Photovoltaics and Energy Security in the Greater Arctic Region
环北极地区的光伏发电与能源安全

IEA PVPS has published a new report under Task 13, Reliability and Performance of Photovoltaic Systems, examining the role of PV in strengthening energy security across the Greater Arctic region.
近日，IEA PVPS Task 13“光伏系统可靠性与性能”工作组发布最新报告，探讨了光伏发电在强化环北极地区能源安全保障中所发挥的作用。

The report, Photovoltaics and Energy Security in the Greater Arctic Region, assesses the unique environmental, technical and economic conditions affecting PV deployment above 60 ° N latitude and provides guidance for reliable, climate-adapted system design.
这份《环北极地区的光伏发电与能源安全》报告，评估了北纬 60° 以上区域影响光伏推广应用的特殊环境、技术与经济条件，并为构建高可靠性、气候适配型光伏系统提供了设计指导。

“Far from being unsuitable for solar energy, the Greater Arctic holds untapped potential for photovoltaics to strengthen energy security, enhance resilience in remote communities, and deliver reliable, low-carbon power – even under the most extreme climatic conditions,” says Joshua Stein, one of the main authors.
报告主要作者之一 Joshua Stein 表示：“环北极地区绝非光伏应用禁区，反而蕴藏着尚未开发的光伏发电潜力，可用于强化能源安全、提升偏远社区供电韧性，并提供可靠的低碳电力 —— 即便在最极端的气候条件下亦是如此。”

Key Findings
要点：

High-latitude solar resources are characterized by high seasonality, low sun elevations and wide azimuth angle variations, meaning fixed arrays experience extended periods with the sun behind the modules compared to lower latitudes.
高纬度地区太阳能资源具有强季节性、低太阳高度角、方位角变化范围大的特征，与低纬度地区相比，固定式光伏阵列会出现较长时间的太阳照射被组件遮挡的情况。

Bifacial modules and vertical PV arrays offer significant performance advantages by capturing more direct, diffuse and reflected light, while also improving snow shedding.
双面光伏组件与垂直式光伏阵列可捕获更多直射光、散射光与反射光，同时提升积雪滑落效率，因此具备显著的性能优势。

While lower temperatures enhance PV efficiency and may slow degradation, Arctic installations require tailored designs – frost-resistant foundations, snow-aware layouts and adapted system engineering – to ensure long-term reliability; encouragingly, several Arctic countries are already deploying PV with climate-specific solutions.
低温环境虽能提升光伏转换效率、延缓组件老化衰减，但北极地区光伏项目需采用定制化设计 —— 包括抗霜冻基础、防积雪布局及适配性系统工程，以保障长期可靠性；值得关注的是，多个北极国家已在应用气候针对性解决方案部署光伏项目。

The report further highlights the importance of high-quality solar resource and albedo data, improved modelling approaches for snow losses, and careful geotechnical assessments in permafrost regions. It concludes that, with climate-adapted engineering and robust performance analysis, PV can make a meaningful contribution to Arctic energy systems.
报告进一步强调，获取高精度太阳能资源与地表反照率数据、优化积雪损耗建模方法，以及在永久冻土区开展严谨的岩土工程评估至关重要。报告还指出，通过气候适配型工程设计与完备的性能分析，光伏发电能够为北极能源系统发展作出重要贡献。