



Division of Astronomical Sciences (AST) Update on Divestment Planning

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Edward Ajhar

Acting Deputy Division Director, MPS/AST



Overview

- Background – Why consider divestment?
- Environmental Review Process
- Status of Facilities



AST Divestment: background

- AST's Overall Goals

1. Provide **open access** to the broad astronomy community for merit-reviewed science on **leading-edge facilities**.
2. Provide **robust grants program** to support forefront research on leading-edge facilities and development of the next generation of scientists.
3. Provide **robust instrumentation program** to support development of the next generation of instruments and facilities.
4. Maintain **balance** among facilities, individual investigator, and instrumentation grants programs.



AST Divestment: background

- AST's budget has remained approximately flat through FY 2017 while
 - Bringing ALMA to full operations.
 - Ramping up DKIST operations.
 - Preparing for LSST operations.
- National Academies report: *New Worlds, New Horizons: A Midterm Assessment (2016)* → FINDING 3-10: *The core grants programs AAG and ATI have declined in real-year dollars and dropped still further in purchasing power over the first half of the decade. This reduction in funding has contributed to a **substantial decline in grant funding rates, threatening the scientific productivity of the U.S. ground-based astronomy program.***



AST Divestment Summary

- Facility divestment from AST budget was recommended in 2012, so portfolio could best address science of recent NRC decadal surveys.
- National Academies report: *New Worlds, New Horizons: A Midterm Assessment (2016)* → RECOMMENDATION 3-1: *The NSF should **proceed with divestment** from ground-based facilities that have a lower scientific impact, implementing the recommendations of the NSF Portfolio Review, which is essential to sustaining the scientific vitality of the U.S. ground-based astronomy program as new facilities come into operation.*



AST Divestment Summary

- NSF has been aggressively pursuing divestment of lower priority facilities.
 - Numerous community committee recommendations to pursue collaborations.
 - To date, implementation of Portfolio Review recommendations by means of cuts to facilities and new collaborations has saved about \$15 million in annual facility spending.



AST Divestment Summary

- Dear Colleague Letter NSF 17-079, released April 27, gives status update.
- NSF has begun a formal environmental review process for some facilities where collaborations have not yet fully developed.
 - **Arecibo Observatory**
 - **Green Bank Observatory**
 - **Sacramento Peak Observatory**
 - Others may follow

Environmental Review Process & Alternatives

- Collaboration Options
 - Collaboration with a federal agency or other entity with no substantial change in operations
 - Transferring ownership interest in the facilities to another entity
 - Other options have been pursued that are specific to individual telescopes or facilities. They may involve changes in scope or mission, or both.
- If no viable collaborations exist
 - Mothballing or site restoration



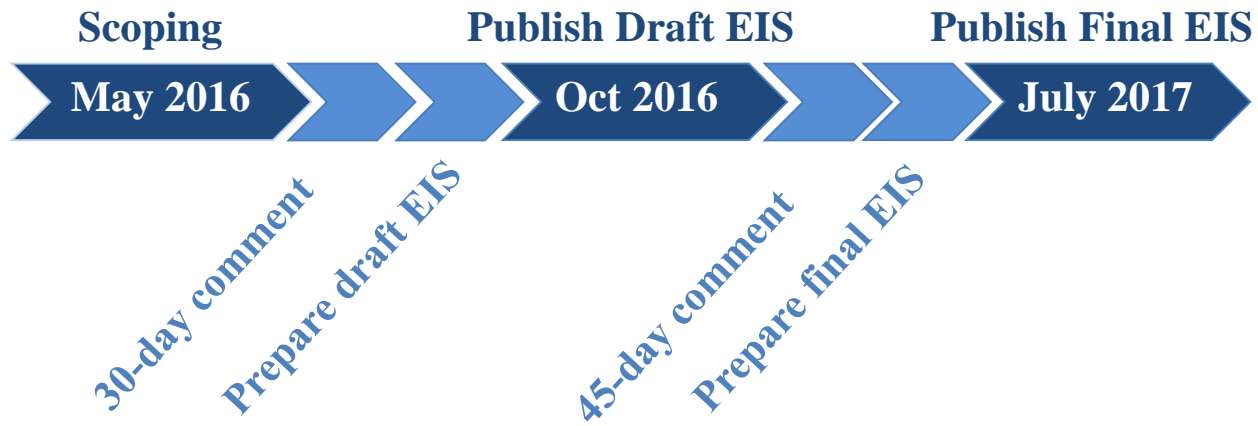


Environmental Review Process & Alternatives

- Proposed Divestment of AST Facilities May Trigger the Following Federal Environmental Statutes:
 - National Environmental Policy Act (NEPA)
 - Section 106 of the National Historic Preservation Act (NHPA)
 - Endangered Species Act (ESA)



Arecibo: Environmental Impact Statement (EIS) timeline





Arecibo Draft EIS Alternatives under Consideration:

- Continued NSF investment for science-focused operations (No-Action Alternative).
- Collaboration with interested parties for continued science-focused operations (Agency Preferred Alternative).
- Collaboration with interested parties for transition to education-focused operations.
- Mothballing of facilities.
- Partial deconstruction and site restoration.
- Full deconstruction and site restoration.



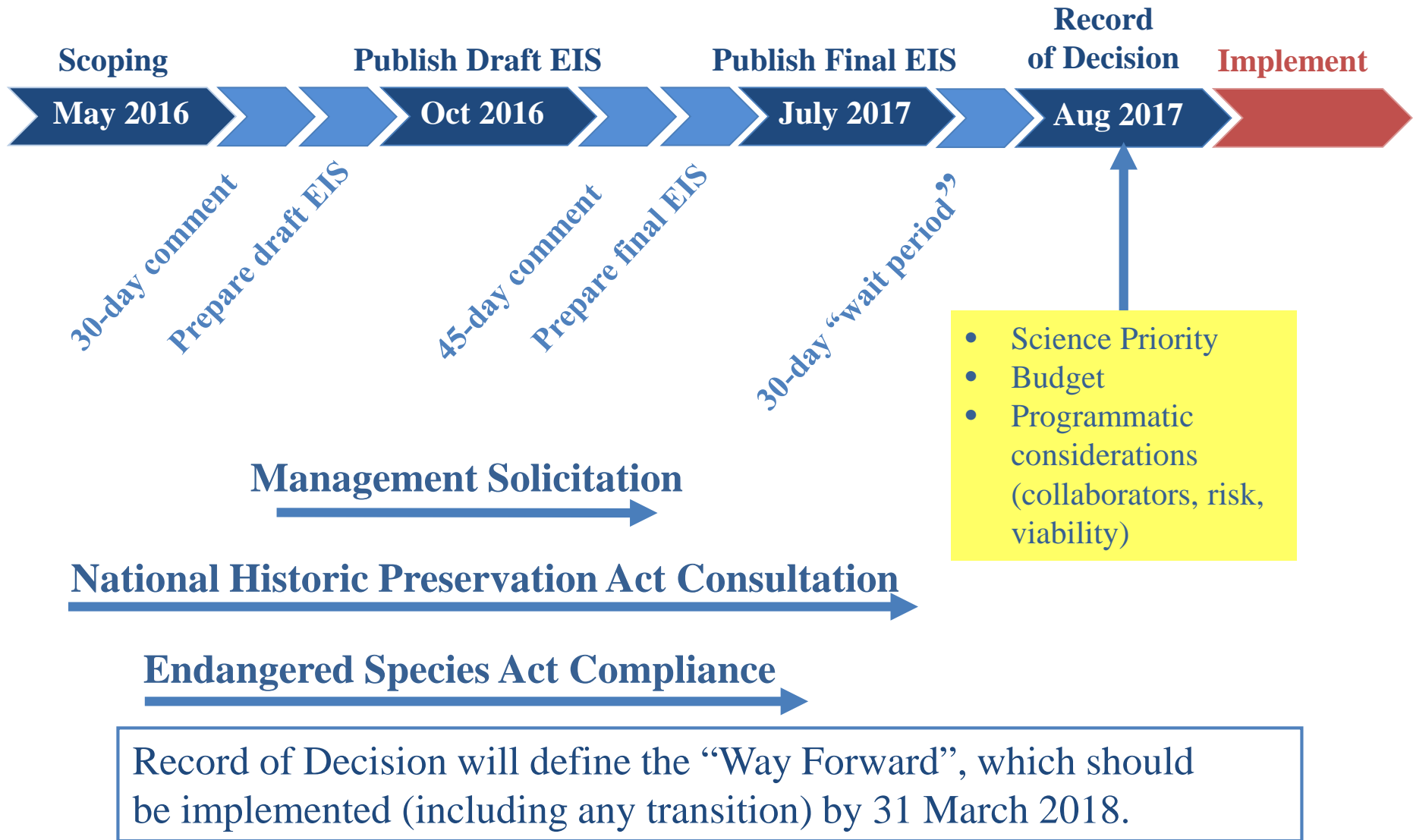
Arecibo Management Solicitation

- Intended to inform the EIS Agency Preferred Alternative: Collaboration with interested parties for continued operations.
- MPS/GEO Dear Colleague Letter 16-144, Sept 30, 2016: *Intent to Release Solicitation Regarding Future Continued Operations of Arecibo*
- Solicitation Released January 25, 2017.
- Proposals were due May 5, 2017. Now under review.
- Reduces NSF support from \$8.2M/yr (FY16) to \$2M/yr over 5 year award.
- Includes NASA Letter of continued support.
- Award made if and only if Record of Decision selects Collaboration alternative.

| Project Year | FY | NSF | | |
|-----------------|-------|-------------|-------------|--------------------|
| | | MPS/AST | GEO/AGS | TOTAL |
| 1 | 18/19 | \$3,600,000 | \$3,550,000 | \$7,150,000 |
| 2 | 19/20 | \$2,500,000 | \$2,500,000 | \$5,000,000 |
| 3 | 20/21 | \$1,750,000 | \$1,750,000 | \$3,500,000 |
| 4 | 21/22 | \$1,250,000 | \$1,250,000 | \$2,500,000 |
| 5 | 22/23 | \$1,000,000 | \$1,000,000 | \$2,000,000 |



Arecibo: How the Parts Fit Together





Divestment Facility Summary

| Telescope | Status |
|----------------|---|
| KPNO 2.1m | Caltech-led consortium (Robo-AO) operating for FY 2016-2018. |
| Mayall 4m | Slated for DESI; bridge from NSF to DOE; NSF/DOE MOU for transition. |
| WIYN 3.5m | NOAO share to NASA-NSF Exoplanet Observational Research Program; NSF/NASA MOU in place; NASA instrument selected. |
| GBO | ~25% collaboration for basic scope; started EIS process on October 19. DEIS under prep. Working to establish federal or other collaborations. |
| LBO/VLBA | Separation from NRAO in FY 2017; IAA with US Navy in place. |
| McMath-Pierce | Limited partner opportunities; very small user community. RFP issued. |
| GONG/SOLIS | SOLIS is off Kitt Peak; GONG refurbishment; Interagency Agreement with NOAA signed (NOAA sharing GONG operations costs). |
| Sacramento Pk. | University consortium in development, and NSF funded NMSU for transition to consortium; started EIS process; completion in 2017. |
| Arecibo | Formal EIS process under way, and issuance of Record of Decision targeted for 2017. Draft EIS released October 28. Final EIS under prep. |
| SOAR | Post-2020 status to be reviewed. |

Backups



AST Divestment Summary

- National Academies report: *New Worlds, New Horizons: A Midterm Assessment (2016)* → FINDING 3-12: *Even following the divestment recommended by the Portfolio Review, the operations costs of ALMA, DKIST, and LSST will compromise the ability of the U.S. community to reap the scientific return from its premier ground-based facilities.*

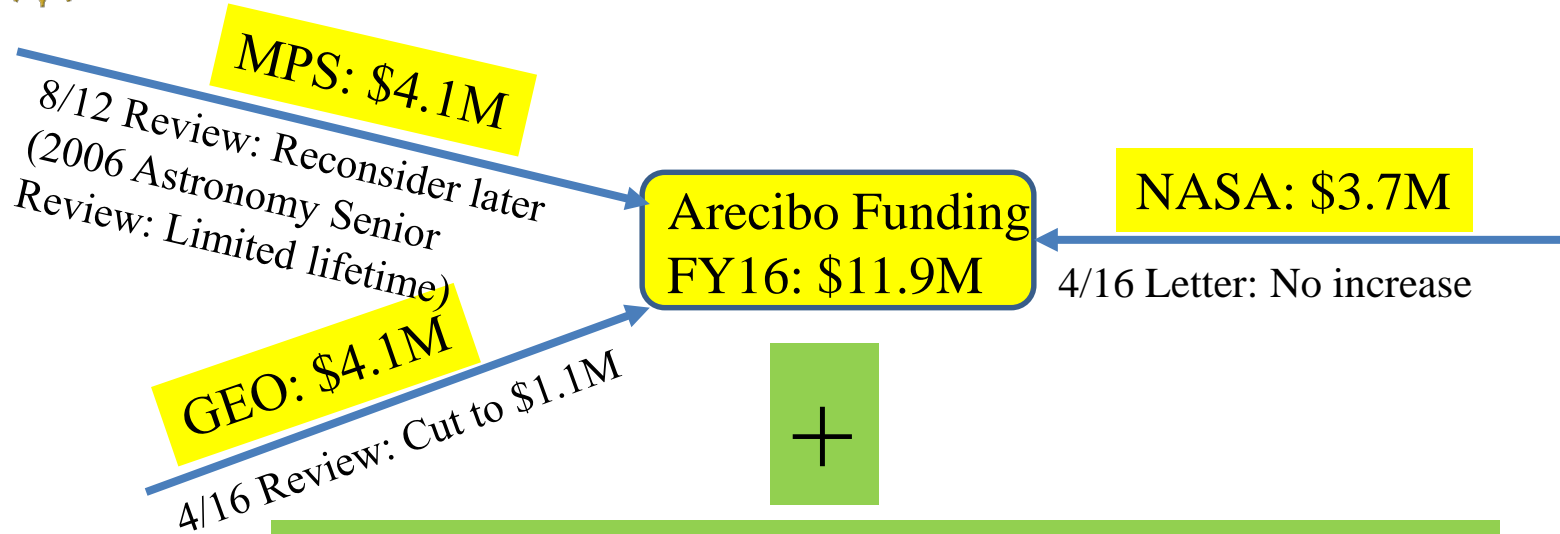


Environmental Reviews - Targeted Timeline

- June-November 2016: Initial scoping periods for EIS processes (now completed)
- October 2016-August 2017: Release of Draft EISs, and comment periods for Draft EISs
- July 2017-December 2017: Release of Final EISs, and 30-day waiting periods
- August 2017-January 2018: Issuance of NSF Records of Decision



Arecibo Observatory: Lead Up to the EIS



01/2016: Dear Colleague Letter Replies to:
Concepts for Future Operation...

02/2016: Engineering Feasibility Study complete.

09/2016: End of current Cooperative Agreement,
now extended to March 31, 2018.



May 2016: Start Environmental Impact Statement (EIS) Process.



Sacramento Peak (Sac Peak) Observatory

- Sac Peak occupies 175 acres and operates under Land Use Agreement with U.S. Forest Service (Lincoln National Forest) in New Mexico
- May 2015: Met with National Solar Observatory (NSO) and representatives of universities seeking to create consortium to operate Sac Peak. Second meeting with NMSU Provost.
- February 2016 and February 2017: NM State Legislature declined to fund NMSU request for funds to enable consortium.
- July 2016: Received bridge proposal from NMSU for transition
- July 2016: Initiated environmental review
- August 2016: Recommended bridge funding
- October 2017: Temporary transfer of operations to NMSU while NSF determines the way forward



McMath-Pierce Solar Observatory

- Iconic solar telescope on Kitt Peak (Arizona).
- NSO has substantially reduced operations, and there is a very limited user community. NSO plans to cease operations in 2017.
- A potential consortium has been unsuccessful at raising funds to date.
- AURA has issued an RFP.
- May start formal environmental review following conclusion of RFP/solicitation process.





National Radio Astronomy Observatory (NRAO)

- Very Long Baseline Array (VLBA) and Green Bank Observatory (GBO) were separated from NRAO at start of FY 2017, as announced in NSF 13-074 (March 2013), which also solicited GBO and VLBA partnership ideas from community.
- VLBA became the Long Baseline Observatory (LBO) in FY 2017.
- Separation facilitates individual collaboration arrangements for these observatories, independent of complexities of larger NRAO.
- Partial collaborations were in place for both GBO and LBO





Long Baseline Observatory (LBO)

- On October 1, 2017, the stand-alone Long Baseline Observatory was initiated, with its operational instrument being the VLBA.
- VLBA consists of ten 2-acre sites — owned by federal government, universities or other state/regional entities.
- U.S. Naval Observatory (USNO) has been important user of VLBA for several years and contributes to its operations.
- USNO uses VLBA for daily measurements of Earth Orientation Parameters (EOP) and regular maintenance of overall Celestial Reference Frame.
 - Achieved by observing networks of natural radio sources (quasars) having positions known to sub-milliarcsecond accuracy (approximately the size of a ruler at the Moon).
- Beginning in FY 2017 USNO is a major funding partner with NSF through an Interagency Agreement. Formal environmental review has been postponed.



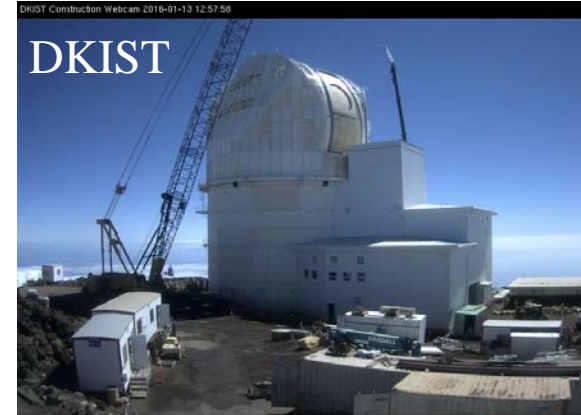
Green Bank Observatory (GBO)

- GBO is located on 2,200 acres of NSF-owned land in West Virginia.
- Breakthrough Prize Foundation established an agreement with managing organization for NRAO (Associated Universities, Inc.), supplying \$2 million in FY 2016 for SETI.
- Other smaller partnerships are in place (WVU, NSF-funded Physics Frontier Center, Max-Planck Institute, Shanghai Observatory).
- Net collaborator (non-NSF) total at present is ~25-30% of GBO costs.
- NSF and AUI have ongoing discussions with U.S. companies and federal agencies regarding use for Space Situational Awareness and other technology activities.
- NSF is currently working with DoD OSD MD5: National Security Technology Accelerator to provide a substantial funding contribution to GBO operations.
- Formal environmental review process began in October 2016.



Why Does NSF Build and Operate Telescopes?

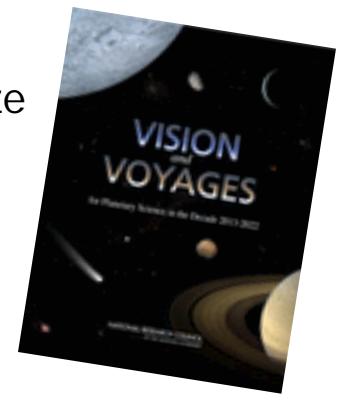
- To advance frontiers of astronomy, NSF must invest in advanced tools for specific science goals
 - Atacama Large Millimeter/submillimeter Array (ALMA): Understand processes of planet, star and galaxy formation
 - Daniel K. Inouye Solar Telescope (DKIST): Probe fundamental length scale of the Sun, to understand energy transport and origin of space weather.
 - Large Synoptic Survey Telescope (LSST): Understand nature of dark energy, the transient astronomical universe and contents of our Solar System.
- Goals can only be achieved from sites with the best observing conditions — low water vapor content, high atmospheric transparency and a high fraction of clear days/nights
 - Such conditions are found at high altitude in the altiplano of Chile, the highest peaks in Hawaii and Antarctica.





Decadal Surveys in Astronomy

- AST relies on National Academies decadal surveys to set priorities for ground-based astronomy program
 - Such NRC studies have been carried out every 10 years since 1960 and are viewed as a successful model for building consensus in a scientific community
- Most recent survey, *New Worlds, New Horizons in Astronomy and Astrophysics (NWNH)*, was released in 2010
 - *NWNH* assumed a 4%/year rise in AST purchasing power over decade
 - *NWNH* recommended “Senior Review” be carried out to prioritize existing vs. new activities in lower budget scenarios





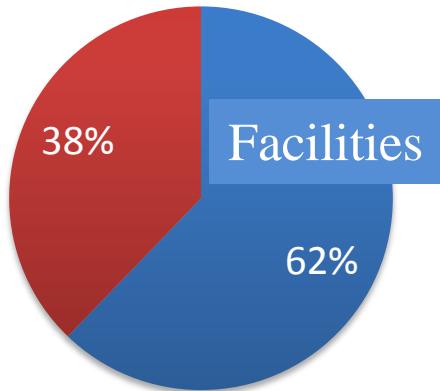
AST Portfolio Review

- Portfolio Review Committee was commissioned in 2011 as broadly representative subcommittee of MPS Advisory Committee
 - Responsive to *NWNH* recommendation for review of ongoing activities in a more constrained budget outlook
 - Charged to recommend program that best addressed *NWNH* science questions within budget scenarios well below *NWNH* assumption (doubling in 10 years)
- Portfolio Review Committee reported out in August 2012
 - Recommended a balance of small, medium and large programs that would require divestment of a number of operating telescopes from AST budget
- Status of NSF responses has been reported regularly
 - Dear Colleague Letters, NSF 14-022 (Dec. 2013), NSF 15-044 (March 2015), NSF 17-
 - Regular (annual or more often) reporting to Astronomy and Astrophysics Advisory Committee, American Astronomical Society town halls, several National Research Council committees, and Congressional staff

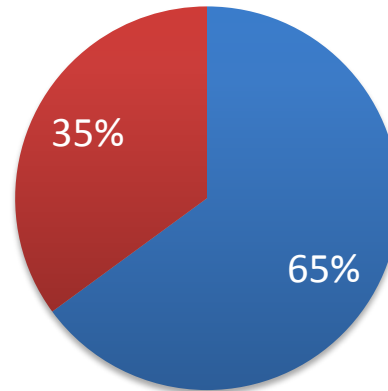


Historical Funding Breakdown

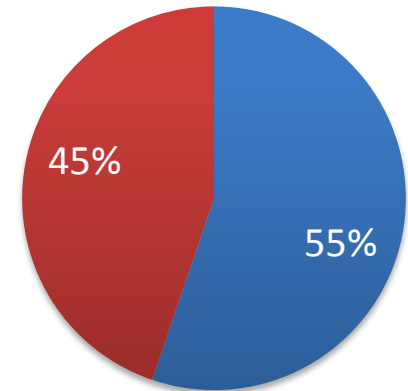
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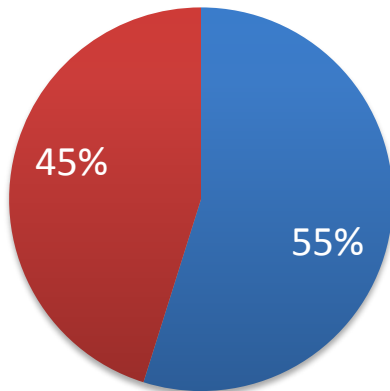
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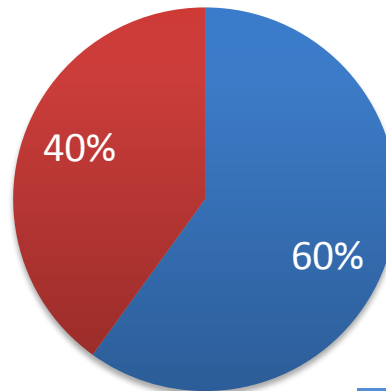
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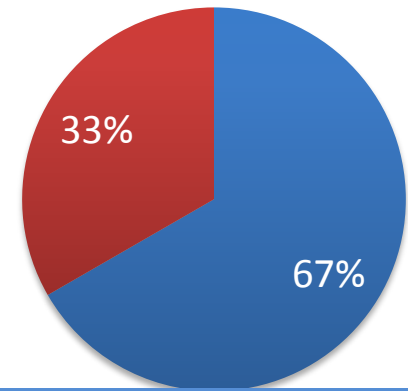
2010



2015



2020?



Assumes flat budget, currently planned facility evolution.



Generic Divestment Response Process

- Pursuing collaborations with universities, institutes and federal agencies
- NSF contracted a consulting firm (CH2MHill) to undertake engineering/environmental feasibility studies that enable NSF to identify viable alternatives for facilities
- Now being followed (2016-2017) by environmental review processes that use viable alternatives informed by feasibility studies as starting points.
 - This review process and consideration of alternatives will occur as part of NSF's environmental compliance obligations under NEPA, NHPA and ESA, prior to selecting preferred alternatives.
 - "No decisions have been made" until reaching the Record of Decision at the end of the environmental review processes.





Hypothetical Budget Runouts for AST

