



Original research article

New materialism, object-oriented ontology and fictive imaginaries: new directions in energy research

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ABSTRACT

This paper takes up the challenge set down by the review work of Hess and Sovacool (2020) and Sovacool et al. (2020) and joins the conversation about future research agendas where STS is aligned towards humanities and social science research of energy solutions. We identified two under-representations in these review papers: 1) New materialism and object-oriented ontological (OOO) approaches and 2) how fictive imaginaries develop the link between OOO and public engagement with energy challenges. We propose that ontology of objects and non-human worlds is central to cocreation work in energy research where there exist assemblages of the Anthropocene. We argue that an ethical, engaged, object-oriented ontology that links with fictive imaginaries is crucial whichever direction STS takes in energy research.

1. Introduction

You need me like the wind needs the trees to blow in
Like the moon needs poetry
The Magnetic Fields, ‘Come Back From San Francisco’

This paper responds to Hess and Sovacool and Sovacool *et al*’s comprehensive reviews of an STS agenda in energy research by outlining the ways in which new materialism and object-oriented ontology (OOO) can expand the field’s horizons and strengthen this project [1,2]. We argue that this will contribute to building the foundations of an emerging collective ethics of sustainability. Objects, their being and their relation to the common human/non-human world have had a remarkable rise to prominence in contemporary theory [3–5]. Materialism has been a crucial part of the Marxist tradition but a more ecological moment for objects is currently placed firmly within STS and affiliated with the arts and social theory. With this new development, there is a connectivity between objects without necessitating a transcendent holism.

As Hess and Sovacool make clear, STS already holds an important position in energy transition, and there is growing potential for further methodologies [1]. A common thread among contemporary STS approaches is to steer a middle ground between epistemological relativism and naïve realism and the review papers significantly aggregate these

[2]. However, we wish to highlight two under-representations in those papers that would further provide the foundations for an emerging collective ethics within this energy and sustainability research agenda and that would continue this common ground STS approach:

- exploring ontology, and specifically new materialism (NM) and object-oriented ontological (OOO) approaches where there has been an increase in interest from STS scholars over the last fifteen years, exploring agency in objects and related ethics; and
- fictive imaginaries as public engagement, as identified in the literature but also those communities and collectives themselves that shape futures around both objects and mythic ideas

Both approaches have significant relevance for looking at fresh perspectives on energy research that provide greater “human”/“nature” resilience in future societies, and crucially add agency to the non-human and inanimate. We propose that the study of ontology in objects and non-human worlds can bolster co-creation work in energy research where assemblages of the Anthropocene can be mapped and studied.

We begin by setting out the ethical landscape for NM/OOO in energy research and then continue to explore materiality and fictive connections within the two papers under review while defining the connecting conceptual frameworks of object ontologies, new materialism and speculative realism and how these might be aligned with the Hess and

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Sovacool theoretical perspectives. We then briefly account for STS works that use OOO and new materialism. The paper then demonstrates where such object ontology emerges through fictive works, particularly film, engaging audiences as collectives for future imaginaries. Our conclusion is that in the cocreation of knowledge research agendas and extended models of energy-landscape analysis, a just transition aesthetic is possible. This will both explore ontology and engage in ethical reflection. We illustrate this with examples from film, documentaries and literature in our reflection.

2. Ontology of things, ethical frameworks and opportunities for transdisciplinary ecological research

Our approach combines an ethics beyond the human with visual and fictive engagement by humans. *Imaginary* as we mean it here has a realism brought about by the collective through fictive representations of shared futures [6]. However, the studies categorised in the review papers were academic and relatively closed to publics. We will briefly explore other avenues, for example how film - and popular Hollywood films in particular - explore new ontologies and new realities of eco-resilience using the materiality of living "Nature" as well as technologies. Visual storytelling can be more effective in engaging publics [6].

Furthermore, there must be included in any multidisciplinary ecological research empirical description of the Earth itself, whether land, trees, lakes, soil or bogs, and accounts of those who try to claim and "speak" for it. Mini-publics and mini-assemblages are being formed around future energy transitions. Our approach will be to dovetail ethically-minded materiality and OOO that engages public imaginaries into the review papers' research pathways. This approach moves us all away from nature/culture dualism, still extant in sustainability and energy research. We argue that an ethical, engaged, object-oriented ontology is critical to any future direction of STS in energy research.

If this short Perspective paper is part of a critical debate with the broader sociotechnical turn in energy research, there is also a stern, critical dialogue within a dialogue here that provides a *meta*-argument – how the ethics of object ontology has pulled away from, and at times parted company with, analytical ethics and therefore requiring greater attention from what is already an emerging ethics of the Anthropocene. Such approaches will align critically with moves across traditional environmental ethics, which has long debated the intricacies of anthropocentrism and the possibility of non-anthropocentric ethics. Specifically, the ethics of OOO will be of interest to environmental ethicists focused on developing non-anthropocentric approaches or towards developing an ethics that can account for the interests of non-human nature. Environmental ethical discussions of anthropocentrism have focused on anthropocentrism that is *ontological* (a perspective about the nature of reality that traditionally prioritises humanity), *ethical* (the stance that humanity is morally superior to species) and *conceptual* (the idea that humans can only understand reality from a human perspective). Environmental ethics scholars have spent considerable time on developing non-anthropocentric ethics and the debate over whether this is possible is ongoing. The conceptual anthropocentric thesis – the idea that our conceptual tools are *de facto* anthropocentric – suggests that we may struggle to properly value and morally respect other species and non-human nature. Insofar as OOO develops new conceptual tools, it can also play a role in developing new ethical frameworks. However, in terms of the environmental ethics perspective on energy systems, the debate focuses mainly on challenging "excuses" not to adopt renewable or sustainable energy systems. It is taken for granted that the use of fossil fuel and nuclear energy sources are a source of environmental injustice, disproportionately harming children, minorities and the less well-off as well as the climate and non-human species [7]. Our perspectivalist approach offers a just transition way forward that brings the subaltern of the human, non-human and material with us.

3. Theoretical amendments: Ontology beyond Sovacool et al's sociotechnical agendas and Hess and Sovacool's sociotechnical matters

Ontology of objects and materiality in particular are not absent from the review papers. In this section, we briefly review the main conceptual parts of both papers that link to the missing elements about how non-human actor and objects might *be* in the philosophical sense. What Hess and Sovacool and Sovacool et al have added impressively to how the STS field relates to energy social science research - as opposed to the overall STS space, as the authors have identified it - is a robust categorisation of the literature. The different cross-sectional approaches of both papers produce exhausting lists of domains that reveal the Western, industrialised bias embedded within energy research. The broad categories empirically derived in early steps of their methodological process were publics, cultural meaning, policy and sociotechnical systems [1]. Positionally an OOO framework would fit within the *sociotechnical systems* and *expertise and publics* domains of Sovacool et al's framework Venn diagram from the literature under review (Fig. 1). Within these empirical constructs of the secondary literature, object-oriented work would slot into the subcategories "actors and networks" and "imaginaries and frames", connecting also with "power, identity and justice". [2]. As already stated, OOO has not been ignored by the papers, but its importance has been under-stated. Of the 68 papers reviewed in Sovacool et al 15 "demonstrated theories of practice, materiality and agency from sociology and science and technology studies" (p28) [2]. From Merton, Mumford and Ellul, through Donna Haraway and Brian Wynne, the sociology – and social – of science evolved through multiple pathways, leading to sociotechnical transitions in sustainability and energy research such as Multi-Level Perspectives. Hess and Sovacool's references to actor-network theory (ANT), perhaps the most prominent of STS theories, opens a door to OOO and materiality by describing how the historical moment characterised by ANT grants agency to how humans delegate to material objects but cause and effect are reinterpretations or reconstructions within the entire system of technology/human relations (p3) [1]. While OOO and new materialism are closely aligned – and explored further later – contemporary OOO ideas in particular can be seen as an evolution of ANT where the actors begin to "matter" again. A similar historical moment is identified by Sovacool et al, Larger Technical Systems (LTSs) which depend on materiality to drive human processes (p10) [2]. This same paper also echoes Bruno Latour's credo to take materiality seriously to address climate change. It is also noteworthy, and quite encouraging for future material ontology dimensions, that many "future research" sections across the Sovacool et al paper mention materiality but current research could have been included with more direct emphasis on OOO as a pathway to this future research [2].

As Hess and Sovacool state, STS approaches attempt to avoid the extremes of epistemological relativism on one side, where there is an equivalence of truth claims and no external reality, and naïve realism on the other where products and processes of scientific knowledge and technology reveal the world as the only reality [1]. The papers succeed in demonstrating increased studies in collaborations, in systems and in practices that overcome this divide – or at least they downplay the metaphysical divide. However, there is a diminished role for ontology that could perhaps have been given more prominence within the analytical framework of these papers. *Ontology* defined here includes the theories and expressions of being and existence and there has been recent emphasis on ontology and agency of non-human objects that characterises this type of new materialism [8–11]. This would include, for example, the assemblages connected with fuel extraction. In other words, this approach looks for *matter* in sociotechnical matters. While Sovacool et al rightly claim in their review that "energy systems are deeply co-produced with human affairs" (p3) [2], Karen Barad provocatively offers a counterpoint that is just as important in their opening line in *Meeting the Universe Halfway*, that "[m]atter and meaning are not separate elements" [12] (p3).

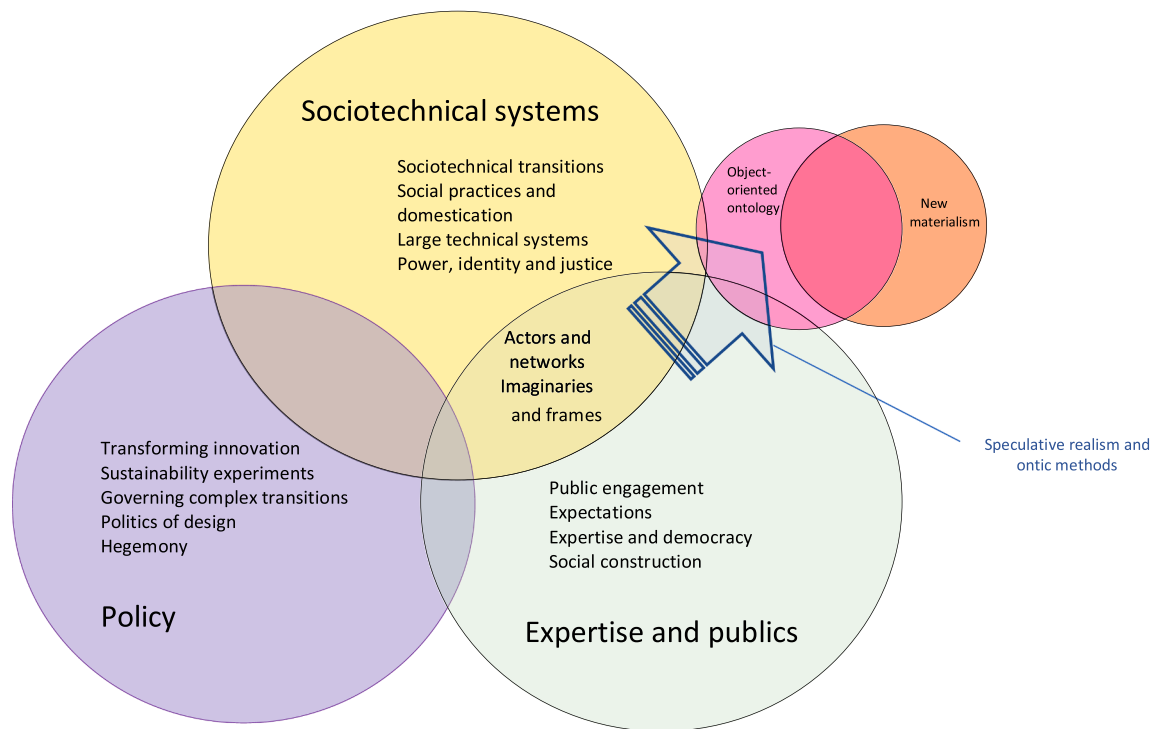


Fig. 1. Sovacool et al's overview of main domains and topics of STS energy and climate research modified to include NM/OOO and speculative realism as ontological approaches engaging publics and the study of objects [2].

While new materialism has had a much longer presence within the wider arts and humanities, the ontological or ontic turn in STS and similar interdisciplinary fields has particularly been enhanced by the emergence of OOO and speculative realism since around 2007 - promoted mostly by Graham Harman [13] - and one can make a case for their study in bolstering “practice work”, that is, the study of practices rather than conceptual or cognitive regimes. Graham Harman brilliantly demonstrates how OOO evolved from and interacts with ANT and argues that Latour had not neglected objects in his work. Latour distinguished between a “thing” requiring discourse and debate and with fractured sides of perspective, and a more solid, self-contained “object”. Climate fiction in particular was identified in Sovacool *et al* as an area of high ontological complexity [2,14]. This paper found that instrumental technoscience critically lowers ontological status of other-than-human, and the richness of data comes about in fictive and personal testimony imaginaries. Fictions, including dystopian tales of climate disaster, can inform our perceptions of real-world places, such as the Mekong Delta, as Jensen demonstrates in his future ethnography. Indeed, “cli-fi” can, in addition to illustrating the “leaky relation between fiction and reality (p190),” also pull societies towards shared goals of safety, security and redemption [14]. Researchers can benefit from engagement with fictive approaches and experience and learn from these parallel-but-aligned worlds.

While OOO focused clearly on objects, the related area of speculative realism emerged from just a small group of philosophers around the same time in 2007 and has been influential in STS. This is a metaphysical realism which gets us beyond Kant as it were, breaking free from the self-enclosed in-themselves of objects and their necessary ontological status to find the noumenal [13,15,16], breaking from Kantian *correlationism* which Meillassoux defined as “the idea according to which we only ever have access to the correlation between thinking and being, and never to either term considered apart from the other” (p5) [17]. Fiction is one methodological approach [14]. Such arguments might appear, however, to be far removed from the concerns of energy ethics which is concerned with justifications for specific ethical choices and challenges the reasons for resisting moves away from dirty energy to cleaner energy. As such,

energy ethics arguments focus extensively on science, which is used to outline the potential harms and to delineate alternatives. Energy ethics is then focused on developing arguments that will work to motivate people to take responsibility for energy change [7]. The perspectives that OOO provides, especially in terms of its appreciation of fictive imaginaries, will expand the social scientific material available for ethicists developing such arguments and can help drive the necessary changes. Speculative realist approaches can then be seen as set of methodologies that can range hugely from the anthropomorphic stories about nature often told to children to literature about ecological spaces without humans. This is the public engagement link between the ANT of ecological objects and NM/OOO [Fig. 1].

There are OOO references in the two articles under review here that have particular potential to align to our proposal for an object-orientation engaged through fictive imaginaries. Sovacool *et al* identified its emergence when mapping participatory collectives and ecologies of participation within the UK energy system [2]. We want to particularly draw attention to the “publicly-engaged objects” in the Ryghaug *et al* and Marres studies that were part of the review [9,10]. It is not a case of how technology leads the human or vice versa; indeed technology and human are not separate phenomena working with each other, but in this framework are enmeshed. Such analysis is also bolstered by Heidegger's view of technology as aligned with being [18]. Van Heur et al, in their comprehensive bibliometric and literature analysis of STS-inclusive journals, did not see enough evidence for a rhetorical ontic turn in STS but instead saw the growth of a scattering of ontological methods, which we dispute [19]. However, as with the Hess and Sovacool papers, the net could possibly have been cast wider in terms of defining STS. There is a myriad of objections and differences across new materialism and OOO, which we mention briefly in the next section but a line can be traced back through Deleuze and Guattari, and Spinoza's influence on the creation of hybrid assemblages through practice rather than the correlationism of Kant.

OOO, in its purest form, breaks with Kant, as there is no transcendent ethics only immanent ethics inscribed in being [15,16]. Gratton, also drawing on the 16th century philosopher Spinoza, sees the task of

materiality without transcendence as that which needs “to work out conceptions of nature, politics and ethics, while in some sense recognising that reason *itself* is formed in and through the becoming of existence [emphasis in original]” [p68], how energy is not only understood but also *becomes* through our (literal) networks of power [15]. The justice aspect may be immanent but transversal and common to all who act or work towards commonality and common ethics.

New materialism and object-oriented ontology are closely connected and both privilege objectual agency [15,20]. Meillassoux describes the necessity of contingency in nature, although he certainly breaks away here from other OOO enthusiasts and reaches into transcendence by placing ethics as true justice in a future world to come [15]. Levinas is a useful guide here, where although ethics is reduced to the epistemological, it attributes an Aristotelian view that in order to reach out to the other, you make the observed the same as the observer – a necessary political correlationism that allows a closer human affinity to animals and plants [21].

When these theories are applied in practice, we can trace the full relationships of action in energy co-creation [22]. Marres and Lezaun describe how energy contestation is often categorised in literate, discursive, even linguistic terms, so that they do not easily connect with material reality [23]. This can also apply to the use of emerging technologies such as synthetic biology or artificial intelligence (AI) in energy, where ethical input is sought in the early stages of the development of novel technologies and systems in order to minimise the harms and maximise the potential benefits of these new systems. The problem of the over-discursive is also well described by Sovacool *et al.* how ethics of technologies are applied where “themes around energy and climate [justice] [are] often addressed more in terms of ethical principles and legal instruments than imperatives for bottom-up, direct emancipatory action” (p18) [2]. This has implications not just for the risk of missing disenfranchised views in a rigid, Enlightenment-humanist system of public engagement, but also for identifying who has power, and what power is invoked for controversial emerging energy technologies, and what dynamic do the technologies themselves create for niche-innovations [2]. The central issue is how to address the engagement of multitudes into complex energy policy decision-making, the “uninvited” (p18), or more precisely the “not invited” that goes beyond humanism.

Also, we acknowledge that the two review papers under discussion here move beyond theory and orient themselves towards policy formation which has considerable merit in an era of Sustainable Development Goals [24] and Responsible Research and Innovation [25]. However, we are also in an era of political detachment, large events moving without deep engagement and where there are increasing injustices and inequalities. To further address the rhetorical question posed by Hess and Sovacool, “What’s not in the [black] box?” [1], an OOO/agential realist framework is bolstered by feminist/intersectionality of species and things. We can strive to ensure that no thing of agency within an ecological ethical framework is left behind.

4. New materialism and object-oriented ontological (OOO) approaches

Let us briefly examine NM and OOO in more detail and their proponent literature. NM and OOO as methods have common overlap with NM preceding OOO historically. Both require fundamental, constitutive and collaborative ethical frameworks for humans and other subjectivities of the Anthropocene. NM, as a loose collection of ideas, can be seen as understanding entities as “bundles” of primary and secondary qualities, which can be described by what they *do* in relation to larger sets of entities with constant change. OOO pays closer attention to how an entity is defined by what it is [5]. And this is where speculative realism assists. OOO conflicts with sociological STS approaches and historical critique itself, as well as traditional historiography. It suggests that objects have agency and may speak for themselves, but humans can only “speculate” on what they say, as we observe and work together. The

attempt to take account of the interests of objects – of the non-human – is essential if we are to move towards a sustainable energy ethics. OOO conflicts with sociological STS approaches and historical critique itself, and traditional historiography. Meillassoux states that, since Kant, continental philosophy has been too influenced by correlationism, not caring to understand the “great outdoors,” while aware of the spectre of positivism. To strong correlationists, knowledge has become a fully human construct. This is where speculative realism fills in the blanks, to a certain degree. The weak-correlationist-to-middle position we present here is in applying the ethics of practices for a good, common world, until one day “we” might all communicate better. While there has been a tradition in environmental ethics of encompassing non-humans and othered genders, in NM, Rosa Braidotti brings the fight further to demand that the subaltern of under-represented gender and non-humans be brought together in a quest similar to Meillassoux’s counter-Enlightenment in OOO, but for Braidotti, it’s a rebellion against the white, heteronormative, patriarchal ideas of humanist Enlightenment [26]. The project of conservation and stewardship of “Nature” has paradoxically destroyed it. Karen Barad’s agential realism and the feminist, ecological materialisms of Jane Bennett and Elizabeth Grosz are also fellow travellers to NM and OOO exploring agency and objectual justice in the products of science [15]. There are variances in terms of ontological constructs and methodological approaches. Some theorists, such as Meillassoux, have pushed their ontic realism as far as possible away from human knowledge [17], while others, such as Harman, Latour and Haraway stay within relationist modes that veer toward this correlationism [3,9,8,27–29]. This tension in NM/OOO-type theories remains, keeping the ideas malleable towards energy transition frameworks.

Woolgar, a pioneer of STS methodologies, does not see a value to STS in OOO, as the hidden things-in-themselves always slip into relationist practices, thus downgrading its “thingness” [30]. We may need to defend a set of disciplines here. Continental philosophy and the guise it has taken by morphing into ideas about objects and practices, remains controversial. To turn to the truly popular for a second, and specifically a public intellectual for the disenfranchised of post-Brexit Britain: the Marxist journalist-turned-scholar Paul Mason admonishes a high-profile critique of the weaknesses of straying beyond logical positivism, a critique which adds to an increasingly polarised political and cultural environment [31]. Similarly, the literal interpretation of naïve animism is often a straw-person argument created to ridicule object ontology. These are not new criticisms. Timothy Morton points out, following Latour, that traditional Marxism has not benefited the environment as it should [32]. Morton applies a new vision of Marxism to ecology well, but Hylton White has a valid point – and Morton would agree – when he sees an unfair critique from Latour of Marx: Marxist inquiry has placed more agency in objects than many OOO-ers would give it credit [27,28,32,33]. It is critical in every sense to retain anti-capitalist critiques across new materialism coming from the non-sustainability of capital itself. Traditional environmental ethical approaches have pursued a similar path – criticising capitalist market ideology and the practices of consumption so prevalent in contemporary society [34,35] whilst analytic ethics, particularly virtue ethics, tends to view the flourishing of individual humans as deeply connected with and dependent on the flourishing of non-human nature [36–40]. The division between analytic and continental philosophies is, as regards the environment, beginning to dissolve.

An STS energy framework would utilise practical examples of bogs for example and “objects of nature” “energising” through ethnographic works but also in literature, as in Maria Zirra’s evocation of Seamus Heaney poems and the lived experience of bogs which are controversial sources of energy [41,42]. Another example is Barad’s enchanted matter rhizomatically distributing itself from idea to beautiful words on the page in search of elusive memory [12]. The material turn forces us to consider the acts of extreme cocreation, that is, the assemblages of peat bog excavation, fracking and wind farm structures and surrounding

politicians, neighbours, civic society organisations and technicians as well as the wind and shale themselves.

5. Fictive imaginaries as public engagement: Identifying communities and collectives that shape futures around mythic ideas

The creative arts have embraced materialism for a longer period than its emergence in STS as applied fictive imaginaries for public engagement. In addition to the use of climate fiction to understand ontological complexity of climate facts, as described above, it is instructive to conduct close readings of film texts with its opposite “reception” in how it engages in both the *zeitgeist* and sentiment of publics. There is, for example, an entire subgenre of petrofiction [43].

In the acclaimed Irish documentary *The Pipe* about a contentious, and at times dangerous – for protestors - dispute about offshore gas drilling, the pipeline is the dark protagonist, a villain destroying a community in this polemic movie [44]. The central theme, represented by the pipeline, is the framing of a narrative by strategic powers, a colonial offering of sacrifice in return for energy. The gas pipe represents a nexus of energy needs, government and corporate interconnections and the conflict with local and broader environmental concerns.

Earth and natural resources as sources of animism and posthumanism are also represented in so-called “arthouse” films. A vision of ecocinema as exploration of other-than-human is shared by Michelangelo Frammartino’s *Le Quattro Volte* and filmmakers Sharon Lockhart and Peter Hutton [45]. In both *Le Quattro Volte* and *Uncle Boonmee Who Can Recall His Past Lives* by Apichatpong Weerasethakul there are allusions to metempsychosis, or transmigration of souls [45,46]. In the case of *Le Quattro Volte* the liveliness, “lived-in-ness” of the tree takes centre-stage after the death of the human protagonist, then switching focus to the chair made from the tree [45]. Boonmee’s deceased wife appears in many non-human guises and in various time-shifts. This is at odds with embodied consciousness of contemporary materiality – the spirit roaming free in inanimate objects – and challenges us to think about time and vitality. Terence Malick’s *The Tree of Life* offers a similar, almost spiritual representation of vital materialism [47].

However, the increased engagement potential of Hollywood blockbusters provides much wider public connections with ideas of OOO and new materialism. These ideas are often inherent, intangible, inarticulate among the subjective experiences of movie-going publics. *Avatar* for example provides old tropes about Wild Western frontier, but as with *Star Wars*, *Interstellar* and other science fiction movies, is set in space [48–50]. In *Avatar*, there was potential for an indigenous cosmopolitics, to use sociologist Isabelle Stenger’s term for politicisation of natural objects, invoking pioneering relationist STS scholar Bruno Latour’s parliament of things – a governance of natural objects by natural objects, a multinaturalism [27,51,52]. However, the re-valorisation of nature is a key theme in Hollywood – in *Avatar* it is increased by the spirituality of trees, but remains modernist in its assumptions about “primitive” aliens and their kinship to the land and natural worlds through non-human and posthuman agency [6]. *Interstellar* and *The Martian* also – problematically from an OOO perspective on possible technologies – create a theme of re-discovery of the wilderness, fleeing an over-consumed Earth to exploit other worlds for inanimate food production to service humans [50,53]. In essence, the same problems are exported elsewhere.

Non-human agency in sustainable energy issues can be described in other ways in fiction, besides pastoral wilderness, vitality and animism. In *Interstellar*, the US Marine tactical robots such as TARS, CASE and KIPP are co-creators of the new space frontier with human explorers [50]. The militaristic machines are given more anthropomorphised voices of empathy than is usual for non-humanoid robots in film, allowing the agenda of colonisation to be softened. In Latour’s framework, nature and culture are one, and the objects and concepts are caught in relationist webs, as with actor-network theory, well-defined in the two papers under review [1,2]. The subjective is in the relation.

Wilson, the anthropomorphized volleyball in *Cast Away* and only companion of the main character played by Tom Hanks marooned alone on an island, *forces more humanity* from the human character [54].

In eco-fiction literature and nature composition, multiple perspectives can be taken. *The Story of Yew* and *H is for Hawk* are good examples where there is ontology of the posthuman and non-human animal without moving towards children’s ideals of anthropomorphised animals [55–57]. The writer’s perspectivist eye can shine light on the ethics of ecology and energy conservation and how it engages publics that might evade policy experts [22,58].

In the review papers, Sovacool *et al* further references Jensen [2,14]:

it is possible to learn from the interplay between “real” nature and “fictitious” nature by anticipating real and fictitious consequences of actions and policies that might shape imaginaries (p16)

Could our objects have a “thingness” about them – in the Latourian terms of entities that pull away, resisting identification as objects - through the discourses of fictive imaginaries? We believe this is what connects many of these materialist theories of energy and energy technologies. Imaginaries are offered as a symbolic solution rather than a set of competing policy framing solutions. There is real potential here to explore this further and to push imaginaries towards policy. This interplay is not just about the imaginaries and frames of humans. The ecosystem can reflexively be explored through the real/imaginative of objects of the ecosystem and their connecting humans networks. After all, to sit down and watch a fictionalised series streamed on Netflix or Hulu about environmental degradation through extraction is to participate in that extraction while bringing about collective imaginaries and these can be explored using STS methods, combining fictive imaginaries with realistic imaginaries. The smart device on which to view the content might have within its network the geopolitics of lithium deposits on Bolivian salt lakes needed to power the device; the copper of the local data centre that links into the content delivery network is likely to have been sourced elsewhere; and then there is the kilowatt hours of electricity needed in watching the series. Energy systems are co-produced with global human action and it is the presentation of future choices that characterises collective energy imaginaries both in content and production [2].

The positivists and the staunch realists among us – avoiding Meillassoux’s jibe about their naiveté – can reach across and agree with the many object ontologists who say categorically this does not mean that oil and rocks are “alive” [17]. Rather we can track what agency can be found in the way a story is weaved into a film about oil and rocks. To present a local example known by us, the authors: Cloughjordan is an Irish eco-village and is both functionally eco-futurist, with its paradigmatic case study for a future sustainable world complete with practical technology and policy, and mythic in terms of the new folklore it adds to the existing history and imaginary of that part of rural Ireland. There are many possibilities for research, such as how primitivism, spiritualism, animism, anthropomorphism, human/non-human relationism and agential realism and these can be expressed in post-colonialist and modernisation projects.

6. Conclusions: Methodologies to elevate OOO and materiality in energy research agendas

In summary, NM/OOO argues that things have agency suggesting that they have interests that we are ethically obliged to respect. In combination with the mapping-out of STS perspectives of Hess and Sovacool and Sovacool *et al*. [1,2] this can greatly inform energy ethics and STS and how publics are engaged about these concepts. Following these frameworks and agendas, we continue the dialogue about potential directions for STS in the service of energy transitions research. We emphasise here the importance of including materiality and non-human perspectives in the energy space, particularly for addressing public and

aesthetic issues for just transition. The use of fictive imaginaries sets out collective values for future ethics and brings us towards exploring ontology in the Anthropocene. STS methodologies can be supported by a sub-category within the framework engaging with ethical OOO and materialisms. While OOO, materiality and fictive imaginaries have formed a small element of the review papers' analysis and there was recognition of the richness in the complexity of ontological approaches to materiality, we argue that much more attention might have been given to their importance in addressing public and systemic approaches to climate change.

With regards to energy policy, this approach helps to define the "who are we?" question in political assemblies of things - paraphrasing Latour - before asserting a sociotechnical imaginary for governance of energy as part of a "collective vision for a good society" but not, however, "realised through technoscientific-oriented policies" (p687) [27,58]. On a larger, transdisciplinary level, OOO creates a more fertile ground for the arts and humanities to flourish in energy research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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References

- [1] D.J. Hess, B.K. Sovacool, Sociotechnical matters: reviewing and integrating science and technology studies with energy social science, *Energy Res. Soc. Sci.* 65 (2020). <http://www.sciencedirect.com/science/article/pii/S2214629620300396>, <https://doi.org/10.1016/j.erss.2020.101462>.
- [2] B.K. Sovacool, D.J. Hess, S. Amir, F.W. Geels, R. Hirsh, L.R. Medina, C. Miller, C. Alvial Palavicino, P. Phadke, M. Ryghaug, J. Schot, A. Silvast, J. Stephens, A. Stirling, B. Turnheim, E. van der Vleuten, H. van Lente, S. Yearley, Sociotechnical agendas: reviewing future directions for energy and climate research, *Energy Res Soc Sci* 70 (2020). <http://www.sciencedirect.com/science/article/pii/S2214629620301924>, <https://doi.org/10.1016/j.erss.2020.101617>.
- [3] M. H. Benson, 'New Materialism: An Ontology for the Anthropocene' *National Resources Journal* 59 (2), 259-280, 2019 <https://digitalrepository.unm.edu/nrj/vol59/iss2/18>.
- [4] N. Gough and C. Adsit-Morris, Words (are) matter: generating material-semiotic lines of flight in environmental education research assemblages (with a little help from SF), *Environmental Education Research*, 26, 9-10, 1491-1508, 2020 DOI: 10.1080/13504622.2019.1663793.
- [5] G. Harman, *Immaterialism: Objects and Social Theory*, Polity (2016).
- [6] P. Brereton, *Environmental Ethics and Film*, Routledge, 2015.
- [7] K. Shrader-Frechette, How Some Scientists and Engineers Contribute to Environmental Injustice, *US National Academy of Engineering: The Bridge*, 47, (1), 36-44, 2017.
- [8] G. Harman, *The only exit from modern philosophy*, *Open Philos.* 3 (2020) 132-146.
- [9] N. Marres, *Material participation: technology, the environment and everyday publics*, Springer, 2016.
- [10] M. Ryghaug, T.M. Skjølsvold, S. Heidenreich, Creating energy citizenship through material participation, *Soc. Stud. Sci.* 48 (2) (2018) 283-303, <https://doi.org/10.1177/0306312718770286>.
- [11] N. Campbell, S. Dunne, P. Ennis, Graham harman, immaterialism: objects and social theory, *Theory Cult. Soc.* 36 (3) (2019) 121-137, <https://doi.org/10.1177/0263276418824638>.
- [12] K. Barad, *Meeting the Universe Half-Way: Quantum Physics and the Entanglement of Matter and Meaning*, Duke Press, Durham, US, 2007.
- [13] L. Bryant, N. Srnicek, G. Harman, *The speculative turn: continental materialism and realism*, Re. Press, Melbourne, 2011.
- [14] C.B. Jensen, *Wound-up worlds and The Wind-up Girl: on the anthropology of climate change and climate fiction*, *Tapuya, Latin Am. Sci. Technol. Soc.* 1 (2018) 186-200.
- [15] P. Gratton, *Speculative Realism: Problems and Prospects*, Bloomsbury, London/ New York, 2014.
- [16] I. Kant, *Critique of Pure Reason*, 2nd ed., Trans. By F.M Müller, Macmillan, London, 1922.
- [17] Q. Meillassoux, *After Finitude: An Essay on the Necessity of Contingency*, Bloomsbury Press, London, 2008.
- [18] M. Heidegger, *On Time and Being*, Trans. By J. Stambaugh, University of Chicago Press, London/Chicago, 1972.
- [19] B. van Heur, L. Leydesdorff, S. Wyatt, Turning to ontology in STS? Turning to STS through 'ontology', *Soc. Stud. Sci.* 43 (3) (2013) 341-362, <https://doi.org/10.1177/0306312712458144>.
- [20] T. Lemke, Materialism without matter: the recurrence of subjectivism in object-oriented ontology, *Distinktion, J. Soc. Theory* 18 (2) (2017) 133-152, <https://doi.org/10.1080/1600910X.2017.1373686>.
- [21] E. Levinas, *Outside the Subject*, Bloomsbury Publishing, 2008.
- [22] L. G. Elkjær, M. Horst and S. Nyborg, Identities, innovation, and governance: A systematic review of co-creation in wind energy transitions *Energy Research and Social Science*, 71, 10.1016/j.erss.2020.101834.
- [23] N. Marres and J. Lezaun, Materials and devices of the public: an Introduction, *Economy and Society*, 40:4, 489-509, 2011 DOI: 10.1080/03085147.2011.602293.
- [24] United Nations, Sustainable Development Goals : Sustainable Development Knowledge Platform, 2020 <https://sustainabledevelopment.un.org/?menu=1300>.
- [25] European Commission, Horizon 2020, Responsible Research and Innovation, 2021, <https://ec.europa.eu/programmes/horizon2020/en/h2020-section/responsible-research-innovation>.
- [26] R. Braidotti, *The Posthuman*, Polity Press, Cambridge, UK, 2013.
- [27] B. Latour, *Politics of Nature: How to Bring the Sciences into Democracy*, Polity Press, Cambridge, 2004.
- [28] B. Latour, *Down to Earth: Politics in the New Climatic Regime*, Polity Press, Cambridge, 2018.
- [29] D. Haraway, *Modest_Witness@Second_Millennium: FemaleMan_Meets_OncoMouse: Feminism and Technoscience* Routledge, New York, 1997.
- [30] S. Woolgar, J. Lezaun, The wrong bin bag: a turn to ontology in science and technology studies? *Soc. Stud. Sci.* 43 (3) (2013) 321-340, <https://doi.org/10.1177/0306312713488820>.
- [31] P. Mason, *Clear Bright Future: A Radical Defence of the Human Being*, Penguin Random House, UK, 2019.
- [32] T. Morton, *Humankind: Solidarity with Non-human People* Verso, Lond. /NY, 2017.
- [33] H. White, Materiality, Form, and Context: Marx contra Latour, *Victorian Studies*, 55 (4), Special Issue: The Ends of History 667-682, 2013 <https://doi.org/10.2979/victorianstudies.55.4.667>.
- [34] I. Gough, Climate change and sustainable welfare: the centrality of human needs, *Cambrid. J. Econ.* 39 (5) (2015) 1191-1214, <https://doi.org/10.1093/cje/bev039>.
- [35] J. O'Neill, Citizenship, well-being and sustainability: epicurus or aristotle? *Analyse Kritik* 28 (2) (2016) 158-172, <https://doi.org/10.1515/auk-2006-0203>.
- [36] P. Cafaro, Gluttony, Arrogance, Greed and Apathy, An Exploration of Environmental Vice. In R. L. Sandler & P. Cafaro (Eds.), *Environmental Virtue Ethics*, Rowman & Littlefield, 2005.
- [37] P. Cafaro, *Environmental Virtue Ethics*, Routledge, In *The Routledge Companion to Virtue Ethics*, 2015.
- [38] Cafaro, P. (2017). Valuing Wild Nature. *The Oxford Handbook of Environmental Ethics*. <https://doi.org/10.1093/oxfordhb/9780199941339.013.12>.
- [39] Cafaro, P., & Sandler, R. (Eds.). *Virtue Ethics and the Environment*. Springer Netherlands, 201, www.springer.com/gb/book/9789400702264.
- [40] R. Sandler, *Character and Environment: A Virtue-Oriented Approach to Environmental Ethics*, Columbia University Press.
- [41] S. Hughes, *Love Leitrim/Hate Fracking: The Affective Technopolitics of Environmental Controversy in Ireland*, PhD thesis, Dublin City University, 2019.
- [42] M. Zirra, *Shelf Lives: Nonhuman Agency and Seamus Heaney's Vibrant Memory Objects*, *Parallax*, 23:4, 458-473, 2017 DOI: 10.1080/13534645.2017.1374516.
- [43] S. Le Menager, *The Aesthetics of Petroleum after Oil!*, *American Literary History* 24 (1) (2012) 59-86, <https://doi.org/10.1093/alh/ajr057>.
- [44] R. Ó Domhnaill, *The Pipe*, Underground Films, 2010.
- [45] M. Frammertino, *Le Quattro Volte*, Vivo Film/Arte/ZDF, 2010.
- [46] A. Weerasethakul, *Uncle Boonmee Who Can Recall His Past Lives*, Kick the Machine, 2010.
- [47] T. Malick, *The Tree of Life*, 20th Century Fox/Searchlight Pictures, 2011.
- [48] J. Cameron, *Avatar*, Dune Entertainment/Ingenious Partners, 2009.
- [49] G. Lucas, *Star Wars*, Lucasfilm, 1977.
- [50] C. Nolan, *Interstellar*, Paramount Pictures/Warner Bros/ Legendary Entertainment, 2014.
- [51] J. Adamson, *Indigenous Literatures, Multinaturalism, and Avatar: The Emergence of Indigenous Cosmopolitics* *American Literary History* 24, 1, 2012, : 143-62. <http://www.jstor.org/stable/41329631>.
- [52] I. Stengers, *Cosmopolitics I-II*, University of Minnesota Press, Trans. by Robert Bononno, 2010.
- [53] R. Scott, *The Martian*, 20th Century Fox, 2016.
- [54] R. Zemeckis, *Cast Away*, 20th Century Fox/Dreamworks, 2000.
- [55] D. M. di Sospiro, *The Story of Yew*, Findhorn Press, 2001.
- [56] H. MacDonald, *H is for Hawk*, Grove Press / Atlantic Monthly Press, 2016.
- [57] C. Wolfe, *What Is Posthumanism?* University of Minnesota Press, 2010.
- [58] J.H Tidwell, J. Smith, *Morals, materials and technoscience: the energy security imaginary in the United States*, *Science, Technology & Human Values* 40 (2015) 687-711, <https://doi.org/10.1177/0162243915577632>.