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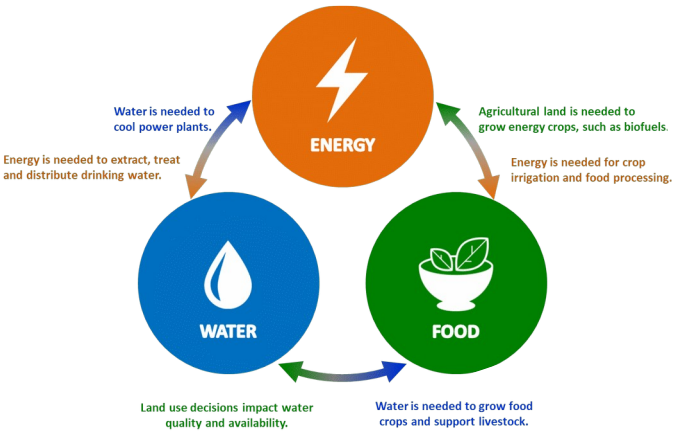
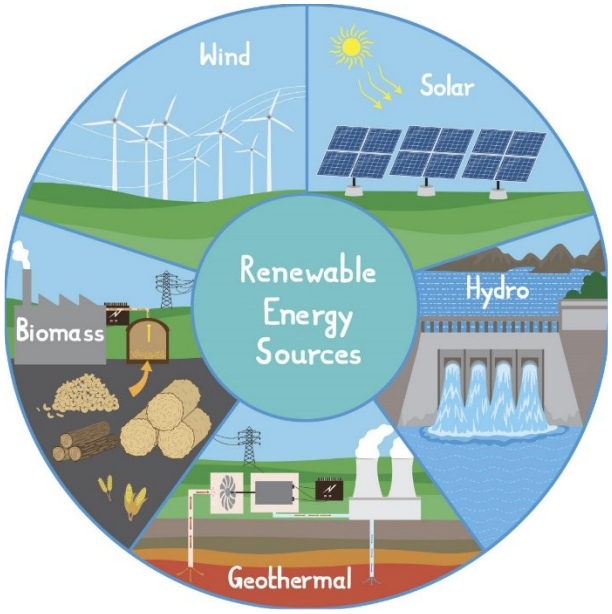
INTEGRATED FOOD-ENERGY SYSTEMS (IFES) CONCEPT FOR CLIMATE-SMART AGRICULTURE

CORRESPONDING MODULE 1





Introduction

An Integrated Food-Energy System (IFES) is a diversified agricultural production system that incorporates agro-biodiversity on the principles of sustainable production. IFES can be small-scale operations managed at village/household level or large-scale operations designed for commercial activities. IFES can optimize land use through a combination of food and energy crops and/or optimize biomass use through cascading sequence of both food and energy production. Depending on the circumstances, the generation of solar, thermal, geothermal, wind and/or hydro energy can be an integral part of the system.

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The wind power

Bulgaria, situated in southeastern Europe, currently relies on fossil fuels and nuclear energy for the majority of its energy generation. The country is self-sufficient for its own energy production and exports large quantities of natural gas. However, in the 21st century, Bulgaria has also become one of the fastest-growing wind energy producers in the world – due in part to its favorable geography. In the northern Black sea coast area of the country there are strong winds, particularly during winter and spring. Generating electricity from wind power is one of the most universally-recognized methods for renewable energy production – and with advances in technology making turbines cheaper and more efficient, a huge window of opportunity has opened up to decarbonize the energy sector.

The wind is almost everywhere, it is consistent in the medium and long-term, the wind power is excellent in remote areas, it is a truly economical green source, occupies very little land, maintenance is simple and occasionally necessary, the environmental impact is minimal, the conversion efficiency is excellent.

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Wind power farms

The largest wind farm in Bulgaria Saint Nikola is located in the municipality of Kavarna and is designed to generate electricity through wind energy to displace fossil fuel-generated electricity. The project is made up of 52 wind turbines with a capacity of 3MW each and reaching just under 150 metres each in height. The farm has a total installed capacity of 156 MWh and provides over 22% of the total installed wind capacities in Bulgaria, at the same time contributing to Bulgaria's commitment to fulfilling the EU requirements for the RES share in the overall energy mix. Until 2020, St. Nikola wind farm generated 3,2 million MWh of wind and reliable energy and saved Bulgaria around 2.6 million tons of carbon emissions. It covers a total area of 60 square kilometres (although only 6 hectares in total is used permanently for the operation of the wind farm). The wind farm's careful design allows for the land to continue to be used as agricultural land by local landowners

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and farmers.

The project provides local social impacts through the upgrade of local roads and the provision of jobs, both skilled and unskilled. The project's corporate social responsibility (CSR) program carries out a wide range of co-projects related to healthcare, education, culture, ecology and sport – all of which are financed to benefit the local community.

St. Nikola wind farm is owned by AES Geo Energy and is one of the two energy projects of AES in Bulgaria – the global technology leader and the largest investor in the Bulgarian energy sector for the last more than 30 years. The investment in the project St. Nikola wind farm amounts to BGN 540 million, provided as capital by The AES Corporation and as financing by the European Bank for Reconstruction and Development and the International Finance Corporation – part of the World Bank.

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St. Nikola wind farm is at the core of the Integrated Early Warning System for Bird Protection, which complies with the European requirements for conservation of wild birds. The integrated system minimizes the risk of bird collisions with the rotating parts of the wind turbines by stopping single turbines or the entire wind farm, and implements a monitoring program during the risk periods for species of conservation significance. The system integrates information from several radar systems, as well as direct on-site monitoring by ornithologists, who regularly monitor birds in the area, assess potential hazards, and, where

necessary, issue turbine shutdown orders.

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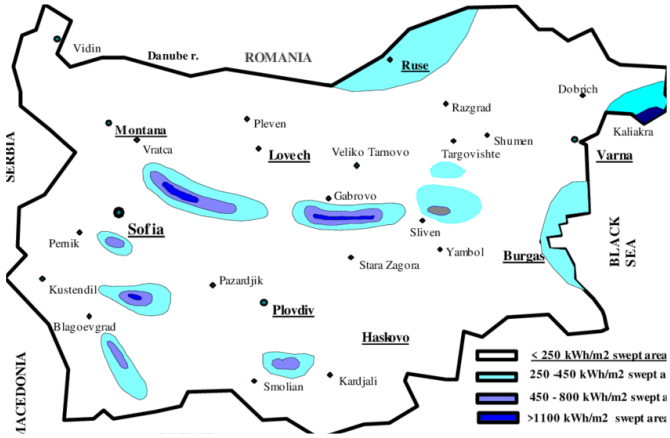
Main data

There are two types of wind generators:

- large (over 80-100KW and using wind over 5m/s) with towers over 30m and for connection to the national electricity grid;
- small (up to 20KW and using wind over 2.5m/s) with towers about 10m. and for local power supply of objects.

Small wind turbines are designed to launch at light wind at 2.5 m/s (above 9 km/h), which makes them widely applicable. They are equipped with a rechargeable battery, which securely powers the site through a local electrical network. Large industrial wind turbines start operating at 4-5 m/s and reach their maximum above 10 m/sec.

Before proceeding to installation, the



Further Information

1. https://agricultureandfoodsecurity.biomedcentral.com/articles/10.1186/2048-7010-1-9
2. https://www.e3s-conferences.org/articles/e3sconf/pdf/2021/62/e3sconf_tererd2021_02011.pdf
3. https://renewablesnow.com/news/bulgaria-could-add-7-gw-of-renewable-capacity-by-2030-industry-767655/
4. https://amcham.bg/2020/07/08/the-largest-wind-farm-in-bulgaria-st-nikola-produced-nearly-28-more-electricity-in-the-first-6-months-of-

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presence and characteristics of wind (preferably constant) are checked on an annual scale. There are 119 weather stations in Bulgaria that record wind speed and direction. Data is available for a period of over 30 years. The turbine performance depends on the wind speed and turbulence, the tower height and the air density, so it is important to know the potential of the region selected for installation.

2020-compared-to-2019/
5. https://ecologi.com/projects/renewable-wind-energy-bulgaria
6. https://geotok-bg.com/Wind.htm
7. https://www.enelgreenpower.com/learning-hub/renewable-energies/wind-energy/advantages-wind-energ

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ANNEX - STRUCTURE OF MODULE CONTENT TO PREPARE SLIDES

Module Name: The name of the partner: Country:

The name of the module	
Target group involved	
Current information about the topic	
Principles of the specific module	
Basic terms/measures of the module/topic	
Training materials (tasks, case studies, exercises)	
Short description of the materials	
Link of the online resources (film or video resources)	
Specific images (to support the purpose of the resources)	
Duration	
Materials	
No of Learners/Representatives	
Individual or group work	
Step by step guide	