Inquiry into Australia's future oil supply and alternative transport fuels

Submission from Pat Naughtin

Dear Committee members,

My submission will be short and simple, and it applies to all four terms of reference.

Here is my submission:

> *When you are writing your report on this inquiry, could you please confine yourself to using the International System Of Units (SI) especially when you are referring to amounts of energy.*
>
> *SI has only one unit for energy — joule — with these multiples to measure larger amounts of energy — kilojoules, megajoules, gigajoules, terajoules, petajoules, exajoules, zettajoules, and yottajoules.*

This is the end of my submission.

Supporting material

You probably need to know a few things about this submission.

What is the legal situation? See *1 Legal issues*.

Why is this submission needed? See *2 Deliberate confusion*.

Is the joule the right unit to use? See *3 Chronology of the joule*.

Why am I making a submission to your inquiry? See: *4 Why do I care about energy issues and the joule?*

Who is Pat Naughtin and does he know what he's talking about? See below signature.

Cheers and best wishes with your inquiry,

Pat Naughtin ASM (NSAA), LCAMS (USMA)*

PO Box 305, Belmont, Geelong, Australia

Phone 61 3 5241 2008

Pat Naughtin is the editor of the 'Numbers and measurement' chapter of the Australian Government Publishing Service 'Style manual – for writers, editors and printers'; he is a Member of the National Speakers Association of Australia and the International Association of Professional Speakers. He is a Lifetime Certified Advanced Metrication Specialist (LCAMS) with the United States Metric Association. For more information about Pat Naughtin go to: http://www.metricationmatters.com/pat_naughtin.html Pat is also the editor of the free online monthly newsletter, 'Metrication matters'. See http://www.metricationmatters.com/newsletter

1 Legal issues

Australia is a signatory of an international treaty that underpins our use of 'The International System of Units (SI)'. Australia became a signatory to the Metre Convention (Convention du Mètre) in 1947; this made metric units legal for use in Australia. In 1960, the Weights and Measures (National Standards) Act 1948 was replaced by the National Measurement Act 1960, which defined Australia's units and standards of measurement as those of 'The International System of Units (SI) with a very small number of exceptions. In 1988, the remaining imperial units were withdrawn from general legal use.

See: http://www.measurement.gov.au/index.cfm?event=object.showContent&objectID=C4E7F12C-BCD6-81AC-1F733492AF7B3121 for details.

By international treaty and in Australian law the unit for energy is the joule. The joule is not a modern unit as it has been the internationally accepted unit for energy since 1889. See *Chronology of the joule (below)*.

2 Deliberate confusion

I see daily evidence of people in the Australian community who are prepared to use subterfuge so that the people of Australia cannot enter into any debate on energy issues because they simply do not understand the archaic and obscure language of energy, and they are unaware that this arises because many energy traders want to use archaic words to hide various (price) realities.

I have no doubt that some folk who put submissions to your committee will continue to do their best to confuse us all with one or other of the old pre-metric measures that are still in use in 2006. The energy industries as a whole are notorious obfuscationists who use, as their primary tool of confusion, many of the old pre-metric (and now officially deprecated) measurement names for different kinds of energy. Here is a list of the 68 that I could find that are currently in use in 2006 — there are probably many others:

> *Atomic energy unit, barrel oil equivalent, billion electron volts, British thermal unit (16 °C), British thermal unit (4 °C), British thermal unit (international), British thermal unit (ISO), British thermal unit (IT), British thermal unit (mean), British thermal unit (thermal), British thermal unit (thermochemical), Calorie, calorie (16 °C), calorie (20 °C), calorie (4 °C), calorie (diet kilocalorie), calorie (int.), calorie (IT) (International Steam Table), calorie (mean), calorie (thermochemical), Celsius heat unit (int.), coulomb volt, cubic centimetre atmospheres, cubic foot atmospheres, cubic metre atmospheres, dutys, dyne centimetres, electron volt, erg, foot-grains, foot-pound force, foot-poundal, gigaelectronvolt, gram calorie, gram calories (mean), hartree, horsepower hours, horsepower hours (metric), inch pound force, Kayser, kilocalorie (16 °C), kilocalorie (4 °C), kilocalorie (int.), kiloelectronvolt, kilogram calories (int.), kilogram force metre, kilojoule, kiloton TNT equivalent, kilowatt hour, kilowatt minute, kilowatt second, megaelectronvolt, megajoule, megaton TNT equivalent, megawatt hours, newton metres, Q unit, quadrillion, quad, Rydberg, therm (EC), therm (US), thermie (16 °C), ton TNT equivalent, tonne coal equivalent, tonne oil equivalent, watt hour, and watt second.*

As an Australian example, I quote from the ABS web page, 'Detailed Energy Statistics, Australia'. Notice how the choices of measuring units make it difficult to compare energy from oil with energy from black or brown coal. Notice too, that it is even difficult to compare electrical energy figures because coal folk use kt, natural gas people use TJ, and hydro-electricity producers use GWh.

(See: http://www.abs.gov.au/Ausstats/abs@.nsf/0/b18980e01b977cdfca256e60007dcfbe?OpenDocument)

> *In 2001-02: 216,316 GWh of electricity, 862,635 TJ of natural gas (including ethane, but excluding liquefied natural gas), 18,727 ML of petrol and 13,503 ML of diesel were produced in Australia.*
>
> *53,576 kt of black coal, 65,075 kt of brown coal and 291,372 TJ of natural gas were used to produce electricity.*
>
> *The supply of electricity and natural gas to end-users resulted in transmission and distribution losses of 14,825 GWh of electricity and 12,093 TJ of natural gas.*
>
> *Australian industry end-users of energy . . . used 136,499 GWh of electricity, 378,576 TJ of natural gas, 9,711 ML of diesel, and 4,469 ML of petrol.*
>
> *. . . Non-renewable fuels used to generate electricity include black coal (53,576 kt), brown coal (65,075 kt), and natural gas (291,372 TJ). Hydro-electricity was the main renewable source of electricity, and in 2001-02, 15,567 GWh of hydro-electricity were produced (table 1).*

3 Chronology of the joule

The chronology of the SI energy unit — joule — went something like this:

1818 James Prescott Joule (1818/1889) was born into a wealthy brewing family in Salford, England.

1840 Joule stated a physical law, now called Joule's Law, that heat is produced in an electrical conductor.

1845 Joule was the first person to measure the equivalence of work and heat by having falling weights rotate paddles in water.

At about this time, Joule shared in discovering the law of the conservation of energy, which says that energy used up in one form reappears in another form and is never lost. His co-workers were Hermann von Helmholtz, Julius von Mayer, and William Thomson (1824/1907) (later Lord Kelvin) and he worked with Lord Kelvin to develop the absolute temperature scale. Joule never claimed to have formulated a general Law of Conservation of Energy but his experiments were certainly fundamental in bringing about that formulation.

1881 At the First International Electrical Congress (IEC) in Paris, five 'practical' electrical units were defined; they were: the ohm, farad, volt, ampere, and coulomb. This decision was based on the recommendations of a British Association for the Advancement of Science and their recommendations were largely based on Joule's researches on electrical energy. See an excellent article by Robert A. Nelson at: http://www.aticourses.com/international_system_units.htm on these and some other metric issues.

1889 In 1889, the year of Joule's death, it seems likely that the British Association for the Advancement of Science (BAAS) suggested the name for the energy unit to honor the name of James Prescott Joule for his pioneering work on electricity and energy. The BAAS promoted this idea actively and the Second Congress of the International Electrical Conference (IEC) added the joule, watt, and a unit of inductance that was later given the name henry.

The joule was adopted by the IEC as the unit for energy and work. The Oxford Dictionary of Weights and Measures quotes 'Le Système International d'Unités (Sevres; France: Bureau International de Poids et Mesures, 1985)' as its source.

1946 The joule was defined by the CIPM. (SI brochure, Appendix 1, Section 2.4 (Electric current)), which shows CIPM resolution 2 giving the definition of the joule.

1948 The joule and its definition were ratified by the CGPM as the official SI unit for energy. This made the joule the 'official' world unit for energy. Resolution 3 of the CGPM (1948) simply said:

> *3. The unit of quantity of heat is the joule.*

They then went on to say in a footnote:

> *Note: It is requested that the results of calorimetric experiments be as far as possible expressed in joules. If the experiments are made by comparison with the rise of temperature of water (and that, for some reason, it is not possible to avoid using the calorie), the information necessary for conversion to joules must be provided. The CIPM, advised by the CCTC, should prepare a table giving, in joules per degree, the most accurate values that can be obtained from experiments on the specific heat of water.*

It seems that the CGPM felt troubled by the promoters of the calorie (or is that Calorie) even then. This footnote has a decidedly grumpy tone in my opinion!

1960 When the CGPM first defined SI, in 1960, it included the joule as the derived unit for energy. This reconfirmed the joule as the official SI metric unit for energy.

1998 The joule is listed in 'The International System of Units (SI) in 'Table 3. SI derived units with special names and symbols' as the SI derived unit for the 'Derived quantity' of 'energy, work, quantity of heat'.

4 Why do I care about energy issues and the joule?

Recently, while I was rewriting my web page on why we should move more rapidly toward using the metric system, I realised that a lack of knowledge about energy, and particularly about how to measure it using joules, kilojoules, and megajoules etc., was seriously hampering a great deal of public debate on extremely important energy issues. I wrote:

Energy

The inability of normal and even highly intelligent and knowledgeable people to comprehend the range and diversity of old energy measures, and the subsequent misunderstandings that this ignorance fosters, can lead to very serious problems in the world.

Consider the world's pressing need to understand how we use our limited energy supplies and how quickly we use them. These questions directly relate to global warming.

A fundamental concept such as energy is essentially simple but even simple issues can confuse all of us, including our politicians, because of the numerous ways they have been considered in the past with so many unrelated measures. This complexity makes it difficult, if not impossible, for politicians to understand even basic quantitative information about the physical world around them. To understand the total world energy issue using old measures is quite difficult (even for scientists and engineers) and almost completely impossible for politicians and the rest of us.

If you want to begin to comprehend global warming, you need to have a working knowledge of most of the 68 old pre-metric energy measures because in the year 2006 they are all still in use:

In contrast, using the metric system to consider energy is relatively easy. We know that energy is measured in joules and that we will probably need to use some large prefixes to understand our energy use on a global scale.

Here are some figures to consider.

Personal

If you are an average teenager you will need 11 000 kilojoules or 11 megajoules of food energy each day. This is 77 megajoules each week — 330 MJ each month — and about 4000 MJ of energy for a whole year.

You might even like to think of this as four gigajoules per annum (4 GJ/a) as there are 1000 megajoules in a gigajoule. Even a hardworking construction worker only needs about 5 gigajoules per annum (5 GJ/a).

Home

In a temperate climate, an average family house uses a bit over 100 gigajoules of energy in a year for cooking and heating. This might go up to 150 GJ in a cold climate.

National

In 2003, the USA used 112 exajoules of energy that was made up from:

- 42 exajoules from petroleum,
- 26 exajoules from natural gas,
- 26 exajoules from coal,
- 11 exajoules from nuclear energy, and
- 7 exajoules from renewable energy.

Note: I chose data from the USA because they are the world's largest energy users.

See: http://metricationmatters.com/why_metrication if you need more information about why I believe that we should move more rapidly to the metric units expressed as 'The International System of Units (SI).