

What about the Rest of the World?

So far this book has been extremely US-centric – and for good reason. The United States is the most carbon intensive nation on this planet, and highly influential. Its ability to phase out fossil fuels strongly indicates the rest of the planet may as well; actually doing so instead of blocking international progress would influence many others.

However it is not quite as simple as “we can do it, so anyone could”. The U.S. may be a carbon intensive society, but we also have an unusually low population density compared to natural resource. We have more biomass available per person than Europe and most of Asia. If we believe the Stanford study, we have a quarter of the world’s wind resources. Still efficiency is pretty much a matter of access to capital and the sun shines everywhere. If the rich world provides capital for renewable developments to the poor ones, the same numbers add up for the world as for the U.S.

The U.S. in 2000 used around 100 quads to supply a population of ~282 million. World population in 2050 is projected to be ~9.25 billion. So if world GDP per capita in 2050 were to be equal to U.S. GDP per capita in 2000, and it squeezed five times the GDP from each unit of energy the U.S. did in 2000, world energy use would be around ~656 quads, ~22 terawatts, about 50% more than at present. Though rich nations, such as the U.S. could make absolute reductions in energy consumption, poor nations will need absolute increases if they are to stop being poor.

Efficiency increases means the world would get more benefit, more GDP from each energy unit used it afford to pay BTU for energy. Thus increases in potential efficiency mean the ability to pay more for clean renewable energy, and still get an increase in GDP, about 2.8 times more as we have already shown in the U.S. analysis.

For example, according to the Congressional Budget Office, on average the cost of electricity production in the U.S. is 8 cents per kWh, so with proper efficiency improvements, both it and the world could afford to pay 19.6 cents per kWh. Natural gas runs at minimum \$6 per MCF, so efficiency increases would let the world pay the equivalent of \$16.80 per MCF – and so on.

Let us start with low temperature heat, space heating, water heating, and air conditioning. With modern evacuated collectors, solar energy can provide heat at about the boiling point of water in almost any climate. With natural zeolites, which can store this indefinitely in very compact spaces there is no reason that almost any climate can't get much of its space, hot water, and air conditioning from solar energy at a price well below \$16.80 per MCF equivalent. Buildings with roofs and south walls shaded by other buildings could get power from their neighbors. The only exceptions are climates in extreme latitudes, and climates with long lasting fogs. (Rain, clouds and morning fog won't prevent 100% solar low temperature power in these circumstances – just make it impractical. Even in Alaska seasonal storage would make it possible to supply all climate control and hot water from the direct solar energy; just not feasible.) So, that is a bit over 7.33 TW right there. Let us allow for climates don't support this due to latitude or really extreme fog, subtract power to run the solar systems and say 7 TW. Bear in mind that we could provide 65% of that at prices competitive with 1998 natural gas, so nearly 100% at much higher prices is not unreasonable.

We might get about 3.4 terawatts of biomass from the following sources:

- 1) Energy crops included on expanded land base provided by inclusion of reserve land, as in the U.S.
- 2) Biodiverse energy plantations on overgrazed, strip mined or otherwise human damaged land. Almost any kind of crop can serve as an energy source. There are hardy perennials suited to most types of damaged land. There are grasses and herbaceous species that will grow in arid, cold climate, others that will grow in arid, warm climates, and a much wider variety that will grow in cold or warm wet climates. Once you reestablish soil, you may be able mix crops, get your biodiversity by combining multiple species in the same place rather than over time. Or you may use more conventional rotations – whatever suits your eco-system.
- 3) Replacement of timber farms with energy plantations as timber for buildings and paper is replaced by paper reduction, use of agricultural fiber for paper, and use of waste straw for building materials. Remember that up to half of straw and stover not only may but must be removed from the soil in sustainable agriculture.
- 4) Alternatively if the culture is already paper efficient, or if for some other reason waste straw and stover cannot be used as a manufacturing input, waste straw may itself be used as an energy source via gasification, F-T, or ultra-clean burning methods.

So biomass could produce a very important 15% of world-wide energy demand; it could provide hydrocarbon chemical stocks and gaseous and liquid fuels for processes that must have them. But again, for this not to be a disaster in practice would require an immense transformation in social context. Given a globalized market, extreme inequality both within and between nations, extreme corporate influence, and outright dictatorships in many nations in practice this would likely come at the expense of food production and the livelihoods of the poor, and often be a net emitter of greenhouse gases, and disrupt both natural and social ecologies in ways aside from greenhouse issues.

Fortunately, renewable electrical potential is far greater than any reasonable forecast for the poor nations as well as the rich. There is no significant demand for electricity that is not within 5,000 kilometers of a major potential dispatchable source – large amounts of geothermal or hydroelectric in rare cases, but mostly solar thermal and wind. (Remember, 5,000 kilometers is probably the practical limit for high voltage DC transmission.)

Take an especially knotty case – the United Kingdom. London has plenty of wind, but also is less than 2,400 kilometers from Tripoli as the crow flies. Transmission from North Africa to London via continental Europe and across the Chunnel would (of course) not be as the crow flies; but it could certainly be kept with that 5,000 kilometer limits.

Of course if Sky Windpower's gyromills prove practical, we could definitely get all we ever want. If they really can provide 2 cents per kWh electricity even more reliably than land based systems, total price for a 95% wind grid including storage could be provided at a cost comparable to fossil fuels today.

There are rare case where hydropower or geothermal may provide a significant percent of a nations electricity; in most nations there is at least enough of one, the other or both to complement wind power.