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# Energy Efficiency: Green Telecom

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TRAI

# Green Telecom is not a hype!

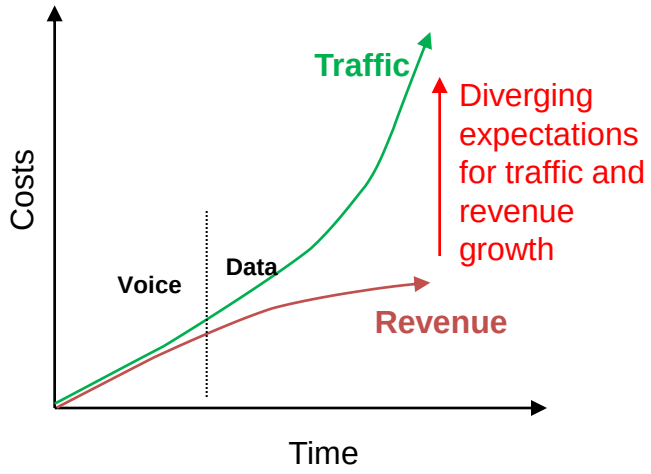
- Reduced power-consumption in equipment reduces energy-consumption
  - And COST of equipment and operation!
- Applications like e.g. Video-conferencing (tele-presence) reduces energy-consumption
  - And COST of travelling!



# Motivation & driver

- Political motivation: $C0_2$ emissions must be reduced
  - The greenhouse effect is an increasing problem
  - Climate change results
- Driver: Reduce cost through reducing energy consumption
  - Equipment power consumption

# Green Telecom as an Enabler




Trends:

- Exponential growth in data traffic
- Number of base stations / area increasing for higher capacity
- Revenue growth constrained and dependent on new services

**Energy use cannot follow traffic growth without significant increase in energy consumption**

- Must reduce energy use per data bit carried

**Number of base stations increasing**

- Operating power per cell must reduce



| **CO2 emissions from the Telecom sector** |
| --- |
| ~4% of emissions from the ICT, (~ 80 million tons of $CO_2$ per year) |
| ~1% from the telecom sector (~20 million tons of $CO_2$ per year.<br>Global emissions from telecom sector ~0.7% |
| $CO_2$ emissions per subscriber: 18kg<br>Global average of 8 Kg |
| Telecom enables second order/third order impacts of ICTs. - tele-working, tele-medicine |
| 100 million tons of $CO_2$ emission reduction GOI target<br>30% reduction using ICT adoption in buildings, transport and other sectors. (National Mission on Enhanced Energy Efficiency, NMEEE) |



# ICT effects

- ICT could deliver 7.8 Gt Co2 emissions saving by 2020
- Expected – cloud computing, smart logistics, smart working & intelligent applications- to save energy
- Telecom enterprises provide various services that reduces society's carbon footprint.

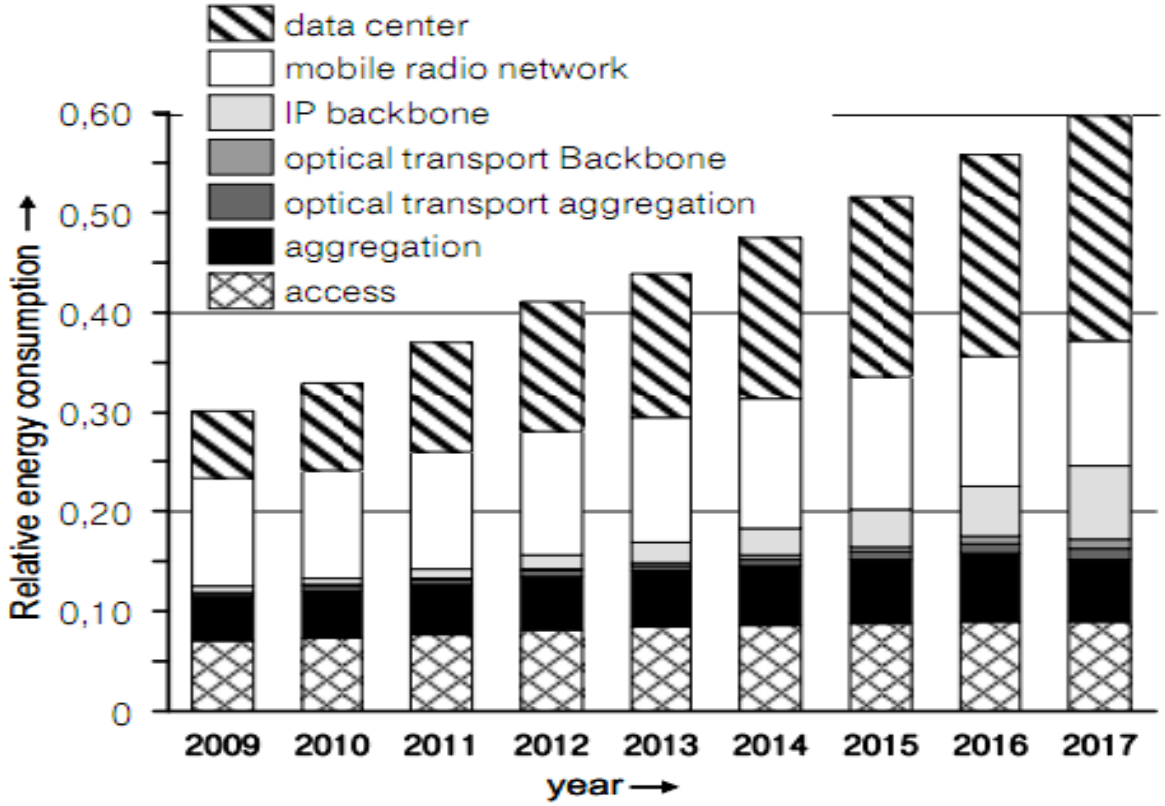


# Power Consumption

- Telecom Power consumption is growing
  - IP-backbone power consumption grows fast
  - Router bypass combats IP-router power consumption
  - 10 G GPON reduces per Mbyte energy efficiency raised by 30%
  - New RANs sharply reduce TCO and power consumption - 67-80% reduction
  - Integrated bearer –IP/OTN reduce 25%
  - Enhance PA efficiency
- International standards – should focus on energy standards, specific guidelines for components o engineering and also regulation of radio spectrum



# Energy consumption distribution and prediction



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# The Effects of ICT on Environmental Sustainability

**1st Order**

(direct result of its existence)

GHG Emission

E-Waste

Hazardous Substances

Use of Scarce and Nonrenewable Resources

**2nd Order**

(from application)

Travel Substitution

Transportation Optimization


E-Business E-Government


Environmental Control Systems

**3rd Order**

(Long term socio-economic structural changes)

Energy Intensity

GHG Intensity

Transportation Intensity

Material Intensity

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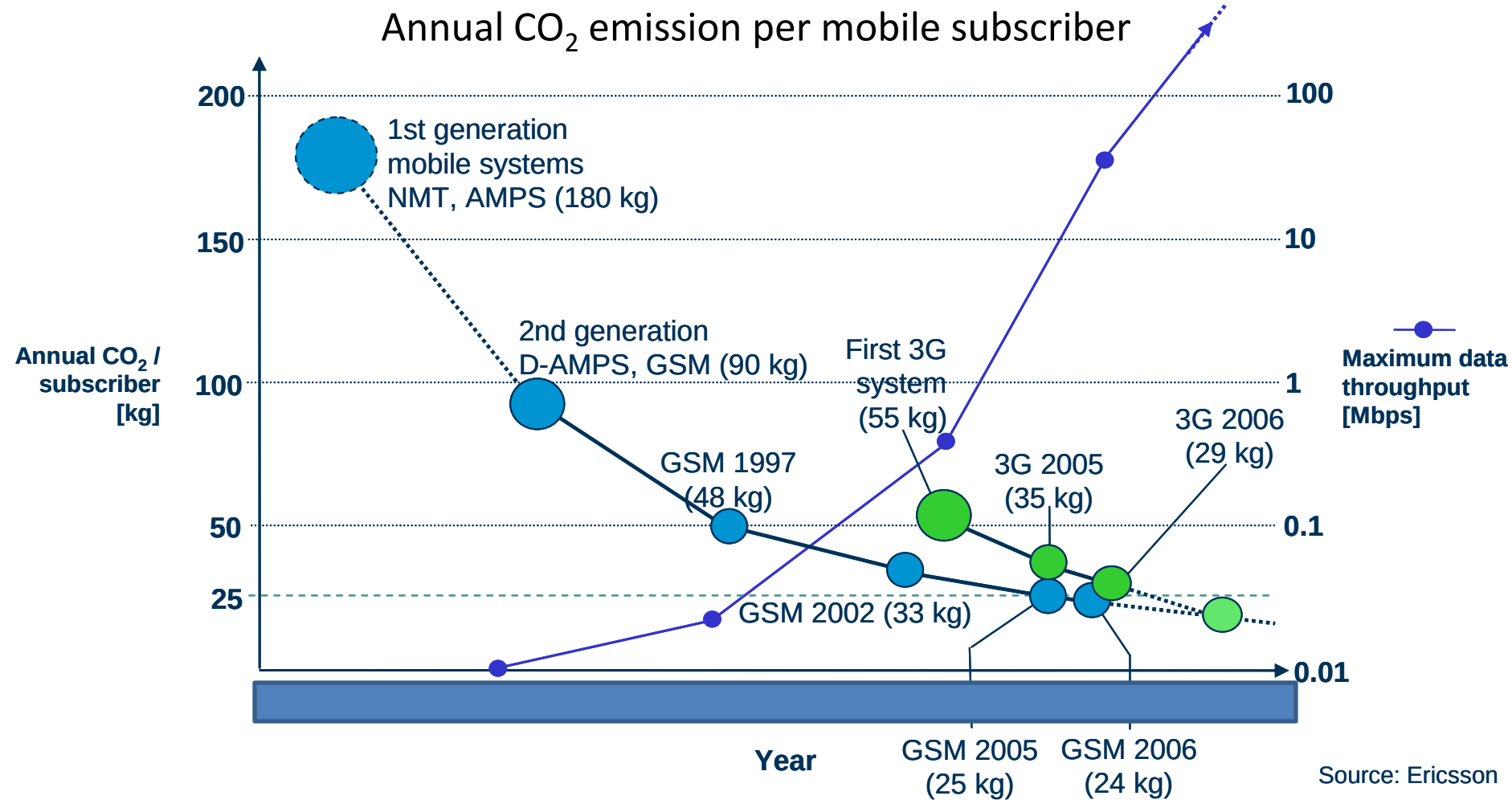
# What trends do ICTs have at the device level?

- Market doubles every 5 years
  - E.g. Broadband expanding to more users
  - Until market saturates
  - Then upgrades replace ‘obsolete’ devices
- New devices become a ‘must have’
  - E.g. HDTV
- Annual growth rate of internet traffic is 85%
  - Increasing the energy conversion depending on the relative efficiency of devices in J/bit
  - Unsustainable growth at the micro level
- **All three trends increase demand for energy mostly sourced from fossil fuel**



# LifeCycle Assessment (LCA)

## Annual $CO_2$ emission per mobile subscriber




Source: Ericsson

# GROWING INDIAN TELECOM MARKET- INCREASING $CO_2$ EMISSION

- India's telecom market is the world's second largest on the basis of number of subscribers
  - And the sector enjoys consistent growth rate
- The revolution in this sector has improved the lives of millions through better connectivity.
- The successful auction of the 3G and Broadband Wireless Access spectrum helped in further growth
- The telecom market is attracting huge amounts of FDI

# ENERGY MANAGEMENT AND CHALLENGES

- Energy is a dominant cost component for telecom companies.
- The energy consumption is mainly for operating the BTS.
- The gap between the demand of the customers connected to the grid and the available electricity is 10% of the total requirement.
- Majority of the mobile towers are in the rural sector, where continuous supply of grid connected electricity is not available.
- Moreover, 25% of these towers are located in areas with no grid connectivity

# ENERGY MANAGEMENT AND CHALLENGES

- Electricity availability in a day ranges from about 7 to 21 hrs. across the major telecom circles in India.
- In order to curb this menace, the telecom companies keep a backup power source.
- The backup power source will be a 15-25KV a diesel generator.
- Energy expenses constitute one third of total OPEX costs for telecom towers.
- Each tower consumes an average of 4000 liter of diesel every year.
- A telecom operator should have to spend Rs. 3 billion every month running this generators.
- By using diesel generator, the telecom sector is responsible for over 8 million tones of $CO_2$ emissions annually.



Green Telecom N/Ws

## Improvement in Supply of Grid Power

- 80 percent of Indian villages have at least an electricity line.
- Less than 52.5% of rural households have access to electricity.
- In urban areas, the access to electricity is around 95%.
- The overall electrification rate in India is 64.5% while 403.7 million people live without access to electricity.
- Due to the precarious power situation, about 70% of the telecom towers have grid/Electricity Board power availability of less than 12 hours.
- Upon improvement in grid supply , then the CO2 emissions levels could be reduced.
- It should be a key objective of the Government, on priority basis, provide grid power to rural sites so that dependency on diesel power is reduced to a large extent.



Consultation

# Consultation Process

•As an endeavor to get stakeholders views on greening the telecom sector, TRAI had issued a consultation paper on "Green Telecommunications" on 3rd February, 2011.

• Based on the comments received during public consultation, the recommendations on "Approach towards Green Telecommunications" were issued on 12th April, 2011.

• The papers suggests methods for enumeration, quantification and dissemination of the green quotient and the metrics behind telecom operations, telecom manufacturing as well as telecom waste disposal that would be a necessary first step in building environmental awareness in this sector, and a necessary precondition for finalising strategies for mitigating their environmental impacts.



# Green Telecom Strategy-India

**Green Telecom Networks** - estimation of carbon footprints of the industry, use methods to reduce CO2 emission and evolve a voluntary Carbon credit policy.

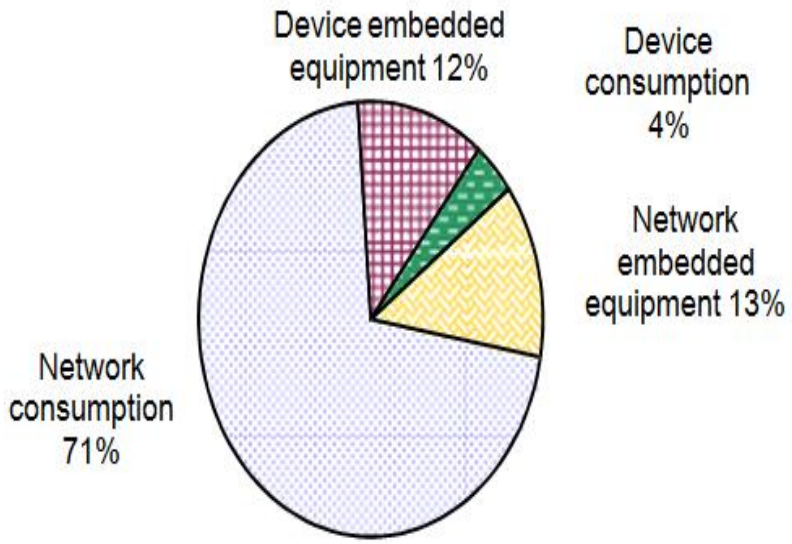
**Green Manufacturing**- greening the manufacturing process involving eco-friendly components , energy efficient manufacturing equipments and adoption of Life Cycle Assessment in manufacturing process.

**Waste disposal-** collection, transportation, recycling and efficient disposal of phones and telecom/network equipments.

**Green Buildings -** optimization of energy , thermal emission and minimization of GHG emissions.

- The Green rating for Integrated Habitat Assessment (GRIHA) adopted by Govt of India as national Green building rating system could be adopted by the service providers for reducing the energy consumption levels and the CO2 emissions levels.

# ENERGY CONSUMPTION in TELECOM




OBJECTIVE

Rural: Diesel 67%, Grid 33%
Urban: Diesel 33%, Grid 67%
Backward: Diesel 87%, Grid 13%

Objective: Reduce consumption of diesel to 33% by the year 2020

Renewable Energy Technologies (RETs) to be used significantly to support ~25% energy by 2020

# Energy Efficiency

| | |
|---|---|
| Overall Network- Arch- All IP or Flat | • Reduce Power; reduce network elements ; smooth evolution |
| Network Elements- Equipment; board or chip set | • High Quality structure; dynamic power saving ; hibernation ;load balancing; SDR etc |
| Power & Cooling system | • Efficient power tech; intelligent cooling; heat exch; etc |
| Clean Power | • Wind power<br>• Solar Power<br>• Bio-energy etc |

# Use of Renewable Sources of Energy

| |
|---|
| •Where sites are beyond the reach of an electricity grid or where the electricity supply is unreliable and are remote enough to make regular maintenance and refueling of diesel generators prohibitive, there are several cost-effective alternative energy sources available |
| • India's current renewable energy base is 18455 MW (11% of total •installed base) |
| • In wind power, India's total installed capacity is planned to at least double by 2022 |
| • India's National Solar Mission aims to see solar energy achieve grid parity with the cheapest coal fired capacity by 2030 and establish the country as a global leader in the field |

Green Telecom N/WS

# Estimation of carbon footprint

•The Carbon footprints in the telecom industry (CT) could be broadly divided into four categories in the Access network:-

**(i) Carbon footprint from Landline (CL)**
**(ii)Carbon footprint from Mobile (CM)**
**(iii) Carbon footprint from Fixed Broadband (CFB)**
**(iv) Carbon footprint from FTTx (CFT )**

•The other THREE vital blocks that add to the Carbon footprints of the telecom network are:-

**(i) Carbon footprint from Core Network (which includes edge/ core Routers / NGN /soft switches / IP Cores /all core items / data centers / all centralized sub systems / peripherals ) (CC)**
**(ii) Carbon footprint from Aggregators or Backhaul (CA)**
**(iii) Carbon footprint from Transmission Networks (CTX)**

•There are also various other factors of the Life Cycle Assessment LCA.



# Y-O-Y CARBON EMISSION CALC

| Year | 2011 | 2012 |
|---|---|---|
| Total Carbon emission (tonnes) | 13189326 | 11995268 |
| SUBSCRIBERS | 700 MILLION | 700 MILLION |
| CO2 PER SUBSCRIBER (PER KG) | 18.8 | 17.1 |



# Estimate the average CO2 emission per user for the telecom sector in India.

- Simple averaging of the averages reported by service providers-erroneous
- Shared by multiple SPS ,partly due to over-counting of telecom services , presence of users with multiple subscriptions



# i , r model

$$CO2_{INDIA} = \sum_{n=1}^{N_{SPS}} CO2_n$$

1. Total CO2 due to the telecom sector in India: $CO2_{INDIA}$
2. Number of service providers in the country: $N_{SPS}$
3. Carbon dioxide attributed to $n^{th}$ SPS: $CO2_n$
4. Carbon dioxide attributed to $n^{th}$ SPS due to an equipment $e$ shared by $k$ tenants: $CO2_{n,e,k}$/k
5. Total subscribers to the telecom industry: $N_{SUB}$
6. Total subscribers to the telecom industry in urban areas: $N_{SUB,URB}$
7. Total subscribers to the telecom industry in rural areas: $N_{SUB,RUR}$
8. Total subscribers to the $n^{th}$ SPS: $N_{SUB,n}$
9. Estimate of total number of unique users of the telecom infrastructure: $N_{USR}$
10. Estimate of total number of unique users in rural areas: $N_{USR,RUR}$
11. Estimate of total number of unique users in rural areas: $N_{USR,URB}$
12. Estimate of urban inflation $i$
13. Estimate of fraction of $N_{USR}$ that is in rural India: $r$



# Methods for reducing Carbon Footprints

- Better network planning
- Adoption of energy efficient equipment and innovative technologies
- Infrastructure Sharing
- Improvement in supply of Grid Power
- Use of Renewable sources of energy



# Energy Bill Estimation Methodology

- Energy Bill Estimation methodology will help the service provider in choosing the best cost energy efficient systems

- Using these calculations, the service providers could find equipment that is most cost effective, over the lifetime of their networks

The total Cost of Operation estimated for the energy consumption over a projected life time =

$$C = \sum_{j=1}^{N} (\alpha * E_{100} + \beta * E_{50} + \gamma * E_{30} + \delta * E_{10} + \varepsilon * E_i) / 1000 * 8765.25 * Ckwh\ j$$

Weights ($\alpha$ , $\beta$ , $\gamma$ , $\delta$ , $\varepsilon$ ) are network utilization weights [$\alpha + \beta + \gamma + \delta + \varepsilon = 1$]

specific to a customer' s network, N is a projected lifetime (in years) and

Ckwh j represents the cost of kilowatt hours in a year of operation. The $E_{100}$ is the energy consumption under highest load (watts), $E_{50}$ is the energy consumption under half load (watts), $E_{30}$ is the energy consumption under thirty percent load (watts) and the $E_{10}$ is the energy consumption under ten percent load (watts).

# Reduction of emissions during manufacturing

| |
|---|
| •Adopting practices that could increase the energy efficiency of handsets |
| •Increase the energy efficiency of chargers or by utilizing solar-power handsets or solar-powered chargers |
| • Ensuring that the handsets are manufactured using materials sourced from companies with green credentials |
| • Carry out research and development of environment friendly equipment which minimize emissions from conceptualization to product delivery |
| • The manufacturer should use renewable materials to manufacture products and recycled materials for packaging, as far as possible and Telecom equipment should conform to global standards for green telecom. |
| • The impact on the environment should be considered at every stage of the product life cycle and assessed in the aspects of resource and energy consumption, waste, recycling, etc., so as to ensure product quality |

# Standardization of Telecom Equipments

- Some existing global standards for green telecom that telecom equipment should conform to are : ISO 14001:2004, OHSAS 18001:1999 , EuP, WRI/WBCSD GHG Protocol and the ISO 14067 standard "Carbon Footprint of Products"

- The energy efficiency may be reported by a factor called **Energy consumption rating [ECR]** (W/Gbps). It is calculated as an energy consumption normalized to effective throughput. In other words, we assume the more energy-efficient network system to be the one that can transport more data (in bits) using the same energy budget (in Joules)

- ECR= [E / T] , where E denotes the maximum energy consumption (in watts) and T denotes the effective system throughput (in bits per second)

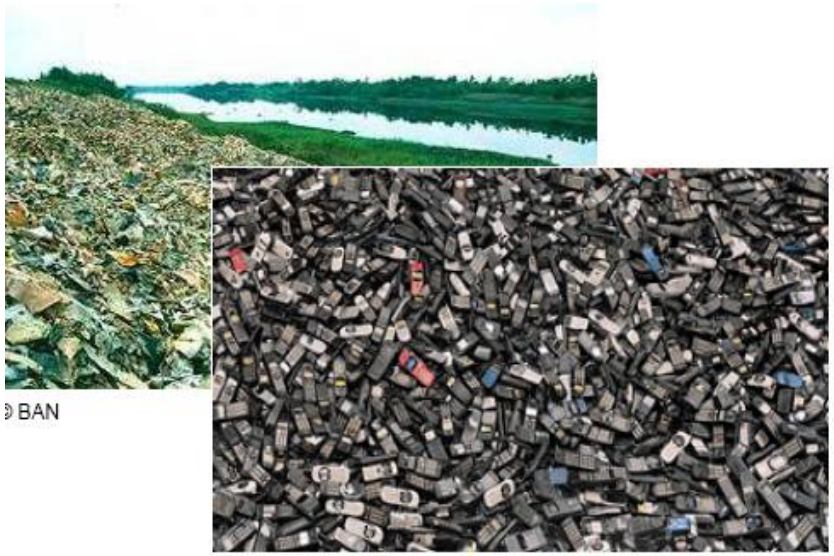
- The tests should cover all the following different scenarios:- 1. Energy Consumption in relation to dynamically changing load, 2. Energy Consumption in relation to Statically changing load, 3. Component level energy footprint, 4. Embedded energy monitoring capabilities 5. Collateral Energy Management.



## Standardization of Telecom Equipments-Contd..

- The results obtained from the tests Nos. 1 to 4 forms the **energy "passport"** of the product under test which can be used directly by consumers for evaluation and energy planning purposes.
- Comparing product metrics will allow the service providers to add energy efficiency to purchase criteria.
- Normalization of the energy consumption to the highest sustained throughput recorder will be estimate of best technology level.
- Energy billing estimates over a period of time (Operational Cost) 'C' could also have to be determined. This will help the service provider to estimate the best product i.e. energy efficient with respect to cost over a period of time.

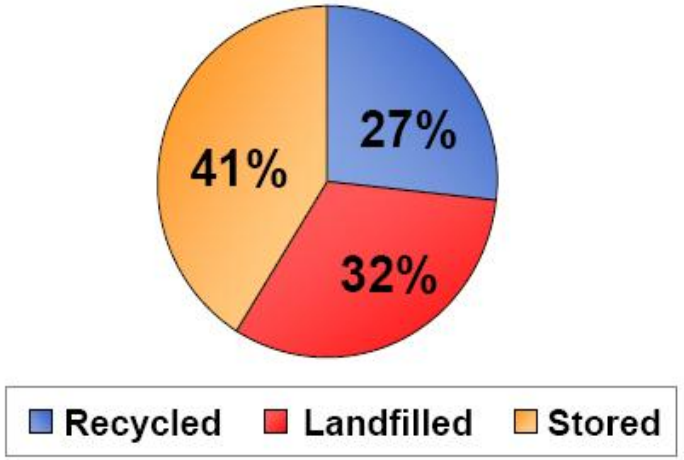
# E-Waste — A Waste Stream Out of Control: It's Toxic and Unsustainable



© BAN

Source: Textually.org

Worldwide PC Disposals
(160 million in 2007; 460,000/day)




**More than 550 million mobile phones will be replaced; only 5% to 10% will be reused.**

**What's in e-waste:**

- Plastics (including PVC)
- Lead
- Cadmium
- Mercury
- Chromium
- Brominated flame retardants
- Beryllium

Gartner

# Summary

- Green Telecom is a buzzword, but not only a hype
- A drive for using RET based BTS is required
- Reduced cost is the most important motivation
- Standardisation is the need of the hour.
- International standards – should focus on energy standards, specific guidelines for components o engineering and also regulation of radio spectrum