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The politics of electricity and nuclear: looking back, looking forward

By Walt Patterson

When Michael Grubb suggested I talk to you about 'the politics of electricity and nuclear: looking back, looking forward' I started making notes. I quickly had enough for a year's course work. I realized I'd have to boil it down a bit. So my comments today are going to be pretty selective. I'll just pick out a few of the key details of a story that could be as long as Wikipedia.

I take 'politics' here to mean, above all, the role of governments, how governments influence electricity and how governments are influenced about electricity: the shape of electricity systems - planning, technology choice, investment decisions, business models and - of course - how we pay to use electricity. For the politics of electricity you go back at least to 1882, to Thomas Edison and the first central-station electricity system, the Pearl Street station in lower Manhattan. That involved politics, because Edison had to run cables through the public streets, notably Wall Street, and had to get permission from the relevant authorities. Planning permission would become a critical political aspect of electricity. It also became a key locus of political pressure, including lobbying and - eventually - public opposition.

Edison's one-time secretary, Samuel Insull, had an almost equally influential impact on the evolution of electricity. At Chicago Edison he persuaded the local government that a central-station electricity system was a 'natural monopoly' - that running more than one set of wires in a neighbourhood was not economic. The government thereupon decreed that no one else could sell electricity in what became a franchise area for the monopoly system. It also, however, imposed a regulatory control on what the monopoly system could charge its captive customers. Whether the system was owned by some level of government, civic or regional, typical in much of Europe, or by private investors, especially in the US, this model, a regulated monopoly franchise with captive customers, soon became the norm for electricity essentially everywhere.

The economies of scale of the generating technologies then available, water power and steam power, meant that making systems larger brought costs rapidly down, accelerating the use of electricity. For system operators, scaling up was straightforward. Larger investments and longer construction times increased the risks; but the risks were borne by the captive customers. If they wanted to use its electricity they had to pay whatever the government or regulator allowed the system to charge. By the late 1950s individual power stations were large enough to light entire cities. A rapidly increasing proportion of these stations burned coal or oil. The apparently low cost of their output did not, unfortunately, include the cost to the environment of the noxious smoke, gases and particulates their fires poured into the surrounding air.

That, however, became a political issue only much later. Instead, the first manifestation of popular concern about electricity and the environment came because the new huge, remotely-sited power stations required long high-voltage transmission lines, tall towers across the landscape. People wanted electricity, but they did not want the towers. They insisted, literally, 'not in my backyard' - NIMBY. Governments, however, routinely overruled objectors, and transmission towers sprang up everywhere, including a lot of backyards.

The low cost of coal- and oil-fired electricity in the late 1950s meant that electricity systems did not want to build power stations using the novel technology of nuclear power - too risky and uncertain, with questions about cost, safety and waste management. But governments were lobbied intensively by the powerful agencies that had created nuclear weapons. The nuclear people were determined to establish nuclear fission also as a civil technology. The psychology was clear: they wanted civil nuclear power to be a boon to humanity, to justify their careers and offset the threat of the weapons - perfectly understandable, but a dubious basis for policy.

In the UK and France, where the national governments owned the systems, direct government edicts sufficed. In the UK the Central Electricity Generating Board and in France Electricity de France reluctantly began to build nuclear power stations. In the US, the federal government and its Atomic Energy Commission told the private electricity companies 'Either you build nuclear power plants or we, the federal government, will do so, using taxpayers' money to compete with you'. Faced by this threat, the private companies decided they had no option but to start building nuclear plants, despite the unpromising economics and the risks. Despite generous federal government subsidies, almost all the early plants, of many different designs, failed. Either they did not work at all, or they were unreliable, or they were simply uneconomic. Some of the failed designs, nevertheless, have recently resurfaced, promoted by enthusiasts who know no history.

In the UK, too, the government and its Atomic Energy Authority tried to promote competition between different reactor designs and suppliers. This laudable objective drastically underestimated the difficult engineering. Having several different designs all under construction simultaneously meant that designers could not learn from their mistakes, which were numerous and costly.

In both the US and the UK, reactor builders needing to bring down the alarming capital cost of their plants opted for rapid scale-up. This aggravated the problem of learning on the job: larger plants were already under construction before their smaller precursors were even completed. In the US, the UK, France, Germany and elsewhere, different nuclear factions politicked fiercely behind the scenes, lobbying their governments to favour one or another design of reactor. At the time, however, the public saw almost nothing of this internal infighting.

By the late 1960s, in OECD countries, electricity was so widely available and cheap that people had begun to take it for granted. Instead they began to notice its less appealing corollaries - not only transmission lines but also landscape destruction by large dams; smoke, sulphur dioxide and particulates from fuel-fired stations; overheated water from turbine cooling; and radioactivity from nuclear plants. Popular protests became too insistent for governments to ignore. The new public concern for 'the environment' prompted the US government under Richard Nixon to pass the Clean Air Act, the first of what became a succession of legal and regulatory measures compelling electricity companies to control emissions from electricity generation based on fire. The public also became aware of previously-secret analyses indicating that an accident at a nuclear power plant might have potentially devastating consequences. From the late 1960s onward environmental issues became a high-profile factor in electricity planning and decision-making.

By the early 1970s electricity planners in many countries were confidently assuming indefinite rapid growth in electricity use. Their investment plans, blessed by governments and regulators, were similarly robust, for ever-larger power stations and many more of them. Then came October 1973, and what became known as the first 'oil shock'. In the wake of another Arab-Israeli war, the Organization of Petroleum Exporting Countries, OPEC, quadrupled the world price of oil within a few weeks. The resulting jolt to the world economy reverberated for years. It also caught electricity

planners completely off guard. Electricity use not only did not increase as forecast, but in some places, including the UK, actually decreased. By the end of the 1970s electricity systems across the OECD were carrying crippling excess generating capacity, which customers had to pay for even when it was unused.

After the 'oil shock' some OECD governments, notably the US and the European Union, looking for 'a substitute for oil', hit on nuclear power. In the US the Nixon administration's 'Project Independence' called for a dramatic and rapid increase in US nuclear power. The EU Commission called for a fourteenfold increase in nuclear power by 1985 - only a decade hence. No one in authority appeared to notice that the main use of oil was for vehicle fuel, and that nuclear power produced only electricity - then almost useless for vehicles.

In the US, in 1973 through 1975, electricity companies started building fifty new nuclear plants, an impressive number by any reckoning. It was, however, the peak; and the fall that followed was precipitous. As economic reality kicked in, the last US order was placed in 1978, after which some three decades elapsed without even one more US order. In due course every US nuclear plant ordered after 1974 was cancelled - some when already 97 per cent completed.

In the UK, in December 1973, the head of the Central Electricity Generating Board told the House of Commons that the CEGB proposed to order 32 new American reactors by 1982, only a decade hence. The outcry that followed, the first major UK controversy over civil nuclear power, combined with the OPEC oil shock and a strike by coalminers, gave the Conservative government under Ted Heath a headache that led to a three-day week, a lost election and the emergence of Margaret Thatcher. The incoming Labour government in July 1974 rejected the 32 American reactors in favour of six reactors of a UK heavy-water design. However, two years later the Atomic Energy Authority told the government that its design would not work. Only much later did we learn that the design proved to have a flaw similar to that of the reactors at Chernobyl.

In 1979 the accident that destroyed the brand-new second reactor at Three Mile Island made a grim outlook for nuclear power even grimmer. In the UK, nevertheless, the newly-elected Thatcher government announced in December 1979 that it wanted the CEGB to order ten new American-design nuclear stations in the coming decade. At the time, the CEGB already had a surplus of generating capacity. The previous government had forced it to order two more twin-reactor nuclear plants of UK design plus another coal-fired plant, in order to keep the UK boilermaking industry from collapsing. Eventually, fifteen years later, long after the CEGB itself was gone, one single American reactor, Sizewell B, at last started up.

In the early 1980s another environmental issue shook the electricity industry. Gases from the coal fires in power station boilers, sent high into the air by tall smokestacks, were coming down as 'acid rain', sometimes in completely different countries, poisoning their waterways and killing their trees. It was an early indication that electricity, long confined within national borders, was becoming an issue for international politics.

That trend gathered momentum in 1988, with a conference in Toronto at which politicians at last noticed what had concerned scientists for decades. Carbon dioxide produced by fire was accumulating in the earth's atmosphere, forming a reflective blanket gradually heating the earth. Initially called 'global warming', a deceptively pleasing label, what became 'climate change' is now widely acknowledged as the most serious threat we as a species face. COP21, now in progress in Paris, may be the most important gathering *homo sapiens* has ever convened. Electricity should be its centrepiece. I'll have more to say about that.

In the UK, the Thatcher government sold off many state-owned entities, including British Gas, cut taxes with the proceeds and accordingly won the 1987 election. Casting about for something else to sell, they hit on the electricity system. However, when the government sold off British Gas, they turned a government monopoly into a private monopoly, which at once treated customers even worse. The government, advised by free-market ideologues, decreed instead that the CEGB would be broken up and monopoly abolished, that henceforth electricity would be sold to users in a competitive market.

Those who planned the privatization and liberalization of UK electricity included lawyers, accountants, economists and political scientists. The result of their efforts suggests that no one involved understood how a synchronized AC electricity system actually works: that electricity is not a storable commodity like natural gas but a process, happening simultaneously throughout an entire interconnected network. Successive UK governments have wrestled for a quarter-century with the concept of an 'electricity market', with acronyms including 'NETA', 'BETTA' and most recently 'ERM' for 'electricity market reform'. This latest effort appears to be reforming the market so that it hardly qualifies as a market at all, with guaranteed prices set by government even out to 35 years hence, in the case of the proposed Hinkley Point C nuclear station.

When the Thatcher government wanted to sell the electricity system, the City of London refused to buy the nuclear stations, considering them far too risky an investment. The government had to keep them, in a government body they initially called Nuclear Electric. But they found that the nuclear stations could not in fact compete with the new gas-fired combined cycle stations. The government imposed a levy of a billion pounds a year on electricity from fossil-fired stations, to be given to Nuclear Electric to compensate. The government did not want to call it a 'nuclear levy', so they called it a 'Non-Fossil-Fuel Obligation', NFFO. The embryonic UK renewables industry said 'we're non-fossil too'. The government eagerly seized this fig-leaf and granted the renewables a share of NFFO - as much as two per cent of the total. The UK support regime for renewables thus originated as a greenwash, to disguise a huge nuclear subsidy. The EU eventually declared the nuclear subsidy illegal state aid, but the UK renewable support mechanism evolved out of it.

The combined-cycle gas-turbine CCGT stations were a dramatic break with earlier electricity trends, in which a better station was always bigger and farther away. CCGTs meant that a better station might be smaller and closer to users. It was the beginning of a new trajectory for electricity systems, away from the traditional centralized model to more and more decentralized. I joined Chatham House, the Royal Institute of International Affairs, in 1991, just as electricity was becoming an international affair. I soon began working on the future of electricity. I could see that the changes were going to go farther and faster than almost anyone then anticipated, as I described in my book *Transforming Electricity.*

As well as CCGTs the decentralized generating options also included gas-fired cogeneration of a wide range of sizes; wind turbines, growing steadily larger, cheaper and more productive; mini- and microhydro for suitable locations; and solar photovoltaics - very expensive in the 1990s but improving at a spectacular rate thereafter, higher performance and lower cost year by year. More specialized technologies including geothermal, solar thermal, tidal and marine-current energy also added to the mix of smaller-scale decentralized electricity options not based on fire.

Decentralized generation required a different network. The traditional electricity network is radial and one-way, carrying electricity from huge remote stations to much smaller users far away. Innovative electricity, with small-scale generation close to users in both location and size, needs a

meshed two-way network, heavily instrumented to keep track of flows not only of electricity but also of value, as users become generators and vice versa.

Now, in 2015, the transition to a new model for electricity is well under way and gathering momentum every day, almost worldwide. The cost of innovative generation, especially photovoltaics, has been dropping so rapidly that many commentators anticipate that PV will be as cheap as coal-fired generation within five years. The dramatic improvement in options for electricity storage are exemplified by Tesla Energy, the new venture of Elon Musk, maker of the Tesla electric car. Tesla's 'gigafactory' in Nevada, producing household batteries for less than $5000, will let householders disconnect completely from the electricity grid, as is already happening in southeastern Australia and the southwestern US.

But this transition is creating winners and losers. The losers, including grid operators and coal suppliers, often the most politically powerful participants, are doing everything in their power to impede the transition. Electricity politics have never been so intense, nor so crucial.

As the political fight intensifies, a new understanding is also dawning. For years we have been preoccupied with the problem of fossil fuels. But fossil fuels are not the problem. The problem is what we do with them. We burn them. We set fire to them. Fire, and what it pours into the air, is the reason you can't breathe in Beijing. Fire, the urgent need to feed fire, is why governments are fighting over the Arctic seabed. Fire, and the carbon dioxide it produces, is why the climate is changing. Fire is the cause of our problems of pollution and security, local and global. We have let fire get out of control.

That is why electricity politics are now more crucial than ever before. Electricity - the right kind of electricity - can save us from fire. For more than a century electricity has been replacing fire to do what we do - make light, exert force, manage information. To get fire back under control requires three measures working together. We need to stop wasting fuel and electricity, by improving energy performance, especially for buildings. We need to shift from fire to electricity in all our activities, including transport. And we need to shift from fire-based to fire-free electricity. Because we evolved with fire, we take it for granted, including its pernicious consequences. We think coal-fired electricity is cheap, while it suffocates cities and upsets the climate. If we cost fire accurately, fire-free electricity is the obvious choice. But the decisions will not be determined by economics. Electricity decisions will be, as they have been for more than a century, political.

Earlier this year I published my latest book, called *Electricity Vs Fire: The Fight For Our Future*. It goes into much more detail than I can today. If you're interested, just google my name, Walt Patterson, and you'll find my website archive, Walt Patterson On Energy, including all the info about *Electricity Vs Fire*. As its subtitle says, it is going to be the fight for our future, and it is going to be a fight over electricity politics. I won't be here to see the outcome, but you will. You'd better pay attention. It's going to shape your world.

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