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Estimating the Socioeconomic Value of Satellite-Derived Solar & Meteorological Data: *A Case Study and Discussion of Tradeoffs*

Presented at:

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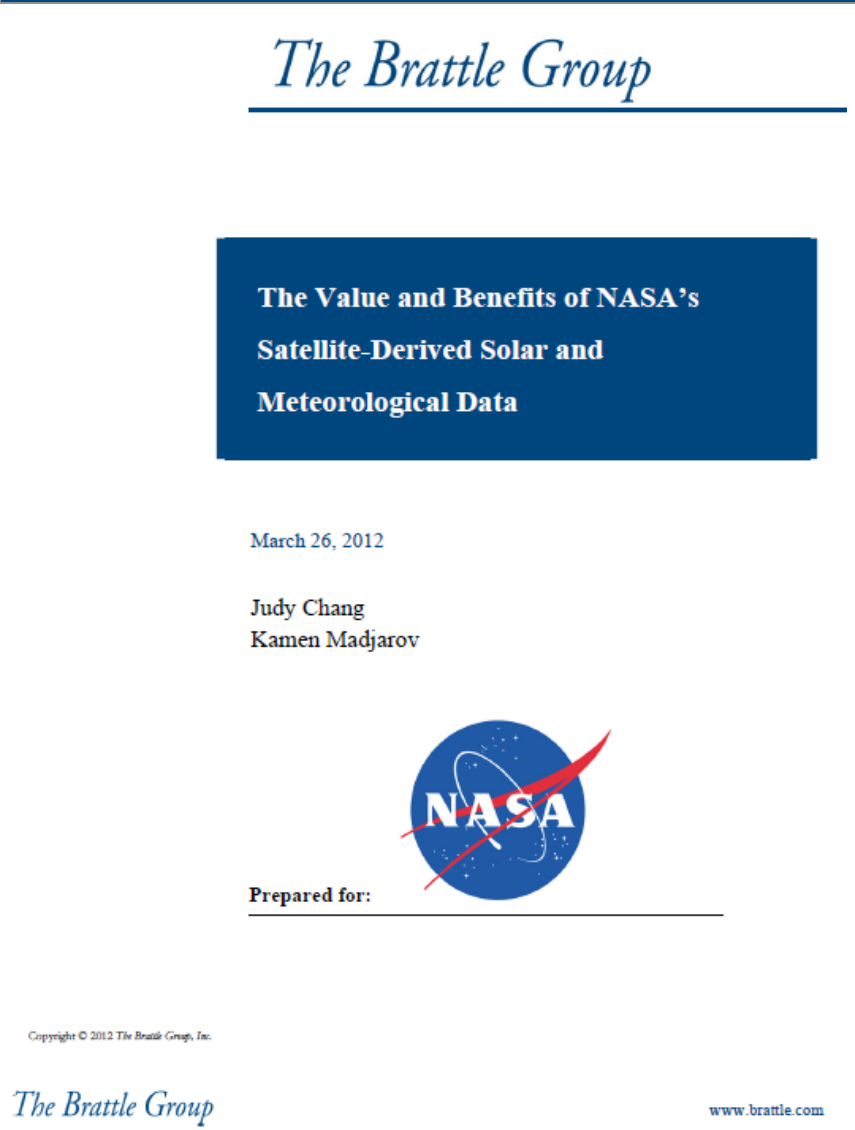
Background & Overview



We were commissioned by NASA to assess the socioeconomic value and benefits of two NASA publicly-available satellite and modeled-derived solar and meteorological data services:

- Surface Meteorology and Solar Energy (SSE)
- Prediction of Worldwide Energy Resource (POWER)

The report identified several major qualitative sources of value, as well as a preliminary high-level estimate of the quantitative economic value of the data services.

Summary of Report Findings

The SSE and POWER data services provide several *qualitative* sources of value because the data:

- Consist of a large selection of meteorological and solar variables in a single source
- Provide global coverage
- Are derived from consistent methodology and measurements
- Contain convenient data formats and are accessible online
- Include derivative variables
- Facilitate renewable energy site selection and evaluation of project performance

Preliminary *quantitative* estimate of economic value: based on existing RETScreen® impact analysis and feedback from RETScreen® staff:

- NASA data services have contributed between $79 million & $790 million over the 1998-2012 period (based on RETScreen® users' feedback alone).

Evaluation of Qualitative Benefits

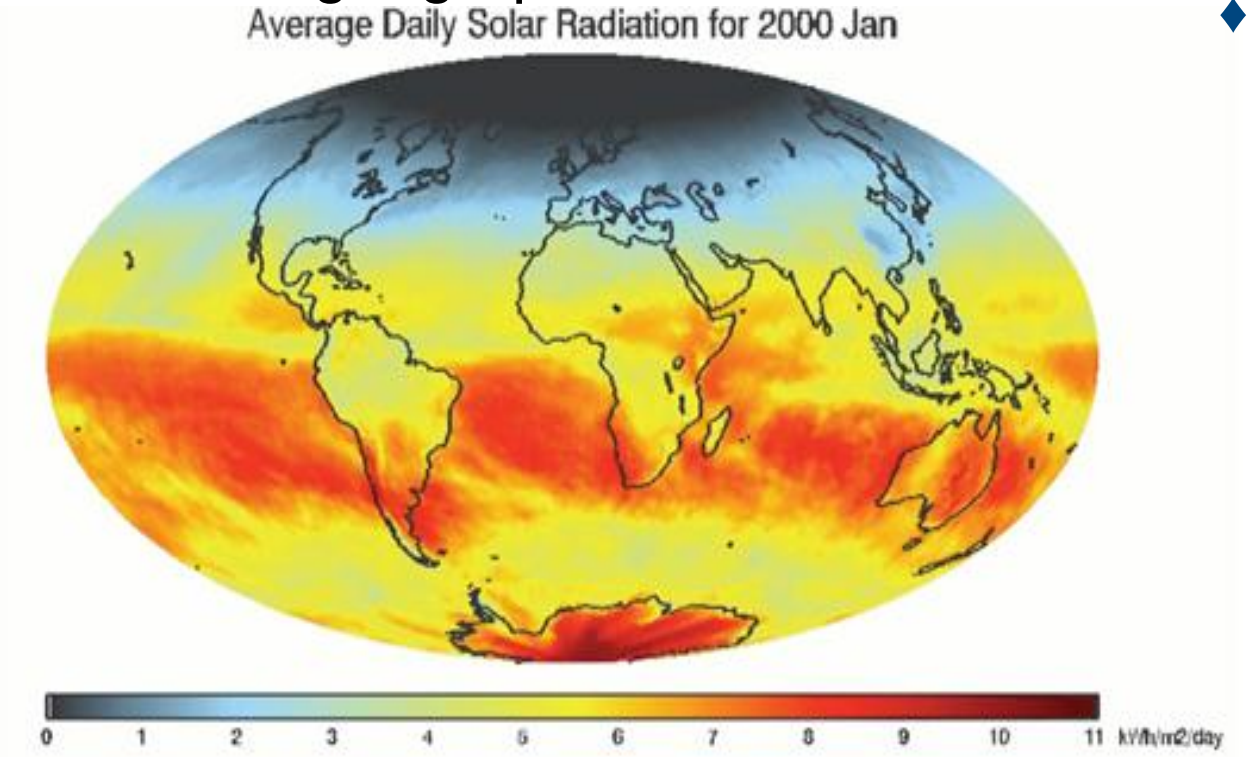
Methodology for identifying the *qualitative* sources of value:

- Review the data offerings and establish a broad context for their use by different user communities: researchers, project developers, policy-makers, etc.
- Understand and evaluate the existence of alternatives and substitutes
- Solicit direct feedback from several users of the NASA datasets, including experts from:
  - Pacific Northwest National Laboratory (PNNL)
  - RETScreen®
  - Ventyx, a energy market modeling company
  - Battelle Memorial Institute

NASA'S Meteorological Data & Services: SSE

Surface Meteorology and Solar Energy (SSE) Data:

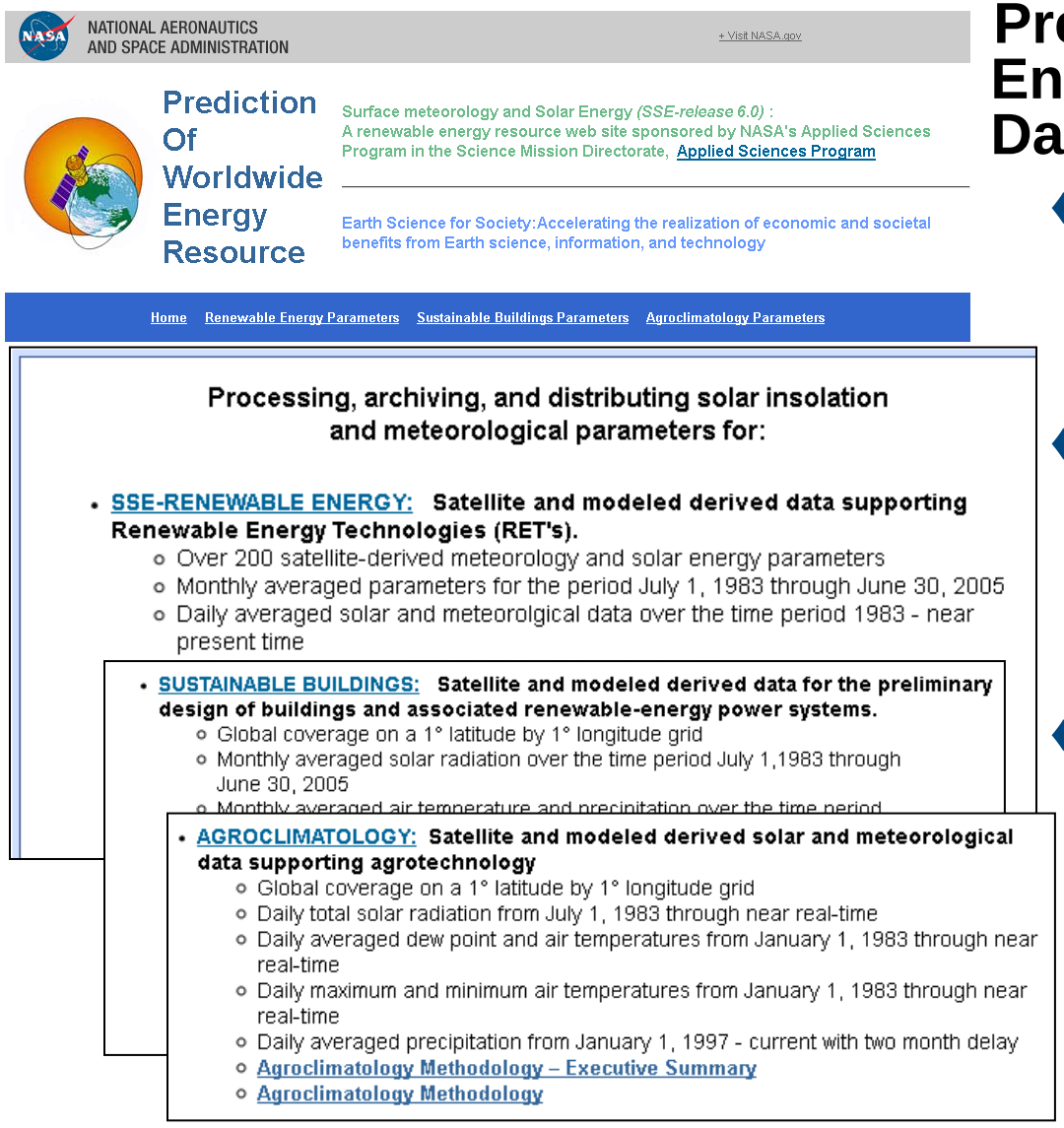
- Initial dataset released in 1997, currently in 6th Release
- Available for the entire Earth's surface on a 1-degree grid-based geographical resolution



- As of early 2012, SSE contains over 200 satellite-derived meteorology and solar energy parameters in monthly averages from July 1983 through June 2005

Source: "Using NASA Satellite and Model Analysis for Renewable Energy and Energy Efficiency Applications," Paul Stackhouse, May 2008

NASA'S Meteorological Data & Services: POWER



Prediction of Worldwide Energy Resource (POWER) Data:

- Established to enhance and supplement the SSE dataset and provide *additional* data
- Provides monthly average climate data, and daily and 3-hour weather data from January 1983 through near real time
- Can be used to evaluate building energy usage and energy savings statistics, as well as for solar project output calibration and benchmarking.

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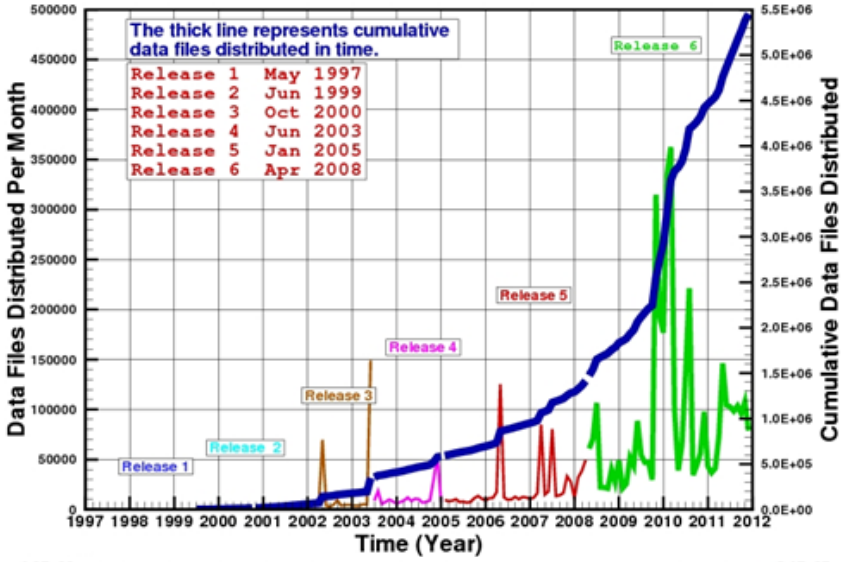
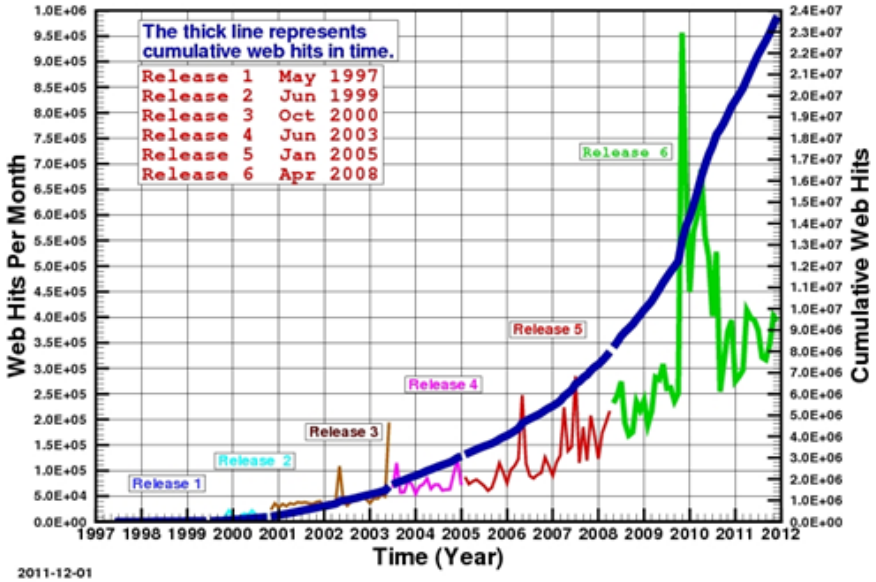
SSE & POWER Data Services Users





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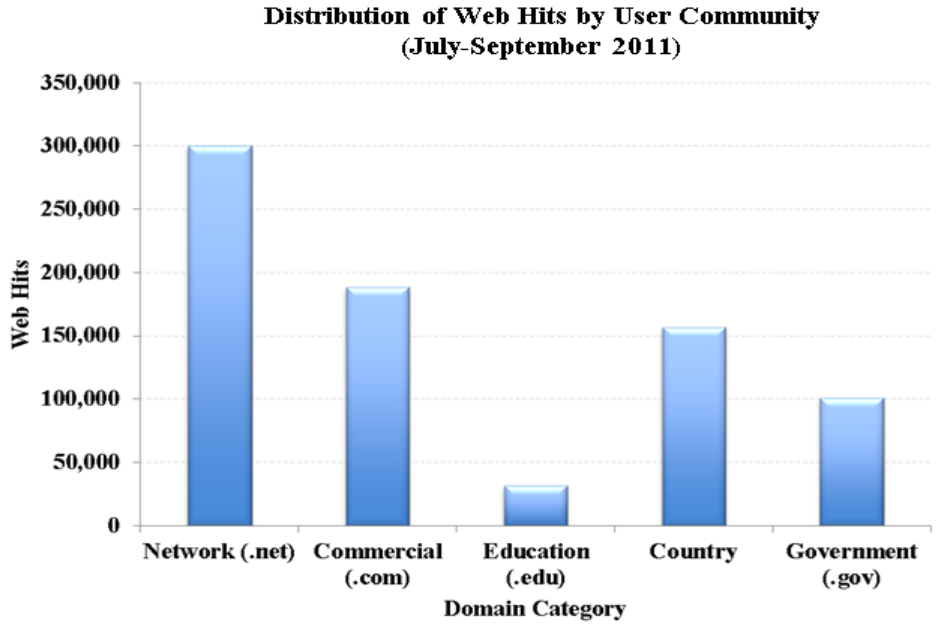
SSE & POWER data are utilized by scientists, researchers, engineers, independent power producers, project developers, and policy makers:

- *Direct* users access and obtain SSE/POWER data from NASA's web portals
- *Indirect* users rely on decision-making software such as RETScreen®



Meteorological & Solar Data Alternatives & Complementary Sources

A number of meteorological data sources are available to the energy industry and researchers. Depending on the methodology through which they were derived, they fall into several primary categories:

- *Direct measurement datasets*
- *Spatially-enhanced datasets*: rely on interpolation of direct measurements to increase the spatial resolution of the data
- *Remotely-sensed datasets*: derived from satellite measurements and analysis
- *Meteorological assimilation datasets*: obtained from global atmospheric models, where initial conditions and forecasts are derived using surface, in-air, and satellite measurements

SSE & POWER are based on *remotely-sensed* and *assimilation parameters*, verified against direct measurement data.

Meteorological & Solar Historical & Forecast Data Alternatives & Complementary Sources

Historical Weather & Solar Data Alternative Sources:

- NOAA's *Global Surface Summary of Day* (GSOD)—data gathered from approximately 9,000 surface weather stations (solar-related parameters generally are not available)
- NREL's *National Solar Radiation Database* (NSRDB)—the 1961-1990 NSRDB contains hourly solar radiation and meteorological data from 237 NWS stations; the 1991-2005 NSRDB provides data for 1,454 locations in the U.S. and its territories

Short-term Weather Forecast Data

- NWS *National Digital Forecast Database* (NDFD)—provides forecasts of meteorological conditions for the U.S. on a 5-km grid-based spatial resolution
- European Centre for Medium-Range Weather Forecasts—makes available weather forecast data derived from global computer models

Principal Qualitative Sources of value

- Large Selection of Variables in a Single Source
- Global Coverage
- Consistency in Derivation Methodology, Measurements, and Spatial and Temporal Coverage
- Convenient Data Formats & Online Access
- Availability of Derivative Variables
- Facilitation of Site Selection & Performance Analyses

Preliminary Quantitative Estimates

Based on our review of the 2004 RETScreen® Impacts Study, we derived an estimated range of the economic benefits provided by NASA's data services:

- RETScreen® is a clean energy decision-making tool maintained by the Canadian government. RETScreen® claims to have more than 319,000 users in 222 countries worldwide.
- The 2004 Study estimated that, over the 1998-2004 period, cumulative user savings attributed to RETScreen® amounted to $240MM in Canada and $600MM worldwide.
- In addition, the study projected that cumulative user savings for the 1998-2012 period would reach $1.8 billion for Canada and $7.9 billion worldwide.

Preliminary Quantitative Estimates

Deriving an order-of-magnitude estimate:

- Based on our discussions with RETScreen®, data acquisition costs range from 1% to 10% of solar project site assessment budgets.
- Site assessment budgets for solar generation projects cover expenditures on data acquisition, engineering and market studies plus other preliminary feasibility analyses. NASA's SSE data have global coverage and are provided at no cost—this offers a clear source of savings on data acquisition costs for project developers.
- Therefore, the approximate scale of economic benefits of the NASA data services can be derived by attributing between 1% and 10% of the user savings estimated in the 2004 RETScreen® Study to NASA's data services:

Initial Estimates of NASA Share of RETScreen® Cumulative User Savings

(CAD$ Million)

	Actual (1998-2004)	Projected (1998-2012)
World	$6 to $60	$79 to $790
Canada	$2.4 to $24	$18 to $180

Sources: "RETScreen® International: Results and Impacts 1996-2012" (2004) and input from RETScreen® staff.

Tradeoffs, Caveats & Challenges

Our quantitative estimates provide a starting point—there are some issues to consider:

- RETScreen® users are only a fraction of all SSE and POWER *direct* and *indirect* users—the combined economic benefits could be larger
- The RETScreen® Impact Study relied on self-reported user savings and extrapolates to the full universe of users
- At some point user savings will likely reach a saturation rate

Caution when asking users for their willingness to pay or using private vendor prices as indicators of value:

- Private providers have already benefited from NASA's data services
- Private data vendors may tailor to niche needs, but market prices for those "competing" solutions may be prohibitively high and not a perfect comparable

Further work on quantifying economic benefits should continue to focus on case studies and pilot programs, for example:

- In the course of our work, we interviewed representatives of Ventyx and Battelle
- The value of enhanced data availability for utilities whose load territories are not well-represented by ground weather stations was the focus of a recent Battelle-Ventyx research collaboration

Next Steps

- Our initial plan is to survey a large sample of SSE & POWER users to understand the types of activities enabled by the NASA data services
- Survey questions have already been developed and we will be working with NASA on the proper channels and means through which to reach out to users
- Using information gathered from respondents, we will be able to classify the downstream activities and develop estimates of socioeconomic impacts
- Depending on the nature and volume of the survey data, analyses using economic input-output models could be considered