STATEMENT OF DR. MARK N. COOPER
ON BEHALF OF
MONTANA ENVIRONMENTAL INFORMATION CENTER

THE CONSUMER AND ECONOMIC BENEFITS OF
A 21ST CENTURY ELECTRICITY SECTOR:
STATE POLICYMAKERS SHOULD ACCELERATE THE TRANSITION TO RELIANCE ON EFFICIENCY. RENEWABLES AND INTELLIGENT GRID MANAGEMENT

ENERGY COMMITTEE
MONTANA LEGISLATURE

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INTRODUCTION AND OVERVIEW

My name is Dr. Mark Cooper. I am a Senior Fellow for Economic Analysis at the Institute for Energy and the Environment of Vermont Law School. I have been analyzing energy issues for over 40 years and have testified over 400 times at federal and state policymaking bodies on energy, telecommunications and technology issues in the U.S. and Canada. My focus is on the economic impact of policy choices from the consumer point of view.. Today, in the electricity sector, the economic, pro-consumer choice is crystal clear.

Now is the time for state policy makers to commit to building a long-term, least cost, low carbon and clean electricity sector based on alternatives to antiquated central station facilities. The tools are available to build such a sector on wind and solar renewables sources, storage, efficiency and intelligent grid management that not only generates reliable, least-cost power, but also relies on local resources, creates local jobs and powers the local economy.

While federal policy decisions may help or hinder the building of this sector, it is ultimately a state level decision over which state policymakers have the necessary authority and resources. In fact, regardless of what federal policymakers decide (I am sure you have noticed a certain recent fickleness on that score), the best thing you can do as policymakers is build a sector that is insulted against (some would say bullet proof to) federal policy.

In my remarks today I will briefly touch on seven reasons why state policy should fully embrace the transition to a 21st century electricity sector based on alternative resources. I have lengthy analyses elaborating on these issues, available at the institute for Energy and the Environment,[1] and the Consumer Federation of America.[2]

The first five of those reasons are purely economic; the last two can be considered environmental. But, let me be clear, the meat and potatoes that favors this policy is simple economics first, second, third, fourth, and fifth. The fact that it is also a positive decision on public health and the environment are just side dishes.

A. Resource Costs:
    1. Long-term costs
    2. Short-term costs
    3. accelerating the transition to a least-cost future by capturing the transformation dividend
B. Macroeconomic Benefits:
    4. jobs
    5. local economic benefits
C. Public health and Environmental impacts:
    6. reduced pollutions
    7. decarbonization of the electricity sector and the economy

[1] https://www.vermontlaw.edu/sites/default/files/2021-07/Building_a_21st_Century_Electricity_System.pdf
[2] https://consumerfed.org/wp-content/uploads/2021/04/Building-a-21st-Century-Electricity-Sector-Report.pdf

While public health and environmental impacts are side dishes that make a positive contribution to the menu from which policymakers can choose, nuclear power is a bitter side dish that should be avoided. In fact, nuclear power has never been able to compete for a place in the electricity system, relying instead on massive subsidies, which have always cost consumers and ratepayers dearly. Nuclear power will ultimately cost at least three times as much the alternatives and does not generate the economic bang that the least-cost approach to the electricity sector does. This is overwhelmingly the case with large, advanced nuclear reactors, but it is also true of Small Modular Reactors. Nuclear power should have no role in that long-term future because it is uneconomic. It cannot compete with the alternatives. However, nuclear power is not only uneconomic at any scale, but from the perspective of public health and environmental security, it is also unsafe at any scale, regardless climate policy.

However, today I want to dwell on the positive options that state authorities have available at this key decision point for policymakers. To do so I begin with the 15th annual report on *The Levelized Cost of Energy* recently published by Lazard which is a major Wall Street investment analyst. In fact, I have relied on Lazard from my first analysis through the publication of my book on the *Political Economy of Electricity* (Praeger, 2017).

RESOURCE COSTS

Long-Run Costs

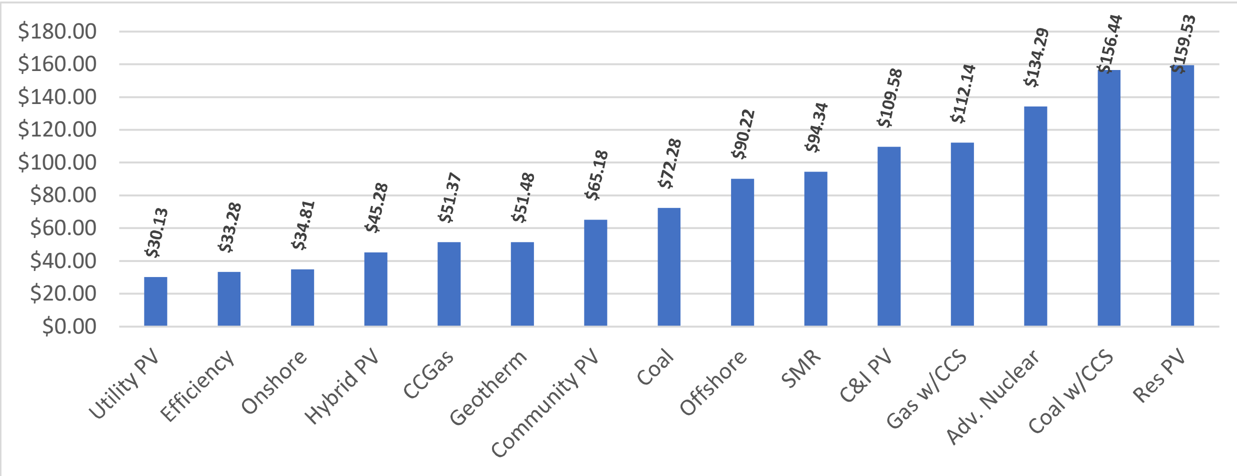
The first challenge that the pursuit of least-cost long term supply based on alternative resources confronts is the "problem" of long-term costs. Are these really the least-cost options? The most important consideration in establishing electricity policy is to start with long-run cost. Once we establish the goal for the long-term we ask, are there reasons, conflicts along the way, that make it difficult or impossible to pursue that goal.

Exhibit ES-1 uses recent cost estimated from Lazard and the Energy Information Administration as the cost estimate and the standard deviation of the estimates as the measure of risk. In the upper graph, I show the expected cost (based on the average estimate of cost and the uncertainty about it (the standard deviation of the estimate) calculated as the distance from the origin (i.e., as the hypotenuse of the risk and cost).

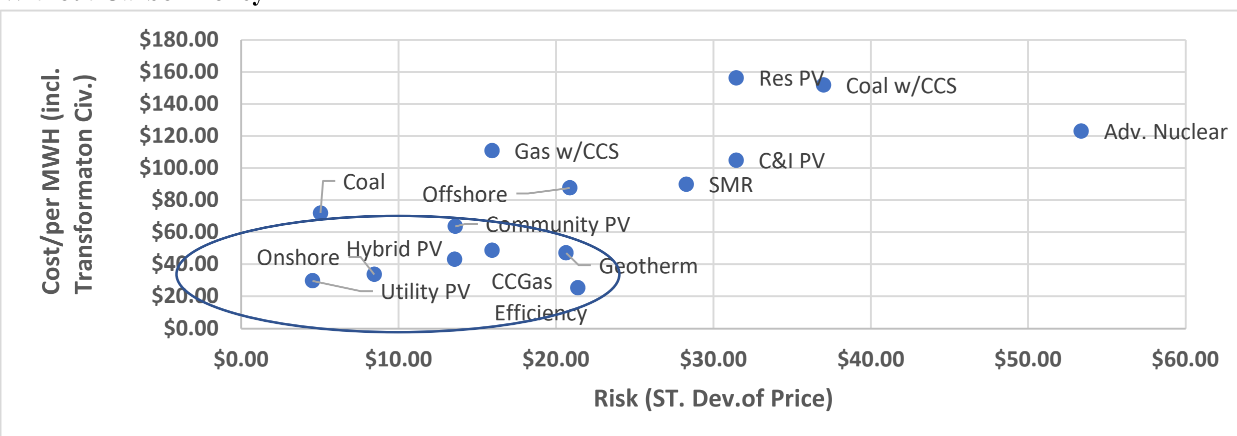
While I start from Lazard, I have made some adjustments. I included efficiency in the early estimates. I have included those estimates because there is strong and consistent evidence that this is what efficiency costs. because Lazard includes a high-end cost for coal with carbon capture, I include a similar high-end cost for natural gas combined cycle plant with carbon capture. This is from an earlier Lazard analysis. I have included a transformation dividend, since the shrinking of the system and reduction in peak demand are part and parcel of the 21st century system. Because Lazard does not include the cost of small modular reactors (SMR), I include my own estimates. The low end is the projected unsubsidized cost, 10-years in the future, from the leading promoters of SMRs. The high end is my estimate of the likely path of cost changes after a decade of research, development and deployment (RD&D) of fifty SMRs. Given the history of nuclear cost escalation, my high-end estimate is probably too optimistic, but it makes the point that SMRs cannot compete with the alternatives.

EXHIBIT ES-1:
COST AND RISK OF RESOURCES

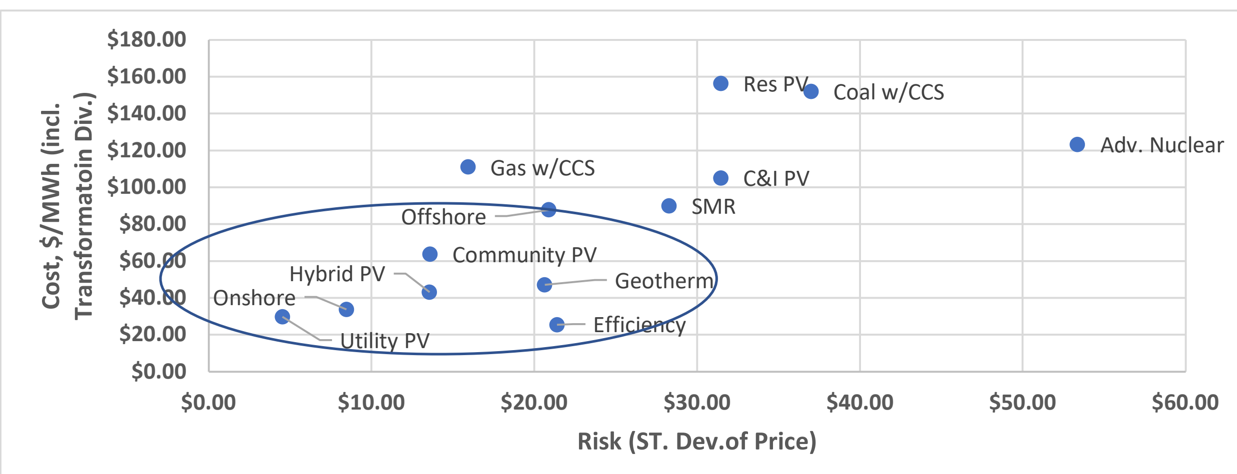
Risk-based expected cost $/MWh (Distance from the origin)



Without Carbon Policy



With Carbon Policy



Sources: Costs, Lazard, *Levelized Cost of Energy. Version 15,* p. 8; Lazard, *Levelized Cost of Energy. Version 15,* October 2021, p. 8; EIA, *Levelized Cost of New Generation Resources m the Annual Energy Outlook 2021,* Table 1a, 1b, Risk is the standard deviation of the cost estimates, alternatives include the transformation dividend.

On the EIA-side, first and foremost, EIA includes a "hybrid Utility PV" option which is composed of utility PV and four hours of battery storage. EIA described it in an ambiguous fashion, but regardless of the description, it is an option that must be included, if only because utilities have embraced it, and battery storage in general. The PV hybrid is less costly that coal and nuclear and close to natural gas.

EIA has low projections for geothermal and combined cycle gas. It has extremely low projections on the cost of new nuclear and always has been unjustifiably optimistic about nuclear costs. The low-cost projections probably reflect the vendor PR on small modular reactors (SMRs) on costs plus the Department of Energy subsidy. My analysis suggest that these projections are too low by at least 50 percent. However, even in the EIA projections, nuclear is about twice as costly as wind and solar, I believe it will be at least three times as costly.

The message is overwhelmingly clear. The upper graph shows the risk-aware expected price. Efficiency, utility photovoltaics, onshore wind and hybrid PV/battery resources, the main alternatives, are much less costly than central station facilities, without considering "the cost of carbon." With carbon policy, offshore wind, an immense resource, becomes competitive. Small modular reactors are the tenth resource, about three times as costly as the basic 4 resources.

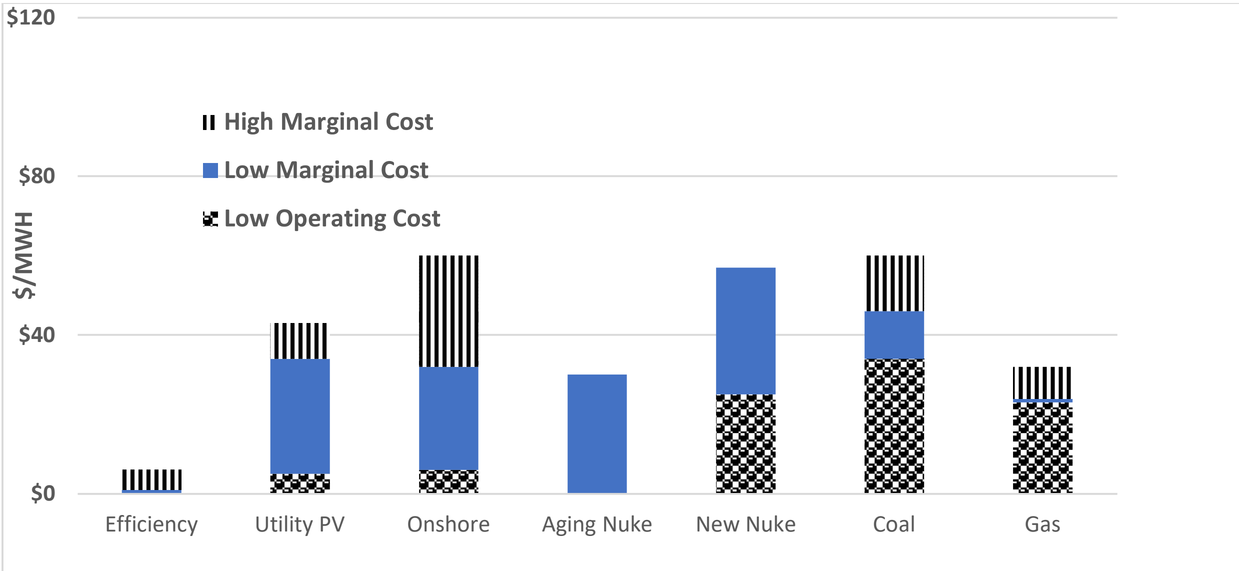
Short-Run Costs

The second challenge in the pursuit of least-cost long term supply based on alternative resources is the "problem" of short-term costs. Is there a conflict between short-term and long-term costs? As shown in Exhibit ES-2, the answer is an emphatic No!

On average, the alternatives are less costly. At worst, they are just cost competitive with central station facilities. In fact, the conclusion is even stronger than Lazard's analysis suggests because it compares the "all-in" cost of alternatives to the "marginal cost" of central station facilities. Over the 25-year life of the alternatives, many of the central station facilities would have to be replaced or refurbished, so this marginal cost is misleading. To make the point, I include the true marginal costs (operational) of the alternatives. Either way, the message is clear. There is no short term reason not to pursue the long term goal.

> In both the short run analysis and the no carbon policy, natural gas becomes the fifth choice in terms of cost (after efficiency, wind, solar and hybrid systems). Given the fact that the alternatives are being installed and growing, it should be clear that this observations does not involve gas as a "bridge fuel" that fills a gap until widespread adoption of renewables. It could be viewed as an option for the end of the transitions, , after the transformation in resources has gone a long way and physical and institutional infrastructure is largely complete. At that point, gas might be competitive as a resource, if two processes have taken place over several decades. First, technological progress in alternatives has slowed and the exhaustion of low-cost resources (especially storage technologies) has led to increasing costs. Second, technological progress in gas technology, consistent with the dynamic operation of the grid and the new marginal role of gas has taken place. Only at that point should gas be considered as an option

EXHIBIT ES-2:
SHORT TERM COSTS PER MWH



Source: Lazard, *Lazard's Levelized Cost of Energy Analysis – Version 14.0,* October 2020, Long Terms Costs are from "Levelized Cost of Energy Key Assumptions. Lazard's Levelized Cost of Energy Resources – Version 14.0, with efficiency from Version 9.0, and gas carbon capture from Version 8.0. Low capture costs reflect the utilization rates that that are used in the low estimate of unabated costs (83% for coal and 70% for gas). Low cost for aging reactors is the operating cost subsidy they have demanded, while the high cost estimate include capital cost recovery. . Short term costs are from LZARD, Levelized Cost of Energy Comparison -- Renewable Energy Versus Marginal Cost of Selected Existing Conventional Generation," and Levelized cost of Energy Components – Low End," for low operating costs.

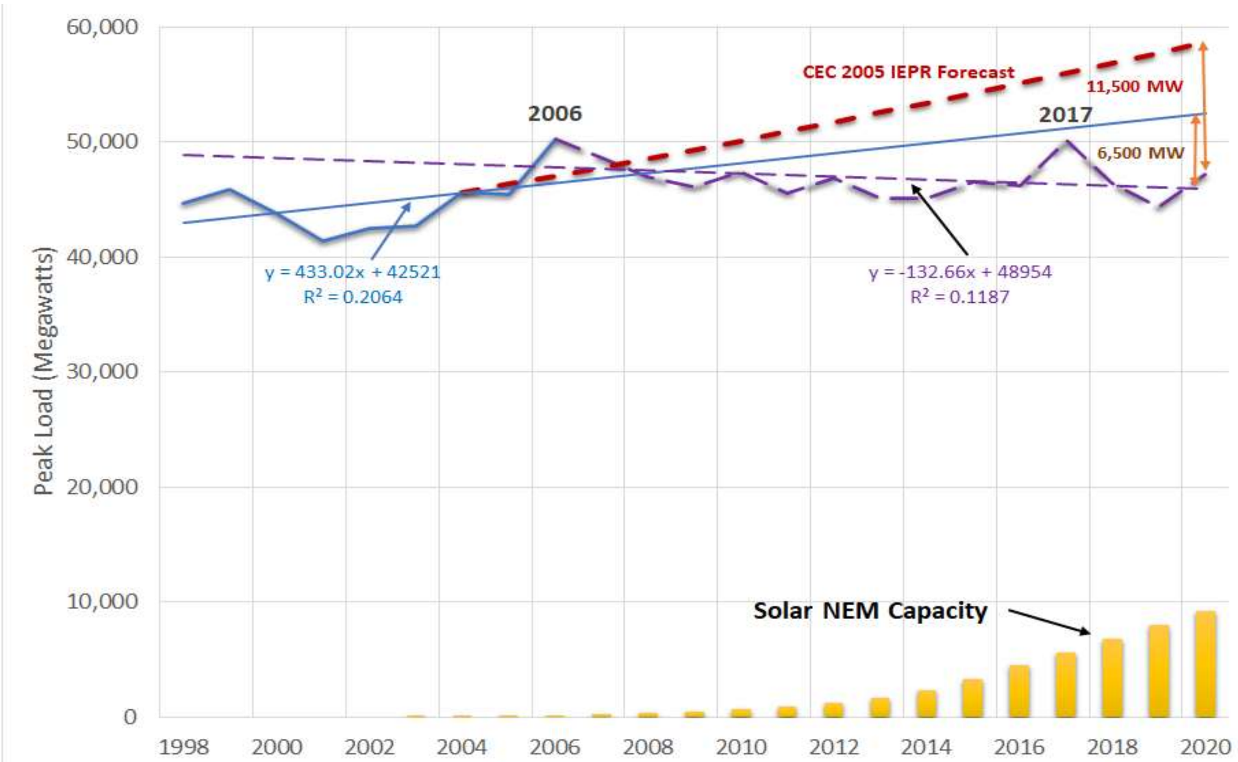
Reduced Demand

The third challenge with the pursuit of least-cost long term supply based on alternative resources is the "problem" of supply. Can an alternative system deliver reliable electricity at a lower cost than central station power? Here we encounter the question of demand. While the answer is complex, and highlights my "economic," as opposed to environmental, point of view, the answer is clear. It can.

In contrast to environmental purists, I believe that (battery) storage will play an important role in ensuring reliable, low cost supply. This is already apparent in Lazard's and EIA's cost analysis. That analysis shows utility photovoltaics, with storage, well positioned on the supply curve. A similar result is shown in the EIA discussion of generating costs. This alternative is attracting a great deal of attention from utilities, and the costs of storage are trending down.

The evidence from the early transition is even better than anticipated. In earlier analyses I have claimed a transformation dividend of 17%, which result from a shrinkage in size of the needed supply due to better integration of supply and demand. The results in California (see Exhibit ES-3) show a larger reduction in peak system demand from solar alone (17%). The total reduction in peak load is over 20%. As peak demand shrinks, so too does the need for transmission capacity. This is a cost benefit, not included in the above long-term resource cost estimates. With marginal costs of transmission estimated in diverse markets, California, Kentucky, PJM, of $37/MWH, this cost savings is substantial

EXHIBIT ES-3:
CALIFORNIA INDEPENDENT SYSTEM OPERATOR (CAISO)
PEAK LOADS 1998-2020 AND SOLAR NET ENERGY METERING (NEM)



Source: Richard McCann, "Why are we punishing customers for doing the right thing?" *M.Cubed*, November 30, 2021. See also, "The scale economy myth of electric utilities," *M.Cubed*, August 3, 2021, and "Transmission: the hidden cost of generation," *M.Cubed*, July 13, 2021.

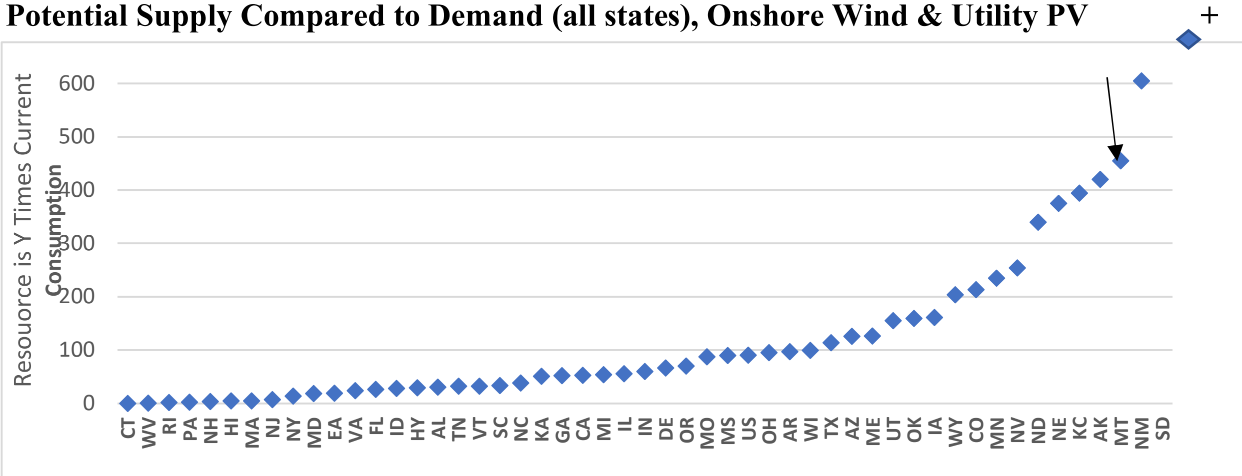
ADEQUATE, RELIABLE SUPPLY

The examination of the potential for alternatives resources crucial and quite encouraging, particularly for Montana, as shown in Exhibit ES-4, where the potential supply of renewables is compared to current demand. Montana is among the most well-endowed states in the nation. In fact, Montana has a richer endowment that 15 of the 16 states that have achieved higher levels of penetration of renewables. It is also well behind the 10 Europeans nations listed in the lower graphs

In addition to strong, early evidence on the transformation dividend and a very rich resource in Montana. There is growing evidence of numerous tools necessary to operate a reliable electricity sector based on the alternatives, as listed in Exhibit ES-5.. The updated appendix to the study I submitted for the record contains over 270 studies of specific tools.

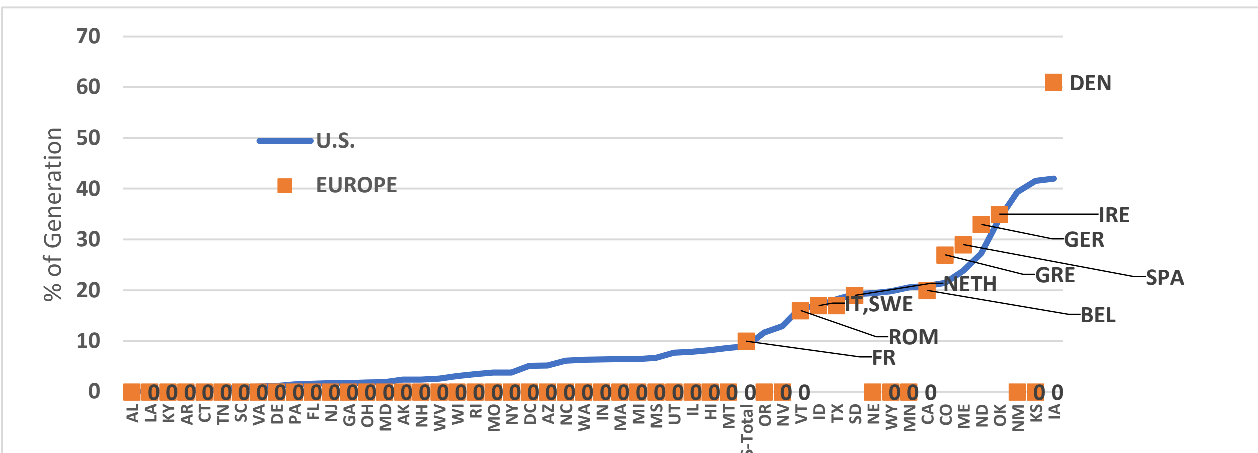
EXHIBIT ES-4:
ASSESSING THE ADEQUACY OF SUPPLY

Potential Supply Compared to Demand (all states), Onshore Wind & Utility PV



Source: Anthony Lopez, et al., *U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis,* NREL, July 2012

Penetration of Generation from Wind and Solar



Energy Information Administration, Electric Supply Monthly, EMBER, *EU Power Sector is 2020.*

EXHIBIT ES-5
MEASURES TO MANAGE AN INTELLIGENT,
DECENTRALIZED ELECTRICITY SECTOR & REDUCE PEAK LOAD

Overall Effect
Lower Cost (including externalities, e.g., uncertainty, choice
Smaller Systems (especially the transformation dividend)
Demand
  Efficiency
  Target efficiency to peak reduction
  Aggressive demand response
  Manage devices (e.g., water heater loads to reduce peak.
  Smart controllers
  Shed inflexible baseload

Rates
  Target fixed-cost recovery to ramping hours
  Time of use rates
Supply
  Diversify renewable supply
  Geographic (particularly wind)
  Technological (wind & solar)
  Target solar to peak supply (west orientation)
  Target Best Sites
  Re-orient conventional supply

Grid management
  Expand balance area
  Improve forecasting
  Integrated power transactions
  Import/export
Dispatchable storage
  Solar thermal electric with storage
  Utility storage in strategic locations
Distributed storage
  Community & individual storage
  Air conditioning water heating w/storage
  Electric vehicles
Deploy fast-ramp generation
Virtual Power Plants

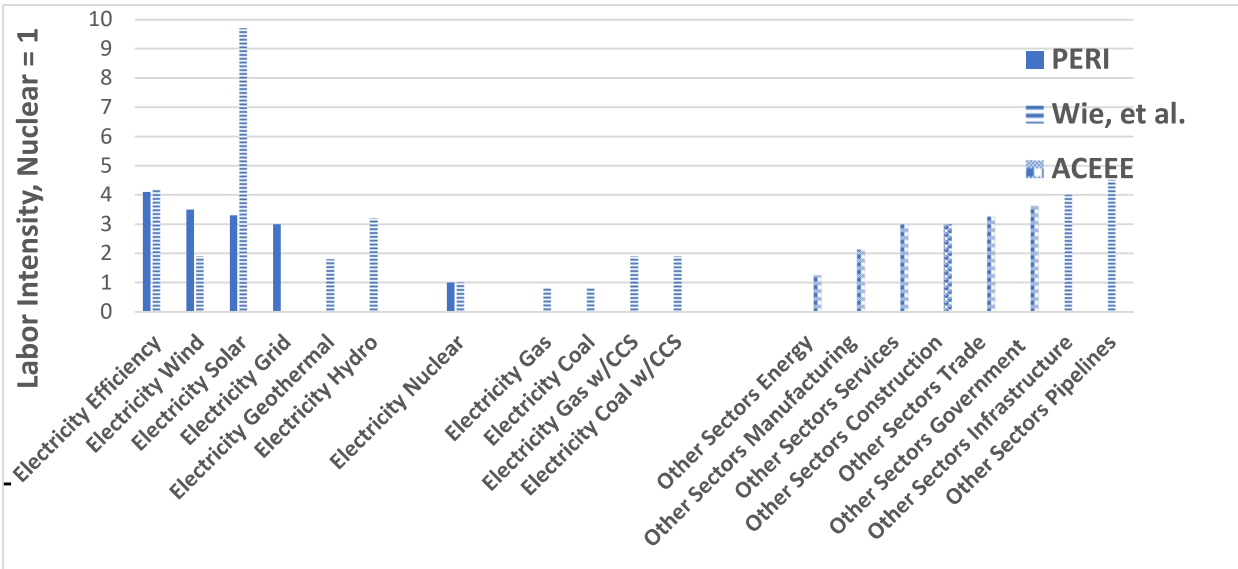
Source: Mark Cooper, *The Political Economy of Electricity: Progressive Capitalism and the Struggle to Build a sustainable Power Sector, (Praeger, 2017), Appendix B Categories;*

MACROECONOMIC IMPACTS: JOBS AND THE LOCAL ECONOMIC MULTIPLIER

Numerous studies have shown that the alternatives energy sources deliver more jobs per dollar of investment or output. Exhibit ES-6 makes two well-known points. First, as shown in the upper graph, the alternatives scenarios create more jobs than traditional central station facilities. Second, spending on central station facilities creates fewer jobs than other types of `economic activity. This has an important impact on the economy.

EXHIBIT ES-6: MACROECONOMIC IMPACTS OF RESOURCE OPTIONS

Labor Intensity for Electric Resources and Other Uses



Sources: Wie, Max Shana Patadia and Daniel Kammen, 2010, "Putting Renewables and Energy Efficiency to work: How Many Jobs Can the Clean energy Industry Generate in the US?", *Energy Policy,* 38. Rachel Gold, et al., *Appliance and Equipment Efficiency Standards: A Money Maker and Job Creator,* American Council for an Energy Efficient Economy, January 2011, p. 9, based on the IMPLAN Model, 2009., *How Infrastructure Investments Support the U.S. Economy: Employment, Productivity and Growth,* James Heintz, Robert Pollin, Heidi Garrett-Peltier, Political Economy Research Institute, January 2009.

Estimates of Economic Multipliers of Net Pocketbook Savings

Modeler	Model Date	Policy Assessed	Region	GDP/$ of Net Savings	
				Base Case	Rebound Adjustment
Roland-Holst	DEAR	Computer Standard	California	1.8	2.0
ENE	REMI	Utility Efficiency	Northeast	2.2	2.4
Cadmus	REMI	Utility Efficiency	Wisconsin	2.5	2.8
Arcadia	REMI	Utility Efficiency	Canada	2.7	3.0

Sources: David Roland-Holst, 2016, *Revised Standardized Regulatory Impact Assessment: Computers, Computer Monitors, and Signage Displays,* prepared for the California Energy Commission, June. ENE, *Energy Efficiency: Engine of Economic Growth: A Macroeconomic Modeling Assessment*, October 2008. Cadmus, 2015, *Focus on Energy, Economic Impacts 2011–2014*, December. Arcadia Center, 2014, *Energy Efficiency: Engine of Economic Growth in Canada: A Macroeconomic Modeling & Tax Revenue Impact Assessment,* October 30,

. Second. as shown in the lower graph of Exhibit ES-6, because the alternatives deliver more jobs per dollar of investment and output, **and are lower in cost,** they have a much larger impact on the local economy. Consumers are spending less on energy and have more to spend on other things, which has a larger multiplier effect. Every dollar saved creates about two dollars of economic growth. Many of the jobs are local, so the spending tends to be disproportionately local.

PUBLIC HEALTH AND THE ENVIRONMENT

Although I have reached this clear conclusion on the basis of the five major economic considerations, it is important to point out that the public health and environmental considerations point in the same direction. Fossil fuels and nuclear power are far form clean. Nuclear power involves significant risks in mining accidents and the storage of waste..

CONCLUSION FOR STATE POLICY MAKERS

Now is the time for state policy makers to commit to building a long-term, least cost, low carbon and clean electricity sector based on alternatives to antiquated central station facilities. The tools are available to build such a sector on wind and solar renewables sources, storage, efficiency and intelligent grid management that not only generates reliable, least-cost power, but also relies on local resources, creates local jobs and powers the local economy.

In my remarks today I have shown seven reasons why state policy should fully embrace the transition to a 21st century electricity sector based on alternative resources. The first five of those reasons are purely economic. The fact that the policy also has a positive net benefit on public health and the environment reinforces the conclusion based on economics.