White Paper

Smart Services: Eco-sustainable Opportunities for Telecom Operators

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I. Introduction & Summary

Without question, climate change is a global reality that affects all consumers and businesses daily. While optimizing communication services is important to minimize CO_2 emissions, all industries must collaborate on an entirely new plane to support fundamental environmental change.

Even though the Information and Communications Technology (ICT) sector is estimated as contributing only 2 to 2.5 percent of total global emissions, the environmental impacts are significant and cannot be ignored. According to the Global e-Sustainability Initiative (GeSI) and the Climate Group, ICT emissions are rising steadily. While the ICT industry emissions represented 0.5 gigatons of carbon dioxide equivalent ($GtCO_2e$) in 2002, they are projected to grow to 1.4 $GtCO_2e$ by 2020.[*] A gigaton represents 1 billion tons of CO_2 emissions.

Moreover, it is also acknowledged that ICT collaboration is vital for helping other industries achieve their carbon footprint goals. As a proof point, GeSI estimates that ICT involvement with these industries by 2020 will deliver cost avoidance savings of $946.5 billion (US) through reductions in electricity and fuel consumption. There is little debate, that the ICT industry is well positioned to deliver applications to help achieve these savings.

Therefore, a key observation of this white paper is that IP-based telecom networks will become the next-generation backbone of other industries, as well. As a result, telecom operators will provide the technology foundation and foster the creation of a new order of environmental economics by increasing the uptake of telecom services in other industries. Since the underlying technical capabilities exist in today's telecom networks, many of these business opportunities can be addressed immediately.

Accordingly, this white paper focuses on how these applications – referred to as "smart services" are being deployed not only to meet consumer and environmental demands, but also to comply with public safety and regulatory requirements. This white paper also examines the role that fixed and mobile broadband access, personal commuting, and device connectivity play in promoting a change in end-user consumption patterns.

Although, this white paper examines a suite of services, including smart buildings, smart collaboration, smart utilities, and smart transportation, it is important to note that these are not the only potential business opportunities. This is because other segments, such as health care, and water and gas grids face similar challenges and are undergoing similar transformations.

[*] GeSI, *Smart 2020: Enabling the low carbon economy in the information age,* June 2008

II. Smart Grid 2.0 & the Internet of Things Explosion

Since the initial steps almost a decade ago, telecom networks continue to migrate from TDM to IP technology, leveraging access to fixed and wireless broadband to deliver a richer end-user application experience. This approach is also important for telecom operators since it not only simplifies network administration and reduces operating costs, but also provides end-to-end quality of service (QoS) for service and application enablement.

Since a network with these attributes – referred to as a high-leverage network (HLN) by Alcatel-Lucent – has a smaller footprint and is easier to scale, it also empowers telecom operator eco-sustainability strategies.

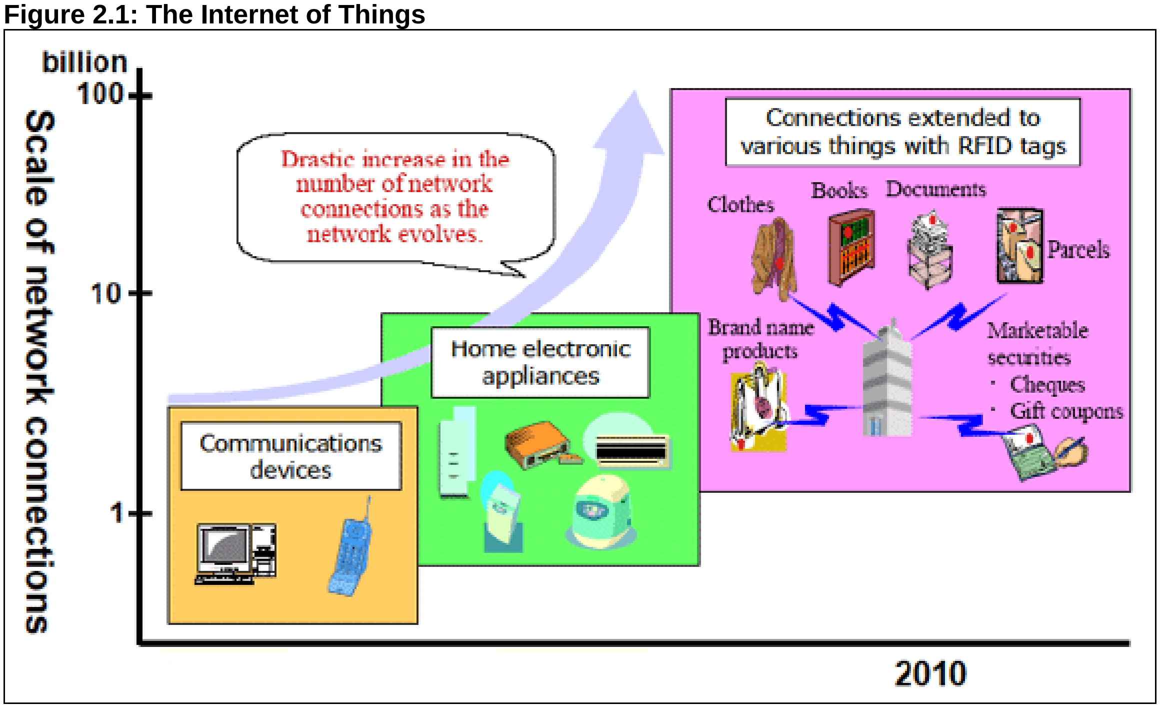
In this section, several of these applications and their environmental benefits are considered. These include:

- Smart Buildings
- Smart Collaboration
- Smart Utilities – Smart Grid and Smart Metering
- Smart Transportation

Although these services and capabilities may appear to be unrelated at first glance, they are in fact closely aligned. This is because they all benefit from the implementation of the "Internet of Things" concept formulated by the ITU.

One of the key constructs of this approach is that devices are connected at an IP level to optimize interworking on a peer-to-peer basis. Accordingly, from a network perspective, whether a "thing" is an automobile, dishwasher, computer, TV, security camera, sensor, or smart meter, is ultimately less important than the protocols, intelligence, and dynamic and self-configuring software capabilities it supports.

Figure 2.1: The Internet of Things



Source: ITU, The Internet of Things, November 2005

2.1 Smart Buildings: The IP Generation

Even though the concepts of smart homes and smart buildings have existed on paper for at least eight years, widespread adoption has not taken place. This can be attributed to the limited availability of several strategic enablers, including:

- Fixed Broadband Access
- Wireless Broadband Access
- Computing Capability
- Device Connectivity

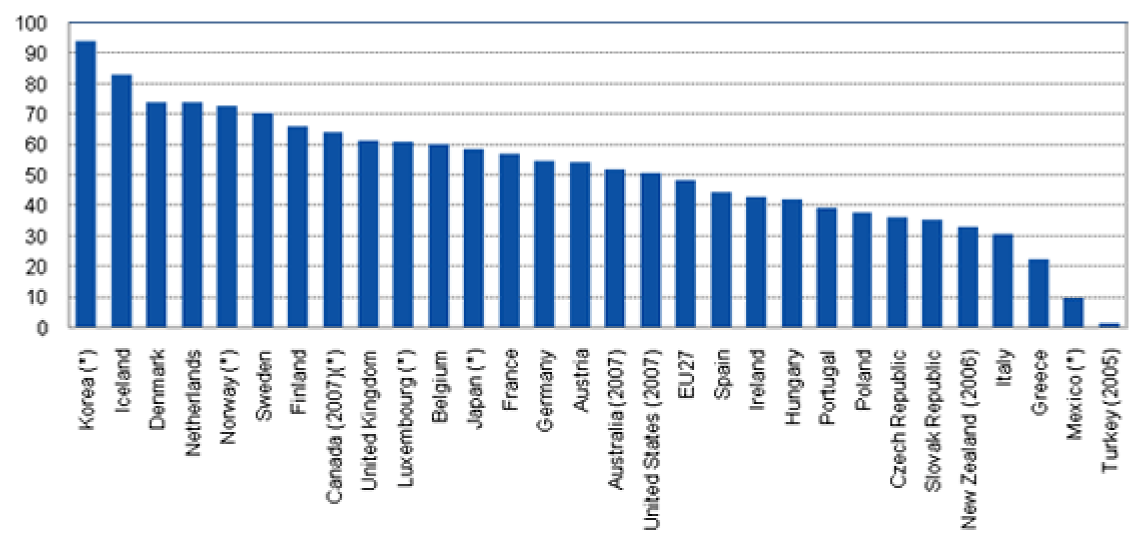
Fixed Broadband Access

While fixed broadband access is now widely available in mature markets, with a subset even utilizing a fiber-to-the-X (FTTx) model, this was not always the case. Furthermore, in many of these same markets, five to seven years ago if broadband was available, it was priced at a premium.

However, as shown in **Figure 2.2**, since 2006, broadband penetration levels in many markets have achieved the base penetration levels required to make smart buildings feasible. In addition, according to the ITU, between 2005 and 2006, the price of broadband connection in established markets by dropped 50 percent.[*]

Therefore, while in the past smart buildings faced limitations imposed by lack of broadband access, this is no longer a factor in most markets.

Figure 2.2: Percentage of Households With Broadband Access



Source: Organization for Economic Cooperation and Development (OECD), December 2008

Wireless Broadband Access

Correspondingly, another important enabler of smart homes and smart buildings is the availability of wireless broadband access. As 2G subscribers continue migrating to 3G networks, they benefit from not just broadband access, but also terminal innovation. This is because 3G mobile devices are converged smart multi-use terminals, with video and data storage capabilities previously only available on PCs.

[*] ITU Internet Report 2006: *digital.life*

Computing Capability

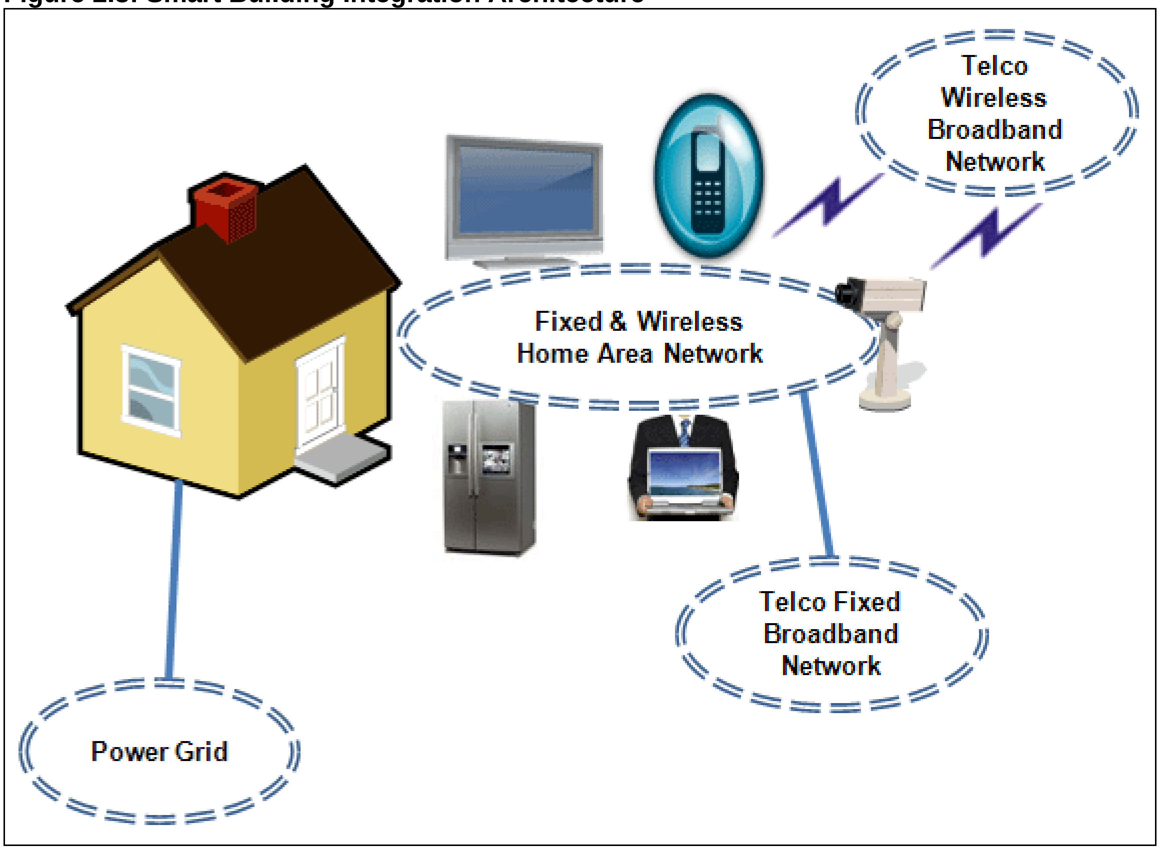
An additional significant smart building enabler, which previously was lacking to users, is computing capability. Since their commercial availability in the early 1980s, laptops have exponentially increased their hardware capacity and can now support 500 GB hard drives, compared to 60 GB in 2001. And with affordable terabit laptops on the horizon, smart buildings will support the upper bounds of computing capabilities necessary to exploit the broadband services delivered by the access networks described above.

Device Connectivity

The final element of smart buildings is device connectivity. In this respect, although progress has been made to interconnect computing and video servers into commercial and home access networks, the final step of interconnecting *all* devices, conceptually aligned with the Internet of Things to enable machine to machine (M2M) communication has yet to take place.

But this is rapidly changing. Progress continues to be made on several levels in appliance design to deliver fully integrated consumer durable appliances, such as refrigerators, lighting systems, ovens, and dishwashers. While the inclusion of a USB interface and a radio frequency identification (RFID) tag in a TV set is seemingly a trivial design change, it delivers the capability to seamlessly manage the devices within a smart building as illustrated below in **Figure 2.3**.

Figure 2.3: Smart Building Integration Architecture



Source: Heavy Reading

Appliance vendors, as described in **Section 2.2**, are taking steps to make this a reality in response to changes in the power delivery model through smart grids and smart meters. As a result, the bottom line for consumers and businesses alike is that device connectivity is a critical component for reducing power consumption and validating the smart building business model.

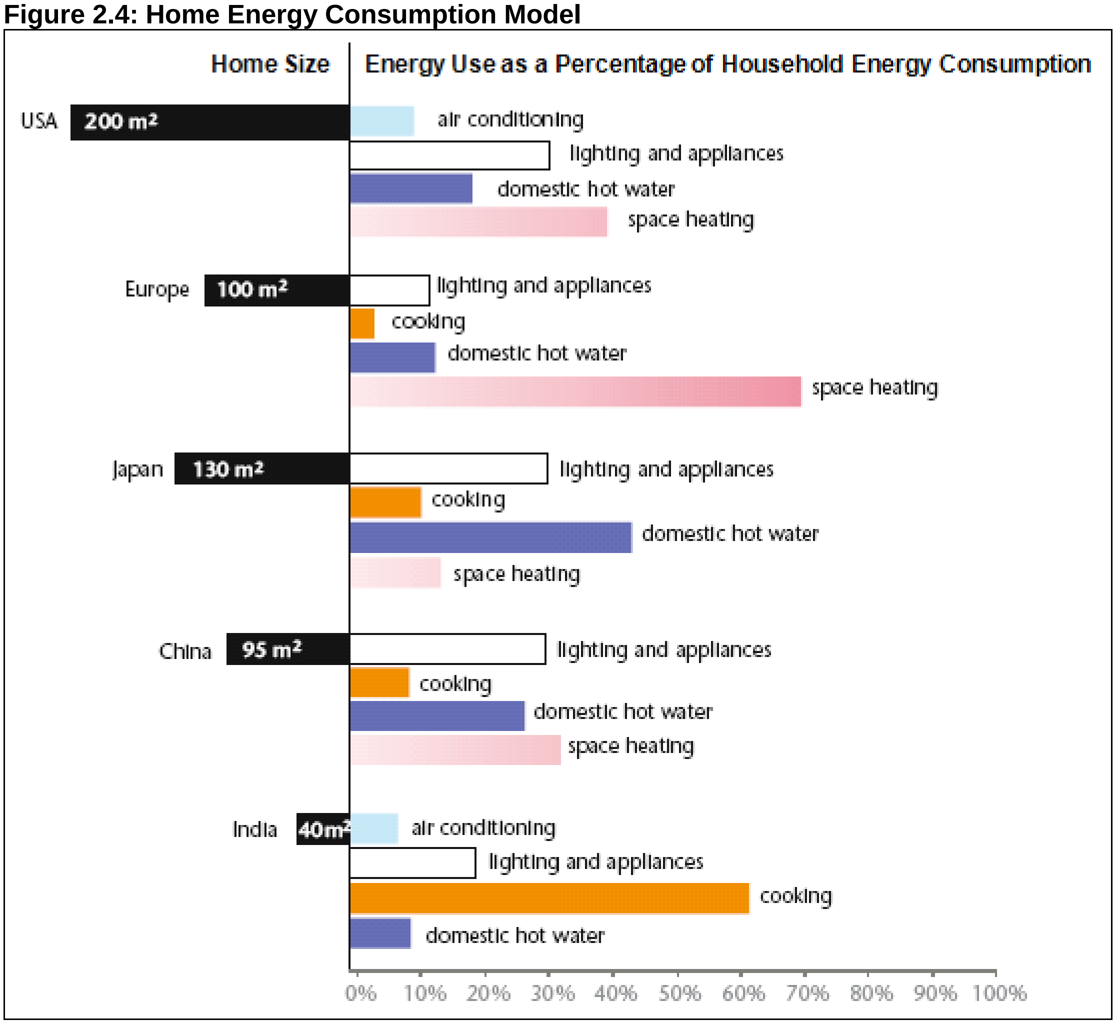
2.2 Smart Buildings: Telecom Operator Business Opportunities

In discussing the existing smart building concept, the model appears to be mainly service-focused and leveraging the traditional telecom triple-play services model. While this is a valid observation, there is a second, less conspicuous point to consider that is of paramount importance.

According to the World Business Council for Sustainable Development (WBCSD), buildings account for almost 40 percent of the world's energy usage, driving more carbon emissions than even the transportation and manufacturing sectors[*]. Therefore, according to the previously referenced GeSI report, globally, the use of smart building technologies would eliminate 1.68 $GtCO_2e$ of emissions savings, which translates into a savings of $340.8 billion (US).

Within these buildings, as illustrated below in **Figure 2.4,** a large portion of the consumption is driven by appliances, which include telecom and video devices. One device that is attracting a great deal of attention is the TV: According to research conducted by the California Energy Commission, current plasma TV consume three times more power than a conventional TV set. As a result, the Commission in 2009 passed a law that will require new TVs sold in California in 2011 to consume 33 percent less power than current models.[†]

Figure 2.4: Home Energy Consumption Model



Source: WBSCD, April 27, 2009

[*] WBCSD, *Energy Efficiency in Buildings – Transforming the Market*, 2009

[†] California Energy Commission, *Efficiency Standards for Televisions*, December 2008

Consequently, while appliance vendors have largely reaped *hardware* benefits in developing Energy Star appliances, these are limited to energy savings based on a usage model, while truly smart appliances of the future will leverage both hardware and IP software efficiencies using smart meters. As a result, several traditional appliance vendors, including General Electric, have recently announced initiatives to create a new line of consumer grid-optimized appliances.[*]

Without intervention, however, smart buildings with more advanced computing and broadband capabilities will actually increase rather than reduce building power consumption, as noted in the TV example above. While this is very much a global concern, particular areas of market focus include Brazil, China, Europe, India, Japan, and the U.S. This is because according to the WBSCD, they account for nearly two-thirds of the world's building energy usage, and consequently face the brunt of the environmental impacts.

As a result, these countries are advocating new approaches. One of these, referred to as demand response (DR) proposes the introduction of a time-of-use sensitive pricing model. While the introduction of such a model is not imminent given it requires approval from regulatory and utility agencies, it is well aligned with the concept of exploiting the intelligence of smart buildings to schedule non-critical functions during off-peak hours.

In return, since smart buildings can interface to fixed and mobile networks, telecom operators gain unprecedented access to subscribers with broadband capabilities that can be leveraged to deliver new revenue generating personalized services.

For example, a telecom operator in a future portal environment could introduce a "power as a service" capability. Such a service would allow subscribers to intelligently control all IP devices, provide off-site storage backup for critical data, and deliver simplified security services. Additional services include support of advanced lighting and heating controls. While benefits will vary, a case-study created by Alcatel-Lucent with Hampshire Hotels documented that the implementation benefits of intelligent guest room temperature and lighting monitoring systems are significant. By introducing such a system Hampshire Hotels realized a 40 percent reduction in electrical costs, saving $1.6 million (US) per year.[†]

2.3 Smart Collaboration

Closely aligned with the development of smart residential and commercial buildings is the ability to leverage their IP backbones to deliver a rich suite of collaborative services. Samples of some of these applications include video conferencing, whiteboarding, unified messaging, and real-time data exchange. These applications are relevant for many use cases including teleworking, e-leaning, and e-health applications, as well as virtualized trade shows and events to minimize travel requirements. Moreover, as discussed below, smart transportation and smart grid administration staff also benefit by using these applications on a daily basis.

Smart Collaboration Opportunities for Telecom Operators

Given the substantial business potential of smart collaboration services, delivering wireless access points, and broadband connections has been a high priority for telecom operators for a number of years, While a survey by the U.S. Telecommuting Coalition (TelCoa) seven years ago identified that 54 percent of companies believed that teleworking made it difficult for employees to share data, telecom operators now have in place the capabilities to eliminate these concerns and reap the environmental impacts.[‡] And the environmental impacts are indisputable: On a global scale, according to the World Wildlife Fund (WWF), increased adoption of virtual meetings and

[*] General Electric, *Press Release* - working with utilities to reshape consumer energy use, October 2008

[†] Alcatel-Lucent, *Hampshire Hotels and Resorts – A Dynamic Hospitality Enterprise*, 2009

[‡] TelCoa, *2003 Telework Survey,* October 2003

telecommuting today would eliminate 3 billion tons of CO_2 emissions in a few decades.* Similarly, a study by TIAX LLC determined that a single full time telecommuter living 22 miles from the office would save 320 gallons of gasoline, reducing CO_2 emissions by 4.5 to 6 tons per year.†

Moreover, with strong support from regulatory agencies, as illustrated in **Figure 2.5,** the WWF estimates that telecommuting has the potential to achieve 21 to 35 percent penetration by 2020.

Figure 2.5: Forecasted Growth Rates for Telecommuting

Telecommuting take up - as % of number of commuters

	2000	2005	2010	2015	2020	2025	2030	2035	2040	2045	2050
USA	11%	17%	23%	29%	35%	41%	46%	52%	58%	64%	70%
EU	5%	8%	15%	22%	29%	36%	42%	49%	56%	63%	70%
Japan	7%	12%	18%	25%	31%	38%	44%	51%	57%	64%	70%
SK AU NZ CA	7%	7%	14%	21%	28%	35%	42%	49%	56%	63%	70%
FSU	3%	4%	10%	15%	21%	27%	32%	38%	44%	49%	55%
Other Europe	3%	4%	10%	15%	21%	27%	32%	38%	44%	49%	55%
China	3%	4%	10%	15%	21%	27%	32%	38%	44%	49%	55%
Other Asia	3%	4%	10%	15%	21%	27%	32%	38%	44%	49%	55%
India	3%	4%	10%	15%	21%	27%	32%	38%	44%	49%	55%
Middle East	3%	4%	10%	15%	21%	27%	32%	38%	44%	49%	55%
Latin America	3%	4%	10%	15%	21%	27%	32%	38%	44%	49%	55%
Africa	3%	4%	10%	15%	21%	27%	32%	38%	44%	49%	55%

Source: WWF, Workplace to Anyplace, March 2009

To make video services available globally, the WWF estimates an additional 4,620 video sites would be needed. While not a trivial expense, the estimated capital cost of $495 million (US) to build these sites is much less expensive than alternatives, such as expanding air infrastructure. For example, the cost of building a third runway at London's Heathrow Airport is estimated at $22 billion (US).

Finally, smart collaboration also optimizes the virtual delivery of goods and services. This approach often referred to as dematerialization advocates Web-based delivery of content, such as music and video downloads, thereby avoiding the requirement to purchase CDs and DVDs. The savings that are realized include not only a reduction in power consumption of manufacturing facilities, but also the environmental penalties associated with transporting products to market.

2.4 Smart Utilities: Grid 2.0 & IP Transformation of Another Kind

Like telecom networks and smart buildings, the power grids of utility networks are also undergoing a comparable IP-based transformation. This is largely due to meeting the future demand challenges associated with supporting new products that are nearing the mass-adoption phase, such as alternative-fuel vehicles.

For this reason, utility networks globally are taking initial steps to migrate from a traditional rigid grid approach to a more intelligent and flexible IP-based smart grid approach. A power network that supports these characteristics is often referred to as Smart Grid 2.0.

The most visible change inherent in this transformation, as shown below in **Figure 2.6**, is the replacement of these 100-year-old grids with smart grids, which incorporate localized microgrids to support alternative energy generation.

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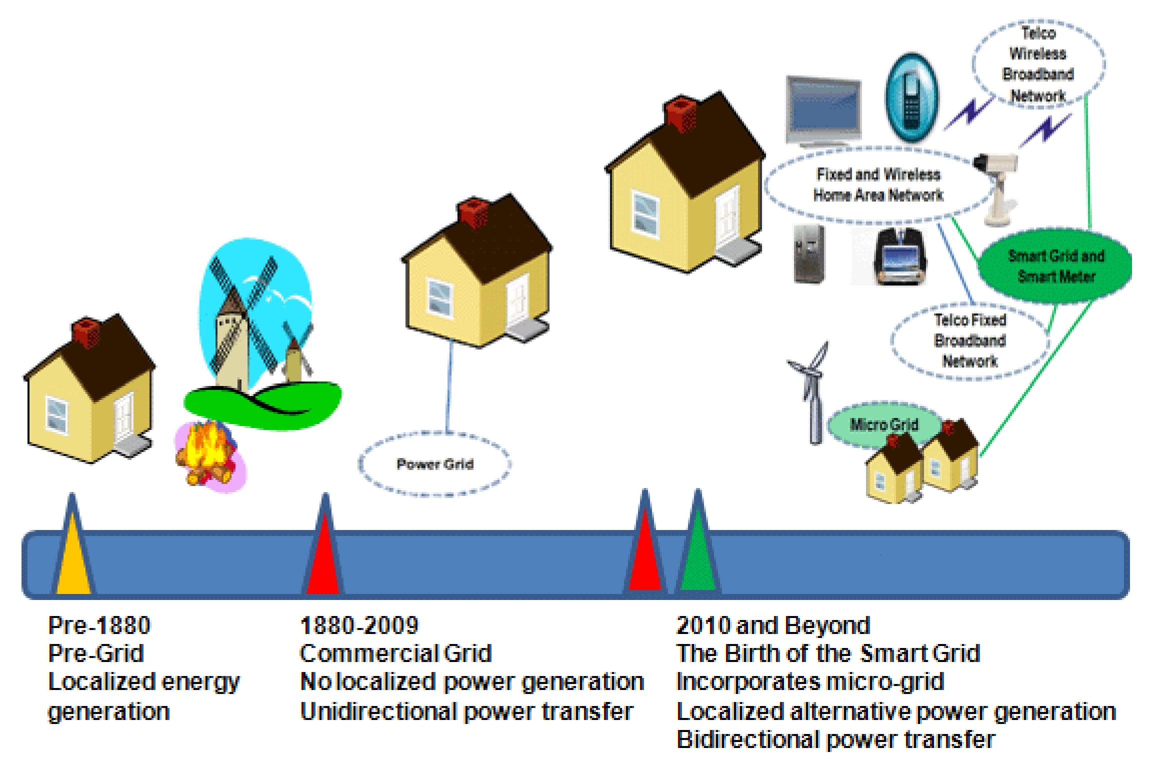
* WWF, *Workplace to Anyplace,* March 2009

† TIAX LLC, *The Energy and Greenhouse Gas Emissions Impact of Telecommuting and E-Commerce,* July 2007

In the U.S. alone, recent analysis from the Electric Power Research Institute (EPRI) estimates that the implementation of smart grid technologies could reduce electricity use by more than four percent by 2030, which equates to a cumulative savings of $20.4 billion (US).*

Figure 2.6: The Power Generation Continuum



Source: Heavy Reading

Still, note that this transition is not simply an extension of the current grid, but rather necessitates a complete redesign to support variable power pricing, real-time access to power profiles, and dynamic allocation of power. *Simply stated, smart grids are radically different from traditional power grids, in that interconnection with telecom networks via IP is an underlying assumption.*

Once interconnected, this also opens up a number of other future service possibilities, such as extending next-generation IMS core networks to also provide policy-based access to smart-grid-enabled power networks via smart meters. In this context, the IP transformation model is relevant for both TDM telecom networks and power networks. This is because both are following similar network evolution paths, as captured in **Figure 2.7**.

Figure 2.7: Power & Telecom Network Similarities

NETWORK TYPE	CUSTOMER INTERFACE	BILLING FLEXIBILITY	NEW SERVICES INNOVATION	DELIVERY METHOD	SURVIVABILITY STRATEGY
Traditional Power Grid	Closed, fixed; micro-grids not supported; non-IP-centric	Limited; difficult to extend	Network-level; limited subscriber personalization	Always on	Closed and hardware-centric
Legacy Telco Network	Closed, fixed; non-IP-centric	Limited; difficult to extend	Network-level; limited subscriber personalization	Always on	Closed and hardware-centric

* EPRI, *Energy Savings and Carbon Emissions Reductions Enabled by a Smart Grid*, September 2008

NETWORK TYPE	CUSTOMER INTERFACE	BILLING FLEXIBILITY	NEW SERVICES INNOVATION	DELIVERY METHOD	SURVIVABILITY STRATEGY
Smart Power Grid	Open, programmable; microgrids supported; IP-centric	Flexible	Subscriber-level personalization	Dynamically adjust to usage	Open, software- and IP-centric
Next-Gen IP-Based Telco Network	Open, programmable; IP-centric	Flexible	Subscriber-level personalization	Dynamically adjust to usage	Open, software- and IP-centric

Source: Heavy Reading

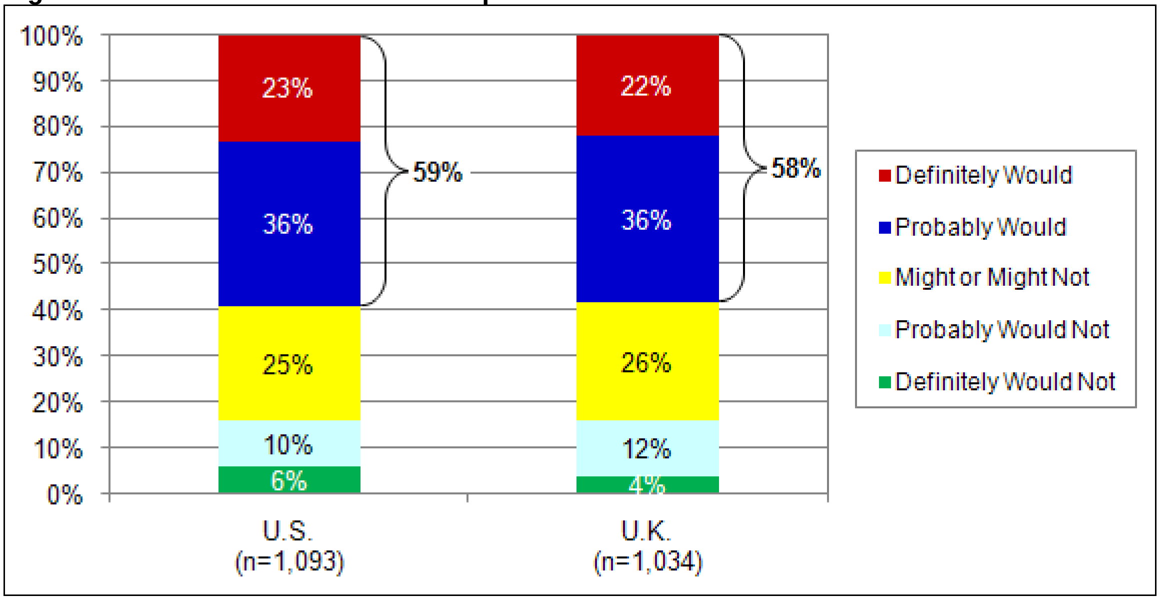
The Emergence of Microgrids

Localized microgrids not supported by today's power grids are another factor driving the move to smart grids. Microgrids are important for several reasons: They reduce strain on the smart grid in heavy-use periods by facilitating use of localized renewable power sources, and also support programmable access to power grids in off hours. The environmental economics of microgrids also encompass the potential to sell power generated locally back to the grid to increase capacity.

Based on this model, smart buildings could potentially be used to store power and sell to it to a smart grid via a smart meter. Buildings that support such capabilities are referred to as *zero-energy buildings*. For this reason, a key design change that must be considered is the bidirectional exchange of power via microgrids, versus the current unidirectional exchange model.

While some may argue that consumers are not interested in altering usage patterns, initial evidence indicates this is not the case. A recent study by GE/Ipsos polling consumers in the U.S. and the U.K. revealed that three out of five people in both countries would change their electricity consumption behavior based on smart grid adoption. As shown in **Figure 2.8**, the survey also revealed that 60 percent and 58 percent, respectively, would monitor energy usage online at least once a week, setting the stage for mass adoption. While not reflected in the survey, the implementation of a demand-response pricing model with significant off-peak hour pricing incentives would also likely drive consumers to monitor usage.

Figure 2.8: Smart Grid Consumer Adoption Metrics

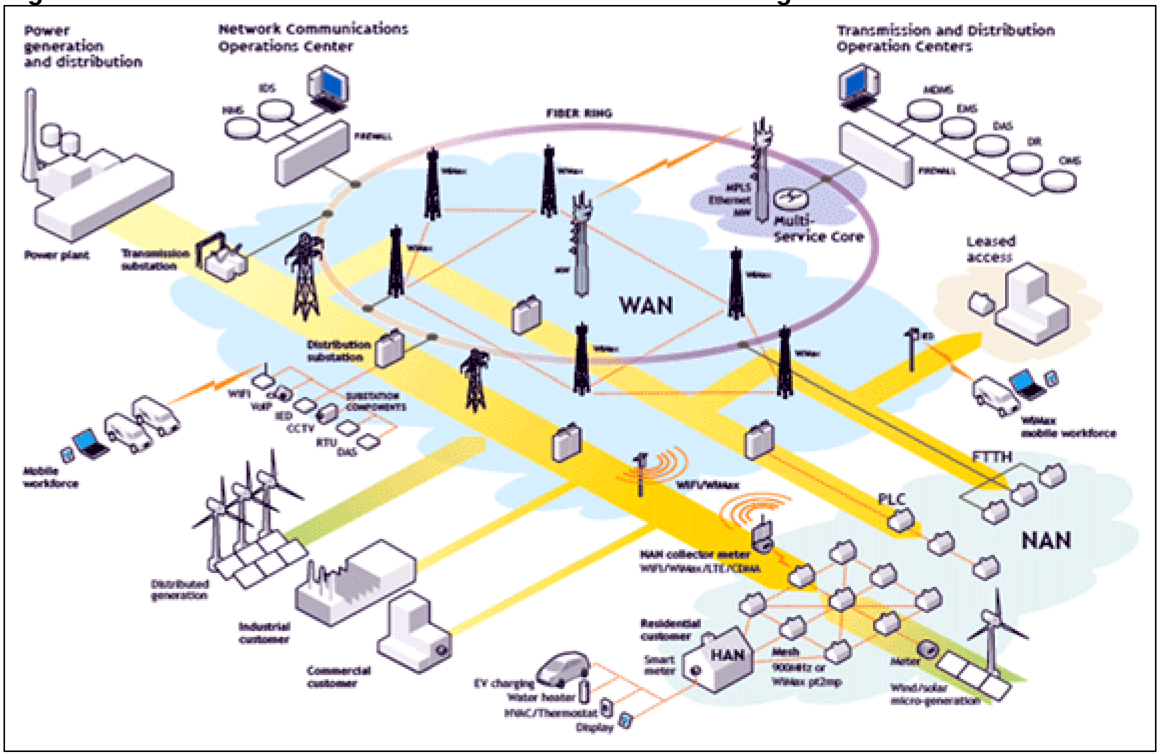


Question: How likely would you be to monitor your energy consumption online?
Source: GE/Ipsos, Smart Grid Technology Online Survey, July 14, 2009

2.5 Smart Grids: Telecom Operator Business Opportunities

In response to the unprecedented level of global interest in smart grids, a select group of telecom operators, including AT&T, Deutsche Telekom, SK Telecom, T-Mobile, Vodafone, and Verizon, working in conjunction with telecom vendors, are embracing smart grid technology. As a result these telecom operators are actively engaging utility providers to develop smart grid reference architectures, such as the one as depicted below in **Figure 2.9** to support future deployments.

Figure 2.9: Powerful Alliances – The Smart Grid Telecom Integration Model



Source: Alcatel-Lucent

While smart grids may not have previously been considered a business opportunity for telecom operators, the foundations have been put in place with IP transformation. Although it is difficult to project the ultimate sizing of smart grids, without question, installing 26 million smart meters and 20 million gas meters in the U.K. alone constitutes a sizable Internet of Things implementation.*

In addition to providing power utilities with telecom backbone connectivity, telcos are also well positioned to deliver important service enablers. Some examples include consulting services to minimize power theft, facilitate subscriber cutovers, and develop fully redundant IP-based grids.

Finally, although this white paper has taken an electricity-centric view of smart grids based on immediate demands and market momentum, this architecture is also applicable to modernization of commercial gas and water grids. Since these utilities face very similar challenges, they also rely heavily on telecom networks to support intelligent access.

2.6 Smart Transportation

The final area examined in this white paper is smart transportation. Considering that, according to GeSI's Smart 2020 report, the transportation sector globally accounts for almost 15 percent total green house gas emissions, developing innovative strategies is a top priority. Savings projected

* U.K. Department of Energy and Climate Change (DECC), *Press Release*, April 2009

by GeSI in 2020 through the use of smart motorways alone would reduce carbon emissions by 1 $GtCO_2e$, resulting in a savings of $107.2 billion (US).[*]

Consequently, an equally meaningful transition is also taking place within the transportation segment in order to address issues related to managing peak demand, as well as improving safety, security, and customer service.

These activities are focused in two distinct areas:

- Smart Traffic Control and Tolls
- Intelligent Train Systems

Smart Traffic Control Opportunities for Telecom Operators

As noted above, the environmental hit associated with the extensive use of internal combustion vehicles is on the rise. For example, in 2007, traffic congestion required U.S.-based commuters to travel an additional 4.2 billion hours. This additional time on the road required the purchasing of an extra 2.8 billion gallons of fuel, thereby resulting in a congestion cost of $87.2 billion (US).[†] In contrast, the estimated congestion costs for 1982 and 1997 based on the same model were $16.7 billion (US) and $53.6 billion (US), respectively.

Therefore, to deal proactively with congestion, the transportation industry is advocating two approaches to mitigate the impact:

- Smart Traffic Routing
- Smart Traffic Road Management

Smart Traffic Routing

The move to smart traffic routing solutions relies on the premise that to decrease gridlock, and reduce accidents, drivers require dynamic access to data. Therefore, smart traffic control systems actively monitor and update traffic flow patterns, proactively providing routing alternatives, before congestion occurs. This not only maximizes traffic flow, it also decreases emergency response time to accidents and breakdowns.

While some smart traffic capabilities can be implemented today, additional infrastructure, such as traffic detectors and cameras, must be deployed to provide end-to-end access. An example of such a deployment can be found in the U.K.: Introduced in 2007, this implementation utilizes 1,500 IP-based closed circuit TV (CCTV) cameras monitored by seven regional control centers and one national center.[‡] By leveraging these capabilities, the U.K. Highways Agency estimates it will reduce road deaths by 33 percent in 2020. [§]

Smart Traffic Road Management

On the other side of the equation, much of the infrastructure described above can also be reused to introduce user pay models to *reduce* rather than *optimize* traffic flow. This approach typically is based on tracking vehicles using global positioning systems (GPS) to bill based on kilometers traveled. The Toll Collect program implemented by Germany in 2005 for commercial vehicles is a recent example.[**]

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[*] GeSI, *Smart 2020: Enabling the low carbon economy in the information age,* June 2008

[†] Texas Transportation Institute, *Urban Mobility Report 2009*, July 2009

[‡] U.K. Highways Agency, *Highways Agency Business Plan 2008-09,* 2008

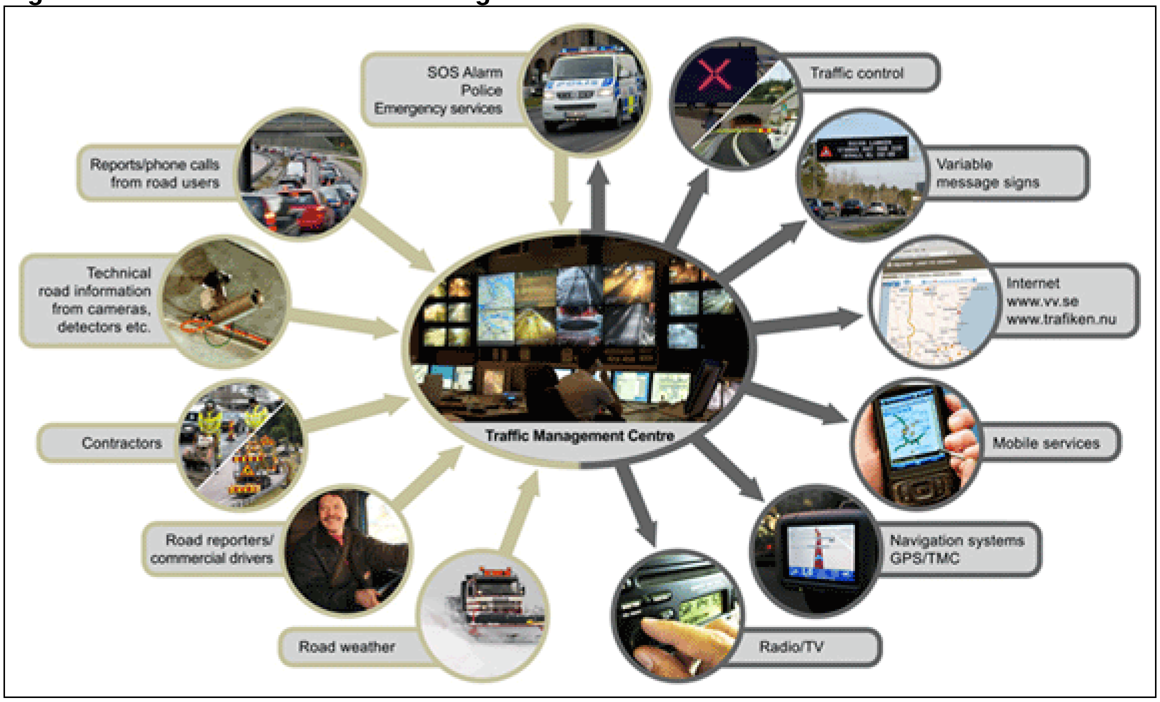
[§] Department for Transport. A *Safer Way: Consultation on Making Britain's Roads the Safest in the World – Executive Summary,* April 2009

[**] Toll Collect GmbH, *Truck Toll in Germany – User Information*, November 2008

However, cities that have implemented smart traffic routing, such as Stockholm, have extended this toll philosophy to cover all vehicles. In Stockholm's case, it introduced a "congestion charge" that varies by time of day and regions entered. From early trials to commercial implementation, Stockholm has experienced a 22 percent reduction the number of vehicles in the core of the city, reducing traffic accidents involving injuries by 10 percent, while decreasing exhaust emissions by 14 percent.*

In both examples, while telecom operators are not the *primary* service provider to drivers, they carry the data traffic and provide vital voice and smart collaboration services to staff in traffic management centers.

Figure 2.10: Smart Traffic Road Management Reference Architecture



Source: Trafik Stockholm

Intelligent Train System Opportunities for Telecom Operators

Another major facet of public transportation that presents significant business opportunities for telecom operators is the support of intelligent train systems. In this market segment, two distinct classes of opportunities exist for telecom operators:

- Commuter Connectivity
- Telecom Backbone Interconnectivity

Commuter Connectivity

As the name suggests, commuter connectivity involves providing voice, Web browsing, and email services for commuters to enhance the end-user experience. Although these services can be supported today, advances in wireless broadband technology and devices will also enhance connectivity, improve user acceptance rates, and ultimately boost revenues for telecom operators.

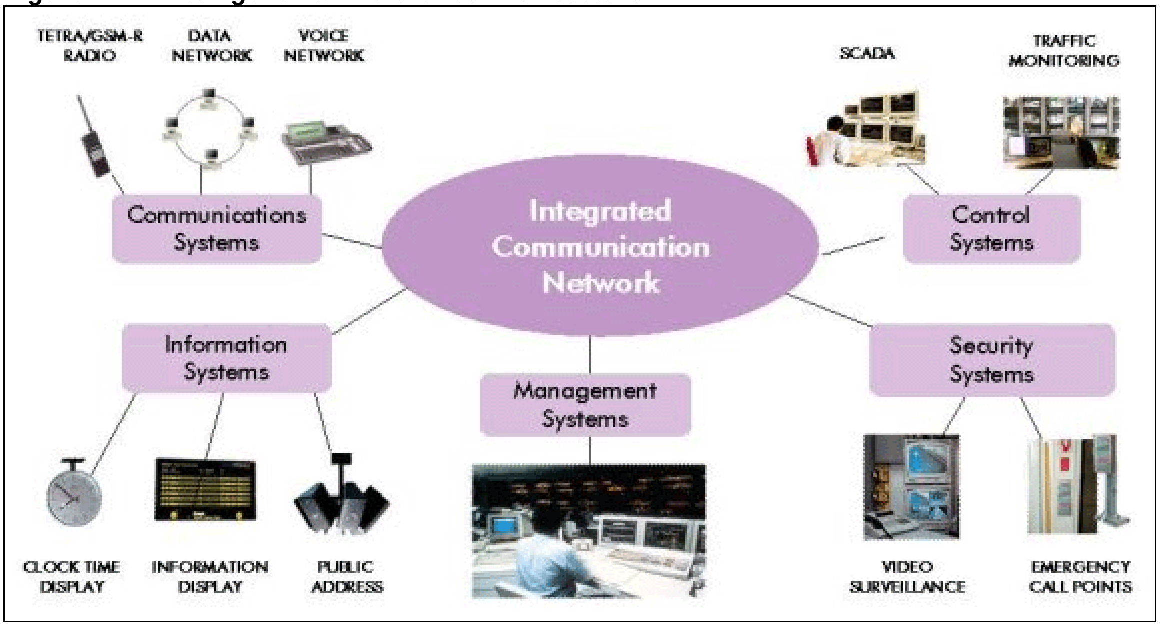
In this scenario, the endgame is to provide users with the same level of access to smart collaboration services as they would receive in smart buildings. Delivering this baseline level of service

* WSP Group, *The Stockholm Experience*, 2008

on trains also plays a very important role in modifying user behavior patterns, motivating more commuters to utilize train services, thereby reducing the number of cars on the road. Therefore, traditional rail operators are now actively investigating technology alternatives and assessing market readiness. In 2009, the U.S. announced the allocation of $8 billion (US) for improvements in rail service and $5 billion (US) for investment in high-speed rail links to increase ridership.*

Telecom Backbone Interconnectivity
Secondly, telecom operators, as in the other examples in this white paper, will provide backbone connectivity. This backbone, as shown in **Figure 2.11**, is utilized by the system administrator to monitor the system, provide surveillance, deliver real-time information on train schedules, and support ancillary capabilities, such as e-ticketing.

Figure 2.11: Intelligent Rail Reference Architecture



Source: Alcatel-Lucent

Since railways currently utilize the GSM-R standard, augmenting these systems with optical networks to support broadband capabilities and GSM-R signaling backhaul is straightforward. One recent example of such an evolution is the upgrading of the Eurotunnel to enhance security and customer service.†

* *Wall Street Journal*, *US Commits $13 Billion to Aid High-Speed Rail*, April 17, 2009

† Alcatel-Lucent, *Eurotunnel selects Alcatel-Lucent to install new European standard, interoperable GSM-R radio-communications system,* December 15, 2009

III. Conclusion

In order to achieve meaningful environmental change on a global scale, cooperation on a number of cross-industry directives is imperative.

First, the always-on power models for devices and networks must give way to a flexible programmable paradigm. Secondly, transportation systems, utility grids, and buildings must develop the capability to intelligently communicate and interact. But equally important, these approaches must factor in the dynamic information needs of subscribers and be capable of delivering enhanced collaborative services and tools regardless of location. *And an IP-based telecom network is the foundation upon which these principles will be built.*

As a result, the fusion of smart buildings, smart collaboration, smart grids and smart meters, and smart transportation will impact business models in a number of ways. This approach will not only revolutionize service delivery and billing models for residential and business customers, but also transform telcos from simply telecom providers into service-agnostic ICT strategic partners.

Therefore, by embracing the new realities of environmental economics, telecom operators have the potential to tap into a number of non-telecom-centric revenue streams that did not exist only a few years ago.

Furthermore, the coupling of IP transformation with the smart services discussed and identified in **Appendix A** is moving rapidly on all fronts and will result in early wins for those telecom operators able to conceptualize the value of IP transformation outside the telecom domain.

Appendix A

This appendix provides a functional level snapshot of some of the environmental economic proof points and milestones that are propelling the global adoption of smart services.

Figure A.1: Global Environmental Initiatives

ANNOUNCED	FOCUS AREA	INITIATIVE
January 2005	Smart Transportation	China commences construction of a $50 billion (US) smart train system. (Source: www.earth2tech.com)
August 2006	Smart Transportation	Stockholm introduces advanced traffic control toll system. (Source: *Wall Street Journal*: "Stockholm's Syndrome")
March 2008	Smart Buildings	European Parliament introduces a proposal requiring that all buildings constructed after December 31, 2018, be zero-energy, generating as much power on-site as they consume. (Source: European Parliament)
July 2008	Smart Transportation	Singapore introduces smart transportation technology to predict traffic congestion and alternative routing. (Source: Environmental Defense Fund, "Singapore: A Pioneer in Taming Traffic")
April 2009	Smart Utilities	Britain announces plans to deploy 26 million smart utility meters and 20 million gas meters. (Source: U.K. Department of Energy and Climate Change)
April 2009	Smart Transportation	U.S. allocates $8 billion (US) to establish high-speed rail corridors. (Source: U.S. Federal Railroad Administration)
May 2009	Smart Collaboration	Australia increases focus on delivery of smart video services, estimating that if only one third of Australian business travelers substituted one trip with a videoconference, the savings on air travel would be $2.2 billion (AUD) and 960 million liters of aviation fuel per year. (Source: Climate Risk, "Towards a High-Bandwidth, Low Carbon Future")
June 2009	Smart Utilities	China announces plan to develop a national smart grid. (Source: State Grid Corporation of China)
June 2009	Smart Utilities	U.S. Department of Energy announces $3.9 billion (US) in grants to support Smart Grid initiatives. (Source: U.S. Department of Energy)
September 2009	Smart Utilities	Korea initiates test-bed trial of smart grid and smart meter technology. (Source: Korea Energy Management Corporation)
December 2009	Smart Buildings	First zero-energy skyscraper in China completed. (Source: *China Daily*)