DIESEL RETROFITS:
THE ALASKAN EXPERIENCE

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1. There are about 150 remote villages in rural Alaska – a lot of villages but the median village size is small, only about 250 people. The overall population of rural Alaska is also very small – only about 75,000 people altogether. Alaska is almost entirely undeveloped and these villages – nearly all of them without road access – are about as remote as any settlements could be. They are almost entirely dependent on oil fuels for heat, transportation, and electric power. Most are located along the coastline or on navigable rivers, and where a viable economy exists, it is typically based on commercial fishing.

   There have been major improvements in living conditions over the last several decades – especially since oil development took off about 25 years ago: improvements in education, communication, housing, and health. A major government initiative to bring adequate water and sewer facilities to rural villages has made a tremendous difference and is still under way. Access to electric power is now essentially universal. Compared with many developing regions in the world, the material standard of living in rural Alaska doesn't look bad at all.

   There are some surprising pockets of real prosperity as well, but village life overall still revolves mostly around the daily and seasonal demands of subsistence hunting and fishing, supplemented by a limited cash economy. Average cash income is very low compared with urban Alaska or with the rest of the country, and the prospects for major gains any time soon aren't good. It is difficult to come up with a scenario of solid economic growth on a broad scale in rural Alaska – the resources just aren't valuable enough in most instances to overcome the logistical challenges and costs.

2. Although average incomes are relatively low, costs are high. Retail residential rates for electric power are typically in the neighborhood of 40 cents per kWh, compared with about 10 cents in urban communities. Because electric power for nearly all of the villages is supplied by isolated diesel power plants, it is often assumed that this 30 cent differential is primarily due to the high cost of fuel. But, as many of you know, that is a mistake. The cost of diesel fuel in rural villages is typically around 7 cents per kWh. By comparison, the cost of fuel in Anchorage – Alaska's largest city where most of the power is generated by burning natural gas – is about 2 cents per kWh. A difference of 5 cents per kWh in fuel costs is significant but doesn't go very far in explaining a 30 cent differential in retail rates.

   What the State has done for the last 15 years or so is to fund a rate subsidy program for rural villages that, on average, pays out about $550 per year to each residential customer, which is about half of the typical residential bill. That's a very effective way to lift the cost burden from rural electric consumers in the short term. And realistically, the subsidy program is sustainable financially over the long term if the politics would permit it. But the politics probably won't permit it and, besides, a genuine reduction in electricity costs, if it could be accomplished, would be a much firmer foundation for whatever economic development might be possible.

3. So how can actual electricity costs be reduced? What seems to explain most of the urban/rural differential in retail power rates is simply economies of scale – each isolated vil-

lage requires a relatively high level of fixed costs, consisting of its own power plant, operators, and management. Because opportunities to increase power sales within the village are very limited or nonexistent, we continue to look at two other approaches to improve scale economies:

A. The first is to build transmission lines between villages so one or more diesel power plants can be turned off. But this has nearly always proven to be uneconomic given the relatively long distances between villages and small village loads.

B. The second approach is to seek administrative economies of scale by merging utility organizations, even though independent power plants must still be operated and maintained. We have found some advantages in doing this, but near term rate reduction is not one of them. What we find instead is that regional utilities tend to take on costs that individual villages typically do not, such as a higher level of preventive maintenance as well as property damage and liability insurance. In our experience, rates tend to go up as a result of rural utility mergers rather than down.

4. We have tried to improve energy efficiency by using the waste heat from the diesel engines to supply district heating systems. But after building about 10 of these, we are hard pressed to find any more village locations where the cost of the district heat system can be recovered from the value of the waste heat. The heating loads tend to be too small and too widely dispersed.

5. We have tried a number of renewable energy options and continue to do so. Some have been more successful than others. I'll touch on them briefly:

A. The State of Alaska spent over $5 million trying to develop a geothermal power plant in the geologically active region of the Aleutian Islands. This particular prospect, which is the best prospect we know of, is located near a volcano a few miles from one of the most productive, high volume fish processing communities in the United States. The processors currently supply their own power from diesel generators and would have been interested in buying from the geothermal plant except for two problems. One was that, despite proposed government subsidies of up to half the capital cost of the project, the projected cost of power was still not quite competitive with diesel. The second was that, due to the unpredictable nature of the fishing industry, none of the processors were willing to sign long term commitments to purchase power at any price. And without long-term purchase commitments, conventional financing for any portion of the project was not available. So the project appears to be dead for the foreseeable future.

B. There has been some consideration of photovoltaics, but PVs have not made any headway with village utilities although they are widely used by industry in supplying power to remote, unmanned locations such as telecommunications facilities. The obvious obstacle in rural Alaska is that energy demand peaks during the winter when sunlight is in short supply. This problem can be solved for a price if

enough panels and batteries are installed but, to date, we haven't seen any numbers that suggest it is economically feasible to do so.

C. Small hydro projects have been built successfully in a handful of villages – nearly all of these are run-of-river projects with no dam or impoundment, and nearly all have required sizeable government subsidies. Most villages in rural Alaska do not have suitable hydro sites anywhere nearby. A number still do, however, and we are finding that private utilities and independent power producers are able to build these projects at much lower cost than the State government had previously projected, and they are building them reasonably well. In fact, the Division of Energy has just issued its first market-rate loan to an independent power producer to build a small hydro project in rural Alaska without any government grant support at all. A rural utility that is now running diesel engines has committed to buy that power. Small hydro can still make a contribution if private developers can continue to cut costs.

D. Finally, although there may not be a lot of sunlight in Alaska during the winter, there is plenty of wind. The State and federal governments are presently funding wind demonstration projects in two communities in rural Alaska – one a relatively large regional center and the other a small village. The State has been asked a few times over the last couple of years to issue grants for additional wind projects but our policy has been that we cannot recommend them for small, rural utilities until they are proven under Alaska conditions with respect to performance, durability, and cost. So we are waiting for the results of these demonstration projects and are hoping that the results will be clear enough to support such conclusions. This leads back to the question of "scaling up". Not scaling up access to electricity in rural Alaska, since this has already been achieved – but rather scaling up the application of renewable energy – in this case, wind.

During the 1980s there were about 100 wind turbines installed in Alaska. As far as we know, few of these operated for more than a year and those that did required major additional investment. People remember this, and the natural legacy is skepticism. So there are questions on long-term performance and concerns about the complexities of maintenance and repair that will be difficult to answer in a 2-year demonstration project.

6. Beyond this, it should be kept in mind that every purveyor of a project or a technology brings along the output of a computer model showing that their project or technology has the lowest long-term cost. It may be obvious but I'd like to say that it is not enough to evaluate project economics with a complex computer model and a statement of factor inputs and results. Without sacrificing depth, greater simplicity and clarity is needed in economic evaluations of renewable energy, as well as clearly favorable results, before most rural Alaska utilities would consider launching into a new technology and before the State could recommend it. Diesel generators are nearly universal in rural Alaska not because of market failure, but because they do well on a broad range of criteria compared with the

competition. At least in Alaska, I believe that economic and financial evaluation of renewable energy demonstration projects must be given a higher priority if the widespread adoption of these technologies is going to occur any time soon.