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HOLIDAY SPECIAL

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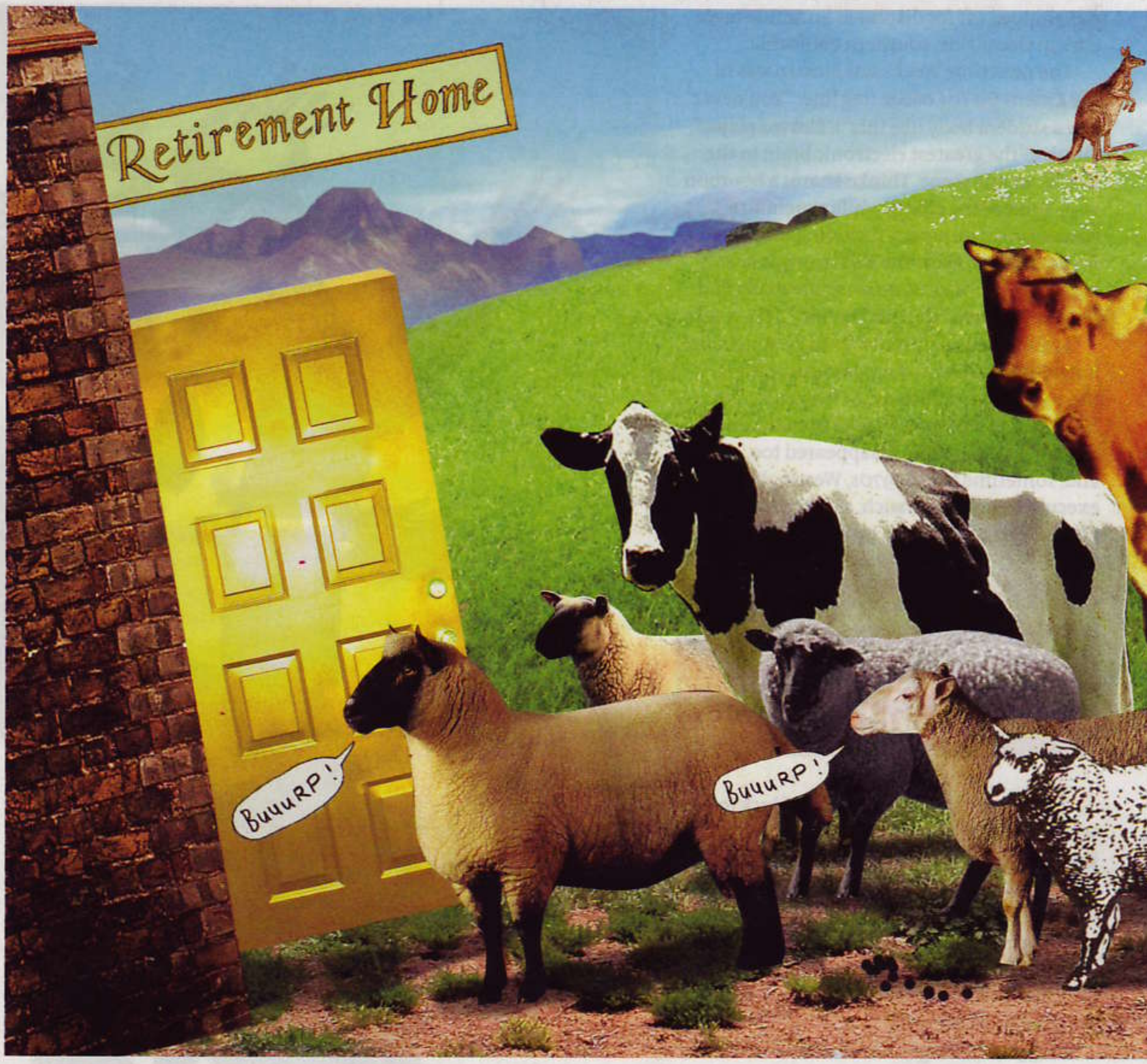

Kangaroos to the rescue

Stop climate change, eat marsupial burgers

COWS, sheep and goats may seem like innocent victims of humanity's appetite for meat, but when it comes to climate change they have a dark secret. Forget cars, planes or even power stations, some of the world's worst greenhouse gas emitters wander idly across rolling pastures chewing the cud, oblivious to the fact that their continuous belching (and to a lesser degree, farting) is warming the planet.

Take New Zealand, where 34.2 million sheep, 9.7 million cattle, 1.4 million deer and 155,000 goats emit 48 per cent of the country's greenhouse gases in the form of methane and nitrous oxide. Worldwide, livestock burps are responsible for 18 per cent of greenhouse gas emissions – more than produced from all forms of transport combined. Methane accounts for the bulk of ruminant green house gas emissions, one tonne of the gas has 25 times the global warming potential of the equivalent amount of carbon dioxide.

Rising populations and incomes are expected to double the global demand for

meat and milk from 229 to 465 million tonnes and 580 to 1043 million tonnes, respectively, by 2050. This will almost double the amount of greenhouse gases produced by livestock, dwarfing attempts to cut emissions elsewhere. Apart from all of us turning to a vegetarian diet, can anything be done to reduce greenhouse gas emissions from livestock?

Several ideas have been proposed to raise animals that are kinder to the environment. In New Zealand, researchers are testing different diets, food additives, vaccines and drug therapies, as well as breeding low-methane animals. One Australian team has even suggested we wean ourselves from cattle and sheep altogether and eat kangaroo instead – they do not emit methane.

Concern for the climate isn't the only factor driving the research. Eight per cent of the energy expended by a ruminant's metabolism goes on producing methane. If livestock stopped making this gas, the energy saved could be diverted into making more meat.

So why do ruminants give off so much methane? It's all down to their stomachs. Sheep and cattle have a pregastric stomach, or rumen, where microbes digest plant matter and produce hydrogen, carbon dioxide and fatty acids. The fatty acids are a useful source of energy to aid animal growth, but the hydrogen and carbon dioxide are not. This is where microorganisms called methanogens come in: they have co-evolved with the animal to consume the carbon dioxide and hydrogen, producing methane. In return, the methanogens gain a home and a food source.

This cosy relationship is now in the cross hairs. In June, researchers from the Pastoral Greenhouse Gas Research Consortium in New Zealand – a group dedicated to reducing methane emissions from livestock – announced they had decoded the genetic sequence of *Methanobrevibacter ruminantium*, one of 20 or so species of methane-producing microbes in sheep and cow stomachs. They are hoping to discover a genetic hallmark for all methanogens, says Graeme Attwood, a microbiologist at the New Zealand-based AgResearch and leader of the consortium's genome-sequencing project. Such methanogen-specific genes might provide a targeted way to knock out these microbes without harming the hundreds of other beneficial species in the rumen. The researchers think the hydrogen and carbon dioxide left behind that would have been digested by methanogens would then be consumed by other microbes, such as acetogens which dominate marsupial guts and are present in smaller numbers in ruminant guts, to produce the nutrient acetate, making the animals healthier too.

"Livestock are responsible for more greenhouse gas emissions than all forms of transport combined"

Going live

While analysing the genes, Attwood and his colleagues discovered the recipe for an enzyme that they believe breaks open chemical bonds unique to the methanogen cell wall. The enzyme originally belonged to a virus that infected the methanogen long ago, becoming incorporated into the microbes' genome as it evolved. Attwood's team has manufactured the enzyme and shown that it kills methanogens in vitro. "It's very exciting," says Attwood. Within the next six months, Attwood and his colleagues plan to test the enzyme in live animals.

The genome sequence is also being used to identify proteins that sit on the outer surface of *M. ruminantium* – the immune system can easily identify these proteins, making them ideal candidates for vaccines. Vaccinating animals against *M. ruminantium* has many benefits, not least that it is cheap to produce and could be given several times a year to livestock grazing in pastures.

This is not the first time an anti-methanogen vaccine has been tried. Four years ago, scientists in Australia developed an anti-methanogen vaccine that lowered methane production in sheep by almost 8 per cent compared with those that did not receive it. But the vaccine did not work in sheep from New Zealand, says Bryce Buddle, who leads ▶