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**Smart Meters, Wireless Networks and Human Health**

Wireless computer networks are quickly becoming ubiquitous in our everyday environment. Most homes, schools, and public spaces now offer people the opportunity to connect to the Internet. Even though these Wi-Fi networks utilize low-powered radiofrequency (RF) transmitters, many people have voiced concerns over the potential adverse health effects of long-term exposure to RF energy.<sup>1</sup>

Wireless local area networks (WLANs) are created every day, which has prompted swift and comprehensive research from the scientific community. Results indicate that RF outputs from WLANs pose negligible health risks, although there is a consensus that a close watch and further research must be conducted to solidify this conclusion.<sup>2</sup>

**Wireless Local Area Network Functions**

A WLAN is used to link two or more devices and provides connection to the Internet through an access point, typically a router, that transmits and receives radio frequencies.<sup>3</sup> The simplicity of installation and everyday use has made WLANs the preferred method of wirelessly connecting to the Internet.<sup>4</sup>

Regarding the amount of radiation associated with WLANs, "Recent surveys have shown that the RF exposures from base stations range from 0.002% to 2% of the levels of international

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<sup>1</sup> Kenneth R. Foster, "Human Exposure to Radiofrequency Energy from Wireless Local Area Networks," *Health Physics Society* 92 (2007): 280-289, accessed April 27, 2012, <http://www.hps.org/hpspublications/articles/wirelessnetworks.html>.

<sup>2</sup> Kenneth R. Foster, "Human Exposure to Radiofrequency Energy from Wireless Local Area Networks."

<sup>3</sup> John H. Cafarella and Jeffrey Fischer, "High Data Rate Wireless Local Area Networks," United States Patent Document No.19, 1998, accessed July 26, 2012, <http://www.google.com/patents?hl=en&lr=&vid=USPAT5809060&id=OkYjAAAAEBAJ&oi=fnd&dq=wireless+local+area+network+patent+no.+19+cafarella&printsec=abstract#v=onepage&q&f=false>.

<sup>4</sup> World Health Organization, "Electromagnetic Fields and Public Health," Media Centre, May 2006, accessed April 27, 2012, <http://www.who.int/mediacentre/factsheets/fs304/en/index.html>.

exposure guidelines, depending on a variety of factors such as the proximity to the antenna and the surrounding environment. This is lower or comparable to RF exposures from radio or television broadcast transmitters."<sup>5</sup>

### **Potential Impacts on Human Health**

Scientific research of molecular level interactions with RF Energy indicates that there is no demonstrable health hazard from long-term exposure to RF energy, but that, "because some biological experiments continue to suggest new possibilities for RF interactions, more scientific research is called for."<sup>6</sup> Research surrounding non-cancer health effects of RF energy is largely a nonissue, and it is worth quoting, in full, the conclusion found by a team of researchers working for the National Institute of Environmental Health Science:

The accumulated evidence does not establish the existence of adverse short- or long-term health effects from the signals produced by base station and local wireless networks. In fact, for similar RF exposure intensities (watts per square meter), the body absorbs about 5 times more of the RF energy from FM radio and television frequencies (around 100 MHz) than from base station frequencies (around 1–2 GHz). It is reassuring to note that radio and TV broadcast stations have been in operation for > 50 years, and health statistics have not demonstrated adverse health consequences.<sup>7</sup>

### **Smart Meters**

Smart meters are devices that measure "attributes of electricity, natural gas, or water as delivered to consumers," and directly transmit that information to utility companies and consumers themselves.<sup>8</sup> They are essential components of an energy "smart grid" because they allow direct, two-way communication between users and utilities. An energy "smart grid" refers to the network that carries energy from its generation point to consumers, and utilizes a variety of technologies to increase efficiency.<sup>9</sup> Smart meters, remote data sensing, automation, and other innovations together are used to modernize the energy grid.<sup>10</sup>

Smart meters allow users to adjust their energy demand to "price changes that reflect the condition of the electricity grid".<sup>11</sup> These adjustments are expected to improve the reliability of

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<sup>5</sup> World Health Organization, "Electromagnetic Fields and Public Health."

<sup>6</sup> Peter A. Valberg, T. Emilie van Deventer, Michael H. Repacholi, "Workgroup Report: Base Stations and Wireless Networks-Radiofrequency (RF) Exposures and Health Consequences," *Environmental Health Perspectives* 115(2007): 416-424, accessed on April 27, 2012, <http://ehp03.niehs.nih.gov/article/info:doi/10.1289/ehp.9633>.

<sup>7</sup> Peter A. Valberg, T. Emilie van Deventer, Michael H. Repacholi, "Workgroup Report: Base Stations and Wireless Networks-Radiofrequency (RF) Exposures and Health Consequences."

<sup>8</sup> California Council on Science and Technology, "Health Effects from Radio Frequency of Smart Meters," January 2011, accessed July 24, 2012 <http://www.ccst.us/publications/2011/2011smartA.pdf>.

<sup>9</sup> Department of Energy, "Smart Grid," Office of Electricity & Energy Reliability, accessed July 24, 2012 <http://energy.gov/oe/technology-development/smart-grid>.

<sup>10</sup> Department of Energy, "Smart Grid."

<sup>11</sup> California Council on Science and Technology, "Health Effects from Radio Frequency of Smart Meters," pg. 11.

energy output, cut costs for producers and consumers, and increase efficiency.<sup>12</sup> The real-time data collection that smart meters provide can help producers balance demand and supply, which will be important “as more intermittent wind and solar generation resources are added to the grid.”<sup>13</sup>

The federal government has made smart meters and other smart grid technology development a priority. The Energy Independence and Security Act (passed in 2007) encourages states to initiate smart grid development by allowing the recovery of investment through utility rates and reimbursements.<sup>14</sup> The American Recovery and Reinvestment Act of 2009 provided \$4.5 billion for smart grid infrastructure development.<sup>15</sup>

RFs are regulated by the Federal Communications Commission (FCC).<sup>16</sup> Smart meters emit the same type of radio frequencies as cell phones and WLANs. However, the quantity of RFs that smart meters release is smaller than those of microwaves and cell phones. RF exposure may also be less intense; cell phones and microwaves may be operated more frequently and at a closer range to the body than smart meters.<sup>17</sup> According to Bruce Cooper, the medical director for the Health District of Northern Larimer County, Colorado, the FCC regulations provide a “wide margin of safety” relative to RF levels known to be harmful.<sup>18</sup> In fact, notes Cooper, research suggests that RF emissions from household smart meters is “1000 times or more” below the regulations created by the FCC with help from the Food and Drug Administration and the Environmental Protection Agency.<sup>19</sup>

There are two types of effects of RFs on the human body: thermal and non-thermal. A research team from the California Council on Science and Technology (CCST) describes thermal effects as “tissue heating from absorbing energy associated with radiofrequency emissions.”<sup>20</sup> Thermal effects are relatively well-identified, understood, and accounted for in FCC regulations.<sup>21</sup> Non-thermal effects, which are the long-term effects of RF exposure, are not well understood. The CCST research team writes, “Some studies have suggested non-thermal effects may include fatigue, headache, irritability, or even cancer. *But these findings have not been scientifically established, and the mechanisms that might lead to non--thermal effects remain uncertain.*”<sup>22</sup>

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<sup>12</sup> California Council on Science and Technology, “Health Effects from Radio Frequency of Smart Meters.”

<sup>13</sup> California Council on Science and Technology, “Health Effects from Radio Frequency of Smart Meters,” pg. 11.

<sup>14</sup> U.S Department of Energy, “Energy Independence and Security Act,” Office of Electricity & Energy Reliability, accessed July 25, 2012, <http://www1.eere.energy.gov/femp/regulations/eisa.html>.

<sup>15</sup> California Council on Science and Technology, “Health Effects from Radio Frequency of Smart Meters.”

<sup>16</sup> Bruce Cooper, “Review of Health Effects Related to Smart Meters,” Health District of Northern Larimer County, Colorado, July 5, 2011, accessed July 24, 2012, [http://www.fcgov.com/utilities/img/site\\_specific/uploads/Review\\_of\\_Health\\_Effects.pdf](http://www.fcgov.com/utilities/img/site_specific/uploads/Review_of_Health_Effects.pdf).

<sup>17</sup> Bruce Cooper, “Review of Health Effects Related to Smart Meters.”

<sup>18</sup> Bruce Cooper, “Review of Health Effects Related to Smart Meters,” p. 1.

<sup>19</sup> Bruce Cooper, “Review of Health Effects Related to Smart Meters,” p. 1.

<sup>20</sup> California Council on Science and Technology, “Health Effects from Radio Frequency of Smart Meters,” p. 7.

<sup>21</sup> California Council on Science and Technology, “Health Effects from Radio Frequency of Smart Meters.”

<sup>22</sup> California Council on Science and Technology, “Health Effects from Radio Frequency of Smart Meters,” p. 7.

Cooper concluded his study for Fort Collins, Colorado noting, “There appears to be no health reason to avoid the use of smart meters.” However, he added that long-term health effects remain uncertain.<sup>23</sup> The findings of the CCST report indicated that more research on both the levels of RFs produced by smart meters as well as thermal and non-thermal health effects should be conducted in the future to achieve more conclusive results. In particular, the team highlighted uncertainty about non-thermal effects: “Not enough is currently known about potential non-thermal impacts of radio frequency emissions to identify or recommend additional standards for such impacts.”<sup>24</sup> Also, the CCST researchers suggested that there may be alternatives to wireless transmission of smart meter data. These include transmitting data through “phone lines, fiber-optic or coaxial cable.”<sup>25</sup> Therefore, smart meters are potentially more adaptable than other technologies such as microwaves, cell phones and WLANs that rely on wireless RFs.<sup>26</sup>

### Conclusion

Much like cellphones, the prevalence of and dependence on wireless networks and the development of smart meters has been a cause for concern for some citizens, politicians, and scientists alike. It is likely that the ubiquity of these modes of communication and data collection will become inescapable as the 21st century progresses. While today's research has declared RF energy and wireless networks a benign presence, the scientific community has stressed the importance of a continued inquiry into the subject.

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Disclaimer: This report has been compiled by undergraduate students at the University of Vermont under the supervision of Professor Anthony Gierzynski. The material contained in the report does not reflect the official policy of the University of Vermont.

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<sup>23</sup> Bruce Cooper, “Review of Health Effects Related to Smart Meters,” p. 2.

<sup>24</sup> California Council on Science and Technology, “Health Effects from Radio Frequency of Smart Meters,” p. 4.

<sup>25</sup> California Council on Science and Technology, “Health Effects from Radio Frequency of Smart Meters,” p. 24.

<sup>26</sup> California Council on Science and Technology, “Health Effects from Radio Frequency of Smart Meters,” p. 24.