Alcatel-Lucent

*Transforming communications for a sustainable planet*

Barry Dambach - September 2010
Alcatel-Lucent Basics

Who We Are
Alcatel-Lucent (2006 Merger)
80,000+ employees; 130 countries; 800 facilities; 10,000 vehicles

Telecom Network Equipment: Product Design, Manufacturing, Installation,
R&D (Bell Labs)

Drivers
Customers, Competitors, Investors, overall Corporate Social Responsibility, Costs
Ben on Eco-Sustainability- “Green is the way forward”

“**My ambition is for Alcatel-Lucent to be best in class in CSR and to be a values-driven business that will make us a better company and underpin our financial success**”

Ben Verwaayen, Contributor, World’s First Reference on CSR, ICCA Handbook 2007

Alcatel-Lucent committed to reduce by 50% its absolute carbon footprint (2008 baseline) by 2020

“I firmly believe that our biggest contribution to combating climate change will be how we help our customers reduce their impact”, Apr 2010

“**Corporate social responsibility - CSR -- has to be part of what we do and what we are, a mandatory consideration of our day-to-day business decisions, not just something that makes us feel good**”, March 2010 (CSR Council March 24 2010)

“**The potential for Green is immense... Corporate leaders are committed. GreenTouch, EARTH and our alternative energy solutions are just the beginning. We just need to do it together..**”

Adolfo Hernandez, Alcatel-Lucent EMEA President
Enablers & Sequence of Events

✓ Office of Business Conduct - Annual Risk Review

✓ First year of combined GHG data showed significant increase in energy use per headcount - as issued in annual CSR Report

✓ Senior Level Discussion to Set a GHG reduction Goal
  ▪ Looked at Facilities only in First Goal - 10% Reduction (Absolute) over next 3 years (2008 Baseline due to data quality concerns)

✓ Developed First Carbon Footprint per WRI GHG Protocol / EPA Emissions Factors

✓ External Benchmarking for Long Term Goal

✓ CEO pushing for “Radical” objectives - to really make a difference
  ▪ 50% Reduction in Carbon footprint by 2020 - Approved by CEO and CSR Council
  ▪ Climate Leaders - 35% Reduction in Carbon footprint by 2017 (10 year rule)

✓ Established Sustainability Group To Drive GHG Reductions
### Key steps to implement a successful Sustainability strategy in the organization

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CSO creates vision</td>
</tr>
<tr>
<td>2</td>
<td>Translate vision into action</td>
</tr>
<tr>
<td>3</td>
<td>Expand boundaries proactively</td>
</tr>
</tbody>
</table>

**Take Sustainability at the Strategic Level**

**Develop and implement commercial programs that deliver real change, not just incremental improvement**

**Embed sustainability in the organization’s DNA, such that the organization looks proactively for new opportunities**

> “Companies where sustainability is a top item in their CEOs’ agendas are twice as likely as others to integrate sustainability into their companies’ business practices. This suggests that senior executives who want to reap the benefits of incorporating sustainability into their companies’ overall strategies must take an active role in the effort” McKinsey
The most sustainable companies perform better than the rest in financials markets

The MSCI World is a stock market index of 1500 'world' stocks. It is maintained by MSCI Inc., formerly Morgan Stanley Capital International, and is often used as a common benchmark for 'world' or 'global' stock funds.

The Dow Jones Sustainability Indices (DJSI) were launched in 1999 to create global indexes tracking the financial performance of the leading sustainability-driven companies.

In 2009, the DJSI World outperformed the MSCI World by 607 basis points: 36.06% to 29.99%

2010 Top 5 Sustainable Companies
1-General Electric
2-Pacific Gas and Electric
3-Nokia-Siemens

Source: Corporate Knights
Our Sustainability Strategy and Focus will reduce our operating costs

1. **Reduce Energy Use**
   Use less electricity and fossil fuel in our operational processes across all of operations - everywhere

2. **Reduce CO2 from Transportation**
   Lease only efficient vehicles, ship products in the most efficient manner, and make marine operations more efficient

3. **Reduce all Waste**
   Reduce not only the use and production of hazardous waste, but all waste streams from all corners of operations

4. **Use Renewable Energy**
   Wherever possible and practical, renewable energy will be used to power our operations to reduce our dependence on costly sources of energy

5. **Supplier Compliance**
   Use our power as a large consumer to drive compliance from our suppliers to ensure we only do business with suppliers who take the environment as seriously as we do

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We are focusing our CO₂e footprint reduction plans on the areas with the highest impact per CO₂e tonne and the biggest spend.
Almost 80% of our Carbon Footprint is generated by Facilities (Electricity & fuel combustion) and Product Shipping (Air & Sea). We have developed a clear plan for both areas.
### ALU CO2 Strategic Abatement Curve: Options to hit 2020 Goal

<table>
<thead>
<tr>
<th>Option</th>
<th>Abatement Impact in CO₂ tons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recycling</td>
<td>125K</td>
</tr>
<tr>
<td>Efficient Lighting</td>
<td>250K</td>
</tr>
<tr>
<td>Purchase of Renewable Energy</td>
<td>375K</td>
</tr>
<tr>
<td>Telecommuting</td>
<td>500K</td>
</tr>
<tr>
<td>Building Insulation</td>
<td>625K</td>
</tr>
<tr>
<td>Behavioural Changes (employees)</td>
<td></td>
</tr>
<tr>
<td>Reduce packaging</td>
<td></td>
</tr>
<tr>
<td>Behavioural Changes (facilities)</td>
<td></td>
</tr>
<tr>
<td>Reduce business travel by all</td>
<td></td>
</tr>
<tr>
<td>HVAC Optimization</td>
<td></td>
</tr>
<tr>
<td>Surface shipping of product</td>
<td></td>
</tr>
</tbody>
</table>

#### Alcatel-Lucent

Our 2009-2012 CO₂ reduction plan addresses mainly low cost/high ROI options. To achieve our 50% reduction goal we will need to address more capital intensive options.
Alcatel-Lucent

Transforming communications for a sustainable planet

Tom Okrasinski - Bell Labs CTO Product Environmental Engineering

September 2010
Eco-sustainability

Why it matters

- Customers
- Investors
- Legislation
- Brand
- Business Sense
Information and Communications Technology (ICT)
An opportunity to tackle climate change

ICT today: about 2% of global emissions

An opportunity for tremendous impact on remaining 98%

ICT can enable a 15% reduction in global emissions by 2020

Potential telecom equipment energy savings by 2020

Zero Growth Line

Source: GeSI - SMART 2020: Enabling the Low Carbon Economy in the Information Age
Alcatel-Lucent’s Eco-sustainability Approach

*Fundamental elements*

- Developing eco-sustainable networks
- Enabling a low carbon economy
- Reducing our carbon footprint

Transforming communications for a sustainable world

*Fueled by Bell Labs Green Research*
Eco Sustainable Networks

An end-to-end approach

Developing Eco Sustainable Networks

- Holistic Life Cycle Approach
  *Eco impact throughout the life cycle*

- Green Research
  *The fundamental foundation / engine*

- Network Transformation
  *Green “High Leveraged Network” benefits*
Developing eco-sustainable networks:

Holistic lifecycle approach delivers eco-sustainable networks

Take-Back, Recycling, Reuse

Network Optimization

Alternative Energies

Energy Efficient Operation

End of Life

Product Life Cycle

Development

Manufacturing and procurement

Packaging and Transportation

Installation

Functional use

Field Services

Recycle

Design for Environment

Product Stewardship

Smart Manufacturing

Eco Packaging

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Developing eco-sustainable networks

*Energy challenges*

**Energy Usage** → an increasingly critical part of network costs

**Energy Usage** → major contributor to the carbon footprint of a network’s lifecycle
Developing eco-sustainable networks

*Where we are with Green Research*

**Global Users**

**Information**

**Video - HD... 3D...**

**Wireless**

**Cloud Services**

**Internet Applications**

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**Carbon Emissions**

- Status quo
- Research Inventory @ 100%

- 300 MtCO₂e

**Years**

- 2010
- 2020

**Sustainable Networking**
Demonstrate technologies in five years that lead to a 1000-fold improvement in energy efficiency

- Draw on expertise across the industry and around the world
- Open invitation to the entire industry
- Founding members are experts from world’s top institutions and operators
- Alcatel-Lucent’s Bell Labs is a founding member
Thinking Differently About Networks

Brilliant Minds ... Leading Experts

- Optimized for energy
- Holistic Approach
- Multi-Discipline
- Equivalent Performance
Developing eco-sustainable networks

*Use less energy and fewer resources*

- **Energy efficient equipment**
  - Moore’s law extended: capacity & density
  - Dynamic power
  - Novel thermal / cooling schemes

- **Network & operation optimization**
  - Network architecture / topology
  - Self-Optimized Networks (SON)
  - Sustainable / Green Power
Innovative Cooling

**Modular Cooling Solution - Data Center / Telco Central Office**

**Conventional Centralized Cooling Solution**

- Transfer heat inefficiently to building chilled water system

**Innovative Modular Cooling Solution**

- Transfer heat efficiently to modular (rack integrated) cooling system

*Up to 90% reduction in energy needed to cool within data centers*
Developing eco-sustainable networks

**Sustainable Power**

Commercialized solar / wind power package coupled with full services suite at network level

Replacing each diesel generator with solar panels / wind turbine saves about 70 tonnes CO2e per year

350+ Sites Installed

**Components**

- Predictable
- Erratic
- Sensitive
- Critical

**Services**

- Planning
- System Design
- Monitoring
- Site Engineering
- Deployment
- Electrical Design

**Our Lab**

350+ Sites Installed
Developing eco-sustainable networks

High Leveraged Network

60-80 times less energy use annually*

* HLN Network deployed in metro area of ~5 million people
Enabling a low carbon economy

**Smart solutions**

- **Smart Grids / Metering**
  *Monitor and control in real-time*

- **Smart Transport**
  *If you travel, travel efficiently*

- **Smart Buildings**
  *Automation of interior environment*
Target ICT Environmental Impact Categories

- **Global Warming Potential** → greenhouse gas emissions ("carbon footprint")
- **Water Use** → "water footprint"
- **Human toxicity, resource depletion, ecotoxicity, eutrophication, smog, ozone depletion, land use, acidification, energy use**

Enabling a low carbon economy

*Methodology for estimating ICT life cycle eco-impacts and benefits*
Enabling a low carbon economy:

*ICT manufacturing - components, assembly & testing*

**ICT - Common Component Groups**
- Printed (Circuit) Wiring Boards
- Integrated Circuits
- Electro-Mechanical Components
- Metallic Mechanical Components
- Polymeric Mechanical Components
- Displays
- Cables
- Batteries
- Large Capacitors
- ICT Specialized Components (e.g. lasers)

**ICT - Assembly & Testing**
- Surface mount / thru-hole circuit pack assembly
- Final product assembly / system integration
- Testing / packing
Enabling a low carbon economy:

**ICT common components - PWB categorical rules, parameters, criteria**

### Printed (Circuit) Wiring Boards

- **Rules / Parameters / Criteria:**
  - Size (sq. cm)
  - Layers (#)
  - Single vs. double sided
  - Surface finish (HASL, Ni/Au)
  - Board type (main, daughter)
  - Board material (FR4)

- **Algorithm:**
  - Simple summation model
  - Pattern Recognition / Regression “Engine”
Enabling a low carbon economy: 
*ICT common components - IC categorical rules, parameters, criteria*

Large Integrated Circuits

- **Rules / Parameters / Criteria:**
  - Large ICs (#)
  - Type (BGA, PLCC, QFP, TQFP)
  - Inputs / Outputs (pin count)

- **Algorithm:**
  - Simple summation model
  - Pattern Recognition / Regression “Engine”
Metal Parts

Rules / Parameters / Criteria:
- Metal Type (e.g. steel, aluminum, zinc alloy)
- Surface finish (e.g. Cr3+, powder coated)
- Recycled material content (%)
- Weight (kg)

Algorithm:
- Simple summation model

\[
GWP_M = \sum (M_1 \times W_{M1}) + (M_2 \times W_{M2}) + \ldots + (M_X \times W_{MX})
\]
Enabling a low carbon economy: 

**ICT products - GWP impact over life cycle stages (examples)**

- Alcatel-Lucent is leading and promoting ICT industry effort to standardize (iNEMI, ITU, GeSI)
- Quick / easy communication of full life cycle eco-impact profile
- Equipment types can be aggregated into network / system configuration for further eco-impact consideration

**Digital Microwave Link**
*Network Communications Product*

- Mfg / Transport / Assembly / Test: 1.1%
- Transport to Customer: 5.8%
- Usage: 1.5%
- End-of-Life: 91.6%

**Total PCF: 20,000 kg CO2e**

**Wireless SOHO Router**
*Network Communications Product*

- Mfg / Transport / Assembly / Test: 0.9%
- Transport to Customer: 13.7%
- Usage: 0.3%
- End-of-Life: 85.1%

**Total PCF: 100 kg CO2e**

**Satellite-linked Automobile Radio**
*Consumer Entertainment Product*

- Mfg / Transport / Assembly / Test: 43.0%
- Transport to Customer: 1.5%
- Usage: 55.5%
- End-of-Life: 0.0%

**Total PCF: 800 kg CO2e**
Enabling a low carbon economy

Methodology* developed to simplify measuring enabling impacts of ICT

* GeSI / BCG “Selective LCA” Methodology - September 2010
Enabling a low carbon economy

*Compare emissions for status quo and ICT system to measure magnitude of impact*

**Deduct eliminated or avoided emissions from status quo system**

- **Status quo emissions**
  - Direct enabling impacts
  - Indirect enabling impacts

**Add emissions generated by ICT system**

- **ICT generated emissions**
  - ICT system emissions
  - Direct rebound effects
  - Indirect rebound effects

**Calculate net emissions reduction**

- **Net ICT enabling impact**

*GeSI / BCG “Selective LCA” Methodology - September 2010*
Enabling a low carbon economy:
*Measuring ICT direct enabling effects*

- ICT system enables CO$_2$e reduction of status quo system through one of three forms of direct impact

<table>
<thead>
<tr>
<th>Forms of direct enabling impact</th>
<th>Description</th>
<th>ICT solution</th>
<th>Impacts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Reduce power consumption</td>
<td>Power consumption reduced, via enhanced efficiency or reduced operation</td>
<td>HVAC automation</td>
<td>Less heating / cooling occurs, using less power</td>
</tr>
<tr>
<td>2 Reduce or eliminate travel / shipment</td>
<td>Less vehicle use to move people or distribution of goods</td>
<td>Telecommuting</td>
<td>Fewer miles traveled</td>
</tr>
<tr>
<td>3 Reduce or eliminate materials</td>
<td>Less production, distribution, storage, disposal of materials</td>
<td>Online media (e.g. music downloads)</td>
<td>Eliminated production, and distribution of CDs and DVDs</td>
</tr>
</tbody>
</table>

* GeSI / BCG “Selective LCA” Methodology - September 2010
Enabling a low carbon economy:  
*Measuring ICT indirect enabling effects*

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**Direct enabling impact of ICT system**

<table>
<thead>
<tr>
<th>Category of indirect impact</th>
<th>Reduce power consumption</th>
<th>Reduce travel / shipment</th>
<th>Reduce materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use of goods</td>
<td>Monitoring of home energy use leads individual to avoid consumption more generally (e.g., via vehicle / office)</td>
<td>Individuals telecommuting may use public transportation in lieu of cars on more regular basis</td>
<td></td>
</tr>
<tr>
<td>Production of goods</td>
<td>Less individuals using office space leads to reduced use of buildings</td>
<td>Less storage of materials lead to reduced use of buildings</td>
<td></td>
</tr>
<tr>
<td>Infrastructure use</td>
<td>Lower energy need results in construction of fewer power plants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Infrastructure development</td>
<td>Over long-term, smaller or fewer buildings constructed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Indirect enabling impacts**

*GeSI / BCG “Selective LCA” Methodology - September 2010*
Enabling a low carbon economy:

*Measuring ICT rebound effects*

**Form of direct enabling impact**

- **Reduce power consumption**
  - Home energy monitoring: increased energy use during non-peak periods in-lieu of use during peak periods

- **Reduce travel/shipment**
  - Telecommuting: energy use above-and-beyond typical office energy use (e.g., television on at home)

- **Reduce materials**
  - Online media: Increased computer use to browse and sample music

**Direct rebound effects**

- Home energy monitoring: increased consumption of goods using savings from lower energy bill

**Indirect rebound effects**

- Telecommuting: Urban sprawl (and associated inefficiencies) from employees’ ability to live further from office

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*GeSI / BCG “Selective LCA” Methodology - September 2010*
## ICT Carbon Accounting

**Example: TelePresence System - Scope of Study**

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
<th>Components of system</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICT</td>
<td>TelePresence system</td>
<td>1 TelePresence unit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Network services</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 HVAC in room</td>
</tr>
<tr>
<td>BAU</td>
<td>Travel for meetings</td>
<td>1 Airplanes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Trains</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 Public vehicles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 Private vehicles</td>
</tr>
</tbody>
</table>
## ICT Carbon Accounting

### Example: TelePresence System - Potential Effects

<table>
<thead>
<tr>
<th>Category</th>
<th>Identified effects</th>
<th>Exclude?</th>
<th>Rationale for exclusion</th>
<th>System components assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct ICT emissions</td>
<td>Emissions from ICT equipment required for TelePresence</td>
<td></td>
<td></td>
<td>TelePresence units; HVAC of room; network components</td>
</tr>
<tr>
<td>Primary enabling</td>
<td>Reduced private vehicle use</td>
<td>Yes</td>
<td>Not part of the purpose of the study</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td>Reduced travel by air</td>
<td></td>
<td></td>
<td>Airplanes</td>
</tr>
<tr>
<td></td>
<td>Reduced travel by rail and public vehicles</td>
<td>Yes</td>
<td>Not part of the purpose of the study</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Secondary enabling</td>
<td>Reduced construction of airplanes, trains, and vehicles (private and public)</td>
<td>Yes</td>
<td>Not relevant for company scale of adoption</td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td>Reduced travel infrastructure (railways and roads)</td>
<td>Yes</td>
<td>Not relevant for company scale of adoption</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Primary rebound</td>
<td>Increased telepresence use from additional meetings</td>
<td></td>
<td></td>
<td>See components from Direct ICT emissions</td>
</tr>
<tr>
<td></td>
<td>Increased travel by rail to replace air travel</td>
<td></td>
<td></td>
<td>Train</td>
</tr>
<tr>
<td>Secondary rebound</td>
<td>None identified</td>
<td></td>
<td></td>
<td>Not applicable</td>
</tr>
</tbody>
</table>

**Notes:**
- [✓] Indicates a category that is included in the assessment.
- [✓] Indicates a category that is excluded from the assessment.

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ICT Carbon Accounting

Example: TelePresence System - Estimated Impact

Estimated Impact of TelePresence Usage

- Ratio of reduced emissions to direct ICT emissions is as high as 50:1
ICT and Sustainability

Summary

• Our approach to sustainability is structured around 3 fundamental elements: economic prosperity, environmental quality, and social integrity. We focus on building smarter / more efficient telecom networks; creating eco-enabling telecom applications; embedding eco-responsibility into the way we think and operate; and creating an eco-conscious culture within our company.

• ICT has a unique capability to not only reduce its own carbon footprint (lower the 2% direct impact) but to reduce other sectors’ carbon footprint (lower the 98% indirect impact).

• Holistic (end-to-end) life cycle approach to telecom networks delivers sustainability in all stages: development, use, end-of-life. Green research delivers the innovation that drives sustainable networks: e.g. fewer / more benign materials, energy efficiency, efficient cooling, sustainable power sources, self-optimizing networks.

• ICT applications (e.g. smart grids, transport, buildings) can enable industries and society to become more sustainable \(\rightarrow\) 15% global annual GHG emissions reduction estimated by 2020.

• Methods to assess and measure ICT’s eco-impact (both costs and benefits) are being introduced via industry consortia (e.g. GeSI, iNEMI) and standards setting organizations (e.g. ISO, ITU, WRI / WBCSD).

• Key to demonstrating ICT’s eco-impact enabling effects to governments and public is in promotion and use of methodologies, refinement of supporting data, and performing case studies.