

ECONOMIC, FINANCIAL AND REGULATORY IMPLICATIONS OF ELECTRICITY DECARBONIZATION

by Leonard S. Hyman and William I. Tilles

[See cited June 2020 paper, Society of Regulatory and Financial Analysts (SURFA) for details]

SUMMARY

Burning carbon-based (fossil fuels) produces greenhouse gas (GHG) emissions that cause global climate change. Substituting electricity for fossil energy sources will reduce GHG emissions as long as the electricity is not produced with fossil fuels. (Electricity generation presently produces 25% of US GHG emissions.) Decarbonization of the electric sector, though, will cost \$4-5 trillion. Add on needed modernization (average electric plant is 35years old) and the industry will have to spend \$7-8 trillion

Program size is not an obstacle to success.

Utilities can raise that money at low cost, do not need government aid and can keep annual real price increase to pay for the program to below 4% (2% for decarbonization and 2% for modernization). The electric bill is 2% of GDP or household income, so average price increases will have small economic impact.

Biggest roadblocks to faster decarbonization are capital-related.

Fossil fuels will still account for half of electric generation in 2050 unless policies change. Generator owners want compensation for fossil fuel assets. Investors in new facilities require assurance of adequate return. Existing regulatory mechanisms can accomplish both if properly employed.

Business and policy changes required.

Decarbonization will accelerate when electricity executives view it as a gigantic business opportunity. and policymakers as not only a means to reduce GHG emissions but also as a big, shovel-ready, high-paying infrastructure project that requires no government money, coming at a time when the economy badly needs one. Why not now?

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Economic, financial and regulatory implications of electricity decarbonization

by Leonard S. Hyman and William I. Tilles

Electricity producers can reduce their greenhouse gas emissions faster and without government money

This is the green electrification strategy: eliminate greenhouse gas (GHG) emissions that raise global temperatures by convincing consumers to switch from fossil fuels, which produce GHGs when burned, to electricity (that is, drive electric not conventional cars or heat with electricity not oil). That strategy will work if electric companies stop burning fuels that emit GHGs, which will require them to spend trillions of dollars on new plant. Decarbonization is a capital-raising project.

The electric sector can finance this capital expenditure (CAPEX) effort at historically low interest rates, profitably, faster, without government aid, with only small price increases to pay for it. The industry would undertake this program now were the right policies in place.

Eliminating fossil fuels from electric generation will reduce America's GHG emissions 25% and electrifying transportation another 29% if vehicle owners consume electricity generated from fossil-free sources.¹ Chemical processes and heating offer additional opportunities for electrification.

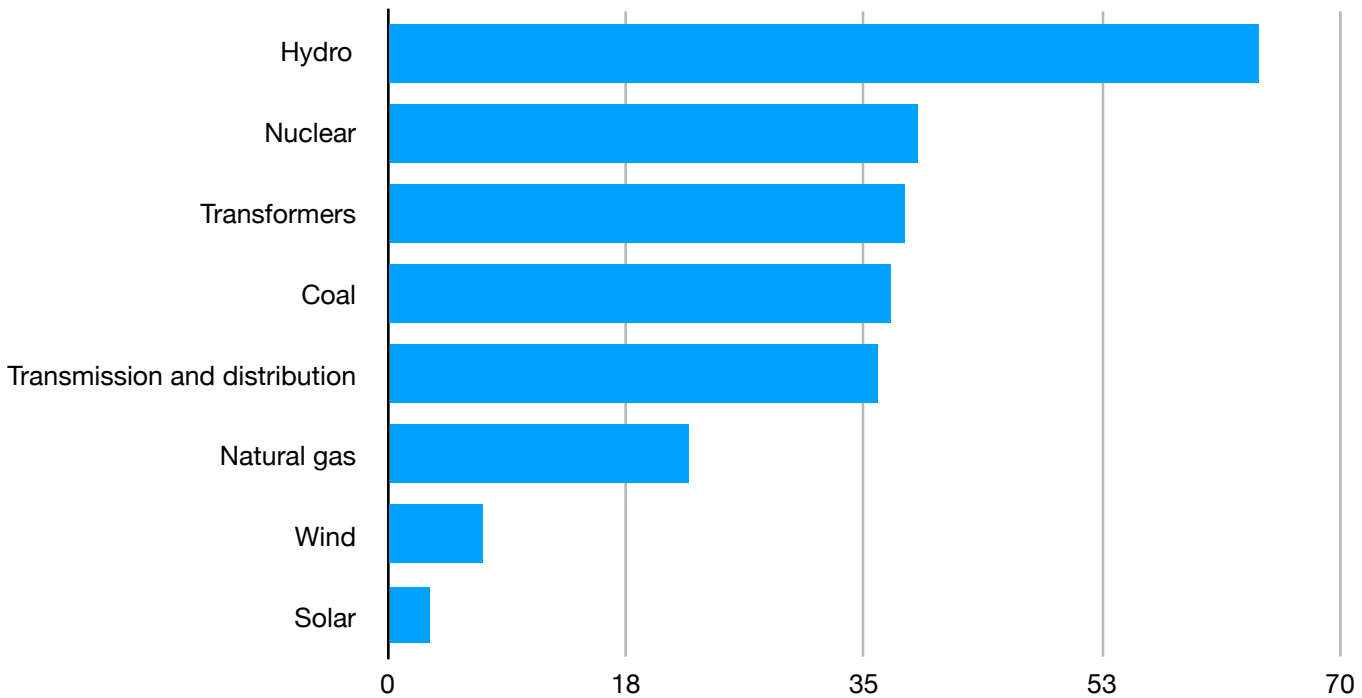
Financial considerations impede electricity decarbonization. No prudent board of directors will authorize these expenditures without assurance that it can protect existing assets and earn an adequate return on new investment. Both conditions require regulatory buy-in. Get the financials right and regulators and managements on board and the money will flow.

1. Decarbonization is only part of the picture

CAPEX to decarbonize existing plant could reach \$4.5 trillion, and replacement of old facilities could raise the total to \$7-8 trillion spent over 20 years.² CAPEX would go higher if demand for electricity rose. Electric industry gross plant now is just under \$2 trillion.

Average electric plant is roughly 35 years old, near the end of its accounting life. (See Figure 1.) Electricity suppliers will have to replace facilities within two decades with or without decarbonization.

Figure 1. Average age of electric utility plant and equipment (years)



Note:

Energy Information Administration, American Society of Civil Engineers, Lawrence Berkeley National Laboratories, Harris Williams reports and Rhodes, *op. cit.*

Plant costs have risen over 35 years.³ A CAPEX program replacing old plant with new raises prices, all other things being equal. Decarbonization is only part of the picture. Price will increase with or without it.

2. The market can finance the spending

A \$ 7-8 trillion program equals \$350-400 billion per year over 20 years, more than the current annual CAPEX of less than \$150 billion. Many electric companies have set 2050 as their zero carbon date, too far out to require immediate action. CAPEX will have to rise dramatically to get from here to there.

In 2019, the electric industry accounted for roughly 4% of America's business CAPEX and 3% of corporate and municipal debt issuances. Capital markets should have little difficulty financing more electricity spending. The suggested CAPEX would raise industry gross plant by 7-8% annually over a 20 years, no more than past growth rates during expansionary periods.

Low risk electric company securities should appeal to investors desperately seeking positive returns after placing more than \$15 trillion into bonds that earn negative negative interest rates and trillions more into accounts that pay barely any return.⁴ They need alternatives.

Financial institutions have lowered their investment standards in order to maintain income. They would gladly buy investment grade "green" bonds, with proceeds designated for environmentally beneficial purposes, such as to decarbonize generation and improve grid efficiency.

Financial markets can support and the industry can manage the CAPEX. The electricity industry, however, has to want to issue the securities that investors surely will buy.

3. Focus on coal

In 2019, coal accounted for 60% of electric industry GHG emissions but only 24% of power generated. Eliminating coal as a fuel— but not replacing it with natural gas — will reduce America's GHG emissions by 15%. Generators could close conventional coal plant first, replace it with output that does not emit GHGs, and leave decisions on other facilities to a later date.

Coal-fired stations make up 28% of the capacity of major coal burning investor- owned utilities (IOUs). Those utilities have \$55 billion (or 10%) of rate base in coal plants and public power agencies possibly another \$15 billion.⁵

Coal-related rate base is a major obstacle to prompt decarbonization. Owners will resist closure of plants not fully depreciated ("paid for") unless compensated for the "stranded" assets. Mechanisms to recover those assets exist. Owners, however, must petition regulators to approve a plan. Asking consumers to pay for assets no longer serving them plus replacement power might trigger a full scale inquiry into the utility's profitability, which could lead to price reductions. It may be less risky for the utility to delay action than to ask.

Utilities that shutter coal-fired stations may prefer to replace their output with gas-fired electricity from existing stations, thereby creating financial benefits for incumbent generators. Replacing coal stations units newly built gas-fired units in fully regulated states increases rate base and earning power of local utilities. Replacing coal with gas, then, favors local utilities and creates financial incentives to delay full decarbonization.

Admittedly, keeping gas in the generating mix provides low-cost system reliability. A partial phase-out of fossil fuels, however, will weaken any industry claim to be the provider of GHG-free energy, a valuable marketing edge. Electric vehicles could become competitive with gasoline-powered cars by the mid 2020s.⁶ If the electric industry cannot sell a green product by then, disruptive enterprises might. Pursuing electrification of transportation is the electricity sector's most visible path to growth. But it needs a clean product to sell. Electricity produced GHG-emitting stations is not that product.

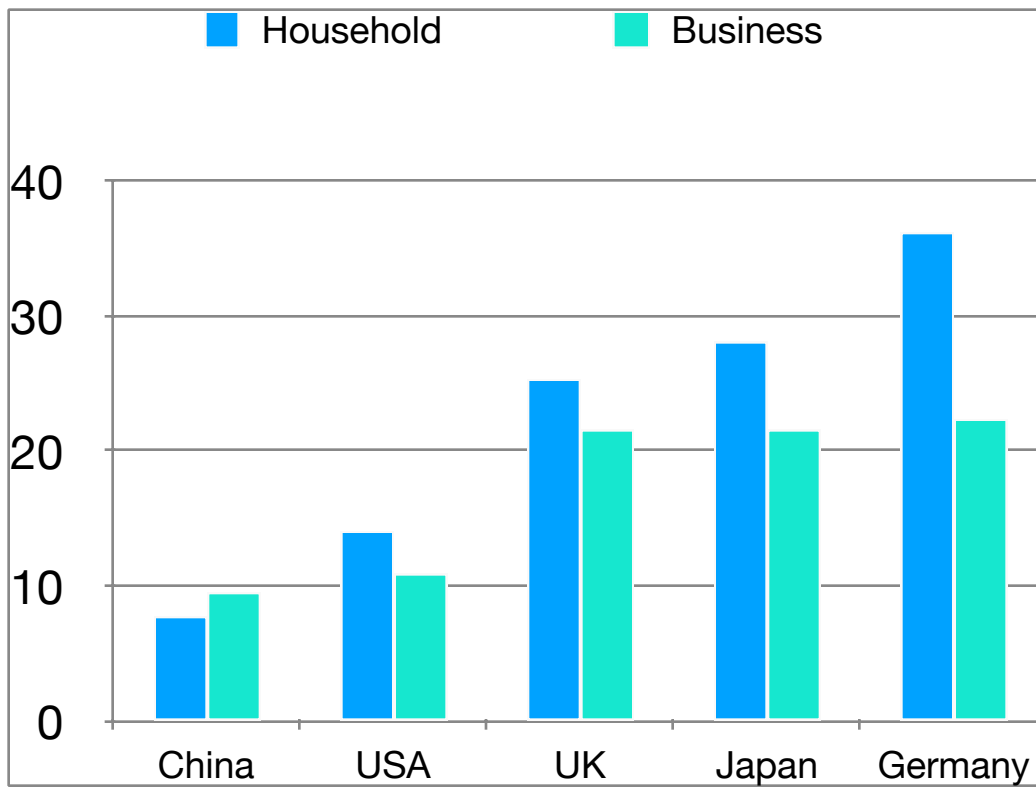
The Energy Information Administration (EIA), in its *Annual Energy Outlook 2020* projected that fossil fuels will generate 61% of electricity in 2020 and 49% in 2050, a slow decline in the face of an urgent problem.⁷ A 20 year program that promptly replaces conventional coal-fired with non-fossil resources would bring down GHG emissions faster. The leisurely effort contemplated by the EIA is inadequate to meet the climate challenge.

Electricity suppliers lack sufficient incentive to speed decarbonization. Regulators and policymakers have the means to accelerate the process. They need the political will to act.

4. Cost of capital counts

Americans pay low prices for electricity (Figure 2). Industrial customers, in fact, pay less than industry in China.

Figure 2. Price of electricity per kwh (¢) in 2019



Note: December 2019, globalpetrolprices.com.

Modernizing or decarbonizing — all other things being equal— will raise price to ultimate customers because new plant costs more than old. A firm that increases invested capital faster than sales maintains return on capital by slashing costs or raising prices. (Electricity suppliers increase invested capital by 6-7% per year while sales rise 1% per year.) For utilities, declining fuel expense provides an offset to higher capital costs, but not necessarily enough.

To evaluate prospects within a financial and regulatory framework, we employed a Wall Street analytic framework that concentrates on investment and cost of capital.⁸ In the future, capital will account for most electricity costs. For simplicity, we assumed no change in industry market, size or structure.⁹

Coal industry executive, Michelle Bloodworth, simplified the biggest problem facing consumers:

... existing power plants have lower fixed costs but similar variable costs compared to ... sources that might replace them... the reason new plants have higher fixed costs is that they begin their

operational lives with a full burden of construction costs to recover. Since existing ... plants have already paid for ... those costs, their ongoing fixed costs are lower...¹⁰

Cost has four components:

1. Fossil fuel expense, which will decline as decarbonization proceeds.
2. Depreciation expense, the annual decline in value as plant ages, will increase as dollar investment in assets grows and the industry installs plant with shorter operating lives.
3. Other operating expense, the bulk of which consist of administrative and operating categories unrelated to volume or type of generation, should hold steady.
4. Pretax operating profit, likely to rise over time, is payment required to attract and keep capital, determined by size of the capital base and by the cost of capital, which is determined by risk. ¹¹

Government- or consumer-owned utilities (public power) have the lowest cost of capital, in part due to government backing and tax advantages. Regulated IOUs pay more. Competitive power producers pay the most because they take more risks. Pretax cost of capital, in mid 2020, was about 8% for competitive producers, 6% for IOUs and 4% for public power. ¹²

Capital will make up a greater part of future total costs, so firms with low capital costs will develop a competitive edge. Public power and regulated utilities and their customers, should benefit from this shift.

5. Price will rise by single digits

The EIA, projects that price will change minimally, sales will grow 1% per year and fossil fuel will account for half of generation through 2050, which seems unlikely. Decarbonization of other sectors of the economy could double electricity consumption and with proper planning do so without causing price increases, say some experts. ¹³ Others counter that decarbonization costs vary greatly and authorities often choose expensive options for political or ideological reasons, so why assume proper planning?¹⁴

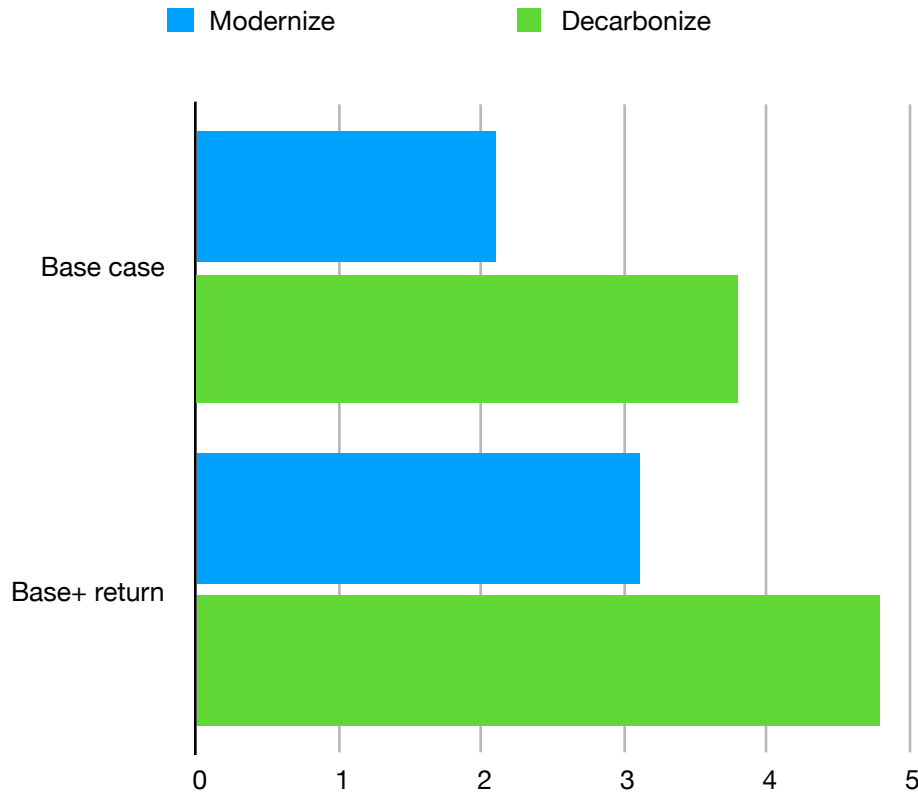
Proponents of change tend to overpromise, utilities have expertise and clout to protect their positions and policy makers often choose uneconomic solutions. Legendary management guru Peter Drucker thought that predicting the future was a futile effort and advised that, instead, we should “anticipate *future effects of events* which have ... happened.”¹⁵

To keep it simple, we ask: how much must price to ultimate customers rise so that electricity providers can raise capital needed to decarbonize, modernize or replace existing plant over 20 years (2020-2039)? We assume no significant changes in sales or costs, such as near term electrification of transportation, dramatic technology cost reductions or need to rebuild the electricity system due to climate change. Nor do we consider whether full decarbonization is the right policy choice. Policy makers can change course.

Return on capital and depreciation will dominate future costs. Fortunately, pre-tax cost of capital is low (less than 6%) and probably will remain so.¹⁶ Depreciation expense, however, will rise as the depreciation rate moves from about 3% (33 year life) now to 6% (17 years) largely due to massive investment in short-lived storage, which could offset the drop in fuel costs. In addition, regulators will impose a surcharge to pay for prematurely retired plant. We calculate an alternative price, too, in case cost of capital returns to the level prevailing before the Great Recession.

Altogether, in real terms, we estimate that over 20 years price will rise 52% (2.1% annually) if the electric industry modernizes and 113% (3.8% annually) if it decarbonizes as well. If capital costs return to pre Great Recession levels, price increases 3.1% - 4.8% annually. The average household bill would go up about \$24 each year to pay for decarbonization. (See Figure 3.)

Figure 3. Real annual % increases in price of electricity (2019-2039)



Notes: Base case— covers cost of operations and capital plus surcharge to amortize undepreciated assets over 10 years. Base+ return includes 4 percentage point higher pretax return on capital.

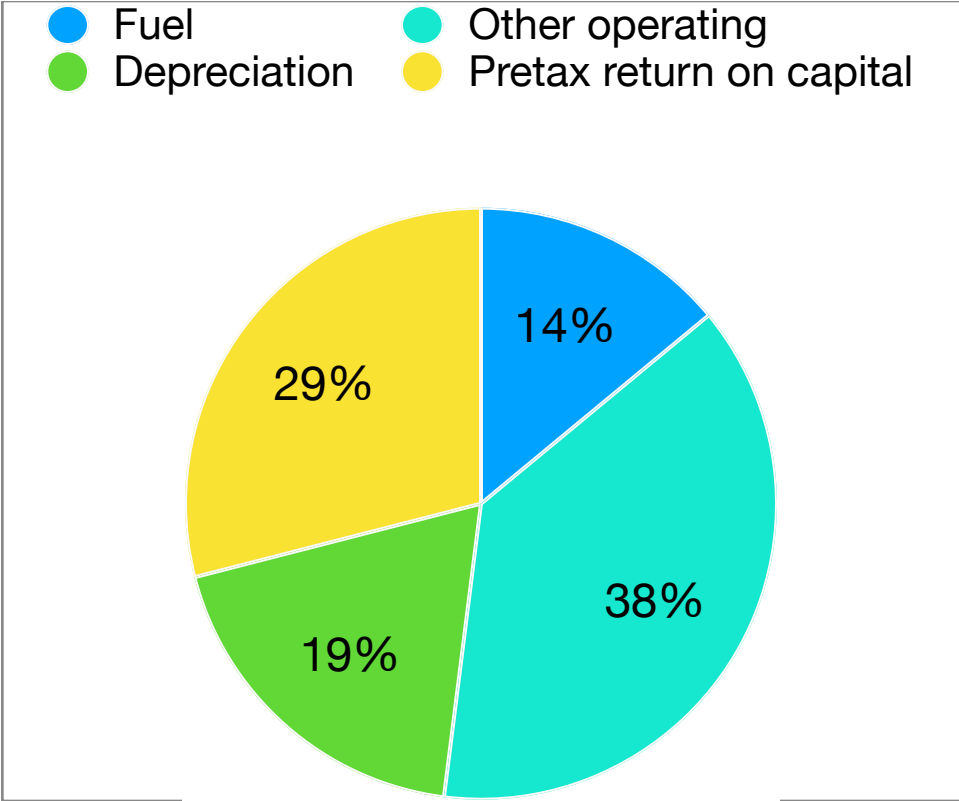
In 2019, electric revenues equaled 2% of gross domestic product and residential electric bills 2% of household income. Raising real electric prices 2-4% per year would have limited economic impact.

The annual price increase, then, should be small, and regulators know how to stretch payments to make sure it stays small.

6. Electricity will become a fixed cost business

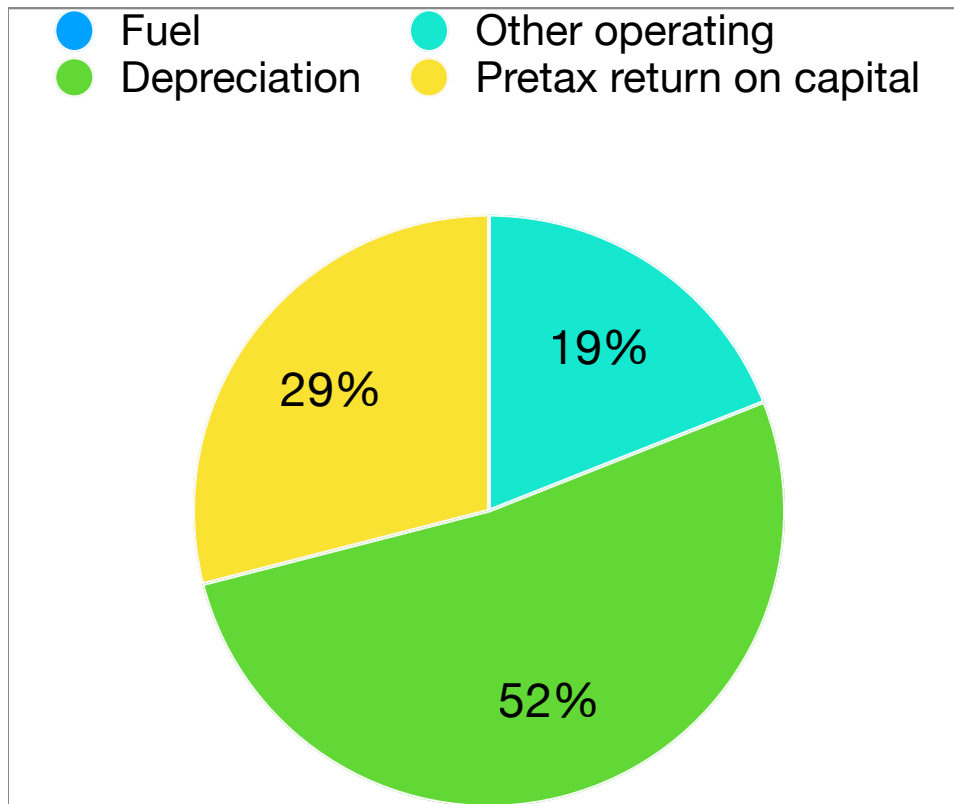
Decarbonization will profoundly change the electric business, doubling the ratio of plant investment to sales. Capital related costs will account for most of the electric bill. (See Figures 4 and 5.)

Figure 4. Components of electric revenues in 2019 (%)



Note: Based on data reported to Edison Electric Institute and Energy Information Administration.

Figure 5. Components of electric revenue in 2039 (%)



Note:
Authors' estimates.

Companies with high fixed costs operating in volatile markets periodically face ruin. Investors figured that out after the last power bubble culminating in Enron's failure. As a result, they provide the lowest cost capital to generators that sell on long term contracts or their functional equivalents, or that operate as regulated utilities. Pension and infrastructure funds and insurance companies are looking for low risk, assured cash flow.

The new cost structure should encourage examination of ownership and financing models originating more than a century ago. Electric companies own grid assets while customers own appliances behind the meter. They finance with a thick layer of equity (shareholder money) as a buffer against risk, although, practically speaking, regulators pass on risk to consumers except for cases of egregious imprudence. In the future, electricity supply may look like a

leasing business, with strength of contract the primary basis for cost of capital. Revenues and costs should become less variable and less risky, thereby reducing need for expensive equity capital. Small non-utilities could execute strong contracts that permit them to raise money as cheaply as utilities. Cost of capital will play a key role in pricing. Reducing it two percentage points (the difference between IOUs and public power) would cut 2039 electric bills by 10%, more than money saved by eliminating fossil fuel costs.

The increasing importance of fixed costs will bring in new investors, and could change the rules of ownership and governance.

7. Carrots and sticks to get the ball rolling

The pace of climate change requires faster electricity decarbonization. Capital market conditions favor transformation, with interest rates at historic lows and a glut of capital seeking safe, positive returns in sustainable investments. The decarbonization/modernization program is as much a financial as an engineering project. It should respond to incentives, with no government money required.

Governments can help. A carbon tax would make fossil-fueled generation less competitive, but could turn into a fee to pollute if generators pass it on in price rather than close polluting power plants. (A tax of \$30 per metric ton, akin to the European price, would add 12% to the average U.S. price of electricity to ultimate customers.) Governments also can order electric companies to generate or purchase electricity produced without GHG emissions, or encourage them to convert to price-competitive renewables.

The Federal government can ease local impacts of decarbonization by diverting carbon tax revenues to states dependent on coal. It can guarantee debt securities issued to compensate utilities for prematurely retired facilities. Public power agencies, with low pretax tax capital costs, can expand to serve more consumers, directly or through wholesale activities.

What will persuade industry leaders to change course, from advocating gas generation as the “transition fuel” for decades to come, to advocating a rapid reduction of electricity’s GHG emissions to zero (assuming that zero is the right number)? When it comes to knowing how to decarbonize in the most effective manner, industry insiders know more about costs and opportunities than outsiders. We need to get them on board.

Few executives will voluntarily undertake a Schumpeterian act of creative destruction, abandoning carbon fuels for a non-fossil future. They need to

view climate change as a business opportunity rather than an assault on their financial well being. To mix a few new and old adages, honey attracts flies better than vinegar, so make them an offer that they can't refuse, a package of incentives that boards of directors cannot reject because share owners would turn on them for refusing profitable business opportunities.

States can utilize existing regulatory procedures to encourage action, for instance, with a three step path to remove fossil-fueled generation from rate base. In the first period, all abandoned fossil-fueled units qualify for treatment as if they remained in rate base. In the second period, abandoned assets earn interest and depreciation, but no return on the equity component of investment. In the third period, abandoned assets do not qualify for any recovery. The timetable provides certainty and investors will push for plant retirement as opposed to having money tied up in non-earning assets.

To simplify asset retirement, reduce costs and encourage fast action, regulators could authorize up front payment for GHG-producing plant if abandoned and replaced by assets that do not emit GHGs or by energy usage reductions that equal resources displaced. Sale of securitization bonds— a standard procedure to fund stranded assets— would provide funds, with a surcharge on electric bills paying bond principal and interest. A Federal guarantee for the bonds would lower interest costs and permit extended bond repayment schedules, reducing monthly charges to consumers and resistance to plant closures.

For that matter, state regulators will, no doubt, want to phase in over several years any noticeable price increases caused by a switch out of fossil fuels. A Federal guarantee on funding the phase-in would lower costs to consumers and make regulatory buy-in more likely.

Cost of capital plays a crucial role in incentive plans. Regulators now set return on stockholder investment (equity) at around 9%, and if current market conditions continue, it could drop to 7%. This low return permits regulators to offer small carrots that produce disproportionate benefits. Raising prices by just over 1% boosts return on equity by one percentage point and net income by 10%. Boards of directors could not ignore that incentive. If offered only on decarbonization investment, it could precipitate an avalanche of activity.

Many electric companies act as conduits, indifferent to what they deliver. To change that attitude, regulators should tack a delivery bonus on GHG-free electricity, to transform companies from bystanders into advocates for change. The electric industry has to get back into the sales mode to make decarbonization- via -electrification happen. Sales people require commissions.

Regulators, too, might determine that electric companies delaying preparation for climate change are taking undue risks, and then emulate bank supervisors who require a thick layer of expensive common equity for banks that take too much risk. Forcing an ultraconservative capitalization on a utility could lead to lower returns to shareholders. Boards of directors would respond. Nobody likes to see returns lowered.

Most mechanisms to encourage decarbonization are already in the regulatory tool kit and ready for utilization.

Bottom Line

Electricity decarbonization requires a change in mindset rather than revolutionary technology or government money. Real prices will rise modestly, not enough to disturb consumers or regulators. Paying extra for clean electricity sooner rather than later is like paying an insurance premium: cheaper to go without it until the house burns down.

The process of decarbonization is modular, consisting of one project following the other, compared to the old nuclear efforts that cost billions apiece, took a decade to construct and had no value unless fully completed. The industry can change course when a new technology emerges, or when demand moves in an unanticipated direction. That flexibility, the avoidance of the giant project, reduces risk for policy makers and investors.

Regulators can and should act now. Financial markets would welcome a chance to invest in a sustainability transformation. Borrowers now would pay historically low interest rates, thus reducing cost to consumers. Politicians unable to enact a grand infrastructure program on their own should embrace this shovel-ready one which is staring them in the face.

The electric industry must focus on decarbonization-via-electrification — not selling electricity — as its main business proposition, and seize it as the biggest opportunity since the popularization of air conditioning.

Decarbonization will transform electricity into a sustainable growth industry, as well as dramatically speed the reduction in GHG emissions. Why wait?

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