



GreenTouch™

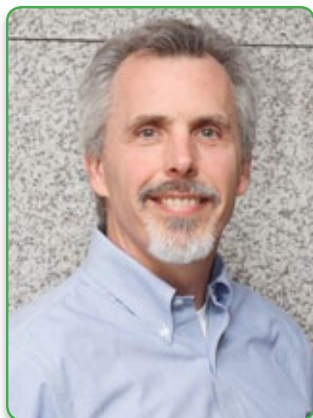
2011–2012 Annual Report

Public Version

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Chairman's Letter



Gee Rittenhouse
Past Chairman
Stichting GreenTouch



Thierry Van Landegem
Current Chairman
Stichting GreenTouch

Dear Friends:

Progress is the theme of our new GreenTouch Annual Report. During our first year, the consortium's focus was to establish our core infrastructure and processes. We are pleased to report very real – and notable – outcomes by members during the organization's second year.

- *Results* – With the introduction of the Bit Interleaved Passive Optical Network (Bi-PON) demo, we introduced to the world our second significant GreenTouch technology. We then showcased both the Bi-PON and Large Scale Antenna System demos in the GreenTouch booth at the TIA Exhibits in June 2012.
- *Outreach* – GreenTouch has partnered with other organizations, including the establishment of formal agreements with the Global e-Sustainability Initiative (GeSI) and the Massachusetts Institute of Technology. We also positioned our two most recent member meetings around key industry events: SuperComputing Conference (SC'11) in Seattle in November 2011 and the Telecommunications Industry Association (TIA) conference (TIA 2012 Inside the Network) in Dallas in June 2012.
- *Funding* – The Executive Board approved funding to four GreenTouch projects, with more projects expected to be funded in the coming year.
- *Growth* – We doubled the number of active GreenTouch Projects year-over-year. Twenty new members joined the consortium since June 2011, for a total of 59 members as of June 30, 2012.
- *Operations* – During the past year, GreenTouch brought our operator members deeper into organizational operations. We added China Mobile as the second operator member on the Executive Board. We also launched a new operators' round-table at our June 2012 member meeting – a session that we will carry into our face-to-face meeting schedule moving forward.

Each of these success points is significant in its own right and the sum of these activities is impressive. Our members' work is already achieving real progress toward delivering, by 2015, the architectures, specifications and solutions and demonstrating key technologies to increase the network energy efficiency by a factor of 1000 compared to 2010 levels.

GreenTouch is of course a forum where researchers come to share ideas and collaborate on building the energy efficient networks of the future. This is exactly what happens within the GreenTouch working groups, research projects and activities. But GreenTouch is about much more than that. We are really about making life better for end users. Our innovations will include the design of a new energy-efficient mobile network that finally allows a rural village in a developing nation to connect to the modern world. We will ensure that broadband customers continue to enjoy high connectivity speeds at a reasonable cost – even with a surge of traffic data and energy costs. So let us emphasize: GreenTouch members are not doing research simply as an academic exercise. We are doing the hard work now that will help ensure that the ICT industry is prepared for the very real challenges our industry will face in the next 10 years and beyond.

Progress also brings some changes to our organization. As we write this annual report, the leadership of GreenTouch is undergoing a transformation to help ensure that during the next year and beyond, we turn clear progress into tangible results. With Thierry Van Landegem's appointment as Chairman of the Executive Board, he will guide the board's strategic planning process to ensure that the work of GreenTouch continues to align with the needs of the industry. The Technical Committee has also re-organized itself to facilitate the dialog and collaboration between different groups and project teams, to arrive at a unified end-to-end network architecture and to ensure that we maximize GreenTouch member resources. We strongly believe that these efforts will accelerate work in numerous areas and will allow our members to further bring their considerable expertise and contributions into GreenTouch.

On behalf of our colleagues on the Executive Board past and present, we sincerely appreciate the efforts of all the GreenTouch members to deliver a very productive second year of operations. For Gee, it has been a pleasure to be involved in the launch and formative stages of what is truly a first-class organization. For Thierry, it will be an honor to guide this organization into what will clearly be a very bright future.

Sincerely,

Gee Rittenhouse
Past Chairman
Stichting GreenTouch

Thierry Van Landegem
Current Chairman
Stichting GreenTouch

About GreenTouch

GreenTouch Executive Board

Dr. Gee Rittenhouse

Bell Labs, Chairman

Dr. Laurent Herault

CEA-LETI

Dr. Chih-Lin I

China Mobile Communications Corporation

Dr. Byung-Chang Kang

Samsung Advanced Institute of Technology

Dr. Rudy Lauwereins

IMEC International

Dr. Laurent Lefèvre

INRIA

Claude Monney

Swisscom Ltd.

Dr. Wen Tong

Huawei Technologies Co., Ltd.

Dr. Rod Tucker

University of Melbourne

GreenTouch Members 2011-2012

- AGH University of Science and Technology
- Alcatel-Lucent/Bell Labs
- AT&T Services, Inc.
- Athens Information Technology (AIT) Center for Research & Education
- Broadcom
- Carnegie Mellon University
- CEA-LETI
- China Mobile Communications Corporation
- Chunghwa Telecom
- Columbia University
- Commscope/Andrew
- Draka Communications
- Dublin City University
- Electronics and Telecommunication Research Institute
- Energy Sciences Network/Lawrence Berkeley Labs
- Fondazione Politecnico di Milano
- France Telecom
- Fraunhofer-Gesellschaft
- Freescale Semiconductor
- Fujitsu Limited
- Huawei Technologies Co., Ltd.
- IBBT
- IMEC International
- Indian Institute of Science
- Indian Institute of Technology Delhi
- INRIA
- K.U. Leuven
- Karlsruhe Institute of Technology
- King Abdulaziz City for Science and technology
- Korea Advanced Institute of Science and Technology (KAIST)
- KT Corporation
- National Chiao Tung University
- National ICT Australia Ltd.
- Nippon Telegraph and Telephone Corp.
- Politecnico di Torino
- Portugal Telecom Inovacao S.A.
- Samsung Advanced Institute of Technology (SAIT)
- Seoul National University
- Shanghai Institute of Microsystem and Information Technology (SIMIT)
- Swisscom (Switzerland) Ltd
- Technical University of Denmark
- The University of Manchester
- The University of Melbourne
- TNO
- Tsinghua University
- TTI
- TU Dresden
- Universitat Paderborn
- University College London
- University of Cambridge
- University of Delaware
- University of L'Aquila
- University of Leeds
- University of Maryland
- University of Missouri-Kansas City
- University of New South Wales
- University of Piraeus Research Center
- University of Rochester
- University of Toronto
- Utah State University
- Vodafone Group Services Limited
- Waterford Institute of Technology
- Zhejiang University
- ZTE Corporation

Technical Committee

Leadership:

- Dan Kilper, Bell Labs, Chair
- Shugong Xu, Huawei, Co-Chair

Chair's Summary / Key Accomplishments:

The Technical Committee is the executive body charged with supporting the various technical sub-committees and working groups in their efforts to achieve the GreenTouch objectives. The responsibilities of the Technical Committee include: 1) Determining the technical architectures that achieve GreenTouch goals, defining and updating the service requirements, and tracking alternative metrics; and 2) providing organizational oversight to document and disseminate consortium projects and outcomes, negotiate and assign new tasks and projects funded by GreenTouch, drive and track progress toward final architectures, identify and track progress toward key demonstrations, document gaps in effort, organize meetings and calls to stimulate progress toward goals, and provide year-end reporting to the Executive Board.



During our second year, the Technical Committee made important strides toward the GreenTouch consortium's ambitious network energy efficiency goals. The near-term strategic goals included completing the first architecture contribution, developing special study groups in key areas related to technical gaps, addressing data center/enterprise networks, executing on the next demonstration opportunities, and building the publication and results portfolio. Mid-year we also identified the need to add a new working group addressing green standards and policies. The initial public roadmap review and open forum was one of the highlights of the technical program at the Seattle all-members' meeting in November 2011. Toward the end of the year we organized two important initiatives: a re-evaluation and re-organization of the technical sub-committee and working group structure and a further roadmap assessment at the all-members' meeting in Dallas in June 2012.

The Technical Committee also collaborated with other organizations. We made major contributions to network models in the Green House Gas Protocol Telecom Network Services Guidelines. GreenTouch also developed new relationships with the Global e-Sustainability Initiative (GeSI), the MIT Microphotonics Center (on lifecycle analyses of telecom services), Optoelectronics Industry Development Associations (OIDA), and the UCSB Institute for Energy Efficiency, formally signing memoranda of understanding with the first two organizations.

We continued to investigate and evaluate the key GreenTouch strategic research directions and associated projects. An initial draft of the Strategic Research Areas document was presented to the consortium at the Dallas member's meeting for review and discussion, with a final version subsequently targeted for completion and release in the September 2012 timeframe. Figure 1 highlights the major research challenges and focus areas that have been identified by the GreenTouch members as the most promising for achieving our main goal of delivering the architecture, specifications and roadmap—and

demonstrating key components—needed to increase network energy efficiency by a factor of 1000 compared to 2010 levels. Working groups continue to refine the project portfolio, build a roadmap and demonstrate key results that will be published in subsequent documents.

Mobile Communications

- Network and system technologies that enable separate signaling and data communication for efficient, high capacity mobility
- Deployment of small cells and smart network management
- Large scale cooperative antenna based systems
- Wireless channel energy and performance tradeoffs

Wireline Access

- Capacity and energy efficient protocols and algorithms
- Home gateway virtualization techniques
- Architectural tradeoffs considering fundamental energy and technology constraints
- Low power micro-electronics and photonic components

Core Networks

- Dynamic, power adaptive networking technologies
- Energy-centric protocols and networking layering/cross-layer functionality
- End-to-end and service aware architectures and technologies

Cross Domain

- Energy efficient electronic communication processing
- Energy efficient optical transceiver technologies
- Cross-layer network simulation tools

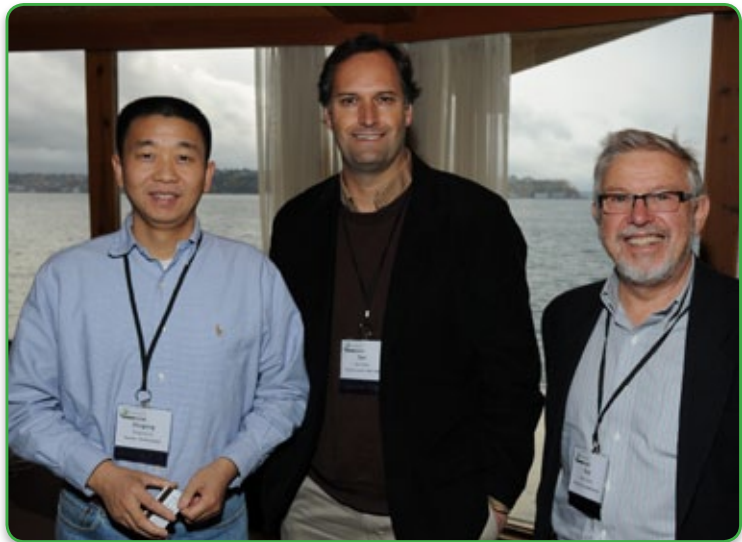
Fig. 1. Major research challenges and focus areas identified in the GreenTouch Roadmap Strategic Research Areas Document.

Special study groups addressing research gaps included energy efficient and low power electronics, wireless backhaul networks, and network modeling. In addition, special sessions were held at the Dallas meeting on smart cities/communities and network energy measurements. We continued discussions with representatives from the International Technology Roadmap for Semiconductor and the potential for large cross-platform efficiency improvements was introduced for further study.

Co-location of the member's meeting with the SuperComputing 2011 Conference facilitated a day long workshop on data center and enterprise networks: "Data Centers Have Gone Green (Or Haven't They?). When Will Networks Follow?" This workshop was organized by GreenTouch members and featured invited speakers from Lawrence Berkeley National Labs, Columbia University, University of Cambridge, Bell Labs, UC San Diego, Microsoft Research Lab, UC Berkeley, HP Labs, Level 3, Ciena and Juniper.

GreenTouch has started discussions with the OIDA on trends and roadmaps for data centers and aggregation networks, including participating in the OIDA workshop: "Optical Communication Networks: Quantitative Metrics in the Data Center."

This year GreenTouch showed several demonstrations in the Wireline Access area. The bit-interleaved passive optical network protocol (Bi-PON) is a cornerstone of the wireline access project portfolio. When used with sleep-mode innovations, it enables efficient bandwidth utilization and eliminates unnecessary high-bandwidth components in client premises equipment. Another GreenTouch demonstration was Bi-PON interoperability with a virtual home gateway, and sleep-mode operation with new green clock and data recovery physical layer electronics. Combined with other technologies under development, these innovations have the potential to achieve a 500-fold efficiency improvement in wireline access networks relative to a 2010 baseline architecture.



We held two major roadmap events this year: the roadmap review in Seattle and the roadmap assessment in Dallas. The roadmap review was a public presentation and discussion of the progress on the GreenTouch project portfolio from each of the technical sub-committees and working groups. The roadmap assessment was a critical evaluation of the current project portfolio and plans related to requirements and the potential to achieve GreenTouch goals. The assessment posed the question, "Where is GreenTouch relative to its main goal for 1000x network efficiency improvement?"

The Services, Applications, and Trends Committee completed its service taxonomy document and the macro traffic trends models. These publications describe boundary conditions for GreenTouch goals and provide critical guidance on service requirements for research and development on energy efficient networks.

We made significant progress in developing the research portfolio and results. We identified a potential end to end network architecture with an initial view of how the current research projects and activities could related to each other for overall large energy efficiency improvements.

The Technical Committee finished the year with a major re-organization of its sub-committee and working group structure. The structure established in the GreenTouch founders meetings was evaluated in light of current working practices and objectives. We created a new streamlined structure that keeps the best attributes of the original structure and adds important changes to facilitate progress as GreenTouch moves forward aggressively towards the completion of our five year goal. The GreenTouch Technical Committee is now well organized, and has the focus and momentum to lead the industry toward sustainable networks for our future.

Services, Applications, & Trends Committee

Leadership:

- Steve Korotky, Bell Labs, Chair
- BianSen, China Mobile, Co-Chair

Chair's Summary / Key Accomplishments:

The Services, Applications and Trends Committee (SAT) helps improve energy efficiency through contributions to the baseline network architecture. The Committee's task is identifying application and network requirements for long-term technology solutions, particularly those affected by macro traffic trends, network characteristics and traffic details, and the taxonomy of feature requirements in applications.

During this reporting period SAT has created recommendations for input to the Baseline Architecture. Committee activities included critical reviews of traffic and architecture documents and whitepapers, and the formulation and approval of recommendations on the baseline architecture document, traffic, a network operator questionnaire, and draft application taxonomy. SAT has addressed these topical areas within three study groups, which have formulated recommendations, reviewed the recommendations with the Technical Committee and its working groups, and disseminated them to the GreenTouch membership.

In addition to its study groups, SAT is the host committee for two new GreenTouch projects that address the empirical assessment of energy consumption in telecom networks and the formulation of energy metrics to permit users to include energy consumption in forming product purchase decisions.



Core Optical Networking and Transmission Working Group

Leadership:

- William Shieh, University of Melbourne, Chair
- Christian Dorize, Bell Labs, Co-Chair

Chair's Summary / Key Accomplishments:

The Core Optical Networking and Transmission Working Group (CONT) explores energy efficiency in the physical layer of metro and long-haul transport networks. CONT has set an ambitious goal of achieving a 50-times improvement in energy efficiency. Achieving this requires innovations from optoelectronic modules and subsystems, to optical link design, to overall optical network design.

CONT made several notable achievements in its second year. We launched a new project called “energy efficient high capacity OFDM transmission” (EFICOST). It addresses energy efficient transmission technologies based on *orthogonal frequency-division multiplexing* (OFDM) to efficiently cope with the increasing power consumption issues of ultra-high capacity signal transmission in long haul networks.

We achieved substantial progress with the HALF-MOON (Highly Adaptive Layer for Meshed On-off Optical Networks) project which was launched last year. HALF-MOON investigates the impact of new transmission technologies such as elastic data-rate devices; the introduction of new device characteristics, such as complete or partial switch-off of optoelectronic devices; and new protocols for reducing the global amount of energy required by the optical network to transport a time-varying amount of data. We compared the sleep mode approach acting on optoelectronic devices with another approach based on link sleep modes. On average, our proposed approach provides 14% lower consumption and up to 27% at low traffic.

CONT also made good progress with “Service Energy Aware Sustainable Optical Networks” (SEASON). Its objective is designing a clean-slate network for maximum energy efficiency through awareness of service requirements. SEASON aims to derive a set of architectural trade-offs, algorithms, and rules for designing future energy efficient networks. It will also create basic technologies for tools to enable future energy efficient networks. SEASON achieved its first major milestone and developed plans for the main network demonstration. Progress continued on the development of physical layer and service layer protocols and control algorithms, as well as the dynamic network capabilities.



Core Switching and Routing Working Group

Leadership:

- Thierry Klein, Bell Labs, Chair
- Jaafar Elmirghani, University of Leeds, Co-Chair

Chair's Summary / Key Accomplishments:

The Core Switching and Routing (CSR) Working Group is primarily focused on components, technologies, systems, algorithms and protocols at the data link layer, the network layer and the transport layer in the traditional network protocol stack. At the same time, we are also investigating interactions with lower and higher layers and research efficiencies that can be obtained from cross-layer optimizations. Some of the areas of interest include, but are not limited to (1) network equipment hardware; (2) network topologies and end to end architectures; (3) integration of application, services and transport layers; (4) traffic engineering and (5) network management, operation and control.



The Working Group currently comprises 76 individual contributors from 30 GreenTouch member organizations, representing industry, academia and research institutions. The members of the CSR Working Group collaborated on 7 projects. Five of these projects are multi-year projects that have been defined in previous years and continued progress has been achieved. In addition two new collaborative projects have been defined and started in this past year. The Working Group has also collaborated with the Core Optical Networking and Transmission (CONT) Working Group on the SEASON project to investigate clean-slate end to end service optimized network architectures and solutions.

All of the projects of the Working Group have made significant progress towards their goals and objectives. In particular the working group has improved its understanding of the power consumption in network elements, such as routers, and obtained further results in low power component technologies, network architectures and topologies and optimized management and control of resources to improve the overall network energy efficiency.

A significant activity of the Working Group this year was to develop a model for the network energy efficiency of the core network. Such a model includes a detailed description of the power consumption and energy efficiency of the individual network elements, the interconnection between the different elements, the management and control of the traffic and the network itself. The energy efficiency model allows us to determine the current network energy efficiency and the “business as usual” trend. It also has sufficient granularity in the modeling to capture the individual research targets and objectives associated with the projects of the CSR working group. In the near future, we will utilize this model to project the energy efficiency that can be achieved based on the current research projects of the Working Group as well as to provide a roadmap and a “green meter” to distinguish the contributions from the individual research objectives towards the overall goal.

Finally the CSR Working Group has continued to review and refine its projections for the overall network energy efficiency improvement opportunity. We believe that an overall energy efficiency gain of 270x can be accomplished through a combination of (1) chip level components, devices and sub-systems (15x); (2) network element design (1.5x); (3) network architecture (2x); (4) dynamic resource management (3x) and improve power utilization efficiency (2x).

Members of the CSR Working Group have helped organize and presented at several GreenTouch sponsored events, such as the GreenTouch Open Forum in Nov. 2011, the Green Telecom and IT Workshop in Bangalore in April 2012, the EU Sustainable Energy Week in Brussels in June 2012. Members have also published at tier-1 conferences, workshop and journals, including INFOCOM, OFC, ECOC, ICC, GLOBECOM and IEEE/OSA Journal of Lightwave Technology, IEEE Photonics Journal and IEEE Network Magazine.

Mobile Communications Working Group

Leadership:

- Ulrich Barth, Bell Labs, Chair
- Azeddine Gati, Orange, Co-Chair

Chair's Summary / Key Accomplishments:

The Mobile Communications Working Group (MC) contributes research to improve energy savings of the wireless access network. These savings will accrue with innovations in architecture, access nodes, and deployment of the mobile communication network for future generations. Examples of promising areas for research include air interface technologies, radio resource management, Multiple-Input-Multiple-Output antenna systems and other antenna technologies, relays and cooperative transmission, power amplifier technologies, base station architectures, baseband processing, backhaul technologies, network topologies, deployment strategies, and operation and management concepts.



The Mobile Communications Working Group is focused on new highly energy efficient air interfaces, tradeoffs between energy efficiency and mobile system design criteria like spectrum efficiency or service delay, power models of wireless access points, dynamic coverage and capacity management, and deployment and management strategies for energy efficient mobile systems.

Participants from mobile vendors, mobile operators, device manufacturers, and academia collaborate in three large umbrella projects, and an architecture sub-group that combines the results from the projects.

Architecture sub-group

The architecture sub-group investigates the general network energy efficiency metrics suitable for various wireless architectures, the calculation methodology of the metrics, and the research roadmap towards energy savings in future wireless access networks.

Last year the architecture group defined the “wireless box,” which shows the study scope of wireless architecture in the end-to-end framework of GreenTouch. The wireless box comprises rich diversity of access technologies, network layouts, and transmission technologies, which prohibits the possibility of a “one-for-all” closed-form mathematical approach to calculate any energy efficiency metric for all scenarios. Instead, we developed an evaluation framework for the wireless networks with four components:

- **Energy efficiency performance metrics**, e.g. KBits/Joule for throughput-oriented scenarios and Watt/km² for coverage-oriented scenarios.
- **Logic of the evaluation framework** – this bottom-up approach starts from the small-scale instantaneous transmission (considering PHY/MAC technologies) of a given time instance and area snapshot, and then averaged over time and space based on large-scale traffic/geographical models.

- **The general methodology for network energy efficiency computation** as examples of applying the logic of the framework for real calculation, and showing where and how different models are used in the computation.
- **Basic supporting models**, mainly the power consumption model (input power->output power-> traffic), the large-scale traffic distribution/variation (time and space) model, and the long-term deployment models (network layouts and fractions of different BSs).

The LSAS umbrella project

Large Scale Antenna Systems (LSAS) seeks to improve wireless energy efficiency through a combination of radiated power reduction and increased throughput. The distinguishing feature of LSAS is that unprecedented numbers of service-antennas communicate with a much smaller number of autonomous terminals over the same time/frequency resources.

The LSAS project developed power modeling for computing total energy efficiency, low-power final amplifiers and the effects of peak-to-average power ratio, pre-coding algorithms, the effects of quantization on beam-forming, the impact of bandwidth expansion, and the question of where and how to deploy unprecedented numbers of service-antennas.

The GTT umbrella project

The Green Transmission Technologies (GTT) project focuses on the energy efficient design of transmission schemes, radio resource management strategies, and signal processing algorithms based on the fundamental tradeoffs in wireless communications. GTT quantified the fundamental tradeoff between bandwidth efficiency and transmit power efficiency under given data rate requirements, and developed a sound framework for minimizing the *total* power – accounting not only for the transmitted power, but also for baseband signal processing.

The BCG² umbrella project

The Beyond Cellular Green Generation (BCG²) project aims to surmount limitations of traditional cellular architectures for dynamic energy management. Its principal idea is separating the signaling network from the data network, and providing energy efficient dynamic capacity provisioning. The project achieved remarkable results in system architecture design and system modeling. Results included the definition of the general system architecture, analysis of possible alternative design options for the system components and its logical functions, the evaluation of the potential energy efficiency gains achievable with the new approach, estimation of the performance bounds, and a first evaluation of the fundamental tradeoffs.

Wireline Access Working Group

Leadership:

- Peter Vetter, Bell Labs, Chair
- Laurent Lefevre, INRIA, Co-Chair

Chair's Summary / Key Accomplishments

During our second year, a highlight was the demonstration of a new energy efficient protocol for Passive Optical Network using Bit Interleaving (Bi-PON). It featured more than an order of magnitude reduction of the power consumption for protocol processing. We showed the Bi-PON demo in March 2012; an advanced demo with integration of a virtual home gateway (VHG) was shown at TIA2012 in June 2012.

Another project about low energy access architectures compares the consumption of different architectural options and modulation formats for optical access networks. While using a common methodology and database, each contributing partners took ownership of one of the different architectural approaches and analyzed its concepts to improve its energy efficiency. The results will be published as a joint paper in 2012.

In addition to the physical layer, we are studying energy efficiency for virtual home gateway (VHG) and quasi-passive Customer Premises Equipment (CPE). This project aims at energy efficiency improvements by simplifying the CPE and virtualizing typical home gateway functions on a central server in the network. We prototyped a VHG and measured a 5-10x improvement of energy efficiency thanks to time sharing of processing resources.

In order to verify our progress toward GreenTouch goals, the Wireline Access Working Group created a roadmap for the different research ideas, and modeled their effect on the total power consumption and energy efficiency of a wireline access network (see Fig. 2). With the combination of all ideas, we estimate more than 50x reduction of the power consumption per subscriber compared to the GPON base line. Considering the traffic growth forecasts in a mature market provided by the GreenTouch SAT committee, this results in an energy efficiency gain of 500x by 2020.

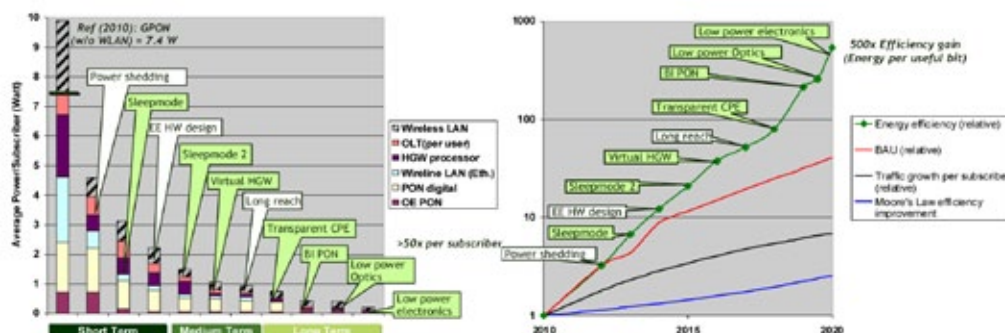


Fig. 2: The combination of ideas that are being worked on in Wireline Access Working Group will result in more than 50x power reduction per subscriber or a 500x improvement of the energy efficiency per bit.

Operations Committee

Leadership:

- Thierry Van Landegem, Bell Labs, Chair
- Rudy Lauwereins, IMEC, Co-Chair

Focus Areas

The Operations Committee plays a key role in the day-to-day management of GreenTouch. It is responsible for financial management, infrastructure and logistics planning, and the oversight of its management partners. During our second year we formed two new Subcommittees of the Operations Committee to provide additional support in the areas of (1) Funded Projects and (2) Marketing and Communications.



Funded Projects Subcommittee

Leadership: Didier Bourse, Bell Labs

Reaching the factor 1,000 is clearly one of the ICT grand challenges for the decade and requires a significant effort and budget. The momentum initiated by GreenTouch is amplified by the possible prioritization and funding of agency research grants and funded collaborations in the different regions. The dedicated GreenTouch Funded Project subcommittee supports this worldwide development. The GreenTouch roadmap, reference architecture and research challenges can be major contributors to the EU, US and APAC scientific research roadmaps, identifying the key challenges to be potentially addressed by different cooperation instruments, and by legal bodies including policy, regulatory and standardization (see Fig. 3).

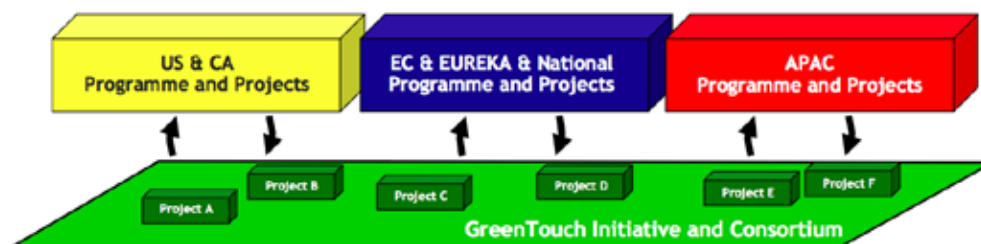


Fig. 3: GreenTouch Initiative and Funded Programs

The subcommittee creates and makes available to GreenTouch members a list of various funding calls for proposals that relate to GreenTouch project areas, and mobilizes GreenTouch members around important

funding opportunities. For example, one of the 2011 calls for proposals was the European Commission ICT Call 8 on Future Networks (FP7-ICT-2011-8), for which several GreenTouch projects contributed proposals related to Green ICT. A specific GreenTouch appendix was developed by the sub-committee for potential inclusion in the submitted proposals documents.

Members from the subcommittee also raise awareness of external funding parties on the work of GreenTouch. For example, GreenTouch was highly visible during the Aalborg Future Internet Assembly (FIA) event last May 2012 in Denmark during the opening plenary presentation by Thierry Van Landegem, "ICT infrastructure as key enabler of Smart Cities." The EC-funded project EARTH was given the prestigious FIA Award. Fig. 4 was developed by the subcommittee to depict the GreenTouch "Grand Challenge" and communicate our perspective for internal and external funded projects that target the factor 1000 of increase in network energy efficiency.

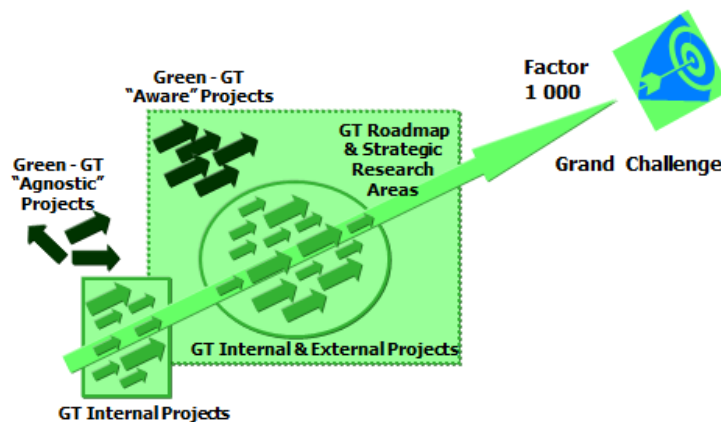


Fig. 4: GreenTouch Grand Challenge

The subcommittee organizes regular phone conferences and participation is open to all GreenTouch members.

Marketing & Communications Subcommittee

Leadership: Kay Seo, Bell Labs

The Marketing & Communications Subcommittee (MCSC) is responsible for managing internal and external communications and marketing activities for GreenTouch and its working groups. Goals include:

- Establish a clear identity for the consortium's unique positioning as green thought leadership and values-based program.
- Generate excitement among GreenTouch members, boost momentum, and make it an exciting place for collaboration.
- Establish an effective communication plan to improve internal communication and member engagement.

- Increase a proactive media relations program by using a variety of media sources to maximize awareness, create excitement, and enhance the consortium's image to support its goals, objectives and programs.
- Develop positive and collaborative relationships with target audiences.
- Reinforce a coherent image to establish "One Clear Voice" throughout all communication channels by creating key messages, talking points, and value proposition.

The Marketing & Communications Subcommittee engaged in a number of initiatives to increase awareness, create excitement and enhance the image of GreenTouch.

The committee started its media push at the end of 2011 by increasing the number of press releases. We launched the second technology demonstration milestone with the Bi-PON project via a virtual media event, with positive media coverage by more than 40 major trade media and analysts.

Following the successful Bi-PON media event, we launched a big media push for GreenTouch's collaboration and sponsorship of the TIA2012 Conference, including joint press releases, TIA NOW video interviews (such as the GreenTouch Chairman with the US Department of Energy CTO, and GreenTouch member China Mobile), the GreenTouch Chairman's key note speech at the TIA2012 VIP event, a Green ICT Educational Track and the GreenTouch Exhibition at TIA2012. The event was co-located with the GreenTouch general members meeting, and generated interest by prospective members.

One of the biggest and positive changes in the MCSC activities is on the policy side. Since the first Memorandum of Understanding signed with GeSI (Global eSustainability Initiative), we have increased the interaction with the organizations in the policy area, a few examples of which include:

- B4E Global Summit 2012 Berlin participation by the GreenTouch Chairman, the outcomes of which were delivered to secure commitments for sustainable development at Rio+20.
- GeSI/GreenTouch Day at EU Sustainable Energy Week in partnership with GeSI on June 20th, 2012 in Brussels, Belgium including speakers from the European Commission, the Climate Group, and GreenTouch Technical Committee and working group representatives.

A more detailed Annual Report is available for GreenTouch members.

If you are interested in contributing to the consortium or getting access to more detailed information, we encourage you to consider joining GreenTouch.

For more information, please email contact@greentouch.org.