# Mitigating Global Climate Change through Equipment Standards;

# Telecom Experience

by

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When the Europeans arrived at Easter Island in the eighteenth century, they found nearly a thousand huge stone statues but only one or two living Polynesians per statue on this desert island. How could those great stones have been moved into place with no logs and few laborers? Research revealed the story. There had been a dense forest with birds, flowers, a complex flourishing civilization and a sizable population. There had been a king and religious building projects, namely stone statues: the moai. But too many trees were cut. Disease and rats got an upper hand. Islanders faced pressures from slave-taking Peruvian mine owners. Eventually the ecology and civilization collapsed concurrently. Decline was rapid: the oral traditions of the Easter Islanders are infused with references to cannibalism.[i]

The Moai of Easter Island[ii]

This is the first story of ecocide that I remember hearing and it seemed to me an exotic mystery. Unfortunately, to the contrary, it is an example of a frequent social trap called the "Tragedy of The Commons." Any single shepherd using a common grazing area benefits individually from adding more sheep to his herd. In contrast, the costs of overgrazing the land are shared by all farmers collectively. Thus, it is in an individual's best interest to increase his herd until all the grass is gone even though all shepherds fail together.

We now face this type of tragedy in the global arena. Our energy consumption creates an unrestricted demand for finite resources of our global ecological system (oil, coal) as well as producing by-products that cause global warming. This over-exploitation could produce serious adverse impacts soon, possibly even the doom of the Easter Islanders.

Such a result does not have to be. We have an advantage over early Polynesians. History doesn't record standards bodies on Easter Island. Standards bodies are adept at balancing the good of an individual company vs. the good of an industry as a whole. Standards groups could and should broaden their focus to address balancing the good of industry versus the good of the terrestrial ecosystem. Such a response to global warming would be a high calling but one that is practicable and highly desirable.

Let me be explicit about this thesis. Standards groups should answer the call to address global climate change because they have a key role to play. This role is the establishment of metrics that will accurately portray the energy efficiency and/or environmental impact of a product or service. Test methods that independently can validate the metrics are required as well. With test results in hand, industries can find ways to regulate themselves without requiring governmental bodies to define requirements which are likely to be less-effective due to the superior knowledge of industry bodies.

The chief weakness of industrial standard-setting bodies though is their tendency to gravitate to the lowest common denominator. Given the pace of global climate change, our world needs a swift convergence to a high common denominator. The answer is to break-out the technical evaluative portion of the standard from the pass/fail criteria.

To put the matter simply, the thesis is: (1) prompt and speedy standard setting actions are needed to mitigate undesirable climate change; and (2) to this end, development of metrics and test methods should be decoupled from the development of pass/fail criteria… and both given the highest priority.

Pass/Fail Criteria – the Energy Efficiency Example

The development of standards for broadband telecommunication network equipment illustrates both the importance of the industry standards-setting process, as well as the desirability of de-coupling measurement and the pass/fail criteria.

Typically, hardware requirements in the telecom industry have clear pass/fail criteria as illustrated in Figure 1. A fiber-optic switching system either operates at a specified high temperature point, or it does not. A WiMax[iii] base station either survives the transportation shock test or it does not. The approach has insured a highly reliable, highly available global telephone infrastructure network. If standards are upheld by the equipment market, compliance determines whether a sale will go through. If standards are ignored by the equipment market, then testing does nothing more than advise the manufacturer of terms that may be written into a warrantee.

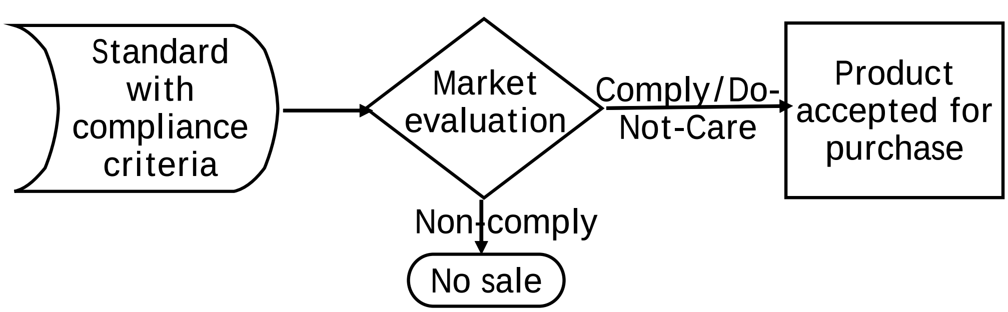


Figure 1 - Typical Implementation of a Standard

It is not surprising that the European Union started with the classic approach (Figure 1) when seeking to improve the energy efficiency of DSL[iv] modems. DSL has been Europe's most popular form of broadband access, hence the name of the Joint Research Council's applicable document is: the Broadband Code of Conduct.[v] A code of conduct is a voluntary agreement and not a standard. Participants are invited to sign the Code and then voluntarily comply with the values set forth for maximum Watts per port on the DSL modem. No entity has yet to sign the Code, although it proved an excellent catalyst for standards initiation.[vi]

In reaction to some of the initial drafts of the Broadband Code of Conduct, the European Telecommunication Standards Institute (ETSI) became involved to provide technical input to the EU's Joint Research Council (JRC). Within a few months, ETSI's Environmental Engineering (EE) body provided an alternative to the JRC's code in the form of a draft standard.

ETSI EE's draft standard, ETSI TS 102 533, Energy Consumption in Broadband Telecommunication Network Equipment, uses a different metric for monitoring efficiency. Instead of "Watts/port," the preferred metric is a "power-rate/reach quotient"[vii] that takes into account system functionality. While the quotient sounds more complex, the concept is familiar to anyone who has ever purchased a car. Miles per gallon (mpg) is simple to compare on the sticker of a car, but it does not tell you how many passengers you can carry. Is this a roadster or an 11-passenger church van? Mpg/passenger tells you a bit more if all you have to look at is a test report.
The important point here is that a standards group has undertaken the task to track the efficiency of a family of telecommunications hardware (DSL equipment). The group's proposal:

- establishes a cogent metric
- verifies its measurability
- sets targets.

Alas, the document has remained in the advanced draft stage for a year due to disagreement over the target values. Thus, the unwillingness to decouple targets from metrics and testing has lead to an undesirable delay in promoting energy efficiency and mitigating climate change.

In North America, ETSI EE's sister committees, ATIS NIPP NPS[viii] and ATIS NIPP NPP[ix] have been learning from the European experience. US telecom service providers, responding to the same concerns of rising electricity costs as the Europeans, have begun to seek details of the energy use of telecom equipment at time of purchase. Again, metrics are needed and standards-setting speed is essential.

The US standards groups are attempting to decouple the pass criteria (US terminology) or target values (EU terminology) from the standard that defines the energy efficiency metric and its measurement method. The flow chart for this new process is shown in Figure 2. The belief is that manufacturers are happy to share data with their customers or market analysts, but not with one another.  Metrics and test methods lend themselves to consensus development, but pass/fail criteria do not.

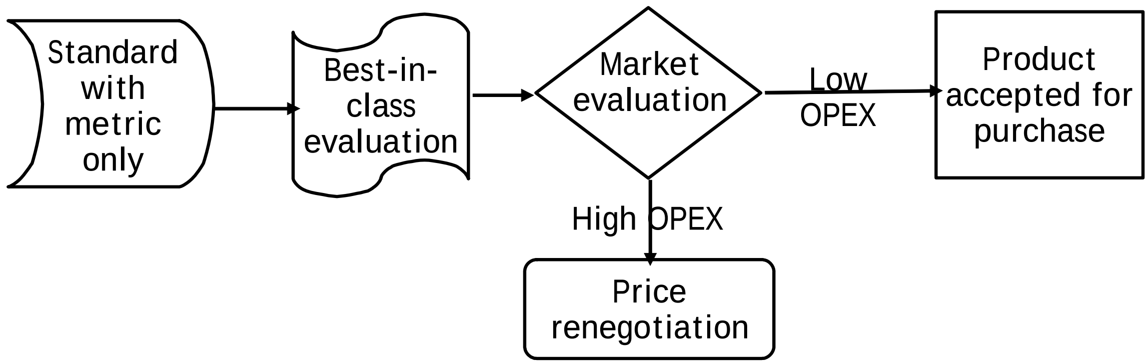


Figure 2 - Standard Implementation is De-Coupled from Compliance Criteria.  Operating Expense (OPEX) is assumed to be a primary buying-criterion.

Metric measurements could be done by the original manufacturers or at independent test labs the same way other compliance tests are done today.  Service providers (who buy network infrastructure equipment and are therefore the customers) are the obvious entities to collect and compare product metrics, and eventually to establish target values.

There are two major organizations of service providers, ETNO (European Telecom Network Operators) and the TCG (Telecom Carrier Group). Corporate consolidation in the telecommunications market makes it reasonable to expect that these organizations can come to agreement on target values.  These may be enforced by technical purchasing requirements, either stated or unstated.  Values can be adjusted without having to change a standard.

The flowchart in Figure 2 implies that the market is changing so that more attention than has been the case in the past will be given to low operating expense (OPEX), thus products that are more energy efficient will be selected.  What we already have seen is that an indication of high operating expenses will invite a price negotiation such that the reduction in capital expense will compensate for higher costs over the lifecycle.

This change in emphasis on energy efficiency will be much for the better for the global climate.  Historically, a communication equipment manufacturer's primary incentive is to lower cost to attract sales.  Service providers, facing steep capital costs and slow depreciation schedules, first consider capital expenses and then, secondarily, operational expenses.  For telecom infrastructure equipment, electric utility costs are the largest portion of the OPEX.  In the past, utility costs have been passed along to consumers similar to the way a landlord often passes along utility costs to a tenant resulting in little incentive for the landlord to improve efficiency.  Now that energy metrics are starting to shed light on the value a customer receives for its electricity dollar, energy efficiency is becoming a high-ranking design requirement.

Life Cycle Thinking

The requirement to design for a small environmental footprint creates remarkable difficulties in assessing the best possible combination of technical performance, longevity, and environmental aspects. This conundrum has been studied by several standards bodies. A few notable examples are:[x]

International Electrotechnical Commission Standard: IEC 62430 "Environmental Conscious Design for Electrical and Electronic Products and Systems"

International Standards Organization: ISO TR 14062:2002 "Environmentally conscious design - Integrating environmental aspects into design and development of electrotechnical products" (also named IEC Guide 114:2005)

ETSI TR102530 (WI:DTR/EE-00002): "Reduction of energy consumption in telecommunications equipment and related infrastructure."

Standards bodies have a new opportunity to help assess the impact of equipment on the environment from "cradle to grave" – the whole life cycle. Many corporate bodies and governments are starting to think in terms of life cycle assessment: tallying up all of the Earth's resources and energy needed to build, run, and recycle a piece of hardware. Figure 3 illustrates the elements that go into the concept of a product lifecycle.

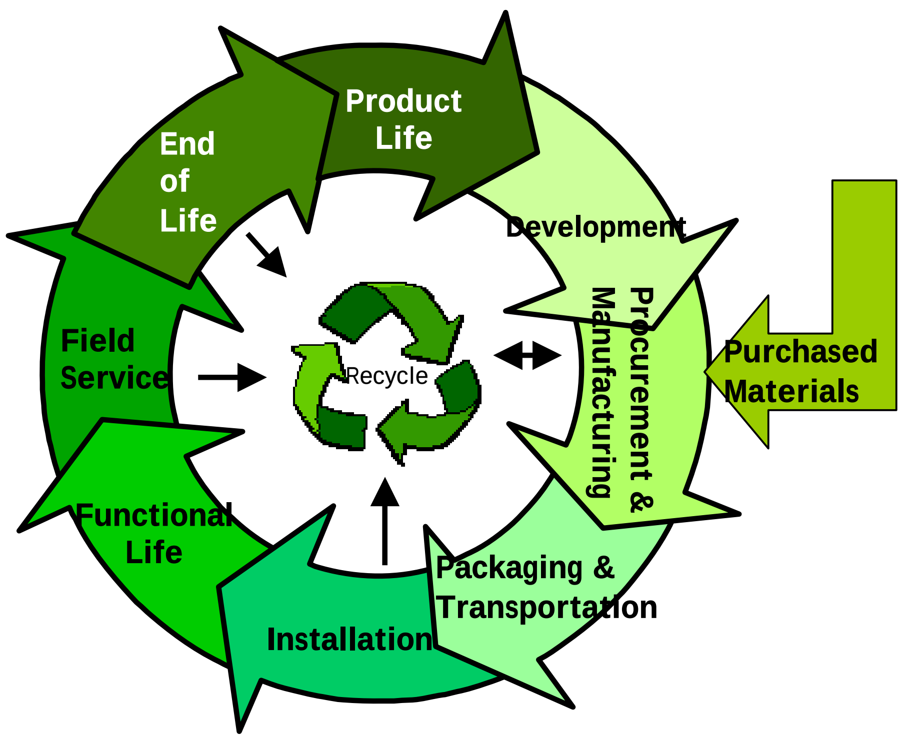


Figure 3 - Product Lifecycle[xi]

What is the role of standards in Life Cycle Assessment (LCA)? In 2004, ATIS NIPP NPP considered trying to standardize life cycle assessment calculations in order to provide a comprehensive view of the "greenness" of manufacturers' products. LCAs are used by telecom manufacturers to measure reductions in the design parameters they can control: materiality (how much material is used to make the item), functionality, and energy use at the design point(s).

Presently, LCAs are hard to compare from company to company. There is considerable work being done in universities on this topic.[xii,xiii] Still, inputs, assumptions, and methodologies can vary widely. They comprehensively show continuous improvement year-over-year for a product line.

Three years into the process of ATIS NIPP NPP attention to the energy issue, it seems that the time is still not right to tackle the huge task of standardizing an LCA. ATIS NIPP, has focused on energy efficiency. Electricity consumption during the use phase is by far the largest component of the environmental footprint for telecom products.[xiv] Infrastructure hardware that houses telephone/internet/media networks has long life compared to most consumer electronics, including phones themselves. A ten year service life is expected for infrastructure hardware. A twenty-five year service life is not uncommon. Most of the circuitry is digital technology and has benefited from miniaturization and efficiency trends. Hence, infrastructure equipment has more functionality in a smaller box than ever before, but also greater power and cooling demands. Telecom hardware runs continuously to enable a 24/7 world. Given this, it is sensible for standards to focus on efficiency and sources of clean electricity generation for the foreseeable future.

One metric that might serve as a proxy for the LCA is weight per functional unit. For small or mid-sized companies, LCAs are not available in any form. Meanwhile, weight can give a ballpark estimate of the amount of material used to produce a function or service. Volume or footprint per functional unit would compliment existing cooling requirement reports.

In sum, it is desirable that standards groups continue to work on LCA methods but no near term results should be expected. Proxy measures deserve to be placeholders until LCA metrics are streamlined

Carbon Equivalency

The goal of life cycle thinking is the production of high value products and services relative to the resources needed to produce, run, and recycle them. The aspiration for telecom products[xv,xvi,xvii] is to reduce the “environmental footprint.” Environmental footprint is usually measured in terms of greenhouse gases (GHG) or simply, Carbon. Scientists studying the Earth’s climate have become convinced that carbon dioxide ($CO_2$) and several other gases are causing the Earth's atmosphere to heat up. The solution to global climate changes it to reduce carbon emissions down to the point of carbon neutrality. At that point, an economic sector can be said to be carbon neutral.

If neutrality cannot be achieved through the industry alone, carbon offsets are needed. Carbon offsets are created in “quantized” form by accounting practices defined in ISO 14064[xviii] and the GHG Protocol from the World Resources Institute.[xix,xx] Similarly, energy and materials expended are converted to $CO_2$ equivalents such that there is a way to "balance" against a green offset. In truth, the telecom industry will continue to emit green house gasses. Yet, overall reductions provided to its costumers being much more important, the datacom/telecom industry could say that it is helping society to achieve carbon neutrality and thus a sustainable economy.

The problem is that carbon equivalents are not established to evaluate the carbon equivalency of a particular product or service; they are defined for larger entities such as corporations. Their goal is to establish an emissions trading[xxi] market for Carbon. In this equation "Carbon" stands for all the green house gases, of which $CO_2$ is dominate. The benefits will most likely be available and pursued by telecom service providers, based on their particular investments and geographic locations[xxii]. However, the datacom/telecom industry must use some sort of metric if it is to develop responsibly the Carbon image benefit of their services. Better still is to use the metric to convince the financial markets of the reduction the industry can provide and to satisfy new customer concerns about climate change.

Energy efficiency attributes of equipment need to be better linked to Carbon metrics. Whether the metrics are defined in terms of carbon offsets or neutrality, the eventual agreed upon terms and accounting practices will most likely be defined by new groups that don't normally write standards such as the Global e-Sustainability Initiative[xxiii] or the Carbon Disclosure Project.[xxiv] These groups' efforts meet the criteria of speed, but as more "standard" standards for carbon equivalences are developed, decoupling targets will be paramount.

International Treaties and Laws on Carbon

International concerns about climate change led the United Nations to create an agreement known as the Kyoto Protocol.[xxv] Countries and businesses that sign this protocol commit to reducing their emissions of $CO_2$ and five other greenhouse gases, or to engage in emissions trading to offset their GHG production.

No country has passed national legislation requiring compliance with its treaty obligation, although the European Commission (EC) and individual US states have been taking action. The EC has passed legislation for vehicle emissions and energy-using products. In New Jersey, the Global Warming Response Act represents the first enforceable statewide program to set mandatory limits on GHG emissions from major industries. When it comes to the telecom industry, or more generally, the Information and Communications Technology (ICT) sector, electricity usage is the largest component of environmental footprint.[xxvi] Although ICT represents a small percentage of the world's Carbon production, it is growing rapidly and has considerable attention in the legislative world.[xv,xxivxxvii] Hence, it needs similar attention in the standards world.

Energy Regulation in Europe

The European Commission has established a framework directive for Energy-using Products, 2005/32/EC, or "EuP."[xxviii] Theoretically, the EuP covers any product that is dependent on energy input. The legislative impact of this directive comes from the implementing measures it spawns. Conformity assessment procedures are left to manufacturers. They can choose between internal design control[xxix] and a management system.[xxx] Compliance is by self-declaration.

The task for the production of harmonized standards (i.e. implementing measures) has been given by the EC to the Comité Européen de Normalisation Electrotechnique (CENELEC) and ETSI with the standardization mandate M/341.[xi, xxxi]

It is interesting to note that the Codes of Conduct[xxxii] have a very vague connection with EuP implementing measures. While Codes meet the criteria[xxxiii] for implementing measures, it is the ETSI standard that fits within the usual processes. The first ETSI standard to attempt this, TS 102 533, has run into problems as discussed. With the Code of Conduct for Data Centres now being constructed, it will be important for resulting standard to decouple pass/fail criteria to attain speed.

Energy Regulation in United States

Data center equipment regulation, particularly the servers that run the Internet, is underway in the US as well. Federal bill H.R.5646 [109th] would require the study of and promoting the use of, energy efficient computer servers in the United States. The bill requires the Environmental Protection Agency (EPA), through the ENERGY STAR program, to study a long set of items including energy efficiency.

Energy Star is a voluntary program administered jointly by the US Department of Energy and the EPA. Products that meet energy efficiency specifications may display the ENERGY STAR label. The label informs consumers who are choosing between products that a labeled product is more energy efficient than a non-labeled product.
Work is also underway to expand the scope of products covered under the EPA's Electronic Products Environmental Assessment Tool (EPEAT). On April 10, 2007, the EPA and its EPEAT partners published a Background and Discussion Document for the EPEAT Standards Development Roadmap for open discussion on what standards should be prioritized and what modifications might be made to the standardization process.

These programs may have benefits but they do not meet the need for network infrastructure equipment, which is both complex and highly configurable. Furthermore, the customers for this product are sophisticated in their technical knowledge. The telecom industry will need to develop its own standards with speed and requirement decoupling in order to avoid EPEAT attention.

Speed

Once the technical or methodology decisions on a standard are made, there is always some delay in publishing the standard. In the US, the process of ANSI[xxxiv] accreditation involves a balloting process that adds 3-4 months to the schedule. Given the convergence of the datacom and telecom industries (commonly referred to as ICT), producing a "major brand" standard such as an American National Standard is well worth doing.

There is a short-cut to getting a standard out though, as in a possible ATIS NIPP process: a properly pre-announced discussion at a plenary meeting may reach consensus about a document allowing it to be published as an ATIS document. This parallel process concept is sketched out in Figure 4. As shown, the ATIS standard provides an interim document meeting most but not all the ANSI essential requirements for an ANSI standard. It is published and available during the time it takes to receive public comment on the document as part of the ANSI process. The numbering system is such that ATIS and the superseding ANSI standard will have the same identification number. Once the ANSI standard is produced, the ATIS standard is replaced by a pointer to the ANSI standard.

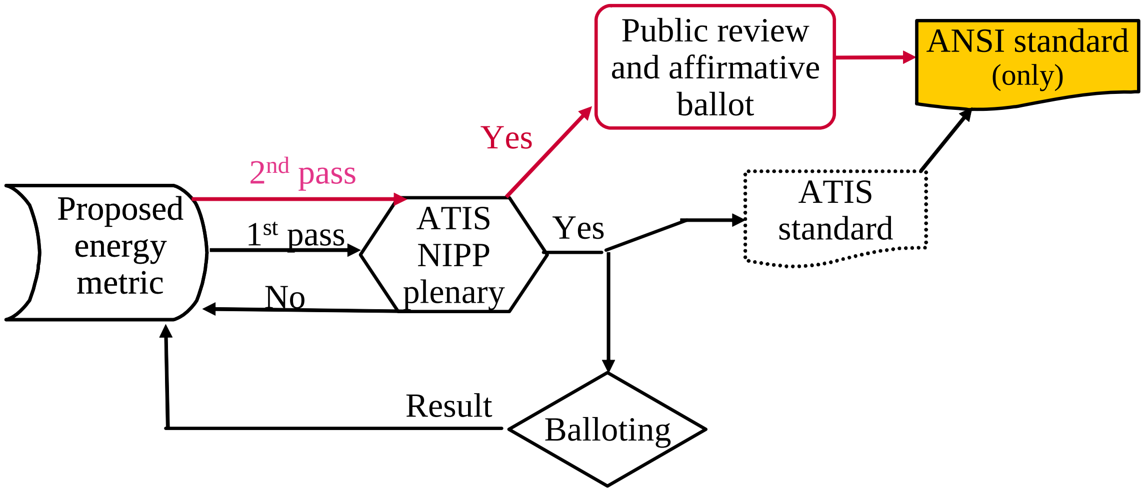


Figure 4 - Simplified process showing how an ad hoc committee could publish an ATIS standard prior to producing an ANSI standard

<u>Conclusion</u>

Standards setting is a vital tool for mitigating global climate change. This paper discusses the use of standards bodies to balance the good of an individual company versus the good of an industry or society as a whole. Of course, standards-setting is no panacea. It is, however, an important arrow in the quiver of responses to global climate change.

Standards setting can make its maximum contribution by the establishment of metrics for determining energy efficiency and environmental impact of products and services and test methods. Focusing on these two tasks will help avoid the inherent pitfall of "a race to the bottom" as a result of setting least-common denominator standards. And, it will produce timely mitigation results. In contrast, attempts to establish pass/fail criteria delay progress and may be counter productive.

Decoupling measure from pass/fail criteria will lead to the development of life-cycle analyses and a focus on the trade-off between acquisition costs and operating costs. This will lead to more efficient procurement decision-making and less environmental damage.

Work is underway in both Europe and the US with respect to setting standards and examining the energy-efficiency and climate-change impact of electronic and telecommunications equipment. This attention is highly desirable. Standards setting groups have technical expertise and ability to generate informed consensus. However, more speed than we see at the present is required by the seriousness of the climate-change problem. In the US, we should take advantage of new ways to publish an industry-acceptable standards prior to a full ANSI balloting. That only speeds the publishing process though. The more insidious problem is least-common denominator consensus. The best solution to these problems, on the basis of experience in the telecommunications-equipment industry, is to focus on metrics and testing and decouple these tasks from establishing pass/fail criteria.

With foresight and effort, we can provide industry with tools for implementing climate change reversal strategies. If we on our island home, Earth, are to avoid the fate of the Easter Islanders, we must meet this challenge.

The Moai of Easter Island[ii]

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[i] Wikipedia: Easter Island

[ii] Microsoft Online clipart

[iii] WiMax = Worldwide Interoperability for Microwave Access. It is a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL. WiMax trades off speed-of-mobility for higher data rates when compared to existing cell phone services.

[iv] DSL is an acronym for Digital Subscriber Line/Loop. It provides data transmission over an embedded base of copper-wire local telephone networks.

[v] The Broadband Code of Conduct and related presentations may be found at: http://re.jrc.ec.europa.eu/energyefficiency/html/standby_initiative_broadband%20communication.htm

[vi] The initial hope of the Code was to achieve a standby mode for DSL equipment. In standby or sleep mode, equipment is powered down such that it is not ready to carry out its intended function, but will awaken upon command. At least on the residential side of the network, standby mode sounds sensible, after all, computer monitors have standby settings. However, the technology of DSL however is such that it will

require extensive standards work on the signal processing algorithms or crosstalk with voice calls and other interference with result. Note that DSL uses the same copper line for voice and data paths.

[vii] The quotient is defined as: $P_{bb}=P_{totBBeq}/N_{subscrib-lines}$

where: $P_{bb}$ is the power consumption per line of broadband equipment for which the targets are defined in the standard. $P_{totBBeq}$ is the power used by the network device (DSLAM), placed at the Central Office or Remote cabinet of the operator, which connect multiple subscriber broadband connections towards a high-speed Internet backbone line. $N_{suscrib-lines}$ is the number of subscribers served by the network device (DSLAM) under test.

[viii] ATIS = Alliance for Telecommunications Industry Solutions; NIPP = Network Interface Power and Protection standards committee, which serves the telecommunication industry under the auspices of ATIS, NPS develops Network Power Systems standards.

[ix] Ibid; NPP develops Network Physical Protection standards.

[x] Gorini, Beniaminio; ETSI Work Programme on energy saving; to be published in the Procedings of INTELEC 2007, ID189; draft provided in advance by Mr. Gorini

[xi] Alcatel-Lucent used with permission.

[xii] Fargnoli, M and Kimura, F.; Sustainable Design of Modern Industrial Products; 13th CIRP International Conference on Life Cycle Engineering; Proceedings of the LCE2006; p. 189-194.

[xiii] Upcoming conferences include 3rd International Conference on Life Cycle Management 2007;Unversity of Zurich at Irchel, August 27 to 29th and InLCA Conference, Portland, Oregon - October 2 - 4th

[xiv] To a lesser extent this is true for datacom products as well. Servers and other datacom equipment does not have a long a life as telecom products.

[xv] ETNO-WWF. 2006. "Saving the climate @ the speed of light. First roadmap for reduced $CO_2$ emissions in the EU and beyond",

http://www.etno.be/Portals/34/ETNO%20Documents/Sustainability/Climate%20Change%20Road%20Map.pdf

[xvi] International Telecommunication Union, 2006. World Telecommunication/ICT report; Measuring ICT for Social and Economic Development. p. 202

[xvii] Irwin, F. 2004. Gaining the Air Quality and Climate Benefit from Telework. http://www.safeclimate.net/business/solutions/teleworkguide.pdf

[xviii] ISO. 2005. Greenhouse gases – ISO 14064 Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements

[xix] World Resource Institute (WRI) – World Business Council for Sustainable Development (WBCSD) 2005. The Greenhouse Gas Protocol; GHG protocol for project accounting, p. 148

[xx] Spannagle, M. 2004. A Comparison of ISO 14064 Part 1 and the GHG Protocol Corporate Module, http://www.ecologia.org/ems/ghg/news/cop9/comparison.html

[xxi] Prindle, WR; Shipley, A.M; Elliott, RN, Energy Efficiency's Role in a Carbon Cap-and-Trade System: Modeling Results from the Regional Greenhouse Gas Initiative; May 2006; Report Number E064 American Council for an Energy-Efficient Economy; http://aceee.org

[xxii] The Global e-Sustainability Initiative is developing a video-teleconferencing tool that equates such service provider-based technology to carbon-saving metrics.

[xxiii] www.gesi.org. See especially the Climate Change Working Group

[xxiv] Carbon Disclosure Project; www.cdproject.net

[xxv] The Kyoto Protocol to the United Nations Framework Convention on Climate Change is an amendment to the international treaty on climate change that went into force in 2005 and expires in 2012. http://unfccc.int/kyoto_protocol/items/2830.php.

[xxvi] ETSI. 2007. TR102531 Environmental Engineering (EE); Better determination of equipment energy consumption for improved sizing of power plant.

[xxvii] Gartner, April 26, 2007 press release. http://www.gartner.com/it/page.jsp?id=503867. Detailing the impact of sector emissions it credited ICT with 2% of global $CO_2$ emissions. This included the in-use phase of all commercial and governmental IT and telecommunications infrastructure worldwide, but not consumer electronics other than cell phones and PCs.

[xxviii] EU, Directive 2005/32/EC of the European Parliament and of the Council of 6 July 2005, http://europa.eu.int/comm/enterprise/eco_design/dir2 005-32.htm

[xxix] defined in Annex IV of the 2005/32/ECD directive in ref xxviii

[xxx] defined in Annex V of the 2005/32/ECD directive in ref xxviii

[xxxi] Liaison was established between ETSI and CENELEC to provide a single response to the European Commission

[xxxii] Including the forthcoming Code of Conduct for Data Centres that covers servers and cooling systems.

[xxxiii] ref. art. 15 of 2005/32/EC in ref xxviii

[xxxiv] ANSI = American National Standards Institute