Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

In the Matter of	)	
	)	
A National Broadband Plan for Our Future	)	GN Docket No. 09-51
	)	
	)	
Comments Sought on International Comparison and Consumer Survey Requirements in the Broadband Data Improvement Act	)	GN Docket No. 09-47
	)	
Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans In a Reasonable and Timely Fashion, And Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, As Amended by the Broadband Data Improvement Act	)	GN Docket No. 09-137

COMMENTS OF GOOGLE INC. – NBP PUBLIC NOTICE #2

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October 2, 2009

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COMMENTS OF GOOGLE INC. – NBP PUBLIC NOTICE #2

Google Inc. files these comments in response to the Federal Communication Commission's ("FCC" or "Commission") Public Notice seeking comment on how broadband infrastructure and services could help achieve efficient implementation of Smart Grid technology, as part of the Commission's development of a National Broadband Plan ("NBP")[1] as directed by the American Recovery and Reinvestment Act of 2009 ("Recovery Act").[2] These comments address Question 4, Real-Time Data, and Question 5, Home Area Networks.

[1] *A National Broadband Plan for Our Future*, NBP Public Notice #2, DA 09-2017 (Sept. 4, 2009) ("NBP Public Notice #2"). *See also A National Broadband Plan for Our Future*, Notice of Inquiry, 24 FCC Rcd. 4342 (2009) ("NOI").

[2] Pub. L. No. 111-5, 123 Stat. 115 (2009).

INTRODUCTION AND SUMMARY

If you cannot measure it, you cannot improve it.
– William Thompson, Lord Kelvin (1821-1907)

In December 2007, the U.S. Congress pronounced that it is the policy of the United States to build a "smart grid" capable of providing consumers with access to electricity usage information.[3] Google has been an advocate of providing consumers with such information and is developing a free, web-enabled software tool called Google PowerMeter to facilitate such access.[4] The Google PowerMeter application, now in its test phase, will enable consumers to receive, at no charge, information about their electricity consumption from utility smart meters and energy management devices.[5]

Today, there is extremely limited ability for households and small businesses to access their energy usage information more than once a month, and even less ability to interact with this data (including remotely) through intelligent devices and other hardware and software. Smart Grid policies that promote easy access to energy consumption information will, over time, save money and energy, reduce greenhouse gas emissions, create more efficient overall power

[3] *See* Energy Independence and Security Act of 2007, Pub. L. No. 110-140, § 1301 and § 1307(a).

[4] *See e.g.*, Comments of Google Inc. submitted to United States Department of Energy in response to Notice of Intent to Issue a Funding Opportunity Announcement for the Smart Grid Investment Grant Program (May 6, 2009); Testimony of Edward Lu, Advanced Projects Program Manager, Google, Inc., Senate Committee on Energy and Natural Resources Hearing on Smart Grid (Mar. 3, 2009); Comments of Google Inc. to California Public Utilities Commission, Proceeding R08-12-009, Order Instituting Rulemaking to Consider Smart Grid Technologies Pursuant to Federal Legislation and on the Commission's own Motion to Actively Guide Policy in California's Development of a Smart Grid System (Feb. 9, 2009). Google is addressing the challenges of energy independence and efficiency on several fronts. Google.org, the company's philanthropic arm, uses information and technology to help solve major global challenges including climate change and energy security. *See* http://www.google.org/.

[5] *See* http://www.google.org/powermeter/.

management including peak demand planning, help with the integration of plug-in vehicles and on-site generation, and spur economic growth.

Smart Grid policy should promote the development of hardware and software tools and programs as part of an open ecosystem to empower consumers to make informed choices about their energy use, encourage participation in third-party demand-response programs, support on-site generation and plug-in vehicle adoption, and spur the development of innovative intelligent devices. Access to the Internet is an important component of the Smart Grid because it can support the transmission and exchange of consumer energy usage information, which will engage and empower consumers.

Specifically, as discussed in more detail below, Google urges the Commission to consider and recommend, as part of the NBP, adoption of policies and goals that seek to:

- Enable all households and small business to have access to near real-time information about their own energy use in a format that is easily accessible and understandable, creating a feedback loop to reduce energy consumption, save money and reduce greenhouse gases.
- Promote Innovation-friendly Home Area Networks grounded in open non-proprietary standards to drive development of creative, new energy management products and services for homes and small businesses.

QUESTION 4: REAL-TIME DATA[6]

As the FCC correctly notes, simply providing consumers access to their energy consumption information, whether via in-home displays, web portals or other methods, reduces energy consumption. To create the most enduring, dramatic reductions consumers should have

[6] Google's comments in this section focus on the questions in Paras. 4(b), (d), (e) and (f) of the NBP Public Notice #2.

access to near real-time information about their energy use in a format that is easily accessible and understandable.

Ideally, a consumer should be able to turn on an appliance and, within seconds or minutes, see the resulting change in their electricity consumption – creating a "Prius effect" for the home.[7] A different matter than the immediacy of feedback is the granularity of the data presented to the consumer. In other words, even if a consumer is not able to access her energy information data until the end of the day (or even the following day), if the information is provided in at least 15-minute increments the consumer will be able to identify specific appliances based on a recollection of when they were used. By contrast, receiving energy usage data that merely provides the aggregate level of household electricity consumption on an hourly or even less frequent basis is not as useful. In the case of less granular information, the consumer will have a more limited understanding of the consumer's actual usage patterns.[8]

A number of studies indicate that access to near real-time information has a direct, measurable and substantial impact on energy consumption. For example, an Oxford University review of research on the effects of providing immediate feedback on electricity usage found that overall demand reductions generally ranged from 5 to 15 percent.[9] Many other tests and pilot programs also are being conducted. A pilot study of near real-time energy use feedback

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[7] The "Prius effect" refers to the fuel-reducing responses of Toyota Prius drivers to that car's real-time fuel-efficiency monitor. *See e.g.*, Michael S. Rosenwald, *For Hybrid Drivers, Every Trip is a Race for Fuel Efficiency*, Wash. Post (May 26, 2008).

[8] In addition to reductions spurred by feedback alone, consumers empowered with energy awareness will be more likely to invest in energy efficiency measures – something that can lead to even great energy savings.

[9] Sarah Darby, *The Effectiveness of Feedback on Energy Consumption: A Review for DEFRA of the Literature on Metering, Billing and Direct Displays* 3 (2006), http://www.eci.ox.ac.uk/research/energy/electric-metering.php.

monitors in Ontario, Canada, for example, followed the electricity consumption of over 400 pilot participants and control customers over a two-and-a-half year period.[10] The average reduction in overall electricity consumption across the sample was 6.5 percent, and energy demand reductions continued throughout the study period. Similarly, a 370-home pilot program by Energy Trust of Oregon concluded earlier this year using in-home displays found that 63 to 75 percent of consumers believed that these devices have changed the way they use energy, especially regarding lighting, air conditioning, computers and dryers.[11] These outcomes echo the results from a pilot program by National Grid, NSTAR, Western Massachusetts Electric in 2007-2008 with over 3,500 homes, and others.

Energy savings prompted by access to near real-time data can be enhanced when combined with programmable appliances and dynamic energy pricing. A study conducted by the Pacific Northwest National Laboratory[12] gave customers in Oregon and Washington access to energy consumption information broken down by appliance every 15 minutes, and allowed them to program their water heaters and thermostats to respond to changes in electricity prices. Participants received cash when they operated their household loads in collaboration with the needs of the grid — *i.e.*, when they reduced their energy usage at times of peak energy demand. Over the year of the study, peak load on the grid was reduced by approximately 15 percent and consumers saved approximately 10 percent on their electricity bills as compared to the previous

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[10] D. Mountain, Mountain Economic Consulting and Associates, Inc., *The Impact of Real-Time Feedback on Residential Electricity Consumption: The Hydro One Pilot* (2006).

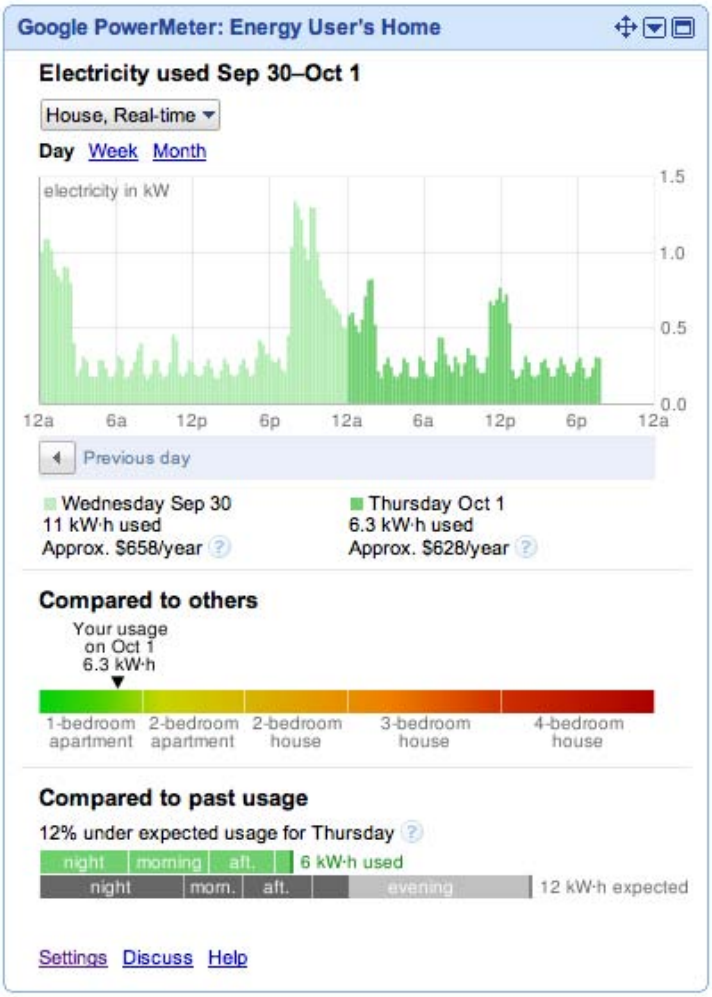
[11] Electric Power Research Institute, *Residential Electricity Use Feedback: A Research Synthesis and Economic Framework*, Final Report, App. E, 4 (Feb. 2009) http://my.epri.com/portal/server.pt?space=CommunityPage&cached=true&parentname=ObjMgr&parentid=2&control=SetCommunity&CommunityID=405.

[12] D.J. Hammerstrom, Pacific Northwest National Laboratory, *Olympic Peninsula Gridwise Study* (2007), http://gridwise.pnl.gov/docs/op_project_final_report_pnnl17167.pdf.

year. Based on these results, the authors determined that, if all customers nationwide were engaged in reducing peak loads, peak electricity prices would be substantially reduced and approximately $70 billion in new generation, transmission and distribution systems could be avoided, with the savings passed along to ratepayers.

Near real-time energy usage information can be provided to customers in a wide variety of ways, including utility-supplied smart meters (advanced metering infrastructure or "AMI"), as well as by consumer-installed hardware and software, empowering consumers to view their data via displays in the home, online, or even on smart phones. While smart meters enable automated reading and accurate collection of consumption data by utilities, as well as delivery of detailed consumption data to consumers, there is no reason to limit these intelligent devices simply to smart meters with usage information. Communications can be interactive, empowering consumers to adjust their behaviors and energy usage according to data about rates, complementary services and other factors.

Google PowerMeter, a free, opt-in, web-enabled software service, draws data from electric utility smart meters and energy management devices to give people access to their home electricity consumption data. Google PowerMeter currently is being tested with several large and small utility companies throughout the United States including San Diego Gas & Electric, TXU Energy, and White River Valley (Missouri) Electric Cooperative, as well as in Canada, Germany and India, and Google plans to expand its rollout later this year. As shown in the following graphic, the Google PowerMeter default view can show the current day's energy consumption in fifteen minute increments compared to the previous day's consumption.



By providing access to this level of granular information in a format that can be easily integrated into daily life, energy usage information will become part of consumers' usual daily routine. This energy usage awareness will also motivate consumers to obtain programmable devices and use any available dynamic energy pricing, and help drive down longer-term consumption trends. Such awareness can also drive consumers to make energy efficiency upgrades that can lead to additional long-term usage reductions and savings.

The benefits of near real-time energy usage data availability scale up very quickly in terms of consumer cost savings, CO2 emission reductions, reduced overall peak usage reductions and decreased need for new generation infrastructure. For example, the average U.S. residential customer spends about $1,200 a year on electricity, meaning that even a 5 to 15 percent consumption reduction due to near real-time feedback could save the average consumer $60 to $180 per year.[13] If just half of U.S. households cut their demand by 10 percent, the electricity

[13] Energy Information Administration ("EIA"), U.S. Average Monthly Bill By Sector, Census Division, and State, Table 5 (2007), http://www.eia.doe.gov/cneaf/electricity/esr/table5.html. The average monthly electricity bill for California households is less than the national average,

savings would be greater than the wind and solar power output.[14] The CO2 emissions avoided would be equal to taking approximately 8 million cars off the road.[15] With the addition of dynamic pricing, programmable appliances, and other incentives, the potential for savings could be significantly greater.

QUESTION 5: HOME AREA NETWORKS

Home Area Networks (HANs) can be implemented in a number of ways. The most common are Ethernet cabling, WiFi (IEEE 802.11 wireless), IPv6 6LOWPAN (IEEE 802.15.4) and Zigbee. Of the four, the first three are open standards supporting the use of the Internet protocols and presumably attractive for that reason. The purpose of HANs is to allow devices in the home to be interconnected with one another and, potentially, to the Internet. Not all devices need to be directly reachable through the Internet, however. Some may be confined to in-home connectivity and, in fact, separated from access to the public Internet. In the context of energy monitoring and management, a HAN can be instrumental in capturing energy consumption information on a very granular basis, for exerting controls on energy consumption and for providing potentially on-demand, real-time feedback on energy usage.

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even though California has some of the highest electricity rates in the country. This is due in large measure to the many successful state energy efficiency initiatives already in place. Next Ten, California Green Innovation Index 63 (2009), http://www.next10.org/pdf/GII/Next10_GII_2009.pdf.

[14] See EIA, Annual Energy Outlook (2008), http://www.eia.doe.gov/oiaf/archive/aeo08/index.html ("*EIA 2006 Annual Energy Outlook*"); American Wind Energy Association, U.S. Wind Energy Projects as of 12/31/2008, http://awea.org/projects.

[15] See EIA 2006 Annual Energy Outlook; U.S. Dep't of Energy, Transportation Energy Data Book (2008), http://cta.ornl.gov/data/index.shtml; Environmental Protection Agency, Greenhouse Gas Equivalencies Calculator (2008), http://www.epa.gov/cleanenergy/energy-resources/calculator.html.

For maximum benefits, near real-time data should be part of an open ecosystem of hardware and software for energy monitoring, home automation, appliance/device control, and demand responses. Third party service providers are likely to bring even greater innovation in data usage and applications. For example, a utility or third party could offer services or applications that analyze energy use, identify inefficient appliances, provide appliance discounts or suggest energy management practices. Interactive devices and/or software, including obvious examples such as thermostats that adjust automatically and dishwashers that run only at preferred times according to energy pricing, monthly usage or other consumer-driven factors, can be developed. One can also imagine energy usage information that shows how "green" the source, such as whether the energy was generated by wind versus coal or a device that turns itself off and on when energy costs rise above a certain set level. Consenting and informed consumers should be able to share their information in a standardized, open format – *i.e.*, a format that is uniform, freely published, and unencumbered by a patent or proprietary claim. The primary goal should be to transparently and securely provide consumers more useful choices and information, regardless of the source.

Further, a HAN platform also can generate innovations by third-party providers, particularly if the data is standardized and uniform. Consenting and informed consumers sharing data with third parties in a standardized, open format, will facilitate the development of a range of products and services. Just as XML allowed Internet services to proliferate through simple, unified, fee-free and open standards to share diverse data, so too can uniformity in energy data bring us a smarter energy framework.

Most importantly, by creating a platform for information exchange, it is likely that – as with the Internet – there are numerous other applications, devices and services that have not yet

been conceived and that will spring from the energy information exchange enabled by intelligent devices. It is important to approach a smarter energy infrastructure with the understanding that data flows two ways. This means that information (consumer usage, pricing and other utility data) can be exchanged between the utility and the consumer, between appliances and other consumer electronic devices (game consoles, etc.), and between consumers, utilities and third-party service providers. All of this information can be exchanged via the Internet, so that consumer energy usage can flow from the smart meter and appliances to the Internet, and demand response requests and information can flow back from the Internet to the smart meter and devices. Enabling the Internet to facilitate this two-way flow helps stimulate competition for services and promotes greater consumer choice.[16]

Broadband infrastructure is significant because it determines the level of robustness and efficiency of the real-time delivery of information, and allows delivery of information on a granular basis, increasing the likelihood that it will lead to rational and efficient choices regarding consumption. By enabling access to various types of information, including information accessed remotely via broadband connections, consumer consumption is best affected. Narrowband simply is not as compelling or useful for consumers and will limit or preclude new Smart Grid applications and services. With the availability of new broadband platforms, including increased use of unlicensed spectrum, we further increase the likelihood of better interactivity between consumers and utilities, empowering consumers to make sound energy choices. Connecting WiFi HANs to the Internet has produced numerous benefits for consumers; additional benefits will result as Internet-connected HANs encompass energy

[16] Moreover, just as the Internet Protocol (IP) is well understood and has formed the foundation to bring us the dynamic creativity and innovation that characterizes the Internet, so too may it prove useful in the roll-out of our national smart grid.

applications and services – some we can foresee (such as Energy Management Systems and Internet Control) and some that we cannot. For this reason, broadband in all its various flavors (DSL, cable, fiber, LTE, WiMax, etc.) has a role in a smarter national energy grid.

CONCLUSION

Today, energy efficiency, renewable energy, plug-in cars, on-site generation and a number of other clean energy opportunities have become high priorities because of serious environmental, security and economic concerns. Capturing these opportunities will require, among other things, a smarter energy infrastructure. We encourage the Commission to consider the points made above as it considers Smart Grid in the context of its National Broadband Plan. We urge the Commission to adopt recommendations that will promote consumer access to near real-time data, including over HAN platforms, using open, non-proprietary standards, in a manner that maximizes consumer choice, engagement and control. This approach will help to ensure that the Smart Grid, essentially an "energy Internet," benefits from the freely flowing information exchange that broadband enables.

Respectfully submitted,

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October 2, 2009