

Calendar No. 211

117TH CONGRESS }
2d Session }

SENATE

{ REPORT
{ 117-160

LEARNING EXCELLENCE AND GOOD EXAM-
PLES FROM NEW DEVELOPERS ACT OF
2021

R E P O R T

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND
TRANSPORTATION

ON

S. 1127



SEPTEMBER 22, 2022.—Ordered to be printed

U.S. GOVERNMENT PUBLISHING OFFICE

29-010

WASHINGTON : 2022

SENATE COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION

ONE HUNDRED SEVENTEENTH CONGRESS

SECOND SESSION

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LEARNING EXCELLENCE AND GOOD EXAMPLES FROM NEW DEVELOPERS ACT OF 2021

SEPTEMBER 22, 2022.—Ordered to be printed

Ms. CANTWELL, from the Committee on Commerce, Science, and
Transportation, submitted the following

R E P O R T

[To accompany S. 1127]

[Including cost estimate of the Congressional Budget Office]

The Committee on Commerce, Science, and Transportation, to which was referred the bill (S. 1127) to require the National Oceanic and Atmospheric Administration to make certain operational models available to the public, and for other purposes, having considered the same, reports favorably thereon without amendment and recommends that the bill do pass.

PURPOSE OF THE BILL

The purpose of S. 1127, the Learning Excellence and Good Examples from New Developers Act of 2021, is to require the National Oceanic and Atmospheric Administration (NOAA) to make certain operational models available to the public to allow collaboration with private sector scientists and academia to improve forecasting model innovation.

BACKGROUND AND NEEDS

The National Weather Service (NWS) leads NOAA's operational weather forecasting efforts through its mission to provide weather, water, and climate data, forecasts, warnings, and impact-based decision support services for the protection of life and property and enhancement of the national economy.¹ Enhancing forecasting accuracy not only helps protect life, but also property from severe

¹ National Weather Service, "About the NWS" (<https://www.weather.gov/about/>).

weather conditions. The economic cost of weather- and climate-related disasters has an enormous negative toll on American communities, and the most costly disasters are becoming more frequent.² In 2021, during the western drought and heatwave, Portland reached a high of 116 Fahrenheit degrees while Seattle reached 108 Fahrenheit degrees.³ This heatwave caused nearly 200 deaths in Washington and Oregon⁴ and massive shellfish die-offs.⁵ From the agricultural impacts to infrastructure damage, businesses and families face substantial financial gain or loss depending on annual weather trends and longer term climate trends. Experts estimate that between 3 and 6 percent of the annual variability in U.S. gross domestic product is attributable to weather.⁶

Congress has long supported Federal efforts to provide accurate forecasts to strengthen the national economy and provide strong decision making support to farmers, ranchers, water managers, and small businesses. To move closer to this goal, several laws have been enacted over the last few years focused on building stronger partnerships between government agencies and the private sector to improve the weather forecasting skill of the United States.

On April 18, 2017, the Weather Research and Forecasting Innovation Act of 2017 (Weather Act) was signed into law to improve NOAA's weather forecasting skill through investment in observational, computing, and modeling capabilities.⁷ The bill included a requirement for NOAA's Office of Oceanic and Atmospheric Research to carry out a Weather Research and Forecasting Innovation program, including a technology transfer initiative in coordination with NWS, the academic sector, and private weather companies. Additionally, the bill further allowed for the Secretary of Commerce, and by extension, NOAA, to contract with commercial providers to purchase weather data or to place weather satellite instruments on cohosted payloads.

On January 7, 2019, the National Integrated Drought Information System (NIDIS) Reauthorization Act of 2018 was signed into law to reauthorize the NIDIS program through 2023.⁸ The bill amended the Weather Research and Forecasting Innovation program authorized in 2017 to include authorization for the Earth Prediction Innovation Center (EPIC). EPIC is intended to advance weather modeling and improve the translation of forecasting research into operational models by leveraging private sector innovations, increasing collaboration between governmental and non-governmental scientists and engineers, strengthening and

²National Centers for Environmental Information, "Billion-Dollar Weather and Climate Disasters: Overview" (<https://www.ncdc.noaa.gov/billions/>). See also, Adam B. Smith, "2018's Billion Dollar Disaster in Context," February 7, 2019 (<https://www.climate.gov/news-features/blogs/beyond-data/2018s-billion-dollar-disasters-context>).

³National Centers for Environmental Information, "Billion-Dollar Weather and Climate Disasters," 2021 (<https://www.ncdc.noaa.gov/billions/events/NWCR/1980-2021>).

⁴Victoria Bekiempis, "Record-breaking US Pacific North-west Heatwave Killed Almost 200 People," *The Guardian*, July 8, 2021 (<https://www.theguardian.com/us-news/2021/jul/08/pacific-northwest-heatwave-deaths>).

⁵Ronald Brownstein, "The Unbearable Summer," *The Atlantic*, August 26, 2021 (<https://www.theatlantic.com/politics/archive/2021/08/summer-2021-climate-change-records/619887/>).

⁶National Weather Service, *National Weather Service Enterprise Analysis Report*, June 8, 2017, p. 7 (https://www.weather.gov/media/about/Final_NWS%20Enterprise%20Analysis%20Report_June%202017.pdf).

⁷Public Law 115-25.

⁸Public Law 115-256.

leveraging internal NOAA resources, and creating a community-based global research modeling system.

The EPIC initiative is intended to increase usability by the public and networks outside of NOAA, and is hosted by a cost-effective technology like cloud computing. These changes will make the current operational models more nimble and effective, and have the potential to greatly advance NOAA's forecasting skill.

The LEGEND Act intends to clarify and strengthen these efforts by requiring that operational weather models be made available to the public, while including permissive authority for NOAA to make experimental models available. The LEGEND Act also would specifically authorize the Administrator to withhold from publication any models or data necessary to protect national security interests.

SUMMARY OF PROVISIONS

If enacted, S. 1127 would do the following:

- Require NOAA to develop and implement a plan to make public the code and other data used in operational Earth system's models.
- Provide the NOAA Administrator authority to enter into agreements and contracts with other Federal agencies and private vendors, and secure necessary infrastructure to support public access to the data and models.
- Amend the Weather Act⁹ with a technical correction.
- Require a report to Congress not later than 2 years after the date of enactment on the implementation of how operational models have been made publicly available.
- Authorize \$2 million annually for each of fiscal years 2022 through 2026.

LEGISLATIVE HISTORY

S. 1127, the LEGEND Act of 2021, was introduced on April 14, 2021, by Senator Thune (for himself and Senator Schatz) and was referred to the Committee on Commerce, Science, and Transportation of the Senate. On November 17, 2021, the Committee met in open Executive Session and, by voice vote, ordered S. 1127 reported favorably without amendment. On December 17, 2021, the bill was reported without amendment and placed on the Senate Legislative Calendar.

In the 116th Congress, an earlier version of this bill, S. 2597, the LEGEND Act of 2020, was introduced on October 15, 2019, by Senator Thune (for himself and Senator Schatz) and was referred to the Committee on Commerce, Science, and Transportation of the Senate. On November 13, 2019, the Committee met in open Executive Session and, by voice vote, ordered S. 2597 reported favorably with an amendment. On December 14, 2020, S. 2597 passed the Senate with an amendment (in the nature of a substitute) by unanimous consent.

ESTIMATED COSTS

In accordance with paragraph 11(a) of rule XXVI of the Standing Rules of the Senate and section 403 of the Congressional Budget

⁹Public Law 115–25.

Act of 1974, the Committee provides the following cost estimate, prepared by the Congressional Budget Office:

U.S. CONGRESS,
CONGRESSIONAL BUDGET OFFICE,
Washington, DC, September 14, 2022.

Hon. MARIA CANTWELL,
*Chair, Committee on Commerce, Science, and Transportation,
U.S. Senate, Washington, DC.*

DEAR MADAM CHAIR: The Congressional Budget Office has prepared the enclosed cost estimate for S. 1127, the LEGEND Act of 2021.

If you wish further details on this estimate, we will be pleased to provide them. The CBO staff contact is Robert Reese.

Sincerely,

PHILLIP L. SWAGEL,
Director.

Enclosure.

S. 1127, LEGEND Act of 2021			
As reported by the Senate Committee on Commerce, Science, and Transportation on December 17, 2021			
By Fiscal Year, Millions of Dollars	2022	2022-2027	2022-2032
Direct Spending (Outlays)	0	0	0
Revenues	0	0	0
Increase or Decrease (-) in the Deficit	0	0	0
Spending Subject to Appropriation (Outlays)	0	102	not estimated
Statutory pay-as-you-go procedures apply?	No	Mandate Effects	
Increases on-budget deficits in any of the four consecutive 10-year periods beginning in 2033?	No	Contains intergovernmental mandate?	No
		Contains private-sector mandate?	No

S. 1127 would direct the National Oceanic and Atmospheric Administration (NOAA) to publish its weather-forecasting models and associated government-owned data in an open-source format on the Internet. The bill would authorize NOAA to establish a program to plan, procure, and support the necessary infrastructure for the publicly accessible models. The bill also would require NOAA to periodically review any improvements made to those open-source models by people outside the government and update its models accordingly. Finally, NOAA would need to report to the Congress on the bill's implementation.

Under current law, NOAA provides public access to some of its operational and research models. The agency would need additional resources to provide access to permanent archives and open-source data for all such models, which currently use many petabytes of data (a petabyte is one million gigabytes).

The bill would authorize the appropriation of \$2 million a year over the 2022–2026 period. Using information from NOAA about the number of models and related data that would need to be made

public under the bill and the cost to convert those data into an open-source format, CBO expects that it would cost significantly more than \$10 million to implement the bill.

CBO estimates NOAA would require \$111 million over the 2022–2027 period to hire 45 additional employees and acquire additional equipment and services, including substantial increases in server capacity and other data storage tools. Using historical spending patterns for similar activities, CBO estimates implementing S. 1127 would cost \$102 million over the 2022–2027 period, assuming appropriation of the authorized and estimated amounts. CBO expects that NOAA would be unable to fully comply with the requirements of S. 1127 if only the \$10 million authorized to be appropriated in the bill was provided to the agency. The costs of the legislation, detailed in Table 1, fall within budget function 300 (natural resources and environment).

TABLE 1.—ESTIMATED INCREASES IN SPENDING SUBJECT TO APPROPRIATION UNDER S. 1127

	By fiscal year, millions of dollars—						
	2022	2023	2024	2025	2026	2027	2022–2027
Estimated Authorizations	2	16	29	31	33	0	111
Estimated Outlays	0	6	18	26	31	21	102

The bill would specifically authorize the appropriation of \$2 million annually over the 2022–2026 period for the National Oceanic and Atmospheric Administration (NOAA) to carry out the bill's requirements. Using information from the agency, CBO estimates that an additional \$101 million would be required over that same period for NOAA to fully implement those requirements. The amounts in this table reflect the levels CBO estimates would be necessary to fully implement the requirements of S. 1127.

The CBO staff contact for this estimate is Robert Reese. The estimate was reviewed by H. Samuel Papenfuss, Deputy Director of Budget Analysis.

REGULATORY IMPACT STATEMENT

In accordance with paragraph 11(b) of rule XXVI of the Standing Rules of the Senate, the Committee provides the following evaluation of the regulatory impact of the legislation, as reported:

NUMBER OF PERSONS COVERED

S. 1127 would not create any new programs or impose any new regulatory requirements and would not subject any individuals or businesses to new regulations.

ECONOMIC IMPACT

S. 1127 is not expected to have a negative impact on the Nation's economy.

PRIVACY

S. 1127 would not affect the personal privacy of individuals.

PAPERWORK

S. 1127 would require a report on implementation from NOAA.

CONGRESSIONALLY DIRECTED SPENDING

In compliance with paragraph 4(b) of rule XLIV of the Standing Rules of the Senate, the Committee provides that no provisions

contained in the bill, as reported, meet the definition of congressionally directed spending items under the rule.

SECTION-BY-SECTION ANALYSIS

Section 1. Short title

This section would provide that the bill may be cited as the “Learning Excellence and Good Examples from New Developers Act of 2021” or the “LEGEND Act of 2021”.

Section 2. Definitions

This section would provide definitions for the following terms: “Administration”, “Administrator”, “Earth Prediction Innovation Center”, “model”, “operational model”, and “suitable model”.

Section 3. Purposes

This section would determine the purposes of this Act are to support modeling innovation by providing interested stakeholders access to the models and data used by NOAA and to encourage NOAA to evaluate and use the resulting innovations as appropriate to improve such modeling.

Section 4. Plan and implementation of plan to make certain models and data available to the public

This section would require NOAA to make any current and future operational models developed by the Administration open source for use by the relevant stakeholders. It would also authorize the agency to determine which, if any, experimental models should be made available to the public as open source code.

This section would ensure that models made publicly available would not jeopardize national security.

This section would also allow the Administrator to determine whether and how to use government servers or private vendor contracts in carrying out efforts to release modeling source code. Further, this section would require the NOAA Administrator to plan and establish a program to support the model sharing infrastructure.

Section 5. Requirement to review models and leverage innovations

This section would require the Earth Prediction Innovation Center (EPIC) to periodically review the private sector’s innovations and improvements to the operational models, and develop and implement a plan to use such innovations to improve the models.

Section 6. Report on implementation

This section would require NOAA to submit a report on the implementation of this bill no later than 2 years after the date of the enactment of this act to the Senate Committee on Commerce, Science, and Transportation, the Senate Committee on Appropriations, the House Committee on Science, Space, and Technology, and the House Committee on Appropriations.

Section 7. Protection of national security interests

This section would give the Administrator the authority to withhold data or models used in operational weather forecasting if the

Administrator determines that doing so would be necessary to protect national security interests.

Section 8. Authorization of appropriations

This section would authorize \$2 million to be appropriated annually to NOAA to carry out the Act for each of fiscal years 2022 through 2026.

CHANGES IN EXISTING LAW

In compliance with paragraph 12 of rule XXVI of the Standing Rules of the Senate, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new material is printed in *italic*, existing law in which no change is proposed is shown in roman):

**WEATHER RESEARCH FORECASTING
AND INNOVATION ACT OF 2017**

* * * * *

[15 U.S.C. 8512(b)]

SEC. 102. WEATHER RESEARCH AND FORECASTING INNOVATION.

(a) PROGRAM.—The Assistant Administrator for the Office of Oceanic and Atmospheric Research shall conduct a program to develop improved understanding of and forecast capabilities for atmospheric events and their impacts, placing priority on developing more accurate, timely, and effective warnings and forecasts of high impact weather events that endanger life and property.

(b) PROGRAM ELEMENTS.—The program described in subsection (a) shall focus on the following activities:

(1) Improving the fundamental understanding of weather consistent with section 101, including the boundary layer and other processes affecting high impact weather events.

(2) Improving the understanding of how the public receives, interprets, and responds to warnings and forecasts of high impact weather events that endanger life and property.

(3) Research and development, and transfer of knowledge, technologies, and applications to the National Weather Service and other appropriate agencies and entities, including the United States weather industry and academic partners, related to—

(A) advanced radar, radar networking technologies, and other ground-based technologies, including those emphasizing rapid, fine-scale sensing of the boundary layer and lower troposphere, and the use of innovative, dual-polarization, phased-array technologies;

(B) aerial weather observing systems;

(C) high performance computing and information technology and wireless communication networks;

(D) advanced numerical weather prediction systems and forecasting tools and techniques that improve the forecasting of timing, track, intensity, and severity of high impact weather, including through—

(i) the development of more effective mesoscale models;

(ii) more effective use of existing, and the development of new, regional and national cloud-resolving models;

(iii) enhanced global weather models; and

(iv) integrated assessment models;

(E) quantitative assessment tools for measuring the impact and value of data and observing systems, including Observing System Simulation Experiments (as described in section 107), Observing System Experiments, and Analyses of Alternatives;

(F) atmospheric chemistry and interactions essential to accurately characterizing atmospheric composition and predicting meteorological processes, including cloud microphysical, precipitation, and atmospheric electrification processes, to more effectively understand their role in severe weather; and

(G) additional sources of weather data and information, including commercial observing systems.

(4) A technology transfer initiative, carried out jointly and in coordination with the Director of the National Weather Service, and in cooperation with the United States weather industry and academic partners, to ensure continuous development and transition of the latest scientific and technological advances into operations of the National Weather Service and to establish a process to sunset outdated and expensive operational methods and tools to enable cost-effective transfer of new methods and tools into operations.

【(4)】 (5) Advancing weather modeling skill, reclaiming and maintaining international leadership in the area of numerical weather prediction, and improving the transition of research into operations by—

(A) leveraging the weather enterprise to provide expertise on removing barriers to improving numerical weather prediction;

(B) enabling scientists and engineers to effectively collaborate in areas important for improving operational global numerical weather prediction skill, including model development, data assimilation techniques, systems architecture integration, and computational efficiencies;

(C) strengthening the National Oceanic and Atmospheric Administration's ability to undertake research projects in pursuit of substantial advancements in weather forecast skill;

(D) utilizing and leverage existing resources across the National Oceanic and Atmospheric Administration enterprise; and

(E) creating a community global weather research modeling system that—

(i) is accessible by the public;

(ii) meets basic end-user requirements for running on public computers and networks located outside of secure National Oceanic and Atmospheric Administration information and technology systems; and

(iii) utilizes, whenever appropriate and cost-effective, innovative strategies and methods, including cloud-based computing capabilities, for hosting and management of part or all of the system described in this subsection.

(c) * * *
* * * * *

