

**Charge to the Priorities of Weather Research (PWR) Study Team
From NOAA Science Advisory Board (SAB)**

15 March 2021

Amendment #1: This amendment was made by the NOAA Science Advisory Board to the "Charge to the Priorities of Weather Research (PWR) Study Team From NOAA Science Advisory Board (SAB)" agreement (the "Agreement") dated 15 March 2021.

- a. The Agreement is amended as follows:

The term of this Agreement is extended through 31 December 2024. This is three years beyond the initial charge to the team to complete the PWR study by 31 December 2021. The initial tasking was completed on time; however, PWR-related activities have continued (briefings, presentations, discussions, and requests from NOAA, SAB, and Congress) and this amendment allows the PWR Study Team to continue formally to engage in this area and communicate with the SAB.

Termination: If no further action is taken by the SAB or the PWR Study Team to either end this charge early or extend it beyond 31 December 2024, the Charge will sunset on 31 December 2024.

- b. Except as described in this Amendment, the Agreement is unaffected. If there is a conflict between this amendment and the Agreement, the terms of this amendment will prevail.

Approved by the SAB on _____ .

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Background

- The FY21 Omnibus Appropriations bill, passed in December 2020, provided language requiring the NOAA Science Advisory Board (SAB) to prepare, within one year, a report on NOAA’s Weather Research Priorities to prioritize federal weather investments over the next decade.
- Final language in FY21 Omnibus:
Report on Weather Research Priorities - In lieu of House language on a Weather Decadal, the agreement directs NOAA's Science Advisory Board to publish a report, not later than one year after enactment of this Act, that provides policymakers with the relevant information necessary to prioritize investments in

weather forecasting, modeling, data assimilation, and supercomputing over the next ten years; and that evaluates future potential Federal investments in science, satellites, radars, and other observation technologies, to include surface and boundary layer observations so that all domestic users of weather information can receive data in the most efficient and effective manner possible.

- The SAB Chair, John Kreider, formed a Priorities of Weather Research (PWR) Scoping Team consisting of key members of the SAB, members of the SAB Environmental Information Services Working Group (EISWG), and NOAA Line Office representatives. This group was tasked to prepare recommendations to define the purpose, scope, and boundaries of the PWR Report for the SAB, as well as an overall framework for the report and criteria for an overarching investment strategy.
- The PWR Scoping Team is made up of the following members:

Organization	Name
SAB	John Kreider, Chair Everette Joseph, Member
SAB Environmental Information Services Working Group (EISWG)	Brad Colman Scott Glenn Bill Gail
NOAA	OAR – Craig McLean NWS – Louis Uccellini NWS – Steve Smith NESDIS – Mitch Goldberg OMAO – Nancy Hann
Other	Bob Winokur, SAB Emeritus

Purpose of PWR Study Team

- The purpose of the PWR Study Team is to evaluate and prioritize potential investments in a requirements-based framework to advance weather research and forecasting capabilities over the next decade.
- The PWR Study is crucial for our nation because weather, water, and climate events take a significant toll on the lives and livelihoods of millions of Americans every year. Policymakers need a long-term strategy to support and fund mission-critical investments. By critically evaluating future potential investments, the PWR Study will advance capabilities of the weather enterprise to deliver improved weather information more efficiently and effectively, leading to better decisions, fewer lives lost, and a more resilient nation.

Strategic framework for the Study

Strategic framework (Figure 1) is based on three principal pillars of the weather enterprise and underlying foundational elements. The three pillars are: (1) Observations & Data Assimilation; (2) Forecasting; and (3) Information Delivery. Science, Computing, Weather Enterprise, and Workforce Development are essential Foundational Elements for all three pillars.

- Observations & Data Assimilation include both experimental and sustained operational capabilities. A wide range of public and private observations is required to support forecasting, meet research needs, and advance science and technology. Data Assimilation is a vital element necessary to ensure the maximum impact from observations on improving forecasts is realized, and provides feedback in observing system design. A growing array of technologies for platforms, sensors, and data management is available: satellites, radars, aircraft and ships, Uncrewed aerial, ocean surface and subsurface Systems (UxS), buoys, floats and drifters, *in-situ* sensors, and associated technologies to enhance observation and data analysis.
- Forecasting includes development and operations of the Unified Forecast System (UFS) to cover both operational and research needs. Coupled earth system models and ensembles are critical components of this framework. This pillar also includes both re-analysis and re-forecasts as they are required for effective post processing in support of longer term forecast products (subseasonal to seasonal, S2S), to contribute to model validation and development, and to help document the long-term climate record.
- Information Delivery is the interactive process for efficient and effective delivery of the data and guidance products, as well as forecasts and warnings, through frameworks that include the existing NWS programs Forecasting a Continuum of Environmental Threats (FACETS) and Impact-Based Decision Support Services (IDSS), and also includes the infrastructure necessary to make the required information available and accessible.

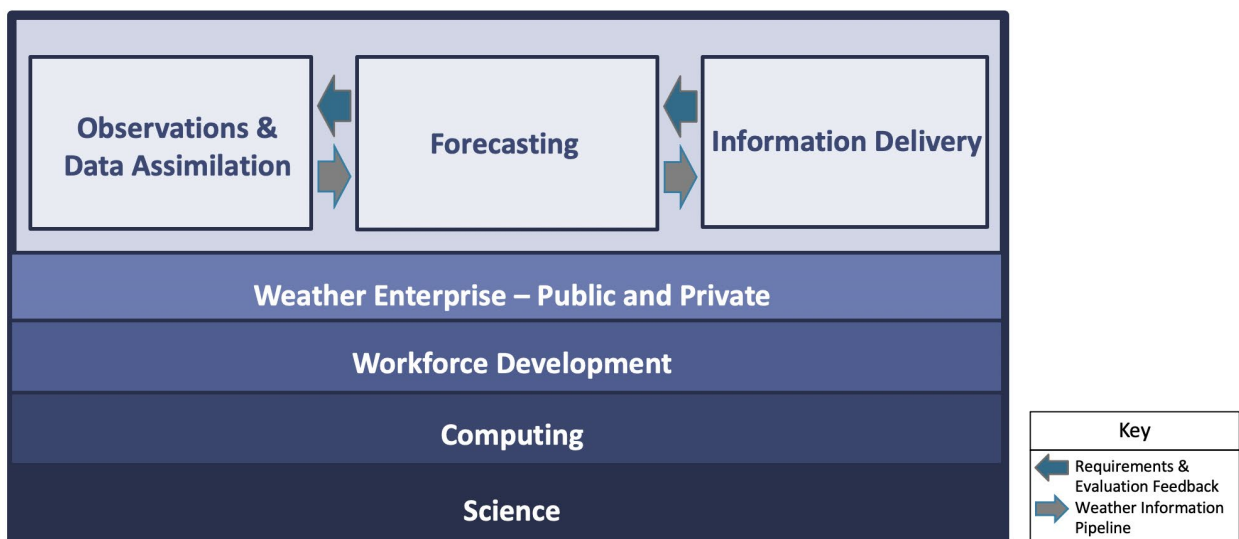


Figure 1. Priorities for Weather Research (PWR) Investments.
A Strategic Framework: Three Pillars & Foundational Elements

The arrows in Figure 1 are critical. The right-to-left arrows indicate the driving influence that critical requirements and assessments of pipeline components have on the process. The resulting product flow is left to right. This feedback loop is crucial to maintain mission focus and ensure system improvements.

The four Foundational Elements at the bottom of Figure 1 provide the essential underpinning for the three pillars:

- Weather Enterprise emphasizes that no single organization can do everything and succeed on its own. Multiple government agencies, the private sector, and academia all have roles to play. Collaboration and Public Private Partnerships (PPP) are essential for overall success. Collaboration and partnerships do not just happen on their own and deserve significant investment of time and resources to ensure success.
- Workforce Development emphasizes the critical importance of people. Investment in training and education, both initially and ongoing, is essential to maintain a competent, diversified workforce, particularly given the rapid pace of change in today's technology. Looking ahead to the next generation of weather scientists and forecasters, and engaging them early as students, is imperative.
- Computing is necessary for all three pillars. It includes consideration of high performance computing (HPC), application of cloud computing, and cyber infrastructure and security.
- Science includes improved understanding of: earth system science that influences the models and the observations; human, social and behavioral sciences that influence how products are developed and delivered; and the research for all potential transitions and feedback loops (research to operations/applications to research, R2X2R) that ensures new science is efficiently made available for sustained operational activities.

Scope, Objectives, and Boundaries of the PWR Study

- Study Scope and Process
 - Collect background information and existing studies and plans
 - Establish and describe criteria to be used in the PWR study process
 - Evaluate and prioritize potential weather research and forecasting investments to meet the charge given in the FY21 Omnibus Appropriations Act
 - Recommend what additional information and analyses NOAA could provide to Congress to help support its requests for necessary investments
- Boundaries
 - Focus is on weather time scales defined in the Weather Research and Forecasting Innovation Act as ranging between nowcasting (minutes) and seasonal (2 years)

- Focus is on federal investments in NOAA, with an awareness of what other federal agencies, private sector, and academia, can provide to advance the research and forecasting priorities
- The Study Team will focus on evaluating and prioritizing potential investments; primarily focused on future and planned investments but may also comment on existing investments in the context of the study scope.
- The Study Team will not develop independent requirements or cost estimates. However, it may comment on requirements or cost estimates from other studies, and it may also recommend, as appropriate, that NOAA develop requirements or funding plans for potential investments.
- Due to broad study breadth and limited time for completion, the study will focus on high level aspects and will not perform detailed analyses into specific aspects of any study component.

Study Team Structure and Support

The PWR Study Team structure includes the following teams (see Figure 2):

- ***SAB PWR Steering Team***

Purpose – supports the PWR Study Team. Support includes ensuring effective bi-directional communication with the Executive Study Team, monitoring progress, oversight, and communication with NOAA leadership as required.

Membership – 1 to 3 SAB members, including Chair of SAB

- ***PWR Executive Study Team***

Purpose – leads overall study effort. The Executive Study Team will select and coordinate three Task Teams, arrange support as required, ensure effective communication and coordination across Task Teams, monitor progress, and provide oversight. This Team will also lead the final integration effort and ensure all four Foundational Elements have been considered to the desired extent.

Membership – 6 to 8 members, with representatives from the broad weather enterprise. Dr. Brad Colman and Dr. Scott Glenn, co-Chairs of the EISWG, will serve as co-leads, and Bill Gail will serve as Senior Advisor to the Study Team. Task team leads will sit on the Executive Study Team. Dr. Colman and Dr. Glenn have authority to select members of the Executive Study Team.

- ***PWR Task Teams***

Purpose – pursue parallel efforts to gather and analyze information for each of the three pillars: Observations & Data Assimilation, Forecasting, and Information Delivery. Each Task Team will also take into account the roles of the four Foundational Elements (Weather Enterprise, Workforce Development, Computing, and Science) in developing priorities for their respective pillars.

Membership – the PWR Executive Study Team will select leaders of all three Task Teams. The Task Team Leaders, in conjunction with the Executive PWR Study Team, will select the appropriate number of members, representing all elements of the weather enterprise.

- ***PWR NOAA Support Team***

Purpose – support PWR Study Teams by providing, in a timely manner, information that enables the Study Teams to effectively and efficiently perform the study through a collaborative reach-back process with the rest of the NOAA organization, including designating small NOAA support teams, as appropriate. Such information includes, but is not limited to, suggesting and providing existing reports, responding to Study Team inquiries by providing NOAA Subject Matter Experts (SMEs) to respond directly and/or performing analyses and research, and providing points of contacts in other, non-NOAA organizations for requested information. The NOAA Support Team will also initially provide an overarching 10-Year View to supplement and help integrate existing NOAA strategies into an efficient starting point for the study.

Membership – one senior manager from each NOAA Line Office. Leader to be determined by NOAA leadership. One person to be identified as primary Point of Contact between the Executive PWR Study Team and the NOAA PWR Support Team.

PWR Study Team Organization

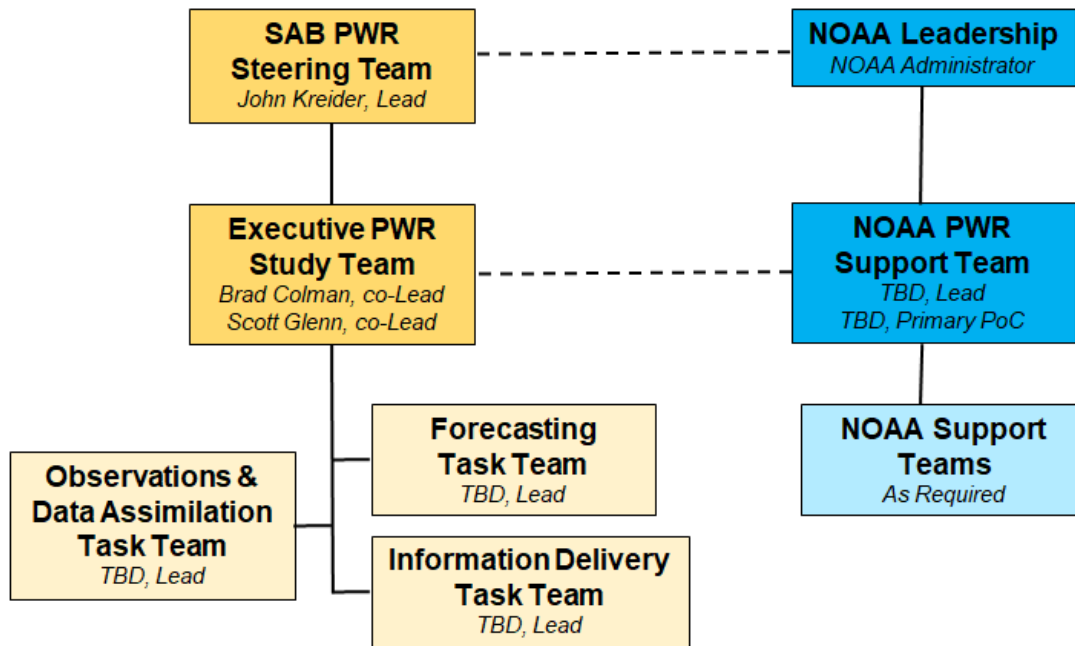


Figure 2 – PWR Study Team Organization

The overall study strategy is illustrated in Figure 3. Due to limited time to perform the study, Task Teams will proceed in parallel to gather information, engage SMEs, analyze information, and develop conclusions and recommendations. An important initial role of the Executive Study Team is to set the stage of mission-driven investments and coordinate work of the Task Teams. Conclusions and recommendations of the three Task Teams will then be integrated for overall conclusions and recommendations of the Study Team.

The four Foundational Elements are all of cardinal importance to the three pillars. Partnerships across the Weather Enterprise are critical. Workforce Development and Computing resources are essential for success and require serious consideration to ensure optimal decisions, which frequently have long-term impact. Finally, Science, including, among others, physical, computer and data, and social, is the fundamental underpinning for future advancement of weather forecasting.

PWR Study Team Parallel Information Gathering Pipeline

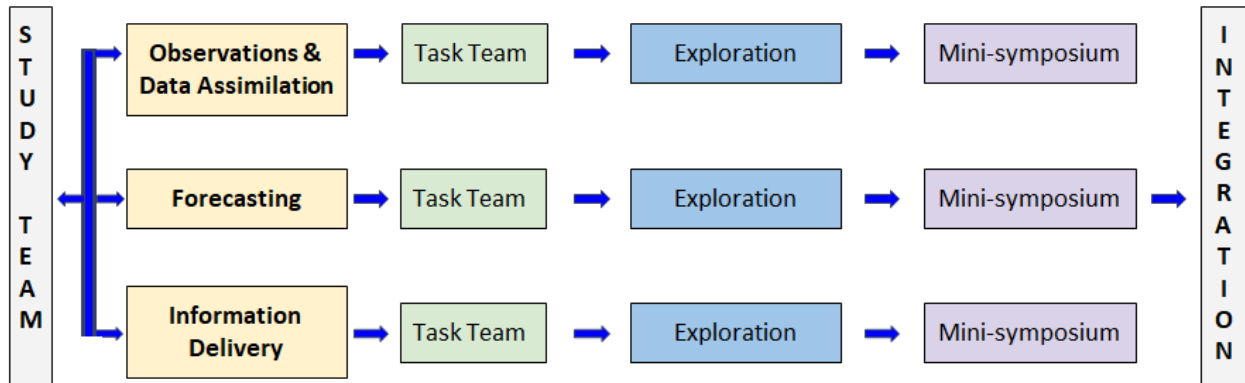


Figure 3 – PWR Study Team Parallel Information Gathering Pipeline

Responsibilities, approach, and process to complete the Study

The PWR Study Team: The Study Team will be responsible for ensuring the PWR report is completed on time and delivered to the SAB. The report will summarize the study group’s evaluation and prioritization of future potential investments that advance mission-critical capabilities, and their recommendations for next steps.

Study Team Responsibilities:

- Finalize overall study scope and process
 - Finalize Team charge and obtain SAB approval
 - Refine the Scoping Team’s strategic framework
 - Finalize overall process, recognizing it is subject to adjustments as needed and when approved by the Steering Team and/or the Executive Study Team
 - Identify scope and number of Task Teams
 - Develop criteria: An initial and critical task of the PWR Study Team will be to formulate a set of criteria that will be applied across Task Team efforts and ultimately guide the overall findings and recommendations of the study. These criteria should:

- support Congressional interest in advancing NOAA’s ability to achieve its weather mission, particularly addressing the increasing frequency and impact of severe weather events
 - adapt a requirements-based framework as applicable
 - reflect the process the SAB uses to select Priority Study Topics
 - inform an overarching investment strategy with a balanced approach to identifying probability of success and reward for investments
 - recognize “investments” include: (1) capitalization/re-capitalization of assets; (2) federal and private infrastructure; (3) service and process improvements; and (4) people (training, education, next generation)
 - recognize physical environment, resulting requirements, and government priorities will change over the next decade, so: (1) recommended strategy should be robust and adaptable with provision for future updates; and (2) primary emphasis should be on investments to be made in the FY23 - FY28 timeframe
- Form Task Teams that will:
 - Identify, aided by the NOAA Support Team, relevant existing NOAA strategic plans, reports, recorded presentations, etc., that describe core NOAA requirements, priorities and potential future directions; then use this material to formulate a baseline scoping of the Team’s core topic
 - Work from this baseline information to identify gaps in both scope and timeliness of material that need to be filled to establish overall priorities in this core topic
 - Identify SMEs for Task Team’s core topic; SMEs may be from any SAB WG, sector (Public, Academic, Private), etc., and have cross-cut targeted expertise
 - Organize a mini-symposium for the team’s core topic that leverages SME presentations and discussion:
 - topics should define and address: core requirements, gaps, opportunities, workforce development needs, and resourcing
 - highlight cross-Federal and key academic/private R2X
 - Participants in the mini-symposium would include SMEs, Task Team members, other Task Team leads, SAB Executive Steering Committee, NOAA liaison from the NOAA Support Team
 - Prepare a mini-symposium summary that:
 - identifies core-topic efforts that address core requirements and are critical to future growth and advancement of weather services
 - provides case studies of successful efforts and documents best practices
 - calls out examples of major impediments and recommends actions NOAA can take to reduce the impact of such impediments

- evaluates and provides strategies to engage the private and academic sectors to stimulate innovation, accelerate advancement, and enhance workforce development
 - evaluates which potential investments are best made by NOAA, which are best made by other organizations (other federal agencies, private sector, academia), and explain why
 - identifies key partnerships, both interagency and Public Private Partnerships (PPPs), which are critical for advancing effectiveness and efficiency of weather enterprise as a whole
 - Evaluates NOAA resources in the context of the team’s prioritization and recommended NOAA actions
 - Provides recommendations on investment priorities
- The Executive PWR Study Team prepares draft PWR report that will:
 - integrate individual task team contributions
 - ensure parallel construction, equivalent level of detail across the three pillars and appropriate links to the foundational elements
 - compile combined summary of priorities and value impacts
 - identify and highlight core-topic area content to highlight in the Executive Summary (ensure balanced cross-cut across pillars)
 - provide selected examples of cost benefit analysis or Return on Invested Capital (ROIC) to demonstrate value of high priority investments
 - comment on year-over-year funding profile, including consideration of lifecycle costs where appropriate and possible

Initial study milestones and timelines

Below is an initial draft of the study milestones and timeline, subject to change by the Steering and/or Executive Study Team as necessary. The timeline is tight and is dependent on multiple efforts including the information gathering phase, the success of the mini-symposia, and the overall report writing process, all of which require significant volunteer efforts and support from NOAA.

- March - SAB discussion and approval of the proposed plan. Spin-up meetings, identify topic areas based on Strategic Framework pillars, formation of teams, and approval; fill out team memberships and hold kick off meetings.
- April - Task Teams, in coordination with the NOAA support team, identify relevant existing NOAA strategic plans, reports, etc. Executive Study Team develops criteria and initial report outline, and communicates results with the Steering Team and NOAA Support Team.
- May - Task Teams complete gap analysis and focus areas; identify SMEs based upon findings. Executive Study Team refines criteria and outline based on feedback

- June - Task Teams hold mini-symposia and prepare mini-symposia summaries.
- July - Executive Study Team extends report outline with more detailed bullets as they develop from mini-symposia.
- August - Present mini-symposia summaries and extended report outline to the SAB at its Summer meeting - answer questions, course corrections, as needed
- August - complete first draft report and distribute for review
- September - receive an initial round of comments and respond
- October - complete second draft report and submit to SAB (~one month before Fall SAB meeting)
- November - Study Team addresses all additional SAB/NOAA Liaison comments
- December - Single-topic SAB meeting. Discussion of final report; review/ approval by the SAB.
- December - Submission of final report by SAB to Congress