Impact of Virtual World on Environment

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ABSTRACT
Technology innovations have morphed the real world and increased the share of virtual interactions. While the convenience aspect of online world is much discussed, seldom we see reference to its impact on nature. This paper evaluates the impact of technology on nature, with respect to virtual world. Existing literature and industry opinions have been reviewed, to build a compelling business case for sustainability. Online world has been able to reduce pollution resulting from logistics, by providing collaboration and communication platform for geographically-dispersed people. Also, the productivity improvement in various activities reduces impact on nature, indirectly. Limitations of technology, in the form of heat generated from data centers, fossil fuel used for electricity generation, and managing end-of-life are also outlined. This paper can be useful to technology providers and users to properly represent their sustainability practices for supporting nature.

General Terms
Green Computing, Green IT, Interdisciplinary

Keywords
Broadband, Technology, Green Computing, Pollution, Productivity, Online World, Virtual World

1. INTRODUCTION
This paper focuses on how technologies related to online applications can help to reduce greenhouse emissions, along with their limitations. It reviews existing literature on various primary researches, and discusses their implications. It has sections for Concern for Nature, Impact on Environment, Literature Review, Online World, and Emerging Technologies,

2. CONCERN FOR NATURE

2.1. Corporate Priorities
Pressure on corporates has increased [(1)] to show they are conducting business in a manner friendly to environment. This has come from share-holder activism, and awareness of common man, many of which are customers. In India, we are seeing many examples of economy growth impeded due to protests, which are concerned about nature and impact of economy growth on local ambience.

The largest enterprise application vendors, like SAP [(2)] and Oracle [(3)] have been offering software applications to track, and report impact of corporate initiatives on nature.

2.2. Government Policies
Recently, U.S. President Barack Obama ([(4)] announced first mandatory restrictions on greenhouse gas emissions. The new regulations, scheduled to be released by the EPA (Environmental Protection Agency), also expands energy efficiency standards for buildings and home appliances. There are a range of such measures to reduce emissions. In coming times, as Governments around the world will take note of capability of online world to influence conservation of nature, the public policies will be influenced, accordingly.

3. IMPACT ON ENVIRONMENT

3.1. Air Pollution
54% of existing impact on air pollution [(5)] has come from logistics and transportation (Figure 1). Online world can address this by bring people together in virtual channel and doing away with the need to travel for persons.

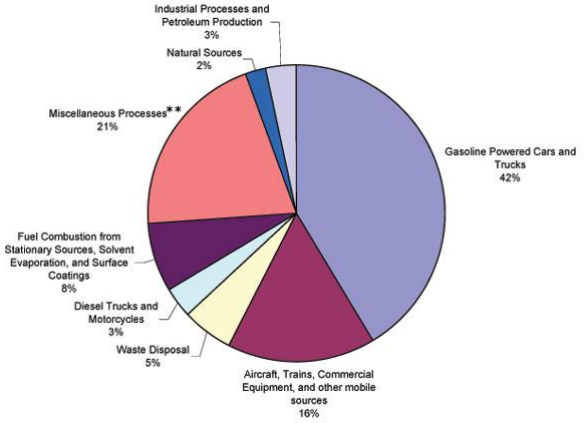

Fig 1: Source of Air pollution in California

Sources: www.bar.ca.gov

3.2. Electronic Waste
Information and Communication Technology products are also contributing to environmental damage by spreading electronic waste. Regulations like WEEE and RoHS are trying to regulate.

3.3. Heat and Energy
Energy consumption and Heat dissipation from technology products is a major concern for environment. There are sporadic efforts to move data centers to arctic location and use for hydro-electric power to take advantage of ambient temperature.

3.4. E-commerce
As online channel is allowing customization of offerings, it is leading to more usage of resources like packaging material, shipping facilities, and associated analytic support. As in earlier section, we noted the reduced travel need for people, the logistics of material increases in e-commerce.

4. LITERATURE REVIEW

Some studies have been conducted to assess the impact of broadband-enabled applications on environment. In 2008, the Global e-Sustainability Initiative's (GeSI's) report SMART 2020: Enabling a Low-Carbon Economy in the information age, demonstrated that ICT-inspired productivity improvements along with travel substitution have the ability to reduce global carbon emissions by 15 percent.

In 2007, American Consumer Institute's report Broadband Services: Economic and Environmental Benefits, forecasts an incremental reduction of more than 1 billion tons of greenhouse gas emissions by 2017.

Also, technology companies have been tracking the impact of their offerings on environment to report sustainability commitment. In the backdrop of these primary research, emerging technologies like social media, mobility and cloud computing are expected to enhance the presence of virtual world in our day-to-day interactions. The resulting improvement in productivity has the potential to solve many issues like environment pollution, fossil fuel crunch, etc.

4.1. BT's Net Good 3:1

The stated aim of BT's Net Good 3:1 [(6)] is "to help society live within the constraints of our planet's resources through their products and people." BT has also a vision of 2020 goal to help customers reduce carbon emissions by at least three times end-to-end carbon impact of BT's business.

BT has identified a number of B2B and B2C products and services that could cut customers' carbon emissions and has developed initial calculations to determine their carbon abatement potential: Telecommuting, Flexible working services, Audio conferencing, Telepresence, Broadband enabled e-commerce benefits, Broadband enabled dematerialization, BT Vision, Field Force Automation, and Data centre services.

BT provides a physical broadband line then they can take credit for the carbon savings due to Telecommuting.

BT offers a service to help companies introduce a flexible working system. This could mean an increase in the proportion of shared desks to improve desk occupancy rates. The net reduction in office space required leads to a reduced energy use within the office. This approach does not model any increased home energy use for workers who then work from home. However, it is difficult to ascertain what proportion of this service results in increase of homeworking versus desk efficiency savings resulting from, for example, people being in meetings and not requiring a desk.

These are reported as part of Scope 3 emissions (Figure 2).

Value chain area	Reporting / calculations
Scope 1 and 2: own operations	BT annual carbon emissions statements.
Scope 3: upstream (supply chain)	Small World Consulting report assessing BT's upstream Scope 3 from procurement spend data using an environmentally extended input-output analysis. Existing BT annual carbon statement which covers: • employee business travel (rail, air and car hire) • non-Kyoto refrigerant gases (e.g. CFCs) an estimate for home workers' carbon footprint
Scope 3: downstream (customers)	Analysis by BT on downstream Scope 3 emissions –use of sold products and end-of-life emissions.

Fig 2: BT's Carbon Foot-print Reporting
Source: BT

4.2. GeSI report SMART 2020

The Global e-Sustainability Initiative's (GeSI) report SMART 2020 [(7)] examines eight consumer activities enabled by the development of broadband technology: Telecommuting, Use of Internet as a primary news source, Downloading video/music, online banking, online auction/purchases, Use of digital photography, and Use of e-mail.

ICT and broadband-enabled services can play a significant role in ensuring a low-carbon economy. In order to reach the full energy efficiency potential of ICT, global policymakers need to continue creating a policy environment that encourages investment in and use of broadband services across economies. Once countries ramp up usage of broadband-enabled services across whole communities or entire cities, countries can achieve the scale required to reap the potential energy efficiency benefits.

Innovative ICT and broadband can play a significant role in fostering a low-carbon, sustainable society.

4.3. ACI

American Consumer Institute's report [(8)] found that, telecommunications and information technologies can play an important role in improving the environment and reducing greenhouse gas emissions. Further work is needed to explore policies that would encourage advances in telecommunications technologies, along with a sound and comprehensive energy policy that encourages energy efficiency, clean energy sources, independence, and conservation. Such policies can make a meaningful and sizable improvement in our environment by slowing energy use, conserving our water and natural resources and reducing greenhouse gas emissions. However, policymakers need to take steps to encourage investment that would benefit consumers and lead to large scale adoption of these important environmental applications.

The following are specific estimates of the emission savings that are likely to result from the cumulative "network" effects of wide adoption and use of broadband-based applications and forecast the additional environmental benefits if trends continue over the next ten years. In terms of greenhouse gas emissions, these activities are likely to produce the following cumulative incremental benefits:

- Business-to-Business and Business-to-Consumer e-commerce is predicted to reduce greenhouse gases by 206.3 million (U.S.) tons.
- Telecommuting will reduce greenhouse gas emissions by 247.7 million tons due to less driving, 28.1 million tons due to reduced office construction, and 312.4 million tons because of energy saved by businesses.
- Teleconferencing could reduce greenhouse emissions by 199.8 million tons, if 10% of airline travel could be replaced by teleconferencing over the next 10 years.
- Reduction in first-class mail, plastics saved from downloading music/video and office paper from emails and electronic documents could reduce emissions by 67.2 million tons. For example, over the next 10 years, shifting newspaper subscriptions from physical to online media alone will save 57.4 million tons of carbon dioxide and other greenhouse gas emissions.

Fig 3: Online World is bring together physically separated people in real-life

Sources: Office.Microsoft.com

5. DISCUSSION

The pervasiveness of online world (Figure 3) has increased in leaps and bounds in recent times. The experience has started to imitate real-world experience with social communities on public networks. Access on mobile devices has stretched the online experience to in-transit and on-field. With wearable computing, individuals can stay connected with online world on-the-go.

Many of the applications of online world are providing new experience to users, and solving existing problems. A large number of them are able to improve productivity of existing processes, [9] contributing to reduction in wastage of various forms, and cause ultimate benefits to nature.

The prowess of technology can be deciphered by the inclination of service providers to stake claim to Smarter Planet, Digital Enterprise, etc.

Developments in networks [10] has increased speed of transmission and reduced cost of deployment drastically. This has resulted in improve user experience for commercial success, at affordable rates. Many applications like location-based services using mapping, video calling, etc. were stymied due to lack of quality networks.

Additionally, the launch of smartphones and tablets with better form factors of size and battery power is helping to develop better applications. The touch screen user interface has made the access more convenient, while on-the-go.

Table 1. Technology impact on productivity

Technology	Benefit to Environment
Mobility	Access touch-points on-the-go helps to make flexible travel plan
Social Media	Community formation reduced the need for face-to-face interaction by traveling
Cloud Computing	Data storage for Access using multiple devices improves productivity
Big Data	Data analysis improves productivity

Various emerging technologies (Table 1) have improved the effectiveness of online world, thereby making the virtual world a credible competitor to real world in multiple dimensions.

If data can be stored for on-demand access from multiple devices, then there is no need to store the data on all devices. This reduces the need for local storage.

ICT enabled by emerging technologies [11] will help in improving lifestyle, by reducing wastage. Communication on wired and wireless media has brought together people separated by distance during last century. With the advent of internet a decade ago, it was possible to communicate with data. This was more cost-effective than the voice communication.

During last decade technology has moved rapidly to make the virtual world resemble the real-life experience:

- In gaming consoles, it is possible to get real-life experience.
- Video Calling, and Video Conferencing giving real-life experience in virtual world

6. LIMITATIONS

Greenpeace called attention [(12)] to the growing, power-hungry data center footprint, citing estimates that cloud computer sites could consume up to 622.6 billion kWh (kilowatts per hour) of power. Jonathan Koomey, Ph.D., consulting professor of civil and environmental engineering at Stanford University estimates that the cloud is already responsible for 1-2% of the world's electricity use.

7. CONCLUSION

The analysis is this study shows that online world seems to benefit nature when evaluated at task level, whereas the impact on a broader level is different.

The biggest benefit of virtual world is the ability to bring together geographically dispersed people, reducing the need to travel. The pollution caused by this travel is the largest contributor to air pollution. As the applications will mature, experience in virtual world will resemble real-world.

However, the additional facilities to the users due to success of online world, has created a situation where nature is suffering at the expense of individual gratification. Corporations are ready to harm environment by making deals, where the benefit financially, without taking into account impact on nature.

We suggest both individuals and corporations to evaluate individual temptation and fiscal priorities in the perspective of impact on nature.

While calibrating business case for public utilities like broadband and mobile services, the benefits should be evaluated taking into account both perspectives.

Similarly corporations vying to attract shareholder attention by implementing environmental-friendly practices should take both kind of impacts into account. Rising concerns for environment may influence customers to transact with corporations that have reliable sustainability practices.

Also, developers of technology products and providers of greenhouse emission tracking applications should make suitable provisions for pros and cons.

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