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DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

The Freezing Point of Industrial Society

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*This is a guest post by **Kiashu**. Kiashu says he has read a lot of books and sometimes been asked to write essays about them, has met a wide variety of people in his life and concluded that no, "they" won't just find an answer to our problems, and we really do have to worry. He is a good example of the fact that in the internet age anyone with a brain and too much time on their hands can find out just about anything and talk about it intelligently.*

When will fossil fuel industrial society end?

When oil costs $240-$1,500 a barrel for several years.

> *One says to me, "I wonder that you do not lay up money; you love to travel; you might take the [railway] cars and go to Fitchburg today and see the country." But I am wiser than that. I have learned that the swiftest traveller is he that goes afoot. I say to my friend, Suppose we try who will get there first. The distance is thirty miles; the fare ninety cents. That is almost a day's wages... Well, I start now on foot, and get there before night... You will in the meanwhile have earned your fare, and arrive there some time tomorrow, or possibly this evening... And so, if the railroad reached round the world, I think that I should keep ahead of you...*
>
> - Walden, Henry David Thoreau

What was true in 1845 when Thoreau wrote that is not true today in the developed West, but is still true in the Third World. Fuel was still expensive enough that a journey of a day's walk taken by mechanical means was more expensive than a day's labour. Resources were more expensive than labour; now in the West labour is more expensive than resources, while in the Third World labour is still very cheap. But will it always be so?

This piece considers that industrialisation could only happen with cheap fuels, and by looking at the countries of the world, tries to figure out just how cheap fuel has to be before lots of people start using it before a country can industrialise with fossil fuels. The flipside to this is seeing how expensive fuel must be before it ***deindustrialises***. This then gives us a clue to if and when will industrial society will end.

By an **industrial society** I mean one in which machines are powered not by human or animal motion and are a part of everyday life, and we design our homes and cities with machines in mind. A non-industrial society may have some machines, but it's not designed around machines; a Kalahari Bushman can happily use a radio, but he does not live in an industrial society, whereas his cousin who moves to Johannesburg and takes the bus to work does, even if she has no radio.

Going from a mostly-manual or animal economy to an industrial one, you can think of it as like the melting of ice into water at 0°C. When there's enough heat (cheap energy) it melts (becomes industrial). But does the reverse apply? If you cool water down to 0°C, it'll freeze. So if the cheap fuel becomes expensive, will we lose all that industry? Does industrial society have a freezing point, a point at which the heat (energy) has been drawn out of it, and so it changes from liquid (industrial) to solid (non-industrial)?

One way to figure this out is to look at the undeveloped countries of the world, consider how affordable fuel is in each one and then estimate how cheap fuel would have to be before they can industrialise ? Next we can look at other countries where incomes have dropped and/or fuel has become expensive, and consider what happened to them. From this we may be able to estimate, **what is the freezing point of industrial society**, the point where it soldifies into a manual economy? What will the price of fuel have to be before we hit that freezing point?

History of energy use

Throughout history, humanity progressed from using only their hands, to using tools, to using animals, and finally to using machines. Progressing from the work of hands to those of tools did not involve an increase in use of energy, but an improvement in the **efficiency** of energy use - a crowbar can let you lift a rock more easily than you can with your bare hands. But adding animals did not let us use energy more efficiently, it simply took energy from somewhere else and put it to work for us - the same applies with machines.

Tools don't need any fuel or food, so if people have the physical resources and skills to make them, they will. But animals and machines are different. Tools did not require extra energy use, they simply used human energy more efficiently.

Animals need food, and so whether they're used or not depends on whether enough excess food is available. Perhaps you have 1 acre, and could plough it in one day with oxen, but the oxen eat a haybale every day. Either you must be able to get 365 haybales from 1 acre, or you must be able to hire the oxen for just one day at something less than that. If you can't do that, then you'll not use the oxen on your land, it's not worth it. In other words, **for animals to be used their food (fuel) must be cheap**.

Machines need fuel, and need it to be cheap. Perhaps you have 1 acre, and could plough it in an hour with a tractor, and six months later harvest it another hour, and from that acre get ten bushels of corn, but the tractor would use two gallons of fuel. If the two gallons of fuel cost more than ten bushels of corn, then you won't use the tractor, it's not worth it. In other words, **for machines to be used their fuel (food) must be cheap**.

We didn't use the animals and machines as soon as they became available, but only when their

use was cheaper than the alternatives. Oxen can plough an acre in a day, and a fit man will take twelve days to do it with a spade, but if oxen cost twelve times as much to feed as men, then men will keep digging. Similarly, tractors can plough ten acres in a day, but if a tractor costs ten times as much as an ox, or one hundred and twenty times as much as a man, then people will keep using oxen.

But whatever the cost of buying the actual animals and machines, the minimum running cost is their fuel/food. So the cost of food and fuel is the limiting factor that determines when a society goes from using tools to animals, and from animals to machines. **There's no animal use without cheap food, and no machine use without cheap fuel**.

What happens when the cheap fuel runs out? Well, either we find a new fuel, or we return to using animals and tools.

> *Note: I won't consider here economies where animals are too unaffordable to use, as we're looking at industrial and non-industrial societies, rather than the different kinds of non-industrial societies. A look at a non-industrial society where animals were unaffordable - in one community farms averaged less than a third of a hectare each - is found in Land relations under unbearable stress: Rwanda caught in the Malthusian trap, Catherine André and Jean-Phillipe Platteau, Journal of Economic Behaviour and Organization 34:1-47 (1998). This is also discussed at some length in Chapter 10 of Jared Diamond's **Collapse**.*

Cheap and expensive fuel

If it is true that fuel affordability determines industrialisation, then we'd expect to see that in places where fuel is expensive, people don't use machines a lot, and where it's cheap they do. Cheap is a relative term. Petrol costs $0.54/lt in Laos, and $1.63 a litre in Belgium, but the Laotians don't use three times as much petrol as the Belgians, since Laotians have an income of $567 and Belgians one of $37,214. Logically, if the Laotians cannot industrialise with an income which can buy them only 1,050lt of fuel, then the Belgians could not stay industrialised if their income could only buy them 1,050lt of fuel if petrol were $35.44 a litre, or if Belgian income halved to $18,607 and petrol were $17.72 a litre.

Different fuel prices and industrialisation

Here our idea is that all things being equal, having cheaper fuel will lead to greater industrialisation fewer people working larger farms, more roads and so on. Let's consider two similar neighbours, Venezuela and Colombia.

In very few countries in the world is the free market allowed to determine the price of fuel without interference by government or corporations. Typically, oil-exporting countries subsidise fuel, keeping them below the market price for crude oil (US$0.38 a litre); while oil-importing countries tax fuel, keeping it above the market price for crude oil. In Venezuela petrol is $0.03/lt but $0.98/lt in neighbouring Colombia; both have similar per capita GDP of around $6,600, but despite their similar wealth Venezuelans should find it easier to live an industrialised lifestyle than Colombians, because of their fuel being cheaper for them. And indeed we find that this is so.

Colombia has many small farms, with 10.3 million agricultural people living and working on 570 million ha, or 55ha per person (coffee plantations are even smaller, on average just 6ha); Venezuela has 2.8 million people on 329 million ha, or 118ha per person. Colombia has 110,635km of roads and rail, or 0.0025km per person, while Venezuela has 96,387km or 0.0037km per person. So Venezuela with cheap fuel has farms twice as large per person involved in agriculture,

and 50% more roads.

> *[As a side note, this shows that Chavez's policy of breaking up large farms and giving them to smallholder peasants is doomed to failure without price guarantees for their goods. In a free market, whoever makes the most profit will tend to absorb the other businesses; in agriculture, cheap fuel means large farms where machinery can be put to best use will make the most profit, while expensive fuel means smaller farms where you don't have to use fuel at all will do best. Smallholders cannot succeed in a free market with fuel at $0.03/lt; but they could succeed if there were fixed prices for their produce, ensuring the smallholder's profits and limiting the larger place's profits. So Venezuela can have cheap fuel and price guarantees, or expensive fuel and a free market; but cheap fuel and a free market leads to big landlords taking everything over.]*

We find similar results around the world: where fuel is cheap, industrialisation follows. But how cheap does it have to be?

I've taken figures for per capita GDP as a rough guide to an average income in that country, and compared these with international fuel prices to see how much fuel an average income could buy. Per capita GDP is not a perfect guide to wealth, since it's just total income divided by population; if an accountant on $100,000 moves into a house with a waitress on $10,000, their average income may be $55,000, but the waitress is not necessarily better off. This is particularly true in countries whose economies rely on exports of raw materials like oil and minerals, which tends to lead to a very few rich people and lots of poor people; for example Angola has a GDP per capita of $2,758, but 70% of the population live on less than half of that. But in terms of considering industrialisation potential, per capita GDP is a decent guide, since even if only 1% of the population can afford cars and televisions, they will ensure that roads and power lines are built.

Food prices vary considerably, however because we want to consider the effect of fuel affordability on industrialisation, we can fix food prices as about that of wheat on the world market - $300/tonne, with 184kg of grain supplying the minimum calories and protein for a moderately active adult, or $55. Food also represents a minimum wealth necessary before anything else can be bought; if your annual income is only $500, whether fuel is $1 or $0.01 per litre doesn't really matter, since between food, water, clothing and housing, you'll be hard-pressed to have anything left to spend on fuel.

Fuel affordability and industrialisation

Of the **top 50** countries in terms of fuel affordability, all are able to buy 10,000 litres or more annually. Their average income is about $28,000. 16 of them are net oil exporters, 3 produce a significant portion of their own oil; 29 are Western or First World countries (Ireland, Australia, Greece, etc); the other 21 are the 16 oil exporters and 5 island-states heavily reliant on tourism or other foreign subsidies for their wealth.

This tells us that what gives you cheap fuel are one or more of having enough to export, a high per capita wealth, and lots of foreign money coming in. You need money or to produce the stuff yourself. (Obvious enough!)

Of those **top 50**, 40 of them are industrialised countries. Of the 10 which aren't, Iraq's slow deindustrialisation has more to do with war than anything else, Turkmenistan was for many years held back by dictatorship, as were Libya and Oman, Venezuela is in the process of industrialising fully, and four are small island-states, which for physical and cultural reasons resist industrialisation. There remains only Gabon, 50th on our list, with their average income able to

buy just over 10,000lt annually. So absent civil conflicts, foreign invasion or dictatorship, being able to buy 10,000lt or more annually should give you industrialisation.

Of the **bottom 50**, none have an income greater than $1,100, none subsidise fuel use, and they average being able to buy 10 years' grain with their income. At the top of them is Nicaragua, whose people can buy about 1,350lt of fuel annually. None are industrialised, and the vast majority of industrial infrastructure beyond gravelled roads was built with foreign supervision and money.

So we see that countries of under 1,500lt of fuel each definitely can't industrialise, and those of more than 10,000lt definitely can. Somewhere between those two figures are when industrialisation becomes achievable for rising fuel affordability, or difficult for dropping fuel affordability.

To create and maintain a modern industrial economy requires fuel affordability of something between 1,500-10,000lt per person annually.

It's not possible to be more precise than this given the data, since some countries like Namibia can afford more than 3,500lt and are not industrialised, while others like Ukraine can only manage 2,800lt but are industrialised; however Namibian wealth is increasing and so they may industrialise, while Ukrainian wealth was once greater but is somewhat unsteady so they may not retain it. Then there are countries like Cuba (3,727lt fuel, 13,667 years' grain), with poor levels of industrialisation in communications and electronics, but good levels in pharmaceuticals.

Most likely, fuel affordability is like other kinds of income it takes a lot to build something up, not so much to maintain it. So a country might go through a period of affordability of 10,000lt fuel and industrialise, and later when fuel drops to 5,000lt affordability, remain industrialised. In support of this, we may note that the former Eastern bloc states and European republics of the USSR were once relatively wealthy and industrialised, and later dropped in wealth but remained industrialised the Czech Reublic tops out at fuel affordability of 10,652lt, and Ukraine's at the bottom with 2,807lt Georgia and Albania are lower, but no-one could really call either of them industrialised, you need more than Hoxha's concrete pillboxes for that.. We also find just above the bottom 50 is North Korea, a country which in the 1960s was wealthier than South Korea at the time, but which had a steady relative decline, and then after 1991 was essentially cut off from reliable oil supplies by the fall of the Soviet Union. It has experienced sending people out of factories and into the fields to produce food by hand, animal and tools, and now can afford 1,418lt annually.

So while it may take less to maintain an industrial society than create it, there is some lower threshold of fuel affordability below which it can't be maintained.

And of course just as some people spend their money with more efficiency than others, getting more bang for their buck, so too will some countries spend their fuel more efficiently, either in building up or maintaining their industry; if there can be one person on $30,000 who can afford a mortgage and one on $40,000 who cannot, it stands to reason that there should be countries with 3,000lt fuel who can afford industrialisation and some on 8,000lt who cannot.

Food affordability and industrialisation

As noted above, however cheap or expensive the fuel, people need to eat before they can lay down asphalt roads, build lathes, drive cars or produce television programmes. So what's the minimum food before a country can industrialise?

The list of countries and their food affordability, since we fixed the food price at $300/tonne, is the same as the list of countries and their per capita GDP. We find that Luxembourg is at the top of the list with being able to get over 293,000 years' grain, and Latvia with 28,500. Of the **top**

50, 37 are Western or First World countries, 8 are net oil exporters (including a Western country, Norway), and the other 6 are the small island-states again. Excepting the small island-states, all are industrialised. The poorest of them is Estonia, with $8,500 income.

Of the **bottom 50**, from Cameroon with $1,002 and able to afford 18 years' grain, to Burundi with $119 and 2 years' grain, only about 10 have any real industrialisation, and it's far from universal consider for example India (at #129), where tens of millions live their lives in airconditioned comfort using computer software in their daily work, while others hoe in the fields and are only one bad harvest away from famine.

So we see that, setting aside small island-states receiving large foreign subsidies, an income of more than $8,500 is required for industrialisation, and an income of less than $1,000 definitely prevents it. The level for industrialisation is probably somewhat higher, since a number of the countries on $8,500-$15,000 are former Soviet countries, where industrial infrastructure was built in wealthier Soviet days.

To create and maintain a modern industrial economy requires food affordability of about 270 years' grain, or $15,000.

Four economies

A modern industrial economy requires fuel affordability of something between 1,500-10,000lt per person annually, and food affordability of about 270 years' grain, or $15,000.

This leads to three types of economies, with a fourth possible one.

Manual Economy

Fuel < 1,500lt, or food < 270 years' grain

Laos, North Korea, Honduras, etc

A manual economy uses hands, tools and animals, but not machines. When fuel is expensive, people turn to manual labour, and food becomes more expensive in proportion (or national income drops, if you prefer to look at it that way). When fuel is cheap, if food remains expensive then they still can't industrialise. Nothing is wasted, and the accoutrements of industrial society televisions, four wheel drives, etc will be objects of wonder or symbols of prestige. The citizens sometimes migrate (as legal migrants, illegals, or refugees) to countries with *mixed-industrial* economies.

Mixed-Industrial Economy

Fuel 1,500-10,000lt, food 270-28,500 years' grain

Ukraine, India, etc

A mixed-industrial economy uses hands, tools and animals in many parts, but also has some use of machines, typically concentrated in cities. Often an economy in transition between *manual* and *wasteful*, or vice versa. Typically, parts are deeply-industrialised while other parts are still in a *manual* economy. Industrial objects will be relatively common but not ubiquitous, often old, and old ones will be kept and repaired. *Wasteful industrial* economies may export their waste to such a country to mine for raw materials for recycling (for example 90% of the world's shipbreaking occurs in India, Bangladesh, China and Turkey). A society which was once a *wasteful industrial* and is now a *mixed industrial* economy may mine its own old landfills. The citizens migrate to wasteful industrial countries; those from the industrial parts migrate legally, those from the manual parts typically illegally.

Wasteful Industrial Economy

Fuel > 10,000lt, food > 28,500 years' grain

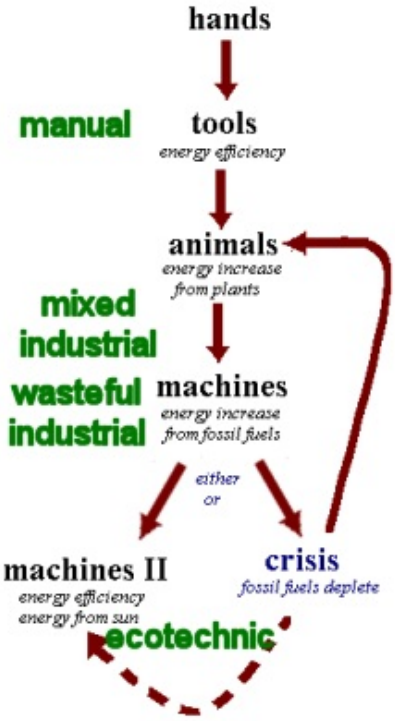
US, Belgium, Japan, etc

In this economy, fuel and food are so affordable that they're often wasted. People leave their airconditioning on when not at home, throw out a quarter or more of their food, and so on. Industrial objects will be discarded rather than repaired, and often discarded when still working to be replaced with something better.

The Ecotechnic Economy

Fuel < 1,500lt, food > 270 years' grain

No such economies yet exist. This would require either extreme taxation or a global fuel shortage, combined with high technology renewable energy, local organic polyculture farming and the like. These are high-technology economies which don't burn fossil fuels for power, and which have little or no waste. Whether such an economy is technically possible or not is the subject for another article; no-one has yet painted a comprehensive picture of what one might look like.



Development of the Four Economies

Returning to the model of the development of technology, from hands to tools to animals and then to machines, we see that we have two possible fates, depending on how we respond to fossil fuel depletion.

Either we begin designing our machines to not use fossil fuels, relying on energy from the sun (solar, wind, geothermal, etc), or else we continue with Business As Usual, and at some point when fossil fuels deplete, their affordability reaches dangerous levels, and with no non-fossil fuel-using machines, we return to the widespread use of animals and tools.

Note that the fuel affordability I'm talking about must be sustained for some years, whether to

begin an industrial society or end it. Lagos is not going to turn into Dubai if fuel is $0.01/lt for a single year, nor will Chicago turn into Timbuktu if fuel jumps to $100 a gallon for a year.

When fuel affordability is 1,500-10,000lt per person annually, the wasteful industrial society can't go on, and will go into recession. For First World countries with an average of $30,000 income, that would be a fuel price of $3-$20 per litre ($11-$76 per gallon, or assuming that crude costs 50% of what petrol/gasoline costs, $240-$1,500 per barrel).

That is, at a fuel price of $3-$20/lt ($240-$1,500/bbl), the wasteful industrial society will be under threat; if this goes on, it's likely to become a mixed-industrial economy. With good planning at this stage, it may change to an ecotechnic economy.

The transition is less likely if the fuel prices are mostly due to high taxes, since a tax of more than 100% on anything creates a significant black market for it, which will keep the *effective* affordability at better level.

With long-term fuel affordability of less than 1,500lt, or prices above $20/lt ($1,500/bbl), transition from a wasteful industrial to a mixed-industrial economy is certain, and eventual transition to a manual economy quite possible. Moving to an ecotechnic economy does not seem likely, as people will lack the funds to invest in the new infrastructure. We do not for example see wind farms and solar panels and electric monorails in Pyongyang, North Korea.

Thus, denying the inevitable depletion of fossil fuels and the falling affordability of them means that a society is more likely to collapse directly from a wasteful industrial to a manual economy, while preparing for it allows the possibility of transiting to an ecotechnic economy.

Prices destroying industrialisation?

In history so far, several economies have gone from wasteful industrial to mixed-industrial, or even manual. However, this has been due not to high fuel prices as such, but to the fuel being unavailable at any price because no-one could or would sell to them. Cuba, North Korea and Iraq are examples of this. And several countries have been unable to industrialise because of unaffordable fuel. But none have yet deindustrialised due simply to the price of fuel.

The importance of the price/supply distinction is that lack of supply *for a particular country* is different to *globally* rising prices and lack of supply, since lack of supply may be political or otherwise temporary. If you are given unpaid leave from your job during a company's time of trouble, you're less likely to look for another job than if you're fired outright. Likewise, a wasteful industrial economy which finds oil prices rising to $240 a barrel may assume it to be temporary, and not prepare to change.

We can imagine, for example, that in 2020 world oil and condensates production has dropped from 84 to 60Mbbl/day, with demand being 20Mbbl in the US, 10Mbbl in the EU, 5Mbbl in Japan, and 20Mbbl in each of China and India, with another 15Mbbl spread out about the world. With 70Mbbl of demand and only 60Mbbl of supply, many regimes are going to assume that with the right combination of military might, diplomacy and trade deals, they can secure a sufficient supply, and therefore they don't bother trying to change to a new kind of economy. They reason that while world supply isn't enough for the *world*, it's enough for *them*, just as when you are one of 1,000 workers and know that 200 will be fired, you don't immediately look for a new job because you hope to be one of the 800 who'll stay.

However, as fossil fuels deplete, it'll be harder for countries to resist change as they did in previous oil shocks simply because previous oil shocks they knew to be temporary. Nonetheless, we can expect that countries will as I said try various combinations of military might, diplomacy and trade deals to put off decisions and change. Thus, even with oil hitting $240/bbl and moving towards $1,500/bbl, we can expect that positive change towards an ecotechnic society will be

slow.

Conclusion

But whether the crisis is prepared for or not, it will come. When oil has an affordability of 1,500-10,000lt, or is $240-$1,500/bbl in today's Western economies, wasteful industrial societies will come under great strain, and move on to at least an attempt at an ecotechnic economy, or else collapse to a mixed-industrial economy. If affordability stays at that low level for several years, or continues to decline, we can expect them to turn into manual economies.

Some western-EU countries are beginning to attempt to move towards Ecotechnic economies, though the eastern-EU's oil use is increasing. But the other 70 of the 85Mbbl/day demand remains and is increasing, with 22Mbbl in the US, 5Mbbl in Japan, 8Mbbl in China and so on. Since supply is declining with no sign of picking up, and demand is increasing with little sign of abatement, it's obvious that the price will continue to rise. Demand destruction will come first from the poorest countries; if you can only afford one barrel of oil a year at $80, then if it becomes $240 you will probably just do without entirely, rather than getting one-third a barrel. These poor countries consume relatively little oil already, perhaps 10Mbbl/day; if they stopped buying tomorrow, their supply would be taken up in 2-3 years by the US, China, Japan and India.

Again we must remember *affordability*. In the 1970s, a drop in world oil supply led to a quadrupling of price and a Western recession, with economies shrinking by 5%. With smaller economies and less money about, the higher prices hurt even more, a vicious economic circle. So we ought to keep the 1,500-10,000lt affordability range in mind, rather than the $240-$1,500/bbl price range. A country with per capita wealth of $50,000 will hit crisis at that 1,500-10,000lt affordability, but that's $400-$2,700/bbl for them; but if they should become a $20,000 country, as is quite possible with a global slowdown in trade due to fossil fuel depletion, then $160-$1,000/bbl oil will do it.

But on the whole, the developed West has a per capita wealth of about $30,000, so that $240-$1,600/bbl oil will bring on a crisis. When could we see such a price? Let's look at the figures for the last several years.

1998 $15
1999 $21
2000 $32
2001 $25
2002 $27
2003 $30
2004 $38
2005 $51
2006 $64

Oil hovered around $20/bbl for most of the 1990s, but has risen in price in eight out of the last nine years, the exception being 2001 when it dropped 22%. The average increase over those nine years, including that drop, has been 23%. This projection would give us $78/bbl this year of 2007, $220/bbl oil in 2012, and $271/bbl in 2013. It would pass $1,600/bbl about 2021. However, reality rarely follows such neat mathematical formulae. Could there be a drop in price? Not likely, says the chief economist for the EIA. Some are even fearing a rise to $250/bbl in the next two years, and taking steps to insure against it, says the Financial Times. In this year of 2007, oil has been as low as $51 and recently hit rather close to $100/barrel.

However, in my judgment a continuation of the current rapid price rise isn't likely, except in the case of US war with Iran, a South Asian nuclear conflict, some combination of another Hurricane Katrina and a very destructive earthquake in Iran, or similarly catastrophic events. However, there are those who say that we're currently at peak oil, and can expect declines of global oil

supply; while the total oil *produced* may not decline much in the next two decades, because of rising consumption in the oil exporting countries, the total *exports* will decline, giving us fuel affordability of 10,000lt in the West, or $240/bbl oil almost certainly by 2015.

At this point, modern wasteful industrial economies will begin coming under strain. Like the old ex-Soviet countries, they may struggle along for a few years but will eventually collapse, becoming mixed-industrial economies, with animal and human power returning to widespread use, but much industry remaining. A picture of what this sort of mixed-industrial economy might look like can be found in how China looks today.

By 2025, if oil production has not declined at all, but demand continues to rise at 2.3% annually, demand for oil will be more than 50% higher than supply, leading to fuel affordability of less than 1,500lt, or oil of more than $1600/bbl. Mixed-industrial economies will then struggle to move to ecotechnic ones, or collapse to manual economies.

Internal conflicts are likely. Already today manual economy regions of countries sometimes rise up against the wasteful industrial regions, economic disparity combining with ethnic tensions to produce violent conflict; this violent conflict then perpetuates the disparity, and the conflict uses resources which both types of economy could have used to enrich themselves. What happens as a country is rising in wealth is just as likely as it falls in wealth. For example, in the US we can imagine that the New England and California areas would remain wasteful industrial, while the South and Southwest might become mixed-industrial or manual economies. If this disparity were to combine with hispanic or black discontents, violent conflict could result. Economic freezing point may turn out to be social boiling point.

Certainly with wars of conquest for access to fossil fuels, smart diplomacy and the like, we may see some countries holding out for a couple of decades longer. But in general, the 2015-25 period will see the end wasteful-industrial economies, and after that will begin a long decline for any who have been unwilling or unable to go to ecotechnic economies.

Is an Ecotechnic society possible? What might it look like?

The answer to the first question is maybe. But it can be difficult to get a realistic picture of what it might look like. When thinking about someone in a manual economy, we can imagine their day, what they do and wear, the tools they use. Likewise we can imagine a wasteful industrial economy, people getting up in the morning, putting on a suit while their coffee machine burbles water, sculling it down and jumping in their car and spending half an hour or so sitting behind other cars moving at only twice walking pace, going into work among bright lights and humming machines, bopping their heads to music from a tiny player. But what will the day of a person in an ecotechnic economy look like?

This requires thought and study, and so will be the subject of another article.