Submission in Response to Victorian State Government's Climate Change Green Paper

Prepared by

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Promoting a healthy and compassionate lifestyle

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Contents

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1. Introduction

In mid 2008, various papers were submitted in response to the Victorian State Government's "Climate of Opportunity" summit. At least two of those papers highlighted the dangers posed by animal agriculture in the context of climate change and related environmental problems.[1] However, it appears that the Government has effectively ignored those papers in preparing its latest Green Paper.

The purpose of this paper is to re-state some of the material from the earlier papers and to provide more recent evidence that any efforts to prevent catastrophic climate change will be futile if the issue of animal agriculture is not addressed.

As in mid 2008, it appears that the Victorian Government may be unwilling to undertake measures that would offend certain powerful interest groups. We simply do not have time to accommodate groups whose interests would prevent us from dealing with a threat of this magnitude.

The key points of this submission are, firstly, that the most significant contribution that we as individuals can make in our efforts to overcome climate change and Australia's other pressing environmental problems is to adopt a completely or predominantly plant-based diet, reducing or avoiding consumption of meat and dairy products. Although fish and other seafood should also be avoided in order to cease the devastating impact of industrial fishing on our oceans, this submission does not address that issue any further.

Secondly, governments and others need to inform the community of the environmental benefits to be derived from an appropriate diet. If the Victorian Government is willing to advertise to encourage us to adopt certain beneficial practices in regard to energy and water consumption, then it should also be willing to do the same in regard to dietary choices, as the environmental benefits of dietary change would be many times greater than the benefits to be derived from the other measures mentioned.

Thirdly, the pricing of animal agriculture products needs to incorporate costs which are currently externalities, in that the pricing needs to fully account for the environmental costs of such products.

The paper also shows that our society's nutritional requirements can easily be satisfied by utilising a plant-based diet.

Although researchers referred to in this paper and elsewhere have utilised a range of approaches to measuring the impact of food production on the environment (under various conditions and with differing results), the findings almost invariably point to a continuum which places a red meat and dairy based diet at one end (i.e. with adverse effects) and a completely plant-based diet at another (i.e. with more favourable effects).

". . . compared to its economic performance, the environmental impacts of the livestock sector are not being adequately addressed, despite the fact that major reductions in impact could be achieved at reasonable cost.

The problem therefore lies mainly with institutional and political obstacles, and the lack of mechanisms to provide environmental feedback, ensure that externalities are accounted for and embed the stewardship of common property resources into the sector.

Why is this so? First, civil society seems to have an inadequate understanding of the scope of the problem. Perhaps even among the majority of environmentalists and environmental policy makers, the truly enormous impact of the livestock sector on climate, biodiversity and water is not fully appreciated."

"Livestock's Long Shadow", United Nations Food & Agriculture Organization, November 2006

This paper focuses on the critical impacts of animal agriculture on climate change and water use. There are other significant environmental impacts attributed to animal agriculture, such as loss of biodiversity, land degradation and water pollution. However, it is not in the scope of this paper to address them. Valuable explanations on these matters can be found in the paper by Mahony referred to in the first paragraph of this section and also Vegetarian Network Victoria's booklet *"Eating up the World: the Environmental Consequences of Human Food Choices"*.[2]

2. Executive Summary

Informing the Community:

- Whilst the Victorian Government has been willing to spend money on advertisements that encourage us to turn off electrical appliances and take shorter showers, it has said little, if anything, about the dramatic effect of our food choices on the environment. This must change; the Government must help to inform the community.

Greenhouse Gas Emissions:

- Animal agriculture will have a bigger impact on climate during the next 20 years than all Australia's coal fired power stations combined, potentially causing us to reach tipping points that lead to catastrophic and irreversible climate change.

Water Consumption:

- Household direct water consumption for Victoria only represents around 8% of the State's total water consumption. Animal agriculture is responsible for 51%, whilst dairy farming alone accounts for 34%.

- Most Victorian household water consumption is indirect consumption through purchases, with food contributing the largest share. Accordingly, modifying food choices can have a far more significant effect on water consumption than actions taken in and around the home, with significant benefits for our river systems.

- Much of the enormous expenditure on new water-related infrastructure projects, along with the environmental and other consequences of such projects, could potentially be avoided or reduced if consumers modified their diets.

Pricing:

- We need to ensure that we allocate our resources in an economically rational manner, in accordance with efficient market practices. This would be achieved by ensuring that input prices allow for externalities, i.e. consequences of the production and delivery process that are experienced by parties who are not directly involved in the transaction. Such pricing should reflect all the environmental costs associated with producing and delivering goods and services.

- The Victorian Government can influence the pricing of food products by the proper pricing of water and other inputs. With the high level of exports from our animal agricultural sector, we are currently effectively exporting (for example) massive amounts of our state's precious water at prices which grossly understate its true value.

Comparative Nutritional and Environmental Impact of Alternative Diets:

- A plant-based diet generally far exceeds animal-based alternatives in terms of nutritional yields and environmental benefits.

3. Informing the Community

Whilst the Victorian Government has been willing to spend money on advertisements that encourage us to turn off electrical appliances and take shorter showers, it has said little, if anything, about our food choices.

Meanwhile, Meat & Livestock Australia (MLA) was named the 2007 advertiser of the year at the Australian Writers & Art Directors awards, for its work in promoting red meat sales, both domestically and internationally[3].

In 1999, the former Labor Premier, Steve Bracks, said that one of the features that would distinguish his government from that of his predecessor was leadership that (amongst other traits), *"credits the people of this state with the intelligence to make their own judgements".*[4]

Why doesn't the government inform the community that they can have a far more significant environmental impact by modifying their diets, than by the other measures referred to in its advertising campaigns?

No one could validly complain if well-informed consumers decided to purchase fewer meat and dairy products for environmental reasons. After all, efficient markets rely on decision-makers being well informed.

To mislead the public of the actual causes of climate change or water shortages is worse than doing nothing at all. It deflects action away from those measures that would help to solve the pressing environmental problems that we face.

> In a speech to the Melbourne Press Club in September 1999, [Steve] Bracks boldly announced three ways in which a Labor government would be different from the Kennett government. The third centred on leadership: *"Leadership that believes in openness and accountability, that isn't afraid of scrutiny, that credits the people of this state with the intelligence to make their own judgements."* **Report by Jason Dowling, The Age, 24 September, 2006**

4. Greenhouse Gas Emissions

"I say that the single most effective action that a person can take to curb global warming is support a moratorium, and eventual phase-out, of coal-fired power plants.

However, in our personal life styles, the most effective action is to begin to alter our diet more toward vegetarian. I do not believe it is realistic to exhort everybody to become vegetarian, but we can greatly reduce the stress on the planet, including global warming, with realistic changes by a large number of people. I have become 80-90% vegetarian. For the sake of nutrition and because of available choices, becoming 100% vegetarian is not easy, and not essential, in my opinion. But a change in that direction is one of the best things we can do – probably more effective than buying a Prius."

James Hansen, Head of the Goddard Institute for Space Studies, NASA[5]

Based on a 20-year GWP (i.e. global warming potential)[i], livestock in Australia produce more CO2-equivalent emissions than all our coal-fired power stations combined.[6]

A 20-year GWP is particularly important when considering the impact of livestock, because methane, a critical factor in livestock's greenhouse effects, generally breaks down in the atmosphere in 9 – 12 years. Accordingly, a 100-year GWP (which shows the average impact over a period of 100 years) greatly understates methane's shorter-term impact.

Although methane may have a shorter life than carbon dioxide (which remains in the atmosphere for many hundreds of years), its impact can be long term if it contributes to us reaching tipping points that result in positive feedback loops with potentially irreversible and catastrophic consequences. Other impacts of livestock production, such as deforestation for animal grazing, can have similarly devastating results.

An example of a tipping point is the thawing of permafrost (frozen land) in Russia, Canada, Alaska and elsewhere, which causes the permafrost to release massive amounts of methane. More methane means more warming, more permafrost thawing, more methane release and so on. This leads to runaway climate change, which no longer depends on emissions generated by humankind.

Although methane may have a shorter life than carbon dioxide (which remains in the atmosphere for many hundreds of years), its impact can be long term if it contributes to us reaching tipping points that result in positive feedback loops with potentially irreversible and catastrophic consequences. Other impacts of livestock production, such as deforestation, can have a similar result.

The remaining comments in this section are based on a 100-year GWP, which understates livestock's impact. However, relative comparisons with other sectors can still be made that undoubtedly show the major effect of the livestock industry on the warming of our planet's atmosphere.

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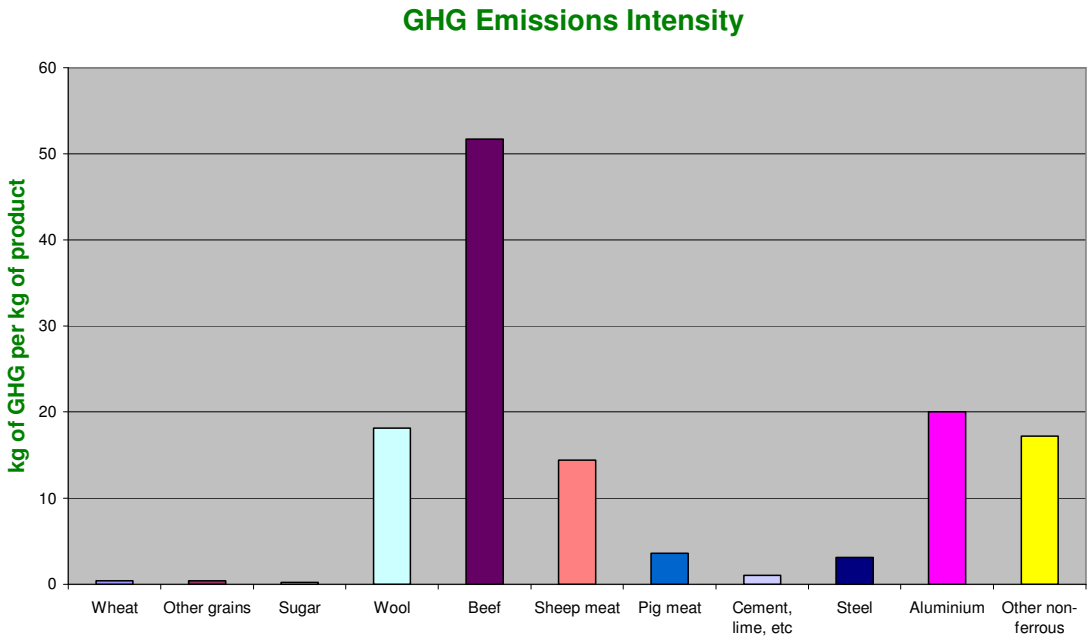
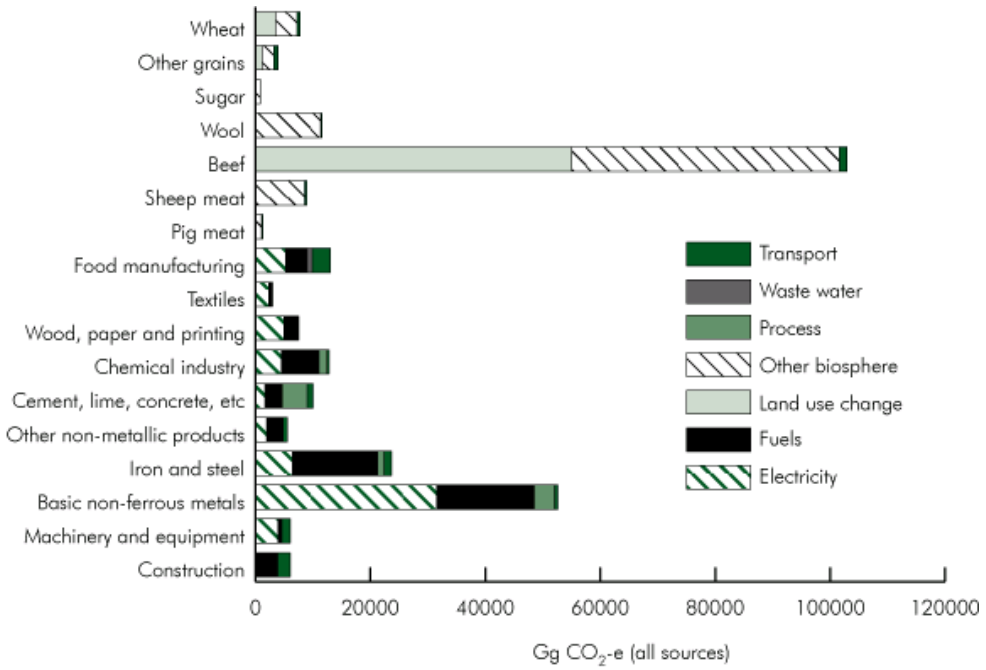
[i] The emissions of different gases can be aggregated by converting them to carbon dioxide equivalents (CO2-e). They are converted by multiplying the mass of emissions by the appropriate global warming potentials (GWPs). GWPs represent the relative warming effect of a unit mass of the gas when compared with the same mass of CO2 over a specific period. For methane, the GWPs used by the UN's Intergovernmental Panel on Climate Change (IPCC) are 21 for 100 years and 72 for 20 years. The UN Food & Agriculture Organization used a GWP of 23 for the 100 year time horizon in its 2006 *"Livestock's Long Shadow"* report.

The greenhouse gas (GHG) emissions intensity[ii] of carcass beef in 1999 (the latest available figures) was more than twice that of aluminium smelting.[7] To add some perspective, aluminium smelting consumes 16% of Australia's (mainly coal-fired) electricity[8] whilst our annual tonnage of beef production is around 10% higher than that of aluminium.[9 & 10]. The GHG emissions intensity of various products can be depicted as follows:



In absolute terms, GHG emissions in Australia from beef alone are nearly double those of all non-ferrous metals, including aluminium, as illustrated in the following chart from the Australian Greenhouse Office's National Greenhouse Inventory:[7]



[ii] Emissions intensity measures the tonnes of CO2-equivalent greenhouse gases per tonne of commodity produced.

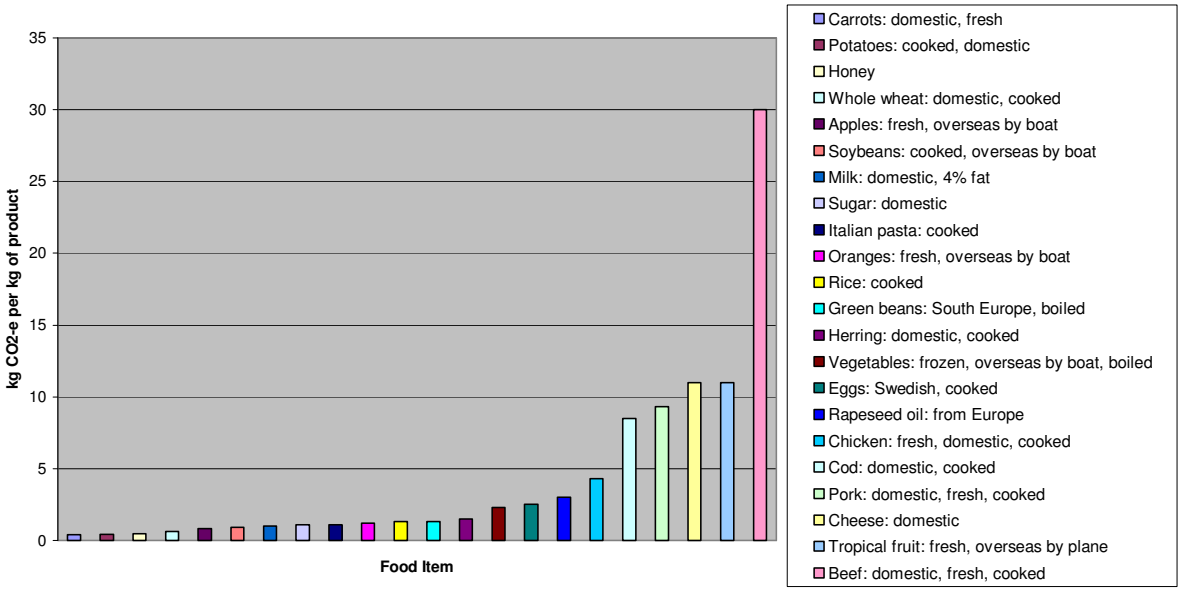
Researchers at the University of Chicago have found that converting from a typical Western diet to a plant-based diet is 50% more effective in reducing GHG emissions than changing one's car from a conventional sedan to a hybrid.[11]

According to the United Nations Food and Agriculture Organization in its 2006 *"Livestock's Long Shadow"* report, the livestock sector produces around 40% more GHG emissions than the entire global transport system.[12]

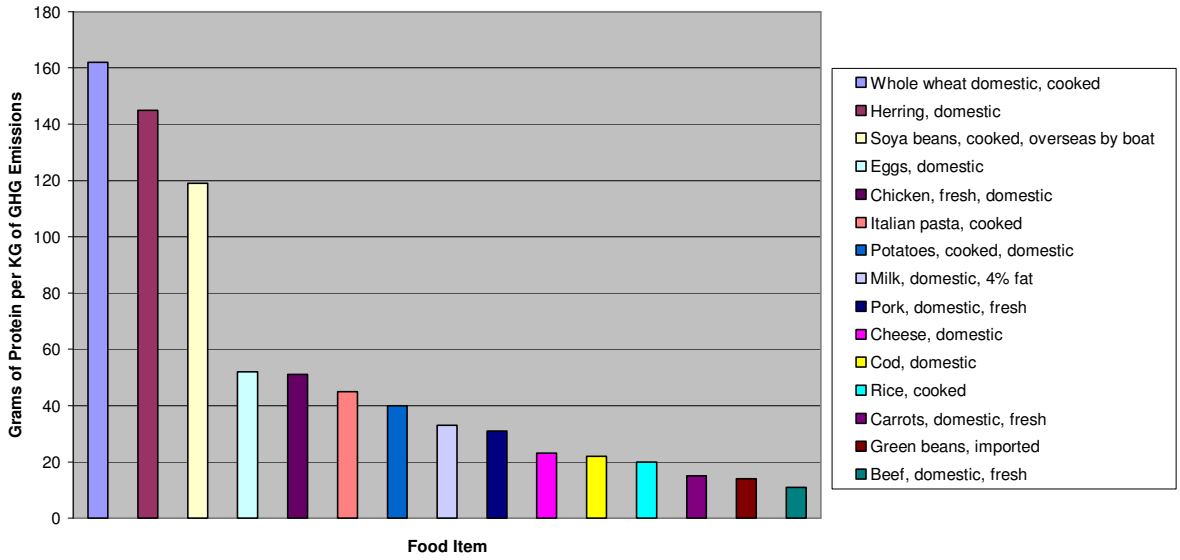
A recent Swedish study has provided GHG emissions intensity figures for a wide range of foods, including legumes, fruit and vegetables, commodities which are often overlooked in reports on this subject. It included CO2-e emissions involved in farming, transportation, processing, retailing, storage and preparation. [13]

Some key points from the study were as follows:

- Beef is the least climate efficient way to produce protein, less efficient than vegetables that are not recognised for their high protein content, such as green beans and carrots. Its emissions intensity ("Beef: domestic, fresh, cooked") is 30, as shown in the following chart, which compares it to various other products:



- Stated another way, per kilogram of GHG emissions produced, carrots have more protein than beef. By the same measure, wheat has around thirteen times and soy beans around ten times more protein than beef, as demonstrated by the following chart:



- It is more "climate efficient" to produce protein from vegetable sources than from animal sources.
- The emissions intensity of fruit and vegetables is usually less than or equal to 2.5, even if there is a significant amount of processing and transportation. Products transported by aeroplane are an exception, because emissions may be as large as for certain meats.
- Some examples in regard to fruit: the emissions intensity figures are 0.82 and 1.2 for "Apples: fresh, overseas by boat" and "Oranges: fresh, overseas by boat" respectively. (Refer to the table below for emissions intensity figures for Australian fruit and vegetables.)
- The emissions intensity of foods rich in carbohydrates, such as potatoes, pasta and wheat is less than 1.1.
- For "Soybeans: cooked, overseas by boat", the figure is 0.92.

As a comparison to the Swedish study to the extent that it reported on fruit and vegetables, we have derived an overall emissions intensity figure of 0.1 for such items produced in Australia. The figure has been calculated from: (a) a measure of tonnes of 2002 CO2-e emissions per $m of revenue from Appendix D of the Department of Climate Change's 2008 CPRS Green Paper; and (b) revenue and tonnage figures for 2002 from the Australian Horticultural Statistics Handbook 2004.

Wherever used in the relevant publications, we have converted tonnes to kilograms for the purpose of our table.

Details are as follows:

Emissions Intensity of Fruit and Vegetables in Australia					
Description	**Kg CO2-e per $m of revenue 2002**[14]	**$m of Rev 2002**[15]	**Total Emissions**	**Kg produced 2002**[16]	**Kg CO2-e per Kg produced**
Fruit & Vegetables	86,000	5,975	513,850,000	5,346,154,000	0.10

Finally, to properly account for CO2-e emissions, we need to ask what we do with the energy which, according to the National Greenhouse Inventory, is the most significant contributor. The answer is that we use it in industry, in agriculture and in domestic homes. In order to properly break out the use of energy within Australia, and determine which industries use how much when all their inputs and outputs are taken into account, another kind of economic report is required.

The CSIRO and the University of Sydney have produced such a report, entitled "Balancing Act – A Triple Bottom-Line Analysis of the Australian Economy".[17] The report analysed 135 sectors of the Australian economy, focusing on environmental, social and financial indicators.

The report showed that when end-use is considered, animal industries are responsible for **over 30%** of total greenhouse emissions in Australia, as follows:

Industry Sector	**Megatonnes CO2-e**	**Percent**
Beef Cattle	122.5	23.6
Sheep & Shorn Wool	23.9	4.61
Dairy Cattle & Milk	8.8	1.7
Pigs	1.3	0.25
Commercial Fishing	0.68	0.13
Meat Products	0.68	0.13
Other Dairy Products	0.59	0.11
Poultry & Eggs	0.58	0.11
Total	**159.03**	**30.64**

5. Water Consumption

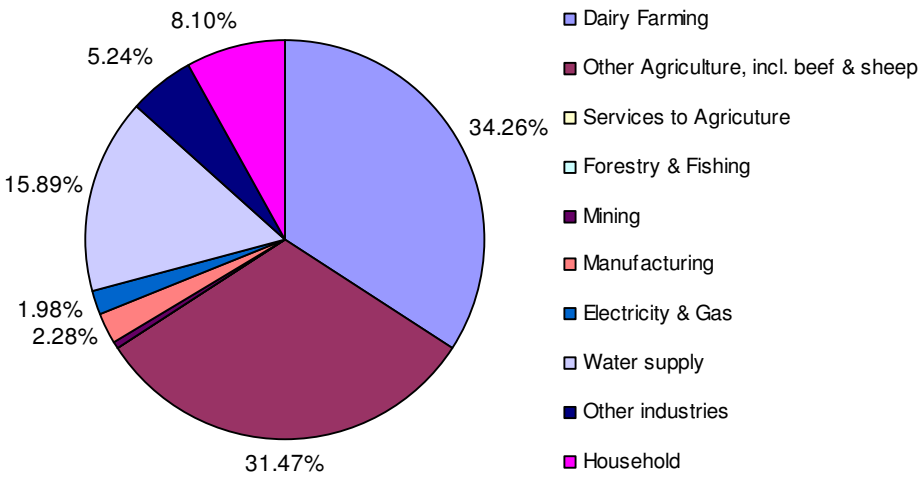
Animal agriculture is responsible for 51% of Victoria's water consumption. The dairy industry alone is responsible for 34%.

Direct water consumption by households only represents 8% of the state's total consumption.

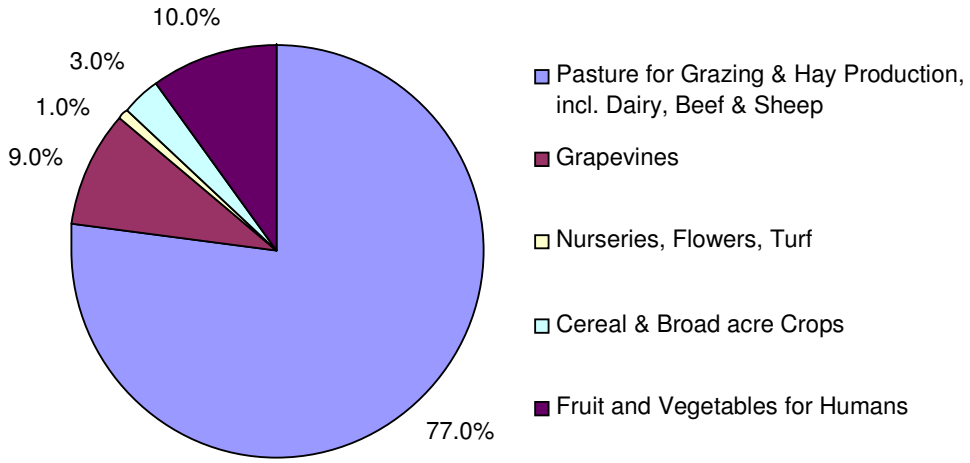
So why does the State Government focus its water-saving advertising on shorter showers? Why not inform the community that they can have a far more significant impact on overall consumption, and help to save our great rivers, by focussing on their diets?

Our consumption figures can be viewed graphically as follows, based on information from the Australian Bureau of Statistics:[18&19]

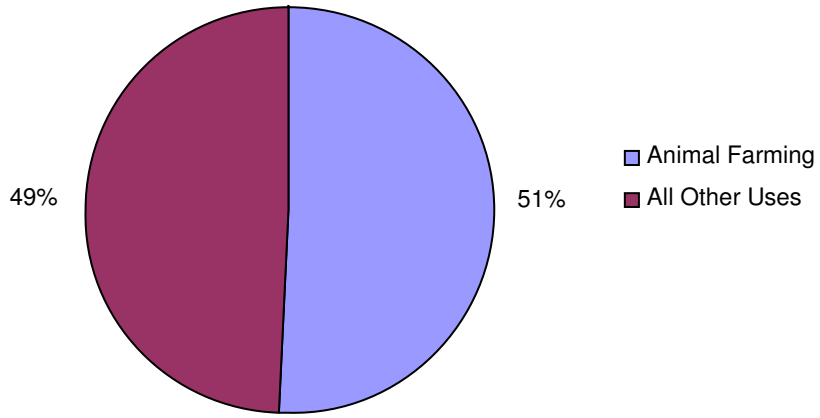
Victorian Water Consumption 2004-05



Water Used on Victorian Farms 2004-05



Animal Farming's Share of Victorian Water Consumption 2004/05



Although a breakdown of farm usage figures was available for 2005/06, the most recent available information on overall consumption was from 2004/05, so that year has been used for all the charts. This approach has not materially affected the results.

According to Professor Wayne Meyer of the CSIRO[20], it takes between 715 and 750 litres of water to produce 1 kg of wheat and between 1,550 and 2,000 litres to produce 1 kg of rice, compared to between 50,000 and 100,000 litres for 1 kg of beef. However, if we were to ask Australians whether rice should be grown in this country, most would probably say no, due to concerns over water consumption. Where is the concern over our massive beef industry, which utilises around 43% of Australia's land area?[21]

Similar to Professor Meyer, David and Marcia Pimentel of Cornell University have reported that producing 1 kg of animal protein requires about 100 times more water than producing 1 kg of grain protein.[22]

Some findings from Associate Professor Ian Rutherfurd of the University of Melbourne *(based partly on information from Wayne Meyer, CSIRO)* are as follows:[23]

- 90% of the water consumed in households in Melbourne is embodied in the production of the food that comes into the house. In one sense, urban food consumers are also consuming rivers.

- Small changes in food choices could potentially lead to water savings that dwarf the savings that can come from changes in direct water consumption. Thus, river condition is, to some extent, a consequence of decisions made in urban supermarkets. The authors believe that this is an empowering observation.

- Urban people, far from being isolated from the environment, make critical decisions about rivers, every day, in their consumption choices.

- The authors suggest four ways that consumers can dramatically reduce their indirect water consumption: (i) waste less food; (ii) select comparable products that use less water; (iii) substitute types of food that use more water for types that use less; and (iv) become a vegetarian. (The authors use the term "vegetarian" to mean a diet free of meat and dairy products.)

- A vegetarian diet can save households up to 35% of their total water usage. That is 13 times the volume of water that would be saved by not watering the garden. The environmental benefits of vegetarianism have been made for many years, and Renault

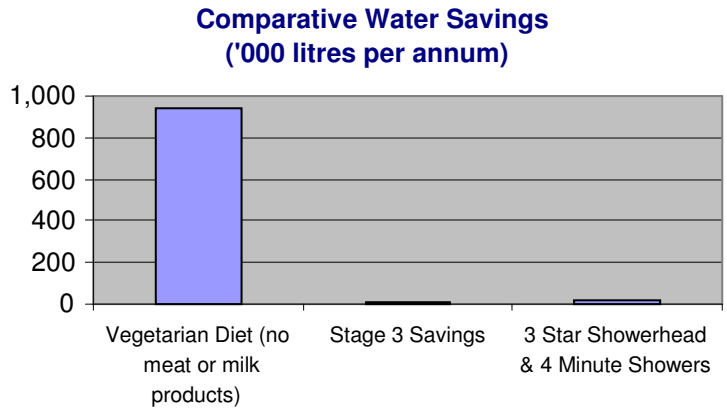
(2003) suggests that an animal product based diet may need 10 times more water than a vegetarian diet.[24] Certainly the water efficiency of vegetable production is startling.

- Based on the estimated water consumption of the average Australian household compared to a vegetarian household (i.e. no meat or dairy products) as presented by the authors, subsequent calculations (not included in the research papers) indicate that the average Australian could save 2,592 litres per day, or 946,000 litres per annum, by changing to a vegetarian diet.

- That figure compares extremely favourably to the 17 litres per person per day (6,205 litres per person per annum) that was saved in Melbourne under Stage 3 water restrictions between 2005 and 2006.[25]

- It also compares extremely favourably to the 20,000 litres per annum saved by using a 3 star showerhead and limiting showers to 4 minutes (not referred to in the research paper).[26]

- The comparison can be viewed graphically as follows:



Much of Victoria's enormous expenditure on new water-related infrastructure projects, along with the environmental and other consequences of such projects, could potentially be avoided or reduced if consumers modified their diets.

6. Pricing

We need to ensure that we allocate our resources in an economically rational manner, in accordance with efficient market practices. This would be achieved by ensuring that current externalities are accounted for in the economic system through appropriate resource rents and charges. Consequences of the production and delivery process that pollute the commons, extract precious resources or rely on an unpaid monopoly use must be subject to fees, such that the public are compensated for these practices. Thus the price paid for goods and services would more fully reflect the total costs, including environmental costs, associated with their production and delivery.

Governments can influence pricing through taxes on inputs, emissions trading schemes and the like. Due to the massive impact of animal agriculture on greenhouse gas emissions, it must be included in the Federal Government's proposed emissions trading scheme if it is intended to produce substantive emissions reductions.

The State Government must also consider taking appropriate resource rents for the commonwealth of the people on water and other inputs that rightly belong to everyone. With the high level of exports from our animal agricultural sector, we are currently effectively exporting, for example, massive amounts of our state's precious water at prices which grossly understate its true value.[iii]

The failure to take appropriate resource rents merely fuels speculation and monopoly behaviour in resource markets, with detrimental impacts on the state economy, and allows speculative monopolist interests to extract the rents for private gain.

In a 2005 article on the CSIRO and University of Sydney's Balancing Act report (refer to Section 4), The Canberra Times stated, "Market prices for beef do not reflect the full environmental costs of production . . . and the Aussie meat pie certainly contributes its share to climate change and land clearing."[27]

Also, "Instead of being influenced by high-powered advertising, celebrity endorsement, habit or cheapness, we should be making choices based on minimising our contribution to land degradation, excessive water use and climate change."

The article quoted the leader of the team that prepared the report, CSIRO researcher, Dr Barney Foran, as saying, "'We need to be a lot better educated about what we buy. It's our consumption that drives the economy. We cannot blame governments all the time, when we are part of the equation."

The article cited the report itself by stating, *"One of the insights emerging from this analysis is that the prices consumers pay for primary production items do not reflect the full value of the natural resources embodied in their production chains."* It quoted Dr Foran as saying, *"We should be paying more for products that have a high environmental account balance. The consumer should be expected to pay a realistic price for food so that we play a part in fixing up the bush, instead of sitting in town and wringing our hands about it."*

"Livestock are one of the most significant contributors to today's most serious environmental problems. Urgent action is required to remedy the situation."

Henning Steinfeld, United Nations Food & Agriculture Organization, 2006

[iii] Dairy and meat products were the highest value food exports from Victoria in 2008, with 34% ($2.399 billion) and 23% ($1.587 billion) respectively of total food and fibre exports. Victoria accounted for 25% of Australia's total food and fibre exports and was Australia's largest state exporter. (Source: Dept of Primary Industries, *"Summary of Victorian Food and Fibre Export Performance 2008 Calendar Year"*, http://www.dpi.vic.gov.au/DPI/nrenti.nsf/LinkView/9E2D508EF2FB4520CA25759A000C265B5B65FD3894DB84E6CA2574AC000CF430/$file/Summary%20Victorian%20Food%20and%20Fibre%20Export%20Performance%202008.pdf (accessed 20 September 2009)

7. Comparative Nutritional and Environmental Impact of Alternative Diets

The tables on the following pages demonstrate that a plant-based diet generally far exceeds animal-based alternatives in terms of nutritional yields and environmental benefits.

Perhaps the only nutrient that is significantly more difficult to obtain directly from plants than animals is Vitamin B12. However, it is easily produced from bacteria, which is a far more natural approach than destroying rainforests and other natural environs, purely for animal agriculture.

To a large extent, the findings reflect a key problem in using animal products to satisfy humankind's nutritional requirements, which is the inherently inefficient nature of the process. It takes many kilograms of plant-based food to produce one kilogram of animal-based food with comparable nutritional value, with significant impacts on energy inputs, emissions, water usage and land usage.

The tables utilise various sources for information on factors such as product yields, GHG emissions and water usage. For example, water figures have been obtained from a paper by Hoekstra and Chapagain, who have reported that, in Australia, 17,112 litres of water are required to produce 1 kilogram of beef.[28] On the other hand, the CSIRO has reported a figure of 50,000 to 100,000 litres,[20] whilst Pimentel has reported 43,000 litres outside Australia.[29]

The GHG emissions intensity of beef has come from a paper by Annika Carlsson-Kanyama and Alejandro Gonzalez, who reported a figure of 30kg of GHG emissions per kilogram of product.[13] The Australian Greenhouse Office has reported a figure of 51.7kg.

Wide variations in product yield can apply, depending on the location and conditions in which products are grown, and some of the yields shown may be high for Australian conditions. For example, the beef yield of 343kg per hectare per annum has been derived by using beef's gross energy output per hectare as reported by Spedding[30] and the energy derived from a quantity of beef as reported in the USDA National Nutrient Database for Standard Reference.[31]

The figure may be achievable in the more intensive cattle farming regions of Australia, but the enormously widespread range of cattle grazing, including grazing in marginal areas, causes our average yield to be significantly lower than reported in the table.

The soybean yield of 2,804kg per hectare has been derived from the U.S. bushels per acre as reported by Nabors[32], and the USDA's bushel weight for soybeans of 60 pounds.[33] For Australian production, the Primary Industry Bank has reported an average yield of 1,880kg per hectare between 1993/94 and 1999/00.[34]

The figures for wheat, rice and potato in the first table have been obtained from the Australian Bureau of Statistics Year Book 2008.[35]

The sources utilised for the tables conservatively highlight the adverse effects of an animal based diet. All the sources reviewed show significant benefits of a plant-based diet relative to the animal-based alternative.

Inputs and Outputs per Hectare of Sample Products *(Refer to previous page for sources of product yields, GHG emissions and water usage figures)*:

Nutrient or Energy	Beef		Soy		Wheat		Rice		Potato	
	Yield (kg/ha)	343	Yield (kg/ha)	2,804	Yield (kg/ha)	2,023	Yield (kg/ha)	9,820	Yield (kg/ha)	35,857
	GHG per ha (kg)	10,295	GHG per ha (kg)	2,580	GHG per ha (kg)	1,275	GHG per ha (kg)	12,766	GHG per ha (kg)	16,136
	Water per ha (litres)	5,872,315	Water per ha (litres)	5,906,002	Water per ha (litres)	3,213,253	Water per ha (litres)	10,036,040	Water per ha (litres)	8,964,286
	Nutrient level per kilo Grams: 1,000	Nutrient level per ha	Nutrient level per kilo Grams: 1,000	Nutrient level per ha	Nutrient level per kilo Grams: 1,000	Nutrient level per ha	Nutrient level per kilo Grams: 1,000	Nutrient level per ha	Nutrient level per kilo Grams: 1,000	Nutrient level per ha
Protein (g)	268.9	92,281	395.9	1,110,335	111.7	226,025	26.6	261,038	25.1	899,427
Energy (kcal)	3,479.0	1,193,883	4,511.6	12,652,272	3,425.5	6,931,423	1,297.5	12,741,139	929.8	33,338,748
Carbohydrates (g)	0.0	0	327.3	917,942	752.1	1,521,900	281.6	2,765,759	211.4	7,579,169
Dietary Fibre (g)	0.0	0	80.8	226,632	94.7	191,583	3.8	37,291	22.1	791,495
Omega 6 (LA) (mg)	6,399.2	2,195,996	107,645.3	301,877,343	9,329.8	18,878,442	620.3	6,090,886	431.4	15,470,139
Omega 3 (ALA) (mg)	2,399.2	823,318	14,430.2	40,467,705	750.0	1,517,594	129.7	1,274,114	130.1	4,665,026
Vitamin A (IU)	0.0	0	0.0	0	0.0	0	0.0	0	100.0	3,585,714
Vitamin C (mg)	0.0	0	45.9	128,805	0.0	0	0.0	0	96.0	3,441,806
Vitamin E (IU)	0.0	0	0.0	0	12.8	25,831	0.6	6,215	0.3	11,992
Vitamin K (mcg)	0.0	0	369.8	1,036,965	24.5	49,510	0.0	0	20.1	719,541
Thiamin (mg)	0.8	288	4.1	11,413	4.3	8,610	1.9	18,646	0.7	23,985
Riboflavin (mg)	2.5	865	7.6	21,196	3.2	6,458	0.0	0	0.3	11,992
Niacin (mg)	24.4	8,363	10.5	29,348	48.9	99,020	14.6	142,949	14.0	503,679
Vitamin B6 (mg)	2.5	865	2.3	6,522	4.3	8,610	0.6	6,215	3.0	107,931
Folate (mcg)	50.0	17,158	2,052.3	5,755,479	779.8	1,577,868	579.7	5,693,114	279.9	10,037,602
Vitamin B12 (mcg)	23.1	7,930	0.0	0	0.0	0	0.0	0	0.0	0
Pantothenic Acid (mg)	2.9	1,009	4.7	13,044	9.6	19,374	3.8	37,291	3.7	131,916
Choline (mg)	1,029.4	353,263	1,200.0	3,365,244	230.9	467,118	20.9	205,101	147.8	5,300,621
Calcium (mg)	129.8	44,554	1,401.2	3,929,378	400.0	809,384	100.0	982,000	149.8	5,372,575
Copper (mg)	1.3	433	11.0	30,979	4.3	8,610	0.6	6,215	1.3	47,969
Fluoride (mg)	0.0	0	0.0	0	0.0	0	410.8	4,033,658	0.0	0
Iron (mg)	31.5	10,814	39.5	110,870	34.0	68,884	12.0	118,089	10.7	383,755
Magnesium (mg)	200.0	68,634	2,279.1	6,391,354	1,223.4	2,475,508	120.3	1,180,886	279.9	10,037,602
Manganese (mg)	0.0	0	22.1	61,957	31.9	64,578	4.4	43,506	2.3	83,946
Phosphorus (mg)	2,029.4	696,432	6,488.4	18,195,793	3,787.2	7,663,313	430.4	4,226,329	699.0	25,064,023
Potassium (mg)	2,340.3	803,132	13,639.5	38,250,297	3,893.6	7,878,575	350.0	3,437,000	5,351.2	191,877,688
Sodium (mg)	0.0	0	19.8	55,435	0.0	0	10.1	99,443	100.0	3,585,714
Selenium (mcg)	249.2	85,504	193.0	541,309	706.4	1,429,337	75.3	739,608	4.0	143,908
Zinc (mg)	84.9	29,126	47.7	133,697	26.6	53,815	5.1	49,722	3.7	131,916

Source of nutritional data: USDA National Nutrient Database for Standard Reference from http://www.ars.usda.gov/Services/docs.htm?docid=8964 and via http://www.nutritiondata.com/

Land area, greenhouse gas emissions and water usage by product *(Sources are shown here, in addition to the end of the paper, for convenience)*:

Using the energy output per hectare of various food products as a base, the following table shows: (i) land area; (ii) GHG emissions per day; and (iii) litres of water per day; involved in feeding one hundred people.

Product	Gross Energy Output (MJ) per Hectare per Year[1]	No. of People Fed per Hectare[2]	Daily kcal Equivalent	No. fed based on 30 year old male whose daily energy expenditure is (kcal): 2,848	kcal per kg of product[3]	Equivalent kg of product (daily yield per hectare)	kg of GHG Emissions per kg of product[4]	kg of GHG Emissions per hectare per day	Hectares required to feed 100 people	kg of GHG Emissions per day to feed 100 people	Litres of Water per kg of product[5]	Litres of Water per hectare per day	Litres of Water per day to feed 100 People (Rounded)
Potatoes	102,000	22	66,746	23.4	930	71.77	0.45	32.30	4.3	138	250	17,942	77,000
Rice	88,000	19	57,585	20.2	1,300	44.30	1.30	57.58	4.9	285	1,022	45,270	224,000
Wheat	70,000	15	45,806	16.1	3,400	13.47	0.63	8.49	6.2	53	1,588	21,394	133,000
Pork	14,000	3	9,161	3.2	2,470	3.71	9.30	34.49	31.1	1,072	5,909	21,916	681,000
Milk	9,000	2	5,889	2.1	600	9.82	1.00	9.82	48.4	475	915	8,981	434,000
Chicken	7,000	2	4,581	1.6	2,390	1.92	4.30	8.24	62.2	512	2,914	5,585	347,000
Beef	5,000	1	3,272	1.1	3,480	0.94	30.00	28.21	87.0	2,455	17,112	16,089	1,400,000

Notes:

1. Source: Spedding CRW 1990 in Lewis b, Assmann G (eds) *"Social & Economic contexts of coronary prevention"*, London: Current Medical Literature, cited in Stanton, R "The coming diet revolution" 2007, http://www.eatwelltas.org.au/PDFs/sustainability_and_diet.pps#334,69,the balanced diet

2. Ibid. (Provided for comparison purposes)

3. Although nutritiondata.com indicates that 1kg of potato has 93 calories, the USDA nutrition database (from which nutritiondata.com draws its data) confirms it is 93 kcal. The same approach applies to other products.

4. Source: Carlsson-Kanyama, A. & Gonzalez, A.D. *"Potential Contributions of Food Consumption Patterns to Climate Change"*, The American Journal of Clinical Nutrition, Vol. 89, No. 5, pp. 1704S-1709S, May 2009, http://www.ajcn.org/cgi/content/abstract/89/5/1704S

5. Source: Hoekstra, A.Y. & Chapagain, A.K. *"Water footprints of nations: Water use by people as a function of their consumption pattern"*, Water Resource Management, 2006, DO1 10.1007/s11269-006-9039-x (Tables 1 & 2), http://www.waterfootprint.org/Reports/Hoekstra_and_Chapagain_2006.pdf. The rice figure is for paddy rice. The figures for husked rice and broken rice are 1,327 and 1,525 respectively

Additional Notes:

(a) The GHG emissions figures are based on a 100-year GWP (global warming potential). A 20-year GWP would increase the emissions intensity of beef.

(b) Alternative emissions intensity figures produced by the Australian Greenhouse Office (now incorporated within the Dept of Climate Change) show more emissions from beef and less from pork, whilst calculations based on information in Appendix D of the Dept of Climate Change's Carbon Pollution Reduction Scheme July 2008 Green Paper and "The Australian Horticulture Statistics Handbook 2004" by Horticulture Australia Ltd show lower figures for fruit and vegetables.

(c) Alternative water usage figures produced by the CSIRO show higher water usage from beef (50,000-100,000 litres), potatoes (500 litres) and paddy rice (1,550 litres) and a lower figure for wheat (750 litres). (Ref: Meyer, W. *"Water for food - the continuing debate"*, http://www.clw.csiro.au/publications/water_for_food.pdf)

(d) The table assumes that an individual's energy requirements are obtained from a single food source.

Nutritional value of foods: sample comparison of diets

Nutrient or Energy	Amount Required by 30 year old male, 178 cm tall, weighing 80 kg and living a "somewhat active" lifestyle:	Tofu 100g Soy Nuts 50g Kidney Beans 50g Brocolli 80g Carrot 50g Potato 150g Almonds 50g Banana 150g Orange 150g Oats 80g Quinoa 100g Cooked Spinach 100g Dried Apricots 65g Avocado 50g W'meal Bread 130g Soymilk 400g % of Daily Requirement	Shortfall	Chicken 200g Brocolli 50g Carrot 50g Potato 150g Almonds 50g Banana 150g Orange 150g Oats 80g Quinoa 100g Cooked Spinach 100g Dried Apricots 65g Avocado 50g W'meal Bread 130g Milk 400g % of Daily Requirement	Shortfall	Beef 200g Brocolli 50g Carrot 50g Potato 150g Almonds 50g Banana 150g Orange 150g Oats 80g Quinoa 100g Cooked Spinach 100g Dried Apricots 65g Avocado 50g W'meal Bread 130g Milk 400g % of Daily Requirement	Shortfall	Tofu 100g Soy Nuts 50g Brocolli 50g Carrot 50g Potato 150g Almonds 50g Banana 150g Orange 150g Oats 80g Quinoa 100g Cooked Spinach 100g Dried Apricots 65g Avocado 50g W'meal Bread 130g Soymilk 400g Egg 60g % of Daily Requirement	Shortfall	Chicken 200g Brocolli 50g Carrot 50g Potato 150g Almonds 50g Banana 150g Orange 150g Oats 80g Quinoa 100g Cooked Spinach 100g Dried Apricots 65g Avocado 50g W'meal Bread 130g Milk 400g Egg 60g % of Daily Requirement	Shortfall	Beef 200g Brocolli 50g Carrot 50g Potato 150g Almonds 50g Banana 150g Orange 150g Oats 80g Quinoa 100g Cooked Spinach 100g Dried Apricots 65g W'meal Bread 130g Milk 400g Egg 60g % of Daily Requirement	Shortfall
Protein	64 g	159%	0%	187%	0%	182%	0%	177%	0%	198%	0%	194%	0%
Energy[1]	2848 kcal	82%	-18%	78%	-22%	86%	-14%	85%	-15%	81%	-19%	89%	-11%
Carbohydrates	130 g	251%	0%	218%	0%	218%	0%	251%	0%	219%	0%	219%	0%
Dietary Fibre	38 g	158%	0%	131%	0%	131%	0%	158%	0%	131%	0%	131%	0%
Omega 6 (LA)	17,000 mg	161%	0%	88%	-12%	66%	-34%	165%	0%	92%	-8%	70%	-30%
Omega 3 (ALA)	1,600 mg	176%	0%	68%	-32%	67%	-33%	178%	0%	71%	-29%	70%	-30%
Vitamin A	3,000 IU	777%	0%	789%	0%	782%	0%	786%	0%	798%	0%	792%	0%
Vitamin C	90 mg	220%	0%	218%	0%	218%	0%	220%	0%	218%	0%	218%	0%
Vitamin E	15 mg	153%	0%	156%	0%	150%	0%	293%	0%	296%	0%	290%	0%
Vitamin K	120 mcg	589%	0%	562%	0%	558%	0%	590%	0%	562%	0%	558%	0%
Thiamin	1.2 mg	150%	0%	126%	0%	140%	0%	165%	0%	141%	0%	155%	0%
Riboflavin	1.3 mg	167%	0%	202%	0%	177%	0%	190%	0%	225%	0%	200%	0%
Niacin	16 mg	117%	0%	191%	0%	133%	0%	117%	0%	191%	0%	133%	0%
Vitamin B6	1.3 mg	217%	0%	253%	0%	227%	0%	221%	0%	257%	0%	232%	0%
Folate	400 mcg	195%	0%	151%	0%	150%	0%	202%	0%	158%	0%	157%	0%
Vitamin B12	2.4 mcg	0%	-100%	72%	-28%	230%	0%	33%	-68%	105%	0%	263%	0%
Pantothenic Acid	5 mg	138%	0%	169%	0%	131%	0%	155%	0%	186%	0%	147%	0%
Choline	550 mg	101%	0%	59%	-41%	96%	-4%	128%	0%	86%	-14%	123%	0%
Calcium	1,000 mg	115%	0%	89%	-11%	86%	-14%	118%	0%	92%	-8%	89%	-11%
Copper	0.9 mg	466%	0%	265%	0%	293%	0%	473%	0%	271%	0%	299%	0%
Fluoride[2]	4,000 mcg	1%	-99%	1%	-99%	1%	-99%	1%	-99%	1%	-99%	1%	-99%
Iron	8.0 mg	343%	0%	260%	0%	307%	0%	356%	0%	273%	0%	321%	0%
Magnesium	400 mg	230%	0%	177%	0%	176%	0%	232%	0%	179%	0%	178%	0%
Manganese	2.3 mg	555%	0%	405%	0%	405%	0%	555%	0%	405%	0%	405%	0%
Phosphorus	700 mg	309%	0%	265%	0%	276%	0%	325%	0%	281%	0%	292%	0%
Potassium	4,700 mg	123%	0%	111%	0%	111%	0%	125%	0%	113%	0%	113%	0%
Selenium	55 mcg	254%	0%	226%	0%	253%	0%	288%	0%	261%	0%	288%	0%
Zinc	11 mg	141%	0%	147%	0%	256%	0%	147%	0%	153%	0%	262%	0%

Legend: = Relevant to plant-based and possibly animal-based diet. = Relevant to animal-based diet only.

Source: USDA National Nutrient Database for Standard Reference from http://www.ars.usda.gov/Services/docs.htm?docid=8964 and via http://www.nutritiondata.com/

Notes:

1. As the nutritional requirements are based on a relatively high energy user, some additional high-energy food sources would be utilised in order to meet daily requirements.
2. Fluoride is often obtained from other sources, such as fortified drinking water.

8. Conclusion

The world's population is running out of time to avoid the catastrophic effects of runaway climate change.

Subjects such as diet must not be regarded as taboo, and must feature heavily in the choices that we make in order to save our planet for all species and future generations. We can no longer regard food choices as being personal when the impacts of these choices have far reaching consequences for our natural resources and climate change.

We trust that this paper and the others referred to in it contribute to the Climate Change Green Paper discussion in a meaningful way, and that strong measures are taken to immediately alleviate climate change.

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