GROUP ON EARTH OBSERVATIONS

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GEO Energy Strategic Plan

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Improving Management of Energy Resources

Strategic 5-10 Year Plan by the GEO Energy Community of Practice

October 12, 2007

EXECUTIVE SUMMARY

This Strategic Plan document, developed by the GEO Energy Community of Practice (CoP), provides a basis for detailed planning over a ten-year time frame. It serves as a framework for securing support for and integration of ongoing and future activities.

At present, the Energy CoP is involved with the broad range of energy development and production. The initial focus has been on the renewable sector and includes sections in biomass, geothermal, hydro, ocean, solar, and wind. These activities of the Energy CoP will expand to encompass the fossil fuel and nuclear energy fields.

The objective of this strategy is to enable the GEO Energy Community of Practice to add value to activities of the national and international energy management and development community by integrating Earth observation information and interoperability standards into their practices by:

- Documenting the needs and requirements of the energy sector;
- Developing best practices for the integration of information;
- Enabling integration of Earth observation information through select demonstration projects in developed and developing countries;
- Enabling the transition of successful pilots into operations through the development of scale-up plans;
- Providing continuing means of dialogue and support for users.

Specific activities include:

- Enhance engagement of energy agencies - such as EUREC (European Renewable Energy Research Centres), IEA (International Energy Agency) - and non-energy organizations - such as UNEP (United Nations Environment Programme), GEF (Global Environment Facility), WMO (World Meteorological Organisation), and WHO (World Health Organisation) - in the interactions with the Energy Community by inviting representatives to be members of the Energy Community of Practice.
- Engage national and international research as well as applied funding agencies/ministries, in long-term prioritization and financial planning for Energy-related GEO efforts through dialogue and consultation.
- Provide an on-line clearing house of information and other resources for both the GEOSS and Energy management and development communities, such as the GEOPortal and the GEOSS-ECP web site and GEONetcast.

- Enhancing interactions between the energy communities and developed and developing nations by means of annual workshops.
- Establish a benchmark process for GEOSS information and its usability for energy community needs. Extend traditional validation and verification strategies to include the point of view of energy users with their specific needs.
- Work with the Capacity Building Committee to formulate a plan for training and education
- Communicate activities of working groups to the energy management and development sectors through hosting of workshops, provision of key note addresses, sponsoring conference sessions and communication in trade publications of the management and development sectors.
- Stream GEOSS information into national and international energy policy through proactive participation in ongoing energy policy development in appropriate fora.
- Engage stakeholders and professional societies in additional energy sectors (which may overlap with other GEOSS Societal Benefit Areas) to include:
  - Energy efficiency (sustainable/green buildings)
  - Climate change impacts on the energy sector (energy load forecasting)
  - Space-weather impacts (energy load forecasting)
  - Short/mid-term/seasonal forecasting (energy load forecasting/renewables)
  - Carbon capture and storage (regulation/monitoring/compliance)
  - Urban heat islands/Population growth (energy load forecasting)

INTRODUCTION

The **Group on Earth Observations** (**GEO**), established by a ministerial-level Summit in February 2003, includes 71 member countries, the European Commission and 46 participating organizations working together to establish a Global Earth Observation System of Systems (GEOSS).

GEOSS will build on and add value to existing Earth observation systems by coordinating their efforts, addressing critical gaps, supporting their interoperability, sharing information, reaching a common understanding of user requirements, and improving delivery of information to users.

GEOSS Energy activities are conducted under the conceptual framework of the Energy Community of Practice (CoP). The Energy CoP is comprised of individuals and organizations with a common interest in improving development and management of worldwide energy resources. The objective of the Energy CoP is to support GEOSS outcomes related to the application of Earth Observation data and information products in the Energy Sector. The mission of the Energy Community of Practice is to add value to the national and international activities of the energy development management community by helping integrate Earth Observation information and interoperability standards into their practices by:

- Documenting the needs and requirements of the Energy Sector;
- Developing best practices for the relevant managements and integration of information;
- Promoting and supporting selected demonstration projects in developed and developing countries;
- Enabling the transition of successful pilots into operations through the development of scale-up plans;
- Providing continuing means of dialogue and support for users;
- Supporting developments in capacity building outreach and training;
- Disseminating knowledge.

The Energy CoP is concerned with the broad range of energy development and production activity. The initial focus has been on the renewable sector encompassing biomass, geothermal, hydro, ocean, solar, and wind. This document will be expanded to encompass the fossil fuel and nuclear energy fields.

More information is provided for the Energy Community of Practice on http://www.geoss-ecp.org/.

This Strategic Plan document, developed by the GEO Energy Community of Practice, provides a basis for detailed planning over a ten-year time frame. It serves as a framework for securing support for and integration of ongoing and future activities. It is to be viewed as a 'living' document and will be revised and updated by the Energy Community of Practice as progress is made on activities and as the scope of the Energy CoP evolves.

Moreover, this Strategic Plan is one of the two major GEO Energy Targets for 2006-2007 (so-called two-year Target) as identified in the GEO 10-Year Implementation Plan.

How GEOSS Will Contribute to Improving the Management of Energy Resources

The following statements are selections from Section 4.3.2 of the "GEO 10-Year Implementation Plan Reference Document" of 2005. They provide the foundation for the GEOSS Energy Societal Benefit Area (SBA).

"The vision is to balance the supply and the demand of energy of the planet in a sound, equitable, sustainable and environmentally responsible way, enabling countries to meet and further their

economic, social and environmental agendas and/or obligations. …. The implementation of GEOSS will offer unique capabilities for the global industry to meet these goals through delivering accurate "Situational Awareness" of both current and future states of the energy system and their environmental context.

At regional level, differences in energy management are influenced by availability, cost, and impacts on ecology, environment, and human health and well-being. GEOSS and its associated modeling capabilities will allow energy management actions to be taken to reduce risk due to weather, climate, water, oceanic, geological Energy and human threats. Using the observing systems and modeled products, coupled with energy decision support models and tools, industry will create "Action Plans" to improve the management of energy resources in a safe, efficient, cost effective, reliable, secure and socially responsible manner…

In addition, GEOSS will contribute significantly to the development of renewable energy systems and their incorporation into the grid and, as a consequence, will decrease the demand on and extend the life expectancy of non-renewable energy sources. …"

Scope of the Plan

The Plan addresses efforts associated with

1) Transitioning existing research capabilities to meet the operational needs of the energy industry.

2) Development of advanced end-to-end modeling and forecasting techniques covering environment and energy processes (including load management, economic forecasts) for the purpose of operational risk management.

3) Guidance for the improvement of information networks through incorporation of integration and inter-operability requirements.

4) Enhancing efforts to raise awareness of, facilitate access to, and improve methodologies for exploitation of GEOSS data and information products by the energy community.

These four 'themes' are associated by number (eg [3,4]) with the Objectives, Supporting Activities, and Recommended Actions Sections of GEO members and the Energy CoP.

1 OBJECTIVES FOR GEO MEMBERS & THE ENERGY COMMUNITY OF PRACTICE

- Conduct outreach activities to raise awareness of the utility of Earth Observation and associated modeling within the Energy Sector in collaboration with other GEO Committees. [4]
- Assist GEO in designing the optimal observing and modeling systems configured to meet the information needs of the energy community on a regional and national basis in both developed and developing countries. [1,2]
- Engage with energy developers, managers and intermediate service providers to the Energy Sector to better understand and then convey the advantages of the use of GEOSS information and communication models through a series of stakeholder's workshops at the regional, national, and international levels. [4]
- Identify key attributes/requirements for information systems desired by the energy community. Address concerns including restricted data access, maintenance of data quality, continuity of information, etc. [3]
- Prioritize the needs of the energy community that GEO can help address in a research priorities plan. (Develop the problem set and determine both the current 'Gap' and future 'Fit' solutions). [1,2,3]
  - Inventory relevant space observations and *in-situ* measurements and associated models of relevance to the Energy Sector and identify existing decision support systems and organizations that could benefit from their integration in Decision Support Systems.
  - Identify, in time and in space coordinates, the list of priority variables to meet the research priority needs (the Solution Set).
- *Identify the operating practices of the energy community and how they access and use data and information as well as how they make decisions. [3]*
- *Advocate for and facilitate the use of GEOSS information and communication models to energy developers, managers and service providers, to elicit "market pull" and benchmark the effectiveness of the information. [1,2,3,4]*
- *Identify funding sources from both governmental and non-governmental organizations and advocate funding for key energy management and delivery demonstration projects that illustrate the improvement in operational performance with the incorporation of GEOSS information. [1,2,4]*
- *Id*entify and mentor participation in regional demonstration projects. [1,4]
  - Determine how the demonstration projects can be incorporated into energy activities in key sectors of developed and developing countries.
  - On a regional basis, examine and identify mechanisms for the incorporation of outcomes of the demonstration projects into operational energy applications in developed and developing countries.
- *Define benchmarks and criteria for successful outcomes. [1,2]*
- *Coordinate with the Architecture and Data Committee and the User Interface Committee on addressing information system requirements. [3]*
- *Enhance the web-based delivery of Energy-related Earth Observation products in formats and sizes* usable in both developed and developing countries, working with the GEOSS Data Management, Architecture, and Outreach committees. [3]

2 SUPPORTING ACTIVITIES OF GEO MEMBERS AND THE ENERGY COP

User Requirement Assessments

- Analyses of the scope of GEOSS products needed now and in the next ten years by energy communities has been performed in the Energy CoP working groups for solar, wind and bioenergy. This has revealed the following foci:

  Wind energy

  - Improved description of the geophysical parameters of interest for onshore wind energy
  - Improved description of offshore wind, through accurate cartography of resources and precise spatial statistical parameters
  - Forecasting of wind energy production on different forecast horizons from nowcasting up to 72 hours, and medium-range timescales of 10 to 15 days, and use of ensemble predictions
  - Integration of resource and forecasting information into decision support tools for load and electricity grid management

  Solar energy

  - Improved algorithms for solar resource monitoring, include more information on atmospheric extinction in the sun belt areas
  - Forecasting of solar irradiance and solar energy production on different forecast horizons from now casting up to 48 hours, use of ensemble predictions
  - Integration of resource and forecasting information into decision support tools for load and electricity grid management
  - Integration of resource information into decision support tools for desalination and water supply structures

  Bioenergy

  - Improved algorithms for dynamic vegetation monitoring which are specifically adapted to energy crops
  - Monitor biomass production and information on weather conditions that influence biomass production and produces variability both in time and space
  - Collaboration with the Agriculture SBA

- A NASA-based analysis of space-borne measurement and modeling assets relevant to the energy community has been performed. This analysis may be extended to other nation's space-borne assets (http://appl-policy.saic.com/NASA_Data_Appropriate_For_Energy_Applications.html).
- Engaging stakeholders and professional societies across the theme groups of the Energy CoP (which may overlap with other GEOSS Societal Benefit Areas). This is being undertaken through a series of focused workshops describing GEOSS products and assessing end-user needs. An example report from a recently-held workshop, targeting the power generation and bioenergy communities, which illustrates the goals, attendees, and outcomes is available at: http://aiwg.gsfc.nasa.gov/esappdocs/evalreports/EM_eval_report.pdf.
- Extending the NASA-based analysis by sector of the utility of space-borne Earth observations and models to inform energy management and policy decisions to other country's assets (e.g., India, Russia, Japan, China). The NASA study inventoried US-based Earth observation measurements and models by theme (e.g., renewable energy, energy

efficiency, space-weather impacts) and identified existing decision support systems which would benefit from the integration of Earth observation measurements.

http://aiwg.gsfc.nasa.gov/esappdocs/evalreports/NASAEnergy.pdf

http://aiwg.gsfc.nasa.gov/esappdocs/evalreports/NASAEnergy2.pdf

National Aeronautics and Space Administration

NASA Solar and Meteorological Data For Regional Level Modeling of Agricultural and Bio-fuel Crop Phenology and Yield Potential

Problem: Agriculture is entering a phase of unprecedented uncertainty. Increased costs of fuel and energy intensive inputs such as fertilizers, irrigation, and pesticides threaten the economic viability of current production systems. Producers are being held to increasingly stringent standards for protecting soil and hydrologic resources. Global grain reserves are at unprecedented low levels in relation to demand, which has escalated with demographic changes and most recently, with use of grain as a bioenergy feedstock. Climate variability and global environmental change add additional dimensions to the uncertainty.

***Solution*:** NASA Langley-developed agricultural data products were used in two decision support systems to assess the utility of Earth observations. One study, with the University of Nebraska, focused on quantifying the accuracy and precision of simulated maize yield potential and its variability using NASA climate data as compared to traditional ground based climate data. The effect of these differences was evaluated with the Hybrid-Maize model (www.hybridmaize.unl.edu). The second study, with the University of Georgia and the United States Department of Agriculture, focused on the utility of the NASA measurements in modeling regional and seasonal variation in time of flowering and yield potential of winter wheat. The chief decision support system used for this study is the DSSAT CSM-CERES-Wheat model. Both studies addressed the impact of using the spaceborne-derived data vs. site-specific data.

***Status*:** The University of Nebraska and the University of Georgia are associated with web based portals that cater to their respective regional agricultural communities (www.hprcc.unl.edu/ and www.georgiaweather.net/). Real time and climatologically weather data, along with various online decision support systems, are provided for use by the public and, more importantly, the agricultural community.

eoMD EARTH OBSERVATION MARKET DEVELOPMENT

EO-WINDFARM

Environmental Information Services for Wind Farm Management

http://www.eo-windfarm.org

EO-Based information service for windfarm management is the focus of the project led by the Nansen Environmental and Remote Sensing Center (Norway). The overall objective of this study is to design and integrate an EO-based mapping service based on end-user demands for geo-information when planning, constructing and operating wind farms.

- Conducting on-line surveys/expert witness for each working-group of the Energy CoP.
- Updating on a continual basis the fit-gap analysis of GEOSS products needed now and in the next 10 years by Energy communities (Table 4.3.5, 10-year reference document).
- Working with the climate modeling science community to develop, assess, and disseminate downscaled model results for regional-level energy assessment activities responding to climate change impacts; e.g., supply and load forecasting, renewable energy resource assessments, urban heat island impacts, and population growth.
- Setting the framework for rationalization and long-term harmonization of data and information sets from a variety of institutions (countries) as a basis for decision support systems that ensures model stability. Issues include physical consistency, disparate formats, and grid resolutions. This is coordinated with the Architecture and Data activities (Task DA-06-04).
- Extending international collaboration in the field of energy meteorology to develop methods, technologies and services based on combined knowledge from the atmospheric and oceanic sectors as well as the energy research field.

space4energy - distributed power grid management based on space technologies

http://www.space4energy.org/

The main objective is to evaluate the contribution of space technologies in terms of EO, telecom-munications and navigation satellites applied in the electrical power grids management, when distributed renewable energy plans are present in the grids. This study is being carried out under the General Study Program (GSP) of the European Space Agency. The project is led by Carlo Gavazzi Space (Milano, It), a space engineering industry with expertise in EO, NAV and TLC, with TERNA (Rome, It), the German Aerospace Center (DLR, D), the Center of Renewable Energy Sources (CRES, Gr) and RISOE National Laboratory (DK). Focus is laid on a better exploitation of the renewable resources (power grid generation) and improvements on power grid performances (power grid distribution).

EO-HYDRO
Environmental Information Services for Hydropower Plant Management

http://www.eohydro.com/

EO-Hydro – a project led by Carlo Gavazzi Space SpA (Italy) - is conceived to improve the hydro power plant management exploiting the newest space technologies. The on-line services on Alps, Canadian and Scandinavian countries are focused on water resource and security management. Snow cover, snow water equivalent, land displacement and runoff forecast are the main services provided by EO-Hydro. All services are based on the processing of satellite data.

Demonstration Projects

- Determining 3 to 5 demonstration projects in developed and developing nations to “close the gap”. For example, SoDa is a web-based set of services dedicated to solar energy (http://www.soda-is.com). The demonstration project based on SoDa aims at offering solar

information worldwide based on interoperation of SoDa and NASA databases. It will serve also as a test-bed for ECP for testing interoperability, architecture and data, standards requirements from ADC and UIC.

- Encouraging national and international funding agencies to incorporate GEOSS/Energy support in long-term financing plans for research and development.
- Proactively engaging formal regional organizations in developing countries such as sectors of Africa, South-east Asia, South America and Oceania (cf., RETScreen, sidebar) to assume a leadership role in operational energy applications. Examples include the Renewable Wind Energy workshops in Beijing in 2006 and Milan in 2007.
- Developing workshops on demonstration projects to be held with Architecture and Data GEOSS committee, and held in conjunction with major Energy focused symposia.

National Aeronautics and Space Administration

Assessing the Utility of Earth Observations to Inform Energy Sector Decision Making

NASA's Applied Sciences Program seeks to extend the benefit of NASA Earth observations and models to inform decision making across the GEO societal benefit areas. At the request of the Program's Energy Management application, Battelle conducted a study to identify themes within the Energy sector that could benefit from the enhanced use of Earth observations and model products.

This two-part study (available at: aiwg.gsfc.nasa.gov/esappdocs/evalreports/NASAEnergy.pdf and aiwg.gsfc.nasa.gov/esappdocs/evalreports/NASAEnergy2.pdf) assessed the types of Earth observations and models, identified decision support systems, and made recommendations of the most promising areas to pursue activities.

While the study was specific to NASA spaceborne observations and models, its methodology could be used to identify observations made by other nation's and region's assets.

In a complementary activity, scientists at SAIC have constructed detailed tables of NASA-based spaceborne measurement and modeling assets relevant to the energy community (appl-policy.saic.com/NASA_Data_Appropriate_For_Energy_Applications.html).

These tables identify the specific measurement products and describe their spatial and temporal resolution, coverage, and availability. This analysis could be extended to other nation's spaceborne assets.

vIEM

Virtual Institute of Energy Meteorology

http://www.viem.de

The Virtual Institute of Energy Meteorology addresses research at the interface between energy systems and meteorology. As the use of renewable energies increases more and more, it will become increasingly important to both assess and accurately forecast and manage, at a variety of temporal and spatial scales, the availability of these intermittent resources.

The Virtual Institute of Energy Meteorology is run jointly by the German Aerospace Center (DLR) and the University of Oldenburg. In its initial phase, the Institute is supported by the "Impuls- und Vernetzungsfonds" of the Helmholtz Association of German Research Centres.

Outreach

- Developing and updating Charters for each Working Group and the Energy Community of Practice as a whole (Governance).
- Communicating activities of working groups to the energy management and development sectors through hosting of workshops, provision of key note addresses, sponsoring conference sessions and communication in trade publications of the management and development sectors.
- Providing on-line information and other resources for both the GEOSS and Energy management and development communities, such as the GEOSS-ECP web site.
- Providing a forum for growing interactions between energy communities in developed and developing nations.
- Maintaining a compendium of requirements and a mechanism to routinely update the listings.
- Contributing information articles to energy trade media on GEOSS contributions to the energy communities.

3 RECOMMENDED ACTIONS

User Requirement Assessments

- Address issues of intellectual property associated with conflicts of open access and private endeavor.
- Enhance engagement of energy organizations (eg EUREC and IEA) and non-energy organizations (e.g. UNEP, GEF, WMO, and WHO) in the interactions with the Energy Community by inviting representatives to be members of the Energy Community of Practice.
- Engage national and international research as well as applied funding agencies/ministries, in long-term prioritization and financial planning for Energy-related GEOSS efforts through dialogue and consultation.

The ENVISOLAR Project
Environmental Information Services for Solar Energy Industries

http://www.envisolar.com

ENVISOLAR aims at the increased use of satellite based solar radiation information in solar energy industries. The project services help end-users in planning, construction and operations of solar energy power plants and while operating conventional power plants.

ENVISOLAR is part of ESA's Earth Observation Services Market Development (EOMD) Activities.

The solar market has a volume of about 600 million EURO/year in Germany and about 100 million EURO/year in the rest of the EU. Expected market volumes in 2010 are 1100 million EURO and 2500 million EURO, respectively. That means the solar energy sector is turning from an idealistically driven to a financially driven market. Therefore, investment assurance is necessary.

Services which can provide the required support are needed for investment decisions and plant management. Another emerging market that promises good benefits is forecasting the electricity load and production for electric utilities.

Scheduling of large power plants needs a precise knowledge of the load. Besides temperature, irradiance is the major environmental influence on the electricity demand. Because of liberalised markets and higher penetration a professional load forecast is necessary to achieve good prices in energy spot markets.

Basic information for the energy market segments outlined above is solar radiation. In detail global, diffuse and direct irradiance are needed.

NASA-Natural Resources Canada Renewable Energy Decision Support Collaboration

Problem: Renewable energy project analysis software requires solar energy and environmental data as inputs for calculating energy production, life-cycle cost, and greenhouse gas emission reductions. Decision support systems used limited ground-based observations which are sparse in the developing world.

Solution: NASA processed, analyzed and validated 20+ years of solar flux and Global Modeling and Assimilation Office GEOS 4 reanalysis assimilation products on a global 1°x1° grid for inclusion into the Langley Surface Meteorology and Solar Energy (SSE) data set (http://eosweb.larc.nasa.gov/sse/).

Status: NASA and Natural Resources Canada have developed a direct link to the SSE website to provide environmental parameters which improve the cost benefit analysis of these projects to RETScreen customers internationally (http://www.retscreen.net).

Demonstration Projects

- Develop a continuing compendium of GEOSS successes for the Energy area and distribute to current and potential stakeholders.
- Provide an on-line clearing house of information and other resources for both the GEOSS and Energy management and development communities, such as the GEOPortal and the GEOSS-ECP web site and GEONetcast.
- For key demonstration projects, diversify the funding base through the identification of potential funding from both governmental and non-governmental sources (e.g., renewable energy venture capitalists).
- Enhancing interactions between the energy communities and developed and developing nations by means of annual workshops.
- Facilitate the development of regional best practice documents by engaging the local institutions in the program development.
- Establish a benchmark process for GEOSS information and its usability for energy community needs. Extend traditional validation and verification strategies to include the point of view of energy users with their specific needs.

Outreach

- Continue to develop working groups (and their charters) for the various sectors of the Energy Community of Practice, such as the Wind Energy and Solar Energy working groups. Ensure that progress is made with nuclear and fossil fuel energy working groups in order to realize the benefits in these two very large components of the Energy Sector.
- Work with the Capacity Building Committee to formulate a plan for training and education.
- Collaborate with organizations that maintain and define interoperable standards for web access.
- Provide an electronic forum for user questions and user support.
- Communicate activities of working groups to the energy management and development sectors through hosting of workshops, provision of key note addresses, sponsoring conference sessions and communication in trade publications of the management and development sectors.
- Contribute to the development of GEOSS contributions to the Energy community at the fundamental research and development level through theme publications in the refereed literature, such as the new IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (A 2008 issue is being developed for both renewable wind and solar energy).

NOAA study of the value of seasonal sea-breeze forecasting in energy demand forecasting for the California coastal region

Sea-breeze events are inadequately captured in the day ahead temperature forecasts. These events cause significant electricity demand forecast errors as demand drops during sea-breeze events.

By bringing in more offshore observations forecast accuracy can be improved. The use of ensemble forecast techniques can also be used to increase the information content of the forecast, providing information about the probability of the forecast temperatures.

This information can be utilized by power distribution grid operators to permit improved power management with consequent cost savings of up to $2m per year.

- Stream GEOSS information into national and international energy policy through proactive participation in ongoing energy policy development in appropriate fora.
- Engage stakeholders and professional societies in additional energy sectors (which may overlap with other GEOSS Societal Benefit Areas) to include:
  - Energy efficiency (sustainable/green buildings)
  - Climate change impacts on the energy sector (energy load forecasting)
  - Space-weather impacts (energy load forecasting)
  - Short/mid-term/seasonal forecasting (energy load forecasting/renewables)
  - Carbon capture and storage (regulation/monitoring/compliance)
  - Urban heat islands/Population growth (energy load forecasting)

Moving Forward

One key Task of the GEO Energy community was to write a 5-10 year strategic plan for the Energy Societal Benefit Area. This document is the first strategic plan for this Societal Benefit Area**.** This edition of the strategic plan will be considered a living document to be updated on a regular basis and has enhanced and extended all of the 2, 6 and 10 year targets originally identified.

In the existing Implementation Plan Reference Document (GEO, 2005) the interval targets have been set for two, six and ten year timelines. They are listed in Appendix A.

Summary of Activities

To date we have:

- Established an internationally-based GEOSS Energy Community of Practice consisting of participants from national space agencies, research and development agencies, universities, energy utilities, and the private sector.
- Developed a charter, organizational structure with committees, co-chairs and volunteer members for the Energy CoP, and an active web page (http://www.geoss-ecp.org/).
- Conducted an Energy Expert Meeting at the GEO Secretariat in August 2006 to discuss recent applications of Earth Observations and models to national and regional-level Energy management activities and to begin the drafting of an Energy CoP Strategic Plan.
- Established a GEOSS near-term demonstration project, "Solar Energy Data for Developing Countries", based on elements of the International Energy Agency Solar Heating and Cooling Programme Task 36 and the SoDA web service.
- Conducted national-level assessments of energy-related Earth Observations, models, decision support systems, and priorities through literature and web source review, and through an open questionnaire hosted on the Energy CoP Web Page.
- Conducted national-level stakeholder's engagement workshops to assess the applicability of Earth observations and models to end-user needs.
- Assisted in the development of a new IEEE Journal on "IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing" to focus on applied topics, many of relevance to GEO. The first issue, planned for first quarter of 2008, is on Renewable Wind Energy and Earth Observations and draws from the Wind Energy Sub-Committee activities of the Energy CoP.
- Developed and Hosted a GEOSS/IEEE/OGC workshop affiliated with the International Polar Year that focuses on: The Impact of Climate Change and Variability on Biodiversity and Energy Development in the Arctic" (August 19 20, 2007, Yellowknife, Canada).

Forward Vision

Recent events (such as the G8 Gleneagles Summit Declaration and the UK Stern Review on the Economics of Climate Change) demonstrate the value of using informed energy management practices to mitigate and adapt to climate change. The GEO Energy Community Practice 10-Year Strategic Plan will enable GEO to contribute in a substantive manner to positive environmental and economic outcomes. The Plan will contribute to requirements for an information system that will assist the international energy community to incorporate Earth observations in their planning and implementation of practices appropriate to the evolving environment.

Mission Statement

The GEO Energy Community of Practice will add value to activities of the national and international energy management and development community by integrating Earth Observation information and interoperability standards into their practices. This will be achieved by:

- Documenting the needs and requirements of the energy sector;
- Developing best practices for the integration of information;
- Enabling integration of Earth Observation information through select demonstration projects in developed and developing countries;
- Enabling the transition of successful pilots into operations through the development of scale-up plans;
- Providing continuing means of dialogue and support for users.

Appendix A

Targets for the Energy SBA identified in the Implementation Plan Reference Document (GEO, 2005).

2-Year Targets

"Facilitate the exchange and use of existing data/products and forecast information through specific initiatives and actions in coordination with the energy community: (i) to raise awareness about the importance and potential of environmental information; (ii) to facilitate access to the existing information and products; and (iii) to develop training and encourage the development of decision-support tools for optimal energy use.

Produce, in coordination with the energy community, a strategic 5-10 year plan for exploitation of the benefits of the new generation of operational observing systems - both space-based and *in situ* - which comes on-stream in this decade. The plan should include efforts on: (i) operationalizing existing research capabilities to meet the needs of the energy industry; (ii) research and development in advanced end-to-end modelling and forecasting techniques (such as ensemble-based methods) covering both environmental and energy processes, and with an emphasis on issues of risk assessment; (iii) the improvement of information networks by linking existing systems and making them inter-operable; (iv) continue efforts to raise awareness of, facilitate access to, and operationalize improved methodologies for exploitation of GEOSS data and information products for the industry."

6-Year Targets

"Produce an evaluation of the Plan's progress with regard to energy and revise strategy as needed. The revised Plan will also include an assessment of the needs of the energy sector for new and/or enhanced GEOSS observations and products.

Facilitate the exchange of data and products for efficient energy management.

Facilitate the use of improved weather and climate products for the development of new energy tailored products and services."

10-Year Targets

"Facilitate the implementation of appropriate space-based and *in situ* - for the continuous and timely data in support of energy operations.

Advocate the development of new generation … weather and climate forecasting models.

Facilitate capacity building in order to bring to equivalent high (national and regional) levels.

Facilitate the development of renewable energy products available through GEOSS."