Community Action for Clean Local Energy Resources

Gerry Braun, IRESN, Inc.

EXECUTIVE SUMMARY

Mass produced clean energy conversion technologies offer a solution to the local climate resiliency challenge. Solar and wind electricity generators, and battery and fuel cell vehicle propulsion systems are the core elements of local energy systems of the future. It had long been cheaper to import transportation fuels and electricity than to produce them locally. No longer. Solar panels and wind turbines are now at life cycle cost parity with large thermal power plants. Affordable long range battery and fuel cell electric vehicles are moving forward to becoming mature competitive products.

In a modern market economy, these energy conversion products can serve the transportation and energy supply needs of a local community and with capacity to spare.

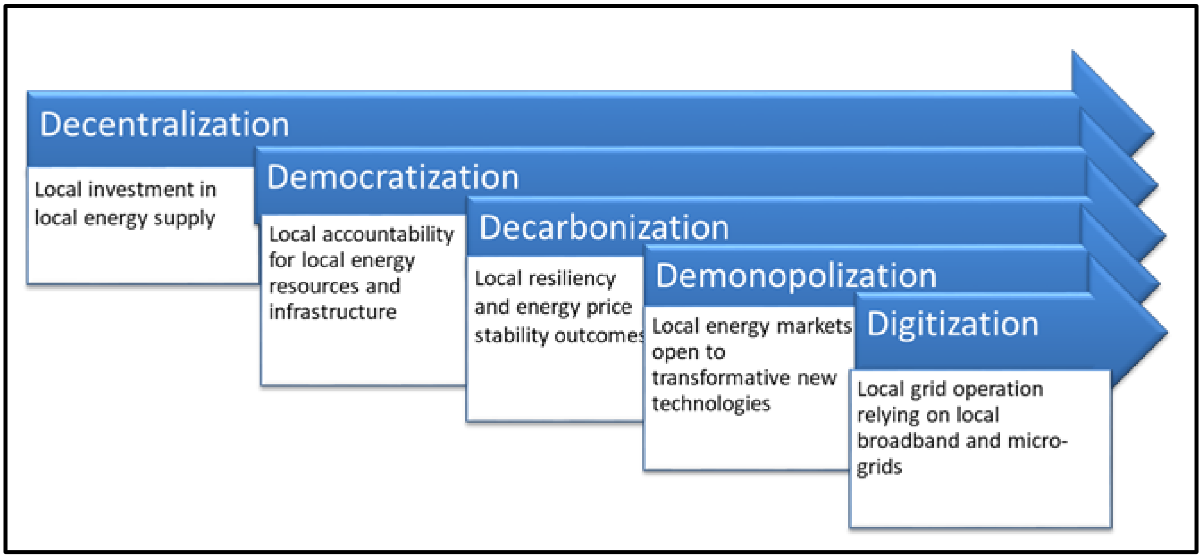
They can. But will they?

A great deal of change is required. It will proceed incrementally and will need to be managed locally. As usual, some communities will take the lead, and others will follow. Meanwhile, state and national governments will need to remove obstacles to energy sector decentralization, decarbonization, democratization and demonopolization.

Smart local energy, i.e., the technical and economic integration of local energy production and use, will be enabled by local high speed data infrastructure. Local utilities providing all types of service, including energy, will need to manage vast amounts of data in order to function most effectively. Cities and counties will need access to energy related data and must learn how to convert it to planning and decision-making information necessary for smart and clean local energy resource development. Where no municipal utility or energy cooperative exists, Community Choice Energy service providers will be essential intermediaries in this process. They will be uniquely positioned to help their local jurisdictions capture the local economic, local energy security and local climate resiliency benefits of micro-grids and vehicle-to-grid energy exchange.

The Five D's of Smart and Clean Local Energy

1. **Decentralization.** The independent grid operator model has already proven itself as a vehicle for proper management of electricity generation systems reliant on fleets of large renewable and natural gas fueled generators. Proper management of local grids reliant on fleets of small renewable and renewably fueled generators and decentralized energy storage will likewise be best managed by locally accountable grid operators and micro-grid owners.
2. **Democratization.** Community Choice Energy has the greatest long term potential to empower local resource development and community level carbon footprint reductions. Cities and counties have a



great deal at stake, both economically and environmentally, in working with Community Choice providers and other energy utilities toward CLER deployment that is intentionally integrated with other local infrastructure, including energy grids, buildings, and transportation fueling services.

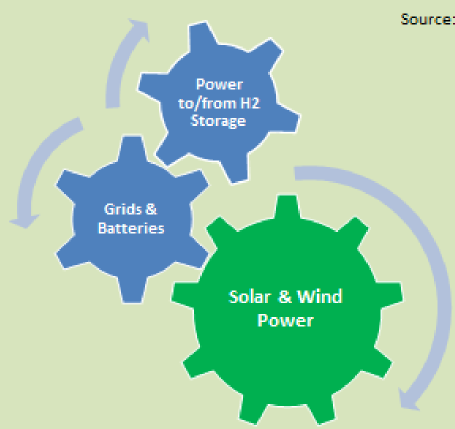
3. **Decarbonization.** By taking a more active role in setting local energy policy and regulating local energy service, cities and counties can rapidly and dramatically reduce local carbon footprints and avoid local economic sub-optimizations. To maximize economic benefits of local energy investment, their policies should enable substitution of zero carbon electricity for carbon based fuels. Important complementary policies will enable "net positive" on site electricity production.
4. **Demonopolization.** As local investment leads to local integration, and local integration leads to accelerated decarbonization, and as decarbonization proceeds, a process of demonopolization will open local energy markets to transformative technologies necessary to fully decarbonize local energy supply and usage.
5. **Digitization.** The proliferation of automated demand response, the need to aggregate and integrate on site solar with on-site and community based storage, and the use of smart electricity meters closer to their full potential will increase opportunities for more efficient and resilient local grid operation, relying increasingly on broadband communications and local and neighborhood micro-grids.

INTRODUCTION

Energy sector decentralization and decarbonization are important California energy policy goals. California relies on state regulatory agencies and state regulated energy utilities as primary policy implementation facilitators. For understandable reasons these organizations tend to move ahead cautiously and step-wise toward relatively short term goals. Meanwhile, parties that have a lot at stake in the longer term, i.e. local jurisdictions, are not yet fully engaged.

Cities and counties may do well to start engaging now by developing a long term vision. Figure 1 identifies major elements of a generic vision that is plausible in California and consistent with its low carbon energy and transportation investments and its emerging emphasis on climate resilience. It features locally produced solar and wind electricity energizing a smarter local grid that is integrated with vehicle based electricity generation and energy storage. For example, fuel cell electric vehicles be a flexible source of grid electricity using hydrogen as both a combined storage medium and zero carbon generation fuel.

Figure 1. Integrative Local Clean Energy



An important aspect of the vision is the integration possible between local building and transportation energy[1] that can drive all components of a local carbon footprint to zero. It is important to note that this scenario is only possible based on the capacities of existing high volume manufacturing industries and existing local energy and transportation infrastructure. An integrative vision like this can help identify potential technology and infrastructure gaps.

Meanwhile, clean local energy industries must work to overcome inertia and soft resistance of counterparts invested in current energy grids and assets. Cities and counties can work in parallel to overcome resistance to clean local energy resources (CLERs).[2]

[1] The vision recognizes that hydrogen fuel cells and batteries powering vehicles can serve additional purposes as stationary power generation and storage capacity when not on the road.

[2] "Distributed energy resources (DERs)" is an alternative term for local energy resources often used by electric utilities and electricity grid operators. Terminology differences account for differing perspectives, i.e., from a regional energy grid perspective, local energy resources are distributed, i.e., connected to an energy (electricity or natural gas) "distribution" grid. From a city or county perspective, distributed energy resources have the important attribute of being local. The two terms generally refer to the same resources. CLERs is the preferred term in the context of community action. Longer term, as local energy resources are added that function independently of energy grids, CLERs may become the generally preferred term.

Resistance is not only predictable but understandable. While there is a policy intention in California to capture the public and environmental benefits of energy sector decentralization and decarbonization, there is also a need to properly manage existing energy infrastructure, including large power generating stations and high voltage transmission lines carrying electricity long distances from these plants to population centers.

Vertically integrated business models favor centralization. In California such models are enshrined in legislation and regulation. Unfortunately, they tend to render increments of CLER-generated electricity economically indistinguishable from increments of electricity generated by central station plants.

Once smaller local grids provide the same levels of reliability as larger grids, the simplifying assumption will become an over-simplification. If allowed to stand, it will result in cost misallocation and missed economic opportunities. The potential for greatly increased local energy investment creates a need for local jurisdictions to weigh in.

No doubt some integrative structuring of large and small scale energy infrastructure will evolve. Meanwhile, the intrinsic economics of local electricity generation will continue to improve. Local jurisdictions will increasingly be drawn into electricity sector participation. Leaders among them will seek to engage because electricity production and its proper integration with other essential services is essential to integrative planning, efficient local investment and long term climate resiliency.

As leading cities and counties learn to use the full toolkit of the digital age, they will invest in greatly improved dialog, data sharing and project and program collaboration with local energy utilities and service providers.

ENERGY SERVICE MODELS

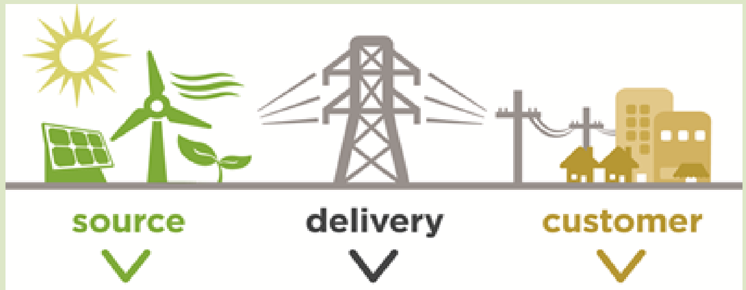
Energy service providers in California have diverse service territories, venues for public accountability, and operational responsibilities. Four basic models are differentiated according to infrastructure ownership and integration. They also differ in the extent they enable or limit collaboration between the energy service provider and local communities.

1. Vertically integrated utilities serving many counties and cities are typically stock companies.[3] Because they are large monopoly enterprises and are regulated at the state level, their capacity and financial incentives for local collaboration are limited.
2. Rural utilities and irrigation districts are typically organized as cooperatives[4] or self-governing public agencies and are therefore owned or created by their customers. Local collaboration is thus an outcome of local accountability.

[3] A portion of their revenues, typically between 10 and 15%, is retained for re-investment on behalf of the stockholders or paid out to them as dividends.
[4] Though California is a leading agricultural state, it has relatively few rural co-ops. The cooperative model is not legislatively enabled and an option for urban areas.

3. Municipal energy utilities are publicly owned. In California some special districts, e.g., SMUD in Sacramento County, cover multiple jurisdictions, but in most cases their boundaries are coterminous with city boundaries, and in many cases the city councils set rates. Local collaboration is inherent.

Figure 2. Community Choice Energy



CCE leverages the market power of aggregation, with a local agency responsible for purchasing wholesale electricity in functional partnership with an investor owned utility that owns and operates electricity delivery infrastructure.

Source: LEAN Energy US

4. Authorized by California law AB 117, enacted in 2002[5], Community Choice Energy Aggregators (CCAs) are local agencies that can be organized with accountability to multiple participating local jurisdictions in a "joint powers agency" (JPA) legal format. Figure 2 shows how they operate within the current electricity service framework. They can also be formed by individual cities. They are the "new kids" on the energy services "block" in California. Governance is typically by boards on which participating jurisdictions are represented. Thus, opportunities for collaboration are enhanced. However, because it takes time to develop staff capacity, the ability to support data sharing and locally specific analysis is still limited in most cases. In the longer term the outlook is favorable. There is currently no state control requiring that the same programs, services and prices apply equally in all parts of a CCA's service area. Thus, among the major energy service options, and from a finance and operations perspective, CCA's have the greatest long term potential to empower economically optimized local resource development and community level carbon footprint reductions.

SMART AND RESILIENT COMMUNITIES AND ENERGY UTILITIES

Cities, counties and energy utilities share a need to be both "smart" and resilient as climate change impacts intensify.

Cities and counties can help meet the need through improved integration of public services and infrastructure, e.g., transportation, waste management, water supply/conservation, and energy supply/conservation. These services are interdependent. For example, supply of water and

[5] About 5% of US electricity is supplied by Community Choice Aggregators. However, legislative frameworks differ across several states where Community Choice is available.

transportation fuels is interrupted when electricity supply for pumping is interrupted. Therefore, integrative planning and operational coordination should be encouraged.

Energy (and especially electricity) markets are being transformed by new, cleaner and more modular sources located in or close to communities. The technical and economic integration of these sources is and increasingly will be enabled by “micro-grids”. Looking ahead, increased and more integrative deployment of “micro-grids” is a technical and economic inevitability. Micro-grids will be discussed in a later section.

While there are trends favoring smart and resilient outcomes, there are also impediments. One major impediment is an energy utility’s current positioning as a monopoly enterprise. It can effectively control customer relationships and all related decisions except level and time of usage. Collaboration, though perhaps desirable, is thus not obligatory or even a priority. Nevertheless, energy utilities actively seeking to develop CLERs[6] may come to understand that local governments are essential partners in stimulating and optimizing CLER investment.

For cities and counties, the main impediment to a smart and resilient energy future is lack of experience with energy except as an institutional energy customer. Other impediments include limited access to: 1) granular, locally specific energy usage data, and 2) fully evaluated resource and project siting inventories. Such access is necessary if local climate action and resiliency development measures are to be aligned with local energy usage and renewable energy opportunities.

Limited capacity is also an impediment. To be useful, information must have a user. At this time most local jurisdictions lack the staff and energy management capacity to consider, interpret and act on granular local usage and supply information. Further, data management capacity tends to be driven by current operational needs, which may not emphasize energy management. In many cases there is as yet no compelling need for information related to optimal and environmentally appropriate site selection, design and permitting of local energy projects and micro-grids.

Other impediments are conceptual. One is the convenient, self-fulfilling assumption that the future will closely resemble the present. Data driven plans, inherently biased toward the data source, i.e., business as usual, are easier to defend than plans informed by long term vision and goals.

Another shared impediment is insufficient motivation on both sides. From a city perspective, there are persistent and familiar problems to solve and obligations to meet. While immediate concerns about cost and reliability sometimes arise, existing energy services are typically acceptable and taken for granted by the city. On the other hand, the utility’s commanding position, i.e., owning infrastructure essential to the city’s ability to function, makes collaboration an option for the utility, but not a priority.

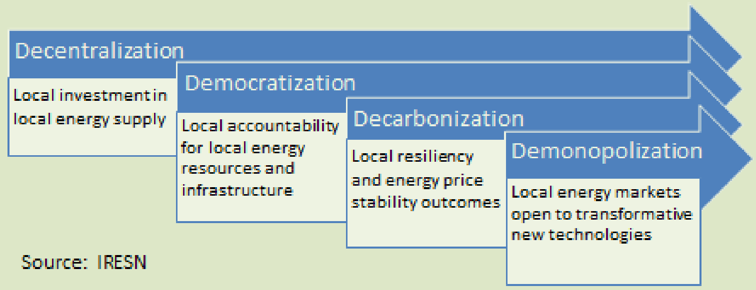
[6] So far in California, the only segment of the energy utility sector with an unconflicted and routinely expressed interest in developing local resources is the community choice segment. On the other hand, existing Community Choice Energy providers are expanding geographically, making a local focus more difficult to maintain.

For these reasons, deep and integrative collaborative engagement between cities or counties and energy utilities is still the exception, not a routine expectation.

ENERGY SECTOR CHANGES

Decentralization.

Figure 3. Energy Sector Transformation Process



Source: IRESN

Historically, monopoly energy service providers were authorized by cities or counties to provide local service. They typically relied on an energy supply network fed by large power plants and/or pipelines carrying electricity and/or fuel to the city from distant sources. Maintenance and use of this source/delivery infrastructure will continue. Replacement will be incremental. Meanwhile, investment in local energy supply is gaining momentum as increasing amounts of solar electricity are generated on homes, buildings and other local structures.[7]

As local investment leads to local control, and local control leads to accelerated decarbonization, and as decarbonization proceeds, a process of demonopolization will occur which will open local energy markets to transformative technologies necessary to complete the energy sector transformation process. Figure 3 outlines the basic process steps discussed in this section, steps that both overlap and reinforce one another.

Democratization

Empowering local elected officials to make decisions affecting local energy service is the key to democratizing the energy sector. In California, Community Choice Energy empowers local decision making and is gaining traction, especially in communities aiming to reduce their carbon footprint. Community Choice authorizes local jurisdictions to take charge of sourcing electricity. Because electricity is a big contributor to a typical city's or county's current carbon footprint, a Community Choice provider can quickly and cost effectively contract for a "cleaner" electricity supply portfolio, i.e. one more heavily weighted toward renewable and/or low carbon electricity than the state-wide portfolio. Doing so causes new renewable plants to be built. The Community Choice provider can also move to generate more renewable energy within its boundaries than regional utilities would otherwise enable/allow to happen.

[7] Neither the US generally, nor California specifically, is in the vanguard of the decentralization movement. Germany appears to be. Areas of the world where power is needed and no large plants and transmission systems exist are also generating market momentum for decentralized energy solutions. For example, the fastest growing markets for micro-grids are in these areas.

Decarbonization

In a wave of activity that peaked several years ago, many California cities, counties, and public institutions developed and approved local climate action plans. The impetus was legislation aiming to reduce unnecessary carbon emissions resulting from local transportation and housing development. So far, the plans have raised public and local government consciousness. However, measurement and verification of carbon footprint reductions targeted in planning documents has been sketchy.

Demonopolization[8]

Increased market competition and energy user choice are by-products of energy sector changes that occur when electricity customers become involved in owning and leasing on-site energy supply infrastructure. All the above-mentioned energy service models exercise monopoly power. In the longer term, micro-grids (see later discussion) are the potential key to further demonopolization. They are also key to energy sector security and resiliency. These benefits merit policy attention even at this early and mostly R&D-driven phase of micro-grid market expansion.

Photo credit: Claverton Group

ELECTRIC UTILITIES AND LOCAL ENERGY RESOURCES

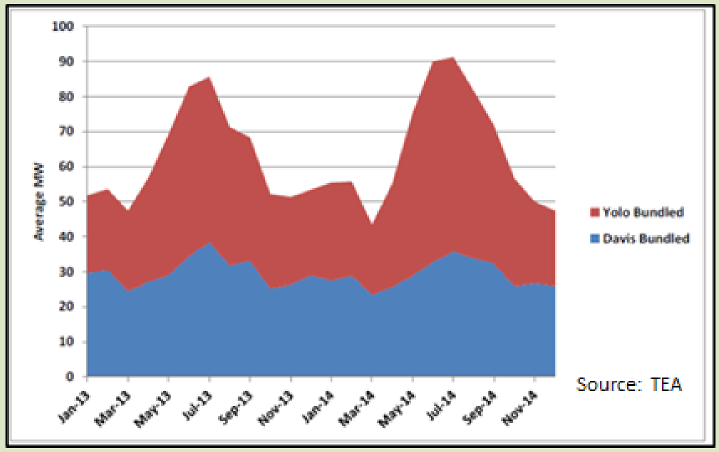
Demand Diversity and Scale

The 20th century electric utility business model captures plant and system scale economies. It also maximizes the benefits of demand diversity to vertically integrated businesses owning large power plants and high voltage transmission grids. Demand profiles differ between customers, customer classes and local jurisdictions on a daily, weekly and annual cycle. Diversity in local demand profiles results in

[8] Energy sector demonopolization began with a wave of energy market "restructuring" in the last decades of the 20th century. The policy purpose was to create competition among suppliers of fuel and bulk electricity. The California electricity crisis of 2000 and 2001 was triggered by a shortage of electricity supply caused by market manipulations, illegal shutdowns of pipelines by the Texas energy consortium Enron, and capped retail electricity prices. The state suffered from multiple large-scale blackouts, and one of the state's largest energy companies declared bankruptcy. The longer term result has been an erosion of the share of the electricity generation market managed by state regulated for profit utilities, aka Investor owned utilities. Source: Wikipedia

more efficient use of capital invested in high voltage transmission. Figure 4[i] provides an example of demand profile diversity. In this case seasonal swings in agricultural usage are moderated somewhat by less dramatic swings in city usage.

Figure 4. Example of Demand Profile Differences – City (blue) vs. County (red)



Some scale and diversity economies are eroding as deployment of more modular generation technologies increases. Nevertheless, economic motivations for better local integration and optimization have not been compelling until recently. Now, with grid electricity prices high and steadily increasing and solar markets and industries maturing, the costs of owning on-site solar electricity production systems are generally attractive in California. But economic valuation of local solar energy resources is in dispute from the perspective of traditional state level economic regulation.[9] Generally, local deployment delivers greater benefits to the local economy, but until economically integrative clean local energy deployment models are in effect, this added value will be captured at the expense of some whole-system scale economies and some additional fixed costs.

“Virtual” Power Plants

The economically integrative “virtual” power plant model is gaining traction in Europe[ii]. Usage changes and power generated at and feeding into a building’s or a campus’s circuits are beginning to affect how much power is/will be needed from legacy central station power plants. When demand is modulated and timed to match local or on site production, it is as if a virtual power plant were helping to power the local area.

Virtually, electricity supply, usage and delivery infrastructure in buildings and neighborhoods helps to power and regulate demand on the local electricity grid. In the future, smart meters, smart appliances, building circuits, rooftop solar and even electric vehicle batteries will be essential components of these “virtual” power plants. A micro-grid (see later discussion) takes the idea a step further by providing integrated control of the local grid and the local energy resources connected to it.

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[9] CLER advocates argue that charging for locally generated power as if it had to be absorbed into the state-wide transmission system and then returned to the local area is a “market distortion” inconsistent with actual power flows. Likewise, there is room for debate about the fair allocation of indirect costs of state-wide incentive programs and high voltage grid expansion programs. Nevertheless, as cost recovery debates continue, CLER owners’ costs are likely to be increasingly competitive across the board.

How much additional high voltage infrastructure will be needed to operate an electricity grid where electricity generation takes place closer and closer to the point of use? It is fair to ask if the most economical way to get electricity to a meter is from behind the meter, behind the meter next door or form sources close to the community or far away. But the best answer will be “It depends”, and specifically it depends in part on benefits and costs to local economies. State regulated energy utilities and their regulators are already facing the question of how to fairly allocate costs between customers relying more on their own and community based power sources vs. customers relying more on remote large power plants.[iii] But this frames the question as if only energy service providers and individual energy users have a stake. The emergence of CLERs requires a new frame for thinking and deciding.

Imagining Change

Generally, large state-regulated energy utilities operate most efficiently and with minimal political exposure by standardizing as much as possible of what they do. There are no special orders. Further, there is as yet no regulatory capacity or rate-setting standard that allows publicly funded programs and publicly regulated rate-making to attempt local optimization. Generally, “one size” is made to fit all.

Even so, based on more efficient and targeted investment by local customers and third parties, there is potential for off-setting savings and even net benefits. With this in mind, micro-grids, CLERs and Community Choice are recognizable electricity sector analogs to wireless networks, cell phones, and optional telecommunications service packages and plans. As electric utilities share this perspective, they will want to consult with local jurisdictions and evolve a concept of “best economic fit” local service.

Smart Meters

Figure 1 depicted current utility owned electricity infrastructure in the simplest possible terms. Power is generated at high voltages, routed through high voltage wires to substations that reduce the voltage for routing through lower voltage wires on to customers. The so called “revenue meter” is like a utility’s cash register. 20th century utility revenue meters are analogous to the old phone system’s rotary dial phones. Current “smart” meters are analogous to the first “smart” phones.[10] As with smart phones, smart meters have more potential capabilities than either energy users or utilities are equipped and motivated to exploit. As they realize this potential, they can enable cities and counties to help their residents and businesses understand how to use meter data and information to save money and make energy investments. Smart energy investments will strengthen and decarbonize local economies.

Information age utilities providing all types of service, including energy, will need to manage vast amounts of data in order to function most effectively. Cities and counties will need access to some of this data and to learn how to convert it to planning and decision-making information supporting CLER development. The essential intermediary in this process may be a local Community Choice Energy agency.

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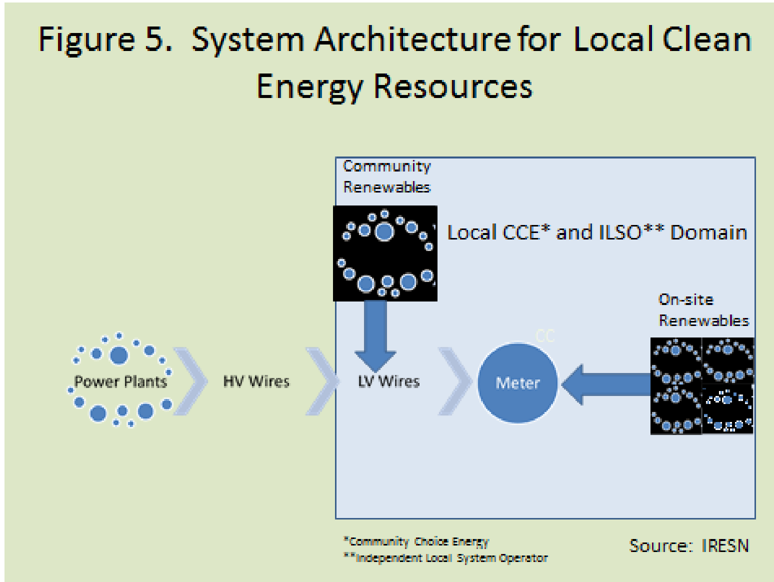
[10] We have the financial crisis and economic stimulus legislation to thank for rescuing the smart meter vision from 20 years in a utility R&D boneyard and into deployment and use.

Decentralized Grid Management



Many states already delegate planning and operational responsibility for reliably balancing overall supply with overall demand to independent companies called "independent system operators". These organizations in turn have begun to think about the organizational structures and system architectures necessary to properly manage systems with high dependence on CLERs.[iv] [v] Figure 5[vi] highlights the operating domain of new local entities that will enable decentralization and accelerated deployment of CLERs, i.e. local independent local system (local grid) operators (ILSOs) and Community Choice Energy providers. A later section will cover CCE in more detail.

CITIES, COUNTIES AND LOCAL ENERGY SUPPLY

Community Action

How does energy market decentralization create a need for community action? Cities and counties will need to determine and expand their role in the planning, siting, permitting and the integration of local energy resources with other local infrastructure, notably water supply, treatment and waste stream processing infrastructure.

The state-regulated energy service model in California accounts for the costs of locating large power plants far from population centers. The costs of energy service are apportioned to all energy users in a service area according to their generic level and place of usage, e.g., home, commercial business, farm or manufacturing plant. The state-regulated model does not, however, account for benefits of locating CLERs close to where electricity is used. It should.

California cities and counties can help grid owners capture economic benefits of optimal CLER siting. They can also guide the site selection process in ways that result in increased local resilience, local infrastructure integration and local carbon footprint reduction.

Getting More Bang For The Local Buck

Current energy service business models carry a significant societal "opportunity cost" [11]. For example, state-regulated electric utilities in California impose limits on the sizing of "net metered" solar arrays on California buildings. Systems must be sized to generate no more than the amount of electricity

[11] Defined as the loss of potential gain from other alternatives when one alternative is chosen.

consumed in previous years. Such restrictions result in a number of "unintended consequences" that create generate economic inefficiency and retard local decarbonization.

Because of net energy metering size restrictions and under-valuation of net production, solar energy systems are typically undersized relative to economically useful roof area. Under-sizing results in higher costs for a unit of electricity than if the system were sized according to economically useful roof area. Then, as a building owner invests in fuel shifting, i.e,. charging electric vehicles and installing heat pumps to replace heating equipment that burns natural gas, carbon footprint reduction benefits are minimized because additional grid electricity must be purchased. Retrofit projects necessary to incrementally increase on-site solar production to match incremental usage increases are unattractive to all parties, i.e. homeowners, solar retailers and installers..

Cities and counties aiming to reduce local carbon footprints need to consider how to eliminate such obstacles by taking a more active role in local energy policy and local energy service. Their policies should support net positive and zero carbon on-site energy production, not net zero or net negative[vii] Community Choice programs in California pay a small premium for the annual amount of electricity generated by on site solar arrays in excess of building usage. This is a good start, but a more integrative local policy approach is needed.

Local policies encouraging solar electrification can result in new zero carbon buildings, neighborhoods and new sub-divisions. In this case the land developer becomes the policy implementer. In the case of existing buildings where the impact is potentially much greater, a local Community Choice program can be an effective ally.

Planning for CLERs

What else can cities and counties do to encourage development of local energy supply projects? Increasingly, energy project developers will be looking for project sites in communities where local supply is encouraged or specified in power sourcing tenders. Taking inventory and ranking the best community renewables sites and sharing economically relevant site profile information with developers can accelerate local energy resource development. In the best cases site profile information will include the best interconnection points in the local grid, the capacity and power flows they can handle, and any actual or avoided grid-related costs attendant on an CLER project at the site.

Surprises due to insufficient modeling and planning are often costly. Whether or not energy service is locally accountable, the community picks up the tab. Integrated local energy analysis[viii] can be used to identify downstream bottlenecks, risks and avoidable costs. Analysis results are especially valuable when thoughtfully and jointly interpreted by cities/counties and local grid owners.

Smart Cities[12] (and Counties)

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[12] The rapidly growing "smart cities" movement is currently led by cities serving large population centers. Nevertheless, counties and smaller cities share an interest and opportunity to embrace and implement its goals.

California cities can choose to join the vanguard of a global "smart cities" movement. The movement is gaining traction and revolves around data and local infrastructure, from transportation to micro-grids. It encompasses all of the new services and web- and data-enabled automation necessary to make modern California cities more resilient in the face of climate change.

The "Internet of Things" is already transforming the way basic services, both public and market based, are delivered to city residents and businesses. Smart cities will need smart local energy grids. Local energy grid owners and cities/counties will need to actively engage with one another to achieve economic integration and seamless inter-operability between smart local energy grids and other public services and infrastructure.

ENERGY UTILITIES AND LOCAL ENERGY SUPPLY

COMMUNITY CHOICE ENERGY (CCE)

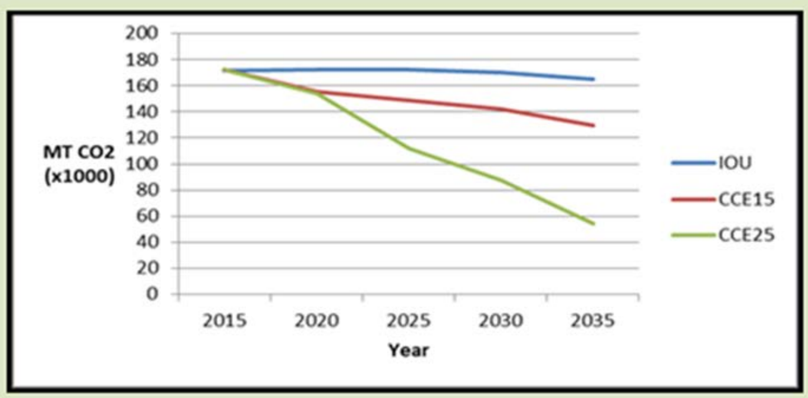
Many California cities and counties have environmental sustainability goals, plans and local initiatives. This leads to awareness of the need for more effective engagement with energy utilities. The current dearth of meaningful avenues for engagement is motivating local initiatives to explore Community Choice and/or other alternative pathways to local climate action.

Local Control

For many California counties and communities exploring Community Choice Energy (CCE), the opportunity for greater local control is a primary motivator. CCE can enable acceleration of a number of desirable changes that would otherwise not be possible, including:

- greater reliance on renewable electricity
- faster and more comprehensive reductions in a community's carbon footprint

Figure 6. GHG Emission Reduction in Three Scenarios for Davis, California



IOU = Business as Usual
CCE15 = Community Choice
CCE25 = Community Choice with LER and fuel substitution emphasis

Source: IRESN

For purposes of appropriate inclusivity, the term "smart city" can be interpreted to embrace all smart local jurisdictions, including both municipalities, rural communities, and counties, small and large.

- greater reliance on local clean energy resources, in turn enabled by more locally-effective energy efficiency investments and programs[13].
- substitution of clean electricity for carbon based fuels in buildings and vehicles

The accelerating effects are significant in all scenarios, even assuming that the current California CCE business model does not evolve. If the CCE business model evolves in ways that allow it to empower and integrate CLERs , the potential to reduce local carbon footprints is much greater than in other scenarios. Figure 6[14] compares three carbon footprint reduction scenarios for Davis, California, assuming: 1) no change in electricity service, 2) CCE in its 2015 embodiment, and 3) CCE in a 2025 embodiment that is highly evolved vs. the 2015 embodiment.

In all jurisdictions, especially those less interested in the above changes, the potential for reduced electricity bills is an enticement to consider Community Choice. Rate parity is a threshold criterion for most if not all communities.

Climate Action

Electricity rates and renewable energy are near term motivators. There are also longer term motivators that get less discussion and analytical attention. Decarbonization is one. Here the need for collaboration between cities, counties and energy utilities is quite plain. Implementation of local climate action plans requires data-driven evaluation and course corrections. These steps in turn require granular data collected and managed by cities and counties as well as granular data collected and managed by energy utilities. CCE programs can serve an integrative role between cities, counties and other energy sector participants based on actionable, locally-specific information and analysis. A CCE program serving as a data hub for local decarbonization measurement and verification is one example.

Electrification

Electrification is essential to locally integrative local climate action. Local climate action initiatives may start with lists of consumer choices, each of which has greenhouse gas reduction benefits. To have a measurable impact, aspirational consumer choices require more public attention and consumer behavior modification than is currently observed in practice.

The climate emergency[ix] requires a more timely, organized and strategic response. Integrated local energy analysis points to the critical importance of electrification in both the building and transportation sectors. To the extent that CCE accelerates deployment of renewable electricity supplies and purchasing electricity at a good price, it is synergistic with a strategy to substitute zero carbon electricity for natural gas in building heating applications and in fueling zero carbon vehicles.

Local Economic Benefits

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[13] There is increasing recognition that one-size-fits-all programs offered by state-regulated utilities are less effective than programs that can be tailored to fit local usage patterns, resources and infrastructure.
[14] Source: http://www.energy.ca.gov/2016publications/CEC-500-2016-015/CEC-500-2016-015-AP-D.pdf

The opportunity to create desirable local jobs and strengthen local economies is another longer term motivator. However, without credible analysis quantifying these benefits on a community by community basis, they cannot be given much weight in CCE program planning and implementation. Nor can they weigh in the rate-setting balance. A rough indication of the magnitude of potential economic resiliency benefits points to the importance of better and more wide-spread modeling and analysis. A preliminary economic benefit case study[x] published by the Climate Protection Center showed economic benefits of local resource development and project activity out-weighing the impact of rate savings available under current regulation.

Local Resiliency Benefits

Finally, the vulnerabilities in larger regional, state and national economies and their “too big to fail” systems and institutions are becoming increasingly apparent. Local jurisdictions are starting to aim for greater local resiliency. A Community Choice program is able to support local resiliency goals in ways that other energy service providers currently do not.

For example, a Community Choice Energy agency could work with a member jurisdiction to enable the deployment of local micro-grids, which generally do not fit the current state-regulated grid owner business model. Community Choice business models may evolve as locally opportune technology and integration choices gain traction.

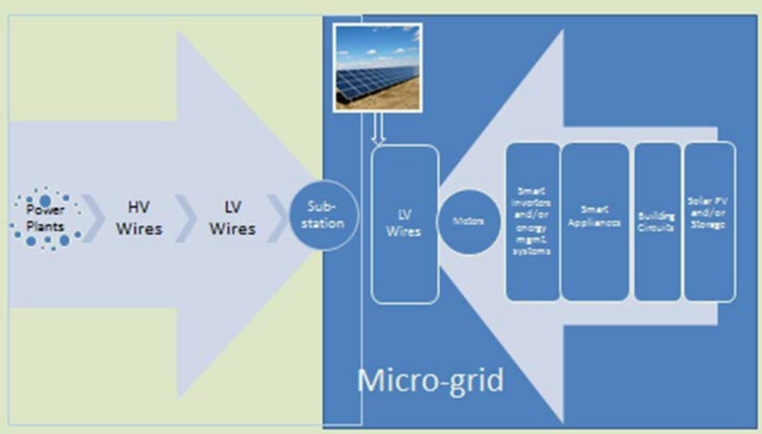
State Policy Benefits

Emerging state policies aiming for state-wide climate resiliency can be shaped by a vision of state-wide resiliency founded on climate resiliency at the local level. CCE programs have a crucial role to play to the extent they can serve as facilitators of essential (and currently quite limited) local government engagement in pursuit of energy security relying on both local and state-wide infrastructure and resources.

MICRO-GRIDS

Micro-grids will deliver localized energy security and can contribute to the resilience of regional grids. Combining the elements of a virtual power plant with the low voltage wires downstream of a distribution sub-station is one way of configuring a so-called micro-grid. Broad, strategic development and deployment of micro-grids will impact both utilities and cities/counties and require their

Figure 7. Solar Micro-grid Concept



Source: IRESN

close communication and cooperation.

A primary reason for cities, counties and utilities to take notice of micro-grids is that they enable power to be generated, matched with local demand and delivered in the in the same neighborhood or commercial or industrial center. This feature and the on-going deployment of on-site and community based solar generation capacity in California suggests a likely prevalence of solar micro-grids, shown conceptually in Figure 7[15].

Early and on-going California micro-grid experience points to a need for considerable mutual learning and coordination between the implementing utility or energy service provider and the host jurisdiction.[16]

Economic Benefits

As cities and counties rely more on local sources such as rooftop solar, it will still make sense for the sources to be diverse and complementary. Local integrated resource planning, an essential service of Community Choice programs, will serve the public economic interest entrusted to regional grid operators and state regulators by reducing the need to expand high voltage transmission systems and pay for their expansion.[17] To maximize this benefit, the local independent system operator and/or local Community Choice agency will need to minimize the imbalance between local supply and local use. In return, the regional grid will be able to absorb and use any local over-generation and also to make up any short-fall in local production.

Reliability

Regional electricity grids allow a city to import its electricity. They collect and deliver electricity from diverse and complementary power plants. This enables reliable, economic operation of the electricity generation system. Some of them generate all the time, some part of the time and on demand, some rarely but very quickly in emergencies. In some cases, more reliability is required than a larger grid can deliver. In these cases, the micro-grid not only delivers local reliability but in emergencies can be brought into play, injecting critical increments of emergency supply to the regional grid.

Decarbonization

Globally, micro-grids will have an expanding array of applications in many venues. In California, their likely best and most pervasive contribution will be to enable aggregation and regulation of local low

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[15] Source: http://www.iresn.org/resources/Presentations/City-Utility-Initiatives.pdf

[16] New York, for example, took this into account and targeted an initially large number of phased projects in its New York Prize program, with the first phase involving exploratory and feasibility level efforts. See: http://www.iresn.org/resources/Mid-16/Article-Smart-Cities.pdf

[17] Costs of maintaining and expanding high voltage grids account for 20% of retail electricity costs in California. The share is projected to increase if centralized renewable power plant deployment proceeds. There is on-going debate as to the justification for recovering these costs from electricity users in areas where CLERs account for a large share of local usage. See: https://www.caiso.com/Documents/IssuePaper-ReviewTransmissionAccessChargeWholesaleBillingDeterminant.pdf

carbon sources in ways that match local load and thus create opportunities for more efficient capital deployment inside and outside the micro-grid. Essential community micro-grid project partners will be grid owners and/or CLER owners and aggregators that provide services to owners of local electricity grids.

Market Expansion

Will larger community micro-grids provide sufficient benefits to justify the risks and costs of deployment at the current stage of technical and economic understanding? Or will currently cost-effective nano-grids, combining solar arrays and battery storage to provide high reliability, be the first evolutionary stage, proliferating rapidly and creating opportunities for low risk incremental expansion? Taking a cue from the solar PV industry's expansion from smaller to larger scale system applications, the market pathway for micro-grids that creates profitable business opportunities for technically qualified local businesses may result in the fastest standardization-driven cost reductions.

CITY-UTILITY COLLABORATION

Micro-grid deployment will benefit from city-utility engagement as it gains market traction. What tools and templates for city utility collaboration and information sharing already exist? Are energy utilities preparing to engage with local communities? Under state regulation, engagement carries with it a cost and no incremental revenue to cover it. So, with some important exceptions, they are not now engaging in a sustained, purposeful way.[18]

Efficiency Programs

In California, state-regulated energy utilities have been the primary implementers of the state's efficiency retrofit programs. Now local Community Choice Energy service providers are launching programs funded from a share of existing energy service surcharges.[19] The cost-effectiveness and societal benefit of these programs can be greatly enhanced by more granular information and geographic targeting. In this context, the coin of the realm will be data.

Data And Databases

For example, a city's geographic information system (GIS) database includes new and retrofit building permitting data that is invaluable in designing and targeting integrated efficiency and solar retrofit programs. A utility interested in spending energy efficiency program funds most cost-effectively would need to mine such databases. Likewise, a city interested in promoting net zero retrofits would need

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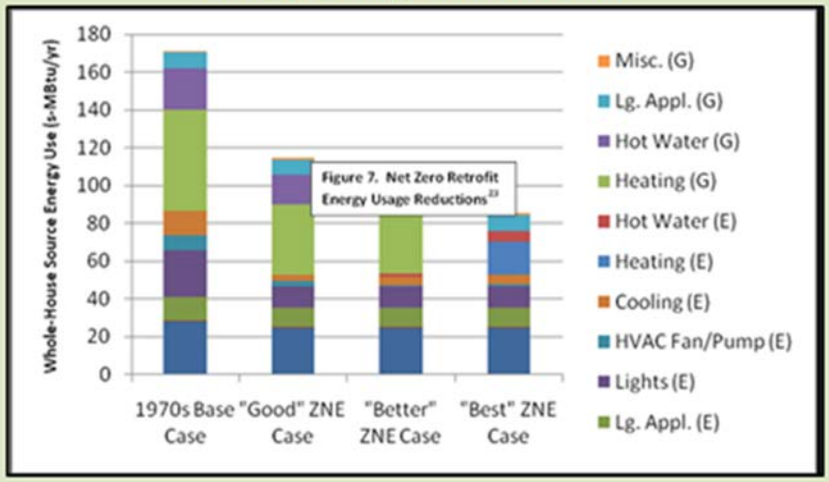
[18] In addition to PG&E's Green Communities Program discussed in the next section, Southern California Edison is offering energy management services to communities in its service territory. See: http://event.lvl3.on24.com/event/12/98/55/1/rt/1/documents/resourceList1469492917003/edison_energy_eaas_webinar_slides__final110916.pdf?dummy=dummyBody

[19] There may be potential for greater savings as CCE managed programs target specific local opportunities. According to ACEEE California currently ranks 11th among US states in savings as a percentage of residential and commercial sales.

Figure 8. 1970s Vintage Home Net Zero Retrofit Energy Usage Reductions



Source: BIRA Energy

access to the utility's customer energy usage databases in order to determine the retrofit packages that would best fit the housing stock in specific neighborhoods.

For example, In the course of the DavisFREE project[xi] , building energy consultants[20] were able to use a city's GIS database to design a net zero retrofit marketing program[xii] that accounted for differences from one neighborhood to the next as to building stock and as-designed usage. Figure 8 shows the energy usage profiling and retrofit strategies locally specific data makes possible. To finish, refine, and roll out the program, access to granular customer energy usage data will be required.

When there is a need to use multiple databases in designing and implementing programs, collaborating database managers and owners need to be committed to data sharing and access if existing databases are to be used to maximum public benefit. One manageable problem is that local agencies and energy utilities have an obligation to handle permitting and usage data according to standards relating to privacy and security. Meeting this obligation while also meeting needs for access to one another's data requires planning, well-executed protocols and anticipation of future data uses. States would do well to ensure funding for the necessary work. It is not currently in the budgets of the relevant local and utility organizations.

CLER data sharing

California utilities and state regulators are starting to identify locational costs that can be used in evaluating CLER project sites. The complement to such information on the city side would be CLER site inventories prioritized according to grid interconnection and local grid infrastructure limitations and benefits. Currently, initiatives like these on both sides are proceeding independently. In the future, cross-leveraging them will involve purposeful two-way data sharing.

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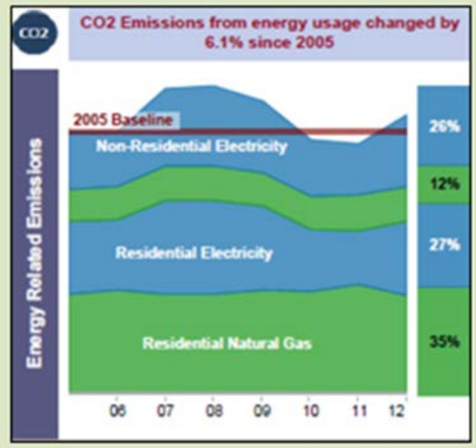
[20] Source: BIRA Energy. Total energy use and end use reductions for 1970s vintage homes in Davis, California. Comparative energy usage for base case and with three retrofit packages. See:
http://www.videoserverssite.com/play/sdall/4211-2015-3-march-net-zero-davis-ca
http://www.energy.ca.gov/2016publications/CEC-500-2016-015/CEC-500-2016-015.pdf

Likewise, community energy profile information can be helpful in preliminary modeling of a city's future energy supply and usage balance and the carbon footprint benefits of alternative interventions. From then on, periodically or continuously updated information is needed for the purposes of carbon footprint tracking and first order energy efficiency program scoping.

Figure 9. Buildings Sector GHG Emissions Profile for Davis, California



Source: PG&E

Some efforts have been undertaken by California utilities to generate profile information. PG&E's Green Communities Program[21] organizes local energy usage and productions information. Its community level statistics, exemplified in Figure 9[22], enable carbon footprint benchmarking and trend analysis. If updated annually, they would also be handy for tracking purposes.

PG&E's program was of some help in developing overall trend assumptions for integrated energy analysis and net zero retrofit program design completed as part of the DavisFREE project. More detail would have been needed to explain year to year differences. Even if broken down by category, annual community level statistics do not suffice. More granularity is required in terms of hourly, daily, seasonal and neighborhood variations.

CLER Project Collaboration

Historically, California city and county governments have had little reason to develop staff capabilities appropriate to CLER projects and operations. Likewise, on the utility side, there has been no financial incentive to develop CLER projects or to evaluate the local (vs. state-wide) effectiveness of an efficiency or low income assistance program. For these reasons, local partnerships that could lead to better local results typically have not received priority attention on either side.

The California Energy Commission's ratepayer funded R&D programs have provided a venue for early stage city-utility engagement in the context of cost-shared local energy resource assessment studies and

[21] PG&E's program, if continued, will benefit greatly from dialog with its intended municipal clients. The program generates information. Users are more likely to need data. What data would they have specified? How much value does information formatted by its supplier have vs. information in a format specified by the user? For each integrated energy analysis relying on externally sourced data, it costs extra money and requires special expertise to apply available data and supplement it with other sources of data that are not included. See https://www.pge.com/en_US/about-pge/environment/what-you-can-do/the-green-communities-program/green-communities-program.page

[22] Source: http://www.energy.ca.gov/2016publications/CEC-500-2016-015/CEC-500-2016-015.pdf

demonstration projects. A robust cross section of California counties and cities now have some introductory experience teaming with energy utilities on specific local initiatives. [xiii]

R&D projects designed to demonstrate new and emerging technology do not necessarily result in direct engagement by local jurisdictions. Generally, local governments and their service enterprises focus on commercially proven technology that is available and strategically important in a local context. Cities and counties may play an R&D contract administration role, but typically third parties actually do the studies and implement the projects. In this framework, city-utility engagement is accomplished through intermediaries rather than directly. It nevertheless can lead to later direct collaboration.

Community Action Guidelines

Clean local energy projects will be pervasive as the electricity sector decentralizes. Are there "baby steps" cities/counties and utilities can take in anticipation of the need for greater collaboration?

Cities and counties will need related capacity and expertise. Fortunately, there are people in most communities who have been involved in local energy projects and/or who understand and have worked with utilities. These "energy experts" are often willing to pitch in if their community has goals they can support and programs and need for experience-based advice.

Data development and scoping analyses are elements of a good starting point.[23] The goal should be an CLER deployment scenario where benefits exceed costs and both are fairly allocated. A credible estimate of the long term economic consequences to both the energy utility and local community would be of particular interest and value. This work requires active participation by city and utility staff, perhaps with the assistance of consultants. Then the resulting estimates can be confidently used in setting local energy resilience policy.

Collaborative Opportunities

Existing programs are another early community action opportunity. Utility-run efficiency programs collect surcharges from ratepayers and, net of a substantial fee, return it to them in the form of rebates for specific purchases. If a rebate program aligns with a city or county's CLER deployment goals, it is in local jurisdiction's interest to promote and encourage local participation. Lacking staff to do so, some jurisdictions rely on local volunteer groups.[24] Typically the relationship between the volunteer groups and the energy utility is limited and requires some level of mediation by city staff.

CONCLUSIONS

Local climate resiliency plans should emphasize substitution of renewable electricity for locally consumed carbon based fuels. Specifically, they should recognize battery and fuel cell electric vehicles as part-time Clean Local Energy Resources. Integration of local energy production and use will be

[23] The DavisFREE project created a template for data development and scoping analysis. See: http://www.energy.ca.gov/2016publications/CEC-500-2016-015/CEC-500-2016-015.pdf

[24] Utility programs sometimes award small grants to the local jurisdiction that can be used by the local volunteer groups to support planning, e.g. preparation of climate action plans.

enabled by local high speed data infrastructure. Local Information Age utilities providing all types of services, including energy, will need to manage vast amounts of data in order to function most effectively. Cities and counties will need access to energy related data learn how to convert it to planning and decision-making information supporting local energy resource development. Where no municipal utility or energy cooperative exists, the essential intermediary in this process will be a Community Choice program. Community Choice service providers are uniquely positioned to help their local jurisdictions capture the local economic, local energy security and local climate resiliency benefits of micro-grids and vehicle to grid energy exchange.

Recent initiatives to improve engagement between California cities and counties and energy utilities point to the need to make data sharing more timely and less cumbersome. As leading cities and counties learn to use the full toolkit of the digital age, they will invest in greatly improved dialog, project and program collaboration with like-minded energy utilities. Smart cities and counties require smart energy services. High speed communications infrastructure, automation, and data-driven decision-making are essential to "smart energy", whether smart grids, smart buildings or smart vehicles. Data sharing between energy utilities and cities and counties will allow both sides to create actionable business and infrastructure investment and management information.

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