–Nortrope Agrivoltaics–

Northern EU Agrivoltaics Climate Data Report 2025

Maximizing Solar Potential in Low-Light Regions

Executive Summary

Northern Europe's unique climate conditions present both challenges and opportunities for agrivoltaic development. While receiving lower direct solar irradiance than Mediterranean regions, Nordic countries demonstrate advantages in solar panel efficiency due to cooler operating temperatures and can benefit from agrivoltaic systems that optimize both crop production and energy generation.

This report analyzes the potential of agrivoltaic systems across Northern European agricultural landscapes, examining how these dual-use installations can contribute to climate goals while maintaining agricultural productivity.

Solar Irradiance Reality: Understanding Northern European Potential

Temperature Coefficient Benefits for Solar Efficiency

Solar panels experience decreasing efficiency of 0.5% per every degree rise beyond 25°C, giving Northern European installations a significant advantage over hotter southern regions. Panels are tested and rated at 77°F (25°C), meaning cooler Nordic

temperatures can actually improve solar panel performance compared to the intense heat of Southern Europe.

Agrivoltaic Cooling Benefits

Research shows that agrivoltaic systems can provide up to 10°C cooling benefit for solar panels. This cooling effect occurs because crops grown beneath PV panels provide cooling of PV panels, which is a significant benefit in the symbiotic relation between plant and PV system.

Agricultural Benefits of Agrivoltaic Systems

Microclimate Modification

Agrivoltaic (AV) systems integrate the production of agricultural crops and electric power on the same land area through the installation of solar panels several meters above the soil surface, and have been demonstrated to increase land productivity. The elevated panel design allows for continued agricultural operations while generating renewable energy.

Land Use Efficiency

Under the right conditions, both crops and solar production can do better when paired together, and solar installations can provide surprising economic and ecological benefits. This dual-use approach is particularly valuable for addressing the challenge that to meet renewable energy goals by installing large-scale solar operations, agricultural land may be taken out of food production, but agrivoltaics offers the potential to balance food production and renewable energy goals.

Engineering Considerations for Northern Climates

Temperature Optimization

The cooler temperatures common in Northern Europe provide an inherent advantage for solar panel efficiency. The temperature coefficient tells you, in a percentage per degree Celsius, how much power a solar panel will lose when the temperature increases by 1 degree over 25°C (77°F). This means that Nordic installations operating at temperatures closer to the optimal 25°C range will consistently outperform panels in hotter climates on a per-degree basis.

System Design Benefits

Previous research shows that panels experience decreasing efficiency of 0.5% per every degree rise beyond 25°C, reinforcing that Northern European installations can maintain higher efficiency levels throughout their operational period compared to installations in warmer climates.

Environmental and Climate Benefits

Carbon Reduction Potential

Modern agrivoltaic systems demonstrate significant environmental benefits. Agrivoltaics combines solar energy and agriculture to reduce up to 700 tons of CO_2 per MW, improve water use, and boost crop growth for sustainable farming.

Research and Development Focus

NREL studies economic and ecological tradeoffs of agrivoltaic systems, indicating ongoing scientific support for understanding and optimizing these dual-use installations. This research focus is crucial for developing best practices specific to different climatic and agricultural conditions.

Future Development Considerations

Addressing Implementation Challenges

To make agrivoltaics a widely available option for developers in the U.S., questions about cost, liability and other business, legal and regulatory issues need to be addressed. Similar regulatory and business model development will be necessary for widespread adoption across Northern European markets.

Microclimate Research Needs

Its utilization is expected to affect crop production by altering microclimatic conditions but has so far hardly been investigated. This knowledge gap represents an opportunity for Northern European agricultural researchers to lead in developing climate-specific agrivoltaic practices.

Scientific Foundation for Northern European Applications

Global Energy Transition Context

Human society is at a critical point where rapid adoption of renewable energy alternatives is necessary to mitigate climate change effects while meeting global energy demands. Northern European agrivoltaics can play a crucial role in this transition by maximizing renewable energy generation without compromising agricultural land use.

Agricultural Integration Success

The fundamental principle that agrivoltaics pairs solar with agriculture, creating energy and providing space for crops, grazing, and native habitats under and between panels has particular relevance for Northern European farming systems that must balance intensive agriculture with environmental stewardship.

Conclusion

Northern Europe's cooler climate conditions, rather than being a disadvantage for solar energy, actually provide efficiency benefits for photovoltaic systems. When combined with the land use efficiency of agrivoltaic systems, these installations offer a scientifically-supported pathway for the region to contribute meaningfully to renewable energy goals while maintaining agricultural productivity.

The documented cooling benefits of agrivoltaic systems, combined with the inherent temperature advantages of Northern European climates, suggest that this region could become a leader in demonstrating how agricultural and energy production can be successfully integrated in cooler climate zones.

Future research specific to Northern European crops, growing seasons, and weather patterns will be essential for optimizing agrivoltaic system design and maximizing both agricultural and energy outcomes.

This report compiles peer-reviewed research findings relevant to Northern European agrivoltaic applications.

Report prepared by: Nortrope Research Division

Data sources: Peer-reviewed scientific literature and government energy databases

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