

Budgeting for climate change: obstacles and opportunities at the US state level

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ABSTRACT

State governments in the United States are well placed to identify opportunities for mitigation and the needs for adaptation to climate change. However, the cost of these efforts can have important implications for budgets that already face pressures from diverse areas such as unfunded pensions and growing health care costs. In this work, the current level of spending on climate-related activities at the state level are evaluated and policy recommendations are developed to improve financial management practices as they relate to climate risk. An examination of state budgets reveals that climate mitigation and adaptation activities represent less than 1% of spending in most states. The data collection highlights the obstacles to collecting accurate spending data and the lack of budgetary and accounting procedures in place. More importantly, the difficulty in benchmarking these activities poses challenges for the analysis of state-level policies as well as planning and modelling future climate-related spending. Other policy contexts, including public pensions and infrastructure, can provide guidance on budgetary and accounting tools that may help states prepare for and more efficiently manage climate-related expenditures.

Key policy insights

- Climate change mitigation and adaptation will require substantial investments across many levels of government on a wide range of activities.
- Currently, US states are not clearly demarcating climate expenditures, hindering the identification of climate-related budgetary risks.
- In the absence of guidelines, these longer term fiscal outlays may remain chronically underfunded in favour of more near-term spending priorities.
- Establishing appropriate financial management and data collection practices is important for more sophisticated cost-effectiveness and policy analyses.

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1. Introduction

Following the 2015 Paris Agreement, there is increased international momentum for climate action and a greater understanding of the costs associated with tackling the problem, namely reductions in greenhouse gas (GHG) emissions and adaptation to the impacts of climate change. While the full extent of the costs remains highly uncertain (Peake & Ekins, 2016), the figures put forth in the decision accompanying the Paris Agreement (decision 1/CP.21) highlight the magnitude of the financial risk, with a target of \$100 billion per year by 2020 in financial assistance for mitigation and adaptation activities in developing countries (United Nations Framework Convention on Climate Change, 2015). Given the scale of these challenges and the need for international coordination and communication, central government agencies have taken the lead in developing climate policies (Fawcett et al., 2015),

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and consequently have been the focus of much of the academic and policy literature (e.g. Ekins & Speck, 2014). Yet, despite the leading role that central governments are expected to play in climate efforts, the activities of subnational governments will be crucial as well, as they are uniquely positioned to identify opportunities for mitigation and the need for adaptation (Corfee-Morlot et al., 2009; Lutsey & Sperling, 2008). Additionally, in many countries, national and subnational governments can diverge substantially in terms of their willingness to pursue climate policy, such as the shift in climate policy between the Obama and Trump administrations at the US federal level (Executive Order No. 13783, 2017) and the stringent emission limits adopted in California (California Global Warming Solutions Act of 2006: emissions limit, 2016).

This paper addresses a gap in the literature by identifying the existing climate change activities and related budgetary commitments of state governments in the United States, highlighting in particular the role of financial management practices. This effort builds on previous work at the federal level and complements existing model-based estimates of mitigation and adaptation costs. While economic models are useful for estimating the costs of climate change and the efficacy of various policy options, they are sensitive to input assumptions (IPCC, 2014), and not a replacement for empirical work documenting the current level of expenditures, particularly at the subnational level.

Under the US federalist system, the federal government devolves responsibility for many functions to state and local governments, including some policy areas that are highly relevant for climate policy. State governments bear primary responsibility for infrastructure financing and development as well as many aspects of environmental policy (Rabe, 2013).¹ Of the \$416 billion of public sector spending on water and transportation infrastructure in 2014, 77% (\$320 billion) came from state and local governments (Congressional Budget Office [CBO], 2015).

Moreover, the federalist system permits states to enact programmes or regulations that are more stringent than those at the federal level; indeed, California has taken the lead with innovative climate policies as well as renewable energy and energy efficiency initiatives (Byrne, Hughes, Rickerson, & Kurdgelashvili, 2007). Such decentralized provision may be economically efficient. Tiebout (1956) points out that centralized provision of public goods is less effective at addressing heterogeneous preferences among the residents of different communities. Decentralization also promotes innovation and experimentation, which may lead to more explicit recognition of the costs of programmes (Oates, 1999).

Despite the merits of addressing certain aspects of climate change at the subnational level (Wheeler, 2008), the substantial variation in state capacities and procedures presents some challenges. If states develop practices independently to track and budget for climate risks, the lack of common metrics and reporting may hamper efforts at communication and planning. Moreover, states vary widely in their political appetite for climate spending as well as their exposure to risks. These challenges highlight the need for a conceptual framework and a set of principles to guide state financial management practices as well to serve as the foundation for more sophisticated policy analyses. With several states forming the United States Climate Alliance with the aim of upholding the Paris Agreement,² this need is greater than ever.

Starting with a classification of common subnational climate activities, this paper examines state budgets for climate-related spending and highlights several of the challenges involved in tracking state budgetary commitments, including (1) a lack of programme-level detail in state budgets, (2) disagreements around what constitutes climate policy and (3) political realities that compel some states to avoid explicitly identifying certain activities as climate-related. After discussing these complications, the paper proceeds to examine other policy areas, namely pensions and infrastructure, to offer guidance regarding budgetary and accounting practices. Finally, the paper offers recommendations to enhance the accuracy and transparency of state-level budgetary information and better identify the long-term financial risks posed by climate change.

2. Methods and data

2.1. Classifying climate change activities

In Table 1, common state-level climate activities undertaken by subnational governments related to climate change mitigation and adaptation are classified by policy instrument and the key targeted sectors. The

Table 1. Climate policies that are frequently adopted state-level by policy type and sector.

Policy instrument	Climate actions	Energy sector	Transport sector	Building sector
<i>Economic Instrument: Taxes</i>	N.A.	Income, sales and property tax incentive programmes for renewable energy/carbon capture and storage [45]	N.A.	Property assessed clean energy (PACE) [41]
<i>Economic Instrument: Tradable Allowances</i>	Regional initiatives [13]	Renewable Energy Credit tracking systems [50]	N.A.	N.A.
<i>Economic: Subsidies and Loans</i>	Financial incentives to utilities for demand-side resources [50 & DC]	Energy efficiency rebates [50 & DC] Loan programmes for energy efficiency, renewable energy, & combined heat & power [48 & DC]	Mandates, incentives for biofuels [45]	PACE loans for energy efficiency, renewable energy, combined heat & power – commercial properties [31 & DC]
<i>Regulatory Approaches</i>	Standards & caps for GHG for energy, transportation and land-use [40]	Net metering policy [44/DC/4 terr.]	Plug-in electric vehicles [45]	Green building standards for state buildings [44] Appliance efficiency standards for those not covered by federal standards [12 & DC]
<i>Information Programmes</i>	GHG reporting & registries [43]	Energy efficiency programmes [48 & DC]	N.A.	N.A.
<i>Government Provision of Public Goods or Services</i>	N.A.	Public benefit funds for research and development [29 & DC]	N.A.	N.A.
<i>Voluntary Actions</i>	N.A.	Energy efficiency goals [4]	N.A.	N.A.

Sources: N.C. Clean Energy Technology Center's Database of State Incentives for Renewables & Energy Efficiency (N.C. Clean Energy Technology Center, 2016); N.C. report on distributed solar policy (N.C. Clean Energy Technology Center, 2015); State Initiatives from the Center for Climate and Energy Solutions (2014) and the US Environmental Protection Agency's reports on state policies for renewable energy, energy efficiency and combined heat & power (United States Environmental Protection Agency [USEPA], 2015) and carbon dioxide emission reductions in the power sector (USEPA, 2014).

Note: In brackets is the number of states that have adopted that policy.

number of states currently pursuing these policies is also listed. The categories are based on the classification of policy instruments by the Intergovernmental Panel for Climate Change (IPCC) (Somanathan et al., 2014): taxes, tradable allowances, financial incentives (loans and subsidies), regulatory approaches, information programmes, government provision of public goods and services, and voluntary actions. The policy activities are divided into four sectors: climate action, energy, transport or building, following the policy map from the Center for Climate and Energy Solutions (C2ES) (2016). The C2ES classification is especially appropriate as it is designed for US states. The lack of standardized identification of climate activities by US states constrains what is captured in this framework. As discussed further below, however, the lack of detail in the budget documents presents a greater limitation.

The largest sector is climate action, which encompasses mitigation and adaptation policies that are state-wide or affect multiple sectors, such as those outlined in Climate Action Plans and Climate Adaptation Plans. Examples include performance standards or caps on emissions for the entire electricity generation sector, participation in a regional cap and trade arrangement or requirements for integrated transportation/land-use planning. The other sectors highlight mitigation policies in specific sectors, such as energy efficiency and renewable portfolio standards, tax incentives for low and zero emission vehicles, and building codes. For example, 'tax credits or rebates for solar installations' are classified as a targeted energy sector subsidy.

The classification into different sectors highlights the fact that adaptation planning is less widely implemented than mitigation; while 34 states have climate action plans with mitigation-related activities, only 15 states have adopted climate adaptation plans, with 5 more in progress (C2ES, 2016). State-level adaptation activities generally fall into one of four categories: research and education; facilitation of existing policies and programmes that improve resilience; integration of adaptive measures into existing planning processes; and development of new policies that reduce vulnerability (Bierbaum et al., 2013). These activities are spread over agriculture, forestry, built environment, disaster preparedness, energy, health, communication, natural environment, professional services, transport and water (Georgeson, Maslin, Poessinouw, & Howard, 2016).

For US states, adaptation activities as identified in the Climate Adaptation Plans generally fall under infrastructure planning or environmental conservation; however, as these activities are spread over multiple sectors and are often integrated into existing programmes, expenditures are not always clearly delineated in state budgets.

Regulatory approaches are the most common policy instrument. Tradeable allowances are less common, though all 50 states participate in the renewable energy certificate tracking system. Government provision of services is rare. Furthermore, the energy sector is the most frequent target; energy policies exist across every type of policy instrument. This is in part because most of the policies in [Table 1](#) are related to mitigation, and energy usage is the primary source of GHG emissions. The frequency of regulatory approaches highlights an aspect of climate policy that may not be fully appreciated outside of a budgeting context; while all policy instruments carry costs, only some carry *direct* budgetary costs – i.e. outlays on the part of the government. The primary cost of regulation falls on the private sector in the form of increased compliance costs. While the focus here is on direct budgetary costs, the costs of regulatory compliance for the private sector are substantial, in some cases exceeding the government costs by a large margin, and consequently, the financial burden on state governments going forward will depend largely on the extent to which they rely on regulation vs. other policy approaches.

Certain climate-related activities may fall outside the boundaries of those categories identified above. For example, agriculture policies, such as policies designed to reduce fertilizer usage, or urban planning may see mitigation and/or adaptation as a co-benefit, but are not primarily identified as climate-related in state budgets, and as a result, these activities are not included in the spending estimates. Disaster management is another example. Climate change is expected to increase the frequency of extreme weather events, and as a result, a large part of climate-related spending may be related to disaster preparedness and response. Nevertheless, the federal government absorbs the majority of this financial risk (Lashof & Stevenson, 2013), and even in cases where states expend funds on disaster management, it is difficult to disentangle what proportion of the spending should be allocated to climate policy. Excluding these categories may render the estimates in this work inconsistent with other research on climate finance; however, as discussed below, a major challenge to establishing best practices is the lack of consensus and definitions for climate-related spending.

2.2. Identifying budgetary commitments for climate activities

Expenditure data are crucial to understanding the extent of states' commitments to combat climate change. This paper categorizes expenditures as either operating expenditures, capital expenditures or tax expenditures (foregone revenues). Estimates are drawn from the most recent available budget, generally fiscal year 2015 or 2016 with a small number from 2014. The data collection process and a list of the budget and tax expenditure documents used as sources are detailed in Supplemental Information (Sections S1, S2 and S3, respectively).

In most states, the environmental or natural resources department is the primary source of climate-related expenditures. A few states present estimates in their Climate Action Plans, but these are not uniformly available. States' enacted operating budgets take the form of appropriations bills passed by the states' legislatures and signed by the governor. Budgets may take the form of a single bill or, as with the US federal government, multiple bills. Capital budgets were also searched for expenditures related to energy efficiency and environmental protection. When no observable climate-relevant expenditures were identified in the capital budgets, emails were sent to state capital budgeting offices, requesting any relevant information. Appropriations drawn from federal funds were excluded; that is, the estimates include only appropriations from a state's own revenue sources.

Tax expenditures represent tax exemptions, deductions or credits that promote certain types of activities. Well-known examples in the US federal income tax code include the mortgage interest deduction and the exclusion of employer-provided health insurance. To obtain data on state tax expenditures, state tax expenditure reports were examined. Unlike operating and capital budgets, tax expenditure reports typically include specific descriptions, enabling easier differentiation of expenditures related to climate policy. Almost all of the tax incentives recorded were targeted towards mitigation activities, such as emissions reduction initiatives, rather than adaptation efforts.

3. Results: estimates of current state-level spending

3.1. Challenges and obstacles to data collection

Tracking climate spending – either across states or over time – is challenging; while the majority of climate-change efforts occur in departments of environment or natural resources, some adaptation and mitigation activities are funded by other departments and in other guises. Part of the reason for the absence of organization and coordination in reporting may be that some states have received little guidance on how to do so. They may also have an incentive to obfuscate climate spending. Consequently, the budget amounts presented in [Figure 1](#) represent rough estimates and capture only those activities whose primary purpose is relevant to climate policy and that could be mapped from budget documents.

Comparing expenditure data across US states is also complicated by the substantial variation in budget definitions and processes. All states have some form of operating budget, but only 24 states produce a separate

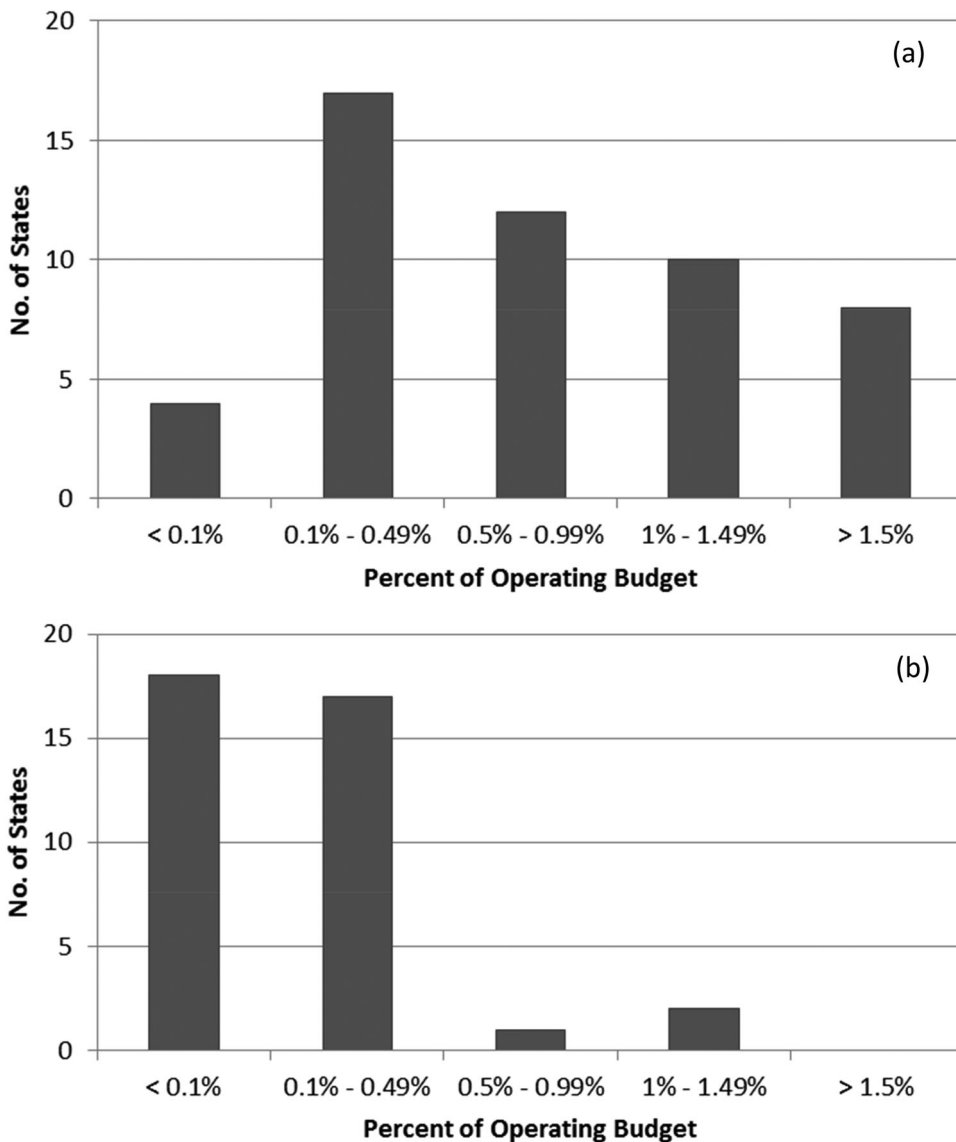


Figure 1. Estimated state expenditures in climate change efforts: (a) operating and capital expenditures; (b) tax expenditures.

capital budget. Four states do not report any tax expenditure information. In fact, a 2014 report on capital budgeting by the National Association of State Budget Officers notes that the vast differences in state capital budgets are partly attributable to differences in ‘basic terms, concepts, measures and policies’ (2014). While the largest differences are found in capital budgets, significant differences exist in the scale and scope of operating budgets and tax expenditure reports. Such large differences make it difficult to compare spending estimates across states or draw conclusions about spending in the aggregate.

Enacted budgets are intended as legally binding directives on spending. While these budgets contain more detailed expenditure data than other sources, the level of detail is still not always sufficient to identify line-items as climate-related. States primarily report spending at the sub-department or department-function level rather than at the programme level. For example, the FY 2015–2016 budget for Colorado indicates that the state Department of Public Health and Environment performs some activities clearly related to mitigation and adaptation (e.g. implementing strategies aimed at reducing emissions) while also performing other functions (e.g. immunization outreach programmes) that are clearly unrelated. Estimating the proportion of relevant spending requires cross-referencing various parts of the appropriations bill and in some cases involves a degree of guesswork. A further complication is that some climate-related activities overlap with other purposes; for example, experts may disagree about the extent to which spending on wetland restoration represents climate adaptation; further, its impact may be very site specific (Erwin, 2009). An additional concern is that while some states have shown a willingness to adopt climate policy, explicit climate policy may be politically unpopular in other states. As a result, we cannot rule out the possibility that in some states, policies that address climate change are concealed under other labels.

3.2. Operating and capital expenditures

Figure 1(a) presents climate-related operating and capital expenditures as a percentage of each states’ total budget. The figure combines the two categories since only 24 states utilize a separate capital budget to explicitly distinguish between operating and capital expenditures. Since capital budgets are primarily debt-financed, and the cost of borrowing is included in operating budgets, the denominator consists only of the operating budget total. More detailed estimates of capital and operating spending are found in Supplementary Information (Section S3).

Operating expenditures comprise the majority of government spending. These expenditures support ongoing projects and policies, including employee salaries and maintenance of infrastructure. Capital expenditures typically represent expenditures on capital projects with expected useful lives of 10 years or more, though definitions vary. For state governments, capital spending is typically for physical infrastructure, including schools, dormitories, government buildings, bridges and roads.

In the budget documents, climate activities comprise less than half of 1% of spending for 21 states. Eight states – California, Florida, New Jersey, Delaware, Missouri, New Mexico, Nevada and New Hampshire – spent more than 1.5%; notably, five of these eight states are coastal. For comparison, states spend approximately 1% of their budgets on public assistance and 5% on corrections.³ More than half of state spending goes to education and health care (Center on Budget and Policy Priorities, 2017). The majority of climate spending appears in the operating budgets; for states with capital budgets, the average amount of capital spending represents approximately 0.21% of the annual operating budget.

3.3. Tax expenditures (foregone revenues)

Figure 1(b) shows tax expenditures as a percentage of the operating budget. Tax expenditures, sometimes referred to as ‘spending through the tax code’, represent revenue that is foregone as a result of tax deductions, exemptions, credits, preferential rates or exemptions. Foregone revenues can have significant budgetary consequences; at the federal level, the sum total of tax expenditures is equal to nearly half of all federal revenues and exceeds spending on Social Security, defence or Medicare (CBO, 2016). Exemptions at the federal level typically apply to the personal or corporate income tax; at the state level, they also frequently apply to sales or property taxes. One common example for climate is the exemption of low-emitting vehicles from state sales tax.

Relative to operating and capital expenditures, the tax expenditures related to climate policy are low. Michigan ‘spends’ the most with \$344 million in tax expenditures, the bulk of which are for vehicle battery credits. More detailed estimates are presented in Supplementary Information (Section S5).

4. Better budgets for climate efforts

Given the results presented above, it is difficult to draw strong conclusions about whether states are devoting sufficient financial resources to meet the challenges posed by climate change. Furthermore, the existing estimates of mitigation and adaptation costs are too imprecise to benchmark these values (e.g. Rosen & Guenther, 2015; Sussman et al., 2014). It is clear, however, that states do not have good resource allocation methods in place. To provide some guidance, this section reviews financial management practices that have been used to address budgetary challenges in other areas, namely pensions, infrastructure, pollution remediation and federal climate policy.

4.1. Public pensions

Although public defined-benefit pension plans have been in place since the early twentieth century, the liabilities related to these plans have not always been transparent, despite the fact that unfunded pension liabilities represent one of the most serious challenges to the long-term fiscal health of state governments. According to some of the most recent estimates, state governments on aggregate face approximately a trillion dollars in unfunded pension liabilities (Pew Charitable Trusts [PEW], 2016a) and a further 600 million dollars in unfunded retiree health care benefits (PEW, 2016b).

In 1997, the Government Accounting Standards Board (GASB) introduced accounting standards that required states to report on their pension funding progress. In their financial statements, states were to report an annual required contribution – an amount calculated by actuaries necessary to cover the benefits earned by employees in the current year as well as cover a portion of unfunded liabilities. This made it possible to track whether states were in fact contributing the ‘required’ (in reality, recommended) amount towards their pensions. Notes to the financial statements also revealed the funding ratio – the ratio of assets set aside for pensions divided by the liabilities. Further progress came in 2012, when GASB required that states report the full extent of pension liabilities on their balance sheets.

While pensions remain a significant fiscal pressure, especially in the aftermath of the financial crisis, states have made significant progress in funding their pensions, which many attribute to the increased transparency. Since the mid-1990s when GASB changed the way state governments report on pension funding, assets per worker have increased markedly and the funding status of public plans has generally looked similar to that of their private sector counterparts (Munnell, Haverstick, Sass, & Aubry, 2008). These reporting changes assisted journalists and researchers in assessing governments’ ability to meet their pension commitments and enabled policy-makers to better assess current and future spending pressures. In short, increases in transparency led to improvements in funding. This is consistent with findings across the public administration literature that budget transparency improves fiscal outcomes and leads to greater public approval (Cucciniello, Porumbescu, & Grimelikhuijsen, 2017), in part because it leaves less room for politicians to act opportunistically (Benito & Bastida, 2009). Research at the US state level has reached similar conclusions. Alt, Lassen, and Skilling (2002) found that more transparent fiscal institutions among US states induce greater effort by politicians, to whom voters then give higher job approval ratings.

4.2. Infrastructure

During the same time period, the GASB also developed guidelines for tracking infrastructure-related spending and assessing the extent of underinvestment. As infrastructure shortcomings may contribute to the financial burden posed by climate change, these guidelines may be especially relevant. In 1999, GASB released Statement No. 34, which required states to include the value of all infrastructure on their balance sheets and report depreciation expenses. Initially, the task of reporting all capital assets seemed to pose a substantial burden. Today, all

state and local governments report on infrastructure, enabling analysts both inside and outside government to assess whether current spending is sufficient to maintain the existing level of capital assets. Just as greater transparency around the extent of pension liabilities has improved funding in that area, there is some evidence that adding infrastructure data to government financial reports has benefited managers and improved the legislature's understanding of infrastructure management (Kraus, 2004).

There are two ways that governments can report on their infrastructure. Here, climate risk consideration could be integrated into the existing reporting framework. If a government can show that infrastructure assets are preserved at or above a certain level, they may report annual maintenance and preservation expenses instead of depreciation. Through this 'modified approach', it is possible to assess the overall status of major groups of infrastructure assets, as well as how conditions have changed over time. For example, the 2015 Comprehensive Annual Financial Report of Kansas City reveals that street lighting and to a lesser extent bridges in the city have been well maintained (97% of street lights in good or better condition in 2015), while the roadway system is in poor shape (57% in substandard condition) (City of Kansas City, 2015). If a government instead reports depreciation, analysts can calculate the ratio of depreciation divided by the total assets being depreciated, giving an estimate of whether – over time – assets are being depreciated faster than they are being replaced.

4.3. Pollution remediation

GASB has also developed standards for pollution remediation. While nowhere near as significant of a liability for state governments as pensions, pollution remediation obligations were not previously reflected on state financial statements, which in some cases meant that states were not offering an accurate portrait of their financial condition. In 2006, GASB issued accounting and financial reporting standards for pollution remediation obligations (GASB Statement 49). The aim was to improve the 'comparability of financial statements by requiring all governments to account for pollution remediation obligations in the same manner' (GASB, 2006). Upon identifying a liability, a state's balance sheet must show those components of the remediation that are 'reasonably estimable' as well as the nature of the outlays that are not reasonably estimable. In other words, if the extent of certain outlays cannot be estimated, then the state must describe them and explain why. The liabilities are recorded at the present value of the costs the government expects to incur to perform the work. These standards apply only to existing pollution rather than to pollution prevention or future pollution remediation activities. Analogously, if states in the future become legally responsible for mitigation or adaptation activities, then in theory these liabilities should also be reflected on state balance sheets. As with pollution remediation, the state would not need to account for *future* climate adaptation expenses, but only those that the state was currently responsible for under the law.

4.4. Federal reporting on climate change expenditures

The examples above illustrate how state governments have confronted financial management challenges in other high-risk areas; however, the extraordinary scope of climate change may require more extensive reporting requirements than those outlined above. Climate change affects a large number of departments and involves a wide range of regulatory and funding approaches; pensions and infrastructure are more narrowly defined and more straightforward in their reporting. For these reasons, this section reviews the US federal government's approach to budgeting and reporting on climate change expenditures. Analogies between budgeting and reporting at the state and federal levels will be imperfect – not just because of differences in the nature of the expenditures, but also because the budgeting process of the US federal government differs from state governments. However, federal processes may offer useful guidance that the other examples do not in terms of the classification of spending and the nature of the reporting.

Since 2002, federal law has periodically required the Office of Management and Budget (2013) to report on federal climate change expenditures. According to the Congressional Research Service (CRS), these reports are produced only when specifically required by legislation; the last such report was produced in August 2013 as a result of language included in FY 2012 appropriations (Leggett, Lattanzio, & Bruner, 2013). The federal report as

well as the Climate Action Plan announced by the Obama administration are organized into four main areas: research and education, clean energy investment to reduce emissions, international assistance to developing countries and climate change adaptation. Between FY 2008 and FY 2013, direct federal funding to address global climate change totalled \$77 billion, approximately 0.4% of federal outlays over the time period. More than 75% has funded technology development and deployment, primarily through the Department of Energy. Tax provisions that may reduce GHG emissions represented an additional \$9.8 billion in foregone revenues.

In their analysis of the federal report, the CRS identified several issues that render the spending estimates imprecise, including:

the level of aggregation of the budget request, changes in scope of what is reported, changes in accounting methods used over time, inconsistencies across agencies in defining and interpreting methods for reporting activities; lack of description by agencies for subaccount level climate-change related activities in their budget documentation; and omissions of reporting of some arguably climate-related activities in the overall program. (Leggett et al., 2013)

This is consistent with questionnaire responses indicating that ‘methods for defining and reporting climate change funding are not reported consistently across the federal government’ (Government Accountability Office [GAO], 2011).

These challenges led GAO and others to recommend an integrated budget review process that uses more consistent reporting. Given inconsistencies and varying definitions, it is unclear how useful the data in the current ‘budget cross-cut’ are. More importantly, the existing data do not appear to have played a role in the budget review process; while the reporting represents an attempt to quantify the aggregate level of climate spending and better understand how spending on different initiatives has changed over time, this information was not referred to in the annual appropriations process nor linked to strategic goals.

Part of the reason that the federal government lacks an integrated budget review process is that there is no strategic plan in place for combating climate change. In the face of the political controversy surrounding climate change in the United States, it is impossible to integrate the current reporting efforts into a strategic resource allocation process. As GAO writes,

without further improvement in how federal climate change funding is defined and reported, strategic priorities are set, and funding is aligned with priorities, it will be difficult for the public and Congress to fully understand how climate change funds are accounted for and how they are spent. (GAO, 2011)

Indeed, the federal government’s experience suggests that before budgeting metrics and financial reporting can be expanded, states must come to closer agreement on actions to combat climate change in addition to definitions and reporting goals.

5. Summary and recommendations

This paper’s aim has been to categorize and benchmark the current level of state spending on climate mitigation and adaptation. State budgets currently provide little detail on climate-related activities, making it difficult to assess state responses to climate change. Furthermore, without sound budgeting and financial reporting practices, it will be challenging for states to move forward with effective climate policies. While spending estimates are imprecise, they suggest that states are allocating only very small fractions of their overall budgets to climate activities. The majority of states (21) are currently spending less than 0.5% of their operating expenditures on mitigation and adaptation. Only eight states are spending more than 1.5%. The bulk of this spending is in the form of operating expenditures; by comparison, the spending detailed in capital budgets and tax expenditure reports is fairly negligible. These estimates reflect direct outlays and foregone revenues; they do not capture the costs of regulation on the private sector, nor do they account for ‘anti-climate policies’, such as tax breaks for fossil fuel industries, that may increase future costs (Compston & Bailey, 2013). At the same time, this study also reveals that states do not provide a very high level of granular detail in appropriations bills, and even when they do, it is very difficult in some cases to isolate spending that is undertaken for mitigation and adaptation purposes. Many activities which directly and indirectly address climate change may be included in the budgets, but are not referenced or categorized.

In light of the budgetary risks that states face from climate change and the lack of financial management practices in place to combat these risks, accounting and budgetary practices in other contexts may provide useful guidance. This paper reviewed guidelines pertaining to state pension spending, state infrastructure spending, pollution remediation efforts and federal climate change expenditure reporting. What lessons do they offer?

1. Transparency around budgetary risks can lead to better funding practices. The effect of GASB reporting standards is more evident for public pensions than infrastructure, possibly because pension liabilities are more easily measurable.⁴ Nevertheless, transparency around liabilities has increased the pressure on state legislators to address shortfalls and clarified the financial trade-offs involved. If GASB – or the states themselves – can bring greater transparency to climate preparedness, and in so doing highlight the costs of doing nothing, then it may well improve efforts at adaptation and mitigation.
2. States can benchmark funding progress. Existing standards related to infrastructure and pollution remediation are illustrative here. States have detailed records on their capital maintenance costs and on the amount of capital assets being depreciated, and they are already required to account for pollution remediation obligations. There is no reason why they cannot keep similarly detailed records on, for example, assets at risk from extreme weather damage.
3. It is challenging – if not impossible – to establish a useful budgeting and reporting framework without first coming to agreement on long-term goals. So long as the politics around climate change are divisive, and with no shared understanding of priorities, attempts at useful cross-cutting budget frameworks may remain elusive.

In the climate context, greater transparency may provide ammunition for opponents to press for the elimination of programmes, and so some caution on this point is in order. However, in states where the politics are less divisive – or the environmental needs are more pressing – there may be more and earlier opportunities to establish greater transparency and financial benchmarks. What guidance should they follow? First, all states can report a schedule of condition assessments and maintenance costs to highlight the condition of infrastructure subject to climate risk, something some states already do using the modified approach for infrastructure reporting. This would give legislators, the media and the public an opportunity to better gauge the efforts of the government and hold them accountable. If states had credible estimates for the decline in the value of these assets over time, then they would be able to quantify the amount of funding that is needed to maintain assets and potentially compare these costs to alternative climate policies, a process that would likely bring greater attention to the costs of inaction. Second, states can develop a cross-cutting budget that collects spending on adaptation and mitigation in one place. As the financial costs associated with climate change become more consequential, a document that better enables legislators to evaluate trade-offs within and among different areas of climate spending – rather than just relative to the rest of the budget – may result in more targeted and efficient expenditures.

Two limitations of this study also point the way to future research. First, there are a wide range of policies that can have implications for climate change, although this may not be the sole or primary goal, such as public transit. A classification scheme that is more detailed than the one developed here could improve the identification of the gaps between climate policies and funding. In fact, the United States Climate Alliance may provide an opportunity to harmonize the reporting practices. Second, the substantial variation in both state reporting practices and climate policy initiatives presents an opportunity to draw lessons regarding financial management from individual state experiences, a topic that has so far received little attention.

This is just a start; there are far more components to effective budgeting and reporting practices than can be addressed here. For example, the United Nations Development Programme (2015) has developed a set of climate finance recommendations, known as CPEIR (Climate Public Expenditure and Institutional Review) for central governments in developing nations. While this paper highlights many challenges, the lack of budget coordination also represents a significant opportunity for states; by building capacity in their budget offices and improving the quality of information available, states may be able to realize considerable efficiency gains and facilitate more sophisticated policy responses. These efforts cannot be accomplished through the

effort of the scientific community alone. Partnerships between the budget office and environmental agencies are necessary, as budget offices can play a key role in organizing cross-agency efforts. This paper represents one attempt at facilitating communications between agencies and providing a starting point for reform.

Notes

1. Local governments also face budget pressures from climate change. The many different kinds of municipal governments in the United States and their overlapping structure make it more difficult to offer general recommendations. We leave this topic for future work.
2. At the time of publication, 13 States (California, Colorado, Connecticut, Delaware, Hawaii, Massachusetts, Minnesota, New York, Oregon, Rhode Island, Vermont, Virginia, and Washington) and Puerto Rico are members of the US Climate Alliance. New York Governor's Press Office (5 June 2017). United States Climate Alliance Adds 10 New Members to Coalition Committed to Upholding the Paris Accord: <https://www.governor.ny.gov/news/united-states-climate-alliance-adds-10-new-members-coalition-committed-upholding-paris-accord>.
3. Corrections spending at the US state level includes the cost of operation and employment for prisons, probation, and rehabilitation of adults and juveniles.
4. Pension costs are not without uncertainty, however. Estimating pension liabilities requires a number of assumptions about mortality rates, salary increases and investment returns, and there remains disagreement about how such liabilities should be calculated.

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