Gender in sustainability transition studies: Concepts, blind spots and future orientations

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ARTICLE INFO	ABSTRACT
	Gender is a vital factor of societal organisation and transformation, and figures prominently in global sustainability agendas. Its social construction and interaction with technological change have been studied extensively. Within the field of sustainability transition (ST) research, however, the complex roles gender plays in socio-technical change are still rarely addressed or conceptualised. Based on a systematic review covering scientific publications from 2010 to 2020 we illustrate this overall gap and explore how gender is operationalised. We draw on Harding's notion of gender as structural, symbolic and behavioural expression to consider implications for understanding regimes, niches, and regime/niche interactions. Our results recognise a variety of conceptual approaches accounting for the diverse implications of gender relations for transition dynamics and their sustainability orientation. In conclusion we recognise the usefulness of the suggested analytical lens for strengthening gender-sensitive inter- and transdisciplinary ST research systematically, and suggest promising avenues for future studies.

1. Introduction

Sustainability transitions (ST) research is concerned with understanding and orienting complex dynamics of socio-technical change (van den Bergh et al., 2011). In the face of wicked sustainability problems, lock-in situations and worsening environmental conditions at local to global scales, the field has rapidly grown into a diverse and rich source of knowledge and inspiration. Multiple other branches of science, as well as policy and practice refer to ST research since it addresses highly relevant societal challenges. In particular, its focus on the urgent need quickly to abandon current development paths and instigate radical change to enable sustainable and resilient futures resonates with diverse agendas (Loorbach et al., 2017; EEA, 2019).

Considering its ambitions in terms of societal transformation and sustainability, as well as its rising influence as an inter- and transdisciplinary science and practice domain, however, ST research appears to display a conceptual gap concerning the roles and relevance of *gender*. This vital factor of societal organisation and transformation has so far received only marginal attention in the contributions and debates that have shaped the field (Kronsell, 2013). Neither the inaugural research agenda formulated by the STRN[1] in the year of its foundation (STRN, 2010), nor a boundary-spanning review of the field published in 2017 (Loorbach et al.) mention the term "gender".

This is not to say that nothing has been discussed or written on gender in sustainability transitions over the past decade. The revised

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STRN agenda of 2019 now does address gender and recognises related research gaps (Köhler et al., 2019). Still, "gender" appears to be framed here only in particular ways: Either as a category accounting for social differences in terms of *impacts* caused by transitions, or regarding the *ethics* used to assess these (Köhler et al., 2019). Both remain essentially disconnected from the principal concern of ST studies to *theorise and guide* deep socio-technical change, encompassing a wide range of structural, cultural and practice dimensions (van den Bergh et al., 2011; Markard et al., 2012; Loorbach et al., 2017).

Such conceptual disengagement is not only out of step with current high-level political commitments such as the UN Sustainable Development Goals (SDG5) or the EU gender equality strategy 2020–25, which demand that gender considerations be placed at the core of societal change, it also fails to explore the diverse and complex de-/stabilising roles gender may play in societal systems, and thus its genuine relevance for sustainability transitions. This is well reflected in recent resurgences of gender politics in countries across the globe, from the US to Poland or Iran, articulating confrontations fuelled by gendered interests and uncertainties linked to ongoing socio-technical change. Although manifold gender equality policies had been adopted globally following the second-wave Women's Movement (e.g., regarding political participation, labour rights, care or violence), these achievements are again being contested by anti-feminist movements worldwide (Charles, 2020; Krizsan and Roggeband, 2018; Paternotte and Kuhar, 2018; Verloo and Paternotte, 2018). In turn, opposition to feminist knowledge production, gender mainstreaming and reproductive rights has also prompted novel forms and scales of feminist activism, as illustrated by the Women's March Global or #MeToo movements. Moreover, with the outbreak of the Covid-19 pandemic in 2020, known patterns of systemic gender inequality and injustice such as gaps in participation, education or payment have become reinforced or recreated, while at the same time awareness and transparency in this regard have seen a substantial increase (see Allmendinger, 2021; WEF, 2021; Azcona et al., 2020; Özkazanç-Pan and Pullen, 2020).

Since gender is at the heart of established norms, cultures, institutions and practices, its salience in the process of current societal transformations (by design or by disaster) seems only consequential. For ST research however this clearly implies the need to acknowledge and conceptually unpack how gender can generate distinctive, albeit context-dependant constraints and opportunities in systemic transformations and thus co-shape particular socio-technical pathways.

Following these initial reflections, this paper provides a systematic review of sustainability transitions research since the formation of the field with a view to elicit the usage of "gender" as an epistemological orientation and analytical perspective. It does so first by briefly revisiting fundamental considerations and concepts used in ST research and in feminist technoscience to understand "socio-technical transitions" and "gender" as a core factor of societal change processes and their sustainability (Section 2). Against this backdrop, the specific review approach and methodology are explained (Section 3). We then synthesise and discuss the results of the review, addressing three analytical questions: 1) What conceptions of "gender" are used in the corpus? 2) What is the related epistemological focus in terms of sustainability transitions? 3) What are the empirical findings regarding gendered influences on sustainability transitions? This includes outlining a conceptualisation of "gender" that aligns with the principal epistemological orientations of ST research and is able to capture the ways in which gender can affect socio-technical transitions towards sustainability (Section 4). In conclusion, we account for relevant insights and gaps and derive orientations for future research that may enhance the development of more gender-sensitive and gender-focused ST theory and approaches.

2. Theoretical frameworks and concepts

Sustainability transitions research developed to address major environmental problems caused by existing large-scale, societally embedded systems of provision, such as energy, water, food, and mobility (Elzen et al., 2004; Grin et al., 2010). They draw on a range of interdisciplinary fields and concepts in order to understand and also influence the development pathways of such systems. In turn, feminist technoscience studies emerged out of feminist critiques exposing the diverse ways in which gender is entangled in today's "sociotechnical networks" as well as practices (Åsberg and Lykke, 2010). They equally make up a rich interdisciplinary field of research, mobilising diverse theoretical and methodological approaches for analysis. In the following we provide a highly synthetic snapshot of these two fields, focusing on key conceptual propositions and their affinities in order to inform our review approach and interpretations.

2.1. Socio-technical transitions towards sustainability

ST studies focus on complex interrelations between multiple social and technological system components in order to understand change dynamics and resulting sustainability impacts. Epistemologically this situates the subject of ST studies at a meso-level between broader societal change (e.g., conflict theories or human-ecology) and organisational or individual change (e.g., business or behavioural studies) (Köhler et al., 2019). The field is also constantly evolving with important boundary areas forming e.g., towards social-ecological system studies or research dealing with socio-economic and socio-political change (Loorbach et al., 2017). Here we concentrate on the socio-technical core, since this forms a distinctive epistemological orientation of the field and will also remain constitutive for future extensions.

Socio-technical transitions are conceived of as shifts from one system configuration to another through coevolving changes in "*established ways of thinking (culture), doing (practices) and organising (structure)*" (van den Bosch and Rotmans, 2008). This perspective not only discards technological determinism and underlines the continuous mutual shaping of technology and society (Bijker et al., 1987; Hughes, 1987; Shove and Walker, 2007), it also highlights three complementary dimensions through which this interweaving and alignment between both occurs: The expression of values, norms or imaginaries through signs, symbols and discourses (*culture*), people and technology (*practice*), and the formation of ordering systems such as infrastructures, organisations and institutions (*structure*). As we argue below (section 1.2), these basic dimensions offer an equally valid entry point for unpacking gender in

sustainability transitions.

In order to also initiate and foster socio-technical *sustainability* transitions, ST research has drawn fundamental inspiration from innovation studies, especially approaches that explain the emergence and diffusion of novel (and more sustainable) solutions. While this orientation initially dominated the field, it was soon complemented by a concern for how socio-technical systems can become destabilised, reconfigured or fully substituted (van den Bergh et al., 2011; Markard et al., 2012). A key conceptual framework to interpret both dynamics and their interactions is the *multi-level perspective* (MLP) (Kemp et al., 1998; Geels, 2002). It identifies a socio-technical *regime* as a dominant configuration of socio-cultural, political, economic and technological factors that maintain the status quo. In turn, socio-technical *niches* are conceived as protected spaces in which innovations are developed that can create pressures for regime change. Additionally, a socio-technical "*landscape*" formed by diverse events and dynamics in the system environment is suggested to shape niche-regime interactions e.g., by creating opportunities or constraints.[2]

This characterisation of socio-technical transition dynamics as struggles between niches and regimes can be traced across the ST literature (see Loorbach et al., 2017) including its most prevalent heuristics and intervention frameworks such as *strategic niche management* (SNM) (Kemp et al., 1998), *technological innovation systems* (TIS) (Bergek et al., 2008), *transition management* (TM) (Loorbach, 2010), or more recently the *X-curve* (Hebinck et al., 2022). Considering that the socio-technical *cultures, structures* and *practices* that characterise regimes and niches are not necessarily identical but rather tend to diverge (most apparently regarding grassroots niches - see e.g. Seyfang and Smith, 2007), we propose to retain the niche-regime distinction for our analysis in terms of gender. Moreover, the term *regime* offers a useful boundary object here to denote a prevailing order, for instance, where the objective is to "*delineate systems of inequalities, in which the gender regime is part of other complex systems*" (Kronsell, 2013, p. 2; Walby, 2009). Therefore, we distinguish three broad epistemological orientations in ST research, respectively aiming to understand:

- *Regime* re-/configuration, de-/stabilisation or interrelations
- *Niche* formation, de-/stabilisation or amplification
- *Niche/regime* interactions and development pathways

The suggested categorisation acknowledges that unpacking the dialectic relations between stability and change forms a core interest of the field (Köhler et al., 2019), especially with a view to assessing their sustainability implications and informing intervention strategies. Given the complexity of socio-technical transitions it also reflects pragmatic choices frequently made by researchers to delimit smaller units of analysis so as to ensure feasibility. Against this backdrop we will now turn towards pertinent conceptions of gender and their relation to socio-technical change in general, and corresponding notions of culture, structure and practice in particular.

2.2. Gender in feminist technoscience

Even though theories about gender cannot be equated with feminist approaches, the former build directly on the innovations and methodological assumptions of the latter. For this reason, and given that feminist theories evolve around the question of how to use scientific knowledge for societal transformations (Wu, 2013), we identify feminist approaches to sociotechnical issues as a helpful entry-point for this discussion. Feminist thinking does not emerge from a homogenous scientific community but instead from individuals and groups from different geographical and social locations, who pursue various goals and agendas (Kerner, 2017). And just as there is no monolithic feminism, no one best approach exists to undertake gender analysis (Harding, 2010). Rather *gender* forms a contested theoretical as well as analytical concept which has been construed in innumerable different ways, reflecting the richness, complexity, and multidimensionality of gendered realities (Kantola and Lombardo, 2017). This implies that the usefulness of different conceptualisations cannot be judged in general terms but depends to a certain extent on the purposes for which they were introduced (Wu, 2013). In the following we therefore focus on understandings of gender in *feminist technoscience* studies, highlighting key debates and deriving a suitable analytical framework to connect with ST research and systematise our review.

Historically, feminist engagement with technology emerged out of the second Women's Movement's political as well as scientific concern to explore technologies' gendered power relations (Lagesen, 2015). Early feminist technoscience investigated how wo/men are positioned differently in relation to various technologies and focused on histories of the gendered division of labour (Wagman and Parks, 2021). One initial challenge was to demonstrate that the prevailing cultural association of technology with masculinity was not 'grounded in nature' (Wajcman, 2010, p.144). The conceptual separation of biological sex and sociocultural gender in the early 1970s (Åsberg et al., 2011) then allowed for such feminine/masculine stereotypes to be denaturalised and deconstructed. Many feminists drew on gender to broaden the narrow view of "women" and to politicise related norms and roles as historical constructs (Adrian et al., 2018; Skewes and Adrian, 2018) subject to societal processes of hierarchisation and structuration (Paulitz, 2021). With this move towards social constructivism, instrumental notions of technology were discarded in favour of recognition of its embeddedness in social (i.e., gendered) rules and relations, as well as its potential to shape these (Wagman and Parks, 2021). Subsequently, many

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[2] The notion of a socio-technical "landscape" has been frequently questioned as a fuzzy concept that "*simply lumps together very different macro-structures and macro-trends*" (Kanger and Schot, 2019, p. 10)", consequently blurring crucial distinctions in terms of spatiotemporal scales, reach or obduracy. Thus, it does also not offer a promising starting point for analysing gender implications of socio-technical transitions. Locating gender in a macro-environment of the system(s) under consideration would even favour its exclusion from differentiated analysis, deflecting from the need to understand its implications *within* the formation and co-evolution of regimes and niches themselves.

feminist accounts embraced the idea of a dynamic co-construction of gender and technology (Faulkner, 2000; Lagesen, 2015; Wajcman, 2007), asking how technologies are linked to the re-/production of divisions and inequalities (Harding, 2010; Wajcman, 2010).

Nevertheless, the widespread use of gender as an a-priori category of binary opposition has been called into question. Critics recognise that such analysis often preconfigures the relationships as well as motivations wo/men have (regarding technologies), and what is considered to be masculine/feminine. It may therefore tend to reproduce prejudices and stereotypes while ignoring the relevance of other complex relations (Lagesen, 2015; Pujol and Montenegro, 2015). Growing unease with static, homogenous understandings of gender is reflected in three important conceptual discussions within feminist (technoscience) studies:

The first one can be traced back to the works of feminists of colour and postcolonial feminists (Hill Collins, 1991; hooks, 1981, 1990; Lorde, 1984; Mohanty, 2003a; Trinh, 1989) who since the late 1980s have opposed academic feminism for being White, middle-class and heterosexist (Adrian et al., 2018; Coddington, 2015; Wajcman, 2010). Their position drew attention to the risks of generalising the experiences of (more) privileged women, but also the limitations of gender(-only) analyses to the exclusion of other forms of inequality (Kantola and Lombardo, 2017). As part of this critique, Crenshaw (1991) coined the term *intersectionality* to identify the interweaving and mutual constitution of various mechanisms of social inequality (Winker and Degele, 2011) – such as patriarchy, racism, capitalist exploitation, or homophobia – as these impact identities and social positions (Sauer, 2018). Consequently, there is a body of work that explores gender in its interdependence with other sociocultural and structural power differentials as well as identity markers (Åsberg and Lykke, 2010).

From the 1990s onward, another crucial strand of debate has evolved around poststructuralist, performative approaches (Butler, 1990). These accounts emphasise complexity and contingency, fluidity and becoming (Faulkner, 2000) to question a fixed conception of gender (Wajcman, 2010). In this perspective gender is considered to be the product of dynamic relational processes emerging from collective understandings as well as practices and interactions (Pujol and Montenegro, 2015). Put differently, it is understood as a set of historically and culturally constructed social norms (Lykke, 2010), which are reiterated and challenged through *practical performance*. Although pertinent binaries – male/female, masculine/feminine – work to organise bodies and make them socially legible (Wagman and Parks, 2021), the lived experiences of individual subjects are constituted through acts of reiteration and must therefore be taken as situated and embodied rather than given (Suchman, 2008). Consequently, while aiming to de-essentialise gender, these approaches equally see technologies as performed and processual in character, rather than given and unchanging (Faulkner, 2000; Wajcman, 2010).

The third thread builds on post-constructivist or material feminisms (e.g. Alaimo and Hekman, 2008; Barad, 2007; Bennett, 2010; Coole and Frost, 2010). They formulate a fundamental critique of multiple dichotomies – subject/object, nature/culture, materiality/discourse or sex/gender – rejecting the idea that one component can be studied separately from the other (Adrian et al., 2018). In particular, these perspectives advocate that *matter* be taken more explicitly into account by approaching the agency of bodily or transcorporeal materialities in non-deterministic, non-essentialising ways (Lykke, 2010). Thereby, they share a non-dualist ontology, which directs analytical attention away from pregiven entities and towards constitutive relational dynamics (Adrian et al., 2018). This 'material turn' owes much to feminist technoscience (Åsberg and Lykke, 2010) which inhabits a long materialist tradition, especially regarding the body (Åsberg et al., 2011). Many scholars (e.g. Haraway, 1991) have dedicated themselves to undoing dominant assumptions about categories and their interrelations, as well as the politics of ordering within such divisions (Åsberg and Lykke, 2010; Suchman, 2008; Wagman and Parks, 2021). This perspective further broadens analyses of gender politics towards questions of how to understand agency, body, and rationality as well as nature/culture-boundaries (Åsberg and Lykke, 2010).

In the course of these discussions over the past decades, *gender* as a (central) analytical category for feminist analyses has evolved into a perspective (Elmhirst, 2011; Misra, 2020) that highlights connections and relationality rather than binaries and dualisms (Coddington, 2015). At the same time, numerous feminists continue to foreground the concept as central, as they consider it to be an indispensable critical, transdisciplinary tool in certain contexts (Sandford, 2015). Especially in its complex entanglement with other social and material categories, gender appears to be vital for a deeper understanding of processes of social change, their inequalities and possible strategies to redress them, as well as for imagining alternative societies (Browne, 2021; Misra, 2020). In this sense, attempts to tackle sustainability issues without a thorough understanding of gender will necessarily remain "*insufficient, unjust and therefore unsustainable*" (MacGregor, 2009, p.124).

Considering the (in part incompatible) ontological and epistemological diversity of gender concepts sketched above and the vivid controversies around gender as an analytical category, we refrain from conclusively defining gender or imposing any particular perspective for our review here. Nevertheless, we do require an 'auxiliary structure' (Weller, 2003, p.359) to guide our search and comparative analysis of presumably heterogeneous approaches. This should enable us to identify and categorise theoretical conceptualisations as well as more implicit understandings of 'gender' in our material without making premature ascriptions. To this end we turn to Sandra Harding's (1986) frequently invoked suggestion to disentangle gender relations and their effects by considering three basic dimensions: 1) *structural/institutional* (manifested, e.g., as organisation of human relations), 2) *symbolic* (expressed, e.g., in cultural meanings and belief systems), and 3) *individual/behavioural* (articulated, e.g., as sense of personal identity, social practices and performances). A major advantage of this approach lies in the fact that it fully aligns with the epistemological orientation of ST research to change in *structures, cultures* and *practices*, thus offering a conceptual bridge between the two fields. Another strength resides in that, while focusing on these fundamental three dimensions, it avoids reducing gender to any one of them (Carvalho, 2020) since they are conceived as closely intertwined (Weller, 2003) and seamlessly interacting (Faulkner, 2000). By leaving open *if* and also *how* these dimensions are articulated it permits the respective assumptions to be mapped out, thereby allowing for the heterogeneity of feminist debates as illustrated in this section. This includes materialist traditions in feminist technoscience, as the role of materiality (if any) can equally be traced across the three dimensions. Moreover, Harding's multi-dimensional model has also been recognised as a useful approach for comprehensive intersectional analyses (e.g., Collins, 1993; Kaijser and Kronsell, 2014; Winker and Degele, 2011)

since intersectionality maps across all three qualities (McCall, 1992). In view of these characteristics, we believe it provides a robust yet flexible enough framework to support our interdisciplinary review.

3. Review methodology

In order to identify the relevant corpus for our analysis we adopted a systematic review approach and used qualitative interpretation as an iterative methodology (Petticrew and Roberts, 2006; Gough et al., 2012) (Fig. 1). On the basis of the three above-mentioned research questions (see 1.1) we were able to focus our analytical process and specify eligible types of literature and databases, the search period as well as suitable search terms and selection criteria. Each step of the review process was discussed and agreed in the interdisciplinary research team, and all interpretations of individual contributions were made involving at least two researchers with complementary expertise in pertinent fields to ensure balanced assessment.

Since this study addresses scientific debates, the focus deliberately lies on *peer-reviewed academic publications* (i.e., excluding reports, conference papers or policy papers). Therefore, we chose the abstract- and citation-databases *Scopus* and *Web of Science Core Collection* (WOS) to conduct our search queries. These databases provide a broad multidisciplinary coverage of 23,500 and 21,000 peer-reviewed journals respectively (Clarivate Analytics, 2018; University of Regensburg, 2020a, 2020b). They offer a comprehensive overview of the publishing output of the global science system - including its immanent limitations and biases (Tennant, 2020).

In the process of selecting our corpus, we confined ourselves to articles and reviews published between 2010 and 2020. Even if early socio-technical transition research dates back to the turn of the millennium or before (Lawhon and Murphy, 2012), it was arguably with the foundation of the international *Sustainability Transition Research Network* (STRN) in 2010 that the formation and institutionalisation of the field took off. Nevertheless, we also verified this restriction of the search period after the selection of search terms through an open test run *without* this limitation whenever the number of hits was very small (~ 50). This confirmed that only few articles published before 2010 corresponded to our search interest, and none of these ultimately met the selection criteria.

Regarding the two large scientific fields of interest for our review (ST and gender studies) we compiled two lists of most pertinent keywords to form sensitive search terms for filtering contributions situated precisely at their intersection. On the one hand, "socio*techn*", "sustainab*", "system*", "transformation*" and "transition*" were initially considered, and on the other hand "gender*", "feminis*", "man", "men", "wom*n", "patriarch*" and "intersectional*". The chosen keywords were then adjusted iteratively to ensure pertinence of the results but also openness to identify references operating at the margins. After the first test runs, some terms were excluded due to the undifferentiated results delivered ("man", "men"), while other terms were added by scanning keywords and abstracts of the interim results ("transition theor*", "transition stud*", "transition approach*", "pathway*", "niche*", "regime*", "masculin*", "feminin*", "male" and "female"). Our final list comprised 20 keywords in total.

We then applied the selected keywords using truncations (*) and Boolean operators (AND and OR) to form different search terms. Pivotal to the variations within and across the two keyword sets was to represent both fields in every query; ST and gender related vocabulary was always connected by "AND". Modifications of keyword combinations were primarily undertaken on the ST side. In the course of these iterations, keywords were connected with "AND" to further specify their usage context e.g., (socio*techn* AND system* AND sustainab*), while "OR" was applied to connect synonyms or words which target the same subject area, e.g., (transition* OR transformation*); (niche* OR regime*). By contrast, gender-related keywords were always joined together by "OR" and their composition remained more or less fixed, e.g., ("gender*" OR "feminis*" OR "wom*n" OR "patriarch*" OR "intersectional*"). In case of a very small number of results in the previous query, this search component was even broadened by adding further keywords (OR "masculin*" OR "feminin*" OR "male" OR "female").

As a standard, the search in Scopus was applied to the categories *title, abstract* and *keywords*, whereas in WOS additionally *author* and *keywords plus*[3] were also considered. In the case of a small number of hits, we also conducted several control runs in Scopus. For this purpose, we repeated the exact same ST-related keywords a second time (e.g., TITLE-ABS-KEY (socio*techn* AND (transformation* OR transition*))) but combined with the search operation ALL ("gender" OR "feminis*"). Consequently, the latter part of the query was applied to *all categories*, including citations. We decided to use only these two keywords as they constitute the most specific and therefore most promising ones, considering that just a single mentioning of these terms in the cited references leads to an appearance in the result list. This step did not deliver new meaningful outcomes, therefore confirming our procedure as appropriate. A full list of all search terms used and search runs is provided in the annex, including the respective number of hits (Annex 1).

For each search run we then selected relevant publications for further analysis by manually analysing their contents in three steps: First, we screened the *titles* of the hits for concerns about a *socio-technical problem*. If there was no indication recognisable that an article actually discussed issues arising in the co-evolution of society and technology, it was excluded. Basic areas of interest thus constituted for example electricity, transport, food, water, heat, buildings or waste (Köhler et al., 2019). In the course of this first screening, a great number of publications therefore had to be excluded since they showed terminological overlaps but no relevant content (e.g., personal transition, political transitions in post-socialist societies). Second, the *abstracts* of the remaining articles (n: 555) were screened for two criteria: On the one hand, a publication was excluded if the socio-technical issue reflected in the title did not solidify. On the other hand, we looked for clues of gender being employed as a theoretically informed category of analysis (i.e., more than just a variable along which data can be dis-aggregated).[4]

Third, for those articles retained we screened the *full texts* (n: 50) by conducting a keyword search in the whole document. In

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[3] "Keywords Plus" are index terms derived from article titles cited by the author (Clarivate Analytics, 2018, p. 35).

[4] Concerning search results from AND ALL(gender OR feminis*)-queries, the second criteria was not applied to the abstract scan.
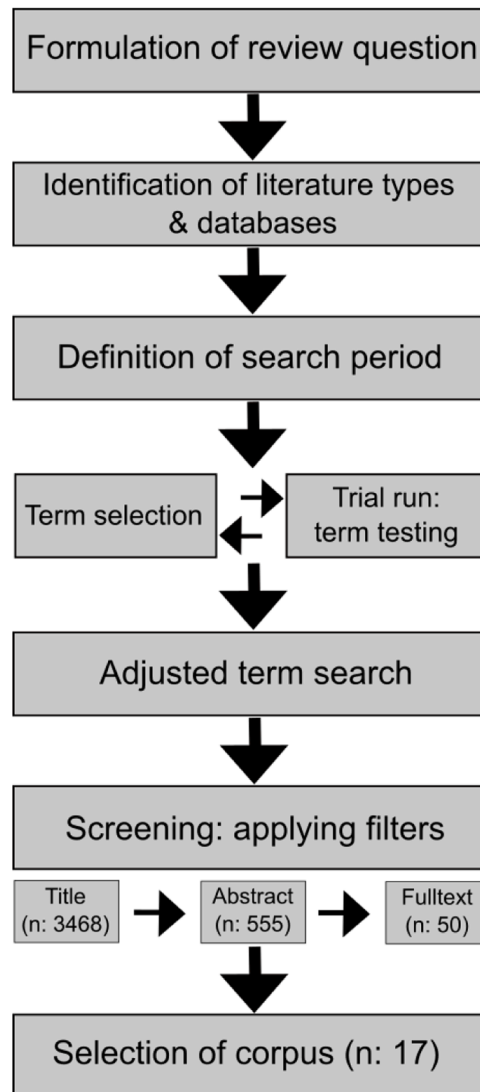
Fig. 1. Overview of the review methodology and process.

addition, we also checked the introduction and the theory sections manually. For this step, we applied the above criteria (socio-technical problem / gender as theoretically informed analytical category). Concerning the latter, our elaboration on gender (Section 2.2 above) provided decisive orientations. Yet it should be noted that this selection criterion has been interpreted rather generously (see 4.2). Additionally, the use of a *system framework* was introduced as a third requirement, considering that socio-technical systems are commonly understood as complex configurations which are constituted by technology, markets, user practices, cultural meanings as well as infrastructure and which are "*transformed, and reproduced by multiple types of actors and institutions operating within or outside a society and at different levels.*" (Lawhon and Murphy, 2012, p.357). This criterion allowed to distinguish more strictly between ST studies and contributions drawing on other ontologies. Only 17 publications met all three requirements and have therefore been included in our corpus.

4. Results and discussion

Overall, the corpus identified was rather small (17). The first and foremost result of our analysis is therefore a sound confirmation of the continued overall lack of conceptual engagement in ST studies with gender as a core factor of societal organisation and trans-formation. Nevertheless, the publishing timeline of the references selected suggests that gender-related questions have received growing attention in recent years. After a seminal contribution by Kronsell (2013) six of the papers were published between 2017 and 2019 and the remaining ten in 2020 alone. Although these are still very low absolute figures they may represent a first indication of a trend, possibly also mirroring the rise of gender issues on political agendas and in societal debates. This clearly corresponds to broader

Annex 1
Review search terms and query results.

SCOPUS SEARCH STRING	DATE	HITS	CONSIDERED
(TITLE-ABS-KEY (sustainab* AND system*) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*)) AND PUBYEAR > 2009	16.09.2020	> 2000	No (not specific)
(TITLE-ABS-KEY sustainab* AND socio*techn*) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*OR masculin* OR feminin* OR male OR female))	10.09.2020	15	Yes
(TITLE-ABS-KEY ("sustainability transition*" OR "sustainability transformation*") AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female))	16.09.2020	16	Yes
(TITLE-ABS-KEY ("sustainability transition*" OR "sustainability transformation*") AND ALL (gender OR feminis*)) AND PUBYEAR > 2009	08.09.2020	98	Yes (control run)
(TITLE-ABS-KEY (sustainab* AND (transformation* OR transition*)) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*)) AND PUBYEAR > 2009	17.09.2020	540	Yes
(TITLE-ABS-KEY (sustainab* AND (niche* OR regime*)) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*)) AND PUBYEAR > 2009	18.09.2020	367	Yes
(TITLE-ABS-KEY (sustainab* AND pathway*) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*)) AND PUBYEAR > 2009	15.09.2020	180	Yes
(TITLE-ABS-KEY (system* AND socio*techn*) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*)) AND PUBYEAR > 2009	15.09.2020	146	Yes
(TITLE-ABS-KEY ("system transition*" OR "system transformation*") AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female))	17.09.2020	123	Yes
(TITLE-ABS-KEY (system* AND (transition* OR transformation*)) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*)) AND PUBYEAR > 2009	17.09.2020	> 5000	No (not specific)
(TITLE-ABS-KEY (system* AND (niche* OR regime*)) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*)) AND PUBYEAR > 2009	18.09.2020	> 3500	No (not specific)
(TITLE-ABS-KEY (system* AND (niche* OR regime*) AND (transition* OR transformation*)) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*)) AND PUBYEAR > 2009	16.09.2020	182	Yes
(TITLE-ABS-KEY (system* AND pathway*) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*)) AND PUBYEAR > 2009	18.09.2020	> 5000	No (not specific)
(TITLE-ABS-KEY (system* AND pathway* AND (transition* OR transformation*)) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*)) AND PUBYEAR > 2009	17.09.2020	273	Yes
(TITLE-ABS-KEY ((transition* OR transformation*) AND socio*techn*) AND TITLE-ABS-KEY(gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female))	16.09.2020	11	Yes
(TITLE-ABS-KEY ((transition* OR transformation*) AND socio*techn*) AND ALL (gender OR feminis*)) AND PUBYEAR > 2009	10.09.2020	49	Yes (control run)
(TITLE-ABS-KEY ((transition* OR transformation*) AND (niche* OR regime*)) AND TITLE-ABS-KEY (gender* OR feminis*)) AND PUBYEAR > 2009	18.09.2020	428	Yes
(TITLE-ABS-KEY ((transition* OR transformation*) AND pathway*) AND TITLE-ABS-KEY (gender* OR feminis*)) AND PUBYEAR > 2009	22.09.2020	438	Yes
(TITLE-ABS-KEY ("transition stud*" OR "transition theor*" OR "transition approach*") AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*)) AND PUBYEAR > 2009	17.09.2020	135	Yes
(TITLE-ABS-KEY ((niche* OR regime*) AND socio*techn*) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female))	23.09.2020	7	Yes
(TITLE-ABS-KEY (pathway* AND socio*techn*) AND TITLE-ABS-KEY (gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female))	23.09.2020	1	Yes

WEB OF SCIENCE: Core Collection SEARCH STRING	DATE	HITS	CONSIDERED
TOPIC: (sustainab* AND system*) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*) AND PY=(2010–2020)	22.09.2020	> 2000	No (not specific)
TOPIC: (sustainab* AND socio*techn*) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female)	22.09.2020	10	Yes
TOPIC: ("sustainability transition*" OR "sustainability transformation*") AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female)	22.09.2020	17	Yes
TOPIC: (sustainab* AND (transformation* OR transition*)) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*) AND PY=(2010–2020)	22.09.2020	558	Yes
TOPIC: (sustainab* AND (niche* OR regime*)) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*) AND PY=(2010–2020)	23.09.2020	140	Yes
TOPIC: (sustainab* AND pathway*) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*) AND PY=(2010–2020)	23.09.2020	177	Yes
TOPIC: (system* AND socio*techn*) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female)	23.09.2020	37	Yes
TOPIC: ("system transition*" OR "system transformation*") AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female)	22.09.2020	50	Yes
TOPIC: (system* AND (transformation* OR transition*)) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*) AND PY=(2010–2020)	22.09.2020	> 4000	No (not specific)
TOPIC: (system* AND (niche* OR regime*)) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*) AND PY=(2010–2020)	23.09.2020	> 2500	No (not specific)
TOPIC: (system* AND (niche* OR regime*) AND (transformation* OR transition*)) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*) AND PY=(2010–2020)	22.09.2020	126	Yes

Annex 1 (*continued*)

WEB OF SCIENCE: Core Collection SEARCH STRING	DATE	HITS	CONSIDERED
TOPIC: (system* AND pathway*) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*) AND PY=(2010–2020)	23.09.2020	> 4500	No (not specific)
TOPIC: (system* AND pathway* AND (transformation* OR transition*) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*) AND PY=(2010–2020)	23.09.2020	241	Yes
TOPIC: ((transformation* OR transition*) AND socio*techn*) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female)	22.09.2020	8	Yes
TOPIC: ((transition* OR transformation*) AND (niche* OR regime*)) AND TOPIC: (gender* OR feminis*) AND PY=(2010–2020)	24.09.2020	438	Yes
TOPIC: ((transition* OR transformation*) AND pathway*) AND TOPIC: (gender* OR feminis*) AND PY=(2010–2020)	24.09.2020	551	Yes
TOPIC: ("transition stud*" OR "transition theor*" OR "transition approach*") AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional*) AND PY=(2010–2020)	22.09.2020	124	Yes
TOPIC: ((niche* OR regime*) AND socio*techn*) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female))	24.09.2020	5	Yes
TOPIC: (pathway* AND socio*techn*) AND TOPIC: (gender* OR feminis* OR wom*n OR patriarch* OR intersectional* OR masculin* OR feminin* OR male OR female))	24.09.2020	1	Yes

but still recent tendencies in the field to examine "just transitions, gender and different forms of power", drawing on sociology, political sciences and critical perspectives (Truffer et al., 2022, p.335). Similarly, an increasing concern for gender and intersectionality is also reflected in current calls to strengthen diversity and justice in future ST research regarding topics, methods and participants (Preuß et al., 2021; Ghosh et al., 2021).

In this section we address our research questions in turn, discussing how "gender" is conceptualised in the corpus, what epistemological orientations can be identified regarding the linkage between gender and sustainability transitions, and finally the related empirical insights obtained.

4.1. Gender conceptions in ST studies

We found diverse forms of conceptual engagement with gender across the 17 papers, including discussions of its structural (13), symbolic (7) and behavioural (9) dimensions. Eleven papers address two dimensions together, while only one attends to all three (Standal et al., 2020). Moreover, most approaches account for some role of *materiality* (14), which usually refers to technologies and artefacts used, but also includes infrastructures, spaces, human bodies, as well as electricity. Only six papers explicitly address *intersectionality* as a concept, while eight attend at least some related interdependencies of gender (e.g., with class, age, ethnicity, wealth, education, health or location).

Seven contributions offer an explicit conceptual view of gender (five of which also focus their research questions on it) and will thus be discussed in detail below. The other ten address gender as a consequence of using analysis approaches that scrutinise social differentiation or individual action in transition processes so that issues of gendering come into sight. This concerns mostly structural aspects (7/10), but some also discuss interactions between the symbolic and behavioural (3/10), or structural and behavioural dimensions (1/10) of gender. Conceptually, however, these papers do not offer additional starting points (Table 1 – see also Annex 2 for a full list of criteria and details).

The earliest contribution by Kronsell (2013) combines transition- and gender studies to illustrate how gender functions as a "crucial principle of social organisation" and is thus relevant to Swedish climate governance. Specifically, she consults constructivist, materialist and standpoint feminist approaches to demonstrate that gender is both material and ideational, since it concerns inequalities and differences in terms of participation, power relations and societal norms. While the author illustrates how gendered *structures* (societal division of un/paid labour, re/production) and *symbolism* (masculinity as dominant norm for governance) profoundly affect the stabilisation of current regimes as well as the upscaling of socio-technical niche innovation, she also conceptualises gender as *materially* constituted in socio-economic relations. Kronsell also highlights the intersectional, interrelated character of gender, but does not elaborate further on this aspect (p. 2f, 11).

Lieu et al. (2020) also approach regime-niche relations from a *structural* and *symbolic* point of view. By applying concepts from innovation- and gender studies (e.g., feminist political ecology, gender mainstreaming), they explore the gendered nature of energy pathways (normative future scenarios) in Canada, Kenya and Spain. The authors introduce an "alternative pathways framework" with which they aim to make their respective gendered perspectives or power dynamics explicit – i.e., division of labour and technical culture privileging male experts. They see these as responsible for exclusions and inequalities in resource access and decision making. Lieu et al. thus underscore the disruptive potential of "female perspectives" in energy transitions and highlight that the exclusion of women's views and voices in decision-making spaces makes it difficult meaningfully to link normative descriptions of alternative imaginaries to reality, create broader popular support, and ultimately accelerate related change processes. In this, they constantly take into account the interlocking character of gender and ethnicity, thus advocating closer examination of intersectionality, while acknowledging the methodological and empirical limitations of their case studies in this regard (p. 1ff, 6, 9ff).

Three papers focus on transition related phenomena that take place within households. They each refer to practice-theoretical approaches and extend them in different ways to include gender relations:

Table 1
Overview of reference analysis and interpretation.

Year	Author/s	System/s	Context/s	Gender conceptualised as	structural / institutional	symbolic	individual / behavioural	Intersectionality	Materiality	Regimes R	Niches N	R/N-Relations
2013	Kronsell	Mobility, energy	Sweden: national (main focus), local, regional	- normative power order - regime materially constituted in economic relations - social characteristic	●	●		●	●			●
2020	Lieu et al.	Energy	Canada: communal, regional, national; Kenya: communal,	social characteristic	●	●		●				●
2020	Thoyre	Energy	United States: houshold	- socially constructed category - process - performance	●		●	○	●			●
2020	Mechlenborg & Gram-Hanssen	Energy	"Westernized" household	floating category: general understanding in performances, materiality, meanings, power relations		●	●	○	●			●
2020	Standal et al.	Energy	Norway & United Kingdom: household	- social inequality: different fields, dispositions, social positions - practices of social differentiation	●	●	●		●		●	
2017	Ahlborg	Energy	Tanzania: village	- category of social difference: hierarchy/ inequality - power relation: produced through situated, embodied practices	●		●	●	●		●	
2018	Ahlborg	Energy	Tanzania: village	category of social difference	●		●	●	●		●	
2018	Greene	Energy (mobility, food, water)	Ireland: households	practice precondition	●			○	●	●		
2020	Glover & Sumberg	Food	Sub-Saharan Africa	- cross-cutting dimension of social difference/ inequality - feature of social relationships	●			●		●		
2020	Alda-Vidal et al.	Sewerage	United Kingdom	social dynamic shaping practices		●	●	○	●	●		
2018	Sovacool & Axsen	Mobility (energy)		aspect of identity formation / behavior		●	●	○	●	●		
2020	Sovacool & Griffiths	Mobility, energy	28 countries (Global North & South)	cultural norm/ identity / behavior		●	●		●	●		
2020	Pilloni et al.	Energy	Israel: village (main focus), regional, national	aspect of culture and lifestyle	●						●	
2020	Cherunya et al.	Sanitation	Kenya: informal settlement	practice precondition	●		●	○	●		●	
2018	Retamal & Schandl	Sanitation (water, energy)	Philippines: city	dimension of social context	●			○	●			●
2019	Anderson et al.	Food (agroecology)	Global South: household, communal, territory, national and international	social division / inequality	●			●				●
2020	Sovacool et al.	Energy (mobility)	Congo & Ghana; communal national, regional, supra-regional,	vulnerability	●			○	●			●

Thoyre (2020) consults sociology of work, sustainable consumption studies and feminist political ecology to point out the gendering of household energy saving measures in the United States. By conceptualising sustainable lighting practices as labour the author uncovers the hitherto neglected workload that replacing inefficient technologies (i.e., light bulbs) of the current energy regime entails – specifically for women. In doing so, Thoyre consistently links *structural* and *behavioural* qualities of gender. On the one hand, she refers to the societal devaluation and feminisation of household labour. Following this, she identifies six phases of additional labour (research, shopping, installation, habits, disposal, clean up) accompanying this shift in materialities and discusses, along the lines of similar tasks, if women or men are more likely to do them. On the other hand, the author makes clear that gender must be understood as a process or, rather, performance, partly produced through sustainability practices. Thus, by accomplishing eco-friendly household tasks especially White middle-class women can (re)construct their identities as "good women" (p. 1–4, 8f).

In order to develop a gender-aware analytical framework for residential energy consumption, Mechlenborg and Gram-Hanssen (2020) combine insights from practice theory and gender studies (e.g., feminist theories about technology, space and un/doing gender). They emphasise the floating and contextual character of gender categories and the need to deconstruct continuously re/produced gender asymmetries. The authors focus on the *symbolic* and *behavioural* dimensions and conceptualise gender as a "general understanding" which permeates and suffuses social practices. Thereby residential activities come into view as gendered performances that are strongly shaped by symbolic dualisms (e.g., fluctuating attachment of masculinity to certain technologies and femininity to particular domestic spaces). Yet Mechlenborg and Gram-Hanssen emphasise that gender not only interacts with meanings, rules and competences in the formation of practices, but is embodied as well as bound to the construction of material worlds. For instance, material spaces frame the way individuals behave, perceive and understand themselves as well as others. Thereby, gender appears to form a vital social factor influencing energy transition pathways (p. 3–7).

The analysis by Standal et al. (2020) focuses on the process of becoming a prosumer in Norway and the UK, unpacking how the different phases of domesticating solar technologies (appropriation, objectification, incorporation and conversion) for household energy production are gendered. Based on a Bourdieu-inspired understanding and operationalisation, Standal et al. emphasise that the societal division of labour results in different dispositions (habitus) and social positions (capital) for wo/men. The authors consistently link this *structural* dimension of gender relations to the *symbolic* association of different technologies as well as domestic spaces with either masculinity or femininity. Thereby they consider how gendered material conditions, responsibilities and ideas significantly influence the ways wo/men interact with technologies. Because such *practices* of energy production and consumption can function to re/produce gendered identities, the authors showcase why and how gender relations in all three dimensions may constitute important enablers or barriers for stabilising a niche (p. 1f, 4f, 7f).

Last but not least, two papers by Ahlborg (2017, 2018) conceptualise power in sustainability transitions by drawing on feminist understandings, which emphasise its relational, emergent and productive character. The author comprehends power/gender relations as produced through situated, embodied *practices* as well as producing material and social effects. In her empirical case study of a Tanzanian pilot project for electrification Ahlborg illustrates the *structural* aspects; i.e., how gendered hierarchies and inequalities in the social organisation around work can lead to an unequal share in resources (capital and time) for women, resulting in a niche design that reinforces social injustice. By consulting feminist political ecology and science and technology studies, she furthermore takes into account the co-constitution of human relations and material environments, which allows her to trace ambiguous effects in the electrification process. By recognising electricity as an actant, which has the potential to transform human capacities (e.g., heavy labour, communication), materiality is also attributed a significant role in empowering women by improving their work situation concerning domestic responsibilities (p. 122–129, 135f).

Building upon these conceptual foundations, the second paper by Ahlborg discusses the failure of a different project in the same domain, this time focussing on the political nature as well as effects of electrification schemes as arenas for power struggles. According to her, such political effects (i.e., effects on social relations as well as material consequences) are produced not only through human agency but from human/technology/nature-interactions in a place that can result in empowerment, while simultaneously creating new relations of domination. In the course of this analysis, she also attends to some of the behavioural aspects involved: How a person's potential to participate in and benefit from niche innovation is conditioned by both, *structural* positioning and *practices* aligned with cultural taboos and norms, such as being a "good woman", or technology being a "man's thing". Consequently, she recognises that simply to provide renewable energy infrastructures does not necessarily result in a just transition (p. 270ff, 275f, 278).

Taken together, these articles offer diverse and complementary understandings of gender as a fundamental aspect of societal power relations and inequalities, thereby also underlining the need for an intersectional perspective. They equally account for gender as a principle of societal organisation (material or discursive) and as a contextual process (situated and embodied practices). Therefore, while few in number, they address the *structural, symbolic* and *behavioural* dimensions of gender comprehensively. Most contributions additionally coincide in emphasising the cross-cutting relevance of *materiality* (artefacts, technologies) as well as *spatiality* (built environs, geographies) for adequately interpreting gender relations and processes (see Annex 2). Considering that these seven analyses all happen to address the energy domain (although in a variety of contexts and at different scales), they offer an intriguing prospect for research designs that purposefully combine perspectives to grasp deeper systemic implications of gender for sustainability transformations.

4.2. Epistemological focus linking gender and transitions

Across the corpus the above range of conceptual approaches to study gender is deployed in conjunction with questions that aim to understand (aspects of) sustainability transitions. Here we recognise the three principal epistemological orientations of ST research identified in 2.1, and how gender issues are linked to each of them (Table 1).

The first orientation aims to understand the (meta-) rules and organising principles through which particular socio-technical *regimes* become dominant, and how these in turn condition and constrain transformative change (Hughes, 1987; Bijker et al., 1987; Geels, 2002). Correspondingly, five contributions examine the ways in which gender forms part of a regime's configuration. Some scholars focus on the *structural* gender dimension in this (Glover and Sumberg, 2020; Greene, 2018), recognising its articulation through the current division of labour and resource access, institutions, locations and policies that incorporate gendered norms, but also the concrete technologies employed (e.g., household appliances such as washing machines, fridges), together shaping gendered "opportunity landscapes" (ibid.). Others explore the de-/stabilising role of *symbolic and individual* gendering instead (Alda-Vidal et al., 2020; Sovacool and Axsen, 2018; Sovacool and Griffiths, 2020), illustrating the critical influence of cultural norms and societal discourses (e.g., concerning cleanliness or macho-ness), that frame gendered differentiations, and of everyday practices (e.g., disposal practices or vehicle use) for the continuous re-/production of feminine/masculine identities/subjectivities. While these contributions are not based on a deductive conceptualisation of gender, they expand the transition perspective by drawing on practice theory or social/cultural anthropology. Consequently, gendered differences are recognised as a key factor that helps to explain the persistence of the status quo, but that can also be considered in designing interventions, potentially leading to more radical change and just outcomes.

The second focus of ST research relates to the emergence and amplification of *niches* that can challenge entrenched regimes and drive socio-technical change (Kemp et al., 1998; Schot and Geels, 2008). Although this may have implied a certain "innovation bias" in the past (Martínez Arranz, 2017), understanding niche formation and dynamics remains critically important for the field (Köhler et al., 2019; Kanger and Schot, 2019). Following this orientation, five articles focus on niche developments with a view to gender implications (Ahlborg, 2018, 2017; Cherunya et al., 2020; Pilloni et al., 2020; Standal et al., 2020). All of them elaborate on *structural* gender dimensions, considering how the division of labour, access to resources (e.g., time, money, social capital) and decision-making, but also conditions of place and spatial settings make a difference in terms of whose interests, needs and values are reflected in the novelties developed. Thus, they show the necessity of considering and addressing the respective social and material contexts of niche formation. Four articles additionally examine the interplay with the *individual* dimension (Ahlborg, 2018, 2017; Cherunya et al., 2020; Standal et al., 2020), highlighting how gendered practices and routines (e.g., toilet use, interaction with renewable energy technology) equally co-shape niche innovations and can affect transition trajectories. Furthermore, one contribution also elaborates on *symbolic* gendering through discourses that frame, e.g., domestic spaces and technological innovation (Standal et al., 2020). By invoking feminist theory, practice theory, sociology (habitus) and/or actor-network theory these approaches unpack the constraints involved in sustainable niche development processes and resulting innovations, but also the conditions and prospects for successful niche amplification.

Third, ST research is necessarily also concerned with the dynamic *relations between regimes and niches* in an integrated perspective, considering how different modes and patterns of interaction can also lead to diverse outcomes in terms of transition pathways and sustainability performance (Smith, 2007; Schot and Geels, 2008). Seven contributions in the corpus adopt this perspective (Anderson et al., 2019; Kronsell, 2013; Lieu et al., 2020; Mechlenborg and Gram-Hanssen, 2020; Retamal and Schandl, 2018; Sovacool et al., 2020; Thoyre, 2020), building on feminist theory and practice theory. They refer to *structural* aspects such as those mentioned above, but additionally draw attention to economic relations, governance, geographies and representational arrangements that shape niche/regime interactions. This tension field is also explored regarding the (distinct) gender discourses and frames (*symbolic*) (Kronsell, 2013; Lieu et al., 2020; Mechlenborg and Gram-Hanssen, 2020) as well as practices including bodies (*individual*) (Mechlenborg and Gram-Hanssen, 2020; Thoyre, 2020) that characterise regimes and niches respectively. The emerging dis-/alignments highlight gender as a key factor influencing the justice orientations and transformativity of pathways.

4.3. Empirical scope and results

Finally, we turn to the empirical scope and results of the studies with a view to assessing their implications for future ST research. The geographical coverage of the corpus appears to be quite global despite its small size, including cases from Europe, Africa, North America and the Middle East. In this, analyses of transition processes in the Global South have a comparatively high share (10/17) and are also prominent amongst recent contributions (6 out of 10 in 2020), although their authors are predominantly located at research organisations in the Global North. Rather than reflecting emerging advocacy from the Global South to address the role of gender in ST studies, we therefore assume this may point to an indirect effect of the general *Global North bias* in scientific literature and databases (Tennant, 2020): As dominant concepts and frameworks are derived from Northern contexts and therefore not well suited for understanding change in the Global South (Cherunya et al., 2020; Pilloni et al., 2020), context-specific gender issues may become visible as vital aspects of the social setting in the course of adjusting frames to Southern circumstances. Considering the continued prevalence of certain stereotypes, e.g., of Southern women as poor, rural and particularly vulnerable (Mohanty, 2003b; Simon-Kumar et al., 2018) as well as a "post-feminist" discourse in the Global North assuming that gender inequality and oppression have been overcome already (Flood et al., 2020), it should be borne in mind that there is a need for context-sensitive, differentiated approaches to gender questions in ST in all parts of the world.

In terms of the transition domains studied, the prevalent focus is on energy (12), followed by mobility (5), sanitation (4) and food (3). All contributions that use an explicit conceptualisation of gender deal with energy (one additionally with mobility), which partly facilitates drawing connections between their insights (see 4.1). Notably, six papers address more than one domain (Kronsell, 2013; Greene, 2018; Sovacool et al., 2020; Sovacool and Griffiths, 2020; Sovacool and Axsen, 2018; Retamal and Schandl, 2018), thus shedding light on the ways in which gender simultaneously affects *multiple* socio-technical systems and their interactions; especially energy and mobility.

Regardless of their varying approaches, empirical contexts and domain coverage, all of the studies reviewed coincide in high-lighting that gender forms a largely underexplored yet highly influential variable of sustainability transitions. Their findings illustrate not only the diverse challenges created through the structural embeddedness, symbolic expression and performative (re-)production of gender in socio-technical systems, but also how these dimensions interact and mutually reinforce each other. Key implications appear to be that gendering:

- *De-/stabilises existing socio-technical systems* – ensuring or unsettling their deep entrenchment in a broader social order;
- *Dis-/encourages change of practices and routines* – including the motives, meanings, competences and materials involved;
- *De-/stabilises niche formation* – in terms of necessary forms of social networking, (self-)organisation or the articulation and positive recognition of otherness and deviant practices;
- *Shapes the disruptiveness and sustainability of innovations and related imaginaries* - affecting justice orientations and other sustainability value propositions, also considering the role of young generations as key actors in debates about alternative futures;
- *Mediates niche/regime interaction and the amplification of emerging sustainability innovations* – facilitating the imposition of current mainstream solutions or the uptake and diffusion of radical innovations.

Nevertheless, although their empirical observations of outcomes and impacts in terms of sustainability transitions tends to be rather negative, these contributions simultaneously emphasise the empowering and transformative *potential* that a gender-sensitive analysis and/or intervention approach offers. As the above list illustrates, such approaches would enable researchers to conceive of and assess critical factors not only as regards the formation and sustainability orientation of either niches or regimes, but also in terms of their coevolution dynamics and resulting transition pathways.

5. Conclusions

With this review we have explored the status in sustainability transition research of conceptual and empirical engagement with "gender" as a vital factor of societal organisation and change. By drawing on insights from feminist technoscience and ST research we have adopted an analytical lens that allows to identify, map and compare contributions with a view to their onto-epistemology regarding gender and transitions. In addition, we have also accounted for the empirical contexts of the studies and their particular findings to obtain further orientations for future research.

Our results for the period 2010–2020 demonstrate an overall scarcity of approaches dealing with gender issues in a theoretically informed way, considering the very low total number of pertinent contributions (17). Even if the publishing timeline may suggest a growing interest in recent years, the size of the corpus identified does not do justice to the ample scientific insights available regarding gender and societal change, the emergent turn towards power and justice in ST studies, or the salience of gender issues in current societal debates and policy agendas. We do acknowledge that the corpus composition is of course delimited by the databases chosen (WoS and Scopus) and we cannot exclude that further pertinent ST studies dealing with gender exist. However, given its influence on global scientific discourses, it is the status within *this* body of peer-reviewed literature that is of interest to this review. Future research may therefore examine if the topic has possibly received more attention in studies published elsewhere, and what this may reflect in terms of scientific publishing systems.

Regarding the conceptualisation of gender relations in ST studies only seven contributions identified mobilise pertinent strands of feminist theory (such as feminist political ecology, constructivist and materialist approaches, theory about technology and space, un/doing gender, gender mainstreaming) that correspond to their particular research interest and subject. Others engage with gender conceptually because they draw on various social science approaches that elucidate processes of social differentiation or individual action more broadly (especially practice theory and strands of social/cultural anthropology). Nevertheless, these perspectives still offer an elaborate conceptual account of particular ways in which gender relations are embedded in and affect socio-technical transitions.

Overall, the corpus reviewed thus demonstrates the high potential to address some of the key deficits of the field concerning power, diversity and justice in sustainability transitions (see Preuß et al., 2021; Truffer et al., 2022) from the vantage point of gender relations. The different studies vividly illustrate the multifaceted influence of gender as a key factor of socio-technical change, largely ignored in mainstream ST research, thus equally suggesting novel avenues for conceptualising change dynamics and intervention options. Following this, future research should certainly consider ways of also including *intersectional relations* in such analysis. Those contributions that do refer to intersectionality or some aspects thereof clearly underscore the importance of linking gender to further categories of social differentiation and inequality. Nevertheless, they also reflect the practical challenges involved (methodological and resource requirements), which often limit the necessary research designs. This calls for research policy to develop programmes to support structured project portfolios, enabling more complex analyses across time, space and subjects – a requirement further underpinned by the considerations below.

We also recognise important opportunities to engage with closely related fields that could further contribute to systematically build up the conceptual foundations for studying gender in sustainability transitions. Notably, over the past years ST researchers have increasingly turned towards *social-ecological system* studies and their epistemologies (Fisher et al., 2022; Hebinck et al., 2022; Huntjens and Kemp, 2022). Regarding gender, this orientation could be further underpinned by ecofeminist approaches (e.g. Merchant, 1996; Mellor, 1997; Salleh, 1997; Gaard, 2011; MacGregor, 2021) and feminist political ecology (e.g. Nightingale, 2011, 2019; Elmhirst, 2015; Bauhardt and Harcourt, 2019) that critically conceptualise society-nature relations, and could thus help to interpret the role of both nature and gender in socio-technical transitions.

Another cross-cutting aspect that deserves more explicit attention is the role *spatiality* plays in both socio-technical transitions and gender relations (see Ahlborg, 2018; Greene, 2018; Mechlenborg and Gram-Hanssen, 2020). Since questions of space and place are addressed by most contributions and were therefore also traced throughout the analysis (see Annex 1), insights from feminist geography (Nelson and Seager, 2005; Coddington, 2015; Datta et al., 2020; Braga Bizarria et al., 2022; Morrow and Parker, 2020; Morrow and Davies, 2022) could be used to more rigorously examine how location, material, discursive and relational spaces interact with the articulation of gender relations.

Regarding the analytical lens adopted for this review, it provides a useful tool to recognise commonalities, complementarities and gaps: Mapping if and how authors attend to the *structural/institutional, symbolic* and *individual/behavioural* dimensions of gender, respectively or in conjunction, offers an integrated account of the different conceptual orientations used, as well as their relations. It also helps to draw out the role of *materiality*, since most papers recognise an important influence on gender relations but they refer to rather distinct material entities and conceptualisations. Future research designs may therefore decide more consciously to pay balanced attention to *all three dimensions*. This is only pursued by one contribution (Standal et al., 2020), although taken together the papers clearly illustrate the significance of *each* dimension *and* their interactions. Using this lens could thus support development of multi-perspectival approaches in order to obtain more systemic understandings of gender implications (e.g., throughout selected domains), as well as to compare different domains with a view to their particular gendered dynamics (e.g., focusing on practices) and intersectionality. It may equally help to examine different material aspects of gender relations and their implications for socio-technical change in a more comprehensive way. Researchers could also further explore specific deficits emerging in the corpus here (e.g., role of symbolism), trace the respective theoretical perspectives used for each dimension to compare their suitability, or explore their combinations.

Most importantly, reflecting on gender relations in terms of *structures, cultures* and *practices* can offer a valuable entry point for ST studies to further engage with the topic and its conceptual foundations. We focused on the basic epistemological orientations to *regimes, niches* and *regime/niche interactions* as a common denominator to identify where and how the three dimensions of gender relations have been explored. It should be acknowledged that this rough typology cannot do justice to the full variety of approaches used in the field, including those actually questioning or rejecting a regime/niche dichotomy. As some scholars suggest, the distance between these two concepts may rather be conceived of as a continuum along which diverse "niche-regimes" can be identified, in terms of power positions (Avelino, 2017; Avelino et al., 2016) or regarding interaction patterns (Ruggiero et al., 2021). While we do agree with this perspective, our approach was meant to facilitate a connection between conceptions of gender and ST research approaches, thus drawing on regimes and niches as widely used boundary objects. Across the corpus the results show that for each of these basic orientations, researchers have already picked up on *all three dimensions* (even if individual contributions focus only on one or two) thereby illuminating the multiple and complex ways in which gendering and socio-technical transition dynamics are intertwined. More specifically, this concerns the fundamental processes and parameters of transitions such as regime de/stabilisation, change of practices, niche formation and amplification as well as the disruptiveness and sustainability orientation of niches. Key future research issues arising here are to better understand gendered dis-/alignments between regimes and niches, between multiple socio-technical systems forming "multi-regime" or nexus configurations across a spectrum of human needs (water, food, energy, mobility, etc.), and the verification of the transformative potential recognised in adopting gender-sensitive approaches.

Regarding the empirical basis of the corpus, the range of key domains addressed and the geographical diversity of study areas provide an intriguing glimpse of the diverse and substantive implications of gender relations for sustainability transitions globally. Nevertheless, further comparative studies across geographies and cultures such as those by Lieu et al. (2020) or Standal et al. (2020) could offer important novel insights regarding different pathways and options for intervention, including cases in the Global North and South. In this regard the complete lack of studies in Asia or Latin America represents a lamentable gap, considering their particular socio-cultural and feminist histories.

Finally, conceptualising gender is equally crucial with a view to designing *transdisciplinary* research approaches that encompass a broad spectrum of arenas, labs or other interaction and innovation formats involving diverse stakeholders. Here the (gendered) role of the (non-)scientific participants in addressing, eliciting and formulating gender-sensitive or gender-focused questions and methods becomes critically important, as do the criteria for stakeholder involvement and the frames and settings of the co-production process (from analysis to evaluation). Anchoring gender conceptually in the transdisciplinary approaches of the field would thus also help foster more sustainable outcomes of ST research.

Declaration of Competing Interest

None.

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References

Adrian, S.W., Skewes, L., Schwennesen, N., 2018. Introduction to Feminist STS at work: challenging dichotomies and privileges. Kvind. Køn Forsk. https://doi.org/10.7146/kkf.v27i1.106340.

Ahlborg, H., 2018. Changing energy geographies: the political effects of a small-scale electrification project. Geoforum 97, 268–280. https://doi.org/10.1016/j.geoforum.2018.09.016.

Ahlborg, H., 2017. Towards a conceptualization of power in energy transitions. Environ. Innov. Soc. Transit. 25, 122–141. https://doi.org/10.1016/j.eist.2017.01.004.

Alaimo, S., Hekman, S.J. (Eds.), 2008. Material Feminisms. Indiana University Press, Bloomington, IN.

Alda-Vidal, C., Browne, A.L., Hoolohan, C., 2020. Unflushables": establishing a global agenda for action on everyday practices associated with sewer blockages, water quality, and plastic pollution. WIREs Water 7. https://doi.org/10.1002/wat2.1452.

Allmendinger, J., 2021. Es Geht Nur gemeinsam! Wie wir Endlich Geschlechtergerechtigkeit erreichen. Ullstein, Berlin.

Anderson, C.R., Bruil, J., Chappell, M.J., Kiss, C., Pimbert, M.P., 2019. From transition to domains of transformation: getting to sustainable and just food systems through agroecology. Sustainability 11, 5272. https://doi.org/10.3390/su11195272.

Åsberg, C., Koobak, R., Johnson, E., 2011. Beyond the humanist imagination. NORA - Nord. J. Fem. Gend. Res. 19, 218–230. https://doi.org/10.1080/08038740.2011.625042.

Åsberg, C., Lykke, N., 2010. Feminist technoscience studies. Eur. J. Womens Stud. 17, 299–305. https://doi.org/10.1177/1350506810377692.

Avelino, F., 2017. Power in sustainability transitions: analysing power and (dis)empowerment in transformative change towards sustainability. Environ. Policy Gov 27, 505–520. https://doi.org/10.1002/eet.1777.

Avelino, F., Grin, J., Pel, B., Jhagroe, S., 2016. The politics of sustainability transitions. J. Environ. Policy Plan. 1–9. https://doi.org/10.1080/1523908X.2016.1216782.

Azcona, G., Bhatt, A., Davies, S., Harman, S., Smith, J., Wenham, C., 2020. Spotlight on gender, COVID-19 and the SDGs: will the pandemic derail hard-won progress on gender equality? Spotlight On the SDGs. UN Women.

Barad, K., 2007. In: Meeting the universe halfway quantum physics and the entanglement of matter and meaning. Duke University Press, Durham.

Bauhardt, C., Harcourt, W. (Eds.), 2019. Feminist Political Ecology and the Economics of care: in Search of Economic alternatives, 1 Edition. ed. Routledge, Abingdon, Oxon.

Bennett, J., 2010. Vibrant matter: a Political Ecology of Things. Duke University Press, Durham.

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., Rickne, A., 2008. Analyzing the functional dynamics of technological innovation systems: a scheme of analysis. Res. Policy 37, 407–429. https://doi.org/10.1016/j.respol.2007.12.003.

Bijker, W., Hughes, T.P., Pinch, T. (Eds.), 1987. The Social construction of Technological systems : New Directions in the Sociology and History of Technology. MIT Press, Cambridge, Mass.

Braga Bizarria, M.T., Palomino-Schalscha, M., Stupples, P., 2022. Community gardens as feminist spaces: a more-than-gendered approach to their transformative potential. Geogr. Compass 16. https://doi.org/10.1111/gec3.12608.

Browne, J., 2021. Introduction. In: Browne, J. (Ed.), Why Gender? Cambridge University Press, pp. 1–14. https://doi.org/10.1017/9781108980548.

Butler, J., 1990. Gender trouble: Feminism and the Subversion of identity, Thinking gender. Routledge, New York.

Carvalho, M.P.D., 2020. Intersectionality: a theoretical exercise based on an empirical research. Cad. Pesqui. 50, 360–374. https://doi.org/10.1590/198053147068.

Charles, N., 2020. Introducing gender and women's studies. In: Richardson, D., Robinson, V. (Eds.), Gender, Politics and Activism, pp. 40–57.

Cherunya, P.C., Ahlborg, H., Truffer, B., 2020. Anchoring innovations in oscillating domestic spaces: why sanitation service offerings fail in informal settlements. Res. Policy 49, 103841. https://doi.org/10.1016/j.respol.2019.103841.

Clarivate Analytics, 2018. Web of Science Core Collection. Descriptive Document.

Coddington, K., 2015. Feminist geographies "beyond" gender: de-coupling feminist research and the gendered subject. Feminist Geographies "Beyond" Gender. Geogr. Compass 9, 214–224. https://doi.org/10.1111/gec3.12207.

Collins, P.H., 1993. Toward a new vision: race, class, and gender as categories of analysis and connection. Race Sex Cl 1, 25–45.

Coole, D., Frost, S. (Eds.), 2010. Introducing the New Materialisms, in: New Materialisms. Duke University Press, pp. 1–44. https://doi.org/10.1515/9780822392996-002.

Crenshaw, K., 1991. Mapping the margins: intersectionality, identity politics, and violence against women of color. Stanford Law Rev 43, 1241. https://doi.org/10.2307/1229039.

Datta, A., Hopkins, P., Johnston, L., Olson, E., Silva, J.M (Eds.), 2020. Routledge Handbook of Gender and Feminist geographies. Routledge. Milton Park, Abingdon, Oxon, New York, NY.

EEA, 2019. Sustainability transitions: Policy and Practice (No. 09/2019), EEA Report. European Environment Agency, Copenhagen.

Elmhirst, R., 2015. Feminist Political Ecology. In: Perreault, T.A., Bridge, G., McCarthy, J. (Eds.), The Routledge Handbook of Political Ecology, Routledge International Handbooks. Routledge. Taylor & Francis Group, London ; New York, NY, pp. 519–530.

Elmhirst, R., 2011. Introducing new feminist political ecologies. Geoforum 42, 129–132. https://doi.org/10.1016/j.geoforum.2011.01.006.

Elzen, B., Geels, F.W., Green, K., 2004. System Innovation and the Transition to sustainability: theory, Evidence and Policy. Edward Elgar Publishing, Cheltenham.

Faulkner, W., 2000. The power and the pleasure? A research agenda for "making gender stick" to engineers. Sci. Technol. Hum. Values 25, 87–119. https://doi.org/10.1177/016224390002500104.

Fisher, E., Brondizio, E., Boyd, E., 2022. Critical social science perspectives on transformations to sustainability. Curr. Opin. Environ. Sustain. 55, 101160 https://doi.org/10.1016/j.cosust.2022.101160.

Flood, M., Dragiewicz, M., Pease, B., 2020. Resistance and backlash to gender equality. Aust. J. Soc. 4 (Issues ajs), 137. https://doi.org/10.1002/ajs4.137.

Gaard, G., 2011. Ecofeminism revisited: rejecting essentialism and re-placing species in a material feminist environmentalism. Fem. Form. 23, 26–53. https://doi.org/10.1353/ff.2011.0017.

Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration processes: a multi-level perspective and a case-study. Res. Policy 31, 1257–1274. https://doi.org/10.1016/S0048-7333(02)00062-8.

Ghosh, B., Ramos-Mejía, M., Machado, R.C., Yuana, S.L., Schiller, K., 2021. Decolonising transitions in the Global South: towards more epistemic diversity in transitions research. Environ. Innov. Soc. Transit. https://doi.org/10.1016/j.eist.2021.10.029.

Glover, D., Sumberg, J., 2020. Youth and Food Systems Transformation. Front. Sustain. Food Syst. 4, 101. https://doi.org/10.3389/fsufs.2020.00101.

Gough, D., Thomas, J., Oliver, S., 2012. Clarifying differences between review designs and methods. Syst. Rev. 1, 28. https://doi.org/10.1186/2046-4053-1-28.

Greene, M., 2018. Socio-technical transitions and dynamics in everyday consumption practice. Glob. Environ. Change 52, 1–9. https://doi.org/10.1016/j.gloenvcha.2018.05.007.

Grin, J., Rotmans, J., Schot, J., 2010. Transitions to Sustainable development : New Directions in the Study of Long Term Transformative Change. Routledge, New York.

Haraway, D.J., 1991. Simians, cyborgs, and women: the Reinvention of Nature. Routledge, New York.

Harding, S., 2010. Wissenschafts- und Technikforschung,. In: Becker, R., Kortendiek, B. (Eds.), Handbuch Frauen- und Geschlechterforschung. VS Verlag für Sozialwissenschaften, Wiesbaden, pp. 312–321. https://doi.org/10.1007/978-3-531-92041-2_36.

Harding, S.G., 1986. The Science Question in Feminism. Cornell University Press, Ithaca.

Hebinck, A., Diercks, G., von Wirth, T., Beers, P.J., Barsties, L., Buchel, S., Greer, R., van Steenbergen, F., Loorbach, D., 2022. An actionable understanding of societal transitions: the X-curve framework. Sustain. Sci. https://doi.org/10.1007/s11625-021-01084-w.

Collins, Hill, 1991. Black Feminist thought: knowledge, consciousness, and the Politics of empowerment, Perspectives on Gender. Routledge, New York London.

hooks, bell, 1990. Yearning: race, gender, and Cultural Politics. South End Press, Boston, MA.

hooks, bell, 1981. Ain't I a woman: Black Women and feminism, 20. Print. South End Press, Boston, Mass.

Hughes, T.P., 1987. The evolution of large technological systems. The Social Construction of Technological Systems : New Directions in the Sociology and History of Technology. MIT Press, Cambridge Mass.

Huntjens, P., Kemp, R., 2022. The importance of a natural social contract and co-evolutionary governance for sustainability transitions. Sustainability 14, 2976. https://doi.org/10.3390/su14052976.

Kaijser, A., Kronsell, A., 2014. Climate change through the lens of intersectionality. Environ. Polit. 23, 417–433. https://doi.org/10.1080/09644016.2013.835203.

Kanger, L., Schot, J., 2019. Deep transitions: theorizing the long-term patterns of socio-technical change. Environ. Innov. Soc. Transit. 32, 7–21. https://doi.org/10.1016/j.eist.2018.07.006.

Kantola, J., Lombardo, E., 2017. Feminist political analysis: exploring strengths, hegemonies and limitations. Fem. Theory 18, 323–341. https://doi.org/10.1177/1464700117721882.

Kemp, R., Schot, J., Hoogma, R., 1998. Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. Technol. Anal. Strateg. Manag. 10, 175–198. https://doi.org/10.1080/09537329808524310.

Kerner, I., 2017. Relations of difference: power and inequality in intersectional and postcolonial feminist theories. Curr. Sociol. 65, 846–866. https://doi.org/10.1177/0011392116665152.

Köhler, J., Geels, F.W., Kern, F., Markard, J., Onsongo, E., Wieczorek, A., Alkemade, F., Avelino, F., Bergek, A., Boons, F., Fünfschilling, L., Hess, D., Holtz, G., Hyysalo, S., Jenkins, K., Kivimaa, P., Martiskainen, M., McMeekin, A., Mühlemeier, M.S., Nykvist, B., Pel, B., Raven, R., Rohracher, H., Sandén, B., Schot, J., Sovacool, B., Turnheim, B., Welch, D., Wells, P., 2019. An agenda for sustainability transitions research: state of the art and future directions. Environ. Innov. Soc. Transit. https://doi.org/10.1016/j.eist.2019.01.004. S2210422418303332.

Krizsan, A., Roggeband, C., 2018. Towards a conceptual framework for struggles over democracy in backsliding states: gender equality policy in Central Eastern Europe. Polit. Gov. 6, 90–100. https://doi.org/10.17645/pag.v6i3.1414.

Kronsell, A., 2013. Gender and transition in climate governance. Environ. Innov. Soc. Transit. 7, 1–15. https://doi.org/10.1016/j.eist.2012.12.003.

Lagesen, V.A., 2015. Gender and technology: from exclusion to inclusion? International Encyclopedia of the Social & Behavioral Sciences. Elsevier, pp. 723–728. https://doi.org/10.1016/B978-0-08-097086-8.85009-6.

Lawhon, M., Murphy, J.T., 2012. Socio-technical regimes and sustainability transitions: insights from political ecology. Prog. Hum. Geogr. 36, 354–378. https://doi.org/10.1177/0309132511427960.

Lieu, J., Sorman, A.H., Johnson, O.W., Virla, L.D., Resurrección, B.P., 2020. Three sides to every story: gender perspectives in energy transition pathways in Canada, Kenya and Spain. Energy Res. Soc. Sci. 68, 101550 https://doi.org/10.1016/j.erss.2020.101550.

Loorbach, D., 2010. Transition management for sustainable development: a prescriptive, complexity-based governance framework. Gov. Int. J. Policy Adm. Inst. 23, 161–183.

Loorbach, D., Frantzeskaki, N., Avelino, F., 2017. Sustainability transitions research: transforming science and practice for societal change. Annu. Rev. Environ. Resour. 42, 599–626. https://doi.org/10.1146/annurev-environ-102014-021340.

Lorde, A., 1984. Sister outsider: Essays and speeches, The Crossing Press feminist Series. Crossing Press, Trumansburg, NY.

Lykke, N., 2010. The timeliness of post-constructionism. NORA - Nord. J. Fem. Gend. Res. 18, 131–136. https://doi.org/10.1080/08038741003757760.

MacGregor, S., 2021. Making matter great again? Ecofeminism, new materialism and the everyday turn in environmental politics. Environ. Polit. 30, 41–60. https://doi.org/10.1080/09644016.2020.1846954.

MacGregor, S., 2009. A stranger silence still: the need for feminist social research on climate change. Sociol. Rev. 57, 124–140. https://doi.org/10.1111/j.1467-954X.2010.01889.x.

Markard, J., Raven, R., Truffer, B., 2012. Sustainability transitions: an emerging field of research and its prospects. Res. Policy 41, 955–967. https://doi.org/10.1016/j.respol.2012.02.013.

Martínez Arranz, A., 2017. Lessons from the past for sustainability transitions? A meta-analysis of socio-technical studies. Glob. Environ. Change 44, 125–143. https://doi.org/10.1016/j.gloenvcha.2017.03.007.

McCall, L., 1992. Does gender fit? Bourdieu, feminism, and conceptions of social order. Theory Soc. 21, 837–867. https://doi.org/10.1007/BF00992814.

Mechlenborg, M., Gram-Hanssen, K., 2020. Gendered homes in theories of practice: a framework for research in residential energy consumption. Energy Res. Soc. Sci. 67, 101538 https://doi.org/10.1016/j.erss.2020.101538.

Mellor, M., 1997. Feminism & Ecology. New York University Press, Washington Square, N.Y.

Merchant, C., 1996. Earthcare: Women and the Environment. Routledge, New York.

Misra, J., 2020. Gender Reckonings: new Social Theory and Research. In: Connell, R., Martin, P.Y., Messerschmidt, J.W., Martin, P., Messerschmidt, J., Messner, M. (Eds.), Categories, Strucutres, and Intersectional Theory. New York University Press, New York, pp. 111–130.

Mohanty, C.T., 2003a. Feminism Without borders: Decolonizing theory, Practicing Solidarity. Duke University Press, Durham ; London.

Mohanty, C.T., 2003b. Under Western eyes: feminist scholarship and colonial discourses. In: Lewis, R., Mills, S. (Eds.), Feminist Postcolonial Theory: A Reader. Routledge, Florence, pp. 49–74.

Morrow, O., Davies, A., 2022. Creating careful circularities: community composting in New York City. Trans. Inst. Br. Geogr. 47, 529–546. https://doi.org/10.1111/tran.12523.

Morrow, O., Parker, B., 2020. Care, commoning and collectivity: from grand domestic revolution to urban transformation. Urban Geogr 41, 607–624. https://doi.org/10.1080/02723638.2020.1785258.

Nelson, L., Seager, J. (Eds.), 2005. A Companion to Feminist Geography, 1st ed. Wiley. https://doi.org/10.1002/9780470996898.

Nightingale, A.J., 2019. Commoning for inclusion? commons, exclusion, property and socio-natural becomings. Int. J. Commons 13, 16. https://doi.org/10.18352/ijc.927.

Nightingale, A.J., 2011. Bounding difference: intersectionality and the material production of gender, caste, class and environment in Nepal. Geoforum 42, 153–162. https://doi.org/10.1016/j.geoforum.2010.03.004.

Feminist frontiers special issue: gendered labor and work, even in pandemic times. In: Özkazanç-Pan, B., Pullen, A. (Eds.), Feminist frontiers special issue: gendered labor and work, even in pandemic times. Gend. Work Organ. 27, 675–926. https://doi.org/10.1111/gwao.12391.

Paternotte, D., Kuhar, R., 2018. Disentangling and locating the "global right": anti-gender campaigns in Europe. Polit. Gov. 6, 6–19. https://doi.org/10.17645/pag.v6i3.1557.

Paulitz, T., 2021. Die Überwindung der Sex /Gender Unterscheidung als Errungenschaft der Gender Studies? Zur Problematik eines dominanten Narrativs. Fem. Stud. 39, 352–372. https://doi.org/10.1515/fs-2021-0036.

Petticrew, M., Roberts, H., 2006. Systematic Reviews in the Social sciences: a Practical Guide. Wiley Interscience, Malden, MA.

Pilloni, M., Hamed, T.A., Joyce, S., 2020. Assessing the success and failure of biogas units in Israel: social niches, practices, and transitions among Bedouin villages. Energy Res. Soc. Sci. 61, 101328 https://doi.org/10.1016/j.erss.2019.101328.

Preuß, S., Galvin, R., Ghosh, B., Dütschke, E., 2021. Diversity in transition: is transitions research diverse (enough)? Environ. Innov. Soc. Transit. 41, 116–118. https://doi.org/10.1016/j.eist.2021.10.020.

Pujol, J., Montenegro, M., 2015. Technology and feminism: a strange couple. Rev. Estud. Soc. 173–185. https://doi.org/10.7440/res51.2015.13.

Retamal, M., Schandl, H., 2018. Dirty laundry in Manila: comparing resource consumption practices for individual and shared laundering. J. Ind. Ecol. 22, 1389–1401. https://doi.org/10.1111/jiec.12696.

Ruggiero, S., Kangas, H.-L., Annala, S., Lazarevic, D., 2021. Business model innovation in demand response firms: beyond the niche-regime dichotomy. Environ. Innov. Soc. Transit. 39, 1–17. https://doi.org/10.1016/j.eist.2021.02.002.

Salleh, A., 1997. Ecofeminism As politics: nature, Marx, and the Postmodern. Zed Books ; distributed in the USA by St. Martin's Press, London ; New York : New York.

Sandford, S., 2015. Contradiction of terms: feminist theory. Philosophy and Transdisciplinarity. Theory Cult. Soc. 32, 159–182. https://doi.org/10.1177/0263276415594238.

Sauer, B., 2018. Intersectionality. Krisis J. Contemp. Philos. 86–87.

Schot, J., Geels, F.W., 2008. Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. Technol. Anal. Strateg. Manag. 20, 537–554. https://doi.org/10.1080/09537320802292651.

Seyfang, G., Smith, A., 2007. Grassroots innovations for sustainable development: towards a new research and policy agenda. Environ. Polit. 16, 584–603. https://doi.org/10.1080/09644010701419121.

Shove, E., Walker, G.P., 2007. Caution! Transitions ahead: politics, practice and transition management. Environ. Plan. A 39, 763–770.

Simon-Kumar, R., MacBride-Stewart, S., Baker, S., Saxena, L.P., 2018. Towards North-South interconnectedness: a critique of gender dualities in sustainable development, the environment and women's health: gender, environment & health in the North-South. Gend. Work Organ. 25, 246–263. https://doi.org/10.1111/gwao.12193.

Skewes, L., Adrian, S.W., 2018. Epistemology, activism, and entanglement - rethinking knowledge production. Kvind. Køn Forsk 15–31. https://doi.org/10.7146/kkf.v27i1.109677.

Smith, A., 2007. Translating sustainabilities between green niches and socio-technical regimes. Technol. Anal. Strateg. Manag. 19, 427–450. https://doi.org/10.1080/09537320701403334.

Sovacool, B.K., Axsen, J., 2018. Functional, symbolic and societal frames for automobility: implications for sustainability transitions. Transp. Res. Part Policy Pract. 118, 730–746. https://doi.org/10.1016/j.tra.2018.10.008.

Sovacool, B.K., Griffiths, S., 2020. The cultural barriers to a low-carbon future: a review of six mobility and energy transitions across 28 countries. Renew. Sustain. Energy Rev. 119, 109569 https://doi.org/10.1016/j.rser.2019.109569.

Sovacool, B.K., Hook, A., Martiskainen, M., Brock, A., Turnheim, B., 2020. The decarbonisation divide: contextualizing landscapes of low-carbon exploitation and toxicity in Africa. Glob. Environ. Change 60, 102028. https://doi.org/10.1016/j.gloenvcha.2019.102028.

Standal, K., Talevi, M., Westskog, H., 2020. Engaging men and women in energy production in Norway and the United Kingdom: the significance of social practices and gender relations. Energy Res. Soc. Sci. 60, 101338 https://doi.org/10.1016/j.erss.2019.101338.

STRN, 2010. A mission statement and research agenda for the Sustainability Transitions Research Network.

Suchman, L., 2008. Feminist STS and the sciences of the artificial. In: Hackett, E.J., Amsterdamska, O., Lynch, M., Wajcman, J. (Eds.), The Handbook of Science and Technology Studies. MIT. Cambridge, Mass.; London, pp. 139–163.

Tennant, J., 2020. Web of Science and Scopus are not global databases of knowledge. Eur. Sci. Ed. 46, e51987. https://doi.org/10.3897/ese.2020.e51987.

Thoyre, A., 2020. Home climate change mitigation practices as gendered labor. Womens Stud. Int. Forum 78, 102314. https://doi.org/10.1016/j.wsif.2019.102314.

Trinh, T.M.-H., 1989. Woman, native, other: Writing Postcoloniality and Feminism. Indiana University Press, Bloomington.

Truffer, B., Rohracher, H., Kivimaa, P., Raven, R., Alkemade, F., Carvalho, L., Feola, G., 2022. A perspective on the future of sustainability transitions research. Environ. Innov. Soc. Transit. 42, 331–339. https://doi.org/10.1016/j.eist.2022.01.006.

University of Regensburg, 2020a. Scopus [WWW Document]. DBIS. URL https://rzblx10.uni-regensburg.de/dbinfo/detail.php?bib_id=slub&colors=&ocolors=&lett=fs&tid=0&titel_id=3636 (accessed 3.11.20).

University of Regensburg, 2020b. Web of Science Core Collection [WWW Document]. DBIS. URL https://rzblx10.uni-regensburg.de/dbinfo/detail.php?bib_id=slub&colors=&ocolors=&lett=fs&tid=0&titel_id=2142 (accessed 3.11.20).

van den Bergh, J.C.J.M., Truffer, B., Kallis, G., 2011. Environmental innovation and societal transitions: introduction and overview. Environ. Innov. Soc. Transit. https://doi.org/10.1016/j.eist.2011.04.010.

Verloo, M., Paternotte, D., 2018. The feminist project under threat in Europe. Polit. Gov. 6, 1–5. https://doi.org/10.17645/pag.v6i3.1736.

Wagman, K.B., Parks, L., 2021. Beyond the command: feminist STS research and critical issues for the design of social machines. Proc. ACM Hum.-Comput. Interact. 5, 1–20. https://doi.org/10.1145/3449175.

Wajcman, J., 2010. Feminist theories of technology. Camb. J. Econ. 34, 143–152. https://doi.org/10.1093/cje/ben057.

Wajcman, J., 2007. From women and technology to gendered technoscience. Inf. Commun. Soc. 10, 287–298. https://doi.org/10.1080/13691180701409770.

Walby, S., 2009. Globalization and inequalities: Complexities and Contested Modernities. SAGE Publications, Los Angeles.

WEF, 2021. Global Gender Gap Report 2021. World Economic Forum, Geneva.

Weller, I., 2003. Feministische Forschung — Nachhaltige Einsprüche. In: Heinz, K., Thiessen, B. (Eds.), Stoffströme Und Geschlechterverhältnisse: Verschlungene Wege Zur Nachhaltigen Gestaltung von Stoffen und Produkten. VS Verlag für Sozialwissenschaften, Wiesbaden, pp. 353–370. https://doi.org/10.1007/978-3-663-10055-3.

Winker, G., Degele, N., 2011. Intersectionality as multi-level analysis: dealing with social inequality. Eur. J. Womens Stud. 18, 51–66. https://doi.org/10.1177/1350506810386084.

Wu, C., 2013. Gender as a category of analysis: reconciling feminist theory with feminist methodology. Grad. J. Soc. Sci. 10, 38–53.