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State of the States Landscape Report:

STATE-LEVEL POLICIES SUPPORTING EQUITABLE K-12 COMPUTER SCIENCE EDUCATION

MassCAN Massachusetts Computing Attainment Network

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ECEP Expanding Computing Education Pathways

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March 1, 2017

Dear Reader,

At BNY Mellon, we want to increase the strength and success of the communities in which our employees work and live around the world. Our firm's investments in these communities, and our commitment to their well-being, forms the core of who we are and how we do business. Our global corporate philanthropy program drives positive change through philanthropic donations and social investments, and we empower our employees to use their skills and resources to make a difference.

One of BNY Mellon's top-priority social investments—and a key strategy in advancing our goals to foster economic empowerment and to build technology/digital capabilities—is our work to promote pathways to technology careers for youth through education, training, skills building, internships, and mentoring. Today's young people are tomorrow's technology innovators. Through BNY Mellon's investments in workforce development programs and educational institutions, we are building a diverse talent pipeline, demystifying the role of technology in financial services, and ensuring that all youth have the next generation business and technology skills they need to contribute to society in a digital world.

As part of these efforts, BNY Mellon is delighted to provide a Sponsorship to EDC/MassCAN to convene a team of national expert partners to write the "State of the States Landscape Report: State-Level Policies Supporting Equitable K–12 Computer Science Education." Like this report's co-authors, we are aware of the extraordinary interest in K–12 computer science (CS) education that is emerging nationwide. By capturing states' progress in developing and implementing a wide range of K–12 CS education policies, we believe that this report can play a powerful role in guiding enhancements to CS education nationwide that will benefit young people and, in the long run, improve their financial well-being. It is a critical moment to pause, take stock of the CS education work that is underway, identify states' challenges and successes, and chart a clear course to move forward.

We look forward to joining you and the report's co-authors for the release of the report on April 3, 2017, at the Building State Capacity for Leadership in K–12 CS Education National Workshop organized by EDC/MassCAN and hosted by Google at its Cambridge Campus.

Best regards,

Jyoti Chopra

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Managing Director, Head of Global Citizenship and Sustainability
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State of the States Landscape Report: State-Level Policies Supporting Equitable K–12 Computer Science Education

This report was prepared collaboratively by a team of authors representing Code.org, Education Commission of the States (ECS), Education Development Center, Inc. and the Massachusetts Computer Attainment Network (EDC/MassCAN), Expanding Computing Education Pathways (ECEP), and SageFox Consulting Group. The two lead authors are listed first; all other authors are listed alphabetically.

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An electronic version of this report is available at the website of each partner organization. The electronic version includes hyperlinks to many resources; hyperlinks are indicated in the print version by underline and blue font.

Code.org: https://code.org/promote
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Executive Summary

Computer science (CS) has profoundly changed the ways that we learn, work, and play. The ubiquity of computing puts a premium on ensuring students' competencies as generators, not just users, of digital resources. Several key reasons lie behind the push to ensure that *all* of today's students develop these competencies:

- Computer knowledge and skills are increasingly being recognized as foundational for an educated citizenry.
- CS is a central component of innovation, economic growth, and employment.
- The current homogeneity of the CS workforce constrains both opportunity and growth at the individual, state, and national levels.

State-level leaders increasingly recognize that they play an important role in supporting and sustaining equitable K–12 CS education. Grassroots CS advocates and education and business stakeholders are engaging with state leaders to develop sound plans for advancing CS education to the benefit of all students and their state's economy.

In this report, we summarize states'[1] progress in developing state-level policies that support equitable K–12 CS education for today's students, with two main goals in mind:

- To provide a resource for states to use in reflecting on their own progress toward realization of K–12 CS education for all
- To identify other states as possible resources

Policy Priorities

The body of this report focuses on progress toward 10 policy priorities widely seen as central to broadening participation in K–12 CS education. These policies were drawn from the recommendations developed by the Code.org Advocacy Coalition in the document Nine Policy Ideas to Make Computer Science Fundamental to K–12 Education. Two of these 10 priorities ground and motivate the remaining eight:

- **State Plan for K–12 Computer Science Education:** A well-articulated state plan increases the collective impact of individual policy efforts by creating a purposeful and coherent strategy for achieving goals.
- **State-Level Initiatives to Address Diversity in Computer Science Education:** Undergirding all the policy work is the goal of broadening student participation in CS education across the K–12 grade span.

These two policy priorities are discussed in narrative form, due to the current lack of reliable data for all states. For each of the remaining eight policy priorities, we provide the following information:

- A rubric that articulates criteria for achievement of this priority area
- A map indicating individual states statuses on the priority area
- Additional contextual information about states' progress in this area
- Information to support further actions toward establishing and implementing the policy: state levers, emerging best practices, and issues to be addressed

1 In this report, "states" refers to all 50 states, the District of Columbia, and the territory of Puerto Rico.

The remaining eight policy priorities are as follows.

- **Adoption of K–12 Computer Science Standards**
- **State-Level Funding for K–12 Computer Science Education**
- **State Computer Science Teacher Certification**
- **State-Approved Pre-Service Teacher Preparation Programs at Institutions of Higher Education**
- **A Dedicated State-Level Computer Science Education Position**
- **A Requirement for All High Schools to Offer Computer Science**
- **Computer Science Can Satisfy a Core High School Graduation Requirement**
- **Computer Science Can Satisfy a Core Admission Requirement at Postsecondary Institutions**

Unless otherwise specified, data were collected between 2015 and 2016 and were verified and updated in early 2017. Across indicators, there is evidence of state-level activity focusing on foundational work, with the potential to have significant impact on providing equitable CS education for all K–12 students in the near future.

Recommendations and Critical Issues Moving Forward

The report concludes by recommending four strategic approaches and three critical issues for moving forward.

Our recommendations:

- **Build a broad base of leadership and ownership among key stakeholders.** A thoughtful, sustained, and sustainable CS effort must be informed throughout the process by an inclusive coalition of dedicated stakeholders committed to developing well-informed policy and successful implementation of state-level scaling.
- **Develop short-, medium-, and long-term strategies, with a view to coherence and sustainability.** State plans must consider the short- and medium-term efforts necessary to achieve long-term goals, realizing that some strategies can be implemented in the short term while capacity for longer-term approaches is under development. Sustained political and financial commitment is critical throughout the process.
- **Use data to monitor progress, inform decision-making, and drive continuous improvement.** States will need to identify the kinds of data that will serve particular goals within the overall plan for broadening participation in K–12 CS education to include all students. Some data may already be at hand or relatively easy to obtain; other information may require new data-gathering processes and structures.
- **Use the growing talent pool of national expertise in national organizations and in leadership states.** A number of leaders in national and state organizations, state departments of education, universities, and nonprofits have worked on advancing K–12 CS education over several years and are willing to share their deep expertise. States can and should call on them to provide expertise and support for their efforts.

Critical issues moving forward:

- **Raise the bar.** As states move forward toward medium- and long-term goals, it is important to continue to raise the bar on both the scale of the effort and the quality of the CS learning opportunities available to students from kindergarten through the end of high school.

- **Commit to sufficient funding to achieve the goal.** In most states, the level of funding currently available to integrate CS into statewide K–12 education reflects an early-stage "testing the waters" approach. To achieve the goals of universal access to CS courses and to prepare a larger and more diverse group of postsecondary CS majors, a significantly greater multi-year funding commitment will be required.
- **Work toward continuous improvement.** States have embarked on an ambitious goal. Providing equitable access to high-quality CS education for all K–12 students involves sustained collaboration among multiple stakeholders, development of policies that intersect and interconnect in complex ways, and support for quality implementation of those policies at scale. As states learn from each other, the policy landscape will continue to change. It is critical to capture snapshots of the landscape on a regular basis in order to make further progress by collectively understanding the policy challenges and by identifying other states that can serve as resources and sounding boards.

Introduction

National and state leaders now recognize the importance of computer science and information technology to our state and regional economies. The knowledge and skills students learn in computer science and IT classes are essential to every industry, from manufacturing to agriculture to medicine. Computing skills are changing our students from being technology consumers to becoming creators and innovators in the global economy.

—Arkansas Governor Asa Hutchinson, in *Bridging the Computer Science Gap: Five Actions States Can Take,* Page 1, Southern Regional Education Board, 2016

Computer science (CS) has profoundly changed the ways that we learn, work, and play. It's virtually impossible to get through a day without engaging with digital technologies that were barely dreamed of 30 or 40 years ago—even infants represent a target audience for educational apps! The ubiquity of computing puts a premium on ensuring students' competencies as generators, not just users, of digital resources.

- **CS knowledge and skills are increasingly being recognized as foundational for an educated citizenry.** Given the rapid pace of innovation and technological change, every student needs a baseline of CS knowledge and skills for personal, civic, and career efficacy. While not every student will become a computer scientist or even decide to pursue a STEM career, all will benefit from learning fundamental CS concepts and practices, including both logical and abstract thinking, data analysis, creative problem solving, troubleshooting, and collaboration.[2] At present, many students lack the opportunity to develop foundational CS knowledge, particularly those who are already underrepresented in postsecondary study of CS and in computing jobs—namely, students of color, girls, low-income students, and students with disabilities.
- **CS is a central component of innovation, economic growth, and employment.** Currently, the United States is the world's innovation leader—a position that results in many economic benefits for the country as a whole, and for CS professionals in particular, whose average salary is nearly double that of all other occupations.[3] If the United States is to remain at the forefront of technological innovation and retain its status as a global economic leader, the size of the CS workforce must increase. Even now, well-paying computing jobs are going begging. Each month, the Conference Board reports more than 500,000 openings for computing jobs nationwide[4] —there are simply not enough adequately trained people to fill the current need for information security analysts, hardware engineers, software developers, computer programmers, data scientists, and other STEM professionals. States must both inspire and prepare a far greater number of students to pursue CS education and related careers.

There are simply not enough adequately trained people to fill the current need for information security analysts, hardware engineers, software developers, computer programmers, data scientists, and other STEM professionals. States must both inspire and prepare a far greater number of students to pursue CS education and related careers.

2 *K–12 Computer Science Framework.* (2016).

3 Change the Equation. (2016). STEM*stistics.*

4 Code.org/promote

- **The current homogeneity of the CS workforce constrains both opportunity and growth at the individual, state, and national levels.** The vast majority of students working in CS-related jobs are men, and most are white or Asian. In 2013, 64.2% of the CS workforce holding CS degrees were white, and another 20.9% were Asian[5] —leaving less than 20% of jobs in CS or related fields going to individuals identifying as Hispanic, African American, Native American, or other indigenous peoples. Overall, women hold only 25% of all computing jobs, and statistics for women of color are even lower.[6] The educational pipeline for individuals with disabilities is extremely narrow: Less than 3% of all undergraduates enrolled in any field of science or engineering were students with disabilities.[7]

Moving forward, we need more diverse and inclusive participation in CS, both to redress previous inequities in access to education and to reap the many proven benefits of a diverse workforce. From an individual perspective, more equitable access to CS education offers the prospect of more remunerative and rewarding employment opportunities for all. From societal and economic perspectives, we need a larger CS workforce just to sustain, let alone grow, the technological sectors of our economy. Even more importantly, broadening participation in CS results in a larger and more diverse talent pool, which will drive both economic and social innovation. The work of computer scientists is central to addressing many of the complex issues facing our world today—issues that require as many different perspectives and creative problem-solving abilities as possible. The more diverse our workforce, the greater the chances of finding promising solutions.

Gone are the days when CS was considered an enrichment opportunity only for highly resourced or especially motivated students. Until the 1960s, computers were beyond the reach of most people and institutions. Since then, organizations and individuals have worked tirelessly to realize the vision of CS for all. From early work exploring how computers could be used to enhance existing approaches to teaching and learning to the development of student-centered tools (such as LOGO) for developing computer literacy, CS education has transitioned from an emphasis

WHAT IS COMPUTER SCIENCE?

As citizens of the 21st century, students are expected to learn to use digital devices such as computers to assist in gathering, organizing, and analyzing information—skills that are often described in terms *of digital literacy*. Many students, parents, and teachers confuse the skills related to digital literacy with those related to CS.[*] CS is its own subject area, with deep roots in mathematics and engineering. It focuses on both theoretical and applied approaches to the *creation* of computational processing. Computer scientists work on the design and development of both hardware and software, applying computing principles to a variety of fields.

* Google, Inc., & Gallup, Inc. (2016). Trends in the state of computer science in U.S. K–12 schools.; K–12 Computer Science Framework. (2016).

5 National Science Board. (2016). *Science and Engineering Indicators* (pp. 3–39).

6 Ashcraft, C., McLain, B., & Eger, E. (2016). *Women in tech: The facts.* NCWIT & Workforce Alliance.

7 National Science Foundation, National Center for Science and Engineering Statistics. (2017). *Women, minorities, and persons with disabilities in science and engineering.*

on technical literacy to fluency in information technology and to computational thinking.[8] Over the last decade, high-quality CS activities, resources, and courses designed to engage a broad range of students increasingly became available in both formal and informal settings. Support from federal agencies, such as the National Science Foundation's Broadening Participation in Computing Alliance Program, helped a large number of local and national efforts develop curricula, tools, and teacher professional development. Beginning in the mid-1980s, the Association for Computing Machinery (ACM) took a series of steps to address K–12 CS, establishing a K–12 task force, proposing a model curriculum, and forming an Education Policy Council. ACM also founded the Computer Science Teachers Association (CSTA) and created the non-partisan Computing in the Core coalition (a precursor of the current Code.org Advocacy Coalition) to advocate for elevating CS to a core subject area in K–12 education. CSTA and the Computing in the Core/Code.org Advocacy Coalition in particular have greatly influenced policy advocacy and education reform at the state level.

State-level leaders increasingly recognize that they can play an important and unique role in supporting, scaling, and sustaining equitable K–12 CS education. Local programmatic efforts, while critically important, will not scale without a broader, comprehensive policy framework to guide them or the resources that states can bring to bear on supporting and sustaining policy implementation over the long term.

These decades of creative and groundbreaking work have brought us to the point where the goal of equitable K–12 CS education can be embraced at the level of state policy. State-level leaders increasingly recognize that they can play an important and unique role in supporting, scaling, and sustaining equitable K–12 CS education. Local programmatic efforts, while critically important, will not scale without a broader, comprehensive policy framework to guide them or the resources that states can bring to bear on supporting and sustaining policy implementation over the long term.

Five years ago, only a handful of groups were working systematically to affect state-level policy change related to equitable CS education across the entire K–12 grade span. The rapid growth in state-level policy initiatives since then makes this an auspicious time for a snapshot of progress across the whole country. The snapshot we offer in this report reflects the legacy of the collective learning from states' efforts to date and provides a data point for documentation of the expansion of state leadership for scaling K–12 CS education for all students. With no sign that the tremendous energy and enthusiasm fueling state-level efforts is abating, our expectation is that the policy landscape will continue to change rapidly and that additional snapshots will be needed on a regular basis to capture accurate information about overall progress toward K–12 CS education for all and the new approaches that states are developing to promote effective implementation of policy supports.

Even with all of the state and national progress being made, we have a long way yet to go. A failure to act boldly and urgently will maintain the status quo, in which access to CS is available to only a fraction of the nation's K-12 students. Aggressively addressing the policy priorities described in this report will more quickly and effectively provide CS opportunities to a whole generation of students.

8 Molnar, A. (1997). Computers in education: A brief history. The Journal, 24(11), 63–68; Tucker, A. (2003). *A model curriculum for K–12 computer science: Final report of the ACM K–12 task force curriculum committee.* New York, NY: Computer Science Teachers Association; Wilson, C., Sudol, L. A., Stephenson, C., & Stehlik, M. (2010). *Running on empty: The failure to teach K–12 computer science in the digital age.* New York, NY: Association for Computing Machinery.

Goals for This Report

In this report, we summarize states' progress in developing state-level policies that support equitable K–12 CS education for today's students, with two main goals in mind:

- To provide a resource for states to use in reflecting on their own progress toward realization of K–12 CS education for all
- To help states identify other states as possible resources

To this end, the report does the following:

- Summarizes, across all states, current progress toward establishing policy priorities for the advancement of equitable K–12 CS education
- Identifies some best practices that states have developed to build momentum toward expanding CS education and implementing policies
- Identifies issues that states are facing in their policy development and implementation efforts
- Shares approaches that states have found to be useful in addressing some of these issues, with the hope that they will be relevant and useful to other states as they continue to develop their own plans

Even with all of the state and national progress being made, we have a long way yet to go. A failure to act boldly and urgently will maintain the status quo, in which access to CS is available to only a fraction of the nation's K-12 students. Aggressively addressing the policy priorities described in this report will more quickly and effectively provide CS opportunities to a whole generation of students.

We have not created a *report card* of states' individual progress, but rather a picture of the nation's collective progress at this moment in time. Our aim is to offer a resource for states to use in reflecting on their own efforts and in identifying other states as possible resources for continued progress toward K–12 CS education for all. To date, there has been remarkable sharing among states as they look to one another for practical wisdom and resources. For example, Expanding Computing Education Pathways Alliance (ECEP)'s experience developing an alliance of states through networking and sharing resources and knowledge contributed substantially to developing a holistic view of this work and the steps required to build toward policy change. This collaborative approach has been extremely valuable, and we hope that it will be further stimulated and supported by this report.

Indicators of States' Progress Toward Implementing Policy Priorities

The bulk of this report focuses on indicators of progress toward 10 policy priorities widely seen as central to broadening participation in K–12 CS education. These priorities were developed collaboratively by a 27-member Advocacy Coalition assembled by Code.org and are among the criteria used by other organizations as well.[9] Two priorities—*State Plan for K–12 Computer Science Education* (#1) and *State-Level Initiatives to Address Diversity in Computer Science Education* (#2)—reflect holistic perspectives on K–12 CS, noting in particular the commitment to diversity and equitable access undergirding the other eight policy priorities and the need for a coherent framework from which to guide the thoughtful development of all policy initiatives.[10] These two policy priorities are discussed in narrative form due to the current lack of reliable data for all states.

9 Code. org (n.d.) *Nine policy ideas to make computer science fundamental to K–12 education.*

10 Although equity of opportunity drives the entire enterprise, articulation of a separate indicator of progress toward diversity is new, and criteria for its assessment are still under development.

For the remaining eight policy priority areas, this report includes the following:

- A rubric that articulates criteria for achievement of this priority area
- A map indicating individual state status on the priority area
- Additional contextual information about states' progress in this area
- Information to support further actions toward establishing and implementing the policy: state levers, emerging best practices, and issues to be addressed

Methodology

The data for states' achievement of policy indicators come largely from Code.org, which has developed robust rubrics and systematically gathered data for all 50 states and the District of Columbia. The authors are in agreement that the rubrics are clear, reasonable, and measurable, and that the corresponding Code.org data are the most reliable data currently available across the set of policy priorities. To achieve the designation of "yes" for an indicator, all elements of the rubric must be achieved. For most indicators, the existing data gathering is at too large a grain size to enable more consistently refined differentiation for those states assigned to the "no" category. Thus, we want to be very respectful of the considerable amount of activity underway and emphasize that a "no" designation does not necessarily mean "no progress;" in the case of many states, their activity can range between early stages of work in a priority area to just falling short of meeting all criteria specified within the rubric.

Co-authors each reviewed and discussed the Code.org data, drawing on our own knowledge and relationships with state leaders to provide updates on activities occurring after Code.org's data gathering. The Education Commission of the States (ECS) September 2016 data[11] was supplemented by Code.org data for policy priority #9 (high school graduation requirements); in early 2017, ECS also gathered primary data for all states for policy priority #10 (postsecondary admission requirements). ECEP added data for Puerto Rico for all policy priorities, based on its working relationships with CS education leaders in the territory. Unless otherwise specified, data were collected between 2015 and 2016; data were verified, updated, and supplemented in early 2017.

Every effort has been made to present the data as fairly and accurately as possible, based on publicly available information and supplemented by conversations with CS education leaders in the states. Yet, because the timeline for producing this report did not allow for extensive additional data gathering, we recognize that there may be inaccuracies in our reporting. We therefore invite state leaders to send updates or corrections, with supporting documentation, to Jim Stanton or Lynn Goldsmith at EDC/MassCAN; contact information is provided on page 48.

Recommendations and Issues to Be Addressed

The report concludes with four recommendations focusing on strategic approaches for moving forward, as well as three critical issues to be addressed as states move forward. We expect that the forward momentum reflected in this report will continue to grow apace in the near future, and that the current landscape will shift substantially on an annual basis in the coming 5 to 10 years.

11 Zinth, J.D. (2016). *Computer science in high school graduation requirements: 2016 update.*

POLICY PRIORITIES

PRIORITY #1: State Plan for K–12 Computer Science Education

"Making computer science a fundamental part of a state's system of education means adding an entirely 'new' subject to most states. States will need to create roadmaps to address a number of policy and implementation issues to integrate computer science as a new subject into its existing system. The plan should articulate the goals for computer science, strategies for accomplishing the goals, and timelines for carrying out the strategies. Equitable access to K–12 computer science must be at the foundation of a state's plan."

Nine Policy Ideas to Make Computer Science Fundamental to K–12 Education (p. 3), Code.org, n.d.

Strategic state plans can be invaluable tools for thinking through the complex CS policy and program implementation interrelationships. The value of taking the time and energy to create a state plan for broadening K–12 CS education lies in the coherence it provides to the overall effort, linking individual policy and implementation efforts to create consistency of purpose and an organized approach. With a well-designed set of interlocking and reinforcing policies, expectations, and approaches to implementation, states will be much better positioned to support and sustain a commitment to providing high-quality CS education for all K–12 students. State plans also provide an opportunity for states and/or statewide organizations to convey to the general public a set of coherent ideas and goals for advancing K–12 CS education.

Key to the creation of an effective state plan is making sure that all relevant stakeholders contribute their knowledge and expertise to its formation. State-level policymakers, educators and administrators from K–12 and postsecondary institutions, business and industry members, and parent and community groups all have perspectives that are needed.

Several states have completed their plans and made them publicly available, and these can be used to inform other states' efforts:

- Thanks to the visionary leadership of Arkansas Governor Asa Hutchinson, the Arkansas Department of Education has developed a strategic plan for CS, which includes sections on Vision and Mission, the Department of Education's Beliefs about CS Education, Goals and Tasks, Roles of Arkansas CS Task Force, and Standards and Curriculum.
- In September 2015, two years after it was launched, the Massachusetts Computing Attainment Network (MassCAN) submitted to the legislature a required three year strategic plan, MassCAN Strategic Plan 2015-2018.

In other states, creation of a state plan is still in process:

- In September 2016, the California state legislature passed, and Governor Brown signed, a bill requiring the State Superintendent of Public Instruction to create by September 2017 a 23-person advisory panel who will develop a long-term plan to make CS education a top priority in the state. ECEP's partner, the Alliance for California Computing Education for Students and Schools (ACCESS), and Code.org worked to support passage of this legislation.

- Many states are now involved in producing state landscape reports for CS education. These documents are intended to capture and identify the range of common CS activities provided in their states and to publicize information regarding these activities, and they can also be used as a basis for developing strategic state plans. ECEP has launched a major effort to support its partner states as they develop these reports.

As states move forward in developing state plans, they should consider the following:

- Allocating funding to support broad and thoughtful participation in the development of the state plan can make a significant difference by providing resources for research, regularly assembling stakeholders to provide input, and disseminating the state plan. Funding may be public, private, or a combination of the two.
- Building stakeholder ownership of the state plan is key for creating and/or uniting the statewide coalitions necessary to advance the needed policies and programs.
- With the new Every Student Succeeds Act (ESSA), it is critically important that CS advocates work closely with their state department of education to ensure that CS is explicitly a part of the state's plan submitted to the United States Department of Education in order for federal funds to be widely used in support of CS education. [12]
- Draw on the experiences and perspectives of colleagues in other states to understand common challenges and the ways others have sought to address them.

12 Code.org (n.d.) *Putting computer science into state plans for the Every Student Succeeds Act.*

PRIORITY #2: State-Level Initiatives to Address Diversity in Computer Science Education

The goal of achieving equity of opportunity for CS learning undergirds all the other policy priorities addressed in this report. Preparing *all* of our children for success in a world that privileges CS competencies is both the right thing to do and the smart thing to do.

The National Science Foundation (NSF) has made a substantial commitment to the multi-year support of eight alliances (including ECEP) dedicated to broadening participation in CS; these alliances conduct research and provide resources to support states and advocates working toward this goal. Similarly, through its multi-year public awareness campaign, the Hour of Code, Code.org is providing unprecedented visibility for providing all children with access to CS education. This report's partner organizations and a growing number of groups (including CSTA and the CS for All Consortium) are working to support states and CS equity advocates around the country. Additional leadership comes from states and districts that have been at the forefront of broadening participation and have served as resources and role models for many. Arkansas, Massachusetts, Utah, and Washington are among the states that have assumed leadership positions; extensive efforts in New York City (CSNYC.org), Chicago, San Francisco, and Broward County (Florida) have moved the needle on broadening participation within those districts as well and have generated new knowledge and approaches for the benefit of others.

Many of those developing new K–12 CS curricula are explicitly designing them to address a wider and more varied range of learners, and their professional development programs are providing teachers with the skills and resources to more effectively recruit and engage underrepresented students. Teachers, in particular, are embracing the equity agenda and providing leadership both in and outside the classroom—for example, as members of policy teams developing standards. Parents are also becoming champions for making CS available to all children.[13] The energy and activity coalescing around K–12 CS education points to great leadership opportunities for states to harness as they begin defining and implementing state policies that are models for advancing equity in CS education.

While much is happening across the country that indicates that many people are deeply engaged in this equity agenda, there remains work to be done to develop criteria for assessing progress toward state-level policies that address diversity and equity. In the meantime, states can take steps to track participation in CS, identify barriers to participation, and leverage initiatives and resources such as those described above to focus on increasing access to quality CS education and inspiring students from currently underserved populations. States can, for example, do some or all of the following:

- **Gather data about progress toward broadening participation. Meaningful demographic information about CS participation will support strategic decision-making.** Adding school quality indicators related to diversity in CS or the availability of CS will help states and districts monitor and improve their progress toward goals of equity and diversity in K–12 CS education. The National Center for Educational Statistics' School Courses for the Exchange of Data program is one example of a resource available to states for tracking the demographics of CS course-taking. This program allows districts to send complete student demographic data to the state department of education for each CS course offered in a middle or high school in a way that securely protects student identity.

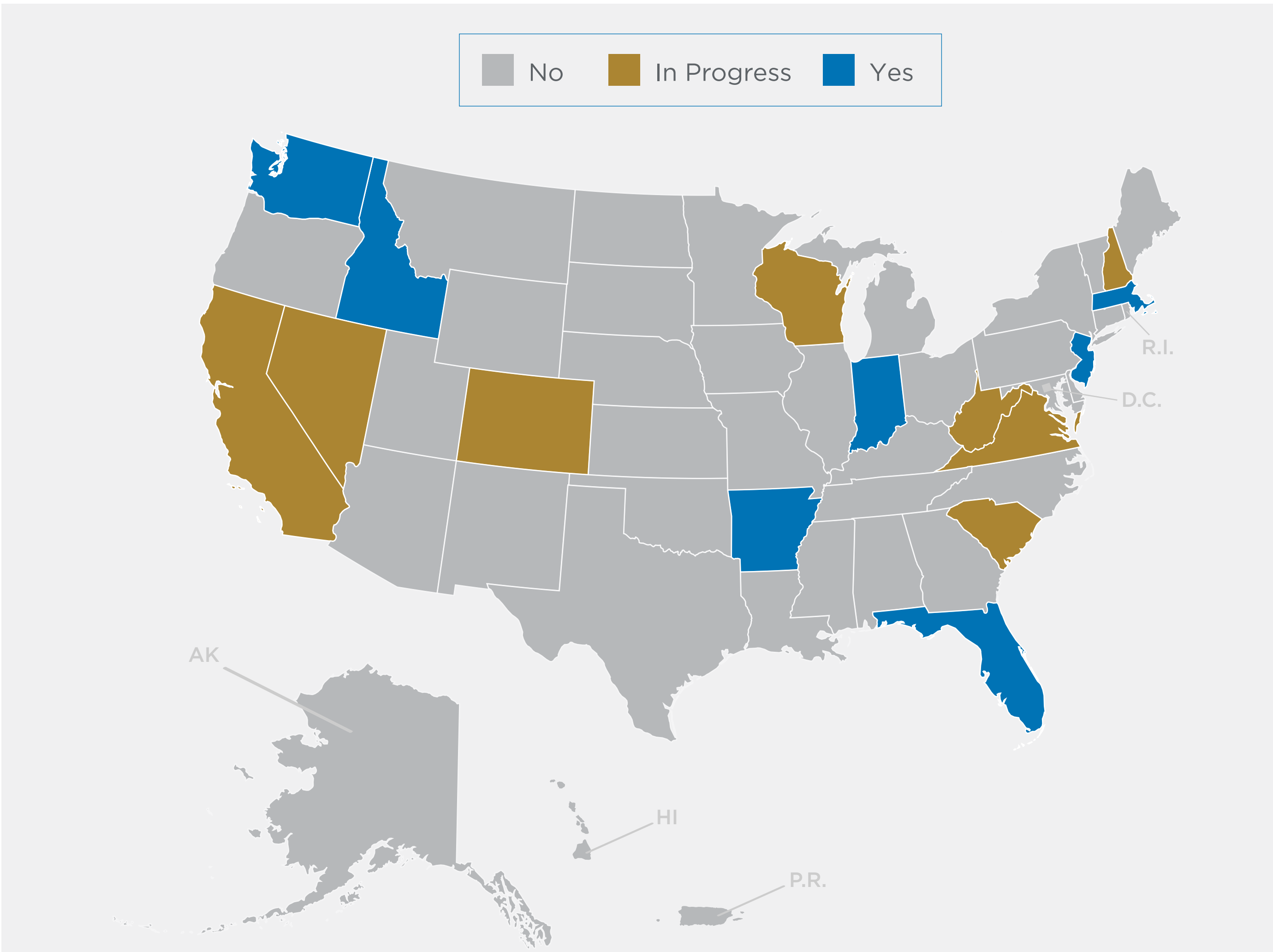
13 Google, Inc., & Gallup, Inc. (2016). *Trends in the state of computer science in U.S. K–12 schools.; K–12 Computer Science Framework.* (2016).

- **Proactively and strategically include equity and diversity in state goals and plans.** When considering the development or adoption of state policies to advance K–12 CS education, equity and diversity should be considered from the beginning. Some state policies explicitly include mentions of diversity. For example, Arizona's SB 1538, which allocated $500,000 for K–12 CS implementation, required recipients of the funding to focus on Native American students; Washington's funding for K–12 CS in 2015 included language indicating that the grant program was intended to increase access to CS to students from underrepresented groups, including female, low-income, and minority students.
- **Identify and remediate barriers to participation of underrepresented groups.** Both structural and social barriers impede participation in CS.[14] Data gathering that is more grounded in local contexts and perceptions is useful for identification of particularly salient barriers and possible approaches to remediation; relevant data, such as those provided in landscape reports, are centrally important for strategic decision-making.[15]
- **Take advantage of organizations that focus on increasing diversity in CS.** NSF currently funds eight alliances for Broadening Participation in Computing, each of which targets a different approach to equity and diversity in CS education:
  - AccessComputing (http://www.washington.edu/accesscomputing/)
  - Computing Alliance of Hispanic-Serving Institutions (http://cahsi.cs.utep.edu)
  - Expanding Computing Education Pathways (http://ecepalliance.org/)
  - Institute for African-American Mentoring in Computer Sciences (http://www.iaamcs.org/)
  - Into the Loop (http://exploringcs.org/)
  - National Center for Women & Information Technology (http://www.ncwit.org/)
  - Students in Technology, Academia, Research, and Service (STARS) Alliance (http://www.starsalliance.org/)
  - Sustainable Diversity in the Computing Research Pipeline (http://cra.org/cerp/)

14 Google, Inc., & Gallup, Inc. (2016). *Diversity gaps in computer science: Exploring the Underrepresentation of Girls, Blacks, and Hispanics.*; Google, Inc. (2014). *Women who choose computer science: What really matters.*; Google, Inc., & Gallup, Inc. (2015). *Searching for computer science: Access and barriers in U.S. K–12 education.*

15 http://ecepalliance.org/how-change-state

PRIORITY #3: Adoption of K–12 Computer Science Standards



RUBRIC

For this report, a state is considered to have K–12 CS standards if the standards meet *all three* of the following criteria:

- cover elementary, middle, and high school
- are publicly accessible on the state's website
- include CS content at all levels (elementary, middle, and high school)

Where Are the States on This Priority Area?

Seven states have publicly accessible K–12 standards for CS content. The table below identifies key differences in the grade organization and location of adopted state CS standards. In the majority of states listed, there are two different sets of standards related to CS at the high school level: one for Career and Technical Education (CTE) programs of study, which typically only reside at the high school level, and one for traditional academic pathways, which also encompass elementary and middle school. Arkansas is an exception in that the academic and CTE standards for CS at the high school level are unified as one set.

STATES WITH K–12 STANDARDS FOR CS CONTENT			
State	**Year adopted**	**Grade bands or individual grades?**	**Where housed?**
Arkansas	2016	K-8: indiv grades 9-12: grade band	CS
Florida	2016	K–2, 3–5, 6–8, 9–12	Science, CTE
Idaho	2017	K–2, 3–5, 6–8, 9–10, 11–12	CS, CTE
Indiana	2016	K–2, 3–5, 6–8; 9–12 (CTE only)	Science, CTE
Massachusetts	2016	K–2, 3–5, 6–8, 9–12	Digital Literacy and CS, CTE
New Jersey	2014	K–2, 3–5, 6–8, 9–12	Technology, CTE
Washington	2016	K–2, 3–5, 6–8, 9–12	CS, CTE

Although relatively few states have addressed all three elements of the rubric, at least eight additional states are currently engaged in the standards development process: California, Colorado, Nevada, New Hampshire, South Carolina, Virginia, West Virginia, and Wisconsin.

Those states at early stages of adopting standards can take advantage of the pioneering work of individual states as well as the availability of documents created by national organizations (such as the K–12 Computer Science Framework and the Interim CSTA Standards). These existing documents will substantially simplify the work for the remaining states, who can use them as inputs into their standards development process rather than build new standards from the ground up.

State levers for action

- **Legislative support:** California AB 1539, Idaho H0397, Washington HB 1813, and West Virginia HB 4730 call for the development of K (or pre–K)–12 standards, identify the makeup of the standards development committee, suggest resources, and set adoption and implementation timelines.
- **Gubernatorial support:** Governors can provide critical motivation and promote legislation supporting CS education, as illustrated by Arkansas Governor Asa Hutchinson, who made coding the highlight of his education platform during his gubernatorial race. Governors of eight states—Arizona, Arkansas, Idaho, Iowa, Nevada, Rhode Island, Virginia, and Washington—have joined the Governors' Partnership for K–12 Computer Science (Governors for CS Partnership), who commit to (1) enabling all high schools to offer CS, (2) funding professional development, and (3) creating K–12 CS standards.

- **State departments of education:** State education agencies in Florida, Indiana, and Massachusetts have taken advantage of scheduled revisions related to other subject area standards to initiate a computer science standards process.

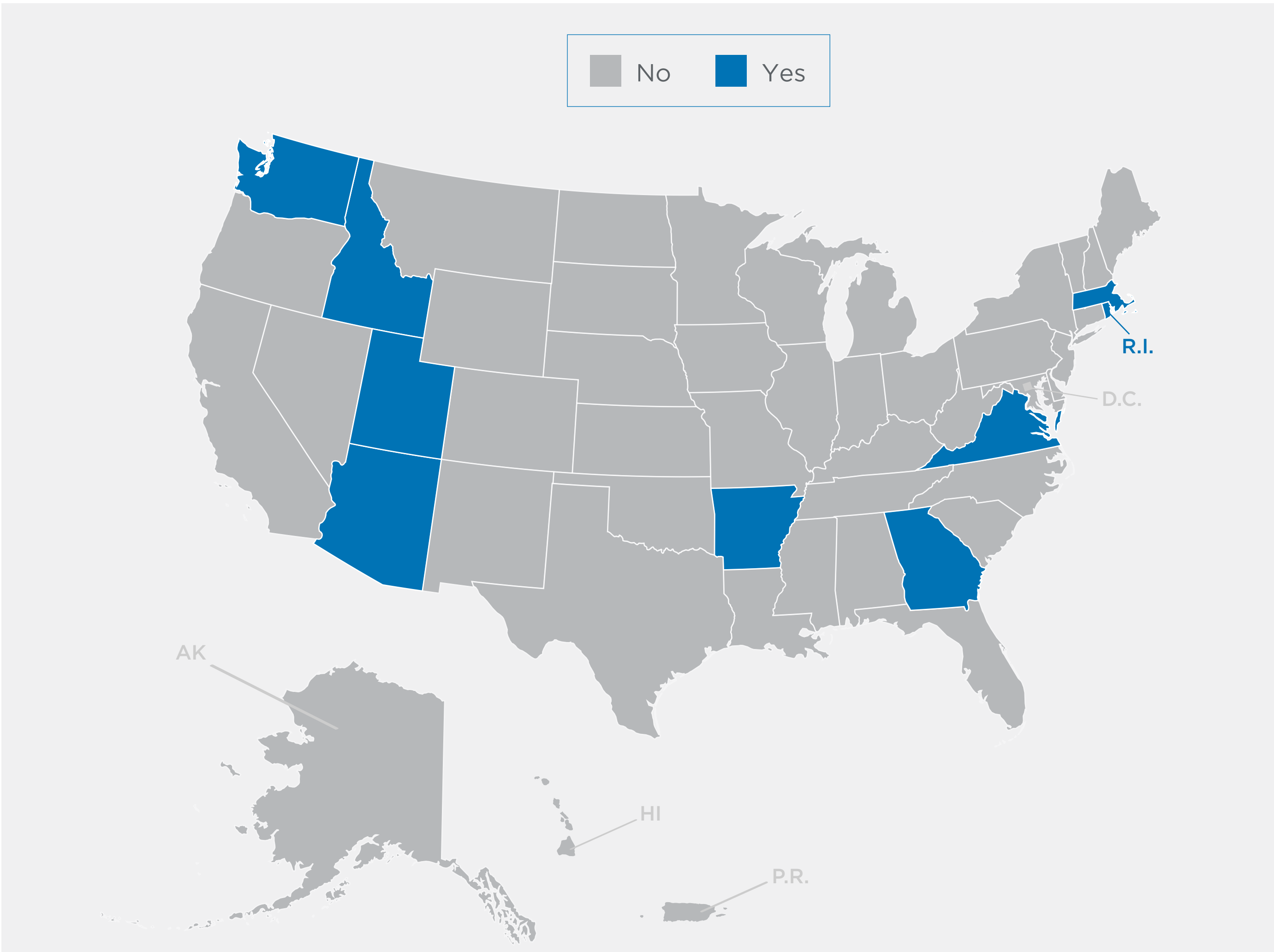
Emerging Best Practices

- **Gather experts from within and outside your state.** Experts from national organizations (e.g., CSTA, Code.org, Cyber Innovation Center, ECEP) and the seven states with standards currently in place have served as advisors in the state standards development process.
- **Institute a shorter revision cycle.** Due to the new and evolving nature of CS education, and the research underway exploring CS learning trajectories and multidisciplinary approaches, some states have replaced the typical four- to five-year revision cycle with a three-year revision cycle to allow for quicker updates.
- **Coordinate with CTE programs.** The overlap between CS and topics in CTE programs, such as database administration, network administration, and software development, provides a great opportunity for cooperation, bolstering academic pathways with specialized experiences drawn from CTE courses, and diversifying the pool of students in CTE courses to include those who have developed an interest and aptitude prior to high school.
- **Coordinate grassroots efforts.** Multi-sector leadership teams of K–12 teachers, administrators, educational researchers, and nonprofit and industry leaders can play a role in encouraging states to develop standards. State efforts often begin with foundational ideas, building toward the writing and adoption of standards as well as other relevant educational policy initiatives in the K–12 and higher education pipeline.

Issues to Be Addressed

- **Cost:** States need to consider the potentially unbudgeted costs associated with developing CS standards (e.g., meeting and/or travel expenses for the standards development committee, additional writing and publishing costs, professional development funds).
  - **Potential solution:** Some states have partnered with nonprofit organizations to secure grants to cover such costs.
- **Ownership:** Due to the absence of a state-level department of CS or dedicated coordinator position, state ownership for standards development may belong in science, mathematics, technology, or other departments such as CTE. A lack of clear ownership can stall efforts or lead to unintended consequences (e.g., requiring CS teachers to have science certification because CS standards are housed within science standards; having CS taught only in CTE programs rather than in academic programs).
  - **Potential solution:** Prior to developing CS standards, thought should be given to working with a cross-departmental team and key stakeholders for follow-on implementation.
- **Implementation:** State teams should consider how standards will be communicated to district and school staff, how district adoption and implementation will be measured, and who will develop and/or identify existing high-quality CS curricula. State education authorities in local-control states should consider early involvement of local leaders.
  - **Potential solution:** Existing meetings for teachers, administrators, and guidance counselors may be logical vehicles for communication; see the National Center for Women and Information Technology's (NCWIT) Counselors for Computing for talking points. Inventories of curricula can be found on Code.org's 3rd party resources page, CSforAll.org, and the LeadCS.org inventory of curriculum resources.

PRIORITY #4: State-Level Funding for K–12 Computer Science Education



RUBRIC

For this report, a state is considered to have dedicated state-level funding to K–12 CS education if *all four* of the following criteria are met:

- the funds are allocated via the approved state budget or state legislation
- the funds are dedicated to CS only
- a description of the funds is written down and publicly accessible
- the funds were allocated for the 2016 or 2017 fiscal year

Where Are the States on This Priority Area?

Nine states have dedicated state-level funding to K–12 CS education for fiscal year 2016 and/or 2017, as shown in the table below. At the time of the publication of this report, at least four states listed below had also allocated funding for CS for fiscal years 2018–2019 (Arkansas, Idaho, Utah, and Virginia), but because other states are in the middle of legislative sessions, we opted not to include data for states beyond 2017 allocations.

State	Fiscal Year and Amount	What Is It For?
Arkansas	2016: $2,500,000 2017: $2,500,000	Variety of CS initiatives, including standards, professional development, and grants
Arizona	2017: $500,000	Grants for a variety of CS initiatives, including curriculum, professional development, and internships
Georgia	2016: $250,000	Professional development
Idaho	2017: $2,000,000	Variety of CS initiatives, including standards, professional development, and resources
Massachusetts	2016: $1,500,000	Infrastructure support for MassCAN requires 1:1 private match to release state funding; private funds to be used to support professional development, developing standards, or developing teacher licensure
Rhode Island	2017: $260,000	Professional development
Utah	2017: $400,000	Professional development and instructional resources
Virginia	2017: $550,000	Professional development
Washington	2016: $1,000,000 2017: $1,000,000	Professional development which requires a 1:1 private match; to be administered via grant program

State levers for action

- **Legislative support:** CS education funding for most of these states was initiated through appropriations in legislation (e.g., AZ SB 1538, ID HB 379, MA FY 2016 budget (lines 7007-1202), UT SB 93). These bills were widely supported by national and state advocacy groups, education organizations, and industry.
- **Gubernatorial support:** In many cases, the funding was driven by the governor's office during general budget discussions or supported by the governor through a specific bill (e.g., RI's FY 2017 budget). The eight state governors who are members of the Governors for CS Partnership have committed their states to providing funding for professional development.
- **Pre-existing efforts:** In all the cases above, funding didn't initiate statewide action on CS, as efforts such as professional learning or standards development already existed. Funding approval followed commitments that the state or parties in the state were already acting on.

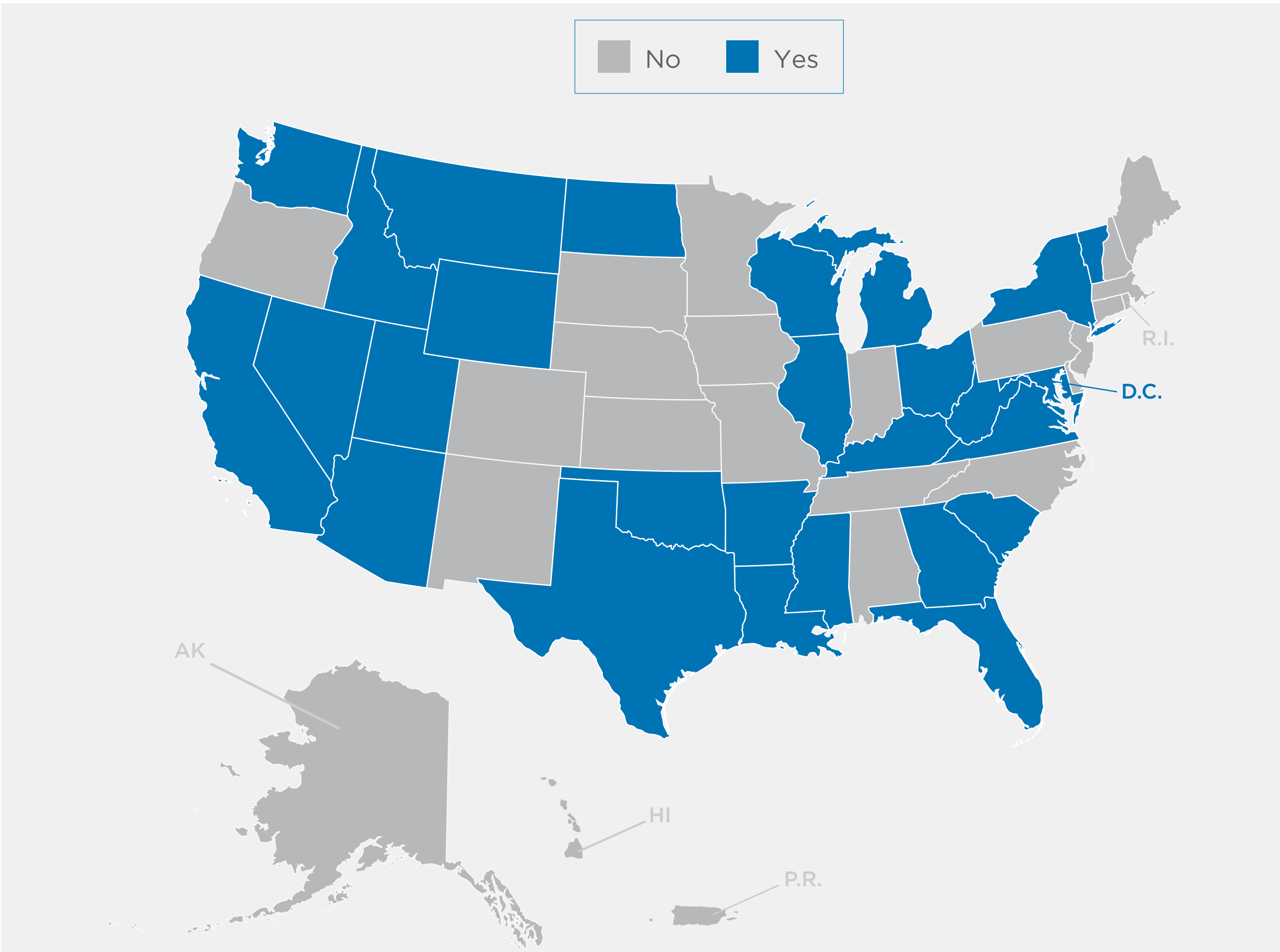
Emerging Best Practices

- **Prioritize professional learning.** Although securing high-quality instructional resources is important, the key lever for increasing students' access to courses is professional learning for in-service teachers.
- **Set grant priorities, such as a focus on equity.** States can meet diversity goals by requiring districts or organizations to demonstrate plans to address underrepresented groups in order to qualify for grants, or by prioritizing districts and organizations that primarily work with underrepresented groups.
- **Dedicate continuing funds or multi-year funding.** It can be difficult for states to ramp up CS efforts quickly, and professional development funding initiatives are generally rolled out over several years. States could consider dedicating the same amount of funds for each year of a biennial budget.
- **Dedicate a portion of federal funds received by the state to CS education.** States can use funds received for STEM education (for example, Math and Science Partnership, ESSA, Perkins, and Title II funds) to provide professional development and supports for CS education.
- **Build partnerships.** Multi-sector partnerships can help state government see clear pathways to sustainability. Include representatives from public institutions of higher education, K–12 education, state government, other state-based institutions, and industry in conversations about funding for K–12 CS. Creating proposals that impact multiple areas may increase funding prospects.

Issues to Be Addressed

- **Administration of funds:** Failure to administer funds in an open, transparent, and well-documented manner can impede statewide initiatives and jeopardize future funding.
    - **Potential solution:** Although the state can administer the funds through district or school-level grants, funding can also be administered by an organization designated by the state. For example, the Washington funds were administered by Washington STEM, a nonprofit STEM education organization, and the Idaho funds were administered by the STEM Action Center.
- **Required matching funds:** Some state-level funding may only be unlocked when matched by external or non-state funds.
    - **Potential solution:** Involve industry partners early in the process of making funding requests through letters of support, testimony, and engaging the appropriations committee. Engage them to provide workshop space for professional learning, and invite them to stakeholder meetings or steering committees for statewide initiatives, such as standards development. In addition, the state should have a clear process in place for receiving matching funds.
- **Allocation of funds:** State governments can allocate funds in different ways, including categorical funding (direct funding to eligible entities, such as local education agency [LEA] or a third party, to provide CS professional development), competitive grants (providing discretionary funding to a granting agency to develop a grant program for LEAs to apply for funds for CS professional development), and set-asides (allocating a percentage of funds "off the top" for statewide or districtwide activities). For example, in 2017 Massachusetts awarded $750,000 in state funding to Project Lead the Way to launch its CS program in 45 grade 6-12 schools. This award generated an additional $300,000 of funding from a private foundation.
    - **Potential solution:** The governor or legislature should consider which option works best for their state.

PRIORITY #5: State Computer Science Teacher Certification



RUBRIC

For this report, a state is considered to have CS teacher certification if the state has an endorsement, certification, licensure, or authorization that explicitly names "CS" and enables a teacher to teach CS courses.

Where Are the States on This Priority Area?

Currently, 27 states and the District of Columbia[16] offer CS teacher certification, though they differ in the type of certification they offer: a full certification or initial license in CS, an endorsement that a candidate adds on as a supplement to an existing license, or both. States also differ by the grade levels the certification covers, whether a subject matter exam is offered, the types of courses required, the number of credits required, and whether the license or endorsement is required in order to teach CS. States without CS certification have no guidelines or requirements, which can lead to a lack of trained educators teaching courses and a wide variety in teacher quality.

A "yes" designation on this indicator simply means that the state has a means of certifying CS teachers—the rubric is agnostic about the quality or rigor of the certification, whether certification is feasible, or whether the state has articulated a clear pathway to certification. In recent years, some states have found it necessary to revise their existing CS certification requirements to ensure that teachers have the knowledge and skill needed for up-to-date CS instruction, while still being feasible to complete.

State levers for action

- **Regulation change:** In some states, the state department of education may have the authority to create a new certification as needed or to change regulations pertaining to teacher certification. When possible, the agency or board should take advantage of existing mechanisms for licensure. For example, if the state already has a list of add-on endorsements that can be achieved through a standardized series of requirements, CS can be added to that list; if the state allows mathematics or science teachers to add other STEM endorsements with limited additional coursework, CS can become an additional endorsement.
- **Legislation:** In several states, new legislation was introduced requiring the development of a CS teacher licensure or add-on endorsement

Emerging Best Practices

- **Develop a plan for a certification process.** Many states are developing task forces to address certification, and some are creating short-, medium-, and long-term plans to ensure that there are quality CS teachers now and in the future.
- **Pathways to certification for in-service teachers:** States are beginning to adopt pathways to certification for in-service teachers that generally fall into one of three types:
    - **Experiential-based pathway.** Teachers provide a portfolio of their CS knowledge and skills, for example, providing evidence of having completed multiple CS professional development programs or demonstration of basic CS abilities. Utah has an "Exploring CS" certification that allows teachers to teach the *Exploring Computer Science* course after completing both *Exploring Computer Science* professional development and Code.org's K–5 online professional learning. Other states "grandfather" teachers by automatically granting CS certification to those who are currently teaching or have recently taught particular CS courses.

16 Arizona, Arkansas, California, District of Columbia, Florida, Georgia, Idaho, Illinois, Kentucky, Louisiana, Maryland, Michigan, Mississippi, Montana, Nevada, New York, North Dakota, Ohio, Oklahoma, South Carolina, Texas, Utah, Vermont, Virginia, Washington, West Virginia, Wisconsin, and Wyoming

- **Course-based pathway:** Teachers complete courses developed by universities and/or professional development providers that are designed to teach subject matter content and pedagogical approaches needed to teach to the CS standards. Some states allow teachers who have completed a recognized professional development program to teach the CS course while planning for a formal certificate or other endorsement, which may count as an “add on” to their license.
- **Certification exams:** A number of states use some type of certification exam to establish teachers’ subject matter knowledge (e.g., Praxis, Pearson).

- **Align course rollout, PD, and certification.** It is important for initiatives to be aligned so that new courses can be taught by qualified teachers. Being strategic at the start of planning by considering the relationship between frameworks, standards, curriculum, and teacher certification will help to create a clear pathway to certification and alignment with other state-led efforts.

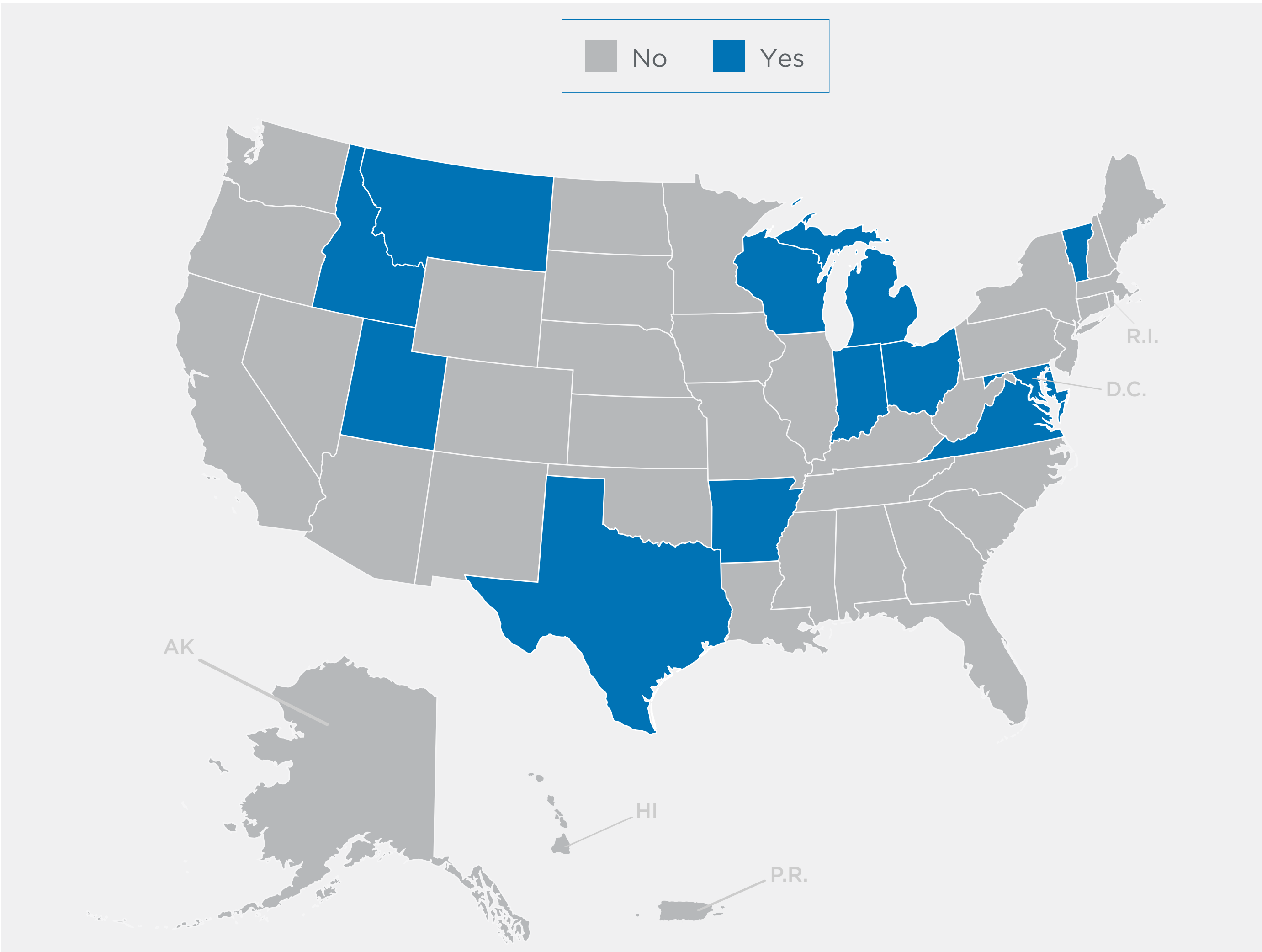
Issues to Be Addressed

- **Demand outstripping supply:** States may need to quickly scale up their teaching force in CS while ensuring that teachers are prepared to teach CS. Although no state has solved the lack of a CS teacher pipeline, many are building toward a sustainable process.
  - **Potential solution:** Develop multi-pronged strategies such as the following: simultaneously develop pre-service CS programs within schools of education or teacher preparation programs; offer or accept CS curriculum-specific professional development; and train specialists, such as librarians, IT staff, and others who have room in their schedule and the ability to integrate new projects.[17] Micro-credentialing, a new professional development model that is personalized and project-based, is another option gaining ground for CS teacher development. In addition, some states allow teachers to teach CS under a temporary license while they complete the requirements for certification.
- **Lack of incentives for teachers to obtain CS certification:** In states where CS certification has rigorous requirements, such as graduating with a CS major, teachers often do not have incentives to seek out CS certification. Some states require rigorous CS coursework or training to become certified (such as the equivalent of a major in CS).
  - **Potential solution:** Provide incentives for teachers to become certified, including tuition reimbursement for CS coursework, and scholarships for pre-service teachers to become dual certified in CS. Consider short- or immediate-term solutions, such as requiring less CS coursework or allowing PD to substitute for CS coursework.
- **High school course coding:** Recognize that the way a course is coded (CTE, core credit) may influence who can teach the course and who takes the course. For example, several states house CS within CTE, precluding mathematics and science teachers from teaching CS, and making access to CS courses more difficult for students who are not enrolled in CTE pathways.
  - **Potential solution:** Dual-code CS courses so that they fit into both CTE pathways (and can be taught by a CTE-licensed teacher) and non-CTE or academic pathways.[18]

17 Code.org.(n.d.) *Recommendations for developing computer science teacher pathways.*

18 Code.org (n.d.) *Rethinking Perkins to expand access to K-12 computer science.*

PRIORITY #6: State-Approved Pre-Service Teacher Preparation Programs at Institutions of Higher Education



RUBRIC

For this report, a state is considered to have approved programs at institutions of higher education if *both* of the following criteria are met:

- the programs prepare pre-service teachers for licensure in CS
- the state makes publicly available a list of such programs in CS

Where Are the States on This Priority Area?

Twelve states have approved pre-service teacher preparation programs at institutions of higher education and have published information about these programs on the website of their state department of education (or other state education authority): Arkansas, Idaho, Indiana, Maryland, Michigan, Montana, Ohio, Texas, Utah, Virginia, Vermont, and Wisconsin. Other states may have approved such programs, but they have not provided a list of which programs prepare teachers in CS. There may be universities in other states that prepare pre-service teachers in CS, but their state either has not approved the program or does not publish the list of approved programs on its website.

State levers for action

- **Standards development:** If a state is moving forward on the development and approval of CS standards, this is an appropriate time to engage with institutions of higher education to begin the process of developing a pre-service teacher preparation program.
- **Certification updates:** States in the process of revamping teacher certification—CS or other—can use this as a time to engage with institutions of higher education around developing teacher preparation pathways.
- **Incentives:** In addition to approving pre-service programs, states can provide incentives, such as offering scholarships for pre-service teachers to take CS, or providing funds to teacher preparation institutions to establish CS education programs.

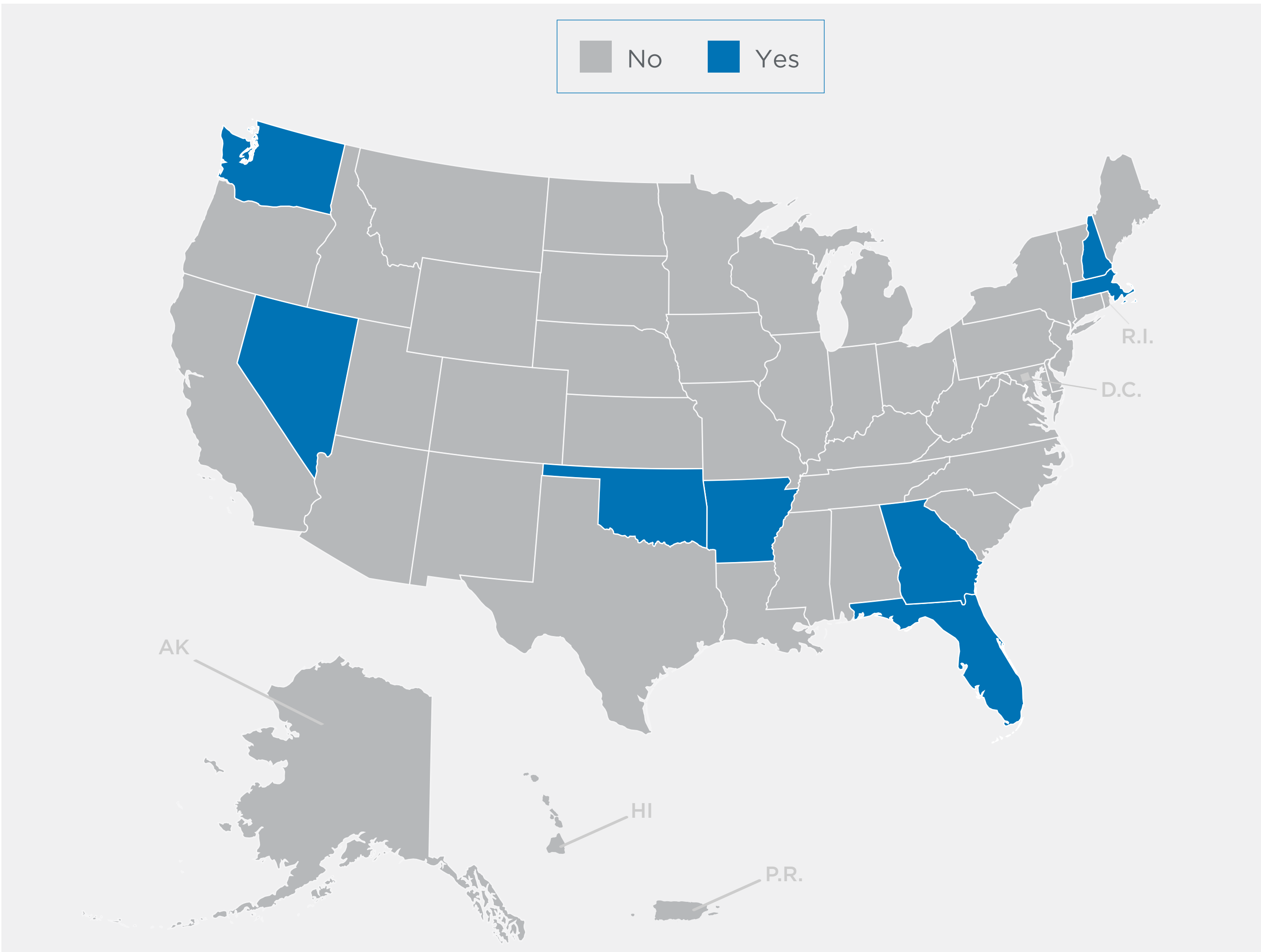
Emerging Best Practices

- **Meet the immediate need by training in-service teachers.** This is a useful short-term solution while building out pre-service training programs, which are an essential part of creating a sustainable pipeline of prepared CS teachers.
- **Make CS part of a core K–12 education.** This provides the motivation for reform in multiple areas of the education system. Continuing to push for creation or adoption of standards, in-service teacher preparation programs, and building off research-supported best practices strengthens the call for pre-service programs.
- **Update existing educational technology courses to include CS content.** Such courses are often required of all pre-service teachers; this is a way to introduce all teachers to the fundamentals of CS and how it can be integrated in other subject areas. This is particularly important for elementary school teachers, who are most likely to integrate CS into their regular classroom instruction. Existing pre-service preparation programs in CTE, educational technology, or STEM should also be updated to include a CS strand.
- **Approval of pre-service programs:** States typically approve pre-service preparation programs; they should make clear that particular institutions of higher education prepare teachers in CS. In some states, institutions of higher education have started the process of pre-service program development and then sought approval and input from the state department of education. Because CS is a new field and a new certification, there are many pathways leading to certified programs.
- **Consider creating an add-on endorsement for pre-service teachers already obtaining licensure in another area.** For example, a program could offer three to four additional courses in CS content and pedagogy so that teachers could obtain both CS endorsement and full certification in another content area (based on the state's endorsement criteria).

Issues to Be Addressed

- **Which comes first: teacher preparation programs or certification?** Some faculty are reluctant to create programs for subjects in where there is no certification. Some states are reluctant to create a certification process when there is no one preparing teachers for certification.
  - **Potential solution:** Work on both simultaneously, with slow phase-in over multiple years. Several states are adopting multiple levels of endorsement to reach in-service teachers while simultaneously developing a pipeline of pre-service teachers.
- **Where to house pre-service CS teacher preparation programs:** They may be housed in a Department of Education or a Department of Computer Science. When in a Department of Education, pre-service teachers typically add on a few CS courses for certification, and many teachers may be reached. When in a Department of Computer Science, the pre-service teachers typically have greater requirements for CS courses, which leads to a greater depth of knowledge of the topic but generally a much smaller pool of potential teachers.
  - **Potential solution:** Faculty in both CS and education departments need to work together. Rather than create new courses, they can find innovative ways to restructure existing courses to fit the needs of future CS teachers.
- **Other resources are needed:** Creating policy is only the first step (or one of the first steps). Certifications need content, pedagogy, assessment tools, and faculty who are prepared to teach pre-service teachers.
  - **Potential solution:** Remember that creating these programs takes time and includes multiple parts of the educational system. Start now and adjust as you go.
- **Lack of CS teaching standards:** Many institutions of higher education are currently accredited under International Society for Technology in Education (ISTE) standards, which focus primarily on technology literacy rather than CS and are not reflective of the current state of CS education.
  - **Potential solution:** Step up efforts on Priority #3: Adoption of K–12 Computer Science Standards. Seven states have created K–12 standards for CS content, which are publicly accessible, and at least eight additional states are in the process of developing CS standards.

PRIORITY #7: A Dedicated State-Level Computer Science Position



RUBRIC

For this report, a state is considered to have a state-level CS education position if *both* of the following criteria are met:

- a state employee has a title reflecting that this position focuses on K–12 CS education issues
- the position is clearly able to impact state policy and programs around CS

Where Are the States on This Priority Area?

Eight states have a position that meets the guidelines for this indicator: Arkansas, Florida, Georgia, Massachusetts, Nevada, New Hampshire, Oklahoma, and Washington. Other states, including California, Maryland and Rhode Island, have offices or individuals who are influencing CS policy and programs.

State	Title	Department
Arkansas	State Director of Computer Science Education	Office of Computer Science
Florida	Computer Science Specialist	Bureau of Standards and Instructional Support
Georgia	Computer Science Education Program Specialist	Curriculum and Instruction
Massachusetts	Computer Science and STEM Integration Specialist	STEM Office
Nevada	Education Programs Professional, Computer Science and STEM	Office of Standards and Instructional Support
New Hampshire	STEM Integration and Computer Science Administrator	Division of Educational Improvement
Oklahoma	Director of Computer Science and Secondary Mathematics	Instruction
Washington	Computer Science Program Specialist	Learning and Teaching

In addition to these eight states, Virginia has identified funding for a position and is poised to hire. Other states, including California, Maryland, and Rhode Island have offices and individuals who are influencing CS policy and programs, although they do not accord with the rubric criteria. For example, California has a state board member who focuses half-time on CS, while the California Department of Education has organized an interdepartmental team. Maryland is addressing the goal of effecting policy at the state level with a statewide network of CS specialists—one in each district—who meet quarterly to discuss CS issues.

State levers for action

- **Funding:** State-level positions have been funded through efforts to advance standards, professional learning, and K–12 curriculum and course pathways. Sometimes the positions are funded via the state budget or other state legislation; in other cases, such as in Massachusetts, positions have been funded through grant monies. While industry would not fund state positions directly, it might be very willing to advocate for a position with state and other funders.
- **Department of education coordination:** Most states do not start their CS education initiatives with the creation of a state-level position. Often, more organic leadership teams are formed within a department of education, and the team provides leadership until the demands necessitate finding someone with more content expertise.

- **Strong STEM centers:** Utah, Rhode Island, and Mississippi, among others, all have STEM Centers with a proven history of moving STEM education initiatives forward in their states. STEM Centers often work in collaboration with state departments of education and may have the capacity to lead efforts to coordinate CS education in a state. The active involvement of a STEM Center can help states recognize the need for and benefits of a dedicated state CS position.

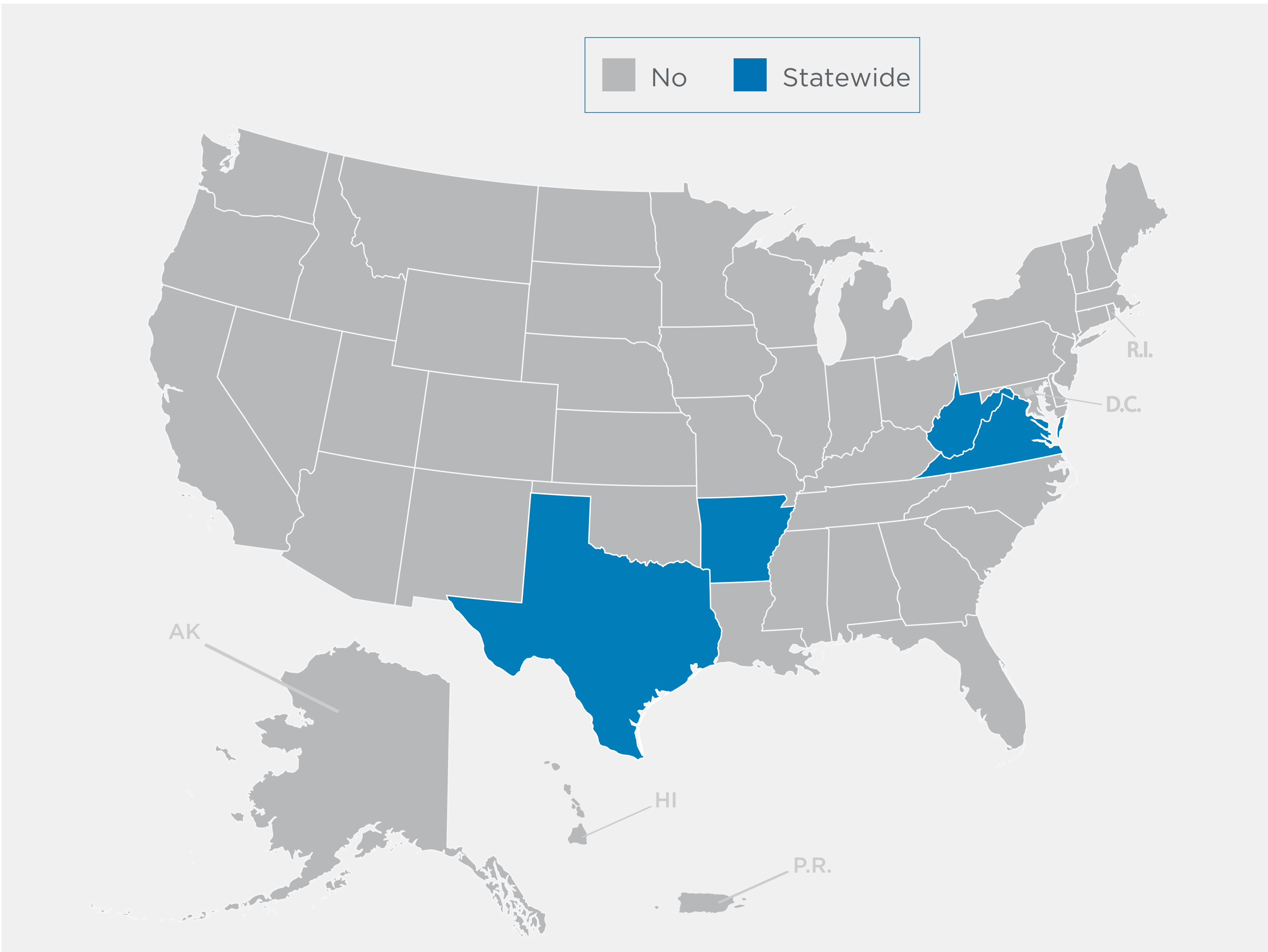
Emerging Best Practices

- **Consider where to locate the position.** At present, states that have a dedicated position have located the CS specialist within their departments of education. The location of the CS education leadership position is important to consider in order to maximize the CS specialist's ability to effectively support and promote policies for equitable K-12 CS education.
- **Make use of STEM Centers whenever possible.** Understanding that state-level leadership positions may take time to be created, state STEM centers can play a role in the coordination of state efforts. These centers are often able to work closely with state departments of education and/or Governor's offices, laying the groundwork for, and building a network of, support for CS initiatives.

Issues to Be Addressed

- **Sustainability:** If a position is funded year to year or is focused on multiple priorities in addition to CS, gaining ground on goals can prove difficult.
    - **Potential solution:** States should have, or should be working toward, a strategic plan, framing how this position will make an impact on the identified goals.
- **Term limits:** State-level initiatives and leadership positions are not immune to normal election cycles.
    - **Potential solution:** When developing CS initiatives at the state level or building support for a state-level position, consider whether the position and the initiatives have broad bipartisan support within the government, or whether they are at risk of being changed or dismantled should key positions turn over.
- **The need to communicate with diverse groups:** Often a CS lead in a department of education needs to perform two vital functions: to serve as an internal and external content expert and to communicate effectively with and advise a range of stakeholders regarding current and proposed state policies and programs.
    - **Potential solution:** Leaders hired for state-level positions, or identified as a leader in a state's CS education work, must have the capacity to collaborate with a diverse group of stakeholders, including K–12 teachers, administrators, local school committees, state government, and industry. Having an effective CS leader within the department of education can be an incentive for the business community to strategically invest in non-state-funded priorities.

PRIORITY #8: A Requirement for All High Schools to Offer Computer Science



RUBRIC

For this report, a state is considered to require all high schools to offer CS if *either* of the following criteria are met:

- state policy requires all public high schools in the state to offer one or more CS courses
- state policy integrates CS into mandatory state standards across disciplines, K–12

Where Are the States on This Priority Area?

Four states have enacted policies to require all public high schools to offer at least one CS course: Arkansas, Texas, Virginia, and West Virginia. The nature of the requirements vary somewhat from state to state, as indicated in the table below. Although policy implementation in Arkansas and Virginia has been supported through related funding, the policies enacted in Texas and West Virginia have not been paired with supplemental state funds to support implementation.

State	Related Funding	Method
Arkansas	Yes	2015 Act 187 (H.B. 1183) requires all high schools to offer CS
Texas	No	2014 state board amendment to 19 TAC § 74.3 requires certain CS courses to be available to each high school student in all districts
Virginia	Yes	2016 H.B. 831 adds K–12 CS to the state's Standards of Learning, which all schools must implement
West Virginia	No	2016 state board amendment to W. Va. Code St. R. § 126-42-5 (Chart 5.4.b.) requires all high schools to offer CS

Other states do not require all high schools to offer CS but have taken other approaches to extend access to CS learning experiences across the state. Connecticut 2015 S.B. 962 adds computer programming to the topics included in the program of instruction offered in public schools but does not specify the grade levels to which this requirement applies. New Hampshire Ed 306.42 requires local school boards to provide the opportunity for students to complete a half-credit information and communication technologies course that includes programming, though implementation varies widely. Rhode Island also does not have an explicit requirement but is spearheading CS4RI, a state initiative that is anticipated to place a CS course in all public high schools by December 2017.

State Levers for Action

- **Legislative action:** Legislation can require all high schools to offer CS. Arkansas requires all public high schools and charter schools to offer at least one computer course, and established a CS task force to review and recommend courses, standards, and potential funding streams.
- **State board action:** State board regulations in some states already specify the courses that high schools must offer to meet state accreditation standards. A state board could amend such regulations to incorporate one or more CS courses.
- **Mandated standards:** CS can be incorporated into all schools by requiring its integration into mandated standards, the approach taken in Virginia.
- **State plan:** State-level CS plans may incorporate an official goal for all high schools to offer CS, as Rhode Island has done. While not creating a mandate, the official goal and plan can leverage other means—such as recommending high-quality curriculum and professional development, and dedicating funds for teacher professional development—to support all high schools' efforts to offer CS.
- **Governors for CS Partnership:** The eight member governors of this partnership have committed to enabling all high schools in their states to offer CS.

Emerging Best Practices

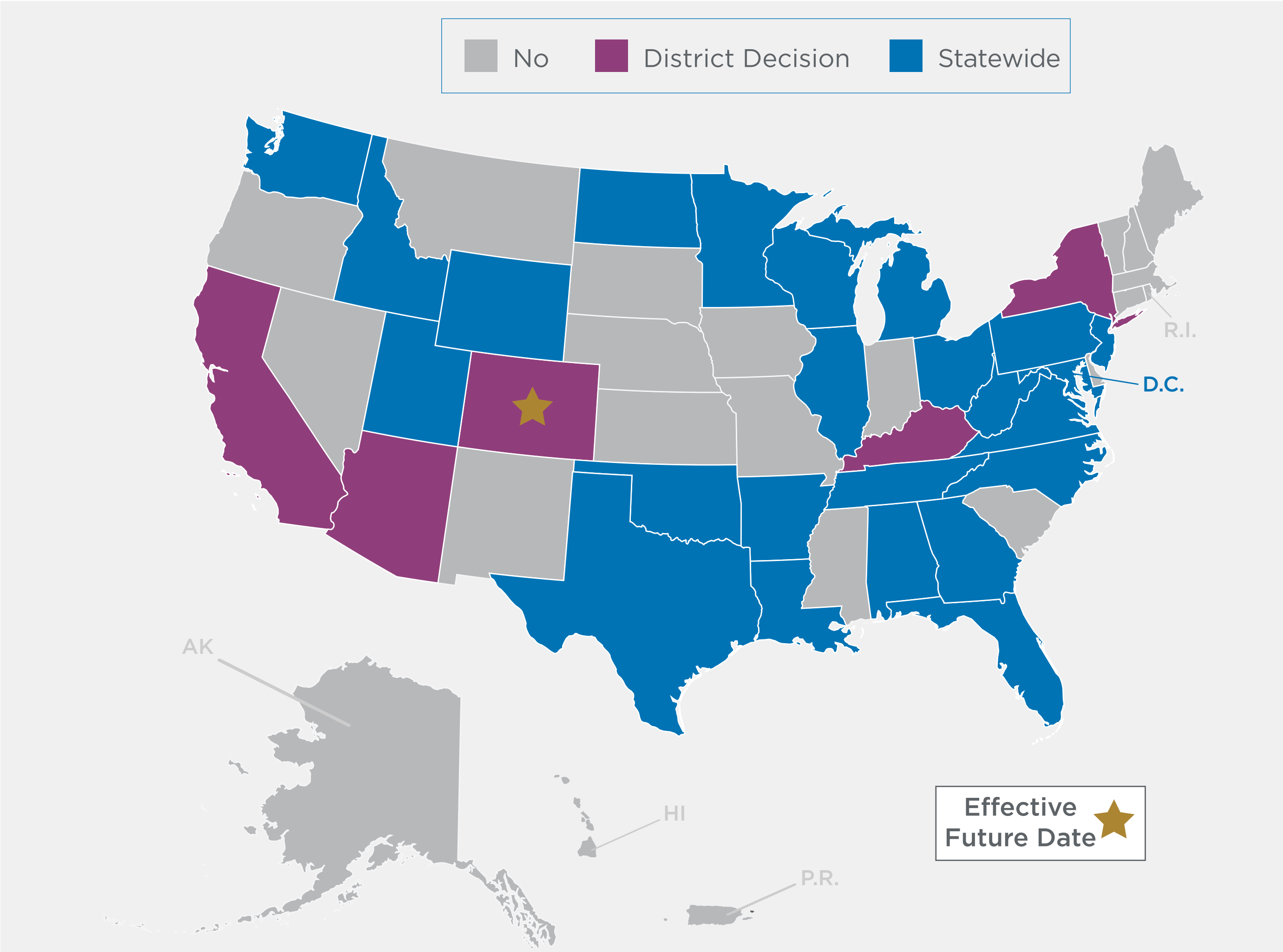
- **Phase in implementation.** Recognizing that many schools will need time to hire and train qualified instructors and develop high-quality courses, states should provide lead time before all high schools must offer CS. States may structure this lead time by either setting annual targets for the number or percentage of high schools offering CS (and targeting funding and support each year to schools that must offer CS the following school year), or simply specifying, a number of years in advance, the school year in which high schools will be expected to offer CS.
- **Develop a rollout plan, and designate someone to oversee it.** A requirement that all high schools offer CS cannot be effectively implemented without significantly ramping up CS capacity and leadership. Developing a statewide plan and appointing someone to oversee its implementation can ensure that various components supporting rollout are moving forward in tandem, and that an agency staff person is empowered to make decisions or alert decision-makers if challenges or setbacks arise.

Issues to Be Addressed

- **Long lead time:** In most states, a requirement that high schools offer CS courses will necessitate as much as several years' lead time for effective implementation.
    - **Potential solution:** States need to be sure to allocate adequate time for both state and local activities.
- **Securing adequate state funding for state activities:** Funds will be needed to develop K–12 or 9–12 CS standards and/or to create or expand teacher preparation and professional development programs, if they are not already in place.
    - **Potential solution:** States may consider supplementing state allocations with federal or private (foundation or corporate) funds, or establishing a public-private partnership.
- **Securing adequate state funding for local activities:** For high schools not already offering CS, adding a course in a new subject area will likely bring attendant costs related to purchasing adequate hardware and broadband, acquiring or developing curricula and instructional materials, and providing teacher professional development. Without dedicated state support, the new course requirement may be viewed as an "unfunded mandate" and face significant opposition from teachers, building and district administrators, and local boards.
- **Securing adequate numbers of qualified teachers:** No states currently have the teaching force needed to offer CS in every high school in the state. Rural and small high schools may be particularly challenged in locating a qualified CS teacher, or hiring a full-time CS teacher to teach one class.
    - **Potential solution:** Create short- and long-term certification options, and work simultaneously on building pre-service pathways; STEM teachers, specialists, and librarians can be recruited and provided with professional learning to teach one course at their schools. Some states have also explored online delivery models.
- **Maintaining high-quality courses and professional development:** When scaling quickly, it is important to maintain a high level of course rigor and quality and to ensure that diversity and equity goals are being met in terms of providing opportunities for deep learning.
    - **Potential solution:** A state committee or task force can evaluate curricular and professional development offerings that meet certification requirements, and provide an approved list to school districts. Take a continuous improvement perspective on scaling up, based on using data to closely monitor quality and make necessary adjustments. For local-control states, the use of data for continuous improvement can be structured for district and building level conversations.

- **CS as a graduation requirement in its own right:** Some states may want to require all students to take a CS course as a graduation requirement. However, this requirement may not be feasible to implement with high-quality courses at scale; it also may not align with college entry requirements.
    - **Potential solution:** A state plan and timeline can be effective for determining the feasibility of implementing a CS graduation requirement. A benchmark could be for the state to first scale up CS offerings such that all high schools offer CS. Once all high schools offer at least one CS course, then more courses can be added to enable all schools to have the capacity for all students to take CS before graduating.

PRIORITY #9: Computer Science Can Satisfy a Core High School Graduation Requirement



RUBRIC

For this report, a state is considered as allowing CS to count as a core graduation credit if at *least one* of the following criteria applies:

- statute or regulation requires districts to allow students to substitute a CS course for a core credit required for high school graduation,
- the chief state school officer, state department of education, state board of education, or other such entity has issued a statement, graduation guidelines, and/or FAQs that explicitly permit CS to fulfill a core credit required for high school graduation, *or*
- a statute or regulation explicitly authorizes districts to allow CS to fulfill a required core credit, but does not mandate that districts award core graduation credit for completion of CS coursework

Where Are the States on This Priority Area?

- Twenty-three states and the District of Columbia require that CS be allowed to fulfill a core graduation credit.
- Policies in four states—Arizona, California, Kentucky, and New York—delegate the decision to districts as to whether CS can count toward a core graduation requirement; these states permit but do not require districts to allow CS to fulfill a mathematics or science credit for high school graduation. These four states will be joined by a fifth state, Colorado, pending state board action (by July 2018) to adopt CS standards that will form the foundation for CS courses that may fulfill mathematics or science requirements.

As the table below indicates, most states that require or permit CS to fulfill a core graduation credit allow it to substitute for mathematics and/or science credits; a few states currently allow CS to fulfill other credit requirements, such as technology or languages other than English.

Statewide

Fulfill requirement for:	AL	AR	DC	FL	GA	ID	IL	LA	MD	MI	MN	NC	ND	NJ	OH	OK	PA	TN	TX	UT	VA	WA	WI	WV
Mathematics	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Science		X		X	X	X				X							X			X	X	X		
Other									X							X			X		X			

District Decision

Fulfill requirement for:	AZ	CA	CO	KY	NY
Mathematics	X	X	X	X	X
Science			X		X
Other					

State Levers for Action

- **Legislative action:** Fifteen states—Arizona, California, Colorado, Florida, Illinois, Michigan, Minnesota, New Jersey, North Dakota, Ohio, Oklahoma, Pennsylvania, Virginia,[19] Washington, and Wisconsin—establish these policies through statute.
- **Regulatory action:** Nine states—Arkansas, Georgia, Idaho, Louisiana, Maryland, New York,[19] Tennessee, Texas, and Utah[19]—establish these policies through state board regulations.
- **Non-regulatory administrative activity:** In seven states (Alabama, Kentucky, New York,[19] North Carolina, Utah,[19] Virginia,[19] and West Virginia) and the District of Columbia, the state commissioner of education, board of education, or department of education has issued a memo, FAQs, letter of guidance, etc. to schools and/or districts setting forth the CS courses that may be applied toward core graduation credit.

19 Action through multiple policymaking approaches.

Emerging Best Practices

- **Make sure that students get the fundamentals in core subject areas.** Many state policies seek to ensure that students have completed foundational coursework in core subject areas (for example, Algebra I or geometry for mathematics or basic lab sciences for science) before allowing a CS course to be applied as a credit substitution. Idaho and Illinois permit CS to fulfill a mathematics credit only if the student has completed Algebra II; Oklahoma and Washington students must either have completed or be concurrently taking Algebra II to allow a CS course to fulfill a mathematics credit.
- **Integrate mathematics or science standards (as appropriate) into CS coursework bearing mathematics or science credit.** To ensure that students' exposure to key content in the discipline for which the CS course is fulfilling a credit requirement, states such as Maryland and Minnesota specify that CS courses must meet state academic standards in the subject for which the CS course can substitute.
- **Ensure CS course rigor.** Some states permit only Advanced Placement (AP) CS to take the place of a mathematics or science credit. Idaho additionally allows a dual credit (dual enrollment) CS course to fulfill a mathematics or science credit. Florida requires students to also earn a related industry certification for a CS course to fulfill a mathematics or science course requirement.

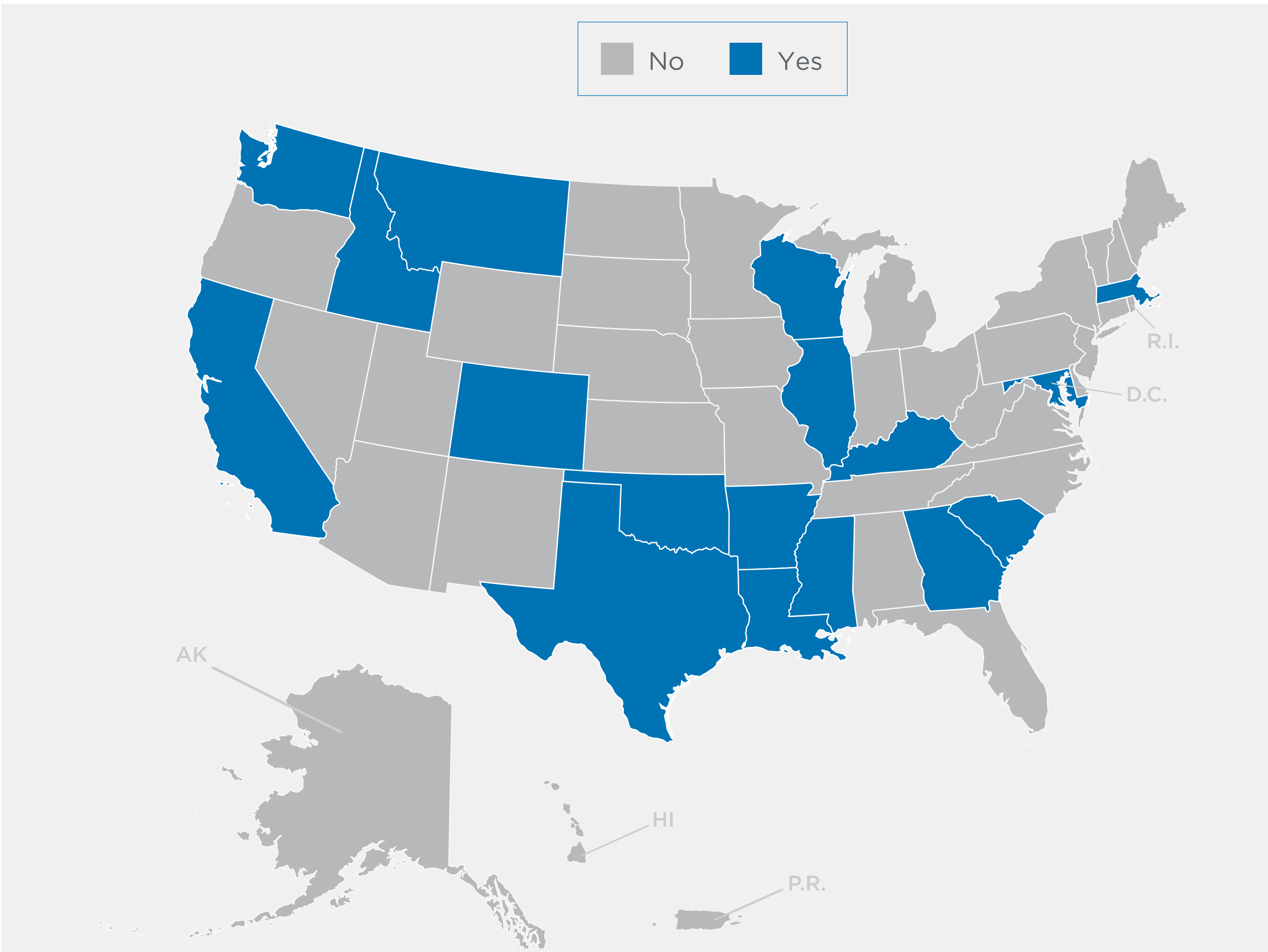
Issues to Be Addressed

- **Pre-high school CS engagement and learning:** CS course-taking choices in high school are influenced by earlier learning opportunities. Students with limited or no exposure to CS in the earlier grades may be less inclined, or prepared, to take high school CS courses that may fulfill a mathematics or science credit.
  - **Potential solution:** Some states, such as Nevada and Indiana, are expanding computing to elementary and middle school students as a way to ensure all students have access to CS. These students will be better situated for success in high school courses. Building-wide CS initiatives for elementary and middle school students also eliminates barriers to course access created by staffing, scheduling, and class time limitations in high school.
- **Limited availability of CS courses in high school:** Students cannot take advantage of opportunities to apply CS coursework toward their high school graduation requirements if they cannot access the CS courses eligible to fulfill those requirements.
  - **Potential solution:** Consider related policies encouraging or requiring all high schools to offer CS. Students could also be allowed to take CS courses at nearby schools or online.
- **Limited AP course access:** Not all schools are able to provide AP Computer Science A, which includes a 20-hour lab component. States permitting only AP Computer Science A to fulfill a mathematics or science credit may find it difficult to broaden students' access to AP Computer Science A coursework.
  - **Potential solution:** States that allow only AP Computer Science A to fulfill mathematics or science credits may consider extending policies to include AP Computer Science Principles, dual enrollment CS, or CS courses plus attainment of an industry-recognized credential.
- **CS course quality:** To ensure the value of CS courses that fulfill a mathematics or science credit, states will need to monitor the quality and rigor of the CS courses offered.
  - **Potential solution:** To aid in maintaining the quality of CS courses, states should consider the availability of rigorous state CS standards, curricula and instructional supports, teacher pre-service and/or certification requirements, and professional learning opportunities for teachers. In-service

professional development, including the availability of professional learning communities, can help to sustain ongoing support for teachers new to CS.

- **Recognition in postsecondary admissions policies:** Without an assurance that four-year institutions in their state will recognize mathematics or science credits fulfilled by a CS course, students may be disinclined to take advantage of course substitution policies.
    - **Potential solution:** States should develop these policies alongside postsecondary institution admission policies to ensure alignment. For more details, see Priority #10.

PRIORITY #10: Computer Science Can Satisfy a Core Admission Requirement at Postsecondary Institutions



RUBRIC

For this report, a state is considered to allow CS to satisfy a core admission requirement at postsecondary institutions if state policy or administrative guidelines allow CS to satisfy a required credit for admission at all public four-year postsecondary institutions in a state.

Where Are the States on This Priority Area?

- Fourteen states require all public four-year postsecondary institutions to allow CS to satisfy a core (non-elective) admission requirement in a core credit required for admission, such as mathematics, science, foreign language, or technology. For mathematics, some states permit a CS credit to be applied only if the course includes rigorous mathematical concepts and is aligned to state curriculum frameworks in mathematics (e.g., Massachusetts), if mathematics is a prerequisite (e.g., Colorado), or the course is on a state-approved list developed by a postsecondary governing authority (multiple states).
- Four states—Massachusetts, Oklahoma, South Carolina, and Wisconsin—require students to have completed specified elective units for admission at all public four-year institutions, and explicitly permit CS courses to be used to fulfill this elective requirement. In fact, South Carolina strongly recommends that the one unit elective requirement be fulfilled by a college preparatory course in CS, though the course must involve significant programming content, not simply keyboarding.

Core requirement for:	AR	CA	CO	GA	ID	IL	KY	LA	MA	MD	MS	MT	OK	SC	TX	WA	WI
Mathematics	X	X	X		X	X	X	X	X	X		X			X	X	
Science	X			X	X				X								
Technology											0.5 unit						
Languages other than English				X					X						X		
Elective									up to 2 units				up to 2 units	1 unit			up to 4 units

Eleven states (Arizona, Florida, Indiana, Kansas, Nevada, North Carolina, North Dakota, South Dakota, Utah, West Virginia, and Wyoming) have statewide or system-wide admission policies for public four-year institutions, but they do not explicitly mention CS as a means for students to complete core or elective admission requirements.

The remaining states, the District of Columbia, and Puerto Rico do not have statewide course requirements for admission to public four-year institutions. Individual public postsecondary institutions have the authority to determine course requirements for admission and whether a CS course may fulfill a core admission requirement.

State Levers for Action

- **State higher education authority:** In states with a single postsecondary system, or a statewide postsecondary governing agency or board with authority to set admission requirements for all public four-year institutions, this entity can include CS in courses that may fulfill core or elective admission requirements.
- **Legislative action:** Legislation may require public postsecondary institutions to permit CS credits fulfilling core graduation requirements to be applied toward postsecondary admission requirements.

Emerging Best Practices

- **Seek alignment between high school graduation policies and postsecondary admission requirements.** Students are well-served by policies that allow CS courses to fulfill core high school graduation requirements when those same credits may be applied toward admission requirements at public four-year institutions in their state.

Issues to Be Addressed

- **Differences between graduation requirements and admission requirements:** States that allow CS to fulfill a core high school graduation requirement do not necessarily have statewide admission policies. And states that have state- or system-wide admission policies do not necessarily require their course admission requirements to reflect the course substitutions allowed for high school graduation.
  - **Potential Solution:** Work to align statewide high school graduation requirements with statewide admission policies for states that have them. For states without statewide admission policies, work with individual university systems to align their admission policies with high school graduation policies.
- **Differences between general admission requirements and requirements for admission to specific postsecondary programs:** It is not uncommon for institutions to set admissions requirements for certain programs (including specialized STEM programs, such as engineering or CS) that exceed the courses required for admission to the institution. For example, a student who fulfills a fourth mathematics credit for high school graduation via CS instead of calculus may fall short of these program-specific admission requirements.
  - **Potential Solution:** Work within the state to ensure that these requirements are made clear; and work within schools to ensure that guidance counselors, students, and parents are well aware of these policies.

Recommendations

The following recommendations take a big-picture view of the work needed to develop and implement state-level policies for equitable K–12 CS education for all students. This report's snapshots of progress for individual policy priorities each identify best practices and recommend issues to consider that are specific to the particular policies. In this section, we return to recommendations that cut across individual policy efforts to support comprehensive, scalable, and sustainable approaches to achieving the goal of educating students for successful engagement in the world they enter after high school. These recommendations can serve as guideposts for states just beginning to develop state-level CS policy initiatives or for those working to enhance efforts that are already underway.

These recommendations build on the extensive experience and accumulated wisdom of states, districts, and national organizations that have been working at the forefront of K–12 CS education. Regardless of the particular policy approaches that states may wish to pursue, states can take advantage of resources, professional networks, and colleagues in other states to help to shape a coherent plan for K–12 CS education and sustain its effective implementation.

1. Build a broad base of leadership and ownership among key stakeholders

A thoughtful, sustained, and sustainable CS effort must be informed throughout the process by an inclusive coalition of dedicated stakeholders committed to developing well-informed policy and successful implementation of state-level scaling. It is especially important that geographically and demographically underrepresented populations be represented if all students are to benefit from state initiatives. This broad base is needed to achieve a number of critical policy activities, including the following:

- Develop and implement the state's K–12 CS strategic plan and goals
- Develop and implement the range of interrelated CS policies identified in this report, in a coherent and thoughtfully sequential way that best prepares the state to achieve its goals
- Ensure close collaboration between state-level advocates and local and grassroots advocates
- Ensure broadly shared accountability for driving sustained results based on refined versions of the strategic plan over a 10–15-year period

First movers. Elected and appointed state leaders need to be among the first movers to demonstrate that the issue of K–12 CS education is a priority for state action. The leadership of state officials sends two important messages: (1) It is worth other key stakeholders' investment of time and resources because the prospect of successfully advancing the K–12 CS agenda is significantly improved, and (2) there is the real prospect that necessary state resources will have to be mobilized to advance this agenda.

The business community also has an essential leadership role to play. Business and industry leaders understand that more and more of today's jobs require foundational CS skills and that this trend will only increase in the future. They can be strong advocates for CS education for all K–12 students, since the future success of state businesses—and the strength and vibrancy of the state's economy—relies on the availability of a local skilled workforce. Companies that cannot find qualified workers may suffer economically or even relocate to states that do have a strong CS workforce. Business leadership can be especially helpful in informing and driving adoption of state strategic plans and goals, as well as the 10 policy priorities addressed in this report.

Strategies for broadly engaging stakeholders. Each state will need to identify the key stakeholders who are particular to their context, but some key groups need to be at the table in all situations, including representatives from higher education, K–12 education, state government, nonprofit organizations, professional associations, and the business sector.

- **State summits:** At the outset of a state-level CS policy initiative, a state summit can bring together state leaders and stakeholders for initial goal setting and relationship building. During the summit, participants can begin to develop a shared agenda for the work required to ensure that all students have access to high-quality CS education.
- **State landscape reports:** Stakeholders need to have a shared understanding of the current status of CS education in their state. Landscape reports can uncover priority areas, promote ownership among certain stakeholders who are uniquely positioned to address specific gaps, and provide a benchmark against which to measure progress.[20]

2. Develop short-, medium-, and long-term strategies, with a view to coherence and sustainability

State plans must consider the short- and medium-term efforts necessary to achieve long-term goals, realizing that some strategies can be implemented in the short term as the capacity for longer-term approaches is under development. Sustained political and financial commitment is critical throughout the process.

- **Specific and measureable goals:** States should consider developing specific, quantifiable goals for a large subset, if not all 10, of the policy priorities addressed in this report. Goals should be framed such that state and local data systems can regularly and accurately measure progress toward their attainment.
- **A broad, integrated approach:** States should take into account the interrelated nature of policy priorities, and consider working on multiple, interconnected policies at the same time. For example, it may be unproductive, if not counterproductive, to focus on a requirement that high schools offer CS without considering standards for CS learning, teacher credentialing, or professional development. Planning ahead with a view to a broad, integrated approach may also minimize unintended consequences of policy adoption, on both other policies and local factors.
- **Sustained and adequate funding and staffing:** States must recognize and adequately allocate funding for the costs and staffing associated with scaling a statewide initiative in the short, medium, and long term. An absence of (or insufficient) funding or staffing can lead to episodic engagement with CS, hampering progress toward state goals and return on existing investments. States should consider using a combination of state and other funding sources, including federal, district, and private (philanthropic and corporate) funds, to adequately address funding and staffing needs.

3. Use data to inform decision-making, monitor progress, and drive continuous improvement

Good decisions need good data to guide them. At each point along the journey toward establishing policies and monitoring the quality of their implementation, data will be needed to inform decision making and action plans. States will need to identify the kinds of data that will serve particular goals within their overall plan for broadening participation in K–12 CS education to include all students. Some data may already be at hand or relatively easy to obtain; other information may require new data-gathering processes and structures.

- **Determine what data are needed:** Different data will likely be needed to monitor progress on implementation and the program impact of different CS policy approaches. Data must then be disaggregated to allow analysis

20 http://expandingcomputing.cs.umass.edu/how-change-state

related to equity and diversity: implementation and program impact related to school and district settings (rural, suburban, and urban) and students (e.g., prior academic achievement, grade level, gender, race/ethnicity, income).

- **Ensure that meaningful data can be regularly collected:** States should ensure that state and/or local data systems have the capacity to regularly collect meaningful data related to program implementation and impact. Data should inform progress toward implementation or achievement of not only long-term targets, but also short- and medium-term goals.
- **Share data with leadership early and often to monitor and adjust strategies as needed:** Actionable data should be shared with state leaders and stakeholders on a regular basis to keep them informed on both problems and progress.
- **Have multiple check-in points during longer timelines:** When setting long-term goals (e.g., development and implementation of a CS teacher certification program in statewide teacher education programs), states should establish regular check-in points to monitor progress, adjust goals and timelines, or correct their course as needed.

4. Use the growing talent pool of national expertise in national organizations and in leadership states

A number of leaders in national and state organizations, state departments of education, universities, and nonprofits have worked on advancing K–12 CS education over the past several years and are willing to share their deep expertise. For example:

- ECEP, funded by the National Science Foundation's Broadening Participation in Computing Alliance Program, supports an alliance of sixteen states and one territory and is a community of engaged state level leaders working to broaden participation in computing. Through educational intervention models, state and national gatherings, and services such as mini-grants, an expert bureau, and the exchange of resources, ECEP is an incubator for state change in CS education.
- Code.org's Advocacy Coalition consists of 27 members representing industry, advocacy groups, K–12 education, and nonprofit organizations and hosts monthly calls. With its partners, Code.org promotes state and federal policies that support K–12 computer science and provides technical assistance to state departments of education. Code.org also manages a nationwide network of 41 regional partners that provide professional development and engage in local and state-level advocacy.
- ECS is widely known and respected as a "go to" resource for state policymakers and leaders; it hosts regular CS presentations and provides customized research, reports, and counsel to states.
- The CS for All Consortium, comprising a membership of 180 organizations, is a relatively new resource that serves as a rich information hub for a number of constituencies.
- CSTA is not only an extraordinarily rich resource for the nation's CS teachers, it also serves a broad audience through its reports and annual conferences.

Our hope is that this report will serve as a resource for identifying states that are making progress on a policy priority that is of great interest to your state. Building a network of CS colleagues is the surest way to stay abreast of the many additional resources that may be able to provide assistance, maximize capacity, and avoid duplication of efforts.

Critical Issues Going Forward

1. Raise the bar

It is hard to overstate the value of the experiences that states have gained in their efforts to make CS an important part of K–12 education. In the early stage of this journey, states started relatively modestly—for example, providing CS professional development to a very small percent of the state's teachers, growing the number and diversity of students taking a high school CS course slowly but steadily, raising public awareness through state meetings and conducting landscape reports, and initiating action to adopt one or more of the policy priorities addressed in this report. As states move forward toward medium- and long-term goals, it is important to continue to raise the bar on both the scale of the effort and the quality of the CS learning opportunities available to students from kindergarten through the end of high school.

However, while these initial efforts may reflect meaningful progress for states, they are inadequate for scaling CS to achieve the twin goals of universal student access to high-quality K–12 CS education and substantial increases in the number and diversity of students pursuing CS degrees. It is time to continue early-stage activities as needed while also envisioning and preparing for a new stage of activities with a more ambitious focus, which might include the following:

- States would continue to offer CS professional development to individual, highly motivated teachers, while simultaneously engaging a group of districts within the state in a pilot program. Such pilot programs could, over a five-year period, offer K-12 standards-based CS professional development to all teachers who are responsible for STEM learning.
- A state could consider setting a five-year goal of having 25% of all high school graduates successfully complete either an AP Computer Science Principles course or an AP Computer Science A course, with at least 70% of those students scoring a three or above on the AP exam.

2. Commit sufficient funding to achieve the goal

In all but very few states, the level of funding currently available to integrate CS into K–12 education statewide reflects an early-stage "testing the waters" approach. Clearly, a new stage of activity designed to more systematically and expeditiously achieve the goals of universal access to CS courses and to prepare a larger and more diverse group of postsecondary CS majors will require a significantly greater multi-year funding commitment.

This issue has great potential to be highly contentious for a number of reasons and thus "kicked down the road," which arguably will result in considerable collateral damage, including fewer students gaining the skills they need for jobs and CS majors, fewer businesses growing at the pace they are striving to, and lost momentum among the most ardent CS supporters.

There seems to be a consensus that because states have the primary responsibility for public education, the large share of funds needed to scale CS education will need to be provided by the states. However, it also seems clear that given the precarious nature of many states' budgets, relying on state funding alone will significantly extend the timeline for statewide scaling. The business community can play a significant role in making the "business case" for supporting state funding to state leaders and also in helping to create broad public awareness and the political will to support budget appropriations. Additionally, the business community would be well-served to help states develop strategies in which strategic investments can effectively leverage state funding. Effective public-private partnerships might be the strongest basis for developing strategies to seek third-party funding from either the federal government and/or foundations and philanthropists.

3. Work toward continuous improvement

States have embarked on an ambitious goal. Providing equitable access to high-quality CS education for all K–12 students involves sustained collaboration among multiple stakeholders, development of policies that intersect and interconnect in complex ways, and support for quality implementation of those policies at scale. As states learn from each other, the policy landscape will continue to change. The snapshot of progress reported here will likely look substantially different within the year, as states continue to take on the challenge of creating a policy environment that will encourage and support high-quality CS teaching and learning. However, it is critical to capture snapshots of the landscape on a regular basis in order to make further progress by collectively understanding the policy challenges and by identifying other states that can serve as resources and sounding boards.

We still have a long way to go before each state has both a robust set of policies in place and effective approaches to implementing those policies. It is important to acknowledge the considerable progress we have made in a very short time, and also to acknowledge the importance of continuous improvement toward the goal of educating all of our children for a world highly dependent on computing skills for both personal and professional success.

Partner Organizations

Code.org is a nonprofit organization dedicated to expanding access to CS and increasing participation among women and underrepresented minorities. Its vision is to elevate CS to a core subject area and to ensure that every student in every school has the opportunity to learn this critical discipline. Code.org organizes the annual Hour of Code campaign, provides curriculum and professional learning for K–12 CS in the largest school districts in the United States, and promotes policies that support CS at the state and federal levels.

Contact: Pat Yongpradit, Chief Academic Officer (pat@code.org); Katie Hendrickson, Advocacy and Policy Manager (katie@code.org)

Education Commission of the States (ECS) is a nonprofit organization that serves state policymakers across the 50 states, the District of Columbia, Puerto Rico, and territories. ECS compiles information on education policies across the spectrum, from early learning through postsecondary and workforce, and regularly issues relevant and timely reports that provide education leaders with concise, factual overviews on these topics. ECS staff likewise provide unbiased advice on policy plans, consult on proposed legislation, testify at legislative hearings and interim committees as third-party experts, and convene education leaders within their states and across states to interact, collaborate, and learn from one another.

Contact: Jennifer Dounay Zinth, Director of High School and STEM (jzinth@ecs.org)

Education Development Center, Inc. (EDC), is an international nonprofit with over 1,000 employees who design, research, implement, and evaluate programs to improve education, health, and economic opportunity worldwide. Collaborating with both public and private partners, it strives for a world where all people are empowered to live healthy, productive lives. EDC has worked in 60 countries around the world and in all 50 U.S. states.

Contact: Lynn Goldsmith, Distinguished Scholar (lgoldsmith@edc.org)

Expanding Computing Education Pathways (ECEP) is an NSF-funded Broadening Participation in Computing Alliance. ECEP seeks to increase the number and diversity of students in the pipeline to computing and computing-intensive degrees by promoting state-level CS education reform. ECEP supports an alliance of 16 states (Alabama, Arkansas, California, Connecticut, Georgia, Indiana, Maryland, Massachusetts, Nevada, New Hampshire, North Carolina, Rhode Island, South Carolina, Texas, Utah, and Virginia) and Puerto Rico in identifying and developing innovative, effective, and replicable educational interventions and in implementing and expanding state-level infrastructure to drive educational policy change.

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Massachusetts Computing Attainment Network (MassCAN), housed at EDC, works to provide every student with an opportunity to learn CS and to inspire and prepare a larger and more diverse group of students to pursue CS at the postsecondary level. MassCAN has collaborated with the Massachusetts Department of Elementary and Secondary Education (DESE) to develop K–12 Digital Literacy and Computer Science Standards and is currently working with DESE to develop CS teacher licensure standards and pathways.

Contact: Jim Stanton, Executive Director (jstanton@edc.org)

SageFox Consulting Group, based in Amherst, Massachusetts, has supported the evaluation of over 200 projects focused on changing the educational landscape. Projects associated with CS education have focused on developing academic pathways; increasing access for historically underrepresented populations; implementing innovative practices, curricula, and new technologies; assessing the scaling and sustainability of teacher professional development; and developing effective strategies for institutional and state-based change.

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