Alaska Climate Teleconferences
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CLIMATE CHANGE IMPACTS ON RENEWABLE ENERGY IN ALASKA
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SUMMARY
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PRESENTATION
The teleconference presentation is available as a .pdf file on the ACCAP Climate Teleconference Website under "Archive of Past Conferences":
http://www.uaf.edu/accap/teleconference.htm

Climate Change Impacts on Renewable Energy in Alaska
***Gwen Holdmann,* Alaska Center for Energy and Power**

In Alaska there are six major potential renewable energy sources. This talk covers each of these and discusses some of the possible impacts climate change could have on these resources.

The first is **biomass** which includes wood, saw mill waste, and fish oil. The graph on slide 5 shows how much biomass we could produce vs. how much energy Alaska uses each year. As you can see even if we did an efficient job at sustainably using our biomass resources, it would still only provide us with just over one-third of the energy that we consume state-wide. This is just one example of how using only one type of renewable resource is not a solution. It's going to take a combination of different resources and technologies. Climate change could potentially have a positive and negative affect on our biomass resources. Increased growing season length and higher CO_2 levels could lead to an increase in Arctic vegetation and an increase in the extent of the Boreal Forest. Slide 8 shows the current area covered by the Boreal Forest compared to the projected area that could be covered in the future. However, an increase in vegetation could also lead to an increase in wildfires and insects. It is hard to predict the extent to which the negative impacts will offset the positive in terms of total available biomass, however, we can expect large changes within the next 100 years.

Another biomass resource is fish oil, which can be used as a biofuel. This is something that is currently being researched by the University of Alaska and is used by several fish processing facilities as a boiler and/or generator fuel. It is generally thought that warmer temperatures could lead to an increase in salmon populations. However, warmer temperatures also mean a likely increase in phytoplankton, which will have a negative impact on the salmon

population. Therefore, the overall impact of warmer water temperatures on salmon is as yet unknown.

The second renewable energy resource to consider is **hydropower**. Today, hydropower supplies 24% of Alaska's electrical power. Our water resources vary due to the climate patterns of El Nino (ENSO) and the Arctic Oscillation (AO). Within the next 100 years we can expect considerable impacts on our hydro-power resources. At this time, UAF scientists, Jessie Cherrie and Amy Tidwell are working on a research project in collaboration with NOAA National Marine Fisheries Service to assess the climate change impacts on hydro-electric power in Southeast Alaska. With more precipitation, permafrost thaw and airborne dust sources from Asia, sedimentation levels in our lakes, streams, and rivers are expected to rise drastically. This will reduce the amount of energy that can be generated from hydro-power and can also damage equipment. More aggressive water events, like storms, will increase erosion also adding to the sedimentation levels. An example of this occurred near Chena Hot Springs in 2006 when Spring Creek, which is normally very clear, became extremely muddy for a period of several months due to permafrost thaw upstream. This impacted a water ram pump used for irrigation, and the project was temporarily shut down as a result.

Hydropower in Norway is also a good example of how climate can impact energy generation. Nearly 100% of electricity in Norway is generated by hydropower, but the water resources there are strongly impacted by the North Atlantic Oscillation (NAO). Incidentally, there is a 92% correlation between what the NAO is doing and the Arctic Oscillation, with the NAO being much better studied, particularly in how it impacts climate and precipitation in northern Europe. With climate change and long-term shifts in the NAO, Norway is expected to become colder and drier, however their hydropower equipment was installed and perfected during an unusually warm and wet NAO cycle. This is causing a shortage of energy, while demand is increasing at the same time due to colder conditions creating an increasing demand for electric space heating. Local Alaskan projects have also been affected by the AO, ENSO and glacier melt. Precipitation is expected to increase in Alaska with climate change, however this will likely occur on a variable schedule which may result in more flood events and runoff could also carry a great deal of sediment. Both would negatively impact current and future hydropower projects in the state.

Capturing energy from the **tides and waves in the ocean** is an emerging field with great potential. This technology is not yet commercially available, but demonstrations of what can be done exist in several locations worldwide. There is a great potential for turning wave energy into a power source, but this is still in the experimental stage. An increase in storm activity that is expected to occur with the warming climate can cause major damage to the equipment. Proposed ocean energy technologies are illustrated on slide 25.

The third resource is **wind**. Right now there are strong winds along the Northwest coast of Alaska which represent opportunities for significant wind power development, but more storms could again cause damage to the equipment. Additionally, an increase in discontinuous permafrost (slide 29) may result in foundation issues for wind turbines.

The potential for **geothermal power** is very good in Alaska. Slide 30 shows a map of the heat flow throughout the state. Fluid that brings the heat to the surface is necessary to use utilize geothermal resources. This requires an area with adequate rainfall and permeability to access the heat underground. A cooling medium such as cold air or water is also needed to condense the steam or refrigerant (in low temperature systems) which is typically used to turn the turbine. (slide 31).

Solar power is useful, even here in Alaska. I maintain solar panels on the roof of my house that supply power to the entire house in the summer and trickle charges the batteries in the winter. But again, increases in storms and clouds are going to limit the amount of sun we receive. Estimated increases in Asian dust, suspended volcanic ash, and other aerosols will all decrease the overall potential for generating electricity from solar energy.

Those are the six renewable potential energy sources that are currently in some form of development. Climate change could have positive and negative impacts on all of them and it will be hard to determine exactly what changes will occur and to what degree and ultimately how that will affect our energy balance.

DISCUSSION QUESTIONS AND COMMENTS

- The village of Eagle was talking about starting a project that would place hydro turbines in the Yukon River. Do you know the status of that project?
    - Yes, that is a joint project between Alaska Power and Telephone, Underwater Electric Kite (UEK) and the Denali Commission. They received funding for the project and it is going through re-design right now. They are finding that placing the turbines on the bottom of the river so as not to disturb the salmon will likely not produce enough power. So they are working on finding a system that won't disturb the fish, yet is also at a level in the river where there will be enough current to generate power. It is slated for instillation in mid-2009.
- What is the source for the storm track chart and the heat source chart in your slides?
    - The storm track graphic can be found on the NOAA Climate Prediction Center website at www.cpc.ncep.noaa.gov.
    - The heat flow chart is from the Southern Methodist University website and is available for download here (http:smu.edu/geothermal/heatflow/Alaska_hf.gif) .
- Can you describe the home solar system you have?
    - Solar systems up here are underrated, yet there really are a lot of opportunities for them. The solar potential for a year here is the same as a year in Seattle or Washington, DC. It just trickle charges in the winter, but it starts to pick up in February. I have a 300kw system for a small house and I'm completely sustainable in the summer with normal energy usage. Of course, we do have a fairly modest demand and it is a small home.
- Can you tell us more about the Alaska Center for Energy and Power?
    - ACEP looks at ways to facilitate and conduct applied energy research. We were started and operate at UAF and we conduct research in 3 main areas:
        - Community energy solutions (including renewables)
        - Powering Alaska's economy, or in other words looking at energy options for current and future industry throughout the state
        - Energy field of the Future, where we are considering ways to maximize our fossil energy resources through advanced extraction technologies
    - ACEP also looks at easy things we can do right now to improve our energy production, including increasing the efficiency of existing energy systems. We're also working on researching tidal and in-stream hydropower and looking at potentially forming collaboration with Maine in this area. We are similarly looking at opportunities in geothermal, wind/diesel, and many other areas which are relevant to Alaska.
- A lot of work was done in the 1980s on the Susitna hydro project, but it never happened. Do you know if there was any look at the potential impacts of climate change on that project?
    - Back when the initial assessment was done there was no consideration of climate change effects, but it's definitely something that we feel is important to look at now. I know others here at the university are interested in looking at that now and reviving that project.
- Are there any projects going on with wind energy?

    - There are a number of wind systems that have been installed in rural communities. In Kotzebue, 8% of energy is produced by wind power. There is some research that needs to be done with improving diesel efficiency and system use. In terms of large scale production, on the Railbelt there's one project on Fire Island, just south of Anchorage and another at Eva Creek near Healy that GVEA is considering.
    - What is the status of those projects?
        - They are in data collection stages and looking at possible manufactures for possible systems.
- Do you have a sense, statewide of the total current renewable electricity generation?
    - It depends on what we're talking about because it comes down to three main areas of energy dependence:
        - Transportation: almost no renewable energy
        - Heating: almost all fossil fuel with a little biomass thrown in. People are starting to use larger, more efficient boilers.
        - Electric Power: 24% is produced by hydropower, so in that area we're doing pretty good, but its basically limited to hydropower alone right now.
- In your hydro-power calculations, if the glaciers continue to melt, how does that change your perspective relative to investing in hydropower?
    - [Amy Tidwell] There are a couple of issues. If the glaciers recede to the point they disappear, that causes a problem. On the other hand you might have an increase in flow during the phase they retreat, until they reach a more steady state. The snowfall on the glaciers can also be a significant factor.
- If you look forward, do you envision a more grided, centralized power generation or more locally generated?
    - Probably a little bit of both. But at the same time when look at these renewable resources there isn't one silver bullet. You can't fly a plane on hydropower so we need a mix of solutions.

To provide feedback on this summary, the teleconference, or to suggest topics for future teleconferences please contact: Sarah Trainor, fnsft@uaf.edu, 907-474-7878.