Session 4 – What are the barriers to translating science into policy?

Papers –

Introductory comments by Hadi Dowlatabadi

- Are governments and civil society prepared for managing the shock of a significant change away from an economy based on fossil fuels?

  This question requires examination of at least three implicit assumptions:

  a) Has the current system been under the control of governments & civil society?
  b) How shocking would it be to continue reliance on fossil fuels?
  c) Is hydrogen the only alternative pathway?

  I would respectfully submit that the current system is a consequence of inept governance and has all the hallmarks of poor citizenship when viewed in the context of equity and power – regionally, nationally and internationally. Furthermore, the institutions that have amassed control over energy as a fossil based commodity are best placed in managing the transition to a new fuel system. Which particular strategy will win the day depends on what we choose as the energy carrier.

  I should also declare a personal bias against H_2. In my view it is far from the only solution and in many cases it is the least practical alternative.

- What non-economic factors (eg popular resistance to change, suspicion of government intentions, attachment to private automobiles, government policies) will have an impact on the extent and speed of the shift to Hydrogen?

  This question requires examination of at least two implicit assumptions:

  d) That there would be no other change to consider in the transition.
  e) That should we adopt the H_2 pathway, it would separate the public from their automobiles or other basic services, thrills and social signaling facilitated through energy consumption.

  In my view, differential public perceptions and tolerance of risk will influence the pattern of any change (institutional & technological). Numerous independent studies of public perceptions of risks associated with H_2 have shown a false association of H_2 with risk of explosions.[1] There is also little recognition that H_2 fires only spread vertically and are far less damaging per event. Finally, accidental fires associated with conventional automobiles are not a major concern although they occur with alarming frequency.[2]

---

[1] A number of public perception studies have shown that the public associates the Hindenberg disaster with H_2 filling of the dirigible, rather than the aluminium coating used for the dirigible fabric.

[2] Between 1992 and 2002 there were over 10,000 accidental automobile fires in the UK per year (http://www.odpm.gov.uk/stellent/groups/odpm_fire/documents/graphic/odpm_fire_028815-33.gif)

On the other hand public concern about climate change may spur adoption of H_2 even when there may be other energy carrier options using a hydrocarbon carrier as would be the case in renewable liquid fuels such as methanol or bio-diesel.

- Would there be significant consequences in terms of a shift in global disparities, inequalities or the social distribution of risks? In the concentration of ownership and near-monopoly control of markets by cartels of trans-boundary corporations?

  Let us first consider the initial conditions that introduction of H_2 is meant to somehow influence. The global disparity of energy supply is enormous: at one end of the spectrum we have >60% of the world's population still relying on conventional biomass for their domestic energy needs; while at the other end solar pv panels, ground source heat-pumps and electric vehicles can lead to the same emission profile for a household, but at roughly $100k/household of investment in supply technology. Why and how would the introduction of H2 influence this disparity?

  History is my first guide to whether H_2 will increase or decrease global disparity. The first electric utility was established by Edison in 1882 to provide streetlights in New York City. Today, 123 years later, 2.1 B of the world's population still do not have access to electricity.[3] This tragedy is the emergent property of international policies & politics, poverty, institutional and social instability, and limited access to primary energy resources. H_2 is capital expensive and inefficient in conversion of primary resources. It requires an energy distribution infrastructure (or even more capital) and it may (at least initially) rely on a human capital that are considerably better trained than is common in the "trades" today. For the next century, it is difficult to imagine H_2 to perform any better than electricity has in the last century.

  The current concentration of assets in commercial energy extraction, production and distribution is the likely platform for the launch of H_2. I can see three models of expansion for H_2: a) central production and distribution of H_2; b) distribution of electricity and local production of H_2; c) distributed energy and H_2 production. The first model favours the current fossil energy giants. The second plays into the hands of the electricity utilities. The third path entertains the romantic notion of H_2 production at home perhaps using renewable resources, but this path has all the pitfalls of high private discount rates even though we shown its overall costs to be lower than a centralized system.[4]

---

[3] http://www.geni.org/globalenergy/library/media_coverage/electricite-de-france/electricity-for-all--targets-timetables-instuments.shtml

[4] Strachan, N. and H. Dowlatabadi (2002). "Distributed Generation and Distribution Utilities." Energy Policy **30**(8): 649-61. Zerriffi, H., H. Dowlatabadi, et al. (2002). "Electricity and conflict: advantages of a distributed system." Electricity Journal **15**(1): 55-65.

- What regional factors in Canada will shape a possible Hydrogen transition (eg the impact on some provincial economies of a shift away from fossil fuels, the concentration of the nuclear industry in Ontario and Quebec)?

  Hopefully Canada will consider its options carefully and not jump towards H_2 without a close consideration of other alternatives. My personal sense is that H_2 has enjoyed an uncritical support in Canada, borne of a romantic notion of its cleanliness and high technology image. In my view, the duo of fuel cells and hydrogen have better niche applications *individually*. However, for the bulk of our needs, electricity is superior energy carrier for stationary sources and hydrocarbons a better form for mobile applications.

  Within Canada, some regions may jump on the "bandwagon" in the hope of stealing a lead. My sense is that those who do so are those who are not blessed with significant fossil resources. These provinces have less experience with the energy systems as a whole and are more likely to fail than succeed in their endeavors. The winners will be firms that bide their time and establish market presence through acquisition of winning smaller initiatives. Given the current geographic pattern of concentrated energy-commerce there is no reason to believe future winners will not emerge from the same.

- On a full life-cycle analysis, would the environmental impacts of Hydrogen production, distribution, storage and use (including the production of the materials entailed in facilities and fuel cells) have a greater adverse environmental impact than continued use of hydrocarbon fuels with improved emission controls?

  A full comparison of environmental impacts of H_2 and its alternatives leads to mixed conclusions based on four factors a) the source of primary energy for H_2 production; b) the existence of a market for the co-produced O_2; c) the relative weights assigned to different environmental impacts (from GHG emissions to land use to formation of PAH, etc.); and d) the final form of hydrogen (compressed gas or liquefied).

  In general, H_2 is a winning option only when GHG emissions are assigned extraordinarily high weights.[5] Otherwise, even when produced from renewable resources the magnitude of externalities depends on where the system boundaries have been drawn.[6]

---

[5] Strømman, A. H. and E. Hertwich (2004). Hybrid Life Cycle Assessment of Large Scale Hydrogen Production Facilities, NTNU: Program for industriell økologi**:** 33.

[6] See for example, the paper by Keith et al on the climate impacts of wind power generation. Keith, D. W., J. F. DeCarolis, et al. (2004). "The influence of large-scale wind-power on global change." Proceedings of the National Academy of Sciences **101**(46): 16115-20.