

# Participatory Multi-Criteria Decision Analysis (MCDA)

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## What is MCDA?

Dam decision makers try to balance competing uses and management objectives, or criteria (e.g. water storage and electricity generation), when making decisions about the future of a dam. MCDA is a structured decision making framework, useful for addressing such complexity. MCDA uses a mathematical approach to weighting decision criteria (i.e. attributes or factors such as project cost, annual electricity generation, or aesthetic value) with preference information to help rank possible decision alternatives (e.g. install hydropower, refurbish existing structures, or remove dam) for decision makers. MCDA can also be participatory, in which decision-makers interact with the process to define preferences used to weight decision criteria in the model. We explore participatory MCDA in a group setting as a means for supporting stakeholders and decision makers participating in Federal Energy Regulatory Commission (FERC)-regulated [hydropower dam](#) relicensing, a process which takes many years and has a few key points of public input.

## Who can use MCDA?

Anyone! We built a web-based user interface to help capture decision maker preference information for use in individual or group MCDA. The interface was built using R Shiny; it is user-



*Colleagues participate in a mock workshop to test an early version of the MCDA tool. Photo credit: Michelle Gregoire.*

friendly, tailored to *participatory* decision-making applications, and is openly accessible online (not true of all participatory MCDA tools). The interface will be free and open source, allowing more advanced users to download and modify the code to suit their own purposes. Versions of our user interface have been tested with (1) students and (2) [Future of Dams](#) researchers in both (a) individual and (b) group settings, and look forward to using the web-based decision support tool with real dam decision makers. Along with the web-based user interface, we are generating a Dam Decision Support Tool specific to an MCDA workshop focused on a set of dams in the Penobscot River

that are coming up for FERC relicensing in the next decade. The toolbox includes a set of [Dam Factsheets](#) and an MCDA-MOGA (Multi-Objective Genetic Algorithm) model (forthcoming) that builds on the earlier work of [Roy et al. \(2018\)](#) and uses Maine dams data from the [New England Dams Database](#) to identify an optimized recommendation for dam decision alternatives at those specific FERC dams in the Penobscot River based on decision maker preferences. We also work closely with stakeholders from federal, state, and local agencies, organizations and groups, as well as colleagues from University of Maine, University of New Hampshire, and the Rhode Island School of Design, to identify evaluative variables with which to critically assess our dam decision making workshops for the usefulness of process and outcomes.

### Related Research

- Raffier, K., Fox, E., Klein, S. (2019) Says Who? A Dam Decision Matrix Comparison Between Stakeholders and News Media. University of Maine Student Symposium. *Poster Presentation*. Bangor, ME.
- Fox, E., Klein, S. (2019). A Multi-Criteria Decision Analysis (MCDA) Tool for Dam Decisions Involving Hydropower. *Paper presentation*. American Association of Geographers Conference. Washington, DC.
- Fox, E., Klein, S. (2018). Free the Rivers? A Transdisciplinary Approach to River Resource Management Decision Support for Small Hydropower Dams. *Paper presentation*. University of Groningen Energy Summer School. Groningen, The Netherlands.
- Raffier, K., Quiring, T., Klein, S., Fox, E., and McGreavy, B. (2018). Using Mixed-Method Media Discourse Content Analysis to Inform MCDA about Dams. *Poster Presentation*. Maine Sustainability and Water Conference. Augusta, ME.
- Fox, E., Klein, S. (2018). Barriers, Opportunities: Small-Scale Hydropower in Maine. *Paper presentation*. American Association of Geographers Conference. New Orleans, LA.
- Fox, E., Klein, S. (2018). 'Recycling' and Rethinking: Dams as Renewable Energy Investments in Maine. *Poster presentation*. Maine Economics Conference. Orono, ME.

### Researchers

- [Emma Fox](#) is a [Ph.D. candidate](#) in Ecology and Environmental Science at the University of Maine's School of Economics. She is interested in building better tools to support participatory processes for renewable energy and natural resource decision making.
- [Sharon Klein](#) is an [Associate Professor](#) in the University of Maine's School of Economics. She is an interdisciplinary energy researcher, and studies community energy initiatives, community solar, small-scale hydropower, and decision making using Multi-Criteria approaches.
- [Sam Roy](#) is a Postdoctoral Researcher in the Senator George J. Mitchell Center for Sustainability Solutions at the University of Maine. He is a data scientist who is interested in machine learning approaches to streamlining decisions about infrastructure improvements and habitat restoration.
- [Kaitlyn Raffier](#) is a graduate from the University of Maine with Bachelor degrees in both Ecology and Environmental Science and Economics. She is interested in data management and communication as well as looking at ways to improve data visualization to help people better understand data and its trends.

## References

Roy, S.G., Uchida, E., de Souza, S.P., Blachly, B., Fox, E., Gardner, K., Gold, A.J., Jansujwicz, J., Klein, S., McGreavy, B., Mo, W., Smith, S.M.C., Vogler, E., Wilson, K., Zydlewski, J., & Hart, D. (2018). A multiscale approach to balance trade-offs among dam infrastructure, river restoration, and cost. *Proceedings of the National Academy of Sciences*, 201807437.  
doi:10.1073/pnas.1807437115. [View](#)

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