the green grid™
get connected to efficient IT

USAGE AND PUBLIC REPORTING GUIDELINES FOR THE GREEN GRID'S INFRASTRUCTURE METRICS (PUE/DCıE)

EDITORS:

JON HAAS, INTEL

JAMIE FROEDGE, EMERSON NETWORK POWER

CONTRIBUTORS:

JOHN PFLUEGER, DELL

DAN AZEVEDO, SYMANTEC

Version 2.1 Release Date: 29 October 2009

TABLE OF CONTENTS

TABLE OF TABLES

EXECUTIVE SUMMARY

As the current infrastructure metrics promoted by The Green Grid (PUE and DCiE) have become more widely adopted, questions have arisen as to how to interpret individual results, compare different results for the same data center, or compare results across different data centers. Additionally, as there are various ways to calculate results, stakeholders in the industry have expressed concerns around the consistency and repeatability of publicly reported measurements. The Green Grid is publishing a set of rules and guidelines and a required process that organizations should follow when making public claims as to PUE or DCiE measurements for their data centers. This includes the definition of standard nomenclature that will enable an individual claimant to communicate key information about their measurements. With proper and transparent public reporting guidelines and availability of key information about reported results, both the credibility and usefulness of these metrics will be enhanced.

NEED FOR COMMON PUE/DCIE NOMENCLATURE & PUBLIC REPORTING GUIDELINES

As more and more organizations report the performance of their data centers in terms of PUE and DCiE, The Green Grid has seen industry stakeholders and followers begin to compare and contrast different data centers. At the moment, The Green Grid discourages use of these metrics to compare different data centers. Each data center has individual characteristics, capabilities, and operational policies that will affect its power performance. In addition, each data center also has different capabilities with respect to collecting and analyzing power consumption data. Without additional information about reported results, interpretations of data collected by different organizations using different approaches over different timeframes may be meaningless or misleading. With this information, the industry can start the analysis assessing whether or not comparison of different data centers is feasible or appropriate.

In addition to issues resulting from the comparison of different data centers' results, the industry also has expressed a desire for a certain amount of 'quality control.' When an organization reports PUE or DCiE data, industry followers and stakeholders want a degree of assurance that the information as presented is meaningful. As The Green Grid has adopted the mantle of being the primary promoter for these metrics, it also has the responsibility to ensure the metrics' integrity.

With this document, The Green Grid addresses these issues. This document provides a set of steps that organizations can follow should they wish to have The Green Grid acknowledge publicly reported metric data, to register that data with The Green Grid, or to participate in any future data center performance awards program or promotional activities as a result of their data center's performance. These steps include the submission of a report to The Green Grid supporting and describing specific claims. The Green Grid will support this process by providing means for companies either to register their results or submit them for official recognition. This document also provides nomenclature to enable an organization reporting results to communicate the manner in which, and over what timeframe, the data was collected. Lastly, this document discusses some common issues in calculating and reporting these metrics that make interpretation difficult and how to avoid these issues when making reporting results and making claims.

REQUIREMENTS FOR ACKNOWLEDGEMENT OR REGISTRATION OF PUE/DCIE RESULTS

This paper considers only the reporting of measurements of data centers at their actual operating conditions. The Green Grid notes that many published PUE or DCiE numbers are not measurements but are estimated by engineers for hypothetical conditions, such as for data centers under construction, or for IT loads other than the actual IT load. These projections, while useful, are not considered measurements or results under The Green Grid guidelines. The Green Grid classifies publicly reported PUE or DCiE results into four categories: Unrecognized, Reported, Registered, and Certified. Descriptions of these classes, along with the expected benefits to reporting organizations, are listed in Table 1.

TABLE 1: THE GREEN GRID'S CLASSIFICATION OF PUBLICLY REPORTED METRICS RESULTS

Class	Description	Benefit to Reporting Organization
Unrecognized	A publicly reported result with no claims of following The Green Grid's guidelines. The Green Grid will not comment on unrecognized results.	
Reported	A publicly reported result by the reporting organization claiming they followed The Green Grid's measurement recommendations and nomenclature guidelines. The Green Grid will not comment on Reported results.	Reporting organization can use standard materials from The Green Grid to explain process and results to audience.
Registered	A publicly reported result, with key report contextual data provided to The Green Grid by the reporting organization to The Green Grid's data center performance database.	Official registration of reported result. Receipt of a registration number from The Green Grid. Link to public report data from The Green Grid's Web site.
Certified	A publicly reported result, with key additional data required for third-party validation or certification of results, provided to The Green Grid by the reporting organization.	All benefits applicable to registered results, plus, consideration of reported results in future The Green Grid award or recognition programs.

The first class of results consists of those results The Green Grid considers to be 'unrecognized'. These are reported results where the reporting organization has not provided any additional detail as to the means or manner through which the data was collected, the timeframe covered by the result, or the granularity with which individual data points in the result were collected. While The Green Grid applauds any attempt to measure or calculate results, it will not comment on unrecognized publicly reported figures. Accordingly, The Green Grid places no requirements on, nor has any specific recommendations for, unrecognized results.

The second class of results consists of those results where the reporting organization has reported using the nomenclature provided in this document and has self-certified that they have followed the measurement

Version 2.1 Release Date: 29 October 2009

methodology for PUE and DCiE defined by The Green Grid [1]. The Green Grid will not recognize these results and will not provide any additional comment on them. Reported results that are not 'Registered' will also not be specifically referenced within The Green Grid's website. Requirements that a reporting organization must satisfy before The Green Grid will recognize a report are listed in Table 2.

TABLE 2: THE GREEN GRID'S REPORTING REQUIREMENTS FOR RECOGNIZED RESULTS

Follow The Green Grid's measurement guidelines in the most recent revision of *PUE / DCiE Detailed Analysis* [1]
Report the process through which the data was collected (Level 1, Level 2, Level 3) using the nomenclature in Appendix 1 of the most recent revision of *PUE / DCiE Detailed Analysis* [1]
Report the timescale of the result and the frequency with which individual data points were collected using the nomenclature in the most recent revision of *PUE / DCiE Detailed Analysis* [1]

The third class of results consists of those results The Green Grid considers to be 'Registered'. In order to register a result with The Green Grid, the reporting organization must provide additional data to The Green Grid about the result being report, in addition to providing those items required for The Green Grid to recognize the results. This information provides additional data that helps set the context of the reported result as well as provide key additional data that The Green Grid will use in commenting on and analyzing overall industry performance and data center energy efficiency trends. The Green Grid will provide a means for reporting organizations to record this data with The Green Grid – most likely a page on The Green Grid's Web site. The initial examples for the data The Green Grid is requesting in listed in Appendix 3. Over time, The Green Grid expects to refine this dataset. Please refer to The Green Grid's Web site for the most up-to-date information on specific data elements. A summary of The Green Grid's requirements for registration of results is listed in Table 3. The Green Grid will provide a registration number to the reporting organization for those results meeting these requirements. This registration number may be used in any public document to verify that the organization has met The Green Grid's requirements.

TABLE 3: ADDITIONAL REQUIREMENTS FOR 'REGISTERED' RESULTS

Report your measurement data and input the required information (see Appendix 2) into the Green Grid's Metrics Data Collection Database (www.thegreengrid.org)
Agree to The Green Grid's metrics public reporting consent form (www.thegreengrid.org for current version)
Report to The Green Grid (by e-mail) any issues or difficulties in following The Green Grid's proscribed processes and guidelines. Email: admin@lists.thegreengrid.org

The last class of results, 'Certified' results, has the most stringent data reporting requirements. In addition to those items required for registration of a result, organizations wishing to qualify for inclusion in any program created by The Green Grid to award or recognize data center energy efficiency must meet additional data requirements. In addition, The Green Grid will require copies of original source materials or publications necessary to validate the claim.

TABLE 4: ADDITIONAL REQUIREMENTS FOR 'CERTIFIED' RESULTS

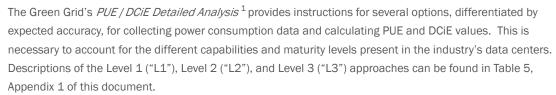| |
|---|
| If requesting a recognized Public Measurement Value provide the extended data set information into the Green Grid's Data Collection Database (www.thegreengrid.org) |
| (Optional if interested in 'co-promotion') send the PUE or DCiE registration number along with a link to any original source material or publication to The Green Grid at admin@lists.thegreengrid.org |

Version 2.1 Release Date: 29 October 2009

Any information about proposed or active recognition programs will be provided by The Green Grid at a later date.

ADDITIONAL GUIDELINES DETAIL

DATA COLLECTION AND METRICS CALCULATIONS

The Green Grid's *PUE / DCiE Detailed Analysis* [1] provides instructions for several options, differentiated by expected accuracy, for collecting power consumption data and calculating PUE and DCiE values. This is necessary to account for the different capabilities and maturity levels present in the industry's data centers. Descriptions of the Level 1 ("L1"), Level 2 ("L2"), and Level 3 ("L3") approaches can be found in Table 5, Appendix 1 of this document.

REPORTING RESULT TIMESCALE AND DATA COLLECTION DETAILS

Given that DCiE and PUE incorporate data pertaining both to power distribution losses and power required by cooling equipment, they will vary over the course of a year, month, or even day. In order to be meaningful, public DCiE and PUE reports must contain information as to the timeframe covered by the calculation, as well as the frequency with which data was collected. Timeframes can be a year, a month, a week, a day or even a single measurement. Individual data points comprising the calculation should be collected either monthly, weekly, daily or continuously.

Some combinations of data collection frequency and measurement level are not allowed. Level 1 calculations will be based on data collected no less frequently than monthly. Level 2 calculations require individual data points to be collected at least daily. Level 3 calculations require data to be collected 'continuously'[*].

Details on the nomenclature and how to communicate timescale and data collection frequency in DCiE or PUE reports can be found in Appendix 1.

REPORTING RESULTS TO THE GREEN GRID

The Green Grid provides a portal for organizations to record information about a specific DCiE or PUE report and the data center about which the organization is making the claim. The initial data elements required for the report are listed in Appendix 2, starting on page 2.

The Green Grid encourages you to adopt these standard methodologies for reporting and use and to submit that data to The Green Grid's Metrics Database. Backup data about your results will, at your discretion, be kept anonymous. Benefits of submission include:

- Increased credibility for reported results
- Potential recognition for your improvements to the PUE/DCiE measurements of your operations
- Participation in an industry-driven process to improve these metrics and their associated measurement processes

---

* 'Continuously' is defined by data sets where individual data points are collected no less frequently than once per hour.

COMMON ISSUES WITH REPORTING OR INTERPRETING PUE/DCIE

As public and private discussions of DCiE and PUE results have become more common, The Green Grid has seen a number of common misunderstandings in calculation and interpretation of PUE/DCiE results. Professionals making claims should be aware of the following issues and ensure they are reporting valid numbers prior to making any public claims.

INFRASTRUCTURE VS. IT

A common problem with collecting and reporting data is the identification of how power consumption should be allocated to the numerator or denominator of the DCiE or PUE calculation. Each load in a data center must be designated as either an IT load, an infrastructure load, or not included in the calculation. Many data centers are in shared-use facilities where there are significant office or other loads that are not related to the data center function; furthermore, there may be shared systems such as cooling towers, switchgear, or ventilation systems. In these cases it is necessary to explicitly describe how these loads have been incorporated into the calculation. The Green Grid plans to establish standards and guidelines for DCiE or PUE calculations for shared use facilities, which will allow meaningful comparison of results between facilities. For purposes of improvement of a specific data center, what remains important is that the calculations be performed in a consistent manner and not the exact allocation of shared loads to the calculation.

PUE and DCiE are metrics that pertain to data center infrastructure. They are not data center productivity metrics nor are they standalone, comprehensive efficiency metrics. PUE and DCiE measure the relationship between total IT power consumed and total facility power consumed at a given point in time or averaged over a longer period of time. When viewed in the proper context, these metrics provide strong guidance and useful insight into the design of efficient power and cooling architectures, the deployment of equipment into those architectures and the day-to-day operation of that equipment.

Issues such as availability of equipment and the productivity of the data center require different metrics and different analysis. Data centers are complex systems. Frequently, changes in aspects of the facility, (commissioning of a new class of server for example), can produce apparent changes in results to another aspect of the facility. Users are advised to take the greatest care around issues of availability. If an action or initiative taken to improve PUE or DCiE may have a negative effect on the availability of the IT equipment in the data center, users of these metrics are advised to review the potential impact on the data center prior to any action.

In addition, neither PUE nor DCiE provide any guidance or insight into the operation or productivity of IT equipment. Currently, The Green Grid is investigating additional metrics and approaches to provide guidance and insight into this area as well[2]. It is also possible, even likely, that changes in the deployment or operation of IT equipment will affect PUE / DCiE calculations. As an example, organizations implementing virtualization in their data centers may reduce overall IT power load, but see an increase in PUE (or a decrease in DCiE). In these instances, the fixed overhead in power distribution and cooling have not changed, but the reduction in IT load results in a seemingly poorer result. Users of these metrics are advised not to become overly concerned when changes in one area affect results in another but rather to try and identify the factors that contributed to it as further opportunities for improvements .

Changes to PUE and DCiE are most meaningful when they are seen as the data center's response to changes

Version 2.1 Release Date: 29 October 2009

in infrastructure equipment or infrastructure operations. Studies investigating the effect of changes in infrastructure equipment or operations on PUE/DCiE should ensure they properly account for any changes occurring to the IT load over the period of time of the study.

POWER VS ENERGY

The PUE and DCiE metrics can be computed using either power (kilowatt) or energy (kilowatt-hour) measurements. For measurements taken continuously and averaged, the results will be the same. However, for measurements taken by periodic or one-time sampling, energy measuring is more accurate. Power measurements only sample the energy flow at the exact time of measurement, while energy measurements accumulate power flow over time. A daily sample of power will only provide PUE/DCiE at the time of the sample, but a daily sample of energy will provide an accumulated or averaged PUE/DCiE over the entire day. These two methods would provide different results for a data center where the day-night outdoor temperature varies significantly, or a dramatically different result for data centers that employ economizer cooling modes. While power based sampling is useful if it is the only practical approach, energy based sampling more accurately reflects energy consumption and is preferred. Most metering systems can be configured to report energy; audits using temporary metering can follow a protocol that accumulates energy.

"BETTER-THAN-PERFECT" PUE OR DCIE MEASUREMENTS

With the increased frequency and discussion of PUE and DCiE results, The Green Grid has occasionally taken note of results that appear to be 'better-than-perfect'. These are reported results where PUE is less than 1.0 or DCiE is greater than 100%.

The PUE and DCiE metrics incorporate three basic elements: power delivered to IT equipment, power lost in power distribution within the data center, and power required by the cooling architecture. PUE and DCiE do not incorporate values for power generated on site or waste heat re-purposed within a larger facility. While these approaches and scenarios may be very commendable, including them in the overall calculation obfuscates results.

Since power distribution losses and cooling equipment power consumption will always take positive values, DCiE can never be greater than 100%, nor can PUE be less than 1.0.

The Green Grid believes that issues such as co-generation, waste heat re-use, and local generation of electricity should be considered in separate metrics. While important, these issues are outside the scope of improving the efficiency of the local power distribution and cooling architectures.

> ****** IN ANY OFFICIAL REPORTS TO THE GREEN GRID, PUE MEASUREMENTS LESS THAN 1.0 OR DCIE MEASUREMENTS GREATER THAN 100% WILL AUTOMATICALLY BE REJECTED. ******

COMPARING RESULTS CALCULATED OVER DIFFERENT TIMEFRAMES AT DIFFERENT GRANULARITY LEVELS

Without some indication as to the time over which particular results were calculated or the frequency with which individual data points were collected, comparison of results are difficult. A yearly average of PUE measurements taken monthly with 12 data points has a different meaning than (e.g.) a single reading collected during a data center's peak load on the coldest day of the year.

Version 2.1 Release Date: 29 October 2009

In general, the timeframe over which a particular result is calculated should correspond to the level of detail or the specific data center issues being studied. Yearly results are good for understanding infrastructure performance at a high-level, but will not be helpful in understanding how data center performance varies through the year. Monthly calculations are good for understanding how the data center varies over a year, but will not pick up behaviors occurring on a weekly basis**. Daily or continuous measurements can provide useful insights in to how your data center handles short-term or rapid changes to various internal and external conditions.

Additionally, the accuracy of a result will be partially determined by the frequency with which individual data points were collected and the number of individual data points in the result. A weekly result that is a roll-up of data collected daily will be different depending upon the time of day the data was collected. Daily variance issues can be addressed with more frequent individual measurements.

COMPARING PUE/DCiE RESULTS BETWEEN DATA CENTERS
PUE and DCiE are excellent metrics for understanding how well a data center is delivering power to its IT equipment. These metrics are best applied, however, to look at trends in an individual facility over time and to measure the effects of different design and operational decisions within a specific facility.

As mentioned earlier in this paper, in general, The Green Grid discourages comparisons of different data centers based on reported PUE/DCiE results. Location, architecture, vintage, size and many other factors all play a role in a data center's final results. A brand new data center, designed for efficiency but with low utilization at initial build-out, may seem less efficient than an older facility that has utilized all available space, power and cooling. Without a full understanding as to the circumstances behind particular results and significant detail as to the design and operation of different facilities, comparison of results across those facilities is likely to be misleading.

It is The Green Grid's hope that, as more data becomes available, we will be able to identify strong relationships between specific data center characteristics and these metrics. Once those relationships are understood, comparison across data centers may be feasible and appropriate.

_____

** For example, differences in performance of a data center over a weekend, compared to a workday.

Version 2.1 Release Date: 29 October 2009

CONCLUSION

In today's environment, data center managers, managing separate facilities, cannot be assured that they can compare PUE/DCiE measurements for their facilities in a meaningful way without guidelines and transparency into the measurement process. If decision-makers take action based on these comparisons, they could lead their organizations down an incorrect path. Standard nomenclature that communicates the manner in which the data was collected, the timeframe on an individual result and the frequency with which individual data points were taken addresses this problem.

In addition, the industry has an expectation that publicly reported measurements are being collected in a manner that elicits credibility. The Green Grid has, and will continue to, refine the protocols for taking PUE and DCiE measurements and calculating summary results. By providing a means to record information about a particular result or data set, along with information about the data center to which the result applies, The Green Grid's public reporting process provides transparency into the data measurement process that the industry will require and standardized nomenclature that may make future data center comparisons meaningful.

Version 2.1 Release Date: 29 October 2009

APPENDIX 1: PUE/DCIE NOMENCLATURE

STANDARD CONSTRUCT FOR COMMUNICATING PUE/DCIE MEASUREMENTS

In order to provide a meaningful report of PUE or DCiE, the reporting organization should provide additional information about the data collection process. This will include information about the manner in which the data was collected, the type of equipment from which the data was collected, the timeframe covered by the reported value and the frequency with which individual data points were collected.

The additional information is provided by appending a subscript to the name of the metric being reported. For example, PUE would be reported and formatted as $PUE_{a,b}$ where 'a' describes the metering placement level (see PUE/DCiE Data Placement Methodology below) of the measurement and 'b' describes the measurement frequency and averaging period. Similarly, DCiE would be reported as $DCiE_{a,b}$.

PUE /DCIE DATA PLACEMENT METHODOLOGY

Data collection metering placement is described either as 'Level 1', 'Level 2', or 'Level 3', according to the definitions provided in the latest revision of The Green Grid's white paper: *PUE / DCiE Detailed Analysis*[1]. Table 5 provides a summary of the information provided in the detailed analysis white paper.

TABLE 5: DCIE MEASUREMENT SAMPLING LEVELS

	Level 1 (L1) (Basic)	Level 2 (L2) (Intermediate)	Level 3 (L3) (Advanced)
IT Equipment Power	UPS	PDU	Server,...
Total Facility Power Where	Data Center input power	Data Center input power less shared HVAC	Data Center input power less shared HVAC plus building lighting, security
Minimum Measurement Interval	Monthly / Weekly/	Daily	Continuous (XX min)

For the "Basic" and "Intermediate" measurement processes, The Green Grid recommends that, if measurements are to be taken on the same day and approximate time to provide similar loading. Many data centers have a fluctuating load due to a change in the IT or support equipment (UPS, Generators etc).

For example, a PUE of 1.5 would be reported as $1.5\ PUE_{L1,\ b}$ if level 1 (basic meter placement) were employed.

Next, the 'b' term or the timeframe and data collection frequency is described.

PUE/DCIE REPORT DATA MEASUREMENT FREQUENCY AND AVERAGING PERIOD

The second subscript, 'b' in a $PUE_{a,b}$ or $DCiE_{a,b}$ report describes the frequency with which individual data points were collected. The subscript is created by appending a character denoting the averaging period and a character denoting the data collection frequency onto the reported metric

- Averaging Period
    - o 'Y' denotes a measurement averaged over a year
        - Frequency must be Monthly, Weekly, Daily or Continuous
    - o 'M' denotes a measurement averaged over a month

Version 2.1 Release Date: 29 October 2009

Frequency must be W, D or C

o 'W' denotes a measurement averaged over a week

Frequency must be D or C

o 'D' denotes a measurement averaged over a day

Frequency must be D or C

• Frequency:

o 'M' denotes a measurement taken monthly

Averaging period must be yearly

o 'W' denotes a measurement taken weekly

Averaging period must be no less than monthly

o 'D' denotes a measurement taken daily

Averaging period must be no less than weekly

o 'C' denotes a measurement taken continuously (at least hourly)

o '--' denotes a single measurement (averaging period not used)

Except for measurements taken continuously, all measurements must be taken at roughly the same time of day.

For example, a PUE of 1.5 would be reported as 1.5 $PUE_{a,WD}$ if daily measurements were taken and a weekly PUE average is being reported.

PUE/DCIE REPORTING EXAMPLES

Given the construct above, Table 6 provides examples of specific reports and their interpretation.

TABLE 6: DCIE AND PUE REPORTING EXAMPLES

0.45 $DCiE_{L1,--}$	Single DCiE measurement (0.45) taken using a Level 1 meter placement
0.51 $DCiE_{L1,YM}$	Yearly average DCiE (0.51), using data points gathered monthly with a Level 1 meter placement
1.6 $PUE_{L1,MW}$	Monthly average PUE (1.6) using data points gathered weekly with a Level 1 meter placement
0.43 $DCiE_{L1,WD}$	Weekly average DCiE (0.43), using data points gathered daily with a Level 1 meter placement
1.8 $PUE_{L2,WC}$	Weekly average PUE using data points gathered continuously with a Level 2 meter placement.
2.1 $PUE_{L3,YC}$	Yearly average PUE (2.1) using continuous measurements with a Level 3 meter placement.

Version 2.1 Release Date: 29 October 2009

APPENDIX 2: SUPPORTING DATA REQUIRED FOR REPORTED, RECOGNIZED AND CERTIFIED PUE AND DCIE MEASUREMENTS

The Green Grid has developing a database for recording key data center information as well as measurement results and contextual information about those results. The first lists in this Appendix is The Green Grid's estimate of the data required to support public PUE or DCiE claims (reported, recognized and certified). The second list are examples of required data for a certified level of registration, required to qualify for TGG recognition awards, List three is optional data examples. The fourth list is The Green Grid's initial estimate of what will be available from the database for public inquiries on a publicly reported measurement that has been acknowledged by The Green Grid (referenced by The Green Grid registration number issued). For a current list of reporting requirements visit www.thegreengrid.org.

These lists are provisional and just examples of current thinking at the time of this writing. The web page/site that captures this information will provide final details as it is expected that operators will be providing inputs to the content and process to fine tune them. Additionally, clarification for data collection may likely be made at the time of the final database fields being published (e.g., where to measure the temperature for xxx, what to count for average age, etc.).

EXAMPLES OF DATA REQUIRED FOR A PUBLICLY REPORTED PUE/DCIE REGISTERED OR CERTIFIED MEASUREMENT

- Contact information note: Only company name will be displayed in public inquiries.
- Data Center location information (address, county)
    - o Note: Only state information will be displayed in public inquiries.
- Measurement results: PUE or DCiE with appropriate nomenclature
- Measurement Methodology information (when, how and result details)

ADDITIONAL DATA REQUIRED FOR CERTIFIED RESULTS (OPTIONAL FOR REPORTED, OR REGISTERED MEASUREMENTS)

- Certification method used (contractor info and results)

OPTIONAL DATA EXAMPLES

- Data Center Size (facility square footage)
- Total Data Center design load for the facility (e.g., 10.2 Megawatt)
- Data center archetype percentages (e.g. 20% web hosting, 80% email)
- Data Center Age
- Numbers of servers, routers, storage devices
- Average Server CPU Utilization
- Percentage of Servers using virtualization
- Average age of IT equipment by type
- Average age of facility equipment by type (cooling and power distribution equipment)
- Data Center level of reliability
- Cooling and air handling details

PUBLICLY TRANSPARENT DATA WHEN A REGISTRATION NUMBER IS RESEARCHED ON TGG SITE

- Registration number and Issue Date

Version 2.1 Release Date: 29 October 2009

- Company name and state.

- Measurement results: PUE or DCiE with appropriate nomenclature

- Date measurement(s) was completed

- Data Center Size (Facility square footage if available)

- **Optional** – link to additional user information if available

For a current list of transparent data visit www.thegreengrid.org

Version 2.1 Release Date: 29 October 2009

WORKS CITED

[1] The Green Grid. (2008, July 22). The Green Grid Metrics: PUE/DCiE Detailed Analysis. Retrieved September 23, 2009, from The Green Grid: http://thegreengrid.org/~/media/WhitePapers/White_Paper_14_-_DCiE_Detailed_Analysis_072208.ashx?lang=en

[2] The Green Grid. (2009, January 5). Proxy Proposals For Measuring Data Center Productivity. Retrieved September 23, 2009, from The Green Grid: http://thegreengrid.org/~/media/WhitePapers/White_Paper_18_-_Proxies_Proposals_for_Measuring_Data_Center_Efficiency.ashx?lang=en

the green grid™