

Using Game Design to Inform a Plastics Treaty: Fostering Collaboration between Science, Machine Learning, and Policymaking

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Using Game Design to Inform a Plastics Treaty: Fostering Collaboration between Science, Machine Learning, and Policymaking

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Introduction: This multi-disciplinary case study details how an interactive decision support tool leverages game design to inform an international plastic pollution treaty.

Design: Seeking to make our scientific findings more usable within the policy process, our interactive software supports manipulation of a mathematical model using techniques borrowed from games. These "ludic" approaches aim

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to enable user agency to find custom policy solutions, invite deep engagement with scientific results, serve audiences of diverse expertise, and accelerate scientific process to keep pace with intergovernmental negotiations.

Implementation: Built in JavaScript and D3 with user-modifiable logic via an ANTLR domain specific language, this browser-based application offers adaptability and explorability for our machine learning results with privacy preserving architecture and offline capability.

Demonstration: Policy makers and the supporting community engaged with this public simulation tool across multiple treaty-related events, investigating plastic waste outcomes under diverse and sometimes unexpected policy scenarios.

Conclusion: Contextualizing our open source software within a broader lineage of digital media research, we reflect on this interactive modeling platform, considering how game design approaches may help facilitate collaboration at the science / policy nexus.

Materials: Available on the public Internet, we host this browser-based decision support tool at global-plastics-tool.org, work also archived at zenodo.org/records/12615011 in a Docker container.

1 Introduction

In his influential “Humane Representation of Thought” presentation, Bret Victor [73] explores how interactivity enables new ways of reasoning to unlock thoughts we “couldn’t think” before. This paper explores one such application of these ideas: the open source global-plastics-tool.org. Constructed by this article’s cross-disciplinary research team as a complement to our traditional academic publication [54], this decision support tool seeks to facilitate iterative policy exploration beyond the capabilities of a static paper. Specifically, we look to game design in crafting this interactivity, attempting to improve usability of our scientific insights for negotiators and stakeholders engaging in the development of the United Nations’ “International Legally Binding Instrument on Plastic Pollution, Including in the Marine Environment” [68].

1.1 Background

Our tool and this analysis participate in a broader dialogue in the literature regarding interactive media to facilitate reasoning in complex problems. This prior work may inform the construction of tools which support policy decisions like designing this “once-in-a-lifetime” global treaty [39].

1.1.1 Explorable explanations. Building on work reaching back to 1960s PLATO [9], Victor draws attention to the possibilities of “explorable explanations” for “active” reading. He observes that, while static media cannot invite response and leave “the reader’s line of thought” both “internal and invisible” [72], new interactive technologies allow readers to “as[k] questions, conside[r] alternatives, questio[n] assumptions, and even questio[n] the trustworthiness of the author.” These design ideas have been applied in education, engineering, and industry to improve user agency and bolster the impact of modeling efforts [11, 21, 23, 31].

1.1.2 Scientific communications. However, years after the formulation of these concepts for interactivity and knowledge building, Dragicevic et al. [27] write that Victor’s ideas still remain uncommon with “very few concrete examples” in academic scientific communication. Continuing to speak in unresponsive media of

papers and slides, the outputs of research still often cannot listen to stakeholders’ perspectives or react to their ideas [73], missing out on “the deep understanding that comes from dialogue and exploration” [72].

1.1.3 Related work. Among the relatively few projects trying to realize this power of interactivity in scientific communication [27], we observe some recent examples in environment and sustainability:

- Driving the Future: Simulation of automotive markets under different incentive, tax, and policy scenarios [38].
- En-ROADS: Interactive simulation for policy impact on greenhouse gas emissions and global warming [57].
- Protect High Seas: Tool to identify potential marine protected area candidates using configurable conservation plans [74].
- MSP Challenge: A multi-user environment for collaborative marine spatial planning with simulation of policy effects [3, 35].

Enabling co-design of science-informed solutions, all of these digital environments turn static information into engaging software which allows users to bi-directionally converse with data.

1.2 Contribution

We build upon prior work by offering an additional documented example of these ideas within the context of international policymaking for plastic pollution, distilling design vocabulary for decision support tools with a focus on three key hurdles in the policy / science gap [66].

1.2.1 Challenge 1: User agency. First, Chris Tyler of the United Kingdom’s Parliamentary Office of Science and Technology warns that scientists “often consider themselves as the ‘experts’ who engage with policy makers” but they should not assume “that [they] are the only expert[s] in the room” [66]. Jan Nolin’s investigation of the process of formulating the Kyoto Proposal similarly highlights the benefits of bidirectional engagement in drafting legislation, underscoring the necessity of bringing expertise from science and policy into dialogue in order to craft effective solutions [46]. With this need for mutual collaboration in mind, consider that the typical medium of scientific communication in the form of a static academic paper may limit policy maker agency and co-creation opportunities. By “display[ing] the author’s argument, and nothing else,” static media only support one-way discussion, possibly hindering the reader’s agency to evaluate questions or alternative ideas [72].

1.2.2 Challenge 2: Approachability. Simulation of policy impacts often requires exploring effects across many dimensions [35, 57]. However, this can be taxing as visualization of highly multi-variate data often encounters “perceptual and cognitive limits” [28]. This presents a design challenge in maintaining the required complexity without tools feeling complicated to the point of becoming inaccessible [7].

1.2.3 Challenge 3: Reading levels. Recommendations to the scientific community on policy engagement often emphasize the need for brief summaries in plain language [32]. However, information designers conversely warn that traditional media like slides cause oversimplification and result in poor decision making [65]. Policy decision support tools may step into this tension: attempting to serve audiences of diverse prior

experience to support both high level reading like the overviews recommended to scientists in decision-maker engagement while simultaneously inviting deeper reading when demanded by the policymaking process.

2 Design

To solve for these three challenges in our treaty decision support tool, we observe that interactive data visualization has previously looked to game design for inspiration. For example, Elijah Meeks applies game world structure concepts [42] while Pottinger et al. explore ludic techniques for tutorialization and agency [52, 55]. We continue that work in using game design to structure the application of different interaction patterns.

2.1 Design for user agency

Though interaction techniques identified by Victor seek to foster model exploration [27, 72], simply exposing our many parameters means that scientific tools like this often require “sophistication to navigate” [55]. If this complexity feels overwhelming, it may inhibit the agency that interactivity otherwise provides. However, video games must also similarly introduce the concepts of a complex novel system. Indeed, prior interactive scientific visualizations feature “Hayashida-style” tutorials [55], leveraging a powerful 4-step technique common to Nintendo’s work [18, 47]:

1. **Introduction:** Show the mechanic to the user.
2. **Development:** Give players a simplified task to try the action.
3. **Twist:** Highlight something unexpected about the skill.
4. **Conclusion:** Challenge users to demonstrate mastery of the lesson.

Even so, tools like those from Pyafscgap using this structure may lead through written tutorials in prescribed example analyses [55]. This explicit guiding of the user may detract from a sense of freedom or make the tool appear non-objective, asking if simulations can orient readers without “lecturing at” them. This “ludonarrative dissonance” problem also appears in games which, as detailed by Clint Hocking, arises when a mechanic used by a player feels out of place with the experience’s intended message or narrative [33, 36]. Specifically, in our tool for the plastic treaty, a written introductory tutorial may:

- Treat users like novices even as the tool invites them to bring their expertise to designing a solution.
- Bias self-directed exploration by showing example insights even though the tool tries to present neutrality.

Believing users should discover solutions instead of having opinions prescribed, we therefore look to Nintendo’s 2017 “The Legend of Zelda: Breath of the Wild” which offers a possible “open world” remedy. It starts journeys in beginning areas with reduced complexity not identified as a tutorial but which still serve the same purpose [60]. With Zelda in mind, this interactive tool still follows a Hayashida sequence to foster tool familiarity required for user agency. However, it uses visual hierarchy instead of narrative to construct a “starting region” to introduce mechanics which blossom in the “full world” in the details tab, making the tutorial “invisible” [14].

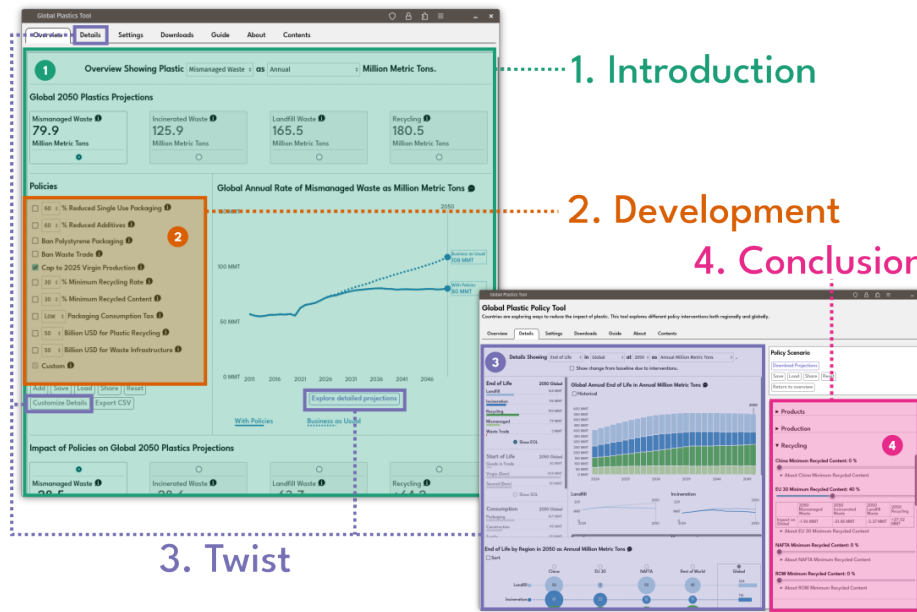


Fig. 1. Visualization structure embeds a Hayashida sequence. The initial business as usual analysis without interaction provides an introduction, the high level policy controls offer development, the details tab adds additional dimensionality for the twist, and the sliders refine initial policy selections for conclusion.

2.2 Design for multi-variate evaluation

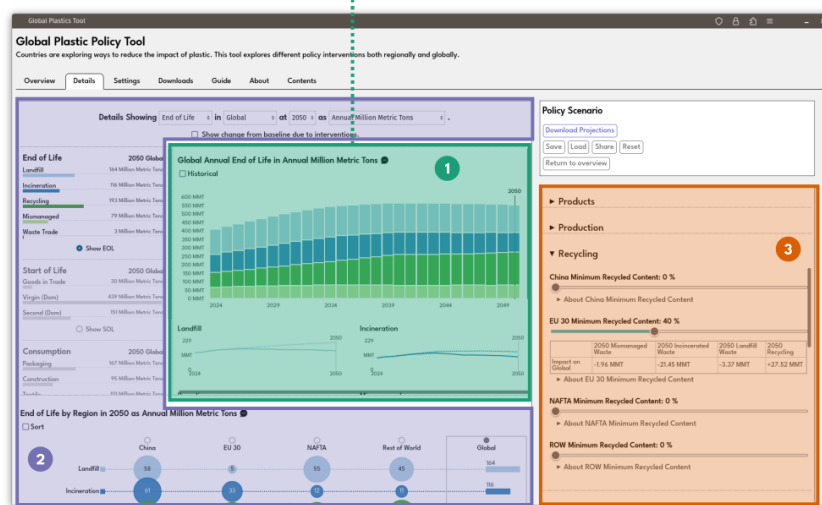
While this introductory sequence considers how first impressions with the tool may avoid a feeling of complexity, evaluating effects of user-designed policy packages can span up to 90 views in the details tab. To balance rich functionality with simplicity, our treaty support software’s design draws inspiration from video games’ separation of play:

- Games with **connected stage designs** like in Rare’s “Banjo-Tooie” allow actions in one area to impact another even as it still separates content into discrete levels [19]. This creates a deep world in the “secondary loop” while building a “primary gameplay loop” [30] that naturally narrows the moment to moment available subset of that complexity.
- Designer James Portnow observes that **open world games** advertise content through “landmarks” which orient players without explicit instruction [50]. As analyzed by Mark Brown, Zelda achieves this by peeking tall secondary loop landmarks over the world’s hilly terrain which hide primary loop landmarks in distant areas [15].

The tool operates in a way similar to a valley seen in Zelda. Though users can only take a limited number of actions at any time related to their current view in the primary loop, the tool keeps secondary loop landmarks (like other lifecycle stages or regions) visible “in the distance” through small previews opening

into those other spaces. These sight-lines try to encourage exploration and pull users “over the hill” into a new valley. Furthermore, like Banjo-Tooie, changes in one area reflect in others.

1. Valley: Current region shows deep detail / local landmarks



3. Mechanics impact whole world

2. Over the hill: Landmarks support quick insights and navigation

Fig. 2. The details tab uses “valleys” to structure primary and secondary loops.

2.3 Design for levels of reading

Even if hidden tutorials and manipulated landmark sightlines introduce the visualization tool’s mechanics and orient users in a complex multi-dimensional space, our software still serves various audiences with different objectives and background familiarity. As Victor writes, explorable explanations should consider how to empower users to “read at multiple levels” of depth [72]. In other words, those knowledgeable of plastics concepts or only seeking high level takeaways may engage with the tool superficially while others may read closely to learn unfamiliar terminology or consider expert details.

To build these multiple simultaneous levels of engagement in our interactive plastic model, producer Rob Nelson observes that a unique “ability that games have and other mediums don’t [is] optional, additional narrative that you can choose to engage with or skip over” [64]. In games:

- **Environmental storytelling** unobtrusively layers content into “setting” like graffiti or signage that the player encounters “along their journey” if they are paying close attention but can optionally be ignored, allowing the user to naturally choose their preferred depth of engagement [17, 22].
- **Rumors** which are subtle mentions of “side-quests” afford unobtrusive opt-in: invitations naturally missed by users who do not want that content or are busy rushing to another objective [16].

These designs aim to support a deep path for those moving slowly and another streamlined route for those moving quickly in which optional elements blend into the background. Similarly, our interface prepares a two track path that, while using Victor’s interaction patterns [72], leverages structural ideas from gaming to determine where to place those elements like tooltips or drawers. Low within the visual hierarchy like environmental storytelling, this architecture aims to allow those in a rush to skip these “rumors” even as they still direct close readers [16].



Fig. 3. A tooltip describes a technical phrase and beacons deeper.

3 Deployment

Along with other smaller libraries mentioned within our [project documentation](#), we implemented our tool using D3 [12] and ANTLR [49]. This runs within the web browser using JavaScript with an optional Progressive Web Application. We targeted our release to policy makers, news media, and other organizations related to negotiating for the United Nations’ “International Legally Binding Instrument on Plastic Pollution, Including in the Marine Environment” [71].

In addition to sharing directly with government delegations as well as other researchers and industry, our software was featured in either official or unofficial “side events” in the Third and Fourth Intergovernmental Negotiating Committee meetings for the treaty [67, 70] as well as at the Sixth Session of the United Nations Environment Assembly [69]. Furthermore, the tool was shared in webinars and news articles [29, 59]. Finally, in addition to these modalities (workshop, kiosk, bilateral, and presentation), web traffic saw just over 13,000 daily page views¹ during November 2023 largely coinciding with news coverage and attention on social media [6, 29, 59]. In these engagements, individuals likely leveraged the tool without us present. The software remains accessible at global-plastics-tool.org as the treaty process is expected to continue with a still unclear end date [34].

As expected by Nolin [46], the tool’s meetings and workshops happened on the sidelines of an unpredictable fast-changing negotiation [77]. As predicted by Victor [72], we found the software helpful in facilitating conversations at the science / policy nexus as we navigated cycles of question and answer. Additionally, we found interactivity helpful with on-the-spot exploring ideas and policy configurations we did not originally

¹As described in our privacy considerations, these numbers do not filter by user agent string or de-duplicate by IP address.

anticipate in our scientific modeling. With that in mind, we next further describe our experiences and strategies for deploying this tool.

3.1 Evaluative constraints

As negotiation theory focuses on the importance of information exchanges [4], consider that evaluative approaches may obtain data about insights within the context of the treaty [45]. For example, Multi-dimensional In-depth Long-term Case-studies (MILC) would involve the disclosure of not just experiences of the tool but also example findings from the data [61]. These perspectives may become crucial to negotiation.

Therefore, even if taking steps to ensure data safety, consideration of the geopolitical context leads us to forgo collection of information about individuals and specific treaty insights or actions within our tool [39]. Respecting this practical need for elevated privacy both enables this interactive science project to participate in this multi-national process and offers a public scientific resource to the community addressing a pressing global concern [78], answering the call to go beyond the paper and “blend research and engagement” to “respond rapidly to real-world events” [63]. This pragmatic stance prevents this case study from providing findings from controlled experiments or diary studies. Even so, we document our strategies as facilitators in workshops and other collaborative meetings in hopes of furthering the utility of our tool [25].

3.2 Development

Nolin observes that “scientific work is usually slow while the pace of policy is erratic” [46]. To understand why, consider that negotiation theory believes collaboration happens across multiple “phases” of information exchange [4] so the needs and questions of stakeholders naturally adjust as perspective evolves. In other words, “scientific input to be effective must thus be timed for readiness when a new phase of policy shifts in” [46]. In this context, both Nolin and Tyler note that policy “decisions usually need to be made pretty quickly” with strong constraints on timeline for additional research [66]. All this in mind, our team developed strategies to keep pace with the plastics policymaking process.

3.2.1 Policy selection. First, we found that the political process offered moments of formal documentation which we used to guide our development activities [4]. In particular, the “zero draft” put out by the United Nations [71] offered a snapshot on the state of thinking for the plastics treaty which guided prioritization, ensuring support was available (where possible) for policies it listed and deciding what to emphasize within our interface. Future documents could similarly help our software keep pace with evolving negotiations or implementation discussions.

3.2.2 Integrated development environment. Despite the benefit of those formal documents, we still required fast implementation loops predicted by Nolin [46]. For example, treaty negotiation developments demanded rapid changes in the tool to support new interventions, sometimes within 24 hours. To keep pace with policy dialogue, our integrated code editor allowed us to quickly prototype these policies, repurposing the sliders intended for user exploration to “debug” our implementations. This operationalized our domain specific language (DSL) for accelerated iteration. Also, thanks to the DSL’s brevity and built-in task-specific operations, the web application often served as the first development environment for a new policy, offering the ability to see how new logic interacts with the model outputs in real time without the delay of a “compile”

step. The “prototype” drawer in the details tab embodies this pattern. Altogether, responding to Nolin’s timeliness requirement, this approach offered us agility as scientists and facilitators in keeping pace with policy conversation [46].

3.3 Facilitation

In addition to refining our development, we also evolved our facilitation practices during deployment.

3.3.1 *Permission to play.* We quickly adopted an approach similar to that recommended by En-ROADS [37] where workshops or presentations using the software feature a “facilitator” who first introduces the motivations and science behind the tool. Offering “permission to play” [75], we used this opportunity to provide an invitation for policy makers to engage with the results through their own inquiry.

3.3.2 *Progression.* Some early presentations tried listing all tool features to accelerate conversation. However, our facilitators ultimately streamlined this introduction and put users in front of the overview tab without proactively mentioning the details tab. They felt that naturally arising questions already draw engagement to the other parts of the tool: the simpler overview tab surveys a broader possibility space at a high level before conversation moves on its own to more deeply considering specific modeling or policy aspects in the details tab.

3.3.3 *Live coding.* In addition to supporting faster development, the DSL achieved sufficient brevity such that the visualization tool could display policy logic within the details tab and allowed us to discuss and modify that code during live demonstrations. Similar to how the game design communities find benefits both from DSLs and a “hot reload” to change programming in-situ [24, 76, 79], facilitators were able to use the code itself pedagogically to describe the details of a policy implementation and use hot code changes to modify that logic based on participant input. This in-situ programming capability creates what Maggie Appleton calls a “Programming Portal” [5]. In exploring user ideas during tool demos, this allowed us to, as Victor writes, “play with the . . . assumptions and analyses [to] see the consequences” in the moment [72], affording an important flexibility during conversation.

3.3.4 *Integrated Monte Carlo.* Not part of the original launch, questions in scientifically expert discussions regarding sensitivity and uncertainty prompted us to add a Monte Carlo feature which can explore output distributions under different assumptions [43]. This further takes advantage of our domain specific language.

3.3.5 *Progressive web application.* Pragmatically, we found heavy network utilization at these events as well as uncertain connectivity at “side-line” locations. To that end, we built a Progressive Web Application which can be installed or cached to run offline.

4 Discussion

We next further detail implementation decisions before considering limitations and opportunities for future work.

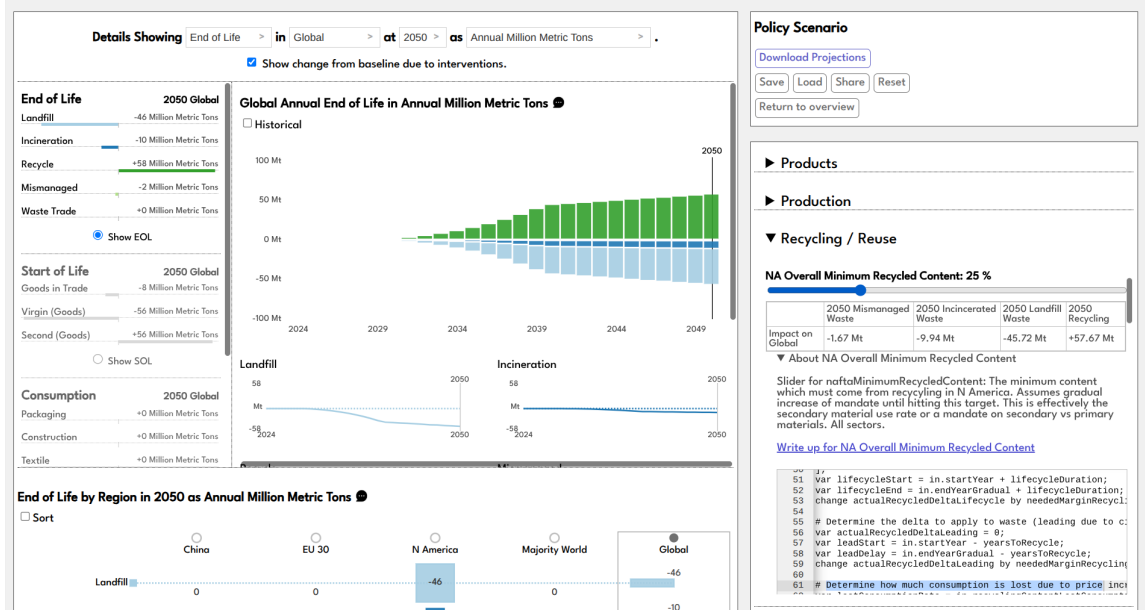


Fig. 4. Screenshot of the tool showing changes to key metrics caused by a North America minimum recycled content mandate with code for that policy visible and editable within the live application. The use of a DSL with hot reload similar to some game development strategies [79] via a Programming Portal [5] may help facilitate exploration of mechanics beyond the slider values alone.

4.1 Technical measures for privacy

To further this software’s stance regarding the avoidance of collecting information about policy makers and their insights within the sensitive context of treaty negotiation, the decision support web application takes a number of privacy-preserving technical steps. Future work in the policy space should also consider the privacy aspects of not just research methods but implementation.

4.1.1 Single page application. We provide a single page application where computation runs client-side so that navigation between elements does not generate network requests that may reveal intentions or activity, a privacy-preserving practice paired with also avoiding use of technologies like “beacons” which would reveal the questions being explored or results being considered by a user [41].

4.1.2 Reduced logging. We disable or curtail certain web provider defaults for logging, in particular strictly limiting use of IP addresses to only what is required for basic operation including traffic routing, security, abuse prevention, and reliability [20].

4.2 Relationship to Victor’s explorable explanations

Many of the objectives of Victor’s explorable explanations influence this work and its design decisions [72]. That said, Victor also emphasizes that, in his definition, these interactive documents convey an argument and not just inform. This explicit argument may run counter to some of our design objectives.

To resolve this tension, we offer that our use of invisible tutorials and the structuring of mechanics, including their default parameterization, itself conveys a form of argument. We believe these design choices offer a way of giving voice to our perspective on this problem as scientists. For example, choosing to include non-zero induced demand in recycling reflects not only our best estimate of policy impact but, as further detailed in our modeling publication [54], also an evidence-informed perspective on some limitations of circularity. In other words, our constraining the user mechanically to achieve their goals within this tool imbues argument. Other projects such as En-ROADS [57] may take a similar approach.

Still, we accept that this is an interpretation of Victor’s ideas potentially beyond his original conception. Indeed, moving our perspective from the tool’s explicit narrative to its mechanics, we believe our work may suggest that an intentional ludonarrative may provide another way to offer some of the potential benefits of explorable explanations in another format. This may help in some specific applications like this one with objectives around agency and co-creation, even if the resulting tools may fall outside his definition. This does not preclude more constrained experiences. For example, we complement our policy maker-focused tool with a simplified scrolling storytelling experience for the general public at plasticstreaty.berkeley.edu.

4.3 Additional future work

Finally, we highlight additional streams of future work.

4.3.1 Role of AI optimization. This tool could try to use multi-variate optimization to propose solutions to users, offering its own “policy answer” alongside user-generated suggestions [10]. However, using the video games lens, doing so could create ludonarrative dissonance. By this we mean that the tool presents itself as a space for users to find their own solutions but an “auto-solve” functionality could run counter to this narrative, putting the mechanics of play in conflict with the explicit narrative. In other words, as an extension of the project’s existing modeling, this hypothetical feature would see the software claiming to invite outside expertise and exploration (with computation as a “helper” in finding a policy design) while simultaneously offering a mechanic providing “optimized” solutions (tool as the source of the “right” policy design).

In this case of interacting with actual policy negotiation, this project intentionally excludes this AI-driven auto-optimization option despite access to the machinery required. If policy makers offer expertise necessary for finding solutions [66], visualization and game design allow that knowledge to participate in co-creation, potentially reaching beyond the limits of blind mathematical optimization. Nevertheless, future work may consider if different design contexts could benefit from this kind of AI-generated solution or may offer studies on evolving policy maker perceptions of these algorithmic designs.

4.3.2 Mediation and motivation. By affording manipulation of systems and financial assumptions, this tool answers Victor’s call for explorable explanations to allow the questioning of modeling [72]. Even so, this dialectic experience executes within the existing treaty process and does not consider how interactive software may mediate or alter that process’ structure itself. While tools to actively guide discussion and resolution of disagreements between stakeholders represent a different goal, this possibility of mediated disagreement resolution remains a possible area for future research. Furthermore, prior work also finds that

role play through similar tools may help facilitate engagement and action which help beyond forming a treaty itself [56].

4.3.3 National and sub-national usage. We recognize opportunities for future use of this tool or similarly designed software at the national or sub-national (such as state) level. This may operate in a context similar to implementation plans from other international treaties such as the Kigali Amendment [44] which has similar software [53]. However, these opportunities may become more clear after continued treaty negotiations.

4.3.4 Default parameters. Note that a number of policies use key parameters which may influence impact. This ranges from the size of investment as shown in the overview tab to assumptions around induced demand on the details tab. We chose default parameterization based on our expectations for which sets were most likely useful based on prior policies [54] or perceived state of negotiation as a way to keep pace with dialogue [46]. Indeed, as mentioned previously, selection of these defaults offers a form of scientific perspective. Still, one may avoid providing an initial default preference and instead require active user input to choose these parameters, possibly furthering goals around neutrality. Though we believe providing these defaults pre-selected may have helped reduce user friction in brief interactions with the tool, other applications may consider this alternative approach.

4.3.5 Human subjects research. This case study considers quality assurance and improvement activity for a single tool and these designs. That said, while this simulation currently remains constrained by the nature of ongoing treaty processes and a desire to avoid collecting information about individuals within this sensitive context, later research could seek generalizable knowledge through human subjects research approaches like MILC [61] which may be more appropriate outside active negotiation. For those efforts, we caution that this interactive tool does not serve the general public and, instead, focuses on active and often knowledgeable treaty participants [66]. Therefore, it remains possible that this unique target audience may engage with this tool differently than other users such as general members of the public [62]. Indeed, situated techniques often respond to “domain experts” with their objectives and backgrounds mediating experience [61]. Later research hoping to build generalizable knowledge may want to ensure the study takes place in-situ. This may require considering leaning away from broad methods which, while reporting on insights generated through the tool, could collect incidentally sensitive information. Instead, one may consider more narrowly constructed instruments which ensure reporting only on general usage patterns.

5 Conclusion

Where the rigidity of static media limits their mutual embrace, this case study considers interactivity to facilitate the valuable conversation between science and policy, a necessary dialogue emphasized by prior work [46, 66]. Adding to the early discourse between video game and information design, we offer a documented open source example of these ideas [27, 72] and how they influenced a practical tool with real-world use in an international treaty negotiation context. Additionally, we also propose a possible ludic vocabulary for building these experiences for evidence-based policy, approaches we found useful in this specific tool’s structural design.

For those facilitating similar machine-mediated conversation, consider a concept from Jesse Schell central to games: experiences are co-created by game and player [58]. In this framing, like games [51], this kind of decision support tool may enable science to be activated and made more complete by the decision maker when it is brought into the framework of their policy expertise. This reaches the ultimate ambition of this tool: using computation to inform policy without prescribing it.

Our global plastics policy simulation tool is available at global-plastics-tool.org. It is free and open source. Again, a scrolling storytelling experience for the general public to complement the detailed interface is also publicly available at plasticstreaty.berkeley.edu.

6 Acknowledgements

Funding from the Eric and Wendy Schmidt Center for Data Science and Environment at the University of California Berkeley, the Benioff Ocean Science Laboratory at the University of California Santa Barbara, the March Marine Initiative, and the Harris Family Charitable Gift Fund.

7 Research material statements

Our web application is available for ongoing use on the public Internet at global-plastics-tool.org. Additionally, our work is also archived at zenodo.org/records/12615011. This utilizes a Docker container.

7.1 Authorship

A. Samuel Pottinger: conceptualization, methodology, software, validation, formal analysis, investigation, writing, visualization. **Nivedita Biyani:** conceptualization, methodology, software, validation, formal analysis, data curation, writing. **Roland Geyer:** conceptualization, methodology, validation, formal analysis, investigation, resources, data curation, supervision, funding acquisition. **Douglas J McCauley:** conceptualization, validation, writing, supervision, project administration, funding acquisition, resources. **Magali de Bruyn:** writing, software. **Molly R Morse:** conceptualization, resources, writing, supervision, project administration. **Neil Nathan:** conceptualization, validation, writing, visualization, resources. **Kevin Koy:** supervision, funding acquisition. **Ciera Martinez:** conceptualization, validation, investigation, resources, writing, supervision, project administration.

Reflecting the tool’s full credits page at global-plastics-tool.org/#about-people at time of writing, we also acknowledge and thank Elijah Baker for policy research, Carl Boettiger for early project advice, Kelly Wang for communications, Linda Nakasone for reporting bugs through the open source community process, and Thought Lab for development of the general public page at plasticstreaty.berkeley.edu which complements the tool. Furthermore, this paper acknowledges and thanks:

- Color Brewer for color schemes [13].
- draw.io tools for diagramming [2].
- All open source libraries in the project README at github.com/SchmidtDSE/plastics-prototype.
- Pandoc for Markdown to LaTeX conversion [40].

Note that, for transparency, the tool also maintains a formal version-controlled and standards-compliant “humans.txt” (global-plastics-tool.org/humans.txt) with comprehensive and detailed individual credits for the entire project which is current at time of this paper’s submission [8]. Finally, thank you to policy makers who have used and considered the tool.

Claude, an AI from Anthropic, was used to help with technical LaTeX issues and basic copyediting but did not substantively write any of the content which appears in this publication [1].

7.2 License

Project code is released under the permissive Berkeley Software Distribution open source license and invites community contributions which are also provided under the same BSD terms [48]. This paper itself is licensed under a Creative Commons Attribution 4.0 International License [26].

7.3 Conflicts of interest

We do not have any conflicts to disclose.

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