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Energy Infrastructure Finance: Local Dollars for Local Energy

Transitioning to clean, climate-friendly and smarter electricity systems means bringing innovative, capital-intensive, and increasingly decentralized power sector infrastructure on stream. National, state, and local policy should recognize and address the implications for finance, particularly the need for investments that capture and optimize local economic benefits.

Gerry Braun and Stan Hazelroth

I. Introduction

In California[1] and the U.S., mature, centralized energy grid infrastructure exists. So does centralized, fuel-intensive electricity supply infrastructure. Transitioning to clean, climate-friendly and smarter electricity systems means bringing innovative, capital-intensive, and increasingly decentralized power sector infrastructure on stream. National, state, and local policy should recognize and address the implications for finance, particularly the need for investments that capture and optimize local economic benefits.

In this regard, we see an urgent need for policy research that informs movement toward a new balance of planning and investment between centralized (Washington, state capitals, and Wall Street) and local. Lacking local empowerment, we see decentralization occurring anyway as a natural evolution, with trial and error adding cost and extending time frames.

1040-6190/, http://dx.doi.org/10.1016/j.tej.2015.05.008

II. Electricity[2] Infrastructure Investment Overview

When electricity infrastructure was first deployed on a large scale, related capital requirements were disproportionate to publicly supportable tax revenue streams. To facilitate balance sheet financing and preclude duplication of grid infrastructure, electric and later natural gas utilities organized as stock corporations were granted monopoly franchises.

The economic boom after World War II resulted in mega-works in water, transportation, and education funded at the state and federal level, with a single entity planning and building each of these systems. Publicly owned energy utilities formed somewhat later in parallel with the continued expansion of investor-owned utilities.[3]

Energy infrastructure investment enabled the creation and expansion of electricity and natural gas grids spanning the North American continent. As these grids and usage became pervasive, relatively little natural gas or electricity was produced locally.

Now, as transformative and locally applied solar, information, and automotive technologies become pervasive in the power sector, they will overlay rather than supplant the older, centralized, and less portable technologies.[4] It is reasonable to assume owners of existing power sector assets will continue to reap the revenues they generate and will invest as necessary to assure their continued productivity. However, other major industries will have an increasing role, directly providing electricity customers with products and services that reshape the U.S. power sector.

III. Ongoing Power Sector Transformation

Power sector decentralization has significant potential to create local economic opportunity. Other forces have already altered the power sector landscape and will continue to do so, including demand stabilization, industry structure, merchant power plants, and renewable electricity portfolios.

Energy demand changes have consequences. **Figure 1** shows that power sector investment in the U.S. declined in the late 20th century as a consequence of slowing population and demand growth, impacting all three major power sector investment categories, i.e. generation, transmission, and distribution.[5]

A. From vertical integration to commoditization

Introduction of competitive frameworks for sourcing electricity (aka ''restructuring'') has resulted in partial ''delamination'' of vertically integrated electricity systems in some states, notably California, opening market windows for merchant plants and brokered electric generation services. Meanwhile, net energy metering of solar electricity systems creates cost saving opportunities for increasing numbers of electricity customers.

Figure 2 shows the recent evolution in California's

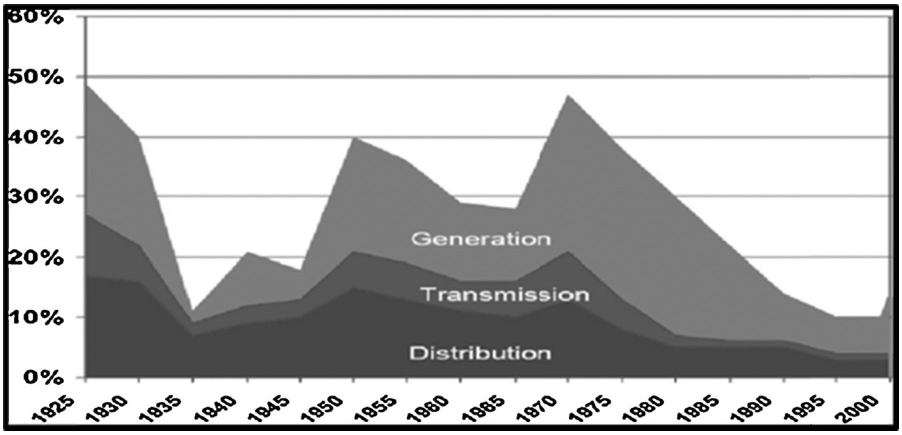

Figure 1: Declining Investments (as Share of Revenues) in the US Electricity Sector, 1925–2000
Source: http://www.globalenergyassessment.org/, Chapter 6, p. 409) from EPRI data, 2003.

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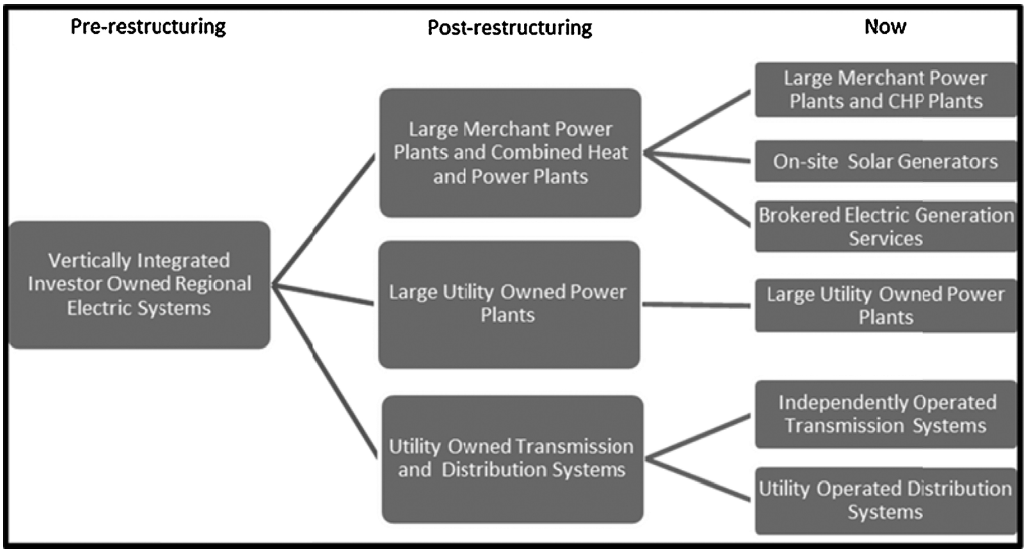


Figure 2: Elements of California Regional Electric Systems

state-regulated electricity sector, from vertically integrated electric systems to systems that rely on merchant as well as utility-owned power plants, and finally to systems that now are beginning to rely on a mix of centralized and decentralized supply. Meanwhile, vertically integrated electric systems relying on centralized generation remain the norm in much of the U.S., including most western states.

B. Power sector transformation is a work in progress

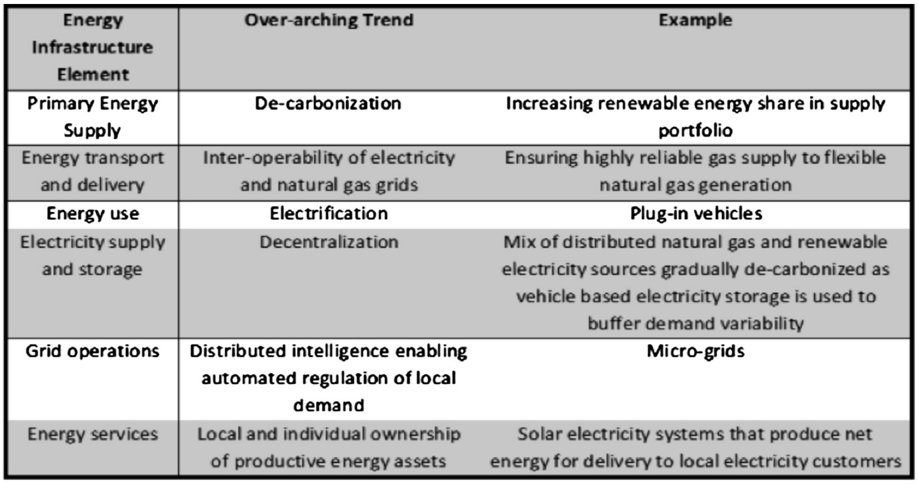
Table 1 concisely summarizes and gives examples of the overarching trends that may further reshape our electricity infrastructure and require adjustments in how electricity infrastructure is financed.

Lessons from renewable power deployment experience are driving trends. In California we are already encountering costs and delays in deploying solar and wind equipment in centralized configurations. This motivates policies that replace the current centralization paradigm with a more balanced approach.

Local policies may also shift as the need increases to balance local electricity supply and demand. Local electricity infrastructure will need to be smarter. In an increasing number of cases local investment and ownership may be motivated by economic advantages accruing to communities that choose to reduce or eliminate their dependence on imported energy.

The matter of local policy would probably be moot if local energy finance were just as expensive and complex as centralized energy finance. It is not. Further, local finance is the key to flexibility and benefits to the local economy.

?**Table 1:** Energy Infrastructure Trends Summary.



Energy Infrastructure Element	Over-arching Trend	Example
Primary Energy Supply	**De-carbonization**	**Increasing renewable energy share in supply portfolio**
Energy transport and delivery	Inter-operability of electricity and natural gas grids	Ensuring highly reliable gas supply to flexible natural gas generation
Energy use	**Electrification**	**Plug-in vehicles**
Electricity supply and storage	Decentralization	Mix of distributed natural gas and renewable electricity sources gradually de-carbonized as vehicle based electricity storage is used to buffer demand variability
Grid operations	**Distributed intelligence enabling automated regulation of local demand**	**Micro-grids**
Energy services	Local and individual ownership of productive energy assets	Solar electricity systems that produce net energy for delivery to local electricity customers

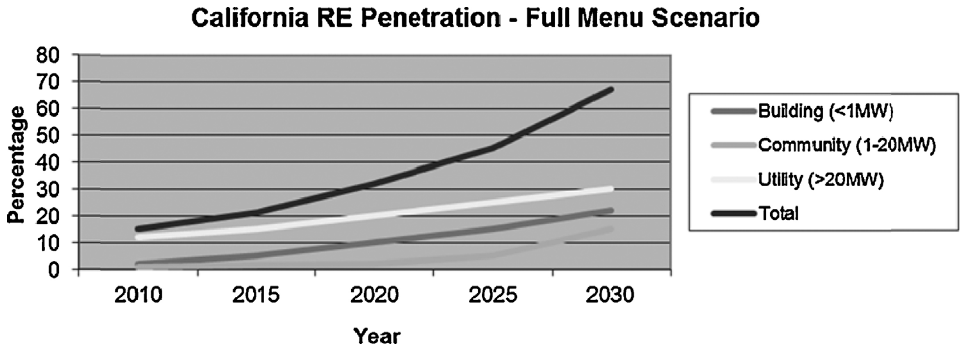


Figure 3: California Renewable Energy Deployment Scenario Assuming All Pathways and Cost-Effective Technologies Enabled
Source: Integrated Resources Network, www.iresn.org.

The pace of renewable energy expansion varies according to resource choices and project scale. Globally, investment in renewable electricity power plants began to surge a decade ago. Historically, larger projects predominated. Annual global investment now exceeds $200 billion, approximately 40 percent of which is in ''small distributed capacity.''[6]

Following the emergence of solar power, the size range for renewable power plants expanded and now spans five orders of magnitude, from kilowatt-scale residential solar projects to large plants of hundreds of megawatts. Figure 3 suggests a scenario where California's renewable electricity portfolio becomes more balanced between contributions from centralized and distributed resources.

New, pervasive building- and community-scale electricity supply technologies have infrastructure consequences. Decentralized and IT enabled deployment of modular energy supply and storage technologies are creating opportunities for more pervasive local participation in energy infrastructure ownership and finance. As more electricity is by or close to electricity customers, local power flows will be bi-directional rather than unidirectional in the past, as shown conceptually in Figure 4.

Figure 4: Current (top) and Future (bottom) Electric System Power Flows
Source: Integrated Resources Network, www.iresn.org.

http://dx.doi.org/10.1016/j.tej.2015.05.008

IV. Power Sector Finance Overview

A. Utility finance

Ownership of infrastructure that delivers electricity to customers has been split in the U.S. between vertically integrated, investor-owned utilities (IOUs) and publicly owned utilities (POUs), i.e. municipal utilities and rural co-operatives.

In recent decades incremental electricity delivery investments have been primarily driven by population growth, with modest effects on costs experienced by electricity customers. Even so, from 2000 to 2012, U.S. IOUs serving 73 percent of U.S. electricity customers invested an average of $32 billion per year in transmission and distribution assets.[7] In a comparable period POUs serving 27 percent of U.S. electricity customers invested approximately $15 billion per year in power-related projects.[8]

Along with electricity transmission and distribution infrastructure, utilities finance power plants on their balance sheets.[9] However, IOU and POU models for finance differ in important respects.

The obvious finance-related difference is cost of capital. Cost of capital calculations and comparisons must account for capital structure (mix of debt and equity), interest cost, debt life, cost of equity, federal and state corporate income taxes, property taxes, post-tax cost of equity, depreciation, and book life.

Electric utility costs of capital vary over a fairly wide range depending on the state of the economy, but regardless of absolute values there is typically a 5 percent point spread by which IOU capital charge rates exceed POU capital charge rates. For example, in a specific recent comparison, required costs of capital incurred by an incumbent IOU were estimated at 9.75 percent, or about twice the interest rate estimated for a new local POU.[10]

A less obvious difference is rating agency evaluations that determine bond ratings and therefore cost of debt-secured by bonds. **Figure 5** shows that the median of POU bond ratings significantly exceeds the median for IOU bonds. The American Public Power Association attributes the difference to local regulation that is generally faster, more responsive to changing conditions, and more supportive of cost-recovery than the lengthy process IOUs experience before state commissions.[11] We agree and note that the comparison has implications for trade-offs between public and private finance of local electricity infrastructure modernization and transformation.[12]

Finally, the mix of investors differs between IOUs and POUs. Fifty percent of POU investor dollars comes from households.[13]

B. Large independent power project finance

The focus of power sector finance innovation of the late 20th century was project finance. Its application to renewable power has been transformative; it is still the primary finance model for wind. Technology maturation, predictable revenue streams, and tax incentives, i.e. credits and accelerated depreciation, have reduced the weighted average cost of capital for large merchant solar and wind power plants below the cost of financing such

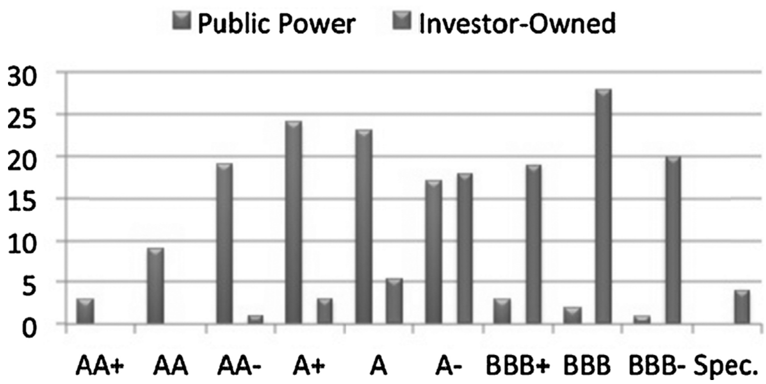


Figure 5: Comparative Ratings Distribution
Source: http://www.publicpower.org/Media/magazine/ArticleDetail.cfm?ItemNumber=36196.

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plants on the balance sheets of investor-owned utilities.

Globally, investment in project financed renewable power plants is at parity with investment in non-renewable power plants. Off-takers, i.e. purchasers of electricity from large merchant plants, can be utilities or large energy users, and utilities can have a role in delivering electricity the users purchase.

As power sector transformation progresses, new finance mechanisms overlay old.

Table 2 summarizes assets, plus capital and revenue sources, for historical mechanisms and recent overlays that have had time to mature.

C. Solar power finance

Until recently municipal and rural utilities or industrial energy users financed most local and on-site power in the U.S. Now a diverse array of private capital sources is being tapped to enable local solar power installations.

Economic stimulus legislation in the wake of the great recession raised a wave of utility-scale wind and solar projects.[14] It also helped drive volume in rooftop systems, resulting in more rapid maturation and cost-efficient operations of residential and commercial rooftop system retailers.

Since solar panels usually carry manufacturer's warranties, and, since a solar plant's annual production is highly predictable, the risk of under-production or other surprises is relatively low. Low risk/low cost capital, short project lead times, and in some cases 100 percent debt, has helped prices for utility-scale solar and wind power plants to become competitive.

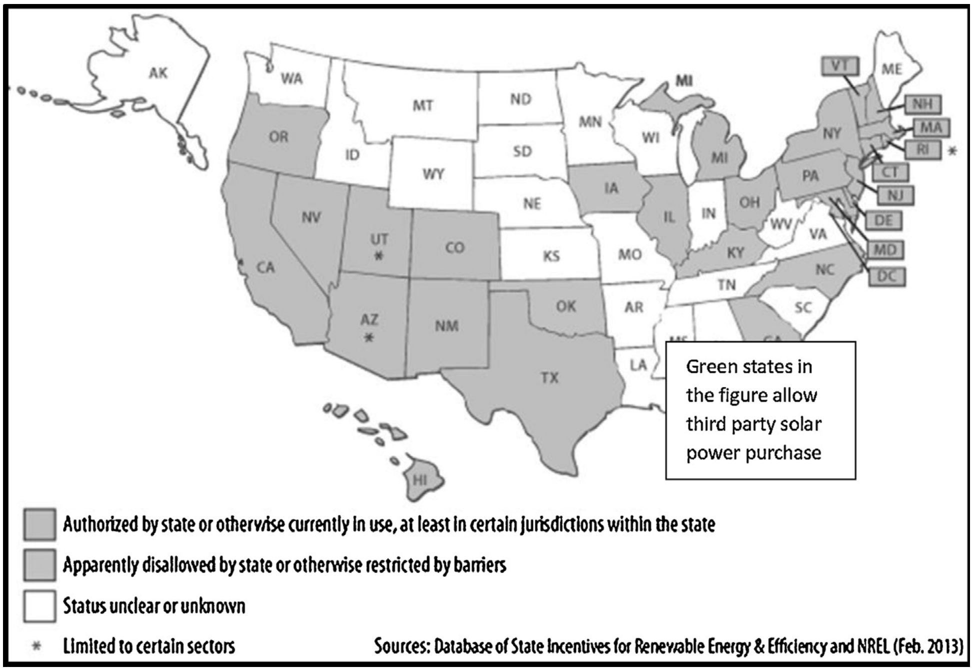
Table 2: California Bulk Electricity System Finance Overview[a]

Asset Description	Capital Source	Revenue Source
Vertically Integrated Utility Assets	Owners of Corporate Stocks and Bonds	Power Sales to Retail Electricity Customers
Large Merchant Power Projects	Equity Investors and Lenders	Power Sales to Electricity Retailers
Public Power Generation and Transmission Assets	Revenue Bond Holders	Generation and Transmission Cooperative Power Sales to Local Distribution Cooperatives
Publicly Owned Electricity Distribution Infrastructure	Revenue Bond Holders and Annual Capital Budgets	Power Sales to Retail Electricity Customers
Electricity User Owned Electricity Distribution Infrastructure	Rural Utility Service (Loans) and Distribution Cooperative Annual Capital Budgets	Power Sales to Retail Electricity Customers
Local Electricity Supply Portfolios	Rural Utility Service (Federal Agency), Equity Investors and Local or Regional Banks	Rural Cooperatives, Municipal Utilities, Community Choice Aggregators and Electricity Customers (indirect)

[a] The California Energy Commission identifies three generic finance models for electricity supply: investor-owned utility (IOU); publicly owned utility (POU); and merchant power plant. The IOU has a higher cost of borrowing than the POU. Merchant power plants are financed according to a variety of strategies adjusted to account for market, technology, and fuel risk, tax avoidance and/or credit opportunities, and the plant's assumed economic life and/or power purchase agreement term. Most new plants approved in California fall in the merchant category. In the years ahead, the trend away from financing on the balance sheets of investor and publicly owned utilities may extend the trend toward increasing financial innovation, diversity, and complexity.

Solar electricity started as a ''cash and carry'' market. The evolutionary next step in the finance of building scale solar system included adaptations of strategies for financing larger energy projects and also strategies for financing building construction and renovation. For example, rooftop solar electricity systems for new and existing homes could either be included in a mortgage or home improvement loan. Alternatively, the residential developer or commercial building owner could arrange for third-party ownership of the solar equipment and related efficiency measures based on payment by the building owner for ''energy services.''

The first finance sector involvement in solar energy hinged on simplifying finance models for large merchant plants to fit the parameters of small merchant plants. Low-cost debt, plus the modularity and plug-and-play attributes of solar PV enable specialized companies to offer solar electricity at the price a building owner would otherwise pay the incumbent utility, with third-party investors owning the rooftop system and capturing available state and federal incentives. Initial projects, many in California, were on large roofs of big box retailers, warehouses, and wineries.



Green states in the figure allow third party solar power purchase

Sources: Database of State Incentives for Renewable Energy & Efficiency and NREL (Feb. 2013)

Figure 6: Third-Party Solar PV Power Purchase Agreements

Because IOUs are protected from competition in state law, state legislation has been required to authorize such third-party solar power purchase agreements in their service areas, and the authorization process is still incomplete in the U.S., as suggested by **Figure 6**.

In just the past few years in California, solar finance innovation began to focus on residential projects. Just as with larger commercial building and utility-scale plants, highly predictable revenues and portability of assets trimmed debt coverage ratios. Tax incentives and equipment performance warranties up to 25 years whittled down the present value of required payments to lenders. Meanwhile, economies of production scale and fierce competition within solar-related industries drove both prices and costs down, and global demand for panels that exceed supply eroded manufacturer price-cost margins. The combined effect was to bring ''grid parity''[15] within reach, with solar electricity prices beginning to undercut grid electricity prices, especially in the residential sector of the California solar electricity market.

Financial sector participation has expanded and evolved in a number of ways. As the rooftop solar electricity market developed, some lending institutions partnered with solar companies to offer the equivalent of home equity loans. In the same period, big box stores partnered with manufacturers to create programs that referred homeowners to local contractors and lenders while directly extending credit for rooftop solar purchases. Meanwhile, some manufacturers and major distributors started offering leasing programs.

Next, pioneered by national solar retailers like Solar City and Sungevity, bundling of revenues from solar leases, loans, and power sales agreements emerged, bringing to mind the bundling of residential mortgages that contributed to financial crises in the U.S. and other countries. Bundling allows Wall Street to ''collateralize'' financial transactions that, unbundled, would be left to local banks and investors.[16]

D. Net metered solar power[17]

The impetus for the initial and continuing expansion of the rooftop solar electricity market in the U.S. has been the gradual proliferation of state laws enabling net energy metering (NEM) of rooftop solar electricity.[18]

Now, in California and many other states, NEM of on-site solar electricity is creating ownership and finance opportunities for new industries, for energy users, and for local businesses, investors, and government jurisdictions. These opportunities, if captured, may allow local energy dollars to recirculate to a greater extent within local economies.

Small solar power projects save money for residential and commercial building owners that either have tax obligations or can qualify vendor or third-party financed installations. Renters or other owners may be eligible for long-term loans from local government or utilities that are repaid by property tax or utility bill add-ons (''property-assessed clean energy'' and ''on-bill financing''). Additional mechanisms to give electricity customers access to solar cost savings are being piloted (e.g. solar as a standard new home feature financed on the new home mortgage, and ''crowd funding''/project finance of community based solar generators, crediting output to renters and others lacking control of suitable roof or ground space for a solar array.)

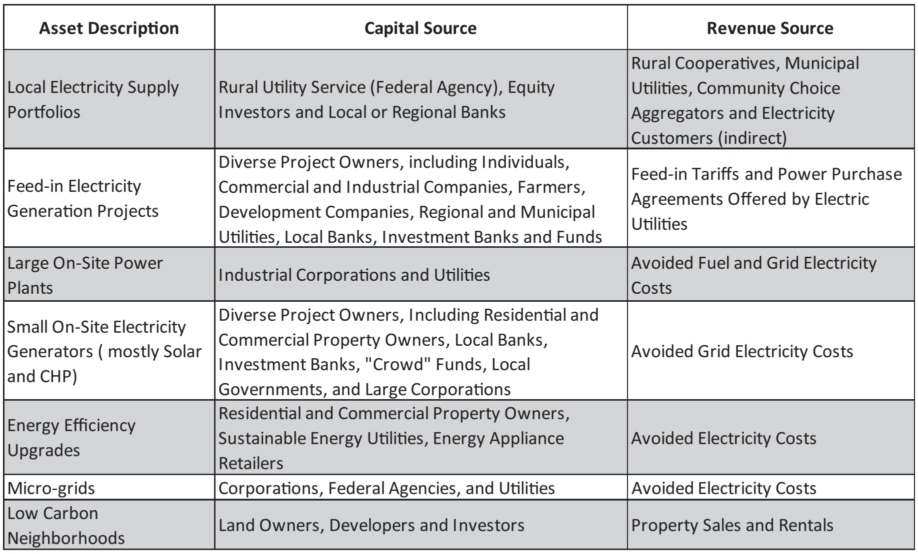
The emerging economic viability of capital-intensive small generators also opened the door to adaptation of finance models previously used for capital-intensive commercial and consumer items like homes and vehicles. Keys, in the case of rooftop solar, included revenue predictability and asset portability. Basically, shifts in ownership opportunities account for the ongoing proliferation of finance models. In most cases they are not so much new models as new applications of existing models to the power sector. **Table 3** summarizes the assets, plus capital and revenue sources, for California's deployment of decentralized energy sources.[19]

California's decentralized energy deployment to date has hinged on net metering, because of utility resistance to feed-in tariffs. This may need to change. Typically, NEM implementation by utilities limits low-cost distributed electricity production at an electricity customer's site to the customer's historical annual usage. This leaves money on the table, i.e. the savings from lower marginal costs of ''oversizing'' solar generation capacity at the same site.[20]

It also limits investment in cost-effective rooftop solar. Many interested and qualified potential solar electricity customers in California are turned away, not because their roofs are too small but because their energy usage is too low to justify the costs of an undersized rooftop PV system.

In a net zero community context, leaving unshaded roof and parking area space unused because of NEM limitations simply drives up the cost of

?**Table 3**: California Decentralized Energy Finance Overview.



Asset Description	Capital Source	Revenue Source
Local Electricity Supply Portfolios	Rural Utility Service (Federal Agency), Equity Investors and Local or Regional Banks	Rural Cooperatives, Municipal Utilities, Community Choice Aggregators and Electricity Customers (indirect)
Feed-in Electricity Generation Projects	Diverse Project Owners, including Individuals, Commercial and Industrial Companies, Farmers, Development Companies, Regional and Municipal Utilities, Local Banks, Investment Banks and Funds	Feed-in Tariffs and Power Purchase Agreements Offered by Electric Utilities
Large On-Site Power Plants	Industrial Corporations and Utilities	Avoided Fuel and Grid Electricity Costs
Small On-Site Electricity Generators (mostly Solar and CHP)	Diverse Project Owners, Including Residential and Commercial Property Owners, Local Banks, Investment Banks, "Crowd" Funds, Local Governments, and Large Corporations	Avoided Grid Electricity Costs
Energy Efficiency Upgrades	Residential and Commercial Property Owners, Sustainable Energy Utilities, Energy Appliance Retailers	Avoided Electricity Costs
Micro-grids	Corporations, Federal Agencies, and Utilities	Avoided Electricity Costs
Low Carbon Neighborhoods	Land Owners, Developers and Investors	Property Sales and Rentals

getting to net zero. Economic optimization of local solar assets, may, for an increasing number of communities, be the key to stable and affordable electricity prices and local economic benefits of local solar electricity deployment. The policy choice between more economically rational implementation of NEM and more aggressive use of feed-in tariffs deserves timely and objective attention.

E. Electricity feed-in tariffs

As discussed above, in the future, feed-in mechanisms in the U.S. could be a complement to or an adaptation of net metering.[21] In Germany, projects financed on the strength of FIT revenues have already delivered on our vision of ''local dollars for local energy.'' Figure 7 shows that local investment accounts for half of all renewable energy deployment funding in Germany. Across Germany, a rural energy revolution is underway. Communities are benefiting from new jobs and increasing tax revenues, an important outcome in the wake of the debt crisis in the Eurozone.[22] The switch to renewables has also greatly strengthened small and midsize businesses, and it has empowered local communities and their citizens to generate their own renewable energy.

The German transition started when both solar and wind electricity were relatively expensive by current standards. By 2011, more than half of the investments in German renewables had been made by small investors. The German energy transition has been and is being driven by citizens and communities. Germans want clean energy, and a lot of them want to produce it themselves. Large corporations, on the other hand, have invested relatively little so far.

By comparison, small-investor ownership of renewable electricity assets in the U.S. is miniscule by comparison with Germany's 50 percent. This has the effect of strengthening Wall Street's role in energy infrastructure finance, while leaving Main Street and local economies on the sidelines.

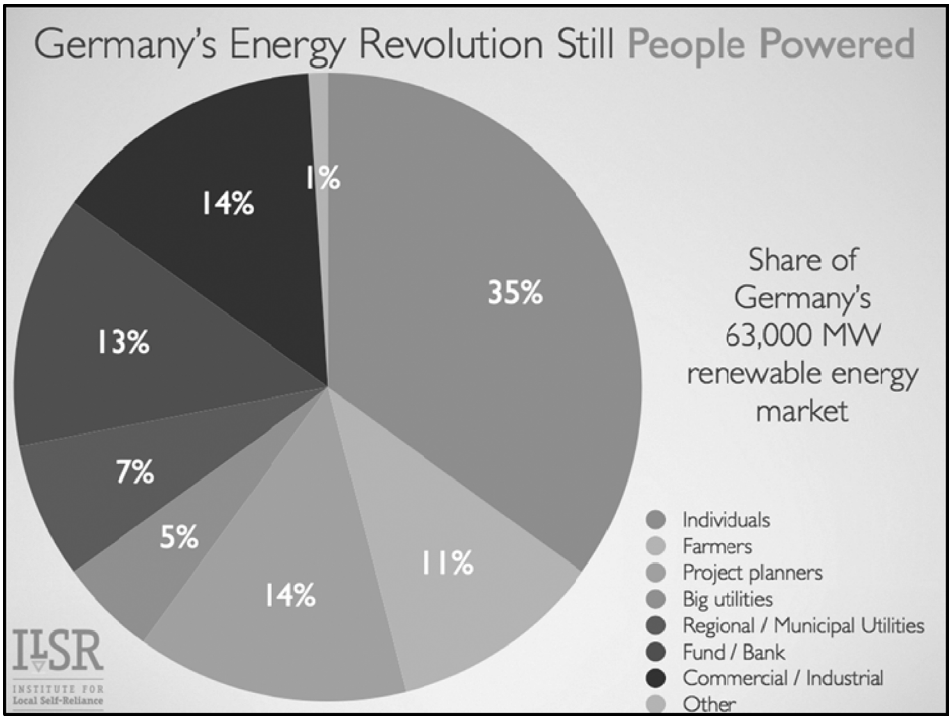


Figure 7: Balance between Small and Large Investors in German Renewable Energy Supply

http://dx.doi.org/10.1016/j.tej.2015.05.008

V. Local Power

A. Public investment considerations

Historically, in California and some other states, low-cost hydroelectric power from federal dams was available to municipal and rural utilities and state university campus distribution grids. ''Preference power'' motivated the launch of many early local electric utilities, as did low-cost finance available to rural utilities.

The following additional motivators emerged in recent decades. Local elected officials are more directly in touch with public concern about energy costs than distant state legislatures. Local concerns about electricity costs in some regions are leading to increasing interest in creating and expanding local electricity service. Rate competition between municipal agencies and investor-owned utilities (IOUs) generally favors local entities because of access to lower cost capital and flexibility to tailor budget allocations to local needs and priorities.

The competitive balance is likely to shift further in favor of local agencies that are able to identify and effectively support development of cost-effective local clean energy resources.

Advocates of climate action are finding that locally governed entities, e.g. community choice aggregators (CCAs), have the flexibility to adjust generation portfolios consistent with local climate action plans. Importantly, they also have the option to source locally generated power, whereas regional utilities may lack motivation and organizational capacity to optimally deploy distributed renewable resources that support local de-carbonization goals.

Local and individual ownership of productive energy assets can address this problem. In California, local banks have provided both working capital for Sonoma Clean Power, early take-out financing for Marin Clean Energy, and loans to their customers who invest in energy efficiency upgrades.

Table 4 summarizes these and other reasons local jurisdictions and agencies choose to have a role in the financing of energy infrastructure and supply.

Table 4: Historical Reasons for Local Financing of Energy Infrastructure and Supply[a]

	Timing	Implementation	Specific Example
Access to Low Cost Power	Historical	Municipal Utilities and Campus Distribution Grids	University of California Campuses
Access to Low Cost Finance	Historical	Rural Generation and Transmission Cooperative	Associated Electric Cooperative: IA, MO, OK
Local Control of Electricity Costs	Emerging	Public Power In General	Sacramento Municipal Utility District
Local Control of Environmental Impacts	Emerging	Community Choice Aggregation	Marin Energy Authority
Local Economic Development	Emerging	Rural Electricity Distribution Cooperative	Plains Electric Generation and Transmission Cooperative: NM
Response to Decentralized Energy	Emerging	Local Integrated Energy Resource Planning	Sonoma Clean Power

[a] In New York, the Hurricane Sandy Recovery Task Force, HUD, and DOE are providing funding and technical assistance to support the planning and implementation of resilient energy communities using microgrid and other distributed generation and storage technologies through the Green Bank Resilience Retrofit program.

B. Community renewable energy

Shared renewable energy arrangements allow several energy customers to share the benefits of one local renewable energy power plant. A shared renewables project pools investments from multiple members of a community and provides power and/or financial benefits in return. There are at least 52 shared renewables projects in 17 different states throughout the U.S.[23]

When the power is supplied strictly by solar energy, it is sometimes called ''community solar.'' Community solar is defined as a solar-electric system that, through a voluntary program, provides power and/or financial benefit to, or is owned by, multiple community members.

''Community wind'' is defined more inclusively, i.e. community wind projects are locally owned by farmers, investors, businesses, schools, utilities, or other public or private entities that utilize wind energy to support and reduce energy costs to the local community. In Denmark, the birthplace of community wind, about 80 percent of installed wind capacity is individually or co-operatively owned; in Germany it's about 51 percent. Sweden also has ''co-operative wind,'' and the community wind market in the UK is growing. Community wind got a late start in the U.S. but accounted for more than 5 percent of the overall U.S. wind market by the end of 2010.[24]

C. Financing decentralized electricity supply for local distribution

Financing tools that facilitate recycling of local dollars locally have emerged alongside traditional methods of local infrastructure finance, notably in the context of solar and wind energy distributed generation (DG) deployment. They include energy user financing of DG systems, long-term power sales agreements with energy consumers yielding revenue streams enabling local bank financing of rooftop solar electricity systems owned by local companies, and loans for energy upgrades that are retired via surcharges on utility and local property tax bills.[25]

Some local renewable resources, including biomass and geothermal DG, are subject to resource depletion (geothermal) or uncertain feedstock availability (biomass) over the longer term. Otherwise, most DG, including solar and wind, has highly predictable annual productivity, greatly reducing finance risks.

Generating electricity locally to meet local needs, while technically and economically advantageous in concept, undermines the premise for granting regional utilities monopoly franchises to provide local service. For this and other reasons, it is a missed opportunity for most regional utilities. States can set goals for ''distributed generation,'' but until regional monopolies see a pathway for distributed generation deployment that does not result in ''revenue erosion'' and/or evoke the specter of corporate ''death spirals,'' they may seek to erect legislative and regulatory barriers to local financing of local energy production. The realistic possibility that barriers will be erected is a risk that must be considered in financing a local renewable electricity generator.

D. Staged financing of electricity supply for local distribution

In the renewable project finance environment created by the American Recovery and Reinvestment Act, tax and depreciation benefits are captured immediately or in the early years of project operation, making it possible for a publicly owned utility to purchase power initially from a renewable project, and then, based on pre-agreed arrangements, take out the private investors and finance the purchase with long-term low-cost debt.

This staged approach has been successfully applied in California by a municipal utility to a wind power plant outside the municipal utility service area.[26] It seems a natural evolutionary step to apply it, for example, to smaller, locally based solar electricity projects, now that solar electricity projects are able to leverage feed-in tariffs to capture initial tax-leveraged financing. The opportunity is available to California POUs and CCAs.

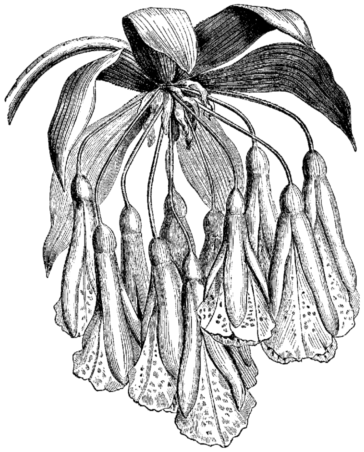
Data centers and other critical infrastructure are turning to battery-coupled solar power systems to capture cost savings and reliability assurance. Some of these facilities may have a much shorter life than their on-site electricity generators, creating opportunities for financial win-win arrangements between initial and later stage generation owners and customers.

E. Financing new electricity service providers

In general, the pace of investment in electricity distribution infrastructure will need to keep up with the pace of investment in decentralized electricity supply and new electricity uses. The need to make local grids smarter and more flexible means local grids will account for an increasing share of electric utility capital investment and asset value. The choice between public and private finance for new local grid infrastructure will be important. Fortunately, new avenues for state facilitation of low-cost public finance are available or in development.

Specifically, California has an Infrastructure and Economic Development Bank that has broad powers to finance 16 categories of California infrastructure, including energy projects. Though little used so far in energy, the bank has published a paper adding green bank loans to its work plan. Few states have banks with such broad statutory authority, but green banks are popping up in many states.

Gov. Jerry Brown and the legislature are moving forward to enhance a program that addresses the void left by the dismantling of California's $5 billion per year redevelopment programs. The governor is proposing in his budget to bring some elements of the program back. The centerpiece of the plan is to use infrastructure finance districts (IFDs), which have taxing authority once created by voters.



F. Strategic importance of existing local public power agencies

POUs may be deterred from embracing decentralized energy technologies by perceived risks. Even so, they are inherently more aware and responsive to local opportunities and concerns than private sector corporations headquartered in distant cities. We must look primarily to incumbent public power entities to embrace and advance the vision of ''local dollars for local energy.'' In California, new CCAs in Marin and Sonoma County are doing just that.

G. Rural/urban clean energy symbiosis

Originally authorized to enable rural electrification, rural co-operatives provide a model for local ownership of local energy assets and shared ownership of centralized generation assets and transmission capacity to deliver electricity to local grids.[27] Urban population centers are the consumers of much of the electricity and natural gas generated and produced in distant central station power plants and natural gas fields. A city typically consumes far more electricity than renewable resources within its boundaries can economically supply under current market restrictions. Meanwhile, as the German experience demonstrates, most rural areas have potentially developable renewable resources that far exceed their own needs. To economically benefit they need to export. So, there are important potential synergies.[28]

Local investment in electricity export opportunities strengthens rural economies and creates jobs.[29] In some rural areas landowners are able to economically benefit simply by leasing land to wind and solar power developers. Where private or local public land can serve as collateral for renewable project loans, there is a better opportunity

http://dx.doi.org/10.1016/j.tej.2015.05.008

for local investment. However, some resource-rich areas are federally owned, e.g. forested areas of northern California. Advocates in northern California have also identified financing and transmission access barriers. Leaders of the USDA and its Rural Utility Service have expressed interest in addressing them.[30]

H. Pivotal role of 'incentives'

Since 2007, the financing of large energy projects has been negatively impacted by the weak economy, as ''tax equity'' availability has dwindled according to limited returns on investment. The impact on electricity infrastructure and continued expansion of renewable electricity production in the U.S. would have been substantial, had U.S. economic stimulus legislation, The American Recovery and Reinvestment Act of 2009 (ARRA), not targeted clean and smart energy.

In the 1990s, the federal government instituted a renewable electricity ''production'' tax credit (PTC) for non-solar renewable electricity sources, as a complement to an originally modest (10 percent) investment tax credit (ITC) available for solar electricity sources. PTC is a per-kilowatt-hour tax credit for electricity generated by qualified energy resources.

To compensate for temporarily limited investor appetite for tax incentives during a deep and extended recession, ARRA reset the expiration of the solar ITC to 2016 and increased it from 10 percent to 30 percent, while also extending five-year tax depreciation to 2016 for solar. ARRA also created a short time window during which taxpayers and projects eligible for the ITC could receive an equivalent amount of cash up front in lieu of tax credits. Likewise, ARRA created a short time window during which taxpayers and new projects eligible for the PTC could opt for either the federal business energy ITC or cash in lieu of the ITC.

The biggest initial beneficiaries of ARRA's renewable energy incentives have been utility-scale solar and wind, respectively, but they have also led to a tipping point in U.S. deployment of distributed solar PV. National and state incentives will presumably be set according to national and state goals, but local jurisdictions can also provide incentives according to their interest in encouraging local investment in local electricity infrastructure.

VI. Conclusions

Pent up local electricity generation investment will drive lagging local energy infrastructure investment. Finance innovations undergirding local supply investment have already been transformative. Navigating the transition to increasingly decentralized energy supplies and infrastructure presents multiple obstacles to both mature and experienced public power entities and their investor-owned counterparts. Newly created entities will enjoy the relative freedom to adapt. Obviously it is in the broader shared public interest to maximize effectiveness of both emerging and established market participants.

Increasing public ownership of energy infrastructure may be a necessary condition for adequate investment and innovation. Transformative changes in energy supply and delivery technology and markets may compel changes in energy infrastructure finance. The balance may have to shift toward public ownership of distribution infrastructure if innovation and investment continue to lag.

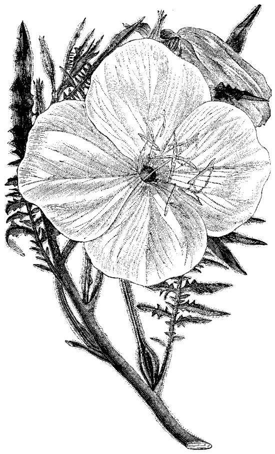
The pace of investment in local energy delivery infrastructure must increase. It currently lags the pace of cost saving distributed generation investment in some communities and regions, where it is already a bottleneck.

Promising to fill the gap, a decentralized energy (DE) revolution is underway. DE saves money by relying on new technologies characterized by predictable economic performance, rapid maturation, and decoupling from the price of carbon. We anticipate an energy services finance paradigm shift driven by the economics of transformative technologies, in particular the opportunities for cost savings through less restricted local power flows and use of clean and efficient on-site generation. The DE revolution will create new revenue streams and drive a shift in the balance and sources of public and private capital for electricity infrastructure. We believe a mix of public and private sector investment in energy infrastructure can continue to offer opportunities for economic optimization, but we also believe the best source of private sector investment in local supply infrastructure will be local energy consumers, and local businesses.

DE adoption can be impeded in the U.S.; over the long term, it cannot be stopped. Comparably sized competitive industries (IT, auto, and solar) are already financing/selling decentralized electricity products, using finance innovations to break through utility industry resistance.

Engaging in energy planning and investment responsive to local needs and opportunities can empower local communities. With electricity generators increasingly localized and with distribution systems needing to accommodate bi-directional energy flows, the economic model that regards them as undifferentiated elements of a larger energy supply pool do not remain valid for pricing or capital allocation purposes.

Change is a given; whether it is orderly or chaotic is a choice. In the past electricity distribution costs and investments were roughly indexed to numbers of meters. In the future ''virtual'' NEM electricity exchange arrangements will stimulate distributed generation infrastructure investment.



New local energy agencies are the leading edge of a new energy infrastructure paradigm. In the future, capital needed to maximize productivity of energy assets will be best allocated by local investors rather than Wall Street.

There are mutual benefits of regional standardization and local flexibility. Newly created public entities must focus on the new functions and opportunities that motivated their creation, while established entities consider how best to incorporate and manage innovation

Policy Research Recommendations:

We recommend that policy research be initiated with a focus on the topics discussed in Section V above. Specifically:

- Policy support to stabilize/reduce finance costs for decentralized electricity supply;
- Assessment of the extent to which local energy resources and dollars can be put to work to the economic benefit of local communities;
- Assessment of the strategic role of incumbent local public power utilities in financing decentralized energy supply and delivery infrastructure;
- Determination of the need and role for new local energy agencies capable of mediating between regional and local grids to manage two-way flows;
- Policies that encourage local investment in microgrids and virtual power plants;
- Policies that enable refinancing of merchant centralized renewable electricity generators by host communities after tax incentives have been captured by ''project companies'';
- Determination of how to remove barriers between rural communities able to develop renewable electricity resources and urban communities needing these resources;

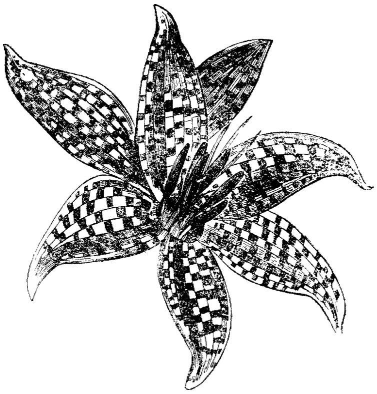
http://dx.doi.org/10.1016/j.tej.2015.05.008

- Adjustments in existing federal renewable electricity incentives to achieve a more capital-efficient balance between centralized and decentralized assets;
- Determination of best practices for local-level policy development in support of local renewable energy resource development and more proactive engagement in energy infrastructure planning and integration with other municipal services;
- Determination of need for clearer and more quantitative understanding of energy infrastructure costs attributable to taxes, finance and related trade-offs. Specifically, in what proportions and at what cost, should the mix include:
- Large corporate monopolies that pay taxes?
- People, local businesses, and banks that pay taxes?
- Local agencies that are not taxed but can use their revenues to secure financing for creation/maintenance of local infrastructure?
- National, state, and local green banks?

These are not academic questions. They have implications for infrastructure modernization. They also have implications for the speed and scale of our response and adaptation to climate change. Under-investment by investor-owned utilities in power sector infrastructure modernization, particularly at the city and county level, may be budget-driven rather than revenue-driven. Can it be mitigated by increasing levels of lower-cost public investment in distributed generation and local electricity distribution assets?■

Endnotes:

1. Our primary reference is California, where renewable resources, electricity sector policies, and other change drivers favor decentralized energy especially when compared to most other states.



2. Asset categories and their capital requirements vary widely between the power sector and energy fuels sectors (natural gas, petroleum, and coal). Our primary focus is the power sector, because it is subject to more rapid transformation affecting finance than fuels sectors.

3. With infrastructure in general, a perennial debate about privatization vs. public ownership of infrastructure continues to engage economists, occasionally bubbling up during times of economic and political crisis.

4. Precedent can be found in the transportation sector, where cars, trucks, and airplanes and related infrastructure overlaid but did not supplant ships, trains, etc.

5. Demand considerations aside, there is growing concern about under-investment in power sector infrastructure, i.e. specifically that private investment is not meeting the challenges of badly needed infrastructure modernization, placing both national and local economies at risk. According to a 2011 report published by the American Society of Civil Engineers, ''[i]f current trends continue, then the nation will face a cumulative electricity infrastructure gap of $107 billion by 2020, rising to $732 billion by 2040.''

6. Source: Bloomberg New Energy Finance Resource Center (http://about.bnef.com/resource-center/).

7. Source: Edison Electric Institute, www.eei.org.

8. Source: http://waysandmeans.house.gov/uploadedfiles/american_public_power_association._the_large_public_power_council._and_the_transmission_access_policy_study_group.pdf.

9. This paradigm has receded in some cases, but it may find new and critical roles in future. Specifically, while power sector infrastructure investments have been at a low ebb in recent decades, there is a need for modernization and adaptation to accommodate resilient and economically optimized decentralized supply and storage assets.

10. Source: http://city-council.cityofdavis.org/Media/CityCouncil/Documents/PDF/CityCouncil/CouncilMeetings/Agendas/20131210/08-Energy-Service-Options-Presentation.pdf.

11. Public power ratings overall are stronger than those of the investor-owned utility (IOU) and merchant sectors, which have stabilized relative to the early part of this decade. For IOUs, only about one-third of ratings are in the ''A'' and ''AA'' categories, while 85 percent are investment grade. Furthermore, about 30 percent of ratings in the IOU sector carry negative indicators (either a negative outlook or on CreditWatch with negative implications). By contrast, 95

http://dx.doi.org/10.1016/j.tej.2015.05.008

percent of public power rating outlooks are stable, while just 3 percent are negative. In addition, the median rating for the IOU and merchant sectors is in the ''BBB'' category, while public power's median rating is ''A,'' and closer to ''A+'' than to ''A−.'' In fact, public power's rating profile exhibits more in common with municipal water and sewer utilities than with the electric utility sectors, given the overlap of governance and regulatory structure, rate-setting methods, and customer bases. **Source:** U.S. Public Finance Report Card: Public Power Ratings Stability Continues Despite Ongoing Challenges.

12. Some POUs, like Palo Alto's municipal utility, are demonstrating that the flexibility to design and implement local clean energy programs according to local goals and with community participation makes a big difference. It results in faster and more cost-effective clean energy deployment than is possible under the ponderous ''one size fits all'' programs that are forced onto investor-owned utilities by state legislation. Specifically, Palo Alto has the flexibility to pay for local renewable electricity supply according to its economic value.

13. Source: http://waysandmeans.house.gov/uploadedfiles/american_public_power_association._the_large_public_power_council._and_the_transmission_access_policy_study_group.pdf.

14. At the same time, facing revenue shortfalls at all levels, state and local governments struggled to sustain traditional state and local government programs and interventions supportive of local clean energy resource development.

15. Defined as unit costs of rooftop solar electricity at or below unit prices utilities charge their residential customers.

16. As we saw in the 2008 crisis, this must be closely regulated to prevent the collateralized bonds from containing too many marginal loans.

17. Net metered solar power is a service where electric energy generated by the consumer can be used to offset electric energy provided by the utility.

18. California briefly authorized retail sales of electricity from a broader range of conventional power plants and resources, but terminated its so-called ''direct access'' program in the wake of its 2002 electricity crisis.

19. For a clear and concise description of some of the more common structures for financing renewable energy projects of all sizes and types, see http://www.greenrhinoenergy.com/finance/renewable/finance_structures.php. The structures vary in the type of participants, source of financing, and allocation of benefits. Their suitability depends on project type, size capabilities, and limitations of participants.

20. Larger PV systems have lower costs per unity of energy delivered.

21. For a discussion of ''net positive electricity,'' see http://iresn.org/news/1528624.

22. Source: Institute for Local Self Reliance, at http://www.ilsr.org/germanys-63000-megawatts-renewable-energy-locally-owned/.

23. Source: SEIA, http://www.seia.org/policy/distributed-solar/shared-renewablescommunity-solar.

24. Source: Renewable Energy World, http://www.renewableenergyworld.com/rea/news/article/2012/07/community-wind-arrives-stateside.

25. Aka ''Property Assessed Clean Energy'' (PACE).

26. For example, municipal utilities purchase electricity from large wind projects, under terms that allow initial project owners to sell down after they've captured incentives only available to entities having tax obligations. Source: Jim Tracy, SMUD, private communication.

27. Their application to urban areas is a possible scenario, though they would not enjoy access to loans restricted to established co-operatives serving rural areas. Nevertheless, mixed urban/rural jurisdictions, e.g. in northern California could potentially form generation and transmission cooperatives serving both rural co-operative and urban community choice aggregators. This proposal, originally put forward by Rusty Klassen, is inactive.

28. It is a small extension of the existing cooperative framework to include urban customers served by publicly owned entities like community choice aggregators and municipal utilities. Changes in federal legislation might be required to allow rural cooperatives to form entities that would export power to urban areas. For a more detailed discussion, see http://www.iresn.org/resources/Documents/USDA%20Strategic%20Analysis,%20Rev.%202.pdf.

29. This paradigm has receded in some cases, but it may find new and critical roles in future. Specifically, while power sector infrastructure investments have been at a low ebb in recent decades, there is a need for modernization and adaptation to accommodate resilient and economically optimized decentralized supply and storage assets.

30. Source: Private communication, Jim Jungwirth, The Watershed Research and Training Center, Hayfork, CA.