Spiraling Opposition:
Feedback Loops in Energy Politics

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Abstract: This paper analyzes the feedback loops hindering renewable energy policy in the United States, particularly at the state level, by drawing from Leah Cardamore Stokes's arguments in her book *Short Circuiting Policy*. It formalizes her arguments with a causal loop diagram to the study the interaction between renewable energy policies, advocates' resources, and opposition from energy incumbents like utilities and fossil fuel producers. The analysis reveals a reinforcing loop where policies increase advocates' resources, enabling further policy support. This is countered by balancing loops through which, after a perception delay, incumbents resist policy change to protect their interests. The paper suggests Stokes' solutions to promoting climate policy largely consist of adjusting the strength of the system's feedback loops, which systems change theory argues would be effective, but she may ignore other solutions. Most notably, she under-emphasizes solutions that change energy politics' goals, one of the most effective ways change any system. Thus, this paper advances understanding of renewable energy policy dynamics by integrating system dynamics with political science to propose novel, systems-thinking-based solutions for promoting climate policy, and it enables future work in system dynamics and other fields to study these dynamics in more detail.

1. Introduction

The United States' climate policies, especially on the state level, are almost certainly inadequate to mitigate climate change at the pace needed to avoid its worst effects. While some states have passed renewable power standards (RPS), which mandate or encourage power providers to generate a certain percent of their power with renewable energy[1], only 55% of power is covered by an RPS. Twelve states have not enacted any clean power goal at all, and of states that have enacted an RPS, 10 have since weakened or repealed those provisions. Some states that have high potential for renewables have little installed capacity; for instance, only 15% of sunny Florida's power comes from clean sources. These trends starkly contrast with the need to grow renewable energy several times faster than historical trends, e.g.,, to decarbonize the electricity grid by 2035, growth in renewable capacity must triple compared to historic trends (Stokes 2020).

Short Circuiting Policy: Interest Groups and the Battle Over Clean Energy and Climate Policy in the American States by Leah Cardamore Stokes (Stokes 2020, henceforth LS) is, to my knowledge, one of the first and most prominent contributions in political science to analyze climate policy inaction at the state level. The author argues the policy may become entrenched through "policy feedback", in which policies promoting renewable energy increase the political influence of renewables producers and their allies, allowing them to advocate for further policies. However, she argues that, once opponents like utilities and fossil fuel producers realize the negative impacts of these policies on fossil fuel assets, they lobby to hinder further policies or even repeal existing ones. While there are plausibly other explanations for inadequate energy policy, such as voters' ignorance about climate change's effects, in four case studies of Texas, Kansas, Arizona, and Ohio, Stokes demonstrates interest groups are primarily responsible for policy inaction. Her theory is therefore arguably one of the most compelling explanations of inadequate green energy policy.

In this article, I formalize the feedback loops in Stokes's theory using the language and tools of system dynamics, and, drawing on previous work on system change, evaluate her proposed solutions and propose additional policies. I summarize her theory using a causal loop diagram (Sterman 2000, Ch. 5), aggregating the broad causal links in her theory and de-emphasizing her rich characterization of those links to focus on her theory's dynamics. In evaluating her solutions, I draw on Meadow's (1997) characterization of methods to enact systems change. I find that Stokes's argument describes a reinforcing feedback loop that describes policy feedback and several balancing loops that allow incumbents to correct the perceived threat to their fossil fuel assets, but only after a significant perception delay. Though not based in system dynamics, Stokes's solutions are equivalent to adjusting feedback loops' gains and creating information flows, both of which Meadows argues are effective "leverage points", or means to create systems change. Further examination of the diagram reveals the ability of policy to address opponents' incentives, especially by changing their goal to maximize profits.

This article contains multiple contributions to both the system dynamics literature and the political science literature, as, to my knowledge, it is one of the first analyses of

[1] Unless otherwise indicated, renewables are defined here as wind and solar power.

renewable energy politics and interest groups using system dynamics. First, this article's causal loop diagram provides a novel and understandable summary of one of the most prominent theories on this issue. Second, this work analyzes Stokes's proposed solutions using a unique perspective rooted in systems thinking. Third, this work proposes new solutions using this perspective, which policy researchers can evaluate and build upon. Fourth, this article enables future system dynamics research to build on its theory, which, because this issue is so feedback-rich, may make significant contributions to promoting much needed climate policy.

2. Case Study: Texas

In this section, I summarize Stokes's case study of Texas (LS, Ch. 2 & 3) to provide intuition for her arguments.

Texas's first RPS bill, the Texas Electric Restructuring Act of 1999, demonstrates how renewable energy policy can create new advocates for renewable energy, which, in turn, leads to even more supportive policy. In part due to lobbying by the Environmental Defense Fund and a public campaign organized by Public Citizen, the initial bill implemented a mandatory target of 3% of Texas's power to come from wind power by 2009. Because the bill was also a reform bill which restructured Texas's electricity market, utilities and fossil fuel producers were too distracted to oppose it. As a result, wind capacity in the state grew ten-fold in the following years. Investment was primarily concentrated in historically poor parts of the state, especially West Texas. A Republican state senator representing that region, Troy Fraser, subsequently introduced a bill in 2005 that would increase the RPS target to 5% of power from wind by 2015 and make significant new investments in transmission. Moreover, since the first RPS bill was passed, many renewable energy producers had entered the state, such as Florida Power & Light, along iwth industry groups like the Wind Coalition. Because of Fraser's and the growing wind industry's support, the bill passed, and due to increasingly ambitious policy Texas now has the largest installed wind capacity of any state.

On the other hand, solar power policies in the state exemplify how opponents can hinder climate policy for decades. When the second RPS bill was introduced, a provision for a separate solar RPS was being considered. After noticing the impacts of the 1999 bill, utilities and fossil fuel producers were concerned that solar power would compete with natural gas when electricity demand peaked, which typically occurs on sunny days, as most of their profits on their gas infrastructure were made during those hours. Using their historically close ties to state legislators, they lobbied to include only a voluntary solar RPS target, using direct negotiation and donations. One indication of the extent of their lobbying is that Gov. Rick Perry received the most donations from the energy industry than any other state politician in the country from 2003 to 2007. Because Texas up to that point had little solar generation, there were few solar producers to advocate for a mandatory target, while the wind industry was focused on advocating for itself. The voluntary RPS therefore passed, hindering solar production, the influence of solar producers, and solar policy for decades to come. For instance, there is still no clear framework to connect distributed solar to Texas's grid. As of 2020, this large and sunny state only has the sixth-largest installed solar capacity of any state, mainly due to developments in solar-friendly states like California.

3. Policy Feedback and Opposition

I summarize Stokes's main arguments (LS, Chapter 2) with a causal loop diagram (CLD) in this section. The ability of policy feedback to create further expansions in renewable energy policy is represented, as well as energy incumbents' opposition after a delay.

The main way renewable energy policy can be expanded is through policy feedback (R1, Figure 1) where renewable energy policy increases advocates' resources, allowing them to advocate for further beneficial policies. I define advocates as any individual or group in favor of renewable energy policy, including renewable energy producers, politicians, environmental groups, activists, etc. Their resources are anything needed to advocate for policy, including financial capital, political connections, information, and motivation. I model resources as a stock, as Stokes notes the ability to advocate for policy is in part a function of accumulation of benefits received from policies over time. Policy may increase resources by providing actual financial resources, information, motivation, or changing political interests. For instance, Texas's RPS bill in 1999 provided financial resources (through increased utility demand) for wind energy producers and political capital through the support of policymakers like Troy Fraser. Using these new resources, advocates then lobby for further policy directly, as when Florida Power and Light testified in favor of the second RPS bill. They can also lobby indirectly, as when the advocacy group Public Citizen knocked on doors to compel Texans to contact their representatives in favor of the initial RPS bill. I discuss determinants of their advocacy's effectiveness below. Advocates' lobbying increases the likelihood of new green energy policy, completing the feedback loop.

After a delay, energy incumbents eventually realize that renewable energy policies may harm their profits and begin advocating against renewables policy, blocking future laws and even repealing existing laws (B1, Figure 1).

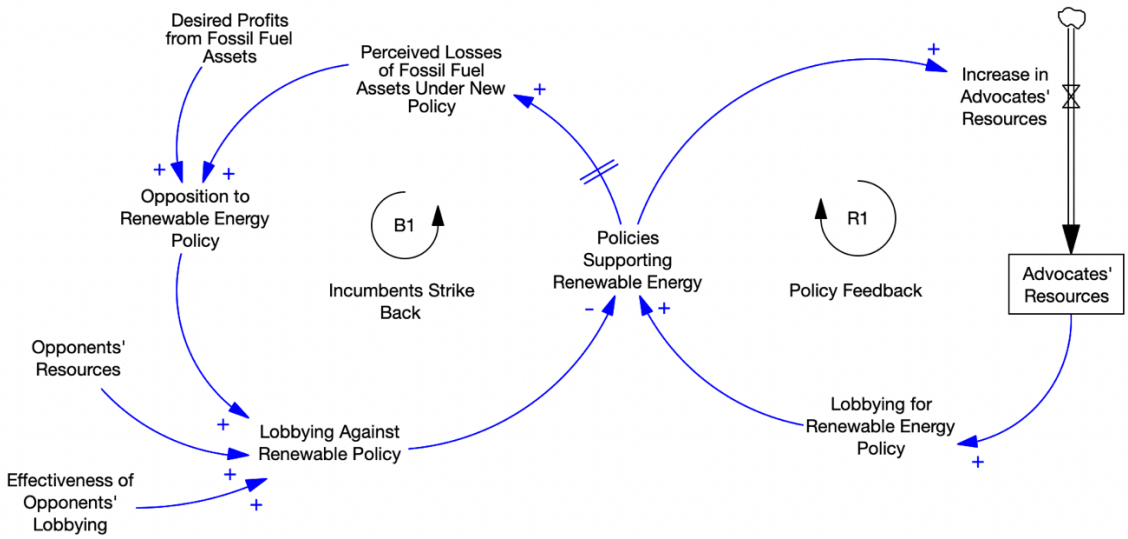
Energy incumbents, such as utilities and fossil fuel producers, understand the effects of policy with a delay due to their initial lack of knowledge of these policies, i.e, due to their bounded rationality. Stokes terms this delay the "fog of enactment." She argues that the fog of enactment occurs because policies are written during a complex negotiation process, during which not every stakeholder is aware of all the elements of a bill or ambiguous language is intentionally used, and due to the fundamental unpredictability of the complex electricity market. The fog is stronger when a bill is novel, contains major reforms, deals with technical matter, or is impacted by both state and federal policy. In these conditions, there may be limited experience or cognitive capacity to understand the impacts of policy. For instance, Texas's initial RPS bill passed because they were distracted by the bill's complex restructuring of Texas's electricity market, and because RPS was not yet a widespread policy, so utilities were unsure of its effects. Thus, this perception delay is crucial in implementing some renewable policy, as it allows some initial policies to pass.

Once incumbents realize the costs of these laws, they use direct and indirect means to hinder further policies. They compare their perceived losses of their fossil fuel assets under renewable energy policies to their desired profits from those assets, as when Texas utilities realized solar may compete with natural gas. This comparison occurs whether incumbents are profit-seeking, i.e., private utilities or simply have a fiduciary duty to their stakeholders,

i.e., public utilities. This financial risk then determines opposition to further policy, as in Texas in 2005.

Energy incumbents oppose further policies through direct and indirect means. Direct means include negotiating directly with policymakers and strategic donations. Indirect means include putting pressure on policymakers by supporting pro-incumbent politicians during primary elections. Incumbents can also challenge renewable energy laws in court and manipulate policymakers' views of public opinion to their favor, e.g., by creating "push polls" that have wording to elicit a specific response. While incumbents lobby using their own stock of resources, because they have had political influence and preferential access to the electricity market for nearly a century (LS, Chapter 3), I assume that it is large and does not change as a result of the dynamics studied here. As discussed below and in section 4, the effectiveness of those resources can be increased by outside support and decreased by public scrutiny.

Figure 1: Policy Feedback, the Fog of Enactment, and Opposition



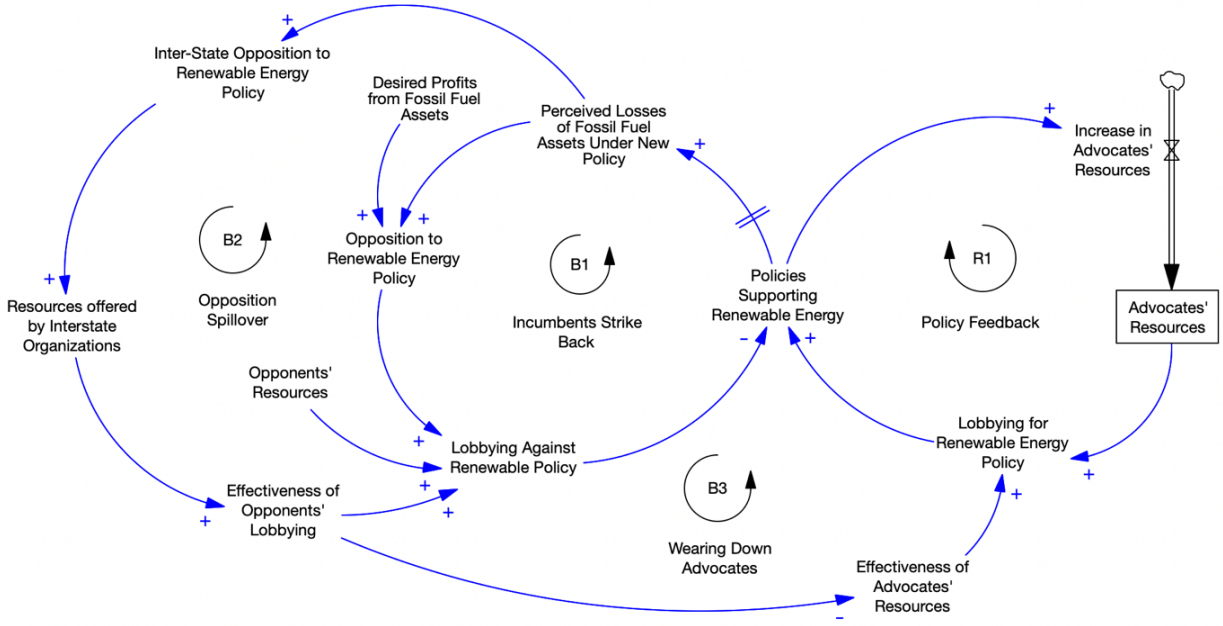
Opponents' lobbying can be strengthened through support from inter-state organizations and by wearing down advocates (B2 and B3, Figure 2).

First, as energy incumbents and their supporters in each state learn about renewable policies' effects, they establish inter-state lobbying organizations to influence policies in each state. These cross-state groups, such as Americans for Prosperity (AFP) and the American Legislative Exchange Council (ALEC), provide resources to incumbents within each state to make their lobbying more effective. For instance, AFP, created by Koch Industries, one of the largest petrochemical producers, used its extensive funds to fake a public campaign and support anti-wind politicians in primary elections to convince conservative Kansas lawmakers to oppose wind (LS, Ch. 6). On the other hand, Stokes argues cross-state

organizations have played a historically weak role for advocates, so a loop analogous to B1 working in favor of advocates is not depicted in the CLD.

Such intense opposition from incumbents may also cause advocates to believe their effectiveness of their resources is low and to cease lobbying. That is, even if their level of resources and intrinsic motivation is high, advocates may believe further lobbying is pointless, reducing their lobbying and further hindering future renewable energy policy. For example, wind power producers in Kansas thought the state's RPS law created too much instability because AFP began advocating for increasingly hostile legislation that could completely dismantle the industry in the state. They began to negotiate with AFP and seek the RPS's repeal to avoid the worst of possible outcomes, despite advocating for its passage a few years prior (LS, Ch. 6).

Figure 2: Enhanced Opposition



4. Analysis of Solutions

I now use the CLD and previous work on systems change (Meadows 1997) to evaluate Stokes's proposed solutions to enable policy feedback (LS, Ch. 9) and propose my own solutions.

Stokes implicitly suggests adjusting the strength, or the gain, of each reinforcing and balancing loop and increasing information flows. For example, she suggests increasing the effectiveness of advocates' resources by having states pay public advocates in public utilities commissions (PUCs), where energy policy is often implemented; increasing the transparency of PUCs; and, most importantly, expanding advocacy into public campaigns and lawsuits.[2] Each of these solutions increases the effectiveness of advocates' resources by providing a

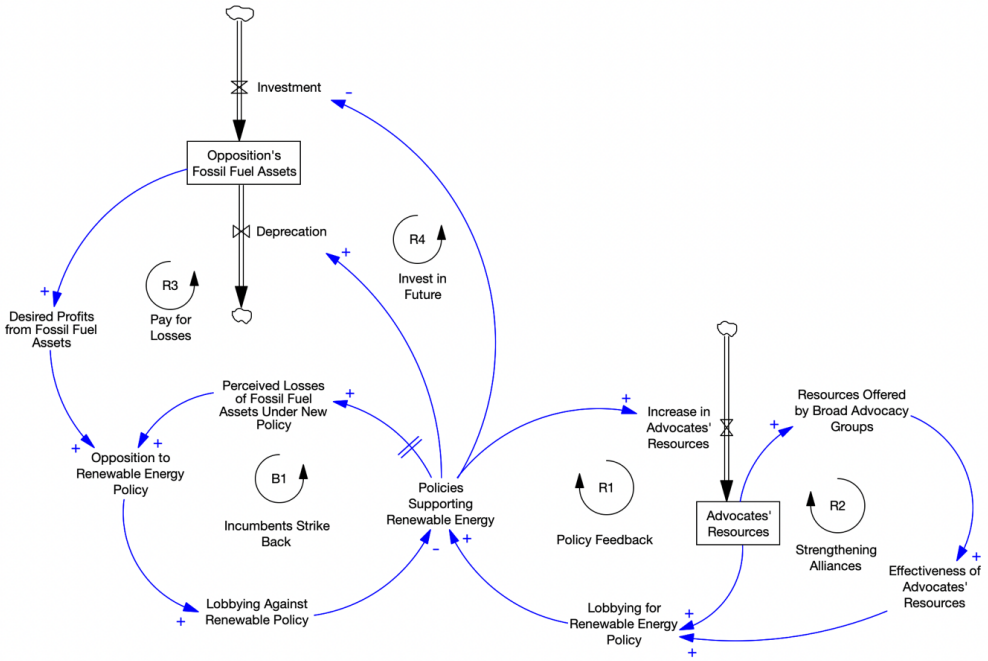
[2] This is not an exhaustive list; I focus on the suggestions the author emphasizes most.

new channel to influence policy or freeing up resources for other measures. Because this effectiveness is a controlling parameter of the reinforcing policy feedback loop, these suggestions are equivalent to increasing its gain.

Stokes also proposes decreasing utilities' influence on PUCs by increasing audits on PUCs, professionalizing those bodies, and increasing public salience. In each case, opponents' resources are less effective. For instance, previous work (McCarty 2014) indicates it is difficult for utilities to influence professional PUCs or those under greater public scrutiny. These solutions decrease the effectiveness of opponents' resources and therefore decrease the gain of balancing loops benefitting opponents.

She also suggests improving information flows, or creating another reinforcing feedback loop, by strengthening advocacy organizations through improved coordination (R2 in Fig. 3). Advocates' organizations are often fragmented compared to their opponents'; for instance, wind industry groups did not advocate for solar power provisions in Texas's second RPS bill. Analogous to the "opposition spillover" balancing loop in Figure 2, resources and information gained by one advocacy group can be shared to other groups through "big tent" advocacy groups analogous to ALEC and AFP. Thus, this additional feedback loop improves the information flows between advocacy groups.

Figure 3: Proposed Solutions to Enabling Policy Feedback



Though Stokes's theory is rooted in the political science literature, not in system dynamics, her solutions broadly comport with previous work on system change. Meadows (1997) argues that adjusting the gain of loops is one of the most effective ways to enact systems change because it can be relatively cheap to do so – compared to, for example, changing the physical infrastructure associated with a system – and because these loops are the sources of instability or other poor outcomes. By adjusting feedback loops' strengths,

Stokes is addressing the root of policy inaction. Similarly, Meadows argues that improving information flow is even more effective at changing systems because it is an easier way of correcting undesirable feedback loops. For instance, it seems likely that encouraging cooperation among renewable energy advocates is much easier than professionalizing PUCs.

Further examination of the CLD and reveals two more solutions that adjust the incentives of energy incumbents.

First, though so far opponents' desired profits from fossil fuel assets have been treated exogenous, renewable energy policies can reduce that desire and so reduce incumbents' incentive to oppose policy. As shown in Figure 3, the desired profits from fossil fuels is determined by the accumulation of incumbents' fossil fuel assets, which increases by investment and decreases by deprecation. Because incumbents have currently invested significant capital into fossil fuel assets, they have a fiduciary duty to shareholders or other stakeholders to earn an acceptable return on those investments (LS, Ch. 9). They therefore oppose policies that may decrease the use and profitability of those assets. If policy were to endogenize those assets by compensating incumbents to no longer use them and thus increase deprecation, incumbents would have less incentive to oppose renewables (R2 in Figure 3).[3] However, Stokes argues that incumbents may then be incentivized to invest further in fossil fuels because they will be compensated to abandon them. To avoid this moral hazard, policies must block fossil fuel investments as well (R3).

Endogenizing fossil fuel assets does have its limitations. To address Stokes's concerns, a model of investment may be needed to determine the policy design necessary to avoid moral hazard. More importantly, Meadows argues that changing the physical structure of a system, as I suggest here, is an expensive and slow way to change a system. That is, it may take too long to deprecate fossil fuel infrastructure at a politically feasible rate and lead to the necessary cuts in emissions.

A more effective solution is to change incumbents' goal to maximize profits. Meadows notes that changing goals is the one of the most effective ways to change a system, because a system's feedback loops and physical infrastructure are structured to meet that goal. The energy politics system currently has the goal to maximize profits for energy incumbents. If their goal was to instead to provide sustainable energy, they would have no incentive to oppose renewable energy policy; thus, perceived losses of fossil fuel assets and its links would not appear in the CLD and break up opponents' balancing feedback loops. It is likely best to convince utilities of this goal intrinsically such that incumbents' mental models themselves are adjusted, but this may be difficult to do.

A possibly easier method to change incumbents' goals is for regulators to compensate them based on whether they meet mitigation targets, instead of the investments they made. While this solution only receives a passing mention in Stokes's argument, it is in line with Meadows's recommendation that changing the rules of the system is an effective way to shift a system, though not as effective as changing its goals. Changing the rules so that utilities' revenue, returns, and executives' compensation are tied to goals like decarbonization is

[3] In reverse, this reinforcing loop is a form of lock-in. When incumbents hinder renewable policies, there are fewer incentives for them to abandon their fossil fuel assets. They therefore maintain their fossil fuel assets and so maintain their incentive to oppose further renewable policies.

referred to as "performance-based regulation," and has already been implemented in New York and other states. However, because utility executives would still have a mental model of profit maximization, they still might further oppose renewable energy policy or seek to repeal performance-based regulation.

5. Conclusion

This article formalizes the feedback loops in arguably one of the most compelling theories on why renewable energy policy has stalled and evaluates its proposals using previous work on systems change. This article suggests that Stokes's theory posits a reinforcing "policy feedback" loop, in which renewable energy policy creates resources to advocate for even more supportive policy, but it is interrupted due to several balancing loops stemming from the influence of energy incumbents. I suggest Stokes's implicitly proposes to increase the strength of this reinforcing loop and decrease those of the balancing loops. Though Stokes is not a system dynamicist, her solutions are supported by Meadows (1997)'s theory of systems change. This article then uses Meadows's theory and the importance of desired profits in the CLD to suggest changing the goals of energy incumbents and to decrease their stocks of fossil fuel infrastructure. Thus, this article uses system thinking to promote solutions that Stokes does not emphasize or seems ambivalent about.

Both qualitative and quantitative work can build on this CLD to analyze and suggest solutions to climate policy inaction. Policy researchers in various fields can not only evaluate original proposals in this article, but they can also use the CLD to find gaps in existing knowledge. For instance, future work may examine how exactly opponents' lobbying discourages advocates (B3 in Figure 2). In system dynamics, qualitative work can formalize the specific channels through which opponents and advocates lobby, along with other details in Stokes's theory which I largely ignore in the diagram, in order to find novel solutions. Quantitative work can investigate the relative strength of each feedback loop and predict the dynamic effects of possible solutions. For example, such work could study whether improving the effectiveness of advocates or limiting opponents' influence is more effective to promote policy in the short- and long-term.

Moreover, it is clear that renewable energy politics may be a fruitful area of study for system dynamicists, as these politics are determined by feedback loops, bounded rationality, and delays. Most importantly, as with all great system dynamics work (Forrester 1961), research on this topic would address one of the greatest challenges of our time.

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