Review of: "[Commentary] Fallacy of Abundant Cheap Nuclear Energy"

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Potential competing interests: No potential competing interests to declare.

The work focuses on the energy created by specific fuels and the energy required to 'produce' the raw material or energy carrier. Based on my comments below and the identified inaccuracies, I would recommend rejecting this article to avoid the distribution of misleading facts. The conclusions may be supported by the facts presented, but the facts presented do not stand any scientific discussions! The conclusion, "Therefore, from simple college physics calculations, it stands that the propaganda of abundant cheap nuclear energy is fallacious," just confirms that even simple college physics applied without any understanding can lead to simplified, wrong results when the basis is wrong and the understanding is missing.

In general, the work should be linked to other correlated approaches, e.g., EROI Energy return on investment - Wikipedia, or on a more scientific level Energy Return on Investment - an overview | ScienceDirect Topics This would maybe help to provide the reader with a proper comparison level with other technologies than just the used examples.

About fusion

"However, they have not given energy to manufacture the deuterium and tritium pellets used for their so-called fusion." – This is an excellent observation; in my view, it would even be required to look deeper into all side systems (the engineering around) which are using energy. However, I would be careful with the wording—why so-called fusion?

Plutonium

"Similarly, it is said by nuclear technologists that one thermal MW day energy is required to produce 0.9 gram of Plutonium." – I think here, the author has fallen into a misunderstanding. The amount of Pu which is produced on 1 MWd reactor operation is a side product; the plant is operated to produce energy, and due to breeding processes, Pu will be produced anyway. In addition, the Pu production is by far not linear, since with longer operation, a part of the Pu is already used for energy production in a power reactor!

Calc 1 is doubled, which is not required. In addition, I would recommend the author to stay with SI units.

Calc 2 is, in my view, not a good basis; the explosive power of Pu in a bomb is highly dependent on the design, and in no 'gadget' all Pu will be fissioned – thus the energy content calculated is not meaningful.

I would recommend starting with the energy per fission of Pu, which is ~ 200 MeV or 7.6586E-12 cal, to be multiplied with the Avogadro constant (6.022 E23) and divided by the molar mass in kg (0.239), which leads to ~1.93E+10 kcal/kg for Pu-239, where about 90% can be harvested in a nuclear reactor.

Thus, the claim of Pu being a false fuel can't be held. Two major errors: a) the thermal energy is not invested to make the Pu, at least not in a civil reactor; b) the determination of the energy content of Pu is not correct due to the process used for the basis.

Uranium

Sorry to be harsh, but the basis itself is wrong from the beginning. The approach used (E=mc2) is when matter is converted into energy completely. I fear we currently have, to my knowledge, no process which allows us to do this to a large extent. The mass loss of a fission reaction is only marginal, see e.g., nuclear physics - Loss of mass in a fission reaction - Physics Stack Exchange, or it can simply be determined by the released energy of 200 MeV per fission, see above. Thus, the energy released when 1 kg of U-235 is fissioned is, in first-order accuracy, the same as that of 1 kg of Pu! Thus, all following considerations are not meaningful, sorry to say this.

To close this, using the data for Olympic Dam shows that the amount of material to be moved to produce 1 kg of reactor uranium (4% enriched) is about 1/5 compared to the amount of coal that has to be burnt to produce the same amount of energy, and the coal has to be moved.

“Therefore, to prepare Uranium fuel, fossil fuels are required in the long run.” – that is just a postulate – any kind of energy source can be used.

“To extract iron from 80% iron ore, the same amount of coal by weight is required.” – this basis is again double wrong: a) a significant part of the coke, not coal, is required to react with the oxide to withdraw it from the iron ore, b) the author is comparing a melting process with a chemical process – the processes are so fundamentally different that the result will not be meaningful in any way.

“France uses 0.3% Uranium ores for its nuclear energy” – for this claim, there is no reference, and it is not understandable at all. Uranium ore contains almost exactly the same amount of U-235. If the author tries to point to this (I don't want to give a course in nuclear processes here to explain why), the 0.3% is the remainder of U-235 in depleted Uranium, thus the leftover of the enrichment process.

“With a complete combustion or fission” – to mention combustion and fission as equivalents is physically and chemically wrong in a way that is completely unacceptable.