Local Renewable Energy Transition Strategies

Gerald Braun

Introduction

More than $2.7 trillion has been invested in building up global renewable energy capacity over the past decade.[i] In those same 10 years, renewable electricity sources more than doubled their share of the global power mix, from 5.9% in 2009 to 13.4% in 2019.

In just one decade, solar and wind equipment manufacturing scale economies, plus innovations in project finance, engineering and construction, have empowered game-changing reductions in renewable electricity costs. In the same decade, on-site solar electricity production and local conversion of organic waste to bio-methane have become locally actionable measures to shrink local carbon footprints.

Local renewable energy transitions strengthen local economies. When benefits are better understood and more widely appreciated, local governments will see compelling reasons to take a more active and supportive role.

In the wake of global renewable industry scale-up and maturation that occurred after California's pioneering wind and solar deployment in the late 1980s, California's renewable energy transition re-started a decade ago.[1] While the U.S. renewable energy transition relies primarily on centralized renewable projects, California's transition depends as much on projects located on energy user property as on power plant projects in the sunniest parts of the state.

Robust transition strategies respond to concerns that the global renewable energy transition is proceeding too slowly to limit climate change before a tipping point is reached. In California, as much money is being invested in locally beneficial solar projects as in large solar projects that export electricity to other areas. Balanced investment in local and centralized projects doubles the rate of GHG emissions reduction by doubling the rate of renewable energy deployment.

Local renewable energy production becomes the foundation for local energy resilience. A balanced investment strategy is also required to exploit synergies between gas fuel and electricity. While renewable electricity bends GHG emissions curves downward, additional downward pressure is added as zero and negative carbon fuel supplies come on stream and renewable hydrogen gains traction as a future transportation fuel and energy storage medium.

The following sections compare U.S. and California renewable transition progress, outline renewable energy's role in local climate action, identify related trade-offs confronting state and local governments, summarize cost, benefit and deployment capacity shifts over the past decade, calibrate economic

[1] California's initial renewable power deployment aborted in the early 1990s as California regulators restructured California's electricity systems to expand natural gas generation. Since 2001, while California's population and economy expanded, new natural gas and renewable power plants helped reduce GHG emissions from California's in-state electricity generation by about a third, to nine percent of total state-wide emissions in 2017.

benefits of local renewable energy investment, discuss local renewable energy transition issues and recommend local renewable energy transition strategies.

Relevant Experience - US and California Transitions

Figure 1[ii] shows that the renewable energy transition in the U.S. now relies on a three part portfolio of natural gas, solar and wind power capacity additions, to meet new power generation capacity needs and to fill supply gaps resulting from coal fired power plant retirements.

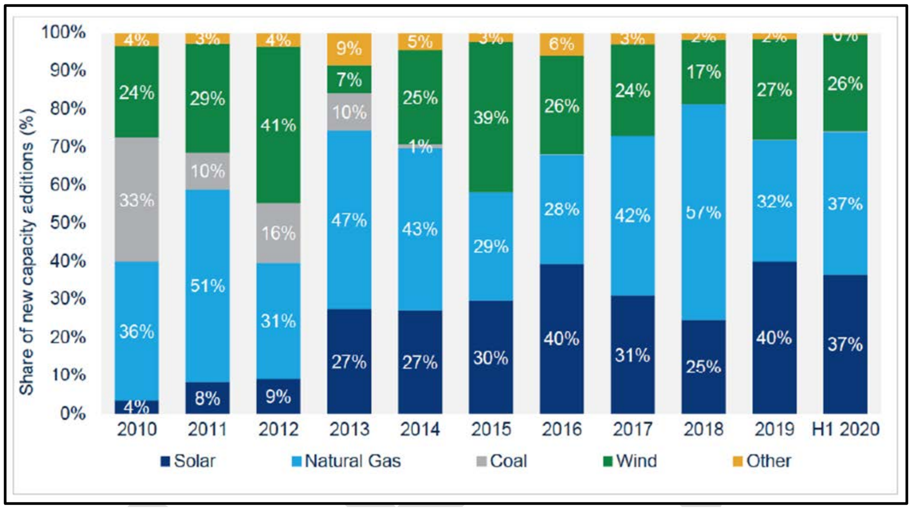

Figure 1. New U.S. Electricity Generation Capacity Additions, 2010 – H1 2020

Figure 2[iii] shows the trajectory of the solar share of California's electricity supply portfolio. "Utility solar" plants feeding electricity into high voltage transmission systems account for roughly 50 percent of capacity additions over the past decade, while deployment on residential and non-residential (mostly commercial) property accounts for the other half.

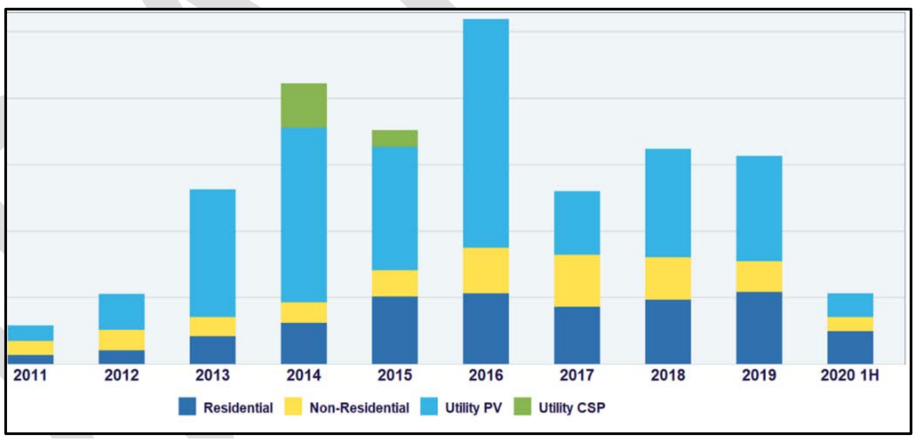

Figure 2. California Annual Solar Installations

Renewable Energy's Role in Local Climate Action

Figure 3[iv] shows climate action plan elements recommended for consideration by southern California cities and counties. Electricity and gas fuel decarbonization elements are additive, synergistic, and comparably effective in most local cases. They support faster decarbonization progress than renewable electricity alone. They are inter-dependent to the extent energy resilience is best (most cost-effectively and completely) achieved by including gas fueled electricity supply[2] in the local electricity supply mix.

[2] Increased production of renewable hydrogen for use transportation and electricity generation and availability of locally produced carbon negative methane is assumed. Blending renewable hydrogen with geologic methane (aka natural gas) is feasible, though there are percentage limits beyond which transport infrastructure must be replaced or retrofitted.

Electricity		Gas Fuel
On-site solar electricity production	and	Carbon negative gas from local waste
Increased renewable electricity imports	and	Increased carbon negative gas imports
Solar/battery powered microgrids	and	Hybrid solar/gas powered microgrids
Solar powered heat pump water heaters	and	Hybrid solar/gas water heating
Solar powered heat pump space heating	and	Hybrid solar/gas space heating
Solar powered battery electric vehicles	and	Solar hydrogen fueled vehicles
Solar powered hybrid electric vehicles	and	Carbon negative gas fueled vehicles
High renewable content retail electricity	and	Micro combined heat and power

Figure 3. Recommended Local California Decarbonization and Resilience Plan Elements

In general, cities and counties must look to deep decarbonization building retrofits and accelerated replacement of gasoline and diesel fueled vehicles as core strategies. Local action plans can identify specific electricity and gas fuel decarbonization and resilience measures that rely on local experience, trends, assets and deployment capacities. There is no shortage of local planning guidance on the electricity side of Figure 3.[v] [3] Local gas fuel planning guidance is also becoming available.[vi]

Deep decarbonization retrofits address all on-site energy use, including on-site vehicle fueling or charging. On-site solar electricity production can shrink city and county carbon footprints, especially when combined with heat pump space and water heating in temperate climates. Solar thermal systems for space and water heating have an important role to play as well when backed up by on-site solar electricity or locally produced fuel. They are an especially effective choice for multi-family buildings or buildings with limited unshaded roof space.

"Carbon negative" refers to the fact that methane produced locally from organic feedstocks lowers GHG emissions much more, even when burned, than if organic feedstocks decompose and release methane into the atmosphere. Carbon negative bio-methane is now used to fuel heavy duty vehicles and is starting to be substituted for pipeline natural gas. Personal vehicles can be powered by batteries charged using locally produced solar electricity or by fuel cells that convert solar generated hydrogen.[4]

Where grid electricity has a high renewable content and/or low carbon intensity, it is an acceptable substitute for on-site solar electricity but only where there are realistic prospects for grid electricity's renewable content to reach high levels within a few years.

Microgrids can increase local energy resilience, partially in the case of solar/battery powered microgrids, and fully in the case of hybrid solar/battery/fuel cell microgrids[vii]. Micro combined heat and power

[3] Local climate action planning in California increasingly to date has emphasized building sector electrification. Some local jurisdictions, e.g., most recently Oakland, have banned natural gas hook ups for new buildings. California's mild winters and the avoidance of solar customer acquisition costs in new construction make this an economically competitive renewable transition element in California's coastal areas and central valley.

[4] Renewable hydrogen prospects are receiving a surge of government and industrial attention in Japan and Germany because of hydrogen's importance as an enabler of long term electricity storage and fuel cell electric vehicle deployment.

(micro CHP) systems fueled by blends of geologic natural gas, bio-methane and renewable hydrogen can provide resilient on-site power or feed electricity into microgrids to make them fully energy resilient.[viii] Carbon intensities of the blends can be adjusted downward over time. In the absence of electric service by a fully resilient community or neighborhood solar/gas microgrid, micro CHP is a resilient source that has the advantage operating cost savings and GHG emissions reductions.

Where there is substantial investment in new housing or high demand for new vehicles, new zero emissions buildings and vehicles merit local policy and planning attention. New zero emissions buildings can add to the impact of deep decarbonization retrofits. California cities and counties have significant, discretion to raise the bar set by the state's energy efficiency and on-site solar standards for new buildings. Some local jurisdictions are starting to mandate "all-electric" new construction, an economically and environmentally rational approach in California where net zero solar electricity is mandated for new construction.[ix] Figure 3 emphasizes measures that apply both to building retrofits and new construction.

Renewable Energy Deployment Trade-offs

Local governments in California review designs and inspect installed systems to ensure that on-site solar installations comply with local building codes, while electric utilities approve related grid interconnections. The cumulative result of their permitting activity is summarized in Figure 4[x], which shows about half of solar electricity deployment in California to date has been local, aka "behind the meter". By contrast, the U.S. has a utility solar sector four times as large as its local (combined residential and non-residential) solar sectors.

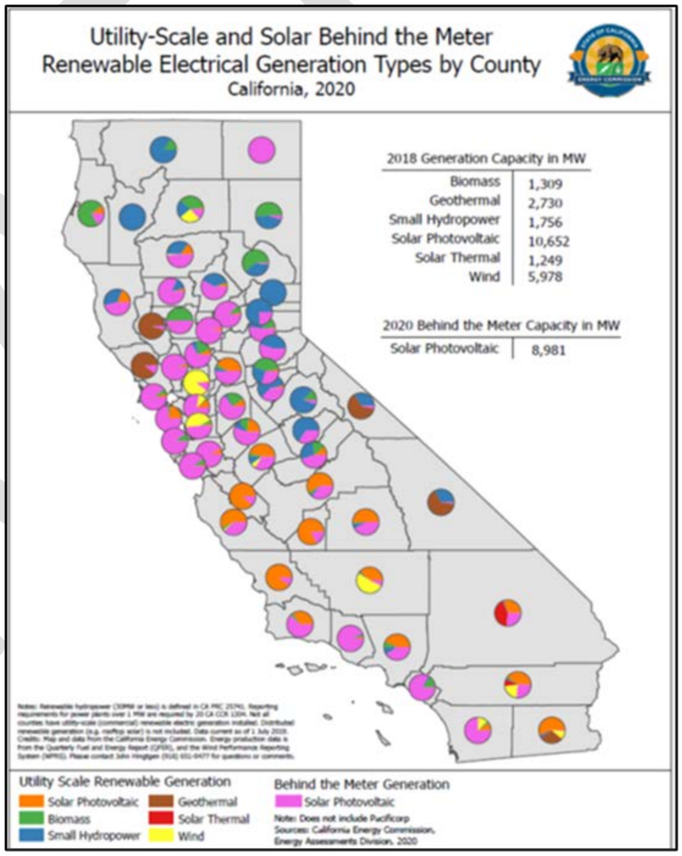

Figure 4. Sources of Renewable Electricity Capacity in California (Source: California Energy Commission)

California's solar power deployment experience can inform its GHG reduction goal setting. For example, what is the best state-wide balance between centralized renewable supply expansion and locally beneficial on-site and community renewable energy deployment? The best local balance will vary because renewable resource opportunities and energy usage patterns differ significantly from one community to the next. Achieving the best local balance will require that local governments reach out and engage with energy service providers, energy users, local solar retailers and energy engineers.

Trade-offs between centralized and local renewable energy production affect the balance between local energy exports and imports. Figure 4 shows that every California county produces renewable energy.

Some counties are net exporters; most are net importers. Each exporting county's renewable product mix differs from others. Most electricity generated by "utility scale" solar power plants in high production counties is exported via California's state-wide power grid and sent to other counties. Transmission charges on these exports now exceed solar power plant bus-bar costs by as much as a factor of two and continue to escalate.

Expansion of renewable energy production confronts local trade-offs as well. For example, locally produced solar electricity is typically not available to renters or residents in low income neighborhoods, resulting in "solar energy deserts" akin to "food deserts". "Community solar"[xi] projects provide an equitable antidote that can work for municipal electric utilities and the communities they serve, because municipal utilities are not state regulated and can price electricity from local solar projects at project-specific costs of production and transport.

California's state-regulated utilities apply the same transmission charges to all the electricity they purchase regardless of how far it travels from source to point of use; they earn profits indexed to the book value of their energy transport assets. Thus, they prefer to offer "solar tariffs" for solar electricity they purchase from utility scale projects feeding into their transmission systems virtually rather than physically.

Can expansion of renewable energy production in the U.S. be accelerated if "wires charges"[5] for community renewable projects are adjusted to account for local energy resilience benefits and actual project-specific transmission grid usage? How much costly and environmentally controversial expansion of regional transmission systems can be avoided by expanding local renewable energy production for local use?

Cost, Benefit and Deployment Capacity Shifts

The trade-off between local and centralized solar electricity deployment has shifted in favor of local in the last ten years in the U.S. Not only have costs plummeted across a five order of magnitude project size range, but cost differences among large, medium and small projects have become less important than costs of transporting and storing solar electricity. Impacts of system scale economies and other contributing factors are quantified in Figure 5.[xii]

<u>Installed Solar Electricity System Costs.</u> In Figure 5 the cost metric is "installed system cost", an appropriate measure of cost reduction progress, especially for "utility-scale" projects.

System productivity varies among solar electricity system sizes and types, (e.g., tracking vs. fixed-tilt utility solar systems). Across a wide system size range, equipment costs vary over a relatively narrow range. However, "soft" costs, notably "customer acquisition" costs for residential and commercial systems, can be high in areas where on-site solar is just beginning to penetrate. Where retail competition is still weak or non-existent, opportunistic pricing of residential and commercial systems also results in higher quoted prices. As installed costs continue to decline in all segments, regions where grid usage charges are set to recover fairly-allocated costs rather than discourage deployment will see faster growth and more cost-efficient deployment.

---

[5] I.e., charges to recover costs of electricity transmission and distribution.

Installed system cost can be an inappropriate and misleading metric for comparisons between on-site solar projects and utility solar projects because the unit value (avoided electricity cost per kWh as perceived by the local energy user) of on-site solar electricity depends on the price of grid electricity. In California, energy transmission and distribution charges are added to the price of grid electricity. As a result, the end use value of electricity produced on-site may be two to three times its cost of production. Customer charges per energy unit for high voltage transmission in California, the largest U.S. on-site solar market, now exceed unit costs of solar electricity production at any scale. Making comparisons even more complicated, financing costs and methods differ greatly from one solar market segment to another. Costs of capital, tax rates and depreciation expenses incurred by electric utilities, solar project developers, and property owners differ significantly.

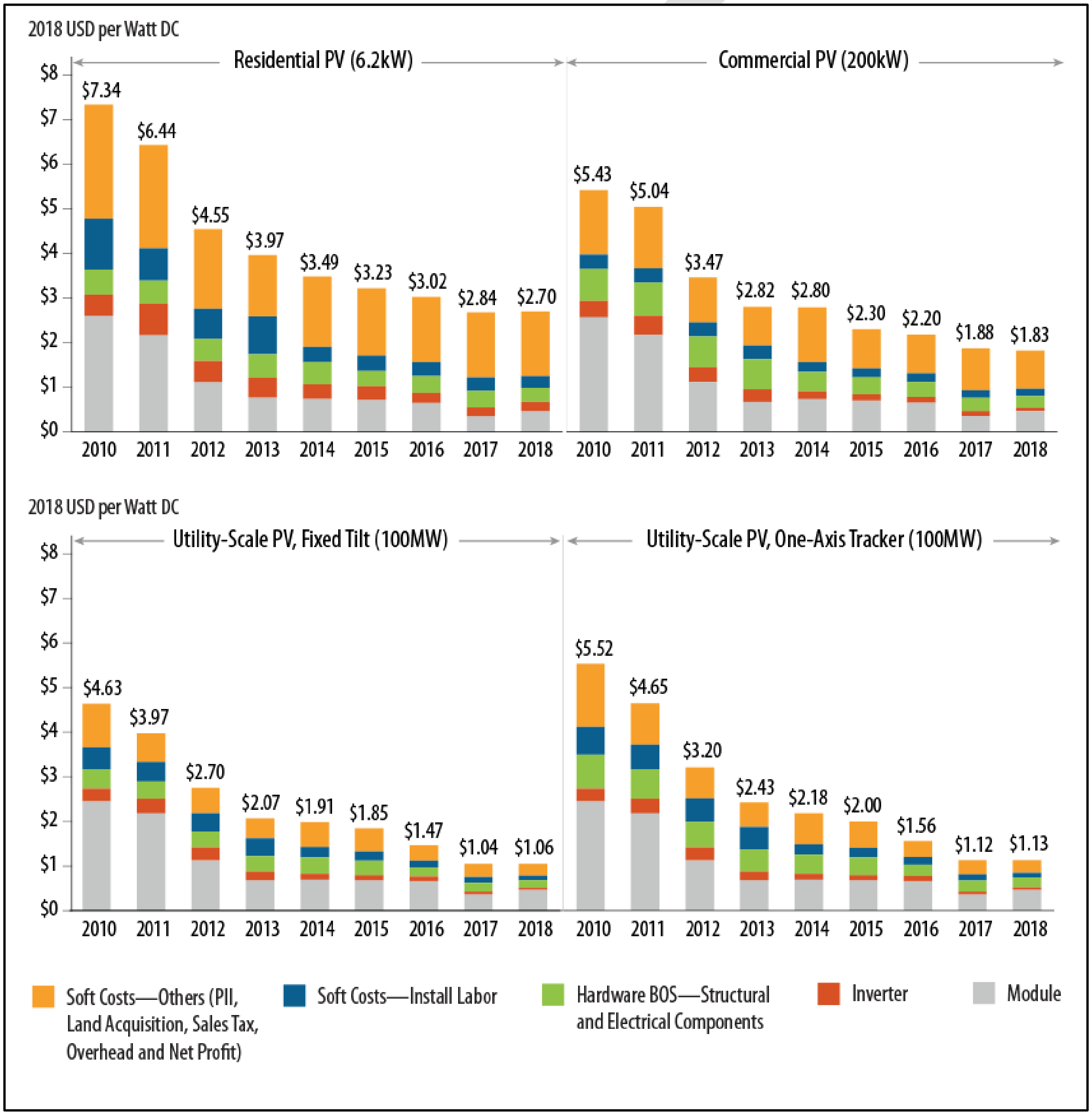

Figure 5. Trends in the Costs of Solar PV Systems in the US

Cost Shifts. Just as bulk wind power has become a cost effective choice for electric utilities serving Great Plains states, bulk utility solar power is becoming a cost-effective choice for utilities in the U.S. "sunbelt" and beyond. As penetration increases, so will the need for longer duration and therefore more costly centralized energy storage.

In general, renewable energy produced locally for local use is a good deal that gets better each year as grid electricity prices continue to escalate. Property owners in northern California now recapture their on-site solar investments in as little as 5-6 years and continue to save money for another 20 years.

Reliability Benefit Shifts. Increasing severity of natural disasters erodes reliability of local services that depend on energy imports. Reliability of electricity service to California communities and energy users has plummeted in recent years for communities and energy users subject to "public safety power shut-offs"[xiii] during seasons when high winds increase wildfire risks. Few California communities are completely immune. Local renewable and energy storage investments are foundational to restoring local reliability to former levels over the long term.

Resilience Benefit Shifts. Extended energy service disruptions devastate local economies. The appropriate risk management approach is to increase local energy resilience. Energy resilience is the local capacity to restore energy service quickly and indefinitely. Increased local renewable energy production and judicious renewable fuel use can provide partial energy resilience, thus mitigating local energy service vulnerabilities. Once technical and institutional impediments are removed, home and business energy investments[6] can be integrated with smarter local energy transport infrastructure and microgrids to make local energy service fully resilient.[7]

Equity Benefit Shifts. Economically insecure neighborhoods need to be more energy secure than their economically secure counterparts. Fairness requires that the benefits of local renewable energy supply be available to all. For example, in places where solar energy saves money and backs up traditional energy service for local businesses and homeowners, it can do the same for renters, who, on average, may have greater need for cost savings and energy security. Working with local solar retailers and energy service providers, local governments can plan and implement strategies to bridge local solar divides.

Local Deployment Capacity Shifts. Deployment capacity is key to cost-efficient investment for all solar technologies and project scales. Expansion of solar project deployment capacities around the world are the outcome of shifts in national industrial policies. Solar deployment capacity shifts in the U.S. have been especially uneven in residential and non-residential segments. State deployment capacity differences are explained in part by political diversity among U.S. states, and by state-to-state differences in retail energy prices offered by state-regulated utilities.

States with long-standing, supportive solar policies had local solar deployment capacities in place when game changing Federal solar tax credits became available ten years ago. Solar deployment in states with supportive policies and relatively high grid electricity unit costs expanded much faster than in other states. California counties and cities with mature local solar deployment capacity are seeing sustained double digit annual on-site solar expansion.

[6] I.e., investments in on-site solar heat and electricity production, community renewable gas and electricity production and battery and fuel cell electric vehicles that exchange electricity with local electricity grids.
[7] "Full resilience" means the ability to quickly restore unrestricted 24/7 energy services.

Valuing Local Renewable Energy Benefits

Economic benefits of local renewable transitions accrue to energy users able to generate solar energy on property they own. They also strengthen local economies because energy expenditures involve dollars that recirculate locally, create local jobs and add to property values.[8] [xiv] Figure 6 shows the estimated economic impacts of on-site solar electricity production in Yolo County, California.

The county has a mix of urban and rural areas with a combined population of roughly 200,000. Its recent experience illustrates how quickly local renewable transitions can progress under the radar of planners and policy makers.[9] County-wide on-site solar deployment in the past five years accounts for most of the local solar capacity that now meets twelve percent of the county's electricity usage, a percentage that could be significantly higher but for regulatory limits on net annual on-site production.

County Electricity Usage (MWH)	1749000
Solar Percent (%)	12
Number of Systems	11801
Combined Capacity (kW)	117134
Estimated Annual Production (MWH)	210841
Avoided Grid Electricity Generation Cost ($M/yr.)	21
Avoided Electricity Import Cost ($M/yr.)	**53**
Number of Direct, Indirect and Induced Jobs	361
Job Creation Benefit to Local Economy ($M/yr.)	**37**
Combined Jobs and Avoided Imports Benefit	**90**
Property Tax Value ($M)	463
Disaster Recovery Value ($M)	??

Figure 6. Estimated Economic Benefits of Yolo County, California On-site Solar Deployment Through 2020

Benefits to the Yolo County economy include desirable jobs and less money leaving the county to pay for grid electricity imports. Combined annual benefits at the end of 2020 are estimated at $90 million. These dollars strengthen the county's ability to fund the implementation of climate adaptation and resilience measures, and they can help address inequities, including the fact that property owners have access to cost-saving locally produced solar electricity - renters do not. Additional economic benefits, harder to quantify on an annual basis, include mitigation of economic productivity losses during public safety power shutoffs, plus faster recovery of local economies in the wake of disasters, physical attacks and cyber-attacks.

Property owner investments deliver significant environmental, economic and resilience benefits to cities and counties. Modest and ever-shrinking differences between unit (per kWh) costs of utility solar electricity supply and unit costs of on-site solar electricity systems point to a growing, beneficial long term role for local systems.

Local Energy Collaboration Targets

Local governments cannot effectively drive local renewable energy transitions without the cooperation of energy service providers. They can target changes in which they and energy service providers have a

[8] Benefits of more local dollars recirculating locally are harder to quantify but may be even more important.
[9] A two and a half year old county-wide Community Choice program may result in improved "radar" going forward.

shared strategic interest, including 1) net negative carbon fuel production, 2) net positive on-site solar electricity production, and 3) data-driven local energy resilience planning.

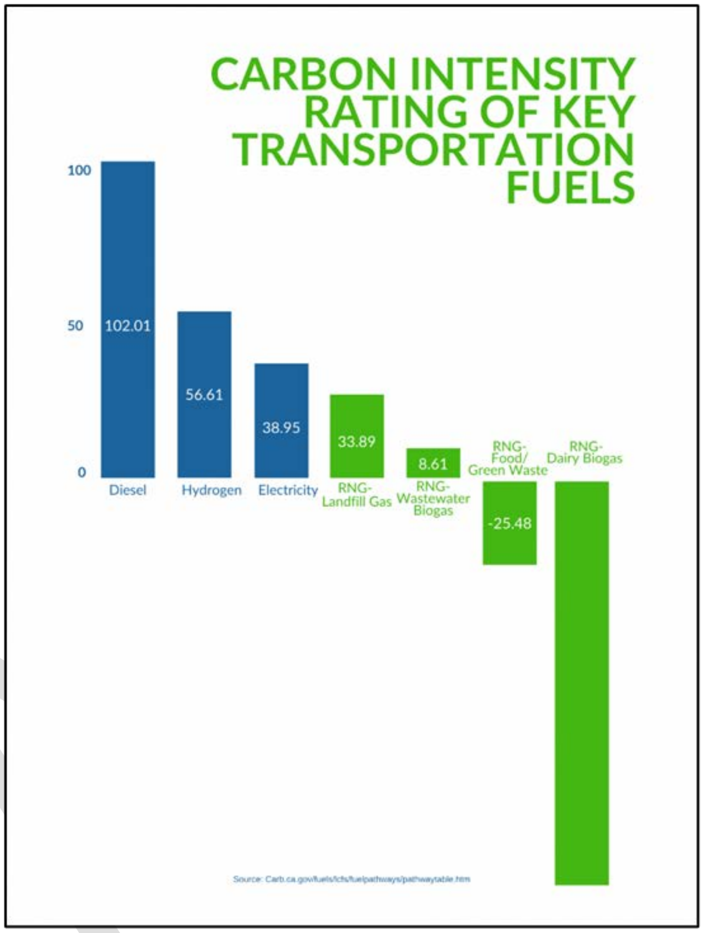

Figure 7. Synthesis of California Air Resource Board Low Carbon Fuel Standard 2020 Pathway Certified Carbon Intensities (Source: AmericanNaturalGas.com)

Net Negative Carbon Fuel Production. Carbon intensities of major energy sources vary widely, both generically, and project-by-project. Figure 7[xv] shows carbon intensities for current and emerging transportation fuels.[10] Bio-methane produced from organic waste streams has widely varying carbon intensities, some deeply negative and some modestly positive, depending on project design and operation. Figure 7 shows that substituting bio-methane,[11] aka renewable natural gas (RNG), for diesel fuel has the greatest potential decarbonization benefit in the transport sector. Other recent studies suggest that sufficient bio-methane production feedstocks are available to support significant substitution of bio-methane for natural gas (aka geologic methane) for building space and water heating.[xvi]

Collaborative engagement is essential to create conditions for investment and cost recovery by local governments that collect and process organic waste streams and by energy utilities with infrastructure to transport and deliver bio-methane for local use.

Net Positive Renewable Electricity. In California and most other US states, "net metered" solar electric arrays on new buildings can be sized to meet projected electricity usage. By contrast, arrays on existing buildings can only be sized to meet historical annual usage. This limitation minimizes local solar electricity production and makes converting an existing residential, commercial or publicly owned building to net zero carbon problematic and unnecessarily costly.

Net zero electricity conversions require on-site solar electricity, purchases of imported renewable electricity, or both, in annual amounts equal to historical electricity usage. Then, as electric vehicles and heat pump appliances add to electricity usage, additional solar panels or additional renewable electricity

---

[10] An alternative fuel's carbon intensity (CI) value is divided by its Energy Economy Ratio (EER) obtain the EER-adjusted CI value, representing the emissions that occur from the use of alternative fuel per MJ of conventional fuel displaced. From a climate perspective, negative is good.

[11] Biogas is the term used for the methane that is developed from the breakdown of organic material in the absence of oxygen from sources such as sewage, municipal solid waste, and farm waste. Biomethane is the fuel that is produced by refining and removing any impurities from the biogas.

purchases are required to upgrade to net zero carbon. Alternatively, especially in cold climates, a combination of carbon negative gas and solar heat collectors may be the most cost effective zero carbon solution for water and space heating where the two options are both on offer.

Before deep decarbonization retrofits became an important local decarbonization strategy, under-sizing solar arrays relative to projected future usage was less consequential. To avoid mismatches between local electricity usage and local solar electricity supply, it now makes more sense to encourage on-site energy storage investments and allow predictable amounts of net annual solar electricity supply to feed into local grids during high usage periods and be credited at fair prices.

To avoid under-sizing solar arrays relative to expected future annual on-site electricity usage, net positive solar electricity production should be allowed and equitably compensated. Net annual production can be made available to renters and others otherwise unable to share economic benefits solar array ownership.

Local Energy Resilience. Grid owners, local governments and energy users share an interest in local energy resilience. Governments and grid owners should be encouraged to work together to achieve appropriate levels of local energy resilience at least cost to the community. Neither utilities nor local governments, acting alone, can achieve the best economic and resilience outcomes for a community. Stepping up coordination of policies and programs makes achieving local energy resilience less problematic, confusing and costly for energy users.

Local governments can determine the amounts of solar electricity feeding into local electricity grids that suffice to support economic activity during prolonged regional grid outages. Utilities can incentivize energy storage investments and net usage patterns consistent with efficient grid asset utilization. Coordinated local policies and plans should be finalized following independent review and public input.

Local Renewable Energy Transition Strategies

What strategies can local governments adopt to ensure that local renewable energy transitions are not impeded or less economically beneficial due to lack of vision, engagement and preparation? Four primary local renewable energy transition strategies are to – 1) adopt a locally specific vision, second, 2) identify and fulfill essential local government roles, 3) plan and implement local decarbonization and energy resilience programs, and 4) support growth and maturation of local private sector renewable deployment and retrofit capacities.

Locally Specific Vision. A locally specific vision is a statement of the changes the jurisdiction has authority and aspires to make that empower economically beneficial local renewable energy investment. In preparation for vision development and adoption, a county's or city's energy sources and usage must be profiled, along with forecasts accounting for trends that are changing the profile. Inputs to integrated local energy analysis[xvii] need to be extracted from multiple databases and regularly updated. So, arrangements for data sharing with energy service providers are essential.

Essential Local Government Roles. Cities and counties are taking roles in local renewable energy deployment that mirror their roles in other areas - enforcing codes, permitting projects, licensing local service providers and generally securing the public interest in safe, competent and environmentally appropriate services supportive of local renewable energy transitions. Cities and counties will also take on new roles, assessing renewable resource potential and zoning options,[xviii]determining and prioritizing which local public facilities require energy resilience upgrades, identifying sites that are suitable for renewable project development, and enforcing local ordinances and regulations governing renewable energy transition services - for example, regulating community renewable energy production and community microgrid operations to ensure equitable cost recovery and service delivery. Technical and analytical support for energy related roles can and likely will be outsourced, but implementation will require new staff competencies – primarily energy engineering and energy management.

<u>Renewable Energy Site Inventories.</u> Counties and cities manage land use within and around their boundaries. Anticipating renewable project developer interest, sites that are environmentally and otherwise suitable for renewable energy development should be inventoried and assessed to determine their economic value for purposes of renewable project development. Some California jurisdictions now have experience that validates the critical need for anticipatory evaluations and decisions.[xix]

<u>Decarbonization and Resilience Program Planning and Implementation.</u> Local renewable energy transitions result in decarbonization, and they empower local energy resilience. To be timely and economically beneficial, they require political and technical attention and informed choices. The same trade-offs confront each local jurisdiction, i.e., trade-offs between 1) on-site solar vs. community renewables, 2) imports and local production, 3) new projects vs. retrofits, 4) zero carbon vs. fully energy resilient, 5) expedient vs. cost-efficient actions, 6) formerly affordable vs. newly affordable technologies, and 7) readiness for action now vs. later.

When vision development and follow-up decarbonization and energy resilience planning is founded on locally specific energy system models and analysis, trade-offs are better informed, and achievable quantitative goals can be set. Plan implementation requires annual budgets and mature capacity to perform essential local government roles, assess progress, and identify and remove roadblocks.

<u>Growth and Maturation of Local Deployment and Retrofit Capacities.</u> In many parts of the US a ~~primary~~ lack of mature local deployment (installation and service) capacity is a main barrier to local renewable energy transitions, not just for solar electricity and heat but also for new generations of energy end use and on-site energy storage systems.

California's ability to ramp up local solar electricity deployment in the past decade is owed to a cadre of one thousand local solar retailers and installers that grew and matured in the years prior to Federal solar tax credits, thanks to a $3B incentive program funded by the state legislature in 2006. Other states rely heavily on utility scale renewables to decarbonize energy use, in part because they do not have a robust and profitable base of solar retailers and installers.

Even in California, the retail solar industry's capacity to deploy larger non-residential systems is less evenly distributed and less mature its residential solar deployment capacity; as a result, there are under-served cities and counties. Capturing local economic benefits of solar energy adoption requires a stable, profitable and growing local market for renewable energy systems. To this end, cities and counties can incentivize investments in local deployment capacity, invest in making critical facilities energy resilient, and approve ordinances requiring energy user consideration of solar electrification investments. They can learn by doing and lead by example by decarbonizing their own operations and facilities, by producing renewable fuels and renewable electricity for local use, and by committing to net zero carbon conversions of public schools and local government buildings and vehicles.

Utility Roles in Local Renewable Energy Transitions

Energy infrastructure transformations in California enabled by locally produced renewable energy will proceed, absent local government engagement, primarily on energy user property where energy transport utility monopoly purviews do not extend. Building and facility electricity circuits are pathways for electricity arriving at a utility meter to proceed to the finish line of an appliance, light or electronic display. More robust functionality to coordinate on site production and storage is technically possible and can be economically rewarding.

Future on-site energy networks will connect to energy storage capacity in electric vehicles and energy storage appliances. They will evolve to serve as microgrids (aka nanogrids[xx]) that match on-site energy use to on-site production when grid electricity service is interrupted for whatever reason, including by the property owner’s choice or by automated decisions to minimize utility charges. Negative and zero carbon gas for vehicles and heating uses will be stored, not only in vehicles but also on-site, first in fueling stations and later in buildings and facilities where gas use and storage can be integrated with on-site electricity production, storage and use.

Energy utilities have long toyed with theoretical business model adjustments. For compelling business risk management reasons, energy transport utilities and wholesale energy procurement organizations have not yet ventured beyond business models appropriate to protected monopolies. They will likely remain primarily energy transporters, grid owners, and wholesale energy buyers. For insurance and liability reasons they typically play no role in on-site energy management or on-site infrastructure investment. Through non-regulated subsidiaries operating in other utilities’ service areas, they may play a more active and profitable role.

Figure 8. Babcock Ranch Solar Micro Community North of Ft. Myers, Florida

Land developers and local jurisdictions can influence the scope and location of utility renewable energy investments. Figure 8 shows a solar micro community in a new net-zero-carbon Florida city. The city will have a population of twenty thousand when fully built out. A utility-owned 150MW solar power plant already operating on land donated by the developer will supply electricity to residents and businesses at the same prices the utility charges customers elsewhere in its service territory. Will other incumbent energy utilities collaborate with land developers, local governments and local wholesale energy providers to achieve comparable initial results and greater long term energy resilience? The answer will vary from state to state in response to state policy and local government initiative.

Unlocking Local Renewable Energy Benefits

Energy policy in the U.S. is the collective responsibility of fifty U.S. states, most of which rely on regulated energy service providers for energy policy implementation. State energy policy is determined in close consultation with regulated for-profit energy utilities who may view local renewable transitions as an opportunity, a risk to current revenue streams and assets, or both.

California is aiming for state-wide carbon neutrality no later than 2045. Its core renewable transition strategies are to increase the renewable content of wholesale electricity supply and to electrify transportation. Where frequent and sometimes long duration public safety power shutoffs occur, expansion of centralized generation causes rather than mitigates local electricity service disruptions.

A more robust set of state strategies would maximize the affordable decarbonization benefits of large renewable projects by empowering expansion of local renewable supply, local energy storage, zero carbon and carbon negative local fuel production and zero carbon vehicle purchases. Resulting local investments and capacities are essential to local energy resilience. As local investments and capacities increase, the scope of energy services efficiently and cost-effectively delivered by regional utility monopolies shrinks, and the scope of services best offered competitively and locally expands, opening pathways and needs for local government engagement, especially regarding energy and economic resilience.

This means local governments will need to engage more actively in guiding local renewable energy transitions. Pathways to engagement differ depending on whether local energy service providers are publicly or privately owned.

California cities served by municipal utilities have more flexibility to plan and implement local renewable energy transitions. However, new municipal utilities are not being formed, in part because Community Choice, which has the perceived benefit of local control, can be implemented with minimal financial exposure. Collaborative municipalization of grid assets prior to deployment in newly developed residential, commercial or industrial areas is a more focused and selective approach to local government engagement in providing energy services.[xxi]

Other jurisdictions are served by regional, for-profit utilities. In these cases, existing relationships need to be renegotiated or unilaterally reset. For example, San Diego and other California cities are engaged in renegotiating the terms of their franchise agreements with energy service providers.[xxii] California cities and counties are also partnering to form locally governed Community Choice wholesale electricity procurement implementers.[xxiii]

Funding Local Renewable Energy Strategy Implementation

Legislatively required permitting teamwork between energy utilities and local governments enabled the growth and maturation of California's retail solar industry. Cities and counties added rooftop solar projects to their funded code enforcement chores. But energy utilities and local jurisdictions still do not pro-actively collaborate, share data or concern themselves with economic benefits of "customer self-generation". The growing importance of energy resilience may soon drive change in a collaborative direction. Energy management and engineering staffing to support local government engagement can be funded in part from municipal services revenues to ensure that non-energy services dependent on energy can be restored as quickly as possible during disaster recovery.

Other funding sources are available. Should cities and counties be allowed to tax local solar property when and wherever it has become cost-effective on a life cycle basis? Doing so in the past, when solar costs were considerably higher, might have impeded local solar deployment, but now taxing the full market value of solar powered homes is a plausible option to help pay for local government engagement that secures economic benefits of accelerated local renewable energy transitions.

State Policies Empowering Local Renewable Energy Transitions

Local governments may lack experience, information, capacities and empowerment to convert motivation into local policy and local policy into action. Local capacity building and collaborative local engagement can lay the groundwork for affordable local renewable energy transitions. In parallel, state legislatures can begin to dismantle barriers to economically beneficial local renewable energy production.

They can also reset the rules of utility cost recovery to level the playing field between centralized and local renewable deployment. Making investments in net positive annual on-site renewable energy production not only legal but economically rewarding should be at the top of state energy policy "to do" lists. Likewise, states that have standards for organic waste "diversion" can follow up by setting standards for conversion of organic waste to energy.

Burdens on state and local economies will increase every year until barriers to local renewable energy transitions are lowered. When will local net positive production be valued at the average cost of the utility's bulk electricity purchases plus transmission costs, rather than at marginal production costs of existing large power plants? When will California stop adding transmission charges on units of renewable electricity generated and delivered locally without passing through the regional transmission system? When will environmental impacts of centralized electricity production, storage and high voltage transmission be considered when setting policies affecting the balance between locally produced and imported renewable energy?

Summary

Progress toward local carbon neutrality can strengthen local economies and make them resilient against crippling disruption.

Local renewable energy transitions can out-pace state and national renewable expansion while addressing local environmental and economic injustices and filling a growing energy resilience gap. US cities and counties that succeed in accelerating local renewable transitions are acting in their economic self-interest. Planning and action in California to encourage investment in local solar energy production has already strengthened local economies in many important ways.

Four recommended local renewable energy transition strategies are to 1) adopt a locally specific vision, second, 2) identify and fulfill essential local government roles, 3) plan and implement local decarbonization and energy resilience programs, and 4) support growth and maturation of local private sector renewable deployment and retrofit capacities. Local governments and energy service providers have a shared strategic interest in targeting 1) net negative carbon fuel production, 2) net positive on-site solar electricity production, and 3) data-driven local energy resilience planning.

References:

[i] https://www.bloombergquint.com/business/solar-and-wind-power-top-growth-in-renewable-energy-worldwide
[ii] https://www.seia.org/research-resources/solar-market-insight-report-2020-q3
[iii] Ibid.
[iv] G. Braun, Local Fuel Gas Decarbonization and Resilience for Southern California, 2020, https://static1.squarespace.com/static/5a68cb054c326de534999b1b/t/5f04de534047b3435f24780e/1594154585215/Local+Gas+Fuel+Decarbonization+and+Resilience+for+Southern+California+-+7-5-20.pdf
[v] https://resources.ca.gov/CNRALegacyFiles/docs/climate/01APG_Planning_for_Adaptive_Communities.pdf
[vi] G. Braun, State Policies for Collaborative Local Renewable Integration, 2019, https://www.sciencedirect.com/science/article/pii/S1040619019302969
[vii] https://microgridknowledge.com/camarillo-microgrid-project/
[viii] http://www.cogeneurope.eu/medialibrary/2015/05/19/d6648069/miro-CHP%20study_merged.pdf
[ix] https://www.greentechmedia.com/articles/read/everything-you-need-to-know-about-californias-new-solar-roof-mandate
[x] https://cecgis-caenergy.opendata.arcgis.com/pages/pdf-maps
[xi] https://www.seia.org/initiatives/community-solar
[xii] https://www.nrel.gov/analysis/solar-installed-system-cost.html
[xiii] Marisa Sotolongo et al.,https://iejusa.org/wp-content/uploads/2020/10/V3.3-Policy-Brief-CA-Shutoffs-Data-Brief.pdf
[xiv] G. Braun and S. Hazelroth, Energy Infrastructure Finance: Local Dollars for Local Energy, 2016, https://www.sciencedirect.com/science/article/pii/S1040619015001104
[xv] https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities
[xvi] https://www.socalgas.com/1443741887279/SoCalGas_Renewable_Gas_Final-Report.pdf
[xvii] G. Braun, Integrated Energy Analysis for Davis, California, 2015, https://www.researchgate.net/publication/299782138_Integrated_Energy_Analysis_for_Davis_California
[xviii] https://www.contracosta.ca.gov/DocumentCenter/View/55843/Final-Contra-Costa-County-Renewable-Resource-Assessment-Technical-Report
[xix] https://www.davisenterprise.com/news/local/criticism-of-brightnight-agreement-continues/
[xx] B. Nordman and K. Christensen, Local Power Distribution with Nanogrids, https://www.researchgate.net/publication/261465587_Local_power_distribution_with_nanogrids
[xxi] https://www.greentechmedia.com/articles/read/california-town-tests-new-model-for-microgrids-as-a-service
[xxii] https://www.voiceofsandiego.org/topics/science-environment/environment-report-new-mayor-council-draw-lines-in-franchise-fee-battle/
[xxiii] https://en.wikipedia.org/wiki/Community_Choice_Aggregation