Declining Oil Production as a Catalyst for High-Speed Rail in North America

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Abstract

This paper assesses the possibility that rising fuel prices following peak oil production will be the catalyst that ends a longstanding impasse over North American intercity passenger rail development. That impasse is claimed to be an unintended consequence of creating public enterprise to maintain conventional passenger train services. Evidence for a peaking of oil production around 2012 is then presented and the implications for subsequent oil prices are considered. The paper concludes by identifying two scenarios under which the transport sector's transition to post-peak oil could include an enhanced role for higher speed passenger trains in North America.

Keywords: high-speed rail; North America; peak oil production

Introduction

This paper assesses the prospect that peak oil production will yield some combination of rising prices and declining availability for most transport fuels that will be a catalyst for ending the longstanding impasse over what to do with North America's intercity passenger trains. Since 1970, North America's national rail passenger policy has been dominated by periodic "budget battles" over the fate of government supported carriers Amtrak and VIA Rail, with state and provincial governments left to plan for, debate, and ultimately avoid launching high speed train networks akin to those found in Europe, Japan, Korea, and Taiwan. Constraints in future oil supplies will raise the value of conservation and alternative energy sources, both of which can be accomplished by electric powered trains operating in the range of 200 kilometers per hour (125 miles per hour). This paper will review the longstanding impasse in North America's passenger rail policy, present the evidence for a future in which transportation must adapt to significant constraints in the availability of oil derived fuels, and consider the prospects for a North American passenger rail renaissance that is motivated by an end of cheap oil.

The impasse on passenger trains in North America

Around the world, the community of experts and interested parties who debate and deliberate over transport policy can be divided between participants who express support for the passenger train's prospects and those who are skeptical – which leads them to embrace opposite conclusions about its future, and to make different recommendations for its present. On one side of the discussion about what is to be done, supporters see passenger trains as a transport mode with much potential and plenty of opportunity for improvement. Such advocates found the means to bring high speed trains such as the Shinkansen and TGV off the drawing board and into commercial operation. Some of these supporters are motivated by the direct material benefits that flow from modernizing passenger trains (e.g., jobs for workers and profits for operators and manufacturers); others are attracted to more diffuse public goods that can accompany a passenger train renaissance (e.g., environmental benefits compared to airport and highway expansion and urban revitalization around train stations).

On the opposite side are the skeptics who see passenger trains as technologically outmoded, economically unpromising, and politically retrograde. Some skeptics oppose the passenger train because of their association with competing transport alternatives. (Cox, 2002; Chambers, 1995) Automotive and aviation interests often resist policy options intended to renew passenger train services. Another group of skeptics tends to weigh in against passenger trains because the means of renewing them are seen to clash with important economic or political principles. (Vranich, 2004; Hilton, 1980) They view passenger rail policy options with development or revitalization goals as advancing a "big government" agenda or as inherently wasteful because of the "laws" of travel behaviour whereby the flexibility of automobiles and the speed of aircraft leave little room for a successful rail alternative.

This debate has been clearly won by supporters in many countries of Europe and north-east Asia, with major high speed train networks developed during the second half of the 20th century. The skeptics have just as clearly carried the day in Central America, South America, and the Middle East, where passenger trains have mostly been abandoned as a means of passenger transport between cities. But in North America, the question of what to do about passenger trains remains unresolved because of a political stalemate regarding the rail mode's relationship to government and other transportation modes.

Anatomy of the impasse in the U.S.

The North American policy impasse exhibits particular characteristics according to differing American and Canadian governmental structures and processes, but the results have been similar. In both countries, passenger trains have been kept running by political half-measures that provide just enough funding to keep some trains running but did little to facilitate the introduction of new technology and commercial organization that could revitalize this mobility mode.

Amtrak's structure and its function represent a problematic muddle of strategies and tactics regarding how to deal with uneconomic passenger trains. From a distance, Amtrak's ambiguous objectives and haphazard instrumentation might seem similar to other U.S. policy domains where creative "fudging" around disputed goals and contested instruments allows for subsequent compromise and fine tuning, exemplified by the military's "don't ask, don't tell" solution that enables homosexuals to serve in the armed forces as long they remain discrete about their sexuality. But although Amtrak's organizational deficiencies were indeed deliberate, they could not be described as intentional. Larger forces of industrial change in the 1970s had made the passenger train's status as a regulated "public service" obligation of private railroads untenable. The need to craft a policy "solution" in the midst of an industrial crisis, with more than half a dozen U.S. railroads serving the Northeast, Midwest, and Great Plains in bankruptcy. Under these circumstances the efficacy of a future rail passenger policy took a distant second place to the immediacy of bailing out bankrupt railroads.

For America's railroads, Amtrak's immediate policy purpose was to rid private enterprise of further economic responsibility for money losing passenger trains, and its ultimate goal was to facilitate the abandonment of intercity passenger trains. Amtrak thus represented a second best solution to persuading the Interstate Commerce Commission to approve abandoning the much reduced intercity train services that were operating in the 1960s. Both the political difficulty in making a clean exit from their remaining passenger service obligations and the mounting economic losses from these trains convinced rail executives that an organizational intermediary had become necessary. Amtrak would assume managerial responsibility, and financial liability, for the remaining intercity passenger trains, leaving railroads free to pursue profit through their freight operations.

Many transport experts, including those who participated in its creation, expected Amtrak to bring down the curtain on the "grand finale" in the American passenger train's dramatic history. Amtrak thus represented a policy “ceiling” in terms of tolerable government intervention for the railroads. For its many skeptics, Amtrak’s greatest accomplishment would be to prove that passenger trains had no future by failing commercially, then going out of business, and wiping the rail passenger policy slate clean. In this perspective, Amtrak was to become a self-effacing policy initiative. There was thus no need to connect this entity to the framework of America’s transportation policy very carefully or completely.

Amtrak’s initial isolation from the earmarked tax revenues and cooperative planning and management of transport infrastructure among national, state, and local governments became a distinctive, and enduring, feature of its institutional design. But for passenger train advocates, there was nothing temporary or tentative about Amtrak’s mission. Their goal was nothing less than renewing the passenger train through massive government investment, akin to what the Japanese had spent on the Shinkansen and the French would invest in the TGV. The $140 million in federal support provided to Amtrak at its inception, which was exhausted in less than a year, was viewed as no more than the down payment on rail renewal. With Washington pouring billions into highway construction, airport expansion, and air traffic control, advocates viewed public spending on new and better trains as wholly appropriate.

Many supporters expected Amtrak to accomplish this turn-around in the course of meeting their specific needs. For organized labor, Amtrak was both a guarantor of job security and an entity that could enhance workers’ standard of living. Security meant running passenger trains with the same workforce that private railroads had previously used. It also meant maintaining the same work rules and seniority provisions that had prevailed. Job security also meant compensating workers who might be displaced by the transition to new operating arrangements (including downsizing of future train services) with up to six years’ wages as a severance package. These terms were written into the *Rail Passenger Service Act* of 1970.

For many smaller and mid-sized communities, Amtrak’s goal was to maintain, if not improve, access to locations that were increasingly left behind by airlines and bus companies. Even if the number of passengers was few, and the immediate market prospects dim, Amtrak was expected to find a way to thrive by serving the many hundreds of communities that other carriers were eager to pass up. For railroad passengers and in particular the 10,000 vocal members of the National Association of Railroad Passengers, maintaining Amtrak’s national scope was quite important.

For its supporters as much as for its skeptics, Amtrak was a second best solution to more extensive or ambitious forms of intervention – ranging from more generous subsidies to private railroads to outright nationalization. Kent Weaver (1985: 87) characterized the tenor of the times in noting that when it came to railroad restructuring, “Innovation in policy instruments served as a substitute for innovation in policy….” In the Nixon administration which created it, Amtrak was just one of numerous expressions of political cynicism being applied to the exigencies of governance.

Rather than confronting, or even seriously considering, the disputed issues surrounding the passenger train's decline, or undertaking the arduous work of developing a new federal partnership with states and localities that were justifiably reluctant to enter the morass of rail passenger renewal, the administration put Amtrak forward as a means of avoiding the problem. The goal that mattered most to the executive branch, at the time that Amtrak was created (perhaps as a result of other and more sinister political activities) was deniability. Such denial came in three variants.

First, Amtrak was intended to create the appearance that rail passenger renewal could be accomplished without tremendous adjustment costs. To subdue the political pressures from "losers" who had jobs and other economic costs at stake from the private railroads' abandonment of passenger service, Amtrak would deny the need for further sacrifice by workers, communities, and users. This denial would curtail further pressures on the Congress. To meet this goal, the administration accepted far-fetched predictions of profitability that were forecast by the Department of Transportation. Such unrealistic analysis was attributed to a mix of technical inexperience and political expediency by an unnamed U.S. Department of Transportation official familiar with the analytical efforts that painted a bright commercial future for Amtrak:

> [USDOT staff] were not technicians. They would hack something out of capital expenditures, and then someone would take some more out, without realizing that it would increase operating expenditures. It got to be a flat-assed lie. It had really blown the whole analytical effort, but by this time we were so committed to the program that we wouldn't let them [the Office of Management and Budget] win. (Weaver, 1985: 95)

Second, Amtrak was supposed to deny the proponents of more "radical" approaches to government intervention in the rail sector an opportunity to control the policy agenda. Amtrak would thus serve as a kind of "policy blocker" – occupying the organizational space that a more ambitious and costly program would have otherwise fit into. Policy blockers are a key element of the policy path dependence described by Pierson (2000) in which initial policy choices become embedded in a network of organized interests – some of which have been created by the policy itself. These policy networks then become powerful constraints on changing both the ways in which policy can be delivered, and the policy goals that can be pursued, since they perceive alternatives to be in a zero sum relationship with the existing arrangement of organization, resources and technology. Amtrak's effect in undermining the pace of high speed train development is illustrative of how its modus operandi of rail passenger preservation displaced the policy option of rail passenger transformation along the lines that unfolded in Japan and western Europe.

Upon its inception, Amtrak took responsibility for implementing the *High Speed Ground Transportation Act* of 1965, which had funded fast train demonstration projects between Boston, New York, and Washington. In the six years between 1965 and Amtrak's creation in 1971, the jet powered "Turbo-Train" was introduced between Boston and New York making the trip in four hours, and the electric "Metroliner" cut train schedules between Washington and New York to under three hours. During the following 29 years, Amtrak scrapped the Turbo-Train and slowed down the Metroliner. Only in 2000, when electrification was extended to Boston and the next generation Acela train went into service, has Amtrak been able to improve upon the train operating performance that existed when it took over the initiative to bring high speed train travel to America's Northeast.

Third, Amtrak was meant to deny future opportunities to blame government for the possible collapse and termination of America's passenger trains. Such blame, if it were to arise, could then be focused on Amtrak's leadership rather than either the government's transportation policy deficiencies or alleged connivance with railroad companies. Amtrak's has exhibited an enduring, and exceptional, ability to attract blame for the passenger train's ongoing shortcomings over the years. Over the last 30 years, Amtrak has largely succeeded in these second and third objectives of the Nixon administration. It has denied supporters the chance to advance more ambitious government initiatives that would bring America closer to the high speed rail renaissance found in Europe and Japan, and it has denied skeptics the opportunity to blame government sufficiently, or directly enough, to terminate further support for keeping conventional intercity trains running.

Anatomy of the impasse in Canada

VIA Rail's particular circumstances reflect differing governance arrangements in Canada, but the impasse over passenger train policy is essentially similar. VIA Rail is both legally and organizationally incomplete due to its launch by Cabinet with minimal input from Canada's Parliament through a process known as an Order-in-Council. While airlines, freight railways, and marine operators are each guided by a specific legislative framework, VIA's lack of a legislative mandate leaves it open to vagaries, since its favor can, and does, rise and fall with the government of the day.

During these decades of policy impasse, when supporters and skeptics were deadlocked over what to do about Amtrak and VIA Rail, numerous proposals for "freestanding" high speed train programs have been explored, but nothing much has been done to implement them (de Cerreno 2007; Perl, 2002). Some arose through state or provincial government leadership, others were driven by private initiative, and others reflected a partnership between private and public sectors. These many different combinations of organization and technology were put forward promising various benefits, opportunities, and advantages relating to transportation (and other) problems including: congestion relief; economic development opportunities; global warming mitigation; and energy crises. What, then, might it take to break the impasse that has kept so many different high speed rail visions from becoming a reality in North America? The next section seeks to outline an energy future where conservation and a diversity of energy sources will be critical to maintaining economic prosperity. In such a future, high speed trains will offer many advantages, compared to other modes. Perhaps the most important of these, from the perspective of shifting the balance of supporters and skeptics behind the longstanding passenger train policy stalemate, is the passenger train's renewed and expanded profit potential.

In a world where cheap oil has become history, a diverse range of transportation interests from airlines and airports to freight rail carriers to electric utilities could all come to see the passenger train as a net benefit to their bottom line. The need for both new energy sources and greatly enhanced energy efficiency could accomplish what decades of subsidies and public debate about the place of passenger trains in Canada and the United States has not. High speed trains may yet play an important role in renewing the role of rail in North America when peak oil production demonstrates the value of taking such a transportation option more seriously than has been done during the years of stalemate over Amtrak and Via Rail Canada. We explore such an energy scenario in the following section.

World oil use and projections

Over 95% of the fuel used in transportation around the world today is a liquid petroleum product made from crude oil. Cars run mostly on gasoline, although Europe also has many vehicles powered by diesel fuel. Trucks run mostly on diesel fuel, although smaller delivery vehicles use gasoline. Small boats use gasoline and large ships invariably use diesel fuel, or a dense, high-sulfur variant known as bunker fuel. Non-electric trains mostly use diesel fuel, for generators that power the electric motors driving their wheels. A few trains still use coal. Propeller airplanes use "avgas" which is similar to the gas once used in automobiles in that it contains a lead compound to reduce the incidence of uncontrolled ignition of the fuel ('knocking'). Jet airplanes use a form of kerosene, which is similar to diesel fuel. The principal transportation energy use that is not derived from petroleum is found in the world's electrified railways and rail transit operations which, along with electric trolley buses, consume electricity produced from a mix of nuclear, fossil fuel, and renewable sources. Almost all of the world's high speed train services are powered by electricity.

World consumption of transport fuels in 2004 was 2.03 billion tonnes or 14.9 billion barrels. (International Energy Agency, 2006: 496) This oil used for transport represented about 58% of all oil use in 2004. The remainder was used for making road surfaces, heating buildings, generating electricity, and as a feedstock for plastics, pharmaceuticals, fertilizers, and pesticides. Compared with this world average of 58%, transport comprised a higher share of oil use in North America (71%) and in Europe (61%) and a lower share in most of the rest of the world, including Japan (43%).

Use of oil for transport has been rising at a higher rate than use of oil for other purposes. The International Energy Agency (IEA) projects a continuation of this difference, as shown in Figure 1. Between 2004 and 2030, oil use for transport is expected to grow from 14.9 to 22.6 billion barrels per year, while oil use for other purposes is expected to grow from 12.2 to 15.8 billion barrels per year.

IEA expects more of the overall *growth* in oil use for transport between 2004 and 2030 to come from poorer (i. e., non-OECD member) countries rather than richer (i.e., OECD member) countries, 5.3 vs. 2.4 billion barrels per year. Poorer countries have many more people (5.2 vs. 1.2 billion in 2004) and their populations are projected to grow more rapidly at 1.1% versus 0.4% per year (International Energy Agency, 2006; U.S. Census Bureau, 2006). As a result, poor countries' increase in oil use *per capita* will be less: from 0.9 to 1.4 barrels per person per year; in richer countries the increase will be from 8.2 to 9.3 barrels per person per year.

This projected growth in oil use for transport can be seen as driven mostly by expansion of motorized transport in poorer countries or as continued, more intensive appropriation of resources by people in richer countries. The key question, however, is not who will be responsible for the growth in oil use for transport but whether such projected consumption can occur at all. Three factors could forestall the growth. One is unavailability of oil, discussed in the next section. The second is action to curb oil use because of its environmental impacts. The third is economic decline or even collapse of certain economies, perhaps the result of the first or the second factors.

The peak in oil production

The single most important fact about oil availability is that the peak of discovery has already been passed and the rate of worldwide consumption is now three or more times the rate of discovery of new oil. The present rate of global consumption is close to 30 billion barrels a year, and the rate of discovery is below 10 billion barrels per year. Discovered oil can be a *proven reserve*, meaning that it is estimated to have a 90% or higher probability of being extractable at current prices with current technology; a *probable reserve*, with 50-90% extractability; a *possible reserve*, with 10-50% extractability; or not qualify as a reserve. (Haider, 2000)

Oil reserves can translate into extraction of crude oil and then production of petrol, diesel fuel, and other oil products. The constraints on extraction have been a controversial matter, but the ultimate constraint is what is discovered. **Oil cannot be extracted if it is not there**.

The most important influence on the rate and extent of extraction appears to the proportion of the oil that has been removed from a reservoir. When little has been removed, production is usually low because few wells have been drilled. As more wells are drilled, production increases until all the easily accessible oil has been removed, and then production begins to decline. Typically, the peak in production is reached when about half of the extractable oil in the reservoir has been removed. The extractable oil is roughly the total of the identified proven and probable reserves. (Greene, *et. al.*, 2006; Bardi, 2005; Bentley, 2002; Hallock Jr., *et. al*., 2004)

What applies to any one oil individual reservoir also applies to a group of reservoirs and to all the reservoirs in total. In the 1950s, geologist M. King Hubbert (1962) applied this thinking to the oil resources of the lower 48 states of the U.S. and concluded that the peak in production from them would occur between 1966 and 1972. It actually occurred in 1970. Since then, peaks in production of *conventional* oil have been identified in 55 of the 64 countries that have produced significant amounts of this oil, and using the same techniques pioneered by Hubbert, the peak in world production has estimated to have occurred in 2006. (Campbell, 2006) Vigorous drilling and aggressive extraction techniques can push the peak back a little—so that it occurs, say when about 55% of the reservoir has been depleted. But in this case, the post-peak decline in production would be steeper. Since it takes a few years of production data to definitively establish whether the peak in conventional oil production has occurred, Campbell's prediction should be validated, or falsified, before the end of this decade.

Using the Hubbert methodology, and with cooperation from geologists in other countries, researchers at Sweden's University of Uppsala have projected that the peak production of *all* petroleum liquids will occur in 2012. This is represented in Figure 2, which shows production of conventional oil by region and production of non-conventional oil by type. Non-conventional oil is found in remote places or requires much mining and processing, or both. Oil from polar regions and from Alberta's oil sands are examples of non-conventional oil. Production of a refinable product from non-conventional oil can cost several times more than extraction of conventional oil. Heavy oil is chiefly production from the oil sands (also known as tar sands) in northern Alberta, Canada. Deepwater oil is extracted through ocean depths of 500 metres and more, chiefly in the Gulf of Mexico and the South Atlantic. Polar oil comes from Arctic regions of the U.S., Canada, and Russia. Each of these petroleum sources deserves special classification because of its remoteness, the difficulty of extraction, and the high potential of environmental damage.

The top layer of the chart in Figure 2, labeled NGL, refers to natural gas liquids. These are by-products of natural gas processing that are used to sweeten—i.e., lighten—the outputs of oil refineries. They are mostly easily liquefiable gases, including propane and butane. Their contribution to oil production is substantial, amounting to about 10% of the total in 2005, a share similar to that of non-conventional oil.

Figure 2 reflects total world petroleum liquids production to 2005 of about 1,036 billion barrels and remaining reserves (proven and probable) of about 1,200 billion barrels. Annual consumption is about 30 billion barrels. Thus, the halfway point in extraction of presently removable oil will be reached in 2012, when 180 billion barrels more has been removed, assuming additions to reserves of about 50 billion barrels. The date will be later if reserves grow more in the meantime either because more is discovered or because of reclassification of what has been discovered into ultimately recoverable reserves. It will be earlier if reserves grow by less or if the total of extractable oil has been overstated.

Even if remaining reserves turn out to be twice what was estimated by the Uppsala research team,[1] the halfway point in extraction of world oil would occur no later than about 2025. (Bartlett, 2000) According to the most frequently cited source, reserves have been rising. From 1995-2005, the average net increase after extraction was 18.6 billion barrels per year. (BP, 2006: 6) Such an increase cannot be sustained if the recent trend in discoveries continues. During the first half of this decade, discoveries 10.4 billion barrels in 2001, 10.9 billion barrels in 2002, 7.7 billion barrels in 2003, 7.6 billion barrels in 2004, and 5.0 billion barrels in 2005. Koppelaar, 2005: 29; Campbell, 2006a: 7)

We believe the Uppsala projection in Figure 2 to be the most authoritative, and the weight of expert opinion seems to be moving towards anticipation of a peak in production of petroleum liquids early in the next decade. Other predictions of peak production range from 2006 or earlier to beyond 2030.[2] The proposition that there will be a peak in oil production is mostly not controversial. Oil is a finite resource, and extraction of it cannot continue indefinitely. When oil production does peak, the transport sector will experience profound changes.

Oil price increases after the peak in production

The mismatch between what may be the most authoritative projections of potential consumption and likely production is set out in Figure 3. By 2020, the mismatch between the projections could be in the order of 30%. However, consumption cannot exceed production beyond the use of so-called strategic reserves and the mopping up of whatever is in the process of delivery. Either production has to rise, which may not be possible, or consumption has to be restrained, by price increases or rationing.

We believe that the recent increase in oil prices has occurred mostly because potential growth in consumption has been restrained by lack of corresponding supply, resulting in prices increases that have somewhat restrained consumption. Higher prices can stimulate production, and we have allowed for this in adding the thin dotted line in Figure 3. This line could be where production and consumption become balanced by price increases. Our proposed balance assumes that high prices will induce about a 15-per-cent increase in “enhanced oil recovery,” and consumption will have been somewhat moderated by new measures.[3] Assuming production does rise to the level suggested by the thin dotted line in Figure 3, the shortfall of what is produced in 2020 from what is required for consumption (IEA’s 2006 projection) is about 25 per cent (actually 28.9 rather than 38.3 billion barrels per year).[4]

How large could the resulting price increases be? According to the U.S. National Commission on Energy Policy (2005: 2), “a roughly four-per-cent global shortfall in daily supply results in a 177 percent increase in the price of oil”. Another analysis by Perry (2001) suggested that a 15% shortfall could result in a 550% increase. This is the shortfall for 2020 illustrated in Figure 3. Thus, an increase in the price of crude oil by a factor of six or more could be expected by this year. It could translate into increases in retail prices of oil products by a factor of four.[5]

Our estimate of such future price increases must be regarded as tentative. There is no solid base of analysis that allows estimation of the price at which such large differences between projected supply and projected demand would be balanced. Nevertheless, we believe that, taking all the foregoing into consideration, the prices of oil-based transport fuels are likely to rise steeply over the next decade. Such increases are the main reason we anticipate an end to the policy impasse over passenger trains in North America.

The preferred scenario: anticipating high oil prices

Maintaining the status quo (more or less) by subsidizing uneconomic intercity passenger trains using technology and business models dating from the first half of the 20th century turned out to be an affordable expenditure in both Canada and the United States during the 1980s and 1990s. During these decades, the real price of energy fell to historic lows and concerns about finite petroleum resources receded far from the public consciousness. Spending hundreds of millions each year in public funds appeared less wasteful to passenger train skeptics than sinking billions more into brand new tracks and trains. Yet to passenger train supporters, this investment in preserving the passenger train as an intercity travel option was better than nothing.

When oil was cheap, North America’s low cost air carriers transformed flying into a means of mass transportation that appeared versatile and efficient. Outside the Boston to Washington “Northeast Corridor” where a passenger train modernization initiative predated the preservation efforts of public enterprise, launching North American counterparts to the Shinkansen and TGV appeared neither commercially feasible nor politically saleable. With abundant petroleum fueling low-fare air travel and a fleet of heavier and more powerful automobiles, North America’s needs did not appear to require introducing a new high speed rail infrastructure. Environmental pollution and airport and highway congestion were not considered serious enough to justify such a major investment. But peak oil production will eventually change that calculus. Concerns about climate change will reinforce the impacts of peak oil production discussed above. For brevity, we address here only the impacts of oil availability. For an extended discussion of how climate and energy concerns could reinforce the search for transport innovations, see Gilbert and Perl (2008).

Instead of trying to predict exactly when high speed train development would break out of the policy impasse discussed above, and then identifying where such developments are most likely to occur, we will conclude this paper by focusing on how such a change in transportation priorities could unfold under two scenarios. The first scenario centers on an **anticipatory transformation** in which public and private leaders recognize the opportunity to make use of high speed trains’ energy advantages before oil production begins its significant decline. The second scenario would be a **reactive recovery** from declining oil availability in which government and industry confront the sudden necessity to create a transport sector that can use much less oil.

Under an anticipatory transformation scenario, government and industry leaders would recognize the considerable opportunities to act ahead of the peak in oil production and come to appreciate the contribution that high speed trains could make to transforming North American railroads into the first mode to get “off oil.” The technology to make electric traction the main form of propulsion for North American railroads is very much off the shelf, with the biggest challenge posed by financing and manufacturing capacity. Should those who, as producers or consumers, rely upon today's most energy intensive transport options – aviation and trucking – take a close look at the future, an electrified rail network could present major opportunities for success in the energy transition following peak oil.

Aviation executives are increasingly aware of the commercial risks posed by peak oil. Writing in the July 2006 issue of *Airways* magazine, Axel Kuhlman (2006: 19) offered a stark assessment of civil aviation's prospects once peak oil arrives, concluding that "… the more sensible airlines should be setting their own agendas for an orderly and profitable demise of the great aviation adventure." Business mogul Richard Branson has attracted considerable attention by pledging to devote up to $3 billion of the profits from his air and rail carriers to alternative energy sources (Revkin and Timmons, 2006). Branson has emphasized this initiative's goal of limiting carbon emissions but the alternative energy production of his new Virgin Fuels group will also extend the ability of aircraft to continue operating in a world of declining oil production. Such new fuels are likely to play an important role in post-peak aviation, as could the blended-wing aircraft body that was proposed by aeronautical engineers from MIT and Cambridge University (Bonoguore, 2006).

The Royal Commission on Environmental Pollution (2002: 25) suggested that blended wing body aircraft could improve fuel efficiency by up to 30%. When coupled with further aggressive conservation measures, the energy intensity of flying might be reduced by 50% in the coming decade. This would offset perhaps half of the increase in jet fuel costs, leaving plenty of incentive to substitute rail on trip segments of less than 500 kilometers, especially where current or future air carriers could provide connecting long haul flights and sell through tickets, possibly even operating the trains (or parts of them) directly as with Virgin Rail in the United Kingdom.

Airports would also become interested in integrating rail into their infrastructure to make use of soon-to-be-excess terminal capacity and to facilitate connection with the remaining long haul flights. European airports have made dramatic innovations in integrating air with intercity rail networks (Perl, 1998), and such efforts could accomplished in North America, if the passenger train network to feed long haul flights was in place, or under development.

Freight railroads could also become eager to pursue electrification to reduce their fuel costs, and to ensure an alternative energy supply. Electric powered freight trains could accommodate much of future long distance freight transport, making use of containers that would use roads only for local delivery and pick up. The costs of a continent sized rail electrification program would be daunting without some form of government sponsorship (i.e., grants, loans, or other public finance mechanisms). Developing an electric infrastructure that could accommodate major increases in both passenger and freight train traffic could thus make today's major freight railroads into supporters of high speed passenger trains. Past skeptics of North American high speed passenger trains could thus become supporters by anticipating the opportunities from the energy advantage that electric rail will be able to offer.

Another scenario: reacting to high oil prices

In the second scenario of reactive recovery, the policy impasse that has constrained a modernization of North American passenger trains will be eclipsed as many skeptics, and some supporters, exit the policy debate through bankruptcy, liquidation and consolidation in a transport sector that is shows many signs of crisis. Under this scenario, government will be far more likely to play a major role in restructuring transportation options. Such activity will demand greater public leadership than in the anticipatory transformation approach, and it would take on a larger scale than either the 1970s restructuring of bankrupt railroads under the United States Railway Association or the post 9-11 support for bankrupt airlines provided by the Air Transportation Stabilization Board.

Government led restructuring of the transportation sector would likely embrace electric trains as for the same reasons as the private and public participants in anticipatory transformation would. But the overall level of mobility would be more likely to shrink as the costs of trying to operate today's oil intensive transport system rose quickly and considerably, destroying much demand for mobility, among other economic effects.

Concluding remarks

In addition to its energy efficiency advantages over driving and flying, rail offers the only transport option with an off-the-shelf technology that can use electricity for intercity travel. Electric traction also provides the option of shifting toward renewable energy sources incrementally by blending power generated from wind, water and the sun into the grid. High-speed rail has proven elsewhere to be as or more convenient than driving or flying.

The way in which peak oil production will facilitate high-speed rail development will differ according to the extent to which the prospect of high fuel price leads to appropriate anticipatory action. Policies could be adopted that seek to diversify intercity transport options ahead of a peak in world production, or they could be adopted after the peak has occurred. Anticipation could avoid interruption of essential intercity movement of people. Faster and more frequent electric trains would be introduced along many travel corridors, but perhaps not as many as in an anticipatory strategy. There would thus be a greater disparity in mobility options for the those traveling in the Northeast and the few other corridors where fast electric trains could be launched relatively soon, and moving around the rest of the continent where today's travel options would become prohibitively expensive.

Over time, the two different paths to developing high speed trains that we have identified might lead to the same outcome, a North American transport system where much more intercity mobility is powered by electricity and makes use of rail's considerable advantages in using electricity with great efficiency to move people and goods rapidly. But that point of convergence could well be several decades after the peak of oil production, with very different implications for how much people will travel in the meantime.

Space does not permit a detailed discussion of what high-speed train services might look like in a post-peak oil future, regardless of which trajectory it is arrived at. But one should not assume that these trains would become a realization of past schemes and dreams for high speed rail across North America, nor even an expansion of the continent's sole existing high speed train, Amtrak's Acela service between Boston and Washington. If saving energy becomes critical, and if the demand for electricity's ability to blend non-petroleum based sources into usable energy grows considerably, then future fast trains may not be as fast as today's are.

Above 200 kilometers per hour (approximately 125 miles per hour) the extra energy needed to speed trains along may not justify the time savings in relation to additional electricity consumed. If this becomes the case, North America's lag in high speed train development may not turn out to have been an obstacle to inventing a rail solution that contributes to post-peak oil transport needs. As Europe and Japan might be re-engineering their bullet trains to slow down and save electricity, North America can pick up where it left off in the early 1970s with the Metroliner project, and deploy 200 km/h electric trains to serve major travel corridors.

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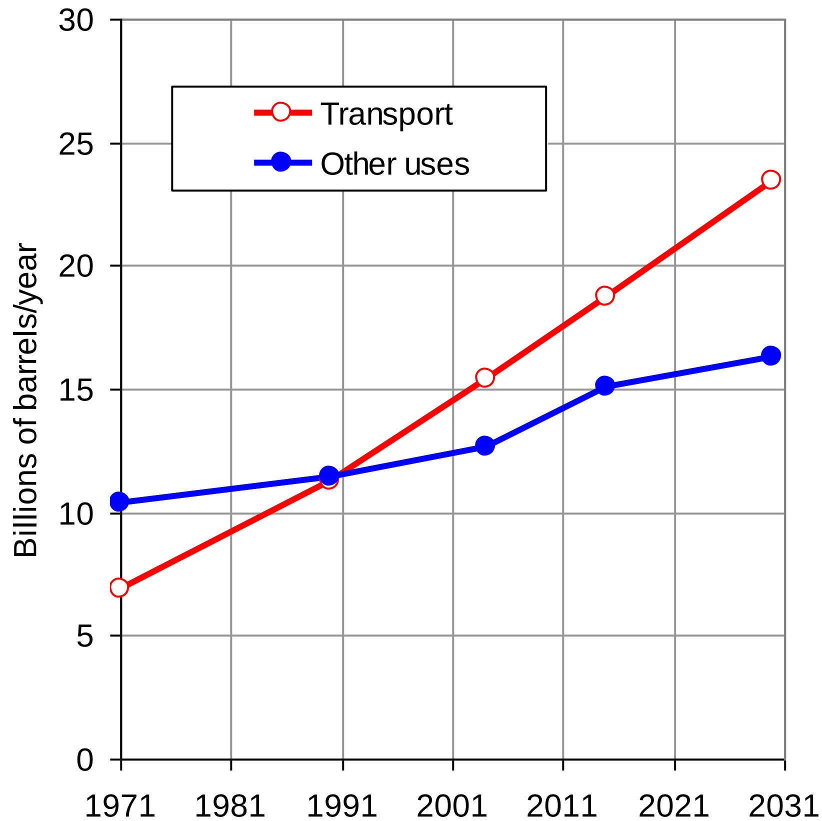
Figure 1

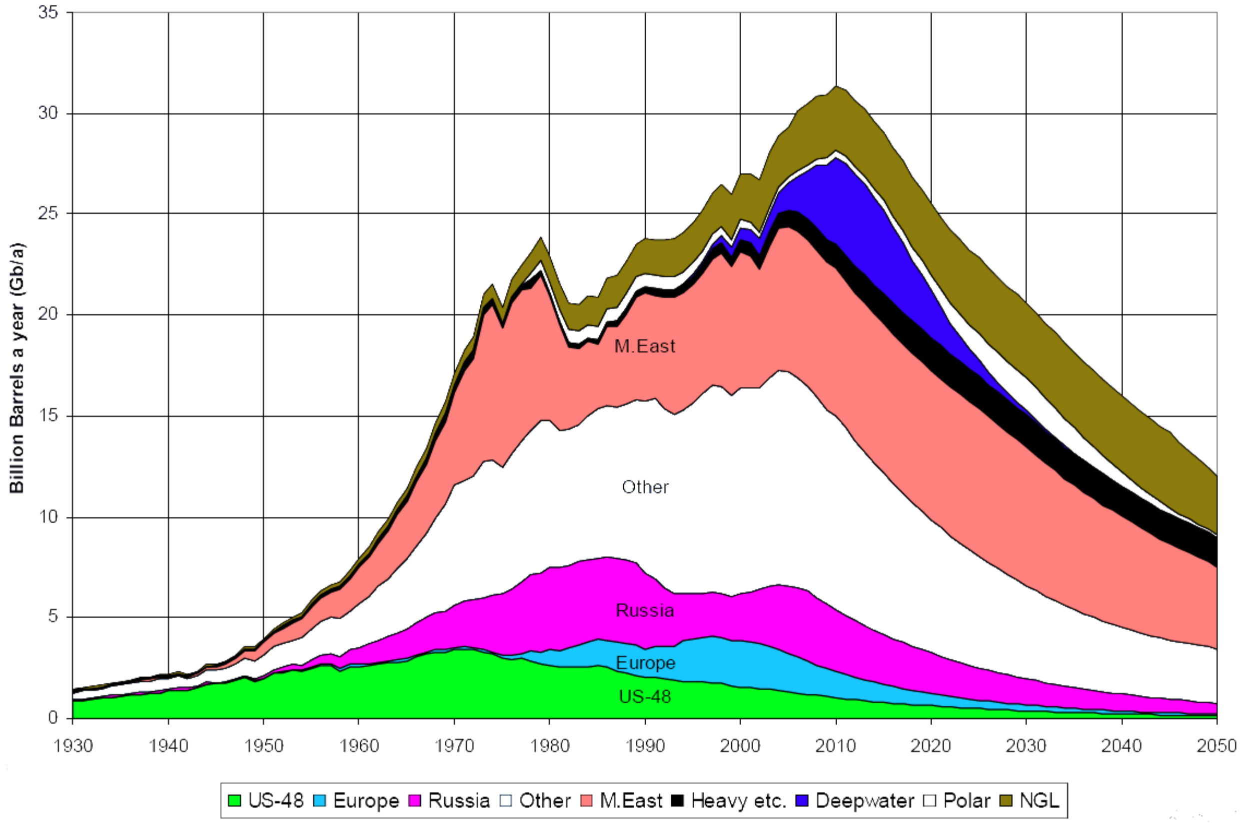
Actual and estimated oil consumption by purpose, 1971-2030



Source: International Energy Agency, *World Energy Outlook*, 2000 and 2006

Figure 2

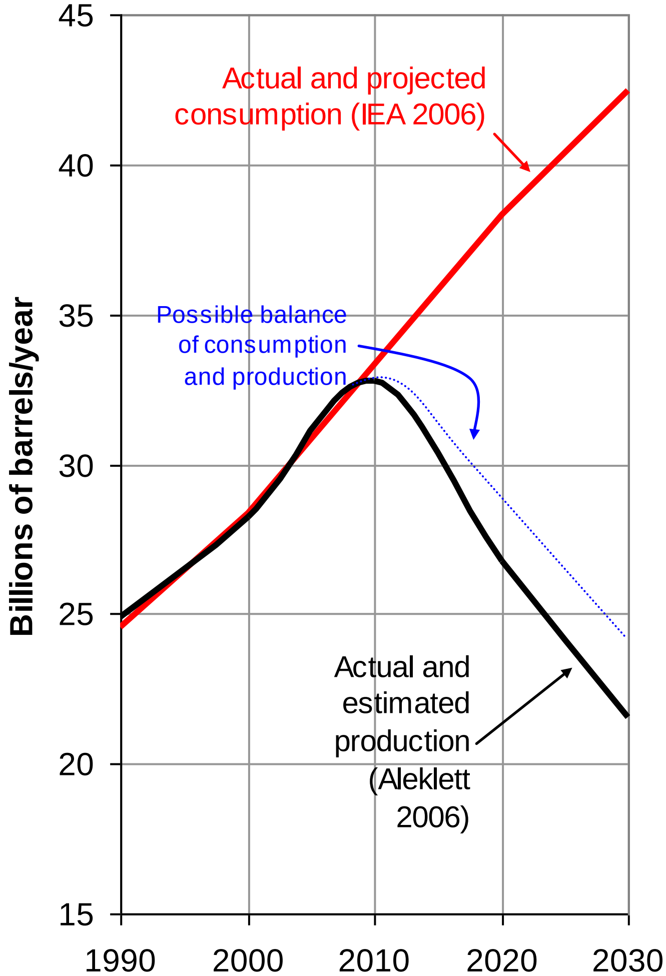
Actual and estimated production of petroleum liquids, by region or type, 1930-2050



Source: Aleklett, 2006.

Figure 3

Actual and estimated consumption and production of petroleum liquids, 1990-2030, showing possible balance of consumption and production from about 2012



Sources: International Energy Agency, 2006; Birol, 2006: 6; Aleklett, 2006

Endnotes

1. Recent estimates of remaining recoverable oil range from about one trillion (most estimates) to almost four trillion barrels (Jackson, 2006). Ugo Bardi (2006) has suggested that high estimates can arise, paradoxically, from an overabundance of data that stimulate biased extrapolations. He noted that overestimates may be more likely to be made just before a peak in production is reached, as may have happened just before U.S. production peaked in 1970.

2. When examining predictions of the year in which oil production will peak, care has to be taken to note what is included in 'oil production'. The date should be earlier if one or both of non-conventional oil and natural gas liquids are not included. Kenneth Deffeyes (2006:49) suggested that conventional oil peaked in 2005. Ali Samsam Bakhtiari (2006) claimed that all petroleum liquids peaked in 2006. Colin Campbell (2006b: 2) claimed that all petroleum liquids will peak in 2010. Rembrandt Koppelaar (2005: 43) argued that all petroleum liquids will peak between 2012–2017. According to Andrews (2005), Sadad al Husseini predicted that all petroleum liquids peaking in 2015. In contrast to these experts, Cambridge Energy Research Associates (Jackson, 2006) has proposed that production of all petroleum liquids will peak after 2030, as has the International Energy Agency (2006). IEA's projection comes with the qualification that investments totaling $4.3 trillion would have to be made to avoid an earlier peak. Most of this investment "is needed to maintain the current level of capacity in the face of natural declines in capacity at producing fields as reserves are depleted (IEA 2006: 102). We do not believe that this level of investment will be forthcoming, because it will seen as unprofitable. If it is made, we do not believe it will produce the anticipated result. The reasons for these beliefs are well set out in sources cited in this note and in the text.

3. In Figure 3.20 on Page 103 of International Energy Agency (2004), 'enhanced oil recovery' was to raise oil production by more than 20 per cent in 2020. However, in International Energy Agency (2006), the device of 'enhanced oil recovery' appears to have been all but abandoned.

4. The total of 28.9 bb/y in 2020 represents a decline by of about 12 per cent from the 2012 peak of 32.9 bb/d suggested in Figure 2, or 1.6 per cent annually. This is a more modest annual rate of decline that the 2 per cent reported by Farrell and Brandt (2006) after an examination of 74 post-peak oil producing regions.

5. This is based on the mid-December 2006 situation in the U.S., where the pump price of gas is in the order of $0.62 per litre, of which about $0.40 represents the cost of crude oil. U.S. prices are in the lower half of the world range.