White Paper
Carbon Footprint Management

Improving your Carbon Footprint:

The impacts of IT infrastructure refresh and process improvements

Anantha Raman
Ashok Radhakrishnan
Hitesh Barot
Intel Corporation

Executive Summary

The long term prognostics of energy availability and climate change have increased the world's focus on sustainability. Both government and corporations are taking necessary steps to become more proactive in minimizing impact and maximizing efficiencies. Intel's Corporate Sustainability group and the IT Sustainability program play the role of key enablers for sustainable operations by addressing the challenges of reducing consumption and emitting less waste.

With clear objectives from Intel, we set forth to define our CO2 baseline for our continuous improvement, to assess the critical energy consumption variables, and to understand the impact of IT infrastructure refresh on the existing footprint. This paper describes the objectives of the assessment, the methodology, key parameters considered while scoping the exercise, analysis of the results and key inferences.

The analysis indicates that the carbon emissions caused by the DC compute infrastructure decreased by 5% in 2008 compared to 2007[§]. Server refresh was a key factor in this footprint reduction. In 2008, the server infrastructure in the DC was refreshed with more energy efficient and higher performing servers based on the newer generation, multi-core processors.

The analysis also indicates that the carbon emissions caused by the DC cooling infrastructure showed a decrease of 12% in 2008 compared to 2007[§]. Cooling efficiencies gained through server refresh and process improvements in the facilities infrastructure; focused on energy efficiency were main contributors to this reduction.

This paper articulates the study done at one of the Intel facilities in India. We expect this paper to be very relevant for other markets as well.

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Introduction

Energy security and climate change have increased the world's focus on Sustainability. Corporations and governments alike are taking necessary steps to monitor the variables that define energy security and climate change.

Intel, as a global corporation has been one of the front runners in energy efficient platforms and sustainability practices for many years. Intel has taken specific measurable corporate goals in reducing its carbon footprint and consequently institutionalized a Corporate Sustainability group and an IT Sustainability program office to meet the challenges in the corporation and within Intel's IT organization respectively. Carbon footprint measurement and management is an integral component to the Intel vision that technology will be fundamental to solving the biggest environmental challenges.

As an emerging market case in point, the Energy Conservation Act which is implemented by the Bureau of Energy Efficiency, Government of India is an illustrative case in point for emerging markets. It mandates effective use of power and continuous control and reporting for buildings having a connected load of greater than 500 KVA (Kilo Volt Amps). The government has formed a national policy group to focus on DC energy efficiency and to develop a National Design Code for Energy Conservation in DCs and a Best Practices Manual for Indian DCs in consultation with industry.

Also, a Prime Ministerial directive called the National Action Plan for Climate Change - NAPCC has been set in force to address both climate change and energy security. This plan identifies eight areas or "missions" for focused energy and climate policy interventions: solar energy, energy efficiency, sustainable habitat, water, Himalayan ecosystems, sustainable agriculture, strategic knowledge for climate change and a "Green India".

Under the current 5-year plan period *i.e.*, by 2012, the expectation is to increase energy efficiency of nine identified energy intensive sectors to save 10,000 MW of power[†]. This is equivalent to reduction of approximately 50 million tons of CO_2[#].

The level of focus on carbon emissions and energy efficiency by Intel as a corporation as well as by the government naturally set the pace for the carbon footprint assessment exercise within Intel in India.

Objective of the assessment

Intel's operations in India are categorized as "non-manufacturing" – viz, it comprises technology design, sales and marketing, information technology and the necessary supporting infrastructure.

The objectives of the carbon footprint assessment were multi-fold:

- Have a defined baseline for our continuous improvement activities into the future
- Understand the most important energy related variables that contribute to the carbon footprint
- Understand the impact of IT infrastructure (server, client) refresh on the footprint

Assessment process

The assessment process required that we understand all the business processes in the organization that have a potential impact on the elements that define the carbon footprint and build a cross-functional team towards enabling an integrated approach.

Scoping the Baselining Exercise

The following factors were considered while scoping the project:

- Determining the organizational boundaries (what locations would be in Scope)
- Determining the time boundary (how many years to assess)
- Determining the process boundaries (what operational processes would be included)

Determining organizational boundaries

While Intel operations in India are spread across multiple offices in various parts of the country; the project focused on two locations in India where all the technology engineering happens. The term "office" used in the paper later on represents these two locations.

Determining time boundaries

The year 2007 was chosen as the baseline for the following reasons:

- The measurement systems deployed, especially in our DCs, had provided us trusted data since 2007
- In 2008, Intel's IT organization had enabled large amount of infrastructure refresh – across servers in the DCs and labs and across the compute infrastructure used by the employees. We wanted to test the hypothesis that infrastructure refresh has a positive impact in reducing the carbon footprint of an organization

Determining process boundaries

We adopted the process to determine the operational boundaries as defined by the GHG Standard Protocol and definition. This process enables a reporting company to determine which activities that result in GHG emissions should be included in its GHG inventory.

Scope 1

GHG emissions that result from emission sources inside the boundary of the organization are known as direct emissions. Scope 1 emissions are direct emissions.

Scope 1- Direct Emissions

For the defined organizational boundary (as above), Scope 1 emission sources were identified as follows:

- Stationary combustion: Diesel generator sets, Liquefied petroleum gas (LPG) cylinders
- Other emissions during installation, use and disposal of refrigeration and air-conditioning equipment

Scope 2 and 3

GHG emissions that are a consequence of the activities of a company but, occur at sources owned or controlled by another company are known as indirect emissions. Indirect emissions include "Scope 2" and "Scope 3" emissions.

Scope 2- Indirect Emissions from purchased electricity

GHG emissions resulting in Scope 2 emissions account for GHG emissions from the consumption of purchased electricity, heat, and/or steam at a facility that falls within a company's organizational boundary.

For the defined organizational boundary for Intel operations in India, Scope 2 emission sources were identified as follows:

- Quantified measure of electricity consumption in units of kilo-watt-hour (KWH)

Scope 3- Indirect emissions other than purchased electricity

GHG emissions other than the emissions from purchased electricity resulting from activities of the organization but at sources not under the control of the organization are known as Scope 3 emissions.

Note

While our study focused on Scope 1, Scope 2 and specific elements in Scope 3, this paper would be confined to the findings within Scope 1 and Scope 2.

Collecting the data

Scope 1

'Actual fuel use records' was employed for emissions due to DG or LPG. For emissions from refrigerants, 'Lifecycle Stage Approach' has been used since it is ideal for equipment users who have contractors servicing their equipment.

Scope 2

Real time metered activity data of power usage was collected for the years 2007 and 2008.

Analysis of the results

The base-lining results were summarized and analyzed along the following vectors:

- Comparison of emissions in Scopes 1, 2 and 3 (2008 versus 2009)
- Break-up of emissions in Scopes 1, 2 and 3 into ingredient components

- Comparison of emissions in Scopes 1 and 2 across multiple locations across the two years

The total of Scope 1 and 2 emissions saw a drop of 12% in 2008 compared to 2007[§]. Scope 2 specifically saw a drop of 9%[§] (equivalent of taking ~572 passenger vehicles off the road for a year[#]).

Scope 1 versus Scope 2 – Year 2008

As we can see in Figure 1 below, the overall split of the footprint between Scope 1: Scope 2 is 5%:95%. The actual figures have not been included. This break up will be further elaborated subsequently.

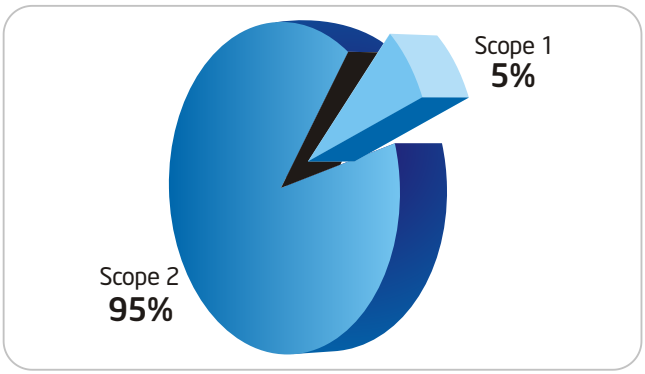

Figure 1: Split of the overall footprint between Scope 1 and Scope 2.

Break-up of Scope 2 – Year 2008

As Scope 2 emissions contributed to a majority of the pie chart above, we are assessing those variables that comprised Scope 2 in more detail.

A sample break up of Scope 2 has been presented in Figure 2 below. The bar charts depict the contributing factors in decreasing order of impact and the line graph indicates the cumulative contribution. For example, for this sample, we can see that DC computing and DC cooling accounted for ~60% of the Scope 2 emissions.

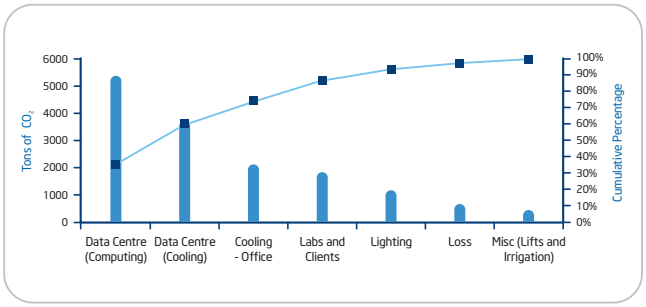

Figure2: Representative break-up of a sample set of the overall footprint – and is not reflective of any facility per se.

Focus areas identified

The two key inferences out of this graph are:

- The big levers for reducing the carbon footprint going forward are DC compute, DC cooling, compute infrastructure outside the DC (in the form of servers in labs, desktop computers and laptop computers) and cooling of the office environment (Together they contribute to almost 80% of Scope 2 emissions[§]).
- The efficiency improvement activities in DC cooling is reflected in the relatively low DC cooling footprint (3490 MT CO_2 in Figure 2) compared to DC compute footprint (5539 MT CO_2) This is the indication of DC infrastructure efficiency.

Emissions impact (2007 versus 2008)

So far the analysis had just provided clarity on the key contributing variables for Scope 1 and Scope 2 and a summary comparison of Scopes 1 and 2 between 2007 & 2008.

In order to test our hypothesis of IT infrastructure having an impact on carbon emissions; we had to delve deeper by breaking up the activities across the two years. Figure 3 below gives a hierarchical view of the percentage reduction in emissions in 2008 compared to 2007.

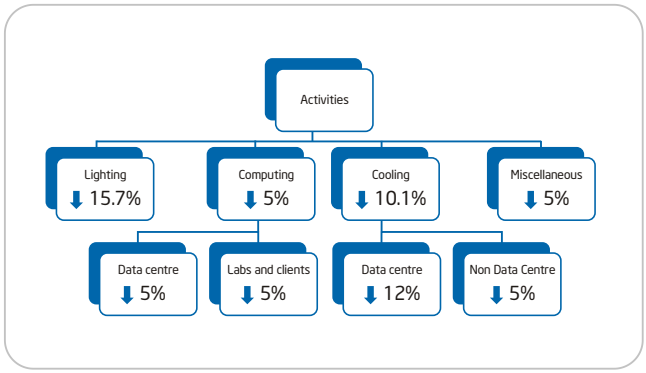

Figure 3: Percentage comparison of Scope 2 emissions reductions between 2007 and 2008 across various variables.

Key inferences

The following inferences can be drawn from Figure 3.

- A significant portion of the server infrastructure in the DCs was refreshed in 2008 with more energy efficient and higher performing servers based on the newer generation, multi-core server infrastructure. IT infrastructure refresh in the DC environment was one of the factors that resulted in this reduction in carbon footprint
- The new generation multi-core servers provide higher compute consolidation ratios, thereby resulting in reduced server footprint in the DC for the same compute capacity; resulting in DC cooling efficiencies – caused by lesser area required to be cooled. This is one of the key contributors to the 12% reduction in the DC cooling footprint[5]
- Specific energy conservation initiatives like cooling set point changes, air management, operating the UPS at a higher load factor, LED's for emergency lights, powering down of humidity control got deployed in 2008 in the facilities infrastructure of the DC. These also have contributed to the 12% reduction in DC cooling footprint

Conclusion

As the adage goes, you can only manage what you measure. With the increasing focus on energy availability and climate change, governments and corporations will be taking necessary steps to become more proactive in minimizing impact and maximizing efficiencies. By assessing the critical energy consumption variables and understanding the impact of IT infrastructure refresh on the existing footprint we have shown a marked reduction in our environmental footprint from 2007.

The paper articulates the methodology, the factors considered while scoping the carbon footprint assessment (organizational/time/process boundaries), analysis summary and key inferences. This base-lining exercise demonstrates that IT infrastructure (server) refresh and process improvements aimed at operational efficiency have an impact in reducing the carbon emissions.

Refresh of server infrastructure in the DC environment is an important contributor to the 5% reduction (from 2007 to 2008) of carbon emissions caused by the DC compute environment. We had refreshed our server infrastructure in the DCs with more energy efficient and higher performing servers based on the newer generation, multi-core server infrastructure.

The server refresh which resulted in lesser footprint in the DC (for the same compute capacity), also resulted in cooling efficiencies – which is one of the contributing factors to the 12% reduction in DC cooling related emissions.

The other important contributor to the 12% reduction is specific energy conservation initiatives undertaken in the facilities infrastructure.

Carbon footprint measurement and management is a focus area for Intel as a corporation and the Corporate Sustainability group and the IT Sustainability program are key enablers towards meeting our carbon emissions reduction goals.

Authors

Anantha Raman is an Operations Manager with Intel Corporate Services.

Ashok Radhakrishnan is a Program Manager with Intel Information Technology.

Hitesh Barot is part of the Global Public Policy team for Intel Corporation.

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Anand Vanchi is an Enterprise Architect with Intel IT.

Ravi Giri is a Staff Engineer with Intel IT.

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Acronyms and Terms

DC: Data Center

DG: Diesel Generator

GHG: Green House Gas

IT Infrastructure: Combination of all computing hardware in an enterprise (servers, data center, labs, desk top computing and mobile computing environment)

LED: Light-Emitting Diode

MT: Metric Tonnes

UPS: Uninterruptible Power Supply

Learn More

http://www.intel.com/it/sustainability.htm

http://www.intel.com/intel/environment/sustainable-operations.htm

http://www.epa.gov/cleanenergy/energy-resources/calculator.html
† http://www.climateactionprogramme.org/news/article/summary_indias_national_action_plan_on_climate_change
§ Intel internal measurements, Q1 2009