Diesel generators are the main source of electrical generation in remote Alaska communities; they also help maintain grid frequency and voltage. Individual generators vary in output from about 30 kW to over 1 MW, with the best diesel generators converting roughly 40% of fuel energy into electricity. The remaining fuel energy is converted to heat.

Current Installations in Alaska

Installation costs were gathered from project Financial Close-Out Reports on the Denali Commission project database. Operations and maintenance costs were collected from the Regulatory Commission of Alaska. The numbers for kWh generated were collected from Power Cost Equalization data on the Alaska Energy Data Gateway website.

Key Performance Metrics

The scale of the installed system directly affects capital costs, with larger systems being more cost-effective per kW. However, appropriately sizing a system for a community is more cost-effective than significantly oversizing the system.

Capacity factors range from less than 5% to more than 25%. The low values are typically for diesel-hydroelectric hybrid systems, for which this measure is not entirely accurate. In addition, rural diesel plants may have low capacity factors, since typically there are three to four generators in-house. These systems are sized so that one to two generators provide power at any given time and the remaining generators are available as backup.

Generators of this size can be expected to operate approximately 60,000–100,000 hours, with larger engine blocks tending to have longer lifespans. An appropriately maintained generator operating for 60,000 hours 35% of the time will last approximately 20 years.
Recommendations

Ensuring proper and continuous maintenance of diesel generators in rural Alaska communities needs to be a high priority, whether through in-person visits, telecommunications upgrades for remotely controlled systems, or further advances in SCADA systems.

Technology Trends

The technology continues to see advances in power output, efficiency, noise reduction, and emissions control. The shapes of combustion chambers in newer engines are designed to maximize the combustion rate of fuel, thus increasing output power and fuel efficiency. The common-rail fuel system can maintain high pressure from the fuel tank to injection, which allows for finer vaporization of fuel and more complete combustion. Nitrous oxide can be reduced through exhaust gas recirculation and selective catalytic reduction.

Control systems have also come a long way. Mechanical control systems have been slowly phased out in favor of electronic control systems, which allow for offsite monitoring of a system and reduction in the number of necessary service calls.

Technology Gaps & Barriers to Success

Diesel generators in rural Alaska communities remain difficult to maintain to the degree necessary for smooth operation. Additionally, Supervisory Control and Data Acquisition (SCADA) systems with remote control capabilities require continuous Internet connection, which is not always available in rural communities.

From 2007 to 2014, the Environmental Protection Agency phased in mandates for diesel engines to use ultra-low-sulfur diesel in most of the United States. Additionally, new stationary diesel engines are required to meet certain emissions standards. Small facilities in rural Alaska have been given some exemptions due to the high cost and difficulty of operations in remote areas, but meeting these mandates is still an area of concern.

For the full report visit www.uaf.edu/acep
For more information on diesel contact Alaska Center for Energy and Power at (907) 474-5402; Alaska Energy Authority — www.akenergyauthority.org

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