

March 10, 2006

Testimony of Daniel M. Kammen

Global Climate Change in California and Beyond - Is There a Way Out?

Feasible and Affordable Solutions

Informational Hearings: Sonoma and Marin Counties, Friday, March 10, 2006

Assemblyman Nation and Assemblywoman Pavley and Members of the Select Committee on Air and Water Quality: I am pleased to speak on behalf of the opportunities we have to address climate change, because of its importance to our state, nation, and our local and the global environment.

I hold the Class of 1935 Distinguished Chair in Energy at the University of California, Berkeley, where I am a professor in the Energy and Resources Group, the Goldman School of Public Policy, and the Department of Nuclear Engineering. I am the founding director of the Renewable and Appropriate Energy Laboratory, an interdisciplinary research unit that explores a diverse set of energy technologies from scientific, engineering, economic and policy issues. I am also the Co-Director of the University of California, Berkeley Institute of the Environment. I have served on the Intergovernmental Panel on Climate Change (IPCC), and have testified before both U. S. House and Senate Committees on the science of regional and global climate change, and on the technical and economic status and potential of wide range of energy systems, notably renewable and energy efficiency technologies for use in both developed and developing nations. I am the author of over 180 research papers, and five books, most of which can be found online at <http://rael.berkeley.edu/papers.html>.

The scientific consensus on the reality of global warming resulting from human activity – primarily the emission of greenhouse gases from fossil-fuel based energy production -- has been well established scientifically (e.g. IPCC, 2001). This reality has been reflected internationally by the ratification of the Kyoto Protocol on Climate Change that would begin the process of redirecting national economies globally toward a path of less environmentally damaging economic activity. While the United States remains the sole major dissenting nation – a decision that we will come to rue economically as well as

environmentally – important action has continued at the state and regional level. Governor Schwarzenegger's Executive Order 3-05, signed, June 1, 2005, at the United Nations sponsored World Environment Day convention of city governments reflects the scientific consensus on global warming, and the recognition that action is needed, and in fact has been long overdue, to redirect our economic activity to also provide sound environmental stewardship.

While Executive Order 3-05 is an excellent first step, a number of additional actions are needed to effectively move our local, and then the national economy in the right direction. Executive Orders do not have the force of law, and can be overturned by future Administrations. This provides only a weak framework for climate stewardship, which requires both immediate action and a long-term commitment.

Today, oil prices reached \$60/barrel and we continue to fight a war in Iraq over oil, both of which signal that action to diversify our energy economy is badly needed. Climate protection legislation that we are considering to day should provide the needed framework to make sound environmental policy a guiding principle of sustainable economic policy. Such a bill will as a beginning adopt for California the internationally agreed Kyoto Protocol steps for climate stabilization - 7% reductions from 1990 Greenhouse Gas emissions by 2010 and 10% by 2020 – and by doing so will recognize and make the law off the land the tremendous economic benefit of establishing clear goals for climate protection.

A clear conclusion from the past three and a half decades of environmental legislation – from the Clean Air Act of 1970 to the present – is that the most effective environmental regulations have been ones where the targets were both clearly defined, and were enacted with the full legal and regulatory power needed to ensure compliance. This alignment is important to our state not only because of its symbolic value, but economically as well because of the significant business opportunities that we will be better positioned to exploit.

Internationally we have seen dramatic growth in the clean energy industry, with the greatest benefits accrued by those states and countries that have set the most aggressive standards. The global wind and solar industries have each been growing by over 20% per year for the past decade, and the biomass power sector has shown recent, dramatic, technical innovation and economic expansion (Kammen, 2005a)

Wind energy is the world's fastest growing energy source on a percentage basis. Globally there was over \$9 billion in wind energy investment in 2004 alone, and worldwide capacity is over 31,000 MW. In Denmark, and some regions of Spain and Germany, 10 – 25% of total annual electricity generated is from wind. The north German state of Schleswig-Holstein, for example, currently meets 25% of annual electricity demand with 2,400 wind turbines that have a total capacity of 1,800 MW. Wind in Schleswig-Holstein has met over 50% of demand for selected months during both 2001 and 2002. Not surprisingly, Germany and Denmark, the nations with the most aggressive wind energy policies, have so far reaped the greatest economic benefits of industrial orders for wind turbines and in employment growth to lead this 'cleantech' sector. These benefits are available to

California should be choose to adopt climate friendly economic growth as the law of the land.

In spite of the limited market access and spasmodic R&D support that renewables have received (Margolis and Kammen, 1999; Kammen and Nemet, 2005), we are in a period of significant technical and economic evolution. Global production of photovoltaic cells has surpassed 1100 MW/year, and has seen sustained growth of roughly 20%/year. California is the third largest market for solar cells globally, behind Japan and Germany. Today we import most of these solar cells. A strong commitment to building an in-state solar energy industry – as AB 1365 and SB1, and the legislation that will come from this hearing process would accomplish (Kammen 2004, 2005a,b) would bring a greater share of the economic development benefits of the clean energy industry to California. In fact, by adopting these bills we would benefit doubly, through more reliable, distributed electricity production, and through the very powerful economic benefits of job creation.

In a recent study (Kammen, Kapadia, and Fripp, 2004) of job creation in the energy industry, my laboratory concluded that the empirical evidence was overwhelming that investments in clean energy technologies – renewable energy and energy efficiency – far outpaced the job creation potential of the fossil-fuel sector. For each dollar invested in low-carbon energy systems *three to five* times more jobs are created than the same level of investment in fossil fuel-based energy production. With energy demand rising a commitment to producing that energy cleanly *and* capturing the clean economic benefits of this next energy and economic wave are simply sound economic as well as environmental policy.

To reap the benefits of leadership in climate protection, and to address climate change in a meaningful way, we should begin with a strong commitment to cut greenhouse gas emissions – such as the Kyoto Protocol's 7% reductions from 1990 levels by 2010. This will not be easy, but with commitments to innovation and action it is possible.

Demonstrated changes in the regional and global climate make the scientific justification for this decision is clear. What is also clear, but less well articulated, is that the *economic benefits* of early action are equally strong. California has a 30-year history of global leadership in developing the technologies and the regulatory policies to make widespread adoption of energy efficiency devices and practices the norm. From energy efficient appliances to compact fluorescent lights (CFLs), to building energy standards, to load-management policies such as the current 20-20 *Flex Your Power* program, California has demonstrated the tremendous economic benefits of the wise use of energy. Our several decade commitment to energy efficiency has redefined what is seen as possible locally as well as globally, and has saved the state and California rate-payers *billions of dollars* as a result.

One of the most important lessons from this history of leadership in energy efficiency is that innovation – technological, economic, and political – can take place at levels far beyond what is initially forecast *if* a strong commitment is made to advancing the sector. While the federal government has charted a largely rudderless course on energy, California's

commitment to efficient and clean energy has paid off again and again in scientific and engineering leadership, economic savings, and environmental gains. A critical piece of the sound energy strategy is that early action and leadership, both political and commercial, is rewarded with greater market share and hence greater economic gains. The recent success of hybrid vehicles – where both Honda and Toyota have sold more cars and moved their production lines to profitability far quicker than either expected – are high-profile examples that continue the tradition seen first in California's history in the area of energy efficiency.

A number of specific actions should be included in the state's climate protection plan, and as a benefit, each will also benefit the state economically in both the long and short term.

Specific actions for the committee to consider including in a bill or bills:

- **Make Energy and the Environment a Core Area of Education in California.** Public interest and action on energy and environmental themes requires attention to make us 'eco-literate and economically savvy.' We must develop in both K-12 and college education a core of instruction in the linkages between energy and both our social and natural environment. The Upward Bound Math-Science Program and the Summer Science Program each serve as highly successful models that could be adapted to the theme of energy for a sustainable California at all educational levels. The launch of Sputnik in 1957 mobilized U. S. science and technology to an unprecedented extent, and should serve as a lesson in how powerful a use-inspired drive to educate and innovate can become. The Spring 2005 Yale Environment Survey found overwhelming interest in energy and environmental sustainability. Contrast that interest with the results of the Third International Mathematics and Science Study (TIMSS) where American secondary school students ranked 19th out of 21 countries surveyed in both math and science general knowledge. California can and should reverse this trend, and sustaining our natural heritage and greening the global energy system is the right place to begin.
- **Make Clean and Secure Energy a State Goal to Meet Economic and Environmental Goals.** We have seen explosive growth in hybrid vehicle sales, very strong interest in ethanol from good (corn) and excellent (cellulosic) sources (Farrell, *et al.*, 2006), and the passage of the million solar roofs effort for solar, as well as the California Public Utilities Commission passing a historic carbon cap and trade system. It is time to put financial support behind a series of initiatives to provide the resources to grow the markets for each of these technologies, as well. Californians for Clean Energy is supporting one such initiative for the November 2006 general election ballot that deserves our support. This initiative will raise \$4 billion through a fee on in-state oil production and put the funds toward innovative energy technologies and businesses in California. The State Attorney General has determined that this fee cannot be passed onto Californians. A goal of the initiative is to reduce gasoline use by 25% as well as building a new, clean energy sector to serve California and the world. I am proud to serve on the Advisory Board of this initiative.

- **Establish a set of Energy Challenges worthy of State Action.** Establish *Sustainable California* awards – modeled after the successful efforts of the Ashoka Innovators awards for social entrepreneurs and the Ansari X Prize for space vehicle launch - that inspire and mobilize our remarkable resources of academia, industry, civil society, and government. These initiatives would support and encourage groups to take action on pressing challenges. An initial set of challenges include:
 - *Buildings that generate cleanly their own energy ('zero energy buildings');*
 - *200 mile per gallon vehicles*
 - *Zero Energy Appliances (Appliances that generate their own power)*
 - *'Distributed Utilities'; challenges and milestones for utilities to act as markets for clean power generated at residences, businesses, and industries.*
- **Make the State of California the driver of clean vehicle deployment.** As the ZEV Mandate and the Pavley Bill (AB 1493) have shown, dramatic improvements in vehicle energy efficiency and reductions in carbon emissions are eminently achievable, given political leadership. A clear message, as well as dramatic carbon and financial savings, would come from a decision to only purchase for state transportation needs vehicles meeting a *high* energy efficiency target, such as 40 miles per gallon for sedans and 30 miles per gallon for utility vehicles. These standards are now possible thanks to improvements in vehicle efficiencies and the wider range of hybrids (including SUV models) now available. A key aspect of such a policy is to announce from the outset that the standards will rise over time.
- **End High-Carbon Energy Importation into California.** California sets the national standard with virtually high-carbon (largely coal) energy generation in-state. This position is only meaningful if we also do not import high-carbon energy into the state. The Frontier Transmission Line, for example, would likely bring large amounts of coal-based power into California, or would effectively permit us to 'siphon off' clean power (such as wind) for our use while financially supporting the construction of new carbon intensive power plants whose output would be used by others (i.e. to receive the 'dirty power'). To be consistent, California needs to set standards for the carbon content of its fuel imports. Eligible sources could either be through clean generation, the trading of carbon emission credits, or environmentally secure carbon sequestration take would take place as part of new power plant construction and financing. Federal action on this issue is needed as well and those discussions should also be a state priority.
- **Recognize and Reflect Economically the Value of Energy Investment to the Economy.** Clean energy production – through investments in energy efficiency and renewable energy generation – has been shown to be a winner in terms of spurring innovation and job creation. This should be reflected in state economic assessments of energy and infrastructure investment.
- **Adopt a carbon tax.** A range of important and innovative climate protection measures are taking shape in California and elsewhere. Each of these measures

would be made more effective and efficient if we simply opted to tax negative environmental and social impacts and reward the energy economy that we want. A carbon tax, combined with a tradable permit program provides a simple, logical, and transparent method to permit the state, industries, and households to reward clean energy systems and tax what which harms our state economy and the environment.

I would like to thank Assemblyman Nation and Assemblywoman Pavley for holding this important hearing, and I would be delighted to provide any additional information that you may request.

References:

Alexander E. Farrell, Richard J. Plevin, Brian T. Turner, Andrew D. Jones, Michael O'Hare, and Daniel M. Kammen (2006) Ethanol can contribute to energy and environmental Goals, *Science*, **311**, 506 – 508.

Intergovernmental Panel on Climate Change (2001) *The Scientific Basis* (Cambridge University Press; Cambridge, UK). All IPCC reports are available online at: <http://www.ipcc.ch/pub/online.htm>.

Kammen, D. M. (2004) "California's energy future. A simple solution for home design -- Look to the sun." *San Francisco Chronicle*, A10, July 18.

Kammen, D. M. (2005a) "An energy policy for the 21st Century", *PolicyMatters*, **2 (2)**, 14 – 19.

Kammen, D. M. (2005b) "Lack of vision on policy clouds energy future", *The San Francisco Chronicle*, **B9**, May 13.

Kammen, D. M., Kapadia, K. and Fripp, M. (2004). "Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?" A Report of the Renewable and Appropriate Energy Laboratory, University of California, Berkeley. Available at: <http://socrates.berkeley.edu/~rael/papers.html#econdev>

Kammen, D. M. and Nemet, G. (2005) "Reversing the incredible shrinking energy R&D budget," *Issues in Science & Technology*, Fall.

Margolis, R. and Kammen, D. M. (1999) "Underinvestment: The energy technology and R&D policy challenge", *Science*, **285**, 690 - 692.