U.S. Senate Energy and Natural Resources Committee – June 8, 2017

Testimony by Cree, Inc.

Cree, Inc. is a leading U.S.-based developer and producer of LEDs, LED lighting and advanced power and RF semiconductors. Cree was founded in 1987 out of NC State University. The global headquarters is in Durham, NC with facilities throughout the United States (Wisconsin, Arkansas, North Carolina and California). Our global employee population is over 6,300.

Cree is a technology company focused on continuous innovation and pushing the boundaries of technology performance to do more and consume less energy. We invented much of the LED technology now delivering energy efficient LED lighting solutions in homes, offices, schools, public facilities and cities across the U.S.

Early LED technology was used in many applications such as flashlights, signs, indicators and signals, but not for general white lighting applications. As Cree continued to improve the performance of its LED technology, we introduced the first white LEDs that met the stringent requirements of general lighting applications in 2006. These LEDs enabled the first commercially viable LED general lighting products beginning in 2007.

Importantly, Cree's focus has always been on both energy efficiency and the quality of light. LED lighting products must meet people's expectations for the quality and appearance of light. Cree didn't want the industry to repeat the failures of CFL bulbs to gain widespread adoption because of user dissatisfaction with the lighting experience.

The early LED lighting products were more expensive than traditional lighting and although they paid for themselves through energy and maintenance savings, adoption was limited by the capital requirements and the "newness" of the technology. Initial payback periods were often 3-5 years, and in some cases as high as 7-9 years. Public institutions and some other organizations were willing to accept longer payback periods, but most commercial entities were looking for paybacks on their investments of 18-24 months.

To make the economics work for more organizations and accelerate adoption, Cree took multiple approaches. One was to invent new technology that

increased performance and energy savings thereby improving the payback periods. The second was to invent new technology that allowed us to reduce the manufactured cost of the products, also leading to improved payback periods.

Innovation was applied at many levels within LED lighting products to drive overall system performance and lower system costs. Improvements in the performance of LED component technology had the greatest impact initially, and we improved performance by over 4x through LED semiconductor research and advancements.

More efficient and higher performance LEDs reduced the system cost of lighting products by reducing the amount of power needed which led to smaller and lower cost power supplies, reducing the amount of cooling needed which led to smaller and lower cost heat sinks and reducing the overall physical size of the products which reduced the material needed.

In addition to higher performance LEDs, the development of more efficient and effective optical designs reduced the amount of light needed, requiring fewer LEDs, and improving the user experience. Each area of the LED lighting system was a target for innovation to increase performance and reduce costs.

As described earlier, the economics of LED lighting was a key enabler of technology adoption. Another factor affecting adoption was the newness and unfamiliarity of the new technology which was often realized as risk by potential customers. To help offset these perceived risks, Cree offered a strong warranty, based on the quality of our products.

Adoption was aided, as well, by utility incentive programs and associated energy efficiency certifications, such as ENERGY STAR, that enabled rebates to reduce the initial cost and hence improve payback. In the consumer market, the strength of the ENERGY STAR brand fostered adoption by giving customers confidence in the new technology.

The federal government, and DOE specifically played a key role in helping LED technology succeed in the market through strategic R&D support, industry demonstrations and trials as well as ENERGY STAR certifications.

Through innovation, we've improved LED lighting performance and reduced costs to the point where some LED streetlights are available under $100, use up to 70% less energy than previous technologies and have paybacks under 2 years. In residential applications, LED bulbs are now available that pay for themselves in 6 months and then last another two decades under normal usage.

Beyond the performance and economics of individual LED lighting products, an area of real promise is that of systems efficiency, in our case intelligent lighting systems. These systems use integrated sensors to detect occupancy and ambient light, as well as communications (the Internet of Things) and data analytics, to save up to 80% of the energy used for lighting while improving the lighting experience for people in buildings. More importantly, these systems can also go beyond just making the lighting more efficient to make the buildings more efficient, the people in them more productive and the organizations more profitable.