The Oil Drum: Europe
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

A review of the underlying fundamentals of nuclear energy

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I've been meaning to do a big nuclear energy diary for a long while, but Real Life constraints have prevented me from doing so. In the meantime, **NNadir** has been providing a steady stream of informative diaries on various aspects of the nuclear energy technology (read them all here).

As NNadir, who does not hide his (pro-nuclear) biases, I'll start by stating mine: I'm favorable to nuclear, as it is vastly superior in all respects to the coal-fired plants that dominate the industry in many countries, but I think we should focus policy first on conservation, then on renewable energy (in particular wind power, the sector I finance), and then only on nuclear. But that does mean that I consider nuclear to be invitable and thus necessary. I would like to note also that I am influenced by the French experience, which is highly successful, and has a number of traits which I think are desirable for the industry (strong State involvement, including for the financing of the sector, strong and independent regulation) and which may reflect my personal biases (the engineers that built and run the sector are alumni of the same university as me).

The macro-issues surrounding nuclear that I can see are as follows:

- is it safe? In particular, can it withstand a major terrorist attack?
- what do we do with the waste?
- do we have enough uranium anyway?
- is it cost effective? And do the announced costs include everything?
- aren't there better options to pursue before nuclear?

Is it safe?

I'll answer that one simply: nuclear energy can theoretically lead to much worse accidents than other industrial activities, but it *can* also be made safe. The risks are understood, the required procedures and technical standards are defined and can be adapted to effectively eliminate the risk of large scale incidents.

The circumstances that would lead to a large scale incident are quite remote and they require more effort, planning and resources than could likely take place. More importantly, should any group with murderous intent ever have access to that kind of resources, they are many much simpler acts that would have a bigger impact than an attack against a nuclear power plant with military grade protection.

Which brings us back to ensuring that safeguards and procedures exist and are actually enforced. That's a task that can only be run and managed by a public body with the ability to retain

competent personnel and to impose rules on the industry. That requires clear laws, a strong culture of regulatory enforcement, and the necessary high level political support and funding for the relevant body.

To me, this is the single most important element to ensure that nuclear is viable, and to make it possible for the public to trust the industry, something that a culture of secrecy and occasional contempt for the public has damaged.

That said, it has to be noted here that we tend to hold the nuclear industry to much higher standards than other bits of the power industry. I fail to understand why the public does not hold the coal industry to the same kinds of requirements, and tolerates amazingly high levels of pollution and other damage to the environment from coal mining and burning operations - and a proven high level of avoidable deaths in the general population every year. Coal (just like roads) seems, for some reason, an acceptable killer.

Two wrongs do not make a right, so there is no reason to argue for similarly sloppy supervision of the nuclear industry, but the double standard has to be noted, in particular with respect to the impact on the cost of each form of generation. A fair requirement would be to apply equivalent rules to all sectors on safety, pollution, and internalisation of all externalities.

What to do with the waste

The very long term, apparently open-ended need to take care into the distant future of what are potentially highly dangerous materials is the other big argument brought forward to show that nuclear energy is an unreasonable proposition.

Again, the technical solutions are, to a large extent, known. The volumes of material, their dangerosity and how they should be handled are known. The technical requirements for safe storage can be met. If done properly, it is possible to say that we are not leaving boig ticking bombs to our descendants. Two important requirements should be that (i) storage be reversible, so that, as we discover new technologies and new uses for nucleotides, we reduce the volume of waste stored and (ii) the cost of storage should be as transparent as possible and fully taken into account in the price of the energy.

Again, these are requirements that can be met with strong regulatory supervision of the industry. And again, these are requirements that are simply not applied to other power generation sources, except for wind power (which is currently obliged to pay for its decommissioning costs, something that I have never seen for any industrial activity, and certainly not for coal-fired plants or chemical factories). Can we make sure that the carbon dioxide spewed out into the atmosphere for the rest of eternity by gas-fired plants is not around to destroy our descendants's livelihood? Can we make sure that the mercury sent in the atmosphere by coal-burning plants - also for eternity - will not be around to pollute what our descendants eat and breathe?

Mercuty kills and hurts more people every year than nuclear waste ever has. Same with carbon dioxide.

How much uranium is there

I'll admit quite frankly that this is the question for which I have the least visibility. I have seen arguments that convincingly demonstrate that uranium is not an issue in the foreseaable future, and I have seen others that point to a looming shortage in a relatively small number of decades. Uranium is a relatively plentiful element, and so is thorium, which could be used in reactors of a slightly different (but known) design, but what matters is how much it costs to bring about the requisite volumes at the necessary concentration. I cannot answer that question myself right now, but would note that the pessimistic scenarios seem to put a "peak uranium" date pretty close to the expected date for peak coal (see this diary: Even coal (clean or not) will not save the

US way of life).

is it cost effective?

Ultimately, all these requirements bring us back to the issue of how much it costs to provide for our needs. I discussed the issue of what influences the cost of electricity in this fairly detailed diary last year (The real cost of electricity - some numbers) which I can only encourage you to read.

With respect to nuclear, as an industry with a combination of high upfront investment costs, low (even if increasing) fuel costs, and high, but far away decommissioning and waste management costs, the fundamental driver of electricity cost is going to be the discount rate used - i.e. the long term cost of money. Low interest rates mean that initial investments can be spread easily over the long term, thus bringing about vastly lower production costs. That means one simple thing: nuclear will always be much cheaper if financed by the State - and that holds true even if (especially if) the State financed all possible technologies. Similarly, the impact on production costs of decommissioning and waste storage requirements will depend on public decisions about the acceptable lifetime of plants. While there are objective technological constraints there, there will always be room for political decisions there. Finally, the cost of catastrophic insurance cannot be borne by the private sector and will always be borne (whether by law as in the US via the Price Anderson Act, or in practice in all countries) by governments, the only entity able to act should a large scale accident happen. How that insurance is priced is to a large extent a political decision, and it will depend fundamentally on the quality of the regulatory oversight imposed on the industry.

This may sound convenient for someone who frequently praises the positive role that government can and should play, but the above shows that nuclear is an industry that can only be viable with heavy governmental involvement, and its competitiveness will hinge on decisions by public authorities, in particular with respect to the cost of financing. Those that argue for nuclear should make that point explicitly, and recognize that investing in nuclear energy requires governmental consent, supervision and involvement, and thus democratic support. once that step is made, the case for a government-run industry is quite strong, provided that the same government is able to put in place independent regulatory oversight at the same time.

What makes nuclear different from other sectors in power generation is that every angle requires government involvement. Wind would benefit from public funding for its high initial investment costs, but requires only limited oversight after that. Coal requires tough regulation of emissions and pollution, but public funding would help it only little.

Aren't there better options to pursue before nuclear?

With all that said, I'll restate here the order in which things would be done, in an ideal world:

- first, *conservation and energy efficiency*. "Negawatts" are the cheapest and most underexploited resource we have;
- second, *renewable energies, starting with wind*. They are proven technologies, are scalable and wind is already competitive, price wise;
- third, *nuclear*. it's the least bad way to provide the base load capacity we'll need in the foreseeable future;
- fourth, *gas-fired plants*. Gas is less polluting than coal, gas turbines are very flexible to use. Such plants will probably be needed (in places that do not have sufficient hydro) to manage the permanent adjustment of supply to demand that electricity requires;
- last, *coal* should be dismantled as quickly as possible from its current high levels of use - and new construction should be stopped.

I often have a discussion about wind with the pro-nuclear crowd; whereby they point out that

wind is still providing an insignificant share of our needs, and that its intermittent nature will impose the presence of some other form of baseload capacity to ensure certainty of supply. To me, the first argument is not one, and we should make all efforts to ensure that wind reaches the 20% of production that are acknowledged as the level that can be absorbed at little cost by the networks. The second one is very real, and barring a breakthrough in storage technology (something not to be discounted) or in some smart combination of wind turbines with other on-demand technologies at a reasonable cost, it is true that wind will not be able to provide for all of our demand, and thus, the least damaging source available is, indeed, nuclear. Solar is still very expensive, and large scale use (again, barring major technology breakthroughs) is likely to involve massive pollution (and depletion) risks as the materials used for now are highly polluting and some are quite scarce. Biomass can play a role within sustainably harvested forestry programmes. Other biofuels and waste will always remain marginal (given the limited supply sources).

Thus, I expect nuclear to be pursued, but it would be better if it were done with the following conditions fulfilled:

- strict public oversight (which should exclude a number of countries from pursuing it);
- full transparency in waste management and accounting;
- democratic support, and
- ideally, public funding.

In fact, these conditions should apply to all forms of power generation, starting with coal-fired plants. But will the public have the stomach for full cost accounting of our current energy use? If, in all likelihood, the answer is no, then we will have an energy policiy that focuses on the exact opposite order: coal will come first, followed by nuclear and some renewables. And we'll keep on dying from air pollution and global warming while worrying about nuclear waste.

Some further diaries:

Is Nuclear Power a Viable Option for Our Energy Needs?> by **Martin Savior here at the Oil Drum**

NNadir diaries over at European Tribune

How Sweden deals with nuclear waste by Starvid

Nuclear renaissance in Europe, part 2 by Starvid

Nuclear renaissance in Europe, part 1 by Starvid

The Nuclear Skeptic Part 2: Megaprojects vs Micropower by DeAnander

The Nuclear Skeptic, Part 1: Sketching the Playing Field by DeAnander

Chernobyl +20: retrospectives and dispatches (long) by DeAnander

Chernobyl's Downplayed Victims by DoDo

Case for nuclear energy 'overwhelming'? by Jerome a Paris

Government works. The exemple of power generation by Jerome a Paris

A Nuclear Lobby Lie by DoDo

Nuclear energy in France - a Sunday special by Jerome a Paris

On waste, the English version of the site of the French nuclear waste management agency is a good place to start.