Energy, Environment and Transportation

This Briefing Paper provides a synopsis of sections of the National Broadband Plan as they relate to energy, the environment and transportation[1]. Chapter 12 covers energy and the environment while Chapter 13 addresses transportation. This section also provides summaries of

- ITS (Intelligent Transportation Systems) Strategic Research Plan, 2010-2014, Executive Summary
- Excerpt from **Bigger Vision, Bolder Action, Brighter Future: Capturing the Promise of Broadband for North Carolina and America (The Baller Herbst Report)**[2]
- IBM's Smarter Cities: Building Smarter Cities (links at the end of each section)

Transportation

(Excerpt from Chapter 13 of the National Broadband Plan)

Background

The transportation industry is the second-largest consumer of energy, a primary reason for the country's reliance on oil and the sector that is the second-highest emitter of greenhouse gases. Broadband and advanced communications infrastructure will play an important role in modernizing various transportation systems by making them safer, cleaner and more efficient.

Promoting Telework

- One survey estimates that 14% of retirees, 31% of homemakers and 29% of adults with disabilities would be willing to join the workforce if given the option to telework.
- Making telework a more widespread option would potentially open up opportunities for 17.5 million individuals.
- The average American spends more than 100 hours per year commuting; 3.5 million people spend more than 90 minutes commuting to work each way every workday.

Telework solutions also help the environment:

- Every additional teleworker reduces annual CO2 emissions by an estimated 2.6-3.6 metric tons per year. Replacing 10% of business air travel with

What Telework incentives should your community consider? Should your community enact Telework policies for City workers?

[1] http://www.broadband.gov/download-plan/

[2] http://www.community-wealth.org/_pdfs/news/recent-articles/10-08/paper-baller-lide.pdf

videoconferencing would reduce carbon emissions by an estimated 36.3 million tons annually.

Recommendations to promote telework:

- The federal and local government should promote telework internally.
- Federal and local government could offer tax incentives for those who work from home.
- There is pending federal legislation to ban states from taxing nonresidents on work done outside the state.
- Congress should consider addressing this double taxation issue that is preventing telework from becoming more widespread.

Smart Transportation

Broadband and other information and communications technologies can reduce emissions by enabling more efficient driving.

- Adding communications technologies to vehicles and to key infrastructure, such as traffic signals, can help reduce the amount of time spent on the road.

- Drivers can optimize routes based on real-time traffic conditions, and commercial operators can plan more efficient routes and supply chain logistics.

- Collectively, information and communications technologies can eliminate as much as 440 million metric tons of greenhouse gas emissions from transportation by 2020.

Automakers are increasingly building wireless communications into vehicles, for safety, navigation, entertainment and productivity.

- OnStar, a service offered by General Motors, uses an embedded cellular connection to provide emergency alert services and diagnostics that can improve a vehicle's performance and gas mileage.
- Ford's SYNC service allows drivers to use their wireless phones to provide in-vehicle connectivity for a variety of entertainment, communications and safety applications.
- Whatever its form factor or application, in-vehicle broadband is likely to contribute to the growing need for commercial broadband spectrum.

Risks of increased driver distraction must be proactively addressed.

- The addition of new technologies in the vehicle must be coupled with a commitment by individuals, families and automakers to use and deploy these technologies responsibly, in a manner that minimizes driver distraction.
- Solutions must be pursued before these applications are widely deployed, rather than as an afterthought.
- The U.S. Department of Transportation (DOT) held a distracted driving summit and launched Distraction.gov, the federal government's official website for distracted driving.
- The federal government should continue to work with industry to safely incorporate the next generation of in-vehicle communications technology.

> What local laws can be enforced to ensure safety for drivers and passengers?

Broadband can also encourage the use of alternatives to automobile transportation and increases public transportation ridership.

- Route-planning applications make public transportation easier to use, and in-vehicle broadband can make mass transit more attractive.
- Intercity bus companies cite broadband as one factor increasing ridership since 2006.
- Several companies offer free Wi-Fi to passengers, a feature Megabus credits with attracting new riders to its Boston-New York City service, which saw ticket sales rise 67% in 2009.

Advanced communications systems also have the potential to help reduce the nation's tens of thousands of automobile fatalities each year.

- Imagine a driver needs to suddenly brake while traveling on a busy highway.
  - An ad hoc vehicle-to-vehicle communications system could allow cars following several vehicles to be alerted of the danger almost as soon as the first car's driver pushed the brake pedal.
  - This would give more drivers a critical opportunity to prevent a high-speed, rear-end collision—a common cause of highway fatalities.

In 1999, the FCC allocated 75 MHz of spectrum in the 5.850–5.925 GHz band for these types of specialized Intelligent Transportation Systems (ITS) applications.

- In the 10 years since the FCC allocated spectrum for ITS applications, commercial wireless data networks have been built to cover much of the country's roadways.

The IntelliDriveSM Applications: A look into the future

(The following was excerpted from the ITS (Intelligent Transportation Systems) Strategic Research Plan, 2010-2014, Executive Summary. IntelliDrive applications are technologies that are placed in vehicles to help alleviate many of our transportation problems)

IntelliDriveSM applications are being developed to address real-world problems. The table on this and the following page depicts significant transportation challenges and identifies how the IntelliDriveSM vision and applications are intended to address them.

Safety Problem	Imagine:
37,261 deaths/year (US)	***-Your vehicle can "see" vehicles you can't see***
5.8 million crashes/year (US) ***Direct economic cost of $230.6 billion***	***-Your vehicle informs you of roadway conditions and hazards that you can't see***

Leading cause of death for ages 4 to 34	***-Your vehicle knows the speed and location of approaching vehicles***

IntelliDriveSM safety applications are designed to increase situational awareness and reduce or eliminate crashes through vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) data transmission that supports: driver advisories, driver warnings, and vehicle and/or infrastructure controls. With these applications, IntelliDriveSM may potentially address up to 82 percent of crash scenarios with unimpaired drivers, preventing tens of thousands of automobile crashes every year (further research will incorporate heavy vehicle crashes including buses, motor carriers, and rail).

Mobility	Imagine
Traffic congestion $87.2 billion annual drain on the U.S. economy:	***Managing the transportation system as if you knew where every vehicle (automobiles, trucks, motor coaches, and transit vehicles) was in real time***
4.2 billion lost hours	***Planning for growth patterns as if you could see complete traffic patterns around development***
2.8 billion gallons of wasted fuel	***Planning travel as if you knew real-time options on all roads, transit, and parking along your route***

IntelliDriveSM mobility applications provide a connected, data-rich travel environment. The network captures **real-time data** from equipment located on-board vehicles (automobiles, trucks, and buses) and within the infrastructure. The data are transmitted wirelessly and are used by transportation managers in a wide range of ***dynamic, multi-modal applications*** to manage the transportation system for optimum performance.

Environment Problem	Imagine
2.8 billion gallons of fuel wasted each year ***22 percent CO2 emissions from vehicles***	***Managing your system for environmental and weather events as if you knew specific information about the road and vehicle***

IntelliDriveSM environmental applications both generate and capture environmentally relevant real-time transportation data and use this data to create actionable information to support and facilitate

"green" transportation choices. They also assist system users and operators with "green" transportation alternatives or options, thus **reducing the environmental impacts of each trip**. For instance, informed travelers may decide to avoid congested routes, take alternate routes, public transit, or reschedule their trip — all of which can make their trip more **fuel-efficient and eco-friendly**. Data generated from IntelliDriveSM systems can also provide operators with detailed, real-time information on vehicle location, speed, and other operating conditions. This information can be used to **improve system operation**. On-board equipment may also advise vehicle owners on how to **optimize the vehicle's operation and maintenance** for maximum fuel efficiency.

Links to IBM's Smarter Cities: Building Smarter Cities

http://www.youtube.com/watch?v=bUyourDcWzw&feature=related
Build a smarter city with fully integrated and real time transportation systems.

http://www.youtube.com/watch?v=0Rb_uVezA5U&feature=relmfu
Congestion charging, electric vehicles, traffic management and improved bus and train services are all changing the face of transport - but how do we continuing leveraging these new advances with fewer resources and a growing city population? Smarter transport in smarter cities.

Energy and the Environment

(The following is excerpted from the National Broadband Plan, Chapter 12, "Energy and the Environment")

Background

U.S. prosperity and national security, as well as the health of the planet, require a national transition to a low-carbon economy and reduced dependence on foreign oil. Congress has demonstrated significant resolve in jump-starting this transition, devoting more than $80 billion in the American Recovery and Reinvestment Act of 2009 (Recovery Act) to clean energy and efficiency investments. Americans have mounted solar panels on their roofs, weatherized their homes, installed efficient light bulbs and traded their "clunkers" for vehicles that get higher gas mileage. But the U.S. economy still runs mostly on domestic fossil fuels and imported oil.

Broadband and advanced communications infrastructure will play an important role in achieving national goals of energy independence and efficiency. Broadband-connected smart homes and businesses will be able to automatically manage lights, thermostats and appliances to simultaneously maximize comfort and minimize customer bills. New companies will emerge to help manage energy use

and environmental impact over the Internet, creating industries and jobs. Televisions, computers and other devices in the home will consume just a fraction of the power they use today, drawing energy only when needed. Large data centers, built and managed to leading energy efficiency standards, will be located near affordable and clean energy sources. Broadband alone cannot solve the country's energy and environmental challenges, but it will be an important part of the solution.

Broadband and the smart grid

The United States is undertaking a massive communications and information technology build out to produce the Smart Grid, which the National Institute of Standards and Technology (NIST) defines as the "two-way flow of electricity and information to create an automated, widely distributed energy delivery network."

- The vision is to build a modern grid that enables energy efficiency and the widespread use of both renewable power and plug-in electric vehicles, reducing the country's dependence on fossil fuels and foreign oil.
- This grid will intelligently detect problems and automatically route power around localized outages, making the energy system more resilient to natural disasters and terrorist attacks. It will keep bills low and minimize greenhouse gas emissions.

The Smart Grid is a national priority for several reasons.

- It will increase the reliability of the electric grid, more efficiently integrate renewable generation, reduce peak demand and support the widespread adoption of electric vehicles.
  - First, as the current patchwork grid has become more interconnected and complex, reliability has become more critical.
  - Power blackouts cost the nation as much as $164 billion per year.
  - The Smart Grid could prevent many blackouts by sensing problems and routing power around them.
- Renewable power and distributed generation will also drive the need for greater communication because they will transform the one-way power system into a sophisticated two-way system, where homes, vehicles and buildings sometimes draw power from the grid and sometimes contribute power to it.
- A recent study by the Pacific Northwest National Laboratory estimates the Smart Grid can reduce greenhouse gas emissions from electricity generation by as much as 12% by 2030, which is equivalent to taking 65 million of today's cars off the road.
- A smarter grid is necessary if America wants to lead in the shift toward vehicle electrification.

Global automakers are developing plug-in hybrid electric or full electric vehicles, and, if successful in the market, these vehicles have the potential to reduce U.S. dependence on foreign oil by half and decrease greenhouse gas emissions of the light duty vehicle fleet by 27%.

- According to a DOE study, the U.S. has enough existing capacity to power 73% of its light-duty vehicle fleet once a smarter grid is in place that can charge vehicles entirely at off-peak times.

Smart meters, which are located at customers' homes and provide two-way communications with their utility, will play a major role in the Smart Grid.

- FERC estimates that the number of smart meters deployed will rise from eight million today to 80 million in 2019.

Today, the more than 3,000 electric utilities in the United States use a variety of networks, including wired and wireless, licensed and unlicensed, private and commercial, fixed and mobile, broadband and narrowband.

- Current narrowband solutions are not able to support the growing number of endpoints requiring connectivity in the modern electric grid, and many utilities believe that solutions using unlicensed spectrum will be suboptimal for mission-critical control applications.
- Sempra Energy has found that it will require "pervasive mobile coverage of at least 100 kbps to all utility assets and customer locations".

In summary, the lack of a mission-critical wide-area broadband network capable of meeting the requirements of the Smart Grid threatens to delay its implementation.

Recommendation 12.2: States should reduce impediments and financial disincentives to using commercial service providers for Smart Grid communications.

- In many states, electric utility incentives are still oriented toward deploying assets and selling more power, not selling less or cleaner power.
- Many large electric utilities have inherent financial incentives to deploy regulator-approved communications systems but have mixed-to-poor incentives to use these systems to deliver energy more efficiently.

Recommendation 12.3: The North American Electric Reliability Corporation (NERC) should clarify its Critical Infrastructure Protection (CIP) security requirements.

Recommendation 12.4: Congress should consider amending the Communications Act to enable utilities to use the proposed public safety 700MHz wireless broadband network.

- In a natural disaster or terrorist attack, clearing downed power lines, fixing natural gas leaks and getting power back to hospitals, transportation hubs, water treatment plants and homes are fundamental to protecting lives and property.

- Once deployed, a smarter grid and broadband-connected utility crews will greatly enhance the effectiveness of these activities.

Recommendation 12.5: The National Telecommunications and Information Administration (NTIA) and the FCC should continue their joint efforts to identify new uses for federal spectrum and should consider the requirements of the Smart Grid.

- Utilities report they are limited by their lack of access to suitable wireless broadband spectrum and that lack of a nationwide band to build an interoperable Smart Grid will slow the nation's progress toward greater energy independence and energy efficiency.

- Identifying a nationwide band in which Smart Grid networks could operate would speed deployment of a standardized and interoperable broadband Smart Grid.

- Establishing a nationwide band would also promote vendor competition and lower equipment costs.

Unleashing innovation in smart homes and buildings

One of the most important and cost-effective ways to meet national energy goals is to encourage energy efficiency in homes and businesses. However, users need better information in order to maximize energy and cost savings. Users do not know the price of electricity, the source of the power or the amount of power needed to run each of their appliances. Smart meters help change this equation because they generate real-time data. In addition to their other operational capabilities such as automated meter reading and remote power monitoring, smart meters can record or transmit three types of information:

- Historical energy consumption data (e.g., "How much power did I use yesterday, last month and last winter?")
- Real-time data (e.g., "How much power am I using right now?")
- Price and demand response data (e.g., "What is the price of electricity right now?")

In dozens of consumer trials, Advanced Metering Infrastructure (AMI) technologies combined with time-based pricing tariffs have led to reductions of both peak demand and total energy consumption.

- A recent study of 15 utility pilots by the Brattle Group found that time-based or dynamic pricing of electricity resulted in a drop of peak demand between 3% and 20%, depending on how the pricing was set up.
- When people see just how expensive electricity is when demand peaks on a hot summer day, they find ways to conserve energy or defer their usage.
- A drop in peak demand also helps the environment because it helps prevent the need for new fossil-fueled power plants.

Even without price incentives, simply providing consumers better information about their energy use has been shown to reduce total consumption by 5–15%, equating to savings of $60–180 per year for the average American household.

Real-time energy consumption and price data also create an opportunity for consumers to select from a growing number of products and services that can help save energy.

- General Electric, for example, is developing refrigerators that automatically wait until power is less expensive before they run a defrost cycle or make ice.
- Whirlpool plans to have one million Smart Grid-compatible clothes dryers available by 2011 and has announced that by 2015 all of its appliances will be able to connect to a Smart Grid.
- Google and Microsoft, among others, have released Internet-based visualization tools that help consumers get a better handle on their energy use.

Broadband is essential to realizing the full potential of smart homes and buildings.

- Pervasive internet connectivity brings innovative competitors, technologies and business models to energy management systems, from sophisticated building management systems to simple home thermostats.

- Broadband allows consumers to monitor and control their home energy use from the convenience of a mobile phone.

The history of the Internet illustrates how entrepreneurs can develop disruptive applications, attract investment capital and compete to deliver value to customers—thereby driving innovation, economic growth and job creation. The federal government should use a combination of incentives, rules and standards to foster an open marketplace where the best ideas, technologies and entrepreneurs can compete for investment capital and customers.

Recommendation 12.7: States should require electric utilities to provide consumers access to, and control of, their own digital energy information, including real-time information from smart meters and historical consumption, price and bill data over the internet.

- If states fail to develop reasonable policies over the next 18 months, Congress should consider national legislation to cover consumer privacy and the accessibility of energy data.

Recommendation 12.8: The Federal Energy Regulatory Commission (FERC) should adopt consumer digital data accessibility and control standards as a model for the states.

Recommendation 12.9: DOE should consider consumer data accessibility policies when evaluating Smart Grid grant applications, report on states' progress toward enacting consumer data accessibility, and develop best practices guidance for states.

Sustainable information and communications technology

ICT industries account for 120 billion kilowatt-hours (kWh) of electricity use annually—approximately 3% of all U.S. electricity.

- They are responsible for 2.5% of the national greenhouse gas emissions, and their emissions share is forecast to grow three times faster than those from other sectors of the economy.
- One study found that 60% of all desktop PCs remain fully powered during nights and weekends.
- Emissions related to mobile networks, in particular, are expected to increase from 10.5 million metric tons of greenhouse gases in 2008 to 11.2 million metric tons in 2013 under a business-as-usual scenario.
- Data centers accounted for 1.5% of U.S. electricity consumption in 2006, and demand is expected to double by 2011.

Recommendation 12.11: The FCC should start a proceeding to improve the energy efficiency and environmental impact of the communications industry.

Recommendation 12.12: The federal government should take a leadership role in improving the energy efficiency of its data centers.

- The federal government owns and operates approximately 10% of the nation's data centers and servers.
- Research suggests that data centers can cut their electricity use by up to 45% by adopting best practices in energy efficiency.
- Federal agencies should take measures to improve the energy efficiency of their data centers in accordance with President Obama's Oct. 5, 2009, Executive Order 13514 that promotes environmental stewardship (including "implementing best management practices for energy-efficient management of servers and Federal data centers")

Can data centers be attracted to your community?

and the announced 28% greenhouse gas emissions reduction target set for the federal government by 2020.

Broadband Benefits: Environmental Sustainability

Excerpt from Bigger Vision, Bolder Action, Brighter Future: Capturing the Promise of Broadband for North Carolina and America (The Baller Herbst Report) Full Report (100 page, 3MB pdf file
Executive Summary (12 page, 2MB pdf file)

Discussion of the environmental benefits of broadband typically begins with the impact of telework on oil consumption and pollution. As discussed in the prior section, this is certainly a real and important factor. But the environmental implications of broadband go far beyond this.

For one thing, broadband enables buildings to communicate with utilities, utilities to communicate with each other, and the energy market to provide real-time information to both buildings and utilities. "Smart buildings" and "smart grids" hold great promise for dramatic reductions and greater efficiencies in energy consumption.

Can local government begin to monitor and manage its own energy use within City/Regional offices?

One of the ways wiring our homes and offices promises large economic payoffs, along with immense environmental benefits, is by allowing interactive monitoring of and more efficient energy use. By creating "smart buildings" tied to the local power grid, as a 2002 Department of Energy report highlighted, utility companies won't have to keep as much wasted reserve power on hand, leading to "lower prices and less price volatility" which will "create a more resilient electric grid that is more robust and secure against brownouts, blackouts, and hostile attacks" - the latter especially attractive in the wake of the 2003 blackout of much of the Northeast and Canada.

The State of California, for example, is funding an ambitious program targeting energy use by commercial buildings. One third of all electricity consumed in the state is by commercial buildings - about $10 billion per year. The goal of the High-Performance Commercial Buildings Project (HPCBS), launched in 2000, is to cut energy use by 70 percent in new buildings and save 50 percent in retrofits of older buildings using broadband connections combined with other technologies.

How can your community learn more about these programs, and begin similar programs?

Another way that broadband enhances environmental sustainability is by enabling a wide range of programs that can collectively contribute to overcoming global problems that experts believe would otherwise be insurmountable. For example, the cities of Amsterdam, Netherlands; San Francisco, Ca.; and Seoul, Korea, with support from Cisco, have launched a pilot program to use fiber optic technology to reduce traffic congestion and carbon dioxide emissions.

Similarly, visionaries in the utility industry are exploring ways to use fiber technologies to manage electricity usage in ways that will significantly reduce the need for expensive new power plants. Billy Ray of Glasgow, Ky., has estimated that the cost of providing FTTH connectivity to the nine million homes in the Tennessee Valley Administration (TVA)'s service area would cost no more - and probably far less -

than the $18 billion that the TVA proposes to spend on expanding its nuclear facilities over the next 10 years, would result in reduced energy usage equivalent to double or triple the electricity that TVA's investment in new facilities would produce, and would give the residents of the TVA region all of the other benefits that flow from FTTH. World-renown fiber expert, Bill St. Arnaud, has similarly proposed creative means of deploying FTTH through utilities to marry critical energy savings with expanding availability of cheap, ubiquitous FTTH.

Perhaps most important of all, broadband also contributes in countless other ways to environmental protection and sustainability, by making production, distribution, and service processes more efficient. The following excerpts from "Digital Prosperity," ITIF's trenchant analysis of the economic benefits of the information technology revolution, illustrate this:

> *Today [information technology] enables just-in-time (JIT) production in which businesses gather better information from suppliers in order to track moment-by-moment changes in the supply chain. The ability to track shipments online allows firms to time production and anticipate bottlenecks in supplies, while up-to-the-minute information about inventories tells suppliers when fresh deliveries are needed. An example of an integrated and informed supply chain is Cisco Systems. Using remote monitoring of production lines, Cisco can detect a problem and adjust production at an assembly line or distribution center immediately in factories across the globe, often not even owned by Cisco, all from its headquarters in San Jose, California.*

Because of difficulty in predicting demand, transportation equipment is often underutilized. For example, trucks might be fully loaded for delivery, but might make the return trip partially or completely empty. Indeed, about one fifth of trucks at any one time are "transporting air." With global positioning systems (GPS), cell phones, and wirelessly connected computers, truck drivers and dispatchers can now more easily find loads to pick up for return deliveries. The Web enables this kind of demand aggregation. Sites like Getloaded.com act as a matching service, preventing excess capacity from going to waste by connecting trailers that would otherwise be traveling empty with loads that need to go to the same destination. One study found on-board computers that allow managers to better coordinate trucks and loads boosted capacity utilization 3.3 percent and saved $16 billion annually in the $500 billion trucking industry.

New advanced teleconferencing technologies that enable "telepresence" (enabling eye contact between participants, life size images, and no jerky video images) will likely spur even more substitution of travel. Compared to reading a newspaper, receiving the news on a PDA wirelessly results in the release of 32 to 140 times less CO2, and several orders of magnitude less NOx and SOx. The energy involved in selling $100 of books for a traditional superstore vs. an online bookseller is 14 times more. Romm documents how a 20 mile round trip to the mall to purchase two 5 pound products consumes about 1 gallon of gasoline. Shipping the packages 1000 miles by truck consumes 0.1 gallon of gasoline.

Links to IBM's Smarter Cities: Building Smarter Cities

http://www.youtube.com/watch?v=AoGj_DHf6S0&feature=channel_video_title

A unique view into the progress and potential for Australia's energy systems. This short video is a light-hearted introduction to the concept of a smarter planet... and what it means for our energy systems. Take a look at what is possible when a system is instrumented, interconnected and intelligent.

http://www.youtube.com/watch?v=jHi02VXg6Ek&feature=channel_video_title
Today, it's about using the flexible grid technology we have better to make way for cheap, reliable electricity for the future. Journalists, Industry Experts and IBMers recognize the evolution of smart grid electrical technology.

http://www.youtube.com/watch?v=lQ0RupXt_8U&lr=1&user=ibmsmarterplanetuk
This Film addresses why cities must implement a smarter energy system on their journey to become smarter cities.

http://www.youtube.com/watch?v=acJQvgcUmOU&lr=1&user=IBMEnergyUtility
Guido Bartels, General Manager, IBM Global Energy and Utilities Industry, and Chairman, Gridwise Alliance, shares his insights on the energy and utilities industry.