Center for American Progress

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Smart Grid, Smart Broadband, Smart Infrastructure

Melding Federal Stimulus Programs to Ensure More Bang for the Buck

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Introduction and summary

With a bit of imagination and coordination among multiple federal programs and agencies, the economic stimulus funding in the American Recovery and Reinvestment Act of 2009 could be used far more efficiently to achieve a diverse set of closely related goals. One section of the act provides billions of federal dollars to fund a "smart grid" for electricity that connects a far more flexible and efficient grid for long-distance transmission to regional feeder lines and local hubs, and then to that "last mile" to residences and businesses. A different part of the act provides billions in funding to upgrade broadband networks for unserved and underserved areas around the country. The broadband network has the same essential structure as the electricity network—long-distance transmission or the "Internet backbone," the feeder lines to local hubs or the "middle mile," and the "last mile" to fixed and wireless users.

Both the smart-grid and broadband efforts involve substantial planning, spending on new wires, and the creation of major new digital infrastructure to connect homes in vastly expanded networks of information exchange. So here's a simple and powerful idea—construction of the electricity grid and the broadband network should go hand in hand. And here is an even more powerful idea—we should combine these efforts with other parts of the Recovery Act, such as health care information technology, education reform, weatherization initiatives, and future policy initiatives to create a nationwide smart infrastructure.

Begin with the Recovery Act's work on the electric grid and broadband network, which should be coordinated with an exciting array of other initiatives. Specifically:

- Commitments for expanded mapping of broadband infrastructure should be coordinated with energy infrastructure planning to benefit from shared right of ways, identification of environmentally sensitive areas, and other potential opportunities for coordination.
- Road construction at minimal extra cost can include conduit pipe for high-speed broadband fiber.
- Health information technology funding can turn health centers into hubs for better broadband for their communities.
- Libraries and schools can similarly be hubs that help their communities have better broadband.
- The home weatherization program can turn into a public-policy triple play, insulating homes, adding smart-grid technology, and installing broadband into qualifying homes all at the same time.

Three common-sense ideas can guide all of the agencies and programs to work together to build the smart infrastructure. The first is the simple mandate to only "dig once, "and the best time to build the smart infrastructure is when a construction crew is already on site. For instance, the Federal Highway Administration estimates that 90 percent of the cost of deploying broadband fiber in a public right of way is associated with digging up and repairing the road to install the buried fiber. The agencies should look for two-fers and three-fers—ways to update our electricity system, deploy broadband, and achieve other goals when spending the stimulus money.

This notion should be further expanded to include the second mandate to "plan once" while coordinating the front-end mapping and data analysis for a host of new information infrastructure projects. By planning once and then digging once we would be installing everything at the same time to reduce the number of times that any given home is touched. What's more, this process would coordinate broadband, smart metering, and energy-efficiency retrofit work at the community level.

The third idea is to find anchor tenants. When developing a shopping mall, the key first step is to sign up "anchor tenants," the large stores such as Macy's or Sears that anchor a mall, with space for the smaller stores to fill in afterwards. The same principle applies to broadband networks and smart infrastructure projects. An anchor tenant such as a community college or health care center can help justify a bigger pipe for an entire community or small town. Once that bigger pipe is in place, residences and other businesses can take advantage of the pipe to gain better service at lower cost.

President Barack Obama stresses that the current stimulus funding should meet short-term goals of reviving demand and also long-term goals of investing in America's future. We must not waste this opportunity to coordinate spending from the smart-grid, broadband, health IT, education, road construction, and other parts of the stimulus package. Instead, the idea of a "smart infrastructure" emphasizes that we can meet multiple goals, including energy efficiency, bringing next-generation services to the underserved, and creating the physical and information infrastructure that is essential for the future of our nation.

Toward a national broadband plan

The Recovery Act funds $7.2 billion for broadband grants to be administered by the Departments of Commerce and Agriculture. The first third of those grants is up for bid by this June, with additional rounds of applications due in the fall of 2009 and the spring of 2010. The focus of these grants is to bring broadband Internet capacity to unserved and underserved communities.

Many of these communities are in rural areas, where homes and businesses are physically remote from the high-speed Internet backbone. Successful broadband implementation, therefore, has to solve the "middle mile" problem of how to get affordable, high-speed connections from the backbone to each locality. In addition, we must solve the "last mile" problem of how to get affordable connections to homes, businesses, and mobile customers.[1]

A recent study by the New America Foundation suggests that road construction and repair can be an enormous help for the broadband middle mile problem.[2] Construction costs for highways are generally at least $3 million per lane, per mile. By contrast, it only costs between $10,000 and $30,000 per mile to install conduit pipe that can hold the fiber-optic lines used for high-speed Internet purposes. Thus, "adding fiber would increase highway construction costs by as little as 1 percent on average."[3]

Including conduit for fiber as part of road construction and repair is thus a prime example of the principle of "dig once." The Federal Highway Administration estimates that 90 percent of the cost of deploying fiber is generally due to digging up and repairing the road. In other words, it is *ten times* more expensive to go back and add fiber once the road is already built.

This principle of "dig once" should be applied to the road construction funded by the Recovery Act as well as become a standard part of future road construction and repair in the United States. Simply put, the "shovel ready" projects should immediately become "broadband ready" projects as well. Conduit for fiber should be laid as part of these projects. Further, highways represent significant right-of-way corridors. These existing routes will be increasingly important as we move to expand our digital infrastructure not only for broadband access but for our energy system as well.

The same logic applies to the Recovery Act's $6.5 billion to fund electricity transmission lines. Much of the construction will take place for high-voltage, long-distance transmission. Other projects will link the long-distance wires to local hubs in regional

"smart grids." For both types of projects, the Department of Energy should coordinate immediately with the broadband agencies—Commerce, Agriculture, and the Federal Communications Commission.

First, within the planning, mapping and design phase of these projects, coordination can increase the efficiency of these efforts by sharing costs across agencies and treating broadband and energy IT as related components of an advanced information backbone for our economy. Second, when construction crews and their bulldozers criss-cross the nation to build electricity lines, which may often be an ideal opportunity to lay conduit for expanded fiber networks at the same time, leveraging existing public easements, permits, and rights of way. Third, because electric line construction will often occur close to specific locations that can take advantage of access to high-speed broadband lines construction can also include cell phone towers, which provide much faster service to customers if the tower itself has a higher-speed connection to the Internet backbone. Special study may be appropriate to see how electric-line construction can bring cheaper and better connection to these cell phone towers, improving rural access to high-speed information services.

In addition, the smart grid we are building needs better communications to keep itself "smart." Deployment of broadband at the regional level can help the electricity grid itself to work more effectively by using expanded access to information to operate more efficiently. One vital advantage is to use the new broadband for improved cybersecurity for the electric grid. Experts in critical infrastructure have emphasized the risk of cyberattacks on the electricity infrastructure, threatening to shut down power to entire geographic areas. The current, relatively weak communications infrastructure places limits on countermeasures against such attacks. With improved broadband for the grid itself, stronger encryption, and other counter-measures can protect the grid from cyberattacks.[4]

The public policy case for broadband-ready construction goes beyond the enormous potential cost savings. There are numerous and compelling reasons to support affordable, high-speed broadband in the United States. For the economy, better broadband is an essential component to technological innovation, productivity growth, jobs, and economic growth. For society, universal broadband contributes to education, health care (through telemedicine), public safety, diversity of content on the Internet, and civic participation. As stated by Robert McChesney and John Podesta, providing "universal, affordable broadband may be the single best thing we can do to make American the pre-eminent economy—and democracy—of the 21st century."[5]

The Recovery Act assigns the Federal Communications Commission the task of creating a National Broadband Plan by February 2010. Nonetheless, the federal government can begin immediately to implement the plan-once philosophy for broadband, road construction, and electric line construction. The multiple agencies should begin immediately to identify specific ways their programs will work together. Notably, grant and loan guarantee applications—for broadband and other stimulus programs—should consider it a plus

factor if a proposal leverages stimulus funding from multiple sources or meets the goals for multiple stimulus programs. The agencies, by sending this strong message of the need to coordinate among the programs, can thus enable a dig once approach for broadband, road construction, and electric line construction.

Between now and next February, the FCC's process for the National Broadband Plan provides the opportunity for more rigorous study and guidance about how best to deliver these efficiencies and positive spillovers in the future. In the Recovery Act, Congress provided $350 million for broadband mapping. This mapping should be coordinated with the Energy Department in order to take advantage of opportunities to dig once, and to make effective use rights-of-way and other resources that can be shared. As an integral part of the broadband plan, there should be specific guidance on how deployment of broadband should be coordinated with expanded use of information technology in our energy system, from our power plants, to transmission lines, and to end use applications in the home. With growing demands for managing energy to reduce global warming, our IT networks are a critical tool to monitor and manage the many diffuse choices that make up our national system for producing and using electricity.

Making the smart grid even smarter

My colleague Bracken Hendricks recently released his "Wired for Progress2.0: Building a National Clean-Energy Smart Grid."[6] Hendricks emphasizes that a clean-energy smart grid consists of two distinct components: a long-distance "sustainable transmission grid" upgrade that will transport wind and other renewable energy across state lines to distant markets, and a digital "smart distribution grid" to deliver the electricity efficiently to local consumers, enabling energy efficiency and local generation of renewable energy. We have already demonstrated that long-distance transmission construction should be coordinated with broadband deployment. With better broadband communications for long-distance and middle-mile electricity transmission, utilities will be able to respond far better to peak demand and outages in part of the system.

The same idea applies to the last mile as smart-grid technology extends to homes and residences. Hendricks describes a range of exciting new capabilities that merge digital information technology into the electricity infrastructure. With better IT, home meters, and smart appliances, consumers will shift demand to off-peak times, saving money for consumers and utilities.[7] The spread of off-peak pricing will make a crucial difference for plug-in electric vehicles, allowing cars to recharge (often from renewable energy sources) during the night and drive during the day. Smart-grid technologies also provide the metering that enables homes and businesses to sell solar-based and other renewable energy into the grid.

The Recovery Act provides $4.5 billion for matching funds for these sorts of smart-grid investments in the last mile. As with long-distance transmission, we should apply the "dig once" principle to these projects for homes and businesses. The goal should be smart-grid deployment coordinated with broadband and energy-efficiency upgrades as well. The Department of Energy should immediately explore ways that its support for smart-grid investments might assist in planning and implementing upgrades for fiber or other high-speed broadband as well. After all, the technology for smart metering in homes is a digital information technology, and coordination in planning, mapping, and execution of the smart grid with efforts to extend the reach of broadband will help to cut costs and improve efficiency.

This sort of coordination with the broadband agencies and broadband providers would advance the goals of the smart-grid system, ensuring that the bandwidth exists for the future for electricity management. A further level of coordination could involve integra-

tion of both home weatherization, smart metering, and broadband upgrades to try for one touch per house—in a further expansion of the dig-once philosophy.

The convergence of smart grid and broadband can benefit a wide array of families. Verizon, for example, made the encouraging announcement last month that it plans to offer smart electricity metering in connection with its FIOS fiber service to the home. Although FIOS has been deployed to date largely in wealthier neighborhoods, the lure of electricity savings combined with broadband can appeal to families at every income level. For a cash-strapped family, getting the smart-grid meter could mean savings every month, and getting broadband at the same time could likewise expand opportunities through education.

An even better deal would be if the home installation is done together with work under the $5 billion in weatherization grants that the Recovery Act provides.[8] Telephone and cable companies have been advertising "triple play" packages for home telephone service, television, and broadband Internet. With the smart use of Recovery Act funds, the government could encourage an even better "triple play" of weatherized homes, smart-grid technology, and broadband installation.

Anchor tenants: Health care centers, schools, and libraries

To help achieve the vision of a smart infrastructure, there are ways to lower costs and increase deployment by building the conduit for broadband into new road and electric grid construction. A complementary task is to identify early adopters in unserved and underserved communities around our nation. These early adopters—community colleges, health care clinics, and libraries—can provide the visible demand for faster broadband. They can become the "anchor tenants" that help bring broadband to more users in their communities.

A health care center in a small town is an excellent example of an anchor tenant. As part of its broader support for health information technology, the Recovery Act provides $2 billion for the acquisition of health IT systems by health centers serving the medically underserved.[9] "Medically underserved" means the population of an urban or rural area designated by the Secretary of Health and Human Services as an area with a shortage of personal health services or a population group designated by the secretary as having a shortage of such services.

Health centers for the medically underserved are prime candidates for a broadband upgrade. Bandwidth of at least 1 megabit per second—and possibly more—is desirable to support high volumes of clinical transactions such as e-prescriptions, lab orders and results, and patient data exchange with other providers for the purposes of care coordination, including telemedicine. These clinical uses will be key to the utility of health IT, and HHS is virtually certain to define them as core elements of "meaningful use" (the standard against which providers must qualify in order to receive health IT incentive payments under the Recovery Act).

In addition, bandwidth of at least 1 Mbps is desirable for smooth operation of today's web-based or web-enabled health IT applications delivered by application service providers—should providers elect to go that route. Many modern software applications rely on real-time communications with updated databases, such as current rules for processing payments or clinical support packages that reflect current best practices. There are often significant functional and security advantages to these sorts of "cloud" computing approaches in which strong broadband connections are often essential to their effective use.

Looking ahead, broadband upgrades will be needed for telemedicine applications. Medically underserved areas, by definition, lack the range of specialists that are available to better-served communities. With excellent broadband, data-intense images from the rural health center can be exchanged with far-off specialists, saving lives and reducing the need

for costly travel to the distant specialists. These telemedicine applications, for now and the near future, thus create strong reasons for substantial bandwidth to the rural health center.

Health-care demand for substantial bandwidth is the perfect description of an anchor tenant at work. To provide substantial bandwidth, there often will need to be upgrades at the middle mile for a bigger and better pipe to the Internet backbone. Once this pipe serves the health center, it is also in place to serve the geographic area around the health center.[10]

The positive spillovers from the health center's use of broadband are familiar from the first round of Internet growth in the 1990s. Under the E-Rate program, schools and libraries received early funding to connect to the Internet (then operating at dial-up speeds that are too slow for many of today's applications). The schools and libraries became the physical place where millions of Americans experienced the Internet for the first time. A generation of American schoolchildren—including the less wealthy—learned computer and Internet skills far sooner than they would have at home. And any visit to a public library today shows the incredible range of people who line up for Internet service.

The next step is to bring fast broadband to far more homes and businesses, creating the platform for education, economic growth, and civic participation. Because modern applications require ever-greater bandwidth, families and businesses that lack access to broadband will find it increasingly difficult to compete in education and the economy.

Returning to the example of the rural health center, a bigger and better pipe to the health center provides a hub that can serve better broadband to the surrounding area. Experts disagree about precisely what business models and technologies will succeed in which markets. Some experts emphasize the potential of WISPs, or wireless internet service providers, perhaps increasingly using Wi-Max technologies (a technical standard for interoperability for high-speed wireless).

Other solutions use a mix of copper or fiber technologies (often from phone companies) or coaxial cable (usually from a cable provider). Regardless of the technology, however, the geographic area around an anchor tenant can have higher-speed and more affordable broadband service once there is a better middle-mile connection to the Internet backbone. In addition, the middle-mile connection to the rural health center can itself support better broadband for locations close to its route, including cell-phone towers.

Looking beyond health centers, the Recovery Act provided $650 million for the Enhancing Education Through Technology program. Using this and other funding sources, community colleges, K-12 schools, and libraries can explore how they can be anchor tenants for their surrounding geographic areas. Similarly, states and localities can use government offices or other facilities receiving government funding as ways to encourage faster and better broadband to underserved and unserved communities. With the idea of "anchor tenants" firmly in mind, underserved areas can think creatively about what will pull better broadband out to the widest possible range of users.

Conclusion

This paper has emphasized how the Recovery Act provides a unique opportunity to build out smart infrastructure across our country. This build-out would be "smart" in the sense that it would leverage the diverse sources of funding to achieve more than is possible if the programs act alone. Just as importantly, this build-out would be "smart" because it would embed information technology deeper into the infrastructure than ever before, bringing the very substantial economic and social benefits of more efficient use of resources, improved community and customer service, and reduced costs immediately and long into the future.

For the electricity grid, coordination with our broadband efforts would bring great benefits. Better sensors and communications embedded in the transmission process will mean the grid is more efficient at sending electricity where it is needed and rerouting around outages. Metering and communications in the last mile will achieve smart-grid benefits such as energy efficiency in homes and the effective use of renewable energy to balance energy load and improve the security and reliability of the grid.

For our broadband initiative, there are large potential efficiencies if the construction crews for roads and transmission lines "dig once" and make the infrastructure ready for high-speed broadband. In the last mile, there may be ways to coordinate weatherization, smart-grid metering, and installation of better broadband, although legislative action may be needed to clarify that this joint action can be funded. Especially as large-scale mapping efforts are undertaken, including with $350 million in mapping funding to the Commerce Department in the Recovery Act, it is important to understand how coordination of the use of existing rights of way can facilitate a host of smart infrastructure upgrades.

Health IT and education initiatives, and other stimulus measures, can also meet their own goals better if high-speed broadband is built as part of Recovery Act projects. Acting as anchor tenants, these facilities can help ensure better middle-mile connections to the Internet backbone, greatly spreading the geographic areas that have access to the higher speeds that broadband users will increasingly require.

Coordination among these projects should begin immediately. Encouragingly, the agencies leading the broadband initiative have already expressed their interest in "leveraging" the different parts of the Recovery Act.[11] Looking ahead, the FCC's National Broadband Plan, due next February, can play a valuable role in mobilizing the diverse agencies and actors who can contribute to building the smart infrastructure that America needs.

Just as rural electrification was a great national project in the 20th century to overcome a technology divide with serious and substantial equity impacts, and was a solution to a problem that created economic benefits that far outweighed the initial cost, so, too, will a coordinated national strategy to upgrade and integrate a smart national information infrastructure early in this century provide a powerful backbone for a renewed and growing economy.

Endnotes

1 For an earlier article that emphasizes the need to coordinate broadband spending with many of the other goals of the stimulus package, see Mark Cooper and Gene Kimmelman, "Building a New Communications System for America at the Grassroots Level," *The Huffington Post*, January 14, 2009, available at http://www.huffingtonpost.com/mark-cooper/building-a-new-communicat_b_157899.html.

2 Benjamin Lennett and Sascha Meinrath, "Building a 21st Century Broadband Superhighway: A Concrete Build-out Plan to Bring High-Speed Fiber to Every Community" (New American Foundation: January 2009), available at http://www.newamerica.net/publications/policy/building_21st_century_broadband_superhighway.

3 Ibid.

4 There has been substantial government and private-sector concern in recent years about the security of the Supervisory Control and Data Acquisition, or SCADA systems used to control the electricity transmission system. *See* Cyber Security Industry Alliance, "SCADA—Get the Facts," available at http://www.csialliance.org/issues/scada/index.html. Specifically, many older SCADA systems "cannot accommodate current enterprise security solutions that soak up central processing unit, or CPU capacity and clog connectivity." Ibid. Improved broadband, installed as part of the new electricity infrastructure, would thus directly contribute to upgrading the cybersecurity of the transmission system.

5 Robert McChesney and John Podesta, "Let There Be Wi-Fi," *Washington Monthly*, January/February 2006, available at http://www.washingtonmonthly.com/features/2006/0601.podesta.html.

6 Bracken Hendricks, "Wired for Progress: Building a National Clean-Energy Smart Grid" (Washington, D.C.: Center for American Progrress, February 2009), available at http://www.americanprogress.org//issues/2009/02/wired_for_progress.html.

7 One concern is that shifting demand to off-peak times may not be feasible for some families, including low-income families with inflexible work schedules. Any requirements or incentives for demand-shifting should be drafted with these concerns in mind.

8 The current terms of the weatherization grants in the Recovery Act may not be flexible enough to support payments for smart-grid and broadband installation at the same time. Congress and the agencies should look for ways to create that flexibility.

9 The funding is available to health centers serving medically underserved communities under Section 330 of the Public Health Act.

10 Especially where government funds are used to pay for the anchor tenant's improved broadband, the terms of service with the broadband provider should provide maximum flexibility for the anchor tenant to make the improved capacity available to the surrounding geographic area, such as through follow-on wired or wireless service.

11 See U.S. Secretary of Agriculture Tom Vilsack, Acting Federal Communications Commission Chairman Michael Copps, and U.S. Department of Commerce Senior Advisor and Acting Chief of Staff Rick Wade, Comments made at the kick-off event by the Department of Commerce, Department of Agriculture, and Federal Communications Commission of the broadband funding initiative, March 10, 2009, available at http://www.ntia.doc.gov/broadbandgrants/090310/transcript_090310.txt.

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Swire recently served on the Obama-Biden Presidential Transition Team, including on the agency review team for the Federal Trade Commission, and on the Technology, Innovation, and Government Reform team, where he worked on broadband policy issues, among others. With Jonathan Zittrain, he is editor of the Cyberspace Law Abstracts of the Social Science Research Network. Many of his writings appear at www.peterswire.net.

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