Efficiency is Only One Part of the Solution

by Ralph C. Martin

Cars vary in how efficient they are with gasoline. Some mid size cars are now capable of traveling 100 kilometres (km) with only 6 litres of gas. Larger vehicles require 8 to 10 litres to go the same distance and some small cars do it with only 5 litres.

Although a 25% efficiency gain of 6 litres per 100 km from 8 litres per 100 km is beneficial, it's not the end of the story. If the car population increases by 25% during the same period, then as a society we are no further advanced in decreasing fuel consumption and lowering emissions of carbon dioxide, a common greenhouse gas (GHG). Furthermore, if on average, people now drive 25,000 km per year instead of a former average of 20,000 km per year, then overall gasoline consumption and GHGs are going up by another 25%.

The biosphere surrounding us responds to the total amount of GHGs which are emitted. As more heat is trapped by increasing concentrations of GHGs around the globe, data and models from the Intergovernmental Panel on Climate Change, indicate that weather will become more variable and less predictable.

A recent report by Canada's Emissions Trends shows that GHG emissions in Canada are expected to be 734 megatonnes by 2020, 122 megatonnes higher than our target of 612 megatonnes, which we agreed to in an international treaty, signed in 2009. Even though energy use and GHG emissions per barrel of oil extracted from the Alberta oil sands and per vehicle driven, are going down, Canadians are extracting too many barrels of oil and driving too many vehicles, too far. To date, the Canadian government reaction has been to focus on improving energy intensity or energy efficiency rather than comprehensively addressing overall energy use and overall GHG emissions.

Agriculture and food are also significant players in energy consumption and GHG emissions. In rural Ontario, it is well known that average corn yields quadrupled from about 40 bushels (bu) per acre to about 160 bu/acre over the last 100 years. However, energy input per acre, mostly from the manufacture of nitrogen fertilizer has also increased. On a graph of the last 100 years, sharply upward pointing curves of increasing crop yields, increasing nitrogen fertilizer use and increasing agricultural energy use, map almost exactly on the curve of population growth. Some argue that population growth pulls crop yields supported by energy and nitrogen fertilizer use.

Others wonder if the economic opportunity for increasing crop yields with more energy and nitrogen fertilizer, have pushed population levels.

Organic agriculture, which does not include the use of synthetic nitrogen fertilizer, has energy inputs **per acre** which are 40 – 50% lower than non-organic agriculture, according to a paper my colleagues and I published in Sustainability, volume 3, pages 322-362. However, when energy use **per kilogram of product** is measured, the story shifts. Non-organic systems produce more kilograms of product per acre. Therefore, their energy use per kilogram of product approaches the energy efficiency of organic systems. Organic systems, depending on the crop, are generally in the range of 0 – 20% lower energy inputs per kilogram of product.

The GHG response is very similar. Organic crop systems have lower GHG emissions per acre but their efficiency advantage is less pronounced when assessing energy use per kilogram of product.

This begs the question of how to squeeze more energy and GHG efficiency per kilogram of product. If more energy is used but even more product becomes available then the energy input per kilogram of product is still lower. Nevertheless, the focus on efficiency per kilogram of product only gets at one part of our overall energy and GHG issues.

It is commonly accepted that about 40% of food produced in North America is wasted. Furthermore, data from the U.S.A. indicate, that on average, people consume up to 1.6 times more calories than required. More appreciation for food, may help us to value it and respectfully use it. Perhaps we already produce enough food.

Ecological theory, based on observations of natural ecosystems, clearly anticipates a limited carrying capacity of food production on this planet. If we overshoot carrying capacity, the ecological systems underpinning food and bio-product production will degrade and much less production will be possible, in the future. Consider the collapse of the cod fishery. Regardless of how efficiently we produce each kilogram of food per input of energy, water and other resources and how few GHGs are emitted per kilogram of food, if we endanger the organizational integrity of interacting ecosystem services with too much overall production and too much pressure on the system, then we will kill the goose laying the golden eggs. We don’t want to go there.

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