

## What should government do to advance the hydrogen economy?

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October 2005

It used to be said that there were only three tools of public policy: greed, sex and fear; and the second of these was awfully hard to deploy. Consequently, the three ways governments in fact use to get people to do specific things -- regulation, suasion, and bribery – actually map into greed and fear. Regulation is all about the fear created in the mind of the economic actor if he does not conform. Greed calls on all the tools of suasion and bribery.

Regulation invokes the coercive power of the state to order by statute that something must not be done, or more rarely, that in certain circumstances, only a narrow range of techniques is permissible. Like all matters of law in public policy, this is best invoked only when a social consensus has already formed. Law is the most conservative tool of public policy, and when applied in advance of the necessary consensus usually fails. Examples include the firearms registry or the 1980-84 national energy program. It is far too early to mandate any specific approach to hydrogen. The technical alternatives are too many, and the probability of freezing technology prematurely too great.

But if “hard” regulation is premature, there are several “soft” approaches that might be used with care. One is standards development. Under the authority of the Standards Council of Canada, organizations like the Canadian Standards Association will convene all stakeholders, when requested by government, industrial or more rarely consumer groups, to hammer out a standard. By codifying industrial best practices, technological risk is reduced and manufacturing processes can begin to take advantage of scale. A useful feature of standards development is that it can concentrate on some small part of a large enterprise where a technical consensus has formed, or where the new practice is a fairly straightforward extension of the old, and thus reduce uncertainty to a useful degree while avoiding premature fossilization. The process is, however, slow and not inexpensive, and tends always to proceed with a view to international harmonization, thus adding further viscosity.

Not much has happened so far with respect to hydrogen standards, as most of the relevant processes have yet to experience the large-scale trials that allow players to exclude some alternatives in favour of clearly superior ones. Exceptions are the CSA’s FC1-2004 and FC3-2004, both dealing with fuel cells. An interesting exception has to do with hydrogen embrittlement of zirconium, a problem that has arisen in the nuclear industry. It is possible that the hard-won experience of Candu reactor operators will be of benefit to the hydrogen economy of the future, since the standards represent the crystallization of their many years

of work and disappointment, but there is some question of whether the work is too specific to Zr.<sup>1</sup>

This is an area where some cautious work by government might pay results. NRC and the CSA, working together, might begin to consider whether the time is yet ripe to codify practice with certain elements of a future hydrogen economy – for example, the avoidance of materials known to have embrittlement, containment, or other physical/chemical problems; or how best to join pipes and valves in a fuel system. But the watchword should be caution. Foreclosing options before they are understood is a big error.

A second area of soft regulation may be “guidelines” or “objectives” to govern government’s own practices, such as the procurement of certain machines. Soft regulations may apply only to the government’s own responsibilities, or to otherwise narrow domains. The advantage is that the rest of society can continue experimenting; the risk is that other economic actors will conclude that the government knows what it is doing and stop.

The federal government has soft regulations, in this meaning of the term, in its current green procurement guidelines, and in respect of other socially desirable ends. Regional and gender equity are currently popular. Provincial governments as well as the federal government used to have unenforceable “guidelines” with respect to drinking water quality, but then along came Walkerton and the guidelines were quickly frozen into regulations – at considerable embarrassment to the federal government, whose own installations in trains, planes, military bases, national parks and Indian reserves, to name but five, turned out to require billions of dollars of investment to meet the now mandatory standards. As a former inmate of the Walkerton inquiry I find it hard to think of circumstances where soft regulations are really beneficial. When applied to procurement, a process already too cumbersome by far, the effect is all too frequently to slow progress in a rapidly moving field.

This leaves suasion. Governments can procure actionable information through research, development and demonstration projects, and can invest directly or indirectly in real-world applications. With respect to the first three, there are many examples of splendid work by the federal government’s own research labs, notably those of NRC, NRCan, Industry and Agriculture. Our relatively advanced degree of “connectedness,” for example, has a long history that runs through the space program, the Communications Research Centre at Shirley’s Bay, and NRC’s collaborations with the predecessors of Nortel. It is when government goes a step beyond the proof of concept stage and becomes a committed investor that things start to go wrong. In the same domain, Telidon and Consolidated Computer were examples of spectacular failures. “Governments are no better and no worse than anyone else at picking winners,” said Sylvia Ostry, “but losers are awfully good at picking governments.”

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<sup>1</sup> Glenn Tubrett, Canadian Standards Association, personal communication, 26 August 2005

In the hydrogen area, the federal government's R&D efforts have arguably been overly concentrated on fuel cells. Very early on, technically informed enthusiasts in the federal government found an industrial champion, a firm that had, it was thought, at least a small chance of being a global winner in one of the industries of the future. That the firm was located in a province whose perennial complaint was that federal technology expenditures always went to central Canada only accelerated this premature concentration. NRC, NRCan, Industry Canada, and even the Business Development Bank of Canada piled on. This is not to say that the firm in question and the technology it was inventing was unworthy: far from it. But a little diversification in a high-risk portfolio is always a good idea.

There are some signs that a broader view may be emerging. One of the classic functions of the Industry department's sector branches has always been to take a long view, and an overview, of particular sectors of interest. Last year it published the first of what one hopes will be a periodic series of profiles.<sup>2</sup> The scientific literature is beginning to take a broad and synoptic view of the system-wide consequences of a shift to hydrogen as a motive fuel,<sup>3</sup> as well as publishing specifics. Governments can create a substantial public good by sponsoring research, and the adaptation of technological developments from abroad to Canada's climatic particulars. In Canada, a larger investment into work done in-house and in the universities would be a no-regrets decision.

The federal government also gets close to the "choosing winners" syndrome through NRC's IRAP program and more particularly through Industry's Technology Partnerships Canada program.<sup>4</sup> IRAP, at least, keeps its cash subsidies small, well diversified, and accompanies them with advice from knowledgeable case officers. TPC is more like a venture capital fund in its approach, but one that has low expectations of a return on investment. It has a special window for hydrogen called the "h<sub>2</sub> Early Adopters Program" – h<sub>2</sub>ea for short – aimed at:

- "Integration of hydrogen and hydrogen-compatible technologies;
- Development of hydrogen infrastructures;
- Development of skills and supply chain in the hydrogen industry;
- Development of codes and standards for the hydrogen industry;
- Increased performance, reliability, durability, and economic viability of hydrogen and hydrogen-compatible technologies; and

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<sup>2</sup> Industry Canada, Fuel Cells Canada, and PriceWaterhouseCoopers, "Canadian hydrogen and fuel cell sector profile 2004," ISBN 0-662-37227-1, 2004

<sup>3</sup> For instance, M.Z. Jacobson, W.G. Colella and D.M. Golden, "Cleaning the air and improving health with hydrogen fuel-cell vehicles," *Science* 308 (24 June 2005):1901-5

<sup>4</sup> TPC was differentiated from its predecessor DIPP principally through rhetorical means, and there is every indication this time-honoured tradition will continue with its successor.

- Increased public, consumer and investor awareness and acceptance of the hydrogen capability.”<sup>5</sup>

This is certainly an ambitious set of goals, a set moreover difficult to accomplish solely through investment in private companies. It is hard to assess performance, however, as all specifics are cloaked in a veneer of commercial confidentiality. Markets are stimulated by the wide availability of good information. Subsidizing the creation of proprietary information is not so unambiguously good.

Of course suasion operates at the level of public communications as well. The degree to which actual investment is catalyzed by political figures extolling the virtues of any particular course of action is debatable, especially if some government-in-waiting feels constrained to take an opposing view, but statements from persons thought relatively more authoritative and objective may carry weight. More generally such statements may indicate a level of social approbation that would have the effect of reducing, for example, certain regulatory risks. There is little harm in political figures taking an advocacy position vis-à-vis hydrogen, but the good ones will be careful, since skeptics will quickly ask for the substance behind the urging. Advocacy not backed by cash or regulation is rightly discounted.

Finally, there is outright bribery. Governments may attempt to rig market outcomes by changing relative prices through the tax system, or by making direct investments in desired outcomes. The latter has the virtue of being, relatively speaking, inexpensive, well-targeted, and efficient, at least in principle. Because direct expenditures – on procurement, to accelerate the development of a market, or in productive capacity, to make sure there is a local champion – can be closely targeted and can in principle pay for only the incremental costs, they are inexpensive. They assume that officials can choose the most meritorious of numerous competing enterprises, can avoid the siren call of regional equity, and can ruthlessly prune the tree when individual branches start to wither. They also attract the critical attention of people who think the Canadian field should contain no tall poppies: for whom equity in all its guises is the supreme social goal. And they are easily auditable.

Tax expenditures trade the absence of such pitfalls for a larger and wider distribution of funds and lessened accountability for their use. Legal definitions of eligible claims offer employment to ingenious lawyers and accountants. The amount of public resources going to a particular project may be far in excess of what might be needed to induce investment; indeed in the limit windfalls flow to people who would have undertaken the investment without any special incentive at all. For these excellent reasons, as well as those relating to the theological purity of the tax system, departments of finance rightly resist tax expenditures as

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<sup>5</sup> <http://tpc-ptc.ic.gc.ca/h2/>, accessed 28 July 2005

a means of accomplishing goals as narrow as stimulating a particular industrial sub-sector.

Bottom line, what might be a good program for the federal government in present circumstances? One set of choices might be as follows:

- **Technology assessment and evaluation:** an external advisory panel, assisted by a small team of scientists, engineers and information specialists at NRC/CISTI, should continuously comb the world literature for advances in hydrogen research and technology, distribute the results to the entire Canadian community of interested parties, and make recommendations regarding areas for Canadian R&D investment.
- **Systems engineering:** NRCan should take the lead in thinking through all of the steps necessary to make hydrogen an attractive substitute for petroleum-derived transportation fuels and through systems analysis define bottlenecks where intensive R&D might reap extraordinary returns.
- **Industry Canada and Finance** might re-examine the SRED tax credit system, in part on the basis of the former's knowledge of the realities of the emerging sector, to ensure that it is optimally designed for the purpose.
- **Industry Canada** might take the lead in funding the Canadian Standards Association to convene interested parties to see whether the time is yet ripe for beginning work on certain specific standards.
- **NRC** should take lead responsibility for a sustained federal program of research and development on hydrogen, while line departments sponsor demonstration projects in their areas of responsibility.
- **Finance**, assisted by Environment and Industry, should examine the tax advantages and subsidies accruing to the production and use of fossil fuels with a view to reducing these monuments to vested interests as circumstances allow.
- **Communications** should reach beyond the specialized technical communities to include the media, schools, and the general public.
- A management secretariat, possibly housed in the Treasury Board though more likely in a line department such as Industry, should authoritatively allocate a multi-departmental program budget, evaluate results, and ensure coherence with related initiatives.

Such a program would not presently rely on political exhortation, new tax incentives beyond the established SRED, general subsidies to producers or consumers, targeted procurement outside of demonstration projects, or direct investment. Its secretariat and managers would be an internal voice arguing against the temptation to subsidize old ways of doing things, such as the subsidized use of fossil fuels