Archive for the 'Nuclear Risk Assessment' Category

IAEA and ExternE-Pol comparative assessments of external energy costs

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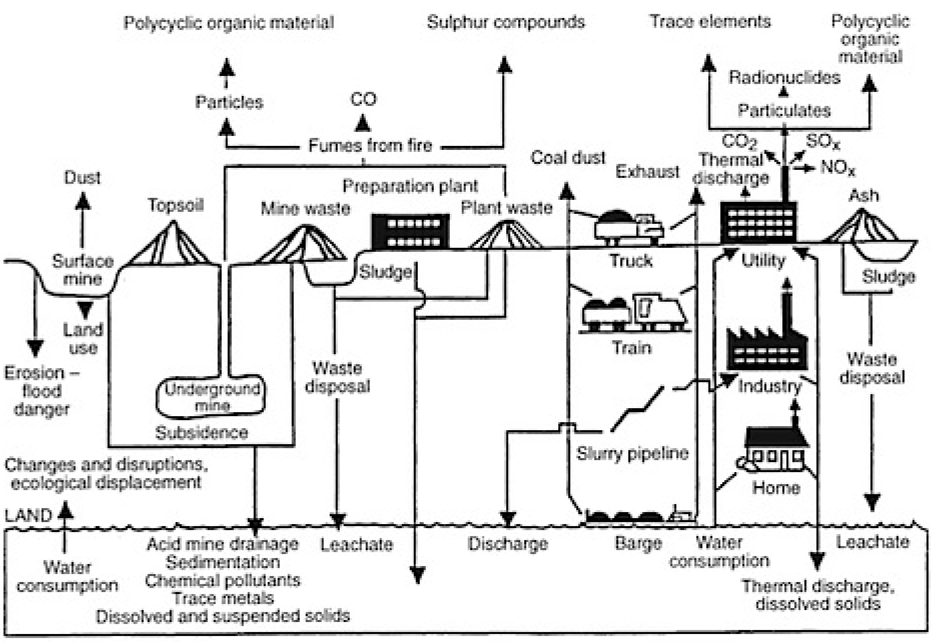
Tags: Nuclear, Nuclear Power, Power

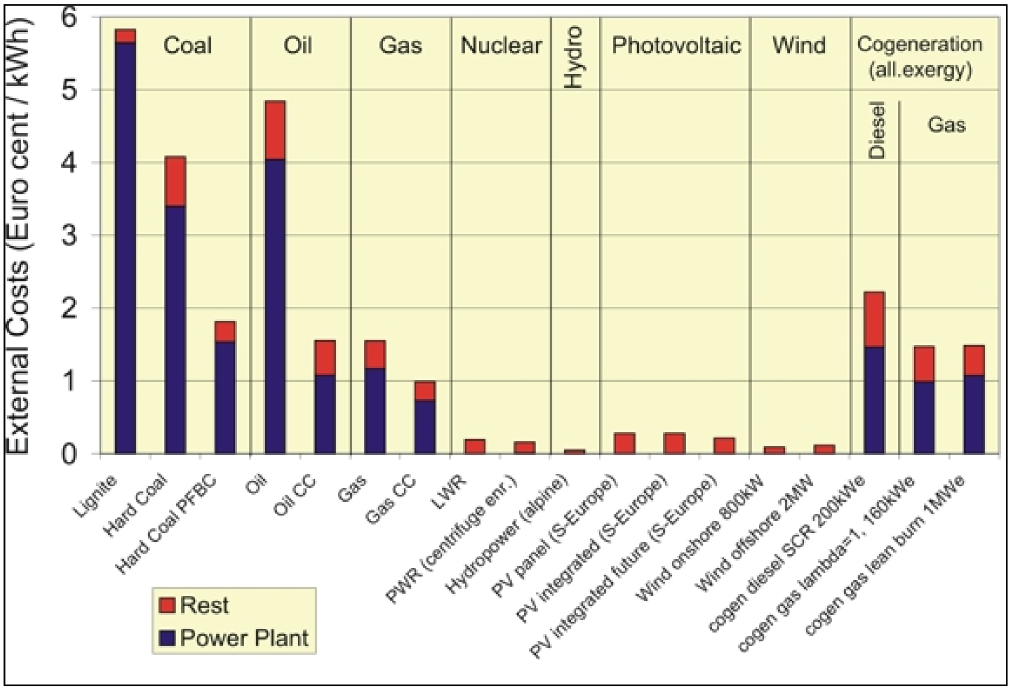
If you are keen to really get stuck into the comparative assessment of various energy sources, you will need these three reports. **First** is the 192 page Health and Environmental Impacts of Electricity Generation Systems: Procedures for Comparative Assessment (PDF) should be on your reading list. There are 179 references and about 40 contributors from Harvard to Israel to Indonesia to Sweden.



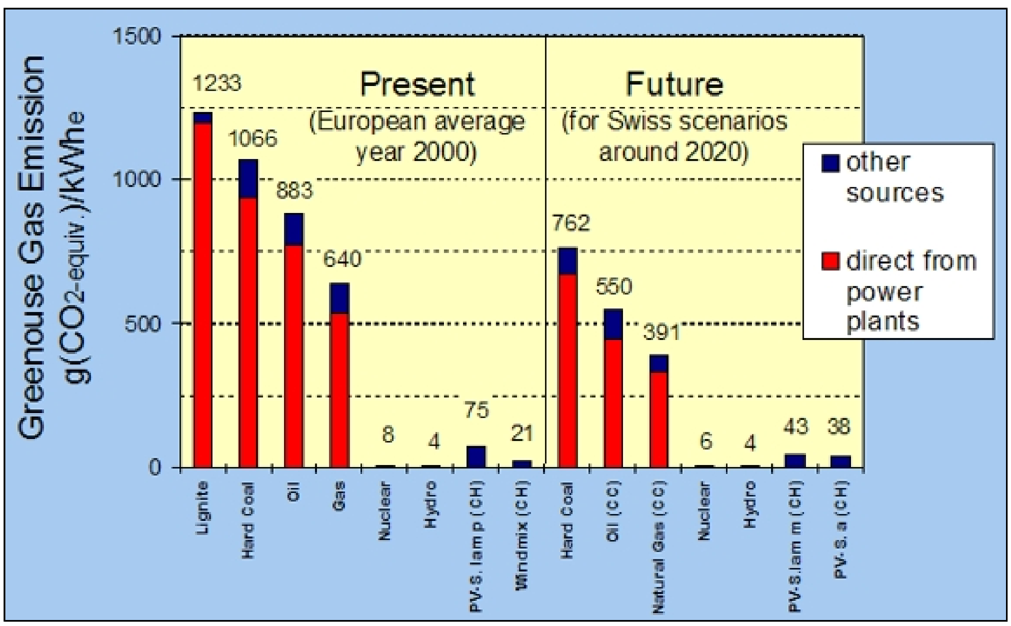
I've not worked out how much overlap there is between this study and the following ExternE study (which is extensively referenced).

Second, the fine details of the ExternE study, please refer to the 222 page ExternE Externalities of Energy Methodology 2005 Update (PDF).

Third, the Paul Scherrer Institute (PSI) was responsible for the Life Cycle Assessment (LCA) of new technologies for the revised ExternE-Pol study. I was pleased to see that the latest external cost figures for nuclear are confirmed as small fractions of one Euro cent, smaller than the solar PV options they studied (which are also negligible). Bottom line is the external costs for nuclear, hydro, solar PV and wind are all at least an order of magnitude less than fossil fuels.



And for those who persist in believing that solar and wind are more global-warming GHG friendly, study the following sample result from the new PSI life cycle assessment of Switzerland's energy mix projected through 2030. Note that even with projected improvements in solar-PV and wind these are still multiples of 7 to 10 times the nuclear contribution.



NRC: Fact Sheet on Probabilistic Risk Assessment (PRA = PSA)

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Tags: Nuclear Power

There are a number of papers available on the internet on the PRA methodology and results. A quick introduction can be found in the U.S. Nuclear Regulatory Commission fact sheet. Excerpt:

> One of the Nuclear Regulatory Commission's key responsibilities is to ensure the operation of nuclear power plants and other NRC-licensed facilities present no undue risk to public health and safety. The agency does this by applying and enforcing a set of technical requirements on plant design and operations, described in Title 10 of the Code of Federal Regulations (10 CFR). Generally, these are written in terms of traditional engineering practices such as "safety margins" in design, construction, and operations. Probabilistic risk assessment (PRA) systematically looks at how the pieces of a complex system work together to ensure safety. PRA allows analysts to quantify risk and identify what could have the most impact on safety.
>
> **Risk**
>
> Risk is determined by two factors:
>
> How often might a particular hazard arise?
>
> How much harm is likely to result?
>
> Risk is reduced in two ways: by making an undesirable event less likely or by making its outcome less serious. The NRC and the nuclear industry use PRA as one way to evaluate overall risk.

Read more »
Note some countries call this "Probabilistic Safety Assessment (PSA)" such as Japan.

PSI: risk assessment for energy-related severe accidents

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The Paul Scherrer Institute (Switzerland) has developed the database ENSAD (Energy-related Severe Accident Database) on energy-related accidents and an assessment of the corresponding externalities (overview of ENSAD as PDF). The database covers the period 1969-2000 and is in the process of being extended to 2005. To my knowledge this is the most comprehensive global study of the subject.

What are severe accidents? From the ENSAD overview

> *The work covers severe accident risks in fossil energy chains, i.e. coal, oil, natural gas and Liquefied Petroleum Gas (LPG), as well as hydropower and nuclear.*
>
> *Based on the literature, there is no unique definition of a severe accident. All definitions include various consequence (damage) types (evacuees, injured persons, fatalities or costs) and a minimum level for each damage type. The differences between the definitions concern both the set of specific consequence types considered and the damage threshold.*
>
> *The PSI database ENSAD uses seven criteria to define a severe accident:*
>
> *1) at least five fatalities or*
>
> *2) at least ten injured or*
>
> *3) at least 200 evacuees or*
>
> *4) extensive ban on consumption of food or*
>
> *5) releases of hydrocarbons exceeding 10 000 t or*

6) enforced clean-up of land and water over an area of at least 25 km2 or

7) economic loss of at least five million USD(2000).

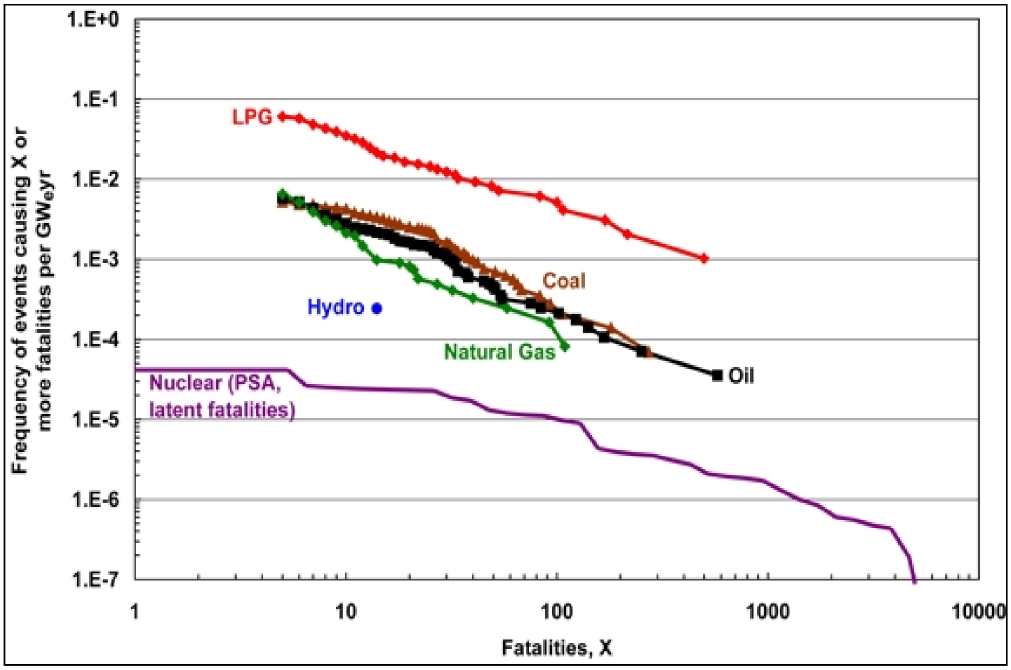

***Figure 2**: Comparison of frequency-consequence curves for full energy chains in OECD countries for the period 1969-2000. The curves for coal, oil, natural gas, LPG and Hydro are based on historical accidents and show immediate fatatlities. For the nuclear chain, the results originate from a plant-specific Probabilistic Safety Assessment (PSA) of a nuclear power plant and reflect latent fatalities.*

PSI has published a short article Risk Assessment Selected Results, from which the above summary of frequency-consequence curves has been extracted. Because there are zero OECD nuclear fatalities, the purple nuclear curve is based on PSA applied to a Swiss nuclear plant. The PSI study for non-OECD countries includes Chernobyl which introduces a non-OECD data point of 31 immediate fatalities (about where the blue Hydro datapoint lies in Figure 2).

From the OECD/NEA 2010 report, which uses the same PSI database:

> *Frequency-consequence (F-N) curves are a common approach in complex engineering industries to express collective or societal risks in quantitative risk assessment. They show the probability of accidents with varying degrees of consequence, such as fatalities. F-N curves provide an estimate of the risk of accidents that affect a large number of people by showing the cumulative frequency (F) of events having N or more fatalities, usually presented in a graph with two logarithmic axes in order to condense a large data range onto one diagram.*
>
> *(…) PSA is a powerful method of assessing safety improvements for a particular plant. However, it is difficult to make comparisons between different reactor units because of differences in plant configurations, initiating events included in the study and the accuracy and completeness of reliability data used in the calculation. Therefore, the CDF and LRF values shown here provide an indication of general safety trends in reactor design developments; they should not be used to make comparisons between reactor types of the same generation.*
>
> *The data presented here are readily available via the internet and they show that the predicted frequency for a large release of radioactivity from a severe nuclear power plant accident has reduced by a factor of 1 600 between the early Generation I reactors and the Generation III/III+ plants being built today.*

MIT study: The Future of the Nuclear Fuel Cycle (major report released)

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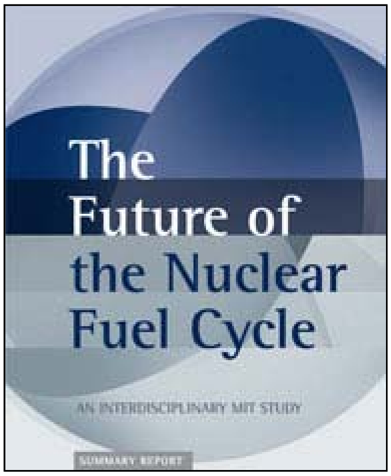
Tags: Nuclear, Nuclear Power, Power

> *(…) The report also* ***strongly supports the present US government policy of providing loan guarantees*** *for the first several new nuclear plants to be built under newly revised licensing rules. Positive experience with "first-mover" plants—the first of these new US plants built after the current long hiatus—could reduce or eliminate financing premiums for nuclear-plant construction. Once those premiums are eliminated, Forsberg says, "we think nuclear power is economically competitive" with coal power, currently the cheapest option for utilities.*



The central conclusion of this just-released MIT study [PDF of the report summary] will not surprise regular Seekerblog readers: **there is plenty of uranium and even more thorium, so there is no resource constraint on the rapid growth of nuclear power**. I recommend reading the summary report carefully (the complete report chapters aren't yet published on the web). For an overview, the MIT Energy Initiative press release is useful:

> *(…) Ernest J. Moniz, director of the MIT Energy Initiative and co-chair of the new study, says the report's conclusion that uranium supplies will not limit growth of the industry runs contrary to the view that had prevailed for decades—one that guided decisions about which technologies were viable. "The failure to understand the extent of the uranium resource was a very big deal" for determining which fuel cycles were developed and the schedule of their development, he says.*

The study concludes that a uranium-initiated breeder design with a unity conversion ratio of 1.0 is likely to be superior to higher-conversion-ratio designs (ratios of 1.2 to 1.3). That's one of several new concepts for me:

> *The new study suggests an alternative: an enriched uranium-initiated breeder reactor in which additional natural or depleted (that is, a remnant of the enrichment process) uranium is added to the reactor core at the same rate nuclear materials are consumed. No excess nuclear materials are produced. This is a much simpler and more efficient self-sustaining fuel cycle.*

One of prof. Fosberg's CSIS presentation slides captures the uranium supply/demand picture succinctly:

> ***Best estimate of 50% increase in uranium cost if:***
>
> ***• Nuclear power grows by a factor of 10 worldwide***
>
> ***• Each reactor operates for a century***

I believe that the new MIT study is a "big deal" — it provides high-credibility backing to almost every nuclear fuel cycle concept that we have been proposing (such as preserving the enormous value of "waste" for future use as fuel cycle feedstock). Our job now is to motivate the politicians to adopt and implement the conclusions.

PS – I'm keen for Appendix A to be released "Thorium Fuel Cycle Options".

Safety, cost and regulation in nuclear electricity generation

Published July 15, 2010 Energy Policy , Nuclear Costs , Nuclear Power , Nuclear Risk Assessment Leave a Comment
Tags: Nuclear, Nuclear Power, Power

Canadian chemist, materials scientist, scientific skeptic, commonsense utilitarian, and rational pragmatist DV82XL contributed a don't-miss guest post to BraveNewClimate. Barry designated this post as TCASE 11.

> (…) Unless you intend to design a nuclear reactor from scratch, you are going to have to accept whatever level of safety is designed into the one you buy. No original equipment manufacturer (OEM) is going to derate their product to cut costs for you. And that will go for things you will have to build yourself, like the containment, and spent fuel facilities. No one is going to risk their brand letting you install their product on a substandard site. But this is not where costs get out of control anyway.
>
> Nor is it in operating safety protocols, which at any rate are tied into general plant integrity routines that must be done anyway. Ultimately cutting back in this area runs the risk of some failure occurring that might stop the plant from producing power, (i.e. stop making money) or causing harm to an employee. In other words most of this falls under housekeeping anyway.
>
> The only place where costs can be controlled which is often (erroneously) referred to as *safety issues*, is unreasonable procedural nonsense during the initial build. Even this is not the real expense in and of itself, but it is the delays that these can cause that push cost overruns into the stratosphere. It is seeing that these do not get out of hand that is the real way to keep costs down. In any sane world too, most of these procedural issues would be properly referred to as Quality Assurance, or Quality Control (QC), as they would have little to do with real safety issues, but in the politically charged world of nuclear power plant (NPP) builds, the antinuclear forces spin these to security and safety issues their own ends.

Do read the whole thing »

Bernard Cohen

Published July 14, 2010 Nuclear Power , Nuclear Risk Assessment , Nuclear Waste Leave a Comment
Tags: Nuclear, Nuclear Power, Power

Physicist Bernard Cohen is a go-to source on nuclear energy. His University of Pittsburgh page includes links to a number of papers, particularly those disproving the LNT Linear No Threshold hypothesis.

Analysis of the 2010 Nuclear Summit and the obsession with highly enriched uranium

Published April 15, 2010 Nuclear Power , Nuclear Risk Assessment Leave a Comment
Tags: Nuclear, Nuclear Power, Power

Politicians continue to profit from inflaming public opinion that terrorists are just about to acquire nuclear weapons. I cannot think of a politician who has lost votes by playing this gambit. Fortunately, the scenario is a Hollywood fantasy. The truth behind the proliferation scare campaign is easily discernible by considering the incentives. Who gains be restricting access to HEU to the existing nuclear weapon states (NWS)? Like most topics in foreign policy, politicians rarely talk about what the real issues are.

Here is an excerpt from a guest post on Brave New Climate by a highly respected chemist (a top-rated Seekerblog reliable source):

Guest post by DV82XL. *He is a Canadian chemist and materials scientist (and regular, valued commenter on BNC).*

(…) First let's make one thing very clear: a subnational group (terrorists) cannot and never will be able to manufacture a nuclear weapon. This is true even if they were handed weapons-grade fissile material up front. Whatever the reasons for this drive to strip every last gram of highly enriched uranium (HEU) from every country in the world that is not one of the existing nuclear weapon states (NWS) 'terrorists' stealing this material to fabricate a weapon, is not one of them. HEU is treated by all countries that own it as if it were more valuable than gold, a critical mass worth of HEU represents a huge investment to a country who acquired it for a purpose, and as part of a program, the fact remains that this stuff is controlled and accounted for very closely, which is why it has never showed up on the black market.

Let's examine the first contention. While it is true a gun-assembled HEU uranium bomb is conceptually simple, building one that will work, is not and requires more resources than an extranational group can muster. A careful review of the facts suggests that there are technical obstacles to such an attack that are insuperable, and there is no evidence that any terrorist group currently possesses the expertise necessary for a nuclear effort. Claims that this is possible glosses over the difficulty of finding the kinds of highly qualified experts such a project would need and omits real consideration of at least a dozen points in the process where something could, and very likely would, go wrong that would bring the whole project to an end.

(…) Looking at it like this, the terrorists can see that it would require a very unlikely series of events and a great deal of effort, and pressed for information, any high school physics teacher will tell them there are no guarantees the damned thing will work. Result, scrap Plan A and go to Plan B: Hijack four widebody aircraft…

(…) This brings us back around to the current nuclear summit and the obsession with weapons-grade uranium and plutonium in the hands of smaller states, and the threat of climate change. If the role of nuclear weapons is seen by smaller powers as a military tool to counter large conventional forces mounting an invasion, or even to counter the projection of might from something like a carrier task force, this renders conventional military power useless as a threat. The current members of the NWS club are also field large conventional forces as well, and several have shown no compunction in using them to further diplomatic or economic ends. The possibility of having those forces rendered useless by a major round of proliferation, particularly in regions where they currently exercise domination and especially in the event that climate change alters the relative value of those same regions, is obviously unpalatable. In short, this is not about keeping the peace, but maintaining the status quo in the international power structure.

There is a price to pay for this however. Putting an end to commercial use of HEU is going to cause problems of its own and these are not insignificant. In fact several countries are balking at the

> prospect and have said as much at the summit. Reading between the lines, it is also clear that their intransigence will be addressed at the G8 meeting later this year.
>
> The two most widespread uses of HEU are as research reactor fuel and as targets for the production of medical and industrial isotopes. While few in number, test reactors, used for experimental fuel development for NPP, also need to be very powerful, and thus need enriched fuel. In addition to research and test reactors, there are also critical assemblies, subcritical assemblies, and pulse reactors that use fuels containing HEU. Critical and subcritical assemblies, for example, are typically used for either basic physics experimentation or to model the properties of proposed reactor cores, while pulsed reactors, are used to produce short, intensive power and radiation impacts.
>
> (…) In short, activities that depend on high flux neutrons, in medicine, industry, and research, will be the private domain of those states that deploy nuclear weapons. This includes the development of nuclear energy, and power reactor design, which requires access to high flux neutrons to qualify material and assemblies, essentially closing the door on any further competition, (as well as the end of CANDU development) putting the NWS in virtual control of nuclear energy all over the globe, further extending their economic hegemony for the foreseeable future.
>
> This is the real story here. The facts are all in front of us, and available to anyone who wishes to explore them. They are not that complex, and the geopolitical, economic and military ramifications of nuclear technology, and the impact of policy on them, are surprisingly simple to understand by anyone that takes the time to background themselves in these topics. I encourage everyone to do so as I believe you will draw the same conclusions I have in these matters.

Highly recommended, please read the whole thing. Do keep in mind that another motivator to promote this theme is the benefit that anti-nuclear advocates receive from creating the (irrational) fear that civilian nuclear electricity automatically means more nuclear weapons.