

## 2016 National Research Infrastructure Roadmap Capability Issues Paper

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Question 1: Are there other capability areas that should be considered?

Question 2: Are these governance characteristics appropriate and are there other factors that should be considered for optimal governance for national research infrastructure.

Question 3: Should national research infrastructure investment assist with access to international facilities?

*Facilitating strategic access to large-scale environmental research infrastructure and facilities available internationally (e.g., NEON, KEON, CERN) would be beneficial as this provides an opportunity to (1) develop more robust models; (2) test broad scientific hypotheses that have applicability across continental and inter-continental scales; (3) share lessons learned on our scientific, technical and engineering designs and protocols.*

*We at NEON have been fortunate to have had the opportunity to collaborate with a number of TERN scientists over the past several years. We have met on several occasions at professional meetings, workshops, and via an on-going dialog though teleconferencing. We have exchanged a number of ideas on protocols, designs and technologies to the benefit of both programs. The major focus to date has been on terrestrial measurements and sampling designs, low altitude remote sensing, and data standardization and infrastructure. We hope in the near future to pursue further dialogue on challenges and opportunities associated with aquatic ecosystems, which are of obvious critical importance globally.*

Question 4: What are the conditions or scenarios where access to international facilities should be prioritised over developing national facilities?

*With regard to environment and natural resources, national observation facilities are clearly of the highest priority. That said, a small strategic investment in international dialog and collaboration is expected to have a multiplier effect by encouraging replication of similar measurement, observations and approaches across continents.*

Question 5: Should research workforce skills be considered a research infrastructure issue?

*Within the ecological and environmental sciences, there is an increasing need to understand status, trend and dynamics across large spatial scales in order to support development and improvement of ecological forecasting models that have application at*

*regional and local levels – not unlike the advances that have been made in weather forecasting over the past several decades.*

*Historically, ecological science has been practiced at relative small spatial scales (1 to 100's of square meters). As we increasingly move into the frontier of continental-scale ecology, it will be critical to develop the research workforce and practitioners of ecological forecasting to take full advantage of the "big data" that will become available as a result of investments in large scale research infrastructure. In addition, the skills required to design, develop, and construct national scale observatories – particularly in the areas of protocol design/implementation and ecological informatics – are unique skills that would have to be "reinvigorated" each time a new facility is initiated. Ensuring that these skills are retained as part of the research infrastructure will ameliorate that development lag time.*

*NEON and TERN have collaborated on issues related to science education and public outreach and would hope to continue this dialog in the coming years and decades.*

**Question 6: How can national research infrastructure assist in training and skills development?**

*By collaborating with universities and other science organizations on workshops that are focused on both designing/building the observatory and using the data collected by the observatory.*

**Question 7: What responsibility should research institutions have in supporting the development of infrastructure ready researchers and technical specialists?**

**Question 8: What principles should be applied for access to national research infrastructure, and are there situations when these should not apply?**

**Question 9: What should the criteria and funding arrangements for defunding or decommissioning look like?**

**Question 10: What financing models should the Government consider to support investment in national research infrastructure?**

**Question 11: When should capabilities be expected to address standard and accreditation requirements?**

*One of the key elements of the NEON program and one that we have discussed extensively with our TERN colleagues is the value of standardization in data collection, handling, documentation, storage and processing. This is key to usefully integrating data across multiple sampling sites, varied sampling platforms, and events separated by time.*

*However, this is no small task here in the US and likewise in Australia given the wide diversity of ecosystems that need to be included. One big advantage of the collaboration between NEON and TERN has been sharing information on what works and what doesn't under various scenarios.*

*Scientific commissioning is a related activity in which NEON is currently engaged – i.e. to demonstrate that the observatory is performing according to the system requirements and benchmarks. Commissioning applies to each of the observatory subsystems – instrumental and observational.*

**Question 12:** Are there international or global models that represent best practice for national research infrastructure that could be considered?

*NEON is certainly one model for large-scale ecological research infrastructure. TERN certainly is another. While each is driven by requirements specific to the US and Australia respectively, there clearly are many opportunities to identify and capitalize on the strengths of each*

**Question 13:** In considering whole of life investment including decommissioning or defunding for national research infrastructure are there examples domestic or international that should be examined?

**Question 14:** Are there alternative financing options, including international models that the Government could consider to support investment in national research infrastructure?

#### **Health and Medical Sciences**

**Question 15:** Are the identified emerging directions and research infrastructure capabilities for Health and Medical Sciences right? Are there any missing or additional needed?

**Question 16:** Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

**Question 17:** Is there anything else that needs to be included or considered in the 2016 Roadmap for the Health and Medical Sciences capability area?

#### **Environment and Natural Resource Management**

**Question 18:** Are the identified emerging directions and research infrastructure capabilities for Environment and Natural Resource Management right? Are there any missing or additional needed?

*One of the key emerging directions, as noted above, is the movement toward large continental-scale ecological research infrastructure intended to enable understanding of ecological process and dynamics at larger spatial scales and over longer time frames (decades) than has been the case historically in ecological research.*

**Question 19:** Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

*NEON, in the US, and similar research infrastructure being developed in Korea and China fall into this category. We have been fortunate, as noted above, to have engaged in a robust dialog between TERN and NEON researchers over the past few years that we believe has benefited both programs. These discussions have focused on terrestrial and*

*airborne monitoring as well as data standardization and infrastructure; and are ripe for future engagement on aquatic systems.*

*NEON is nearing the end of its construction period and has begun initial operations in earnest. We expect to realize many lessons learned over the next several years and would hope to take advantage of opportunities to provide input to Australia's national environmental monitoring programs, such as TERN, and to take lessons from Australia's experience. Continuing this collaboration on the "nuts and bolts" of continental scale ecological observing over the next decade and beyond and leveraging collective efforts among the US, Australia and other international partners will most assuredly pay large dividends to our understanding of the pace, direction and forecasting of ecological change at continental scales. We should also hope to gain better insights into the relationship between such change and, e.g., agricultural productivity, human health and ecosystems services more generally.*

**Question 20:** Is there anything else that needs to be included or considered in the 2016 Roadmap for the Environment and Natural Resource Management capability area?

*We believe Australia--TERN is in the unique positioned to take on a global leadership role with respect to large-scale ecosystem monitoring and analysis.*

#### **Advanced Physics, Chemistry, Mathematics and Materials**

**Question 21:** Are the identified emerging directions and research infrastructure capabilities for Advanced Physics, Chemistry, Mathematics and Materials right? Are there any missing or additional needed?

**Question 22:** Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

**Question 23:** Is there anything else that needs to be included or considered in the 2016 Roadmap for the Advanced Physics, Chemistry, Mathematics and Materials capability area?

#### **Understanding Cultures and Communities**

**Question 24:** Are the identified emerging directions and research infrastructure capabilities for Understanding Cultures and Communities right? Are there any missing or additional needed?

**Question 25:** Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

**Question 26:** Is there anything else that needs to be included or considered in the 2016 Roadmap for the Understanding Cultures and Communities capability area?

#### **National Security**

**Question 27:** Are the identified emerging directions and research infrastructure capabilities for National Security right? Are there any missing or additional needed?

**Question 28:** Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

**Question 29:** Is there anything else that needs to be included or considered in the 2016 Roadmap for the National Security capability area?

#### **Underpinning Research Infrastructure**

**Question 30:** Are the identified emerging directions and research infrastructure capabilities for Underpinning Research Infrastructure right? Are there any missing or additional needed?

**Question 31:** Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

**Question 32:** Is there anything else that needs to be included or considered in the 2016 Roadmap for the Underpinning Research Infrastructure capability area?

#### **Data for Research and Discoverability**

**Question 33:** Are the identified emerging directions and research infrastructure capabilities for Data for Research and Discoverability right? Are there any missing or additional needed?

**Question 34:** Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

**Question 35:** Is there anything else that needs to be included or considered in the 2016 Roadmap for the Data for Research and Discoverability capability area?

#### **Other comments**

If you believe that there are issues not addressed in this Issues Paper or the associated questions, please provide your comments under this heading noting the overall 20 page limit of submissions.