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RESEARCH ARTICLE

Technology hype, promises, and expectations: The discussion on small modular reactors in the Finnish newspaper 'Helsingin Sanomat' in 2000–2022

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Abstract • While the construction of collective promises is vital to the success of any techno-scientific innovation, it also entails the risk of overpromising and cycles of hype and disappointment. This article explores the discursive construction of the nuclear sector's latest promise concerning small modular reactors (SMRs), using Finland as an example. It provides a brief overview of the Finnish context of SMR development and analyzes its coverage in the leading Finnish daily newspaper Helsingin Sanomat 2000–2022. Efforts at promise construction have so far been aimed at building legitimacy for SMRs, while strengthening credibility – another key element of successful promise construction – has only just begun. The increasing number of SMR-related articles indicates a growing hype, but the absence of a corresponding 'hype language' suggests that the considerable media attention does not automatically translate into emphatic media coverage and discursive hyping.

Technologie-Hype, Versprechen und Erwartungen:

Diskussion über kleine modulare Reaktoren in der finnischen Tageszeitung Helsingin Sanomat im Zeitraum 2000–2022

Zusammenfassung • Die Konstruktion kollektiver Versprechen ist zwar für den Erfolg jeder technologisch-wissenschaftlichen Innovation von entscheidender Bedeutung, birgt jedoch auch das Risiko allzu gro-

ßer Versprechungen und Hype-Zyklen sowie Enttäuschung. Dieser Forschungsartikel untersucht die diskursive Konstruktion neuester Versprechen im Nuklearsektor am Beispiel kleiner modularer Reaktoren (SMRs) in Finnland. Er gibt einen kurzen Überblick über die SMR-Entwicklung in Finnland und analysiert die Berichterstattung in der führenden finnischen Tageszeitung Helsingin Sanomat zwischen 2000 und 2022. Bisher zielten die Bemühungen darauf ab, die Legitimität von SMRs zu stärken, während die Verbesserung der Glaubwürdigkeit – eine weitere wichtige Voraussetzung für die erfolgreiche Konstruktion von Versprechen – gerade erst begonnen hat. Die wachsende Zahl von SMR-bezogenen Artikeln deutet auf einen zunehmenden Hype hin, aber das Fehlen einer entsprechenden 'Hype-Sprache' legt nahe, dass die beträchtliche Medienaufmerksamkeit nicht automatisch zu einer verstärkten Medienberichterstattung und einem diskursiven Hype führt.

Keywords • techno-scientific promises, media analysis, hype cycle, nuclear energy, small modular reactors

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Introduction

There is a need to better understand how technological future scripts and technological hype cycles are constructed and how they evolve. Science and Technology Studies (STS) have shown that techno-scientific promises and expectations have significant performative power to shape the trajectories of modern societies (Konrad et al. 2016).

This research article applies the perspective of sociology of expectations to explore the intertwining of the hype and con-

struction of the techno-scientific promises concerning nuclear technologies. To illustrate these processes, we examine the promise construction concerning the so-called small modular reactors (SMRs) in Finland. As the latest in the series of nuclear sector promises, SMRs are generally defined as reactors with a capacity of 10–300 megawatt, built in a modular, assembly-line fashion. The SMRs constitute a heterogeneous group of dozens of designs, some based on the currently operating light-water reactor technologies and others applying more innovative approaches. A number of prototypes are expected to be in operation by 2030 (NEA 2023), including the LDR-50 small-reactor designed by the Technical Research Centre of Finland (VTT) mainly for district heating. Overall, the SMRs are still very much a future promise rather than current-day reality, with implementation and the risk of disillusionment predicted by the hype cycle still some way off.

The current enthusiasm, perhaps hype, around SMRs has its background in the increasingly pressing needs to cut carbon emissions, the heightened concerns for energy security especially after the Russian invasion in Ukraine, in February 2022, and the nuclear industry's attempts to survive in a stiffening competition with ever-cheaper renewable energy technologies.

Throughout its history, the nuclear sector has experienced cycles of ups and downs, periods of enthusiasm and hope concerning specific technologies (e.g. fast breeders, successive reactor 'generations', fusion, geological disposal of waste) followed by disillusionment, polemic and again revival of reformulated promises (Kaijser et al. 2021). The 'nuclear renaissance' (Nuttall 2022) announced by the industry at the turn of the millennium was cut short, partly because of the 2011 Fukushima accident, as were the previous attempts to bring SMR technologies to the market in the US in the early 2000s (Thomas and Ramana 2022). Importantly, the ongoing latest wave of enthusiasm for SMRs is spurred by the formidable difficulties that the construction of large nuclear power plant projects has in recent

articles relating to SMRs published over the period, 2) the trends and the match with the hype cycle model, 3) the main themes and specific SMR promises and expectations, and 4) the type of 'hype language' employed. We observe that the bulk of the promise construction efforts has focused on building legitimacy for SMRs, while the strengthening of credibility – another key ingredient of successful promise construction – is only at an early phase. As for the discursive 'hyping', we note that hype, as measured by the amount of media attention, is not always accompanied by semantic hype, that is, overly optimistic and exaggerated language. We furthermore stress that trends of possible media hype are embedded in their societal context.

Theorizing technological hype, promises and expectations

Our analysis draws on concepts from the sociology of expectations, which has highlighted the crucial role of techno-scientific promising in shaping innovation and deployment of new technologies. Regardless of whether they are fulfilled or not, promises make things happen, by aligning actors, institutions, and capital; guiding activities; providing structure and legitimacy; reducing uncertainty; as well as fostering and steering investment (Borup et al. 2006; Van Lente 2012; Joly 2010).

A techno-scientific promise can be understood as a specific form of anticipation and expectation, which encompasses both the relatively vague visions and more specific statements about the future of a given technology (Parks 2020). For instance, the 'umbrella' SMR promise consists of a large variety of specific reactor designs under development. These designs – which vary widely in terms of their energy output, size, fuel type, enrichment level, fueling frequency, site location, and spent fuel characteristics – each constitute a specific promise of its own. The viability of a promise – whether general or specific – is not an

As for the discursive 'hyping', we note that hype as measured by the amount of media attention is not always accompanied by semantic hype, that is, overly optimistic and exaggerated language.

years faced in the West (Lehtonen 2021). Compared with these megaprojects, the SMRs promise to be cheaper, safer, quicker to deploy, and more compatible with the decentralized and renewables-dominated energy systems of the future (NEA 2023).

In the following, we will explore the discursive dimension of the construction of the SMR promise in Finland. We first briefly review the key policy initiatives and processes in support of the SMRs, and then analyze SMR reporting in the leading Finnish daily newspaper Helsingin Sanomat (HS) in 2000–2022. The media analysis explores 1) the distribution of the ar-

herent attribute of the technology in question but instead an outcome of processes whereby its legitimacy and credibility are collectively constructed, through the interaction between promissory discourses, their counter-narratives, institutions, and material realities. To be legitimate, a promise needs to address a societal problem widely recognized as important and urgent, whereas credibility hinges on the perceived ability of the technology to address that challenge. Credibility typically builds upon past experience and/or the perceived competence and trustworthiness of the proponents of the technology. Legitimacy and credibility

are built through ‘trials of strength’ (Joly 2010; Chateauraynaud 2011) – whereby the promise is confronted with counter-narratives, detractors, and unanticipated situations.

When a techno-scientific promise fails to materialize, it engenders disappointment and disillusionment, corresponding to the disappointment phase of the Gartner consultancy hype cycle (figure 1).

The hype cycle model assumes this to occur when the technology enters into the implementation phase (Joly 2010; Konrad et al. 2012). The hype cycle, with its pre-defined five phases of innovation (innovation trigger, peak of inflated expectations, trough of disillusionment, slope of enlightenment, and plateau of productivity) is obviously simplistic and deterministic (Borup et al. 2006), and has been criticized on many accounts (Dedehayir and Steinert 2016; Steinert and Leifer 2010).

Yet, the construction of promises often indeed results in hypes. Moreover, regardless of its ability to accurately describe the evolution of a technology, the hype cycle is performative: Whether realistic or ‘excessive’, hype cycles shape the very development of technologies that they seek to describe, for instance when innovation actors anticipate hype and adjust their behaviors accordingly (Konrad 2006; Joly 2010; Alvial-Palavicino 2015). Unlike the hype cycle assumes, promise construction entails gradual modification of the initial promise, not merely hype and disappointment relating to an immutable initial promise (Joly and Le Renard 2021; Lehtonen 2023).

While the hype cycle denotes the amount of attention that the media gives to a techno-scientific innovation, the nature of that attention is likewise crucial. Therefore, we also examine the ‘hype language’ in the articles, i.e., how enthusiastically the SMR promise is presented as a solution to the given problems.

The media is a key public arena in which discursive battles between proponents and detractors of techno-scientific promises are fought, dramatized, and performed (Kojo et al. 2023). These discursive battles contribute to the construction and deconstruction of the promise, generating hype and fueling disappointment, and triggering changes in institutional and material realities. These changes feed back on the discursive battles, shaping the promise discourses and expectations. It is this discursive creation of expectations, as one of the resources and strategies mobilized by actors to steer promise construction, that the media analysis in this research article focuses on. It does so by analyzing the promises and expectations, and identifying indications of hype relating to the SMRs in the leading Finnish daily newspaper.

To place this analysis within a broader context, the following section briefly describes the societal context for the SMR promise construction in Finland.

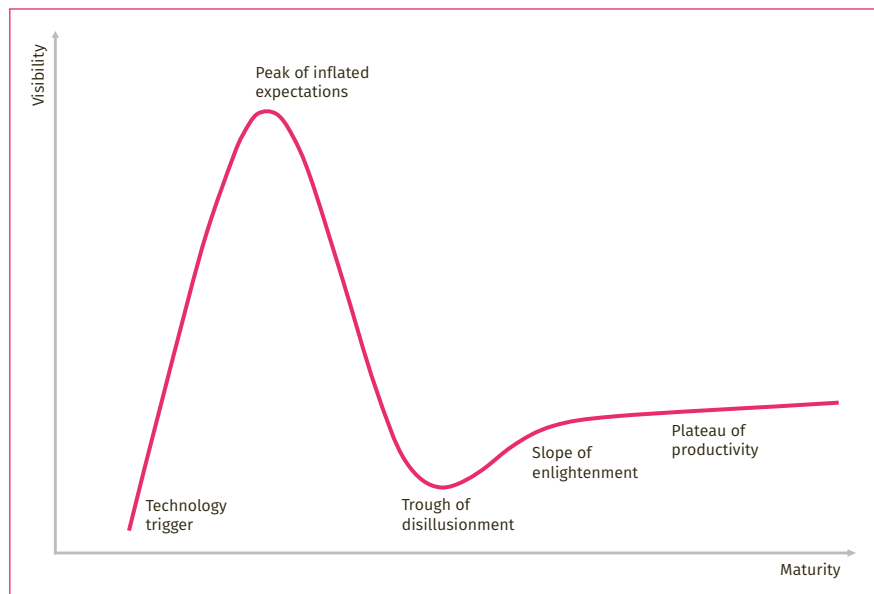


Fig. 1: The Gartner Consultancy hype cycle.

Source: Borup et al. 2006, p. 291

The Finnish context for SMR promise construction

Nuclear power accounts for about 35 % of electricity production in Finland. It has been an important part of the country’s energy policy since the late 1970s, and has since then enjoyed widespread support across the political spectrum. In 2002, Finland became the first Western country to approve the construction of a new nuclear power plant (NPP, OL3 UNIT) since the Chernobyl accident in 1986. In 2010, the government approved the construction of further two large NPP units – OL4 and Hanhikivi 1.

As elsewhere, also in Finland the problems with the large NPP projects have driven interest for SMR technology. OL3 entered commercial operation in 2023, 14 years behind the original schedule, and at an estimated cost almost four times higher than the original EUR 3.2 billion (Proctor 2023). Two other NPP projects have been cancelled. OL4 was suspended in 2015 because of the delays with OL3 (TVO 2015), and Hanhikivi 1 was terminated in 2022, after the Russian invasion in Ukraine, given that the Russian Rosatom was both the main shareholder and technology supplier for Fennovoima (Husu and Kojo 2022).

While Finland’s currently operating NPPs produce only electricity, SMRs are suggested mainly as a means of decarbonizing district heating (Tulkki et al. 2022). Early studies on nuclear district heating in Finland were carried out in the 70s (Leppänen 2019, pp. 6–10). In the early 2010s, the power company Fortum explored the use of nuclear energy for district heating, and pondered on the possibility of switching to smaller power plants, to reduce financial cost and risk (Lähteenmaa 2013). Fortum (2010) flagged for nuclear energy as ‘the most cost-effective’ and environmentally friendly district heating option for the Helsinki metropolitan area in 2020–2080. More recently, local

politicians in the metropolitan area have shown growing interest in SMRs as a means of reaching the ambitious carbon-neutrality targets by 2030 (Tulkki et al. 2022).

In addition to the state-owned research institute (VTT) small reactor mentioned earlier, also the technical LUT University has embarked on the development of its own LUTHER experimental SMR design, based on light water low-temperature, low-pressure reactor (Truong et al. 2021).

As part of the effort to establish a national ‘SMR ecosystem’, initiated in 2020 (Häkkinen et al. 2023), the adaptation of the regulatory framework for the needs of possible future SMRs is underway, as part of the overall reform of the Nuclear Energy Act. The work enjoys both political and industry support, and seeks to remove “regulatory and licensing barriers” that would hinder the “introduction of series-produced SMRs” and the associated climate benefits (Kojo et al. 2023, p. 5).

The media analysis: data and methods

To explore the discursive dimension of promise construction, we analyzed the SMR debates in the leading Finnish newspaper Helsingin Sanomat in 2000–2022. HS dominates the Finnish media landscape as the only major national daily newspaper, and is among the country’s three most trusted news media outlets (Media-alan tutkimussäätiö 2023).

Articles were searched on the newspaper’s own online database, combining as search terms the derivative of either ‘mini’, ‘small’, ‘modular’, or ‘heating and SMR’ with the derivative of one of the terms ‘reactor’, ‘nuclear reactor’ and ‘nuclear power’, in Finnish, or using a compound word formed by applying the same principle. Once duplicates had been removed, the screening for relevance of the remaining 892 newspaper articles and the elimination of articles concerning SMRs for naval, test and research purposes, and for spacecrafts and missiles resulted in a final text corpus of 104 texts.

support the interpretations and back up the arguments. The following software was used for the analysis: NVivo 1.7.1 and Microsoft Excel (multiple versions).

Promises, expectations and hype surrounding small nuclear reactors in Helsingin Sanomat

The distribution of the articles from 2000 to 2022 (figure 2) follows three distinctive phases. At the first phase (2000–2017), small nuclear reactors are mentioned occasionally, in up to three articles per year (altogether 17 articles). The interest picks up at the second phase (2018–2020), with 6–7 articles per year (altogether 19 articles). The final phase (2021–2022) indicates possibly mounting hype and rapidly growing media attention, with 28 articles in 2021 and 40 articles in 2022.

At phase one, the mentions of SMRs were too few to allow a meaningful analysis of the most prominent themes. However, at phase two, climate change and district heating were the themes that started to bring visibility to SMRs. These were central also at the beginning of phase three: In 2021, the most prominent themes were 1) combating climate change, reducing emissions and pursuing carbon neutrality; 2) use of SMRs for district heating to reduce emissions; and 3) a new age of, or future prospects of, nuclear energy and the role of SMRs in such a future. Year 2022 brought to the fore 1) the energy crisis, and the concerns over energy security and self-sufficiency; 2) reports concerning the reform of the Nuclear Energy Act and SMR regulation, while the topic 3) from the previous period (a new age of nuclear and the role of SMRs in it) still remained prominent.

The style of the analysed articles in HS was rather restrained. Explicit promises were rare, except in opinion pieces (HS 01.07.2021; 16. 12. 2021; 03. 01. 2022; 02. 12. 2022). Instead, the articles typically featured somewhat cautiously phrased expectations or aspirations. Examples included: “[...]It is hoped that se-

The viability of a promise – whether general or specific – is not an inherent attribute of the technology in question but instead an outcome of processes.

The analysis focused on four topics in SMR reporting: 1) The distribution of the articles; 2) the trends and match with the hype cycle model; 3) the most frequent themes and the associated promises and expectations; and 4) the types of ‘hype language’. The qualitative textual analysis combined close reading and a hermeneutic approach. The texts were subjected to several iterative reading rounds whereby the material considered important for interpretation was highlighted and then re-examined. References and quotations are in the following section used to

ries-produced small reactors will reduce the cost of building nuclear power and bring nuclear energy into new uses” (HS 29.01.2022); SMRs “[...] are supposed to be sort of off-the-shelf purchasable power plants, which could in principle be produced in series” (HS 17. 10. 2022); “In small nuclear power plants, so-called passive safety systems are also being pursued” (HS 20. 10. 2022); and, “Small nuclear power plants may be able to solve the problem of the high cost and slowness of nuclear power” (HS 18.06.2022). Summing up, alongside improved safety, the ex-

pected main benefits of SMRs were their “small size, versatility, speed of construction and lower costs” (HS 09.11.2021).

The understated style of HS clearly extends also to its use of ‘hype language’. The articles seldom applied straightforward hyping up, i.e. portraying small nuclear reactors in an excessively positive light. In 2021, the closest to hyping were mentions of small nuclear reactors as “seemingly very promising” (HS 01.6.2021), a “potential future technology” (HS 12.04.2021) and “now emerging as one of the interesting alternatives” (HS 09.12.2021). Yet, an editorial ended on a rather bold note stating: “[...] but the future belongs to small power plants” (HS 27.10.2021). In 2022, while by no means prevalent, hype was somewhat less restrained, and gaining immediacy, as small nuclear reactors were referred to, for example, as a “hot topic” (HS 01.07.2022), “a particularly viable option” (HS 02.12.2022), and a “subject of high expectations” (HS 29.01.2022). The articles presented such reactors as being capable of transforming energy production, making it more climate-friendly, and even “solving” the energy transition (HS 03.01.2022; 30.05.2022; 09.02.2022; 31.03.2022). An editorial from February 2022 rehearsed the declaration from a few months earlier: “The future belongs to small modular nuclear power plants, not to old-fashioned giants” (HS 14.02.2022).

Conclusions

This research article explored SMR hype and promise construction in Finland. The analysis illustrated the embeddedness of promise discourses within the evolving societal context.

The analysis of Helsingin Sanomat’s SMR reporting identified three phases, with only sporadic references to such reactors during the first 17 years, an awakening interest since 2018, and a rapidly growing media attention since 2021. The rapid increase in the visibility of SMRs in the third phase indicates signs of hype, in quantitative terms. During this phase, the articles focused on legitimizing the SMR promise, that is, on demonstrating the urgency and societal relevance of the problems that SMRs are expected to solve. The articles highlighted the potential of SMRs in combating climate change, in decarbonizing district heating, and in inaugurating a new era for nuclear energy. In 2022, with the aggravation of the energy crisis as a result of the Russian invasion in Ukraine, these themes were complemented by concerns over energy security. In 2022, HS also showed increasing interest in the plans to reform the Nuclear Energy Act, in particular to facilitate the possible deployment of SMRs.

Despite the increasing number of articles mentioning SMRs – suggesting a possible mounting of hype – from early on the HS

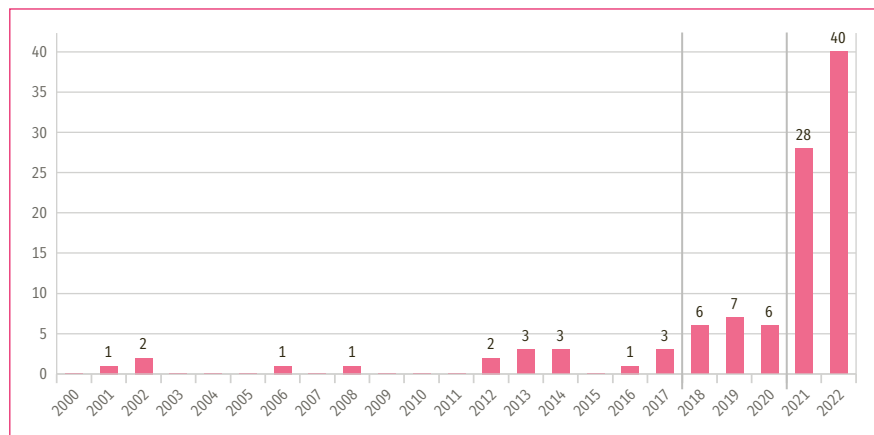


Fig.2: The number of HS articles relating to small nuclear reactors, per year, in the final text corpus.

Source: authors' own compilation

articles generally kept to a cautious language, without making explicit promises concerning the potential of SMRs. Hype defined as the amount of media attention was therefore not accompanied by a corresponding semantic hype. In 2022, however, the HS language began to show signs of hype. In its editorials, HS took quite a clear stance, both in 2021 and 2022, rather confidently declaring that the future belongs to small nuclear plants.

The careful and restrained but gradually changing language of the leading Finnish newspaper shows signs of emerging discursive construction of credibility. The SMR promise construction has thus far mainly focused on legitimization, with climate change, energy security, energy independence, and the past problems with the construction of large reactors as key arguments. HS has hardly sought to establish credibility for the promise – for instance, it rarely refers to authoritative experts or past experience of nuclear technology development to back up the claim that SMRs are viable. More generally, the construction of credibility via efforts to bring about institutional and material change are also at an early stage in Finland. However, some measures have been initiated such as state-financed R & D, feasibility studies by major utilities, development of domestic SMR designs by a technical university and VTT, and a reform of the regulatory framework.

Certain caution is in order when interpreting the degree of ‘hyping’ and the Finnish SMR promise. Firstly, an analysis of a wider range of publications, notably technical and economic journals and magazines, might reveal a different picture of hyping. Second, given that the very function of hyping and promise construction is to facilitate and enable the deployment of a technology, determining whether hype is ‘excessive’ becomes a moving target, and can be done only after the event. What seems excessive today may in hindsight turn out to be realistic, precisely thanks to successful promise construction, including ‘hyping’. The future will tell whether the incipient ‘hyping’ over the SMRs, as revealed in the media debate, will successfully combine with the institutional and material dimensions of promise construc-

tion, or whether the hype will soon turn into disappointment once implementation gets underway, as predicted by the hype cycle model. The absence from HS reporting of clear counter-narratives that could help balance the expectations suggests that the risk of a hype disappointment sequence could indeed be real.

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