Global Journal of Research in Engineering & Computer Sciences
ISSN: 2583-2727 (Online)
Volume 03| Issue 06 | Nov.-Dec. | 2023
Journal homepage: https://gjrpublication.com/gjrecs/
Original Research Article

Design, Production, Installation, Commissioning, Energy Management and Project Management of an Energy Park Plant Consisting of Renewable Energy Systems Established at Igdir University

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DOI: 10.5281/zenodo.10406670 **Submission Date:** 15 Nov. 2023 | **Published Date:** 19 Dec. 2023

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Abstract

This article explains the design, production, installation, commissioning and project management of an energy park plant consisting of renewable energy systems established at Igdır University, Turkey. The mentioned energy park plant is located at the campus section of Vocational School of Higher Education for Technical Sciences. The energy park consists of various renewable energy systems which are photovoltaic solar collector energy system, wind energy system and solar dish type collector – concentrator system.

These types of energy park plants can produce both electrical energy and also heat energy. Moreover, electrical vehicles can be charged with the electrical energy obtained from these types of energy park plants. Both environmental benefits and also economical savings can be obtained by the application of such type energy production models.

The wind turbine installed on Igdır University Energy Park is the first Wind Turbine Plant (WTP) of Igdır city. Therefore, this is a very important feature of this energy park plant.

In addition, this is also scientifically and mathematically very important that the solar dish type collector – concentrator system has an original – unique geometrical model called as DODECAGON which has 12 equal segments. This solar dish collector – concentrator forms a dodecagon geometry, and this solar dish is the first DODECAGON geometry which is produced physically. Therefore, this is a very important geometrical model in the aspect of mathematical perspective. The solar dish collector – concentrator installed at Igdır University Energy Park, is the first physically manufactured DODECAGON shape. The solar dish type collector – concentrator system can focus the solar energy and concentrate the heat since it has a reflective mirror surface. This concentrated heat energy may be used either for producing electricity or for obtaining heat source in order to be able to employ it domestical and/or industrial purposes.

Igdır University Energy Park Project is established in accordance with the Project Management principles. Moreover, Igdır University Energy Park Plant makes a great contribution for the TS EN ISO 50001 Energy Management System and also for the Energy Efficiency studies of Igdır University. The Energy Park is an inseparable part of Energy Management System.

Keywords: Energy, Energy Transfer, Energy Park Plant, Renewable Energy Systems, Project Management, Energy Management, Energy Efficiency, Solar Energy, Wind Energy, Solar Dish type Collector – Concentrator, Dodecagon.

INTRODUCTION

The fossil fuels are mostly used as the primary energy source all over the world for both domestic and industrial necessities. These fossil fuel resources which are used for producing electrical energy and heat energy, cause environmental pollution as air pollution, water pollution and soil pollution. Therefore, the environmental pollution shall be the most important problem that humanity is expected to face in the coming century since the population of human beings are using and consuming natural resources rapidly, moreover, they are adding hundreds of pollutants in the form of metals, acids, bases and etc. This situation creates an abnormal situation which results in an imbalance for the natural systems. A lot of countries all over the world, apply many stringent restrictions for the environmental pollution, and there are many laws, political arrangements. A pollution free environment will require a high cost, often an expensive operation. [5]

Thanks to the renewable energy resources, such as solar energy, wind energy, water energy and also other alternative sources, a pollution free environment may be available if the proper technical processes are applied while using the renewable and alternative resources as the primary energy source.

As an environmentally friendly energy production model, an energy park plant consisting of renewable energy systems has been established at Igdır University, Turkey. This article explains the design, production, installation, commissioning and project management of this energy park plant consisting of solar and wind energy systems.

By this study, it has been tried to create such an idea that a pollution free environment may be available if such type energy park plants are established and installed as energy production systems. These types of energy park plants can produce both electrical energy and also heat energy. Moreover, electrical vehicles can be charged with the electrical energy obtained from these types of energy park plants.

Not only the domestic and industrial electrical energy is produced, but also the heat energy required for domestic and industrial usage is obtained by the proper applications of energy park plants consisting of renewable alternative energy production systems, which are similar to the energy park plant established at Igdır University, Turkey.

So, the first goal of this study is to provide a concise statement of the requirements and opportunities for obtaining environmental benefits. The second objective will be to provide economical savings while providing the environmental benefits at the same time.[5] As a conclusion the energy park plant installed at Igdır University shall be a unique model as an environmentally friendly renewable alternative energy production system for the whole world. Both environmental benefits and also economical savings can be obtained by the application of such type energy production models.

Method, Findings and Discussion

This article explains the design, production, installation, commissioning and project management of an energy park plant consisting of renewable energy systems established at Igdır University, Turkey. The mentioned energy park plant is located at the campus section of Vocational School of Higher Education for Technical Sciences. The energy park consists of various renewable energy systems which are photovoltaic solar collector energy system, wind energy system and solar dish type collector – concentrator system.

The wind turbine installed on Igdır University Energy Park is the first Wind Turbine Plant (WTP) of Igdır city. Therefore, this is a very important feature of this energy park plant.

The photovoltaic solar collector system produces electrical energy directly from the solar energy. There are 3 ea. mono solar panel modules, each of having 205 Watt capacity. Therefore, the complete PV solar module has a compact capacity of 615 Watt. The electrical energy produced by photovoltaic system is DC – Direct Current and it is stored at solar batteries and then converted to 220 V – AC, Alternating Current by an inverter system. The DC-AC inverter has a total capacity of 1500 Watt.

The wind turbine has the capacity of 12 V and 500 Watt. The electrical energy produced by this wind turbine is also DC – Direct Current and it is also stored at solar batteries and then converted to 220 V – AC, Alternating Current by the inverter system. There is 1 ea. wind turbine charge controller device and 1 ea. solar charge controller device. There is a complete control panel and this compact unit has an AC/DC Measurement Module. There 2 ea. energy storage batteries, one is 12 V, 200 AH, the other is 12 V 180 AH, in capacity. By calculation, each of these batteries has a capacity of approximately 2400 Wh or 2.4 kWh. That means, an energy efficient 20 W electric bulb can operate approximately 240 hours, in other words 10 days.

The DC-AC inverter having a capacity of 1500 Watt, has also a separate connection for AC electrical devices. That means, it is possible to operate directly AC electrical devices and machines by using the electrical output connection of this inverter.

There is a PC Interface Module on the control panel for computer interface and system connection. This PC Interface Module allows to make various experiments for energy production and consumption amounts. Therefore, Igdır University Energy Park provides an opportunity to realize scientific and technical academic studies.

The solar dish type collector – concentrator system has an original – unique geometrical model called as DODECAGON which has 12 equal segments. This solar dish collector – concentrator forms a dodecagon geometry, and this solar dish is the first DODECAGON geometry which is produced physically. Therefore, this is a very important geometrical model in the aspect of mathematical perspective. The solar dish collector – concentrator installed at Igdır University Energy Park, is the first physically manufactured DODECAGON shape. This geometrical model is very important scientifically and mathematically. [1], [2], [3], [4], [6] The solar dish type collector – concentrator system can focus the solar energy and concentrate the heat since it has a reflective mirror surface. This concentrated heat energy may be used either for producing electricity or for obtaining heat source in order to be able to employ it domestical and/or industrial purposes.

Igdır University Energy Park Project is established in accordance with the Project Management principles.[7] Moreover, Igdır University Energy Park Plant makes a great contribution for the TS EN ISO 50001 Energy Management System and also for the Energy Efficiency studies of Igdır University. The Energy Park is an inseparable part of Energy Management System.[8], [9]

CONCLUSION

The following below figures belong to the mentioned energy park plant consisting of renewable energy systems established at Igdır University, Turkey.

Figure 1 The wind turbine installed on Igdır University Energy Park is the first Wind Turbine Plant (WTP) of Igdır city.

Figure 2 The solar PV panel module and wind turbine produce lighting electricity at the night time.

Figure 3, Figure 4, Figure 5, Figure 6 The complete compact control panel unit consisting of Solar Charge Controller, Wind Turbine Charge Controller, AC/DC Measurement Module, PC Interface Module, DC/AC Inverter.

Figure 7 Batteries used for Energy Storage.

Figure 8 Solar Battery Technical Specification.

Figure 9 Solar Charge Controller Technical Specification.

Figure 10 Solar Charge Controller.

Figure 11 Wind Turbine Technical Specification.

Figure 12 PV Photovoltaic Solar Panel Module Technical Specification.

Figure 13 PV Photovoltaic Solar Panel Module Installation.

Figure 14 PV Photovoltaic Solar Panel Modules.

Figure 15 Solar Dish type Collector – Concentrator, Dodecagon Shape.

Figure 16, Figure 17, Figure 18 Solar Dish type Collector – Concentrator, Dodecagon Shape. This solar dish collector – concentrator forms a dodecagon geometry, and this solar dish is the first DODECAGON geometry which is produced physically. Therefore, this is a very important geometrical model in the aspect of mathematical perspective. The solar dish collector – concentrator installed at Igdır University Energy Park, is the first physically manufactured DODECAGON shape. This geometrical model is very important scientifically and mathematically.

Figure 19 The solar PV panel module and wind turbine produce lighting electricity at the night time.

Figure 20 The night landscape scenery of Igdır city from the view of Igdır University Campus Energy Park.

Figure 21, Figure 22, Figure 23 The general view of Igdır University Energy Park.

Figure_1: The wind turbine installed on Igdır University Energy Park is the first Wind Turbine Plant (WTP) of Igdır city.

Figure_2: The solar PV panel module and wind turbine produce lighting electricity at the night time.

Figure_3: The complete compact control panel unit consisting of Solar Charge Controller, Wind Turbine Charge Controller, **AC/DC Measurement Module, PC Interface Module, DC/AC Inverter.**

Figure-4: The complete compact control panel unit consisting of Solar Charge Controller, Wind Turbine Charge Controller, **AC/DC Measurement Module, PC Interface Module, DC/AC Inverter.**

Figure_5: The complete compact control panel unit consisting of Solar Charge Controller, Wind Turbine Charge Controller, **AC/DC Measurement Module, PC Interface Module, DC/AC Inverter.**

Figure_6: The complete compact control panel unit consisting of Solar Charge Controller, Wind Turbine Charge Controller, **AC/DC Measurement Module, PC Interface Module, DC/AC Inverter.**

Figure_7: Batteries used for Energy Storage.

Figure_8: Solar Battery Technical Specification.

Figure_9: Solar Charge Controller Technical Specification.

Figure_10: Solar Charge Controller.

Figure_11: Wind Turbine Technical Specification.

Figure_12: PV Photovoltaic Solar Panel Module Technical Specification.

Figure_13: PV Photovoltaic Solar Panel Module Installation.

Figure_14: PV Photovoltaic Solar Panel Modules.

Figure_15: Solar Dish type Collector – Concentrator, Dodecagon Shape.

Figure_16: Solar Dish type Collector – Concentrator, Dodecagon Shape.

This solar dish collector – concentrator forms a dodecagon geometry, and this solar dish is the first DODECAGON geometry which is produced physically. Therefore, this is a very important geometrical model in the aspect of mathematical perspective. The solar dish collector – concentrator installed at Igdır University Energy Park, is the first physically manufactured DODECAGON shape. This geometrical model is very important scientifically and mathematically.

Figure_17: Solar Dish type Collector – Concentrator, Dodecagon Shape.

This solar dish collector – concentrator forms a dodecagon geometry, and this solar dish is the first DODECAGON geometry which is produced physically. Therefore, this is a very important geometrical model in the aspect of mathematical perspective. The solar dish collector – concentrator installed at Igdır University Energy Park, is the first physically manufactured DODECAGON shape. This geometrical model is very important scientifically and mathematically.

Figure_18: Solar Dish type Collector – Concentrator, Dodecagon Shape.

This solar dish collector – concentrator forms a dodecagon geometry, and this solar dish is the first DODECAGON geometry which is produced physically. Therefore, this is a very important geometrical model in the aspect of mathematical perspective. The solar dish collector – concentrator installed at Igdır University Energy Park, is the first physically manufactured DODECAGON shape. This geometrical model is very important scientifically and mathematically.

Figure_19: The solar PV panel module and wind turbine produce lighting electricity at the night time.

Figure_20: The night landscape scenery of Igdır city from the view of Igdır University Campus Energy Park.

Figure_21: The general view of Igdır University Energy Park.

Figure_22: The general view of Igdır University Energy Park.

Figure_23: The general view of Igdır University Energy Park.

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CITATION
Emin T. E. (2023). Design, Production, Installation, Commissioning, Energy Management and Project Management of an Energy Park Plant Consisting of Renewable Energy Systems Established at Igdir University. In Global Journal of Research in Engineering & Computer Sciences (Vol. 3, Number 6, pp. 67–82). https://doi.org/10.5281/zenodo.10406670