The nuclear option against climate change

Associated risks, limitations and barriers to alternatives

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Exectutive Summary[1]

- **Risks: Reinforcing the use of nuclear energy would inevitably increase nuclear proliferation, the risk of a major accident and the accumulation of radwaste, which are intrinsic to this option and have grown with it.**
- **Efficiency: Nuclear energy only accounts for "avoiding" a few percents of worldwide emissions and its role, limited to the restricted area of electricity related emissions, decreases as more efficient options develop.**
- **Consistency: Nuclear new build displaces faster and cheaper options that are available to reduce emissions; existing reactors also act as a barrier to the urgent implementation of those better options.**

Introduction

Climate change is a major risk calling, as a matter of priority, for the urgent abatement of the use of fossil fuels, which together account for more of 80% of the world energy consumption. This can be reached combining a reduction of the amount of energy needed to satisfy energy services, and the replacement of fossil fuels by non-carbon energy resources. While the role of renewables is generally admitted, although their capacity to deliver remains questioned, resorting to the nuclear option for this replacement is much disputed.

This important issue is considered here under three complementary perspectives: beyond the obvious question of specific risks attached to this option, the analysis focuses on the efficiency of nuclear energy to cut greenhouse gas emissions, and the role that it could play in an overall consistent strategy up to the required level of global reduction of emissions.

Specific risks attached to the use of nuclear energy

Nuclear energy comes with some risks which, by their nature, make it a special option. Compared to other options considered to tackle climate change, these specific risks mostly relate to three major concerns.

- ***Nuclear proliferation, the hidden but persistent threat*** - The first risk attached to the civilian use of nuclear energy has historically been that of the diversion of its materials and technologies for military purposes. While the local consequences of exploding a nuclear weapon are by themselves catastrophic, a global nuclear war could even lead to a "nuclear winter" threatening humanity.
- ***Nuclear accident, a reassessed and growing risk*** - Major nuclear accidents have been more than 100 times more frequent than theoretically planned, revealing the weaknesses of existing safety features. They have heavy, long-lasting consequences on the populations and the economy of the countries they hit. Still many factors, from ageing to economic pressure through terrorist threats, tend to increase that risk today.
- ***Nuclear waste, materials and contaminated sites accumulating*** - Nuclear power produces radioactive waste, of which the most active could yet not be disposed of in any country. It also goes with radioactive discharges into the environment at every step of the production chain.

The specific risks attached to this energy have grown with the use of nuclear power. Whatever everyone's assessment of their seriousness is, these risks would certainly further increase if nuclear power is further developed and its use expands to more countries.

A limited efficiency in curbing emissions

The impact of using nuclear power on reducing greenhouse gas emissions needs to be characterized. This actually relies on an estimate of the "avoided" emissions that it allows compared to not using it.

- ***Indirect but not negligible CO_2 emissions*** - Nuclear power, through its lifecycle, is indirectly emitting greenhouse gas emissions, in the order of some tens of grams of CO_2 per kWh – a level close to that of renewables and significantly lower than that of fossil fuels, but still not nil.
- ***Avoided emissions, depending on the "mix"*** - These indirect emissions must be compared to those "avoided" by nuclear generation, that is the emissions which would arise from the same production without nuclear

1. The full report, *"L'option nucléaire contre le changement climatique – Risques associés, limites et frein aux alternatives"* , was commissionned by Amis de la Terre, the Heinrich Böll Foundation, France Nature Environnement, Greenpeace, Réseau action climat - France, Réseau "Sortir du nucléaire", and WISE Amsterdam.

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power. The result very much depends on what one assumes nuclear power is to replace in each case, whether it be coal power or renewables, or even energy efficiency displacing the need for power. A reasonably conservative method consists in considering that nuclear power replaces a proportionate mix of the existing sources of electricity at the time, leaving aside potential action on demand.

- ***A marginal contribution to the evolution of emissions*** - Using this method, nuclear power accounts for around 1.5 billion tons of CO_2 avoided compared to today's yearly emissions. This remains quite marginal, especially compared to the 20 times higher growth of actual emissions since nuclear power was introduced. Up to its current level of development, nuclear energy has never been able to curb the increasing trend.
- ***A declining role in energy and climate policies*** - Furthermore, stagnation of nuclear power and its declining role in world electric production take its contribution down. Using the same method again, nuclear "avoided" emissions amounted to a maximum of 6% of actual CO_2 emissions by 2000, now down to less than 4%.
- ***A restricted range of action*** - Also, the substitution by nuclear power is limited to a share of the electric sector, which represents less than one fourth of the total emissions. The development of nuclear power up to nearly 80% of French electricity production accounted for a cut by around 15% of the country's CO_2 emissions. While no further impact could be expected, this brought France's overall greenhouse gas emissions no lower than four times a sustainable level.

Greenhouse gas emissions that are "avoided" by the use of nuclear power instead of other energy sources, taking into account its own indirect emissions, have been marginal, with no impact on the overall increase of worldwide emissions, and are now declining. Moreover, since its action is mostly limited to a share of the emissions of the electric sector, nuclear power, even pushed to its maximum, is by nature not able to bring emissions down to a sustainable level.

A barrier to most performing options

Taking these limitations into account, nuclear power can only appear as a complementary option to other actions to tackle climate change. Then it is a matter of how nuclear power fits in a global strategy which mobilises in the most consistent and efficient way the different options, with a distinction between new build and existing reactors.

- ***The limitations to voluntarism*** - Prospective scenarios generally see a contribution of around 10% at most of nuclear power to the overall reduction of greenhouse gas emissions needed in the coming decades. A greater contribution would call for a dramatic change of scale of the world nuclear fleet that is completely out of reach. In fact, even this minor level of contribution would require a major effort to build new reactors in numbers never sustained before and unlikely to be reached in the current situation.
- ***The dynamics for other options*** - The idea that such an effort is still needed to ensure that nuclear power fulfills this additional role is historically based on a stronger confidence in the deployment of new reactors than the acceleration of renewables growth. Their real dynamics is nowadays just the opposite. Electric renewables have gathered on average ten times more investments than nuclear power over the last decade.
- ***The lost competitiveness of nuclear power*** - Nuclear power has generally seen a continuous increase of its costs, now to the point of becoming less competitive than the most efficient renewables, which on the contrary see a steady decrease of their costs. As a result, the construction of new reactors turns into one of the most expensive options to cut emissions, and this trend is likely to persist.
- ***An insufficient action*** - While the US illustrate that a country can be both the first nuclear producer and the second greenhouse gas emitter in the world, there is no country showing the role of nuclear power to bring down emissions to a sustainable level. From the shift of priorities in China to the problems of new reactors projects in Europe, relying on new reactors always appears more difficult to implement, slower to deliver and less effective than energy efficiency and renewables projects, for which opportunities exist everywhere.
- ***An unnecessary option*** - Conversely, an increasing number of countries provides demonstrations, at various levels, of the feasibility, speed of implementation and effectiveness of these options. This is illustrated by Germany, which manages to decrease its global greenhouse gas emissions while phasing out nuclear power.
- ***An obstacle to energy transition*** - Maintaining existing reactors could nevertheless be seen as an asset in climate change policies. On the contrary, energy transition scenarios for France show that its decrease is key for achieving climate objectives. This is because nuclear power acts as a barrier to the type of in-depth change of the energy system that is needed to meet that goal. By doing so, it also postpones the economic fruits, especially the jobs creation, that this energy transition bears.

The urgency calls not for adding all the options without priority, but to select the most effective ones and combine them in the most consistent strategy. Nuclear power can only pretend to a minor role, complementary to the developments needed in any case on energy efficiency and renewables. However, new reactors turn to be more expensive, slower and delivering less than additional efforts in those directions. Moreover, existing reactors create a counter-productive obstacle to the fast implementation of these most effective options.