# Assessment of Energy Efficiency in the Indian Data Centers and Initiation of a Private/Public Partnership to Further Efficiency Goals

Join initiative by **LBNL & ECO-III Project**

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# Trip Report:  Assessment of Energy Efficiency in the Indian Data Centers and Initiation of a Private/Public Partnership to Further Efficiency Goals

February 29, 2008
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## Contents:

# Summary:

With funding from the US Department of Energy (DOE), and in partnership with the US Agency for International Development (USAID)'s ECO-III Project, Dale Sartor of the Lawrence Berkeley National Laboratory (LBNL) spent a week (January 17 to 25th, 2008) in India working with government and industry representatives to assess the state of the art for energy efficiency in Indian data centers and to identify opportunities for improvement. Activities included:

- Meetings with Indian government agencies, NGOs, industry organizations, industry leaders, and USAID
- Site visits to three data centers in Bangalore (India's "Silicon Valley")
- Organization and participation in a half-day brainstorming meeting with government and industry to establish an efficiency initiative
- Organization and participation in an all day awareness building workshop

The Indian information technology (IT) industry is multi-national and their data centers are representative of those throughout the world. However, the players must draw on corporate and international resources as there are few public Indian sources of efficiency information, and there are no industry forums to share information among peers. In a brainstorming session, barriers to improving Indian data center efficiency were discussed and four primary barriers/needs surfaced:

1. Lack of awareness
2. Lack of technical expertise (capacity building)
3. Lack of institutional framework (e.g., to share information and to develop a value proposition)
4. Lack of energy benchmarking

In both the brainstorming meeting and the workshop, as well as in one-on-one meetings with industry and government, there was universal agreement on the need to establish an industry led initiative to address the barriers. It was felt that the government and international organizations could play a catalytic role and provide technical resources for such an initiative. ECO-III will take the next steps to outline the initiative and host formulation meetings.

Recommendations fell into five main categories:

1. Create information/awareness framework
2. Perform capacity building/training
3. Establish an industry forum to facilitate capacity building and to stimulate peer to peer exchanges of information (lessons learned)
4. Develop performance indicators and benchmarking framework
5. Create regulatory, standards, and incentives framework

In addition, India-specific technical research and development needs were identified.

# Assessment of Energy Efficiency in Indian Data Centers

## *Contacts:*

Over the week activity, Satish Kumar (ECO-III), Dale Sartor (LBNL) and in many cases Archana Walia (USAID/India) met with many government and industry leaders to assess energy efficiency and discuss ways to improve the state of the industry.

### Government Organizations:

1. USAID
2. Indian Ministry of Power's Bureau of Energy Efficiency (BEE)

### Industry Organizations:

1. Confederation of Indian Industry (CII)
2. National Association of Software and Services Companies (NASSCOM)
3. The Alliance to Save Energy (ASE)

### Companies:

1. Conzerv
2. IBM (visited corporate data center as well as worldwide control facility)
3. HP (visited corporate data center)
4. Network Appliance Systems (visited corporate data center)
5. Wipro Technologies
6. Nature First
7. Emerson
8. Others attending the Workshop (see attendee list in Appendix)

## *Findings*

### State of the industry:

The efficiencies of the data centers we saw were generally no different than data center efficiency elsewhere (i.e., in the US). In fact, two of the sites (HP and Net App) demonstrated international state-of-the-art efficiency technologies. HP's data center deployed their smart dynamic cooling technology on a full scale, and Net App's center utilized overhead air distribution with complete hot/cold aisle isolation. Discussions and presentations at the brainstorming meeting as well as the workshop confirmed that Indian data centers face the same issues and opportunities as their US counterparts. However, they lack strong industry organizations and forums focused on efficiency and there are no country specific public sources of information. This is especially important to Indian-only companies – data center owners, designers, and builders (non-multinational companies) with which we did not have significant interaction outside the workshop. However, all those we met with supported the need for better, unbiased information and industry forums.

**India unique issues:**

1. Poor power quality and reliability (leads to increased power chain energy losses)
2. Lack of natural gas infrastructure (changing in some areas)
3. Hot, humid, and poor outdoor air quality results in less opportunity for water and air side "free cooling"
4. Serious water shortages (chillers and computer room air conditioners, or CRACs, are generally air cooled)


Tour of Net App's high efficiency data center with cold aisle isolation.

# Brainstorming Meeting

A half-day brainstorming meeting (or "charrette") was organized and held January 22nd 2008 to identify barriers to energy efficiency in Indian data centers, solutions/strategies to overcome those barriers, and plan next steps. The goal was to develop a concept for an initiative that could be presented to the larger industry group at the Workshop.

## *Objectives*

Objectives of the charrette:

- Identify key issues in the design, construction, operation and maintenance of data centers and their impact on power supply in India
- Develop a public/private partnership initiative to promote sustainable data centers in India; and
- Identify specific design options considered to be best practice in India and methods to transform market (e.g., India-specific design guide)

## *Attendees*

The attendees included key industry and government organizations as well as several industry leaders:

1. Archana Walia, USAID
2. Samir Menon, Nature First
3. Rajdeep Sahrawat, NASSCOM
4. Amit Antil, IBM
5. Mohandas Mekanapurath, Hewlett Packard
6. Ravi Meghani, Wipro Technologies
7. Koshy Cherail, Conzerv
8. Suprotim Ganguly, CII
9. Shanmugam Ramu, NetApp ( participation via conference call)
10. Satish Kumar, ECO-III Project
11. Ravi Kapoor, ECO-III Project
12. Dale Sartor, LBNL

## *Outcomes*

The following barriers, solutions, and next steps were identified:

**Barriers** (in no particular order)
- Lack of institutional framework
- Need for informed regulatory push
- Lack of awareness
- Lack of exposure to best practices
- Lack of value proposition
- Power distribution (energy loss at every point)
  - Lack of available energy-efficient solutions (e.g., DC based power supply systems)
- Risk averseness
  - Emphasis on reliability and redundancy
- Lack of technical expertise
- Lack of interaction between IT and facility staff
- Lack of integrated building design approach
- Lack of good design information (e.g., management of cooling loads and air distribution)
- Quality and reliability of power supply
- Lack of comparative benchmark data
  - Energy input
  - Output
    - Computation
    - Service delivered
- Infrastructure not keeping up with IT technology
- Need for better cost information

**Solutions**

- **Create Information/Awareness Framework**
    - *Industry forums: awards, workshops*
    - *Public domain knowledge: case studies, best practices, etc.*
    - *CEO value proposition (e.g., business case document and presentation)*

- **Perform Capacity Building/Training**
    - *Curriculum (higher education, corporate learning)*
    - *Design charette – facilitation and guidelines*
    - *Sample contract documents (incentives)*

- **Develop Performance Indicators and Benchmarking Framework**
    - *Agree on indicators, collect data, disseminate to promote best practices*

- **Create Regulatory, Standards, and Incentives Framework**
    - *IT governance body*
    - *Gap analysis*
    - *Background paper, road map*

**Next Steps**

- Brief BEE
- Involve NASSCOM, CII—and identify other key stakeholders, e.g., Indian Society of Heating, Refrigerating and Airconditioning Engineers (ISHRAE), International Facility Management Association (IFMA) Indian Chapter—to establish the public-private partnership (e.g., Green Grid initiative in the US) to carry the agenda forward
- Present at Awareness Workshop (draft findings and recommendations)
    - *Distribute draft barriers and strategies*
    - *Discuss action plan (form private/public group)*
    - *Solicit support/involvement*
- Schedule kickoff meeting for the industry-government group

# Awareness Workshop

## *Description of Workshop*

A full day awareness workshop was organized and held. Key government and industry organizations were asked to participate and all did. Presenters as well as attendees were carefully selected to assure broad representation and quality participation. The workshop was not advertised (invitation only). 65 professionals attended.

See Appendix for Workshop Brochure.
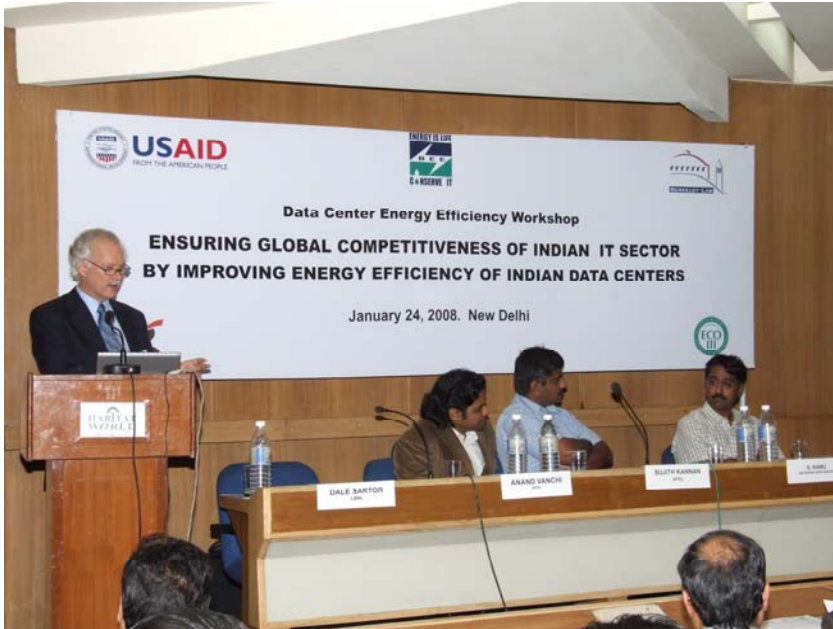
Dale Sartor of LBNL speaking at Awareness Workshop

## *Workshop agenda*

The workshop agenda comprised five sessions:

1.  The Inaugural Session included short presentations from ECO-III, USAID, BEE, NASSCOM, CII, and LBNL to set the stage for the workshop.
2.  The first technical session established the context, reviewed trends and benchmarked performance, and described IBM's Project Big Green.
3.  The second technical session described international best practices in data center design and operation, looked at data center power optimization in two Intel India data centers, and presented a case study of efficiency at India's Network Appliance.
4.  The third technical session covered HP's Dynamic Smart Cooling application in India (1st full scale application in the World), energy efficiency from APC, and information resources.
5.  The last session was an interactive panel discussion on a national data center efficiency initiative. Panelists represented ECO-III, USAID, BEE, CII and NASSCOM and there was significant interaction with industry representatives.

See Appendix for full agenda, and copy of presentations.

## *Workshop attendees*

The 65 attendees represented a broad spectrum of the private and public sector. A list of all attendees is provided in the appendix.

## *Evaluation*

An evaluation questionnaire was utilized.  Participants were asked to rate the Workshop in four broad categories:

1. Achievement of objectives and workshop coverage
2. Presentations
3. Workshop handout material
4. Audio visual material

Each category had three to five rating factors.  In all categories and for all factors the vast majority (e.g., 90+%) rated the workshop good or excellent.  For overall satisfaction of the workshop, 16 rated it excellent, 14 good, 2 satisfactory, and none poor.

Participants suggested case studies (20) and a design guide (23) should be available while others suggested the need for tip sheets (14) and user manual/guide (12).

Specific comments included:
- Need for standards and independent certification
- Offer workshop in other cities
- Provide presentations on web (will be done)
- Include European expertise
- Benchmarking needed

Several of the industry speakers commented how much they benefited from the workshop (and the need for such a forum).

In an e-mail, Suprotim Ganguly from CII summed up the workshop as, "It was indeed inspiring to experience the high level of enthusiasm and willingness of all the IT and other stake holder Industries to take forward the idea of Industry-Government partnership in achieving the world class energy efficiency practices in Indian Data Centres."

# Recommendations and Next Steps

## *Recommendations*

1. Create information/awareness framework
   a. Develop awareness material for use by government and industry organizations
   b. Establish recognition programs such as awards
   c. Offer workshops
   d. Develop public domain knowledge: case studies, best practices, etc.
   e. Develop CEO value proposition (e.g., business case document and presentation)
2. Perform capacity building/training

a. Develop capacity building materials, for example curriculum (higher education, and corporate learning)
   b. Stimulate use of design charettes – facilitation and guidelines
   c. Develop sample contract documents (e.g., contractual incentives)
3. Establish an industry forum to facilitate capacity building and to stimulate peer to peer exchanges of information (lessons learned)
4. Develop performance indicators and benchmarking framework
   a. Establish benchmarking protocols, tools, and data bases for India
   b. Agree on indicators, collect data, disseminate to promote best practices
   c. Develop an environmental performance criteria (LEED for data centers)
5. Create regulatory, standards, and incentives framework
   a. Establish a governance body
   b. Perform a Gap Analysis
   c. Develop background paper(s) and a road map
6. Research needs:
   a. Initial benchmarking and market assessment studies. Develop tools and data bases.
   b. Explore water issues relative to cooling (i.e., Are air-cooled chillers and CRAC units really best for India? How much water is used in the generation of new power in India?)
   c. Evaluate if outside air can be used directly or indirectly to cool Indian data centers – in which climates, with what filtration/treatment?
   d. Evaluate if the diesel generators used extensively in data centers can be made cleaner and utilized in combined heat and power (CHP) applications where the heat is used for air conditioning.
   e. Evaluate if existing and new natural gas distribution systems can be depended on for CHP applications in data centers. Can strategic alliances be established, and is government policy needed?

## *Next Steps*

1. Host follow-up strategic meeting with key players
   a. Develop roadmap for initiative
   b. Identify roles for government (Indian and international), and industry
   c. Involve NASSCOM and CII, and identify other key stakeholders— e.g., ISHRAE, IFMA Indian Chapter—to establish the public-private partnership
2. Develop awareness and capacity building material:
   a. Opportunity brochure
   b. Best practice information
   c. Training material and delivery
3. Establish an industry forum


## *Role for APP/DOE/EPA*

The Indian IT/data center industry is poised to take on a leadership role in establishing an energy efficiency initiative. Government and international organizations can play an

important facilitator and catalytic role.  BEE, ECO-III, and USAID are ready to help. They need technical support to help tap international resources and customize for the Indian market. DOE and EPA could help move such an initiative forward by engaging their BEE counterparts on the APP/BATF in discussions about the recommendations from this project, and working with BEE to design a potential multilateral India data center initiative in the context of the APP.

### *Memo/summary from Satish Kumar*

In a memo to all the speakers, Satish Kumar, Team Leader from USAID ECO-III project wrote:

> "I would like to take this opportunity to thank everybody for their contributions in making yesterday's workshop a resounding success. Starting with our data center visits (thanks to IBM, HP, and NetApp for their hospitality and willingness to work in a collaborative fashion under this new initiative), followed by the brainstorming session with key stakeholders that greatly helped us in identifying a strategy that can be turned into a draft action plan for data center energy efficiency in India, and capped by a remarkably high quality workshop (my sincere thanks to all the speakers starting from the inaugural session and continuing through the three technical sessions) that provided ample opportunities to everyone (including experts in this field) to learn something on this new topic. The feedback from the participants of the workshop has been very positive.

> "ECO-III project is particularly encouraged by the fact that BEE together with NASSCOM and CII is willing to look at an industry-government partnership that can take this initiative forward."

## Website

In a typical week (mid January) approximately 10% of the visits to the LBNL data center website are from India.  India is third behind the US and UK.  Several of the speakers at the awareness workshop referenced material from the LBNL site.  Therefore, following the workshop, a *Data Centers in India* website has been created on the LBNL website to support this activity.  See:
http://hightech.lbl.gov/DC-India/India-datacenters.html

Web pages include:
1.  Opportunity Summary (brochure content being developed by ECO-III)
2.  Initiative Summary (January 15, 2008 one pager)
3.  Resources and References (links to LBNL, DOE, EPA, ECO-III, USAID, BEE, CII, NASSCOM, ASHRAE, Green Grid, Up Time Institute, 7x24, etc.)
4.  Charette Summary: Barriers, Solutions, Next steps
5.  Workshop
    a.  Brochure
    b.  Agenda
    c.  List of attendees
    d.  Presentations (PDF)
    e.  Handout - Draft DOE Assessment Input and Actions Spreadsheet

# Appendix

See the following Appendixes:

- Workshop Brochure
- Workshop agenda
- Workshop attendees
- Workshop presentations
- Photos

## *Workshop Brochure*

See PDF file at http://hightech.lbl.gov/DC-India/India-datacenters.html
 consisting of:

- Cover
- Draft Agenda
- Description of Activity
- LBNL Data Center Brochure (2 pages)
- ECO-III Brochure (2 pages)

*Workshop agenda*

# ENSURING GLOBAL COMPETITIVENESS OF INDIAN IT SECTOR BY IMPROVING ENERGY EFFICIENCY OF INDIAN DATA CENTERS

THURSDAY, 24TH JANUARY 2008. INDIA HABITAT CENTRE, NEW DELHI

DRAFT AGENDA

09:00 – 09:30 **Registration**

09:30 – 11:00 **Inaugural Session**
   a) Welcome Address: Dr. Satish Kumar, COP, ECO III Project
   b) About ECO III Project: Mr. Glenn Whaley, USAID
   c) National Program on Data Center Energy Efficiency: BEE
   d) Industry Perspective on Greening of the IT Sector: Mr. Som Mittal, Chairman, NASSCOM
   e) Topic to be decided: CII
   f) Energy Efficiency in High Tech Buildings: Mr. Dale Sartor, LBNL

11:00 – 11:15 **Tea/coffee Break**

11:15 - 12:45 **Technical Session I**
   a) Setting the Context for Data Center Energy Efficiency in India: Satish Kumar
   b) Benchmarking Trends and Performance, and Key Design Issues. Dale Sartor, LBNL
   c) Project Big Green for Data Centers: Sanjeev Gupta, IBM
   d) Questions & Answers

12:45 – 1:45 **Lunch**

1:45. – 3:15 **Technical Session II**
   a) International Best Practices in Data Centers Design and Operation: Mr. Dale Sartor, LBNL
   b) Power Density & Efficiency Optimization of existing Low Density Datacenters: Anand Vanchi and Sujith Kannan, Intel
   c) Data Center Efficiency Case Study, Mr. S. Ramu, Network Appliances
   d) Questions & Answers

3:15 – 3:30 **Tea/coffee Break**

3:30. – 4:45 **Technical Session III**
   a) Dynamic Smart Cooling: Mr. M. Mohandas HP
   b) Topic to be decided: Scneider Electric/APC
   c) Summary of Technical Sessions, Dale Sartor, LBNL
   d) Questions & Answers

4:45 - 5:45 **Panel Discussion and Interactive Sessions**
   a) Summary of Tuesday's Strategic Planning for National Efficiency Initiative
   b) Objective: Develop a Strategy for Producing a Best Practices in Data Centers
      Moderator: Mr. S. Padmanaban, USAID
   c) Panelists From (each to describe their vision and role): BEE, CII, NASCOM, IBM, HP, NetApp, Intel, Schneider Electric

5:45 Close**: Dr. Satish Kumar**

## *Workshop attendees*

### Data Center Workshop
### Thursday, 24<sup>th</sup> January 2008
### IHC, New Delhi
### PARTICIPANTS   LIST

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## *Workshop presentations*

See PDF files at http://hightech.lbl.gov/DC-India/India-datacenters.html
 for the following presentations:

- High Tech Building Efficiency – Sartor - LBNL
- Green Building – Srinivas - CII
- Context – Kumar – IRG-ECOIII
- Tech Session I Benchmarking – Sartor – LBNL
- Project Big Green – Gupta – IBM
- Tech Session II Best Practices – Sartor – LBNL
- Power Density and Efficiency – Vanchi – Intel
- Efficiency and Going Green – Ramu – NetApp
- Dynamic Smart Cooling – Mekanapurath – HP
- Energy Efficiency – Chakraborty - APC
- Tech Session III Summary – Sartor – LBNL