United States Senate Committee on Indian Affairs

Testimony for the September 18, 2009 Roundtable on

Indian Energy and Energy Efficiency Opportunities

by

Daniel M. Kammen

Professor in the Energy and Resources Group (ERG)
Professor of Public Policy in the Goldman School of Public Policy
Co-director Berkeley Center for the Environment
Director, Renewable and Appropriate Energy Laboratory (RAEL)
University of California, Berkeley

http://kammen.berkeey.edu *http://rael.berkeley.edu*

Introduction & Summary

Chairman Byron Dorgan, Vice-Chair John Barrasso, and other members of the Senate Indian Affairs Committee, I appreciate your attention to this vital issue, and your fact-finding efforts to develop legislation to support Native American and wider regional efforts to foster sustainable development. Native American lands now lie at the center of discussions and potentially efforts to meet the economic and cultural needs of tribal communities, and offer an opportunity for partnerships to contribute to wider North American energy sustainability and independence.

My laboratory, the Renewable and Appropriate Energy Laboratory (RAEL) has experience in the design and implementation of clean energy building systems (both new buildings and retrofits) as well as specific technology solutions (solar thermal, photovoltaics, waste to energy, marine energy, wind and hydro power) in over 20 countries (detailed online at http://rael.berkeley.edu). I have worked with the U. S. Department of Energy to develop curriculums and to provide outreach support to the tribal colleges and tribal energy officers for the Native American Renewable Energy Education Project (NAREEP), and am currently working with two Native American communities, the Tuolumne Band of Me-Wuk Indians (Tuolomne, CA) and the Cedarville Rancheria Band of Northern Paitue Indians, to plan and implement low-carbon, pro-growth energy and economic plans.

In the case of this testimony I am truly honored to support directly the extensive efforts of Ms. Reba Fuller and the Tuolumne Band of Me-Wuk Indians who are looking at clean energy projects on their tribal lands to not only meet local energy needs as well as to provide clean energy generation for sale to the regional utility. Many of my comments today are in the spirit developed by the Me-Wuk in their vision of an agenda of local, regional and national economic growth, job creation, and an export-oriented industrial base.

The Context of High- and Low-Carbon Energy

America is at an energy crossroads. As a nation, we are dependent on fossil fuels at a time of growing demand and dwindling supply. Meanwhile, fossil fuel use continues to impose massive environmental and economic costs. Now our country must choose between paying to continue the status quo and investing in a new energy future.

Enabling the transition to a more sustainable energy economy has become central to public and private sector discussions of our future (Augustine, 2005).

Environment California recently released a study, which concluded that:

> The costs of continuing on our current energy path are steep. American consumers and businesses already spend roughly $700 billion to $1 trillion each year on coal, oil and natural gas, and suffer the incalculable costs of pollution from fossil fuels through damage to our health and environment. If America continues along a business-as-usual energy path, U.S. fossil fuel spending is likely to grow, totaling an estimated $23 trillion between 2010 and 2030 (Environment California, 2009)

A diverse set of studies from academic groups, to industry and venture capital teams, to overseas governments have all weighted in on the cost/benefit ratio of this process, but at the very least, agreement exists that paths to a low-carbon economy do exist and that an interaction of science, technology, and policy actions would be needed to make this a reality.

At present the economic assessments of the benefits or costs of greatly expanding the low-carbon energy sector. My laboratory has taken part in a study that for California, achieving a 25% reduction in greenhouse gas emissions by 2020 would create over 80,000 new jobs (Kammen, 2007), a finding confirmed by quite different modeling methods (Roland-Holst, 2006).

Findings: Clean Energy as an Economic Driver of Sustainable Native Peoples Projects

The first and most important finding is that Native American lands are the sites of some exceptional solar, wind, biomass and hydropower resources, as well as traditional – and in many places controversial – uranium and coal mining, ecologically problematic hydroelectric facilities, and fossil-fuel power plants. In these brief comments I will not explore in detail the opportunities for expansion of carbon-intensive energy production (or resource mining) on Native American lands that here-to-fore has been the status quo. This is largely because the environmental (both local and global) imperative to develop scenarios of low-carbon growth not only presents challenges, but more importantly, a substantial opportunity to develop new economically powerful yet sustainable industries to meet Native American and wider North American energy needs.

Key findings and recommendations from the work of my team at RAEL include:

- **Energy Poverty Exists and Must be Addressed for Many Indigenous Peoples:** *Significant* energy poverty exists on many Native American lands, which impacts families basic well-being, health, childhood and life-long education, and the ability of women, children, and men to achieve their potential (107th Congress, 2002; and CCR, 2003). Electrification rates on some tribal lands are on par with some of the poorest nations on the planet. This is true, ironically, even where the tribe overall is rich in energy resources for export to the United States (EIA, 2000; Middleton,2008). This situation is not acceptable or necessary.

  Recommendation: Energy efficiency programs, from the targeted sale or distribution of efficient stoves, boilers and furnaces, air conditioning, lighting, and transportation are largely lacking on Tribal Lands (Elliott, 1998; CERT, 2005). First and foremost, education and access to efficient technologies is needed, and, if sustained, would save families, businesses, and tribal administrations tremendous amounts of money, prevent illness, and improve school and working conditions for *millions* of Native Peoples (107th Congress, 2002; and CCR, 2003).

- **Clean Energy Resources are a Unique and Largely Untapped Resource for Tribal Peoples:** Study after study has found that wind, solar, biomass and other low-carbon resources are abundant – even uniquely so – on Native American lands (Middleton,2008). Navajo, Crow, Zuni, Rosebud, Me-Wuk and other tribes all have some of the best renewable energy resources *in the world*. There have been more than enough resource studies to initiate solar, wind and biofuel resource extraction to meet Tribal and potentially larger North American energy goals. The National Renewable Energy Laboratory here in Golden and Boulder, Colorado, have documented these resources to an exceptional degree (http://www.wrapair.org/tribal/). The rough estimate that 10% of total North American energy resources are found on the 5% of land which is tribally held or managed has remained a rough but accurate indicator of the diversity and richness of this resource (Middleton,2008).

  In many cases, the issues are <u>not</u> the total amount of clean energy resources, but the constraints of insufficient capital to begin the harvesting process, uncertain markets for clean energy, and lack of long-term partnerships to access these resources in ways that treat the Tribes as equal partners in the management of these new resources. Some programs, notably at NREL and within the Bureau of Land Management/Indian Affairs do exist to build these linkages, but considerably more could be done.

  Recommendation: Partner with Tribal nations and bands to examine the opportunities for new financing mechanisms that access clean energy resources <u>and</u> preserve both tribal autonomy and commercial energy generation once local needs are met.

- **The Expansion and Upgrade of the Transmission System Critically Impacts Native American Clean Energy Development:** Of all the technologies, grid extension and direction to harvest clean energy resources is perhaps the most critical and capital intensive issue facing the Tribes. Grid extension to and through Tribal lands is today a *complex, time consuming and expensive process* that requires partnerships, trust, and shared goals between all parties. These resource issues are described in some detail in the next section.

Recommendation: Make grid-expansion and 'Smart grid' test-beds that integrate tribal energy resources a Tribal and national priority.

Detailed Analysis of Clean Energy Resource from Tribal Lands

Economic modeling of Western power production and usage reveals that the most cost-effective power production choices for many States are derived from renewable sources.
Preliminary results from the Switch model developed in my laboratory suggests that the optimal power investment for California (as an example, the largest power market in the US west) would generate at least 40 percent of renewable electricity by roughly 2025, while increasing both imports and exports with adjacent states.

Expansions in the capacity of existing high-voltage transmission lines and some major new high-voltage lines, mostly in and out of the Central Valley, would be needed regardless of the Renewable Portfolio Standard target. But choosing different targets changes the mix of generation resources that transmission will tap and can tap in the future. Once transmission is permitted and built, after financial and political capital is expended, the new lines shape the future economic landscape and define choices for electricity generation. The transmission decisions that flow from a higher RPS enable greater choice, dilution of permitting and cost risk, and lower mid- and long-term costs.

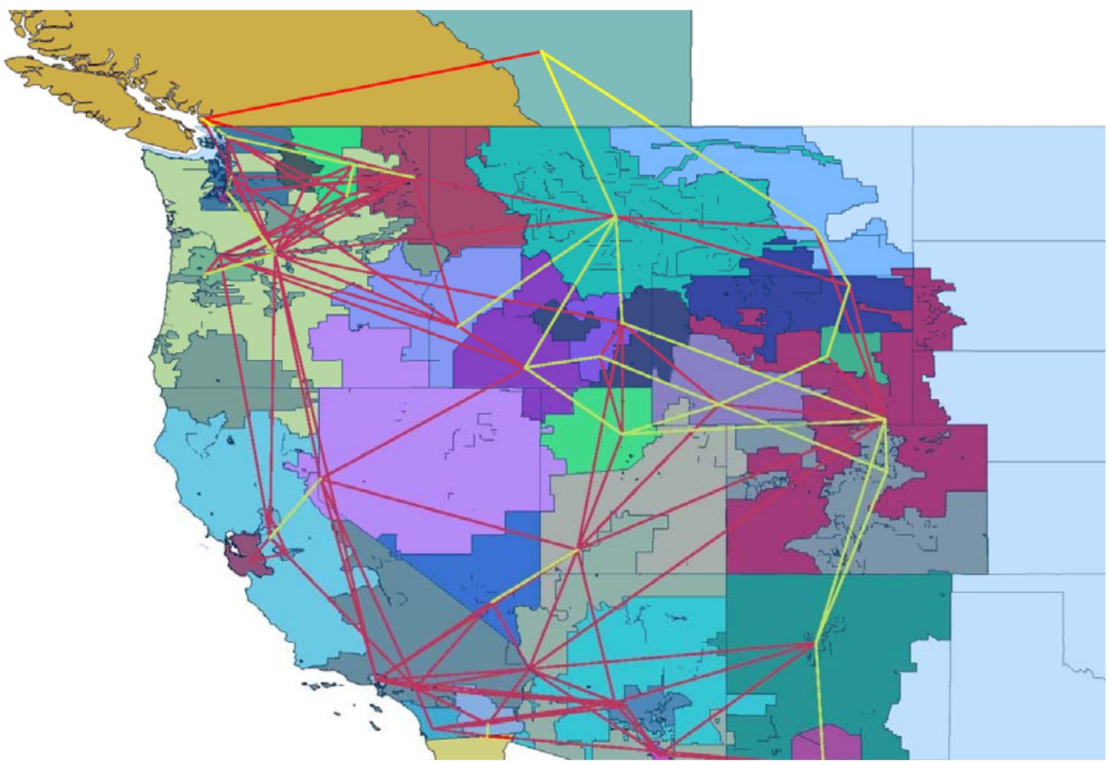

Figure 1: Current power transfer capability on the western high-voltage grid (red) and *Switch* build out (gold) by 2022 under \$0/tCO_2 scenario to enable the new clean energy generation show in Figure 2. *Note: the key power lines to build (yellow) are largely from areas of exceptional wind energy resources on or near Native American lands to the large urban centers of western U. S.*

The timing and magnitude of these transmission investments can vary considerably with the deployment of distributed generation and investment in energy efficiency. Our model, Switch West, calculates an optimal portfolio with a small but strategic role for distributed PV, supplying only 4 percent of California electricity from rooftop solar panels by 2020 but higher amounts in critical spots, for example, close to 10 percent of total demand for Los Angeles Department of Water and Power from mid-decade onward.

A regional depiction of economically optimal power production for an average hour in 2022 can be found in Figure 2, with renewable sources limited to types of wind turbines, solar thermal plants and solar panels available today. The \$0/ton CO_2 carbon price bar presumes no additional climate policy is put in place through 2022.

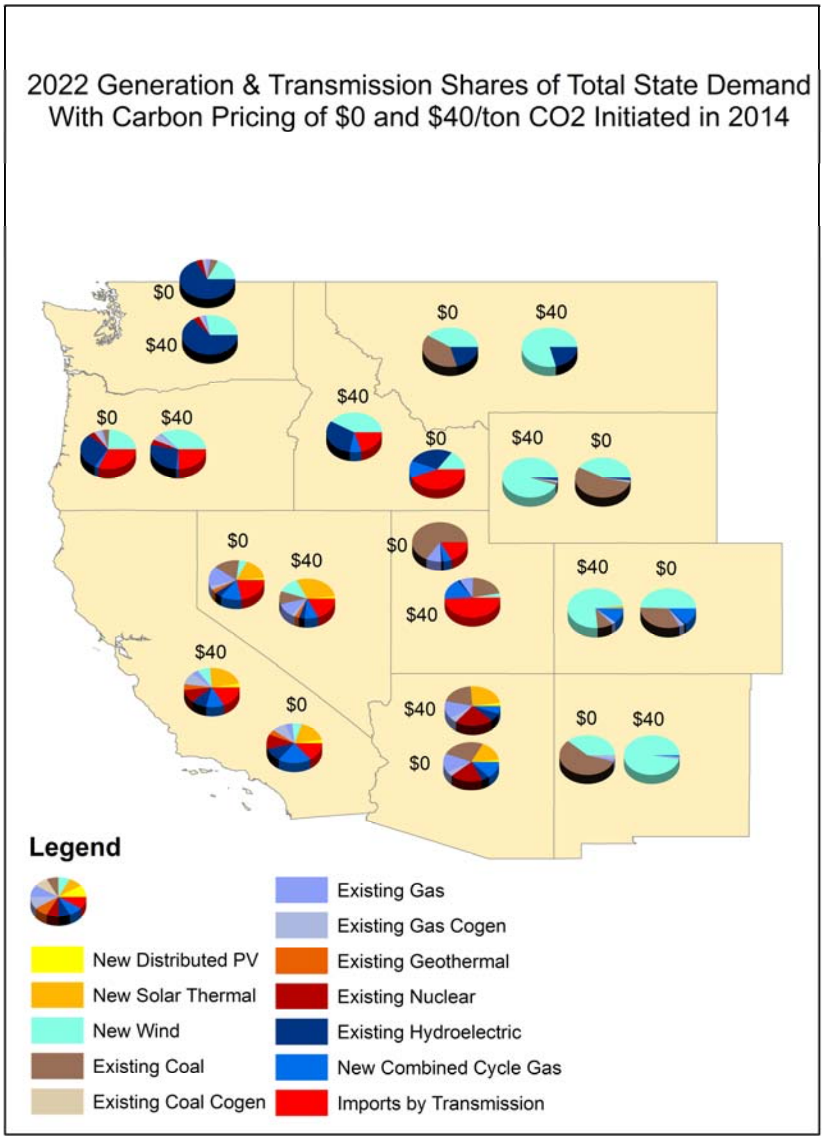

Figure 2: New energy generation deployed by 2022 under two carbon price scenarios, $\$0/tCO_2$ and $\$40/tCO_2$ (with the price enacted by 2014). Legend shows the three key deployments, solar PV, wind, and solar thermal. Note: The low deployment of clean energy within Utah reflects availability of inexpensive coal at the mine-mouth and transmission of renewable generation from surrounding states.

The need and timing for transmission investment also varies with less certain development of other domestic renewable sources. The Crow, Navajo, Rosebud and many other reservations are the sites of some of the most exceptional solar and wind resources *on the planet.*

Job Growth in a Green Economy – Empirical Lessons and Strong Prospects for the Tribes

Expanding the use of renewable energy is not only good for our energy self-sufficiency and the environment; it also has a significant positive impact on employment. My students and I have examined the *observed* job growth in a number of technology sectors (Kammen, Kapadia and Fripp, 2004; Kammen, 2007; Engel and Kammen, 2009; and online spreadsheets to calculate job creation: http://rael.berkeley.edu/node/517).

We reviewed 13 independent reports and studies that analyzed the economic and employment impacts of the clean energy industry in the United States and Europe. These studies employ a wide range of methods, which adds credence to the findings. In addition to reviewing and comparing these studies, we have examined the assumptions used in each case, and developed a job creation model which shows their implications for employment under several future energy scenarios.

Energy Technology	Source of Estimate	Average Employment Over Life of Facility (jobs/MWa)		
		Construction, Manufacturing, Installation	O&M and fuel processing	Total Employment
PV 1	REPP, 2001	6.21	1.20	7.41
PV 2	Greenpeace, 2001	5.76	4.80	10.56
Wind 1	REPP, 2001	0.43	0.27	0.71
Wind 2	EWEA/Greenpeace, 2003	2.51	0.27	2.79
Biomass Ğ high estimate	REPP, 2001	0.40	2.44	2.84
Biomass Ğ low estimate	REPP, 2001	0.40	0.38	0.78
Coal	REPP, 2001	0.27	0.74	1.01
Gas	Kammen, from REPP, 2001; CALPIRG, 2003; BLS, 2004	0.25	0.70	0.95

Table 1: Average employment for different energy technologies. “MWa” refers to average installed megawatts de-rated by the capacity factor of the technology; thus, for a 1 MW solar facility operating on average 21% of the time, the power output would be 0.21 MWa. References in parentheses and sources refer to the studies reviewed in the text. The biomass energy studies are a proxy for jobs that could derive from an expansion of biofuels (e.g. ethanol use) in regional or the national energy mix (Kammen, *et al*, 2004).

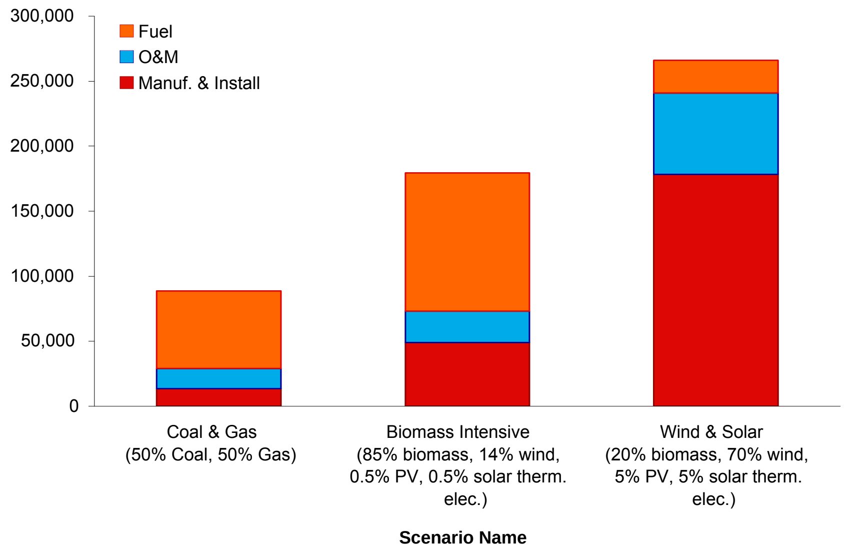

Figure 3: Comparison of the estimated employment created by meeting the equivalent of 20 percent of current U.S. electricity demand via and expansion of fossil or renewables-based electricity generation. These totals use the jobs per megawatt numbers from Table 1. These scenarios are for different fuel mixtures that could comprise a federal Renewable Energy Portfolio Standard.

A key result emerges from our work, and can be seen in Table 1. Across a broad range of scenarios, the renewable energy sector generates more jobs than the fossil fuel-based energy sector per unit of energy delivered (i.e., per average megawatt). In addition, we find that supporting renewables within a comprehensive and coordinated energy policy that also supports energy efficiency and sustainable transportation will yield far greater employment benefits than supporting one or two of these sectors separately. Further, generating local employment – including that in inner-cities, rural communities, and in areas in need of economic stimulus -- through the deployment of local and sustainable energy technologies is an important and underutilized way to enhance national security and international stability. Conversely, we find that the employment rate in fossil fuel-related industries has been declining steadily for reasons that have little to do with environmental regulation.

The U. S. Government Accounting Office conducted its own study of the job creation potential of a clean energy economy (GAO, 2004). In an important assessment of rural employment and income opportunities, they found that:

> … a tribe, farmer or community who lease land for a wind project can expect to receive $2,000 to $5,000 per turbine per year in lease payments. In addition, large wind power projects in some of the nation's poorest rural counties have added much needed tax revenues and employment opportunities.

Technology exports have impacts well beyond domestic job creation. In fact, if properly managed, the development of a thriving 'cleantech' sector can address a vital global issues, namely the emissions trajectories of major developing nations. Native peoples are ideally places to access and manage these resources to meet local and regional clean energy needs.

Acknowledgments

This work was supported by a grant from the Energy Foundation, the Karsten Family Foundation endowment of the Renewable and Appropriate Energy Laboratory, and the support of the University of California Class of 1935. I am delighted to Reba Fuller and the entire Me Wuk Tuolomne Tribe, Brandon Glenn, and Jamil Farbes for partnerships, discussions, and efforts to move clean energy ideas into practice.

References

107th U.S. Congress, (2002). Committee Reports for the 107th Congress, Senate Report 107-141 - Concurrent Resolution on the Budget FY 2003, Profile of Indian Country In Brief. Washington, DC, Congressional Research Service.

Augustine, N. R. (2005) *Rising Above The Gathering Storm: Energizing and Employing America for a Brighter Economic Future*. Washington, DC, National Academies Press.

Council of Energy Resource Tribes (2005). Final Report, Energy Audits of Buildings on Rosebud Sioux Tribal Lands in South Dakota, Denver, Colorado. Prepared by the Council of Energy Resource Tribe and Synertech Systems Corporation, DOE

DOE, (2000). Energy Consumption and Renewable Energy Development Potential on Indian

Lands , Tribal Energy Program, DOE-EERE - Energy Information Administration, Office of Coal, Nuclear, Electronic and Alternative Fuels, Washington, DC. U.S. Department of Energy,

DOE, 2006. Tribal Energy Program Review, U.S. Department Of Energy - Office of Energy Efficiency and Renewable Energy Tribal Energy Program, Lizana K. Pierce, Project Manager, www.eere.energygov/tribalenergy/guide/wind_energy_resources.html. (October) 2006.

Elliott, John, (1998). Lowering Energy Bills in American Indian Households: A Case Study of the Rosebud Sioux Tribe, Master's Project, Energy and Resources Group, University of California at Berkeley (Berkeley, CA).

Engel, Detlev and Kammen, Daniel M., with Wei, Max, Patadia, Shana, and Januario, Cassia S. (2009) *Green Jobs and the Clean Energy Economy* Copenhagen Climate Council – Thought Leadership Series Report #8 (Copenhagen, Denmark).

Environment California (2009) *The High Cost of Fossil Fuels* (Sacramento, CA)

Kammen, D. M. (2007) Testimony on "Green Jobs Created by Global Warming Initiatives", United States Senate Committee on Environment and Public Works, September 25, 2007. Senator Barbara Boxer (D-CA), Chair.

Middleton, Robert (2008), Director, Office of Indian Energy And Economic Development, Office of The Assistant Secretary-Indian Affairs, Department of The Interior,Statement Before The Senate Select Committee on Indian Affairs, May 1, 2008 (Washington, DC).

Roland-Holst, D. (2006) Economic Assessment of some California Greenhouse Gas Control Policies: Applications of the BEAR Model, in *Managing Greenhouse Gas Emissions in California* (Farrell, A. E. and Hanemann, M., editors), The Energy Foundation and The William and Flora Hewlett Foundation (Berkeley, CA).

U.S. Census Bureau (2000). Census 2000 Geographic Terms and Concepts, U.S. Bureau of the Census (Washington, DC).

U.S. Census Bureau (2002a). Census 2000 Brief, The American Indian and Alaska Native Population: 2000, Ogunwole, Stella, U.S. Census, (Washington, DC).

U.S. Census Bureau (2002b). 2000 Census of Population and Housing, Summary File 3: Technical Documentation. Brief on AIAN designation and Brief on poverty threshold. Washington, D.C.: Census Bureau (Washington, DC)..

U.S. Census Bureau (2003a). American fact extracts and glossary references. Retrieved December.-January., 2006-2007 (Washington, DC).

U.S. Census Bureau (2003b). Poverty: How the Census Bureau Measures Poverty from www.census.gov/hhes/poverty/povdef.html (Washington, DC).

U.S. Census Bureau, (2006). We the People: American Indians and Alaska Natives in the United States, by Stella U. Ogunwole, U.S. Census Bureau, Economics and Statistics Administration, U.S. Department of Commerce, (February) 2006 (Washington, DC).

U.S. CCR, (2003). A Quiet Crisis - Federal Funding and Unmet Needs in Indian Country, U.S. Commission on Civil Rights, U.S. Congress, Washington, DC.

Daniel M. Kammen is the Class of 1935 Distinguished Professor of Energy at the University of California, Berkeley, where he holds appointments in the Energy and Resources Group, the Goldman School of Public Policy, and the department of Nuclear Engineering. Kammen is the founding director of the Renewable and Appropriate Energy Laboratory (RAEL) and the co-Director of the Berkeley Institute of the Environment. Kammen is the Director of the Transportation Sustainability Research Center. Kammen received his undergraduate (Cornell A., B. '84) and graduate (Harvard M. A. '86, Ph.D. '88) training is in physics After postdoctoral work at Caltech and Harvard, Kammen was professor and Chair of the Science, Technology and Environmental Policy at Princeton University in the Woodrow Wilson School of Public and International Affairs from 1993 – 1998. He then moved to the University of California, Berkeley. Kammen directs research programs on energy supply, transmission, the smart grid and low-carbon energy systems, on the life-cycle impacts of transportation options including electrified vehicles and land-use planning, and on energy for community development in Africa, Asia, and in Latin America. Daniel Kammen is a coordinating lead author for the Intergovernmental Panel on Climate Change (IPCC), which won the Nobel Peace Prize in 2007. He hosted the Discovery Channel series 'Ecopolis, and had appeared on Frontline, NOVA, and twice on '60 Minutes'. Kammen is the author of over 200 journal publications, 30 technical reports, and has testified in front of state and the US House and Senate over 30 times.

Version date: September 17, 2009