Peak Oil Futures: Same Crisis, Different Responses

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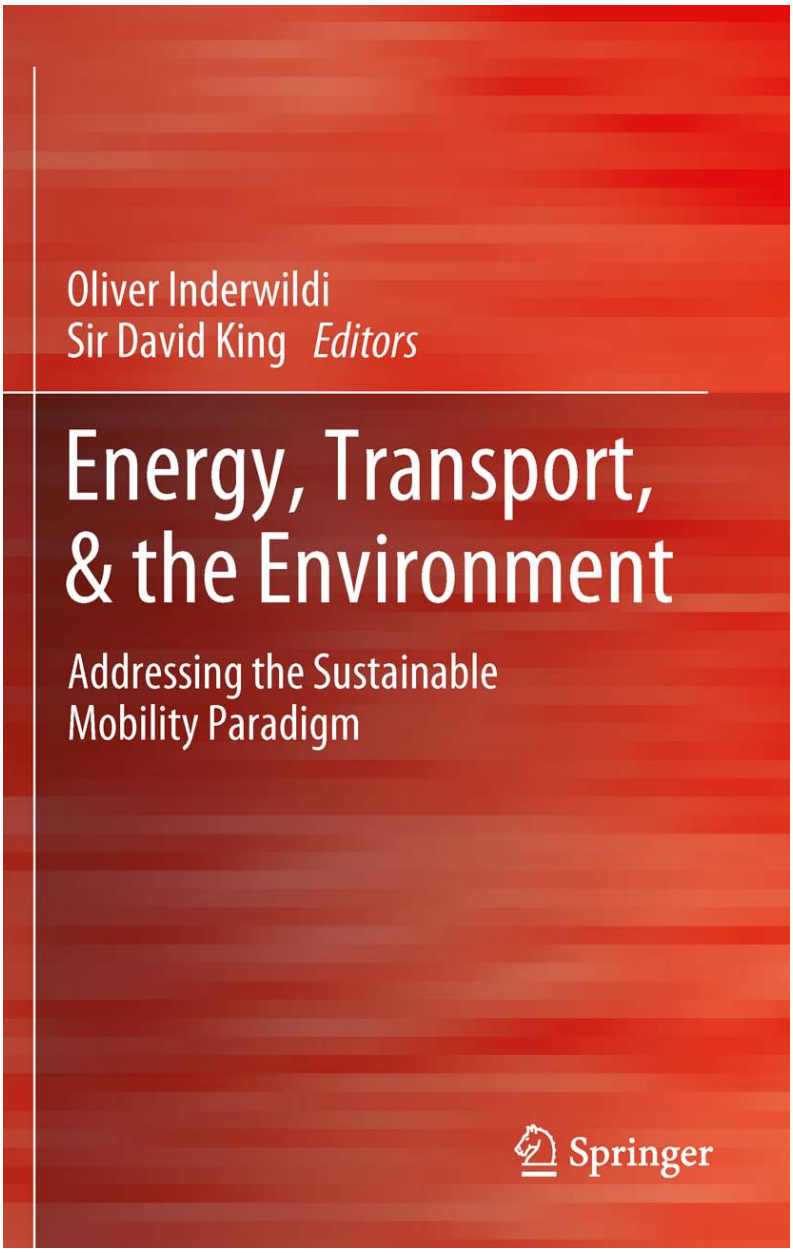

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Jörg Friedrichs

Abstract Peak oil theory predicts that global oil production will soon start a terminal decline. Most proponents of the theory imply that no adequate alternate resource and technology will be available to replace oil as the backbone resource of industrial society. To understand what may happen if the proponents of peak oil theory are right, I analyze the historical experience of countries that have gone through a comparable experience. Japan (1918–1945), North Korea (1990s) and Cuba (1990s) have all been facing severe oil supply disruptions in the order of 20% or more. Despite the unique features of each case, it is possible to derive clues on how different parts of the world would react to a global energy crunch. The historical record suggests at least three possible peak oil trajectories: predatory militarism, totalitarian retrenchment, and socioeconomic adaptation.

1 Introduction

The Stone Age came to an end not for a shortage of stones. The Coal Age came to an end not for a shortage of coal. But, contra former Saudi Oil Minister Sheikh Yamani, the Oil Age may come to an end for a shortage of oil. This is what the proponents of "peak oil theory" suggest. Peak oil theory predicts that oil

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production will soon start a terminal decline. Most authors imply, further, that no adequate alternate resource and technology will be available to replace oil as the backbone resource of industrial society.[1]

To be sure, the demise of oil has been predicted many times over. Oil shortages were predicted in the 1920s, 1930s, and 1940s. Peak oil theory was first introduced in 1956 by oil geologist Marion King Hubbert. During the oil crisis of 1973, US Ambassador to Saudi Arabia James Akins declared that "This time the wolf is here" [1]. Similar cries were heard in the second oil crisis of 1979.

Although the history of oil is the chronicle of a death foretold, oil is a finite resource. It is bound to first become scarce and then run out. The extrapolation of unfettered growth into the indefinite future is therefore misleading, and a peak of global oil production is only a matter of time. Peak oil theorists proffer serious arguments why, despite many false alarms in the past, Cassandra will turn out to be right this time. In this chapter I am not going to repeat their arguments. I am not personally committed to peak oil, and I will be more than happy if Cassandra is proven wrong this one more time.

However, given the momentous importance of oil for our industrial way of life the precautionary principle mandates to take warnings of peak oil seriously and assess possible consequences. In this spirit, I am not debating peak oil but asking the "what if" question: what is likely to happen if peak oil occurs? As a baseline for my assessment, I assume a decline of global oil production in the order of 2–5% per year for a couple of decades.[2] In line with most peak oil theorists, I further assume that no adequate alternate resource and technology will be available to replace oil as the backbone resource of industrial society.

While a global peak of oil production would per definition be a planetary event, reactions would vary in different parts of the world. Insofar as globalization has been fueled by cheap and abundant energy, traded as a commodity on a free market, increasing conflict over scarce energy resources would undermine the very foundations of the world-wide social, economic, and political normalization processes that have been observed over the past few centuries. As a consequence the world would once again become more diverse and, thus, less "global".

In this chapter, I focus on oil importing countries, which constitute the vast majority of states. Because an event comparable to peak oil has never happened at the planetary level, I resort to cases where severe oil supply disruptions in the order of 20% have occurred at the national level.[3] I believe that studying national

[1] For select readings on peak oil see Owen et al. [36], Aleklett et al. [2], Sorrell et al. [44], Hirsch [22], Brandt [7], United States Government Accountability Office [49], Hirsch et al. [24], Hubbert [26].

[2] The predictions of most peak oil theorists are in this band; see the overviews provided by Sorrell et al. ([45], pp. 4998–4999) and Hirsch [22].

[3] This is far above the formal threshold that the International Energy Agency stipulates for an international oil supply disruption (7%), and also higher than the shortfalls of global oil production during the oil crises of the 1970s (less than 7%).

analogs to peak oil as "proxy" cases is the best analytical strategy available to gain clarity about the effects peak oil would have on oil importing countries.

My first case is Japanese *predatory militarism* before and during the Pacific War. The specter of future resource shortages had played an important role in shaping Japan's imperialist strategy ever since the end of World War I. When an American oil embargo became imminent, in 1941, Japan preemptively attacked the US Naval Base at Pearl Harbor and radicalized its war of conquest in order to gain access to the rich oil supplies of the East Indies.

My second case is *totalitarian retrenchment* in North Korea after the end of the Cold War. When subsidized deliveries of oil and other vital resources from the Soviet Union were disrupted, the "Hermit Kingdom" reacted in a shockingly reckless way. Elite privileges were preserved in the face of hundreds of thousands of North Koreans dying from hunger. While this may be morally repugnant, it represents another possible peak oil scenario.

My third case is *socioeconomic adaptation* in Cuba, which was challenged by a similar disruption of subsidized deliveries from the Soviet Union. While this plunged Cuba into a deep crisis, there was no mass starvation comparable to North Korea. Instead, Cubans relied on social networks and non-industrial modes of production to cope with energy scarcity and the concomitant shortage of food. They were actively encouraged to do so by the regime in Havana.

My cases suggest three possible "peak oil futures", i.e. trajectories that different parts of the world may take in case of peak oil. This obviously does not imply that responses to a global peak of oil production would follow exactly the same lines as the national reactions to oil supply disruptions described in my case studies. Japan in the 1940s, as well as North Korea and Cuba in the 1990s, were unique places. It must make a difference that, in the 2000s, all oil importing countries are integrated in global market structures. Their circumstances vary. Therefore, we can easily imagine additional peak oil trajectories such as the mobilization of national sentiment by populist regimes. Nevertheless, my three case studies are sufficiently similar to a peak oil scenario to conjure up plausible conjectures on how different parts of the world would react to a global energy crunch.

So-called "techno-optimists" object to "Malthusians" that a global decline of oil production would not only lead to higher prices but also trigger a transition from oil to other energy sources, such as renewable energy or a new generation of nuclear reactors. But alas, this argument is countered by another piece of historical evidence. After the American War of Secession, the South of the United States was deprived of slaves as the backbone resource of its socioeconomic way of life. One would expect this to be the easiest case for a smooth energy transition. After the Civil War, Southerners only had to look to the North of their own country for investment and innovative technologies. Nevertheless, the modernization of "Dixieland" took at least a century. Insofar as a similar "upgrade" does not seem to be available in the event of peak oil, there is no reason to be particularly optimistic about a smooth transition to a post-oil (or post-carbon) society.

In the first three sections, I present my case studies. Each outlines the historical response of a country to an acute or (in the Japanese case) anticipated severe oil

supply disruption. Next, I formulate generic hypotheses about the factors on which it would depend how different parts of the world would react to a global energy crunch. To counter the view that the transition to a post-oil society will be easy, I subsequently present my fourth case study on "Dixieland" after the American Civil War. I then formulate specific conjectures on how different parts of the world would react to a peak of global oil production. In the final section, I discuss possible factors that may mitigate the negative impact of peak oil.

2 Predatory Militarism: Japan, 1918–1945

In September 1945, defeated Japan was so fuel-starved that it was difficult to find an ambulance with sufficient fuel to transport Premier Tojo to a hospital after his attempted suicide. Pine roots had been dug out from mountainsides all over the country in a desperate attempt to find a resinous substitute to fossil fuel. Much of the Japanese air force and navy had been sacrificed in kamikaze raids, at least in part because there was not sufficient petrol to refuel planes and ships to return from their sorties and keep fighting ([58], pp. 362–367).

Ultimately, this is a dramatic case of a self-fulfilling prophecy. The main lesson the Japanese military had taken home from World War I was that a country cut off from access to raw materials was bound to lose in a military contest due to a trade embargo. In their view, Germany had lost the War because it did not muster the necessary industrial base or access to foreign markets to achieve wartime autarky. To be prepared for a similar war, resource-poor Japan would have to control access to strategic resources. Only a self-sufficient economic bloc in East Asia would sufficiently prop up Japanese industrial capacity to secure the desired status of a great power ([4], pp. 9–21, [5]).

It was precisely to prevent fuel starvation and external dependency on other strategic resources that Japan embarked on aggressive military campaigns. After a liberal interlude in the 1920s, the next decade saw the invasion of Manchuria (1931) followed by the invasion of China (1937). The paramount goal was to achieve self-sufficiency in an economic bloc that was later, in 1940, to be proclaimed as the "Greater East Asia Co-prosperity Sphere".

Even from the cynical viewpoint of Japanese military planners, however, it soon turned out that the targets had not been selected wisely. While Manchuria and the other occupied territories yielded significant quantities of food, coal, and iron ore, very little oil came from these areas. Instead of becoming more self-sufficient, Japan grew even more dependent on the importation of critical commodities—especially from the United States. The situation was particularly dramatic for petroleum, which was entirely indispensable as a military transportation fuel. Since the US was the dominant producer of petroleum at the time, Japan was heavily dependent on American deliveries. Japan imported 90% of its petroleum consumption, of which 75–80% was shipped from California. For the critically important gasoline, the dependence was even higher ([33], pp. 156–157).

With that in mind, it is easy to understand (not to condone) why the Japanese onslaught in East Asia degenerated into the total War in the Pacific when Japan felt threatened by the specter of a US trade embargo. The only alternative to importing oil from the US was looting it from Borneo and Sumatra in the East Indies. To reduce Japanese vulnerability to a US embargo, a southward advance was thus irresistibly appealing—especially to elements in the Japanese navy.

The idea of a southward advance became even more compelling after the start of the Second World War in Europe, when increasing demand for resources in the European theatre led to rising commodity prices. In the late 1930s the US, which had hitherto limited itself to token gestures, gradually began introducing real economic sanctions against Japan. Given the worsening fuel scarcity and in anticipation of a full-blown embargo, the Japanese army began its southward advance. Japan started an offensive in southern China in 1939, and occupied the northern part of French Indochina in September 1940 ([4], pp. 136–175).

When the full-blown American trade embargo finally came in July 1941, Tokyo took it as the ultimate confirmation that there was no other choice than to move further southwards and to tap the rich mineral resources available in the Dutch East Indies, and particularly the petroleum that was being extracted in the British part of Borneo. To secure its flank in the imminent military offensive, the Japanese navy famously endeavored a pre-emptive attack on the US Pacific Fleet stationed at Pearl Harbor. The intention was to roll over East Asia and create a geopolitical bloc while America was directing most of its attention toward the European theatre, and later to negotiate some settlement with the US from a position of relative strength [29, 33, 39].

None of this is to deny that Japanese imperialism reaches back to the late nineteenth century, that imperial Japan was a military aggressor, and that the war in East Asia started in 1931 rather than 1941. On the contrary, all of this is an important part of the story. During the 1930s, resource-starved Japan tried to build a regional economic bloc to prevent strangulation. Japan was prompted by the specter of fuel starvation to scrap the Open Door policy of free trade and to radicalize its strategy of predatory militarism to secure access to vital energy resources. The American trade embargo further radicalized this geopolitical bent.

3 Totalitarian Retrenchment: North Korea, 1990s

Whereas Japan in the 1930s and early 1940s went on conquest to assert its status as a great power and secure access to vital supplies, the totalitarian regime of North Korea in the 1990s retrenched in order to preserve elite privileges after the demise of the Soviet Union. As a consequence, a terrible famine between 1995 and 1998 led to the starvation of an estimated 600,000 to 1 million people, or 3–5% of the North Korean population ([17], p. 234).

This was in glaring contradiction to the self-proclaimed national ideology of self-reliance (*juche*). In line with that ideology, up until the 1980s the regime had

heavily invested in coalmines and hydropower to satisfy the country's enormous energy needs. Furthermore, Pyongyang had developed a toxic industrial agriculture to feed the highly urbanized North Korean population. Farming was based on irrigation, mechanization, electrification, and the prodigal use of chemicals. In 1990, estimated per capita energy use was twice as large in North Korea as in China and more than half that of Japan ([54], p. 112).

All of this came to naught with the demise of the Soviet Union, when it turned out that access to oil was the Achilles heel of the North Korean economy. Since North Korea does not possess any proven reserves of petroleum, oil was mostly imported from the Soviet Union in exchange for political allegiance. In 1991, post-Soviet Russia stopped subsidized exports of oil and other vital goods to North Korea. Two years later, Russian exports to North Korea were down by 90% ([20], pp. 27–32).[4] This had dramatic effects. While the North Korean regime reserved most remaining fuel for the military, the rest of the industry nearly collapsed and agricultural production languished around subsistence level. Already in 1991, Pyongyang launched a "Let's Eat Two Meals a Day" campaign. In 1994, when Kim Il-sung bequeathed leadership to his son Kim Jong-il, a serious food crisis was looming. After a series of decent harvests due to favorable weather conditions in the early 1990s, severe floods and droughts led to the Great Famine between 1995 and 1998 ([20], pp. 73–76).

The Great Famine is a paradigm example of how the lack of an economic backbone resource such as oil can have momentous systemic ripple effects. To begin with, North Korean land machines depended on oil. Without fuel, tractors and other machines were not running. The next problem was transportation. Fuel was needed to bring fertilizer and other inputs to farms, and agricultural products to urban consumers. Fuel was also needed to ship coal from mines to fertilizer plants, where coal was converted into soil nutrients.[5] Fuel was further needed to get coal to power stations for electricity generation. As a consequence, electricity was yet another problem. Without sufficient electricity, irrigation pumping, and electrical railways became intermittent. The intermittency of electrical railways further affected transportation. Without reliable trains, it became even more difficult to bring coal to fertilizer plants or power stations, to transport fertilizer to farms, and to get agricultural products to urban consumers [54].

Thus, interlocking energy shortages combined with shortages of industrial inputs and a general decline of infrastructure to produce a dramatic decline of production, and thus an almost hopeless situation. While the entire economy was

[4] In 1993 China refused to step in for Russia, demanding hard currency for any further exports and radically cutting deliveries of "friendship grain".

[5] In North Korea, coal was used in the production of fertilizers both as an energy source and as a chemical feedstock ([54], pp. 117–119). Fertilizer use fell by more than 80% from 1989 to 1998 ([14], p. 14).

damaged, the consequences were most dramatic in agriculture where there was plummeting food production, considerable loss of arable land, and a rapid depletion of soil fertility. Restoring soil fertility would have required large amounts of lime, which however could not be transported without fuel. In a desperate attempt to replace land machines, draft oxen slowly became more numerous. But, unlike tractors, work animals compete with humans for food. The energy crisis also compelled many poor people to rely on biomass for cooking and heating. Unlike fossil fuel, however, the extraction of biomass reduces soil fertility, which in turn aggravated the agricultural crisis.

As a result of such interlocking vicious circles, the production of rice and maize fell by almost 50% between 1991 and 1998. North Korea was thus compelled to apply for international food aid. After a considerable time lag, the worst starvation was stopped in the late 1990s. But since North Korea's industrial agriculture cannot be restored without a viable energy regime, even today there is still a protracted food crisis with an ever-present risk of further starvation.[6]

To some extent it is of course true that the Great Famine was due to a malfunction of North Korea's Stalinist regime [35]. However, Pyongyang's performance is dysfunctional only when measured against Western humanitarian standards. On its own (considerably more cynical) terms, the regime has been incredibly successful. The crisis prompted North Korean elites to abandon the Stalinist path of wasteful industrialism, and administer systemic scarcity instead. This negative policy choice made it possible to avoid an economic and political opening, thus preserving cherished elite privileges. While the Soviet Union and most other communist regimes have disappeared, the Democratic People's Republic of Korea is still on the map. North Korea has even become a nuclear power, which sometimes enables Pyongyang to extort international concessions. While such brinkmanship may be morally repugnant, Korean-style totalitarian retrenchment is without doubt a possible response to a severe energy supply disruption.

4 Socioeconomic Adaptation: Cuba, 1990s

Cuba faced an energy supply disruption in the 1990s similar to the one experienced by North Korea. When taking into account subsidized oil deliveries from China to North Korea which lasted until 1993, the Cuban supply shock was even more dramatic. Subsidized energy supplies from the Soviet Bloc ceased to 100%. The CIA estimated the decline of Cuban fuel imports between 1989 and 1993 at a whopping 71% (quoted in Díaz Briquets and Pérez López [12], pp. 250).[7]

[6] See the Special Reports of the Crop and Food Security Assessment Mission to the DPRK (especially [13, 14, 53]).

[7] Official Cuban figures for the decline of imported raw materials and other vital inputs to industrial production and electricity generation were on a similar level (reported in Wright [57], p. 68). Even according to the most conservative estimate of the US Energy Information

In 1990, the Cuban leader Fidel Castro was forced to proclaim a national emergency called the "Special Period in Time of Peace". The crisis devastated the entire Cuban economy. Machines lay idle in the absence of fuel and spare parts. Public and private transportation were in shambles. Workers had difficulties getting to their jobs. Factories and households all over the island were struck by unpredictable electrical power outages ([37], pp. 138–140). As in North Korea, the most painful effects were felt in the food sector. The nutritional intake of the average Cuban—especially protein and fat—fell considerably below the level of basic human needs ([3], pp. 154–169). Consumers resorted to chopped-up grapefruit peel as a surrogate for beef, and some people started breeding chicken in their flats or raising livestock on their balconies ([37], p. 138).

Nevertheless, people in Cuba were not dying from malnutrition and starvation. Homeless people and gangs of street children, turned into scavengers, were not characteristic features of Cuban townscapes. Nor were violence, crime, desperation, and hopelessness characteristic features of Cuban neighborhood life [47]. This is in remarkable contrast to North Korea. Although reliable reports on the situation in North Korea are in short supply, reports from exiles indicate that during the 1990s everyday life in the "Hermit Kingdom" could be characterized as solitary, poor, nasty, brutish, and short [35]. As mentioned, there was a famine killing 3–5% of the North Korean population. While life was certainly hard during the "Special Period", nothing of that sort happened in Cuba.

Overall, the regime in Havana was more humane than its counterpart in Pyongyang. After some initial tinkering, it undertook cautious reforms. The country was opened for tourism, parts of the informal sector were legalized, and various forms of local self-help were encouraged [37]. To some extent, Cubans were also helped in their efforts to cope with the crisis by a benign climate, remittances, foreign investment, and international aid.

However the real miracle was done by the Cuban people. Against all odds, ordinary people managed to get by due to the remarkable cohesion of Cuban society at the level of local communities. Although Cuba is highly urbanized, the typical *barrio* is an urban village. Households are tightly embedded in neighborhood life. Most families have lived in the same home for generations. The typical Cuban household is shared by an extended family. Cuba's multi-generational family households include aunts, uncles, and cousins. People cultivate close relationships with friends and relatives inside and outside their *barrio* [47].[8]

One should not idealize this. Families were stuck in their homes because the regime had frozen the property structure after the revolution. Thus, people were cramped into narrow spaces because they had no other choice. The regime had invested in community cohesion not so much to create social glue but rather to

(Footnote 7 continued)
Administration, between 1989 and 1992 the consumption of petroleum in Cuba fell by 20% and the net consumption of electricity by 24% (http://www.eia.gov/countries/, viewed on 22 April 2011).

[8] In a survey, 86% of people from vulnerable neighborhoods in Havana declared that they could count on support from relatives, 97% from friends, and 89% from neighbors ([47], p. 142).

sustain political control. But be that as it may, the result was that most Cubans could rely on their families, friends, and neighbors. This local solidarity, or social capital, helped them to make ends meet during the "Special Period". As one inhabitant of a vulnerable neighborhood put it, the crisis brought people closer together because it forced them to rely on one another (quoted in Taylor [47], p. 140).

Traditional knowledge was another decisive factor in feeding the population. Although most land had been collectivized after the revolution of 1959, about 4% of Cuban farmers had kept their plots. Another 11% was organized in private cooperatives [8]. The survival of traditional family farms and private cooperatives alongside industrial agriculture turned out to be an important asset. Independent farms were more resilient to the crisis than state farms, because they operated with less fuel and agrochemical inputs. Cuba's surviving family farmers kept important traditional knowledge that could now be recovered. Other formerly independent farmers had moved to state farms or urban areas, where they could provide valuable know-how for self-supply and urban agriculture.

Urban agriculture was a local self-help movement, facilitated by the availability of traditional knowledge in combination with technologies of organic gardening and the Cuban-specific rustic ingenuity. Idle stretches of land between concrete blocks or in urban peripheries were turned into makeshift organic gardens. Vacant or abandoned plots in close vicinity to people's homes were transformed into plantation sites. People used whatever urban wastelands they could occupy to grow vegetables and other foodstuffs. By the mid-1990s, there were hundreds of registered horticultural clubs in Havana alone. An urban cultivator explained in an interview: "When the Special Period started, horticultural clubs were organized by farmers themselves (…). Special emphasis was made to involve the whole family in these activities (…). We wanted also to develop more collaboration and mutual help among ourselves; we exchanged seeds, varieties, and experiences. We achieved a sense and spirit of mutual help, solidarity, and we learned about agricultural production" (quoted in [9], p. 98).

As already mentioned, one should be careful not to idealize this. Environmentalists have exalted urban farming during the Special Period as a social "experiment", or even alternative "model" of organic agriculture (see for example Rosset and Benjamin [40], Cruz and Sánchez Medina [11]). In reality, Cuba's detour into low-input agriculture was of course not driven by ecological consciousness but by dire necessity. From the second half of the 1990s, when the economic situation improved and industrial inputs became more widely available, Cuba started drifting back to industrial farming. This was helped by the discovery of Cuban oil reserves and subsidized deliveries from Venezuela. Nevertheless it is encouraging to note that, during the early and mid-1990s, Cubans managed for a few years to mitigate an atrocious oil supply shock by their remarkable community ethos. The comparison with North Korea shows that this was not a minor achievement.

5 Peak Oil Trajectories

The historical cases of Japan, North Korea, and Cuba suggest three different patterns of how societies may respond to a severe energy supply disruption. Despite the fact that peak oil would initially be experienced as a global energy crunch rather than as a series of national crises, it seems reasonable to expect a comparable gamut of reactions. Countries prone to military solutions may follow a Japanese-style strategy of predatory militarism. Countries with a recent authoritarian tradition may follow a North Korean path of totalitarian retrenchment. Countries with a strong community ethos may embark on Cuban-style socioeconomic adaptation, relying on their people to mitigate the effects of energy scarcity.

As mentioned, it is of course possible to imagine further reactive patterns, such as the mobilization of national sentiment by populist regimes. But even so, the three peak oil scenarios identified can help us to derive plausible scenarios of how different parts of the world would be likely to react to a peak oil scenario.

Given its unrivaled military capabilities, the United States would be the most obvious candidates for a "Japanese" strategy of predatory militarism. In case of peak oil, the US may be tempted to use its unique power projection capacity to secure privileged access to oil. It has happened sometimes in the past, and may happen more often in the future, that US decision makers find military coercion more effective than trade. China is no match for the US, but it would be capable of using its military muscle to secure access to oil and gas in Central Asia and, possibly, the South China Sea. Elsewhere the PRC would be unlikely to use a predatory strategy because, for the foreseeable future, its maritime forces and air power are not strong enough. Countries like India or Israel have even more limited military clout, but may be tempted to engage in geopolitical operations in their regional neighborhood to secure access to important energy resources.

A "North Korean" solution of totalitarian retrenchment that "screws" the population to preserve elite privileges is most likely in countries with a strong authoritarian tradition. In consolidated democracies, totalitarian retrenchment is much harder to imagine. Nevertheless, the history of twentieth-century Europe shows that even liberal democracies can and do sometimes degenerate into tyranny. It is difficult to predict to what point even in consolidated liberal democracies political culture could deteriorate in a protracted and serious crisis. Political elites in less consolidated democracies might experience fewer constraints and scruples right from the start. For example, elites in the second-wave democracies of Latin America may have lesser qualms than their counterparts in Western Europe about "screwing" their own population to preserve elite privileges.

Compared to predatory militarism and totalitarian retrenchment, "Cuban-style" socioeconomic adaptation is far more desirable from a normative

viewpoint. At the local level, people in many developing countries may be able to mitigate the effects of peak oil by reverting to community-based values and a subsistence lifestyle.[9] Such a regression would be relatively easy for people in societies where individualism, industrialism, and mass consumerism have not yet struck deep roots. Socioeconomic adaptation would be far more difficult for people in Western societies, where individualism, industrialism, and mass consumerism have held sway for such a long time that a smooth regression is hard to imagine. And yet, survival in many presently industrial Western societies may ultimately depend on support from local communities and a subsistence-based lifestyle.

In abstract terms, this leaves us with three causal propositions, or "hypotheses".

Hypothesis 1: The greater a country's military potential and the stronger the perception that force will be more effective than the free market to protect access to vital resources, the more likely there will be a strategy of predatory militarism.

Hypothesis 2: The shorter and the less a country or society has practiced humanism, pluralism, and liberal democracy, the more likely its elites will be willing and able to impose a policy of totalitarian retrenchment on their population.

Hypothesis 3: The shorter and the less a country or society has been exposed to individualism, industrialism, and mass consumerism, the more likely there will be an adaptive regression to community-based values and a subsistence lifestyle.

This is of course not to deny that oil exporting countries would be in a somewhat more comfortable position. Other things being equal, they could use the increased revenue from oil exportation to increase their power and wealth, while subsidizing domestic consumption and bolstering their economies—if, that is, they do not fall prey to predatory militarism; and if they evade the "resource curse" that has bedeviled so many developing countries in the twentieth century.

In the transition, large private Western oil companies such as Exxon and Shell would lose further ground to the state-controlled companies of oil exporting countries such as Saudi Arabia's Aramco or Nigeria's NNPC. As a consequence, even oil importing countries would increasingly rely on state-controlled companies such as China's CNPC [50]. Both in the realm of power politics and on the "marketplace of ideas", the ability of Western countries to impose liberal democracy through instruments such as development assistance and economic conditionality would further dwindle [31].

This can be formulated as yet another causal proposition, or "hypothesis".

Hypothesis 4: In the event of peak oil, there will be winners and losers. It seems reasonable to expect a redistribution of power and wealth from oil importers to oil exporters, and from private to state-controlled companies.

[9] Given the high population pressure in most developing countries, however, large segments of the population would fall victim to famine, disease and conflict.

6 Energy Transition?

So-called "techno-optimists" object to "peak-oil pessimists" that scarcity would not only lead to higher oil prices but would also trigger a transition to alternate energy sources, such as renewable energy or a new generation of improved nuclear reactors [43]. Some optimists are even as confident as to predict that revolutionary technologies such as solar energy or nuclear fusion will eventually make oil redundant [6, 52].

Could there not be a transition from oil to some alternate technology or resource? Since energy shifts have happened in the past, for example from coal to oil, is it not unimaginative and unnecessarily defeatist to discard such a possibility for the future [38]? Could there not be a revolutionary technological breakthrough, or some other positive surprise, around the corner that would catapult industrial society "beyond oil" (or even "beyond carbon")?

Alas, time is an issue. Developing and rolling out new technologies takes a tremendous amount of time. Moreover, while it is highly alluring to imagine the sudden appearance of a *deus ex machina*, such as the discovery of a new energy resource or a revolutionary technological breakthrough, past transitions such as the energy shift from coal to oil do not seem to be appropriate historical precedents [42]. After all, oil was a superior surrogate for coal. No such superior surrogate for oil seems to be available today [28].

Therefore, rather than looking at past energy shifts, we need to look at a situation where the challenge was to radically alter an entrenched socioeconomic way of life. This leads us to another case study: Dixieland after the American Civil War. What can be gleaned from this case is that the formation of the "new consciousness" necessary for radical social change is a painfully slow process.

The socioeconomic backbone resource of the Old South was neither wood nor coal nor oil, but human slaves. Precisely because the slave economy worked, white Southerners were willing to defend it in the bloody War of Secession of 1861–1865 [16, 55]. The abolition of slavery after the War plunged the South into a deep crisis. The War was followed by the Reconstruction Era (1865–1877), when the victorious North tried to enlist dissident elites and former slaves to impose its political and socio-economic institutions on a reluctant South. Despite the introduction of representation and suffrage for former slaves, reconstruction was mostly thwarted by the recalcitrance of traditionalist Southern elites. Heavy subsidization of railroads by Republican state governments in the South did not lead to the hoped-for modernization but rather to corruption, making a few investors rich and otherwise contributing to soaring public deficits. After the withdrawal of the last federal troops from the South, race inequality was re-established under the banner of white supremacy [15].

Later in the nineteenth century, Southern elites started to try and move on. As a matter of fact, they were not prevented by their conservative values from embracing industrial capitalism. Initially, this amounted to an uneasy compromise between cherished industrialization and dreaded modernization. On the one hand,

Southern elites became obsessed with the idea that an industrializing "New South" would rise like phoenix from the ashes of the "Old South". On the other hand, they remained loyal to time-honored values of agrarianism and patriarchal society. As Mark Twain put it in 1883, cultural life on the Mississippi was characterized by "practical, common-sense, progressive ideas, and progressive works, mixed up with the duel, the inflated speech, and the jejune romanticism of an absurd past that is dead, and out of charity ought to be buried" ([48], p. 264).

This was reflected in a quasi-colonial economy. While railroads were finally built on a massive scale, often with Northern capital, Southern industrialization was initially dominated by low-wage and labor-intensive manufacturing. Most industries were dedicated to the processing of agricultural goods (e.g. in cotton mills) or natural resources (e.g. in blast furnaces). The real industrial takeoff came much later, after several generations of socio-economic backwardness, and after the New Deal of the 1930s (electrification) and the war economy of World War II. In the mid-twentieth century, Dixieland finally became a growth region and came to be seen as part of the American "Sunbelt" [10, 56]. The Civil Rights Act of 1964 famously put an end to official race segregation in the South, although some race issues remain until the present day.

While there is a decently happy ending to the story, it took a century for the South to recover and catch up. This is remarkable because, to understand how a technological and socioeconomic upgrade might look like, Southerners only had to look to the North of their own country. There, industrial capitalism with its superior technologies and know-how was unfolding before their very eyes. With the right incentives in place, attracting Northern investment and technology transfers would not have been too difficult. But although conditions for an industrial upgrade were uniquely favorable, the 100 years from the Civil War to the Civil Rights Act are replete of unpleasant memories such as race riots and labor revolts, as well as the Ku Klux Klan and Jim Crow Laws.

Dixie is a cautionary tale for those who believe that, after peak oil, there will be an easy technological upgrade. If even in the US South, despite uniquely favorable circumstances, adaptation took a full century, then a technological upgrade will be much harder under the more challenging circumstances of a global energy crunch. The world would be struggling with an energetic downgrade, rather than an industrial upgrade as in the case of the American South. Developing new energy technologies is never fast and easy, and even less so in times of crisis. After peak oil, we should expect extremely slow and painful processes of social and technological adjustment that may last for a century or more.

This can be stated as my last and most general proposition, or "hypothesis".

Hypothesis 5: In the event of peak oil, we should not expect either immediate collapse or a smooth transition. People do not give up their lifestyle easily. We should expect painful adaptation processes that may last for a century or more.

7 Same Crisis, Different Responses

Based on the heuristic insights and causal hypotheses gleaned from the case studies, we are now in a position to second-guess how different parts of the world would react to a peak oil scenario. *Please note that my conjectures are limited to the first couple of decades after peak oil.*[10] Please do also note that the picture provided in this section is deliberately broad-brush. Nothing of what I am going to say must be understood in a deterministic way. All I can offer is a set of tentative and indicative conjectures, rather than scientifically exact point predictions.

As a baseline, I need to make some assumptions. First, I assume that, after a few years on a "bumpy plateau", oil production will fall by about 2–5% per year.[11] Second, I assume that no adequate alternate resource and technology will be available to replace oil as the backbone resource of industrial society. Third, I rely on knowledge about historical and institutional path dependencies in particular countries and world regions. While the long-term future is fundamentally open, in the short and medium term there are path dependencies that make some trajectories far more likely than others. For example we roughly know which countries have strong power projection capabilities, recent authoritarian traditions, and high levels of "social capital". We also know which regions possess significant reserves of energy resources, and how these resources have been managed so far.

In *North America*, the United States combines strong dependency on foreign oil deliveries with an unrivaled capacity to project military power. A predatory strategy will therefore be tempting. To be sure, America's free trade ideology militates against the open recourse to military coercion. The US will support the free market for oil as long as it is convenient. When the oil market comes under pressure because of tightening international supply, the US is likely to continue to defend it for a while. But when soaring oil prices start crippling the national economy, US leaders may find that military coercion is more effective. The US is then likely to put the blame on foreigners and pursue a geopolitical strategy of "energy security" to protect the American way of life [30]. Why keep negotiating with recalcitrant leaders such as Chavez if there is a military option? This is not to say that the military option is easy, as the Iraq war has shown. However, military coercion is likely to gain ascendancy relative to free market rhetoric as oil supplies become scarcer. The resource-rich neighbors of the US, Canada and Mexico, would become tied more closely to the American core.

In *Latin America*, medium-sized oil producing countries such as Venezuela and Ecuador may try to profiteer from soaring oil prices. If they engage in a strategy of brinkmanship and deny the US oil on favorable terms, their political regimes may be toppled. While this would further increase anti-American resentment in the region, political elites are likely to ultimately acquiesce to

[10] For the long-term perspective see Greer [18, 19].

[11] The predictions of most peak oil theorists are in this band; see the overviews provided by Sorrell et al. ([45], pp. 4998-4999) and Hirsch [22].

American hardball tactics. In the past, Latin American elites have often opportunistically colluded with the US. Eventually, resource-rich Brazil may be able to escape intervention due to its larger size and geographical distance from the US. If Brazil manages to offer sufficient benefits to neighboring countries, a regional state complex around Brazil may be possible. Otherwise, energy-poor Latin American countries would enter a serious crisis. We may then see how much Cuban-style socioeconomic adaptation is possible in other Latin American societies.

After peak oil, *Western Europe* would enter a difficult quandary. Although advanced industrial countries like Germany and France have the capacity to rearm, predatory militarism is not a credible option for them. Since Europeans have good historical reasons to dread militarism, the social consensus necessary for this strategy would not be forthcoming at the decisive initial stages of geopolitical positioning. For the same historical reasons, in most of Western Europe the path of totalitarian retrenchment does not seem to be available either. Concomitantly, Western European countries would be forced to strike opportunistic "bargains" with Russia and the oil exporting countries across the Mediterranean. Due to their asymmetrical nature, however, such deals are inherently fragile and subject to constant renegotiation. Investment in renewable energy and innovative technologies might somewhat mitigate the transition, but ultimately Europeans could hardly avoid a transition to a more community-based lifestyle. Despite the present affluence of Western European societies (and, in part, precisely because of it), this would be extremely painful and last for several generations.[12]

Ordinary Western Europeans would be forced to rely on local communities for their welfare if not survival. However, a regression to community-based values and a subsistence lifestyle would be difficult because the habits of industrial society are deeply rooted. Western Europe's problems would be compounded by social segregation along immigrant groups and/or religious fault lines which, on the one hand, might enhance communal support for specific communities but, on the other, would conjure up severe conflict in Europe's multiethnic societies.

The situation in *Japan* would be largely comparable, although Japan is far less multi-ethnic than Western Europe and people may be more willing to accept disruptions to their taken-for-granted lifestyles.[13] Like in the Western European case, the unavoidable transition to community-based values and a subsistence lifestyle would be painful and last for generations.

The situation would be somewhat different in countries and regions that have industrialized later and/or have a more recent authoritarian tradition that may be

[12] The UK might try to evade the quandary by stressing its special relationship with the US, but it is debatable whether Britain could offer enough benefits to its North American ally to justify the burden of provisioning another 60 million people with subsidized fuel.

[13] This has been confirmed in 2011, when the Japanese responded in a highly calm and disciplined way to a Tsunami followed by serious social mayhem and a spectacular nuclear meltdown at the facilities in Fukushima.

recovered. Thus, totalitarian retrenchment and socioeconomic adaptation are far more likely and easy to imagine in various countries of *Eastern Europe* and *Southeast Asia* than in Western Europe and Japan.

In *Least Developed Countries*, common people with limited exposure to industrial lifestyles would be forced to rely on the cohesion of social groups for their survival. Particularly but not exclusively in *Sub-Saharan Africa*, state failure and conflict over scarce resources would become endemic. The inevitable end of the oil-based "green revolution" in agriculture and the demise of international aid would wreak environmental havoc and human insecurity. The production of "biofuels" might mitigate the energy situation of wealthy strata, but would crowd out food production and thus exacerbate the plight of the poor. The ecological situation would be aggravated by vital biomass being removed from the soil as a combustible. In most places, the unavoidable consequence would be famine, disease, and mass exodus. In some places, however, a revival of community-based values and a return to a subsistence lifestyle may mitigate the effects.

The elites of oil exporting countries such as Nigeria, Angola, and Equatorial Guinea would keep selling their oil to the highest bidder, especially when the bid is backed by sufficient military clout, and when there are no onerous obligations with regard to democratization and human rights. If the US gives up its dysfunctional democratization agenda, it will have better access to African resources than Europe, China, or Japan. It is an open question how much ordinary people in the African petro-states would benefit from the revenues (but people in African countries that do not have fossil fuel reserves would certainly suffer more).

In Asia, *Russia* has enough energy to provide for its own needs. It would become a more important regional player due to its abundant energy resources. *China*, by contrast, heavily relies on imported oil. To preserve its industrial capacity, the country might be tempted to secure access to vital resources from Central Asia by military means. Authoritarian retrenchment may be lurking as an additional option.[14] *India* has more limited military clout and a less authoritarian state tradition, but may nevertheless be tempted to engage in limited geopolitical operations in its regional neighborhood. Small and resource-poor outposts of industrial civilization, such as Singapore, would struggle to survive.

The oil exporting countries of *Central Asia* and the *Middle East* would benefit more than in the past from their comparative advantage. Due to the effects of rising oil prices, their economies would continue to grow in relative and absolute terms. As a result, their oil consumption would be stable or even increase at a time when it would be declining in the rest of the world ([41], pp. 57–83). While the "resource curse" would persist in countries with particularly corrupt elites, in others political freedom may improve alongside the level of industrialization and

[14] Despite an increasing internal market, China still heavily relies on the exportation of industrial products. It may not yet have accumulated enough economic wealth to insulate itself against the demise of international free trade.

the standard of living. The Middle East would almost certainly replace Western Europe as the most attractive destination for Muslim migrants.

8 Final Considerations

So far it has been assumed that, in the event of peak oil, no obvious alternate resource and technology would be available to replace oil as the backbone resource of industrial society. To mitigate the impact of peak oil, there is a desperate need for a massive crash program to develop and implement a mix of surrogate resources and adequate new technologies. The program would have to start early, as it would come to fruition only after far more than a decade [24]. In the absence of such a crash program, and after the onset of the crisis, rather than grandiose designs we should expect haphazard moves to make the best of a difficult situation [23, 34].[15]

The most appealing energy resource to mitigate the impact of peak oil is *natural gas* as a transition fuel. Although reserves are limited, gas is more abundant than oil. Recently there have been encouraging developments in the extraction of unconventional gas, most notably shale gas. However, the "shale gas revolution" is uncertain and may have severe environmental side effects [46, 51]. Also, it is important to bear in mind that gas is not a liquid fuel. While oil is easily transported and traded, gas requires pipelines or needs to be liquefied. Most of the world's existing vehicle fleet runs on oil, not gas. Compensating a decline of 2–5% of oil production per year with gas would be a tall order.

Coal is still relatively abundant in the United States, Asia, and Australia [21, 25, 32]. At least for a few decades it would inevitably become a more important source of energy. Rising oil prices would make mining and transportation more expensive, but coal-rich countries are motivated to tackle such challenges as long as coal production makes financial and energetic sense. Related carbon emissions would lead to harmful consequences for the environment and global climate, not least because heavy investment in clean coal technologies is unlikely under crisis conditions.

To gain access to recoverable *oil reserves*, protected areas from the Arctic to Antarctica would be cleared for exploitation. Unconventional oil from tar sands and oil shale would to be exploited, regardless of the harmful environmental consequences. As in the case of clean coal technologies, heavy investment of scarce financial resources in environmentally friendly technologies is unlikely under crisis conditions. An obvious downside of such otherwise desirable technologies is that they tend to reduce the energy return on energy invested (EROEI), which would hardly be acceptable in a situation of increasing energy scarcity.

[15] Especially the decline of petrol-based transportation after peak oil may pose a challenge to the implementation of ambitious modernization programs.

In the unlikely event that massive financial resources and planning horizons of more than 15 years are still available after peak oil, *nuclear reactors* may be rushed through regardless of the risks involved. However, this can only make a limited contribution. The current share of nuclear power in world energy production is only about 6%, and it could hardly expand very much under crisis conditions. Moreover, uranium is as finite as any other energy resource.[16]

To the extent possible in times of turmoil, there would be further investment in *renewable energy*. But this could hardly make up for the losses. The share of renewable energy in the global mix is larger than that of nuclear power, but it is still relatively low.[17] It is debatable how much and how quickly it could be expanded under crisis conditions. Even the most appealing forms of renewable energy have downsides, such as intermittency and a low EROEI. Expanding the share of renewable energy beyond 20% is therefore likely to require a demanding energy infrastructure, and thus a shift from incremental to systemic change. The production of a wind turbine requires significant inputs of energy and raw materials, which are currently supplied from non-renewable resources. Biofuels displace food production and may crowd out important ecosystem services. Despite all these problems, the odds for renewable energy are better than for nuclear power.

From a technical viewpoint, the dependency of industrial society on any *specific* primary energy source, such as oil, could be reduced by relying more on electricity. In theory, this has the potential of mitigating the impact of peak oil and postponing the decline of overall world energy consumption. However, the low price elasticity of oil indicates that this would require considerable investment over a sustained period of time ([27], pp. 89–124). While the conversion of the existing vehicle fleet to electricity is a tall order, the *generic* dependency of industrial society on fossil fuels for electricity production would remain in place.

From an ecological viewpoint, electrification must therefore be supplemented by a combination of conservation, increased efficiency, and renewable energy. Even so, infinite growth on a finite planet is impossible. Industrial society as we know it cannot last forever, and at some point it is bound to become unviable. While my analysis covers only the first couple of decades after peak oil, even in this limited time-span the social and political prospects are daunting.

Most of us would certainly prefer industrial society to continue unabated, perhaps mitigated to avoid the worst effects of anthropogenic climate change. Even though we may not like the idea of a global energy crunch, however, it would be utterly imprudent not to take the prospects of peak oil very seriously.

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[16] For a range of realistic estimates see Moriarty and Honnery ([34], p. 2472).

[17] Renewable energy accounts for about 20% of global energy consumption, but only if we include traditional biomass and hydropower. This is somewhat odd, as poor Ethiopian women collecting firewood, and gigantic installations such as the Chinese Three Gorges Dam, are hardly what we mean by the term. If we do not include traditional biomass and hydropower, the figure is much smaller.

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