

# Electricity and Hydrogen in Canada's Energy Future

There are two energy currencies which can be derived from all the alternative energy sources which we have considered. They are electricity and hydrogen. We see these two currencies dominating Canada's energy mix in the long term because they satisfy our criteria for determining the direction a new energy policy should take.

- Consideration number one was that *conservation* should be encouraged. This should be done no matter what the energy mix and simply means that energy should be used judiciously and efficiently.
- The second principle stated that energy should be derived from *renewable* and/or *inexhaustible energy sources*. Wind, geothermal, hydro, tidal, biomass, solar and nuclear energy all satisfy these criteria. (Living organisms and biomimetic systems — systems which mimic the chemical reactions of living organisms — may also be developed which can evolve hydrogen.)
- Third, all of the energy sources named (with the exception of nuclear, the environmental hazards of which have not yet been determined to our satisfaction) are relatively *environmentally benign*, as are the currencies produced (hydrogen and electricity) and as are the "combustion" products of these currencies (water and low-quality heat).
- Fourth, the variety of sources, diversity of production methods, options for storage and transportation, and spectrum of end uses possible for these energy currencies allow development of a system which will indeed be very *flexible*. (Another consideration worth noting in this connection is that electricity and hydrogen are *interconvertible* using electrolysis or fuel cells, further increasing the flexibility of this energy system.)
- Fifth, the resources required to produce hydrogen and electricity are plentiful in Canada, giving us the potential to become completely energy self-sufficient, thereby eliminating *strategic concerns*.
- Sixth, the flexibility of this system coupled with the wide variety of potential energy sources throughout the country ensure that Canada can achieve *regional diversity* in energy supply and demand management.
- Seventh, the facts that a hydrogen-electric energy system would be less polluting than our present system, that this mix would create employment across the whole country and that such a system would generate technological and economic spinoffs through the export of new Canadian technology abroad are excellent *social benefits*.

The flexibility of a hydrogen-electric system is indicated diagrammatically in Figure 4-6, which indicates various possibilities for hydrogen production and use in an industrial society.

For a considerable time to come, oil will continue to play an important role in our energy mix since we already have the infrastructure for its production, distribution and use in place and because it is the source of a broad range of convenient fuels. Although Canada is lacking large reserves of light crude oil, our nation does have oil sands in abundance. Thus one way we will continue to meet our unavoidable requirements for petroleum products is through converting our heavy crudes into light oils by adding hydrogen. (The addition of hydrogen increases the hydrogen/carbon ratio of heavy oils, changing them into light oils.) Today the hydrogen required for this process is typically obtained by stripping it from the methane (CH<sub>4</sub>) molecule, the main constituent of natural gas. But this practice is clearly wasteful of hydrocarbon resources and we believe that hydrogen produced by electrolysis (splitting of water into hydrogen and oxygen by means of an electrical current) should be used in the future to upgrade heavy oils. In this connection we have an abundance of sites for both small- and large-scale hydro-electric developments in Canada and even remote sites now considered uneconomic could be harnessed to generate electricity which could in turn be used to produce hydrogen.

We have observed the increasing requirement for energy in Canada's energy supply industries — our nation requires progressively more energy to extend conventional energy supplies. This suggests that Canada needs to be more innovative in approaching the supply problem. For example, Canadian utilities will build more thermal-electric generating stations and these stations, bound by the laws of thermodynamics,