

Thorium MSR Foundation Update 2019

This Update 2019 supplements the Annual Report 2019 of the Thorium MSR Foundation. While publishing the [Annual Report](#) is a legal requirement, this Update gives you a more comprehensive picture of what the Foundation has been doing.

2019 was a year of shifting public opinion and steady progress

In 2019, the debate about nuclear energy really broke out in the Netherlands. We think it's fair to credit comedian Arjan Lubach for kickstarting this overdue debate. On November 4, 2018, his TV show 'Zondag met Lubach' kicked open the doors of the policy makers of the energy transition, doors that had been closed to the option of nuclear power, with a provoking and hilarious episode of his show. The episode was remarkably well researched. It can be watched here: <https://www.youtube.com/watch?v=YjFWiMJdotM> (choose English subtitles in the lower right corner).

Of course, Lubach's TV show did not appear out of nowhere. In the preceding years, a number of persistent and knowledgeable commenters had been pointing out the necessity to add nuclear to the toolkit that should make our economy carbon neutral. In the Dutch media, like in the media in most the western world, articles about renewable energy fail to put their development in the proper perspective of what is needed. Even for the better-informed, it is almost impossible to get an accurate impression of how much effort it will take to get a real-world transition, and to what extend the technologies and plans discussed could contribute to reaching a meaningful result. A telling example was provided by some reactions to the premature closure of the Fessenheim nuclear power plant in France. The praise in response to this closure from European 'green' parties, is inexplicable if one realizes that this single closure of an old (yet well-functioning) nuclear power plant, wiped out all clean power capacity build-up by the installation of solar panels in France, since it began, decades ago. However, this silent disaster never made it to the headlines of the newspapers.

Fortunately, a growing number of people are becoming aware of some challenging aspects of what in the Netherlands is called the 'energy transition'.

Why an energy transition without nuclear has a high risk of falling short

The first of these aspects is the enormity of the task. This aspect is slowly dawning on ever more people. As countries that have ratified 'Paris' are struggling to come up with their own feasible and credible pathways to achieving sustainable and emission-free power, ever more people are aware that emissions do not stop at borders, and a reduction in one country can easily be nullified by increasing emissions in other countries – especially in developing countries, where poverty reduction very understandably has a higher priority than climate policy.

Another challenging aspect is that advertised cost reductions of wind and solar energy often obfuscate the fact that what ultimately matters is not the cost of the power produced at the source, but rather the cost of transforming the electricity system, and ultimately, the cost of transforming the energy system as a whole. Renewable energy production units are spread over large areas. Building the infrastructure needed to transport their electricity is usually not included in the cost per

kWh of the production units. Neither is the cost of the back-up of the power production units, necessary to compensate their intermittent production. These 'external' costs are usually not included in the advertised costs of renewable energies. But these have to be paid nevertheless.

A more fundamental aspect of variable renewable energy is that once a considerable share of variable renewable energy is added to the electricity system, market prices for the electricity produced tends to drop to zero and below at times of favorable production conditions. In these market conditions, every source becomes the competitor of every other. This so called 'canibalization' effect can be an obstacle in deploying larger shares of variable sources. These price drops do not mean that electricity becomes 'cheap' as some politicians seem to think – it rather means that at these times, production units are not earning money, while their cost still have to be paid.

A specific anomaly that ever more people are becoming aware of is already briefly mentioned: the closure of existing, well-functioning nuclear power plants. Every closure of an existing nuclear power plant wipes out the effects of the growth of clean power from other sources. We've already mentioned 'Fessenheim', but Germany also continues to close its fine nuclear power plants, like the ones in Gundremmingen (early 2019) and Philippsburg (early 2020) as if neither climate, nor clean air is an issue. In Germany, these closures are often justified by statements that 'these are necessary for the Energiewende', but in times of climate change, coal and lignite plants should be closed first, and closures of clean nuclear power should be avoided.

In the Netherlands, over the course of 2019, the burning of biomass has become politically unfashionable. While it is strongly supported by the EU's energy policy, biomass has problematic aspects. In the Netherlands, the construction of dozens of biomass plants for district heating has been planned. These plans have become controversial in the course of a year. This has put regional governments in a fix: by law, they are obliged to support the 'energy transition'. However, the people in the regions oppose the tools used ever more strongly: wind turbines on land, fields of solar panels and biomass plants face a growing, and sometimes fierce opposition. A growing number of people ask: 'why don't we use nuclear power?'.

As more and more people start understanding these unpleasant facts about Europe's energy transition, we see an emerging credibility problem of political and other societal parties that promote an energy pathway that exclusively relies on wind and solar power, while excluding nuclear power. We see an important support for nuclear energy in the 2018 reports of the IPCC that nuclear power has a so called 'system emission' of CO₂ that is low and comparable to the system emissions of wind power. Green parties and other traditional opponents of nuclear power now have to explain why their assessment of nuclear power's system emissions contradicts IPCC science.¹

In contrast, as also Lubach has pointed out in his TV-show, is that in each of the four IPCC example scenario's in the section 'Breakdown of contributions to global net CO₂ emissions in four illustrative model pathways', described in the Source: IPCC Special Report on Global Warming of 1.5°C, nuclear

¹ The scientific IPCC-assessment of system emissions are described in table III-A-2 of 'Annex III': https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_annex-iii.pdf

power plays an important role, varying from *doubling* its capacity in the more modest scenario to growing *six fold* in the most ambitious one.²

Why we need molten salt reactors, even while PWR's are safe and affordable

As the Thorium MSR Foundation, it is our strong conviction that the development of thorium molten salt reactors can make a considerable contribution to solving the societal stalemate between growing opposition to expensive, increasingly unpopular climate policy on the one side of the political spectrum, and unproductive yet historically explicable, strong antinuclear sentiments on the other side of the spectrum.

To understand the possible contribution of MSR's, we have to distinguish the several aspects of thorium molten salt reactors: first the molten salt technology, then the thorium.

The most promising aspect of the molten salt technology is its potential to make nuclear cheaper than the obvious competitor: fossil fuel power. This expectation is based on the simpler and cheaper 'safety case' of molten salt reactors. The simpler and cheaper safety case is based on 'inherently safe properties' of molten salt reactors. This means that with molten salt reactors, the required high safety standards can be met, or even improved upon, at a smaller cost.

The possibility to use thorium, more specifically the possibility to create a closed thorium fuel cycle in a thermal reactor, implies a quantum leap in fuel efficiency. This would also imply a quantum leap in the reduction of the need for mining. It would also imply a quantum leap in the reduction of nuclear waste production. If we manage to build 'the right reactor' meaning we could create a reactor with good CAPEX and a closed thorium fuel cycle, one kilogram of mined 'heavy metal' would produce about a hundred times more energy, and at the same time effectuate a parallel reduction in mining needs and production of nuclear waste.

It is far from unreasonable to expect that for a large majority of the population, molten salt reactor technology, especially in combination with thorium, will be an attractive technology to endorse. The use of thorium molten salt reactor technology therefore may well present the ultimate 'middle ground' that appeals to the widest range of people. And it does so for a good reason: it provides a pathway to a controllable energy source that would help to realize the lowest system footprint of all energy sources, while delivering clean, dispatchable electricity that is cheaper than dirty electricity from coal. And MSR, like every nuclear power plant, has an extra bonus: every MSR added to the transition plan, will reduce the need to rebuild large parts of our power infrastructure.

In short: once realized, the thorium MSR will offer the cheapest, fastest and cleanest way to decarbonize crucial sections of the electricity system of industrialized nations. Once the technology is firmly established, it may offer a strong proposition to produce synthetic fuels that do not add CO₂ to the atmosphere and that can compete with liquid fossil fuels.

Cooperation with the broader pronuclear movement

In August 2018, Michael Shellenberger visited Europe. Early meetings in Amsterdam with pronuclear activists from all over Europe resulted in the establishment of several European Nuclear Pride Groups, including a Dutch branch. The meeting resulted in the organization of the first Nuclear Pride Fest, to be held later that year in Munich in October 2018 – which became a huge media success.

² https://www.ipcc.ch/site/assets/uploads/sites/2/2019/06/SR15_Full_Report_High_Res.pdf

During his Amsterdam visit, Shellenberger spoke negative about the idea to let the future of nuclear depend on the development of molten salt reactors, which he thought were a dream for a too distant future.

In response, rather than distancing and separating ourselves from his movement, it seemed all the more important to connect. Early developments of complex technologies are vulnerable: they can easily be hurt by inadequate information, whether it comes from antinuclear groups or from under informed pronuclear groups.

We believe that any dichotomy between the present-day nuclear sector and a credible development of molten salt reactors is unproductive. We do understand Michael Shellenberger's standpoint that at the present time, it is important to focus on presently available technology and on keeping well-functioning nuclear power plants open as long as is possible. When countries look for near term expansion of their nuclear fleet, or when these countries want to build reactors on the shorter term, the choice for proven designs is no doubt a good strategy. Life-extensions of existing reactors should be a 'no brainer' for any country that takes climate policy seriously – it is THE most cost-effective option for a low-carbon policy by far. A country's policy on nuclear power can be considered the litmus test for how serious the nation is about reducing CO₂-emissions. Closure of a well-functioning nuclear power plant while investing in renewables denotes the choice for a policy that will have a hard time explaining how it is serious about reducing CO₂-emissions. We consider it as no less than cynical if a country closes a nuclear power plant and replaces it with gas plants. The most recent example is the premature closing of Indian Point Nuclear Plant in New York, a perfectly well-functioning plant, that now will be replaced by methane power plants.

As we said, Michael Shellenberger's critical remarks about molten salt reactors have not stopped us from cooperating with Europe's Nuclear Pride Groups. Quite on the contrary, over the last two years, a close cooperation has evolved. This has allowed us to explain, certainly within these groups, why Dutch research institutions have a special position in molten salt reactor research and development. In the case of the Netherlands, MSR-research is real and hands-on, rather than a subject of political hand-waving. We have also been able to explain why this development is in no way incompatible with supporting the existing nuclear sector in the Netherlands. It is also quite compatible with supporting the build-up of political momentum to develop PWR-based nuclear capacity. Having a good and healthy nuclear sector is a prerequisite for the development of real world molten salt reactors in the near future. This has been the standpoint on which the Thorium MSR Foundation and Environmental Progress agreed, in a meeting with the EP staff in October 11, in Amsterdam. Our shared priority is to keep a healthy nuclear sector. We actively support actions to keep open present power reactors and also initiatives to develop new, PWR-based, nuclear capacity.

Another connection was reinforced in 2019 by a staff meeting between the Thorium MSR Foundation and Stichting Groene Kernenergie ('the Green Nuclear Power Foundation') early in the summer. Although there had been positive contacts at the personal level for quite a while, this meeting allowed us to discuss developmental intricacies of molten salt reactors, specific design challenges and, most of all, explain more about the special opportunities the Netherlands have in this development path. 'Groene Kernenergie' is doing important work especially in informing the public about the need to develop MSR's, and about the numerous misunderstandings that surround nuclear power in a broader sense. The meeting has strengthened the network and both foundations

will cooperate to further establish the goal of providing accurate information and avoid future backtracks on present claims.

Continued focus on pointing out The Netherlands unique opportunity

In the meantime, the Foundation will also continue with its own specific contribution: explain the need to develop molten salt reactors, explain the special opportunity that the Netherlands have in this development, and to find support for funding the all-important real-world hands-on research for which the Netherlands have outstanding facilities, capabilities and hence, opportunities. A large factor in this is Petten's High Flux Reactor (responsible for the production of about 1/3 of medical radioisotopes worldwide), and NRG's 'hot cell lab' facilities next to the reactor in Petten. Another large factor is the Reactor Institute Delf (RID) with its smaller research reactor, and, of course, all the knowledge that is present, fostered and developed at each of these knowledge centers. Dutch researchers on molten salt technology also cooperate closely with the European Commission's Joint Research Centre (JRC) in Karlsruhe, Germany. TU Delft's Jan Leen Kloosterman is leading the European MSR program SAMOSAFER. In short, the Netherlands are in the center of the European MSR research.

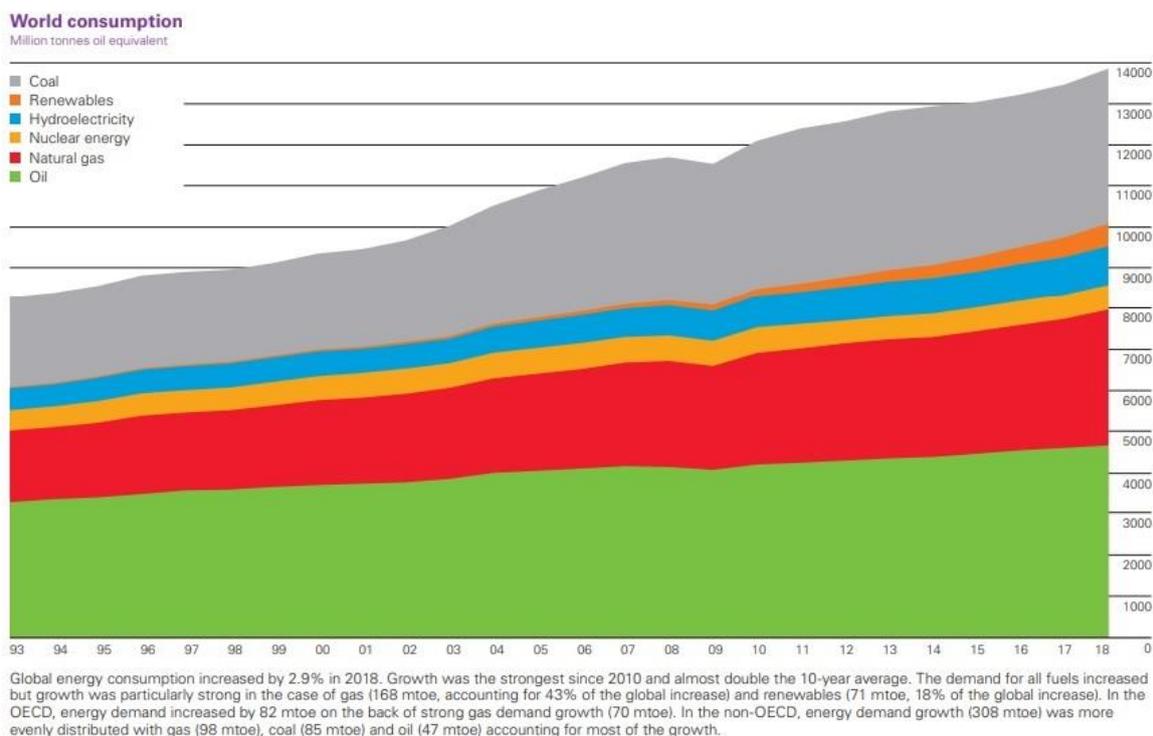
How to assess the realism of the perspective of MSR-development?

From the outset, it has been the purpose of the Thorium MSR Foundation to provide accurate information on molten salt reactor development and to avoid future backtracks on present claims. In that light it is necessary to agree to some critics that have pointed out that not all molten salt reactor proposals or initiatives live up to credibility standards. Some startups seem to be based on claims that may be difficult if possible, at all to realize. We've already seen how Transatomic Power, the molten salt reactor startup of Leslie Dewan and Mark Massie, had to backtrack on their central claims, as they made public early 2017. <https://www.technologyreview.com/s/603731/nuclear-energy-startup-transatomic-backtracks-on-key-promises/>. Based on assessments made by hands-on experts in the nuclear research field, several of the best known plans of present day MSR-startups may have to backtrack on claims that they have made too early in the process.

A demise like that of Trans-atomic Power, and the possibility that other startups will have to make similar backtracks in the future, poses a risk for realistic opportunities and possible pathways. It is very important to keep in mind that information on molten salt reactor development that is available in the public domain are NOT representative for the actual and factual developments that are taking place, worldwide. Several companies, and several initiatives, worldwide, are under way. What is at stake is that these initiatives are developing Intellectual Property (IP), which means that after the initial online exchange of MSR-enthusiasts that started around 2006, the game has changed. What was once called a 'molten salt reactor movement' (if such a thing ever existed) has evolved from a bunch of nerdy online 'techies', who were discussing possible reactor designs on internet discussion groups and blogs in the early 2000s, to a colorful collection of startups. Most of these do not exist of the people who participated in the early discussions. Some of these startups are hardly funded. Some are well-funded. Some are working around the clock to develop their IP, in the hope to transform that IP into a generation of energy devices that will ultimately open the doorway to a future with clean power for all. In the public domain, they will not even hint at the actual IP that is being developed. In short: the most meaningful developments take place under the radar. There is no other way to develop this IP. This implies that there is not a single person on this planet, however big their expertise in the field of MSR-development, that can tell which startup will

be the first to have a commercial MSR ready for the market, or when that will be. That is because there is not a single person on this planet who has signed Non-Disclosure Agreements (NDA) with all the relevant parties, let alone that this person knows which of all these efforts will be the first to bear fruit, or when.

The resulting uncertainty is gratefully exploited by opponents who provide so-called 'proof' that molten salt reactors will take a long time to actually become available. These critics, some with their own interests in the energy transition, state that the development of MSR, either with or without a closed fuel thorium cycle, 'takes too long' to be relevant for the worldwide energy transition. That, of course, is a remarkable standpoint, as the worldwide energy transition, if we take into account credible global statistics, like those of BP, is not going fast enough to produce any substantial results in the foreseeable future.³



These critics also do not take into account the possibility that the development process of the molten salt reactor may be much further advanced already, than is publicly known. The most promising ideas that the Thorium MSR Foundation is aware of, are unknown in the public domain. And there may be even better ideas out there that we haven't heard of. In other words: molten salt reactors may be here much sooner than any of these critics would expect – let alone would care to admit.

The happiest 3d party of all negative framing of nuclear power is, of course, the fossil fuel industry. The fossil fuel industry remains the big winner for the time being, just as it remains the big winner from all antinuclear action – whether it comes from clueless scaremongering about innocent effects

³ <https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf>

of low dose radiation, or from antinuclear NGO's claims about 'unresolved waste issues' or from EU commissioner Frans Timmermans when he claims that 'nuclear is 'too expensive' or 'lasts too long' – statements that willfully ignore the role that governments plays in maintaining an unequal playing field. The fossil fuel industry is always the big winner of any antinuclear action, a fact that traditional environmental groups do not like to be reminded of.

An overview of the Foundation's activities in 2019 can be found in our [Annual Report 2019](#).

Plans for corona and post corona times

At the time of writing this report, it has become clear that corona will be with us for a long time, and unless a vaccine is introduced, the limitations will last well into 2021. For the Foundation, this may pose a very welcome opportunity to strengthen its online presence. During 2018 and 2019, we often had plans for Meet&Greets, but these depend on international parties visiting The Netherlands. It often happened that these could not continue due to the busy agenda of the visitors. In the new world, we see a growing ability of a growing part of the population to attend webinars. This will give us new opportunities to spread real knowledge about MSR's. We will be organizing webinars, starting in the spring of 2020. Announcements for these will be made on our Facebook page.

Support us and multiply our results!

Your support acts as a multiplier of our efforts. A donation not only enhances our possibilities to communicate and spread the message. Every donation is a strong moral support and it reinforces our legitimacy and credibility.

You can support us by:

Visiting and sharing our website: <https://www.thmsr.com/nl/>

Following and liking our Facebook page: <https://www.facebook.com/thmsr.nl/>

Visiting our webinars (announcements on our Facebook page):

<https://www.facebook.com/thmsr.nl/>

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