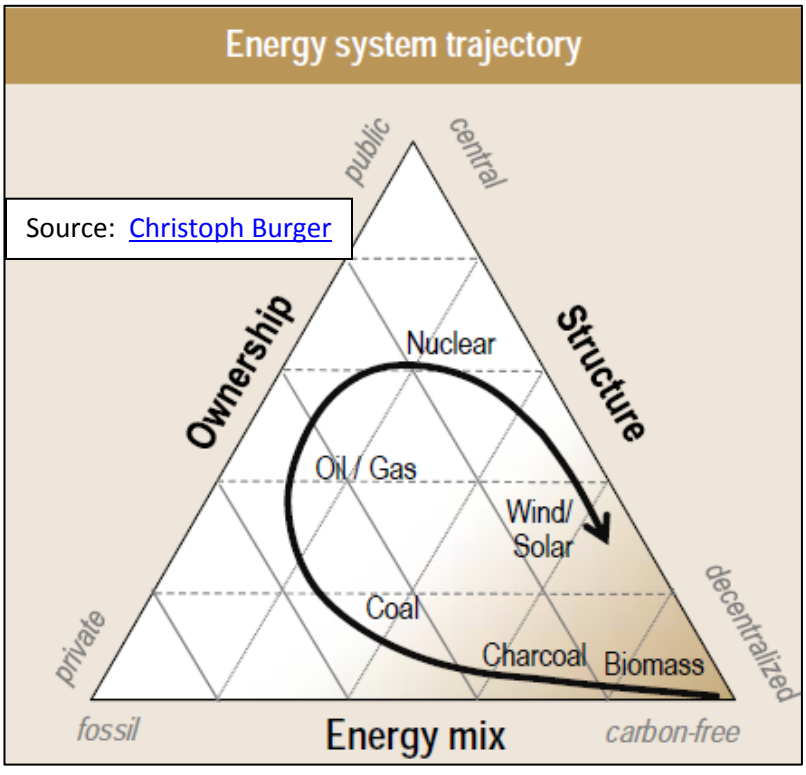
IRESN Themes
Contributed by Gerry Braun

Decentralized Energy (DE)

An NPR interview about the on-going "smart cities" boom suggested that the boom is as much about replacing corporate markets that collapsed on IBM, CISCO and Siemens during the recession with government markets launched with stimulus support. The temporary stimulus opportunities now need to be replaced with markets for tools cities might imagine using. The important catch is that cities wouldn't own and operate any new infrastructure. It would be an outsourced service, like cloud computing, not physically in the city, maybe not in the same country. This may not be a great idea. In the words of the interviewee, a city running its traffic signals this way is "essentially a city is outsourcing its brains." Brings to mind the notion of outsourcing decentralized energy development to giant utilities. Integration is not easy now and getting harder as a result of the continual deluge of new bits of infrastructure to integrate. Nevertheless, energy infrastructure integration will be much easier on a decentralized scale.

Energy market decentralization is advancing on a number of fronts. Manifestations include the explosive growth of net metered solar electricity in California and Hawaii, the surge in sales of backup generators in the wake of Hurricane Sandy, and California's 2020 goals for distributed generation and combined heat and power. There are now more jobs in the US solar industry than in US auto manufacturing.[1] Industry sales of home generators have been growing about 17% a year. Another reliable manifestation is the attention being paid by the conference and policy industries. Meetings are being called, white papers are being generated and articles are being written about "power industry transformation".

Germany is providing a case study for the rest of the world. The implications of the German experience are thoughtfully digested and articulated in a book entitled The Decentralized Energy Revolution: Business Strategies for a New Paradigm, by Christoph Burger and Jens Weinmann. The figure below from the book that we are coming to the end stage of a lengthy energy industry trajectory that moves toward a decentralized structure of carbon free energy and private ownership.



[1] Source: Solar Foundation and US Energy Information Administration

DE Innovation and Technology Transfer

I've reflected in earlier articles on the ever-expanding diversity of energy options, primarily sources and uses of electricity. For several decades, expanding diversity has been driven by product and system innovation. Technology transfer processes that occur naturally in the competitive industries played and continue to play a major role in capturing the benefits of corporate and public R&D investments.

On the path to decentralized energy, new industries may need to innovate in new ways. For example, an important recent innovation in solar energy has little to do with products and systems and much to do with how solar energy systems, especially residential solar energy systems, are financed. Not only that, one of the most innovative and fastest growing solar electricity retailers is pioneering an innovative approach to innovation itself.

Sungevity is looking to innovate across more of the value chain. It has developed an incubator-accelerator program, the SfunCube, to attract and nurture other solar start-ups.

Danny Kennedy of Sungevity with Emily Kirsch, of SfunCube, in her program's offices. (Credit Jim Wilson/The New York Times)

According to a New York Times article, SfunCube's real aim is to create a place that inspires the kinds of "creative collisions" that allow for further innovation to speed adoption of solar energy, mainly by bringing its cost down. Companies that are offered space in the SfunCube must agree to pursue that goal, whether by developing more efficient technologies, say, or coming up with new ways of financing projects.

It is worth asking whether, elsewhere in the energy sector, traditional innovation and technology transfer models are also changing or are in need of change. New market participants, e.g. energy users whose decisions and investments in supply affect other energy users, need to be part of the technology transfer process if innovation processes are to proceed purposefully rather than opportunistically for short term gains alone.

There is a parallel and equally urgent need to unplug channels and opportunities for innovation and technology transfer in cities and communities. This will require a major public policy shift that

empowers local jurisdictions and businesses. The best empowerment will be to take down political and economic barriers to the use of local energy resources while designing publicly funded energy programs to fit local circumstances.

Decentralized Energy Finance

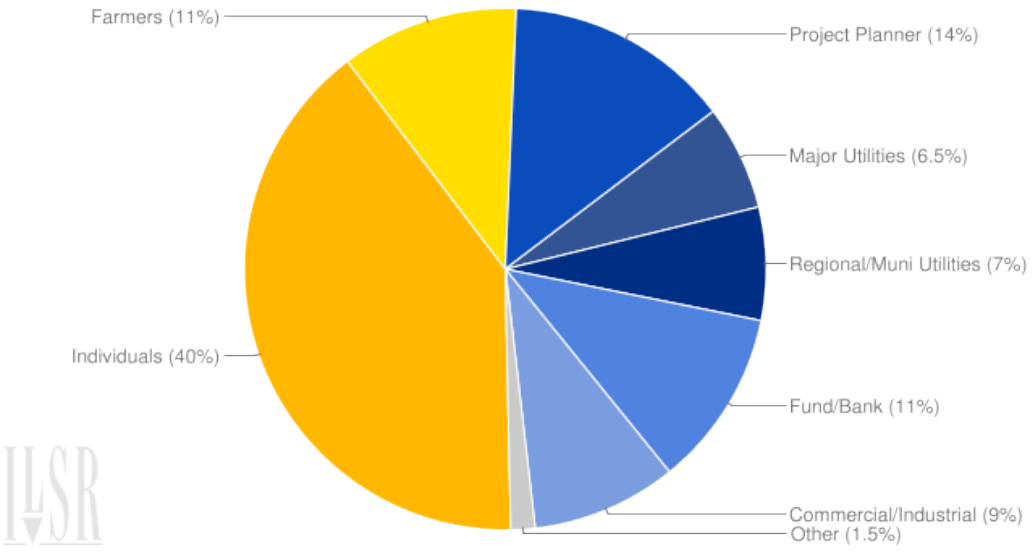
Goals of energy finance have historically included efficient capital allocation and economically productive infrastructure. Accelerating changes in energy supply and delivery technology and markets will compel changes in energy infrastructure finance. Specifically, there is a rapidly accelerating paradigm shift driven by the economics of transformative technologies.

The 20th century strategy for financing energy infrastructure and electricity supply was founded on a premise of locational equity and uniformity. Investments in centralized infrastructure benefitted all affected local populations and economies in rough proportion to energy consumption. So, costs could be fairly indexed and recovered across vast geographic regions according to individual customer energy demand and consumption.

With energy supply increasingly localized and with electricity distribution systems needing to accommodate bi-directional energy flows profoundly influenced by local circumstances, all local energy is no longer created equal. 20th century thinking regarded it as an undifferentiated element of a larger energy supply pool. This simplifying assumption will no longer remain valid for pricing or capital allocation purposes. We face increasingly serious capital misallocations if we cling to the old model.

In the future, a significant if not primary share of the capital needed to maximize productivity of energy assets will be best allocated by local investors rather than Wall Street.

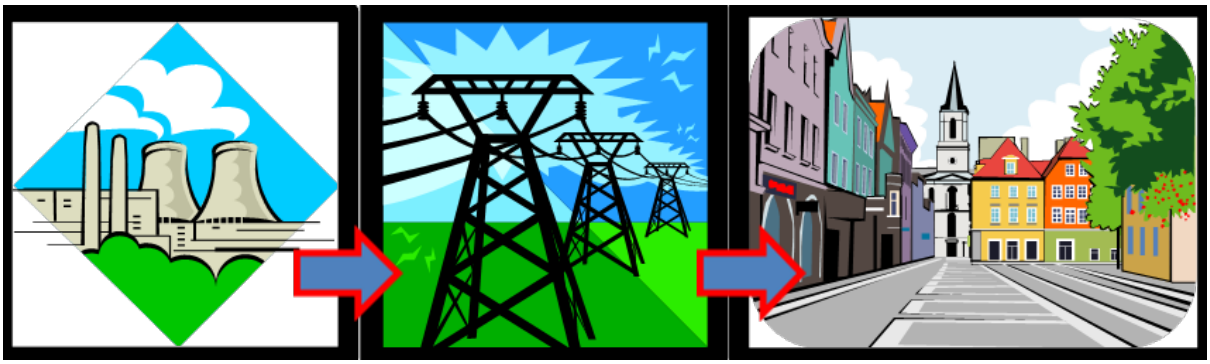
In the US, and even in California, we may be somewhat behind the curve in the matter of ordinary people owning energy supply infrastructure. Meanwhile, Germany may be providing a preview of 21st century infrastructure ownership. The figure below shows that half of Germany's 53 GW renewable energy supply is locally owned.



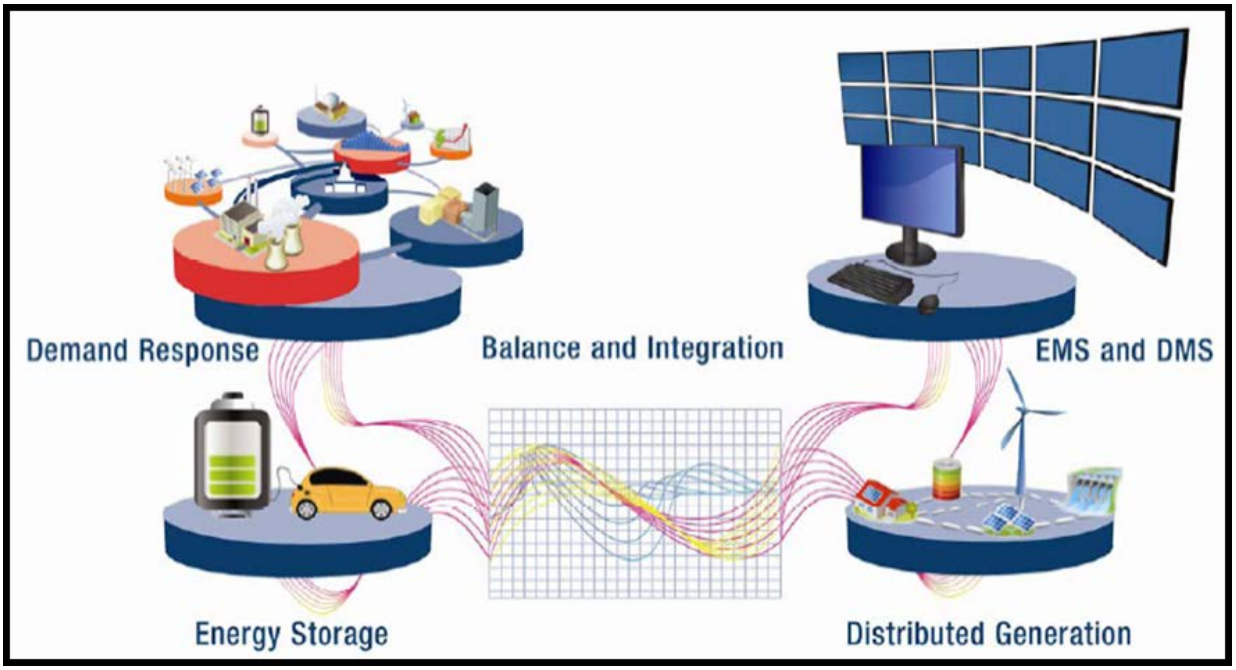
Share of Germany's 53 GW renewable energy market above (Source: Institute for Local Self Reliance http://www.ilsr.org/half-germanys-53000-megawatts-renewable-energy-locally-owned/)

Net Positive Renewable Electricity

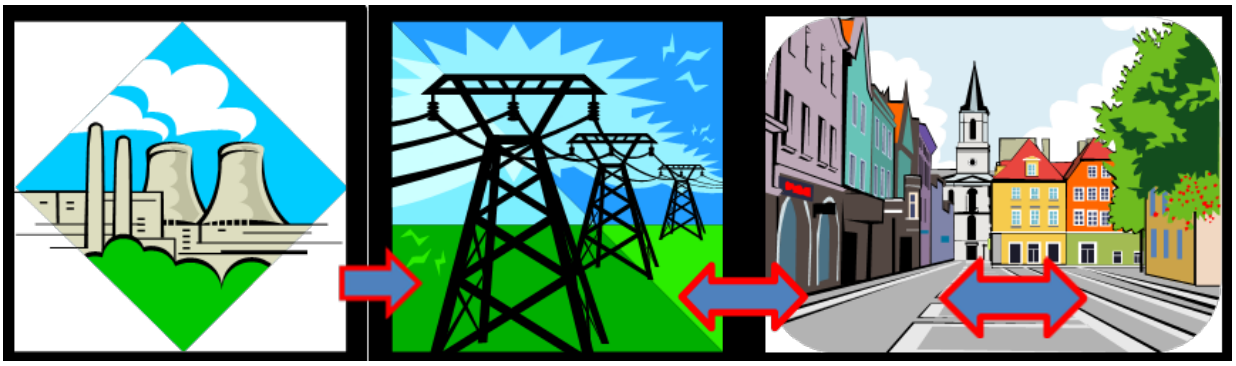
The outlines of a new framework for electricity supply and delivery are beginning to emerge. Its early manifestations are the newly created local energy agencies that organize local supply and delivery resources and operate them in concert with existing centralized resources and infrastructure. Evolution of the new framework will be driven by a growing awareness of what is now both technically possible and manageable and also increasingly economically preferred. The sequence of figures below schematically show the old paradigm, the new, and the technologies that mediate between new and old. The transformative bridge between old and new consists of local systems able to purchase, sell and exchange electricity and provide for local infrastructure inter-operability. They are variously referred to as mini-grids, micro-grids and virtual power plants.



Old paradigm above: radial power flow



Transformative bridge above: Mini-grids, micro-grids and virtual power plants (Source: KEMA)



New paradigm above: bi-directional power flow from transmission to distribution and within distribution

Net positive renewable electricity will be an important feature of the new paradigm. Many energy users and communities will supply their own annual demand, more or less, depending on what they can economically generate. Some will be net positive. Some will be net negative. It is time to start thinking about buildings that include "behind the meter" electricity supply (mostly solar PV as yet) as "nano-grids" needing to be integrated with micro-, mini- and mega-grids. Net metering at the revenue meter will need to evolve to credit on site electricity production according to its fully integrated economic value. The present intentionally unattractive surrogate value, i.e. marginal cost of centralized generation incurred by incumbent generators, will not motivate consumer decisions aligned with the public interest . The self-indulgent notion that solar electricity must be curtailed so that no adaptation is required of incumbent monopolies will need to give way to the more progressive notion that successful integration requires changes on both sides of the grid interconnection.

Enabling and empowering net electricity transactions and otherwise navigating the transition to increasingly decentralized energy supplies and infrastructure confronts multiple obstacles. Jurisdictions currently served by mature and experienced public power entities may be at a significant advantage – they can independently decide to move forward. But they also suffer some of the same disadvantage as their investor- owned counterparts. They too, are monopolies, and business as usual beckons.

On the other hand, newly created entities, e.g. community choice aggregators, will enjoy the relative freedom to adapt their business models to new and emerging technical and economic opportunities. It is in the broader public interest to maximize the benefits of both emerging and established entities while minimizing their inherent risks and liabilities. Newly created public entities must focus on the new functions and opportunities that motivated their creation, while established public entities must consider how best to incorporate and manage innovation created by new market entrants.

Local Energy Infrastructure Integration

Consider the photo collage below. 50% of many California communities' carbon footprints are due to use of carbon based fuels for transportation. Only now, after decades of technology development and demonstrations, vehicle fueling options are expanding, from the historical gasoline/diesel dominance to natural gas, electricity and hydrogen . This evolution is not just about vehicles, it has serious implications for infrastructure planning and investment.

Vehicles are generally fueled locally. With fueling options that increasingly rely on local energy grids, a more complex and diverse local energy supply and distribution infrastructure is on the horizon. Infrastructure will need to be planned locally in order to account for widely differing adoption rates for

Compressed natural gas refueling station above
Electric vehicle refueling below

Gasoline and diesel station above
Hydrogen refueling station below

new vehicle types. Moreover, existing electricity and natural gas distribution infrastructure will be affected differently depending on rates of adoption of solar PV and electric vehicles. Integrated local energy infrastructure planning will be necessary. Properly done, it can result in more robust and resilient local energy services.