



Sustainable ICT Networks: The GreenTouch Vision

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GOING GREEN: NEXT REVOLUTION OF 21ST CENTURY

“How do we get Green out of the talking shop into reality? Remember the Internet in the 80's? Green can be the same motor for innovation and inspire a new wave of economic growth.”

Ben Verwaayen
CEO Alcatel-Lucent



“I have always believed that IT is an engine of an efficient economy, it can also drive a greener one.”

Michael Dell
Founder and CEO Dell, Inc
Forbes Magazine, Nov. 2009

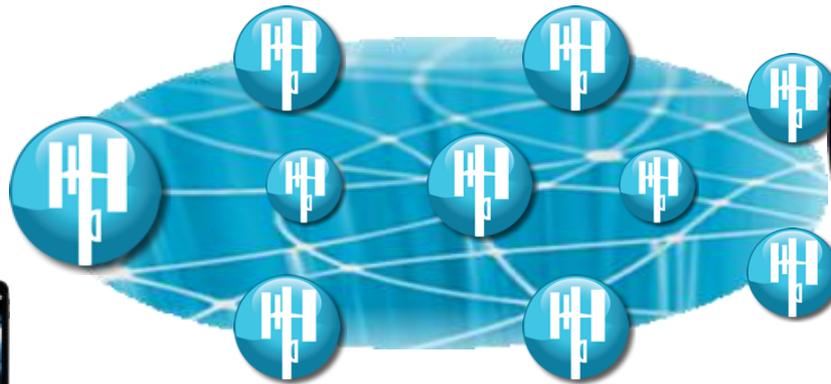


**GREEN
=
MOTOR FOR INNOVATION
+
ECONOMIC DRIVER**

Green is the single most important opportunity for the 21st century for all industries and specifically for ICT

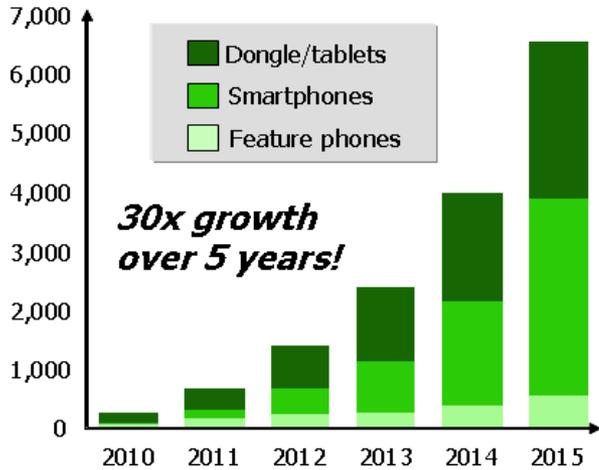
Need new business models and innovation and co-creation frameworks

A NEW WIRELESS WORLD / INTERNET



MASSIVE DATA TRAFFIC GROWTH

Pbytes/Month

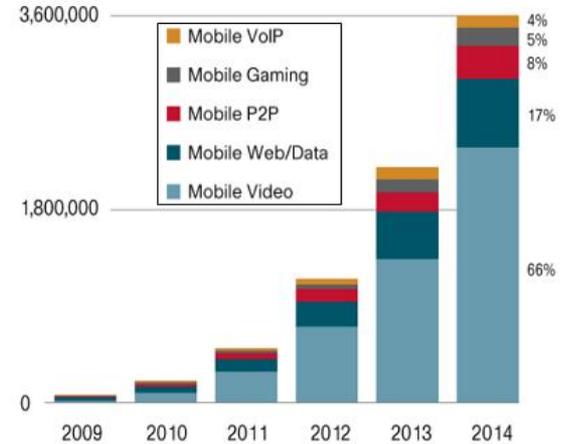


30x growth over 5 years!

MORE DATA MEANS MORE POWER

TB per Month

108% CAGR 2009-2014



Source: Cisco VNI Mobile, 2010

Today

Future



- 17.5 GigaWatts
- ~ 9 Hoover Dams
- ~ 15 nuclear power plants

- ~ 15M car emissions a year
- ~ 150,000 Paris to New York round-trip flights

GOOGLE DATA CENTERS



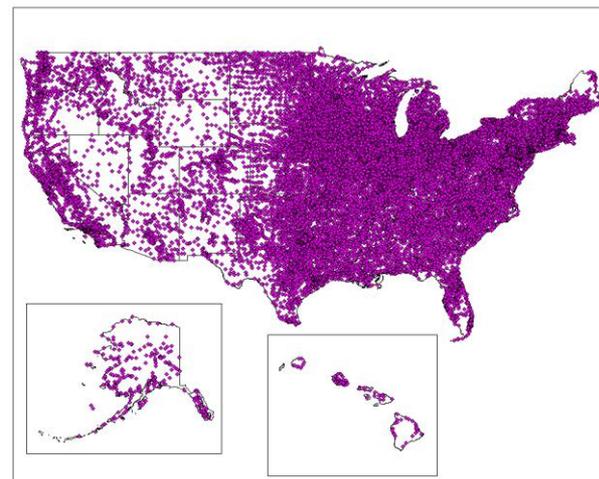
A small number of large data centers



.... BUT GOOGLE IS NOT ALONE

Telco Central Offices, Enterprises, Colocation Data Centers, etc. also have servers... (It's not all Google, Facebook and Microsoft).

Large number of small data centers in US central offices



2020 ICT CARBON FOOTPRINT

820m tons CO₂

PCs, peripherals
and printers
57%

Telecoms
infrastructure
and devices
25%

360m tons CO₂



Source: The Climate Group

Data
centres
18%

260m tons CO₂

Total emissions: 1.43bn tonnes CO₂ equivalent

The Climate Group, GeSI report
"Smart 2020", 2008

- 2007 Worldwide ICT carbon footprint: 2% = 830 m tons CO₂
- Comparable to the global aviation industry
- Expected to grow to 4% by 2020

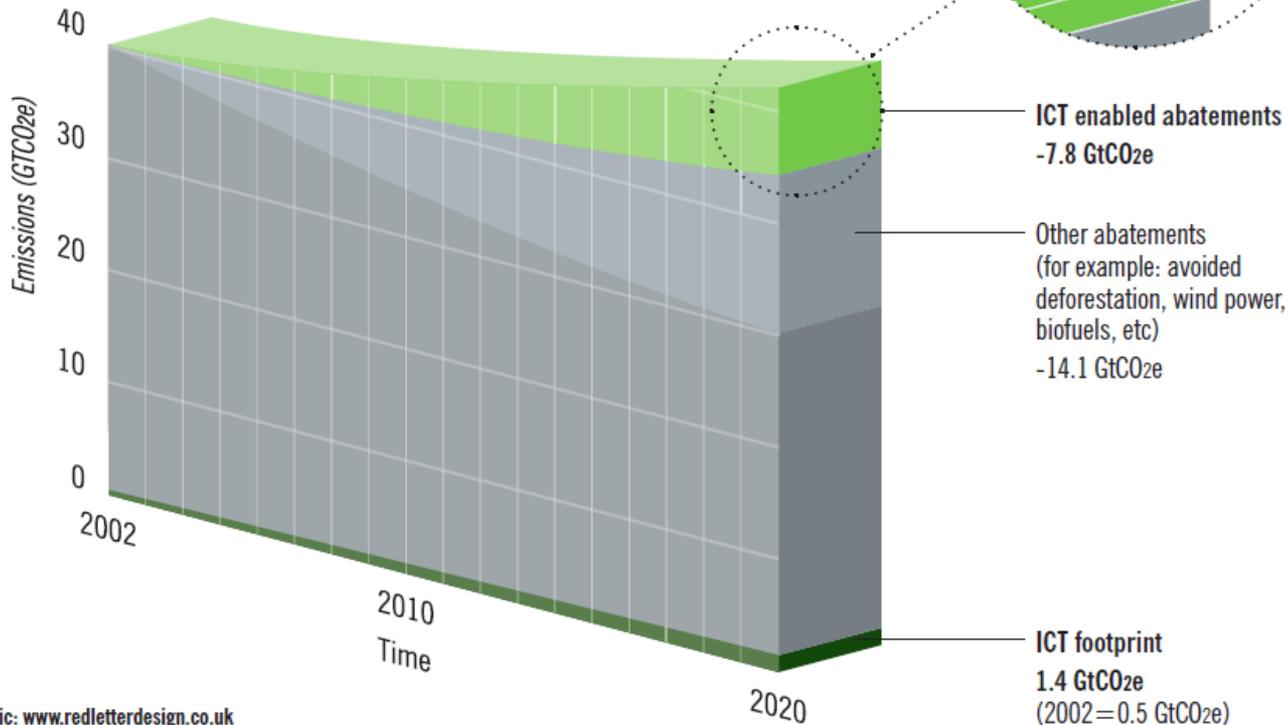
ICT IMPACT: GREENING BY ICT

Expressed as gigatonnes of carbon dioxide equivalent (GtCO_{2e})

■ Emissions ■ ICT footprint ■ Selected ICT-enabled abatements ■ Other abatements³

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

ICT today: about 2% of global emissions



An opportunity for tremendous impact on remaining 98%

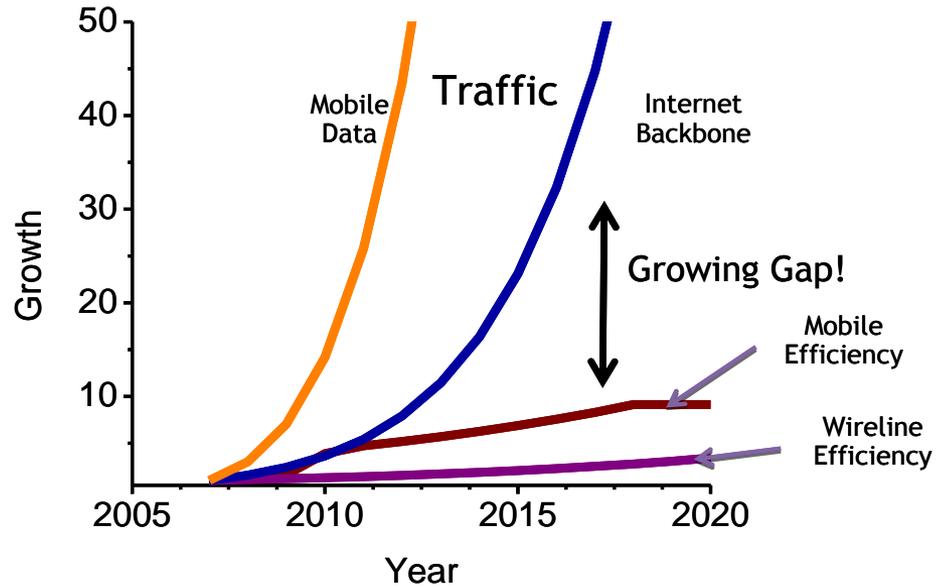
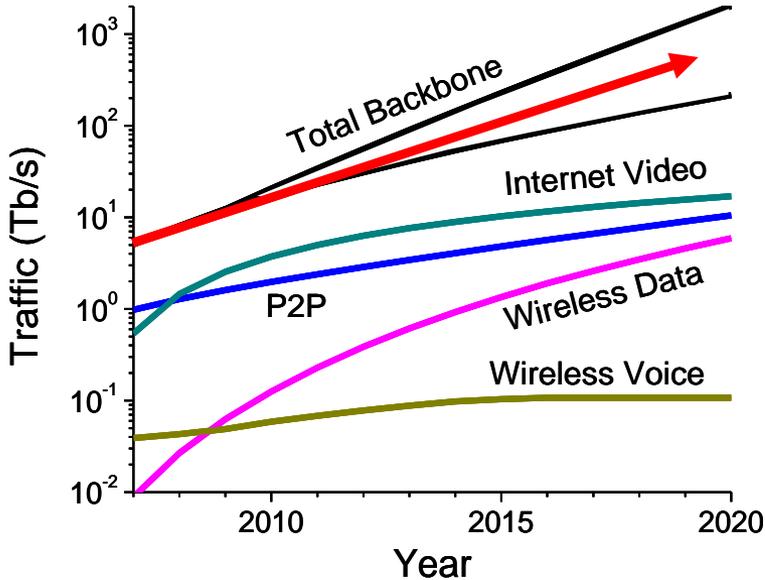
ICT making a real, positive impact, but ICT has some direct challenges

Graphic: www.redletterdesign.co.uk

Source: GeSI – SMART 2020: Enabling the Low Carbon Economy in the Information Age

GROWING NETWORK ENERGY GAP

North America



Data from: RHK, McKinsey-JPMorgan, AT&T, MINTS, Arbor, ALU, and Bell Labs Analysis: Linear regression on $\log(\text{traffic growth rate})$ versus $\log(\text{time})$ with Bayesian learning to compute uncertainty

INTERNET
=5th



HIGHEST COUNTRY

If the internet was a country: energy consumption is higher than Russia and a little less than Japan

ENERGY
+27%
INCREASE



Energy consumption in communications service provider (CSP) networks is forecast to increase by 27% from 2012 to 2016

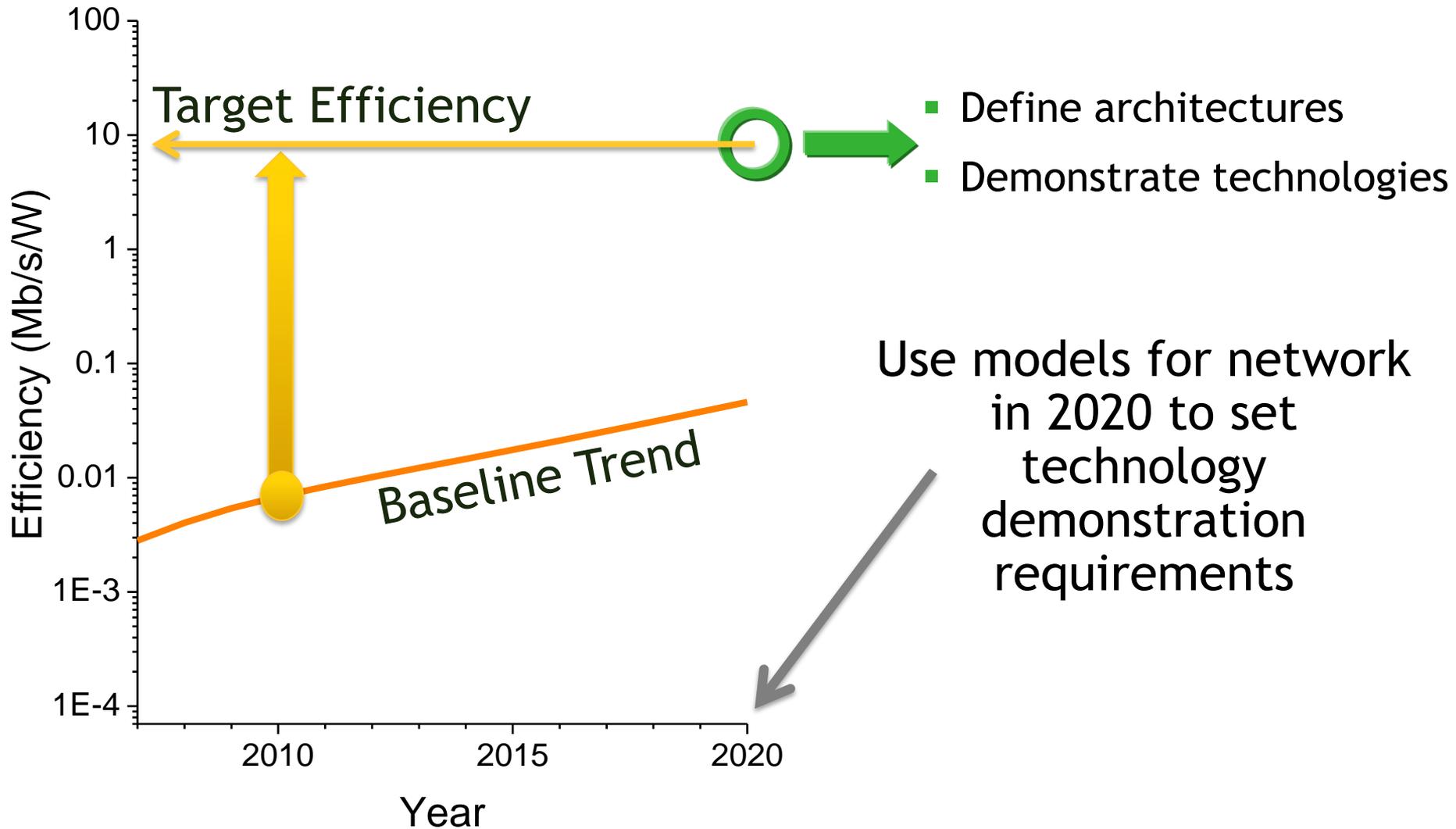
- **Global research consortium** representing industry, government and academic organizations
- Launched in May 2010
- Focus on **sustainability** and growth
- **Holistic** and **ambitious**: Goal of 1000x
- **57 member organizations**
- **300+ leading scientists**
- Recognized by the **World Economic Forum** as an industry-led best practice toward sustainability
- Moving from fundamental research into the **pre-competitive area** through standardization
- Leading **Green ICT**: cooperation with other NGOs such as GeSI, ITU-T, GreenGrid, Carbon Trust, ITRS
- Creating a **new innovation model** for sustainability

It takes an ecosystem

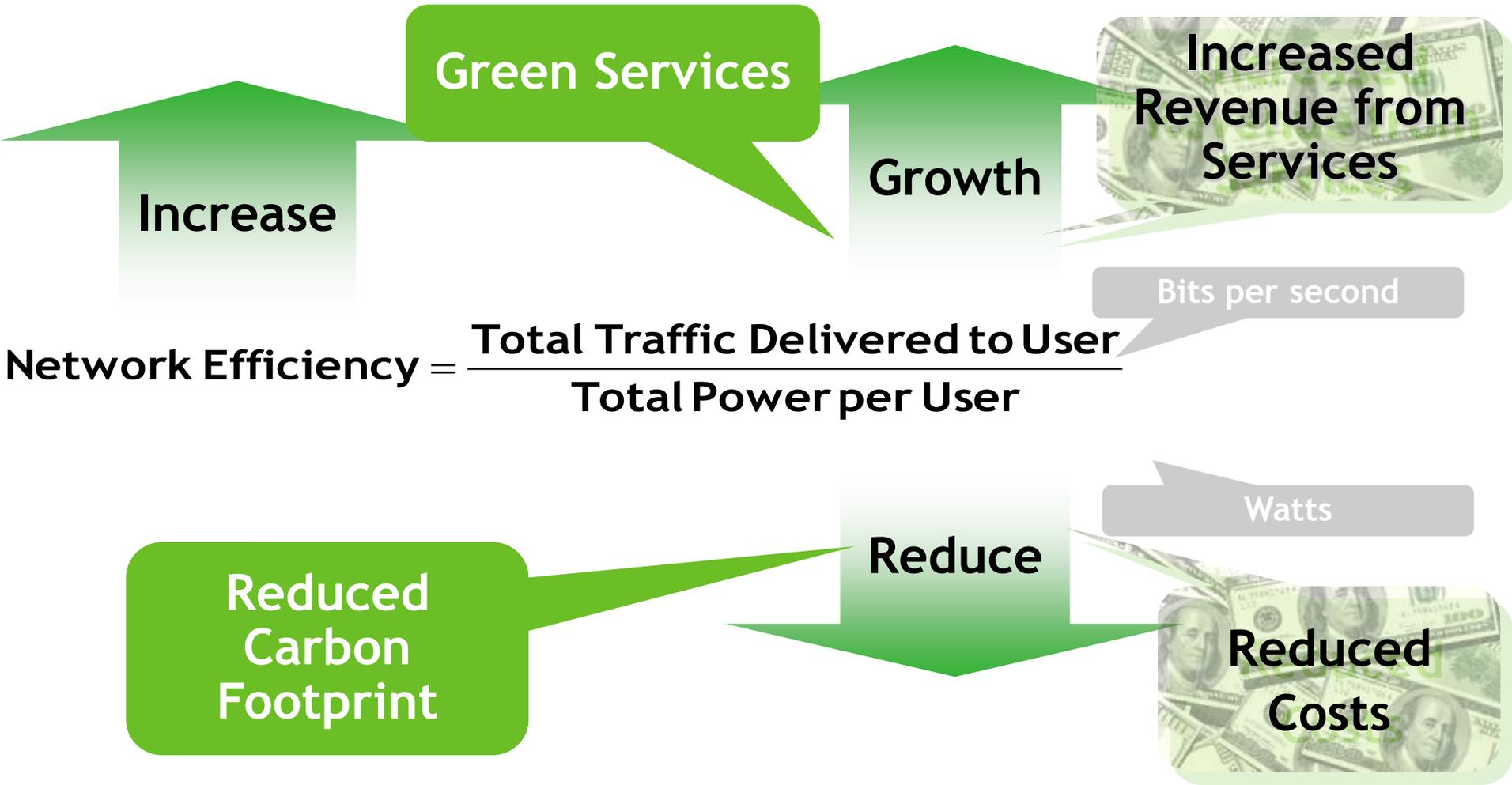


DELIVER ARCHITECTURE, SPECIFICATIONS AND SOLUTIONS AND DEMONSTRATE KEY TECHNOLOGIES TO INCREASE NETWORK ENERGY EFFICIENCY BY A FACTOR 1000 COMPARED TO 2010

GREENTOUCH™ CONSORTIUM 5 YEAR GOAL



WHY NETWORK ENERGY EFFICIENCY?

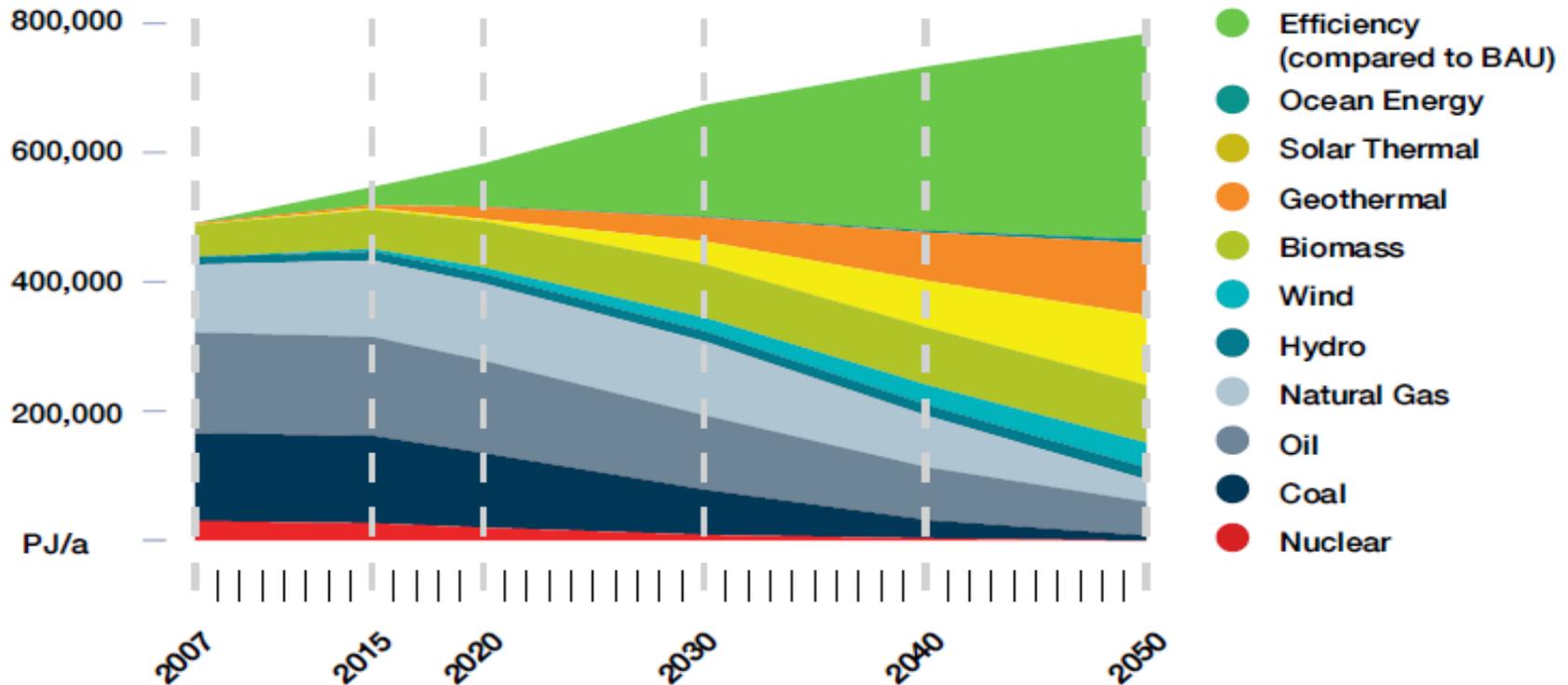


Makes both Environmental and Economic Sense

EFFICIENCY AND RENEWABLE ENERGY SOURCES

Development of primary energy consumption under the three scenarios

('Efficiency' = Reduction compared to the reference scenario)



Greenpeace, G. Cook, J.V. Horn, 'How dirty is your data'
 2011 Greenpeace, EREC 'Energy (R)evolution' 2010

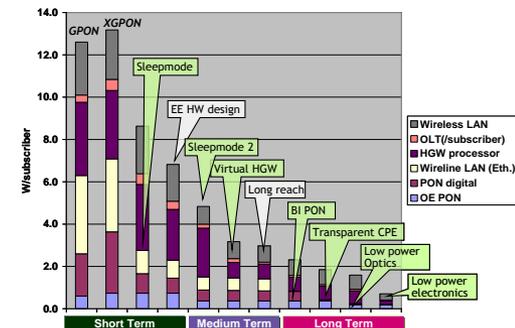
GREENTOUCH STATUS: WHERE ARE WE?

- Over 15 research programs and 25 research projects underway
 - Wireless and mobile communications
 - Wireline access
 - Core networks and optical transmission
 - Services, applications and trends

- New approaches being taken:
 - Devices and low power electronics / photonics
 - Architectures, algorithms and protocols
 - "Power-follows-load" intelligent management
 - Service and energy optimized networks

- Two major public demonstrations in wireless and fiber-to-the-home technologies

- Establish and define common reference architecture and roadmap with strategic research directions



SOME RESEARCH PROJECTS...

Beyond Cellular - Green Mobile Networks
Virtual Home Gateway
Optimal End-to-End Resource Allocation
Service Energy Aware Optical Networks
Green Transmission Technologies
Minimum Energy Access Architectures
Single-Chip Linecards
Large-Scale Antenna Systems
Highly-Adaptive Layer Mesh Networks
Massive MIMO



Bell Labs



Bell Labs



25+
Projects

CONCLUSIONS

- ICT networks are growing rapidly
 - Scaling networks is becoming more difficult
 - Bringing focus to energy efficiency
- ICT and research communities are organizing to address challenges
 - Dramatic, holistic change, but over long term evolution
 - Cooperative organizations such as GreenTouch guiding evolution
- Several promising research directions and initial results have been obtained
- More work remains!

Thank you!

