

The costs of carbon tax for greenhouse growers

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The price of energy is a serious worry for greenhouse operators today. Growers face rising fuel prices, and on top of that the carbon tax that the New Zealand government wants to introduce by 1 April 2007. Carbon tax will add an estimated 10 to 30% to the current energy price. The previous articles in this series were about energy saving in greenhouses. The present article, in response to questions from growers, looks at carbon tax. There are still uncertainties about carbon tax, even more so with the elections coming up. Despite the uncertainties we made some calculations about how much the carbon tax would cost for various fuels. The calculations are based on energy content and carbon content of the fuels, and on an assumed carbon tax rate of \$15 per tonne CO₂. The calculated carbon tax is shown in tables, expressed in \$ per tonne of fuel, \$ per Gigajoule and \$ per ha.

Carbon tax

The government intends to introduce a carbon tax in New Zealand from 1 April 2007. This will be a charge on all fossil fuels that emit CO₂, including coal, gas, diesel, petrol and heavy fuel oil. Hon Pete Hodgson has announced that the carbon tax will initially be set at \$15 per tonne, and will only be adjusted if the price of emission units on the international market varies substantially from this. It will be capped at a maximum of NZ\$25 a tonne of CO₂ for 2008-2012 (*this paragraph was taken from www.climatechange.govt.nz/policy-initiatives/carbon-tax.html*).

Carbon tax per energy unit or volume

We calculated carbon tax for a number of fuels based on their energy content and carbon content (*technical data taken from NZ energy information handbook, by J.T.Baines, ISBN 0-473-01662-1*). Some unit conversion is necessary. For instance, coal is measured in weight (kg or tonnes), and its energy content is often given in British Thermal Units (BTU). Oil and gas are measured in volume (litres and m³) and their energy content is given in Joule (J), MegaJoules (MJ), GigaJoules (GJ), or kiloWatt-hour (kWh). To allow comparison, units are converted to other units by straightforward multiplications in a spreadsheet.

Carbon tax is assumed at a rate of \$15 per tonne CO₂ emitted. In case it would be set at a different level, the \$ figures shown in the tables need to be adjusted accordingly. For instance if the carbon tax is set at \$10 instead of \$15 per tonne CO₂, the figures will be 1/3 lower. If carbon tax would be set at \$25 per tonne CO₂, the figures would be 2/3 higher.

Carbon tax per ha

To give more meaning to these figures, we calculated the costs of carbon tax per hectare of greenhouse. We assumed various levels of energy input between 500 and 2500 MJ/m²/year (this equals 5,000 to 25,000 GJ/ha/year). A good indication, representative for many growers, is 1500 MJ/m²/year. This figure is used in Table 2, which also shows how many tonnes of coal or m³ of gas equals 1500 MJ/m²/year. Energy use of 2000 J/m²/year or more is not unusual for intensive heating especially on the South Island, while close to 1000 MJ/m²/year is possible for growers on the North Island with less intensive heating. A very low level of 500 MJ/m²/year applies only to greenhouses that are not heated in the winter.

Results

Table 1 shows that carbon tax varies from \$0.79 to \$1.43 per GigaJoule energy, or from \$2.85 to \$5.14 per 1000 kiloWatt-hour (1000 kWh or 1 MWh) energy. Related to the weight of the fuel, it varies from \$21 to \$48 per tonne of fuel. Note that gas is not measured in tonnes, but in m³ or GJ. For a greenhouse with average energy consumption of 1500 MJ/m²/year, the carbon tax varies from less than \$12,000 to over \$21,000 per ha. The last table shows carbon tax in \$ per ha for various levels of energy input.

Concluding remarks

Obviously, carbon tax comes on top of the 'normal' energy price. It would be interesting to look at the % price increase caused by carbon tax. However, then we have to print the 'normal' prices. These are too patchy, as they depend on contract, negotiation, location, delivery costs, availability, etc. We can only estimate the order of magnitude of the % price increase, and this appears to be in the range 10-30% of the current price in most cases. Note that a fuel that attracts a relatively high carbon tax, such as coal, often has a relatively low 'normal' price. Hence its total price can be lower than the price of another fuel with a low carbon tax. There are various types of coal, gas, oil, etc, and the carbon tax costs for a particular case can be slightly different from what is shown in the tables. The carbon tax costs will also be different if the carbon tax rate is set at a different level than \$15 per tonne CO₂.

Energy records

A final note is that it can be worthwhile for greenhouse operators to keep records of their energy use. In case of coal also the energy content (or calorific value) should be recorded. Overseas growers who look at energy consumption get a better understanding of where the money goes, and generally develop energy-wise practices. Energy recording may prove to be useful in the future, for demonstrating that energy use in greenhouses has declined over the years.

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Tables 1, 2, 3. Calculated carbon tax (in red) for greenhouses for various fuels and for various levels of energy consumption, at a carbon tax rate of NZ\$15 per tonne CO₂.

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TABLE 1 - MAIN FEATURES & CARBON TAX OF VARIOUS FUELS							CARBON TAX AT \$15/TONNE CO ₂		
FUEL	UNIT	CARBON CONTENT	ENERGY CONTENT	ENERGY CONTENT	CO ₂ EMISSION per kg fuel	CO ₂ EMISSION per GJ	CARBON TAX PER GIGAJOULE	CARBON TAX PER 1000 kWh	CARBON TAX PER TON FUEL
		%	→	units	kg/kg	kg/GJ	\$/GJ	\$/MWh	\$/tonne
coal, bitumous	kg	78	32.1	MJ/kg	2.86	88.8	\$1.33	\$4.80	\$42.84
coal, sub-bitumous	kg	56	22.6	MJ/kg	2.06	91.2	\$1.37	\$4.93	\$30.96
coal, all lignite	kg	39	15.0	MJ/kg	1.43	95.2	\$1.43	\$5.14	\$21.45
coal, all NZ production	kg	62	25.1	MJ/kg	2.27	90.4	\$1.36	\$4.88	\$34.09
fuel oil - light	litre		40.3	MJ/litre	-	72.5	\$1.09	\$3.92	-
"	kg	88	44.5	MJ/kg	3.23	72.5	\$1.09	\$3.92	\$48.39
fuel oil - heavy	litre		40.8	MJ/litre	-	74.8	\$1.12	\$4.04	-
"	kg	88	43.1	MJ/kg	3.23	74.8	\$1.12	\$4.04	\$48.39
diesel oil ('AGO')	litre	86	38.3	MJ/litre	-	68.7	\$1.03	\$3.71	-
"	kg	86	45.8	MJ/kg	3.15	68.7	\$1.03	\$3.71	\$47.29
propane	kg	82	50.4	MJ/kg	3.01	59.6	\$0.89	\$3.22	\$45.09
"	litre		25.6	MJ/litre	-	59.6	\$0.89	\$3.22	-
butane	kg	83	49.5	MJ/kg	3.04	61.4	\$0.92	\$3.32	\$45.64
"	litre		28.4	MJ/litre	-	61.4	\$0.92	\$3.32	-
LPG	kg	82	50.0	MJ/kg	3.02	60.4	\$0.91	\$3.26	\$45.31
"	litre		26.5	MJ/litre	-	60.4	\$0.91	\$3.26	-
natural gas (Maui)	m ³	68	39.0	MJ/m ³	-	52.8	\$0.79	\$2.85	-
"	kWh		3.6	MJ/kWh	-	52.8	\$0.79	\$2.85	-

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TABLE 2 - AMOUNT OF FUEL USED, CO2 EMITTED & CARBON TAX PER m² AT ENERGY USE 1500 MJ/m²/year

FUEL	AMOUNT OF FUEL USED	UNITS	CO2 EMISSION kg CO2/m ² /y	CARBON TAX \$ per ha p year
	→	units	kg/m ² /y	\$/m ² /y
coal, bituminous	46.7	kg/m ² /y	133	\$2.00
coal, sub-bituminous	66.4	kg/m ² /y	137	\$2.05
coal, all lignite	100.0	kg/m ² /y	143	\$2.14
coal, all NZ prod.	59.8	kg/m ² /y	136	\$2.03
fuel oil - light	37.2	litre/m ² /y	109	\$1.63
"	33.7	kg/m ² /y	109	\$1.63
fuel oil - heavy	36.8	litre/m ² /y	112	\$1.68
"	34.8	kg/m ² /y	112	\$1.68
diesel oil ('AGO')	39.2	litre/m ² /y	103	\$1.55
"	32.8	kg/m ² /y	103	\$1.55
propane	29.8	kg/m ² /y	89	\$1.34
"	58.6	litre/m ² /y	89	\$1.34
butane	30.3	kg/m ² /y	92	\$1.38
"	52.8	litre/m ² /y	92	\$1.38
LPG	30.0	kg/m ² /y	91	\$1.36
"	56.6	litre/m ² /y	91	\$1.36
natural gas (Maui)	38.5	m ³ /m ² /y	79	\$1.19
"	416.7	kWh/m ² /y	79	\$1.19

TABLE 3 - CARBON TAX PER HA PER YEAR AT VARIOUS LEVELS OF ENERGY USE

	at 500 MJ/m ² /y	at 1000 MJ/m ² /y	at 1500 MJ/m ² /y	at 2000 MJ/m ² /y	at 2500 MJ/m ² /y
	\$/ha/y	\$/ha/y	\$/ha/y	\$/ha/y	\$/ha/y
coal, bituminous	\$6,660	\$13,320	\$19,980	\$26,640	\$33,300
coal, sub-bituminous	\$6,840	\$13,680	\$20,520	\$27,360	\$34,200
coal, all lignite	\$7,140	\$14,280	\$21,420	\$28,560	\$35,700
coal, all NZ prod.	\$6,780	\$13,560	\$20,340	\$27,120	\$33,900
fuel oil - light	\$5,438	\$10,875	\$16,313	\$21,750	\$27,188
"	\$5,438	\$10,875	\$16,313	\$21,750	\$27,188
fuel oil - heavy	\$5,610	\$11,220	\$16,830	\$22,440	\$28,050
"	\$5,610	\$11,220	\$16,830	\$22,440	\$28,050
diesel oil ('AGO')	\$5,153	\$10,305	\$15,458	\$20,610	\$25,763
"	\$5,153	\$10,305	\$15,458	\$20,610	\$25,763
propane	\$4,470	\$8,940	\$13,410	\$17,880	\$22,350
"	\$4,470	\$8,940	\$13,410	\$17,880	\$22,350
butane	\$4,605	\$9,210	\$13,815	\$18,420	\$23,025
"	\$4,605	\$9,210	\$13,815	\$18,420	\$23,025
LPG	\$4,530	\$9,060	\$13,590	\$18,120	\$22,650
"	\$4,530	\$9,060	\$13,590	\$18,120	\$22,650
natural gas (Maui)	\$3,960	\$7,920	\$11,880	\$15,840	\$19,800
"	\$3,960	\$7,920	\$11,880	\$15,840	\$19,800