

# Demonstrating the Benefits of Electronic Software Distribution

A study of greenhouse gas  
emissions reduction

An Accenture/WSP White Paper

October 2009

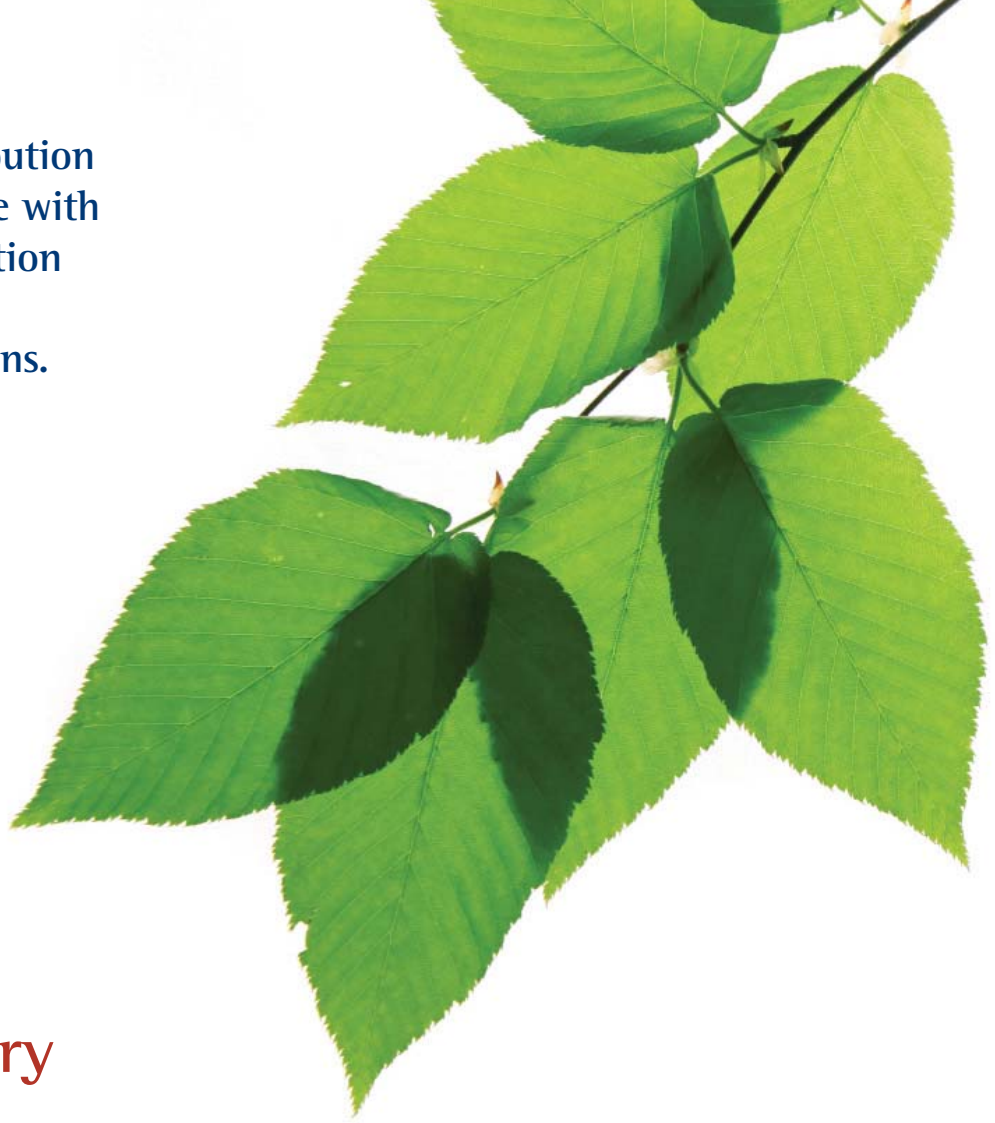
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Replacing traditional distribution of DVD/CD disk kit software with electronic software distribution (ESD) can result in a 91% reduction in carbon emissions.



## Executive Summary

A carbon footprint Life Cycle Assessment (LCA) commissioned by Microsoft and conducted by Accenture and WSP Environment & Energy found that replacing traditional distribution of DVD/CD disk kit software with electronic software distribution (ESD) can result in a 91% reduction in carbon emissions for most Microsoft Volume Licensing<sup>1</sup> (VL) customers. Leading standards were applied to calculate the greenhouse gas (GHG) emissions arising from both physical and electronic media software distribution such as disk manufacturing & distribution activities and electricity use. If Enterprise Agreement (EA), EA Subscription, and Select License VL customers were to choose electronic distribution through Microsoft's Volume License Service Center, they would have the potential to collectively reduce 4,058 metric tons of carbon dioxide equivalent greenhouse gas (GHG) emissions over the term of their VL

contract, which is typically three years. According to the EPA's Greenhouse Gas Equivalencies Calculator<sup>2</sup>, this quantity of emissions is approximately equal to:

- 9,437 barrels of oil consumed, or
- The electricity use of 563 homes for one year, or
- Carbon sequestered annually by 922 acres of pine or fir forest

Accenture and WSP Environment & Energy found that Microsoft encourages Volume Licensing customers to choose digital downloading of their business software products and updates through its Digital by Choice promotional campaign. While financial motives surely exist as a driver for this campaign, there is also a strong

motivation to understand and account for the environmental impacts of software distribution. This study of a select set of Microsoft Volume Licensing customers demonstrates the potential for broader GHG emission reduction benefits across Microsoft's business and the software industry as a whole, when customers choose digital software fulfillment.



## Information and Communications Technology and Sustainability

Microsoft has made a number of commitments to reducing the climate impacts of its business activities including those of its supply chain and customers. This commitment, together with others made by leading Information and Communications Technology (ICT) companies has led to a better understanding of the potential contribution the sector can make in reducing the climate impacts of business and society. The recent Global e-Sustainability Initiative (GeSI) report titled: "SMART 2020 Enabling the Low Carbon Economy in the Information Age"<sup>3</sup> suggests that ICT can and should facilitate significant reductions in carbon emissions by rethinking and optimizing business processes and changing consumer behavior.

This white paper explores the carbon reduction opportunity associated with Microsoft's transition from physical to electronic media software distribution methods. The specific software products analyzed in this study represent a small fraction of software and other services which can be fulfilled digitally, and thus there is a need to continue developing this knowledge to enhance emissions reduction opportunities throughout the sector. The results are therefore relevant to other software companies, data centers, and service providers interested in cost saving opportunities, resource reduction, and transportation efficiency.

# Carbon Footprint Analysis

To understand the relative environmental impacts of the software download and physical media distribution channels, Accenture and WSP Environment & Energy compared different supply chain and distribution scenarios and quantified the associated climate impacts through an end-to-end Life Cycle Assessment (LCA).

The carbon footprint study analyzed emissions related to Enterprise Agreement (EA), EA Subscription, and Select License Volume Licensing customer software distribution during a typical three year licensing agreement. Volume Licensing agreements allow enterprise customers to run software on multiple computers within a single purchasing organization. The scope of the study was confined to Volume Licensing customer software distribution in North America and EMEA as of March 2009.

Over the course of an agreement, it was determined that Volume Licensing customers could receive anywhere from 95 to 135 media disks through traditional distribution channels. However, if they opt to exclusively download their software through the Microsoft Volume Licensing Service Center<sup>4</sup>, the resulting GHG emissions can be reduced by up to 91%. In order to draw this conclusion, leading standards for the assessment of greenhouse gas (GHG) emissions of goods and services<sup>5</sup> were applied in calculating the emissions arising from all processes necessary to fulfill software agreements through both electronic and physical media distribution scenarios.

Calculations of electronic software delivery (ESD) include the infrastructure, networking equipment and energy required to host, fulfill, download, and

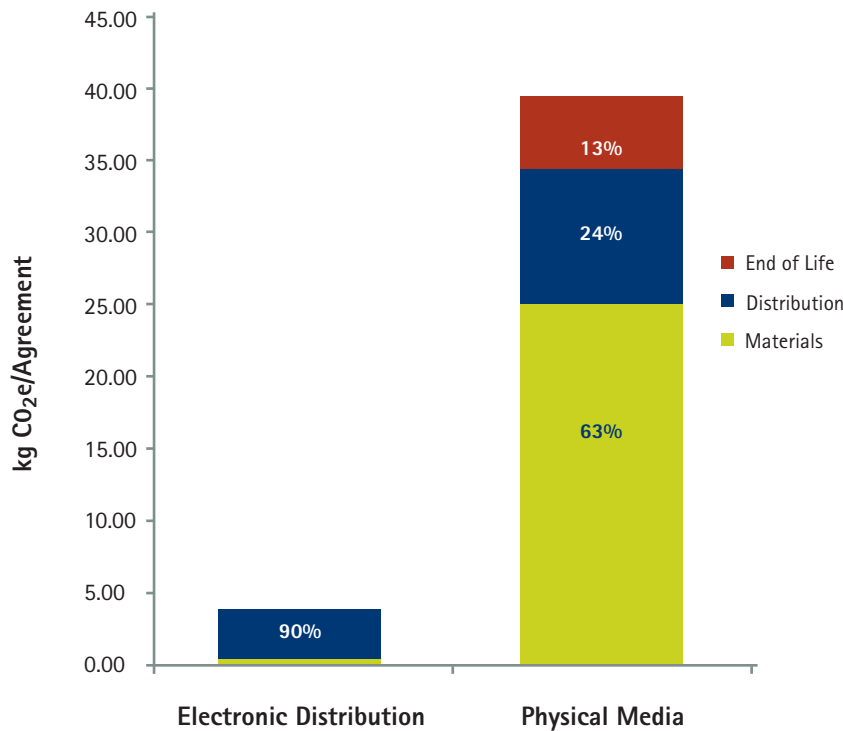
save software and quarterly updates to a customer's enterprise server. The results were calculated in kilograms of carbon dioxide equivalent emissions (kg CO<sub>2</sub> e) per agreement. The chart "Lifecycle GHG Emissions per Software License Agreement" categorizes and compares the emissions associated with digital versus physical fulfillment options.

Emissions related to the manufacturing of discs and packaging was the largest contributor to the overall footprint of physically distributed software (63%), followed by emissions from distribution (24%) and end-of-life activities (13%). Emissions related to digital distribution were primarily from electricity use associated with the distribution function (90%).

## The Processes Necessary to Fulfill Software Agreements Include:

Process	Physical Media	Electronic Distribution
<b>Embedded Energy</b>	Raw materials for manufacturing media disks and associated packaging	Raw Materials for manufacturing servers and networking equipment
<b>Supplier Logistics</b>	Transportation from 1st tier suppliers to manufacturer	Transportation from 1st tier suppliers to manufacturer
<b>Process Energy</b>	Electricity required for manufacturing	Electricity required for publishing and releasing software bits
<b>Distribution</b>	Includes transportation to media kits by air, ground and marine freight from manufactures, to distribution hubs, and to final end user	Electricity required for critical performance and cooling of hosting and fulfillment servers; assumes 24 hours a day, 7 days a week, 365 days a year; includes electronic download of software onto an enterprise server
<b>End of Life</b>	Customer recycling and disposal of media disks and packaging	Recycling and retirement of servers and networking equipment

## Lifecycle GHG Emissions per Software License Agreement



“The results heavily favor digital distribution on all fronts—global warming, raw material usage, waste reduction, and energy consumption.”

Noah Horowitz, Senior Scientist, NRDC

## Opportunities

This analysis builds upon Microsoft's previous carbon footprint study which found significant environmental benefits to providing Microsoft Office 2007 software to consumers online. The Life Cycle Assessment (LCA) model applied in these analyses have highlighted specific opportunities in the physical and electronic media supply chains to reduce GHG emissions and increase energy efficiency in the delivery of software products. The implications of this study are that significant GHG emission reductions can be achieved if similar electronic distribution methods are adopted industry-wide across media and software distribution channels.

Natural Resources Defense Council's (NRDC) senior scientist, Noah Horowitz, notes, “We greatly appreciate Microsoft's decision to retain highly qualified, independent consultants to

quantitatively assess the environmental impacts of switching from physical to digital software distribution. Until now, we had assumed there would be benefits in moving away from all the plastic and paper found in physical media, but we were in the dark as to how this would pencil out from a carbon perspective. The good news here is that despite the incremental energy use at the data centers, the results heavily favor digital distribution on all fronts—global warming, raw material usage, waste reduction, and energy consumption.”

Coupled with greater data center efficiency, the opportunity for reducing supply chain emissions through digital distribution can increase even further. By aggressively pursuing energy efficiency and purchasing renewable or low-carbon energy for data centers,

software and content publishers can improve on an already-positive story about digital distribution, and can further distance themselves from a process that has traditionally relied on materials and global transportation networks that are fossil fuels intensive.

The results of this study contribute to the growing knowledge base of sustainable practices in the ICT industry and encourage further efforts in understanding the potential benefits of using an increasingly connected digital network to provide goods and services to customers.

# Summary of Assumptions and Methodology

## Model Overview

- The model is independently developed based on ISO 14044 guidelines for Life Cycle Assessment, BSI PAS 2050 Specifications for the Assessment of Greenhouse gas (GHG) Emissions of Goods and Services, and the WRI/WBCSD GHG Protocol
- Primary data was provided by Microsoft and used only the most conservative (highest) estimates of data center power usage
- Secondary data was derived from the Ecolnvent database and other publicly available databases collated on SimaPro
- Data on the power consumption of servers was derived from industry averages based on Koomey, J. G. "Estimating Total Power Consumption by Servers in the U.S. and the World" – February 15, 2007
- The study quantified all Enterprise Agreement (EA), EA Subscription, and Select License Volume Licensing fulfillment activities for both physical media and electronic media customers
- The study assumed that 45% of customers receiving physical media also download additional content<sup>6</sup>, and that 1% of the customers that have opted into solely electronic software delivery will use the Microsoft network for repeated downloads
- The aggregated global results in this report have been extrapolated from the study's findings based on a scope limited to the EMEA and North American regions

## Scope of Study

### Emissions Included

- |  |                 |
|--|-----------------|
| • CO2 always included. Additional GHGs must always be included if it is demonstrated they contribute greater than 10% of the total GHG footprint (based on CO2e) | <b>Included</b> |
|--|-----------------|

### Product LCA Emissions Boundaries (always included)

- |   |                 |
|---|-----------------|
| • Extraction or primary production of raw materials (mineral extraction, fossil fuel extraction, purification and refining) | <b>Included</b> |
| • Agricultural Production   | <b>NA</b>       |
| • Manufacture of Product  | <b>Included</b> |
| • Extraction and primary processing of raw materials for packaging  | <b>Included</b> |
| • Manufacture and processing of packaging materials   | <b>Included</b> |
| • Transportation of raw materials to manufacturing sites  | <b>Included</b> |
| • Manufacturing processes and manufacture of chemicals used in processing   | <b>Included</b> |
| • Transportation of finished products to retail outlets/customers   | <b>Included</b> |
| • Refrigeration and refrigerants used up to the retail outlet   | <b>NA</b>       |

### Product LCA Emissions Boundaries (voluntary)

- |   |                 |
|---|-----------------|
| • Manufacturing of physical infrastructure or machinery used in manufacture and delivery of products (e.g. embodied energy in factory equipment and vehicles) unless these are already considered in existing LCA studies | <b>Excluded</b> |
| • Management operations/offices not directly involved in manufacturing processes or logistics   | <b>Excluded</b> |
| • Storage of products in retail outlets   | <b>Excluded</b> |
| • Use Phase Emission  | <b>Excluded</b> |
| • Waste Disposal Emissions  | <b>Included</b> |
| • Allocation of Emissions to co-products  | <b>NA</b>       |

### Data Sources and Transparency of Data Quality

- |  |                  |
|--|------------------|
| • Direct Process Data                          | <b>Microsoft</b> |
| • Raw Material and chemical manufacturing data | <b>Ecolnvent</b> |
| • WBCSD-WRI Corporate GHG Inventory data       | <b>Included</b>  |

- |  |   |
|--|---|
| • Functional Unit: 3 year software licensing agreement   | (hydrofluorocarbons), PFCs (perfluorocarbons)   |
| • Geographical specificity: Distribution to Volume License Enterprise Agreement (EA), EA Subscription, and Select License customers in North America and EMEA (112 countries)  | • The study also includes sources of emissions which make a material contribution to the lifecycle of the functional unit and at least 95% of the anticipated emissions of the functional unit      |
| • GHG emissions included are stated as carbon dioxide equivalent (CO2eq) emissions and take into account the 6 primary GHG gases including, CO2 (carbon dioxide), SF6 (sulphur hexafluoride), CH4 (methane), N2O (nitrous oxide), HFCs | • The study excludes the use phase of the product by the final customer, since use is assumed to be the same for physically and electronically distributed products, once the product is installed. |

## Materials

- Emissions from physical materials were estimated based on the weight and composition of the components of each kit in the Bill of Materials provided by Microsoft. Materials were categorized into the following: DVDs, plastic tabs, media binder (plastic, metal), corrugated box, paper, plastic packaging, packing fill paper and plastic media sleeves.
- Physical kits distributed over a 3 year licensing agreement include an initial Welcome Kit, quarterly subscription kit updates, and additional aftermarket media disks delivered upon request
- Stamping and manufacture of the disks occurs regionally; materials are sourced from China
- Packaging materials are sourced locally within 250 miles/402 km
- Volume Licensing customers receive 95 to 133 media disks in 13 to 62 kits through traditional distribution channels
- Average weight of Welcome kit (including packaging) is 2.2 kg
- Average weight of updates and additional media is 0.2 kg
- Emissions related to the material, manufacture, assembly and recovery of servers and networking equipment were amortized over 3 years

## Process Energy for IT Infrastructure

- Estimated power consumption of Microsoft's servers is based on direct measurement of annual electrical consumption and including essential energy for infrastructure and cooling
- Power requirements for volume and mid-range servers are in-line with Koomey's published weighted average
- The model includes essential power for critical IT environment and utilizes a Power Usage Effectiveness (PUE) ratio provided by Microsoft
- Network run time assumes 8,760 hours per year

## Supply Chain Logistics & Distribution

- Emission factors for transportation were derived from the World Resource Institute / World Business Council for Sustainable Development GHG Protocol CO2 emissions from Mobile Sources

- Distances from first tier suppliers through distribution hubs to the customers in North America and EMEA are considered. A conservative estimate of 322 km from each regional distribution hub to the customer was used in our analysis based on population geographic statistical areas
- Emissions were calculated based on frequency, modes, distance and weight (ton-kilometers) of the physical media shipped
- Servers are assumed to be manufactured in Asia and transported by marine freight to EMEA and North America

## Electronic Software Distribution

- This study was limited to VL electronic distribution for North America and EMEA. Primary data from these data centers was used to calculate the volume of distribution
- For Electronic Software Distribution, all of the Microsoft and third party vendor server networks associated with hosting and fulfilling the software were accounted for, along with the emissions associated with data transfer and user download
- Average file size is 667 MB
- Includes energy use from end users' PC and monitor estimated to be 192 kWh/year
- Assumed connection speeds are equivalent to T1 (70% of customers), T3 (20% of customers) and 56K (10% of customers)
- Research from the National Laboratory for Applied Network Research (NLNR) Project informed the path of data transfer which requires approximately 15 hops from a data center to the end users
- Life Cycle Inventory of a server derived from Masanet E., et al. 'Optimization of Product Life Cycles to Reduce Greenhouse Gas Emissions in California'. California Energy Commission, PIER Energy-Related Environmental Research. CEC-500-2005-110-F. August 5, 2005

## End of Life (EOL) Processes

- End Of Life calculations include the emissions associated with recycling and land filling IT equipment amortized over 3 years (the equivalent of the life of the agreement)
- Conservative assumption of 20% recycling and recovery for servers and network equipment
- Recycling CD / DVDs is generally not cost effective, thus emissions factors for disposal of DVDs are based on a model for landfill of LDPE
- End of Life for paper and PET plastic through MSW channels is proportional to US recycling rates of all paper and paperboard products in MSW: 40% for printed material and 3% for PET plastic
- All waste is land filled rather than incinerated and no landfill methane capture occurs

## Model Exclusions

- Energy consumed during software development
- Tertiary suppliers and process materials which are not significant (i.e. do not constitute an input to 95% of the product or process)
- Suppliers providing ad hoc or less than 90% of the raw material supplies
- Employee commuting
- Human energy consumption
- Offsetting of emissions from any other part of the supply chain
- Embedded energy of capital equipment, transportation vehicles, buildings and their energy use
- Maintenance of capital equipment
- Associated energy and emissions for inventory storage at distribution centers and operations (HVAC, lighting)
- Refrigerants (except where used in primary production of raw inputs)
- GHG emissions from initial manufacturing of a recycled material
- Use of Software

## About Accenture

Accenture is a global management consulting, technology services and outsourcing company. Combining unparalleled experience, comprehensive capabilities across all industries and business functions, and extensive research on the world's most successful companies, Accenture collaborates with clients to help them become high-performance businesses and governments. Clients are assisted in developing and implementing sustainability strategies and solutions that not only protect the environment and enhance social wellbeing, but also serve as an engine for economic growth and high performance. With approximately 177,000 people serving clients in more than 120 countries, the company generated net revenues of US\$21.58 billion for the fiscal year ended Aug. 31, 2009. Its home page is [www.accenture.com](http://www.accenture.com).

## About WSP Environment & Energy

WSP Environment & Energy is one of the world's leading global consultancies, delivering solutions to environmental, energy, and sustainability issues. With over 1,000 people across 65 offices globally, WSP Environment and Energy offers a full-service consulting practice to a range of commercial and industrial clients, many of whom are *Fortune* 500 and FTSE 250 companies. WSP helps its clients increase business performance through process improvement, risk mitigation, and design and implementation of sustainable business practices. WSP Environment & Energy is part of WSP Group plc. Its home page is [www.wspenvironmental.com/usa](http://www.wspenvironmental.com/usa).

## For Further Information

To understand how Accenture and WSP Environment & Energy can help you integrate sustainability approaches into your business, contact:

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<sup>1</sup> Volume Licensing agreements allow enterprise customers to run software on multiple computers within a single purchasing organization. Learn more at: <http://www.microsoft.com/licensing/>

<sup>2</sup> <http://www.epa.gov/cleanenergy/energy-resources/calculator.html>

<sup>3</sup> <http://www.gesi.org>

<sup>4</sup> The Volume Licensing Service Center may be found at: [www.microsoft.com/licensing](http://www.microsoft.com/licensing)

<sup>5</sup> ISO 14044 guidelines for Life Cycle Assessment and BSI PAS 2050 Specifications for the Assessment of Greenhouse gas (GHG) Emissions of Goods and Services

<sup>6</sup> The additional downloads performed by traditional customers have not been incorporated into the results. The boundaries of the study provide for a comparison of media distribution through an exclusively physical supply chain versus an exclusively digital software delivery.