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Abstract: Sustainability transitions require structural changes in society. There is a need for utilising new and established methods of futures inquiry. This paper presents how design visioning has been used to initiate, stimulate and shift stakeholder conversations in the Visions and Pathways 2040 project which aimed to develop innovation strategies and policies to achieve low-carbon, resilient futures in Australian cities. We recommend that teams working in sustainability transitions research should ideally have internal design capacity or, they regularly engage with outsourced design capacity throughout the project. Since it is not possible to directly engage all stakeholders in transition projects, the research teams should reflect on the extent of participation and the implications of this extent on the politics of the project on an ongoing and transparent way. We identified exploring the implications of thinking styles, professional backgrounds and organisational associations in visioning exercises as a future research direction.

Keywords: Climate change, design for sustainability, transitions, system transformations, Australia

1. Introduction

Sustainability transitions require structural changes in society and how society interacts with the natural and built environment (Loorbach, 2010). They also require approaches that adopt a strong sustainability position, enable radical innovations and mind-set changes as well as that have long-term and systemic outlook (Gaziulusoy, 2015). In order to achieve sustainability transitions three types of knowledge need to be generated: systems knowledge, target knowledge and transformation knowledge (Pohl & Hirsch-Hadorn, 2007). Systems knowledge focuses on the present states of systems to understand what needs to change. Target knowledge generates alternative future proposals for those systems that are desirable and plausible. Transformation knowledge, on the other hand, is about building the potential paths between the current -undesirable, unsustainable- and future -desirable, sustainable- states of the systems that are subject to transformation.

Transitions have been framed as design challenges with technological, creative and political dimensions (Gaziulusoy & Ryan, 2015). Design has several roles to play in transitions, in addressing these three challenges and in the generation of the three types of knowledge needed for transitions.
Systems knowledge is relatively easy to generate as it is about understanding the current states of systems. Traditional forms of discovery-based scientific research have been successful in understanding technological, ecological and social causes of unsustainability in systems. Nevertheless, for generation of target knowledge and transformation knowledge discovery-based research is not sufficient as these types of knowledge require creative imagination of new system concepts and articulation of pathways that can link unsustainable present states of the systems to (imagined) sustainable future states. This calls for utilisation of new and established methods of futures inquiry. One challenge in creating momentum for rapid structural changes has been the fixation of stakeholders on the perceived barriers of change in the present state and not being able to imagine alternative future states that are plausible as well as sustainable. The conundrum is so that anticipatory knowledge is non-verifiable therefore any assumption about the probable occurrence of a given scenario is subjective (Wiek et al., 2013). In addition, acting towards imagined futures that are not projections of current reality is dependent on agency and mobilisation of actors. Therefore, it is important to scrutinise particular future propositions from the point of view of desirability by those who have the agency to develop and implement change strategies. Nevertheless, this creates a question about representation of all stakeholders in the processes utilised as agency is a function of power and neither agency nor power is distributed evenly among all stakeholders of large, systemic transformations. For this reason, there is a need for constructing participatory processes that will enable articulation of not only alignment but also of the conflicting perspectives on what can occur, and the diversity of values on how the change should take place. These processes, rather than presenting one viable future outcome, should demonstrate the diversity of viable alternative futures that could emerge from present technological and socio-cultural signals taking into account the observable and potential value conflicts among stakeholders.

This paper presents how design visioning has been used to initiate, stimulate and shift stakeholder conversations in the Visions and Pathways 2040 project which aimed to develop innovation strategies and policies to achieve low-carbon, resilient futures in Australian cities. Our findings claim that transition processes are messy design problems due to the large number of stakeholders involved, uncertainties associated with anticipatory knowledge generation, and political nature of transition projects. We demonstrate how participatory design visioning has been used to demonstrate the spectrum of (conflicting) values within the stakeholder group, to articulate the signs of emerging alternative futures, and to conceptualise innovations that would not have been conceived otherwise.

2. Design Visioning: Australian Cities in 2040
2.1 Project Background

Among issues related to sustainability, mitigation of future climate change and adaptation to the climate change that is already locked-in is the most urgent, encompassing and challenging issue (Climate Council, 2015). Cities have become the focus of endeavours related to climate change as contexts where the problem is intensified and innovative solution potential is high (Gaziulusoy & Ryan, 2015). With this in mind, Victorian Innovation Lab (VEIL) of University of Melbourne have been leading a four-year project on transitions to low-carbon and resilient futures in Australian cities in collaboration with several business and governmental partners as well as two other Australian universities. The project, Visions and Pathways 2040 (VP2040), combined analytical and creative participatory, future-oriented research methods to challenge existing, business-as-usual proposals for climate change mitigation and adaptation by way of investigating potential development paths of
emerging technological as well as socio-cultural innovations using systemic vision and scenario development. The core project team of VP2040 consisted of five researchers (Project Leader, 2 Principal Researchers, 1 Junior Researcher, 1 Research Assistant) supported by three PhD students and in-kind contributions of several area experts.

2.2 Project Methodology and Outcomes

The scope of this paper covers the first two-and-a-half years of the project to articulate how participatory design visioning was used to synthesise analytical research and creative futures investigation in development of four alternative future scenarios for low-carbon, resilient cities in Australia. The methodology followed was radically iterative typical of transdisciplinary research and evolved in response to emerging research needs and stakeholder expectations following a general outline (Pohl & Hirsch Hadorn, 2007; Carew & Wickson, 2010). Figure 1 displays a simplified model of this iterative methodology.

The project started with desktop research reviewing theories of system innovations and transitions, futures inquiry methods, emerging social, organisational and technological innovations, and existing low-carbon roadmaps for Australia (Alexander, 2014; Gaziulusoy & Twomey, 2014; McGrail, 2014; McGrail & Gaziulusoy, 2014). This was followed by three visioning workshops held in Melbourne and Sydney. A total of 96 participants attended these workshops. The participants represented businesses from the built environment sector, peak bodies, consultants, local governments, advocacy groups, social entrepreneurs and research organisations. In both cities a total of 16 commissioned designers participated in the workshops; in Melbourne as facilitators, in Sydney as observers of group discussions. The specific disciplinary background of these designers covered architecture,
industrial design, interaction design and service design. These 16 designers were commissioned based on three main criteria: 1. Ability to think systemically; 2. Knowledge of sustainability; 3. Skills of visualisation. In the visioning workshops the participants were asked to describe support systems, neighbourhoods, technologies and products and services of a low-carbon, resilient city which was also desirable to live in in 2040. The table discussions were captured by notes, drawings and voice recorders. These records were analysed as “design briefs” in one-week long design charrettes that followed the workshops in each city were. In these design charrettes the project researchers and commissioned designers integrated findings of desktop research and insights generated from the records of visioning workshops. The output of these charrettes were a series of images representing critical moments or artefacts of low-carbon resilient futures (i.e. “Glimpses of the Future”) (Ryan, Twomey, Gaziulusoy & McGrail, 2015). After the design charrettes in each city, a feedback session was held with some of the workshop participants who were presented with the future glimpses and asked to respond to these visualisations. This process had to aims: 1. To evaluate the process of synthesis during the design charrettes; 2. To elaborate more on features of a city that is seen as desirable, low-carbon and resilient. These glimpses were also used for the second aim in official and unofficial conversations held with stakeholders. Notes were taken both during the feedback session and in stakeholder meetings.

Visioning workshops and stakeholder conversations enabled the project team to identify a series of critical value differences within the stakeholder group about what counts as desirable components of a low-carbon resilient future as well as opinion differences about the potential role of certain emerging innovations in creating momentum for systemic transformations that will eventually achieve a low-carbon and resilient future (McGrail, Gaziulusoy & Twomey, 2015). In the meantime, responding to emerging needs for research based on findings of stakeholder engagements, more desktop research was carried out about current drivers of urban change, major uncertainties associated with the evolution of city support systems, urban space and form, embedding of new technologies in urban and household environments, sources of emissions reductions, economic and political institutions and urban lifestyles (Ryan, Twomey, Gaziulusoy, McGrail & Chandler, 2016). While these stakeholder conversations and desktop research were ongoing, the research team started to develop prototype scenarios which evolved as insights from the research and stakeholder engagement evolved. Finally, four prototype scenarios were taken to a scenarios workshop in Adelaide. There were 43 participants in this workshop with a representation diversity similar to visioning workshops. The participants in this workshop were asked to challenge the logic of each scenario and further develop them. They were also asked to develop and act out personas to depict how life would be like for individuals living in those scenarios. Discussions at each table were audio recorded and the acting out of personas were video recorded. Following this workshop the research team analysed these recordings and undertook more desktop research about newly emerging themes that could be integrated in the scenarios. The team also undertook a series of interviews with ten individuals with expertise in areas relevant to urban context and climate change. These interviews were loosely used to check the comprehensiveness of the evolving list of critical value and opinion differences as well as provided inspiration for the formulation of initially the prototype scenarios and later the detailed scenarios. The detailed scenarios were visualised depicting how life would be like in these four alternative low-carbon and resilient futures across three generic urban density scales (i.e. low, medium and high). Figure 2 displays these scenarios with associated keywords that define their main characteristics. Figure 3 shows how greenhouse gas emission reductions are achieved in each scenario across a spectrum of consumption reduction and efficiency increase. Figure 4 shows political-economic positioning of these scenarios.
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Figure 2. Scenario visualisations

| CleanTech/Market Living | Planned/Regulated Living | Entrepreneurial/Networked Living | Community/Balanced Living |
|-------------------------|--------------------------|---------------------------------|---------------------------|
| High Density             |                          |                                 |                           |
| Medium Density           |                          |                                 |                           |
| Low Density              |                          |                                 |                           |

Keywords
- Ecological modernisation; price-driven efficiency; circular economy; service economy
- Centralised governance; social equality/egalitarianism; public service; sustainable urbanism
- Peer-to-peer; collaborative economy; micro-businesses; freelance workers; diversity and creativity
- Localisation; well-being; balanced living; alternative forms of enterprises and exchange; caring for the commons

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2.3 Reflections

Design in the context of futures and at the level of systems is currently at the frontier of design for sustainability field specifically (Ceschin & Gaziulusoy, 2016) and of design research and practice in general (Jones, 2014). Vision and scenario development to strategise for systemic transformations have been used only for a couple of decades (Young et al., 2001; Manzini & Meroni, 2007; Ryan 2008; Neuvonen et al., 2015). Quist (2002) points that, in contrast to explorative scenarios (which
explore likely or possible futures), normative scenarios (which articulates particular “norms” that the futures should be aligned with such as sustainability) are referred to as “design scenarios” or “design-orienting scenarios”. In that sense, the visualisations, although often seen by our stakeholders as the only relevant element of the project work to design, are secondary design artefacts that were fundamentally visually communicating the primary design artefacts that stemmed from the project: i.e. the scenarios themselves. This is not to reduce the crucial role played by scenario visualisations in stimulating stakeholder imagination and conversations, but to point to the fact that they are representations of the primary design artefacts, communicating much less detail than scenarios. Nevertheless, we would not be able to reach the detail and internal coherence in these scenarios if they were not iteratively conceived alongside their visualisations. Imagining futures of highly complex systems such as cities which have several artefactual as well as interactional layers solely by conversational or textual inquiry is an excruciatingly difficult cognitive task even if not totally impossible. For this reason, we do assert that visual thinking by way of creating, deconstructing and reconstructing future glimpses and scenario visualisations is not an ornamental but a fundamental component of normative scenario development for sustainability transitions. Therefore, we recommend that teams working in sustainability transitions research should ideally have internal design capacity or, in cases where this is not possible, they regularly engage with outsourced design capacity throughout the project.

Design visioning can be situated within the emerging practice of design futures in the sense described by Jones (2014) that it formulates “designed artefacts that reflect alternative future possibilities in ways that stimulate stakeholder imagination (p.109)”. In design visioning there is a continuum of designed artefacts ranging from individual products or services to entire urban systems. In our understanding the depicted relationships between individual products/services, the urban environments they reside in and the people who live in those urban environments are also designed artefacts. It is the nature of these relationships from which the internal logic of each distinct scenario emerges; without coherence in the design of those relationships it would not be possible to establish internal consistency of the scenarios.

Although, internal consistency of scenarios is cited among quality criteria (Wiek & Iwaniec, 2013) and therefore hints on scenario credibility, the scenarios are not the ultimate goal in design visioning. Given any set of presented scenarios only portrays a few possibilities out of numerous likely futures, the most important outputs are not the scenarios themselves, but the conversations they prompt which enable understanding of associated uncertainties, different perspectives, range of options and strategies to move forward (Milestad, Sevnfelt & Dreborg, 2014). Therefore, scenarios both embody and themselves are intermediate designed artefacts in design visioning, in service of participatory decision making and action. The key design activity in transition projects is process-oriented design rather than output-oriented design. For this reason, our recommendation is, at times when there are resource constraints (time and funding), project managers allocate more of the resources on the process of stakeholder engagement and research synthesis during scenario development rather than increasing the visual quality and detail of scenario visualisations.

Design visioning, in the context of VP2040 project, proved to be a viable way of generating the three types of knowledge mentioned by Pohl and Hirsch-Hadorn (2007) as necessary for sustainability transitions. Through intertwined and synthesizing sequences of desktop research, workshops and stakeholder engagements, the research team generated system knowledge (identified present actors, emerging innovations that might assist in transitioning and which can be parts of new socio-technical systems, and articulated interrelationships between different scales and layers of city systems), target knowledge (produced future glimpses and scenarios) and transformation knowledge
(scenarios provide hints on pathways). Although procedurally and on paper, developing pathways is one step further than developing scenarios, in our engagements we have come to realise that, the perceived possibility of a pathway towards any given scenario is an important determinant in whether that scenario will be seen as credible, plausible and therefore worth to further investigate. In that sense, generation of transformation knowledge has to be resonant with generation of system and target knowledge. This gives result to a “methodological messiness”; a situation which is acknowledged to be both typical in similar (i.e. transdisciplinary) projects and yet difficult to manage (Carew & Wickson, 2010; Lang, et al., 2012; Pohl, 2014) as, such “emergence” is counter to the traditional logic of conceiving methodologies. Therefore our recommendation is to preserve a certain level of methodological flexibility.

Starting from the proposal phase of the project, the research team encountered different types of resistance at different levels of stakeholder interaction. The first of these was the expectation of the funding body for the project to use a timeframe longer than 25 years and to identify “technological innovation paths” in the “built environment”. In the opinion of the research team (based on the collective expertise of the members), was that timeframes longer than 25 years would result in futuristic visions and scenarios that are very distant from present reality, therefore they would not be relatable by the broader stakeholders and would not be useful to identify emerging signals of change to drive transitions. Similarly, the research team also acknowledged that transitions were not only functions of technological change but also socio-cultural, organisational and institutional innovations that co-evolve with one another and not only the built environment but also the lifestyles needed to be crucial research foci. The uncertainty about timeframes and scope of futures inquiry prevailed well into the final months of the first year in the form of a “silent negotiation”. Only after the visioning workshops and release of future glimpses which was followed by positive feedback of the stakeholders and partners from local governments and businesses there happened a “shift” and the representatives of the funding body started to adopt a language referencing systems level and social change. Another typical resistance from some stakeholders occurred during the feedback sessions following design charrettes that generated future glimpses. There were participants in these sessions who were specifically questioning the financing mechanisms for realising the ideas presented in the glimpses. Although low in number, these participants challenged the plausibility of ideas on the grounds of financial mechanisms not being discussed although plausibility evaluation was not the purpose of these particular sessions. In some cases, this slowed down the feedback discussions in groups and interfered with generation of rich insights. On one hand we interpreted this as a facilitation challenge, therefore an aspect in research that is not fully controllable, on the other hand we identified exploring the implications of thinking styles, professional backgrounds and organisational associations in visioning exercises as a future research direction.

Robinson et al. (2011) highlighted the trade-off associated with participatory approaches to envisioning sustainability by stating that although participation may enhance buy-in, the participants may find the complexity of the choices they are asked to make difficult. Quist (2009) on the other hand found that it is possible to achieve significant follow-up and spin-off in similar projects with limited participation. Nevertheless, the sole function of participation in decision-making and policy design is not only increasing the chances of uptake of ideas. Participation is also closely connected with representation of different stakeholders and therefore has a highly political and democratic function. Deliberative processes have been subject to criticisms for using exclusionary criteria in participant selection (Abelson et al., 2003). Transition studies engages with “front-runners”, at least in the earlier phases of transition projects (Loorbach & Rotmans, 2010). In VP2040, following substantial “deliberation on deliberation” as a research team, we also adopted a similar approach to...
this. Our criteria for participant selection before the visioning workshops covered included, 1. Not a climate denier or skeptic; 2. Has agency to make decisions about the future of cities; 3. Has substantial knowledge about one or more aspects of urban context in regards to climate change. We also adopted a Latourian position and framed participants as network configurations (with official and unofficial components) bringing in other in-direct (intentional or unintentional) participants rather than stand-alone subjects (Andersen et al., 2015). This alleviated the problem of ensuring full representation of stakeholders in large, highly-complex systems (such as cities as in our case) to a certain extent. For example by way of directly involving council workers in the research processes, certain knowledge about the different citizen communities they engage was transferred to the researchers and other direct participants. Nevertheless, as it is impossible to ensure full representation of citizens in urban transition projects, our recommendation for other researchers is to beware of the political nature of transition projects and reflect on the extent of representation and political implications of this extent on an ongoing basis and in a transparent manner.

3. Closure

In this paper we presented the methodology of design visioning in the context of Visions and Pathways 2040 project which focused on transitioning to low-carbon and resilient futures in Australian cities as a viable way to generate the three types of knowledge – systems, target and transformation knowledge- necessary for societal transformations to sustainability. Design visioning is a mixed-method research and engagement methodology used in VP2040 project to identify emerging technological, organisational and socio-cultural innovations that can assist with transitions and the different stakeholder views on what constitutes a desirable and low-carbon future. Based on our experiences we derived the following recommendations:

- There to be internal design capacity in research teams and in cases when this is not possible, ongoing and regular engagement with outsourced design capacity.
- Allocating more resources on the process of stakeholder engagement and research synthesis than perfecting scenario visualisations in cases where there are funding and/or time scarcities;
- Preserving a certain level of methodological flexibility to accommodate methodological messiness of transition projects.
- Undertaking further research on implications of thinking styles, professional backgrounds and organisational associations in visioning exercises as a future research direction.
- Reflecting on and communicating the political implications of participatory characterises of projects.

References

Abelson, J., Forest, P. G., Eyles, J., Smith, P., Martin, E., & Gauvin, F. P. (2003). Deliberations about deliberative methods: Issues in the design and evaluation of public participation processes. Social Science and Medicine, 57(2), 239-251.

Alexander, S. (2014). Disruptive Social Innovation for a Low-Carbon World. Melbourne, Australia: Victorian Eco-innovation Lab.

Andersen, L. B., Danholt, P., Halskov, K., Hansen, N. B., & Lauritsen, P. (2015). Participation as a matter of concern in participatory design. CoDesign, 11(3-4), 250-261. doi:10.1080/15710882.2015.1081246
Carew, A. L., & Wickson, F. (2010). The TD Wheel: A heuristic to shape, support and evaluate transdisciplinary research. Futures, 42(10), 1146-1155.

Ceschin, F., & Gaziulusoy, I. (2016). Evolution of design for sustainability: From product design to design for system innovations and transitions. Design Studies, 47, 118-163. doi:http://dx.doi.org/10.1016/j.destud.2016.09.002

Climate Council. (2015). Climate Change 2015: Growing Risks, Critical Choices: Climate Council of Australia.

Gaziulusoy, A. I. (2015). A critical review of approaches available for design and innovation teams through the perspective of sustainability science and system innovation theories. Journal of Cleaner Production, 107, 366-377. doi:http://dx.doi.org/10.1016/j.jclepro.2015.01.012

Heugens, P. P. M. A. R., & van Oosterhout, J. (2001). To boldly go where no man has gone before: integrating cognitive and physical features in scenario studies. Futures, 33(10), 861-872. doi:http://dx.doi.org/10.1016/S0016-3287(01)00023-4

Jones, P. H. (2014). Systemic Design Principles for Complex Social Systems. In G. S. Metcalf (Ed.), Social Systems and Design (pp. 91-128): Springer Japan.

Lang, D. J., Wiek, A., Bergmann, M., Stauffacher, M., Martens, P., Moll, P., . . . Thomas, C. J. (2012). Transdisciplinary research in sustainability science: practice, principles, and challenges. Sustainability Science, 7, 25-43. doi:http://dx.doi.org/10.1007/s11625-011-0149-x

Loorbach, D. (2010). Transition management for sustainable development: A prescriptive, complexity-based governance framework. Governance, 23(1), 161-183.

Loorbach, D., & Rotmans, J. (2010). The practice of transition management: Examples and lessons from four distinct cases. Futures, 42(3), 237-246. doi:http://dx.doi.org/10.1016/j.futures.2009.11.009

Manzini, E., & Meroni, A. (2007). Emerging User Demands for Sustainable Solutions, EMUDE. In R. Michel (Ed.), Design Research Now (pp. 157-179). Basel: Birkhäuser

McGrail, S. (2014). A review of roadmaps for transitioning to a zero carbon built environment in Australia. Melbourne, Australia: Victorian Eco-innovation Lab.

McGrail, S., & Gaziulusoy, A. I. (2014). Using Futures Inquiry to Create Low-carbon, Resilient Urban Futures: A Review of Practice, Theory and Process Options for the Visions and Pathways Project. Retrieved from

McGrail, S., Gaziulusoy, A. I., & Twomey, P. (2015). Framing Processes in the Envisioning of Low-Carbon, Resilient Cities: Results from Two Visioning Exercises. Sustainability, 7, 8649-8683. doi:10.3390/su7078649

Milestad, R., Svenfelt, Å., & Dreborg, K. H. (2014). Developing integrated explorative and normative scenarios: The case of future land use in a climate-neutral Sweden. Futures, 60, 59-71. doi:http://dx.doi.org/10.1016/j.futures.2014.04.015

Neuvonen, A., Kuitininen, O., Saler, K., Höjer, M., Rantanen, K., Lähteenöja, S., . . . Vargas, M. (2015). Nordic Cities Beyond Digital Disruption. Retrieved from

Pohl, C. (2014). From Complexity to Solvability: The Praxeology of Transdisciplinary Research In K. Huutoniemi & P. Tapio (Eds.), Transdisciplinary Sustainability Studies: A Heuristic Approach (pp. 103-118): Routledge.
Pohl, C., & Hirsch Hadorn, G. (2007). *Principles for Designing Transdisciplinary Research: Proposed by the Swiss Academy of Arts and Sciences* (A. B. Zimmermann, Trans.). Munich: Oekom Verlag.

Quist, J. (2002). *Public and Stakeholder Participation in Sustainability Scenario Construction and Evaluation through Focus Groups: a Dutch case study*. Paper presented at the 22nd annual IAIA conference ‘Assessing the Impact of Impact Assessment, Impact assessment for Informed Decision Making, The Hague, 15-21 June 2002.

Quist, J. (2009). *Stakeholder and user involvement in backcasting and how this influences follow-up and spin-off*. Paper presented at the Joint Actions On Climate Change”, Aalborg, Denmark, 8-10 June 2009.

Robinson, J., Burch, S., Talwar, S., O’Shea, M., & Walsh, M. (2011). Envisioning sustainability: Recent progress in the use of participatory backcasting approaches for sustainability research. *Technological Forecasting and Social Change, 78*(5), 756-768. doi:http://dx.doi.org/10.1016/j.techfore.2010.12.006

Ryan, C. (2008). *The Melbourne 2032 Project: Design visions as a mechanism for (sustainable) paradigm change*. Paper presented at the Changing the Change: Design Visions and Proposals Conference, 10-12 July 2008, Turin, Italy.

Ryan, C., Twomey, P., Gaziulusoy, A. I., & McGrail, S. (2015). *Visions 2040 - Results from the first year of Visions and Pathways 2040: Glimpses of the future and critical uncertainties*. Melbourne, Australia: Victorian Eco-innovation Lab.

Ryan, C., Twomey, P., Gaziulusoy, A. I., McGrail, S., & Chandler, P. (2016). *Scenarios 2040 - Results from the second year of Visions and Pathways 2040: Scenarios of Low-carbon Living*. Melbourne, Australia: Victorian Eco-innovation Lab.

Wiek, A., & Iwaniec, D. (2013). Quality criteria for visions and visioning in sustainability science. *Sustainability Science, 2013*. doi:10.1007/s11625-013-0208-6

Wiek, A., Withycombe Keeler, L., Schweizer, V., & Lang, D. J. (2013). Plausibility indications in future scenarios. *International Journal of Foresight and Innovation Policy, 9*(2-3-4), 133-147. doi:10.1504/IJFIP.2013.058611

Young, D. C. W., Quist, J., Toth, D. K., Anderson, D. K., & Green, P. K. (2001). Exploring sustainable futures through 'Design Orienting Scenarios' – The case of shopping, cooking and eating. *The Journal of Sustainable Product Design, 1*(2), 117-129.

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