INTRODUCTION

The Toyota USA Foundation, SpatialSci, The University of Montana, and the Montana Association of Geographic Professionals (MAGIP) are pleased to announce the second annual **Montana GIS in Schools Competition** for middle and high school students. The title for this year's competition is ***Mapping Montana's Energy Alternatives*.**

COMPETITION CHALLENGE

Background

There are many reasons to consider energy production from alternative (or renewable) sources – these include reduction of greenhouse gas emissions that contribute to climate change, decrease in the amount of toxins that are by-products of energy use, conservation of many of the natural resources that we currently use as sources of energy, and protection of natural areas and landscapes. As oil and gas prices steadily increase, economic concerns may also motivate interests in alternative energies. Renewable energy utilizes natural resources such as sunlight, wind, tides and geothermal heat, which are naturally replenished. Renewable energy technologies range from solar power, wind power, and hydroelectricity to biomass and biofuels for transportation. About 13 percent of the energy the world uses comes from renewables, with most of this coming from traditional biomass like wood-burning. Hydropower is the next largest source, providing 2-3%, and modern technologies like geothermal, wind, solar, and marine energy together produce less than 1% of total world energy demand energy (Party 2002).

Renewable Energy for Montana

Appropriate renewable energy technologies vary with geography. For example, marine energy (from waves and tides) can only be harnessed in coastal locations. Solar energy arrays are best-suited to regions with predominantly cloud-free, sunny conditions. Montana currently generates very little of its electricity mix from renewable sources, although the potential exists to successfully generate most or all of our electricity needs using renewable technologies (Nielsen, Innis et al. 2002).

Questions for Analysis

What renewable energy sources are best suited for Montana? Do different regions within the state vary in terms of their suitability? How would you develop an alternative energy plan for Montana? Which areas would you develop for alternative energy production, and how would you move this energy from its sources to other areas within the state? What other considerations are important for energy development (for example, endangered species, wildlife, habitat, and economic concerns).

Wind turbines

Solar cells

References

Nielsen, J., S. Innis, et al. (2002). "Renewable Energy Atlas of the West." Land and Water Fund of the Rockies, Boulder Co.

Party, P. (2002). Renewables in Global Energy Supply: An IEA Fact Sheet, París.

PROJECT GUIDELINES

Each participant (individual or team) will prepare a GIS-based project to address renewable/alternative energy in Montana. The GIS project must include:

1) At least one ArcMap layout image (but not more than three) that makes a unique contribution to understanding and addressing Montana's energy alternatives. Layouts should be free of clutter, confusing colors or symbols, and use clear, direct captions and titles. Layouts should also include necessary map elements including legend, scale bar, and north arrow.

2) A written summary which includes the elements outlined below:

a) *Expected Changes*
In one or two sentences describe Montana's potential for generating electricity through renewable sources.

b) *Data*
Describe the data used (including sources, spatial and temporal scale, resolution, and quality) and explain how the data helped your alternative energy analysis. Projects should draw from a combination of **at least three** geographic data sets.

c) *Geospatial Tools*
Describe any geospatial tools used in the investigation.

d) *Findings*
What are your conclusions? How did you arrive at them? Are there any limitations to your analysis? What decisions should your community and the state of Montana make based on your analysis? Provide one new question you now have about alternative energy that you would like to answer using GIS.

e) *Solutions*
Outline one or more actions that Montana decision-makers and/or Montana residents can make to address the findings you have made in your report.

PROJECT SUPPORT

An extensive bibliography on renewable energy resources is provided here. In addition, there are many more resources available on the Internet.

SUBMISSIONS AND JUDGING

All resources for the competition will be made available October 15, 2007. GIS Project submissions must be **postmarked by April 30, 2008**. Competition submissions should be submitted on CD-ROM to the address below:

Dr. Lisa Blank
School of Education
32 Campus Drive
University of Montana
Missoula, MT 59812

All submissions must include:
1. A completed Competition Entry form (available on the SpatialSci website)
2. ArcMap layout (s)
3. Written summary including all of the elements described above

Competition entries will be judged by GIS professionals who are members of the Montana Association of Geographic Information Professionals. Judges will evaluate the quality and clarity of the written account and the merits of the spatial and analytical project components.

Specifically, judges will be looking at how well GIS projects used:
1. Geographically referenced data about Montana and renewable energy;
2. GIS to analyze data;
3. GIS to effectively present data; and,
4. GIS to understand and assess the potential for renewable energy generation in Montana.

Written summaries will be judged on the quality of:
1. Reasoning used to make assessments, based on data and information from current sources;
2. Findings that demonstrate an understanding of alternative energy and its role in Montana; and,
3. Writing mechanics (paragraphs, punctuation, grammar, and spelling).

WINNERS AND PRIZES

The intention of the Montana GIS in Schools competition is to promote and support effective teaching and learning of GIS. The teacher submitting the winning school entry will be awarded a $250 cash prize. The winning student or student team will also receive a $250 cash award. Announcements of the winners will be made by May of 2008, via the SpatialSci website (http://www.spatialsci.com).

2007-2008 GIS COMPETITION LINKS

General Information:

Montana Green Power – Information on alternative energy including solar, wind, and other renewables: http://www.montanagreenpower.com/

National Renewable Energy Laboratory - nation's primary laboratory for renewable energy and energy efficiency research and development: http://www.nrel.gov/

Montana Wind Energy Atlas – comprehensive analysis of wind energy data available as of 1987. Data collected by a variety of public and private organizations at 158 wind monitoring sites around Montana, and are available at site and county levels: http://www.deq.state.mt.us/Energy/wind_atlas/wind_atlas_index.asp

U.S. Department of Energy's Energy Efficiency and Renewable Energy Program – includes information on alternative energies including solar, geothermal, hydrogen, biomass, and wind power: http://www.eere.energy.gov/

National Center for Appropriate Technology - serves economically disadvantaged people by providing information and access to appropriate technologies that can help improve their lives: http://www.ncat.org/

Rocky Mountain Institute - not-for-profit "think and do tank" that works with individuals and organizations of every imaginable kind to help them use energy and resources efficiently while being ever-better stewards of the environment: http://www.rmi.org/

H2Education and the Alternative Energy Learning Site - the Alternative Energy Learning Site, located in Missoula, Montana, provides educational opportunities to the public about renewable energy technologies. The site includes a 10 kilowatt wind turbine, 2 kilowatt solar photovoltaic array, a proton exchange membrane fuel cell and a battery back-up unit. H2Education provides educational resources on hydrogen technology: http://www.h2education.com/index.php/sID/6a63f9e4/tID/03cd5987/fuseaction/education.main.htm

Geospatial and other data:

National Renewable Energy Laboratory's Dynamic Maps, GIS Data and Analysis Tools Website - provides dynamically-generated maps of renewable energy resources (solar, wind, biomass, hydrogen) that determine which energy technologies are viable solutions in national and international regions. This site also provides access to an FTP site where you can download data and Geospatial Toolkits: http://www.nrel.gov/gis/

National Climatic Data Center - NCDC is the world's largest active archive of weather data. NCDC produces numerous climate publications and responds to data requests from all over the world. Available data sets include land – and satellite-based upper air and marine weather and climate at various spatial and temporal resolutions: http://www.ncdc.noaa.gov/oa/ncdc.html

U.S. Department of Energy's Energy Efficiency and Renewable Energy Program – validated state wind maps: http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_maps.asp

Wind Energy Resource Atlas of the United States – includes regional wind speed summaries and a great selection of graphical maps showing seasonal and annual wind resources at state and regional levels (see "List of Maps" link toward the bottom of the document): http://rredc.nrel.gov/wind/pubs/atlas/

National Renewable Energy Laboratory's United States Atlas of Renewable Resources - View, zoom into and print interactive maps of solar, wind, geothermal and biomass resources in the US: http://www.energyatlas.org/

Reports and documents available on the SpatialSci website:

Hydrogen, wind, biodiesel, and ethanol - alternative energy sources to fuel Montana's future? (2004). Helena, MT, Montana Environmental Quality Council.

Monana wind power - a consumer's guide to harnessing the wind. (2004). NorthWestern Energy.

AERO (2007). Repowering Montana - a blueprint for home grown energy self-reliance. Helena, Alternative Energy Resources Organization (AERO).

Appenzeller, T. (2004). "The End of Cheap Oil." National Geographic 205(6): 80-109.

Ball, J. (2005). Tilting at energy windmills. The Wall Street Journal.

Nielsen, J., S. Innis, et al. (2002). "Renewable Energy Atlas of the West." Land and Water Fund of the Rockies, Boulder Co.

Party, P. (2002). Renewables in Global Energy Supply: An IEA Fact Sheet, París.