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Perspectives

Saving innovative climate and energy research: Four recommendations for Mission Innovation

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ABSTRACT

Mission Innovation (MI), a fledgling initiative to boost energy innovation around the world, is in danger of collapsing if the Trump administration fulfills promises to slash U.S. support. To save MI, member states meeting at the June 2017 Beijing Ministerial should reframe the initiative to pursue both quantitative and qualitative goals, pledge to support ongoing operations, and welcome contributions—albeit diminished—from the U.S. Whether or not MI can continue to elevate energy innovation to the highest political levels, it has revealed important opportunities to advance global innovation efforts and helpful lessons to guide other international initiatives that aim to combat climate change.

1. Introduction

Confronting climate change will require new clean energy technologies that can reduce global emissions without compromising other goals like economic growth or energy access for the poor [1]. But researchers and entrepreneurs face tall obstacles to developing and commercializing next-generation technologies: public funding for energy research and development lags that for health, space, and defense, and limited private capital for new clean energy technology ventures is growing even scarcer [2–4]. In the last seventy years, there have been three waves of public investment in innovation in clean energy, but each one has stalled or crashed, hindering innovation (SI Text). Once again, the world risks halting newly-established momentum for energy innovation as the Trump administration in the United States—which currently accounts for over one third of global public funding for clean energy innovation—contemplates shuttering government offices that administer energy R & D programs [5].

That would be a disappointing about-face from progress made under President Obama, President Trump's predecessor [6]. At the December 2015 Paris Climate Change Conference, twenty countries signed a "Mission Innovation" (MI) pledge aimed at spurring a sustained global wave of clean energy innovation by doubling public funding for energy research and development (R & D), with global levels reaching over $32 billion per year within five years (Fig. 1)[1]. MI was an especially promising initiative to advance global clean energy innovation because of its political prominence and a membership that accounted for nearly all global energy R & D funding. And since the inaugural MI summit in San Francisco in 2016, ministers from around the world have made progress in standing up a multi-national secretariat, adding new members (the European Union, Netherlands, and Finland), and agreeing on a set of activities and goals.

Yet uncertainty clouds MI's future. Because the Obama administration spearheaded the creation of MI, staff at the U.S. Department of Energy presently compose most of the MI secretariat that conducts its day-to-day operations. The Trump administration has been silent on whether it remains committed to serving as MI's lead institutional sponsor. However, President Trump has expressed skepticism about climate change and vowed to curtail funding for international climate organizations [7]. And the release of his administration's budget proposal revealed an intention to decrease, rather than increase, energy R & D funding *en route* to fulfilling the Obama administration's pledge to double funding under MI [8]. It is currently unclear whether the U.S. will remain a member of MI. It is similarly unclear that MI can achieve its original doubling goals without U.S. contributions (Fig. 1). With declining US budgets, the funding shortfall could amount to 10 billion per year below the original MI goal by 2021. Should other MI countries scale back their commitments, absolute global funding levels would decline.

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[1] At the December 2015 Paris Climate Change Conference, twenty countries signed a "Mission Innovation" (MI) pledge aimed at spurring a sustained global wave of clean energy innovation by doubling public funding for energy research and development (R & D), with global levels reaching over $32 billion per year within five years (Fig. 1). Mission Innovation's Enabling Framework, Baseline and Doubling Plans, and Innovation Challenges are available at.: www.mission-innovation.net.

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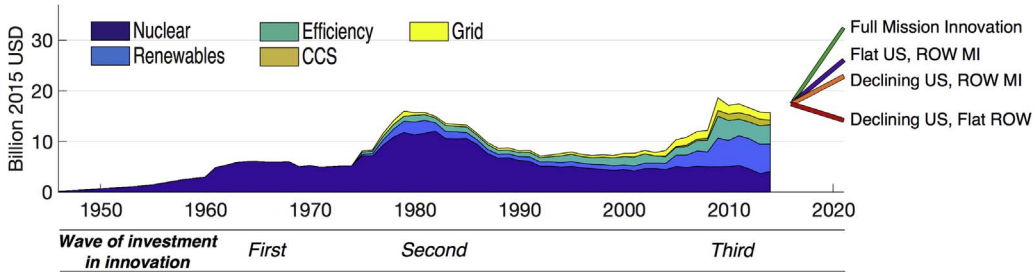

Fig. 1. Timeseries of global clean energy R & D and waves of investment in innovation, 1946–2021. Full implementation of MI would bring total global funding to at least 32 billion/yr by 2021, an unprecedented level over at least 70 years. Yet, stagnant or declining commitments by the US or rest of world (ROW) could jeopardize recent progress on global energy innovation. Here we project global R & D through 2021 for full MI implementation, a flat and 50% R & D decline for the US, and a doubling and flat R & D in other MI countries. With declining US budgets, a global R & D funding gap could be as large as 10 billion by 2021. R & D data for different waves of innovation are independent and not strictly comparable. For methods and further discussion, see SI Text.

But MI's future does not have to hew to the priorities expressed at its conception. In particular, the newfound implausibility of meeting MI's quantitative doubling target presents new opportunities to improve innovation outcomes. Quality is different from quantity, and there are many ways that MI can improve the quality of energy R & D and even induce new quantities of private funds—without doubling the quantity of public funds.

At the second annual MI summit, hosted by China in June 2017, member states should refocus MI's goals away from the quantitative doubling target, instead renewing MI's focus on enhancing innovation outcomes. They should also take steps to secure the continuity of the initiative by relocating the secretariat away from the United States. Although one option is to house MI within an established institution like the International Energy Agency (IEA), a better solution would be for multiple member states to share duties, ensuring that members stay engaged in the initiative's evolution. Finally, member states will face a choice to shun the United States for reneging on its doubling commitment or to take advantage of the experience and resources it will still have to offer, even given new political realities. They should opt for the latter.

2. Four activities to enhance innovation

MI's origin was a hastily arranged agreement spearheaded by President Obama, Bill Gates, and Indian Prime Minister Narendra Modi, to whom credit is due for the initiative's name. Quantitative doubling of public R & D spending was an easily explainable target, so it headlined the initial announcement at Paris. But MI's Launch Statement also included promises to collaborate, engage the private sector, and share information.

Already, MI's members have proffered four activities in addition to achieving a quantitative doubling goal—facilitating information sharing, identifying innovation needs, spurring international collaborations, and attracting private sector participation. These are laudable goals that address serious deficiencies in the global energy innovation landscape, whether or not funding increases are secured. Below, we describe progress to date and opportunities for further enhancement of each of these activities. Ultimately, they can allow MI to be an overarching framework for global energy innovation efforts, enabling opportunistic collaborations and accelerating domestic investment plans.

2.1. Facilitate information sharing

Data should be the foundation of any global effort to accelerate energy innovation. MI's enabling framework created mechanisms to share information related to country-level investment plans and to facilitate cooperation and engagement both among members and with the private sector. Already, members have set forth focus areas for investments and provided much-needed plans detailing their public R & D funding.

Moving forward, data sharing initiatives should promote transparency, accountability, and collaboration [9]. Of particular interest are funding estimates that are comparable, detailed, and inclusive: for instance, members could share technology-specific national R & D expenditures, estimates of corporate R & D expenditures, and information on private research trends. A robust effort would better enable MI countries to track progress towards their goal of doubling public R & D funding, expose gaps in funding for particular technologies, and suggest partnerships. Increased disclosure would also enable members to apply peer pressure and hold each other accountable for making progress toward their commitments.

2.2. Identify innovation needs

By partnering with experts in academia, industry, and member state governments, MI can occupy a unique position in developing a view of the frontiers of clean energy technology, and identifying gaps and overlap in technology development efforts [10]. Over the past year, MI members have defined country-level technology focus areas, assembled a library of technology roadmaps, and collectively determined seven 'Innovation Challenges' aimed at developing diverse technologies, from smart grids to carbon capture. Going forward, MI member states will need to be well informed as they choose investment priorities in R & D, inspired by end-use technologies needed to fight climate change [11]. And MI can serve as a forum for member states to voluntarily coordinate the development of their R & D funding plans, for example by jointly reviewing research results or setting technology milestones [12].

2.3. Spur collaborations and novel institutions

Collaborations between MI members can lower R & D program costs and increase access to expertise and facilities while preventing duplication of effort. In some ad hoc cases, collaborations have achieved high levels of political support and funding and have even improved bilateral relationships, like U.S. clean energy partnerships with China and India [13]. Throughout 2016, MI members announced joint R & D projects on diverse topics like supercritical CO_2 power cycles and clean energy materials. Through MI, countries will have repeated opportunities to formalize international collaborations with leader-level support and improve upon existing mechanisms [14].

In addition to spawning collaborations, MI can also serve as a global testbed for new innovation institutions and a venue for countries who have experienced success with novel institutions to help others do the same. For example, the United States has invested in several new initiatives—such as ARPA-E, energy innovation hubs, energy frontier research centers, and Cyclotron Road—that abandon the traditional linear model of innovation and instead aim to convene academia, industry, and government researchers to collaborate on R & D and product commercialization [8]. The United Kingdom has arguably done