NOTE: The first phase of the Environmental Framing Consortium project (which underlies the bulk of this issue) focused upon an in-depth analysis of identity, characterization, and process frames, with much less effort devoted to exploring technical fact-finding -- the primary subject of this article. Though drawing from the case studies of the EFC project to inform our work, readers should recognize that the research foundation for this article is more limited.

Just the Facts, Please: Framing and Technical Information

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Bios

Guy Burgess received his Ph.D. in Sociology, working with Kenneth Boulding at the University of Colorado, in 1979. His dissertation and postdoctoral work at M.I.T. focused upon those conflict dynamics that undermine society's ability to make wise, equitable, and efficient decisions regarding complex environmental issues. He co-founded the University of Colorado Conflict Research Consortium in 1988, and has co-directed it with his wife Heidi Burgess since its inception. The Consortium seeks to develop more constructive ways of approaching intractable conflicts. The Burgesses and the Consortium have also been at the forefront of efforts to harness the World Wide Web as a tool for better delivering conflict-related information to practitioners, educators, students, and disputants. He is co-director of two major William and Flora Hewlett-funded initiatives (the Intractable Conflict Knowledge Base Project and CRInfo, the Conflict Resolution Information Source) and co-author (with Heidi Burgess) of *The Encyclopedia of Conflict Resolution*.

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Abstract

We use the concept of framing to explore how information producers and users understand, interpret, and interact with the technical and scientific fact-finding efforts associated with environmental disputes. We introduce three key categories of fact-finding frames that describe how stakeholders think about trust and certainty, research objectives and technical communication, and provide illustrations drawn from environmental disputes. We conclude by suggesting a number of steps that could improve the ways in which experts, policy makers, and lay public deal with the factual basis of environmental issues.

Just the Facts, Please: Framing and Technical Information

Our society chooses among alternative environmental futures through decisions expected to yield, upon implementation, the results sought. However, if our collective understanding of the link between decisions and outcomes is flawed, the expected results may not follow. Common-sense understanding is often inadequate for identifying environmental problems and evaluating possible solutions. Therefore, our future hinges to a considerable extent on society's understanding and sensible use of technical information and scientific analyses. How we make sense of -- or frame -- the information we use to evaluate probable consequences of environmental decisions is, therefore, critical.

> Consider the stakeholders seeking to improve water quality in a Cleveland watershed, the Doan Brook (Kaufman & Momen, 2003). Alternatives included large underground structures for stormwater control, and "soft" practices for diverting runoff from paved surfaces away from the brook. The choice required prediction and evaluation of consequences of these alternative approaches. Bolstered by extensive past experience, engineers could predict rather accurately the size of tunnels necessary for specific results. The "soft" solutions had more uncertain consequences heavily dependent on where and how they are put into practice and maintained. Nevertheless, residents preferred the "soft" means to underground tunnels on philosophical, rather than technical grounds (Kaufman & Momen, 2003).
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> Or consider the Cleveland Clean Air Century Campaign (CCACC), a consensus-building initiative (co-facilitated by one of the authors) to reduce neighborhood air toxics through voluntary measures. Residents, some of whom smoke heavily and use inside their homes pesticides and cleaning products known to cause respiratory ailments (especially among the very young and the elderly), firmly believe industry to be the culprit for the area's air quality woes. Technical assessments showed that attending to indoor air problems would eliminate a considerable portion of pollutants (and would be very cost-effective). Nevertheless, residents feel the poor air quality is mostly due to the unscrupulous industrial operators in their midst who release noxious substances into the environment with impunity.
>
> In both examples, the lay parties discounted strategies grounded in technical information.

In general, to build an accurate base for decisions, we need various kinds of information.

Environmental situations are particularly challenging due to the highly technical content of the relevant information, making recourse to expert input indispensable. While many factors affect the ability to incorporate technical expertise into environmental decisions, we focus in this article on the key role played by the social and psychological dynamics of framing. We describe how those who produce the information and those who use it think about -- or frame -- environmental fact-finding, and we suggest some strategies for enhancing the communication between experts, environmental professionals, and decision makers.

Framing in Environmental Disputes

Individuals use frames as interpretive devices, to make sense of the world around them (Tannen 1979). They also actively engage in framing for others' benefit when they select, interpret, and present information in the midst of a dispute. Framing focuses attention on aspects of decisions by "imparting meaning and significance to elements within the frame and setting them apart from what is outside the frame" (Buechler 2000, 41).

Other articles in this issue describe identity, characterization, and process frames, central to the Environmental Framing Consortium's (EFC) empirical research. Drawing on the EFC's case analyses of intractable environmental disputes (Lewicki, et. al. 2003), we reach beyond this work to explore fact-finding frames. These frames shape how experts construe their tasks, and they also mediate public responses to core technical aspects of environmental disputes.

We begin with the *research objectives* frames held by information producers -- scientists, engineers, and environmental professionals – regarding how these experts view the scope, value, and practical application of their expertise (Table I.) We examine next the thinking of lay information users -- elected public representatives, interest groups, news reporters, and citizens --

who may require technical information to understand environmental issues. *Certainty* frames influence whether and how much they seek out information. *Credibility assessment* frames are applied to the evaluation of the trustworthiness of expert opinions, contradictory at times. (People commonly hold several fact-finding frames simultaneously, which may be both a necessary and a productive strategy for handling complex information.) Next we explore *technical communication* frames affecting the mutual relationship between information users and producers around the collection, interpretation, and communication of technical data. The interplay of fact-finding frames shapes people's images of environmental issues often at the core of disputes, such as the vulnerability of natural ecosystems to human activity, health effects of low-level pollution, or the costs and benefits of population growth. We conclude with a number of suggestions for promoting constructive framing of environmental technical information.

1. Information-Producers' Research Objective Frames

While pursuit of the truth may be a top priority, information producers cannot avoid considerations stemming from the demands and interests of research funders, and the subtle effects of personal priorities on work outcomes. Research objective frames influence the manner in which research is conducted, and the tenor of results.

Strongest Case

Some information producers construe their task to be the development of the strongest possible factual case for their client. Experts holding this frame conduct or selectively cite supportive studies, while filtering out or seeking to rebut contradictory evidence. The consequence may be intentional or perhaps unintentional omission of certain data, modeling or analysis results. Models, based of necessity on researchers' simplifying assumptions, present an

opportunity for helping a client's case and are therefore especially vulnerable to strongest-case suspicions. Since many interest groups engage in investigative work, accurate reporting is more likely to result from the adversarial interplay between competing studies. Nevertheless, the danger exists that contributions of technical analysis may be lost whenever technical studies appear indistinguishable from political discourse.

Neutral Analysis

Information producers with a neutral analysis frame construe their task as seeking facts regardless of which side they might bolster in a dispute. These researchers believe their professional reputations depend upon the degree to which their peers, as well as lay decision makers, consider their work as thorough, complete, and unaligned. In some cases, the knowledge of experts with this frame -- such as data mediators -- is sought to cut through the political wrangling of vested interest groups. Except for high-profile cases, funding is usually scarce for this kind of work. Another challenge is persuading audiences that tend to expect strongest-case arguments that the researchers are indeed impartial; this is especially difficult when findings contradict stakeholders' commonly held beliefs or are perceived as undermining their case.

Joint Fact-Finding

Information producers who frame their role as joint fact-finding work together with disputing parties to identify research needs, design fact-finding strategies, oversee their implementation, and report results. This approach, while difficult for information producers not used to deliberative processes, and likely slower-paced and more resource-intensive, yields an inclusive information collection and evaluation process. Though not everyone involved has the expertise or training to actually conduct all the fact-finding, researchers' data collection, analysis, and presentation is guided by, and incorporates, a truly collective and diverse voice of

the interested public. This approach requires a trade-off between up-front expedience of the fact-finding process and likely increased acceptability of results at the end by those who feel their views have been taken into account. Since the process of dealing with contested fact-finding results can also be lengthy and require resources, despite appearances to the contrary, in at least some cases joint fact-finding may be more cost-effective than the more traditional approach entailing experts that conduct research and report their results.

Value-Based Recommendation

Information producers who construe their task as providing policy recommendations overlay technical analyses with value assessments based on moral arguments. This frame blurs the line between research and advocacy. Though not necessarily intentionally biased, the researcher holding this frame analyzes whether a particular policy is better or worse than competing alternatives in light of own or clients' values. Problems arise when results clad as expert opinions conceal the value content.

Once research has been completed, information producers have to communicate results to those who would incorporate the information in their decisions. Communication of technical information is not merely a neutral reporting act: rather, it is often a rhetorical one (McCloskey, et. al. 1987). We would expect information producers' research objective frames to have consequences for the kind of interaction they are likely to have with information users, who also hold fact-finding frames. The users' frames tend to be more or less permeable to new information, and to affect the depth of the search, the trust they place in findings, and the extent to which they will factor fact-finding results in environmental decisions. The next section discusses these frames.

2. Information Users' Fact-Finding Frames

Lay decision makers' and the general public's fact-finding frames (Table 2) include *certainty frames*, affecting the extent of the search for information, and *credibility frame*s, shaping perceptions of the trustworthiness of this information.

Certainty Frames

Parties to environmental disputes have varying levels of sophistication in conceptualizing the nature of environmental problems, the likely costs, and the effectiveness of alternative solutions. The degree of certainty that people attach to their conceptualizations impacts how they see the need for environmental fact-finding.

The certainty frames we consider here are milestones along a continuum of viewpoints: at one end users see their conceptualization of the problem in such certain terms they reject additional technical information out of hand (conclusive frames), while at the other end they feel action requires a lot more information than usually available (analysis paralysis frames). In-between, we find individuals willing to postpone judgment until some information has been located and processed (investigative frames), after which they feel prepared to act. Although certainty frames refers to the correctness of one's conceptualization of problems, it tends to crop up in debates over environmental risk tolerance.

Conclusive frame: "I Know Enough"

Considering technical information that challenges strongly held beliefs can be uncomfortable. To avoid this discomfort, some conclude that what they already know is sufficient and correct, except, not surprisingly, when new information supports their current

views, reinforcing the belief that they were right all along. Conversely, they tend to dismiss information that contradicts what they hold true, and/or challenges their purposes.

This frame poses a serious obstacle to fact-finding and to societal learning about technical issues. It is especially troubling when the facts people "know" are demonstrably inaccurate and may lead to costly and/or ineffectual decisions.

> Cleveland residents who rejected the notion that their own smoking and house cleaning habits might be more hazardous to their health than industrial emissions in their neighborhood exemplify this situation. Before the CCACC they had undergone extensive training in understanding risk assessments and environmental regulations that addressed industrial pollution. This made it more difficult to fit in the new information about indoor air pollutants with the already established belief about the industrial culprits.

Investigative frame: “I need to find out more.”

Those who approach environmental problems from an investigative frame respond to challenges by collecting and reviewing information from a range of sources, to educate themselves on the issues at stake. They favor action despite residual uncertainty.

> Stakeholders in the Doan Brook case spent more than a year trying to understand water quality issues and flooding dynamics data assembled by civil and environmental engineers. The CCACC research process lasted only a few months, and was based on the best available knowledge. In both cases, before making decisions, stakeholders needed to learn more than they knew at the outset, but they reached a point when they felt adequately informed to act, even if they admittedly lacked complete information.

Analysis paralysis frame: “I can’t decide until I know for sure.”

No single study can paint a complete picture of all the risks involved in an environmental decision. With typically limited resources and technical assistance, stakeholders must decide based on incomplete information about how alternatives will unfold in practice. Decision makers may then feel they are taking chances with the public’s health or the survival of a threatened species. To avoid making such difficult decisions, some insist on more studies to reduce uncertainty. Irreducible uncertainties do exist, however, and analysis paralysis ensues.

Stalemates amount to a decision to uphold the status-quo, providing tactical advantage to those seeking to delay change, which may be costlier and riskier to the environment than the alternative decisions.

> In controversies such as the Drake case (Gray & Hanke, 2003), regarding the risks of incinerating contaminated soil, some may think they *already know* the dangers of incineration, suspecting that efforts to persuade them otherwise are politically motivated. Others, including political leaders, may be uncomfortable with the irreducibility of risk and uncertainty, delaying decisions until they *know for sure,* thus succumbing to analysis paralysis. Those with an investigative frame may try to *find out more* about the nature of the risks, seeking out available information that might lead to a wise cleanup decision.

People challenged to evaluate arguments based on complex technical information may switch to frames of expert credibility. That is, instead of evaluating the information content, they assess its provenance and use the information if provided by trusted sources. Combined with an "I already know" frame, this impairs the ability to be persuaded by evidence contradicting currently held views. In what follows, we outline trust frames information users apply to the task of assessing source credibility.

Credibility/Trust Frames

While people can readily assess the merits of non-technical information, technical information is not as transparent. To contend with this challenge, decision makers and the general public faced with contradictory evidence develop credibility assessment strategies. Instead of investing scarce time and resources in deciphering the information, they opt to trust it when it stems from sources they frame as credible. Sometimes this strategy works, but occasionally it leads to rejection of reliable results or acceptance of erroneous information, both of which distort decision-making processes and outcomes.

> In the Edwards Aquifer dispute over claims to a scarce and vital water resource in Texas (Putnam, 2003), forecasts of water availability and of the effect of various levels of water use were a key bone of contention, with heavy users and

property rights advocates aligned against forecasts showing they should change their practices – a stance not independent of their goals, but also driven by their suspicion that the information providers had a conservation agenda.

Neighborhood residents in the Cleveland Air Toxics Project overcame a longstanding mistrust of public agency-supplied information as they insisted on USEPA monitoring of industrial pollution. Although they struggled with their choice, it was consistent with their perceptions of where the health risks lay. Opting for indoor control measures, for example, would have required changes in individual behavior (stop smoking and using hazardous sprays around the house), as well as a reconsideration of information they already framed as true about industrial pollution in their area, and their characterization of manufacturers as unscrupulous in their practices.

In turn, substituting trust in sources for information content requires signs by which to recognize which sources to frame as credible.

Group Endorsement Frames

Those with interests and positions similar to one's own are sometimes framed as trustworthy. Interest group affiliation can be used to assess credibility. One benefit of joining interest groups is the fact-assessment service they provide, though their partisan perspective may distort information they support or refute.

In the Colorado Growth Case (Gardner et al. 2003) interested individuals who opposed sprawling growth trusted, and therefore relied heavily on, information that received *group endorsements* from organizations such as the Sierra Club, who would be unlikely to balance the information by also providing data that supported the positions of libertarians or property rights advocates.

Credentials Frames

Expecting the traditional impartiality at the core of academic and certain research organizations, some stakeholders frame information producers with academic credentials, or working for reputable organizations, as credible experts. Those working for a state research or university institute may be deemed more trustworthy than political think-tanks or private research firms. Access to such expertise may be difficult for some, however. This is especially true for community groups in financially disadvantaged areas.

> In the Doan Brook case (Kaufman & Momen, 2003), people participating in the yearlong deliberative process felt buried under complicated engineering details. Lay participants reached a point where, by their own account, they had to base their decision less on the merits of proposed alternatives than on the extent to which they trusted the proponents. They effectively switched to a credentials frame to evaluate and to accept information they felt they were neither equipped nor patient enough to process. Although the participants trusted the engineers based on their expert status, there is a negative consequence to this failure of producers and users of information to communicate clearly and effectively. The participants gave away their opportunity to genuine input in this public decision and were not in a position to explain their support for the alternative to be implemented. Their choice was based on trusting the source of information rather than on the information content.

Objectivity Frames

Some information users trust information by virtue of their faith in the scientific method and their assessment that the information producers have adhered to it, though they may have a stake in the conflict. Users holding this frame assume scientific information to be accurate and reliable, untainted by political or personal motive. A kind of negative objectivity frame leads others faced with hard-to-comprehend information to reject it because it was produced by the scientific method, viewed as inherently tainted.

Personal Relationship Frames

Credibility assessment depends at times on trust established when building personal relationships. Those who approach information credibility through a relationship frame found their judgments on the trust built through direct contact between information producers and users. Thus characterizing experts as trustworthy on a personal level is likely to yield confidence in their work, especially in the absence of ability to evaluate the content.

> In cases like the management of the Doan Brook watershed, some are likely to rely heavily on information that receives *group endorsements* from organizations such as the Sierra Club or Ecocity Cleveland. Others may rely on personal *relationships* they have established in the context of numerous public meetings related to watershed management issues. Some planners and public agency technicians may depend primarily on *credentialed* experts. With respect to controversial facts, such as documenting the damage associated with lawn

fertilizers and herbicides, some type of *expert* independent review process could give people the confidence they need to make hard decisions.

Information producers and information users interact in ways reflective of their views regarding the nature of the expert-lay communication. We examine next some frames that shape this interaction.

3. Technical Communication Frames

After information producers complete their research, they have to communicate their results to those who seek to incorporate the information into their decisions. The acceptability or persuasiveness of technical information hinges on the manner in which it is communicated. The information user needs the information presented in clear and concise terms, easily applied to the policy process. When information produces are unaware of the need to communicate their information persuasively and in an accessible format, while information users are suspicious of producers' motives and struggle with the meaning of the information, the unfortunate result is failure to incorporate effectively relevant, available information in public decisions.

The complex issues related to urban sprawl and growth control (Burgess, et al.,2003) illustrate the interactions between information producers' research objective frames and information users' certainty frames. Developers prepare analyses of their projects, including possible adverse impacts and mitigation measures. Impact document preparers make the strongest case for their clients, while neighborhood and environmental groups – some motivated by not-in-my-backyard impulses – seek information that supports anti-growth agendas, or reject others' facts as unnecessary. University-based researchers might be asked to document pros and cons of the competing perspectives surrounding growth disputes. A *joint fact-finding* approach might emerge in studies performed as part of a regional council of governments' efforts to negotiate a metro area-wide urban growth boundary. The participatory structure of such councils fosters research designs that address concerns of competing and, at times, overlapping interest groups.

Most fact-finding work is communicated through written reports and presentations reflecting the producers' technical communication frames – expert-to-expert, expert-to-lay or

even lay-to-expert (Table 3). They entail expectations about the audience's level of technical proficiency, with consequences for the language used, and the level of expertise needed to interpret the findings.

> In a complex water resource management problems such as the one involving the large and heavily-used Edwards Aquifer, some technical reports are likely to be for experts only, containing insights into aquifer flow dynamics and the economic ramifications of regulatory changes. Occasionally reports may cull all technical information regarding advantages and disadvantages of each major policy alternative. Many interest groups may also offer their own fact-based position papers, defending their preferred approaches to the problem.

While each such type of product may have a role to play in the decision process, each has to be pitched to the appropriate audience, making the nature of the product transparent, so that parties do not mistake a position paper for a neutral analysis, or struggle unnecessarily with information only experts can decipher. Both transparency of purpose and matching format to the audience pay off, while mixing in value judgments is likely to undermine credibility and reduce the chances that the information is incorporated in decisions.

Expert-to-Expert Frames

Some information producers construe the dissemination of technical results as an exchange between experts formulated in strictly technical language. The expert-to-expert frame assumes users are familiar with the concepts, ideas, jargon, measures, and methods of a scientific research report. In some cases, the audiences are indeed experts. Frequently, however, these research findings must be presented to audiences with relatively low levels of technical proficiency. Even reports initially intended for experts may enter lay decision-making processes unintentionally.

Information producers holding this frame lack awareness of the necessity to reach lay audiences, and/or the willingness to make any effort to make accessible the findings and their practical implications. At times, the technical language is used intentionally in public settings to

signal expertise, or to undermine the audience's ability to disagree with the technical aspects of a debate. Such behavior hinders non-experts' decision process and contributes to the framing of technical information as irrelevant to environmental decisions, activating the users' "I already know" frame, having little choice but to trust the expert's advice or reject it out of hand.

Expert-to-Lay Communication

Information producers holding an expert-to-lay communication frame make conscious efforts to convey the practical significance of their work. Their reports may include assessments of policy implications and use plain, jargon-free language. However, even experts who intend to address their findings to a non-technical public may wrongly assume that certain technical facts are "common knowledge".

> In the CCACC project, technically challenging information about indoor health risks made it attractive for residents to discount it and stick to the belief that combating industrial pollution should be the priority. The complexity of the technical information may have led residents to adhere more firmly to their initial positions. In the Doan Brook case, the engineering firm hired to provide decision support collected and processed watershed data and presented analysis results to the lay public committee in relatively transparent terms related to the issues participants raised. Nevertheless, a full understanding of technical aspects eluded lay participants.

In these and other cases, the issues may remain so technically complex that audiences will switch to credibility frames, evaluating expert reports by their authors' credibility. At such times, strong credentials, coupled with the perception that information producers made an honest effort at transparency and comprehensiveness contribute to the building of a positive relationship that translates into trust in the information presented.

Lay-to-Expert Frames

Users are not the only ones reluctant to consider information that challenges what they already hold true. Producers adopting unfavorable lay-to-expert frames resist information from

lay sources that does not fit well with their own conclusions. For example, models that estimate levels of air pollutants at county, state or national levels can fall severely off-mark when applied to smaller geographic units, especially since monitors on which these assessments are based are not always sited using local knowledge of pollution sources and wind patterns. Residents may know that model assessments do not fit their reality, but may have a difficult time convincing model producers of discrepancies, or of the sub-optimal location of monitoring equipment. Conversely, producers holding a favorable lay-to-expert frame may be open to lay knowledge and to engaging in joint fact-finding with the parties to an environmental dispute.

Regardless of how they frame communication, information producers face the task of conveying to their audiences their research objective frame, especially when it can enhance the credibility of their reports.

> In the Edwards Aquifer dispute over claims to a scarce and vital water resource in Texas (Putnam & Peterson, 2003), forecasts of water availability and of the effect of various levels of water use were a key bone of contention. Heavy users and property rights advocates aligned against expert forecasts that concluded that they should change their water use practices because they suspected providers of a promoting a conservation agenda. If the information producers had a neutral frame, they failed to communicate it effectively to their audiences in this case.

To further enhance the credibility of their work, information producers may want to build on knowledge of how potential users frame fact-finding processes. For example, producers might work to build positive *relationships* with various information users – interest group representatives, decision makers, and the general public.

> In the Colorado Growth Case, failure to build working relationships among planners, city officials, landowners, and environmentalists created mistrust at public hearing in El Paso County. Angry citizens did not accept the claimed merits of zoning in rural segments of the county. Instead, they threatened the officials and planners whom they believed to be interested only in profiting from their land.

Conclusion: The Importance of Fact-Finding Frames

The frames individuals hold about technical information and its sources affect the nature and accuracy of their images, or conceptualizations, of physical reality. These images underlie their views of nature (whether the environment is viewed as robust, fragile or invincible), environmental risks (whether low-level pollutants constitute health risks), and urban growth and development (whether urban growth is largely harmful or beneficial). The lay public and policy makers factor these views in their positions on disputed environmental issues. To the extent that some conflicts are at least partly attributable to erroneous images of environmental information, the remedy lies in improving the fact-finding process. Some strategies are suggested below.

Framing Strategies for Fact-Finding

While there is no device for determining unequivocally which fact-finding frames are likely to produce the most beneficial results in terms of incorporating factual information in environmental decisions, it seems that some are more helpful and others more problematic. In this concluding, section we suggest a number of strategies we believe could improve the framing of environmental fact-finding processes. (Note: The practical advice offered here has not been empirically tested and should only be viewed as a set of suggestions that must be evaluated in the context of specific disputes).

Strategies for Information Users

Since better decisions are likely to result from informed processes, it is in the interest of users to actively seek factual information, to equip themselves with tools for evaluating effectively the reliability of information and its sources, and to be aware of some of the framing pitfalls identified above. To that end, users should seek avenues for available information to

become sufficiently accessible that lay decision makers feel comfortable in factoring it in their decisions. This may include actively seeking:

- Experts already trusted by key user groups who may be willing to serve as interpreters and/or independent evaluators.
- Opportunities to question experts without fear of ridicule. "Safe" environments can encourage people to reconsider their images of key environmental facts, so both producers and users should favor them.

Strategies For Information Producers

Our analysis suggests that the extent to which technical information gets factored into policy decisions may hinge partly on how it is communicated to users. It follows that information producers can actively enhance usability of their results through awareness of the ways in which users frame fact-finding. In the short run, in an ongoing situation, information producers can and should promote transparency of content and process by which they assemble information with technical content.

Transparency of content requires that studies be conducted so that independent experts can review and, where appropriate, verify their trustworthiness. To that end, information producers should:

- Separate technical facts from their (value-based) interpretations in fact-finding reports.
- Make explicit the value-based goals that might be advanced by alternative policies.
- Specify assumptions underlying any analysis.
- Acknowledge uncertainties and the extent to which further work might (or might not) be able to reduce them.

Transparency of process requires that audiences be provided with the tools for evaluating the credibility of fact-finding processes. Thus information producers might:

- Refer information users to other factual sources that could offer a "second opinion."
- Forego any tactical misuse and falsification of technical information (even in advocacy research settings).
- Acknowledge sources of research support and any associated conflicts of interest, along with any steps taken to address such concerns.
- Provide community groups with technical advice they can trust.

Information producers might enhance the extent to which their results are incorporated into policy decisions by engaging in *communication-enhancing practices* such as:

- Resisting the tendency to generalize beyond the limits of available information.
- Assuming responsibility for communicating findings in terms understandable to lay stakeholders.
- Integrating credibility-building (or trustworthiness demonstration) efforts into all stages of the analysis process.
- Working with opposing groups to publicly disclose areas of factual agreement and disagreement and to jointly design and administer a process for resolving points of contention.

In the long run, it is in the interest of information producers to ensure their audiences' capability to incorporate technical information in environmental decisions. Therefore, they should pursue a sustained, long-term effort to disseminate information about key environmental facts that enjoy expert consensus. This strategy can be particularly effective when used as part of

a *general public education* program, outside of the context of any specific, ongoing dispute. Information providers can:

- Offer information at different levels, from very simple to highly detailed.
- Include in reporting sessions the tools for understanding reports, by giving information about issues, tools for investigation and additional sources of corroborative information.
- Broadly disseminate, to the society as a whole, factual information in easily accessible formats, using multiple distribution avenues -- newspapers, television, radio (especially talk shows), the Internet, libraries, and public meetings.

The nature of individual beliefs regarding the objective facts associated with particular environmental policy controversies significantly influences the way in which people approach specific policy issues. Efforts to address environmental problems more constructively require the parties to develop more accurate images of the objective facts. The ability to foster such images are ultimately constrained by the ways in which information users and producers frame their fact-finding work. This article illuminated this framing process in ways that we believe will facilitate more constructive fact-finding processes. These frames are more than academic curiosities. By understanding these framing processes that underlying most, if not all fact processing behaviors, scholars, mediators, and members of the lay public can achieve a more complete understanding of how frames influence the various interpretations of technical facts and fact-finding processes.

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Table 1: Information Producers' Research Objective Frames

Shape the way in which expert information producers view their work's objectives.

Frame Class	Frame Types	Frame Meaning: the fact-finder's role is
Research Objective Frame	**Strongest case**	to produce the strongest possible factual case for the client
	Neutral analysis	to produce a neutral analysis of the situation and available options.
	Joint fact-finding	to participate in joint development and administration of a fact-finding process, involving all interested parties.
	Value-based recommendations	to combine technical studies with value assessments to produce specific policy recommendations.

Table 2: Information Users' Certainty and Credibility Frames

Shape the way in which lay decision makers and the general public view technical information.

Frame Class	Frame Types	Frame Meaning
Certainty Frames Related to the information user's search for information	**Conclusive**	Facts have already been firmly established so further participation in fact-finding efforts is a waste of time.
	Investigative	The likelihood that an environmental decision will have the desired results can be enhanced by reasonable amounts of research.
	Analysis Paralysis	Decisions should not be made until factual uncertainties have been resolved.
Credibility/Trust Frames .		**Information credibility can be determined by:**
	Group endorsement	the endorsement of trusted interest groups.
	Credentials	the academic credentials of experts doing the analysis.
	Objectivity	the research organizations reputation for neutrality and objectivity.
	Personal relationships	trusting personal relationships with the experts.

Table 3: Technical Communication Frames

Shape the way in which information users and producers exchange information

Frame Class	Frame Types	Frame Meaning
Technical Communication / Frame Related to how information producers communicate with information users.	**Expert-to-Expert**	Reports are written for experts, on specific (narrow) technical issues.
	Expert-to-Lay	Reports are written for general, lay audiences and assess probable consequences of policy alternatives.
	Lay-to-Expert	Lay audiences have insights to contribute to the fact-finding process.