OPTIMIZATION OF PROJECTS IN THE FIELD OF RENEWABLE ENERGY TECHNOLOGIES

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Abstract:The transition to renewable energy sources is imperative for addressing global energy demands and mitigating the adverse effects of climate change. However, the successful implementation of renewable energy projects hinges on optimizing various technical, economic, and environmental parameters. This paper explores the role of optimization in enhancing the efficiency, reliability, and cost-effectiveness of renewable energy technologies, including solar, wind, hydro, and hybrid systems. Key areas such as site selection, system design, hybrid integration, and economic evaluation are analyzed through advanced optimization techniques such as genetic algorithms, multi-criteria decision-making, and simulation tools like HOMER and MATLAB. The study emphasizes that optimization not only improves energy yield and reduces operational costs but also contributes to the long-term sustainability and scalability of renewable energy initiatives. By applying interdisciplinary optimization approaches, stakeholders can make informed decisions that accelerate the deployment of clean energy solutions and support global energy resilience.

Keywords: Renewable energy, optimization, solar energy, wind power, hybrid systems, site selection, system design, energy efficiency, cost minimization

Introduction

Renewable energy is energy collected from renewable sources that are naturally replenished over time. It includes sources such as sunlight, wind, water movement, and geothermal heat. By 2021, more than a quarter of electricity will be produced from renewable sources [1]. Green energy is an environmentally friendly energy production system from renewable sources. This type of energy does not emit or emits very few harmful gases (for example, carbon dioxide - coon) that cause climate change, unlike traditional sources (coal, oil, gas). The main types of green energy are: solar energy - using solar panels to generate electricity or heat. Wind energy-Wind turbines generate electricity from the air stream. Hydropower is the production of electricity using rivers or watercourses. Biomass is the production of energy from sources such as plants and organic waste. Geothermal energy is the production of energy through the use of Earth's heat. Green energy The advantages of energy are that it does not harm the environment, runs on renewable and inexhaustible resources, and can be economically beneficial in the long run, ensuring energy independence. Green energy is a very important direction in combating climate change and ensuring environmental sustainability. In general, thanks to projects and investments carried out in Uzbekistan in the field of green energy, the country is taking important steps towards increasing the production of environmentally friendly energy, preserving natural resources and protecting the environment.

Solar panels and batteries in a house can often be used for the same house or combined with other apartments if they are connected to the power grid [2].

Figure 1 Komekurayama photovoltaic plant in Kofu, Japan

When we conducted a study, becoming interested in Energy Programming, it turned out that there are many different concepts in this field, such as energy optimization, energy conservation, or modeling renewable energy systems, which kata requires research. We will consider Programming related to the modeling and optimization of energy systems for research reasons. This question is often used to optimize energy systems, manage renewable energy sources (such as solar and wind energy), and ensure energy conservation.

Here are some of the basic concepts and practices of energy programming:

Energy system optimization is the efficient management of energy production, storage, and distribution. It is used in many different fields: industrial production, electric grids, renewable energy sources, etc.

When optimizing energy systems, the following programming languages and methods are used: Python is the most popular language for modeling energy networks and systems. For example, libraries such as pandas, NumPy, and SciPy are used for data analysis. MATLAB is widely used in optimization and modeling of energy systems. Julia is a language used for fast calculations to optimize power systems.

For example: solar energy optimization

If we want to optimize solar energy, we can solve the following problem by programming:

Optimization of the location of solar panels.

Forecasting energy production at different times of the day.

Management of energy storage systems.

For this, for example, a solar energy production model can be calculated as follows:

```python
import numpy as np
import matplotlib.pyplot as plt
import numpy as np
import matplotlib.pyplot as plt
# Quyosh nuri intensivligini (kW/m^2) vaqtga qarab hisoblash
def solar_irradiance(time_of_day):
    return 1.0 * np.sin(np.pi * (time_of_day / 12))
# Quyosh panellarining samaradorligi
def panel_output(irradiance, area, efficiency):
    return irradiance * area * efficiency
# Vaqtni kunlik davrda hisoblash
time_of_day = np.linspace(0, 24, 100)
irradiance = solar_irradiance(time_of_day)
panel_area = 20  # m^2
```

```
efficiency = 0.15  # samaradorlik
# Energiya ishlab chiqarish
power_output = panel_output(irradiance, panel_area, efficiency)
# Natijani chizish
plt.plot(time_of_day, power_output)
plt.xlabel('Vaqt (soat)')
plt.ylabel('Quyosh panellaridan energiya ishlab chiqarish (kW)')
plt.title('Quyosh energiyasini ishlab chiqarish kun davomida')
plt.show()
```
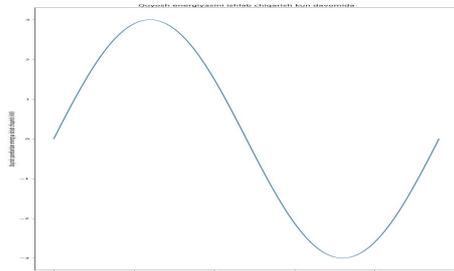

Figure 1

From the graph of Figure 1, the program describes the intensity of sunlight and the result of the production of energy from solar panels.

Sunrise at Fenton wind farm in Minnesota, USA

In the modeling of renewable energy systems, various sources of energy production such as solar, wind, or hydroelectric plant systems are modeled. These processes can be as follows:calculating the location of wind turbines, the efficiency of production and their operation in different conditions, forecasting the flow of Water, Water Resources and the production capabilities of the hydroelectric plant.

Three Gorges Dam on the Yanszi River, China

Energy saving and efficiency improvement. When optimizing energy savings, tasks such as energy optimization of buildings or efficient management of industrial processes are considered.

In this case, it is advisable to create a model of energy saving systems and optimize energy consumption.

For example, it is necessary to calculate the energy efficiency of the building. The calculation of the thermal insulation of the building and the efficiency of heating systems kata is important. In energy storage systems analysis, the optimization of energy storage systems is important to ensure the balance of energy production and consumption. In this area, it is necessary to analyze and optimize the efficiency of batteries and other energy storage systems.

For example: battery charge time and discharge efficiency

```python
import numpy as np
# Calculation of the battery charging and discharge formula
def battery_efficiency(input_power, battery_capacity, discharge_time):
    charge = input_power * discharge_time  # Quvvatning batareyaga etkazilishi
    if charge > battery_capacity:
        charge = battery_capacity  # Batareya to'liq zaryadlandi
    return charge
# Misol
input_power = 5  # kW
battery_capacity = 50  # kWh
discharge_time = 8  # soat
charged_energy = battery_efficiency(input_power, battery_capacity, discharge_time)
print(f"Batareya zaryadlandi: {charged_energy} kWh")
```

This program calculates the amount of energy transferred to the battery and indicates its state of charge.

In energy optimization and forecasting, the following methods are highly effective.

Programming techniques can be used to predict the efficiency of energy production and consumption. This plays an important role in optimizing energy systems.

Summing up, we say that if we learn to program Energy, study the above examples and work with codes in languages such as Python, MATLAB or Julia. These practices help to increase our knowledge of energy networks, renewable energy sources, energy conservation and optimization.

REFERENCES:

1. REN21. „RENEWABLES 2021 GLOBAL STATUS REPORT" (inglizcha). www.ren21.net. Qaraldi: 25-aprel 2022-yil.

2. „Getting the most out of tomorrow's grid requires digitisation and demand response". The Economist. Qaraldi: 24-iyun 2022-yil.

3. REN21 Renewables Global Status Report 2011.