily load distribution profile of the Ramshar new city

HOMER makes energy balance calculations for each hour in a year to simulate the operation of a system. HOMER can provide assistance to synthesize the load profiles (with randomness) by entering the values for a typical day when the hourly load profiles do not exist for a whole year.

According to the table.1, the minimum load demand occurs between 6:00 and 7:00 O'clock while the maximum value of the load demand with 84.226kW/h occurs between 19:00 and 20:00.

Table.1. Value of the load demand of the day in Ramshar new city

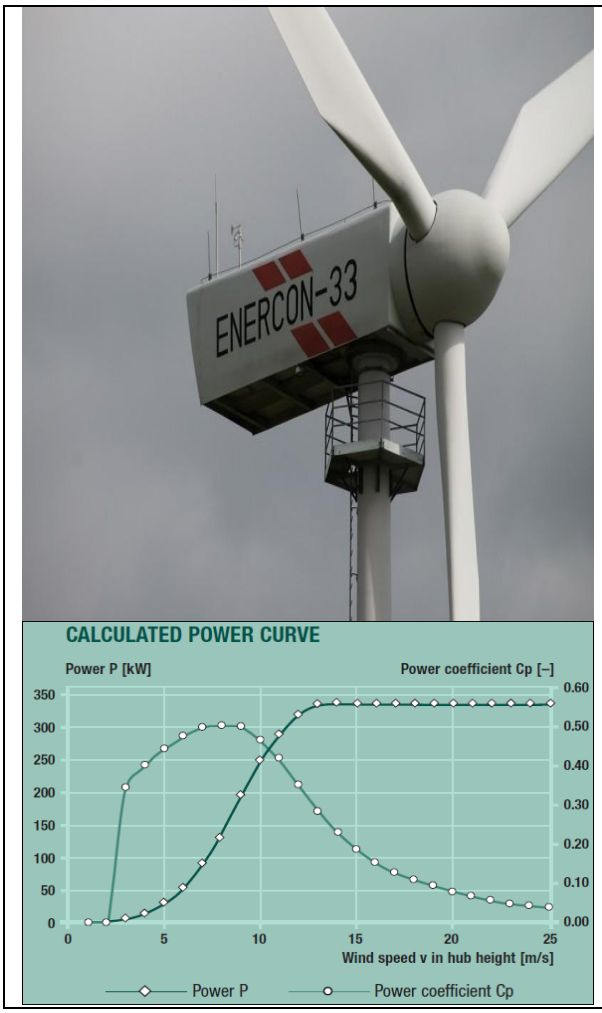
Load (Kw)	The Hours of the Day	Load (Kw)	The Hours of the Day	Load (Kw)	The Hours of the Day	Load (Kw)	The Hours of the Day
83.951	- 18:00 19:00	**83.134**	- 12:00 13:00	**65.012**	07:00 - 06:00	**74.671**	01:00 - 00:00
84.226	- 19:00 20:00	**80.457**	- 13:00 14:00	**65.564**	08:00 - 07:00	**72.564**	02:00 - 01:00
81.805	- 20:00 21:00	**78.414**	- 14:00 15:00	**68.789**	09:00 - 08:00	**70.331**	03:00 - 02:00
81.426	- 21:00 22:00	**79.426**	- 15:00 16:00	**76.222**	10:00 - 09:00	**68.447**	04:00 - 03:00
79.133	- 22:00 23:00	**79.284**	- 16:00 17:00	**79.748**	11:00 - 10:00	**67.222**	05:00 - 04:00
76.280	- 23:00 00:00	**80.386**	- 17:00 18:00	**82.179**	12:00 - 11:00	**65.329**	06:00 - 05:00

Wind system

The wind speed variations are of great impact on the energy availability produced by the system. Thus, wind turbine rating is usually much higher compared to the average electrical power demand. For our study, we have considered the Enercon E33Wind Turbine and rated at 330 kW/AC. The cost of the system is 750,000$, the replacement and maintenance costs are taken as 484,000$ and 15600$/year. The lifetime of the wind turbine is taken as 25 year.

Table.2. The costs of EnerconE33 Wind Turbine

The cost of repair and maintenance($)	The cost of the replacement($)	The cost of the system ($)	Size (Kw)
15600	**484000**	**750000**	330



Rated power:	330 kW
Rotor diameter:	33.4 m
Hub height:	44 – 50 m
Wind class (IEC):	IEC/NVN I and IEC/NVN II
Turbine concept:	Gearless, variable speed, variable pitch control
Rotor	
Type:	Upwind rotor with active pitch control
Direction of rotation:	Clockwise
Number of blades:	3
Swept area:	876 m²
Blade material:	Fibreglass (epoxy resin); integrated lightning protection
Rotational speed:	Variable, 18 – 45 rpm
Pitch control:	ENERCON blade pitch system, one independent pitching system per rotor blade with allocated emergency supply
Drive train with generator	
Hub:	Rigid
Main bearings:	Single-row cylindrical roller bearings
Generator:	ENERCON direct-drive synchronous annular generator
Grid feeding:	ENERCON converter
Braking systems:	– 3 independent blade pitch systems with emergency supply – Rotor brake – Rotor lock
Yaw control:	Active via adjustment gears, load-dependent damping
Cut-out wind speed:	28 – 34 m/s

Fig.3. Specifications of the Enercon E33 Wind Turbine

Wind data at in Ramshar new city

Wind is used as wind energy which is extracted with wind machines like wind turbines. To install a wind turbine we need sufficient wind velocity so that we get maximum of power density. Site selection is necessary in this case. For this we need to collect wind data. After collection of wind data, the compilation of that wind data is very important as it decides the type, design, and location of wind turbine[10].

Wind data were collected at Zabol, which is situated in north of Sistan, a backward place of East region of Iran. The data collected were compiled using the HOMER. Data recorded for the last three years and the sample data were depicted in Fig.4. After the analysis various graphs in HOMER for that particular data, we observed that wind velocity is nice. The maximum wind velocity is obtained in summer.

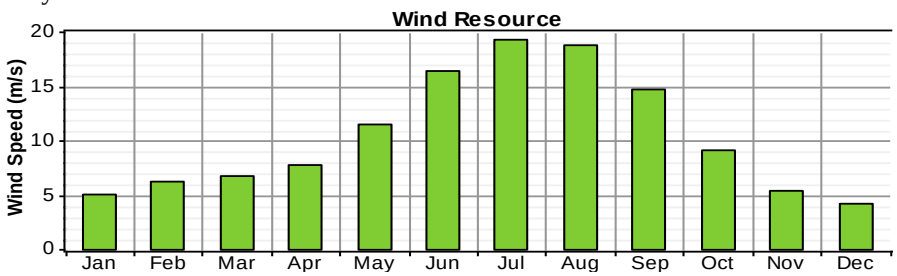


Fig.4. Annually wind speed distribution of the region.

The powerful winds of Sistan and solar energy with more than 6 kWh meters per day, divine renewable energy that has created the best conditions in the region. Strong winds in some areas of the province, annual average rate of 10 meters per second blowing. For example, more than 310 days with the wind blowing in the region of Sistan rare desire dominant north of the suitability of the plateau is plain to create large farms, wind power. Implement a hybrid system using free energy can be both consumer demand and peak shaving once again to meet the provincial power company.

Diesel Generators

In the total energy supply of the Ramshar new city of a diesel generator AC in the proposed model has been used in addition to the backup role will increase the reliability of the system [11]. The price of fuel for each liter of 0/09$/L has

been considered but the fuel cost, doses up to 0/09$/L to 0/3$/L also for variables is considered sensitive. The initial cost of diesel generator is considered to be 40000$. The main objective in this study was the use of diesel as a backup system is needed to be able to do load power supply.

Table.2. The costs of Diesel generators

The cost of repair and maintenance($/year)	The cost of the replacement($)	The cost of the system ($)	Size (Kw)
1500	**32000**	**40000**	150

Simulation Software

To meet the renewable energy system analysis and optimization needs, we use HOMER, a computer model that simplifies the task of evaluating design options for both off-grid and grid-connected power systems for remote, stand-alone and distributed generation (DG) applications. HOMER's optimization and sensitivity analysis algorithms allow the user to evaluate the economic and technical feasibility of a large number of technology options and to account for uncertainties in technology costs, energy resource availability, and other variables [12-13].

Hybrid System Modeling

The use of renewable energy sources has been developed recently and predictably gets a significant contribution of electrical production coming to take over the world. Hybrid systems today, a special place in the basket of the world's energy. In low energy environments, combined with the existing energy resources, talent can be a good method for powering the area required. This article includes a hybrid energy system modeling, renewable energy sources for rural and remote areas of the network design. The purpose of this design is to optimize the total cost of production, increase reliability, reduce environmental pollution along with renewable energy sources and efficient use of local energy sources, is available in natural.

III. RESULTS AND DISCUSSION

In this case, the average wind speed is equal to 11 m/s, the price per liter of diesel generator fuel is equal to 0/09$.HOMER simulates system configurations with all of the combinations of components that were specified in the component input. It discards from the results, all non-feasible system configurations, which are those that do not adequately meet the load, given either the available resource or constraints that were specified.

Table.3. Load flow of all possible scenarios.

E33 Quantity	Diesel (KW)	Grid (KW)	Initial capital	operating cost ($/yr)	Total NPC ($)	COE ($/kWh)	Renewable fraction	Capacity shortage	Diesel (L)	D 50 (hrs)
1	50	25	770,000	26,258	1,105,668	0.042	0.89	0.07	41,922	3,479
1	50	15	770,000	26,270	1,105,820	0.043	0.90	0.10	44,486	3,641
1	50	20	770,000	26,301	1,106,215	0.043	0.90	0.08	43,341	3,553
2	50	15	1,520,000	29,827	1,901,291	0.039	0.95	0.09	39,408	3,000
2	50	20	1,520,000	30,067	1,904,362	0.039	0.95	0.08	38,813	2,986
2	50	25	1,520,000	30,176	1,905,757	0.039	0.95	0.06	37,802	2,964
3	50	15	2,270,000	34,936	2,716,593	0.038	0.97	0.09	38,197	2,857
3	50	20	2,270,000	35,171	2,719,607	0.038	0.97	0.07	37,611	2,840
3	50	25	2,270,000	35,312	2,721,402	0.038	0.97	0.06	36,693	2,829
4	50	10	3,020,000	45,755	3,604,904	0.044	0.97	0.10	37,887	2,796
4	50	15	3,020,000	46,087	3,609,152	0.044	0.97	0.09	37,608	2,788
4	50	20	3,020,000	46,353	3,612,542	0.044	0.97	0.07	37,102	2,782
4	50	25	3,020,000	46,487	3,614,262	0.044	0.97	0.06	36,181	2,768
5	50	10	3,770,000	60,434	4,542,552	0.054	0.98	0.10	37,485	2,746
5	50	15	3,770,000	60,762	4,546,747	0.054	0.97	0.08	37,201	2,736
5	50	20	3,770,000	61,024	4,550,088	0.054	0.97	0.07	36,691	2,728
5	50	25	3,770,000	61,188	4,552,191	0.054	0.97	0.06	35,847	2,725
6	50	10	4,520,000	75,504	5,485,200	0.065	0.98	0.10	37,264	2,719
6	50	15	4,520,000	75,841	5,489,500	0.064	0.97	0.08	37,003	2,712
6	50	20	4,520,000	76,103	5,492,848	0.064	0.97	0.07	36,496	2,704
6	50	25	4,520,000	76,257	5,494,827	0.064	0.97	0.06	35,631	2,697
7	50	10	5,270,000	90,735	6,429,894	0.075	0.98	0.10	37,074	2,695
7	50	15	5,270,000	91,077	6,434,272	0.075	0.97	0.08	36,830	2,690
7	50	20	5,270,000	91,347	6,437,717	0.075	0.97	0.07	36,344	2,685
7	50	25	5,270,000	91,501	6,439,691	0.075	0.97	0.06	35,479	2,678
8	50	10	6,020,000	106,069	7,375,914	0.085	0.98	0.10	36,950	2,680
8	50	15	6,020,000	106,418	7,380,384	0.085	0.97	0.08	36,724	2,678

8	50	20	6,020,000	106,688	7,383,829	0.085	0.97	0.07	36,239	2,673
8	50	25	6,020,000	106,850	7,385,896	0.085	0.97	0.06	35,392	2,669
9	50	10	6,770,000	121,468	8,322,767	0.096	0.98	0.10	36,858	2,670
9	50	15	6,770,000	121,813	8,327,175	0.096	0.98	0.08	36,623	2,666
9	50	20	6,770,000	122,075	8,330,529	0.096	0.97	0.07	36,152	2,663
9	50	25	6,770,000	122,208	8,332,234	0.096	0.97	0.06	35,300	2,658
10	50	10	7,520,000	136,886	9,269,867	0.107	0.98	0.10	36,783	2,661
10	50	15	7,520,000	137,203	9,273,914	0.106	0.98	0.08	36,542	2,656
10	50	20	7,520,000	137,452	9,277,092	0.106	0.97	0.07	36,070	2,653
10	50	25	7,520,000	137,587	9,278,829	0.106	0.97	0.06	35,225	2,649
11	50	10	8,270,000	152,330	10,217,288	0.117	0.98	0.10	36,718	2,653
11	50	15	8,270,000	152,646	10,221,323	0.117	0.98	0.08	36,475	2,648
11	50	20	8,270,000	152,899	10,224,568	0.117	0.97	0.07	36,016	2,647
11	50	25	8,270,000	153,038	10,226,345	0.117	0.97	0.06	35,179	2,644
12	50	10	9,020,000	167,821	11,165,311	0.128	0.98	0.10	36,660	2,646
12	50	15	9,020,000	168,144	11,169,447	0.127	0.98	0.08	36,436	2,644
12	50	20	9,020,000	168,398	11,172,691	0.127	0.97	0.07	35,977	2,643
12	50	25	9,020,000	168,529	11,174,364	0.127	0.97	0.06	35,120	2,637
13	50	10	9,770,000	183,335	12,113,643	0.138	0.98	0.10	36,627	2,643
13	50	15	9,770,000	183,651	12,117,676	0.138	0.98	0.08	36,383	2,638
13	50	20	9,770,000	183,902	12,120,886	0.138	0.97	0.07	35,918	2,636
13	50	25	9,770,000	184,046	12,122,729	0.138	0.97	0.06	35,094	2,635
14	50	10	10,520,000	198,853	13,062,009	0.149	0.98	0.10	36,574	2,637
14	50	15	10,520,000	199,179	13,066,176	0.148	0.98	0.08	36,356	2,636
14	50	20	10,520,000	199,433	13,069,423	0.148	0.97	0.07	35,898	2,635
14	50	25	10,520,000	199,575	13,071,239	0.148	0.97	0.06	35,070	2,633
15	50	10	11,270,000	214,390	14,010,629	0.159	0.98	0.10	36,547	2,635
15	50	15	11,270,000	214,717	14,014,800	0.159	0.98	0.08	36,330	2,634
15	50	20	11,270,000	214,971	14,018,053	0.159	0.97	0.07	35,875	2,633
15	50	25	11,270,000	215,111	14,019,846	0.159	0.97	0.06	35,044	2,630

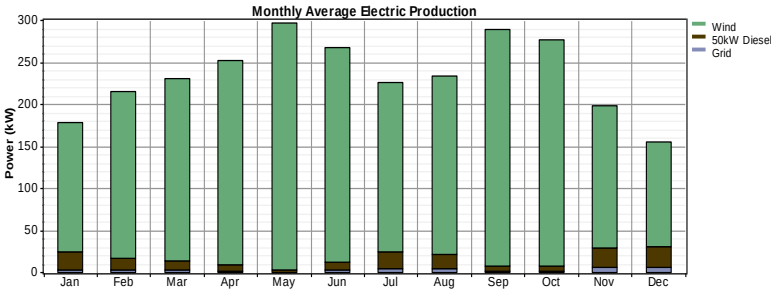
As is clear from the table above after dispatch with Homer software many cases occurred that among them, the most economical mode when a wind speed of 11 m/s and the price of fuel is $ 0.09 per liter. The comparison criteria will be the Initial Capital (IC), the Total Net Present Cost (NPC), the Cost of Energy (COE) as well as the system Capacity Shortage.

A summary of the technical and economical results obtained by Homer is displayed on Table.4. From this Fig we can notice that based on the NPC, COE and the breakeven grid extension distance that the hydrokinetic is the best option to supply the load with electricity.The results show that the region's energy supply with respect to the pattern defined time Including diesel generators and wind turbines using hybrid system with supply part of the power will be provided by the main network. Total NPC cost is 1,105,668$ economic state that has significant differences with other states.

Table.4. The most optimal amounts simulation mode

E33 Quantity	Diesel (KW)	Grid (KW)	Initial capital	operating cost ($/yr)	Total NPC ($)	COE ($/kWh)	Renewable fraction	Capacity shortage	Diesel (L)	D 50 (hrs)
1	50	25	770,000	26,258	1,105,668	0.042	0.89	0.07	41,922	3,479

From electrical energy required per year, diesel generators, wind turbines and main grid to supply each part of which is as follows.



Production	kWh/yr.	%
E33	1911043	93
Diesel	119498	6
Main Grid	28663	1
Total	2059204	100

Fig.5. Energy supply system by the DG units

The following graphs sensitivity analysis systems for wind speed 11 m/s and the price of fuel is $ 0.09 per liter for show times. This graph contains Total Net Present Cost (NPC), Cost of Energy (COE) and Cost of Operation and Management (O&D) respectively.

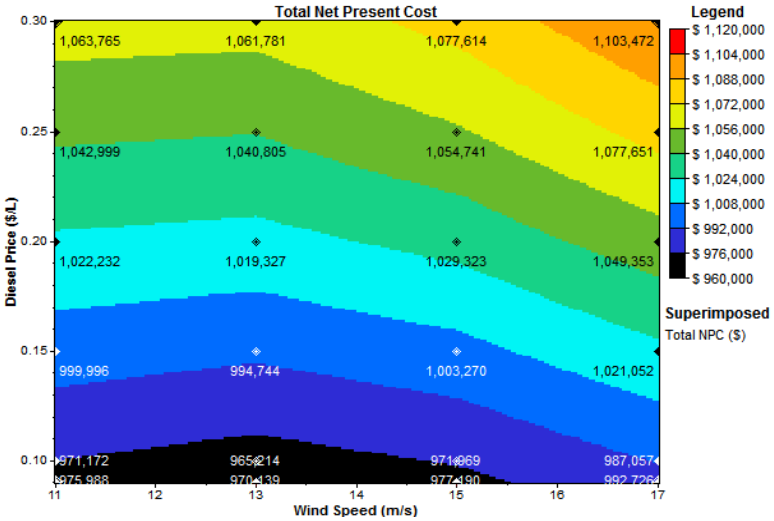


Fig. 6.Total Net Present Cost (NPC) in this project

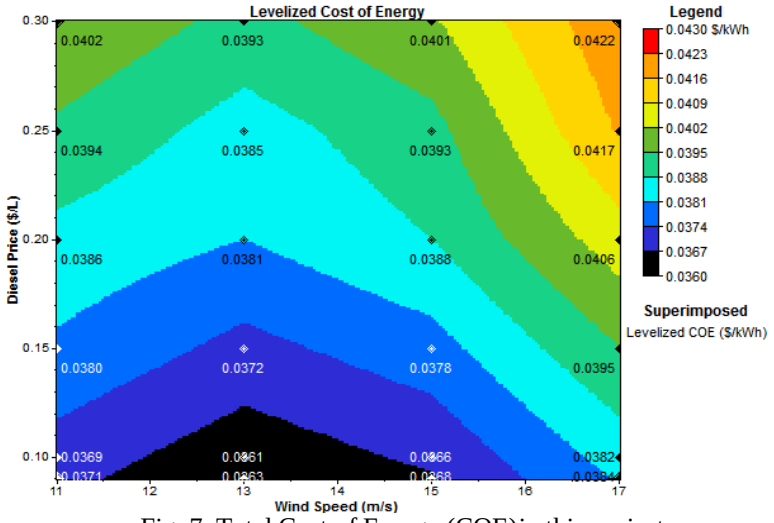


Fig. 7. Total Cost of Energy (COE)in this project

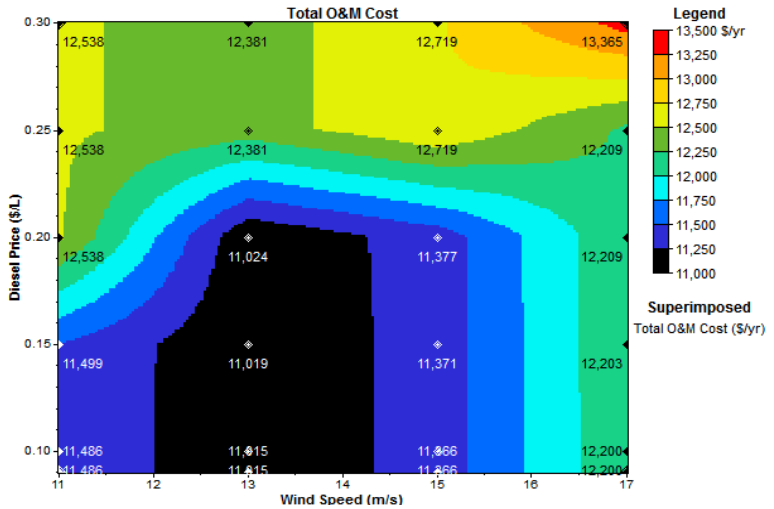


Fig. 8. Total Cost of Operation and Management (O&D) in this project

IV. CONCLUSIONS

Nowadays, renewable energy systems, with the lowest levels of pollutant gases, plus save energy, in terms of economic instrument to be able to compete with conventional energy production system of using fossil fuel independent or attached to cargo of the higher importance of long distance network and is very difficult. In this study, some of sources

of energy (wind, and diesel generators) and main gridwere examined and supplies using the optimized software for HOMER it became clear that for the domestic consumer is independent of the network in the region, taking into account wind speed.The system is the most economical combination of diesel generators, wind turbines and main grid in Ramshar new city.

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