

Australia's Invisible Energy Trade

Mike Wilson, June 2011

Objectives

- To examine energy consumption in Australia, the sectors of the economy that are intensive energy consumers, and what this means in terms of our exports and imports.
- The implications with respect to carbon-related policy decisions.
- To dispel the myth that Australia is a voracious energy consumer.

What is Intensity of Use?

Professor Wilfred Malenbaum had a pragmatic way of looking at the problem of forecasting future consumption of commodities. In a nutshell his theory of intensity of use (IU) suggested that commodity consumption (wheat, copper, coal etc) follows a predictable relationship with GDP ([Gross Domestic Product](#)). Intensity of use is simply the ratio of material consumption as measured in physical units (tonnes, joules etc) to GDP in currency units (dollars for our purposes).

He suggested that IU trends plotted over time for an economy, or against GDPPC (GDP per capita) when comparing different economies, follow a predictable inverted U-shaped pattern. The fundamental reasons for this are:

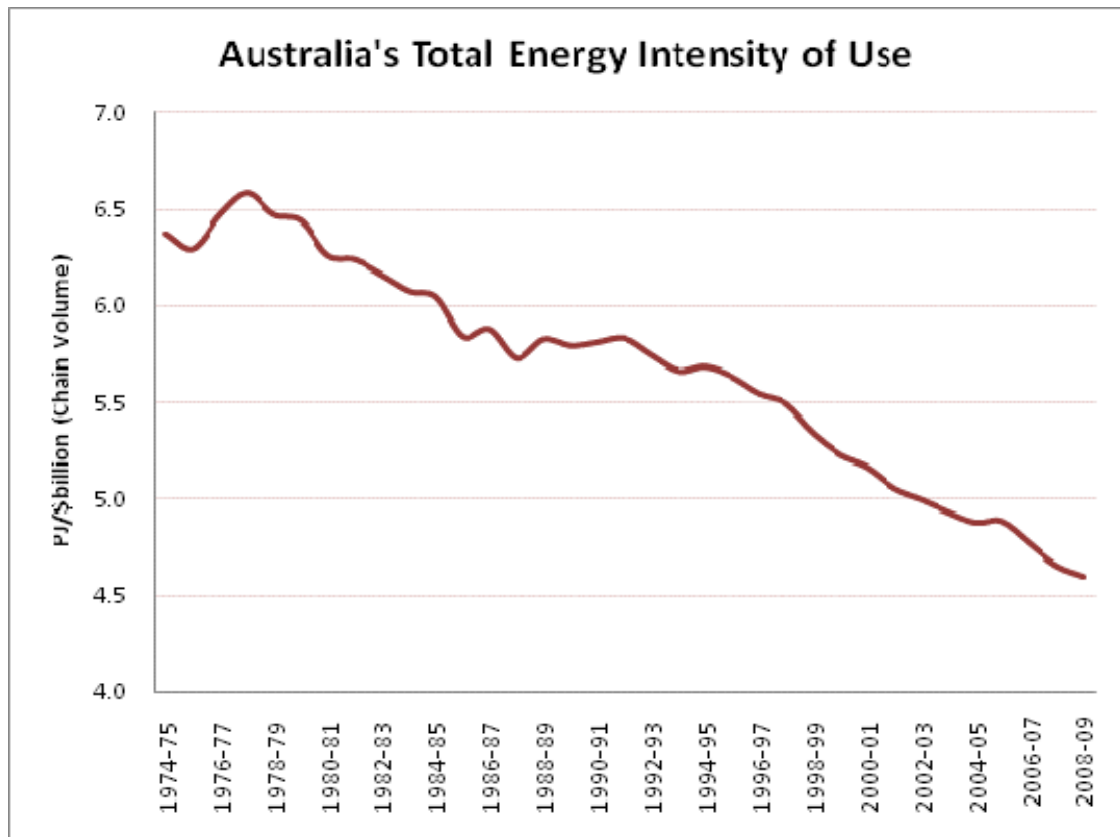
- 1) As an economy begins to develop material consumption dominates the economic activity as it builds vital infrastructure and the IU curve sweeps upwards.
- 2) Eventually economies restructure to the point where the services industries dominate and material use becomes smaller in relation to GDP. At this point the IU curve goes into decline (e.g. any developed nation including Australia).

IU and forecasting

Intensity of Use would be just another interesting concept were it not for its value in forecasting long-term commodity consumption patterns. If you fit a trend line to the IU relationship for a country and then make projections for GDP growth, you can back out predicted values for commodity consumption. It is a useful approach for long-term (e.g. 10-year or 20-year economic) projections but can't (like most models) account for major disruptive technologies.

Australia's energy IU

With all the media coverage claiming Australia's voracious appetite for energy you'd think that our IU curve would be upward sloping, yes? Not so:

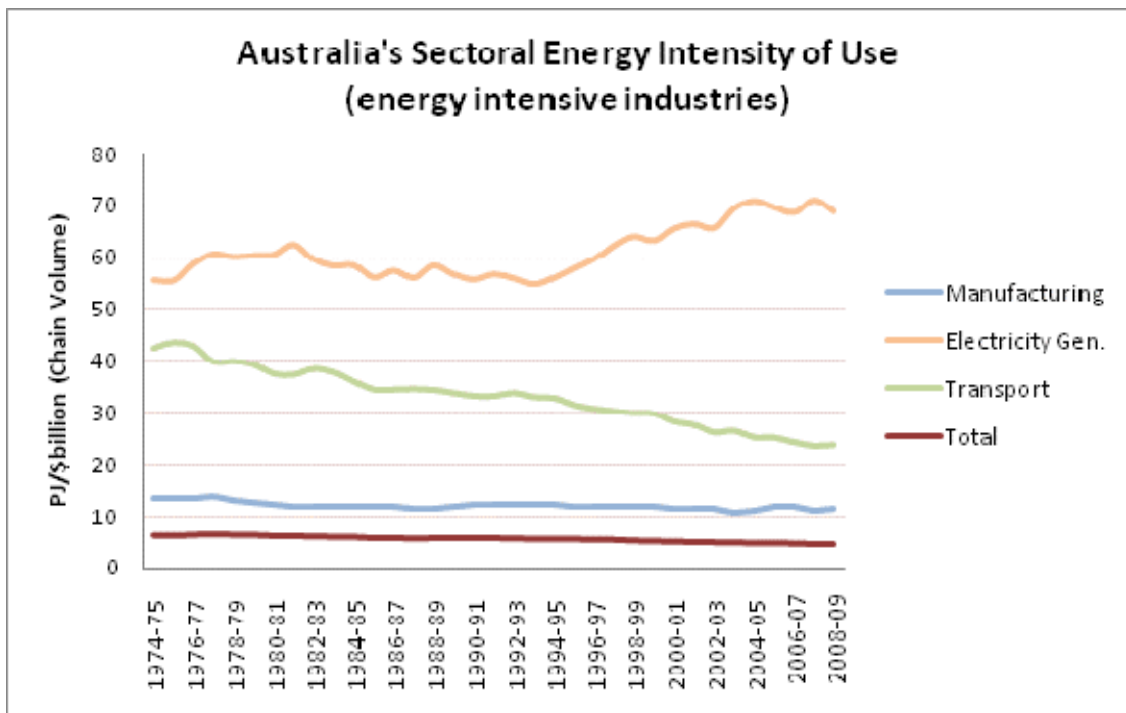


As you can see the Australian IU has consistently declined since at least the mid 1970s to the present. But energy use over that same period more than doubled. Therefore we know that the economy (GDP) has grown more rapidly than energy consumption over that period, such that the ratio of the two (IU) declined.

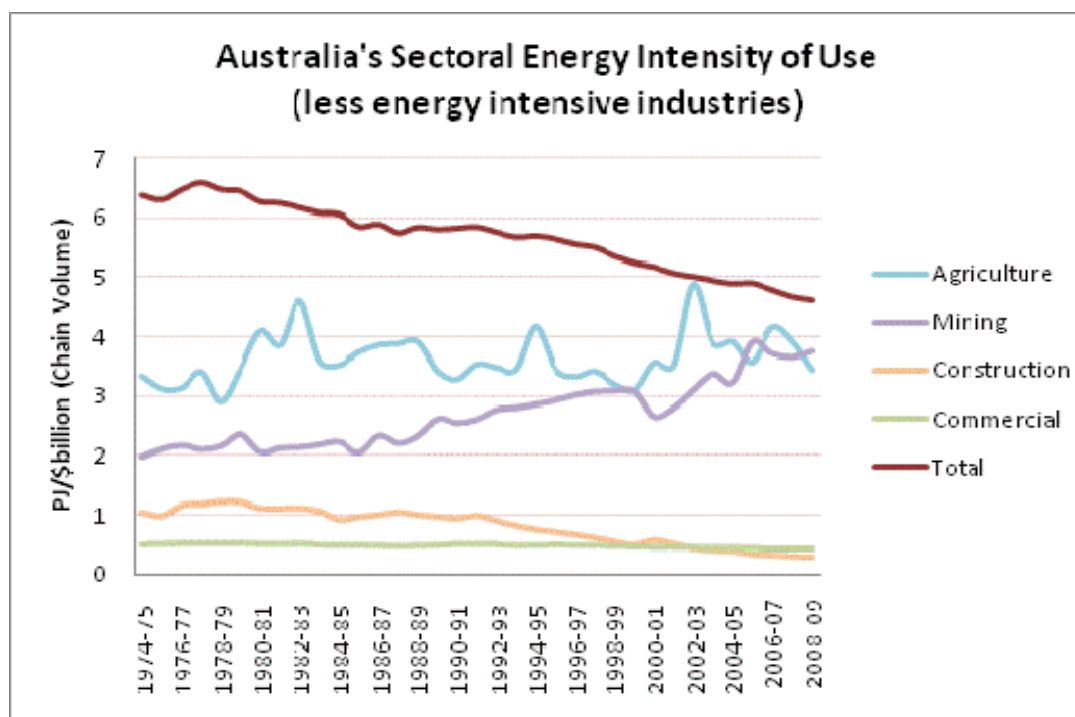
You may also recall that China said that their contribution to climate change policy would be to decrease their economy's energy intensity ... well Australia can merrily make that promise too, we've been doing it for decades. As we shall see later, China was already on a downward trajectory in energy IU when they made this generous gesture. In other words they were proposing to continue business as usual. The Chinese may be many things, but they are not stupid and they know how to spin a good statistic for political purposes ☺

What Australian sectors are energy intensive?

You aren't restricted to the whole economy when studying IU. You can break it down to individual sectors and sub-sectors. The following graphs show Australia's energy intensity for the main economic sectors and the "Total" line is the IU for the entire Australian economy as shown above (we can compare all the trends because the units are consistent, that is to say J/\$):



And (note change of vertical scale):



Not unexpectedly we see the energy intensive sectors are electricity generation, transport and manufacturing. The less intensive sectors are agriculture, mining, construction and commercial (services etc).

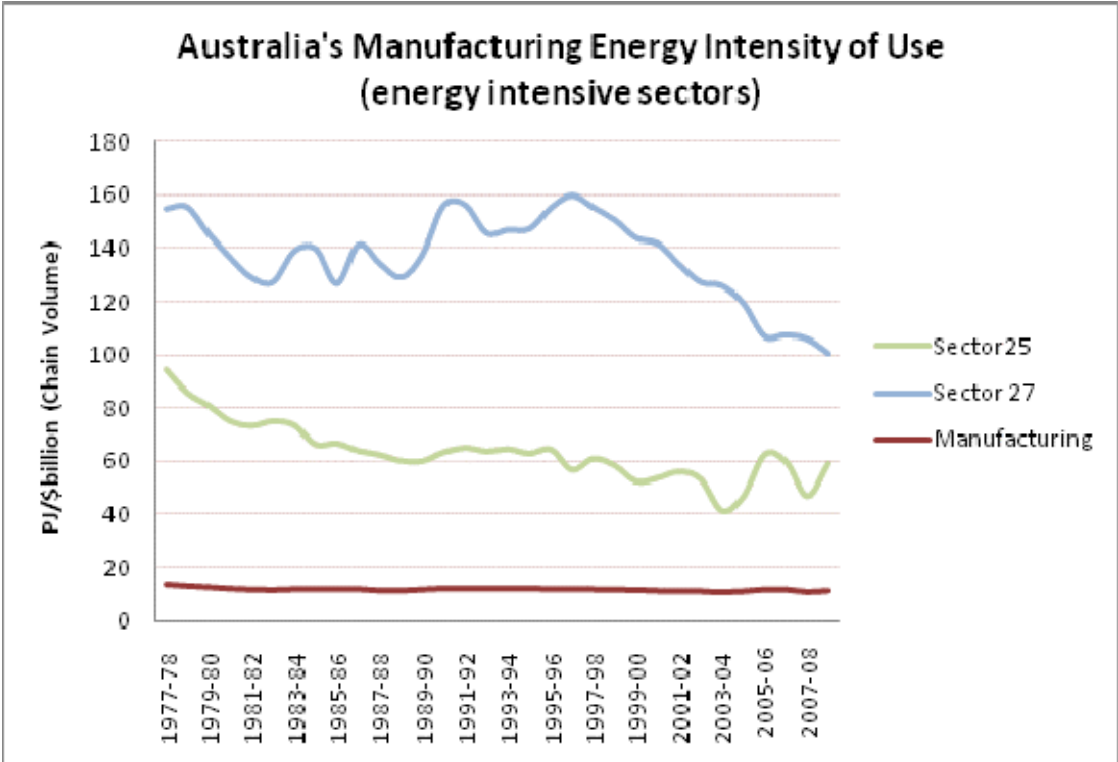
It is pleasing to see the transport sector exhibiting a declining energy intensity suggesting increased fuel efficiency is driving this sector's trend. It is not clear why the electricity generation sector has an increasing trend, but my gut feel would be

that electricity tariffs have been artificially depressed for a while in Australia. Hence the hikes we had to have in WA recently, for example ... Verve was running at a significant loss and being subsidised by the State Government.

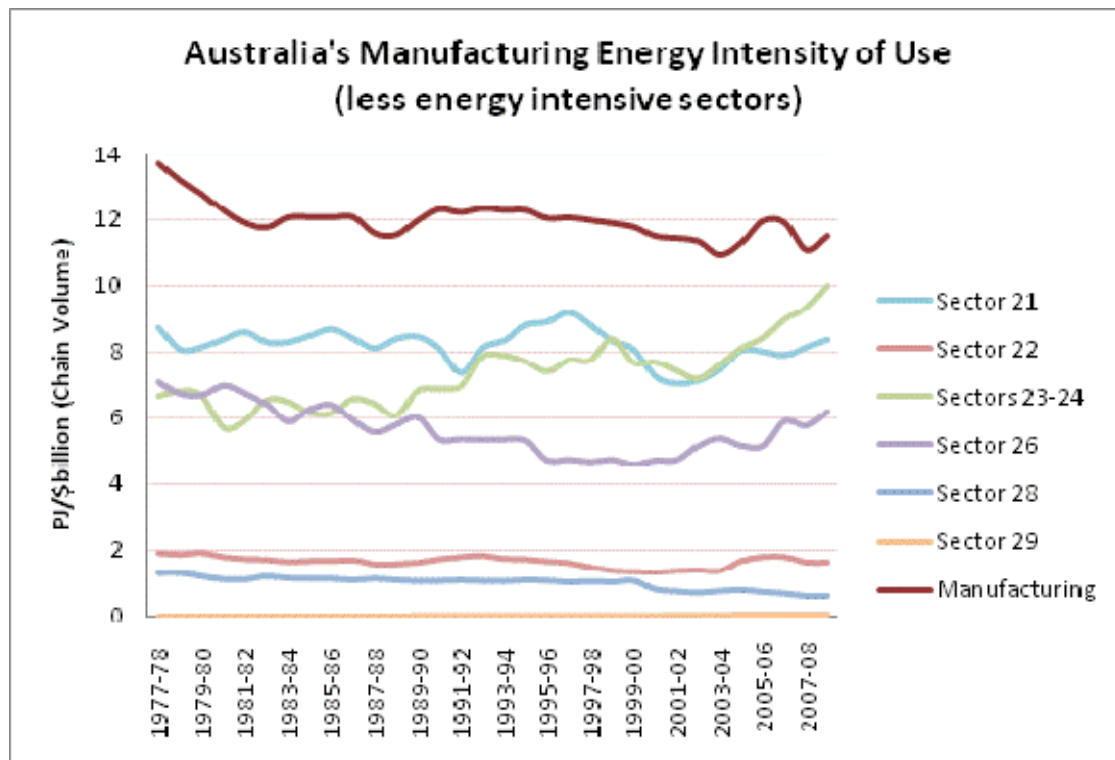
You might ask why mining is so low. This is because ABS accounting practices do not include metal production as part of mining, but under manufacturing. So we need to disaggregate the manufacturing sector further to get a clearer picture of what is going on.

Australian manufacturing energy intensity

Following a similar approach the two graphs below show the energy intensity for the various manufacturing subsectors where the whole manufacturing sector energy intensity is included for comparison, labelled manufacturing:



And (note change of vertical scale):



Sectors 25 (Petroleum, coal and chemical manufacturing) and 27 (metal products) clearly dominate energy intensity in the Australian manufacturing sector.

Energy intensity and trade

Thanks for putting up with me so far ... here's the payoff (hopefully). This becomes useful to the "carbon price" debate when you marry up energy intensity and Australia's trade.

Australia's trade is going gangbusters. Australia exported merchandise (does not include services) to the tune of \$231 billion in 2010, over \$102 billion of which came from WA. On the flipside Australia imported \$210 billion, while WA only imported \$26 billion. If it wasn't for WA we'd be running a massive trade deficit in Australia, instead we have a decent-sized trade surplus.

But what is it Australia sends overseas, and what is it we import? We export predominantly ores, metal, energy fuels and agricultural goods (iron ore \$49b, coal \$43b, gold \$14b, petroleum \$10b, natural gas \$9b, etc). We import mostly highly manufactured items, with petroleum being the main exception (petroleum \$16b, cars \$16b, petroleum oils \$10b, medicaments \$8b, telecoms equipment \$8b, gold \$7b etc).

Why do we export **and** import gold and petroleum you ask? That's because we get unrefined gold from mines overseas, refine it near Perth airport and send it back out again as pure gold. As for petroleum we export and import because refineries require a mix of feed stocks (heavy and light crudes) to make all the end products demanded by the economy. I trust this explains the peculiar data elements.

Now the key question ... how much energy is embodied in the exports and imports from Australia? It becomes clear, after looking at the disaggregated manufacturing industry graphs that Australia predominantly exports energy intensive goods, but imports predominantly goods that are less energy intensive. In other words we send a lot of energy overseas congealed into other forms such as aluminium metal, copper, LNG etc The amount we get back in highly manufactured goods is dwarfed by the amounts we send out.

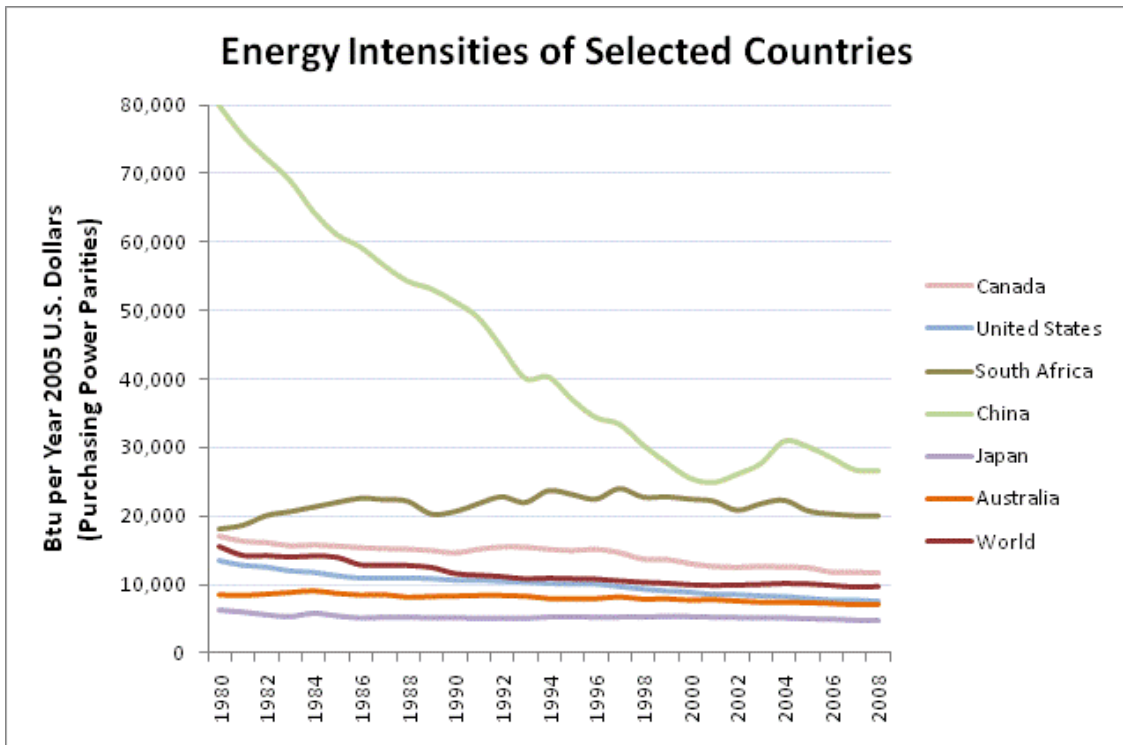
The policy relevance

Why did I bother to churn through all these numbers you ask? The main reason is to unequivocally demonstrate that not only is Australia a massive net exporter of energy products, but we are also a massive net energy exporter in terms of energy embodied in other goods (primarily metals and petroleum products). So when politicians seek to penalise us for our energy consumption, you must first have them stare these facts in the face and admit that much of this energy consumption is by proxy for consumers in other countries ... not so much for our benefit. You must also answer the question: if we were to close those “carbon-polluting” industries, what would happen?

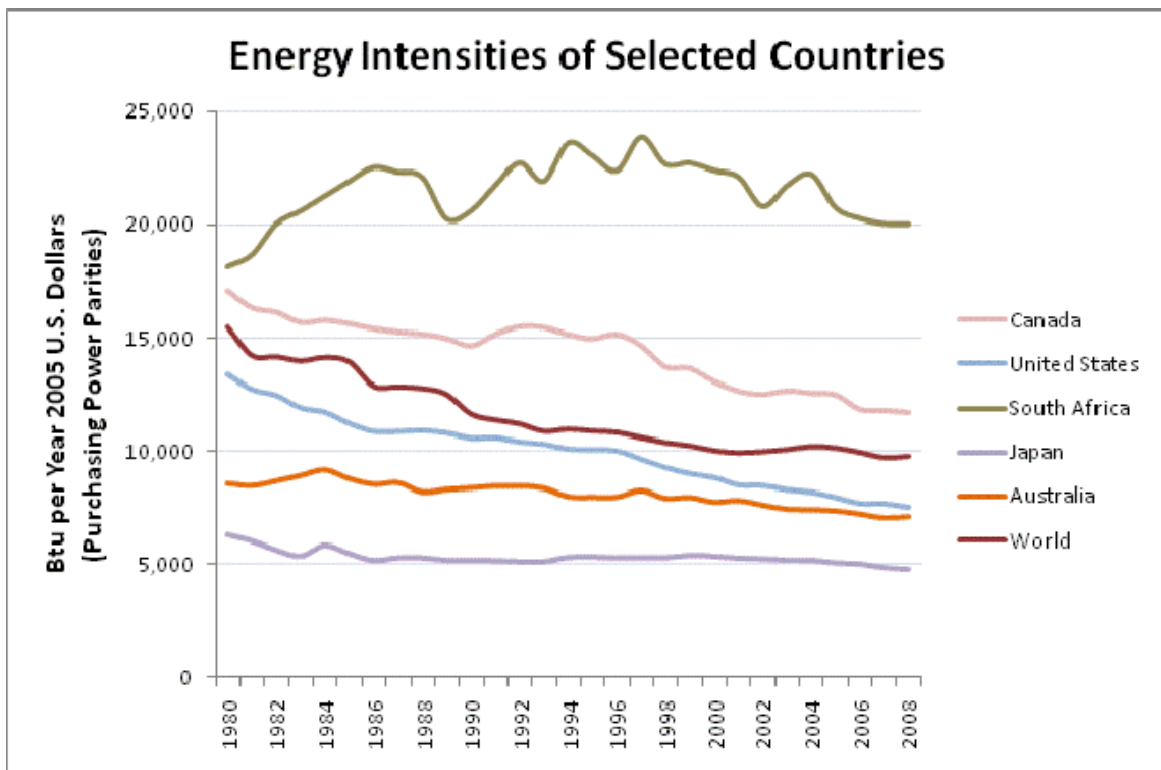
This is best illustrated by the folly of “carbon taxing” the LNG industry, which is entirely destined for overseas consumption. Not only that, the resulting natural gas, which is predominantly used for electricity generation in Japan and China, would be replacing coal-fired power stations which create higher CO₂ emissions per kWh generated. This is why it is vitally important to protect the energy-intensive trade-exposed industries (EITEs) from a unilateral “carbon price.”

Australia vs the world

People keep carping on about Australia being a high consumer of energy on a per capita basis. Well here's Australia's energy IU plotted against a selection of other countries:



It is a tad difficult to make out the trends when China dominates the graphic (note the downward trend in China's energy IU mentioned earlier). So here is a scaled up version of the same graph without the Chinese trend line:



That puts things in perspective, no? We are below average, and I mean that in the best possible way ... compared to the average for all the countries. So, not only are we below average when it comes to energy consumption relative to GDP generation,

but much of that energy ends up going overseas, as demonstrated previously. If that doesn't dispel the myth that we are intensive energy consumers in Australia, I have no idea what will.

Conclusions

I think it is useful to summarise the main findings as general statements:

- People say Australia is a massive per capita consumer of energy – this is not relevant because we are:
 - below average energy consumers on an energy intensity basis (i.e. energy used to generate GDP);
 - massive net exporters of energy goods; and
 - massive net exporters of energy embodied in non-energy goods.
- Australia produces largely energy intensive goods for export, and therefore taxing the energy sources makes our domestic producers less competitive on the world market. The inevitable result is that multinational companies will go offshore for energy intensive projects.
- Australia is not the end user of much of the energy she consumes ... much of it is destined for overseas consumers. The moral imperative for “carbon” taxation is therefore largely misplaced. If there were no overseas demand for our energy intensive goods we would not be consuming the associated energy in the first place which created the emissions.

I would highly recommend reading Tony Abbott's piece in The Australian as he touches on many of the points I have covered:

<http://www.theaustralian.com.au/news/opinion/pm-is-just-adding-crippling-costs/story-e6frg6zo-1226017292537>

Minor Disclaimer

It should be noted that there are limitations to this type of analysis. The energy associated with each sector and sub-sector represents an energy “value-added” component for that stage of processing, and not the total embodied energy in that product. For example, motor vehicle manufacturing includes the energy required to construct motor vehicles, but not the energy embodied in each of the sub-components such as the metal in the engine block, frame and transmission. As such the energy embodied in motor vehicles would be underestimated.

The only way to achieve a closer approximation of embodied energy would be to perform extensive [input-output analysis](#) on the entire economy at a highly disaggregated level. I have no doubt whatsoever that the end results would not change the bullet point conclusions above.

References

ABARE energy statistics:

http://adl.brs.gov.au/data/warehouse/pe_abarebrs99001693/energyUpdateTableB2008-09.xls

http://adl.brs.gov.au/data/warehouse/pe_abarebrs99001693/energyUpdateTableF2008-09.xls

ABS table 33 in:

National accounts data:

<http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5206.0Dec%202010?OpenDocument>

Trade data (table 15a):

<http://www.abs.gov.au/AUSSTATS/abs@.nsf/DetailsPage/5368.0Jan%202011?OpenDocument>

EIA:

<http://tonto.eia.doe.gov/cfapps/ipdbproject/IEDIndex3.cfm>

Go to Indicators → Energy intensity.

The EIA has not adjusted for PPP (Purchasing Power Parity) because they use market exchange rates.