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Users, Consumers, Citizens: a Systematic Review of their Roles in Sustainability Transitions

Bram Verhees and Geert Verbong

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Eindhoven Centre for Innovation Studies (ECIS),
School of Innovation Sciences,
Eindhoven University of Technology, The Netherlands

Users, Consumers, Citizens: a Systematic Review of their Roles in Sustainability Transitions

Authors: Bram Verhees[1,C], Geert Verbong[1]

[1] School of Innovation Sciences – Eindhoven University of Technology (NL)

[C] Corresponding author: b.verhees@tue.nl +31(0)40.247.2962

Abstract:

Despite the widely recognized importance of users, consumers and citizens in sustainability transitions, transition studies offer highly fragmented perspectives that make it difficult to discern their various roles in sustainable innovation. This paper therefore has two aims: (1) to clarify how users, consumers and citizens have been conceptualized in transition studies literature, and (2) to synthesize a typology of user, consumer and citizen roles. Because expert reviews tend to be highly selective and interpretive, we opted for a systematic literature review and compiled a set of 349 papers that refer user, consumer or citizen in their title or abstract, and also cite one of 100 'core publications' in the transition studies field. To decrease bias and increase reproducibility, we use a systematic software-assisted content analysis that facilitates the disentanglement of multiple perspectives on a phenomenon of interest. It allows deep exploration of large collections of texts through classification of documents, the discovery of recurring themes, the identification of keywords, and the extraction of meaningful contexts in which these appear. A bottom-up thematic document classification (on the level of integral abstracts) reveals four categories of abstracts that correspond with the empirical domains of energy, mobility, food and water. A bottom-up thematic analysis of elementary contexts (on the level of sentences) highlights six significant themes across these empirical domains: transition, stakeholder, user, practice, market, and methodology. We interpret the significance of these themes and how they relate to our research interest. Then, to explore our research interest more in-depth, we use top-down (supervised) methods for exploring the contexts in which user, consumer and citizen appear. We find that though there is some degree of overlap, the terms are used mostly in different contexts and methods, and with different aims. Finally, we synthesize our findings into a typology of user, consumer and citizen roles along two dimensions: resist – produce, and individual – collective.

Keywords: user; consumer; citizen; sustainability transition; systematic review

1. Introduction

Many societies currently face persistent sustainability problems that are inextricably entwined with the systems that currently realize key societal functions such as energy, food and mobility. The scale of these problems has prompted researchers to argue that incremental innovation will be insufficient in the long run and that *sustainability transitions* are required instead: new socio-technical systems need to emerge around sustainable innovations and replace incumbent ones (Grin et al, 2010). Yet the interconnected nature of these systems, which consist of technological and non-technological elements involved in the production, distribution and use of technology (figure 1), renders change difficult (Geels, 2004).

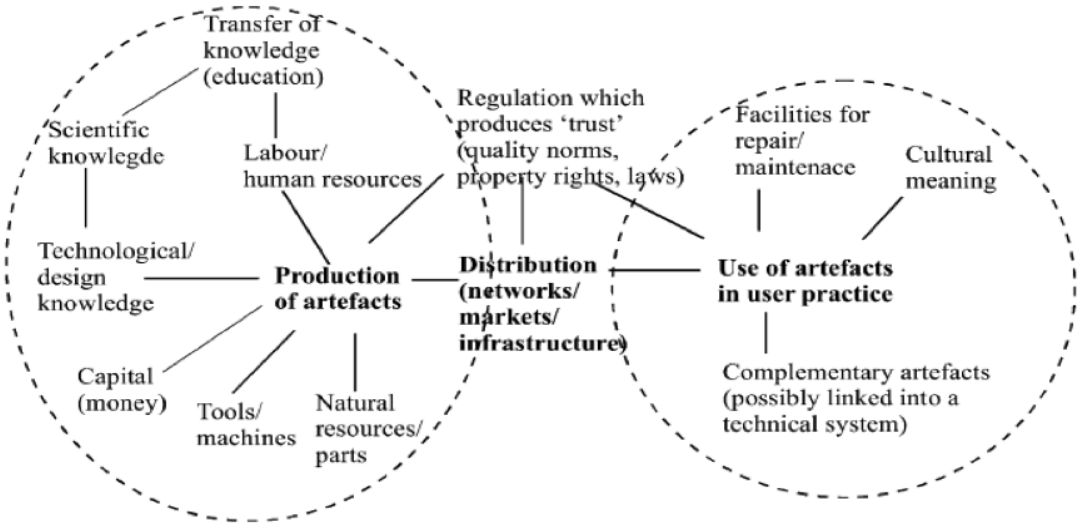

Figure 1. Elements of socio-technical systems (Geels, 2004).

Over the past decade, the emerging field of transition studies has shown that socio-technical system *can* change, and has advanced our understanding of *how* they do. Four paradigms largely structure the field: 'transition management' (Kern and Smith, 2008; Loorbach, 2010; Rotmans et al., 2001), 'strategic niche management' (Kemp et al., 1998; Raven and Geels, 2010; Smith, 2007), the 'multi-level perspective on sociotechnical transitions' (Geels, 2002; Geels and Schot, 2007; Smith et al., 2010), and technological innovation systems (Bergek et al.,2008; Jacobsson and Johnson, 2000; Hekkert et al., 2007)[1]. As can be seen in figure 1, *use* is one of the three key elements of socio-technical systems, alongside production and distribution. As such, the role of users in transition processes is a subject of interest for the growing field of transition studies. Analytical attention for the role of users in innovation processes in itself is nothing new: it has been acknowledged that users provide producers with feedback for better products at least since the days of Adam Smith (Bogers et al., 2010). Von Hippel (1988) took the argument further by showing how users don't just help *improve* but can also *generate* innovations. In subsequent

[1] The main tenets of these four frameworks, which provide the starting point for the systematic literature review this paper develops, will be discussed in Section 3 (results).

decades, Bogers et. al (2010) argue, "(…) the research on users as innovators has extended to areas as diverse as industry dynamics, entrepreneurship, firm boundaries, innovation communities, measurement and policy". Two arguments for the innovative behavior of so-called *lead users* is that they (1) experience specific needs before the rest of the market does, and that they (2) stand to benefit significantly from a solution for these needs.

These solutions typically take the form of *product* innovations, which are then either developed and marketed by the lead users themselves or by existing businesses. The question then arises if the same lead-user dynamic applies to sustainability-related *system* innovations. This question has led to an EU-funded project called 'EU-Innovate', which seeks to "(…) investigate the creative, innovate and entrepreneurial roles of users in developing sustainable novel products, services and systems" (www.euinnovate.com). Given the increasing recognition of users as potential sources of sustainable innovation (e.g. Shove, 2003; Ornetzeder, and Rohracher et al., 2006; Pettersen et al., 2013), we believe it to be useful to offer a comprehensive review of the role of users in sustainability transitions. Therefore, this paper seeks to answer the following research question:

Which roles can users have in sustainability transitions?

Certainly the field of transition studies has already devoted substantial attention – either explicitly or implicitly - to various categories of users in the context of system innovations towards sustainability. Nevertheless, a comprehensive overview of these is so far lacking. Moreover, *"[t]he categories also need to be refined, to include not only rejection and resistance but also forced use, reluctant use, partial use, selective use"* (Wyatt, 2014: 1). For these reasons, we shall address this question through a systematic review of transition studies literature.

2. Methodology

2.1 Systematic review

Systematic reviews have emerged in the medical field to support evidence-based medicine, but are increasingly applied in other fields, as well (Landa et al, 2011; King's College Library Services, 2014). A systematic review aims to provide a comprehensive summary of literature on a specific topic. In terms of the common distinction between primary and secondary research: whereas primary research would empirically address a particular research question, a systematic review can be thought of as a type of secondary research that *"reviews all the primary studies relating to a specific research question with the aim of integrating/synthesising evidence related to a specific research question"* (EBSE, 2007: iv). What further differentiates a systematic review from a 'regular' literature review is that it aims to achieve the same level of repeatability[2] that

[2] Note that this refers to reproducibility but not necessarily to replicability. At a later date, the

the primary studies it relies on do. As such, "[a]ll the methodology the reviewers have used to look for and assess articles is set out in the review so other people can see what the researchers have done and repeat their work(…)" (King's College Library Services, 2014: 3).

2.2 Data collection

Landa *et al.* (2011) set out guidelines to carry out an objective, repeatable review. These include identifying databases, defining research search terms, articulating and applying inclusion and exclusion criteria, and verifying that the selection is representative. We have done this in the following way:

1. Identifying the database

As a starting point, we limited our search to articles, book chapters and reviews that have been indexed in Scopus, a bibliographic database containing abstracts and citations from over 20,000 peer-reviewed academic journals (www.scopus.com). We opted for Scopus because Falagas et al. (2008) have found that it "offers about 20% more coverage than Web of Science, whereas Google Scholar offers results of inconsistent accuracy" and because its main drawback (i.e. that it exclusively holds articles published after 1995) it not problematic because the field of transition studies emerged only around 1998 and by far most contributions appear after 2000.

2. Delimiting the field

Simply searching Scopus for articles that include 'transition studies', 'sustainability transition', or 'transition' in their titles, keywords of abstracts proved to be insufficient: it produced large numbers of either false exclusions (esp. in the former two cases, as not all contributions to the field employ this exact terminology) or false inclusions (esp. in the latter case, since 'transition' is a generic term in a variety of academic fields). As an alternative, we use a strategy similar to the one used my Markard et al. in their 2010 review of the transition studies field (Markard *et al.,* 2012). We used the following steps:

- We conduced a general Scopus search for articles whose title, abstract or keywords refer to any of the four paradigms which structure the field (Markard *et al.,* 2012). The resulting search phrase was *TITLE-ABS-KEY ("strategic niche management" OR "technological innovation system" OR "technological system" OR "multi level perspective" OR "transition management").* On 1 July 2014, this produced 2725 results
- We sorted the results by number of citations they had accumulated until that date (descending) and manually removed articles that were not in the field of transition studies. Exclusion criteria used were year of publication (after 1998) and journal categories (e.g. natural sciences journals). In case of

method of data collection spelled out in the next subsection may yield a different (i.e. broader) set of articles, which may lead to different insights. In the medical field, the possibility of taking on board progressive insight when repeating the systematic review is considered a strength rather than a weakness of the method.

doubt, we read the abstract and removed the article when it was obvious that no connection to transition studies themes (technological change, system innovation, sustainable technology etc.) was present. In cases of doubt, we left the articles in. We continued until we had a list of the 100 most-cited articles (h-index=46). We refer to this as the 'core list'.

- We then retrieved a list of all articles citing at least one article from said core list. On 1 July 2014, this produced 3,097 results, which we limited to journal articles (2,603). We refer to this list as 'the field'.

3. Finding relevant contributions

Although 'user' seems to be a relatively specific term, it is actually somewhat ambiguous: users can be individuals but also organizations (either of which can be a user of one thing while being a producer of another), and the question of who the user of a particular innovation is, is not always clear either, such as in the case of a physician who may be seen as a 'user' of a drug produced by a pharmaceutical company whose feedback is key for its development, while a patient is the end-user (Ornetzeder and Rohracher, 2006). Secondly, while a generic word, the term 'user' correlates more strongly with some literatures than with others: in economics, for example, the term 'consumer' is found more often to describe phenomena we're interested in. Although we limit the scope of our study to the field of transition studies, it is both an emerging and interdisciplinary field, so we cannot assume consistency of terminology. Generally, we *"(…) need to consider the alternatives to 'user' that are sometimes deployed to describe technology practices in different domains and disciplines in order to clarify interdisciplinary collaboration"* (Wyatt, 2014: 3). And thirdly, the term *user* implies that only those who actually *use* technology are relevant for the innovation process, whereas studies in the field of science and technology studies have shown the importance of various categories of *non*-users as well, such as resisting, rejecting, excluded and expelled citizens (*Wyatt et al.,* 2002). We have addressed these issues by expanding the scope of our search: our Scopus query aimed to limit the 'field' of 2,603 articles to those of interest for our purposes was *TITLE-ABS-KEY (user* OR consumer* OR citizen*).* The asterisk is a wildcard for any number of characters (including 0), so that plural forms, conjugations and compound words are also found. On 1 July 2014, this yielded 349 journal articles (h-index=33) in the field of transition studies that deal with users, consumers or citizens. We then analysed the metadata (authors, publication years, journals) and created graphic representations of these (see: Section 3).

2.2 Data extraction and -synthesis

Having acquired a good set of articles, the next step in systematic reviews is to extract the data necessary to answer the research question. In the medical field that spawned the systematic review method, studies tend to be quantitative in nature and the guidelines for data extraction reflect this: researchers are to (pre)define categories of numerical values that they extract from each study, such as total participants, variance etc. (EBSE, 2007). These numerical data can

then be subjected to a meta-analysis: a statistical technique for integrating the results of multiple quantitative studies.

However, extracting and synthesizing data in this manner is not possible in this case. Firstly, most studies in the field of transition studies are qualitative, and their epistemological orientation is generally different from the quantitative studies in e.g. the medical field: they are underpinned by a 'process model' that focuses on developing plausible narratives that give meaning to a specific sequence of events, rather than by a 'variance model' that focuses on developing theory that explains causes/consequences of a general phenomenon in its context (Bruner, 1991; Van de Ven, 2007). Secondly, the articles in the acquired dataset speak about users in a wide range of empirical domains and from a great variety of theoretical frameworks. One option to resolve these two issues is to resort to a more traditional 'expert review', which relies on the expertise of the reviewer to accurately interpret the material. While is often practiced (it is by far the most common type of review paper), this compromises the repeatability of the review. We therefor chose a different strategy: to identify the contribution of these different perspectives to the involvement of users in transitions in a way that is more consistent with the philosophy of the systematic review, we followed Biraghi and Gambetti (2013) in *adopting "(…) a systematic software-assisted content analysis, appropriate when the research aims are to disentangle multiple perspectives on a phenomenon".* Like Biraghi and Gambetti, who did a systematic review of management literature to determine the value of corporate branding, we use the software package T-LAB version 9.1 (www.tlab.it/en). The use of T-LAB within the field of transition studies is not completely new, as at least one study uses it to analyse media discourses on biofuels (Sengers *et al.,* 2010), but its use for a systematic review is an innovation in the field. T-LAB offers set of automated content analysis tools that allow meaningful patterns of words and themes to emerge from large quantities of textual documents. In all cases, the first step is to input an appropriately formatted 'corpus' of texts. T-LAB automatically[3] processes the texts, counting occurrences of words, grouping conjugations, plural forms and different spellings etc. of specific words into lemmas, removes 'stop words' and groups 'multi words' (so that e.g. 'Von' and 'Hippel' do not appear as two lemmas but rather as one), and selects more limited of lemmas most characteristic for the texts (the 'keywords') that is used for further analyses.

We prepared our corpus by downloading the abstracts for the 349 papers in our dataset from Scopus. We then copy/pasted the abstracts into a text file making sure only abstract text were included (i.e. removing titles, keywords, copyright information etc.), separated the documents using the appropriate codes, and tagged each document with a variable (publication year). We then fed the corpus into T-LAB, which correctly identified 349 documents consisting of 67,100 total words (on average some 200 words per abstract) composed of 7,076 unique

[3] It should be noted than all these automated steps can be supervised and altered by the researcher.

words. We opted for automated removal op stop-words (such as 'and', 'the' etc.) but manually checked the results to be sure: no alternations to the automated process needed to be made. T-Lab then presented us with the option to check its automatically-generated multi-word list, to which we manually added 160 strings of words that T-LAB found to be occurring frequently together, but had not tagged as multi-words (see: Appendix I). Automatic lemmatization subsequently his produced a final list of 5,259 lemmas, from which T-LAB selected 806 'keywords'. This list was used as the basis for the following analyses:

1. Bottom-up (unsupervised) classification of integral abstracts into groups
2. Bottom-up (unsupervised) identification themes within/across the abstracts (to
3. Top-down (supervised) exploration of the main associations of our search terms and interpretation of the key contexts in which our search terms occur.

Ad 1: Classifying the abstracts

The 'thematic document classification' tool allows researchers to automatically classify large numbers of documents into a small number of themes. As this is not yet a common method, we will now explain its use in some detail. First, the software produces a table enumerating how often each word in the dataset (NB not each *key*word) occurs in each document. Then, it performs several statistical operations in this table, including normalization using TF-IDF, a numerical weighting factor that is used in text mining and measures how 'important' a word is to a document in a corpus (Rajamaran and Ullman, 2011). It then clusters the documents using bisecting K-means, an iterative partitioning algorithm (Savaresi *et al.,* 2000). T-LAB subsequently performs a comparative analysis by constructing a table that enumerates how often each word (in the rows) occurs in each of the clusters (in the columns) obtained though the previous steps, and applying a chi square test to determine if a significant difference is present between the average and observed frequencies within a cluster. These clusters, which are internally homogeneous and externally heterogeneous, are useful in and of themselves: they are groups of documents (in our case: abstracts) with a specific theme (which represented by a list of the most characteristic words). But in order to facilitate interpretation by a researcher, T-LAB also performs a correspondence analysis - a sort of component analysis (PCA) but for categorical instead of continuous data. Like PCA, it reduces the number of dimensions within which the data can be represented, allowing the clusters ('themes') to be plotted visually along a two- or three factorial axes to be explored by the researcher (ref: T-LAB manual).

As Lancia (2012) states in a paper explaining the logic of the various T-LAB tools, these factors *"can be considered as classification principles (…) i.e. as organizers of the relationships between the data – that put similar things together, distinguish them from different things and construct kinship between categories of things"* (Lancia, 2012: 18). In a paper evaluating the use of automatic content analysis for psychotherapy process research, Salvatore *et al.*

(2012) found that estimates of semantic similarity are consistent with the corresponding estimates provided by human coders and conclude that the content analysis is indistinguishable from that performed by human coders. Nevertheless, none of this absolves the researcher from thinking and interpreting: T-LAB is merely a tool to help find order in the complexity of large number of texts. As Lancia (2012) argues, this 'unsupervised' method for clustering textual units is both 'powerful' and 'weak': *"[I]t is powerful because it looks for similarities in a 'human-like' way, and – for this very reason – it is also weak: in fact, the way the data are partitioned into groups (i.e. clusters) needs the human being as a sort of referee (…) [T]he statistical (…) meaning of the factors is one thing and the models for interpreting them within each scientific discipline are another (…) [I]f science did not try to explain the factors that generate some order in the phenomena studied, it would have no reason for existing."* (Lancia, 2012: 3-19). Once the clusters were obtained, we analysed the characteristic lemmas in each one, and grouped them together into empirical concepts, theoretical concepts, and user-related concepts (see: table 2). To assist us in meaningfully interpreting the factorial axes, we then used a correspondence analysis tool (examining lemmas at each pole), and a specificity analysis of the least typical words for every cluster in relation to the others.

Ad 2: Identifying themes within/across abstracts

Whereas the thematic document analysis allows us to classify abstracts on the level of the integral document, another method is needed to investigate themes *within* the abstracts on the level of sentences. Specific abstracts, after all, can incorporate multiple themes, and specific themes can be expected to span multiple abstracts. T-LAB offers a tool for such a more 'fine-grained' search with its 'thematic analysis of elementary contexts' tool. It starts with the same list of 806 keywords, and the rest of the procedure is also quite similar. The main difference is that instead of investigating occurrence and co-occurrence of keywords in the context of entire documents (i.e. abstracts), it uses so-called 'elementary contexts'. In practice, these elementary contexts are most often whole sentences[4]. In this case, T-LAB found exactly 1,700 elementary contexts (±40 words per context). Manual inspection of a random sample learned that these were indeed whole sentences in the large majority of cases.

Ad 3: Exploring the context of our search terms

Here, the goal is to analyse our dataset in a more top-down (supervised) fashion, guided by our research interest, as the kind of bottom-up (unsupervised) thematic analysis of our dataset described above will inevitably uncover themes strictly outside the scope of our research interest. To investigate the contexts in which our initial search terms (*user, consumer, citizen)* appear in the dataset, we uses two T-LAB tools:

[4] If, however, T-LAB cannot find a full stop (e.g. due to formatting errors or imperfect OCR) *or* if the sentence exceeds 400 characters, the software defines the elementary context using a statistical criterion without cutting lemmas (source: T-LAB manual)

- *Concordances.* One of the more straightforward T-LAB tools, it allows us to extract all elementary contexts based on occurrence: i.e. display ~sentences in which our selected search terms are simply present. We use this tool to create a table of *"adjectives describing use and users"* as well as *"nouns for which user can be used as an adjective"*, as suggested in (Wyatt, 2014).
- *Word associations.* This tool allows us to investigate co-occurrence between a selected keyword and other words in elementary contexts (±sentences). It visualizes these relationships as a radial diagram: a word map that displays the relative 'closeness' to a selected keyword. Closeness is calculated using cosine coefficient as an association index (Salton, 1989), which is calculated and ranked for all keywords: words are included in the plot of they appear in the top 20.
- *Key contexts of thematic words.* This produces lists of meaningful sentences that allows a deeper exploration of our keywords. Here, 'meaningful' means that it extracts elementary contexts in which a selected keyword co-occurs with words with which it is strongly associated (multiple co-occurrence). In other words: it seeks out and displays bits of text in which the keyword appears together with one (or more) of the words that come from the 'word associations' step, in order to increase the chance that the sentence is relevant to our interest.

3. Results

Interest the user of the words user, consumer or citizen in abstracts that cite papers in our core list has increased significantly over the past decade (figure 2).

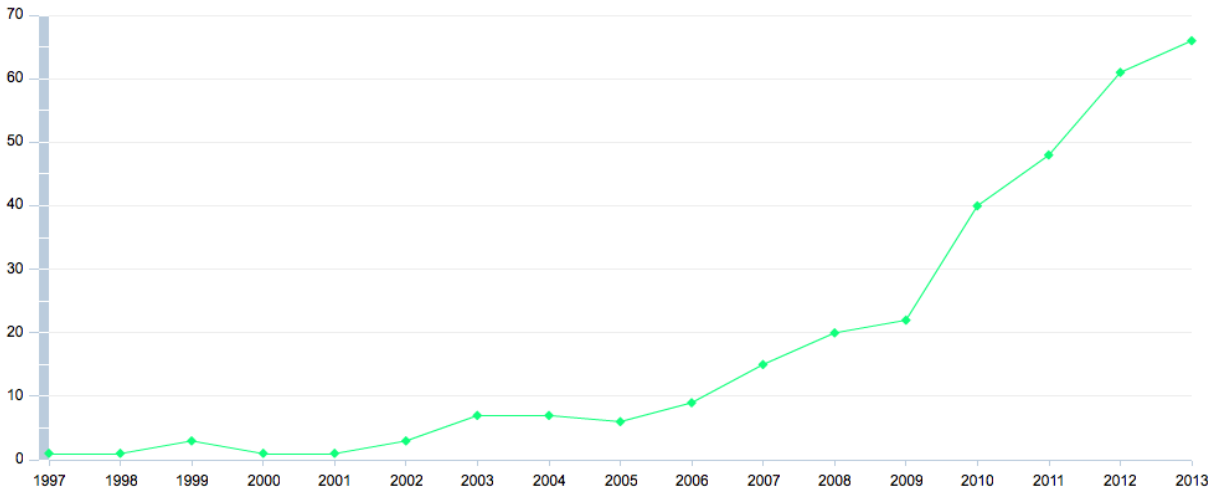

Figure 2. Dataset distribution over time

Of the 349 results, 327 (94%) have been published in 160 peer-reviewed journals. The top 25 publications (coincidentally all journals with >2 publications) account for >50% of the total (see: table 1). The top 10 authors and the numer of contributions to our dataset are: R. Kemp (6), F. Geels (6), A. Tukker (5), A. Wiek (5), H. Rohracher (4), J. Schot (4), K. Shum (4), G. Spaargaren (4), R. Verganti (4), L. Whitmarch (4).

Energy Policy	32	Business Strategy and the Environment	4
Technology Analysis and Strategic Management	16	Global Environmental Change	4
Technological Forecasting and Social Change	15	Energy Efficiency	4
Journal of Cleaner Production	12	Science and Public Policy	4
Research Policy	11	Science and Engineering Ethics	4
Ecological Economics	8	Technovation	3
Local Environment	7	Biofuels Bioproducts and Biorefining	3
Technology in Society	6	Building Research and Information	3
Sustainability Science	5	Journal of Consumer Culture	3
Innovation	5	Environmental Science and Policy	3
Environmental Innovation and Societal Transitions	5	International Journal of Hydrogen Energy	3
Journal of Environmental Management	4	Journal of Product Innovation Management	3
Futures	4		

Table 1. Top 25 publications and contributions to our dataset.

The distribution of papers over academic subject areas is of some interest, as well. Although 23 subjects areas are present in our dataset, the largest contribution by far come from the three subject areas *environmental sciences, social sciences,* and *business, management and accounting* which together account for almost 60% of the papers (figure 3). Besides 2 contributions from *biochemistry* and *immunology,* none of the fields listed give rise to suspicions about false inclusions.

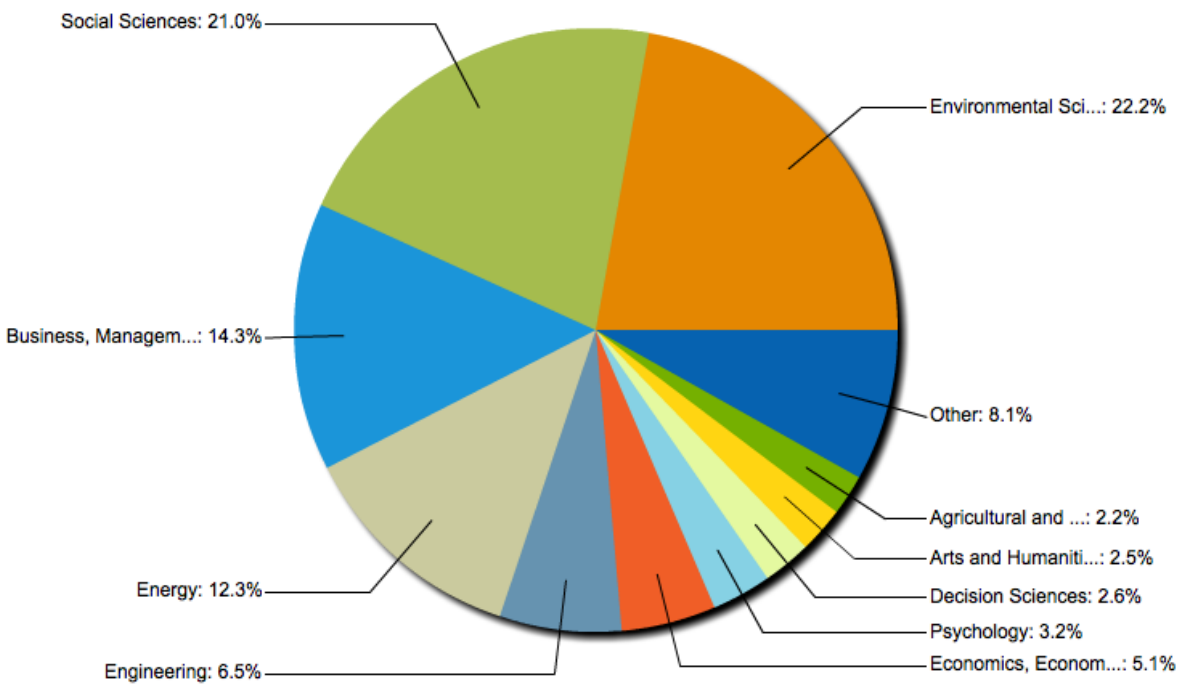

Figure 3. Dataset distribution over subject areas.

3.1 Document classification

As a first examination of our dataset, and to identify any false inclusions that might remain, we classified the abstracts. Using the method described in section 2.2 under (1), T-LAB identified, through its unsupervised (bottom-up) clustering algorithms, four significant clusters. T-LAB automatically names these clusters with one of the top characteristic keywords, based on a combination of high chi^2 value and the ratio between the total occurrences of that word within the cluster and the dataset. These names were: *PV, water, vehicle* and *food.* These clusters consist of sets of abstracts, and are represented by the most characteristic words in the respective sets. Table 2 shows the top 20 words by χ^2 value; the automatically generated cluster labels appear in shaded cells.

CLUSTER 1			***CLUSTER 2***			***CLUSTER 3***			***CLUSTER 4***		
LEMMA	*X²*	*RATIO*	*LEMMA*	*X²*	*RATIO*	*LEMMA*	*X²*	*RATIO*	*LEMMA*	*X²*	*RATIO*
PV	264	31/31	water	154	69/85	model	130	130/165	research	97	119/194
Germany	102	15/18	urban	132	55/65	vehicle	111	65/66	food	68	40/48
waste	88	15/20	plan	106	55/73	technology	75	204/349	community	52	46/66
photovoltaic	84	12/14	city	96	41/49	behavior	54	33/34	innovation	49	139/290
wood	76	10/11	governance	64	53/88	hydrogen	44	25/25	quality	46	29/36
medium	71	12/16	resource	54	47/80	fuel	43	44/56	farmer	43	24/28
flow	68	13/19	coastal	40	14/15	biofuels	42	24/24	local	43	66/116
provision	65	15/25	India	40	14/15	adoption	38	41/53	process	42	105/213
deployment	63	21/45	sea	38	12/12	Electric	37	25/27	product	41	68/122
network-bound_systems	60	7/7	hospital	37	13/14	transition	35	107/188	participatory	33	21/26
learning	57	29/80	house	32	24/38	design	32	85/144	organic	33	17/19
electricity	54	28/78	floodplain	32	10/10	electric_ vehicles	32	20/21	expert	30	22/29
energy_efficien-cy innovation	51	6/6	conflict	29	16/22	CTA	26	15/15	network	30	49/88
curve	50	7/8	infrasystem	29	9/9	economy	24	38/56	deliberative	29	12/12
energy_ conservation	50	7/8	nurse	29	9/9	transportation	23	13/13	ethical	29	12/12
construction	44	14/29	social-ecological	29	9/9	transport	22	33/48	citizen	28	50/92
prevention	42	6/7	capacity	28	27/48	AFV	21	12/12	grassroots_ innovations	27	11/11
learn	38	29/97	Australia	27	10/11	crop	21	12/12	ministry	27	11/11
sanitation	37	7/10	greywater	25	8/8	consumer	20	111/219	PTA	27	11/11

Table 2. Top 20 most characteristic lemmas for four document clusters (shaded=label)

When we interpret what T-LAB finds to be the most significant differentiator between documents, we see that the clusters are *empirical domains.* Articles in the field of transition studies typically consist of qualitative single case studies regarding what is referred to a ' societal function': comparative or cross-domain empirical work, as well as purely theoretical contributions, are relatively rare (Geels, 2011). As such, the clustering seems to make sense in that on the level of integral documents, the societal function under study is the most obvious (and

significant) differentiator. The list in table 1 is not exhaustive[5]: exploring the total list of lemmas characteristic for each cluster (PV: 127, water: 227, vehicle: 234, food: 287) reveals interesting information.

- The 'PV' cluster (35 documents, 10% of total) is not exclusively about solar photovoltaics: words like *network-bound systems, energy policy, waste, wood, burn, electricity, generation, efficiency, conservation, pellet, grid-connection* etc. point to the domain of 'energy' being a more useful common denominator. Lemmas related to theories and frameworks used in this cluster are *sustainable innovation, innovation systems, technological innovation systems, public-private.* When examining the list for words related to users, we find terms like *producer, market, liberalization, municipality, town, inhabitant, small-scale, local, collaboration, decentralize, household*, but also *barrier* and *resistance.*
- The 'water' cluster (79 documents, 23% of total) is obviously strongly characterized by water-related words: *water, water policy, water management, greywater, groundwater, stormwater, dike, river, floodplain management, coastal, sea, shrimp*. However, it is one of the more heterogeneous clusters, as geography is clearly a key subtheme, with words like *suburban, city, planning, neighbourhood, architecture* as well as many names of continents, countries and cities (*Africa, Japan, Korea, Australia, India, South-Africa, Denmark Malaysia, Santiago, Sorsogon City, Delhi, Johannesburg*). We will go into this combination in the next section. In terms of frameworks and theoretical concepts, we find words like *co-operative governance, path creation, transdisciplinary, cross-sectoral, socio-technical, narrative, legitimacy, life cycle, ecosystem, social-ecological, vulnerability, resilience.* In relation to the theme of users, we find words like *end-use, co-opererative governance* and *private sector,* but also *conflict* and *opposition.* For the sake of comprehensiveness, it should be noted that this cluster also holds a small number of articles relating to heath care[6].
- The 'vehicle' cluster *vehicle* (130 documents, 37% of total) is all about mobility with words like *vehicle, automobile, hybrid, car, electric vehicle, automotive, mobility, transport, road infrastructure, engine, gasoline, hydrogen, biofuels, biogas.* In terms of theory and frameworks, this cluster appears closest to the core list (the 100 original articles that defined 'the field') with lemmas like *Constructive Technology Assessment (CTA), practice theory, transition management, technological regimes, technological transitions, system innovation, multi-level perspective, radical, lock-in, historical case study, evolutionary, reconfiguration, design-driven innovation.* Interestingly, *strategic niche* management or the *niche* concept do not appear

[5] Note that the cut-off point for the total number of items on the list is a p-value of <.05

[6] We examined this further by performing a thematic analysis of elementary contexts of the water cluster (as opposed to the whole dataset as in section 3.2). This revealed 'hospital' to be a clearly distinct subtheme (e.g. *hospital, medication, nurse, medical, care, CPT, trial*). Although only loosely related to transition studies and not to the sustainability theme, we left it in because (1) it is a small theme as only appears in 67 out of 1,700 elementary contexts (<4%), and (2) because it *does* relate significantly to our user theme (e.g. *patient-centeredness).*

on this list: not because it doesn't occur frequently in this cluster (it does), but because it frequently occurs in the others, too. Given the 'systemic' nature of the studies in this cluster, it also has more characteristic words that are related to (broadly) use than the preceding two: here, we find *diffusion, adoption, early adopters, market penetration, consumer, customer, buyer, marketplace, purchase price, rational, taste, user practices, lifestyle, green consumerism, mediator, citizenship, user-centered.*

- The 'food' cluster (105 documents, 30% of total) cover the whole food system supply chain: *food system, supply chain, bio-based, biotechnology, agriculture, farm, husbandry, pasture, animal, egg production, farmer, tractor, grain, supermarket, local organic food, nutrient, halal.* Methodologically and theoretically, we see words like *scenario development, hype cycle, actor-network theory (ANT), life cycle analysis (LCA), grassroots innovation, participatory processes, ethical, deliberative, (social) justice.* Like the vehicle cluster, it has relatively many words in relation to our user theme and while some are similar, most are markedly different: *lead user, expert, practitioner, consumer behaviour, consumption practices, user involvement, intermediary, forum, civil society, public participation, low-income.*

The results are summarized in table 3.

Label	**Empirical concepts**	**Theoretical concepts**	**User-related concepts**
PV (35 docs)	*Network-bound systems, energy policy, waste, wood, burn, electricity, generation, efficiency, conservation, pellet, grid-connection*	*Technological innovation, sustainable innovation, innovation systems, technological innovation systems, public-private*	*producer, market, liberalization, municipality, town, inhabitant, small-scale, local, collaboration, decentralize, household, barrier, resistance*
Water (79 docs)	*Water, water policy, water management, greywater, groundwater, stormwater, dike, river, floodplain management, coastal, sea, shrimp, suburban, city, planning, neighbourhood, architecture, Africa, Japan, Korea, Australia, India, South-Africa, Denmark Malaysia, Santiago, Sorsogon City, Delhi, Johannesburg.*	*co-operative governance,, path creation, transdisciplinary, cross-sectoral, socio-technical, narrative, legitimacy, life cycle, ecosystem, social-ecological, vulnerability, resilience.*	*end-use, co-opererative governance, patient-centeredness, private sector, conflict, opposition.*
Vehicle (130 docs)	*vehicle, automobile, hybrid, car, electric vehicle, automotive, mobility, transport, road infrastructure, engine, gasoline, hydrogen, biofuels, biogas.*	*Constructive technology assessment (CTA), practice theory, transition management, technological regimes, technological transitions, system innovation, radical, multi-level perspective, lock-in, historical case study, evolutionary, reconfiguration, design-driven innovation*	*diffusion, adoption, early adopters, market penetration, consumer, customer, buyer, purchase price, marketplace, rational, taste, user practices, lifestyle, green consumerism, mediator, user-centered.*

Food (105 docs)	*food system, supply chain, bio-based, biotechnology, agriculture, farm, husbandry, pasture, animal, egg production, farmer, tractor, grain, supermarket, local organic food, nutrient, halal.*	*Scenario development, hype cycle, actor-network theory (ANT), life cycle analysis (LCA), grassroots innovation, participatory processes, ethical, deliberative,(social) justice.*	*citizen, consumer behaviour, intermediary, lead user, expert, practitioner, consumer behaviour, consumption practices, user involvement, intermediary, forum, civil society, public participation, low-income.*

Table 3. Four documents clusters' names and their characteristic empirical, theoretical and user-related concepts.

Spatially, the clusters relate to each other as visualised in figure 4. The factorial axes and the clusters' positions are calculated by T-LAB. Three factorial axes appear, which we subsequently interpreted. T-LAB offers two tools that can be of help for interpretation: (1) a correspondence analysis tool that allows researchers to examine the lemmas that appear at the positive and negative extremes of each axis (regardless of the cluster in which they appear), and (2) a specificity analysis that allows researchers to examine the *least typical words* for every cluster *in relation to the others* (see: table 4).

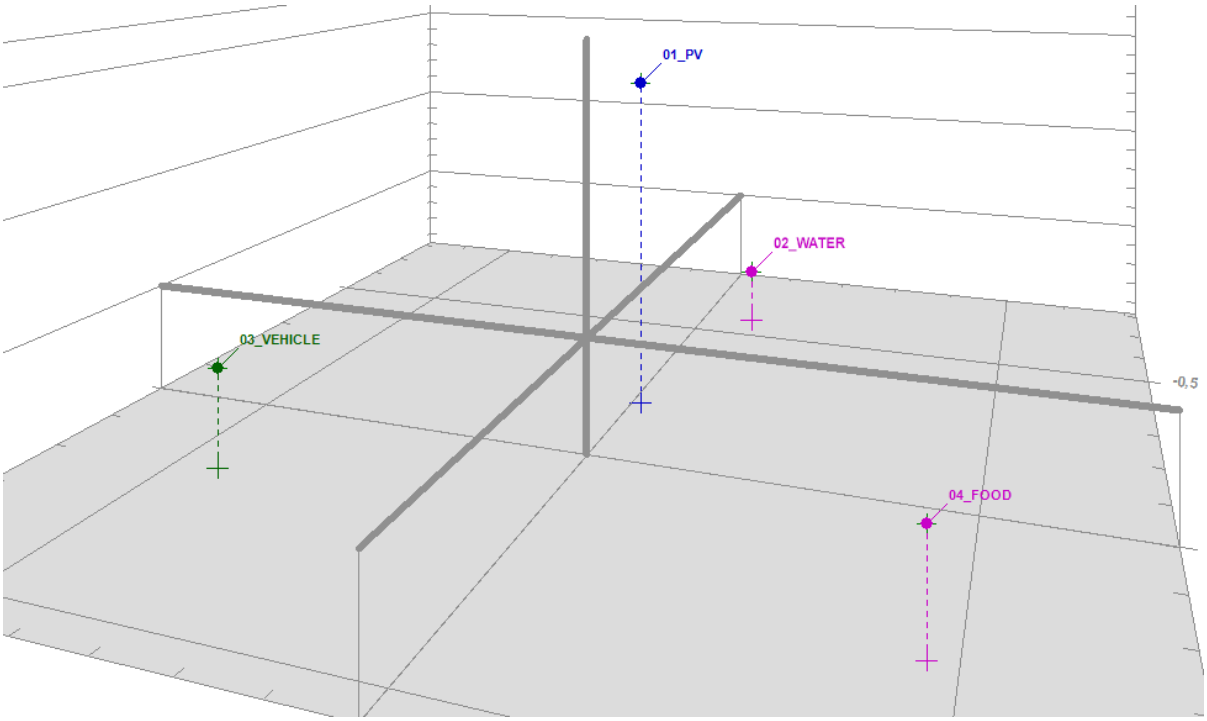

Figure 4. Spatial relations between four document clusters (source: T-LAB).

Firstly, the X-axis differentiates mostly between the 'food' (agriculture) cluster on one end and the 'vehicle' (mobility) cluster on the other: from this perspective, PV and food are positioned near the zero point. Specificity analysis shows that *citizen, participatory processes, community* and *grassroots innovation* score highly (see: table 2) while *technology* and *price* are the least typical lemmas for the food cluster (see: table 3): here, *innovation* need not be (hi-)tech. Conversely, technology is at the core of the vehicle cluster (though the word itself does not appear, many of the characteristic lemmas *are* technologies) and *consumer, manufacturer, markets, purchase price* etc. as well. Whereas in the

vehicle cluster users are consumers who adopt radical innovations produced by market parties, in the food cluster they are citizens who are actively involved in the innovation process. This leads us to interpret the X-axis as a spectrum from users as passive consumers on one end to users and active (co)producers on the other.

Secondly, the Y-axis differentiates mostly between the 'water' cluster on one end, and the 'food' and 'vehicle' ones on the other: PV is somewhat near the zero point from this perspective. This begs the question: in what respect are food and vehicle clusters (so contrasting along the X-axis) similar when compared the water cluster? The answer is *innovation*: it is key to both the food (n=139) and vehicle (n=109) clusters, albeit in vastly different ways (see: X-axis). Specificity analysis (table 4) shows that innovation is the *least* common word in the water cluster. In the water cluster, *governance* scores highly, which is atypical of both the vehicle and the food cluster (respectively only 15% and 17% of all occurrences of the word, even though the clusters are respectively 65% and 33% larger). In all three categories, sustainability is a key term, albeit using different words. In the food cluster, the highest-scoring related term is *sustainable development;* in the vehicle cluster it's *green consumerism;* and in the water cluster it's *climate change*[7]*.* This leads us to interpret the Y-axis as a spectrum from more innovation process-related, to more policy process-related approaches to sustainability.

Thirdly, the Z-axis differentiates between the PV cluster on one end, and the water and vehicle clusters on the other. Interestingly, while energy is a key domain for transition studies, the abstracts in the dataset that talk about users in this domain tend *not* to do so in terms of transition studies terminology. A specificity analysis revealed that 'transition' is actually the *least* typical word in in this cluster when compared to the others. (see: table 4). Table 1 also reveals that papers in this cluster tends to use more 'traditional' concepts like 'technological innovation' and 'innovation systems'. As such, we can interpret the Z-axis as a spectrum from more 'fringe contributions' to more 'core contributions' to transition studies field.

PV			***WATER***			***VEHICLE***			***FOOD***		
WORD	*RATIO*	*X²*	*WORD*	*RATIO*	*X²*	*WORD*	*RATIO*	*X²*	*WORD*	*RATIO*	*X²*
transition	8/188	7,9	innovation	16/290	54,6	local	10/116	38,58	transition	10/188	52,5
potential	2/97	7,4	market	8/166	33,5	plan	3/73	32,78	model	12/165	38,8
plan	1/73	6,5	model	12/165	25,3	research	34/194	29,76	energy	23/197	29,7
future	4/117	6,3	product	7/122	22,3	urban	4/65	25,59	technology	63/349	21,5
regime	1/71	6,3	consumer	23/219	21,9	community	5/66	23,59	water	6/85	20,3
community	1/66	5,7	vehicle	1/66	18,3	food	2/48	21,46	service	7/89	19,8
influence	1/62	5,2	technology	53/349	14,9	project	12/90	20,58	regime	4/71	19,2
identify	2/77	5,2	food	1/48	12,6	stakeholder	17/108	19,8	deployment	1/45	15,9

[7] It is important to note here that sustainability etc. was not a selection criterion in constructing the dataset at any point: it emerged as a key theme as a result of the (normative) focus of the transition studies field.

adoption	1/53	4,2	practise	20/164	12,5	citizen	13/92	19,61	heat	1/41	14,3
develop	7/135	4,1	actor	7/87	12,1	city	3/49	19,32	urban	6/65	12,6

Table 4. Specificity analysis: top ten least typical words per cluster.

3.2 Themes within/across abstracts

After having classified entire abstracts into clusters that corresponded strongly with empirical domains, we went on to explore commonality between the themes *within* the abstracts. To achieve this 'higher resolution', we used the 'thematic analysis of elementary contexts' tool, whereby the 'elementary contexts' were sentences (rather than integral abstracts, as in section 3.0). Using this method, T-LAB identified six themes, which it automatically labelled (1) *transition*, (2) *stakeholder*, (3) *user*, (4) *methodology*, (5) *learning* and (6) *vehicle*. Table 4 lists the top 10 lemmas for each of these, with shaded cells indicating theme titles[8][9].

CLUSTER 1 (23% of contexts)			***CLUSTER 2 (22% of contexts)***			***CLUSTER 3 (14% of contexts)***		
LEMMA	*X^2*	*RATIO*	*LEMMA*	*X^2*	*RATIO*	*LEMMA*	*X^2*	*RATIO*
transition	296	143/188	plan	128	56/73	technology	141	127/349
water	167	70/85	stakeholder	111	69/108	user	125	82/194
energy	149	118/197	local	105	71/116	innovation	76	93/290
carbon	118	43/48	citizen	101	60/92	knowledge	67	42/97
heat	75	33/41	project	60	50/90	successful	53	20/35
emission	75	34/43	farmer	59	23/28	provide	45	33/82
low	70	28/33	decision-making	53	20/24	exist	40	27/65
gas	58	19/20	deliberative	43	12/12	medical	35	11/17
path	45	19/23	research	34	76/194	transfer	30	10/16
regime	40	39/71	integrate	33	33/64	factor	30	24/62
CLUSTER 4 (13% of contexts)			***CLUSTER 5 (16% of contexts)***			***CLUSTER 6 (12% of contexts)***		
LEMMA	*X^2*	*RATIO*	*LEMMA*	*X^2*	*RATIO*	*LEMMA*	*X^2*	*RATIO*
research	74	64/194	practice	397	122/164	vehicle	145	38/65
experience	66	31/69	learn	286	78/97	fuel	137	34/56
paper	59	78/281	learning	271	68/80	model	131	65/165
methodology	58	18/31	consumption	150	54/80	AFV	94	12/12
empirical	56	22/44	article	84	52/104	market	93	58/166
base	55	38/103	theory	68	44/90	diffusion	77	28/59
different	52	41/119	sustainable_ consumption	49	20/32	pioneer	70	11/13
study	51	56/187	change	48	68/194	refuel	70	10/11
interview	48	18/35	niche	39	28/60	adoption	68	25/53
data	48	17/32	discourse	35	14/22	engine	63	8/8

Table 5. Ten most characteristic lemmas for six thematic clusters (shaded=theme label).

[8] The original T-LAB label for cluster 5 read 'practise'. Upon inspection, it was found that this was the result of automatic lemmatization, whereby the noun 'practice' was grouped into the lemma of the verb 'practise' (while the latter hardly appears in the corpus at all). We have changed the label manually to reflect this.

[9] Again, the lists of characteristic words are much longer. We do not reproduce them here for the sake of brevity. In the body text, we will list several additional characteristic words when discussing the clusters.

We will now analyse and interpret each of these clusters (which represent themes), and discuss how they relate to, or conceptualize, users.

Theme 1: transition

This is the largest cluster, accounting for 395 of the 1700 elementary contexts. Characterized by lemmas like *regime, socio-technical, regime, energy transitions, path creation, transition pathways, reconfiguration, substitution, transformation, lock-in, multi-level, coevolution, system innovation,* the cluster is clearly about the multi-level perspective (MLP) as one of the four paradigms which structure the field. The MLP adopts a hierarchical conceptualization of the social world in which the innovation process unfolds. Transitions are argued to come about through interaction between three analytical levels:

- *Landscape*: exogenous events or long-term trends (e.g. climate change).
- *Regimes:* sets of heterogeneous rules (e.g. routines, competences, lifestyles, practices, institutions, regulations) that entrench socio-technical systems.
- *Niches*: the 'seeds' of alternative socio-technical systems.

Multiple transition pathways have been identified (Geels and Schot, 2007), but most empirical studies have emphasized one in which landscape developments exert sufficient pressure on a regime to force a 'window of opportunity' for a sufficiently developed niche-innovation to 'break through' and develop into a new, more sustainable, socio-technical system (Geels, 2004). These studies often relate to the energy domain (which explains lemmas like like *energy sources, gas, heat, nuclear, biomass electricity, microgeneration, low-carbon, decentralize, smart-grids, electricity system, CO2, power, greenhouse, emission, climate change)* and focus on the relation between a sustainable innovation developed in a niche (e.g. smart grid) and a regime that acts as a barrier (e.g. electricity system). Regarding our research interest of users, we find relatively few characteristic lemmas. A possible reason for this is that the level of analysis, which in MLP studies is usually integral systems. In general, the concept of 'use' is crucial to the 'socio-technical systems' definition (see: figure 1), but discussions of user involvement concentrate on the niche level (Shove, 2003). These therefore form a specific cluster of elementary contexts (theme 3).

Theme 2: stakeholder

The second-largest theme (374/1700 contexts) is characterized by lemmas like *stakeholder, multi-stakeholder, local, citizen, practitioner, deliberative, decision-making, constructive technology assessment, participatory technology assessment, future, vision, implementation, participatory processes, public participation, social learning, co-operative governance.* These concepts show that this theme is closely related to two forms of technology assessment: constructive (CTA) and participatory (PTA). Both forms attempt to move beyond 'regular' technology assessment by being more inclusive: CTA is a method for addressing social issues around an innovation by influencing its design practices through *feeding back* assessment results into the actual technology construction process

(an avenue for users to co-shape technologies), while PTA is a form of technology assessment that includes a variety of social actors as assessors: intermediary organizations, experts, stakeholders (e.g. prospective users or others impacted by some decision), and other citizens. PTA methods include scenario workshops, visioning exercises etc. and are aimed at achieving consensus. Here, the user is a *stakeholder or citizen*: someone who is a prospective user, or otherwise affected by, and should 'get a say' in, some technology-relation decision.

Theme 3: user

Given that *user** was a search term for obtaining the dataset, one might expect user to be a theme. This is not self-evident, however: if the word user would be ubiquitous and user relatively homogeneously throughout the dataset, it would not be characteristic of any particular cluster of sentences. It clearly is, however, which indicates that the word 'user' occurs in a relatively specific context (much like the word 'citizen', which is strongly tied to theme 2). Interpreting the cluster's characteristic lemmas leads us to distinguish two main literatures that use the word user:

- Characteristic like *role of users, innovation processes, mediator, technology commercialization, design-driven innovation, hype cycle, technology transfer, uptake, firms, innovation studies* indicate strands of academic thought in innovation studies that analyse the role of users in the innovation process. Sometimes referred to as 'democratization of innovation', these studies show that innovation users can do more than simply buy: they can also (co)produce innovation (e.g. Von Hippel, 1986). Here, users are mostly seen as a source of *ideas* that lead to technological (product) innovations, which are then commercialized by firms.
- The user theme is also characterized by lemmas like *strategic niche management, successful, sustainability research, socio-technical systems, socio-technical regimes, articulate, expectation, actor.* These are indicative of strategic niche management (SNM). SNM is a method for increasing the chance of success for socio-technical system innovations: it revolves around nurturing sustainable innovations in protected spaces until such time as they are ready to replace incumbent socio-technical regimes (Kemp *et al,* 1998, Raven and Geels, 2010). Three elements are key for this: the formation of broad and heterogeneous networks of actors, the articulation of shared and specific expectations, and the presence of social and second-loop learning. Users are integral to all three processes: they should be included in the actor network; their expectations should be taken on board; and learning should be focused not only on technical lessons but also user requirements. Here, then, users have a more direct influence on sustainable innovation, but the initiative in SNM studies typically lies with other actors.

Theme 4: methodology

T-LAB identified a cluster of elementary contexts which it labelled 'methodology'

and which is characterized by lemmas like *research, paper, empirical, study, interview, data, analysis, literature, report, survey, source, finding, conceptual framework* etc*.* It makes sense for this to emerge as a theme in a dataset composed of abstracts of scientific articles: one would *expect* it to identify something so common as the methodological statement. So, while this result is not specifically of interest for answering our research question, it does speak to the validity of the T-LAB method for finding themes within documents and increases confidence that the other themes identified by this method are meaningful, as well.

Theme 5: practice

Lemmas characteristic of the cluster of elementary contexts labelled 'practice'[10] are: *sustainable consumption, green consumerism, consumer behaviour, consumption practices, consumption patterns, discourse, taste, lifestyle, culture, legitimacy, practice theory, practice-based, citizenship, critical, domestication.* Such concepts are closely related to the field of Science, Technology and Society studies (STS) which concerns itself with questions of how society, culture and politics political shape technological innovation and vice versa. The inclusion of STS contributions in our dataset is neither false nor surprising: STS in general (and ideas about the social construction of technology (Bijker *et al.,* 1987) and large technical systems (Hughes, 1987) in particular) is one of the founding disciplines for the field of transition studies. But more importantly, technology domestication and social practice theorists have productively engaged with the transitions field by providing constructive critiques, and signs of synthesis between these fields and the transitions field are visible in e.g. contributions that hypothesize how user involvement plays out at socio-technical regime and landscape levels (e.g. Shove, 2003).

'Social practices' refer to 'everyday activities' (e.g. showering, cooking, commuting, doing the laundry) and how these are performed similarly by groups of people in society (i.e. the 'social' part of social practice). Social practices are seen as a nexus of lifestyles, tastes, skills, physical activities, cognitive processes, technologies etc. Social practice *theory,* then, is concerned with the mechanisms and dynamics of the rise and fall of social practices. In relation to sustainable innovations, it examines how users configure and appropriate these. Clearly, users are the main level of analysis here: in fact, social practice theorists have criticized transition studies for its emphasis on systems and their structure rather than users and their agency in relation to sustainable innovation (Shove and Walker, 2007). Characteristic words for this context cluster also include *niche, SNM, learning processes,* and *actor-network,* which we propose is because it is framed as the main 'rival theory' that social practice theory criticizes as a point-of-entry into the field.

Theme 6: vehicle

While the empirical distinctions that determined the document classification in section 3.1 largely fall away when analysing the texts on the level of sentences,

it is retained for this cluster of contexts. Characteristic lemmas like *vehicle, fuel* and *(internal combustion) engine, electric vehicles, fuel cell* make it clear that mobility is a central theme in our dataset. Yet more important than the empirical domain are lemmas like *market, niche markets, diffusion, adoption, early adopters, consumer, consumer preference, customer, choice, supplier, supply chains, industry, purchase, price, investment* and *budget* that indicate that this these is close to traditional innovation studies and Schumpeterian neo-classical economics: here, it's about actors who make rational purchase decisions. The word *market* (the highest non-mobility χ^2 value lemma) would perhaps have been a better label. The word *user* doesn't even occur as a characteristic lemma in this cluster, while the word *consumer* is central. The theme also connects to innovation diffusion research: a model of at what rate innovations are adopted based on a classification of consumers as either early adopters, early majority, late majority or laggards (e.g. Rogers, 2003). Words like *agent-based, model, dynamic,* and *simulation* also point to agent-based modelling contributions that seek to simulate (re-create and predict) the actions of individual agents.

In either case, 'users' are consumers with a largely passive role in the innovation process, shaping technological trajectories only via the feedback their purchase decisions provide. Given the complexity of the innovations studied in relation to sustainable mobility (electric vehicles, fuel cells etc.), it seems evident that the most pressing user-related question is 'how can we make them buy this?'. Yet, many insights could be gained from studying electric mobility from e.g. a social practice perspective, and electric mobility even was a foundational case study for the strategic niche management perspective (Hoogma *et al.,* 2002). Unfortunately, neither types of contribution are represented in the dataset (in the latter case because it is in the form of a book) and as such, do not appear in this thematic cluster.

Spatially, the clusters relate to each other as visualised in figure 7. Again, the factorial axes and the clusters' positions are calculated by T-LAB: our task is 'merely' to interpret them. We do so as follows:

- The x-axis strongly juxtaposes the stakeholder theme with the transition theme. We interpret the x-axis as a difference in the level of analysis: actors versus systems. While the underlying 'stakeholder' abstracts focus on actors and are concerned with realizing inclusion and consensus, the 'transition' abstracts focus on systems and are concerned with realizing sustainability transitions.
- The y-axis strongly juxtaposes the vehicle theme with the practice theme. We interpret the Y-axis as difference in the analytical focus: consumers versus users. While the market-oriented approaches analyse sustainable innovation from the perspective of peoples' purchase decisions, the social practice contributions analyse it from the perspective of their practices: *how/why users purchase sustainable innovations versus how/why they integrate them into their daily lives.*
- The z-axis roughly clusters the stakeholder and transition themes on one end

with the practice and vehicle themes on the other. This is interesting, as both stakeholder strongly contrasted with transition (x-axis) and practice with vehicle (y-axis). So what binds them together here in contrast with the other? We interpret the z-axis as a difference in interest in the involvement of users in sustainable innovation processes: high versus low. In both the stakeholder and transition themes, user involvement is crucial, even though its aims and the level on which it is analysed differ. On the other hand, neither the technology-in-the-market focussed vehicle theme nor the technology-in-use focused practice theme are very interested in user involvement: in traditional conceptualizations of the innovation process, 'projected' or 'simulated' (modelled) users are considered sufficient, whereas social practice theory flat out questions the assumption that greater user involvement results in more sustainable innovation (Shove, 2003).

- The fourth factorial axis (obviously not represented in Figure 5) differentiates between the methodology theme on one end, and all the rest on the other, which we interpret as a dichotomy between the methodology section of the abstracts and the rest of their content: an indicator that the factorial axes indeed correspond to real-world phenomena.

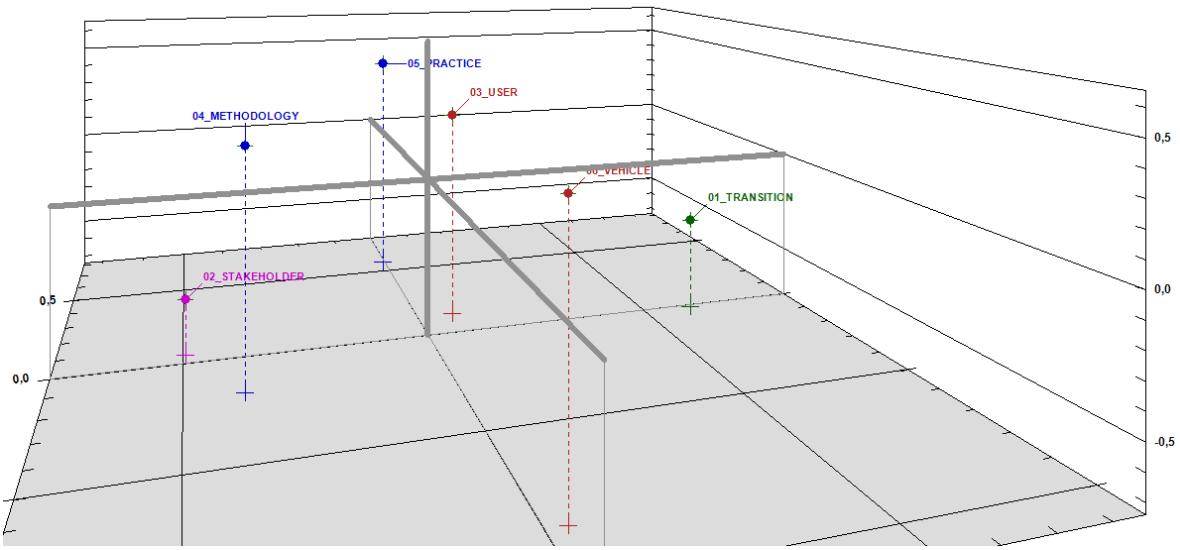

Figure 5. Spatial relations between six thematic clusters (source: T-LAB).

3.3 Top-down contexts of search terms

The kind of bottom-up (unsupervised) thematic analysis of our dataset that we performed in section 3.2 inevitably uncovers themes other than our core research interest in users, consumers and citizens. Although we did relate each emergent thematic cluster to the user theme (in ways that we have set out in section 3.2), we have also analysed our dataset in a more top-down (supervised) fashion, guided by our research interest, using the three tools described in section 2.2 (ad 3).

Concordances

Using T-LAB, we extracted a list of all sentences in *which user, consumer, citizen appear*, and then manually compiled, as Wyatt (2014) suggests, *"a list of adjectives describing use and users"* as well as *"nouns for which user can be used as an adjective*" and extend this list to include *consumer* and *user.* The results appear in Appendix II. Examining this list, we make the following observations:

- 'User' is clearly a very heterogeneous term and drawing lines between users and producers can be arbitrary: users of one thing can be producers of another. As Rohracher (2005) argues, users don't have to be individuals: they can also be firms. A firm can be a producer of a service, but a user of a product and as such can be considered a 'user-innovator' when it feeds back to producers. This conflation leads to terms like *proximate, distal, immediate* and *end user.*
- For 'users', many adjectives describe a broad range of 'things' that are used, e.g. resources, energy, water, information, knowledge, services, vehicles. For consumers, this is tied strongly to the mobility domain in our dataset, with consumption of e.g. energy, diesel, fuel and transport.
- There are several mentions of 'collectives' for all three words, indicating that users, consumers and citizens are not only relevant on the individual level, *e.g. user-, consumer- and citizen groups, user- and consumer organizations, user communities, user associations, web of consumers, citizen forums-* and *panels.* In addition, organizations and firms composed of multiple actors are sometimes considered individual users.
- Many adjectives describe individual characteristics: we see e.g. *inexperienced, low-income, professional, specialist, non-specialist* users, *green, low-income, mainstream, rational, working-class* consumers, and *affected, (environmentally) concerned, engaged, demanding, non-expert, responsible* citizens.
- Citizen is, even by definition, a wider category than user or consumer. In this context, it involves not only those who use or purchase a sustainable innovation, but also those who are otherwise affected by it.
- It is clearly considered important to somehow involve these people, as there are many instances of words like user-, consumer- and citizen *participation* and *engagement,* user- and consumer *input,* user- and citizen *involvement,* and citizen *deliberation.*
- Involving consumers mostly means studying them and measuring such characteristics using consumer *research, -studies, -psychology,* and *-interviews.* Citizens are more critically involved via citizen *conferences, -networks, -panels, -workshops* and *–juries.*
- Although *behavior* appears alongside user-, consumer- and citizen; *needs* alongside both user and citizen; and *expectations* and *practices* alongside both user and consumer, such characteristics are mostly used in relation to consumers, with words like *–attitudes, -affinity, -awareness, -choice, -incentives, information insufficiency, motivations, perceptions, trust* and *values* appearing exclusively alongside the word consumer.

- Several adjectives describe *fictitious* users and consumers that don't exist yet: *anticipated users, prospective users, would-be users, future consumers.*
- Whereas consumers are mostly seen as adopters of innovations (e.g. consumer *adoption, -choice, -incentives, -willingness to pay*) and their influence on the innovation process is limited to consumer *input,* users can be sources of innovation, as well (e.g. *user-led innovation, user innovation).*
- Finally, words like *user resistance, consumer concerns, concerned citizen* indicate an interesting theme that we have so far not encountered in our analysis but will explore further in the next subsections.

Word associations

Though users, consumers and citizens have several things in common in this dataset (e.g. their collectivist nature as *groups*, and study of their attitudes and behaviour, and the importance of their *engagement* and *participation* for sustainable innovation), they are typically used in quite different contexts that, as we have shown, relate to different strands of academic thought on the innovation process. To investigate this further, we used T-LAB's word associations tool, which plots the co-occurrence of these words with other keywords in sentences. The results are plotted in figures 6, 7, and 8.

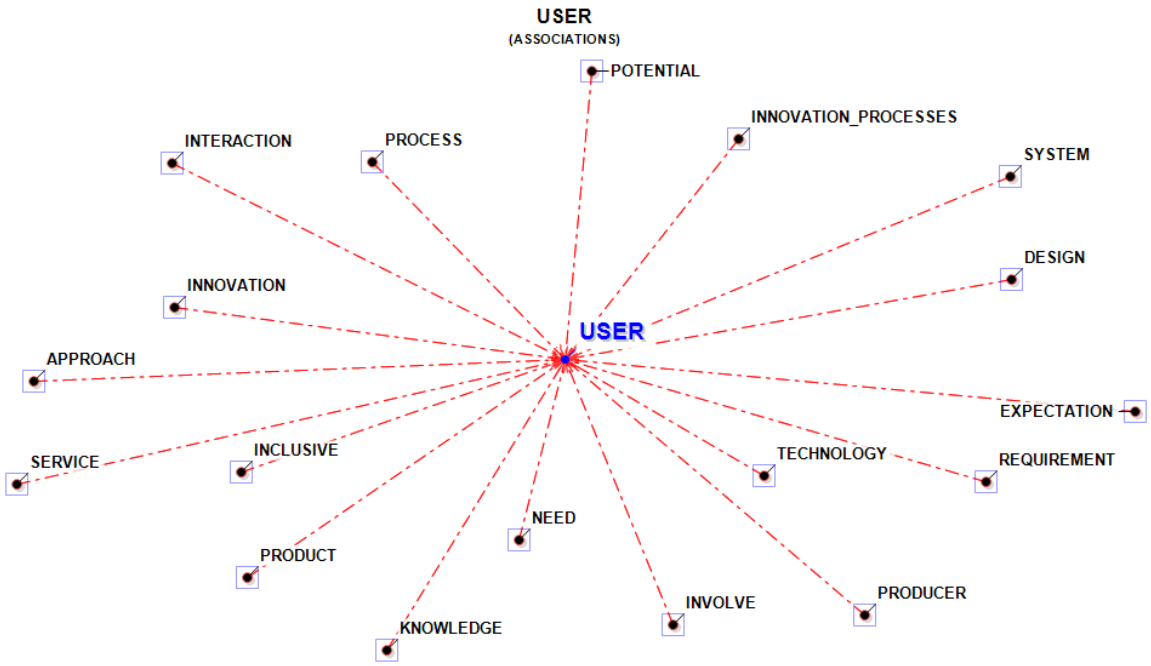

Figure 6. Radial diagram of 'user' associations (source: T-LAB)

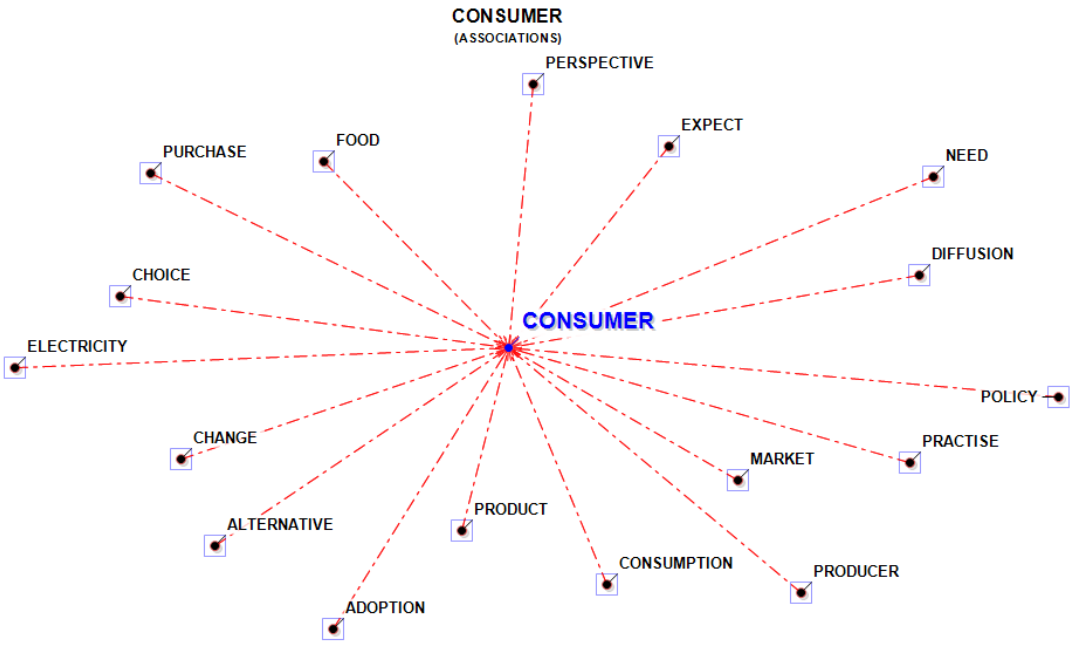

Figure 7. Radial diagram of 'consumer' associations (source: T-LAB)

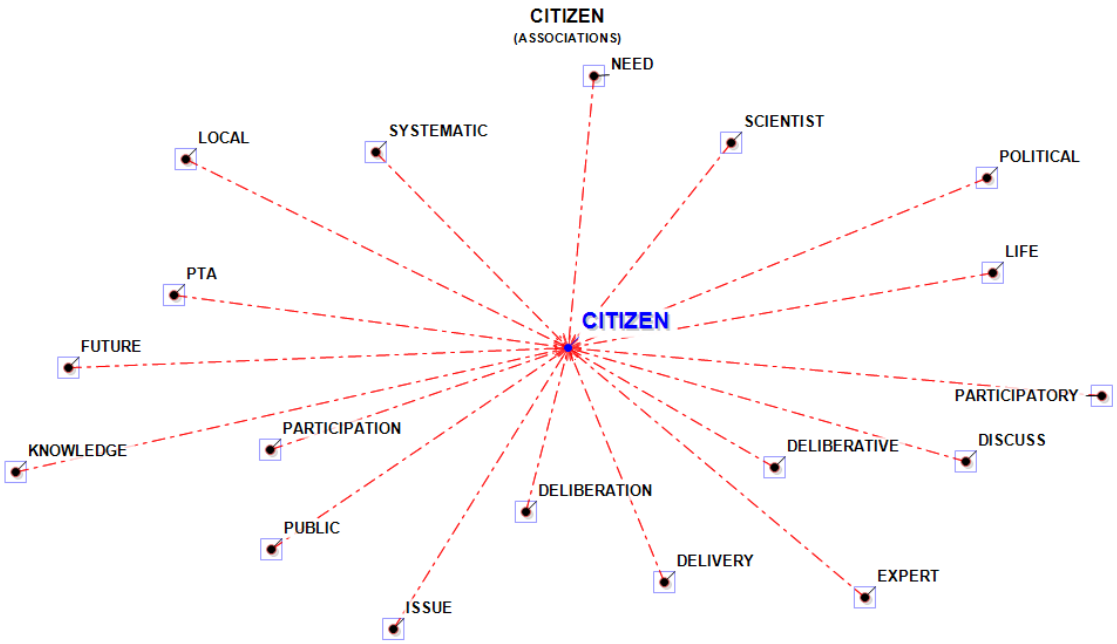

Figure 8. Radial diagram of 'citizen' associations (source: T-LAB)

Interestingly, *none* of the words frequently co-occur with any word relating to sustainability, and the words *technology* and *innovation* only frequently co-occur with 'user'. Additionally, both user and consumer frequently co-occur with *product,* but only *user* co-occurs with *system*. This indicates that papers in our dataset that explicitly discuss 'consumers' tend to deal with product- rather than system innovations, and that papers that deal with system innovation or transition tend to talk about 'users' instead of 'consumers'. Nevertheless, both frequently co-occur the word *producer,* implying that 'user-producer' as well as 'consumer-producer' dichotomies are common.

Frequent co-occurrence of *consumer* in sentences with *market, purchase, choice* and *adoption, diffusion* further corroborate our ideas about the term 'consumer' being more tied to 'classical' innovation studies literature as well as social practice research (*practice).* Finally, *citizen*'s closeness to *deliberation, participation, expert, public* strengthens out impressions about its prevalence in participatory technology assessment literature.

In the following section, we aim at a deeper exploration of these keywords by extracting and analysing meaningful sections of text in which they appear.

Key contexts of thematic words

We extracted the elementary contexts (~sentences) in which *user, consumer* or *citizen* co-occur with one or more the words with which they are strongly associated (i.e. with the terms in figures 5,6 and 7), in order to increase the chance that the sentences found are relevant to our interest. User yielded 100 contexts, consumer yielded 100 as well, and citizen yielded 79. T-Lab sorts these by weighted (consine) descending order. We then *manually selected 15 that we, based on our own expertise and intepretation deemed to be representative from each* and grouped them into tables 6, 7 and 8. We discuss these below.

1	"The main institutional, technical, and economic challenges that need to be addressed during the ongoing socio-technical transition process are also explored. Improving the level of knowledge of these systems among **user**s would reduce the risk of social refusal of the new technology."
2	"In the process of radically transforming the electricity system, strategic system builders need to align many forces, including consumers, who play an important role in the functioning of such large networked systems. System builders need to explore, for instance, whether and how **user**s can be motivated to be flexible in relation to moving electricity consumption over time."
3	"over time, the socio-technical configurations of the energy system became very durable as existing technologies become embedded in regulatory frameworks, infrastructure, **user**s practices and expert communities."
4	"This transformation is conceptualised as a regime shift: a change in the rule set that underpins technical change, guiding innovative activity and output into particular directions. Examples of such rules are technical standards, product standards, **user** requirements, design rules and organisational rules of how to produce, what to produce."
5	"Transition management helps various actors to be more engaged with long-term change, but that a process of re-institutionalisation is needed to make serious progress to systems of mobility which combine **user** benefits with societal benefits."
6	"Within the Dutch transition policy framework, the transition to hydrogen-based transport is seen as a promising option towards a sustainable transport system. One aspect of such transition processes that is emphasized in Transition management is learning about **user** behaviour and preferences."
7	"In an evaluation with ten criteria that measure a scenario's performance from a **user** perspective, the radical scenario performs worst since it does not meet current individualistic **user** requirements. Our findings suggest that lock-ins of **user**s' expectations act as barriers for the diffusion of novel transportation systems."
8	"Wood-burning stove **user**s enjoy a decentralized and also more tangible and visible form of heating supply, one that is not part of wider energy supply systems. Moreover, stove **user**s alter infrastructural conditions in order to pursue personal strategies for domestic heating and comfort"
9	"**User**s in these case studies were involved in the design or planning processes, sometimes in a very selective way and with limited influence, sometimes very active and for quite a long period of time. Especially in the case of renewable energy technologies self-building groups were highly successful and resulted in improved and widely disseminated technologies."

10	"using eco-impact class as the first axis, and the (conventional) innovativeness criteria - as judged by the experts - as the second axis, we develop an eco impact-innovativeness grid. It illustrates that a vast majority of **user** submissions falls into the classes incremental innovation and radical conventional innovation."
11	"Producers have knowledge about technical solutions and **user**s about their needs, the context of use, and their own capabilities as **user**s. Both sets of knowledge are characterized by "stickiness'': They move relatively freely within their own domain but are difficult to transfer outside of it."
12	"An improvement of these interactions and learning processes could have a high potential to better adapt technologies to the needs and practices of diverse groups of **user**s."
13	"Experts have agreed that suppliers of solar PV system must customize their flexible characteristics to address local unique **user**s' and applications requirements and compete on price/performance basis."
14	"It is often supposed that greater **user** involvement will result in more sustainable, more socially inclusive designs and technologies. I take issue with this proposition on the grounds that it fails to acknowledge the prior structuring of **user**s' expectations or the socio-technical regimes and landscapes in which specific innovations take root."
15	"In this paper we will pose the question whether a higher level of **user** participation could be used as a strategy to improve the development and dissemination of sustainable energy technologies. We will especially focus on **user**-led innovation processes with a high involvement of individual end-**user**s."

Table 6. Selection of meaningful contexts for 'user'.

Quotes 1-6 clearly relate explicitly to transitions, and they are quite revealing about how users are conceptualized in these 'core' contributions (i.e. ones that are close to the fields 4 main paradigms). Quote 1 clearly argues for a knowledge deficit model: if only users would be more knowledgeable, they would not resist innovations. This links it to quote 7, which argues that user expectations might constitute 'barriers' to transition. Similarly, quotes 3 and 4 mention 'user requirements' and 'user practices' as elements that stabilize regimes and resist change. Quote 2 therefor argues that for a transition to occur, users need to be motivated into new behaviours in order to 'align' them with other 'forces'. Quotes 5 and 6 relate to transition management: quote 5 argues that for sustainability transitions to occur, user benefits should coincide with societal benefets. As such, quote 6 states that is key to learn about user behaviour and preferences. Quotes 8 and 9 are examples of users being the source of innovation rather than its adopters, but quote 10 qualifies this by arguing that these are usually more incremental innovations than the radical, disruptive ones that are assumed to be required for successful sustainability transitions. In quotes 11–13, users are not innovators themselves, but rather contribute to better sustainable technologies through producers' increased understanding of their needs. However, quotes 14-15 respectively question and explore the validity of the underlying assumption that this works.

1	"The study indicates that an enacting mode of environmental interpretation may be superior to a discovering mode, and suggests that for companies having a discovering mode there may be a need to complement existing engineering practice with insights into **consumer** psychology, and bundling of common good versus private good product attributes."
2	"A probabilistic Monte Carlo simulation model is used to assess **consumer** heterogeneity for early and mass market adopters. For early adopters full battery electric vehicles (BEVs) are competitive but unable to surpass diesels or hybrids due to purchase price premium and lack of charging availability."
3	"Research findings are presented from a survey of customers of a local organic food cooperative in Norfolk, UK which examines **consumer** motivations and perceptions of alternative and mainstream food provisioning."

4	"We investigated **consumer** preferences for these technologies as well as the effects of attributes such as installation cost, energy price, energy efficiency, and perception on **consumer**s' choices. Considering these effects, we developed a model that estimates the diffusion of these technologies into the residential sector of Japan through 2025 and the resulting CO2 emission reduction."
5	"this perspective first demonstrates that information insufficiency (the gap between **consumer**s' need for information and their perceived knowledge) is a good predictor of information-seeking behavior, specifically in the case of biofuels. Secondly, it shows that women, older, and less educated people report higher levels of information insufficiency."
6	"By drawing on theory of innovation adoption and theory of reasoned action we show that **consumer**s' perceptions of AFV attributes lead to a general attitude formation towards AFV. In conjunction with **consumer**s' subjective and personal norm, this in turn determines AFV adoption behavior."
7	"Government policies that seek to manage or control consumption, or persuade **consumer**s to change their behaviour, are important but unlikely to be sufficient to bring about Sustainable consumption."
8	"The existence of habits - not fully conscious forms of behavior - is important as it contradicts rational choice theory. Their presence thus calls for the setting of new instruments as it is difficult to expect **consumer**s to be capable of exercising control over their consumption of energy in reaction to given incentives. (…) This is further increased in the evolutionary perspective where the current carbon-based socio-technical system constrains and shapes **consumer**s' choices through structural forces.""
9	"An axiom that has shaped policy approaches to Sustainable consumption has been that if more **consumer**s understand the environmental consequences of their consumption patterns, through their market choices they would inevitably put pressure on retailers and manufacturers to move towards sustainable production."
10	"The result is the proliferation of consumption of "green "products, eco-labels, **consumer** awareness campaigns, etc. This paper, however, argues that the dominant focus on green **consumer**ism as against the need for structural changes towards a broader systemic shift is unrealistic."
11	"promoting green **consumer**ism at once lays responsibility on **consumer**s to undertake the function of maintaining economic growth while simultaneously, even if contradictorily, bearing the burden to drive the system towards sustainability."
12	"Prospects for future innovation to reduce the carbon intensity of everyday **consumer** products rest significantly on the path dependent processes that have caused current products with their associated modes of provision and practices of consumption to be as they are."
13	"Discussions will include the balance between routinization and reflectivity as well as ways to understand the role of new technology in introducing change in **consumer** practices."
14	"it focuses on the experience of the solidarity-based purchasing groups, **consumer**s' organisations promoted by groups of citizens aiming at getting control of the food they consume. Using an actor-network perspective, the article analyses how purchasing and consumption routines change when **consumer**s join these initiatives."
15	"In discussions on smart grids, it is often stated that residential end-users will play a more active role in the management of electric power Supply and demand. They are expected to shift from a passive role as **consumer** of electricity to an active role as co-provider. (…) There appears to be a lack of product and service design that supports end-users in their role as co-providers in a smart grid. This is reflected in the lack of thought given to how the end-users' process of behavioral change can be supported to enable the transition from **consumer** to co-provider."

Table 7. Selection of meaningful contexts for 'consumer'.

Quotes 1-8 all relate to the study of consumer characteristics such as their psychology, heterogeneity, motivations, perceptions, preferences, choices, norms, needs, knowledge, and behaviours. Several (e.g. quotes 2,3,4) use quantitative techniques such as probabilistic modelling and surveys to measure or simulate these. The outcomes are used for different purposes: e.g. in quote 1 for creating better sustainable innovations, and in quotes 2, 4 and 6 to predict or influence the diffusion of sustainable innovations. Conversely, quotes 7 and 8 are rather more pessimistic about the possibility of influencing consumer behaviour

in the direction of sustainability. Quotes 9-10-11 (actually 3 elementary contexts from the same abstract) even refer to such attempts as consumer scapegoatism: it should not be consumers' responsibility to maintain growth through buying *and* realize a sustainable society. Quotes 12-13 clearly adopt the social practice theory perspective on the relation between consumers and sustainable innovations, while quotes 14-15 respectively discuss the influence of consumer collectives, and the shift from passive consumer roles to more active, co-producing ones.

1	"Transition processes towards more sustainable socio-technical energy, transport or production systems, however, are hardly imaginable without a broader participation of engaged **citizen**s. This paper presents and compares three cases of successful Grassroots innovations for sustainability."
2	"Opening closed urban planning processes and using open innovation tools can foster bottom-up urban energy system transformation by addressing the interactive ways of decision-making integrating company representatives and **citizen**s."
3	"We conclude with three remarks about the importance of **citizen** participation for understanding local conditions for change, processes of localized internationalization, and new roles for nation states facing the climate change challenge. "
4	"it considers the relevance of CTA to the achievement of more democratic decision-making about technology. in addition, the paper directs attention towards differences in participants' discursive capacities and rhetorical skills that may affect the role and contribution of non-expert **citizen**s in technology assessment."
5	"**Citizen**s' conferences as a form of participatory technology assessment (pTA) are said to increase democratic legitimacy, take up lay knowledge and improve technological solutions. Today it is part of science and technology policy rhetoric and, sometimes, practice.
6	"Two different methods - expert focus groups and **citizen** deliberative workshops - were employed to elicit knowledge and preferences of European stake-holders in respect of sustainable mobility. Findings from these exercises indicate areas of both convergence and divergence in the visions of sustainable mobility futures depicted by different stakeholder groups."
7	"This study focuses on the **citizen** fora and describes an assessment of effectiveness based on an evaluation framework developed on the basis of concepts from constructive technology assessment and deliberative democracy."
8	"The paper contributes to more effective pTA by proposing a new 'guiding vision' for **citizen** deliberations, anticipating more influential policy pathways and proposing new skills for pTA."
9	"The tone of Imagine is to empower **citizen**s to own their own sustainability and to plan for sustainable futures. The method, developed for spatial and temporal sustainability assessment, has been trialled by countries in the Mediterranean region within Coastal Area Management Programmes"
10	"The approach allows **citizen**s to learn about and self-evaluate their own sustainability by developing their own sustainability indicators in a manner which is participatory and evidence based."
11	"We conclude, among others, that **citizen** involvement can, under specific socio-political and institutional conditions, build trust among stakeholders and increase local legitimacy for interventions by government agencies."
12	"Stakeholder feedback suggests the process was valuable and acted as a forum for social learning and the co-production of knowledge by **citizen**s and experts, while at the same time empowering these groups to participate in an important social issue such as transport."
13	"It provides additional evidence that, given a structured, constructive environment for deliberation, and access to information and expertise, lay **citizen**s can and do produce policy-relevant recommendations in highly technical arenas."
14	"Despite welcoming rhetoric and increased practice of **citizen** participation in S&T governance, there is little evidence of the political impact of such processes."
15	"New social movement organisations in the Netherlands, which aim at accelerating the Dutch energy transition through assisting (local) **citizen**s' initiatives, claim to be part of a new type of environmental movement."

Table 8. Selection of meaningful contexts for 'citizen'.

Virtually all quotes are about citizen involvement. Its purposes vary: political and policy

impact, self-empowerment, building stakeholder trust, increasing democratic legitimacy, and improving decision-making processes. Quotes 1-3 argue how important citizen involvement is especially for sustainable system innovation. We found that many of the abstracts related to frameworks and methods for citizen involvement: either using, testing or improving extant ones such as CTA and PTA (e.g. quotes 4,5,8) or developing new ones (quotes 9,10). Tools include citizen workshops, conferences, fora, and deliberations. Quotes 11-13 attest to how valuable such methods are for building stakeholder trust, increasing legitimacy for policy interventions, empowering citizens, and improving the quality of policy recommendations. However, quote 14 questions the efficacy, arguing that there is little evidence of its political impact.

5. Conclusion & discussion

We argued that despite the widely recognized importance of users, consumers and citizens in sustainability transitions, transition studies offer highly fragmented perspectives that make it difficult to discern the various types and which roles they are argued to have in sustainable innovation. This paper first aim therefore was to clarify how users, consumers and citizens have been conceptualized in transition studies literature. We believe we have succeeded in this goal. Figures 6-8 and tables 6-8 provide a basis for interpreting the different types. Though users, consumers and citizens are discussed as having similar features (e.g. their collectivist nature as *groups*); are studied for their attitudes and behaviour; and their engagement is argued to be important for the success of sustainable innovations; they are typically used in quite different contexts.

Appendix I gives an exhaustive list of the types of users, citizens and consumers discussed in our dataset. Especially 'user' is used in very diverse ways that, as we have shown, relate to various strands academic thought. We have summarized these in Table 9. It should be noted that Table 9 does not *exclusively* contain terms that are also found in Appendix I (and therefor our dataset): we have arrived at Table X by expanding the scope of our review somewhat (e.g. Appendix 1 contains the word 'user resistance' which put us on the trail of what in Wyatt *et al.* (2002) is called 'resisting' but also 'rejecting', 'excluced' and 'expelled' users).

	type	~synonyms	~definition	field	main use	text(s)
IMAGINED USERS	projected user	*(socially) constructed user*	Users as imagined by designers, to whom they assign "specific tastes, competences, motives, aspirations, political prejudices" (Akrich, 1992)	*ANT, STS, cultural studies, gender studies*	Used by producers as a proxy for real user involvement. Designers subsequently 'inscribe' innovations with these socially constructed needs of users.	*Akrich (1992)*
	represented user	*mediated user*	Imagined users "brought into the process [of articulation and negotiation of projected users] by mediators who often claim to represent specific users" (Schot and Albert de la Bruheze, 2003)	*history of technology, STS*	Used to emphasize/research the 'mediation process' of aligning real use with constructed needs ('projected users') and mediated interests ('represented users').	*Schot and Albert de la Bruheze (2003)*
	anticipated user	*future-, potential user*	Aggregated consumer and consumption projections	*engineering, marketing, business*	Generic concept, used e.g. by producers to estimate market potential and/or mobilize resources	*N/A*
NON-USERS	resisting user	*voluntary non-user*	People who don't use "because they do not want to" (Wyatt et al, 2002)	*STS, computer science, social movement studies*	Used to move beyond knowledge deficit model ('if users understand, they will accept'); argue for taking resistance seriously in design- and policy processes.	*Wyatt et al. (2002), Benford & Snow (2000)*
	rejecting user	*voluntary former user*	Former users who "stopped voluntarily, perhaps because they find it boring or expensive, or because they have perfectly adequate alternative sources" (Wyatt et al. 2002)	*STS, computer science*	Used to emphasize that rejection of innovation is more than simple the negation of acceptance, and may be entirely rational	*Wyatt et al. (2002)*
	excluded user	*involuntary non-user*	People who don't use because "they cannot get access for a variety of reasons; and can thus be considered as socially and technically 'excluded'." (Wyatt et al. 2002)	*STS, computer science*	Used to highlight involuntary non-use implications for social justice issues	*Wyatt et al. (2002)*
	expelled user	*involuntary former user*	Former users who "(…) have stopped using it involuntarily either because of cost or because of the loss of institutional access". (Wyatt et al. 2002)	*STS, computer science*	Used to highlight involuntary discontinuation implications for social justice issues	*Wyatt et al. (2002)*
ACTUAL USERS	lay- vs. professional user	*naive-, amateur-, novice-, (non)specialist-, (in)experienced user*	Users "(…)who have not gone through the training or socialisation into the particular profession (...) which we refer to as the index profession" (Hogg and Williamson, 2001) versus those who have.	*computer science, engineering, medicine, user-centered design*	Used to distinguish between users based on their knowledge/skills	*Grudin (1990), Gundry et al. (1999), Chau & Hu (2001)*
	end- vs. immediate users	*final-, distal- vs. proximate user*	Users for whom a product or service is ultimately designed, versus other users in the use chain who make end use possible.	*computer science, engineering, medicine, user-centered design*	Used to indicate user position in a chain of service or product use relative to its producer (end user being by far the more often-used).	*Doll & Torkzadeh, (1988), Franke & Shah (2003)*
	configured user	*co-constructed user*	Users who are locked into certain practices and behaviours by the technologies they use	*ANT, STS*	Used to highlight that technologies configure their actual users: lock them into certain practices by having been 'inscribed' by their designers with visions of future users	*Woolgar (1992)*
	configuring user	*domesticating, appropriating user*	Users who are attempting to 'fit' innovations into their daily lives and practices	*social practice theory, STS*	Used to highlight that, while users are configured by the technologies they use, they also have agency in configuring these technologies in return (especially used for domestic technologies)	*Shove (2003)*
	lead user	*user-innovator*	Competent and resourceful users who face future general needs before the rest of the market does, and stand to benefit significantly from a solution to these needs	*economics, innovation studies*	Used to describe the user as a source of novelty	*Von Hippel (1986)*
	enthusiast, visionary, pragmatist, conservative,sceptic user	*Innovator, early adopter, early majority, late majority, laggard*	User categories based on how soon innovations are adopted compared to peers	*innovation diffusion theory, marketing, business*	Used to describe and explain the process of diffusion of innovations over time	*Rogers (2003)*

Table 9. User types and associated literatures.

Whereas Table 9 provides insights into the various *types* of users, this does not yet speak to their *roles* in sustainability transitions. Again, it is the heterogeneity of frameworks and theories in the field of transition studies (taken broadly) that renders it almost impossible to come to some over-arching, integrative statement about the mechanisms and dynamics over user, consumer and citizen involvement. That said, our second goal was less ambitious that that: we set out to synthesize a typology of user, consumer and citizen roles. The (partly) automated content analysis tools offered by T-LAB have been of great assistance here in uncovering 'hidden dimensions' (i.e. factorial axes) and 'themes' (i.e. clusters of abstracts or sentences characterized by frequently co-occurring keywords) underlying the abstracts in our dataset. Synthesizing these insights leads us to construct a typology based on two dimensions (figure 9).

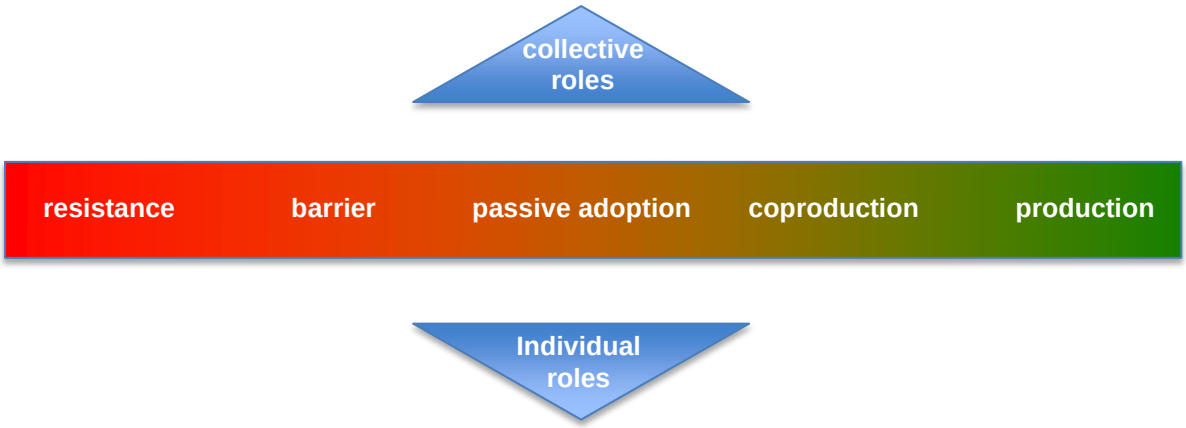

Figure 9. User roles in sustainability transtions.

The first dimension is a spectrum of user, consumer and citizen behaviours in relation to sustainable innovation. It is adapted from X-axis in of figure 4, which distinguished between passive consumers on one end to users and active (co)producers on the other. From one extreme to the other, this spectrum includes roles such as:

- active resistance by citizens to a sustainable innovation;
- less active forms of resistance in the form of barriers due to user/consumer preferences and practices;
- passive adopter roles (e.g. consumers as buyers);
- users as sustainable co-producers (e.g. through smart grids);
- user-led sustainable innovation

The second is not a dimension but rather the dichotomy between individual and collective roles that we flagged earlier as a key theme emerging from the concordance, word association and key contexts:

- Individual roles can range from 'Not In My Back Yard' (NIMBY) sentiments and actions, to the 'classic' role of users as consumers: those who simply buy your products (or not). Personality characteristics, such early adopters, early

majority, late majority and laggards, can result in adoption or non-adoption (whereby *non*-users roles, such as resistors, rejecters, excluded and expelled individuals (Wyatt, 2014) are also important. Another interesting individual role is that of the 'socially constructed' or 'projected user': a fictitious individual user whose supposed needs producers target, and the 'configured user': a user who is 'trained' in his/her interaction with an innovation by the 'script' in the technology itself. Moving towards the right in the spectrum, we find more active roles for users in sustainable innovation, e.g. users as co-producers: 'user innovation' wherein 'lead users' are a key source of ideas that lead to innovations (which are then marketed by firms). More active roles still are e.g. individual households as small decentralized renewable energy producers (grid-connected solar PV) or 'user entrepreneurs' who convert sustainable solutions to a problem they experience into a business.

- Conversely, collective roles all somehow use 'the power of the group'. Barrier-like collective roles can range from large-scale social movements actively resisting innovations through organized protests and political pressure (e.g. nuclear power (Geels and Verhees, 2011)) to more passive collective barriers such as consumer practices and values. Moving towards the right, we would 'represented users' (spoken for by organizations that claim to represent user groups: collectives that mediate between real users and producers). Further right still, we might find concepts like 'collaborative consumption' (examples are co-housing, car sharing etc.), 'cloud-based' and 'peer-to-peer' business models in the IT domain, and 'collective buying power'-based business model: autonomous associations of users who cooperate for mutual benefit (e.g. collective purchasing of PV panels to bring down prices in spite of absence of government subsidies). Even more active collective roles include 'crowd funding' (wherein collective users are a source of capital for technological innovations: these collective user investors thus influence the innovation process in a much more active way than simply buying innovations), and 'cooperatives' (groups of users that do not own their own land/roofs but collectively rent plots / roof space and install relatively large capacities of collectively purchased turbines / PV modules and in doing so, effectively become small, collective energy producers). Finally, 'community innovation' is worth mentioning is this respect: groups of users collective users that act as initiators, designers and maintainers of technological projects in their own locality (e.g. street, neighbourhood, village), as well as 'grassroots innovation', in which social movement organizations (a form of collective users) actively produce sustainable innovations for such niche markets but, in doing so, expand beyond their locality and form the seeds of mainstream solutions.

Although our results show that by far most extant analyses these various roles on the level of individuals, we believe we have shown that on the collective level, different dynamics can be observed and different mechanisms operate.

Appendix I. Manually added multi-words (n=160).

auxiliary power units	energy services	local organic food	stakeholder involvement
broadband transition	energy sources	management strategies	strategic niche management
case studies	energy supply	management systems	supply and demand
case study	energy system	market penetration	sustainability research
change scenarios	energy systems	metropolitan Area	sustainability transitions
civil society	energy technologies	multi-level perspective	Sustainable consumption
clean energy programs	energy transitions	network-bound systems	sustainable development
climate change	environmental impacts	niche management	Sustainable Innovation
co-operative governance	environmental innovations	niche markets	sustainable mobility
conceptual framework	environmental management	novel technologies	sustainable production
consumer behaviour	everyday life	participatory processes	system innovation
consumer demand	FC APUs	participatory technology assessment	systems of innovation
consumer preferences	flood risk management	path creation	technical change
consumption patterns	floodplain management	planning process	technological change
consumption practices	food networks	planning processes	technological changes
crucial role	food system	policy implications	technological development
design elements	fossil fuels	policy measures	technological innovation
design-driven innovation	fuel cells	power units	technological innovation systems
developing countries	fuel poverty	practice theory	technological innovations
development projects	future research	product development	technological regimes
early adopters	gas emissions	product signs	Technological transitions
early phase	grassroots innovations	public participation	technology and society
economic growth	green consumerism	radical innovations	technology assessment
efficiency innovation	green electricity tariffs	renewable energy	Technology commercialization
egg production	green infrastructure	renewable energy technology	technology development
electric cars	greenhouse gas emissions	research agenda	technology development projects
electric vehicle adoption	heating systems	research and development	technology studies
electric vehicles	historical case study	research process	theoretical framework
electricity system	hype cycle	road infrastructure	transition management
electricity tariffs	hype cycles	role of users	transition pathways
emerging technologies	ICT innovation	scenario development	transition theory
empirical data	important role	science and technology	urban energy systems
empirical studies	increasing returns	smart grids	urban sustainability
empirical study	information insufficiency	social innovation	user involvement
energy conservation	innovation process	social learning	user practices
energy consumption	innovation processes	social sciences	value chain
energy efficiency	innovation studies	socio-technical regimes	vehicle technologies
energy efficiency innovation	Innovation Systems	socio-technical system	water management
energy policy	key actors	socio-technical systems	water policy
energy saving	learning processes	Sorsogon City	water sector

Appendix II. Table of *user, consumer, citizen* as adjectives and nouns

USER		**CONSUMER**		**CITIZEN**	
…USED AS ADJECTIVE	*ADJECTIVE DESCRIBING…*	*…USED AS ADJECTIVE*	*ADJECTIVE DESCRIBING…*	*…USED AS ADJECTIVE*	*ADJECTIVE DESCRIBING…*
acceptability	anticipated	willingness_to_pay	diesel	-consumer	affected
activities	configured	adoption	early	behaviour	demanding
associations	constructed	affinity	energy	capabilities	Dutch
behaviour	current	aspects	final	conferences	engaged
benefits	distal	attitudes	fuel	deliberation	enrolling
communities	domestic	awareness	future	discourses	environmentally concerned
engagement	end	behaviour	green	empowerment	individual
expecations	energy	choice	grid	engagement	local
experiences	future	concerns	household	forum	non-expert
groups	immediate	costs	individual	groups	responsible
habits	inexperienced	criteria	low-income	involvement	
(-led) innovation	information	culture	mainstream	jury	
input	knowledge	decision	muslim	needs	
interaction	local	dynamics	rational	networks	
interface	low-income	economies	transport	panels	
involvement	nonspecialist	engagement	web of -	participation	
needs	potential	expectations	working-class	science	
organizations	product	goods		views	
participation	professional	groups		workshops	
practice	prospective	heterogeneity			
profiles	proximate	incentives			
requirements	regular	influences			
research	resource	information insufficiency			
resistance	service	input			
responsibilities	specialist	integration			
rights	ultimate end	interviews			
routines	vehicle	markets			
submissions	water	motivations			
	would-be	organizations			
		participation			
		perceptions			
		perspective			
		population			
		practices			
		preference			
		privacy			
		psychology			
		recognition			
		research			
		response			
		studies			
		trends			
		trust			
		values			
		willines to pay			

References

Akrich, M. 1992. The De-Scription of Technical Objects. In W. Bijker and J. Law (Eds.) *Shaping Technology, Building Society: Studies in Sociotechnical Change*. Cambridge, Mass, MIT Press: 205-224.

Benford, R.D and Snow, D.A. 2000. 'Framing processes and social movements: An overview and assessment', *Annual Review of Sociology,* 26: 611-639.

Bergek, A., Jacobsson, S., Carlsson, B., Lindmark, S., Rickne, A., 2008. Analyzing the functional dynamics of technological innovation systems: a scheme of analysis. *Research Policy* 37, 407–429.

Bijker, W.E., Hughes, T.P., Pinch, T.J., 1987. *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology.* MIT Press, Cambridge/MA.

Biraghi, S., Gambetti, R. 2013. Corporate branding: Where are we? A systematic communication-based inquiry. *Journal of Marketing Communications*

Bogers, M., Afuah, A., Bastian, B., 2010. Users as Innovators: A Review, Critique, and Future Research Directions. *Journal of Management*, Vol. 36, No. 4.

Bruner, J. 1991. The Narrative Construction of Reality. *Critical Inquiry* 18(1), 1-21.

Chau, P.Y.K., Hu, P.J.H. 2001. Information technology acceptance by individual professionals: A model comparison approach. *Decision Sciences* 32 (4), 699-719

Doll, W., Torkzadeh, G. 2008. The Measurement of End-User Computing Satisfaction. *MIS Quarterly*, 12(2).

EBSE. 2007. *Guidelines for performing Systematic Literature Reviews in Software Engineering v 2.3.* EBSE technical report. EBSE 2007-01

Falagas, ME; Pitsouni, EI; Malietzis, GA; Pappas, G. 2008. Comparison of PubMed, Scopus, Web of Science, and Google Scholar: Strengths and weaknesses. *FASEB Journal* 22 (2): 338–42.

Franke, N., Shah, S. 2003. How communities support innovative activities: An exploration of assistance and sharing among end-users*. Research Policy* 32 (1): 157-178

Geels, F.W. 2004. From sectoral systems of innovation to socio-technical systems - Insights about dynamics and change from sociology and institutional theory. *Research policy*, 33(6-7) 897-920.

Geels, F.W. 2011. The multi-level perspective on sustainability transitions: Responses to seven criticisms. *Environmental Innovation and Societal Transitions*, 1(1), 24-40

Geels, F.W., 2002. Technological transitions as evolutionary reconfiguration

processes: a multi-level perspective and a case-study. *Research Policy* 31, 1257–1274.

Geels, F.W., Schot, J., 2007. 'Typology of sociotechnical transition pathways'. *Research Policy*, 36, 399–417.

Geels, F.W., Verhees, B. 2011. Cultural legitimacy and framing struggles in innovation journeys: a cultural-performative perspective and a case study of Dutch nuclear energy (1945-1986). *Technological Forecasting and Social Change*, 78(6), 910-930

Grin, J., Rotmans, J., Schot, J. 2010 (Eds.). *Transitions to sustainable development. New directions on the study of long term transformative change.* New York: Routledge.

Grudin, J. 1990. The Computer Reaches Out: The Historical Continuity of Interface Design Evolution and Practice in User Interface Engineering. *Proceedings of ACM CHI'90 Conference on Human Factors in Computing Systems*. 261-268.

Gundry, J. W., Comess, K. A., DeRook, F. A., Jorgenson, D., & Bardy, G. H. (1999). Comparison of naive sixth-grade children with trained professionals in the use of an automated external defibrillator. *Circulation, 100,* 1703-1707.

Hekkert, M., Suurs, R.A.A., Negro, S., Kuhlmann, S., Smits, R., 2007. Functions of innovation systems: a new approach for analysing technological change. *Technological Forecasting and Social Change* 74, 413–432.

Hogg, C., Williamson, C. 2001. Whose interests do lay people represent? Towards an understanding of the role of lay people as members of committees. *Health Expectations.* 4(1) 2-9 .

Hoogma, R., Kemp, R., Schot, J. 2002. *Experimenting for Sustainable Transport: The Approach of Strategic Niche Management.*

Hughes, T.P., 1987. The evolution of large technological systems. In: Bijker, W., Hughes, T.P., Pinch, T. (Eds.), *The Social Construction of Technological Systems*. Cambridge/MA, pp. 51–82.

Jacobsson, S., Johnson, A., 2000. The diffusion of renewable energy technology: an analytical framework and key issues for research. *Energy Policy* 28, 625–640.

Kemp, R., Schot, J., Hoogma, R., 1998. Regime shifts to sustainability through processes of niche formation: the approach of strategic niche management. *Technology Analysis & Strategic Management* 10, 175–195.

Kern, F., Smith, A., 2008. Restructuring energy systems for sustainability? Energy transition policy in the Netherlands. *Energy Policy* 36, 4093–4103.

King's College Library Services. 2014. *Systematic Reviews.* Last accesed 27/8/2014 on http://www.kcl.ac.uk/library/help/documents/Systematic-

Review-User-Guide.pdf

Lancia, F. 2012. The logic of T-LAB tools explained. Last accessed on 28/8/2014 on http://mytlab.com/textscope.pdf

Landa, A.H., I. Szabo, L. Le Brun, I. Owen, G. Fletcher, M. Hill. 2011. An Evidence-Based Approach to Scoping Reviews. *Electronic Journal of Information Systems Evaluation* 14(1).

Loorbach, D., 2010. Transition management for sustainable development: a prescriptive, complexity-based governance framework. *Governance* 23, 161–183

Markard, J., Raven, R.P.J.M. & Truffer, B., 2012, Sustainability transitions: an emerging field of research and its prospects. Research Policy, 41(6), 955-967

Ornetzeder, M., Rohracher, H. 2006. User-led innovations and participation processes: lessons from sustainable energy technologies. *Energy Policy* 34 (2), 138-150

Pettersen, I.N., Boks, C., Tukker, A. 2013. Framing the role of design in transformation of consumption practices: beyond the designer-product-user triad. *Int. J. Technology Management* 64(1/20).

Rajaraman, A.; Ullman, J. D. (2011). "Data Mining". Mining of Massive Datasets. pp. 1–17.

Raven, R., Geels, F.W., 2010. Socio-cognitive evolution in niche development: comparative analysis of biogas development in Denmark and the Netherlands (1973–2004). *Technovation* 30, 87–99.

Rogers, E.M. 2003. *Diffusion of innovations.* New York: Free Press.

Rohracher, H. 2005. From passive consumers to active participants: the diverse roles of users in innovation processes, in: H. Rohracher (Ed.), *User Involvement in Innovation Processes.* Strategies and Limitations from a Socio-Technical Perspective, Profil-Verlag, Munich, 2005, pp. 9–35.

Rotmans, J., Kemp, R., van Asselt, M., 2001. More evolution than revolution. Transition management in public policy. *Foresight* 3, 15–31.

Salton, G. 1989. *Automatic Text Processing: The Transformation, Analysis and Retrieval of Information by Computer.* Reading, Massachusetts: Addison-Wesley.

Salvatore S, Gennaro A, Auletta AF, Tonti M, Nitti M. 2012. Automated method of content analysis: a device for psychotherapy process research*. Psychother Res.* 22(3):256-73.

Savaresi, S. Boley, D., Bittanti, S., Gazzaniga, G. 2000. Choosing the cluster to split in bisecting divisive clustering algorithms.

Schot, J.W., Albert de la Bruhèze, A.A. 2003. The Mediated Design of Products,

Consumption and Consumers in the Twentieth Century, in: N. Outshoorn and T. Pinch (Eds), *How Users Matter: The Co-Construction of Users and Technology,* Cambridge, MA: MIT Press, 228-245.

Sengers, F., Raven, R.P.J.M. & Venrooij, A. 2010. From riches to rags : biofuels, media discourses and resistance to sustainable energy technologies. *Energy Policy*, 38(9), 5013-5027.

Shove, E., 2003. Users, technologies and expectations of comfort, cleanliness and convenience. *Innovation*. 16(2):193-207.

Shove, E., Walker, G., 2007. CAUTION! Transitions ahead: politics, practice and sustainable transition management. *Environment and Planning A* 39, 763–770.

Smith, A., 2007. Translating sustainabilities between green niches and sociotechnical regimes. *Technology Analysis & Strategic Management* 19, 427–450.

Smith, A., Voß, J.-P., Grin, J., 2010. Innovation studies and sustainability transitions: the allure of the multi-level perspective and its challenges. *Research Policy* 39, 435–448.

Van de Ven, A. H. 2007. *Engaged Scholarship: A Guide for Organizational and Social Research*. Oxford: Oxford University Press.

Von Hippel, E. 1986. Lead users: a source of novel product concepts. *Management science* 32.7 791-805.

Von Hippel, E. 1988. *The sources of innovation*. New York: Oxford University Press.

Woolgar, S. 1992. Configuring the user. In: J. Law (ed) *A Sociology of Monsters: essays on power, technology and domination.* London: Routledge. 57-99.

Wyatt, S. (2014). Bringing users and non-users into being across methods and disciplines. *Conference paper for Annual Association for Computing Machinery Conference on Human Factors in Computing Systems (Toronto, 26 Apr–1 May)*.

Wyatt, S., Thomas, G. and Terranova, T. (2002) They came, they surfed, they went back to the beach: Conceptualising use and non-use of the Internet, in S. Woolgar (ed.) Virtual Society? Technology, Cyberbole, Reality. Oxford, Oxford University Press, pp.23-40.