Reckless choice

For many years Ontario has stubbornly clung to its reliance on natural gas as its primary energy source even though that has made it completely impossible to achieve the province's GHG reduction objectives. Now, the supply of natural gas from Alberta is nearly exhausted and we will soon be obliged to import fracked shale gas from the US and that makes the problems even more serious, to a point that is potentially calamitous.

Under its LTEP Ontario will soon be importing 1.4 trillion cubic feet (Tcf) of natural gas annually compared to 1 Tcf in the previous calculations (summarized in SJ in February, 2014).

* The estimates for the fugitive emissions from the pipelines (calculated by the supply industry to be about 3.4%) are now being challenged by direct measurements of methane in the atmosphere that indicate that the actual levels may be three times higher than the industry claims. These fugitive emissions will moreover be higher for fracked gas because of the losses that occur during the fracking process, a process that may be repeated up to 18 times per well to stimulate gas flow.

* In addition to the fugitive gas that escapes from the pipelines there is a much larger danger - that the fracking process is releasing enormous amounts of natural gas that is no longer sealed in the shale rock. That methane will initially be a mile underground so it will take time to reach the surface but there is no barrier to stop it. This ground leakage from the fracking operations is likely to result in GHG emissions that will dwarf those from burning the natural gas and from the fugitive pipeline emissions.

* To top it off, the IPCC has found that the previous value for the GWP of methane was too low (at 72, using 20 yr averaging) and should be increased to 86.

At the present time we do not know exactly how much methane is leaking via the fugitive emissions or how much has been released from the shale and now exists as a deep but mobile underground cloud, and we don't know how much of that cloud will eventually reach the surface and contribute to the atmospheric GHG. However, the shale gas is now being produced on a large scale and big investments are being made to bring it to Ontario so it is imperative to consider the GHG emissions even if we can only make very rough estimates for some of the values. In the following calculations (scaled from the Feb/14 values) the value for fugitive emissions splits the difference between the atmospheric measurements and the calculated industry values, the ground leaks are arbitrarily assumed to amount to 0.01% of the methane content of the shale, and the economically recoverable natural gas is assumed to amount to 2% of the content, which is the established overall figure for natural gas wells.

Consumption	- 1.4 Tcf/y (from Navigant review for the OEB)
Fugitive emissions	- (3.4+3*3.4)/2 = 6.8% (Howarth et al)
Ground leaks	- 0.01% of rock's methane content (only affects the timing)
Natural gas production	- 2% of rock's methane content (Inst. f. Energy Research)
GHG generation in Ontario	- 1.4*55 Mt = 77 Mt of CO2
+ fugitive	- 6.8% of (20.4 Mt * 1.4 * 86) = 167 Mt(equivalent)
Total GHG from pipeline	- 77+167 = 244 Mt(equivalent)
Plus corresp. ground leaks	- 26.3 Mt in 2015, growing to 920 Mt in 2050
Plus GHG from other sources	- (165 - 77) + 920 Mt in 2050 = 1008 Mt(and still growing!!!!)

The ground leak rate is based on the total amount of natural gas in the rock because once the rock has been shattered any trapped methane only needs to travel a short distance via bulk diffusion to reach a fissure that will serve as an escape route. The figure for the leak rate does not change the ulitmate outcome - it just determines the length of time that will elspse before the emissions reach calamitous levels.

The Ontario government incorrectly claims that the total emissions from all GHG sources put together will amount to only 165 Mt(equivalent). That is based on the assumption that both the fugitive emissions and the ground leaks should be ignored, but those emissions would not exist if Ontario did not use the natural gas so such an assumption is absurd. The federal government inventory figures (on which the Ontario numbers are based) ascribes the fugitive emissions to the place where they are generated, not where the natural gas is used, so they are inappropriate for consideration in choosing a fuel. What we need to know is the total for the emissions that will result from the choice of energy sources.

If Ontario proceeds with its LTEP then based on the above numbers it will be responsible for generating 1008 Mt of GHG per year by 2050, not the paltry 165 Mt that they claim, and the rate will continue to grow if the fracking continues.

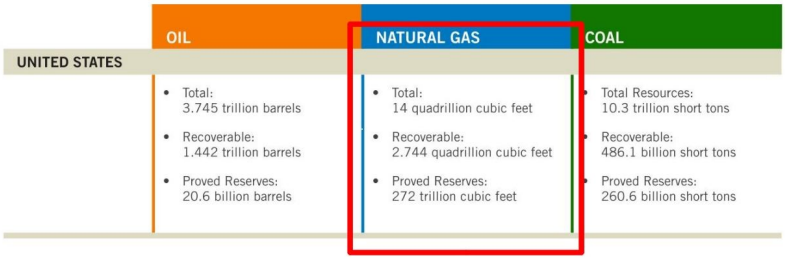
Such emissions would be calamitous from both an environmental point of view and from an economic point of view (because such a choice could not be sustained). The government may want to claim that the fugitive or ground escape numbers should be different, or that the IPCC GWP value for methane is not valid, but if so **it is absolutely mandatory** that they subject those numbers to transparent, public and expert reviews. The consequences are much too big to ignore. To date, the errors in the government figures have been pointed out repeatedly but the various government ministries, production organizations and oversight agencies have all turned a blind eye.

There are less expensive, cleaner and more sustainable sources of energy available that could completely replace natural gas. We can live without natural gas so the onus is on the government to show how the continued use of natural gas would be anything other than an extremely reckless choice.

Appendix

The most significant contribution to the 1008 Mt figure comes from the ground leakage from around shale gas wells, and in particular from the Marcellus formation that will replace Alberta gas for Ontario. There have been a great many reports concerning fracked natural gas appearing in well water, bubbling out of streams, escaping from fissures in the ground, etc., but it appears that very little work is being done (or perhaps being reported) to determine the overall magnitude of the ground leakage.

The best guide at the moment may be the statistics for the natural gas industry as a whole.



Only a small part of the natural gas resources are classified as being technically recoverable and only about 10% of the technically recoverable gas is economically recoverable (the proved reserves). For shale gas virtually none of it is recoverable prior to fracking because it is sealed in the impermeable shale rock. Fracking, and in some cases repeated fracking, releases some of the natural gas from its rock prison, making the resource viable for recovery. For lack of better data the logical starting point is to assume that the technically recoverable portion is comparable to that for natural gas as a whole. The Marcellus formation contains an estimated total of 1500 Tcf of natural gas, so if it follows the standard natural gas pattern then there should be about 84 Tcf of technically recoverable gas (the EIA estimate is 141 Tcf) and about 8.4Tcf of economically recoverable gas (proved reserves, but this will depend on price and other factors). Note that this is only enough to supply Ontario for 6 years! (and Marcellus is the largest of the US shale plays, so continued supply is a major issue). That is in reasonable agreement with the estimates for Marcellus by the USGS and Halliburton, but the EIA has recently (Dec 2014) raised their estimate of proved reserves to 64.9 Tcf.

What that means is that in each year after Ontario's 1.4 Tcf of gas has been recovered there remains an additional 12.6 Tcf of newly released but unused gas floating around in the now-permeable shale and surrounding materials (which were permeable to begin with). Every year this mass of methane will increase linearly by about 25 Mt and the equivalent GHG(eq) that is stored in the ground will increase by 86 times that amount, or 2150 Mt. By the year 2050 that GHG burden will have increased to an astounding 75,000 Mt! During that time the shale will have become progressively more permeable and for each fracking operation another 6 million gallons of water will have been injected, less than half of which will be extracted. By that time, and with that amount of free methane in the ground, the amount that will be escaping via water dissolution, entrainment and fissure leakage will almost certainly present an extremely serious problem for which there will be no remedy, and the emissions will continue for decades after the wells have ceased production. The area of the Marcellus shale formation is 95,000 square miles so it would not be possible to cover it with a huge plastic sheet like those used to reduce the leakage from garbage dumps. We will have created a truly disastous situation that we will not be able to control.

We know that significant amounts of methane are leaking from such sites now, even though we are only at the beginning of the build-up. We don't yet know what the rate of leakage is but utimately it doesn't much matter whether we release that huge amount of methane in ten or a hundred years - the damage will have been done when we made a truly senseless decision, and it will be irrevocable.

Natural gas from conventional sources is always trapped by some means - in a salt dome, by an impermeable shale or coal bed, etc., so the mobile portion of the shale gas is very different in that it is no longer trapped. For the first few years of shale gas operations the ground emissions will not appear to be serious but they will grow linearly with time. The gas has been in the ground for 380 million years so the passage of another 35 years is only a blink of time, but it could prove to be a truly destructive period.

The Ontario government has failed to make a case for the use of shale gas. In addition to its excessive GHG emissions it introduces safety and health hazards, provides only a temporary source of dirty energy, and it would be billions of dollars more expensive than a clean, safe alternative energy source such as that provided by exergy stores.