BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF CALIFORNIA

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Order Instituting Rulemaking Regarding Policies, Procedures and Rules for Development of Distribution Resources Plans Pursuant to Public Utilities Code Section 769.	R.14-08-013 (Filed: August 14, 2014)

COMMENTS OF THE WORLD BUSINESS ACADEMY IN RESPONSE TO QUESTIONS POSED IN THE ORDER INSTITUTING RULEMAKING

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In accordance with the provisions of Rule 1.4 of the Rules of Practice and Procedure of the California Public Utilities Commission ("Commission") and with Section 3.1 of the Order Instituting Rulemaking in this proceeding, which invites all interested parties to comment on a list of questions set forth therein, the World Business Academy hereby provides its Comments in response to said questions.

I. THE ACADEMY'S INTEREST IN THIS PROCEEDING

The World Business Academy ("Academy") is a public benefit corporation that formally began investigating the various issues associated with energy infrastructure in 1995, which it followed with a book (*Profiles in Power*) on the subject in 1997, and subsequently with a lengthy well-researched and footnoted chapter on the subject in its book (*Freedom From Mid-East Oil*) published in 2007. In addition to those two books, the Academy has published more than a dozen

articles on the subject of energy up to the present time in various journals both domestically and abroad, including the American Bar Association's *ABA Journal*.[1] Finally, the Academy's Founder and President, Rinaldo S. Brutoco, recently gave a lecture, entitled "Nuclear Power: A Mistake in Search of a Mission," at the University of California, Santa Barbara's Walter H. Capps Center for the Study of Ethics, Religion, and Public Life, which has been downloaded 120,000 times in the past six months.

The main purpose of the Academy's participation in this proceeding is to assist the Commission in identifying the optimal path forward for guiding regulated utilities on developing Distributed Resource Plans ("DRPs") that will result in the realization of California's aggressive clean energy goals (including achieving or surpassing the current 33% renewable portfolio standard by 2020, and the reduction of all anthropogenic greenhouse gas—" GHG"—emissions by 2050 to a level that is 80% less than what such emissions were in 1990) in a manner that both maximizes the reliability of the distribution grid and does so as cost effectively as possible.

The Academy recognizes, however, that achievement of this second goal, in particular, will require dramatic changes in the way we generate and utilize the energy resources that we have come to depend on as part of our advanced, technology-based way of life. Moving systematically toward this goal—and of particular relevance to what the Commission should be directing its utilities to actively implement in connection with their DRPs—the Commission

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[1] The Academy has sought to use its business expertise and its prominent network of Fellows to educate and thereby encourage businesses to understand the connection between environmentally and socially responsible business practices and a renewed and expanded economy. For example, through its free public monthly radio show (*New Paradigms in Business*, a commentary on business and society), the Academy analyzes and advocates "best business practices" with respect to energy sources and use, educating business about the strengths and weaknesses of each form of energy, the appropriate mix of energy sources, the benefits and drawbacks of various sources of energy supply, and the externalized costs of different energy sources.

should specifically acknowledge that one of the most promising technological shifts that we, as a society, can and should make as quickly as possible is to replace fossil fuels with hydrogen as the universal medium for storing and then generating energy.

Hydrogen, when used in mobile[2] and stationary fuel cells, stands as the ultimate fuel to replace fossil fuels for transportation, residential, commercial, and utility-scale electricity needs. Moreover, unlike finite fossil fuels, the amount of available hydrogen is virtually limitless. The technology to produce hydrogen by electrolysis of water is well established, and with sufficient economies of scale, a hydrogen-based energy economy will be less expensive, more reliable, and much cleaner than continued reliance on fossil-fuel technologies. Most importantly, the electricity needed to electrolyze hydrogen from water, including grey water and waste water, can be generated from 100% renewable energy, the volume of which is only limited by the infrastructure developed to collect these abundant resources.

II. COMMENTS

A. Overview

The OIR seeks specific input on a series of 16 questions set forth at Section 3.1 of that Order. The Academy does wish to provide specific input in response to 5 of those questions, but considers that its specific responses need to be put into a broader context in order for those specific points to be seen as part of a larger vision. In this regard, the Academy notes that the OIR itself speaks in terms of considering "an appropriate vision or set of principles to guide the

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[2] Mobile fuel cells are electric vehicles which use very small fuel cells (*e.g.* the Honda FCX Clarity stores its fuel cell in the front seat arm rest) providing electricity to the vehicle instead of larger, heavy batteries. Viewed this way, hydrogen fuel cells are a highly desirable incremental addition to the State's growing electric vehicle fleet.

IOUs' development of their RRP proposals."[3] The following overview should therefore be seen as the Academy's attempt to put into words some of the ideas that should be a central element of any such broader vision that the Commission seeks to articulate in this proceeding.

The Academy recently issued a vision for the procurement of enough renewable energy resources to meet 100% of California's electricity needs within ten years of program implementation. Called the "California Moonshot Project,"[4] this call to action is modeled after President Kennedy's 1961 challenge to send a man to the moon and return him safely before the end of that decade. The technology to revolutionize our energy system exists today, and with state regulatory approval and support, fossil and nuclear fuel can be completely eliminated from California within 10 years *at no additional cost to the consumer*. This can be achieved by leveraging cutting-edge research and modeling at leading universities, by implementing a unique blend of bottom-up and top-down strategies, and by deploying vast private-sector resources to finance the conversion to a 100% renewable energy system.

Central to this ambitious but attainable goal is a 2014 study by a research team led by Stanford University Professor Mark Z. Jacobson[5], outlining the requirements, costs, benefits, and policies associated with implementing a large-scale conversion to a renewable energy infrastructure for the entire state of California. This study assumes "all new energy powered with wind, water, and sun ("WWS") by 2020, 80-85% of existing energy replaced by 2030, and 100% replaced by 2050."

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3 See OIR, at page 3.

4 http://worldbusiness.org/wp-content/uploads/2014/03/The-California-Moonshot-Project-Final-Version-for-Print1.pdf

5 Jacobson, Mark, "A roadmap for repowering California for all purposes with wind, water, and sunlight," Energy 73 (2014) 875-889. *Also see*, http://news.stanford.edu/news/2014/february/fifty-states-renewables-022414.html.

Similarly, a 2012 study by University of Delaware researchers, Willett Kempton and Cory Budischak,[6] also concluded that renewable energy production and energy storage using hydrogen gas could fully power a large electricity grid by 2030 at costs comparable to the non-renewable systems in use today.

When President Kennedy issued the original Moonshot challenge, it seemed almost unimaginable that the United States would be able to land a man on the moon in ten years, but this goal became a national mission, and with extraordinary will and focus, the country pulled together the scientific and engineering teams necessary to accomplish this goal. The Academy understands that current national politics are much more constrained than they were in the 1960s, but such is not the case in California, which is already a world leader in the international movement toward an ever-increasing reliance on clean and renewable energy sources.

If we are able to re-create the same kind of will and focus today, there is every reason to believe that California, the eighth-largest economy in the world, can achieve these aggressive but clean-energy objectives within a ten-year period.

At first glance, converting California to 100% renewable energy in ten years may seem like an impossible mission (much like Kennedy's "Moonshot" appeared to be in 1961); however, the forces are aligned currently to make this goal completely achievable. Such forces include:

- Widespread public support of renewable energy that has created a political opening for state and local officials to offer serious policy solutions for fixing the energy and

[6] Budischak, Cory, Kempton, Willett, Sewell, Thomson, Heather, Mach, Leon, Veron, Dana, "Cost-minimized combinations of wind power, solar power and electrochemical storage, powering the grid up to 99.9% of the time," Journal of Power Sources 225 (2013) 60-74.

economic problems in California and for meeting/exceeding the state's carbon reduction mandates.

- The existence of technology to transition California off of nuclear power and fossil fuels that is price-competitive with existing risky and dirty energy resources.
- The 90% drop in cost of photovoltaic cells to generate electricity over the past decade, and a similar drop of 75% for wind turbines. These existing economic efficiencies in solar and wind portend even greater drops for the cost of energy going forward and foreshadow a similar drop for the cost of electrolyzers and fuel cells as the benefits of mass production kick in.
- The existence of substantial funding at the State level for climate change interventions, and a multiplier effect through public-private partnerships that will optimize the cost effectiveness of such funding.
- A shift in global consciousness that has created a deep and widespread understanding of the climate crisis. As a result of this shift, people are yearning for leadership and innovation to reduce carbon emissions and create a clean, renewable economy.
- The enormous opportunity for profit in the renewable energy sector that will be created during the complete conversion from fossil fuels to a renewable economy, and the tens (if not hundreds) of thousands of California jobs that will be generated from this conversion, stimulating investment and catalyzing a new economic renaissance in California while also significantly reducing the vast public health and climate change costs associated with fossil fuels.

The Academy's experience when engaging the public on these issues is unanimous support for such an endeavor. Poll after poll has shown widespread and growing public support for bold initiatives to reduce carbon emissions and develop renewable energy sources.[7]

In the face of the stark reality of climate change, there is also unimaginable economic growth, thousands of new, well-paying jobs (*e.g.*, manufacturing and installation) and societal benefit just waiting to be unleashed. Now is the time for this Commission to take control of our collective energy future and to move beyond scarcity and risk into a paradigm of energy abundance and security, fueled by the virtually limitless energy of the sun, wind, and water, and the ability to store that energy as hydrogen gas. These changes are inevitable. They *are* going to happen. But California, the most innovative and imaginative place on Earth, has the opportunity now, in this proceeding, to take the bold actions needed to accelerate the pace and the magnitude of these changes and to avoid creating billions of dollars' worth of fossil fuel burning assets from becoming "stranded" five-to-ten years from now.

In keeping with the request set forth in the OIR, the Academy's answers to the following questions are each under two pages double-spaced (equivalent to one page single-spaced) in length.

B. Question 1: What specific criteria should the Commission consider to guide the investor-owned electric utilities' (IOUs) development of Distribution Resources Plan Proposals (DRPs), including what characteristics, requirements and specifications are necessary to enable a distribution grid that is at once reliable, safe, resilient, cost-efficient, open to distributed energy resources, and enables the achievement of California's energy and climate goals?

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[7] PollingReport.com, Energy, *See also* "Poll: Americans Overwhelmingly Support Alternative Energy," U.S. News & World Report, "Gallup Poll Shows Public Favor of Renewable Energies," theenergycollective.com, "Swing State Polls Show that Voters Support Clean, Renewable Energy," acore.com.

Rapid development and deployment of microgrids by IOUs must be a key element in the development of their DRPs. Given that California's climate is so conducive to widespread deployment of distributed renewable energy resources, microgrids, relying primarily on renewable energy and supported by carbon neutral fuel cell plants generating power from renewable-based hydrogen gas, will inevitably become an important part of the state's energy system.

The end-state of our proposed distribution design lies between the "grid as back-up" and "grid as network" models as described on page 12 of the "More than Smart" report attached as Addendum B to the OIR.[8] While we envision the current state-wide energy grid as being comprised of a network of microgrids[9], our model places a premium on self-sustainability to the point where a properly designed and implemented microgrid should be able to weather a sustained period of low-renewable output of up to a week or more. This can be accomplished through the strategic location of fuel cell/electrolysis plants within the microgrid at the substation level and development of renewable infrastructure beyond maximum-load projections so that all excess-renewable energy can be directed into forms of storage optimally purposed for short to long-term energy needs.

There is virtually unanimous agreement within the scientific community that man-made climate change exists, the rate of change is accelerating, and that a geometrically accelerating

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8 "More than Smart: A Framework to Make the Distribution Grid More Open, Efficient and Resilient," (p. 12), released August 12, 2014 by Greentech Leadership Group and CalTech's Resnick Institute.

9 Villarreal, Christopher, Erickson, David, and Zafar, Marzia, "Microgrids: A Regulatory Perspective," California Public Utilities Commission, Policy & Planning Division, April 14, 2014, p. 9.

experience of extreme weather events will occur in the future.[10] Ultimately, every microgrid will need to develop strategic energy reserves for long-term system reliability and resiliency, and we have determined that the only storage medium capable of covering extended power generation shortages is hydrogen gas created from the electrolysis of grey or waste water (or sea water when using Ocean Thermal Energy Conversion "OTEC" technology)[11]. Under our proposed system, traditional grid concepts such as "over-generation" and "curtailment" are no longer relevant as all excess energy collected through renewable sources will either be used directly to meet load requirements or diverted first to short-term storage capacity (to be used within the daily "duck curve" intermittency cycle) and then to electrolysis for the maintenance of local long-term hydrogen reserves.

Under this scenario, widespread development of such microgrids will create a virtuous cycle whereby microgrid-based communities will not only meet nearly all of their local energy needs, they will in many cases generate ***more*** electricity than needed and use any surplus generation to produce hydrogen either as a strategic reserve or a commodity to be sold locally as a transportation fuel or exported to other states and localities as a secondary revenue source. Thus, the most extraordinary feature of such hydrogen-based microgrids is the essentially limitless (other than the scope of local renewable infrastructure) amount of renewable energy that can be produced within their footprint. This simple approach "takes the lid off" our ability to tap renewable resources to the maximum extent possible.

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10 *See*, "Intergovernmental Panel on Climate Change, Fifth Assessment Report." *See also,* NBCNews.com, "IPCC Sharpens Warnings in Draft of New Climate Change Report," and Bloomberg.com, "Irreversible Damage Seen From Climate Change in UN Leak," (August 27, 2014).

11 Vega, Luis A., "Ocean Thermal Energy Conversion," Encyclopedia of Sustainability Science and Technology, Springer, August 2012, pp. 7296-7328.

C. Question 2: What specific elements must a DRP include to demonstrate compliance with the statutory requirements for the plan adopted in AB 327?

As detailed in the Academy's comments to Question 1 above, in order to comply with the spirit and letter of AB 327 (which specifically requires the IOUs to identify any additional spending necessary to integrate cost effective distributed resources into distribution planning), each of the IOUs must include in its DRP a systematic program element to invest—at the earliest possible date—in microgrid systems based on locally generated renewable energy resources to both meet real time energy demands and create surplus local renewable generation for electrolysis of water into hydrogen as a strategic reserve, transportation fuel, and export commodity, or must formally offer to let the private sector do so.

Under the Academy's proposed model for DRPs, there is no situation calling for a reduction in local generation capacity, as all excess power can be (i) used either directly to address demand, (ii) stored for later use at night, or (iii) converted to hydrogen as a strategic reserve or revenue source when sold to other distributed systems or the transportation sector. Under this scenario, all available pathways toward increasing renewable energy supply should be considered. In this regard, the Academy notes that stationary fuel cell plants and modular electrolyzer units capable of producing 24 kg. of hydrogen per day are currently available for scalable installation within microgrid systems (larger ones have also been designed awaiting purchase orders), both at the distribution node and in remote locations outside of the microgrid's distribution radius. Such fuel cell plants also offer the flexibility of initially operating on natural gas and renewable biogas generated from local waste treatment facilities. By integrating other public systems into microgrid operations, additional synergies can be achieved to reduce operational cost and increase energy generation.

D. Question 5: What specific considerations and methods should be considered to support the integration of DERs into IOU distribution planning and operations?

Again, the Academy's points made in response to Questions 1 and 2 already delineate the specific considerations and methods to be considered to support the integration of DERs into IOU distribution planning and operations; however, the Academy hereby states, by way of an offer of proof, that it is prepared to make available the following evidence in support of its proposals for review within the context of this proceeding:

- A highly respected California energy expert who will demonstrate why microgrids are necessarily the future of California's energy system;
- Representatives of fuel cell manufacturers who will vouch for the reliability, flexibility, safety, environmental superiority and cost-effectiveness of their technologies;
- A representative of a major gas marketer that will demonstrate the ready availability of hydrogen as a feedstock for fuel cells;
- A well-known individual who successfully converted the power system on his own extensive property to the use of solar PV plus hydrogen for backup;
- Internationally respected leaders who will support the vision that a clean and sustainable distributed power system is not only feasible, but is ultimately the direction in which the world will be heading; and
- Scientists and engineers who have designed and built working demonstration plants utilizing Ocean Thermal Energy Conversion "OTEC"[12] technology to produce both energy and desalinated water.

E. Question 6: What specific distribution planning and operations methods should be considered to support the provision of distribution reliability services by DERs?

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12 *See,* Vega, Luis A., "Ocean Thermal Energy Conversion," *supra*.

Microgrid reliability will be determined by relative storage capacity and the strategic distribution of DERs in relation to end users, so that reserves are immediately accessible on demand for short- and long-term fluctuations of renewable energy generation. Since all renewable power will ultimately be generated, stored, and consumed within the confines of the microgrid, the system will be virtually 100% reliable, with any outages or repairs covered by planned redundancy measures via a tiered network of overlapping service radii that can be extended to cover affected areas.

Given the establishment of appropriate reserves and redundant systems, there will be no impact—either in the form of renewable energy shortages, infrastructure failures/repairs or outside disruptions (natural or man-made)—that cannot more easily be resolved within the microgrid framework than within the current, terrorist-vulnerable grid system. Contingencies will either be predictable and recurring (*i.e.*, during the 24-hour "duck curve" cycle and annual seasonal fluctuations) or non-recurring (see impacts listed above). Within the 24-hour cycle, fuel cell plants will operate on a minimal "standby" basis during periods of peak generation, and then be programmed to slowly ramp upwards as renewable generation levels fall below microgrid demand.

Another planning element to maintain long-term reliability will concern projecting load growth over a 20-year period, which would include projections of when maximum capacity within the microgrid will be reached and the development of contingency plans to install additional microgrid hubs to service future areas of development.

Finally, the Academy would also point out that several of the non-CPUC-jurisdictional municipal utilities in the State (including, but not limited to, the City of Palo Alto and the Sacramento Municipal Utility District) are already developing sophisticated distribution resource

planning paradigms. The Academy would accordingly urge this Commission to look to the on-going efforts of these municipal utilities as potential models for the form and substance of distributed resource planning efforts that it should be directing its jurisdictional investor-owned utilities to undertake.

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F. Question 7: What types of benefits should be considered when quantifying the value of DER integration in distribution system planning and operations?

The most outstanding benefits of a renewable/hydrogen-based distribution system discussed herein would, of course, be environmental: a zero-carbon and zero NO_X, SO_X and PPM emission system with no associated water pollution or hazardous waste of any kind. No other technology can boast the environmental advantages of a renewable/hydrogen-based distribution system. It is admittedly difficult to fully quantify such environmental benefits in monetary terms, but there is abundant literature on the health costs of air pollution, and a well-received recent study by the U.S. Environmental Protection Agency has identified the social costs of carbon.[13]

Another key benefit of such a system would be the elimination of the economic risks inherent in relying on fossil fuels. Much press coverage has been given over the past year or so to the "flood" of new natural gas that will be available from the dramatic increase in hydraulic fracturing ("fracking") in various parts of the United States, but this press coverage has overlooked four key facts: (1) "fracked" wells have very short life spans compared to traditional gas wells; (2) many states have already moved to prohibit or suspend fracking, and the Academy

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13 *See*, http://www.epa.gov/climatechange/EPAactivities/economics/scc.html.

believes more will do so as the water requirements of fracking become clearer and the permanent damage to aquifers become known and better understood; (3) a major push to allow for the overseas export of considerable amounts of such gas (which will inevitably cause the price of gas to rise); and (4) historically, gas prices are highly variable. We all seem to forget that in 2005, the price of gas in California was more than twice what it is today. Gas may be cheap today, but it will not always be so. Renewable energy, by contrast, unlike gas, has no significant variable cost component based on scarcity, and hydrogen generated from renewables will also have a relatively constant market cost. In fact, renewables are exactly opposite of fossil fuels in that the more renewable energy we use, the less expensive it is to use in the future (*e.g.*, as the capital investment costs in solar and wind facilities are amortized over time, the actual costs of the continuing use of such facilities will drop to nearly zero).

Rebuilding a distributed energy system from the ground up also offers a wide range of positive economic benefits. Development and maintenance of DERs will provide a vast number of high-quality jobs to local residents, and local hydrogen production for storage reserves and the transportation sector will provide a secondary revenue source for the community. Investment in the development and manufacture of distributed energy technologies will also provide export markets that will provide continued economic resurgence within the state.

G. Question 10: Should the DRPs include specific measures or projects that serve to demonstrate how specific types of DER can be integrated into distribution planning and operation? If so, what are some examples that IOUs should consider?

A DRP should include at least one (and preferably a set) of microgrid projects incorporating locally generated renewable energy, supported by fuel cell generation plants running initially on natural gas or biogas, and then quickly transitioning to operate 100% on hydrogen feed stocks from expanded renewable infrastructure. Not only will such projects prove

this technology's feasibility, they will also serve as examples of pioneering enterprise that will facilitate the rapid evolution of California's power system into a permanently sustainable and environmentally benign system based on abundant renewable sources. In addition, the rapid evolution of the state's power system toward this model will eliminate the need for any major new transmission lines, which are, as this Commission well knows, expensive, controversial, unattractive and difficult to permit.

It should be noted that when we discuss "microgrid projects," we are not referring to the very small scale projects such as those implemented by San Diego Gas & Electric Company (SDG&E) in remote areas like Borrego Springs. Rather, we envision that the microgrid projects implemented under the respective IOUs' DRPs will cover the entire area served by a given substation in the IOUs' urban load pockets, such that from 20,000 to 50,000 residential customers could be served by each such microgrid. We note the following obvious target areas for the initial implementation of such projects within the service territory of all three of the major IOUs under the Commission's jurisdiction: the Central Valley and Santa Clara County for Pacific Gas & Electric Company, the Central Valley and the Inland Empire for Southern California Edison and the inland North County area for SDG&E.

One existing microgrid that could serve as a model for what the IOUs should undertake on a much broader basis is the 42 MW system that has been installed at the campus of the University of California, San Diego, which is already saving the University some $800,000 in energy costs every month.[14]

H. Question 12: What principles should the Commission consider in setting criteria to govern the review and approval of the DRPs?

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[14] *See*, http://www.energybiz.com/article/13/09/microgrids-would-enhance-smart-grids.

The foregoing comments have set forth a set of key principles that the Commission needs to keep in mind as it moves forward to oversee the development of, and to approve, the IOUs' DRPs. To summarize, those principles are:

- DRPs must be consistent with California's aggressive clean energy goals in a manner that both maximizes the reliability of the distribution grid and does so as cost effectively as possible.
- The rapid development and deployment of microgrids by the IOUs must be a key element in the development of their DRPs.
- Each DRP must incorporate—for development on the fastest possible schedule—at least one microgrid project that ultimately relies on a 100% renewable-based system, using fuel cells running on hydrogen to provide a buffer when renewable energy generation falls below peak demand or is otherwise unavailable.
- The electricity needed to electrolyze hydrogen from water, including grey water and waste water by-products, can be generated from 100% renewable energy, the volume of which is only limited by the infrastructure developed to collect these abundant resources.

III. NOTICE

Service of notices, orders, and other communications and correspondence in this proceeding should be directed to the Academy's representatives at the addresses set forth below:

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IV. CONCLUSION

The Academy respectfully requests that the Commission take the foregoing comments into account as it moves forward to determine the scope of this proceeding and to provide guidance to its regulated utilities on the key criteria that should guide the development of the utilities' respective DRPs.

Respectfully submitted,

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