

Chapter 8

Prospects for Energy Supply of the Arctic Zone Objects of Russia Using Frost-Resistant Solar Modules

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ABSTRACT

The scientific work is devoted to the prospect of using frost-resistant solar modules with extended service life of various designs for energy supply of infrastructure facilities of the Arctic zone of Russia. The general characteristic of the region under consideration is given, and its energy specifics, directions of energy development based on renewable energy sources are considered. In the work, frost-resistant planar photovoltaic modules and solar roofing panels with an extended service life for power supply of objects are proposed. For simultaneous heat and electrical generation, frost-resistant planar photovoltaic thermal roofing panels and concentrator solar installation with high-voltage matrix solar modules with a voltage of 1000 V and an electrical efficiency of up to 28% are proposed. The considered solar modules have an extended rated power period due to the use of the technology of sealing solar cells with a two-component polysiloxane compound and are able to work effectively at large negative ambient temperatures and large ranges of its fluctuations.

INTRODUCTION

Currently, the economy faces a technological challenge – the transition to a new technological structure in production, services, and management. The resource-saving approach suggests that the pilot should consider those sectors and regions where the successful implementation of advanced technologies is vital. Given the difficult natural and climatic conditions, the Arctic is a favorable testing ground for technological innovation. In addition, the Arctic is becoming the center of attention of the country's leadership. The

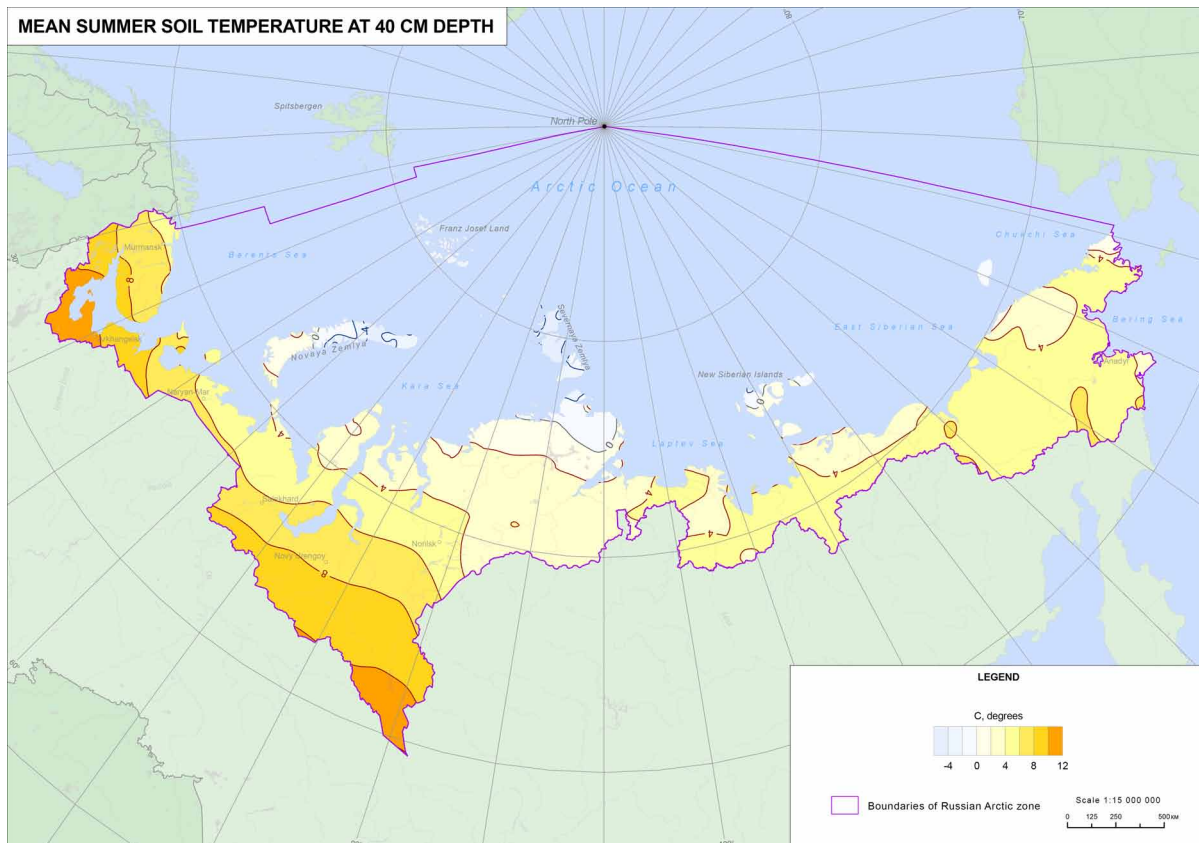
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President of Russian Federation instructed to restore and expand the degree of development and control of the territories of the Arctic zone (we are talking about transport and logistics infrastructure, places of extraction and processing of raw materials in the Arctic). All this must be done taking into account the use of advanced technologies (often having a dual purpose) (Degtyarev, Panchenko & Mayorov, 2018).

ARCTIC ZONES OF THE RUSSIAN FEDERATION AND PREREQUISITES FOR THE DEVELOPMENT OF ENERGY BASED ON RENEWABLE ENERGY SOURCES

The Arctic is defined as the area around the North Pole, including the Arctic Ocean and surrounding areas. The southern border is conditional, there is no clear concept of the territory of the Arctic, it can be drawn along the southern border of the Arctic climatic zone (the dominance zone of the Arctic air masses), the zone of Arctic deserts or the tundra zone, or, for example, “mechanically” – along the Arctic Circle (Figure 1) (ael-msu.org). The Arctic zone of the Russian Federation (AZRF) is a heterogeneous region that requires a differentiated approach to the development of energy from renewable energy sources (RES).

Figure 1. Arctic zone of the Russian Federation and soil temperature in the summer in a depth of 40 centimeters in this area



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