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We all know that energy is a foundational element of modern civilization. One need look no further than data comparing per capita energy consumption and various measures of economic development, like GDP, life expectancy, and infant mortality to see this.

The same relationship that holds between energy and economic development also holds for carbon dioxide emissions. If one were not aware of the relationship between CO2 and energy, based on the data alone you could be forgiven for assuming that CO2 was some sort of essential catalyst needed to enable economies to flourish. The reality is that owing to our extensive reliance on fossil fuels, CO2 has become a proxy for energy consumption and by extension a rough proxy for economic development.

Increasingly, however, CO2 has also become an indicator of less positive things. In the U.S. much has been made of our excessive reliance on fossil fuels and the national security implications of basing our economic well-being on resources that often are controlled by regimes that are not aligned with, or are outright hostile to, U.S. interests. Similarly, extensive reliance on carbon intensive resources

has been linked to a variety of environmental problems. The most significant of these is human-induced climate change.

To the extent CO2 is either directly responsible for, or a proxy for a host of ills associated with our current energy system, the answer is straightforward: reduce the amount of CO2. Of course, this solution, while obvious, is not so straightforward. It asks us to either reduce demand for energy services outright or substantially reduce the carbon intensity of the energy services that are critical to our way of life.

Frankly, the former is a pipe-dream. We seem incapable of self-denial. Indeed, if one looks at the discussions regarding a global climate treaty, the principle issue, particularly for the developing world, has been over the extent to which a climate regime requires them to sacrifice their development agenda on the altar of global warming. This leaves the second option: reducing the carbon intensity of the energy services that we demand.

California has embraced this challenge. Through a variety of policy tools we seek to transform our energy system into one that maintains a vibrant and growing economy, but does so using significantly fewer resources and emitting far fewer emissions.

These policies run the full spectrum, from demand side approaches, which seek to reduce demand for energy through the widespread deployment of energy efficiency measures and demand response tools, to supply side approaches which rely on clean fuel sources. California's pursuit of these policies dates back over three decades and has been motivated by a variety of factors.

I'd like to spend a moment discussing these motivations in fairly broad strokes before turning attention to California's specific efforts to promote renewable energy development. There are three inflection points in the evolution of California energy policy: the oil embargos of the 1970s, the California Energy Crisis of 2000-2001, and scientific consensus on human-induced global warming.

Although all three of these play an important role, the oil embargos were, for lack of a better term, the creation event that initiated California's dramatic shift toward clean energy policy. For the U.S. in general, the embargo was a wake up call, albeit one the nation quickly forgot. For California, it has had long-lasting impacts.

In 1978, in the wake of the oil embargo, the federal government passed the Public Utilities Regulatory Policies Act. This legislation encouraged states to establish policies under which regulated utilities would be obligated to procure energy from preferred generation

technologies, including combined heat and power systems, and renewable facilities, at so-called “avoided cost”. The hope was that this would stimulate the deployment of alternative generating technologies throughout the country, and in so doing, reduce our vulnerability to oil shocks.

States were given significant latitude in determining how to calculate avoided cost, and in implementing PURPA, California established a price that led to substantial deployment of renewable and cogeneration facilities. This really marked the beginning of California’s commitment to renewable energy.

It was in this same timeframe that California also began its efforts to promote greater energy efficiency, through the establishment of energy efficiency standards for both building and appliances.

On both fronts, California has enjoyed significant success. PURPA resulted in the deployment of thousands of MW of renewable capacity, much of which is still in operation today. In terms of energy efficiency, the results were also impressive. Up until about 1974, California per capita electricity consumption tracked closed with the rest of the nation. After 1974, while the rest of the country’s per capita energy consumption increased from around 8,000 kWh per

year to around 12,000 kWh per year, California's remained essentially flat.

The next major event that fundamentally impacted state energy policy was the California Energy Crisis. Much like the oil embargos, the California Energy Crisis highlighted the vulnerability of the system to artificial energy shortages, this time due to gaming by certain bad actors. In addition to forcing sweeping reforms in the basic structure of the energy market, the energy crisis also led to the adoption of the so-called "loading order" by the state's key energy agencies, the CPUC and our sister agency, the California Energy Commission.

The loading order was the state's first clear articulation of its energy resource priorities. It identified energy efficiency and demand response as the resources of first choice, followed by renewables, both utility scale and distributed. Only after these resources have been fully exploited should the state build gas-fired power plants.

Lastly is climate change. After 2001 a scientific consensus emerged regarding the substantial role of mankind in the increases in the concentrations of CO2 in the atmosphere and the impact this was having on the global climate system. This consensus was reflected in the United Nation's Intergovernmental Panel on Climate Change's Fourth Assessment Report.

Importantly this report indicated, among other things, that a.) warming was unequivocal, and b.) most of the increase in temperatures observed in the 20th century is due to human activity. During this same period Governor Schwarzenegger issued an executive order which called on the state to take action in light of the substantial economic and public health implications of climate change. The executive order also highlighted the potential economic advantage of transitioning to a low carbon economy, in particular the opportunity to become a leader in clean energy. The Executive Order laid the groundwork for the adoption of the " Global Climate Solutions Act of 2006". This law established goals for reductions in economy-wide greenhouse gas emissions, first to 1990 levels by 2020 and to 80% below 1990 levels by 2050. These targets are comparable to the reductions identified by the UNIPCC as necessary to prevent catastrophic climate change.

To call these emission reduction goals ambitious would be an understatement. Currently per capita CO2e emissions in California are 13.3 tonnes per year. To reach the 2020 target these emissions need to fall to about 10 tonnes per person, or a reduction of about 25%. Between 2020 and 2050, emissions will need to decline to a mere 1.5 tonnes per person, a further decline of about 85%. To put this into a development context, this amount corresponds to current

per capita CO2 emissions in India. Assuming maintenance of our current lifestyles, achieving this target neccessarily means the near complete decarbonization of our energy system.

While there are a variety of strategies that can and will be employed to meet our mid and long term emission reduction goals, I'd like to spend my remaining time talking about one of those strategies in particular, namely the state's renewable energy mandates. Many of you in this room likely have more than a passing familiarity with this program. The cornerstone of our current renewables policy is the renewables portfolio standard, or "RPS".

Originally established in 2002, the RPS program currently requires the states investor owned utilities and other obligated entities to procure 20% of their energy from renewable resources by 2010. Currently, renewable energy deliveries account for approximately 14% of retail sales. I would note however, that the state has taken a number of steps that strongly suggest that this goal will be increased to 33% by 2020, and to that end, our attention is increasingly turning to this expanded target.

At its most basic, the RPS program is a targeted procurement program under which obligated entities, accounting for roughly three quarters of the energy sold in the state, issue annual solicitations or

pursue bilateral contracts with independent power developers for the delivery of renewable energy. Within the suite of technologies that are deemed eligible to participate, the program is technology neutral. That said, in assessing the relative value of projects that bid into their solicitations, obligated entities, most notably the investor owned utilities, rely on a “least-cost, best fit” evaluative framework that considers not only costs, but also the extent to which the deliveries dovetail with their resource needs. Thus solar projects, while generally more expensive than wind projects, may be ranked higher because solar output coincides much more closely to system peak demand.

As a contracting vehicle, the RPS has been a success. The IOUs have entered into contracts representing over 12,000 MW of renewable capacity. In terms of the technologies represented, 1,500 MW is from geothermal, 4,000 from solar, and 6,000 from wind. Over time the mix of energy has changed significantly, with fairly dramatic increases in the representation of solar technologies. In 2006, solar bids accounted for 30% of the GWH represented. In 2009 this jumped to approximately 50%. And while solar represents only about 2.5% of the IOUs renewable deliveries today, it is anticipated to grow to about 37% by 2020.

While the anticipated deployment of renewables in general and solar in particular appears bright, it's important to remember that this is based on contracts. A contract is nothing more than words on paper, and we have found that transforming these words into physical projects to be a formidable challenge. There are myriad factors that play into this, ranging from the global financial crisis, to permitting issues around projects, and the transmission infrastructure that is required.

Viewed through the lens of local and regional environmental interests, renewable energy projects raise substantial concerns about land use and water, given the vast stretches of land required and the role of water for cooling. In addition, over the longer term we recognize that integrating significant amounts of renewables, much of which is intermittent in nature, creates new operational challenges for the grid.

As a state and as an agency, we have attempted to respond to each of these issues. Although our ability to directly address the new financial realities born of the global economic downturn is limited, we continue to actively encourage the IOUs to leverage their balance sheets to support renewable development, whether through outright project development and ownership or as via passive tax equity investment. The large investor owned utilities represent among the few entities that have any tax equity appetite in the current financial

environment. As a result, they can continue to take advantage of the federal tax benefits.

As already mentioned, transmission represents another substantial challenge to the deployment of renewable projects. As the principle state agency responsible for the siting of new transmission facilities in California, my agency has a clear role in facilitating investments in transmission infrastructure. To that end we have approved a number of large transmission projects.

These include transmission projects to access the Tehachapi region, which when fully built out will provide access to about 4500 MW of wind, and our approval of the Sunrise Powerlink, a project anticipated to deliver substantial amounts of solar and geothermal power from the Imperial Valley. We also recently authorized SCE to begin construction of the Devers-to-the-River transmission projects. This line will provide access to additional renewable resources in Southern California. However, much remains to be done if we are to realize our longer term renewable energy goals.

Much has been made of the challenges transmission projects face in California. Indeed, owing to a strict environmental permitting process and the NIMBYism that greets virtually any proposed transmission

line, transmission development stands as the key barrier to the achievement of our renewable energy goals.

Given the challenges we've seen with permitting and interconnecting large scale renewable projects, there is growing interest in expanding the role of distributed wholesale renewable energy projects. These are smaller projects that, owing to their smaller geographic and electrical footprint, are likely to face less opposition than larger scale projects, and additionally, do not require substantial transmission upgrades. This is relatively new territory for the state. To date, support for distributed renewable resources has been pursued through programs, like the California Solar Initiative, which provide rebates to support applications expressly intended to reduce onsite load. Despite their greater certainty and potentially faster speed to market, the ability of these projects to effectively compete with large scale projects in the RPS is limited owing to the price advantage larger facilities enjoy. One approach to addressing this is through solicitation "carve-outs", in which the IOUs initiate solicitations that are specifically oriented toward smaller scale projects, generally those less than 20 MW in scale.

Last year we adopted a decision authorizing SCE to develop 500 MW of rooftop solar projects in the 1 – 2 MW range. This decision authorized SCE to develop 250 MW of utility owned generation and

another 250 MW from independent power producers. Both PG&E and SDG&E have applications pending before us seeking much the same thing. Additionally, staff is now looking at a more technology neutral program that would similarly target smaller scale renewable projects that can come online relatively quickly. We expect to have a decision on this in the second quarter of this year. Increased reliance on smaller systems, however, also creates its own set of challenges. Whereas with large scale projects the issue tends to be whether there is adequate transmission infrastructure, for smaller scale projects, there are real questions regarding the capacity of the distribution system to support these facilities. We recently organized a stakeholder group to begin exploring these issues.

Should we be successful in bringing all of these resources online it will undoubtedly have substantial implications on grid operations. Renewables, specifically wind and solar, are unique in that they produce energy as nature deems fit. Furthermore, because the moment to moment output of these facilities can vary substantially, integration of these resources will require substantial ramp and regulation services. As a result, in my view, storage technologies are really part and parcel of our overall renewable efforts. Storage can serve to safeguard the value of our investment in renewable resources by ensuring that the energy produced is relevant to the energy demands of the state. Going forward I think it will become

increasingly important for us to take a closer look at the need for storage and pursue more policies that promote its deployment.

While a comprehensive strategy around storage has yet to be articulated, there are some noteworthy efforts underway. As part of the American Recovery and Reinvestment Act, a substantial amount of money was earmarked to support Smart Grid demonstration projects. California-based projects received about $86 million from these funds to explore a variety of storage technologies and applications. These include $24.9 million to PG&E to support feasibility and permitting efforts related to a 300 MW compressed air energy storage facility and another $25 million to Southern California Edison to pursue an 8 MW lithium ion battery storage project. Last month, the CPUC authorized matching funds from PG&E ratepayers of an additional $24.9 million.

Unrelated to stimulus funding, a number of proposals have come forward to pursue large-scale hydro pump storage projects, including the 500 MW Lake Elsinore Pump Storage Project, and another project that would convert a defunct mining operation at Iron Mountain in Southern California into a 1300 MW pump storage facility.

Related to storage is the prospect of vehicle electrification. Electric vehicles can be viewed as a form of distributed storage. In California, electric vehicles can greatly enhance the value of the considerable amounts of wind energy being developed. As I've said, wind tends to blow off peak, which ordinarily would mean it would displace relatively low emission conventional facilities. If this wind energy were used to charge electric vehicles, it would instead displace gasoline combustion, which stands as one of the least efficient uses of energy, and certainly one of the largest contributors to California's overall carbon footprint.

Last year we initiated an Order Instituting a Rulemaking to consider the implications of widespread vehicle electrification. This OIR will consider grid and distribution system impacts, approaches to pricing to reduce these impacts, as well as the appropriate regulatory regime to enable third parties, like A Better Place, to provide the charging infrastructure that is fundamental to widespread electric vehicle use.

As I hope my remarks have made clear, California is seeking nothing less than a complete transformation of its energy system. Given the threat of climate change, I don't think we have much choice. In pursuit of this effort we have created a regulatory framework to encourage increased reliance on energy efficiency and renewable

resources, recognizing that this transition necessitates a host of investments in supporting infrastructure.

The complexity of this effort is daunting. This fact is often lost on policy makers who tend to focus on lofty goals without fully appreciating the institutional and structural barriers these goals face. This isn't to say that policy makers shouldn't push the envelope. Indeed doing so can pressure test the system and cast into stark relief what those barriers are so that they can be addressed directly.

Ultimately, the choices we make today, in terms of which technologies we support, the infrastructure investments we pursue, and the institutional reforms we implement, will have a profound impact on the options we have tomorrow. As an example, consider the investments Luz International made in the SEGS plants in Southern California so many years ago. These investments, in my view, have played an invaluable role in proving the core technology, and, importantly, set the stage for the dramatic rise of concentrating solar power as a truly viable energy option. Similarly, our current efforts lay the groundwork for revolutionizing our energy system.

In the interest of time, I will close there. In the years ahead I look forward to working with many of you in our ongoing efforts to build a truly sustainable energy future, a future California will pursue with

vigor, regardless of the fits and starts in Washington DC, and the disappointment of Copenhagen. We intend to remake our energy economy and believe it will redound to the benefit of our society, our nation, and, I hope, our world.