CARBONOMICS

Trinity of Elements 6, 92 and 94 may Re-define the World Economy

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Progress of civilization and ethical gains from global productivity are held hostage by Element 6 [1]. To pay the ransom, the existing world order may need re-engineering to sense and respond with a dynamic and agile economic infrastructure that can sustain higher transaction costs [2]. The international currency of growth shall be forced to adapt and adopt an economic standard where operations may be pegged to the cost of unit energy based on an index of about US$100-US$150 per barrel of oil at 2008 rates [3]. This prediction is not about actual cost of crude but based on estimates that energy from nuclear fission and coal with carbon sequestration will be comfortably competitive if oil price approaches US$150 per barrel [4].

The cartel of oil producing nations may be unaware that they may be fueling a designed dis-incentivization strategy to punctuate the pursuit of alternative non-fossil energy sources by aiding price volatility. The inflation of $35 per barrel price of oil in 2004 to nearly $150 per barrel in July 2008 occurred without any key changes in production. The current price (January 2009) under $50 per barrel does not appear to be associated with any major resource reorganization. Coordinated development and deployment of non-fossil energy sources must be a priority for 21st Century world leaders who may need to inculcate the personal discipline necessary to remain oblivious of the Russian roulette of oil prices and platitudes from actors, such as, OPEC.

The obvious answer to the carbon conundrum is US Patent 2,708,656 and has been staring in our face for half a century: nuclear fission [5]. The political positioning of ‘nuclear’ catalysed by the well orchestrated ‘march of unreason’ [6] by effective groups of environmental dissidents are forcing rational thinkers with good intentions to generate short lived, poorly designed,
In is producing that these carbon initiatives are gaining momentum. It may serve as a necessary but perhaps a bit wobbly platform for the climate control debate. In the next quarter century, with the rise of a new generation of thinkers and leaders, the potential for demise of carbon regulatory measures are imminent. One reason is embedded in the flawed principle of its construction. It assumes that enforcing a price on carbon will act as a financial incentive to use non-fossil fuels. The logic is weak because carbon taxation primarily impacts the end-user or the average citizen. But, the investment and ability to manufacture and distribute non-fossil energy is concentrated in the hands of a few behemoths and/or governments. The stimulus for the end-user to use green or renewable or non-fossil fuel is blunted by the lack of adequate non-fossil energy supply. Availability of the latter is not controlled by the consumer but carbon pricing may affect the cost of goods and services, which will be passed on to the end customer, in some form or the other.

Hence, carbon pricing may be viewed by some as a deterrent to productivity and may increase transaction cost, if implemented. Having said that, a pragmatist faced with the present state of global quagmire must reluctantly add that the short-term impact of carbon pricing may merit implementation despite the bleak prediction about its long-term value (beyond 2050). Thus, the current call for carbon pricing is a sign of the times. Perhaps ‘doing’ something is viewed with sympathy by the public even though citizens may not be scientifically literate to understand that tax and price does not address the science of reducing carbon emissions or the root cause producing the effect (i.e. emissions). In fact, carbon pricing may turn the age-old aphorism on its head: go where the pastures are not so green! Carbon pricing in the 21st Century “systems age” may also ring similar to the cliché of running out of iron ore in the middle of the industrial age.

In other words, carbon pricing may produce the unanticipated effect of industries migrating to zones where carbon regulation is not ratified or sloppy in its execution and enforcement. It may be optimistic to anticipate global harmony on carbon pricing and taxation (carbox) schemes. Governments may ignore carbon regulations to attract businesses. Ireland, an EU member state, has successfully resisted EU calls for uniformity in corporate tax. In order to attract and keep big
corporations operating and “cooking” their finances in Ireland, the government has held fast to the low 12.5% corporate tax. Recently, the Irish ignited the wrath of some in the EU by ignoring EU’s call for constitutional harmony by voting against the adoption of the Lisbon Treaty.

Technically, carbon pricing initiatives shall be plagued with acrimony stemming from ambiguities about models, standards, metrics and data dependencies. Lack of global accord shall segue to an uneven playing field of carbon haves and have nots. But, viewed from the perspective that the glass is half full, legislating carbon pricing may drive home the awareness that climate change affects all and each one of us has a role to play, no matter how small or insignificant. Perhaps, imbued by a genuine sense of camaraderie to reduce carbon emissions or stimulated by an urgency to shake off the economic burden of carbon taxation or to legally defy the validity of carbon legislation, the energy industry may join forces with other industries, academia and government to educate and inform the masses why investment in nuclear fission energy guarantees sustainable return with long term benefits for the economy and the environment. The prudent solution is to immediately ramp up to generate an abundant supply of non-fossil energy from safe nuclear fission, without aggravating the global carbon footprint.

Hence, it may be good news that the US Nuclear Regulatory Commission (USNRC) has registered applications for licenses to build 25 new reactors, since July 2007. The projection that in 2030 nuclear energy shall provide about 10% of the global energy demand may be short sighted [3]. By 2030, China and India’s energy demand is expected to be in excess of 4,000 and 1,000 million tones of oil equivalent (MTOE), respectively. The global demand for energy is expected to approach 15,000 MTOE by 2030. It should be met by an abundance of non-fossil energy supply.

The advances in the next few decades should enable reduction of the unit cost of nuclear energy from $150 per barrel oil equivalent, estimated at present. Capital expenses, amortized over time, shall further aid nuclear energy cost reduction and stabilization rather than carbon taxation and the burden of bureaucracy implicit in carbon compliance. It appears that the energy debate is losing its coordinates in the cost versus value argument. The value of non-fossil nuclear energy is far more important that the present or perceived cost. In 1960, DEC produced PDP-1, a desktop computer at $120,000. Today, even Wal-Mart sells super powerful desktop computers and they are priced at $500 or less. In 1956, Ampex pioneered the video recorder market and each VCR
unit was priced at $50,000 \cite{11}. If you can find a VCR in 2009 then expect to pay $50 or less. By 2050, the unit cost of clean and safe non-fossil energy from nuclear fission may follow similar trends in addition to competition from emerging energy supply from nuclear fusion plants \cite{12}.

The path to global productivity and improvements in standard of living may not be constructed through the tunnel of energy conservation. Availability of energy to fuel progress should be almost a non-issue. An analogy may be found in the cost of computing. It has decreased so much so that applications, irrespective of complexity, may ignore the cost of processing power as an insurmountable transaction cost. The amount of computing power (micro-processors) in a birthday card that sings a tune, when opened, is greater than all the computing power that existed on this earth before 1950. A garden variety chronometer watch bought from a corner convenience store has more computing power than all computers in Silicon Valley before 1975. Can we imagine a world where Nintendo Wii, Sony PSP, Match.com, Facebook, eBay, Amazon and Google users may be required to pay a “computer processing tax” or “MIPS based pricing” for using computing intensive applications? How about an IOU (internet over-user) tax scheme?

Innovation in renewable sources may add to the safety net of grid based electricity powered by nuclear energy. Innovation in hydrogen generation through replication of photosynthesis \cite{13} and hydrogen storage in carbon nanostructure \cite{14} based fuel cell may usher in key changes in the transportation industry \cite{15}. Other forms of entrepreneurial innovation may make it possible for green energy manufacturing systems (GEMS) to produce alternative liquid fuels such as butanol and pentanol, through metabolic genomic engineering of microorganisms \cite{16} feeding on biomass waste, rather than items with food value (corn or sugarcane) as a source of carbon.

Harnessing the power from renewables begs innovation in storage technologies. Wind, wave and solar energy are excellent alternatives as long as the need for affordable storage does not arise. The best batteries, at present, can store only about 300 watt-hours of energy per kilogram (gasoline stores about 13,000 watt-hours per kilogram) and is one of the available solutions for storing solar energy (or any energy) if it is to be used when the sun is not shining. Similarly, the numbers add up poorly if wind energy \cite{13} is used to pump water at an elevation and then (run the water through a turbine to) generate electricity. One kilogram of water raised to 100 metres stores about one kilojoule of energy. One kilogram of gasoline stores 45,000 kilojoules of energy.
If policy and principles are based on scientific evidence, then, one must wonder whether carbon pricing or levying a duty based on emissions can be rationalized as an incentive when non-fossil alternatives are still embryonic in their development or demonized by society (nuclear energy).

But, there is no doubt that ‘something’ must be done to restrain the unbounded and perhaps irrational growth of the carbon footprint created by human endeavour. Energy conservation through micro-metering and monitoring usage by deploying wireless sensor networks [17] to reduce waste are healthy approaches to limit the carbon footprint. Accumulation of carbon credits by demonstrating the reduction of carbon footprint is certainly a goal worth pursuing, at all times. However, the metrics and data stream necessary to determine carbon savings and assignment of carbon credits are still developing [18]. This quagmire may offer temporary advantages and innovative opportunities for integrating systems that may meter and monitor usage, document reduction in footprint over time and generate online metrics-based real-time analytics. This integrated system may serve as a platform or a standard operating procedure promoted the by climate control organizations [18] or innovators [19]. Entrepreneurs [20] may have the wisdom to grasp these emerging needs and profit from creating analytics (eg: metrics, carbon calculators) and predictive engines [21] that may eventually surface from cloud computing as web services. It may also enable grocery chains to affix carbon footprint numbers to your banana [7], depending on its source, production, transport and distribution, or, in other words, the digital carbon supplychain [20]. If you pay more for a banana imported from Central America, then, the carbon pricing scheme in effect, masquerades the temporary failure of government incentives and leadership to provide global public goods [22], in this case, safe supply of non-fossil energy.

Later in the 21st Century, to provide about 10 billion people in the world an adequate level of energy prosperity, conservatively estimated at a couple of kilowatt-hours per person, the global demand may exceed 60 terawatts or the equivalent of almost a billion barrels of oil per day [23]. The largest hydroelectric power station in China (Three Gorges Dam), when completed at a cost in excess of US$22.5 billion, may generate peak power of 22.5 gigawatts, an order of magnitude more energy than what is currently generated by the Hoover Dam or the largest nuclear reactor in operation [24]. The sheer construction necessary to build enough power plants to meet the
domestic energy demand will be staggering even if the US were capable of reducing its energy craving and consume a mere 10% (only 6 terawatts) of the projected global energy demand.

Climate control and carbon pricing may soon become synonymous but will it address the root cause or aid the terawatt challenge? The implication of taxing the key mediums of global productivity (i.e. energy) is similar to the scenario where one hopes that a race horse will win despite the burden of a carrying a heavy load around its neck. Economic hindrances imposed on mediums of growth (i.e. energy), communication (i.e. internet), human capital (i.e., healthcare) and capacity development (i.e., immigration) may only serve to slow the progress of civilization.

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