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A R T I C L E

HOW ALGORITHM-ASSISTED DECISIONMAKING IS INFLUENCING ENVIRONMENTAL LAW AND CLIMATE ADAPTATION

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I. Introduction

Agencies responsible for water and energy systems increasingly rely on algorithm-assisted decisionmaking to regulate these systems and shepherd them through climate adaptation.[1] Legal scholars, attorneys, and environmental equity advocates should care about this fundamental change in governance for three reasons. First, climate adaptation depends on these tools. Second, algorithmic tools are not policy-neutral; rather they embed value-laden assumptions and biases. And third, the "rules" of this new forum impede equity and democratic participation, without deliberate countermeasures.

This Article proposes an initial step in the development of such countermeasures: a framework for evaluating how algorithm-assisted decisionmaking, in environmental and energy regulation, influences law and what the consequences are for equity and participation.

II. The Challenge of Adapting Water and Energy Systems to a New Climate and the Role of Algorithms and Modeling

Freshwater systems in the United States are regulated, negotiated, and managed to meet multiple, and at times conflicting, purposes.[2] Climate change exacerbates many existing challenges to water governance by altering the quantity, flow, and quality of available freshwater.[3] Negotiation and agency regulation can prevent, or minimize, future conflicts among uses, which in turn, rely heavily on software assistance to create an array of scenarios to guide decisionmaking.[4]

Energy systems face a different set of challenges.[5] To reduce greenhouse gas (GHG) emissions, energy generation systems are swapping out old fossil fuels for new renewable energy and storage.[6] Regulators and balancing authorities are responsible for managing the transition from fossil fuels to renewables in a way that maintains grid reliability.[7] Popular writing and scholarship characterizes the energy system's relation to climate change as a source of

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1. *See generally* Deniz Ozkundakci et al., *Building a Reliable Evidence Base Legal Challenges in Environmental Decision-Making Call for a More Rigorous Adoption of Best Practices in Environmental Modelling*, 88 Env't Sci. & Pol'y 52, 52-62 (2018).
2. *See* Edella Schlager & William Blomquist, Embracing Watershed Politics 149-50 (2011); *see also* Sonya F. Ziaja, *Role of Knowledge Networks and Boundary Organizataions in Coproduction: A Short History of a Decision Support Tool and Model for Adapting Multiuse Reservoir and Water Energy Governance to Climate Change in California,* 11 Weather, Climate, & Soc'y 826 (2019); Sandra Postel & Brian Richter, Rivers for Life: Managing Water for People and Nature (2003); Helen Ingram, *Water as a Multi-Dimensional Value Implications for Participation and Transparency*, 6 Int'l Env't Agreements: Pol'y, L., & Econ. 429, 429-33 (2006).
3. *See, e.g.*, Thomas Johnson et al., *Water*, *in* 2 Fourth National Climate Assessment: Impacts, Risks, and Adaptation in the United States 147 (David Reidmiller et al. eds., 2018), https://nca2018.globalchange.gov/downloads/NCA4_2018_FullReport.pdf.
4. *See, e.g.*, Comm. on Models in the Regul. Decision Process, Nat'l Rsch. Council, Models in Environmental Regulatory Decision Making, at ix (2007), http://nap.edu/11972. ("The use of computational models is an essential element of the environmental regulatory process."); Ziaja, *supra* note 2, at 833 tbl.2; Ozkundakci et al., *supra* note 1, at 52-62; Sonya F.P. Ziaja, *Rules and Values in Virtual Optimization of California Hydropower*, 57 Nat. Res. J. 329 (2017); Wendy Wagner et al., *Misunderstanding Models in Environmental and Public Health Regulation*, 18 N.Y.U. Env't L.J. 293 (2010); Marcela Brugnach et al., *Uncertainty Matters Computer Models at the Science-Policy Interface*, 21 Water Res. Mgmt. 1075 (2007).
5. *See generally* California's Fourth Climate Change Assessment: Statewide Summary Report 84 (2019), https://www.energy.ca.gov/sites/default/files/2019-11/Statewide_Reports-SUM-CCCA4-2018-013_Statewide_Summary_Report_ADA.pdf; *see also* 2 Fourth National Climate Assessment: Impacts, Risks, and Adaptation in the United States, *supra* note 3, at 76.
6. *See* 100 Percent Clean Energy Act of 2018, S.B. 100, 2017-2018 Leg., Reg. Sess. (Cal. 2018); *see also* The Reg'l Greenhouse Gas Initiative: An Initiative of E. States of the U.S., https://www.rggi.org/ (last visited Feb. 20, 2021).
7. *See* Shelley Welton, *Rethinking Grid Governance for the Climate Change Era*, 109 Calif. L. Rev. 209, 250 (2021).

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GHGs or a solution to curbing emissions.[8] But, the energy system itself is also vulnerable to climate impacts.[9]

Algorithms and "algorithmic decisionmaking"[10] (ADM) are discussed and debated far more now than even a decade ago.[11] An algorithm is a sequential process of calculations—or more simply, what the programmer instructs a computer to do with data.[12] Computer models of climate systems, social-economic-environmental systems, and energy grid expansion require algorithms to function. These software products and models may represent existing conditions,[13] or solve for least-cost policy options,[14] among others.

This Article uses the term algorithm-*assisted* decisionmaking, which includes, but is not exclusive to, ADM. Unlike ADM, algorithm-assisted decisionmaking recognizes the place of technology within human systems.[15] Both rely on quantification to represent the reality of complex environmental systems.[16] Climate change has increased the complexity of making decisions for water and energy planning, leading regulators to rely more heavily on algorithmic tools.

III. The Development and Use of Algorithm-Assisted Decisionmaking in Governance

Environmental scholarship was among the first to point out the disconnect between policymaking and modeling, and to posit solutions for bridging that gap.[17] In a 1997 paper, Stephen Schneider argued that Integrated Assessment Modeling (IAM) was intended to be a useful tool for policymakers to govern the environment.[18] But, because environmental models are necessarily complex and contain "value-laden assumptions," they can "obscure values or make implicit cultural assumptions about how nature or society works" and "diminish the openness of the decisionmaking process," making it "less rational."[19] Schneider proposed a means to express uncertainty in modeling results, arguing that modelers had a "special obligation to make . . . tools transparent as possible,"[20] and "[m]ost critical . . . to engage in a vigorous outreach program to entrain decisionmakers and citizens at all levels into the process of helping to design, test, and use IAMs for real policy questions."[21]

From Schneider's work, we can derive three diagnostic categories to address concerns: uncertainty, transparency, and stakeholder collaboration.

A. Uncertainty

Many environmental systems are complex adaptive systems[22]—where underlying cause-and-effect relationships may not be known or knowable. This is called system uncertainty or "model uncertainty."[23] Using a "reductionist approach" simplifies the system structure, which conceals the underlying system uncertainty.[24] Solutions for resolving uncertainty rely on increased stakeholder involvement in the modeling process,[25] or greater forthrightness about uncertainty from modelers.[26] Marcela Brugnach and others argue that by doing both, projects are able to help decisionmakers understand the model and build trust between modelers and stakeholders.[27]

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8. Craig D. Zamuda et al., *Energy Supply, Delivery, and Demand*, *in* 2 Fourth National Climate Assessment: Impacts, Risks, and Adaptation in the United States, *supra* note 3, at 196.
9. *See id.* at 175-76.
10. *See*, *e.g.*, Mike Ananny & Kate Crawford, *Seeing Without Knowing Limitations of the Transparency Ideal and Its Application to Algorithmic Accountability*, 20 New Media & Soc'y 973 (2016).
11. *See*, *e.g.*, Bruno Lepri et al., *Fair, Transparent, and Accountable Algorithmic Decision-Making Processes*, 31 Phil. & Tech. 611 (2018).
12. *See generally* Harry Surden, *Machine Learning and Law*, 89 Wash. L. Rev. 87 (2014); Harry Surden, *Artificial Intelligence and Law: An Overview*, 35 Ga. State U. L. Rev. 1319 (2019).
13. *See* Dave Owen, *Mapping, Modeling, and the Fragmentation of Environmental Law*, 45 Utah L. Rev. 219, 245 (2013).
14. Ziaja, *Rules and Values*, *supra* note 4, at 331.
15. *See*, *e.g.*, Surden, *Artificial Intelligence and Law: An Overview*, *supra* note 12.
16. *See generally* Linda Pilkey-Jarvis & Orrin H. Pilkey, *Useless Arithmetic Ten Points to Ponder When Using Mathematical Models in Environmental Decision Making*, 68 Pub. Admin. Rev. 470 (2008).
17. *See generally* Edward A. Parson, *Integrated Assessment and Environmental Policy Making in Pursuit of Usefulness*, 23 Energy Pol'y 463 (1995); *see also* Edward A. Parson, *Three Dilemmas in the Integrated Assessment of Climatic Change: An Editorial Comment*, 34 Climatic Change 315, 321-24 (1996); Diana M. Liverman, *Forecasting the Impact of Climate on Food Systems Model Testing and Model Linkage*, 11 Climatic Change 267 (1987); Brian Wynne & Simon Shackley, *Environmental Models Truth Machines of Social Heuristics?*, 21 Globe: Revue Internationale d'Etudes Quebecoises 6, 6-8 (1994); Marjolein B.A. van Asselt & Jan Rotmans, *Uncertainty in Integrated Assessment Modelling From Positivism to Pluralism*, 54 Climatic Change 75 (2002).
18. *See generally* Stephen H. Schneider, *Integrated Assessment Modeling of Global Climate Change Transparent Rational Tool for Policy Making or Opaque Screen Hiding Value-Laden Assumptions?*, 2 Env't Modeling & Assessment 229, 229 (1997). Notably, Dave Owen and James Fine trace the tension between modeling and participation even further in case law. *See* James D. Fine & Dave Owen, *Technocracy and Democracy Conflicts Between Models and Participation in Environmental Law and Planning*, 56 Hastings L.J. 914-15 (2005) (citing to Sierra Club v. Costle, 657 F.2d 298 (D.C. Cir. 1981)).
19. Schneider, *supra* note 18 at 230.
20. *Id.*
21. *Id.*
22. *See* Bobbi Low et al., *Redundancy and Diversity Do They Influence Optimal Management?*, *in* Navigating Social-Ecological Systems: Building Resilience for Complexity and Change 83, 103 (Fikret Berkes et al. eds., 2002) (describing complex adaptive systems as being "composed of a large number of active elements whose rich patterns of interactions produce emergent properties—which are not easy to predict by analyzing the separate system components").
23. James Wilson, *Scientific Uncertainty, Complex Systems, and the Design of Common-Pool Institutions*, *in* The Drama of the commons 327, 333 (Elinor Ostrom et al. eds., 2002); *see also* Fine & Owen, *supra* note 18, at 922-26 (discussing sources of uncertainty in simulation models).
24. Wilson, *supra* note 23, at 328.
25. *See*, *e.g.*, Brugnach et al., *supra* note 4.
26. Wagner et al., *supra* note 4, at 7 (both participation and transparency); *see also* Ozkundakci et al., *supra* note 1, at 61 ("[I]f models are to be of substantial help in environmental and resource management decision-making, then modellers and decision-makers will need to ensure that there is a clear understanding of the purpose of a model, the modelling process is transparent, and that best practice guidelines are followed."). *See generally* John Bistline et al., *Deepening Transparency About Value-Laden Assumptions in Energy and Environmental Modelling Improving Best Practices for Both Modellers and Non-Modellers*, 21 Climate Pol'y 1 (2020) (arguing that interdisciplinary collaboration is needed to unearth and openly discuss hidden "value-laden" assumptions in environmental and energy models).
27. *See* Brugnach et al., *supra* note 4, at 1082.

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B. Transparency

Legal approaches to algorithm-assisted decisionmaking problems have focused on transparency as a solution.[28] However, transparency alone may not be sufficient to overcome algorithm-assisted decisionmaking's obfuscation of uncertainty and associated "value-laden" assumptions. Many environmental models and software include a descriptive model process manual, which describes the model's structure, calibration, and data, and generally how the model works. But, this does not necessarily make the model accessible to non-engineering audiences.[29]

C. Stakeholder Collaboration

Schneider proposed stakeholder collaboration as important to the future of environmental modeling, calling for the "increased involvement of diverse policy actors in the development and use of assessments and assessment tools."[30] While existing literature does not agree on the appropriate timing and extent of stakeholder collaboration for model development, much of the literature maintains that stakeholder collaboration should occur throughout the modeling process.[31]

D. Implications for Equity Across Uncertainty, Transparency, and Stakeholder Collaboration

Value-laden assumptions in decisionmaking are tied to substantive and procedural equity. In a democracy, choices among competing visions of equity are political dilemmas,[32] subject to deliberation.[33] Deliberation depends on participation[34] and accessibility.[35] The nature of algorithmic tools and the typical design process of such tools frustrates participation in and accessibility of deliberation.

IV. Framework for Evaluating Value-Laden Assumptions in Algorithm-Assisted Decisionmaking

I suggest a six-part framework for evaluating value-laden assumptions in algorithm-assisted decisionmaking (see Table 1 next page). This framework provides a structure to answer some of the concerns posed by Schneider, and serves as a guide for attorneys and policymakers for approaching algorithm-assisted decisionmaking tools, and focuses on attributes that may influence equity.

V. Cross Case Comparison and Application of Framework

How would this framework function in practice? Below, I present and compare two models: one for water regulation and the other for energy planning. While both models influence law and regulation of resources, they raise different issues of equity due to divergences in design processes and logics.

A. Water Governance and Algorithm-Assisted Decisionmaking on the Sacramento River

The main mechanism for managing the Sacramento River for flood control, distributing water to cities and farms, and protecting stream flow for aquatic habitat, is deciding when to release water from reservoirs. For the large dams along the Sacramento, that decision is predetermined by the U.S. Army Corps of Engineers' "rule curve," the maximum fill line for that reservoir for each month of the year.[36] Most curves were set in the mid-20th century.[37] Those assumptions about seasonal precipitation, temperature, and evaporation rates no longer hold true because of climate change.[38] Additionally, few agency rules for regulating stream flow from hydropower projects were designed with the other rules in mind.[39]

Algorithm-assisted decisionmaking has been a useful workaround to limitations of existing law. The California Department of Water Resources installed a software

28. *See* Sandra Wachter, *The GDPR and the Internet of Things A Three-Step Transparency Model*, 10 L., Innovation & Tech. 266, 280 (2018).
29. For example, see U.S. EPA's model documentation for the SAGE model of the U.S. economy for environmental planning. Alex Marten et al., *SAGE Model Documentation (2.0.1)*, U.S. EPA, https://www.epa.gov/environmental-economics/cge-modeling-regulatory-analysis (last visited Jan. 4, 2022).
30. Schneider, *supra* note 18, at 235.
31. *See, e.g.*, Katharine J. Mach et al., *Actionable Knowledge and the Art of Engagement*, 42 Current Op. Env't Sustainability 30, 32-33 (2020); Jens Christian Refsgaard et al., *Uncertainty in the Environmental Modelling Process—A Framework and Guidance*, 22 Env't Modelling & Software 1543, 1544-45 (2007); Susanne C. Moser, *Can Science on Transformation Transform Science? Lessons From Co-Design*, 20 Current Op. Env't Sustainability 106, 111-12 (2016).
32. *See* Deborah Stone, Policy Paradox: The Art of Political Decisionmaking 39 (1997); Daniel Bromley, Sufficient Reason: Volitional Pragmatism and the Meaning of Economic Institutions 16 (2010):

> In democratic states, these declarations of what must (or ought to) be done emanate from the judicial and parliamentary branches of government. That is, after all, the reason why these branches of government exist. It is in the discourses of parliaments—and the considerations of the courts—that debates about the relative merits of Y and ~Y take place. Although Paretian economists may feel uncomfortable at the prospect of making choices without prices (and thus without monetary estimates of $\Sigma\$V_Y$), this is a misplaced concern. Democratic structures and processes exist for precisely those purposes.

(internal citations omitted)).
33. *See* Bromley, *supra* note 32, at 31-42.
34. *See* Sherry R. Arnstein, *A Ladder of Citizen Participation*, 35 J. Am. Inst. Plan. 216, 220 (1969).
35. Jonathan Skinner-Thompson, *Procedural Environmental Justice*, 97 Wash. L. Rev. 399 (2022).
36. *See* Ann D. Willis et al., *Climate Change and Flood Operations in the Sacramento Basin, California*, 9 S.F. Estuary & Watershed Sci. 1, 1 (2011).
37. *See* Ziaja, *Rules and Values*, *supra* note 4, at 343-44.
38. *Id.*
39. *See* Joshua H. Viers, *Hydropower Relicensing and Climate Change*, 47 J. Am. Water Res. Ass'n 655, 657-58 (2011); Willis et al., *supra* note 36, at 8 (A notable exception to this is the New Bullards Bar dam, whose operating manual mandates coordination with the St. Mary's dam, which was never built).

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Table 1

	Model Itself	Design Process
Uncertainty	How is governance and conflict represented?	How is uncertainty communicated and to whom?
	To what extent do the model's mechanisms for assigning weighted values and choosing optimal solutions reflect existing governance?	Who is involved in determining sources of uncertainty?
	What are the kinds of uncertainty in the system being modeled that simplification may obscure?	
Transparency	Is the logic of the model explicable?	Are participants in the design and implementation known?
	What aspects, if any, of the model are "black box" and unknowable?	
	Are the inputs and parameters open to verification from outside sources?	
Stakeholder Collaboration	Is stakeholder collaboration advisory or determinative?	Who determines which stakeholders are relevant? With what parameters? Can stakeholders themselves expand who participates?
	Is stakeholder knowledge incorporated into the model?	
		To what extent do stakeholders determine processes for collaboration?
		How are disagreements among stakeholders and designers resolved?

program called INFORM, that works alongside human water managers to regulate the flow of the Sacramento.[40] INFORM coordinates reservoir operations across multiple spatial and temporal scales, while including short- and long-term weather and climate forecasts.[41]

Existing law and regulation are represented in INFORM through operational rules. After a human water manager chooses the specific time horizon, INFORM creates "runs" from the model sets and evaluates trade offs for water uses, before presenting the water manager with analyzed results for "optimal" operations management.[42] Multi-year studies confirm that INFORM outperforms normal reservoir decisionmaking.[43]

INFORM's representation of law and policy depends not just on law on the books, but also informal law as practiced and interpreted by water managers.[44] The design team incorporated these perceptions and practices into INFORM's algorithms.[45]

40. *See* Ziaja, *Role of Knowledge Networks*, *supra* note 2, at 827.
41. *See id.*
42. *See id.* at 827-28.
43. *See* Huaming Yao & Aris Georgakakos, *Assessment of Folsom Lake Response to Historical and Potential Future Climate Scenarios 2. Reservoir Management*, 249 J. Hydrology 176, 187-88 (2001).
44. *See generally* Ziaja, *Role of Knowledge Networks*, *supra* note 2.
45. *See id.* at 356-57; *see also* Telephone Interview with Konstantine Georgakakos, Hydrologic Rsch. Ctr., Scripps Inst. of Oceanography, San Diego, CA (Dec. 6, 2016); *see also* Interview with Guido Franco, Cal. Energy Comm'n, Sacramento, CA (Apr. 6, 2016).

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B. *Integrated Resource Planning for Renewable Energy Build Out and Algorithm-Assisted Decisionmaking*

California's Legislature has set increasingly ambitious targets to reduce GHG emissions.[46] By 2015, the legislature, in SB 350 set GHG emissions and renewable energy development targets for regulated electric utilities[47] and requires each regulated utility to submit an Integrated Resource Plan (IRP) to be evaluated by the California Public Utilities Commission (the Commission).[48] In response to SB 350, the Commission established the IRP and Long Term Procurement Plan (IRPLTPP), an "umbrella" administrative proceeding to evaluate electricity procurement policies and capacity requirements.[49]

The Commission opened a quasi-legislative rulemaking to comply with the IRP directive in SB 350[50] and contracted with an energy and environmental consulting firm to develop a decision support tool to assess energy procurement scenarios called "RESOLVE."[51]It solves for optimal capital allocation,[52] grid reliability, and GHG targets.[53]

RESOLVE depends on some simplification of the physical, legal, and political world it is representing. RESOLVE's core simplification (geography in buckets, and time as non-sequential samples) makes quickly running different scenarios feasible.

C. *Comparison of Value-Laden Assumptions in INFORM and RESOLVE Across Uncertainty, Transparency, and Stakeholder Collaboration*

The framework divides algorithm-assisted decisionmaking tools into two components: the model itself and the design process behind the model. Under each, questions target how uncertainty, transparency, and stakeholder collaboration lead to or resolve value-laden assumptions.

1. Uncertainty

The framework's investigation into uncertainty first considers how governance and conflict are represented. In both INFORM and RESOLVE, the mechanism of governance is literally mechanical, a quantified optimization problem. The course of action is determined by assigning values and solving for least-cost solutions.

The framework then asks how the model's mechanisms reflect existing governance. INFORM and RESOLVE diverge significantly from existing real-world governance because in the real world, the "value" of choices and their consequences are not determined by numerical value or exchange value, but through deliberation.[54] There are numerical values associated with energy build out and resource adequacy that drive RESOLVE. However, modelers choose what those values are, rather than arriving at those values as the result of a true market.

The framework also asks whether there are sources of inherent uncertainty in the social-ecological-technical system being represented, and whether simplification preserves or obscures those sources. INFORM, for example, can only model and represent a few of aspects of the Sacramento River.[55] The simplified governance mechanism in RESOLVE may obscure uncertainty surrounding a key input for energy modeling. For example, the existence of procurement contracts can shift the market price for other energy procurement,[56] but the influence of these contracts is not modeled in RESOLVE.[57]

In the design process, the framework asks about the processes for communicating uncertainty. The INFORM research team communicated uncertainty in the model to the working group at semiannual meetings.[58] The working group discussed system uncertainty with the researchers at the same meetings.[59] For RESOLVE, model uncertainty is discussed openly by the modelers to the working group.[60]

2. Transparency

The framework begins by asking whether the logic of a model is explicable. There are models that are relatively simple, like RESOLVE. And then there are models whose logic is nominally explicable, but difficult for even experts

46. *See* California Global Warming Solutions Act of 2006, A.B. 32, 2005-2006 Leg., Reg. Sess. (Cal. 2006).
47. Cal. S.B. 350.
48. Cal. Pub. Util. Code §454.51-52; *see also* Cal. Pub. Util. Comm'n, 16-02-007, Order Instituting Rulemaking to Develop an Electricity Integrated Resource Planning Framework and to Coordinate and Refine Long-Term Procurement Planning Requirements (2016) [hereinafter 2016 Order Instituting Rulemaking].
49. *See* 2016 Order Instituting Rulemaking, *supra* note 48, at 3, 25; *see also Integrated Resource Plan and Long Term Procurement Plan (IRP-LTPP)*, Cal. Pub. Util. Comm'n, https://www.cpuc.ca.gov/irp/ (last visited Dec. 27, 2021).
50. *See generally* 2016 Order Instituting Rulemaking, *supra* note 48.
51. *See generally RESOLVE Renewable Energy Solutions Model*, Energy & Env't Econ., Inc. (E3), https://www.ethree.com/tools/resolve-renewable-energy-solutions-model/ (last visited Dec. 27, 2021).
52. The capital cost allocation mechanism is important here because unlike thermal generation, wind and solar energy generation does not require fuel; so, the more renewable generation is integrated into the grid, the higher the percentage of capital costs. Interview with Mohit Chhabra (November 2020) (on file with author).
53. Energy & Env't Econ., Inc., RESOLVE Capacity Expansion Model: User Manual 3-4 (2019), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2019-2020-irp-events-and-materials/resolve-user-guide——public-release-20191106.pdf.
54. Inputs & Assumptions: 2019-2020 Integrated Resource Planning, Cal. Pub. Util. Comm'n 4-5 (November 2019), https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2019-2020-irp-events-and-materials/inputs--assumptions-2019-2020-cpuc-irp_20191106.pdf.
55. *See* Ziaja, *Role of Knowledge Networks*, *supra* note 2, at 837.
56. *See generally* Severin Borenstein & James Bushnell, *The U.S. Electricity Industry After 20 Years of Restructuring* (Nat'l Bureau of Econ. Rsch., Working Paper No. 21113, 2015), https://www.nber.org/system/files/working_papers/w21113/w21113.pdf; Severin Borenstein et al., *Expecting the Unexpected Emissions Uncertainty and Environmental Market Design* 24 (Nat'l Bureau of Econ. Rsch., Working Paper No. 20999, 2018), https://www.nber.org/system/files/working_papers/w20999/w20999.pdf.
57. *See* Energy & Env't Econ., Inc., *supra* note 53, at 3-4.
58. Ziaja, *Role of Knowledge Networks*, *supra* note 2.
59. *See id.*
60. Interview with E3 staff (Feb. 4, 2021) (on file with author); Interview with CPUC Staffer (2020); Interview with Mohit Chhabra, *supra* note 52.

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to understand. INFORM falls into this latter category. Answers to this question, therefore, vary based on who is trying to understand the model.

The framework also asks whether the inputs and parameters are open to verification from outside sources. The Commission requires that RESOLVE be transparent.[61] It operates under a public license and the data sources are open to the public.[62] Because INFORM is operated by the Department of Water Resources, its inputs are subject to the state's public records act.[63] However, prior interviews show that when developing the model, the researchers consulted reservoir operators and included parameters to represent circumstances under which operators felt they could deviate from law on the books.[64] But none of the researchers interviewed could recall what those parameters were.[65] The result is that there are elements of the model that are obscured and may no longer be knowable.

Regarding the design process, the framework asks whether the participants in the design and implementation are known. Both RESOLVE and INFORM are state-funded and the development and implementation process are matters of public record. In both cases, the participants are known or discoverable.

3. Stakeholder Collaboration

The framework begins by asking two questions. First, is stakeholder collaboration advisory or determinative? Both INFORM and RESOLVE have had technical advisory groups. For INFORM's process, stakeholder collaboration was determinative. It also depended on consensus decisionmaking. For RESOLVE, the working group is purely advisory. Second, is stakeholder knowledge incorporated into the model? For both RESOLVE and INFORM, knowledge from the working groups changed inputs to the model.[66]

The framework then asks three sets of questions regarding the design process. First, who determines which stakeholders are relevant in the process? Those who determined the stakeholders relevant to the development of INFORM changed over time.[67] At the beginning, the researchers developed connections with agencies that could end up using their product.[68] Once the product development was funded by government agencies, those agencies chose additional stakeholders for the technical advisory committee.[69] However, once the advisory committee began meeting, the participants could suggest additional stakeholders who would be interested in the outcome or who could provide specific input.[70] The process was different for RESOLVE. On paper, it was the administrative law judge, with advice from a staffer within the analysis division of the Commission, who weighed the input and advice of stakeholders before determining which comments influence the development of RESOLVE.[71] In practice, the opinions of the regulated utilities, the expertise of the modelers, and the political pressures of the moment can add a thumb to the scale.

Second, to what extent do stakeholders determine collaboration processes? For RESOLVE, stakeholders do not formally drive the collaboration, but rather the Commission determines the process.[72] However, since several of the participants are from organizations with few staff, some will informally work together, strategize, and jointly submit comments to divide up the work.[73] For INFORM, the funding agencies set the minimum standards for collaboration.[74] Once initial advisory group meetings took place, stakeholders and researchers jointly determined the process for collaboration.[75]

And third, how are disagreements among stakeholders and designers resolved? The answers determine whose vision is embedded in the algorithmic tools. For INFORM, disagreement was resolved through discussion of working group members and researchers.[76] For RESOLVE, disagreements are synthesized by the assigned administrative law judge, who then makes a recommendation to the Commission.[77]

VI. Equity Considerations

It seems from these two cases that for stakeholders to understand the models and therefore meaningfully contribute to their development, those stakeholders need an extraordinarily high level of technical expertise, and the available time (or economic interest) to commit to providing input. For both INFORM and RESOLVE, the network of active and expert stakeholders influences the inputs and param-

61. Cal. Pub. Util. Comm'n, Fact Sheet: Decision on 2019-20 Electric Resource Portfolios to Inform Integrated Resource Plans and Transmission Planning (2020), https://www.cpuc.ca.gov/-/media/cpuc-website/files/legacyfiles/i/6442464699-irp-2019-rsp-fact-sheet-v3.pdf.
62. *See RESOLVE Model Inputs and Results Used for 2019 IRP Reference System Plan Decision*, Cal. Pub. Utils. Comm'n (Mar. 23, 2020), https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2019-20-irp-events-and-materials/resolve-model-inputs-and-results-used-for-2019-irp-reference-system-plan-decision.
63. *See* California Public Records Act, Cal. Gov't Code §§6250-6270.7.
64. Ziaja, *Role of Knowledge Networks*, *supra* note 2 at 827-28.
65. *Id.*
66. For detailed INFORM results from the working group, see Ziaja, *Role of Knowledge Networks*, *supra* note 2, at 824-31 Fig.1.
67. *Id.* at 836-39.
68. *Id.* at 836-38.
69. *Id.*
70. *Id.* at 839.
71. *See*, *e.g.*, Administrative Law Judge's Ruling Seeking Comments on Proposed Preferred System Plan, Order Instituting rulemaking to Continue Electric Integrated Resource Planning and Related Procurement Processes (Aug. 17, 2021) https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M399/K450/399450008.PDF.
72. Interview with working group participants (on file with author).
73. Interview with Mohit Chhabra, *supra* note 52.
74. *See* Ziaja, *Role of Knowledge Networks*, *supra* note 2, at 843.
75. *Id.* at 839.
76. Interviews with working group participants, *supra* note 72.
77. *Id.* For an example of comments, see Comments of the Natural Resources Defense Council (NRDC) on 2019-2020 Electric Resource Portfolios to Inform Integrated Resource Plans and Transmission Planning, in Order Instituting Rulemaking to Develop an Electricity Integrated Resource Planning Framework and to Coordinate and Refine Long Term Procurement Planning Requirements (Mar. 12, 2020), https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M329/K437/329437858.PDF.

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eters for the two tools—driving the development and implementation of water and energy regulation, and those systems' adaptation to climate change. Ultimately, these networks are embodied in the decision support systems they create.

Here, we run straight into the main tension between the need for these tools and the need for participation. If (1) the focus on equity is who is being left out and whether the political arena is open and accessible; (2) the ability to influence algorithm-assisted decisionmaking tools depends on high technical capacity along with an economic or mission interest; and (3) the network of people and organizations who do participate in the development of the model influence inputs and parameters which embed value-laden assumptions and biases; then are algorithmic tools destined to be inequitable in environmental governance? And because of our dependence on these tools, are environmental, natural resource, and energy planning doomed to be increasingly inaccessible and inequitable with greater complexity? Possibly.

But the two cases and the framework provide some hope. Even though not all stakeholders in the RESOLVE process completely understood the model, they nonetheless are able to comment and raise their concerns to decisionmakers and modelers alike. This means that decisionmakers are at least aware of the concerns and can act accordingly. The open process of development still serves a governance function. The history of INFORM, meanwhile, demonstrates that close collaboration between modelers and stakeholders is possible.

In the end, the framework presented in this Article can be boiled down to a single question: is equity (substantive and procedural) included in the network for producing algorithmic tools? By assessing how uncertainty is created and communicated, the extent to which a model and its process of development are transparent, and the role of stakeholders in the production of the model, the framework provides a way for legal practitioners and advocates to approach the question of equity in algorithm-assisted decisionmaking. It also allows them to become involved in making these tools more equitable.

VII. Conclusion

Algorithmic tools are new fora for decisionmaking and the development of law with different rules and different players than a legislative body, court, or city council. It is still governance, though, and concerns about existing power imbalances in decisionmaking are relevant to how decisions are made within mathematical models. This Article offers a practical means for attorneys, watchdog organizations, and responsible decisionmakers to examine and assess algorithmic tools in a holistic manner. By considering sources of value-laden assumptions across uncertainty, transparency, and stakeholder collaboration, this framework indicates inflection points for substantive equity. By also considering the process of development, this framework incorporates lessons from the past two decades of social science on the importance of networks for the legitimacy and acceptability of scientific products.