



Failures of Social License put Technology Rather than People First

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No Silver Bullets

Current events add to the appeal of rethinking the relationship between society and the energy sector. However, good intentions should not burden technologists with overcoming decades of mistrust. Responsibility for new relationships between energy providers and consumers will require investment of time and effort to rebuild trust in institutions. Media, government, academia and corporations all require distinct and necessary maintenance of their social contracts to create the conditions for meaningful change to the electricity sector. Despite the potential of many fusion innovations, energy solutions will remain in the messy domain of people and politics. Contemporary interest in seeing fusion companies lead transformation of public participation in energy systems potentially sets up many stakeholders for disappointing results. Fusion energy itself will play a minor role in efforts to set and achieve social and environmental justice goals.

My twenty years of community-level experience have convinced me that social acceptance requires ongoing and iterative effort. It isn't something anyone can effectively plan with a guaranteed result. As Tom Nichols explains, "When trust collapses, experts and lay people become warring factions. And when that happens, democracy itself can enter a death spiral that presents an immediate danger of decay into either rule of the mob or towards elitist technocracy [1]". I will continue to resist projects that rely on science communicators and ethicists to lead trust-building efforts without equal participation from scientists, engineers and their managers. Social acceptance is a problem that cannot be outsourced to so-called specialists. Government, industry, academia and neighbors must acknowledge their interdependence.

Planning is crucial. Inclusive planning reflects and shapes an organizational culture that can succeed. To be effective, planning reflects consensus building around the accepted process of iteration, rejection and revision. Unlike the design basis for an engineering project, community engagement is best when it is people-oriented. This takes the technology providers out of the center of an effort and reduces emphasis on the technology.

There is no six-sigma process to ensure success. It's simply the hard work of building and maintaining relationships, complicated by the layers of personal and networked communications existing within any organization. Proven practices can be identified; however, the cultural context may render successful stakeholder engagement efforts in one scenario highly inappropriate in another. Stakeholder involvement defies any or every structure, system, or component of an energy facility. The reference bounds are dynamic, evolving and subjective. For technologists seeking controlling parameters, this becomes a source of ongoing frustration. For neighbors, it ensures standing to find an equitable role in decision making.

For fast moving, budget-constrained start-up companies, improved relationships between society and science will become part of each organizations' culture. Carving stakeholder engagement out as a line item or program undermines its effectiveness. It's like going on a first date and announcing ones' intention to marry. Demanding evidence of good intentions sets up unachievable expectations. However, recognizing the constraints of what businesses can do before they've completed their early investor milestones and the limitations of technology-first education can help to avoid future misunderstandings.

What's the Buzz About?

Excitement about fusion energy isn't new. German American physicist Hans Bethe gets credited as the father of fusion - he won a Nobel Prize for his 1938 work proving fusion produces the enormous energy emitted by stars and

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proposed two processes for how it gets done. The United Kingdom's Atomic Energy Authority registered the first patent related to a fusion machine in 1946. Since then, media buzz about fusion has enjoyed a cicada's rhythm, emerging every 17 years or so on a new wave of hype about the future.

Eight years ago, internet analysis of media revealed that the fusion topic was relegated to scientific journals and narrow, deep tech aficionado channels. In the last two years, mainstream coverage has rocketed popular articles to the top of search engine content. Hype designates fusion energy as the "holy grail of energy." This enthusiasm distracts industry leaders and electricity consumers alike from more fundamental challenges among power providers [2].

Beneath the din of arguments by technology developers on the better or best forms of electricity production lies a drumbeat of change at the utility level. Power providers include generators, distributors and grid operators. This complex, regulated mix of private and public interests plays a complicated role in the energy transition. Until system-wide effects are better articulated, fanfare for the ways to generate electrons will be misplaced.

Celebrating the Abstract Perceptions of Fusion

Fusion energy offers great promise and hope, two attributes of the energy transition that are in great demand among many audiences. Unlocking the power of the sun on earth opens enormous possibilities. The promise of disconnecting energy production from geography inspires a rethinking of how energy supply chains function altogether. After decades of public sector investment to expand the bounds of fusion knowledge, the private sector's enthusiasm reflects crucial progress towards commercial prospects to benefit an evolving planet.

Fusion's most recent appeal reflects the growing urgency for greenhouse gas reductions. To stay associated with the climate movement, the nascent fusion sector must recognize their technologies represent a means to an end, not the desired result. Climate changes threaten the human population and the natural systems that sustain it. Modern societies function with tremendous amounts of electricity; and each generation source will leave its own environmental impact. As a result, the energy transition will be phased and evolving as efforts must address not only electricity production but energy use in transportation and industry as well. In the assessment of Arthur D. Little consultants, "Despite extensive efforts, we have a long way to go before achieving a low-carbon economy [3]".

So far, the private fusion sector has received a warm welcome. More and more mainstream environmentalists accept

that electricity providers will need to supplement the global energy mix with firm, carbon-free alternatives. Weather-dependent sources like wind and solar must be expanded further but continue to emerge as ultimately insufficient. The potential for fusion, grid-scale storage and deep rock geothermal will continue to evolve as energy demand grows to meet future needs [4, 5].

Calls for enhanced stakeholder engagement in the incipient private fusion sector reflect growing sensitivity to issues of environmental and social justice in the broader sector. They speak to a crucial need to reset the relationship between societies and energy systems. However, focus on fusion technology itself will fail in the quest for upstream stakeholder engagement. A technology-first approach immediately engages stakeholders with focus on their deficient knowledge of fusion physics rather than creating an equitable dynamic for exchange.

Senior Lecturer at the University of Melbourne, Darrin Durant, offers a useful critique in *Arena Magazine*. He notes the failures of science communication in the fusion domain, particularly around the difficulties of enabling non-technical audiences to appreciate fusion performance. He writes, "The most accurate way of communicating fusion performance would be with the Q plasma with reference to the Q gain expected to be required for commercialization." He goes on to explain how radically different these values would be for tokamaks and lasers, concluding, "You can already see how difficult it is to package that set of information in a two-sentence soundbite [6]".

Indeed. The fusion sector is currently competing on performance measures which remain irrelevant to the average person on the street. This makes stakeholder engagement more difficult. Fusion media coverage and marketing materials invite readers to infer that today's evidence is sufficient to deliver on near-term milestones. This may be adequate and accurate information for investor audiences, and it delivers on important business goals. However, it lends itself to misinterpretation of outside energy sector insiders, leading to debate over what is fact, hype, or dishonesty.

The private sector will continue to cater to its distinct and diverse audiences. In pursuit of public understanding of fusion energy's risks and benefits, the gap between what is relevant to investors in fusion versus what consumers want to know will generate confusion.

Carrying Forward the Mistakes of the Past

Recent calls-to-action emphasize the roles private fusion developers should play in cultivating public acceptance of their technologies. At a recent U.S. summit on fusion, the Biden-Harris administration announced community

engagement initiatives that are designed to facilitate stakeholder engagement. White House official, Brenda Mallory, said, “By working to integrate environmental justice on the front end of development, we have a chance to ensure fusion energy benefits all and does not repeat the harmful mistakes of the past.”

To adequately integrate stakeholder engagement earlier into the design process, energy advocates of all varieties must recognize public ire is often technology independent. Increasing opposition to wind and solar farms reveal the distinction. Extensive research in recent years has zeroed in on how people perceive risks and what companies communicate about their technologies. The diffusion of innovation into broader systems of social and economic impacts treads along the same areas of interest, regardless of a specific technology. The question is not how to crowdsource the design and development of better energy-producing widgets. The translation of technology into the social and economic power structures that control electricity generating plants is where the conflict resides.

By separating the technology from the social construct of the power plant, new contours of public debate emerge. Public controversy regarding energy installations clusters around three areas of interest:

1. Perceptions of risks and benefits of a technology project.
2. The role of authorities and the distribution of decision making across society.
3. Localization of a project's inception.

Technology solutions seldom address social and political problems. The challenge for fusion companies is that there is a lot of excitement about the technology itself. The pursuit of the innovation and the future that fusion technology represent isolating conversations. Educational materials on the different approaches to sustain a plasma or graphics that differentiate private companies' technologies are deeply technical. More significantly, they are less relevant to the realpolitik of community interests. As power plants, fusion energy technology (or their operators) will encounter different levels of evaluation. People will emerge as stakeholders

as they seek control or influence on new construction projects.^{vii} Advocates for fusion energy as well as promoters of formalized social licence programs must proceed realistically on what any new technology can achieve.

Improving public participation in energy decision-making is important. The fusion industry's success will rely on realistic expectations - both in terms of the promises technologists can make and the hopes we - as advocates, developers, sponsors, regulators, neighbors, and yet to be motivated stakeholders - set for defining meaningful citizen involvement. Educating on fusion basics to gain early input on design criteria represents a minor variable in this complex social equation. The fusion sector can improve better public involvement in the energy transition by acknowledging the future will be a mix of electricity generation options. Private companies, civil society and government will need to collaborate and to work across sectors to improve decision making and achieve social and environmental justice goals.

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