Standardization of Telecom Equipment for Green Telecom

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Abstract

Now a day, the telecom vendors have started labeling their offerings as "green" and "environment-friendly" But one important detail about this theme is often missing: verifiable data to support these "green" marketing claims. ECR initiative tries to fill this resulting gap by discussing the practical aspects of achieving and objectively measuring energy efficiency in the telecom world. As a first step, we can define an efficiency metric that supports informed decisions related to power consumption of the network equipment. In the remainder of the document, new criteria are used to define the best energy practices and the practical aspects of energy efficiency for the networking industry.

1. Introduction

India has announced the goal of reducing the GHG emissions intensity of its GDP by 20-25% by the year 2020 as compared to 2005. In India around 4% of the GHG emissions are from the ICT sector which is around 80 million tonnes of CO2 emission every year. And around 25% of this emission i.e. 1% of the total GHG emissions are from the telecom sector which is around 20 million tonnes of CO2. In India, total carbon emission on account of diesel used by telecom towers is estimated to be around 10 Mt of carbon-dioxide. First step for carbon emission reduction by the ICT sector is to measure emission quantities from telecom networks and devices, encompassing the entire cycle from manufacturing to waste disposal. Measuring the impact of ICTs on climate change is an emerging area that needs to be further improved, including the calculation and collection of data that will help monitor environmental impacts along the complete ICT devices and services life cycles, including embedded GHG emissions and GHG emissions during use and end of life phases. Green ICT metrics enable telecom operators to quickly estimate the energy efficiency and carbon footprint involved in their operations. Green ICT metrics will also help to compare the results of one telecom operator with other operators to find any energy efficiency improvement need to be made. The primary aspect of green ICT metrics would be the estimation of carbon footprints, minimization of energy consumption in telecom networks through use of energy-efficient technologies and protocols, transitioning to renewable energy sources, eco-friendly consumables and evolving a carbon credit policy.

The predominant constituent of CO2 emission in the telecom network is during the actual use of the network equipment. The utilization of the network leads to power consumption, which is the prime factor for emission of CO2 in the network. The reduction in power consumption could be effected by better network planning, effective infra-sharing, and adaptation of energy efficient technologies, use of renewable energy sources and effective use of available power. In the telecom network, the components that contribute to carbon emissions include the Radio Access Network (RAN), Fixed line network, Fiber to the x (FTTx) networks in the access networks, the core, Aggregators(backhauls) and the transmission systems in the central core network. The distribution of power consumption across these networks is indicated in Figure 1 below:

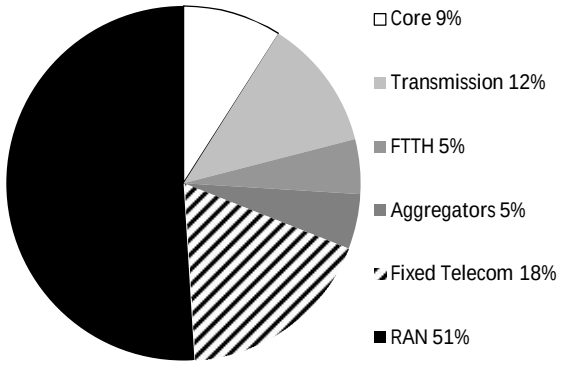

Figure 1: The distribution of power consumption across the telecom access network.

Some of the measures that could be followed by the service providers for reducing the telecom sector footprint could be broadly classified as:

i) Better network planning
ii) Infrastructure sharing
iii) Adoption of energy efficient equipment and innovative technologies
iv) Improvement in supply of grid power
v) Use of renewable sources of energy

2. TRAI Recommendations & DoT's directions

The Telecom Regulatory Authority of India (TRAI) has released a consultation paper on "*green telecom*" in 2010 which offers guidance for the use of eco-friendly equipment in the ICT sector. The paper addresses the critical issues like increasing carbon foot print-contribution of telecom industry, need for carbon credit policy for the sector, methods/ options to reduce the carbon foot print by ICT industry in India, standardization of Green Telecom equipment and incentive for their adoption and framework for monitoring carbon emission and corrective action for telecom sector. Based on the TRAI's recommendations, DOT issued the following directions to the licensees for implementation with immediate effect:

1. At least 50% of all rural towers and 20% of the urban towers are to be powered by hybrid power (Renewable Energy Technologies (RET) + Grid power) by 2015, while 75% of rural towers and 33% of urban towers are to be powered by hybrid power by 2020.

2. All telecom products, equipments and services in the telecom network should be Energy and performance assessed and certified " Green Passport [GP]" utilizing the ECR's Rating and the Energy 'passport' determined by the year 2015.

3. TEC shall be the nodal centre that will certify telecom products, equipments and services on the basis of ECR ratings. TEC may either appoint independent certifying agencies under its guidance or shall certify the same through their Quality Assurance teams. TEC shall prepare and bring out the 'ECR Document' delineating the specifics of the test procedures and the measurement methodology utilized.

4. All service providers should declare to TRAI, the carbon footprint of their network operations in the format prescribed by TRAI. This declaration should be undertaken after adopting the formulae and procedures prescribed by TRAI. The Declaration of the carbon footprints should be done twice in a year i.e. half yearly report for the period ending September to be submitted by 15th of November and the succeeding half yearly report for the period ending March to be submitted by 15th of May each year.

5. Service providers should adopt a Voluntary Code of Practice encompassing energy efficient Network Planning, infra-sharing, deployment of energy efficient technologies and adoption of Renewable Energy Technology (RET) including the following elements:

a. The network operators should progressively induct carefully designed and optimized energy efficient radio networks that reduce overall power and energy consumption.
b. Service providers should Endeavour to ensure that the total power consumption of each BTS will not exceed 500W by the year 2020 for 2+2+2 Configuration of BTS. TEC shall regularly standardize and prescribe specifications for Telecom Equipments of different Technologies with respect to power consumption levels. Services providers should adhere to the TEC specifications in order to reduce the total power consumption of BTS.
c. A phased programme should be put in place by the telecom services providers to have their cell sites, particularly in the rural areas, powered by hybrid renewable sources including wind energy, solar energy, fuel cells or a combination thereof. The eventual goal under this phased programme is to ensure that around 50% of all towers in the rural areas are powered by hybrid renewable sources by the year 2015.
d. Service providers through their associations should consensually evolve the voluntary code of practice and submit the same to TRAI within three months from the date of issue of this letter.

6. Services providers should evolve a 'Carbon Credit Policy' in line with carbon credit

norms with the ultimate objective of achieving a maximum of 50% over the carbon footprint levels of the Base Year in rural areas and achieving a maximum of 66% over the carbon footprint levels of the Base Year in urban areas by the year 2020. The base year for calculating all existing carbon footprints would be 2011, with an implementation period of one year. Hence the first year of carbon reduction would be the year 2012.

7. Based on the details of footprint declared by all service providers, service providers should aim at Carbon emission d\reduction targets for the mobile network at 5% by the year 2012 – 2013, 8% by the year 2014-2015, 12% by the year 2016- 2017 and 17% by the year 2018- 2019.

It has also been decided by the DOT to adopt measures recommended by TRAI on green Telecommunications. Accordingly all the mobile phones/Telephone instruments manufacturers were directed to follow the E-wastage (Management and Handling) rule 2011 dated 12th May 2011 notified by the Ministry of Environment and Forests, while manufacturing/distributing phones. The following directions were issued to the mobile phone/telephone instruments manufacturers for implementation:

1. All Mobile Phones/telephone instruments should be free of brominates and chlorinated compounds and antimony trioxide in accordance with the E-wastage (Management and Handling) rule 2011 dated 12th May 2011 notified by the Ministry of Environment and Forests.
2. All Mobile manufacturers/distributors should be required to place collection bins at appropriate places for collection of e-wastage-mobile phones, batteries, chargers etc. The e wastage should be safely disposed or recycled as per the prevailing standards. The collection, storage, transportation, segregation, refurbishment, dismantling, recycling and disposal of all e-wastage shall be in accordance with the E-wastage (Management and Handling) rule 2011 dated 12th May 2011 notified by the Ministry of Environment and Forests and the procedures prescribed in the guidelines by the pollution control board from time to time.

3. TEC Agenda on Green Telecom

Based on TRAI's recommendation, Department of Telecommunication issued the following guidelines:

1. All Telecom products, equipments and services in the Telecom Network should be Energy and Performance Assessed and certified " Green Passport[GP]" utilizing the ECR's Rating and the Energy 'passport' determined by the year 2015.
2. The TEC should be nodal centre that will certify telecom products, equipments and services on the basis of ECR ratings. TEC could either appoint independent certifying agencies

under its guidance or will certify the same through their Quality Assurance Teams. TEC should also prepare and bring out the 'ECR Document delineating the specifics of the test procedures and the measurement methodology utilized.

3. Service providers should Endeavour to ensure that the total power consumption of each BTS will not exceed 500W by the year 2020 for 2+2+2 configuration of BTS.

Accordingly, TEC has been entrusted with the job of certification of Telecom Products, equipments and services on the basis of ECR ratings. It has also been decided that TEC will regularly standardize and prescribe specifications for Telecom Equipments of different technologies with respect to power consumption levels. Service providers should adhere to the TEC specifications in order to reduce the total power consumption of BTS.

4. What is a Carbon Footprint?

In most cases Carbon Footprint is used as a generic synonym for emissions of carbon dioxide or greenhouse gases expressed in CO2 equivalents. It can be defined as it is a measure of the exclusive total amount of carbon dioxide emissions that is directly and indirectly caused by an activity or is accumulated over the life stages of a product. Although, there is not any single definition of Carbon Footprint. Few of them are as follows:

• "The property that is often referred to as a carbon footprint is actually a 'carbon weight' of kilograms or tonnes per person or activity." - Hammond 2007

• The total set of greenhouse gas (GHG) Emissions caused by an organization, event, Product or person - Carbon Trust, 2009

• A measure of the total amount of carbon dioxide (CO2) and Methane (CH4) emissions of a defined population, system or activity, considering all relevant sources, sinks and storage within the spatial and temporal boundary of the population, system or activity of interest. Calculated as carbon dioxide equivalent (CO2e) using the relevant 100 year global warming potential (GWP100)." Wright, L.; Kemp, S., Williams, I. (2011).

• "The demand on bio capacity required to sequester (through photosynthesis) the carbon dioxide (CO2) emissions from fossil fuel combustions" Global Footprint Network, 2007

Total Carbon Footprint of Telecom Sector is the sum of Carbon footprints:

$$\mathbf{C_T} = C_L + C_M + C_{FB} + C_{FT} + C_C + C_A + C_{TX} + C_{IP} \text{ (in tonnes)}$$

Where

C_M is Carbon footprint of 'Mobile Networks',

C_{FB} is Carbon footprint of 'Fixed Broadband',

C_{FT} is Carbon footprint of 'Fiber to the X'

C_L is Carbon footprint of 'Landline Networks',

C_C is Carbon footprint of Core Networks,

C_A is Carbon footprint of Aggregates/Backhauls

C_{TX} is Carbon footprint of Transmission Networks

C_{IP} is Carbon footprint of Telecom Infrastructure Providers

5. International approaches to determine Energy Efficiency

5.1 European Telecommunications Standards Institute (ETSI): ETSI technical committee on Environmental Engineering (ETSI EE) is concerned with the reduction of energy consumption and GHG emissions in telecommunications equipment and related infrastructure. They consider their work scope as follows:

- The use of alternative energy sources in telecommunication installations.
- Reverse powering of small access network node by end-user equipment.
- Energy efficiency of wireless access network equipment.
- ICT energy consumption and global energy impact assessment methods.
- Life Cycle Assessment (LCA) of ICT equipment, networks and services.

ETSI is looking to measure energy consumption of equipment, and power consumption at different traffic loads. The metrics provided by ETSI facilitates measuring the power used by ICT equipment at various loads. For example in case of RBS equipment power consumption of the equipment is:

$$P_{equipment} = \frac{P_{BH} * t_{BH} + P_{med} * t_{med} + P_{low} * t_{low}}{t_{BH} + t_{med} + t_{low}}$$

[W]

Where

P_{BH} is the power consumption [W] with busy hour load.

P_{med} is the power consumption [W] with medium term load.

P_{low} is the power consumption [W] with low load.

t_{BH}, t_{med} and t_{low} [hour] are duration of different load levels.

5.2 International Telecommunication Union (ITU-T): ITU-T established the focus group on ICTs and climate change in July 2008 and took into account two study points: reducing energy consumption in ICT products and helping other sectors reduce their energy consumption. Based on that the scope of ITU-T SG5 was expanded 2009 to also cover climate change and energy efficiency related issues.

ITU-T SG 5 is discusses mainly on clarification of GHG mitigation techniques; GHG impact assessment methodologies for contribution by the green of ICTs and the green by ICTs, DC power feeding system; energy efficiency metrics; universal power adapter for mobile cell phones; and environmental protection and recycling. As per ITU-T power management capability of equipment can be measured as follows:

- Energy Consumption Rating or ECR

$$ECR = \frac{E_f}{T_f} \text{ [Watts/ Gbps]}$$

Where:

T_f = maximum throughput (Gbps) achieved in the measurement.

E_f = energy consumption (Watts) measured during running test.

- TEER value.
- Energy Efficiency :

$$Power\ Usage\ effectiveness\ (PUE) = \frac{Total\ facility\ power\ consumption}{ICT\ equipment\ power\ consumption}$$

5.3 Alliance for Telecommunication Industry Solutions (ATIS): The ATIS executive committee of the board commissioned the creation of an exploratory group on green, in September 2008.

The Sustainability in Telecom Energy Efficiency Committee (STEP) develops and recommends standards and technical reports related to power systems, electrical and physical protection for the exchange and interexchange carrier networks, and interfaces associated with user access to telecommunications networks. Efforts relating to the green initiative occur in the following subcommittees and working groups:

The Telecommunications Energy Efficiency Subcommittee (STEP-TEE) develops standards and technical reports which define energy efficiency metrics, measurement techniques and new technologies, as well as operational practices for telecommunications components, systems and facilities.

The Network Physical Protection Subcommittee Pb-free Working Group (STEP - NPP PWG) proposes, develops, and recommends standards and technical reports relating to the use of lead or the restriction of lead in solder used in the manufacturing of telecommunications network equipment.

ATIS is looking to measure energy consumption of equipment, and power consumption at different traffic loads. The metrics provided by ATIS facilitates measuring the power used by ICT equipment at various loads. They recommend TEER as metric to measure the energy efficiency in ICT sector.

Telecommunications Energy Efficiency Ratio or TEER is the ratio of useful work over Power.

$$TEER = \frac{Usefulwork}{power} \text{ [Mbps (example)/W]}$$

where:

Usefulwork = It can be data rate, throughput, processes per second, etc.

power = Power in Watts (dependent on the equipment measurement).

The higher the TEER value, the more energy efficient the equipment is compared to other like equipment.

5.4 Japanese ICT Ecology Guideline Council: They have classified telecom equipment in broadly seven categories on the basis of ISO-OSI model. Efficiency of the equipment are defined in terms of Figure of merit which is defines as either

- Power Consumption
- $\frac{\text{Power consumption (W)}}{\text{Maximum effective transmission rate (Gbps)}}$
- $\frac{\text{Maximum throughput (Gbps)}}{\text{Avg power consumption (W)}}$
- $\frac{\text{Average power consumption (W)}}{\text{Total number of lines}}$

6. Green ICT metrics

The generic definition of telecommunications equipment efficiency is the ratio of power to the useful work done. Useful work and power are terms that would be defined in each supplemental standard. Additionally, in the supplemental standards, the following would be provided:

a. The scale of the energy efficiency metric for each class of equipment would be defined so that the metrics for similar class of equipment may be made comparable.

b. The lower the value of the energy efficiency metric, the more energy efficient is the metric compared to others of similar configuration.

1. **Equipment level energy efficiency indication**

a. Quantify the energy efficiency at the equipment level

b. Help in selecting efficient ICT equipments in design and planning phase

2. **Facility level energy efficiency indication**

a. Express the energy efficiency at the facility or site level

b. Consider air-conditioning, lighting of the facility

3. **Power usage efficiency indication with different loads**

a. Capability to express the impact of ICT in terms of the power usage efficiency

b. Choose equipment that provides highest energy efficiency at various loads

4. **Carbon footprint indication**

a. Capability to express the impact of ICT in terms of the carbon (GHG) emissions

b. Consider the source of the power

5. **Benchmarking**

a. Metrics should allow benchmark values

b. Evaluation of various ICT facilities

6. **Unambiguous meaning**

a. Metrics should have clear meaning

b. Designed to indicate the relative improvement amongst compared ICT products and services

7. Adaptable to new technology development

a. Metrics should be technology independent

b. It should be applicable to all current technologies and adaptable to future technologies .

8. **Metrics need to be vendor neutral**

a. It should be acceptable to all stakeholders

7. ECR - ECR Definition, Test procedure and Measurement methodology

7.1 Defining Efficiency Criteria: The Energy Consumption Rating (ECR) is a framework for measuring the energy efficiency of Network and Telecom Devices. The energy consumption for telecom equipment is not a simple metric; it depends on many parameters, most prominently technology, performance, and applications. This mix of parameters makes it challenging to estimate the actual energy efficiency of network equipment.

As different vendors develop competing technologies and architectures, this leads to unequal power consumption between equipment belonging to the same class. Therefore, in theory, to determine the winner in energy consumption, it would be sufficient to put two or more network devices under the same load and measure their respective power draw. In reality, however, this is rarely possible.

First of all, full-scale testing of network equipment requires a non-trivial investment in test gear, possibly costing millions of dollars in the case of high-end routers and switches. Second, network devices come in different capacities, and this raises a question as to what should be the system configuration for the test.

Fully configured platforms of unequal scale will obviously produce energy readings that are not directly comparable.

In order to define efficiency metric, there is need to normalize energy consumption E by effective full-duplex throughput T. This will give us a normalized energy consumption rating (ECR),

$$ECR = E/T$$

Where E denotes the energy consumption (in watts) and T denotes the effective system throughput (in bits per second).

The values of E and T may come from either internal testing or the vendor's data; in both the cases, they should be verifiable.

For the current generation of network equipment, ECR is most conveniently expressed in watts/Gbps, identifying the amount of energy (in joules) required to move an array of data (in

bits) across the device. Equipments with better (lower) ECR ratings will spend less energy to move the same amount of payload.

7.2 Base Metrics and Device Comparisons: Comparing product metrics allows consumers, enterprises and carriers to add energy efficiency to purchase criteria. The most straightforward way to estimate the technology level of a network or telecom system is to normalize its energy consumption to the highest sustained throughput recorded in the test.

ECR = E100/Tf *(expressed in W/Gbps)*

where

Tf = maximum throughput (Gbps) (See "Effective Throughput Calculation")

E100 = energy consumption (watts) measured during step 2 of Test Procedure 1

ECR1 (energy consumption rating) is normalized to W/Gbps and has a physical meaning of energy consumption to move one gigabit worth of line-level data per second. ECR typically reflects the best possible platform performance within a set of hardware and software features.

Although ECR is an accurate measure of SUT technology level, network systems in the field are unlikely to demonstrate comparable efficiency numbers over sustained intervals. This situation is related to the fact that packet networks tend to exhibit low long-term utilization numbers coupled with significant short-term bursts (peaks), which causes service providers to size network infrastructure based on the higher end of traffic profiles and subsequently lose energy efficiency during off-peak times.

There is compelling opportunity for energy savings here because vendors can choose to optimize their products for energy consumption in the middle—rather than at the top—of their operational load band. If the energy efficiency needs to be measured for varying load, energy efficiency metric over a variable-load cycle (ECR-VL) [19] is a good metric and recommended by TRAI. This fact can be reflected in a weighted, variable-load metric, such as ECR-VL:

$$\textbf{ECR-VL} = \frac{(\alpha * E100 + \beta * E50 + \gamma * E30 + \delta * E10 + \varepsilon * Ei)}{(\alpha * Tf + \beta * T50 + \gamma * T30 + \delta * T10)}$$

Where

Tf = maximum throughput (Gbps) achieved in the measurement cycle

T50 = Tf * 0.5

T30 = Tf * 0.3

T10 = Tf * 0.1

E100 = energy consumption (watts) measured during step 2, Test Procedure 1

E50 = energy consumption (watts) measured during step 3, Test Procedure 1

E30 = energy consumption (watts) measured during step 4, Test Procedure 1

E10 = energy consumption (watts) measured during step 5, Test Procedure 1

Ei = energy consumption (watts) measured during step 6, Test Procedure 1

α, β, γ, δ, ε are weight coefficients selected such as (α + β + γ + δ + ε) = 1

ECR-VL is measured in W/Gbps and has a physical meaning of an average energy rating in a reference network described by array of utilization weights (α, β, γ, δ, **ε**).

In this weight array, α represents a relative weight of a peak-utilization period and ε represents a relative weight of an idle interval during which a network system does no useful work. All other weights are sized for relative duration of the intervals in between.

An ideal network system following the Barroso's principle of energy-proportional computing [IEEE Computer 2007] should be able to demonstrate an ECR-VL rating to be close to ECR. Therefore, ECR-VL is a measure of dynamic (real-time) energy management capability of a network device.

Example 1

he SUT has demonstrated the following results:

Tf *= 627.20 Gbps @* ***E****100 = 5,856 Watts*

T50 *= 313.60 Gbps @* ***E****50 = 5,616 Watts @* ***P****50 = 5,120 Watts*

T30 *= 188.16 Gbps @* ***E****30 = 5,520 Watts @* ***P****30 = 4,810 Watts*

Ti *= 0 Gbps @* ***E****i = 5,376 Watts*

ECR *= E100/Tf = 5,856/627.20 =* ***9.34*** *W/Gbps*

Considering α = 0.1, β = 0.5, γ=0.3, δ=0, ε = 0.1:

ECR-VL *= (α*E100 + β*E50 + γ*E30 + ε *Ei)/ (α*Tf + β*T50 + γ*T30) =*

*= (0.1*5,856 + 0.5*5,616 + 0.3*5,520 + 0.1*5,376)/(0.1*627.2 + 0.5*313.6 + 0.3*188.2) = 5587.2/275.968 =* ***20.25*** *W/Gbps*

Example 2

Four routers from different vendors demonstrated the following results:

	Product A	Product B	Product C	Product D
Product class	Core router	Core router	Core router	Core router
Nominal capacity (vendor rated, halfduplex)	640 Gbps	1.28 Tbps	1.6 Tbps	3.2 Tbps
Tf *(measured)*	300.1 Gbps	627.2 Gbps	790 Gbps	1.42 Tbps
E100 *(measured)*	4,501 W	5,856 W	7,990 W	11,360 W
ECR	15 W/Gbps	9.34 W/Gbps	10 W/Gbps	**8 W/Gbps**
ECR-VL	30 W/Gbps	20 W/Gbps	**12 W/Gbps**	14 W/Gbps

From this table we can see the effect of normalization: Although Product A has the lowest energy consumption per system, its

relative efficiency numbers are the worst in its class.

Likewise, Product D has the highest absolute consumption but demonstrates the best peak efficiency. However, the lowest cost of operation will probably (depending on traffic profile) be shown by Product C, which has the best dynamic-energy management capabilities.

7.3 What to expect from an ECR Metric: As we mentioned before, *ECR* can be a valid differentiator within a product class, where several vendors may contend for energy efficiency with competing technologies and system architectures. Equipment with better (lower) *ECR* ratings will spend less energy to move the same amount of payload. This is where network equipment loses the analogy to light bulbs and passenger cars—the amount of commercial payload (system capacity) must be factored into efficiency estimates. If capacity requirements are growing, they may or may not be satisfied within the energy budget originally reserved for the legacy network. Internet traffic can, in fact, be compared to commercial freight—it naturally takes more energy to transport an increasing volume of cargo.

Contingent on standardization [ECR 1.0.2], knowledge of an efficiency metric immediately positions a product relative to its competition on the energy grid; this is informative and promotes competition.

But the value of a normalized efficiency rating goes well beyond head-to-head platform comparisons.

A standardized way of measuring energy efficiency paves the way for forward-looking requirements and goals. A typical network equipment vendor cannot comply with the goals set by a single testing laboratory—this does not scale, as every customer may come with a unique set of tests and network conditions. The picture changes with *ECR*, which represents a unified way of testing and can be used for defining long-term R&D targets.

On the other hand, standardization of *ECR* measurements will mean that each specific (customer) setting may not be met exactly. For instance, if a customer only plans to deploy 600 Gbps of switching capacity, and the considered platform is rated at 1.6 Tbps in a full configuration, the standardized *ECR* value will not match the actual efficiency numbers observed in the field. The same restriction applies to a standardized test load relative to any particular packet traffic.

However, there is a good chance that relative *ECR* standings between the platforms will stay the same across a wide range of configurations and offered load profiles—an important assumption that represents a compromise between custom and standardized testing. While

the latter should be freely and widely available, the former may require significant investments, but yield better precision. We expect that for most practical purposes, a standardized *ECR* rating will be an adequate energy performance estimate.

In environmental terms, choosing equipment with a 10 percent ECR advantage can be equal to a one year advantage on the carbon emission roadmap; a 50 percent advantage can be as good as reaching a forward-looking target covering the lifetime of new network deployment. This is where technology intersects with ecology.

8. Conclusion

Following ratification of the Kyoto protocol, many countries have accepted CO2 reduction targets relative to 1990 emission levels. As a result, energy-consuming industries have to comply with the new legislation. The monetary aspect of such a transition may have less impact compared to political values and administrative mandates that can cause some corporations to find themselves in dire need of energy-efficient technologies. Looking at immediate targets (2008-2010), ECR forms the basis for equipment selection criteria. When planning for future (2011-2020) goals, ECR becomes a set of values and common language to speak to equipment manufacturers, which can be critically important for success of environmental efforts worldwide.

As far as the TEC role is concerned, the GR on Power system based on renewable energy sources (Solar and wind) has been released by TEC. It has been observed that only IP based devices/equipments such as Routers, Ethernet Switches, Gateways, can be green certified through ECR based consumption Ratings. M/s IXIA has demonstrated through a webinar how to measure ECR of a device, therefore, it may be possible to measure ECR of any IP device in the lab. The issues under discussions include classification of Telecom Equipments based on functions and mode of operations, prioritization based on their severity of impact on carbon emission, devising suitable ratios and metrics for measuring ECR for packet switched network, recommending assessment procedure and scales for rating based on the value of metrics need to be estimated

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