



Australian Government

Department of the Environment, Water, Heritage and the Arts

National Solar Schools Program

Data Collection, Storage and
Visualisation System
Requirements and Specifications

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Section 1: Background

1.1 National Solar Schools Program

The National Solar Schools Program (NSSP) will help Australian schools take practical action to tackle climate change by offering grants of up to \$50 000 (GST exclusive) to install solar and other renewable power systems, solar hot water systems, rainwater tanks and a range of energy efficiency measures including insulation, energy efficient lighting and ceiling fans.

The objectives of the NSSP are to:

- allow schools to:
 - generate their own electricity from renewable sources
 - improve their energy efficiency and reduce their energy consumption
 - adapt to climate change by making use of rainwater collected from school roofs
 - provide educational benefits for school students and their communities
- support the growth of the renewable energy industry.

1.2 Data Collection, Storage and Visualisation Objectives

While the objectives noted above relate to the entire program, there are three key objectives that are specifically associated with data collection, storage and visualisation and these are detailed below.

1.2.1 *Behavioural Change*

A significant objective of the data collection, storage and visualisation element of the NSSP is to achieve behavioural change in energy consumption and usage across staff, students, families and friends of schools. It is intended that this will be achieved by ensuring continuous dynamic engagement with the school community regarding a school's energy consumption, the effectiveness of various energy efficiency actions and the relative performance of the school's solar PV system.

This engagement may occur through a variety of mechanisms including:

- live data within the school
- school intranets and web pages
- school newsletters
- school curricula.

1.2.2 *Educational Outcomes*

The educational outcomes of data collection, storage and visualisation are more specifically tailored around the provision of information and services relating to energy consumption and generation within a given school rather than on the development of particular curriculum resources.

The information and services provided as an outcome of the data collection, storage and visualisation must include the:

- capacity to support educational programs from Year 1 through to Year 10
- ability to be integrated into curricula that relate to the following broad disciplines:
 - Social Sciences
 - Information Technology Studies
 - Physical Sciences
 - Mathematics
- ability for students to engage with the energy data and systems within their classrooms.

1.2.3 Policy Development and Research

While still regarded as a key objective of the data collection, storage and visualisation element of the program, policy development and research as an outcome in its own right is considered secondary to behavioural change and educational outcomes.

The policy development and research objectives are primarily focused on ensuring that there is consistency in the accuracy and frequency of the data that are collected across all the schools funded by the NSSP. This will ensure any policy development or research activities that are undertaken are able to be conducted with rigour.

1.3 Use of Requirements and Specifications

These requirements and specifications are intended to be read in conjunction with the NSSP Guidelines.

These requirements and specifications have been developed to be a 'minimum specification' for the data collection, storage and visualisation element of the NSSP and, as such, include items that are noted as 'optional' in addition to those that are mandatory. Unless otherwise noted, all data collection, storage and visualisation requirements and specifications shall be regarded as mandatory.

Some state and territory education authorities and local education boards may develop additional requirements that are in excess of the data collection, storage and visualisation requirements and specifications noted in this document. In these cases, the additional requirements must be followed only to the extent that they do not reduce or diminish the effectiveness of the data collection, storage and visualisation requirements and specifications.

1.4 Approved Components

Applications for funding to the NSSP will be approved only where the components utilised for data collection, storage and visualisation are included on the Approved Components List maintained by the NSSP.

The Approved Components List consists of devices and components that have been submitted by suppliers and manufacturers for approval and that have been independently assessed as complying with the requirements and specifications in this document.

Application forms for the Approved Components List can be downloaded from the NSSP website:

www.environment.gov.au/nationalsolarschools

Section 2: Glossary

The glossary below includes many words and names that have various colloquial meanings. The definitions below are specifically related to their use within the NSSP. Although there may exist other definitions than those noted below, for the purposes of the program only those definitions below will be accepted in the assessment and approvals of applications.

| | |
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| 802.1 | A wireless protocol used widely for wireless area networks in homes, offices and industrial environments – it includes rules on encryption and security. |
| ActiveX Controls | ActiveX controls – small program building blocks – can serve to create distributed applications that work over the internet through web browsers. Examples include customised applications for gathering data, viewing certain kinds of files and displaying animation. |
| Black Data | Net Energy Consumption Data of the school or site being monitored. |
| .CSV | A Comma Separated Variable file is a computer data file used for the digital storage of data structured in a table of lists form, where each associated item (member) in a group is in association with others also separated by the commas of its set. CSV files are often used for moving tabular data between two different computer programs, for example between a database program and a spreadsheet program. |
| CT | Current Transducer – a donut-shaped device that is installed around a primary power supply cable and provides an output that is proportional to the current flowing through the cable that it surrounds. |
| Extranet | An intranet that covers multiple sites, not necessarily co-located. For example a school may have three different campuses that are all able to see the same intranet, although the intranet would not be visible to internet users outside the schools. |
| FTP | File Transfer Protocol – a network protocol used to exchange and manipulate files over a computer network, such as the internet. An FTP client may connect to an FTP server to manipulate files on that server. |
| FTP-Push | A modified version of FTP where the FTP Server pushes the data through to a client at pre-determined intervals rather than waiting for the client to request the data. This is particularly useful where a firewall prevents incoming messages from external clients contacting a local server or host. |
| GPRS | A packet-oriented mobile data service available to users of the 2G cellular communication systems global system for mobile communications (GSM), as well as in the 3G systems such as Telstra's NextG systems. In the 2G systems, GPRS provides data rates of 56-114 kbit/s. |
| Green Data | Renewable energy generation data, specifically from a PV system or other renewable energy systems installed as part of the NSSP. It does not refer to green energy purchased from a utility. |
| Interval Meter | An electronic meter that is capable of providing measured output of energy consumption over user-defined time periods. |
| Intranet | A private computer network that uses internet technologies to securely share any part of an organisation's information or operational systems with its staff and/or students. Sometimes the term refers only to the organisation's internal website, but often it is a more extensive part of the organisation's computer infrastructure. Private websites are an important component and focal point of internal communication and collaboration. An intranet can be understood as a private version of the internet, or as a private extension of the internet confined to an organisation. |
| Modbus | A serial communications protocol published by Modicon in 1979 for use with its programmable logic controllers (PLCs). It has become a de facto standard communications protocol in industry and is now the most commonly available means of connecting industrial electronic devices. |

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| ODBC | <p>Open Database Connectivity provides a way for client programs (e.g. Visual Basic, Excel, Access, Q+E etc) to access a wide range of databases or data sources.</p> <p>ODBC is a standardised API developed according to the specifications of the SQL Access Group that allows one to connect to SQL databases. It defines a set of function calls, error codes and data types that can be used to develop database-independent applications.</p> |
| Ports | <p>Software-based and hardware-based locations within communications hardware such as firewalls. The availability or access to ports is normally restricted to certain types of communications traffic from particular locations or devices. Ports will generally be closed to traffic unless specifically opened by the system administrator.</p> |
| Pulse Meter | <p>A simple energy meter that provides a pulsed output, generally a switched output, that pulses each time a defined amount of energy has passed through the meter – typically 1 pulse per 100Whs.</p> |
| Smart Meter | <p>Often used to refer to meters with a range of different functionalities; Smart Meters are specifically defined as: Electronic Power Meters, capable of measuring energy variables over defined intervals with some capacity for data storage and communications with external devices.</p> |
| SOAP | <p>SOAP, originally defined as Simple Object Access Protocol, is a protocol specification for exchanging structured information in the implementation of Web Services in computer networks. It relies on Extensible Markup Language (XML) as its message format and usually relies on other Application Layer protocols (most notably Remote Procedure Call (RPC) and HTTP) for message negotiation and transmission. SOAP can form the foundation layer of a Web Services protocol stack, providing a basic messaging framework upon which Web Services can be built.</p> |
| SQL | <p>Sequential Query Logic is a database computer language designed for the retrieval and management of data in relational database management systems. It allows for remote access to data over the internet with user-definable queries.</p> |
| Utility Meter | <p>A power meter, mechanical or electronic, generally owned by the utility and used to measure and charge customers for energy consumption. Utility meters must be certified by the Australian Government's National Measurement Institute.</p> <p>In some circumstances there may be multiple utility meters per site or school. For example, there may be a meter for the main school buildings, another for sports oval lights, a third for a swimming pool and a fourth on the maintenance shed.</p> |
| Web 2.0 | <p>Refers to a perceived second generation of web development and design that aims to facilitate communication, secure information sharing, inter-operability and collaboration on the World Wide Web. Web 2.0 concepts have led to the development and evolution of web-based communities, hosted services, and applications such as social networking sites, video-sharing sites, wikis and blogs.</p> |
| Web-box | <p>A device that aggregates data from a number of different sources via a range of communication protocols, stores the data on-board and is able to provide that data either via FTP or web pages hosted on an internal web server.</p> |
| Web-platform | <p>Refers to a user interface that utilises a web browser such as Internet Explorer or Firefox as a user interface regardless of whether the data and information displayed on the browser is hosted locally or remotely, or whether the data and information is available for public or private viewing.</p> |
| ZigBee | <p>ZigBee is a low-cost, low-power, wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range.</p> |

Section 3: Requirements and Specifications

3.1 Data Collection

3.1.1 *Data Source and Location*

3.1.1.1 *Green Data*

- (i) Data shall be collected from renewable energy (RE) sources funded through the NSSP including solar, wind or micro-hydro.
- (ii) Data may be collected directly from the inverter where the inverter has such functionality built in and the functionality meets the other requirements noted in 3.1.2.1, specifically including the accuracy of the data measuring devices.
- (iii) Where the inverter is unable to measure the energy generated, additional meters shall be installed immediately downstream of the inverter.
- (iv) Where there are multiple RE systems funded by the NSSP, or one large RE system with multiple smaller connection points, all points of supply onto the school electrical distribution system must be measured.
- (v) **Optional** – where there are existing RE systems installed at a school it is preferable for the output of these systems to be measured also.

3.1.1.2 *Black Data*

- (i) Data shall be collected from the primary source of supply to the school.
- (ii) Where there are multiple sources of supply to the school, a single metering point is acceptable subject to the following requirements:
 - (a) the metering point identified represents at least 65% of the supply capacity to the school
 - (b) the metering point measures the consumption of the central administration building, IT rooms, library and plant rooms
 - (c) the metering point measures all 3 phases, where there is a 3-phase supply to the school.
- (iii) **Optional** – where capacity exists, it is preferable to be able to measure consumption data from a single point that covers the entire site.
- (iv) **Optional** – where there are multiple sources of supply and metering to the school it is preferable to collect data from all points, notwithstanding that this may require the installation of additional meters.

3.1.1.3 *Temperature*

- (i) Ambient temperature data shall be collected from the school.
- (ii) Ambient temperature sensors shall be located in such a way as to not be adversely affected by buildings or other structures.
- (iii) Ambient temperature sensors shall not be located in direct sunlight; where there is no shading available a simple shade cover shall be constructed for the sensor.
- (iv) Notwithstanding the above, ambient temperature sensors do not have to be installed to Bureau of Meteorology weather station standards.

3.1.2 *Data Types and Accuracy*

3.1.2.1 *Green Data*

- (i) The data shall include, at a minimum, the energy generation data in kWh.
- (i) The data collection interval shall be no more than 30 minutes.
- (ii) The data shall be collected with meters and CTs that are at least Class 2 standard.
- (iii) Subject to meeting the Class noted above, meters presently certified by the National Measurement Institute are deemed to already comply whether or not the particular meter is explicitly noted on the Approved Components List.
- (iv) Where the RE system has been installed in a 3-phase configuration, with either a 3-phase inverter, or 3 single-phase inverters, all phases must be metered.
- (v) **Optional** – it is preferable that information on current, voltage, frequency and total harmonic distortion is collected. In these instances averages over the interval are acceptable.

3.1.2.2 *Black Data*

- (i) The data shall include, at a minimum, the energy consumption data in kWh.
- (ii) The data collection interval shall be no more than 30 minutes.
- (iii) The data shall be collected with meters and CTs that are at least Class 1 standard.
- (iv) Subject to meeting the Class noted above, meters presently certified by the National Measurement Institute are deemed to already comply whether or not the particular meter is explicitly noted on the Approved Components List.

3.1.2.3 *Temperature*

- (i) Temperature data shall be measured as the average value over the interval period.
- (ii) Temperature probes shall be accurate to within +/-5%.
- (iii) **Optional** – where possible it is preferable to be able to measure other weather parameters including panel temperatures, humidity, wind speed and insolation.

3.1.3 *Existing Measurement Devices*

3.1.3.1 *Utility Meters*

- (i) Where the school's electricity utility is able to provide direct access to the data contained within their utility meters, this shall be regarded as an acceptable solution subject to meeting all the requirements noted elsewhere in this document.
- (ii) Where the school's electricity utility is prepared to provide access to pulsing outputs from their utility meter, these pulse outputs may be used subject to meeting all the requirements noted elsewhere in this document.
- (iii) Where a utility is mandated to change over the site meter(s) as a result of existing legislative or regulatory requirements, the NSSP will not fund the upgrade of the existing meter.
- (iv) The NSSP will not fund the installation of bi-directional meters unless the electricity utility has a mandatory requirement to upgrade the site meter(s) to bi-directional meters when RE systems are connected, irrespective of whether the school is seeking to receive payment for exported energy.

3.1.3.2 *Power Quality Meters*

Some school plant rooms and switchboards may contain existing analogue or digital meters. In these cases the meters may be reused subject to the following requirements:

- (i) The existing meters and CTs meet all the other requirements within this document.
- (ii) The reuse of the meters and CTs does not remove existing capacity to monitor energy within the school.
- (iii) Existing CTs may have additional meters 'piggy backed' with existing meters subject to validation being completed to ensure that the impedances of the respective devices are matched and do not unduly affect the performance of the other devices connected.

3.1.3.3 *Weather Stations*

- (i) Existing weather stations may be used to provide the temperature and other weather data subject to meeting all other requirements within this document.

3.2 Data Storage

3.2.1 *General Requirements*

All data collected for a given school shall:

- (i) be aggregated and stored in one location
- (ii) be stored for a minimum of 5 years
- (iii) be stored on a 'First In, First Out (FIFO)' basis after five years
- (iv) be able to be retrieved in a .CSV format
- (v) be accessible via queries from within the school by either ODBC or Web Services protocols such as SOAP, regardless of whether the data is stored onsite or offsite
- (vi) be stored with all variables sharing the same time stamping reference
- (vii) be collected in such a way that null records will be recorded with a time stamp and be given a zero value
- (viii) be stored with at least one decimal place
- (ix) be accessible with no greater than 24 hours difference between the time the data is being requested and the most recent data point returned
- (x) **not** be required to be viewable outside the school's intranet and/or extranet
- (xi) **Optional** – it is preferable that data be available up to and including the most recent sample regardless of the sampling interval.

3.2.2 *Data Stored 'Onsite'*

3.2.2.1 *Hardware-based Aggregation and Storage*

Where data is stored in a non PC-based hardware device such as a data logger or web-box, the following shall apply:

- (i) The device must have sufficient storage to be able to meet the requirements of 3.2.1(iii).
- (ii) On-board storage using 'memory cards' is acceptable.
- (iii) The storage device must be powered via an Uninterruptible Power Supply, or have sufficient on-board battery storage to continue collecting data for at least 30 minutes after a loss of power to the unit.
- (iv) Configuration of the unit must be password protected.
- (v) The device must be capable of transferring data via FTP.
- (vi) **Optional** – it is preferable that the device be capable of operating under 'FTP-Push' mode.

3.2.2.2 *Software-based Aggregation and Storage*

Where data is stored on a PC-based device utilising a software package to manage the aggregation and storage of the data, the following shall apply:

- (i) Software packages must be offered with a software licence for the duration of the operation of the NSSP within the offer price, regardless of whether the offer price is a single lump sum or has a structured payment schedule over the life of the program.
- (ii) Software packages must be authorised for installation on school IT systems by school IT Managers.
- (iii) Funding will not be provided to purchase PCs or server hardware on which the software and data will be stored.

3.2.3 *Data Stored 'Offsite'*

Data stored offsite must:

- (i) be available for access by the school at any time without prior notice to the host
- (ii) **not** have any restriction on the rights of access or use of the data by the school or the NSSP
- (iii) have security mechanisms in place that prevent access to stored data by any user or client other than those explicitly authorised by the school
- (iv) have a structured data backup routine in place.

3.2.4 *Service and Maintenance*

Where a software-based solution for data storage is proposed, the following service and maintenance requirements shall apply:

- (i) Suppliers must ensure that there is a service and maintenance plan in place for management of the software for at least 5 years.
- (ii) **Optional** – service and maintenance plans may include monitoring of data streams for integrity and correct operation of RE systems.

3.3 Data Communication and Transmission

3.3.1 *General*

Communications protocols for transmission of data shall meet the following requirements:

- (i) Utilise common protocols for data transmission such as ZigBee or Modbus, or
- (ii) Where a proprietary protocol is proposed, all software, dongles or other tools and manuals required for configuration and operation of the communication devices must be provided to the school at the conclusion of installation.
- (iii) Wireless protocols must have client-host identification and security protocols to prevent the inadvertent collection of data from devices not specifically associated with the school.

3.3.2 *Device Communications*

Where a hard-wired solution between the various meters and the central data aggregation point is not possible, the following shall apply:

- (i) Devices must be able to provide data to the central aggregation point on a continuous basis.
- (ii) Packet transfer of arrays of data is permissible, subject to the data meeting other requirements within this document.

3.3.3 Remote Communications

Where devices are interrogated remotely, the following shall apply:

- (i) Remote telecommunications protocols such as GPRS are allowable provided the cost of utilising such a service is fully covered within the offered price, regardless of whether the price is based on a single lump sum or a schedule of fees.
- (ii) **Optional** – where an electricity utility allows for connection by a school or agent of the school to the site utility meter, the cost of supply and installation of communication hardware including GPRS modems to the utility meter shall be supported by the NSSP.

3.4 Data Visualisation Including Websites

3.4.1 Web Visualisation

3.4.1.1 General

Web-based visualisations, regardless of hosting location on an intranet, extranet or the internet, shall:

- (i) operate on the following browser platforms:
 - (a) IE6 and above
 - (b) Safari
 - (c) Firefox
 - (d) Chrome
- (ii) utilise graphical devices and functions for the display and presentation of data with user-selectable timer periods, i.e. day, month, year
- (iii) **not** use ActiveX controls except where the ActiveX control is required to enable functionality of another graphical device (such as Flash) specifically within IE6
- (iv) allow visualisation of the following parameters utilising graphs and numerical displays:
 - Green and Black data in most recent interval – subject to 3.2.1 (ix) – **numerical**
 - interval measurements for the most recent day – **numerical**
 - total measurements for each day of the previous week and month – **graphical**
 - average daily measurements for each month of the previous year – **graphical**
 - Green and Black energy measured for year to date compared to the same period last year
 - average temperatures for periods noted above
 - number of tonnes of CO_{2e} emitted and saved for periods noted above
 - **Optional** – it is preferable that the CO_{2e} measurements noted above be converted to a more relevant metric, e.g. number of PCs powered by energy saved or consumed
 - **Optional** – it is preferable that users be able to select and define periods for which they wish to review graphs
- (v) allow users to download data from the website utilising user-definable queries with the output being provided in .CSV format
- (vi) **Optional** – it is preferable that Web 2.0 form and functionality be utilised in the development of web applications.

3.4.1.2 *Internally Hosted Websites*

Internally hosted websites shall:

- (i) be available for viewing anywhere within the school intranet and/or extranet
- (ii) not be required to be viewable outside the school's intranet and/or extranet, i.e. the website does **not** need to be made public.

3.4.1.3 *Externally Hosted Websites*

Externally hosted websites shall:

- (i) be available without restriction to school staff and students
- (ii) **not** require the payment of fees or charges in addition to those specifically noted and agreed to by the school at the acceptance of the supplier's proposal
- (iii) **not** allow the viewing of school data by any party other than those explicitly authorised by the school, unless the school gives specific permission for all data on the website to be made public
- (iv) **Optional** – it is preferable that schools be able to compare the performance of their RE systems and energy consumption with other schools.

3.4.2 *External Displays and Public Screens*

Optional – all requirements noted below are considered to be optional:

It is highly desirable for schools to be able to provide instantaneous visual indications of Green and Black energy generation and consumption in prominent locations within the schools. Where such displays are proposed, it is recommended that they comply with the following requirements:

- (i) Hardware and software required to present data on screens may be funded by the NSSP, however new screens will **not** be funded by the NSSP.
- (ii) Displays must show instantaneous data from both Green and Black sources.
- (iii) Screens must be at least 14" diagonally.
- (iv) It is preferable that screens be LCD whether new or existing.
- (v) Timing mechanisms should be supplied so that the screens do not operate outside normal school hours.
- (vi) Data on screens must be dynamic in nature and it is preferable that the data be animated.
- (vii) Data shall be presented in such a way that it is viewable from a distance of up to 3 metres.