NIWA
Taihoro Nukurangi

Climate-Energy Matters

a quarterly newsletter from the National Centre for Climate-Energy Solutions

Climate change business opportunities

The New Zealand Business Council for Sustainable Development is concerned that New Zealand businesses risk missing out on the significant opportunities that are likely to arise out of the climate change challenge.

In its Climate Change Business Opportunities report, the Council described 32 potential opportunities that participating companies identified within their operations. They ranged from providing knowledge and services, to "climate-friendly" branding, to investment in emission-reduction projects.

Stephen Tindall

Chairman Stephen Tindall said that the Council had identified significant business opportunities associated with the need to reduce greenhouse gas emissions. However, he warned that a lack of awareness and innovative thinking could mean that businesses missed out.

"Our eco-efficiency energy management programme at The Warehouse is saving us about $3 million a year as well as reducing greenhouse gas emissions. A number of our energy management initiatives are simply the clever application of common sense."

The Council released the report to encourage businesses to think positively and creatively about the climate change challenge and to collaborate on seeking solutions.

An excellent example was the collaboration between Waste Management and Mighty River Power that trapped methane from Waste Management's Redvale landfill and used it to generate power for about 700 homes.

Similarly, BP international showed that reducing greenhouse gas emissions was good for a company's financial bottom line. Since 1997, BP has reduced its greenhouse gases by 10% from the 1990 level, and at the same time created US$650 million in value. BP Oil New Zealand Chief Executive Peter Griffiths is convinced that other companies can achieve similar results.

Another example is the fuel use strategy developed by Urgent Couriers. According to Managing Director Steve Bonnici, "... by lowering CO_2 emissions we are reducing our impact on the environment at the same time as we're improving our contractors' financial sustainability."

Analysis of the specific areas of commercial building energy efficiency, wood waste to energy, the Clean Development Mechanism (under the Kyoto Protocol, countries can get credit for investing in emission-reduction projects in developing countries), methane reduction through ruminant efficiency, and climate-friendly branding revealed revenue opportunities of over NZ$350 million per year. The resulting greenhouse gas savings would be about 9 million tonnes of CO_2 per year. That is estimated to be the emissions reduction equivalent of taking more than 2 million average family cars off the road.

This analysis is only the beginning – a taster to get business thinking – there are plenty more opportunities out there. For example, optimising transport systems has the potential to deliver enormous financial and greenhouse gas savings.

"For most companies, climate change is now a risk management issue with a significant upside", said Mr Tindall. "Therefore, it makes good business sense to get to work as early as possible and understand and work to minimise greenhouse gas emissions, and identify business opportunities that are likely to arise from a carbon constrained economy. If we don't act soon, we'll miss out!"

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Catalytic converters won't save the planet by themselves, but they do have their uses

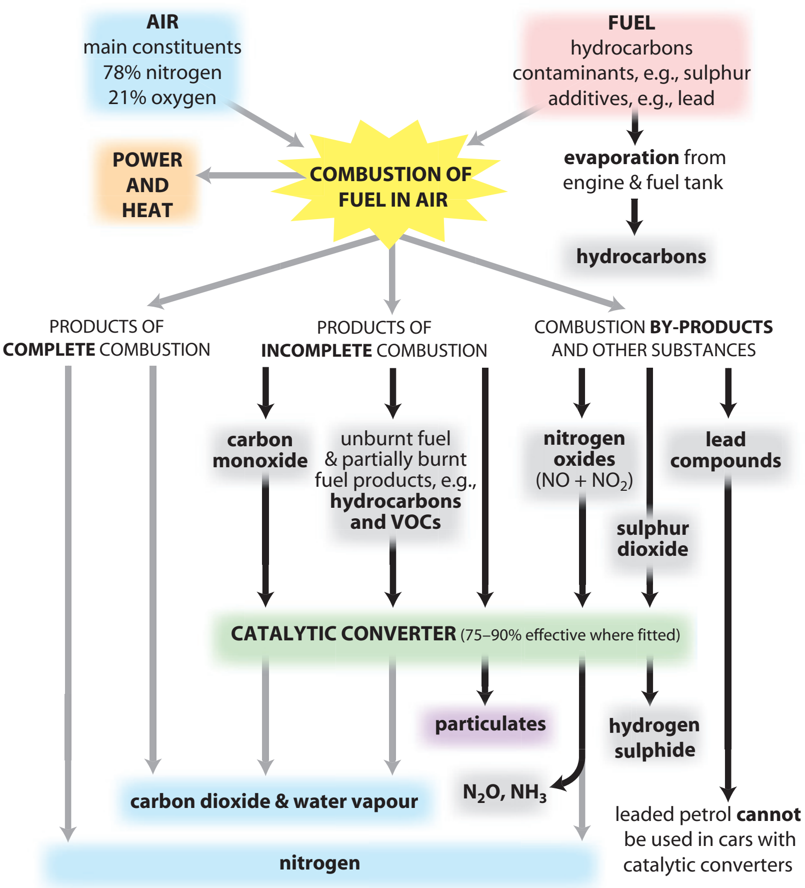
Motor vehicle use is now generally recognised as the source of more air pollution than any other single human activity. In urban areas, where more than 70% of the population in OECD countries live, levels of motor vehicle pollution frequently exceed internationally agreed air quality guidelines. The situation is no different in New Zealand.

What are the pollutants?

Vehicles contaminate the atmosphere through fuel combustion, fuel evaporation, stirring up road dust, and wearing brake linings and tyres. The key pollutants include:

- common ambient air pollutants
  e.g., carbon monoxide (CO), nitrogen oxides (NO_x), sulphur dioxide (SO_2), fine particulate matter (less than 10 μm*, PM_{10})
- greenhouse gases
  e.g., carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O)
- hazardous air pollutants
  e.g., hydrocarbons and volatile organic compounds (VOCs) such as benzene and formaldehyde, heavy metals such as copper and zinc in particulate form
- visibility-reducing pollutants
  e.g., photochemical smog from NO_x and VOCs combining in the presence of strong sunlight to produce ozone and other oxidants.

* 1 μm = 1 millionth of a metre.



The process in internal combustion engines.

What are the options for control or management?

The considerations include:

- what goes into the engine?
  using cleaner-burning fuels reduces exhaust emissions by up to about 90%
- how does the engine perform?
  using new engine technology (e.g., fuel injection, engine management systems) reduces evaporative emissions by up to about 80% and exhaust emissions by up to about 40%
- how does the driver perform?
  promoting maintenance and fuel-efficient driving reduces exhaust emissions by up to about 50–80%
- how does the road perform?
  minimising bottlenecks and improving traffic flow reduces exhaust emissions by up to about 90%
- what comes out of the engine?
  using catalytic converters reduces exhaust emissions by up to about 90%, using carbon canisters to catch evaporative emissions and special fuel nozzles to cut refuelling losses reduces evaporative emissions by up to about 95%, adopting emission standards as part of the warrant of fitness reduces exhaust emissions by up to about 90%.

Would catalytic converters help?

Catalytic converters are basically an after-treatment solution. They don't treat the cause of the emissions, which is that petrol-fuelled internal combustion engines operate inefficiently (see figure). They can have a significant effect on improving local urban air quality by reducing emissions by up to 90%, but their limitations need to be taken into consideration (see table).

Pros

- reduce up to 75–90% of:
  CO, NO_x, SO_x
  VOCs, including aromatics

Cons

- have no effect on PM_{10}
- need 10–15 minute warm-up
- need maintenance
- currently available only for petrol models and only for exhaust emissions

The main reason why catalytic converters do not have a bigger impact in controlling urban air pollution in New Zealand is that most trips are short and the catalyst has not had sufficient time to operate properly.

What about the future?

There are a number of developments on the horizon to further improve emission performance. All petrol vehicles currently entering New Zealand for sale are now equipped with catalysts, and manufacturers are working on special trap systems to limit particulate emissions from diesel vehicles. Some hybrid and cleaner-fuelled vehicles, which have reduced emissions at source, have been imported, but essentially as showcase prototypes rather than true market options. As a consequence, given the age and turnover of the fleet, it will be many years before we see any major positive effect of these developments on urban air quality.

What can we do in the meantime?

The news is not all bleak, however, because there is one area where every motorist can help – both in terms of minimising vehicle emissions and in terms of maximising fuel economy – and that is by simply maintaining their car. Research overseas has shown that "**the absolute emission differences between well- and badly-maintained vehicles of any age are considerably larger than observable effects of emission control technology and vehicle age.**"
So, take up the challenge and tune your vehicle today!

Dr Gerda Kuschel (g.kuschel@niwa.co.nz)

What does Global Warming Potential mean?

Why is New Zealand unique?

Unlike most countries, a large fraction of New Zealand's greenhouse gas emissions is methane (CH_4), rather than carbon dioxide (CO_2). CO_2 is typically produced from combustion, whereas CH_4 is primarily emitted from ruminants such as sheep and cows. Nitrous oxide (N_2O), another greenhouse gas, is also released from soils and pastures, and as agriculture intensifies and more nitrogen fertilisers are applied, more N_2O goes into the atmosphere.

How do emissions affect climate?

The ability of a gas to warm the Earth's surface over time depends on its:

1. radiation absorption properties,
2. present concentration in the atmosphere,
3. expected future emissions from the surface (sources),
4. lifetime in the atmosphere (removal).

Therefore, to compare the relative climatic effects of instantaneous emissions of two gases, their contributions to global warming over some future time period (the time horizon) are calculated and ratioed. For each gas, the product of its concentration and radiative efficiency, due to a 1 kg increase, is summed over the time horizon. When carbon dioxide (CO_2) is used as the reference gas (the denominator in the ratio), this ratio is referred to as the global warming potential (GWP). For the Kyoto Protocol, to determine the total contribution from each country to future climate change, the emissions of each gas are multiplied by the appropriate GWP and then summed to produce a CO_2 equivalent emission. This means that the emissions of a range of gases can be compared in terms of their future impact on climate.

Why are GWPs important?

Each extra molecule of CH_4 has as much effect on infra-red radiation as about 30 extra molecules of CO_2, but a pulse of CH_4 into the atmosphere lasts on average for about 12 years, whereas a significant fraction of CO_2 lasts for centuries. Therefore, over longer periods, CH_4 is less significant and its impact depends on the time horizon. For the Kyoto Protocol, the time horizon was set at 100 years, with a resultant GWP for CH_4 of 21. A longer time horizon would result in a smaller GWP for CH_4. The GWP for CH_4 has recently been revised (due to a revised CO_2 GWP) to 23. This means that integrated over 100 years, an emission of 1 tonne of CH_4 has the same effect on climate as the emission of 23 tonnes of CO_2. GWPs for other greenhouse gases are 296 for N_2O and 22 200 for SF_6.

What does this mean for New Zealand?

Although New Zealand may not emit the quantities (tonnes) of greenhouse gases of many other countries, the impact of our emissions on climate change is proportionally higher because our non-CO_2 greenhouse gases have higher GWPs. As a consequence, any mitigation strategies that can be developed to prevent the release of each tonne of CH_4 are going to be up to 23 times more effective at meeting New Zealand's greenhouse gas mitigation obligations than strategies to prevent the release of each tonne of CO_2.

Dr Greg Bodeker (g.bodeker@niwa.co.nz)

Houses – climate and change

"You can't pass heat from a cooler to a hotter,
Try it if you like, but you'd far better not-a"
Flanders & Swann
"First and Second Laws" (of Thermodynamics)

We create buildings to, among other things, protect ourselves from the extremes of the natural climate. The artificial climate produced within buildings can be tempered to provide suitable levels of temperature, humidity, and ventilation. The availability of controllable energy (oil, natural gas, electricity, wood, coal, etc.) has meant that buildings of the mid-to-late 20th century need no longer rely on design and materials to provide a level of comfort for users.

But what is going on inside these modern buildings – what is the artificial climate like? There is little research on the conditions inside New Zealand homes and the relationship with the external climate – and the little that is available is largely concerned with "special" groups, such as the elderly or young. This lack of information means we do not know whether the design or construction of our buildings is actually supporting the needs of the users. It also means that we do not have the base data to understand the likely consequences of climate change, the impacts of changes in demand on the energy supply transmission system, or even the best way to implement the National Energy Efficiency and Conservation Strategy.

In 1995 BRANZ started to look for answers. With funding from FRST, the Building Research Levy, EECA, Transpower, and a range of other government and industry organisations, BRANZ has been actively working to understand energy use and services in New Zealand houses. The Household Energy End-Use Project (HEEP) has now monitored 200 houses, and by the end of 2004 will have monitored 400 randomly selected houses throughout New Zealand. The data from this monitoring are the first factual data on household energy use and indoor temperatures available since 1971, and the only data which cover all fuel types.

Initial results suggest that New Zealand houses have lower indoor temperatures than would be expected in countries with a cool climate, and that there is a very strong link between the indoor and outdoor temperatures. Even when heating is being used, the indoor temperature is rarely stable – it tracks the outdoor temperature.

Fourier's Law relates the flow of heat to the temperature difference between the inside and outside. If the average outside temperature is 13 °C, and the inside is heated to 18 °C, the heating energy needed to maintain this 5 °C difference relates to the level of thermal resistance between the inside and outside. If the outside temperatures drop, or the inside temperatures rise, by only 1 °C – the result is a 20% increase in the heating energy use, assuming the thermal resistance is unchanged.

The winter (May to September) Auckland long-term average (1909–80) temperature is 12.2 °C, and many of the current HEEP sample houses have average indoor winter evening temperatures of less than 18 °C, so the example is far from hypothetical. If all Auckland households decided to be just a little warmer in winter, the implications for energy use and climate change gas emissions would be considerable.

Over the next 4 years we will refine this analysis with NIWA climate data. The ultimate goals include an understanding of how New Zealand homes are heated, what opportunities there are to improve their energy efficiency, and the implications for climate change gas emissions.

Copies of HEEP annual reports are available from the BRANZ web site: www.branz.co.nz.

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