
ARCTIC CONTAMINANTS ACTION PROGRAM

# RENEWABLE ENERGY

## INVESTMENTS IN THE ARCTIC

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## Summary

The Arctic Contaminants Action Program (ACAP) supported two studies exploring the potential for converting energy sources for rural Arctic communities from highly-polluting diesel fuel to cleaner renewable energy, with the goal of providing data that can guide other communities when making future energy investments.


## Background

Diesel fuel is an increasingly expensive commodity in the Arctic. A number of factors contribute to this price. Without a robust road system, fuel must be transported by air or barge. In addition, the harsh weather of the Arctic makes infrastructure more vulnerable to costly maintenance and repairs. In addition, properly-functioning diesel systems emit greenhouse gases such as carbon dioxide ($CO_2$), nitrous oxide ($NO_x$), sulfur oxide ($SO_x$), and black carbon into the atmosphere. Thankfully, a number of technologies exist to improve efficiency and address this multi-faceted problem.

## Studies

The first feasibility study – mapping substitution solutions for diesel power plants in Arctic and Northwest Russia – researched the reliability of upgrading small-scale diesel stations to include intermittent renewable power generation, along with diesel. If feasible, this potential shift would not only reduce costs, but would reduce emissions of black carbon, greenhouse gases, and other hazardous air pollutants as well.

The second feasibility study – energy-supply conversion in the Dolgoschelye settlement – examined the unique constraints and needs of energy generation in northern Russia. The study examined Dolgoschelye, a fishing village of 600 inhabitants. The fisheries are fueled by diesel generators from the mid-1980s that are inefficient and produce hazardous air pollutants. At the same time, annual electricity demand is steadily increasing by 5 to 7 percent each year, highlighting the need to modernize the energy system to ensure long-term sustainability.

## Recommended modernization

These reports highlight a variety of modernization techniques that Arctic communities could adopt to reduce pollution and diversify their energy sources. The following three options are designed to offer increasingly complex investment strategies, depending on resource availability.

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## Lessons learned

The process of conducting these feasibility studies highlighted a number of lessons learned.

| | |
|---|---|
| Stage 1 | - Install energy-efficient lighting<br>- Switch from electrical to thermal heating at public buildings<br>- Improve power factor in the grid |
| Stage 2 | - Adopt new diesel aggregate and improve power load management |
| Stage 3 | - Construct wind power facility<br>- Develop wood gasification technology to combine with diesel engines |

Capacity building and sustainability: Infrastructure must be well-suited to the Arctic climate, and capacity must be built with local practitioners so that they can maintain the equipment on their own.

System integration: When integrating multiple technologies, testing must take place to ensure that automation processes seamlessly alternate between different energy sources.

Combining energy sources: Reducing end-user energy demand at any level could significantly reduce both distribution losses and power generation requirements, without raising associated costs. This means that energy efficiency measures should be evaluated along with renewable energy sources.

## Next steps

ACAP is already using the results of these studies in a group of community-based demonstration projects in Russia. ACAP is also identifying best practices from existing projects that can be used to encourage more investment. The table below highlights some of the savings and emissions reductions from the Dolgoschelye report, which are predicted for the various proposed energy alternatives.

Predicted savings and reductions for proposed energy alternatives

| Proposed measures | Savings | | | Emissions reductions (kg/year) | | | | |
|---|---|---|---|---|---|---|---|---|
| | **RUR/year** | **Diesel ton/year** | **Electricity kWh/year** | **$NO_x$** | **PM-10** | **$CO_2$** | **BC** | **$SO_2$** |
| Energy efficient lighting | 286,000 | 5.9 | 18,970 | 443 | 31 | 16,484 | 23 | 29 |
| Replace electrical heating at public buildings with thermal | 2,231,200 | 66.2 | 217,730 | 4,911 | 347 | 111,656 | 257 | 202 |
| Replace electrical heating at school with heat pump | 1,389,280 | 28.6 | 92,276 | 2,149 | 151 | 79,907 | 113 | 141 |
| Improve power factor in grid | 2,751,520 | 56.5 | 182,520 | 4,245 | 298 | 157,858 | 224 | 279 |
| New diesel aggregates | 3,308,600 | 76 | N/A | 5,710 | 401 | 212,340 | 301 | 375 |
| Waste heat recovery from diesel generators at school | 2,552,900 | 39 | 108,860 | 3,424 | 1,324 | 108,964 | 176 | 251 |
| Construct wind power facility | 8,414,000 | 172.8 | 558,140 | 12,982 | 913 | 482,794 | 684 | 854 |
| Convert to solar power with batteries | 2,398,317 | 52.3 | 131,372 | 3,929 | 276 | 146,123 | 207 | 258 |
| Convert to solar power without batteries | 1,980,460 | 40.7 | 131,372 | 3,058 | 215 | 113,714 | 161 | 201 |
| Combine wood gasification with diesel engines | 8,755,803 | 335 | N/A | 20,479 | -8,853 | 935,990 | -539 | 1,106 |

*Energy Supply Conversion in Dolgoschelye Settlement, Mezenskiy District, Arkhangelsk Region, Russia.* Norsk Energi. Draft Final Report. April 2015.

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