



A system leverage points approach to governance for sustainable development

Mitzi Bolton¹ 

Received: 22 September 2021 / Accepted: 23 May 2022 / Published online: 11 August 2022
© The Author(s) 2022, corrected publication 2022

Abstract

Governments are inherently responsible for citizens' well-being. Given that achieving sustainable development ["Development that meets the needs of the present without compromising the ability of the future generations to meet their own needs"—(WCED in *Our common future*, Oxford University Press, New York, 1987)] is core to the attainment and maintenance of citizens' well-being, and increasingly understood to require major transformations in integrated social, technological and ecological systems (Sachs et al. in *The decade of action for the sustainable development goals: sustainable development report 2021*, Cambridge, 2021), it follows that governments have a significant role in shaping transformations. Muted progress on long-standing social, environmental, and economic challenges alongside spiralling public budgets and intergenerational debt suggests, however, that public governance systems are inadequate to facilitate the transformations urgently required. Conceptualising the practice of public decision-making as a complex system, this paper investigates whether known influences on public decision-makers can be linked to Meadows' (Leverage points: places to intervene in a system, Sustainability Institute, North Charleston, 1999) leverage point framework. Finding meaningful connections, it further explores how the leverage point framework can be employed to engage decision-making influences as enablers of desirable public outcomes. It is contended that shifting decision-makers' focus one step beyond currently prevalent leverage points will set in motion the transformations in governance required to facilitate sustainable development.

Keywords Leverage points · Systems · Sustainable development · Governance · Government · Public sector

Introduction

The world faces an ever-evolving raft of complex, interconnected, enduring problems to address and consider. Planetary boundaries are being exceeded or increasingly tested (Rockström et al. 2009; Steffen et al. 2015), with direct and flow-on impacts between boundaries (Lade et al. 2020), including climate change (IPCC 2021) and biodiversity loss (FAO 2019; IPBES 2019) and their respective consequences for access to basic human needs, quality of life, and migration patterns (Kaczan and Orgill-Meyer 2020). While front of mind for many as we seek to manage and rebuild from the pandemic, the need to mitigate the risk of future zoonotic

diseases (De Sadeleer and Godfroid 2020) is yet another long-standing significant challenge to face. Complex and wicked problems are also visible through rising inequalities across and within countries (Wilkinson and Pickett 2009; Stiglitz 2015; Balestra and Tonkin 2018; Alvaredo et al. 2018), which impact trust, shared visions of a desirable society (Bain et al. 2019), and the institutions of government responsible for delivering those visions (McGrath 2017).

The above concerns and many more are compounded by muted or insufficient progress on the international agreements intended to help address them, such as the United Nations Sustainable Development Goals (SDGs) (UNGA 2015). Similarly, Australia's Report on Government Services (RoGS) annually documents how slow and inadequate progress is in many areas of national and subnational social policy (such as education, justice, emergency management, health, community services like child protection, and housing and homelessness) (PC 2022). This is despite repeated attempts at reform. The SDGs and RoGS articulate and track progress on shared visions, but also demonstrate that merely

Handled by Eefje Cuppen, Leiden University, Netherlands.

✉ Mitzi Bolton
mitzi.bolton@monash.edu

¹ Monash Sustainable Development Institute, Monash University, Melbourne, Australia

coming up with plans and frameworks achieves little without their effective implementation. Thus, attention also needs to be given to what stops governments from delivering on shared visions, like the SDGs and RoGS, and steps taken to improve the effectiveness and efficiency of their efforts.

Every decision within government forms an aspect of public governance. Every actor within government, be they elected, members of the judiciary or public servants, forms part of that governance infrastructure. While elected officials may set the co-ordinates for where society is going through their promises or announcements, how the destination is reached is heavily influenced by public servants at all levels. Whether through influencing political decisions, or developing and implementing policy and legislation to provide for them, public servants are what power government action. That is, much of the governance of government action occurs through the public service—the worker bees of government. Hence, the capability and capacity of our public sectors heavily influence success in achieving the desired public policy outcomes. Correspondingly, in this paper, governance is specifically considered from the perspective of activities leading to and arising from public-sector decisions and, in particular, the role of public servants as public decision-makers.

Simply declaring that public servants need to do more or are somehow wilfully failing in their responsibilities is, however, unhelpful. Public servants are not working to actively impede enhancement or protection of our way of life; it is their way of life too. Indeed, many choose their careers to address complex problems more actively. They are, however, constrained in their attempts to do so by a multitude of influencing factors (Bolton 2020). Public decision-makers fail to consistently achieve stated objectives not because of corruption, laziness, or lack of will—though on occasion these will play a role—but rather the complexity of the operating environment they find themselves in.

Nevertheless, the repeated failure to deliver on community expectations across public policy domains is not something that can be brushed aside or accepted as ‘the way things are’, or ‘the best we can do’. On the contrary, the pandemic has highlighted that we can and must do things differently to address shared problems quickly (WHO 2021; Apuzzo and Kirkpatrick 2020). If our way of life is to be enhanced or maintained within planetary boundaries, new governance approaches deliberately targeting weaknesses in current methods are needed.

A systems governance approach

One such approach could be to recognise public decision-making for what it is—a complex system—and bring systems thinking into the equation. We live in systems, we work in systems, and yet we try to solve problems within them by taking a siloed or linear approach. It is illogical to think this could work, and yet, we do

it over and over again. Government especially is largely structured in siloes, from minister to street-level bureaucrat. Moreover, there can be a tendency to view public problems through the lens of what matters in the moment or a single policy domain, rather than to sit with and find ways to conceptualise the, at times, Escher-like whole. Recognising this, Meadows’ work on leverage points (LPs) provides a useful framework for understanding where and why political and government decisions become ‘stuck’ (Meadows 1999, 2008; see Box 1).

Box 1: System leverage points, as defined by Meadows (1999)

12. Constants, parameters, numbers (such as subsidies, taxes, standards)
11. The sizes of buffers and other stabilising stocks, relative to their flows
10. The structure of material stocks and flows (such as transport networks, population, age structures)
9. The lengths of delays, relative to the rate of system change
8. The strength of negative feedback loops, relative to the impacts they are trying to correct against
7. The gain around driving positive feedback loops
6. The structure of information flows (who does and does not have access to what kinds of information)
5. The rules of the system (such as incentives, punishments, constraints)
4. The power to add, change, evolve, or self-organise system structure
3. The goals of the system
2. The mindset or paradigm out of which the system—its goals, structure, rules, delays, parameters—arises
1. The power to transcend paradigms

On balance, Meadows argued the levers can be ordered hierarchically: she considered shallower leverage points within the hierarchy (e.g. numerical parameters, the size and structure of buffers, and stocks and flows within the system) easier to change, but ultimately less impactful upon the overall functioning of the system—though also argued, this is where much of our public debate focuses; in the middle, she identified leverage points relating to the system’s overall design and feedback mechanisms; finally, she argued deeper leverage points within the hierarchy (e.g. transcending paradigms, the mindset from which systems emerge, and the goals of the system) are harder to employ but more likely to lead to system transformation if successfully applied.

A significant caveat is that systems are complex and unpredictable. It is entirely possible that in some instances, the linearity implied by Meadows’ framework and its application within this paper will not exist. Indeed, Meadows

noted differing contexts may mean that positions within the framework shift on occasion (for example, delays may operate as deeper points of leverage where their length is able to be altered). Still, while recognising this and perhaps illuminating the difficulty of breaking from linear thinking, the leverage points are generally discussed in a hierarchal fashion by Meadows and much of the literature and that recognition and approach are also applied here.

An increasingly popular way to visualise the leverage points in recent years has been the introduction of the ‘iceberg model’ (Bosch and Smith 2007; Davelaar 2021). The iceberg represents lower-order leverage points as the visible ice (being shallower, more tangible, and easier to predict the behaviour of), while middle- to higher-order leverage points are represented by ice below the surface (being deeper, harder to conceptualise, and predict, but more impactful if engaged). Extending the iceberg metaphor to the public decision context, attention tends to be focussed on the overt and easily engaged decision or problem elements (the lower-order or shallow leverage points). However, as with icebergs, it is the more covert or less tangible elements (the higher-order or deeper leverage points) which hold the greatest potential for transformative impact.

For example, debates about the *amount* of social support or welfare provided to citizens are often topical and impassioned, but largely unresolved, as regardless of whether people are offered $\$x$ or $\$x \pm y$ in welfare payments, the debate is focused on applying the lowest-order leverage points (numerical parameters) and the system will essentially continue to function as it has before. The value of ‘ y ’ will make a difference to some individuals, but the system itself will not change. A more significant change to the system would, for instance, be the introduction of a universal basic income which would more radically alter the structure and rules of the welfare system.

The value of systems thinking as a tool to enhance the achievement of sustainability has been drawing increased attention. Fischer and Riechers (2019) argue that Meadows’ framework is an ‘under-recognised’ tool in the field of sustainability and propose that, ‘conceptual, qualitative empirical or quantitative empirical work’ drawing on the strengths of the framework may, ‘yield both practical and theoretical advances’. Egerer et al. (2021) applied leverage points as a weighting system to understand and prioritise climate change adaptation measures within the Saxony agricultural sector. Further, a recent special issue on the topic identifies nine questions to help drive research and practice aimed at sustainability transformations through the application and consideration of leverage points (Leventon et al. 2021a). Relatedly, the Earth System Governance (2018) community¹ presented a research framework aimed at mobilising

and coordinating research efforts reflecting the rapid evolution, emergence, and increase in complexity of the challenges humanity faces. This framework has four focal points: transformations, inequality, the Anthropocene, and diversity. Transformations are particularly relevant here, and the need for them is articulated by Burch et al. (2019) from three angles: (1) governance *for* transformations—decision-making that facilitates the conditions necessary for transformations to occur; (2) governance *of* transformations—decision-making that regulates or oversees transformations underway; and (3) transformations *in* governance—alterations to the how and what of the decision-making practice itself.

The complex problems flagged earlier suggest that successful governance *for* and *of* transformations has been lacking to date: The conditions for transformation have not been widely established, and where they have (e.g. in relation to altered food and energy systems to help address the climate crisis), the anticipated transformations have not been as swift or impactful as hoped. In recognition of this, perhaps our governance systems need to transform first so as to better position the lead out of more sustainable futures. Given the complex and contested governance operating space that exists, and the muted impact of the hundreds of billions spent to achieve desired public outcomes (PC 2021), it is hard to argue transformations *in* governance are not required.

The aforementioned multitude of influencing factors decision-makers must contend with are also complex, not only in number but also in function. Decision-making influences have both transformation-enabling and -inhibiting traits. Similarly, influences are both characteristics of the public decision-making system that leverage points can act upon *and*, pending the circumstances, themselves be expressions of leverage points. Further, influences can represent multiple levers, with the dominant lever expressed in any particular situation depending on the decision context and actors involved. For example: *evidence*² is acted on by and a product of the system, through which parameters are created and responded to; however, evidence may similarly act as negative (LP8) or reinforcing feedback loops (LP7), pushing the system in one direction or another.

The variable nature and role of decision-making influences, as structural or actor-based system elements, add additional complexity: some of the influences are relatively fixed in nature (e.g. the *Institutions*³ within which

¹ A network of researchers recognising the need for enhanced “governance mechanisms to cope with the current transitions in the biogeochemical systems of the planet” (Burch et al. 2019).

² The suite of decision-making influences are defined in Appendix A, those mentioned explicitly in the text are also defined in footnotes: *Evidence* reflects, consideration of evidence or information in decision-making, what ‘counts’ as evidence (e.g. qualitative and quantitative), and availability of data.

³ *Institutions*—the characteristics of the machinery of government, such as the Victorian Public Sector and departments and agencies within it as individual and combined institutions, as well as the structure of those institutions and administrative tools to support their

decision-making occurs, *Legislation*⁴ that imposes requirements upon decision-makers); some influences manifest in different ways pending the actions of individuals (e.g. the *Personal characteristics of decision-makers*,⁵ the *Engagement*⁶ approaches taken to communicate decisions, and indeed the *Framing*⁷ of such engagement); and still others have the ability to reflect both structures and actors (e.g. *Complexity*⁸). This latter variability in influence nature is perhaps what stymies some decision-makers from becoming policy entrepreneurs within their roles, as they do not realise the extent of their capacity as actors with the ability to influence system outcomes (Bolton 2020).

Considering the increased scholarly interest, the demonstrated need to accelerate sustainability and governance transformations, and the previously identified influences upon public decision-makers, this paper seeks to answer the following research question: can the influences on public decision-makers be linked to the leverage point framework? If so, what does that suggest about where efforts can be focused to drive transformations in governance for more sustainable outcomes?

Defining the system under consideration as the space and processes embodied by public decision-makers and the institutions within which they act to deliver optimal public outcomes, this paper commences by empirically exploring the relationships between decision-making influences and leverage points. With these in hand, consideration is given to how leverage points might be deliberately used to encourage enabling manifestations of the decision-making influences. A key outcome of this consideration is the suggestion that decision-makers can and ought to apply tools that exercise leverage one point deeper in the leverage point hierarchy to drive system change. Finally, areas of caution are flagged,

Footnote 3 (continued)

functioning. Further, how these impact who has authority to consider and make a public decision and also government inertia (designed and unintentional) in responding to perceived needs for public decisions.

⁴ *Legislation*—the legal requirements acting as opportunities and barriers, such as inbuilt policy resilience.

⁵ *Personal characteristics of public decision-makers*—the skills, experience, attributes, and personal capabilities of public decision-makers. This includes their values and motivation, willingness or perceived ability to be frank and fearless, and self-perceived ability to influence public decisions.

⁶ *Engagement*—how (and if) communication with stakeholders occurs and the framing of that messaging.

⁷ *Framing*—discussed in the sense raised by Lakoff (2014), and Tversky and Kahneman (1981), and how it is used to present ideas more or less favourably.

⁸ *Complexity*—the array of considerations within and of decisions, and how this leads to increased uncertainty and public decision-makers feeling overwhelmed.

tempered by a recognition that the choices made through our governance systems today will heavily determine the nature of the Anthropocene⁹ experienced by future generations.

Methods

Identification of system variables

Public decision-making system variables or influences were identified previously through inductive thematic analysis of interviews conducted with 35 current or former public servants associated with the Victorian Public Sector (VPS). The VPS is the subnational civil service responsible for supporting the State of Victoria, one of Australia's six federated states. Participants ranged in seniority from frontline or street-level bureaucrats to organisational leaders, and collectively represented all 2017–18 Victorian government departments. Interview topics included decision-making approaches and considerations, definitions of evidence and sustainable development, awareness of the SDGs, and participant's suggestions of changes needed to enhance public decision-making. The interviews did not explicitly reference system leverage points or thinking, nor were participants explicitly asked to identify factors influencing their decisions which, as stated, were subsequently identified through inductive thematic analysis. The full list of decision-making influences and their definitions is provided in Appendix A.

Analysis of influence–leverage point relationships

The 40 decision-making influences identified through the prior thematic analysis were each considered in terms of their potential to act as each of Meadows' 12 system leverage points. This involved: (1) repeatedly reading the descriptions Meadows (1999, 2008) provides, in conjunction with the author-developed definitions for each decision-making influence and the interview text coded to those influences; (2) making annotations as to why a potential match was considered to exist or not; and (3) repeating the latter steps 4–7 days later to confirm the decision, until no further changes were recorded (this occurred after a fifth review). The final rationale for the matches made is included in Appendix B, and further debate on the matches identified through this process is welcomed.

The results of this latter process enabled simple calculation of the number of intersecting decision-making

⁹ Crutzen (2002) introduced the idea of the Anthropocene as a new geological age, arguing mankind's impact on the planet has become a 'significant geological force' which has shifted planetary functioning from the relatively stable functioning of the Holocene to unknown territory.

influences per leverage point (LP). Considering the number of matches as a marker of opportunities for the leverage points to be applied, the latter process similarly enabled consideration of which *leverage points* have the most potential to be active within the public decision-making system in Victoria.

Recognising the frailty of using a total numbers approach only, the literature was searched for other leverage point ranking methods and, finding nothing of relevance at the time, novel alternate ranking approaches were developed and tested. The most meaningful of these, a reverse linear weighting, applied Meadow's heuristic of a hierarchy to provide a comparative value to each leverage point. Leverage point 1, the power to transcend paradigms, having the most power to alter a system was given twelve points. LP2, the mindset out of which systems arise, being the second most powerful was given eleven points, and so on, down to LP12, constants, parameters, numbers, which, having the least power, was given one point. The number of intersecting decision-making influences per LP was then multiplied by these corresponding weights to better reflect Meadows' hierarchy within the ranking of leverage point prevalence in the VPS (i.e. leverage point 1: 12 weighted points \times 7 influences intersected = 84).

While still a simple measure and, as aforementioned, in some contexts the linearity it implies may not be reflective of systems functioning, for the purposes of a general comparative approach to the total number of matches, this weighted approach was found to be valuable. Assigning values to leverage points to enable ranking is also an approach taken by Egerer et al. (2021).

Results

Influences–leverage points relationships

Table 1 provides an overview of the influence–leverage point relationships identified. It illustrates that all decision-making influences have the potential to operate as multiple leverage points and vice versa. It further shows a universal relationship between influences and reinforcing feedback loops (LP7), and a near universal relationship between decision-making influences and the power to alter system structures (LP4).

An annotated rationale for each of the 220 identified relationships is included in Appendix B. The results of this analysis are likely to have applicability to other jurisdictions for two reasons: (1) participants spanned the gamut of roles, responsibilities, and policy areas, ranging in seniority from frontline or street-level bureaucrats to organisational leaders across the sector; (2) the Victorian Public Sector operates within a Westminster system of government and serves a

population of approximately 6.7 million people (ABS 2020), attributes which are likely to be reflected elsewhere.

Priority leverage points in the Victorian Public Sector

Ranking leverage points by the total number of related decision-making influences (Table 2, column 2, 'influences intersected') further demonstrates that LP7, reinforcing feedback loops (40/40 matches), and LP4, the ability to evolve or change the system (39/40 matches), are the most accessible leverage points within the public decision-making system in Victoria. 'Accessibility' is considered from the perspective of the number of opportunities to effect change on the system, as it could be argued that an increased number of opportunities to intervene makes a decision-making influence or leverage point more likely to be used and applied within governance processes, and, therefore, more practically valuable to decision-makers. The latter leverage points, LP4 and LP7, each have almost double the potential number of influence–leverage point interactions as the next, LP11, the size of buffers (22/40).

When the reverse linear weighting is applied, the power to alter system structures (LP4) and reinforcing feedback loops (LP7) remain the most dominant leverage points, followed by LP3, the origins of paradigms (see Table 2, column 4 'weighted ranking'). That is, when considered through the lens of the 40 influences decision-makers must contend with, the dominant leverage points under both frequency and weighted analysis are the ability to evolve or change the system (LP4) and reinforcing feedback loops (LP7).

Discussion

Leverage points as catalysts for enabling influences

This analysis found that the decision-making influences upon public decision-makers can clearly be linked to system leverage points. Where they are, one of the most striking things is the universal relationship between decision-making influences and reinforcing feedback loops (LP7), and the almost universal relationship between influences and the leverage point of self-organisation or system evolution (LP4). This is not to suggest that every influence reinforces the status quo or alters the system structure in the same way—a reinforcing feedback loop for *Ministers*¹⁰ would be different

¹⁰ *Ministers*—the position, interests, incentives, and capabilities of ministers (grouped, as ministers are not the primary focus of this research).

Table 1 Presence of relationships between leverage points and public decision-making influences

Leverage point (<i>attributed weight</i>)												
Influence	12. Constants, parameters, numbers (1)	11. Size of buffers (2)	10. Structure (3)	9. Length of delays (4)	8. Negative feedback loops (5)	7. Positive feedback loops (6)	6. Information flows (7)	5. Rules of the system (8)	4. Ability to evolve or change the system (9)	3. System goals (10)	2. Origins of paradigms (11)	1. Ability to transcend paradigms (12)
Alignment of SD and PDs	X					X			X		X	
Appetite for change	X			X	X	X			X			X
Businesses/non-govt. actors					X	X	X	X	X			
Central and review agencies	X				X	X		X	X		X	
Cognitive biases	X			X		X	X		X		X	X
Collaboration						X	X		X			
Commitment to concepts				X	X	X		X	X	X	X	
Complexity	X			X		X			X			
Culture	X			X	X	X			X		X	X
Economics	X				X	X	X	X	X	X	X	
Election cycles	X		X		X	X	X	X	X		X	
Engagement				X	X	X	X		X			
Evaluation	X			X	X	X	X		X		X	
Evidence	X			X	X	X	X	X	X		X	
Framing						X	X		X		X	X
Funding	X			X		X			X			
Governance	X		X		X	X	X	X	X		X	
Implementation				X		X	X		X			
Institutions	X		X			X		X	X		X	
Jurisdiction	X		X			X		X	X			
Leadership						X		X	X			X
Legislation	X		X	X		X	X	X	X			
Mandate				X		X		X	X			
Media				X		X	X		X		X	
Ministers			X			X		X	X			

Table 1 (continued)

Leverage point (attributed weight)												
	12. Constants, parameters, numbers (1)	11. Size of buffers (2)	10. Structure (3)	9. Length of delays (4)	8. Negative feedback loops (5)	7. Positive feedback loops (6)	6. Information flows (7)	5. Rules of the system (8)	4. Ability to evolve or change the system (9)	3. System goals (10)	2. Origins of paradigms (11)	1. Ability to transcend paradigms (12)
Paradigms	X	X				X		X			X	
PDMers' understanding	X	X				X			X			
PDMing considerations						X		X	X			
PDMing processes	X	X	X	X		X	X	X	X			
Personal characteristics of PDMers						X			X			X
Politics				X	X	X		X	X			
Public awareness				X	X	X			X			
R/ship—bureaucracy and ministers				X	X	X			X			
R/ship—PDMers and community		X		X	X	X			X			
Resources—capability/capacity	X	X		X		X			X			
Risk		X				X	X	X	X			X
Role of Gov	X	X	X			X	X	X	X	X	X	
Scale	X					X		X	X			
Strategic planning		X		X		X	X		X			
Time	X	X				X	X	X	X			
Total number of leverage point—Influence relationships	13	22	8	20	16	40	17	20	39	3	15	7

Notes: Definitions of each influence are provided in Appendix A. Influences intersecting with a leverage point are indicated by a cross (X). The weighting given to each leverage point is noted in italics in each column heading, and the number of leverage points intersected by each influence is noted in the bottom row

PDMing public decision-making, *PDMer* public decision-maker, *PDs* public decisions, *SD* sustainable development

Table 2 The prominence of leverage points intersecting with influences

Leverage Point (attributed weight)	Influences intersected (#)	Frequency ranking [^]	Weighted ranking [*]
12. Constants, parameters, numbers (1)	13	9	12
11. Size of buffers (2)	22	3	9
10. Structure (3)	8	10	11
9. Length of delays, relative to system change (4)	20	4	7
8. Negative feedback loops (5)	16	7	7
7. Positive/reinforcing feedback loops (6)	40	1	2
6. Information flows (7)	17	6	5
5. Rules of the system (8)	20	4	4
4. Ability to evolve or change the system (9)	39	2	1
3. System goals (10)	3	12	10
2. Origins of paradigms (11)	15	8	3
1. Ability to transcend paradigms (12)	7	11	6

Notes: values are formatted (coloured) to aid visual review of importance; blue are most important, white of middling importance and red of least importance. More vibrant colours indicate scale extremities

[^]Based on the total number of decision-making influences intersected; ^{*}weighting calculated by multiplying the attributed LP weight (i.e. assigning a score of 12 to LP1, a score of 11 to LP2, etc.) by the number of decision-making influences intersected

to a feedback loop for *Evidence*¹¹ or *Risk*.¹² Nevertheless, reinforcing feedback loops exist for all of the influences.

These commonalities shift consideration beyond which *influences* are best placed to stimulate system change, to which *leverage points* have the most potential to do so. That is, knowing the decision-making influences within this decision-making system, and that they can have both positive and detrimental impacts, we can turn our minds to which leverage points can be applied to encourage positive influence expression. The benefit of this is that, rather than focusing on determining which decision-making *influences* are most impactful and determining how to individually master all forty of them to activate transformations, efforts can instead be applied to particular *leverage points* to simultaneously drive change across multiple influences and throughout the decision-making system. For example, if a concerted effort were made to identify, confirm and, where necessary, alter reinforcing feedback loops within the public decision-making system, the behaviour and outcomes of multiple if not all influences within that system would be altered.

In a way, this approach is trying to achieve the same outcome as Abson et al. (2017). In exploring the potential to group leverage points based on shared characteristics (intent, design, feedbacks, and parameters), they mused that further

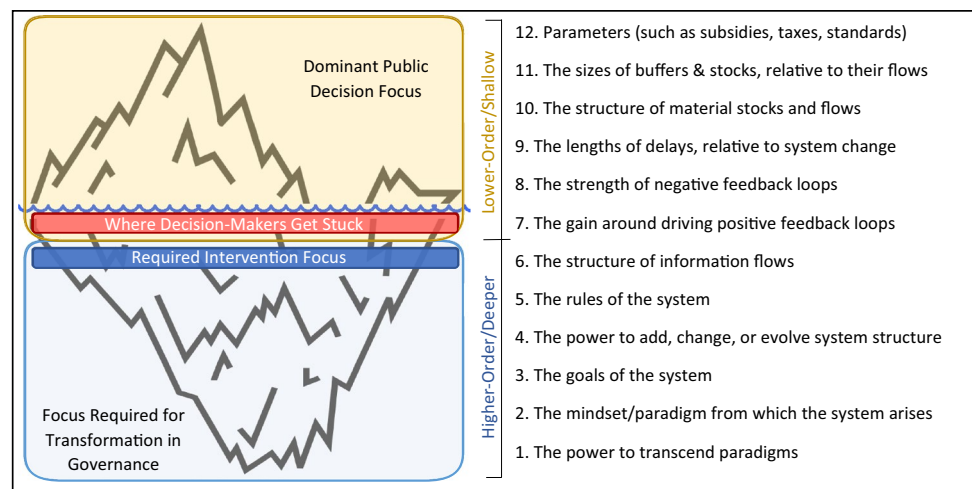
research is needed to determine if there is a differentiated effect between a single or combined leverage point focus. The suggestion here is that a single lever focus reflecting an aggregation of *influences* upon public decision-making may be more transparent and impactful. That is, a single lever approach may make it easier to identify existing path dependencies and the likely flow-on impacts of deliberate system change. A single leverage point focus may also see attention *on* the whole system rather than subcomponents *within* it (Kim 1999), giving rise to greater appreciation of the overall context and synergies. Similarly, a deliberate choice to apply a single leverage point across all or many decision-making influences may streamline the focus of system reformers enhancing efficiency through reduced need to identify and corral the ‘energy for change’ recognised as necessary by Birney (2021).

But which leverage point ought to receive this attention? Applying a purist approach, one would adopt the leverage point hypothesised to be most impactful, transcendence of paradigms (LP1). However, transcending paradigms within public decisions is arguably out of reach for many public servants and thankfully so, as some might question the legitimacy of non-elected officials seeking to drive transcendence of paradigms within public decisions (Leventon et al. 2021a). Returning to the findings here, one could apply the leverage points that all or most of the decision-making influences are interacting with, the power to alter system structures (LP4) and reinforcing feedback loops (LP7). However, given that any change made within these leverage points would still be operating at the level of the existing dominant

¹¹ *Evidence*—consideration of evidence or information in decision-making, what ‘counts’ as evidence (e.g. qualitative and quantitative), and availability of data.

¹² *Risk*—Appetites for taking decisions outside of tried-and-true approaches, and behaviours driven by an avoidance of criticism.

Fig. 1 A conceptual model of how to address problematic reinforcing feedback loops, within the context of Meadows' (1999) leverage point hierarchy (right) and the popularised iceberg model



system dynamics, it is arguable that the system will respond by seeking to restore its current equilibrium.

Perhaps instead, efforts could be focussed on the leverage points one step deeper than each of those considered to have the potential to be universally active within the current decision-making system (i.e. LP4 → LP3; LP7 → LP6) (see Fig. 1). As is discussed in the following sections, applying a deeper leverage point in this way could drive system change by effectively disturbing the status quo just enough to override it. Hence, a one-deeper approach may balance the practical constraints and considerations of decision-making within public institutions with the need for transformation in governance, in a democratically sound way.

Altering system structures with altered system goals

As noted, almost all influences have the potential to alter system structures (LP4), thus LP4 is a lever with the potential to be highly impactful within current governance arrangements. Focussing on the next leverage point deeper in the hierarchy to change or clearly restate system goals (LP3) will provide opportunity to deliberately construct a holistic narrative for action around which the system will respond and likely shift. If this approach were desired, then a focus on the decision-making influences identified as having the potential to alter system goals (i.e. *Economics*,¹³

Role of Government,¹⁴ and *Commitment to Concepts*¹⁵) could help.

For example, while our policy-making commitment to the concept of sustainable development is questionable at times (Bolton 2021; Sachs et al. 2021), advocacy and affirmation of it continues. Furthermore, agitation for an altered focus on economics and the role of government are increasingly visible in both academic and government circles. For example, there are now a proliferation of people (Jackson 2009, 2021; Piketty 2014; Bregman 2016; Raworth 2017; Cottam 2018; Trebeck and Williams 2019; Coscieme et al. 2019; Mazzucato 2021) and even some governments (Wellbeing Economy Alliance 2021; New Zealand Government 2019) looking to change economic paradigms, and reaffirm the role of government to enhance efforts toward a just and prosperous life for all. Similarly, regulatory practice has been seen to evolve from prescription to co- and self-regulatory regimes (Sparrow 2020) and even general duties (Edwards et al. 2020). Hence, it seems there is some recognition of the systemic impact altered expression of the decision-making influences of *Economics*, the *Role of Government*, and *Commitment to Concepts* has upon system goals, and a preliminary willingness to deviate from current paths. Revisiting system goals may also have additional benefits, such as stimulating a virtuous cycle to alter or at least revisit the acceptability of the mindsets which led to our current system. However, while noble and potentially quite effective, as demonstrated by the incorporation of such considerations in

¹³ *Economics*—Understanding and application of different schools of thought, growth as a goal, externalities, monetary/financial costs, and Maslow's hierarchy of needs.

¹⁴ *Role of government*—conceptions of the purpose of public decision-makers and government as a whole, and the impact this has on licenses to act and individual decisions to influence (or not) particular outcomes.

¹⁵ *Commitment to concepts*—acceptance and application of sustainable development or the SDGs, reflections on the application and impact of these concepts/tools on public decision-making.

formal public decisions (New Zealand Government 2019), few public servants will feel comfortable driving changes in system goals without already having some indicative authority to do so from elected or senior officials. That is, even if it is theoretically possible for public servants to alter system goals, individuals' core beliefs or wider societal norms on the role of the public sector may prevent them from doing so (Sabatier 1987), suggesting this leverage point is also inaccessible to many public decision-makers.

Addressing reinforcing feedback loops through altered information flows

The association of recurring reinforcing feedback loops with each decision-making influence in this system explains why switched-on, well-meaning, self-efficacious, public decision-makers may give up on achieving stated objectives. Having repeatedly hit up against these loops they reason there is nothing more they can do. To use the iceberg analogy, reinforcing feedback loops sits just below the water line—If we look, we can see them but, we do have to look, and, when we do, we may struggle to see beneath them with our existing tools. Encouragingly, considering the relationships between influences and leverage points (Table 1) once again highlights other levers exist. Shifting governance attention one point deeper, from reinforcing feedback loops (LP7) to the structure of information flows (LP6), may aid managed disruption of the underperforming status quo.

Conveniently, some significant, accessible, and well-recognised decision-making influences, such as *Cognitive biases*,¹⁶ *Collaboration*,¹⁷ *Engagement*,¹⁸ *Evaluation*,¹⁹ *Evidence*,²⁰ and *Framing*,²¹ have the potential to alter information flows. Similarly, a focus on altered information flows is also an approach that aligns with popular and ever-increasing calls for evidence-based or informed decision-making to be an integral part of public decision-making processes (OECD 2020; Head 2008). Moreover, practical examples of an altered information flow approach already exist. For

example, cross-government networks that facilitate information exchange and learning (both across and within jurisdictional boundaries), staff-led initiatives to focus attention on desired objectives (Bryant and Thomson 2021), and investment in improved data management systems (EPA 2013, 39; VAGO 2013, 19–20). There is also increasing interest and appetite for the use of technology as potential decision-making aids (PC 2020).

As fields which excel in collecting and presenting information in novel ways, artificial intelligence (AI) and data science provide an array of example tools which could sit within an information flow altering toolbox. By providing new pathways for existing or previously uncollected data to reach decision-makers in novel and status quo-disrupting formats, these technologies can shift the governance focus above reinforcing feedback loops (Miller 2020).

Brenner (2012) notes a risk of 'drowning in a sea of data and thirsting for some theoretical framework with which to understand it'. AI and advanced data science tools can help avoid this trap. These tools excel at creating novel information flows to connect information (new or pre-existing) and decision-makers in new ways. These flows draw attention to hereto unrecognised knowledge and enable robust predictions and assessment of possible futures. In doing so, they better position decision-makers to make informed, holistic policy improvements. For example, Bayesian networks, a form of causal probabilistic modelling, can cut through intractable data-collection loops to identify and rationalise priority interventions. This enables decision-makers to shift their focus from data collection and analysis to the business cases for one to two calculated front runners. Further, applying approaches in a modelled context first, per the Bayesian Network example, may provide additional comfort to decision-makers looking to employ LP-informed approaches. Such modelling provides timely, but safe opportunities to test and explore solutions before implementing them at scale or directly within the community. At a grander scale, the UK Ministry of Justice has commenced linking tens of millions of data records to better understand interaction patterns within their social and criminal justice systems to enable a more holistic approach to identifying 'what works' (ADR UK 2021; Office for National Statistics 2021). If successful, this approach could mark a shift towards more fully understanding the impact public institutions and point in system decisions have on individual's life trajectories, and where changes in well-meaning but ultimately poor decisions and processes are required.

Examples such as these ought to provide confidence to public decision-makers that enhancing information flows (LP6) is an accessible, yet systematically deep, leverage point which can be adopted or at least piloted more widely. However, while AI and advanced data science hold much promise, the latter example applications are far from the norm, and ultimately a suite of tools that support enhanced and novel

¹⁶ *Cognitive biases* defined here as, "Heuristics, personal anecdotes and pain points that influence decisions, and their associated unintended consequences."

¹⁷ *Collaboration* defined here as, "How actors work together, particular public decision-makers and parliamentarians."

¹⁸ *Engagement* defined here as, "How (and if) communication with stakeholders occurs and the framing of that messaging."

¹⁹ *Evaluation* defined here as, "Both consideration or focus on outcomes and evaluation of public decisions".

²⁰ *Evidence* defined here as, "Consideration of evidence or information in decision-making, what 'counts' as evidence (e.g. qualitative and quantitative), and availability of data."

²¹ *Framing* defined here in the sense raised by Lakoff (2014), and Tversky and Kahneman (1981), and how language is used to present ideas more/less favourably.

information flows is needed to cater to the varied needs and appetites of differing decision-makers in differing contexts.

The need for caution

There is, of course, a need for caution when intervening in systems and to be particularly cognizant of proverbial butterfly wings in generating change elsewhere. Any plans to intervene may benefit from a third-party reference group or steering committee, providing advice but not approvals, to ensure those leading systems work do not lose sight of critical connections and consequences.

Still, systems are constantly incrementally changing, whether by design or in response to shifts within the other systems they are a part of. Further, part of our governance considerations when choosing whether or not to ‘dance’ with system change must be whether existing systems are fit for purpose and operating as desired. As articulated earlier, this is arguably not the case in relation to governance for and of sustainability transformations.

Further, consideration of what our institutions need to be and do to facilitate a good Anthropocene must focus not just on the how and the what of our institutions, but also the when. The sixth IPCC Report (2021) notes both, “climate change is already affecting every inhabited region across the globe with human influence contributing to many observed changes in weather and climate extremes”, and that, “global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered”, because, “there are already substantial committed changes associated with past greenhouse gas emissions”. More succinctly, there is little time to act. In the context of the Anthropocene and the planet’s threatened tipping points, there is a need for well-considered and efficient catalysts of change now.

Given the need for caution in stimulating transformative system change, limited time in which to undertake those transformations before further adverse consequences are ‘locked in’, existing decision-making influences inhibiting those necessary transformations, and, public servants’ (dis) comfort with their role in such transformations, it would seem prudent to focus on holistic, efficient, transparent, and accessible mechanisms for change to our governance systems. Altering information flows can meet these criteria.

Making space for public decision-maker agency

Hypothetically, enhancing information flows (LP6) overcomes a critical driver of disappointing public decisions, reinforcing feedback loops (LP7). Enhancing information flows also appears to be a more accessible lever to everyday bureaucrats and therefore more likely to be mainstreamed within business-as-usual decision-making than changes to system goals (LP3): it is one thing to challenge reinforcing

feedback loops within your decision-making sphere, but quite another to question dominant societal paradigms.

Starting with more accessible levers may act as a gateway to alter public decision-maker mindsets and empower them to see their influence and role-modelling potential within the system (Nielsen et al. 2021). This may also enable greater consideration of the how and why of decision-maker, community, and organisational values (Horcea-Milcu et al. 2019), allowing the ‘inner dimensions’ described by Woiwode et al. (2021), as well as more traditionally focussed upon techno-scientific advances, to begin to influence sustainability transformations.

In time, by demonstrating the value and pathway to employing deeper leverage points, introducing novel information flows (LP6) may engender greater comfort and authorisation for public decision-makers to embrace deeper leverage points. It may also see greater application of what Newell et al. (2021) refer to as ‘spiral’ scaling of transformation, where the pathway forward involves dynamic shifts between the use of shallow and deep scale interventions, pending the outcomes of public decision outcomes along the way—a leap—consolidate—repeat approach to transformation. That is, applying a one deeper approach now may help stretch us beyond the use of systems thinking as a framework for navigating current paradigms toward a broader realisation of the nested nature of the systems within which we live and work (Leventon 2021a, b).

In the meantime, creating a toolbox of approaches that can be employed across a range of public decision-making settings may empower public decision-makers to exercise their individual agency to apply tools one step deeper. Doing so may disrupt the reinforcing feedback loops that have prevented the achievement of collective aspirations and set transformations *in* governance in motion.

Conclusions

Humanity is at an inflection point: business as usual is not possible if the well-being of current and future generations is to be secured. Continuing to careen down a road of unsolved complex issues risks a significant question for democracy and public institutions: if governments and societies do not endeavour to improve imperfect things for the betterment of all, what is their role?

This paper sought to explore how transformations *in* governance might be enabled. The suggestions here are not posited to usurp or upend existing democratic processes, quite the opposite. The core objective of this research is to enable democratically expressed aspirations to be realised within the realities of our governance and planetary systems. It couples: prior research identifying barriers to public decision-making *for* and *of* the sustainability transformations global, national and subnational governments have

repeatedly reaffirmed; calls to increase empirical research on applications of Donella Meadows' leverage point framework within sustainability science; and the recent Earth System Governance transformation agenda.

Influences upon public decision-makers were repeatedly linked to Meadows' framework, enabling a better understanding of which leverage points are currently dominant within the public decision-making system of Victoria. It is clear in this assessment that two moderately to highly powerful leverage points are routinely present within Victoria's governance system: reinforcing feedback loops and the ability to alter system structures.

With this knowledge in hand and reflecting on Meadows' core leverage point argument (that higher-order influences are harder to apply but also more impactful), this paper contends that employing tools reflecting leverage points one step deeper in the hierarchy may enable decision-makers to disrupt current system machinations.

It would be remiss not to acknowledge that there is danger and unpredictability in system change, certainly there is a danger that the leverage point framework cannot be applied with the linearity implied. However, it is also imperative to consider the very real and well-recognised risks of not altering the unsustainable trajectory current governance systems enable. While deploying deeper leverage points would require careful planning and orchestration to anticipate and mitigate perverse outcomes, doing so would likely prove transformational and deliver efficient, transparent, change in a time frame better reflecting the urgency of the complex challenges facing decision-makers today. Moreover, if little else, enhancing information flows ought to help drive improvements in the evidence-base of our public decisions.

Employing an approach which enhances information flows within public decision-making processes through the increased use of existing and novel approaches appears to be a relatively accessible and benign way to achieve stated public objectives. A future research agenda could look to confirm or dispel the one step deeper model through the identification and piloting of a suite of information flow enhancing tools. Having a suite would enable the uptake of deeper leverage points in a way that best fits the decision-making context and personal agency of the decision-makers involved. Enabling public decision-makers to counteract dominant feedback loops in democratically sound ways may just be the lever needed to master the influences currently holding them, and us, back from achieving our goals for sustainable development and a good life for all.

Appendix A: Influences and their definitions

Definitions of the 40 influences (identified through inductive thematic analysis of 35 public servant interviews) are as follows:

Alignment of sustainable development and public decisions—reflects discussion on assumptions about alignment between sustainable development (SD) or the sustainable development goals (SDGs) and public decisions (PDs), as well as considerations and perspectives on the principles of SD.

Appetite for change—talks to expectations, willingness or calls for change, i.e. alignment with social values, how compatible SD is with other values, and the recognition of need for the SDGs within Australia.

Businesses/non-government actors—applications of ESD by actors with influence outside of government and lobbying of government by those actors.

Central and review agencies—the role of central and pain points that influence decisions, and their associated unintended consequences.

Collaboration—how actors work together, particularly public decision-makers and parliamentarians.

Commitment to concepts—acceptance and application of sustainable development or the SDGs, reflections on the application, and impact of these concepts/tools on public decision-making.

Complexity—within and of decisions, how this leads to increased uncertainty and public decision-makers feeling overwhelmed.

Culture—considerations of culture, people or frameworks, and their impact on public decision-making practices.

Economics—understanding and application of different schools of thought, growth as a goal, externalities, monetary/financial costs, and Maslow's hierarchy of needs.

Election cycles—the impact of elections on decision-making and actor's behaviours.

Engagement—how (and if) communication with stakeholders occurs and the framing of that messaging.

Evaluation—both consideration and focus on outcomes and evaluation of public decisions.

Evidence—consideration of evidence or information in decision-making, what 'counts' as evidence (e.g. qualitative and quantitative), and availability of data.

Framing—covers framing in the sense raised by Lakoff (2014), and Tversky and Kahneman (1981), and how it is used to present ideas more/less favourably.²²

Funding—availability of economic resources to facilitate public decisions to be made and implemented.

Governance—arrangements within and across public decisions to ensure their rigour, such as accountability, KPIs and transparency.

²² Lakoff, George. 2014. *The All New Don't Think Of An Elephant*. USA: Chelsea Green Publishing.

Tversky, Amos, and Daniel Kahneman. 1981. "The Framing Of Decisions And The Psychology Of Choice." *Science* 211:453–458. <https://doi.org/10.1126/science.7455683>.

Implementation—putting decisions into practice, including whether stakeholders have the capabilities necessary and expected of them to achieve the desired outcomes.

Institutions—characteristics of the machinery of government, such as the Victorian Public Sector and departments and agencies within it as individual and combined institutions, as well as the structure of those institutions and administrative tools to support their functioning, plus how these impact who has authority to consider and make a public decision and also government inertia (designed and unintentional) in responding to perceived needs for public decisions.

Jurisdiction—consideration of where the Head of Power for a decision sits across jurisdictions, as well as how that impacts willingness to act.

Leadership—covers the concept of leadership as well as the need or demonstration of leadership by individuals, senior officials, ministers and/or organisations.

Legislation—legal requirements acting as opportunities and barriers, such as inbuilt policy resilience (inertia).

Mandate—the provision or lack of authority (e.g. crises, external scrutiny, political/party driven, expectations and responsibilities conferred on organisations) to make a decision in a particular area.

Media—presence, use and impact of the media in shaping public decisions.

Ministers—the position, interests, incentives, and capabilities of ministers (grouped, as ministers are not the primary focus of this research).

Paradigms—the impact of established ‘rules’ within a society that govern the way it thinks and acts in determining what is possible within public decision-making, including the presence of luck or serendipity, and focus on the short-term (*n.b.* growth is covered separately under economics).

Public decision-makers’ understanding—public decision-makers’ understandings (including definitions) and awareness of sustainable development and the SDGs, including confusion with one another and the Millennium Development Goals (MDGs).

Public decision-making considerations—success of prior or parallel projects, availability and reliance on technology, and government priorities (including overall public decision-making goals, competing priorities across portfolios, the comparative priority of ESD and SDG impacting their status as goals within decisions). Also includes less commonly mentioned factors considered in making public decisions.

Public decision-making processes—the stages and act of making public decisions, from understanding and follow through of the whole public decision-making process to individual components such as problem definition, options identification and analyses, and recognition of the importance of separating stages to retain objectivity. Also includes the transparency of the process and how it is communicated within briefing notes.

Personal characteristics of public decision-makers’—the skills, experience, attributes, and personal capabilities of public decision-makers. This includes their values and motivation, willingness or perceived ability to be frank and fearless, and self-perceived ability to influence public decisions. For example, dichotomies were present between those felt they could have meaningful impact, compared to those who felt their impact was tightly constrained and/or that it was not their role to try to influence outcomes.

Politics—the impact of political beliefs, gameplay, party dynamics, power struggles and allegiances.

Public awareness—public understanding, awareness of and support for SD or the SDGs.

Relationship between bureaucracy and ministers—how public decision-makers and their ministers interact and view each other.

Relationship between Public decision-makers and community—how public decision-makers and the community interact and view each other, the trust between them and the impact of this on connections between them.

Resources—capability/capacity—the amount of full time equivalent (FTE) staff available and the relevance of their skills and experience to the task at hand, as well as the use of consultants and citizen scientists to undertake work considered to be within the remit of public decision-makers. Also, a general catch all for where ‘resources’ are mentioned outside of the context covered in other resource-relevant influences (e.g. around data, funding, time, institutions).

Risk—appetites for taking decisions outside of tried-and-true approaches, and behaviours driven by an avoidance of criticism.

Role of public decision-makers/government—conceptions of the purpose of public decision-makers and government as a whole, and the impact this has on licenses to act and individual decisions to influence (or not) particular outcomes.

Scale—the size of problems requiring public decisions.

Strategic planning—proactively utilising processes to anticipate future policy needs and drive consideration of a more strategic than reactive view, culminating in reports that set agenda and measurable goals.

Time—both as a capacity-limiting resource and as a consideration within public decisions.

Appendix B: Influences and leverage points

Detailed annotations as to why influences were deemed to act or have the potential to act as leverage points. Connections are based on the question, *Does the influence act as (or have potential to act as) as a Leverage Point in public decision-making for sustainable development?*

Influence	Leverage point	12. Constants, parameters, numbers	11. Size of buffers	10. Structure	9. Length of delays, relative to system change	8. Negative feedback loops	7. Reinforcing feedback loops	6. Information flows	5. Rules of the system	4. Ability to evolve or change the system	3. System goals	2. Origins of paradigms	1. Ability to transcend paradigms
Alignment of sustainable development (SD) and public decisions	Assumptions stabilise/reinforce the status quo, but also create inconsistencies in application of sustainable development or the SDGs as different assumptions persist	Not directly considering SD in decisions perpetuates assumptions about what the SD/SDGs are. Further, arriving at an accepted decision without actively looking for alignment with SD/SDGs, rewards not looking for alignments and encourages future decisions to also avoid doing so	Challenging assumptions would enable gaps to be identified, leading to sustainable change	Culture of assumed alignment between policy objectives and SD/SDGs									
Appetite for change	Determines responsiveness of change	Hard to predict, crises can act to create 'jumpiness', but typically collective appetite is slow to change/operating at a different speed to the system	Determines rate of response to undesirable outcomes	Presents in multiple ways pending culture: fear of change, comfort with status quo, constant desire for new, relentless change seeking out utopian comfort. Once established creates cycle that persists	Creates/prevents opportunity to change the system								There are no limits on what can be, if it is wanted

Influence	Leverage point	12. Constants, parameters, numbers	11. Size of buffers	10. Structure	9. Length of delays, relative to system change	8. Negative feedback loops	7. Reinforcing feedback loops	6. Information flows	5. Rules of the system	4. Ability to evolve or change the system	3. System goals	2. Origins of paradigms	1. Ability to transcend paradigms
Businesses/ non-government actors						(Where disagreeing) advise decision-makers where outcomes are not what is desired; impact tends to be moderated by how confident actors are	Lobby decision-makers to get desired outcomes, success encourages future lobbying of decision-makers	Share/with-hold information that informs public decisions	Able to influence the rules	Can lobby and influence change to occur/hot			
Central and review agencies		Act to pull agencies and departments together in the same direction (create consistency and resistance to 'jumpiness')				Advise decision-makers if decision is missing something/if implementation is not achieving desired outcomes	Belief that departments are achieving SD means consideration of SD is not required by central/review agencies, resulting in such considerations being deprioritised by departments relative to other mandated/checked consideration		Set rules for the public sector and decision-making within it	Able to drive change in system due to role and figurative proximity to department		Advise and reinforce how and what the public sector ought to think about, focus on and approach its work	

Influence	Leverage point	1. Ability to transcend paradigms	2. Origins of paradigms	3. System goals	4. Ability to evolve or change the system	5. Rules of the system	6. Information flows	7. Reinforcing feedback loops	8. Negative feedback loops	9. Length of delays, relative to system change	10. Structure	11. Size of buffers	12. Constants, parameters, numbers
Cognitive biases	Lock in thinking	Challenging biases allows them to be broken	Heuristics mould new information to fit existing conceptions of the world		Recognising them allows for evolution		Impact how information is recognised, received, and used	Heuristics reinforce thinking		Heuristics slow and obfuscate information moving in the system			
Collaboration					Can drive innovation		Increase opportunities for information exchange	Where teams experience groupthink/lack of diverse views, false/limited beliefs can be reinforced	Provide opportunity to learn what is/ not working and desired	Determines rate of response			
Commitment to concept of sustainable development			Potential to create new paradigms via recognition of finite planet and inequalities	Commitments form the system goals	Impacts ability to challenge unaligned system goals	Commitments reflect/shape system rules		Level of commitment to SD drives action toward/away from SD					
Complexity	Greater complexity yields a greater number of parameters to consider, and to drive/inhibit action				Provides multiple opportunities and permutations for change, determines types of evolution possible			Where issues seem overly complex, attempts will not be made to holistically address them, leading to reduced understanding of situations and greater belief that situations are too complex to holistically address		Increases difficulty of predicting delay effects: can slow/unexpectedly speed up the system			

Influence	Leverage point	1. Ability to transcend paradigms	2. Origins of paradigms	3. System goals	4. Ability to evolve or change the system	5. Rules of the system	6. Information flows	7. Reinforcing feedback loops	8. Negative feedback loops	9. Length of delays, relative to system change	10. Structure	11. Size of buffers	12. Constants, parameters, numbers
Culture	Determines how we respond to a change or opportunity to act; how we work together impacts the flow of information and action in the system	Can facilitate collective transcendence of paradigms	Petri dish for what is accepted, determines mindsets of decision-makers, influences stakeholder responses	Economic prosperity (often flated with growth) seen as goal	Determines ability and likelihood of changing what the rules are	Markets and economic standards determine what ought to be considered and happens in response to a public decision	Application of diverse array of economic considerations through fields such as behavioural economics	The more people think/ behave one way, the more others are encouraged to think/ behave that way, reinforcing belief the thoughts/ actions of the first group are right	Can act as a measure of the health of decision-making activities	Impacts rate of action and information exchange within the system			
Economics	Provides many of the constants, parameters and metrics within Westminster decision-making		Success of neoliberal perspectives in the second half of the twentieth century		Differing schools of economic thought can influence the shape of the decision-making system in differing directions		Increased focus on growth drives fixation on growth at expense of other understandings of the breadth and possible applications of economics	Market can act as a measure of public decision success or failure					Dominant paradigms of, and use within decision-making, provide stability to how the system operates

Influence	Leverage point	1. Ability to transcend paradigms	2. Origins of paradigms	3. System goals	4. Ability to evolve or change the system	5. Rules of the system	6. Information flows	7. Reinforcing feedback loops	8. Negative feedback loops	9. Length of delay, relative to system change	10. Structure	11. Size of buffers	12. Constants, parameters, numbers
Election cycles	Timing of elections form constraint in which decision-making is considered	Set expectations around what is possible and when; opportunity for new paradigms to emerge			Provide opportunity to re-evaluate what is important	Determine who has control of the rule book and for how long	Catalyst for hiding or providing information	Cycle drives thinking and public decisions aligned with the cycle, and rewards those who offer public decisions that marry with it (i.e. decisions that can be made and implemented in one cycle)	Source of feedback on what is desired, and whether goals are perceived to have been met		Fixed evaluation mechanism		
Engagement					Provides opportunity to create new structures, flows and feedback loops		Brings new information into system	Arriving at an accepted decision based on "targeted" engagement, encourages future decisions to rely on that "targeted" audience or a similarly small cohort	Provides opportunity to learn what is/ not working and desired	Can enhance or delay receipt of feedback or inhibit timely decisions			
Evaluation	Allows for gradual change rather than shocks				Catalyst for system change		Drives information capture and altered behaviours	Limited evaluation reduces ability to recognise the benefits of evaluation, leading to less evaluation	Allows for correction of system	Timeliness of, determines ability to know if a decision is having the desired effect			

Influence	Leverage point	1. Ability to transcend paradigms	2. Origins of paradigms	3. System goals	4. Ability to evolve or change the system	5. Rules of the system	6. Information flows	7. Reinforcing feedback loops	8. Negative feedback loops	9. Length of delays, relative to system change	10. Structure	11. Size of buffers	12. Constants, parameters, numbers
Evidence	Provides information about the system (sets hard parameters)	Informs, and is informed by, what is accepted as 'true'	Largest source of new information to the system, which can challenge understandings and change narrative of what is important and how system ought to operate	Determines what is, e.g. natural laws	Can create new loops if it is available, accessible, useable, cleansed, meaningful, and complete	Arriving at an accepted decision based on limited or subjective evidence, can encourage future decisions to also rely on limited or subjective evidence	Negative feedback is by definition evidence	Accessibility and timely use of information determines the length of delays	Timeless of, relative to identified need	Amount committed, shapes scope of possible change	Accessibility to, determines rate at which system can operate		
Framing		Enables the storyteller to shape the stories to be whatever they want them to be	Introduces or changes narratives on what is important, and overall functioning of the system	Presenting or signaling only part of the information creates asymmetries	Successfully presenting arguments in a particular perspective, rewards that perspective and discourages consideration or future presentations of other perspectives	Limited funding reduces ability to intervene, limited demonstrable intervention can lead to further reduced funding							
Funding													

Influence	Leverage point	1. Ability to transcend paradigms	2. Origins of paradigms	3. System goals	4. Ability to evolve or change the system	5. Rules of the system	6. Information flows	7. Reinforcing feedback loops	8. Negative feedback loops	9. Length of delay, relative to system change	10. Structure	11. Size of buffers	12. Constants, parameters, numbers
Governance	Stabilises system by locking in what is acceptable, limiting reactionary change	Reinforces what is accepted, shapes decision-maker mindsets	Can alter who has power, and the approach taken to operate the system	Determines who is responsible for what	Requires documents to approach altered behaviour	Less transparency drives less accountability	Drives accountability	Determines how subsystems operate					
Implementation			Purpose is to enact change in the system; better implemented programs evolve	Opportunity to gather and test information	The more that is delivered that more that is expected		Timeliness of, relative to identified need						
Institutions	Act to pull agencies/departments together in the same direction (create consistency across decision-makers)	Reinforce what is accepted, determines mindsets of decision-maker	Power to create new structures (e.g. machinery of government changes); or, limit change	Determines who is responsible for what	Institutional inertia/enduring nature drives conservatism/status quo	Locks in thinking (like mortar holding pipes in place)							

Influence	Leverage point	1. Ability to transcend paradigms	2. Origins of paradigms	3. System goals	4. Ability to evolve or change the system	5. Rules of the system	6. Information flows	7. Reinforcing feedback loops	8. Negative feedback loops	9. Length of delays, relative to system change	10. Structure	11. Size of buffers	12. Constants, parameters, numbers
Jurisdiction	<p>Provides consistency on which matters are considered by whom to what degree within the system</p> <p>Head of power determines if/where public decisions can proceed, i.e. sets structures</p>				<p>Where unclear/not being exercised, other jurisdictions can choose to act (e.g. States creating policy in absence of national policy; Tas Dams Case)</p>	<p>Determines who is responsible for what</p>		<p>Inaction because of a belief that another jurisdiction is responsible (without reviewing the Head of Power) will leave control of the issue (perhaps falsely) with a particular jurisdiction, and inaction by other jurisdictions will continue</p>					
Leadership					<p>When exercised can innovate/challenge status quo, and drive change</p>	<p>When exercised can set what the rules are and who has control/influence over them</p>		<p>Leads to greater un/certainty and reduced/increased respect for those considered to be in leadership positions, making it harder/easier for leaders to obtain the authority to exercise leadership</p>					
			<p>Ability to challenge or reinforce paradigms</p>										<p>Great leaders able to lift those around them above paradigms, and see leadership as action rather than role</p>

Influence	Leverage point	12. Constants, parameters, numbers	11. Size of buffers	10. Structure	9. Length of delays, relative to system change	8. Negative feedback loops	7. Reinforcing feedback loops	6. Information flows	5. Rules of the system	4. Ability to evolve or change the system	3. System goals	2. Origins of paradigms	1. Ability to transcend paradigms
Legislation	Can act as a constant where there is resistance to legislative change	Legislative inertia, regulatory timelines	Articulates goals and sets out how to achieve them (inherent part of Westminster system)	Timeliness of legislative change to reflect needs of system	Where legislative tools are unused or unreviewed, there is (often) no provocation to consider if they should be used or reviewed	Can create information requirements	Set out the shared ideas of society	Can be remade if desired. Sunsetting requirements prompt consideration to evolve					
Mandate				Timeliness of mandate to reflect system needs and change	Mandate to act drives action which, if done well, generates additional mandates		Reinforces system rules	Provides impetus for change where inconsistent with existing paradigms					
Media				Responsiveness to report on an issue drives speed with which decisions are made	Media interaction increases and likelihood of media attention; also, reflects back what activities are received positively, encourages more of those activities	Role is to share info/ act as clearing-house and interpreter of info. Changing nature of media and media cycles leads to changed decision-maker behaviour/information loops	Highlight system weaknesses, catalyst for change	Reinforce/question what is accepted					

Influence	Leverage point	12. Constants, parameters, numbers	11. Size of buffers	10. Structure	9. Length of delays, relative to system change	8. Negative feedback loops	7. Reinforcing feedback loops	6. Information flows	5. Rules of the system	4. Ability to evolve or change the system	3. System goals	2. Origins of paradigms	1. Ability to transcend paradigms
Ministers				Key decision-makers turn the system on/off, facilitate system goals			Actions that retain or improve party standing and electoral support encourage actions to retain standing/support	Pending seniority can set the rules		Have strongest ability to change the system, within party/societal acceptance limits. Desire for legacy can lead to system change			
Paradigms	Act as constants	Level of acceptance and embeddedness of paradigms determine how responsive the system is to new ideas and pressures				Current thinking locks in rewarding and perpetuation of those paradigms		Set the limits of rules, shape them, and inhibit different thinking (existing paradigms do not want to be changed)				Establish what society believes to be the goals, and why	
Public decision-makers' understanding	Degree of openness determines whether action is proposed/taken (closed mindsets can act as a limiting constant)	Greater knowledge levels act to limit under/overreactions				Limited understanding (closed-mindedness) reinforces thinking and actions, and decreases likelihood of seeking to increase/broaden understanding				Improved understanding/awareness of opportunities can lead to increased innovation, or recognition of need for evolution			

Influence	Leverage point	1. Ability to transcend paradigms	2. Origins of paradigms	3. System goals	4. Ability to evolve or change the system	5. Rules of the system	6. Information flows	7. Reinforcing feedback loops	8. Negative feedback loops	9. Length of delays, relative to system change	10. Structure	11. Size of buffers	12. Constants, parameters, numbers
Public decision-making considerations	<p>Prioritising x over y, sees more emphasis on x and greater priority given to it going forward</p> <p>Influence what is seen as important/ the constraints decision-makers work in</p> <p>Provide opportunity to discuss alternate visions for what and how things are done; documented success elsewhere gives confidence to try change locally</p>												
Public decision-making processes	<p>(Should) act as constants, however, often aren't employed consistently</p> <p>Provide consistency to limit kneejerk reactions</p> <p>Facilitate operation of structure</p> <p>Speed of processes determines relative delays</p> <p>(Not) following process and arriving at an accepted decision, rewards (not) following process in future</p> <p>Determine trajectory of decision-makers outputs, self-confidence, self-determines future trajectories</p>				Processes such as options identification and evaluation drive consideration of alternate approaches <p>Determine who, what and how decisions can be made, and scope for change</p>								
Personal characteristics of public decision-makers					Self-belief/ belief in ability to effect change drives attempts to do so								

Influence	Leverage point	12. Constants, parameters, numbers	11. Size of buffers	10. Structure	9. Length of delays, relative to system change	8. Negative feedback loops	7. Reinforcing feedback loops	6. Information flows	5. Rules of the system	4. Ability to evolve or change the system	3. System goals	2. Origins of paradigms	1. Ability to transcend paradigms
Politics		Drives speed with which decisions are made	Shine a light on questionable decisions of others	(Dis)incentives drive politically favourable action, and further (dis)incentivises future actions	Can create new rules (not legislation) that bind future govts e.g. accepted jurisdictional credit ratings	Changes per conditions; contest of ideals on how the system should operate							
Public awareness		Speed and level of understanding determine whether issues can be responded to at the rate required, e.g. climate change	Advise decision-makers where policy and implementation are not achieving desired outcomes	Limited understanding forces current thinking and limited mandate for change	Where greater may help catalyse change								

Influence	Leverage point	12. Constants, parameters, numbers	11. Size of buffers	10. Structure	9. Length of delays, relative to system change	8. Negative feedback loops	7. Reinforcing feedback loops	6. Information flows	5. Rules of the system	4. Ability to evolve or change the system	3. System goals	2. Origins of paradigms	1. Ability to transcend paradigms
Relationship—bureaucracy and ministers	Quality of relationship—determines willingness to accept advice/direction, and extent to which boundaries can be safely pushed	Good relationships provide timely turnaround and running of the system; poor relationships can result in information being ignored or kneejerk reactions	Mechanism to obtain negative feedback	(Dis)trustful relationships create/reduce friction, avoidance, and manipulation, leading to greater (dis)trust which reinforces the weakness/strength of relationships	Can be used to influence changes to the rules, feedbacks, and structure								
Relationship—Public decision-makers and community	Quality of relationship—determines willingness to accept decisions/feedback, and limits over/under-reactions to community concerns	Good relationships provide timely information/feedback to the system; poor relationships can result in information being ignored or kneejerk reactions	Mechanism to obtain negative feedback	Disrespectful or distrustful relationships lead to increased friction in interactions and apathy toward participation, resulting in reduced desire to interact from all parties, leading to greater disrespect/distrust	Can be used to influence changes to the rules, feedbacks, and structure								

Influence	Leverage point	12. Constants, parameters, numbers	11. Size of buffers	10. Structure	9. Length of delays, relative to system change	8. Negative feedback loops	7. Reinforcing feedback loops	6. Information flows	5. Rules of the system	4. Ability to evolve or change the system	3. System goals	2. Origins of paradigms	1. Ability to transcend paradigms
Resources— capability/ capacity	The size of these act as determinants of the speed at which the system can operate	Size and skill of workforce determine ability to respond to key issues and think beyond the immediate term	Determine speed with which decisions can be made	Limited resourcing reduces ability to intervene, limited demonstrable interventions leads to reduced resourcing (until a crisis hits)	Appetites impact how information is couched and responded to, to avoid unfavourable outcomes (fear drives behaviour)	Drives behaviours that alter the system	Creates boundaries on who can do what	May evolve slowly balancing need to maintain relevance with need to act as a buffer to fads; Or, as seen recently, shift to extremes in response to societal dissatisfaction	Clear role creates balance to maintain main- tain confidence in govern- ment and democ- racy	Ideologies on the role of govern- ment shape the para- digms that underpin governance systems, and the scope for change	Appetite deter- mines will- ingness to question para- digms		
Risk		Appetite deter- mines activity, creates consistency across decisions	Fear of risk arising from change fur- ther cements the status quo and fears of challenging it	Appetites deter- mine the options and con- straints of the system									
Role of gov- ernment	Where clearly articulated, acts as constant within the system (who decides and does what)	Clarity of role provides consistency, purpose, direction to avoid kneejerk reactions	Creates requirements for how the system is laid out and oper- ates	Governments act in accordance with interpretations of role reinforcing expectations/remit and shaping future inter- pretations									

Influence	Leverage point	12. Constants, parameters, numbers	11. Size of buffers	10. Structure	9. Length of delays, relative to system change	8. Negative feedback loops	7. Reinforcing feedback loops	6. Information flows	5. Rules of the system	4. Ability to evolve or change the system	3. System goals	2. Origins of paradigms	1. Ability to transcend paradigms
Scale	Influences number of parameters to consider, and which drive or inhibit action (akin to size of Meadows' bathtub)						Things that are considered too large to address will be left unaddressed in favour of smaller scale issues, reinforcing decision-maker skill development and continued focus on smaller scale issues			Size of a problem influences recognition of need for system change, and degree to which change occurs			
Strategic planning	Creates opportunity to foresee issues and create multiple pathways to pivot pending circumstance, i.e. provides distance from crises				Foresight assists in making delays appropriate to the system		Demonstrated use renews license to do it (but other influences often act to limit this loop existing)	Creates opportunities for new information loops to be made through broadening of decision-maker mindset		Creates space for System 2/ deliberative thinking increasing opportunities for innovation and change at a holistic level			

Influence	Leverage point	1. Ability to transcend paradigms	2. Origins of paradigms	3. System goals	4. Ability to evolve or change the system	5. Rules of the system	6. Information flows	7. Reinforcing feedback loops	8. Negative feedback loops	9. Length of delays, relative to system change	10. Structure	11. Size of buffers	12. Constants, parameters, numbers
Time	Constraint limiting volume of opportunities to consider larger picture/alternate pathways (i.e. determinant of locked in thinking)				Where available provides capacity to consider and implement change through other influences or leverage points (i.e. allows decision-maker to operate in System 2)	Time to make decisions and the time horizon considered within decisions both act as constraints	Determines ability to collect and consider information	Making decisions within a time period demonstrates the ability to do so such that future decisions are expected to be made in similar time frames				Impacts ability to operate purposefully and respond thoughtfully to policy issues	

Acknowledgements The author thanks everyone who participated in this research, and her supervisors and colleagues at ANU and Monash University for their guidance. The author also thanks the two anonymous reviewers whose feedback was genuinely helpful, and Martin and Mulder for their encouragement to her every day.

Funding Open Access funding enabled and organized by CAUL and its Member Institutions. This research was funded by an Australian Government Research Training Program Grant.

Declarations

Conflict of interests None.

Ethics This research received ethics approval from the Australian National University Human Research Ethics Committee (Protocol 2016/630).

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

- ABS (2020) National, state and territory population. edited by Australian Bureau of Statistics
- Abson DJ, Fischer J, Leventon J, Newig J, Schomerus T, Vilsmaier U, von Wehrden H, Abernethy P, Ives CD, Jäger NW, Lang DJ (2017) Leverage points for sustainability transformation. *Ambio* 46(1):30–39. <https://doi.org/10.1007/s13280-016-0800-y>
- ADR UK (2021) Data first: harnessing the potential of linked administrative data for the justice system. <https://www.gov.uk/government/publications/joined-up-data-in-government-the-future-of-data-linking-methods/splink-moj-s-open-source-library-for-probabilistic-record-linkage-at-scale>
- Alvaredo F, Chancel L, Piketty T, Saez E, Zucman G (2018) World inequality report. World Inequality Database
- Apuzzo M, Kirkpatrick DD (2020) Covid-19 changed how the world does science, together. *The New York Times*. <https://www.nytimes.com/2020/04/01/world/europe/coronavirus-science-research-cooperation.html>
- Bain PG, Kroonenberg PM, Johansson L-O, Milfont TL, Crimston CR, Kurz T, Bushina E, Calligaro C, Demarque C, Guan Y, Joonha P (2019) Public views of the sustainable development goals across countries. *Nat Sustain* 2(9):819–825. <https://doi.org/10.1038/s41893-019-0365-4>
- Balestra C, Tonkin R (2018) Inequalities in household wealth across OECD countries: Evidence from the OECD wealth distribution database. OECD Statistics Working Papers, No. 2018/01, OECD Publishing, Paris. <https://doi.org/10.1787/7e1bf673-en>
- Birney A (2021) How do we know where there is potential to intervene and leverage impact in a changing system? The practitioners

- perspective. *Sustain Sci* 16(3):749–765. <https://doi.org/10.1007/s11625-021-00956-5>
- Bolton M (2020) Factors influencing public sector decisions and the achievement of sustainable development in the State of Victoria, Australia. Doctor of Philosophy, Crawford School of Public Policy, Australian National University
- Bolton M (2021) Public sector understanding of sustainable development and the sustainable development goals: a case study of Victoria, Australia. *Curr Res Environ Sustain* 3:100056. <https://doi.org/10.1016/j.crsust.2021.100056>
- Bosch M, Smith, (2007) Systems thinking—language of complexity for scientists and managers. In: Bosch Harrison S, Herbohn JA (eds) *Improving the triple bottom line returns from small-scale forestry*. The University of Queensland, Brisbane
- Bregman R (2016) *Utopia for realists*. Bloomsbury
- Brenner S (2012) Life's code script. *Nature* 482(7386):461–461. <https://doi.org/10.1038/482461a>
- Bryant J, Thomson G (2021) Learning as a key leverage point for sustainability transformations: a case study of a local government in Perth, Western Australia. *Sustain Sci* 16(3):795–807. <https://doi.org/10.1007/s11625-020-00808-8>
- Burch S, Gupta A, Inoue CYA, Kalfagianni A, Persson Å, Gerlak AK, Ishii A, Patterson J, Pickering J, Scobie M, Van der Heijden J, Vervoort J, Adler C, Bloomfield M, Djalante R, Dryzek J, Galaz V, Gordon C, Harmon R, Jinnah S, Kim RE, Olsson L, Van Leeuwen J, Ramasar V, Wapner P, Zondervan R (2019) New directions in earth system governance research. *Earth Syst Govern*. <https://doi.org/10.1016/j.esg.2019.100006>
- Cottam H (2018) *Radical help: How we can remake the relationships between us and revolutionise the welfare state*. Hachette UK
- Coscieme L, Sutton P, Mortensen LF, Kubiszewski I, Costanza R, Trebeck K, Pulselli FM, Giannetti BF, Fioramonti L (2019) Overcoming the myths of mainstream economics to enable a new wellbeing economy. *Sustainability* 11(16):4374
- Crutzen P (2002) Geology of mankind. *Nature* 415:23–23. <https://doi.org/10.1038/415023a>
- Davelaar D (2021) Transformation for sustainability: a deep leverage points approach. *Sustain Sci* 16(3):727–747. <https://doi.org/10.1007/s11625-020-00872-0>
- De Sadeleer N, Godfroid J (2020) The story behind COVID-19: animal diseases at the crossroads of wildlife, livestock and human health. *Eur J Risk Regul* 11(2):210–227. <https://doi.org/10.1017/err.2020.45>
- Earth System Governance Project (2018) *Earth system governance. science and implementation plan of the earth system governance project*. Utrecht, The Netherlands
- Edwards J, Windholz E, Faulkner N, Werbeloff L (2020) Implementing general environmental duties: challenges and opportunities. *Aust J Public Adm*. <https://doi.org/10.1111/1467-8500.12456>
- Egerer S, Cotera RV, Celliers L, Costa MM (2021) A leverage points analysis of a qualitative system dynamics model for climate change adaptation in agriculture. *Agric Syst* 189:103052. <https://doi.org/10.1016/j.agry.2021.103052>
- EPA (2013) *EPA annual report 2012–2013*. Carlton
- FAO (2019) *The state of the World's biodiversity for food and agriculture*. In: Bélanger J, Pilling D (eds) *FAO commission on genetic resources for food and agriculture assessments*, Rome. p 572. <http://www.fao.org/3/CA3129EN/CA3129EN.pdf>
- Fischer J, Riechers M (2019) A leverage points perspective on sustainability. *People Nat* 1(1):1–6. <https://doi.org/10.1002/pan3.13>
- Head BW (2008) Three lenses of evidence-based policy. *Aust J Public Adm* 67:1–11. <https://doi.org/10.1111/j.1467-8500.2007.00564.x>
- Horcea-Milcu A-I, Abson DJ, Apetrei CI, Duse IA, Freeth R, Riechers M, Lam DPM, Dorninger C, Lang DJ (2019) Values in transformational sustainability science: four perspectives for change. *Sustain Sci* 14(5):1425–1437. <https://doi.org/10.1007/s11625-019-00656-1>
- IPBES (2019). In: Brondizio ES, Settele J, Díaz S, Ngo HT (eds) *Global assessment report of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Service*. IPBES Secretariat, Bonn
- IPCC (2021) *Climate change 2021: the physical science basis*. In: Masson-Delmotte V, Zhai P, Pirani A, Connors SL, Péan C, Berger S, Caud N, Chen Y, Goldfarb L, Gomis MI, Huang M, Leitzell K, Lonnoy E, Matthews JBR, Maycock TK, Waterfield T, Yelekçi O, Yu R, Zhou B (eds) *Contribution of Working Group I to the sixth assessment report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom
- Jackson T (2009) *Prosperity without growth: Economics for a finite planet*. Routledge
- Jackson T (2021) *Post growth: life after capitalism*. Polity Press
- Kaczan DJ, Orgill-Meyer J (2020) The impact of climate change on migration: a synthesis of recent empirical insights. *Clim Change* 158(3):281–300. <https://doi.org/10.1007/s10584-019-02560-0>
- Kim DH (1999) *Introduction to systems thinking*, vol 16. Pegasus Communications Inc., Arcadia
- Lade SJ, Steffen W, de Vries W, Carpenter SR, Donges JF, Gerten D, Hoff H, Newbold T, Richardson K, Rockström J (2020) Human impacts on planetary boundaries amplified by earth system interactions. *Nat Sustain* 3(2):119–128. <https://doi.org/10.1038/s41893-019-0454-4>
- Lakoff G (2014) *The all new don't think of an elephant*. Chelsea Green Publishing, Hartford
- Leventon J (2021) Scaling behaviour change for a 1.5 degree world: transformations and systems thinking. *Glob Sustain* 4:e27. <https://doi.org/10.1017/sus.2021.27>
- Leventon J, Abson DJ, Lang DJ (2021a) Leverage points for sustainability transformations: nine guiding questions for sustainability science and practice. *Sustain Sci* 16(3):721–726. <https://doi.org/10.1007/s11625-021-00961-8>
- Leventon J, Duşe IA, Horcea-Milcu A-I (2021b) Leveraging biodiversity action from plural values: transformations of governance systems. *Front Ecol Evol*. <https://doi.org/10.3389/fevo.2021.609853>
- Mazzucato M (2021) *Mission economy: A moonshot guide to changing capitalism*. Penguin, UK
- McGrath M (2017) Beyond distrust: when the public loses faith in American institutions. *Natl Civ Rev* 106(2):46–51. <https://doi.org/10.1002/ncr.21321>
- Meadows D (1999) *Leverage points: places to intervene in a system*. Sustainability Institute, North Charleston
- Meadows D (2008) *Thinking in systems: a primer*. Chelsea Green Publishing, Hartford
- Miller L, Bolton M, Boulton J, Mintrom, Nicholson A, Rüdiger C, Skinner R, Raven R, Webb G (2020) AI for monitoring the sustainable development goals and supporting and promoting action and policy development. In: 2020 IEEE/ITU international conference on artificial intelligence for good (AI4G), 21–25 Sept. 2020
- New Zealand Government (2019) *The Wellbeing Budget*. <https://www.treasury.govt.nz/publications/wellbeing-budget/wellbeing-budget-2019>. 978-1-98-858042-5
- Newell P, Twena M, Daley F (2021) Scaling behaviour change for a 1.5-degree world: challenges and opportunities. *Glob Sustain* 4:e22. <https://doi.org/10.1017/sus.2021.23>
- Nielsen KS, Nicholas KA, Creutzig F, Dietz T, Stern PC (2021) The role of high-socioeconomic-status people in locking in or rapidly reducing energy-driven greenhouse gas emissions. *Nat Energy* 6(11):1011–1016. <https://doi.org/10.1038/s41560-021-00900-y>
- OECD (2020) *Building capacity for evidence-informed policy-making*. Online
- Office for National Statistics, UK (2021) *Splink: MoJ's open source library for probabilistic record linkage at scale*. <https://www.gov>

- [uk/government/publications/joined-up-data-in-government-the-future-of-data-linking-methods/splink-mojs-open-source-library-for-probabilistic-record-linkage-at-scale](#). Accessed 9 Aug
- PC (2020) Regulatory technology information paper. Productivity Commission
- PC (2021) Report on government services 2021 productivity commission: steering committee for the review of government service provision
- PC (2022) Report on government services. Productivity Commission. <https://www.pc.gov.au/research/ongoing/report-on-government-services>. Accessed 14 Feb
- Piketty T (2014) Capital in the twenty-first century. Harvard University Press
- Raworth K (2017) Doughnut economics: seven ways to think like a 21st-century economist. Chelsea Green Publishing
- Rockström J, Steffen W, Noone K, Persson Å, Chapin FS III, Lambin E, Lenton TM, Scheffer M, Folke C, Schellnhuber H, Nykvist B, De Wit CA, Hughes T, van der Leeuw S, Rodhe H, Sörlin S, Snyder PK, Costanza R, Svedin U, Falkenmark M, Karlberg L, Corell RW, Fabry VJ, Hansen J, Walker B, Liverman D, Richardson K, Crutzen P, Foley J (2009) Planetary boundaries: exploring the safe operating space for humanity. *Ecol Soc* 14(2):32. <https://www.ecologyandsociety.org/vol14/iss2/art32/>
- Sabatier P (1987) Knowledge, policy-oriented learning, and policy change: an advocacy coalition framework. *Knowledge* 8(4):649–692. <https://doi.org/10.1177/0164025987008004005>
- Sachs J, Kroll C, Lafortune G, Fuller G, Woelm F (2021) The decade of action for the sustainable development goals. Sustainable development report 2021, Cambridge
- Sparrow M (2020) Fundamentals of regulatory design. Independently published. 979-8-670-95928-5
- Steffen W, Richardson K, Rockstrom J, Cornell SE, Fetzer I, Bennett EM, Biggs R, Carpenter SR, de Vries W, de Wit CA, Folke C, Gerten D, Heinke J, Mace GM, Persson LM, Ramanathan V, Rayers B, Sörlin S (2015) Planetary boundaries: guiding human development on a changing planet. *Science*. <https://doi.org/10.1126/science.1259855>
- Stiglitz JE (2015) Inequality and economic growth. *Polit Quart* 86:134–155
- Transforming Our World The 2030 agenda for sustainable development
- Trebeck K, Williams J (2019) The economics of arrival: Ideas for a grown-up economy. Policy Press
- Tversky A, Kahneman D (1981) The framing of decisions and the psychology of choice. *Science* 211:453–458. <https://doi.org/10.1126/science.7455683>
- UNGA (2015) United Nations General Assembly. A/RES/70/1: Transforming our World: the 2030 agenda for sustainable development
- VAGO (2013) Environment and sustainability sector. Performance reporting, Melbourne
- WCED (1987) Our common future. Oxford University Press, New York
- Wellbeing Economy Alliance (2021) Wellbeing Economy Governments. <https://weall.org/wego>. Accessed 11 Aug 2021
- WHO (2021) COVAX: Working for global equitable access to COVID-19 vaccines. World Health Organisation. <https://www.who.int/initiatives/act-accelerator/covax>. Accessed 13 Aug
- Wilkinson R, Pickett K (2009) The spirit level. Penguin Books, London
- Woiwode C, Schöpke N, Bina O, Veciana S, Kunze I, Parodi O, Schweizer-Ries P, Wamsler C (2021) Inner transformation to sustainability as a deep leverage point: fostering new avenues for change through dialogue and reflection. *Sustain Sci* 16(3):841–858. <https://doi.org/10.1007/s11625-020-00882-y>

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.