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CLIMATE POLICY LAB
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Mission Innovation 2.0

Recommendations for the Second Mission Innovation Ministerial in Beijing, China

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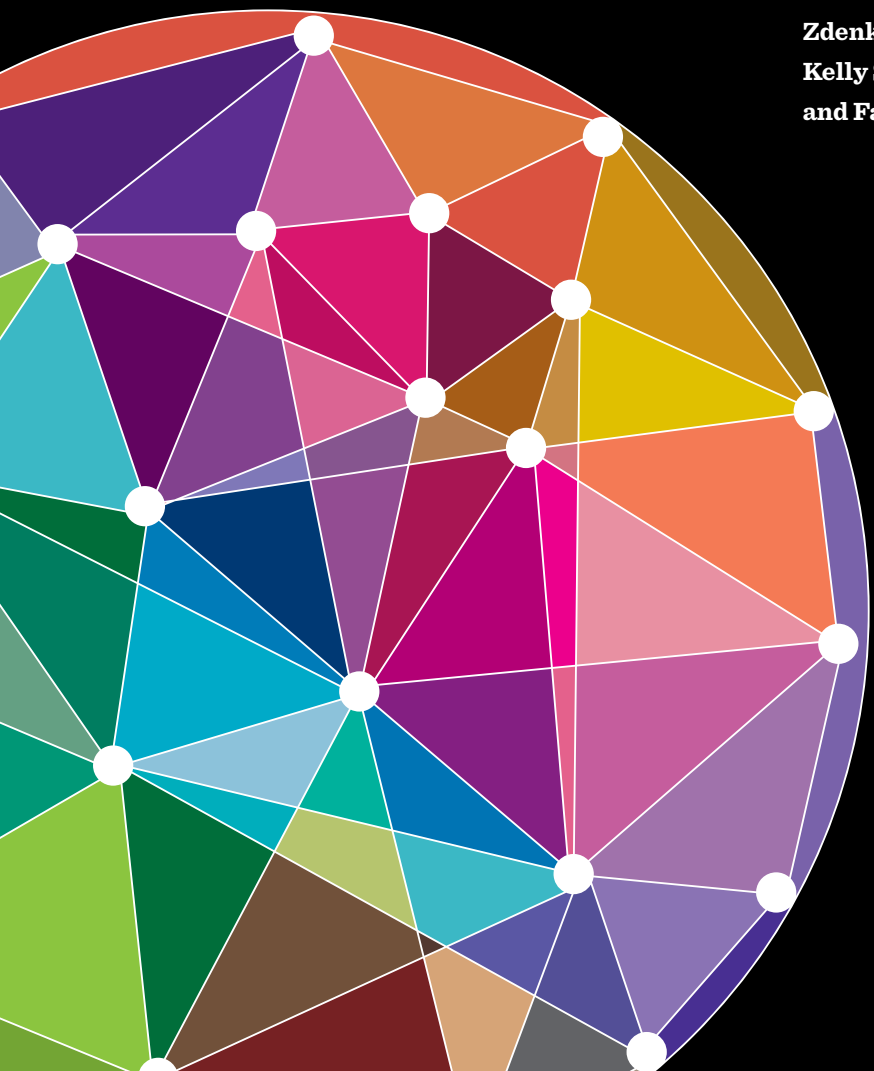

Summary of key recommendations

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1. Create more diversified and realistic goals

Mission Innovation's original stated goal was to "develop and scale breakthrough technologies and substantial cost reductions" for clean energy technologies. Its overarching mission is to "accelerate the pace of clean energy innovation to achieve performance breakthroughs and cost reductions to provide widely affordable and reliable clean energy solutions that will revolutionize energy systems throughout the world over the next two decades and beyond." In the context of the original announcement, Mission Innovation countries also committed to "aim" to double government investments in clean energy research, development, and demonstration (RD&D) spending.

We recommend that Mission Innovation countries create a more diversified and realistic set of goals within the Mission Innovation framework. Although the doubling goal was commendable, it was arbitrary and simply a means for achieving the ultimate goal. It is more important to set realistic, performance-based goals that focus explicitly on accelerating the pace of clean energy innovation. Pace can be measured through assessment of annual rates of improvement across different innovation metrics.

Given that all of the countries committed to develop and scale breakthrough technologies, as well as to achieve substantial cost reductions, each country should set performance-based goals as well as cost reduction goals for each technology category. It is just as important to be able to measure progress against these more granular goals and so we also recommend an improved data collection and management system as discussed below. Finally, the official internal reports of several countries lack details about which technology categories their pledges include (e.g. investment in cleaner fossil fuels or nuclear fission), and this detail should be provided when countries revise their goals.

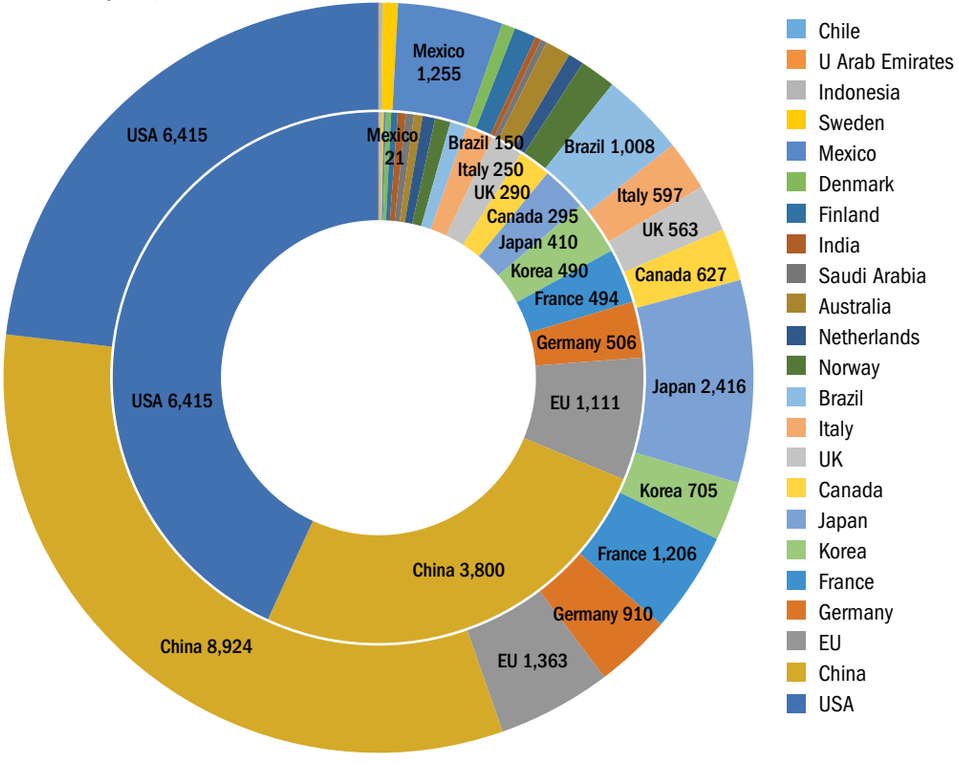
For those countries that indicated that they could double their investments faster than in five years (e.g. Indonesia, Chile, and Mexico), they should revise their pledges accordingly.[1] There is significant room for growth in clean energy investments in many countries (see Figure 1). When government investments pledged as part of the Mission Innovation baseline (inner circle) are compared with total government investments in energy RD&D (outer circle),[2] it is clear that many countries could expand clean energy

1 Indonesia plans to double its baseline within one year and to increase spending almost 10-fold by the end of the fifth year (from USD $17 million to $150 million/year). Chile plans to increase its investments 88% within the first year (from USD $4.18 million to $7.8 million). Mexico's first year increment represents more than a doubling of its baseline (from USD$20.71 million to $70.93 million).

2 The total government investments are composed of central government funding and other categories that include funding from state or local governments, from SOEs, or non-for-profit organizations. For the European Union, the spending in the outer circle represent the spending for and as reported by the European Commission.

RD&D spending within their overall energy RD&D portfolio to achieve the Mission Innovation goals. Furthermore, while many countries may wish to increase overall spending, for others, the baseline may have been unrealistic in the first place.

Figure 1: Pledged versus potential energy RD&D spending (in million USD; baseline year)



Comparison of each country's pledged level of spending in clean energy R&D (inner circle) and the level of energy RD&D funding reported to the IEA for that country's baseline year(s) (outer circle). For non-IEA countries where data is available, the values reflect the spending in energy RD&D as reported in local reports and other sources. For non-IEA countries where data is not available (India, Chile, United Arab Emirates, and Saudi Arabia), total energy RD&D spending is assumed to be equal to the pledged value. The sum of the Mission Innovation pledges represents 53% of total energy RD&D expenditures.

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2. Improve the data collection and management system

One of the best attributes of Mission Innovation is that it is a partnership of the leading countries in energy innovation, encompassing both industrialized and developing countries. Because the International Energy Agency (IEA) is only obliged to collect data on industrialized countries' energy RD&D investments, Mission Innovation provides an institutional setting for non-OECD, (Organization for Economic Cooperation and Development) countries to report their own data. Data collection and management under the Mission Innovation framework could be improved in several ways. First, definitions of clean energy RD&D should be harmonized across the 22 Mission Innovation countries (and the European Union). Some countries exclude certain types of investments, and others do not specify the categories of investment. Ideally, the definitions will reflect the main classification of the IEA RD&D database so that comparisons can be made across all countries. The clean energy RD&D focus areas are a good first step in that direction. In addition, country reports should clarify whether or not the data reflect research, development, and demonstration (RD&D) spending or merely research and development (R&D) spending.

Box A: Complementary innovation metrics that should be collected and reported by Mission Innovation countries

- Number and type of public activities/projects in RD&D phase, per type of technology
- Cost reductions by technology
- Performance improvements by technology (e.g. improved efficiency)
- Tax incentives for both RD&D and deployment
- Annual rates of improvement in individual technologies
- Number of specialized research centers/active university labs for RD&D per type of technology
- Number and type of personnel engaged in government-funded clean energy RD&D innovation projects
- Patents applied for and granted in clean energy RD&D
- Clean energy deployment spending by category
- Private sector spending on clean energy RD&D
- Amount of cost sharing and leverage created with public private partnerships

Harmonization of countries' internal energy reports and budgets to be consistent with the IEA framework will take time. We recommend that countries report data on an annual basis, recognizing that it will take time for the reporting to be comprehensive and fully accurate.

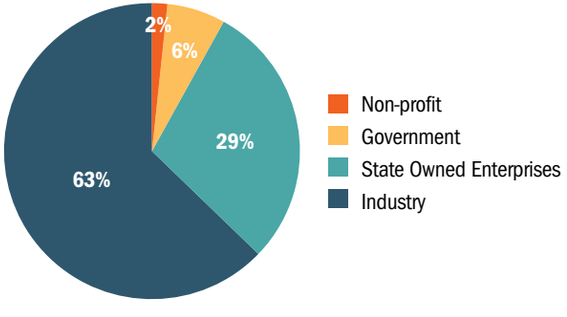
To improve consistency in reporting, each country should establish a point of contact authorized to collect and report the data to Mission Innovation and available to respond to inquiries about that country's efforts. To improve transparency and clarity, countries should publish and share documents in which national data can be found and pledged amounts verified. This information should also be accessible on the Mission Innovation webpage.

We also recommend that additional innovation data be collected consistently, to enable cross-country comparisons. It would be most beneficial to collect a set of indicators that complement the information on expenditures to make the reporting of a country's energy RD&D data more reflective of actual effort. Suggested metrics are provided in Box A.

3. Maximize the potential for collaboration with the private sector

Different actors in the clean energy innovation system serve unique functions, and ideally work together to achieve innovation goals. The potential for Mission Innovation countries to collaborate with the private sector was increased when the Breakthrough Energy Coalition (BEC) was announced in concert with Mission Innovation. According to BEC, a "dramatically scaled-up public research pipeline, linked to a different kind of private investor who is willing to truly put patient and flexible risk capital" will accelerate the cycle of clean energy innovation.[3] By working with BEC, its sister organization, Breakthrough Energy Ventures, and other corporate partners in public-private partnerships, Mission Innovation could achieve substantial cost reductions and scaling up of clean energy technologies.

Figure 2: Distribution of total energy RD&D funding in China by source of finance; 2015



3 http://www.b-t.energy/coalition/

Other private sector organizations should be engaged aside from the BEC. For instance, the Oil and Gas Climate Initiative (OGCI) recently launched OGCI Climate Investments, partnership that will invest $1 billion over the coming years to support start-ups and help develop and demonstrate innovative technologies that have the potential to reduce greenhouse gas emissions significantly.[4] Private-sector partners can also help to identify promising technology opportunities. For instance, the World Economic Forum recently published a report based on consultation with the private sector and other stakeholders identifying "game changers" in energy technologies. This report identifies three energy innovation priorities that should be addressed through public-private partnerships.[5]

Considerable evidence exists that the private sector welcomes partnerships with governments to share both cost and risk. If Mission Innovation countries are more transparent about their investment priorities and goals, the private sector will know which governments to approach to partner with on specific innovation projects. To go one step further, Mission Innovation countries could then create additional specific goals together with their private sector partners.

Enhanced public-private cooperation could easily be implemented in countries with large state-owned enterprises (SOEs) because collaborative RD&D partnerships are embedded in the ownership structure of these companies. A large number of Mission Innovation countries have substantial energy investments in SOEs. In China, for example, nearly one third of total energy RD&D spending is conducted by SOEs (see Figure 2). Specific strategies for aligning investments of the SOEs with government goals could further improve the likelihood of achieving the Mission Innovation goals.

4. Address gaps in the portfolio

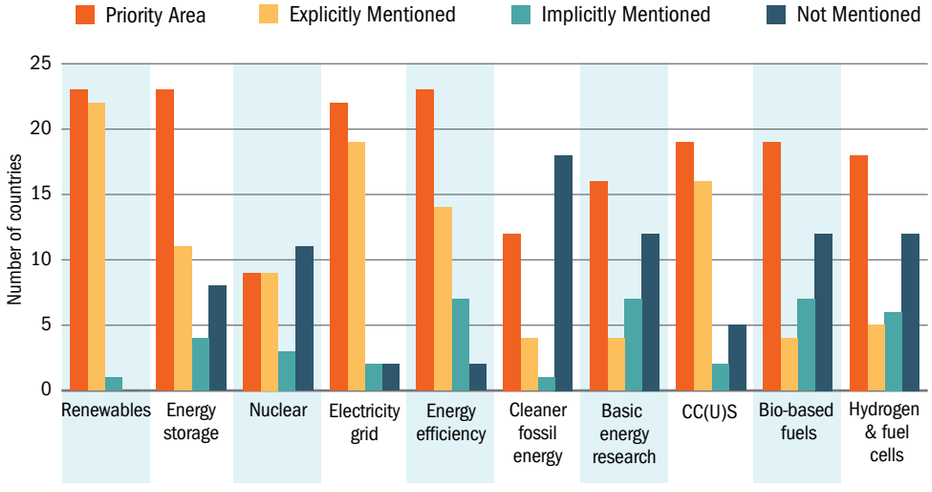
Gaps are apparent in the overall portfolio, and they should be addressed individually or collectively. Although not all countries provided disaggregated information about the areas of focus for their clean energy RD&D investments, most Mission Innovation countries clarified priorities in their submissions. Based on these submissions it is possible to obtain some insights about possible gaps in the overall portfolio that could be addressed individually or together.

Both energy efficiency and energy storage are potential gaps across the portfolio where additional investment is warranted. Figure 3 shows all of the areas in which each member country could identify priority sub-areas for investment. Almost all Mission Innovation countries mention renewable energy and electricity grid in their submissions, and nearly all indicate that energy efficiency is a priority area, but only 60% actually mention it in their definition. Less than half of the Mission Innovation

4 http://www.oilandgasclimateinitiative.com/climateInvestments
5 WEF (2017): advanced energy acceleration, mobility revolution, energy system fragmentation.

countries include nuclear energy in their definitions, and while every country mentioned energy storage as a priority area, fewer than 50% explicitly mention it in their definition. Some countries include energy efficiency explicitly in their definition, but several do not (including China, the UK, Finland, Indonesia, Mexico and Sweden). As a related matter, "energy efficiency" is not an established reporting category for Mission Innovation, and this situation should be rectified. Currently, only "industry & buildings", and "vehicles & other transportation" are available as reporting categories, and so countries may be discounting the importance of energy efficiency in the overall matrix.

Figure 3: Key areas of R&D interest in the defined baselines



"Priority Area" means a country considers the category among its areas of focus. "Explicitly Mentioned" means that a country, while not necessarily selecting the area as a priority, includes it explicitly in the definition of clean energy R&D (investment). "Implicitly Mentioned" indicates that the country does not include the category in the definition, but considers it in its overall narrative. "Not mentioned" indicates that the given country neither includes the category in its definition nor in its narrative. The category "Energy efficiency" comprises either or both "Industry & buildings" and "Vehicles & other transportation".

Another area of potential confusion is in the area of cleaner fossil energy. In the IEA classification of RD&D energy spending, carbon capture and storage is included within the fossil fuels-related technology. In the Mission Innovation priority focus areas, cleaner fossil energy and carbon capture and storage are mentioned separately. Twelve out of the twenty-two (and the EU) countries specify cleaner fossil energy among their priorities, and, for China, for example, clean and efficient development and utilization of coal is clarified as the top priority in its narrative. Similarly, Canada mentions "fossil fuels" in the definition without specific plans.

Finally, we recommend strengthened cooperation with the IEA and the International Renewable Energy Agency (IRENA), so countries can lean on them for guidance on

the technical aspects of data collection. They also could become a valuable resource in reaching out to countries outside Mission Innovation that might become potential regional partners for RD&D activities in specific technological fields.

Methodology

The data collection underpinning our analysis is an ongoing process. We ultimately aim to develop a robust open access database that would exhaustively reflect the currently available information, and its gaps, for all major countries' energy RD&D spending. At present, we have collected information on energy RD&D mainly from publicly-available sources. The data collection has been carried out on two levels: (1) on the international and regional level via databases of the IEA, OECD, the World Bank, and the regional development agencies such as the Asian Development Bank and the Inter-American Development Bank, as well as regional organizations focused on science and technology, including the Network for Science and Technology Indicators – Ibero-American and Inter-American – RICYT. Since many of the sources for the non-IEA countries provide aggregate values for energy RD&D funding, we extended the data collection to (2) the national level, reviewing and including information available through the countries' statistical agencies, the budgets of the local ministries which may include energy RD&D components, and the financial and annual reports of the major state owned companies in energy. Our success in the overall effort has been highly improved by our collaboration and consultations with the IEA.

References

Breakthrough Energy Coalition, accessed 04/2017 at http://www.b-t.energy/coalition/

CONACYT (2013) and CONACYT (2014), "Informe General del Estado de la Ciencia y la Tecnologia (in Spanish)" Consejo Nacional de Ciencia y Tecnologia, accessed 03/2017 at www.conacyt.gob.mx

CONACYT (2014), "Programa Especial de Ciencia, tecnologia e Innovacion 2014-2018", Consejo Nacional de Ciencia y Tecnologia, accessed 03/2017 at www.conacyt.gob.mx

Eletrobras (2016), "Annual Report on Form 20-F", Centrais Elétricas Brasileiras S.A., accessed 03/2017

Gallagher, K. S., Anadon, L. D., Kempener, R. and Wilson, C. (2011), Trends in investments in global energy research, development, and demonstration. WIREs Climate Change, 2: 373–396. doi: 10.1002/wcc.112

Gallagher, K. S., Grübler, A., Kuhl, L., Nemet, G. and Wilson, C. (2012), The Energy Technology Innovation System, Annual Review of Environment and Resources, Vol. 37: 137-162.

IEA: RD&D budget database accessible at http://wds.iea.org/WDS/Common/Login/login.aspx

IEA Guide to Reporting Energy RD&D Budget/Expenditure Statistics (http://www.iea.org/stats/RDD%20Manual.pdf)

Kempener, R., Anadon, L.D., Gallagher, K.S., & K. Jiang. (2012). Energy RD&D Investments in the Major Emerging Economies and the United States. Historical Case Studies of Energy Technology Innovation in: Chapter 24, The Global Energy Assessment. Grubler A., Aguayo, F., Gallagher, K.S., Hekkert, M., Jiang, K., Mytelka, L., Neij, L., Nemet, G. & C. Wilson. Cambridge University Press: Cambridge, UK.

MEMR (2010), "Rencana Strategis Kementerian Energi Dan Sumber Daya Mineral Tahun 2010 – 2014", Strategic Plan, Ministry of Energy and Mineral Resources of the Republic of Indonesia; accessed 03/2017 at https://www.esdm.go.id/en/publication/the-strategic-plan

MEMR (2015), "Renstra Kesdm 2015-2019", Strategic Plan, Ministry of Energy and Mineral Resources of the Republic of Indonesia; accessed 03/2017 at https://www.esdm.go.id/en/publication/the-strategic-plan

MCTI (2013) – MCTI (2015), "Demonstrativo da Arrecadação, Orçamento e Execução dos Fundos Setoriais", Ministério da Ciência, Tecnologia e Inovação, Brazil, accessed 03/2017 at http://www.mct.gov.br/index.php/content/view/27646.html

Mission Innovation Accelerating the Clean energy Revolution, accessed 04/2017 at http://mission-innovation.net/

Mission Innovation: Baseline, Doubling, and Narrative Information Submitted by Mission Innovation Countries and the European Union, November 2016; accessed 04/2017 at http://mission-innovation.net/wp-content/uploads/2016/06/MI-Country-Plans-and-Priorities.pdf

Oil and Gas Climate Initiative Climate Investments, accessed 05/2017 at http://www.oilandgasclimateinitiative.com/climateInvestments

Pemex (2011) – Pemex (2016), "Informe Anual 2010" – "Informe Anual 2015", Petroleos Mexicanos, accessed 03/2017 at http://www.pemex.com/ri/Publicaciones/Paginas/Informe-Anual.aspx

Pertamina (2015), "Annual Report 2015", Pertamina, Indonesia, 2015.

Petrobras (2011) – Petrobras (2016), "Annual Report on Form 20-F", Petróleo Brasileiro, accessed 03/2017

PT Gas (2015), "Annual Report 2015", PT Perusahaan Gas Negara, Indonesia.

PwC (2016), "Power in Indonesia – Investment and Taxation Guide", PricewaterhouseCoopers, 2016.

SHCP (2007), "DECRETO por el que se reforman y adicionan diversas disposiciones de la Ley Federal de Derechos, en materia de hidrocarburos y se derogan y reforman diversas disposiciones del Decreto que reforma diversas disposiciones del Título Segundo, Capítulo XII, de la Ley Federal de Derechos, publicado el 21 de diciembre de 2005.", Secretaria de Hacienda y Credito Publico, 2007.

State Statistical Bureau (2016), "China Statistical Yearbook on Science and Technology", State Statistical Bureau, State Science and Technology Commission, accessed 04/2017.

UNESCO, accessed 04/2017 at http://www.uis.unesco.org/ScienceTechnology/Pages/innovation-statistics.aspx

WEF (2017), "Game Changers in the Energy System Emerging Themes Reshaping the Energy Landscape", World Economic Forum and McKinsey & Company, 2017. Accessed 05/2017 at http://www3.weforum.org/docs/WEF_Game_Changers_in_the_Energy_System.pdf

World Bank (2017), "World Development Indicators Online, 2017" online database by the World Bank Group, accessed 03/2017 at http://data.worldbank.org/

Databanks from OECD library (MSTI, ANBERD, STAN), IEA, UNESCO, World Bank Databank, ADB, IDB, RICYT, yearbooks, annual reports, innovation plans, etc.

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