Living Cool: A New Story

Sussex Energy Group presentation by Walt Patterson - 28 January 2020

Let me start by asking how many of you have heard me speak here before. How many? Those of you who have may recall that I'm working on a follow-up to my most recent book. I hope you'll forgive me if I recap some of my earlier analysis for the benefit of those of you new to this stuff. My previous book came out in 2015. It's called *Electricity Versus Fire*, and the subtitle is '*The Fight For Our Future*'. The paperback is available from Amazon for a fiver plus postage, but you can also download *Electricity Vs Fire* free from my website archive, Walt Patterson On Energy - <www.waltpatterson.org> .

As I said when I spoke here two years ago, friends and colleagues who read the book told me 'Walt, it's really good, but it ends just when it's most exciting...!'. I had to confess: I was getting well out of my comfort zone, into topics I didn't yet understand well enough. I had to stop writing the book, for fear of making a fool of myself. Instead I had to do some serious homework.

I've now done a lot of that homework, and the new book, the follow-up to Electricity Versus Fire, is at last under way. Its provisional title is *Living Cool*, and the subtitle is *Taking The Heat Out Of What We Do*. This is how the draft text begins:

The Earth is too hot, and getting hotter. We know why. But somehow we never talk about it. We talk about fossil fuels, and about carbon emissions. But those are symptoms, not the cause. The problem is not fossil fuels. It is what we do with them. We burn them. The problem is fire. The Earth is getting too hot because of fire - because of fire, and how we use it.

We used to need fire. With fire we got warmth. We got light after sunset. We got cooked food. We got watertight clay pottery. We got smelted metals. Eventually, first with the steam engine, then with the internal combustion engine, we got motive power and mobility. Fire created our modern world.

But fire also brought dangers - some we always knew about, others we did not. Fire is hot - far too hot to touch. Fire can hurt or even kill you. Fire makes smoke that stings your eyes and chokes your throat. Fire makes air hard to breathe. Fire can rapidly destroy what you value - your crops, your animals, your possessions, your home.

Besides these immediate dangers, we now know of others, more insidious, more alarming. Along with the visible smoke and particulates, fire also produces invisible gases. Nitrogen and sulphur oxides and polycyclic hydrocarbons from fire make city air unbreathable. Carbon dioxide from fire accumulates in the atmosphere, reflecting back heat that would otherwise escape to outer space, relentlessly raising the temperature at the surface of the Earth. The consequences are already all too evident - melting glaciers and icecaps, more violent storms, wildfires, droughts and floods, with worse to come.

We long accepted these dangers, because we wanted the benefits fire offered. But fire also gave us another benefit, arguably its greatest. Fire gave us the materials to produce and control electricity.

Now we can do with electricity most of what we used to do with fire. We can adjust temperatures up and down, with electric heaters and chillers. We can make light, with electric lamps. We can exert force and move things, with electric motors. Perhaps now most important of all, we can manage information, with electric sensors and computers - a newly essential human activity for which fire is no use.

Fire is a chemical process that destroys what it happens in. Electricity is a physical process that does not. Fire always produces temperatures far too high for most human activities. Electricity can function at any temperature desired, down almost to absolute zero. Unlike fire, electricity is flexible, versatile and clean.

For most human activities, we can now replace fire with electricity. One central problem nevertheless remains. We still make far too much of our electricity with fire. We don't have to. We can make it with moving water and air, and even with sunlight, and we can store this fire-free electricity to use when we want to; and all these processes are growing steadily cheaper and more reliable. But too many powerful entities still want us to use fire. Huge companies and entire countries get their revenue from feeding fire. Moreover, within the past century we have created a global economy modeled on fire, a Fire Economy, a 'consumer society' in which the basis of far too many transactions is equivalent to fire, consuming resources as fire does, turning them rapidly into waste, frequently toxic or pernicious. On a finite planet this cannot continue.

The story we have told ourselves for many decades, about what we call 'energy' and its role in human activities, is getting us into ever deeper trouble. We need to tell ourselves a new and better story about the way we live, about what we do and how we do it - a new story about how human society works. This book proposes a new story: a transition from a Fire Economy to an Electric Economy. But a fire-free Electric Economy will look different and function very differently from the Fire Economy that now threatens our future. The transition will inevitably create winners and losers; and the losers, including some of the most influential agents on the planet, will not go quietly.

That's how the current draft of the new book opens. It continues in four parts. Part I is called The Fire Story. It tells how fire came into human experience - how, in all probability, lightning started fire, and how our human precursors the Neanderthals learned to feed, to control and eventually to start fires. No other animal has learned to do this. We humans are the only animals that can start and control fire. This ability, and how we use it, has divorced us ever farther from nature and the constructive natural systems on which all human life depends.

Fire has also, of course, created our modern world. It has given us the ability to raise and lower local temperatures, to make light, and - by using the steam engine and then other forms of fire-based or 'combustion' engines - to exert force and move things - abilities not only beyond other animals but also beyond those of unaided human beings. But fire has also given us the materials that enable us to produce and control electricity. I'll return to that shortly.

Throughout the past century the role of fire in our daily lives has become both more ubiquitous and less visible, especially in the richer parts of the world. Indeed the story we have learned to tell ourselves, what I call the Fire Story, never actually mentions fire. Instead we have become preoccupied not with fire itself but with the fuel to feed it. Moreover, for almost half a century, beginning in the early 1970s, we have stopped talking about 'fuel' and substituted the word 'energy', borrowed from physics and then severely misused. I myself am a lapsed nuclear physicist, and the expressions 'energy production' and 'energy consumption' make my teeth ache. So does

‘energy conservation’, as a policy objective. We cannot produce nor consume energy, nor do we have to conserve it. Nature already does that for us, as per the first law of thermodynamics.

But what we now call ‘energy’ is just shorthand for all fuels plus electricity, a pointless and confusing mishmash of quite different entities. Until the early 1970s all these multifarious activities had their own separate identities, to go with the very different risks, competences, decisions and management they required. The oil business was global, the coal business almost entirely national or regional. Unlike oil or coal, the natural gas business involved a fixed network with monopoly attributes. It was thus similar in some respects to electricity, but in other respects very different.

In the early 1970s, however, some academic analysts and media commentators began to employ a convenient shorthand, in which the vaguely common attributes of different fuels were lumped together with electricity and called 'energy'. The Ford Foundation Energy Policy Project, 1971-74, was the first significant manifestation of this usage. But it received a dramatic boost in the autumn of 1973. The 'oil shock', when the Organization of Petroleum Exporting Countries quadrupled the world price of petroleum, coincided with problems of natural gas supply in the northeastern US, labour unrest in the UK coal industry and similar problems elsewhere. Shortages of petrol and fuel oil, power cuts, price rises and system breakdowns caused severe economic disruption in many parts of the world. Politicians and the media proclaimed an 'energy crisis'.

One of the first responses to the energy crisis was for governments, politicians and commentators to demand a 'substitute for oil'. An immediate beneficiary of this sudden enthusiasm was nuclear power, notably in France and Japan. Few politicians seemed to realize the obvious inconsistency of this proposal. The most important and distinctive role of petroleum and its products was then - and indeed still is - in fueling transport, particularly motor vehicles. Nuclear power produces what was called baseload electricity. It was and still is essentially irrelevant for motor vehicles, at least until electric vehicles become a lot more common. Even for less specialized applications such as heating, the substitution entails not just replacing fuel oil with electricity but replacing the entire system of technology through which it flows, especially the end-use technology. You cannot run an oil heater on electricity, or an electric heater on oil.

The search for a 'substitute for oil' in the mid-1970s nevertheless set the pattern for what I call the Fire Story, for future discussions of what was thenceforth called energy and energy policy. Using the word 'energy' as shorthand for all fuels plus electricity allowed non-specialists, particularly politicians, to presume that they were all more or less the same commodity and interchangeable, that one could substitute for another, with no reference to the timescales or technologies involved.

In the intervening decades, government statistics, energy forecasting and scenarios, and other analytic and planning tools of energy policy have focused on measured commodity quantities and flows of fuels and electricity, described as aggregates and averages. This approach takes techology and physical assets for granted - not only the technology to produce and deliver the fuel or electricity, but also the technology to use it, to deliver the service the user actually wants. It tells us about commodities, but nothing about the multifarious physical infrastructures through which they flow, or the investment the infrastructures entail, or the services that they deliver to users. It is what I call a Fire Economy, focusing on consumption - on what we use up and turn into waste.

The aggregates and averages of commodity quantities smear together many different applications and services, with vastly different attributes, ranging from vital and acutely sensitive to incidental and undemanding. If all you want to know is how much oil, coal or natural gas is sold, such information will tell you. If, however, we want to manage entire human activities, not only how

these activities use fire or electricity but how they deliver the services we desire, we collect the wrong data, and we analyze it wrong. This crucial error is a central feature of what I call the Fire Story we have been telling ourselves, the story now getting us into ever deeper trouble.

Part II of the new book challenges this traditional Fire Story, pointing out its inconsistencies, inaccuracies and omissions, and the rapidly increasing threat it represents not only to human civilization but indeed to human life itself. Part III of the book then introduces the Electric Story, an alternative description of human activities and the systems we use to carry them out.

The Electric Story began, more than two centuries ago, with Alessandro Volta's battery - no fire. Then came Hans Oersted and Michael Faraday, moving a wire in a magnetic field to generate electricity. For half a century, with the electric telegraph and arc light, we made electricity with batteries and with dynamos turned by water wheels - no fire. Then, however, Thomas Edison turned the dynamo with a coal-fired steam engine, and the Electric Story became interwoven with the Fire Story for a century. Not entirely, to be sure - water wheels were replaced with water turbines and dams, and hydroelectricity became a major category of fire-free electricity. But both stories assumed that generating electricity entailed either fire or a process akin to fire, 'consuming' something, using it up, either fuel or water stored behind a dam.

Then, from the 1960s onwards, other categories of fire-free electricity emerged, at first gradually and then at what has now become a breathtaking pace. This innovative Electric Story differs profoundly from the traditional Fire Story. In this Electric Story, we generate fire-free electricity by harvesting natural processes such as wind and sunlight. This fire-free electricity is what I call 'infrastructure electricity'. You invest in physical infrastructure such as wind turbines and solar panels, and they then produce electricity throughout their working lives, with no fuel cost or fuel price risk, and without 'consuming' anything except, very gradually, the materials from which they are made. This fire-free electricity, now also often with batteries for storage, takes the place of fire, to raise and lower local temperatures, to make light, to exert force and move things, and - ever more important - to manage information.

But the Electric Story had - and has - more surprises in store. Unlike traditional generation, innovative fire-free generation is modular, coming in much smaller units. Even a large windfarm still consists of individual turbines much smaller than the huge turbo-alternators common in fire-based generators. That means that fire-free generation can come on stream much faster, produce electricity and revenue sooner, and fail much more gracefully and less disruptively. Innovative networks now include so-called 'microgrids', combining generation and loads close together both in layout and in size, under local control and able to operate in so-called 'island' mode if the wider network fails. Microgrids are now springing up at universities and military bases, and could rapidly spread to many other users, for instance, airports, ports, shopping malls and entire neighbourhoods. Even individual buildings now already can incorporate solar panels and batteries, disconnecting completely from the traditional grid, as is already happening in the southwestern US and parts of Australia. In the fire-free Electric Economy, infrastructure keeps the lights on.

Needless to say traditional electricity suppliers, and the fire-feeders who provide their fuel, are less than keen on these developments, and oppose them bitterly. We are already caught up in a power struggle between fire and fire-free electricity, and this power struggle will intensify. Part IV of the new book describes the political power struggle now under way, and explores its implications for planning, for finance, and for jobs and employment; its effect on social and political transactions and international relations; and its environmental impact.

Locally, the devastating consequences of air pollution from fire on human health are becoming impossible to ignore. Globally, the accelerating breakdown of the climate, again primarily because of fire, is happening far faster than all but the most pessimistic forecasts. The urgency of a transition from a Fire Economy to a fire-free Electric Economy grows daily more acute.

We humans base our activities on the stories we tell ourselves. We urgently need to tell ourselves a different, a better story to guide our activities. The transition from a Fire Economy to an Electric Economy is a better story, that could even become remarkable. Over time, as the transition matures, human activity systems could converge completely toward constructive natural activity systems, functioning entirely at low temperatures and without fire, as constructive natural systems do. We humans could at last reinstate our membership of wholly interdependent nature. But time is short. If we are to have breathable cities and a planet cool enough to live on, we have to put out the fire.

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