

Leveraging participatory system dynamics to coordinate regional net zero transitions in Australia

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Abstract: The challenge of industrial decarbonisation demands transformative action, yet it has frequently been tackled in a fragmented manner, with sectoral change occurring in silos and with rigid techno-economic methods used for risk and opportunity analysis. In hard-to-abate-sectors, decarbonisation demands system reconfiguration rather than electrification or technology substitution alone. For example, decarbonising iron production will not only require Direct Reduced Iron facilities, but these will need to be embedded in industrial hubs incorporating complementary hydrogen facilities, ports, and upgraded energy and transport infrastructure. Additionally, considerations about community and labour development will be crucial as new jobs are generated and traditional roles are either transformed or eliminated. Similarly, establishing a clean fuels sector cannot rely only on the facilities, markets, or regulatory processes set up for traditional fuels, and instead must involve coordination across sectors like agriculture, electricity, and hydrogen production, as well as the initiation of new markets and regulations, such as the International Civil Aviation Organisation's environmental guidelines pertaining to land clearing. There is growing recognition in the transition literature that we need methods for risk and opportunity analysis that not only incorporate these inter-sectoral dynamics but also take a place-based approach (Andersen et al., 2020; Devine-Wright, 2022). In Australia, products like green iron or clean fuels are likely to be produced in regional areas, each with its own unique combination of big industries, smaller businesses, natural landscapes, and economic and social profile. And because there is no common, clear, or single pathway to reach net zero, there can be apprehension, or even hostility, to a net zero agenda. Models can be a useful boundary object to expose multi-value outcomes of different transition pathway choices, and to support planning and negotiation around options. And incorporating specific consideration of place into transition planning and analysis is a way to unlock co-aligned social or environmental benefits that could drive greater support for decarbonisation activities within a region. Taking this theory into applied settings, CSIRO has developed a Place-based Participatory System Dynamics Approach as a distinctive way of coordinating across sectors for the transition to net zero in Australian regions. Drawing from place-based transition literature and participatory modelling practice, this approach has been iteratively developed and piloted alongside collaborators and through engagement with over 20 stakeholder groups in the Upper Spencer Gulf, South Australia, and in the Tamar Valley Region of Tasmania. Iteratively refined with stakeholders from government, industry and community, the approach was developed through a four-step process: (1) building a place-based contextual understanding of each region, (2) engaging in participatory systems mapping of regional dynamics, (3) conducting tailored analysis of challenges and opportunities within the region, and (4) exploring options for collaborative pathway development. We illustrate the usefulness of this approach with two examples from South Australia and Tasmania, where regional transition opportunities exist in iron and clean fuels production respectively, but where there are common challenges around coordination and pathway evaluation. We highlight through these examples how a Place-based Participatory System Dynamics Approach can support stakeholders to gain a more holistic regional view of their region, incorporate broader quantitative and qualitative data capture and analysis into their planning processes, and conduct more inclusive, transparent and rapid assessment cycles of challenges and opportunities when navigating the transition to net zero.

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