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BAY AREA SCIENCE AND INNOVATION CONSORTIUM

Innovative Energy Solutions from the San Francisco Bay Area: Fueling a Clean Energy Future

is the second in a series of *Science Futures* reports produced by the Bay Area Science and Innovation Consortium (BASIC), a program of the Bay Area Economic Forum.

Foreword

The world's supply of fossil fuels is being depleted at an ever-increasing rate and there will be no replenishment. In barely 200 years, the human race has consumed a substantial portion of the fossil fuels that were built up over hundreds of millions of years. The leading R&D institutes in the San Francisco Bay Area are working to develop a broad range of alternative energy technologies that are renewable and carbon-neutral. These alternative technologies fall under the general categories of biomass fuel, electrochemical and magnetic technologies, geothermal energy, hydrogen fuel, solar, wind and nuclear energy. Bay Area researchers are also investigating an extensive variety of strategies for improving the efficiencies of the fossil-fuel energy technologies in use today. The ultimate goal is to provide an overall energy portfolio that is viable, sustainable and environmentally supportable.

Highlights

Biomass Fuel: The awarding of a \$500 million grant from BP, to a partnership that includes UC Berkeley and Berkeley Lab, to create the Energy Biosciences Institute (EBI) and a \$125 million grant from the U.S. Department of Energy, to a six member partnership led by Berkeley Lab, for the establishment of the Joint BioEnergy Institute (JBEI) has catapulted the San Francisco Bay Area into the national spotlight for biofuels R&D. Other major grants for biomass projects based at UC Davis and Stanford have further solidified the Bay Area's pre-eminence in this burgeoning field.

Electrochemical and Magnetic Technologies: Advanced electrochemical batteries and fuel cells have been called by their strongest supporters the "holy grail of energy research." Strong R&D efforts based in Berkeley, Stanford, Davis, Livermore and San Francisco point to small, non-polluting devices that produce energy without combustion and which could help meet transportation and residential power needs and could also serve as stationary electrical power generators.

Geothermal Energy: Geothermal energy, the heat that originates from deep below the earth's surface, is both renewable (if managed properly) and environmentally benign. California leads the nation in installed geothermal capacity, yet there are still significant additional unexploited geothermal resources, especially around the Bay Area. R&D by Bay Area institutes is leading to continuously more effective and efficient development of the geothermal resource base for California and the rest of the nation, with the ultimate goal of making geothermal energy an economically competitive contributor to the U.S. energy supply.

Hydrogen Fuel: The use of hydrogen as an energy carrier for vehicles opens up the possibility of zero emissions when a fuel cell is utilized. However, zero emission vehicles are not the full story since the pathway by which the hydrogen is made will influence the total “well-to-wheels” emissions. Research in the Bay Area led by Chevron, the Lawrence Livermore and Sandia National Laboratories, UC Davis and others is focused on technologies that will be necessary for a hydrogen-based energy economy.

Solar Energy: In terms of being renewable and carbon-neutral, there is no better source of energy than the sun. The copious availability of solar radiation in the Bay Area makes the region an ideal test bed for solar energy production research and development. Bay Area R&D institutes are conducting research on and have implemented solar energy systems for consumers ranging from satellite companies, to community colleges, to businesses and residential homes.

Wind Energy: Starting with the creation of wind farms or wind plants in California in the 1980s, worldwide installed wind power capacity has grown rapidly. Wind energy conversion systems do not generate air pollution, and their cost is competitive with that of fossil fuel power plants. Furthermore, a wind plant can be installed, connected to the grid, and start generating electricity within a year. Bay Area institutes, led by the Livermore National Lab and UC Davis, are developing innovative technical and marketing solutions to address regional, national and international wind energy issues. This includes the development of remarkable new wind turbine blade technologies.

Nuclear Energy: There are two forms of nuclear energy, fission, in which atomic nuclei are split to release thermal energy, and fusion, in which a pair of lighter atomic nuclei are fused together to form a single heavier nucleus, releasing even great amounts of thermal energy. The use of fission energy is already a commercial reality, whereas fusion energy remains an elusive dream. BASIC members and other Bay Area R&D institutes have research programs aimed at improving the former and developing the latter.

Energy Efficiency: Energy efficiency has been called “the lowest fruit on the tree” because it remains the cheapest, fastest and most economically rewarding way of forestalling the energy crisis and reducing further exacerbation of global warming effects. Since the 1970s, predating the first oil price shocks, the Bay Area has been a leader in developing energy efficient end-use technologies, and in conducting end-use energy analysis. From “smart windows,” to energy-efficient lighting, Bay Area public and private researchers have already developed technologies that have saved billions of consumer dollars, and are creating the next generation of technologies that will further reduce energy use, fossil fuel pollution and greenhouse gas emissions.