Transitioning to Renewable Energy: Development Opportunities and Concerns for Rural New York

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I. Introduction[1]

Rural America has long provided the bulk of food and energy, including oil, consumed by U.S. residents. While the broad stability of this relationship will not change any time soon, emerging energy trends herald a shifting landscape. In light of this, New York residents and policymakers, both rural and urban, must grapple seriously with the prospect of rebalancing our enormous collective appetite for affordable energy against many competing goals and concerns.

Many environmental, economic, and policy signals point to the desirability of a shift away from fossil fuels. Rural New York communities especially can anticipate the increasing need to integrate new forms and scales of renewable energy production into familiar landscapes: biomass energy where farm and forest land has predominated, wind energy atop the state's mostly wooded hills and breezy skylines, small scale hydropower throughout the valleys, scattered solar even in our seasonally variable climate, and more.

The export of renewable energy from rural places, once in decline, is already resurgent. With vision, planning, and policy change, rural communities could supplement a growing renewable energy export economy with new systems of locally generated and distributed energy. They could graft sensible "local energy" policies onto "local food" policies, lessening the need for the costly transmission and transportation of electricity and other fuels.

The prospect of renewable energy development represents a beacon of hope for many rural residents, and is frequently though not always less divisive in New York communities than are fossil fuel alternatives like natural gas. Policymakers would be remiss, however, to ignore the challenges and concerns associated with a full-fledged energy transition of any kind, which by definition involves major change. Rapid renewable energy development, as with nearly every other growth industry, has at a minimum the potential to generate significant changes in community character.

Rural communities in New York and many other states have at their disposal a variety of policies and programs that have begun to be used to foster local renewable energy development while addressing inherent challenges. New York's Cleaner Greener Program, one example, is now the key vehicle for competitively funding energy projects and regional sustainability plans throughout the state. Any transition to renewable energy should encompass strategies that adapt to local circumstances, an outcome best achieved through broad community participation.

II. Energy Systems Today

An energy system can be thought of as a constellation of dispersed energy resources that are connected to end users through transmission and distribution networks. The process by which raw forms of energy are transformed and then consumed involves six phases: exploration, extraction, processing, distribution, storage, and end use.[2] Throughout this process, the most notable environmental impacts for rural places occur at the exploration, extraction, and processing phases, as they typically involve great effort and expenditure to locate the resource, retrieve it from the earth, and distill or mechanically transform it into a usable energy commodity.[3]

III. Energy Conservation and Efficiency

At every stage of an energy system—from exploration to end use—work must be done and energy expended. During the energy conversion process, some of the energy content of a raw energy source is unavoidably (but some avoidably) consumed or lost as waste heat or light.[4] In fact, only about two-fifths of the energy that is converted from primary sources in the U.S. actually provides useful energy services. Most of the lost energy involves heat wasted during electricity generation and in automobile engines.[5]

This highlights the critical importance of targeted conservation and efficiency measures in the production of energy. For example, in conventional electricity generating plants,[6] about two-thirds of the energy is lost as heat at the power plant.[7] Alternative systems (*e.g.*, combined cycle and combined heat and power, or CHP) reuse some of their waste heat for additional electricity production and are often able to capture residual heat for process or space heating in nearby facilities. Conservation and efficiency measures are therefore critical to consider in the development of future technology, regardless of the fuel used.

Though ahead of many others, New Yorkers can also reduce household energy consumption through improved energy efficiency measures and "lifestyle" choices.[8] These involve the use of energy-efficient technologies, more efficient land use planning and building design, and more sustainable transport. Rural places face distinctive efficiency challenges and opportunities with each.[9]

IV. Energy Transmission, Distribution, and Management

The closer the source of energy production to the point of consumption, the lower the investment needed in transmission and distribution. Energy produced close to market, then, generally earns a corresponding value premium. Most energy supplies—renewable and otherwise—are remote from urban consumers, however, and large scale generation facilities are seldom compatible with urban land uses. Consequently, an enormous infrastructure investment has been made in transmission and distribution systems to connect generators with consumers.[10] Though electricity can be economically moved long distances through the electric grid, it is not efficient to move heat for more than short distances. Thus, usable heat is generated (or captured/converted in the cases of solar and geothermal heating systems or lakewater cooling systems, for example) at or near the point of use, regardless of fuel source.

In the case of electricity in particular, extensive networks of transmission and distribution lines are required before most electricity can be used, in addition to a host of converters (*i.e.*, lights, appliances, electric motors) ready to use the delivered energy.[11] Historically, the costs derived from installing, operating, and maintaining the transmission and distribution system comprised about two-thirds of the total costs of producing and delivering electricity to residential-commercial customers, and over one third of the total costs of supplying electricity to large industrial customers.[12] A regional, more recent estimate suggests a more even split.[13]

Because concentrations of renewable energy resources tend, like nonrenewable resources, to be distributed across rural areas in parts of the country that are distant from urban centers of demand, transmission issues are central to future renewable energy development and to both rural and urban areas. A seminal U.S. Department of Energy (2008) report showing that wind energy could provide 20 percent of the nation's electricity needs by 2030 serves as a good case in point.[14] In order for large-scale wind generation to be successful, the report identified as a primary barrier the development of transmission infrastructure. The power industry has argued that the current transmission and permitting system is too balkanized, instead needing reform and centralization to foster "planning for an electric transmission system with the needs of the entire country in mind rather than the local fixes that compose the patchwork of today's transmission system."[15] Similar arguments, focused more on plant siting than transmission, motivated passage of New York's Power NY Act of 2011.[16] The political ramifications of these kinds of shifts in authority are highly charged.

The compatibility of renewable energy with small scale distributed generation systems offers a promising alternative to producing and distributing renewable energy within rural communities themselves. Distributed electric generation systems[17] differ from conventional centralized systems by generating electricity and/or heat from many small energy sources at or near the point of use. Distributed generation is most frequently considered in the context of electricity production, but need not be restricted to that form of energy. Combined heat and power (CHP) systems are also compatible with renewables. Such distributed generation can be designed to employ multiple fuels, either alone or in combination.

V. Renewable New York

New York State meets nearly 12 percent of its primary energy needs with renewables, mostly from hydroelectric power and biomass.[18] The State's most recent State Energy Plan foresees a "technical" potential of meeting up to about 40 percent of total demand before the end of this decade, with the greatest growth from forestry/agricultural biomass, wind, and solar photovoltaic (PV). This growth comes with a caveat, however: "achieving the full potential in the near-term given current economic and technical realities would come at an extraordinary cost," including an estimated $300 billion just for solar/wind installations.[19]

The Energy Plan mentions but does not evaluate the significance of renewables, and especially biofuels, for rural communities. The plan notes, "[b]iofuels may also play a more significant role in rural communities, and by creating distribution systems for local use of fuels, farms may play a key role in growing suitable energy crops, aid[ing] in the conversion of such crops into usable fuels, and then hav[ing] local communities and on-farm use of such fuels serve as primary markets."[20] A supplemental "Biofuels Roadmap" further suggests biomass's potential to create new jobs, "especially in rural areas."[21] However, the report most significantly includes the recommendation for more analysis and information on economic, environmental, and "rural sociological impacts" of proposed policy options.[22]

VI. Rural Opportunities and Concerns

Given its abundance of energy resources and open space, rural America has the opportunity to lead the next energy transition. Renewable energy potential from rural places far outstrips that of urban places in nearly every category.[23] Replacing fossil fuels requires shifting to less energy-dense sources. These require by nature more space per unit of energy collected, handled, and stored.[24] Renewable energy sources as a rule yield less energy per unit of land area by an order of magnitude or more in comparison to fossil fuels. Though lower pollution at the site of generation presents many new urban opportunities for renewables, siting considerations mostly point to less developed landscapes as preferable.

Table 1 shows the number of acres typically required per megawatt of generating capacity for different kinds of renewable and nonrenewable electricity generating technologies. Fthenakis and Kim have shown that energy dense fossil fuels tend to economize on land "transformation" per unit of electric output.[25] Among the renewable sites studied in that article, photovoltaic installations were among the most "land efficient" (roughly comparable to natural gas), and biomass among the least. Importantly, characteristics of the land transformation or utilization for energy production are very different for each of the generation processes. For example, photovoltaics and wind turbines may be located on low-quality lands or lands used for multiple purposes (*e.g.*, grazing, shading). Moreover, because the energy is not depletable, no new land is required to continually renew the feedstock as is the case for fossil fuels. On the other hand, in order to continue supplying energy over time, renewable energy installations require some permanent disturbance of the landscape.

Table 1. Electricity Generation Footprints[26]

Wind farms	40-60 acres per megawatt
Geothermal	1 acre per megawatt
Solar photovoltaic	10 acres per megawatt
Solar thermal	6 acres per megawatt
Gas turbines	0.4-2 acres per megawatt
Coal (including mine)	0.4-20 acres per megawatt

VII. New Approaches to Economic Development

Aside from its physical impact and contribution to New York State's energy portfolio, renewable energy also represents an important economic development opportunity for rural communities. With regard to rural implications in particular, scholars have noted the evolution of economic development theory and practice over the years away from "smokestack chasing" and toward more complex, place-based "*community* economic development" approaches.[27] Traditional policies have focused on export markets and basic advantages in land, labor, and capital resources, while research on rural economic development has long highlighted the importance of the interplay of three determinative "facts of life": (1) natural resource advantages or endowments, (2) economies of concentration or agglomeration, and (3) costs of transport and communication.[28] Community economic development approaches add an emphasis on the role of institutions, social and cultural factors, and governance and decision-making capacities. These added emphases open the door to more strategies for economic development in rural areas, but they also draw attention to challenges in rural institutional and governance capacity which often parallel their lack of critical mass in economic arenas (*e.g.*, skilled labor force, industry clustering, marketing potential).

This evolution in economic development theory and practice has been summarized in one recent review as a shift away from "the pursuit of mobile capital to cultivation of local economic assets," with increasing attention being given to the economic, environmental, and equitable "triple bottom line" concepts undergirding sustainable development.[29] Significantly, Carley et al. argue further that the context of intensifying national concern about climate change, energy price volatility, and insecure foreign energy supplies has set the political and economic stage for a converging relationship between energy and economic development policy.[30] Their exposition of "energy based economic development" enumerates several specific goals:

- Increased energy self sufficiency,
- Increased energy diversification,
- Energy focused economic growth, and
- Development more broadly conceptualized as enhanced collective well-being.[31]

The emphasis on the "cultivation of local economic assets" is highly compatible with the distributed energy generation systems discussed previously. Also notable are the parallels of several if not all of these goals with those underpinning the growing support for local and regional food systems.[32] Jensen highlights as motivating tenets of the local and regional food movement concerns about community based *economic development* ("buy local"), *food security* and its relation to social justice, *food safety* and its relation to the "shorter supply chains of regional production systems," and enhanced *environmental sustainability* and *sense of community* through increased localization.[33] Carley et al.'s energy-based economic development goals cannot be mapped precisely onto these terms, but it is not a stretch to see support for local and regional energy systems increasingly based on motivations to "buy local"; improve energy security and social justice regarding a volatile and essential commodity; shorten "supply chains of regional production systems"; and enhance environmental sustainability and sense of community through increased localization.[34]

Johnson has suggested that rural America will benefit from a renewable, especially biofuel, based economy because of "the double dividend of distributed energy... [that] turns remoteness on its head."[35] The double dividend is earned because rural fuel producers can avoid the extra costs of transporting refined fossil fuels into their area and then (assuming a relative cost advantage for locally produced renewable transportation fuels) reduce the costs of shipping all rural goods and services elsewhere. Rural production of distributed energy, especially if it meets local needs first, also has the potential to loosen some of the links that tether rural places to the vagaries of footloose multinational energy corporations and foreign governments. Distributed generation can be an important ally of relocalization.

VIII. Challenges and Concerns of Rural Energy Development

The challenges involved in transitioning to renewable energy are considerable, and they require unique approaches and solutions in rural areas. Broader concerns policymakers will confront include unstable economic growth; those related to the preservation of social ties and effective community development; and issues related to the interaction between water and energy.

A. Volatility and Change

As energy transitions take place, rural communities must be prepared for the economic volatility associated with possible energy development scenarios. While energy development is often celebrated for its job creation and economic development potential, there are less well-considered concerns that communities must address related to rapid population growth and increased employment. Rapid change of any kind, especially if it is not under the control of those affected by it, has been understood to be a mixed community blessing by sociologists from at least the time of Durkheim in the late 19th Century.

Though most research into the well-known rural boom/bust phenomenon has looked at the cycles associated with depletable resources where there is an inevitable eventual bust, renewable energy development is not exempt from significant ups and downs. The energy sector overall exhibits at the very least the volatility of overall economic growth, and the renewables sector in particular is vulnerable to the political tug of war over energy policy. Other factors familiar to farmers, such as weather and land and food policy, can cause additional variance in renewables markets. It is also noteworthy that oil prices and crop (including many biofuel crops) prices tend to be correlated to no small degree because of the extensive fossil fuel inputs involved in modern agriculture.

In any event, rural communities are not always ready to handle influxes of people and economic activity, and "booms" can potentially result in negative effects to society and local economies.[36] Furthermore, small towns and rural areas may be more likely to experience consequences of economic impacts that would be less noticed in a large, metropolitan area.[37] Despite these challenges, small town and rural municipalities may have a more comprehensive understanding of the local ramifications of economic booms, given their relative smaller size and lower level of complexity.[38]

B. Regional Economic Stability and Diversity

In preparing for local economic development generated by energy transitions, it is also important to consider the relationship between economic stability and diversity. Stability can be defined as the absence of variation in economic activity over time. Diversity, however, refers to differences in economic structure, or variety of economic activity.[39] Economists have hypothesized that more industrially diverse areas should experience more stable economic growth and lower rates of unemployment than less diverse economies. This can essentially be explained by the notion that a diverse economy has a wide variety of industries that help to smooth out macro-level fluctuations experienced by any individual industry. Employment gains in some industries, in other words, mitigate employment losses in other industries, effectively lowering region wide unemployment.

In terms of the actual effects economic diversity has on growth and stability, results are mixed. Some researchers[40] find no correlation between economic instability and diversity, while others[41] observe a positive relationship between diversity and stability. Wagner and Deller suggest further that there is a theoretical inconsistency of jointly pursuing economic growth (typically dependent on specialization), and diversity.[42]

The most convincing research concludes logically that the most stable economies are based on the most stable employers. Diversity only helps if the mix of sectors includes stable sectors, or as noted above in some cases if additional sectors balance each other counter-cyclically. The web of economic diversity in predominately rural regions is almost by definition likely to be thinner than in areas with greater population concentration. In the context of this article, the most important stability question is likely to be whether or not renewable energy production in rural New York complements or competes with other rural economic mainstays such as tourism, agriculture, and public sector employment.

C. Water and Energy

The relationship between water and energy is intimate, multifaceted, and important. It is of special significance in rural areas, which serve as sources/sinks/regeneration sites for many kinds of water and energy resources. Insofar as fossil fuel consumption contributes to greenhouse gas emissions, any changes in climate, weather patterns, and precipitation are causally linked to energy consumption.

Similarly, energy extraction practices that alter forestation or land use practices can have feedbacks that affect precipitation patterns and water supplies regionally. In addition, significant amounts of energy can be consumed simply in moving or treating water for irrigation, household use, and sewage and wastewater treatment. Here, however, our attention is focused more on the extent to which the demand for energy leads to the demand for water in energy production. In some locations, energy and water development can provide complementary resources to support the nation's needs while stimulating economic development. In other parts of the country where water is scarce and water-intensive energy resources are abundant, conflicts will inevitably arise.

Indeed, various elements of the energy production process affect both water quantity *and* quality. Oil and gas exploration and production, for instance, not only use water-intensive drilling and fracturing processes, but can potentially impact surface and groundwater as well. The transport of energy through pipelines, similarly, can affect groundwater quality as pipes are buried beneath the earth's surface.

The production of renewable energy can also leave its mark on water usage. Crops used for producing biofuels and ethanol require water for growing and refining, while water is subsequently needed in the treatment of refinery wastewater. The amount of water used or affected by the production of solar and wind power is relatively small; a nominal amount is used for cleaning solar panels and windmill blades.

Connections between water and energy production are particularly important to rural America, given the geographic diversity of energy production potential (*i.e.*, solar in the U.S. Southwest and biomass in the Northwest). The likelihood and extent of future water shortages is also regionally specific, and New York's relative abundance of water will undoubtedly factor into energy development scenario planning.

IX. Summary and Outstanding Issues

The premise of this article is that a transition to renewable energy is inevitable if on an uncertain timeline, and that there is a unique set of possibilities for rural New York during this transition. These possibilities, unique though they may be, also present many important questions to be addressed.

A. Building Sustainable Wealth

As noted, both food and energy are primarily produced for domestic if not international export. This opens the door to wealth-creation in rural communities, but does not guarantee that the wealth will stay there. Will increased land-energy rents be invested locally or fund landowner retirements to other states? What financial, regulatory and regional economic development mechanisms can most effectively help rural communities keep a fair share of the wealth "down on the farm?" Are the State's rural financial and economic development institutions, governments, and utilities prepared?

Different forms of renewable energy have significantly different wealth and job creation profiles. Many are capital intensive; only biomass requires a significant amount of local enterprise to provide a feedstock. How significant then is the potential for the "local" manufacture of energy capital? Will rural areas benefit from lower cost access to the energy they produce? To what extent can rural enterprises add value beyond raw energy exports to local products? Will rural workers be qualified for new jobs, or will they go primarily to in-migrants? Will the people who take the jobs, regardless of their origin, be long-term or short-term residents of rural communities?

Questions about entrepreneurship and innovation are pressing. How can policymakers and communities encourage entrepreneurship within local and regional food systems in rural regions, paying particular attention the potential for distributed energy and district energy systems? Can rural entrepreneurs benefit from participating in and promoting climate change mitigation and ecosystem services through diversity and new technologies on their land?

B. Social Equity: Who Will Benefit and Who Will Lose?

This topic has equity dimensions that involve the impacts of change among people currently living in rural places and those who will likely move both to and away from them because of energy transition effects. It has regional implications that will be related to the uneven distribution of both renewable and nonrenewable energy resources around the country and state. It focuses attention on minority, Native American, and low-income rural populations—with vastly different access to rural land resources—asking how they can more fully participate in and benefit from renewable energy development.

This topic also involves questions of the way the relationship between rural and urban places will change. Because food and energy systems have been increasingly internationalized for commodities produced in rural places, it also involves international equity issues, just as farm policy does. The old question of who owns, and will in the future, own and control rural land is relevant. Both economic theory and history suggest that owners of land suitable for renewable energy production are likely to be the first-ring beneficiaries of this transition. What will landowners who gain windfalls do with their gains? Will they spend them quickly on consumer goods or invest? Will they use the land as before, or change the use of land? Will they keep their money in the region or spend nearly all of it elsewhere? Will they continue to live locally or themselves move elsewhere?

C. Regional Collaboration and Urban-Rural Interdependence

Rural and urban energy systems are and will remain interdependent, though in a renewably fueled society not in the same way and to the same degree. Among questions that remain: How do regional energy systems contribute to or detract from economic development and environmental quality in rural—and quality of life and public health outcomes in urban—places? Will local and regional energy systems increasingly focused on renewables help protect farmland from "development?"

Moreover, how will rural places currently supported by the tourism sector be affected, and how will urban people relate to a countryside that is reverting from an amenity landscape back to a production landscape? Will renewable energy policies to supply the urban population provide further incentives for farm consolidation, or will they open new doors for medium and small scale agriculture? How does energy-driven relocalization interact with existing policy supporting more energy efficient and compact development patterns, with its focus on more dense settlement of pre-existing urban communities while protecting farm and open space?

D. How Can Rural Communities Prepare for the Changes That Will Affect Them?

Most people have chosen to live where they do. Although some change is often welcome, dramatic change is normally not. During the transition to renewable energy, there will be dramatic, even transformational change in many rural communities as landscapes are converted from their current uses. Much of this change will in effect be part of a deal rural places make with urban places to exchange money and jobs for energy.

Even if a rural majority favors more wind and solar and more intensive use of crop- and forestland, some will dissent. Even communities that are not home to an intensive energy industry are likely to be affected as the need to dramatically expand the electricity grid, while simultaneously making it "smarter," will intrude upon their backyards.

These changes will not simply pass over parts of rural America that have increasingly been valued for their beauty and amenity value and the tourism economy. Some do not agree that a wind turbine is a grand addition to the skyline. Even the wealth and prosperity that may come to many communities will likely bring change, division, and newcomers. Conflict is inevitable. But communities with the proper governance infrastructure, consensus building skills, land use planning capacity, and financial and capital planning tools to deal with change will be the best prepared for the future opportunities this transition will bring.

Endnotes

1. Adapted from Adam Blair, David Kay, and Rod Howe, *Transitioning to Renewable Energy: Development Opportunities and Concerns for Rural America*, RUPRI Rural Futures Lab Foundation Paper No. 2, Rural Policy Research Institute, http://cardi.cornell.edu/cals/devsoc/outreach/cardi/news/loader.cfm?csModule=security/getfile&PageID=1007992 (July 2011).
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16. *See* http://cardi.cornell.edu/cals/devsoc/outreach/cardi/programs/land-use/loader.cfm?csModule=security/getfile&PageID=1024193, accessed February 4, 2013.

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18. *See* UNITED STATES ENERGY INFORMATION ADMINISTRATION, NEW YORK STATE ENERGY PROFILE, http://www.eia.gov/beta/state/print.cfm?sid=NY.

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21. *See* NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY, RESEARCH AND DEVELOPMENT TECHNICAL REPORTS, BIOMASS, SOLAR, WIND, REPORTS, RENEWABLE FUELS ROADMAP, http://www.nyserda.ny.gov//Publications/Research-and-Development-Technical-Reports/Biomass-Solar-Wind-Reports/Renewable-Fuels-Roadmap.aspx 3-7.

22. *See* NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY, RESEARCH AND DEVELOPMENT TECHNICAL REPORTS, BIOMASS, SOLAR, WIND, REPORTS, RENEWABLE FUELS ROADMAP, http://www.nyserda.ny.gov//Publications/Research-and-Development-Technical-Reports/Biomass-Solar-Wind-Reports/Renewable-Fuels-Roadmap.aspx 5-18.

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