
Report Prepared for the

Wyoming School Facilities Department

November 30, 2014

Authors:

Robert Godby
David Aadland
Roger Coupal
Chris Weingardt
Anne Alexander

Center for Energy Economics and Public Policy,
Department of Economics and Finance
University of Wyoming
Laramie, WY 82071
Executive Summary:

Funded primarily through coal revenues from coal lease bonus payments and from Federal and State mineral royalties, the School Facilities Department (SFD) faces potential revenue shortfalls due to anticipated changes in coal emissions regulation and other market changes. The SFD, with responsibility for new capital construction for educational facilities, including school, administration and operations facilities, major renovation and expansion of such facilities, minor capital expenditures including repair and facility upkeep, and school maintenance operations and utilities, has overseen significant investment in the State’s educational resources in the last decade. These efforts have recently been substantial, and have included the construction of new and replacement schools due to increased enrollment, and previously deferred maintenance caused by the distressed budgets the State faced in prior decades. These expenditures are anticipated to slow as current programs and new construction increase the capacity and improve facility condition across the state, but it is unclear whether reduced future revenue streams could require an additional decrease in expenditure or alternatively the identification of increased revenue resources to continue to provide and maintain adequate educational facilities in the public school system of the state. The purpose of this report is to identify possible future revenue outcomes and expenditure forecasts to ascertain whether such concern is warranted.

To evaluate the extent of the challenges in funding the SFD may face in the near future, this study was commissioned and asked to complete the following tasks: (i) the creation of a set of revenue scenarios describing how SFD funding sources in the state may change in the next three biennia (2017 to 2022). These scenarios were defined by first identifying the primary factors anticipated to affect SFD funding over this period, and how changes in these factors could affect SFD-earmarked revenues. Internally this effort was referred to as the development of an “outside” model. (ii) The creation of a model describing the primary drivers of SFD expenditures to derive predictions of SFD funding needs over the period from 2017 to 2022. This model, a model of new construction, major and minor maintenance expenditure needs was referred to internally as the “inside” model. (iii) A “gap analysis” comparing the projected revenue outcomes and costs to determine the scenarios under which a gap in revenues and costs occurs, how such a gap may evolve over time, and the degree to which SFD resources may be inadequate to cover predicted costs over the next three biennia.

Part 1 of this report describes the construction of the outside model. Accomplishing this task required a review of state funding, distribution models and past revenue streams to determine a forecast of future revenue outcomes. SFD revenues primarily depend on coal market outcomes – specifically coal lease bonus payments, which over the past decade have supported the majority of the SFD’s non-discretionary ear-marked funding. Secondary sources of income include state and federal mineral royalties, however these have accounted for a relatively small portion of total funding over the past decade. The outlook for coal lease bonus revenues has weakened considerably since 2012 when records were set for such sales. This weakness is due to real weakness in national coal market outlooks. Further, record sales in 2011 and 2012 appear to have
depleted the inventory of potential future leases for sale and it takes several years for new leases to be identified and approved for sale.

Using known coal-lease payments from historic sales, and using a revenue model developed for this project based on state revenues from severance taxes, royalties and other sources, a set of projections were made regarding SFD funding through 2022. With respect to royalty income, the findings of this report indicate that because of the nature of the State’s distribution formulas and the scale of Wyoming’s energy commodity production, there is almost no foreseeable scenario in which mineral royalties earmarked for the SFD will fall below $26.6 million in any future biennium. Due to the same distribution rules, however, there is also no foreseeable scenario in which royalty revenues will exceed $26.6 million in any biennium unless legislation is enacted to change Wyoming’s revenue distribution practices, therefore we see royalty payments remaining very stable throughout the period we were asked to consider regardless of how total royalty payments to the state fluctuate.

![Figure ES-1: Past and Anticipated Coal Lease Bonus Payments to Wyoming](image)

Coal lease bonus (CLB) revenues, however, are a major source of concern. As shown in Figure ES-1, these revenues are anticipated to end in 2017 if no new sales occur, reducing the SFD revenue stream by approximately 95 percent from levels experienced in the 2013-14 biennium. As shown in Figure ES-2, CLB revenues will remain strong through 2015-16, but as the payments end in 2017, revenue falls significantly. Since CLB revenues only persist for 5 years after a lease is sold, unless new sales of coal leases are pending in the near future, almost the entire SFD revenue stream will disappear.

Our analysis of the coal market and the inventory of available new leases for sale suggests that while there is a possibility of new leases being sold, there is not enough potential revenue in new sales should they occur to make up the decline in revenues expiring coal lease bonus payments will cause. We consider several scenarios and find that at best and using the most optimistic
market assumptions, potential new coal lease sales combined with mineral royalties funding available in 2017-2018 could at best provide only 51 percent of the revenues that were available in 2013-14. These revenue streams in the most optimistic scenarios would drop further, to approximately a quarter of 2013-14 revenue levels by the 2019-2020 biennium. Later outcomes are even more pessimistic and, while the nature of the actual revenue profile experienced will depend on the timing and price of any future lease sales, in all cases we foresee a significant decline in SFD-earmarked revenues using the current state revenue distribution model.

![Chart showing revenue streams](image)

**Figure ES-2: Forecast SFD Biennial Revenue Streams assuming no new CLB Sales through 2022.**

Part 2 of this report describes the construction of the inside model, which required the creation of an econometric model of SFD expenditures to identify the primary variables affecting these costs and their effects on SFD expenditure. The inside model predicts three components: (i) new capital construction, (ii) major maintenance of existing buildings, and (iii) minor maintenance and operating expenses. New capital construction is the largest component of overall costs and depends on the Facilities Condition Index (FCI) of existing buildings, as well as district-level enrollment projections. Major maintenance expenses feedback into new capital expenses by helping to improve the FCI. Figure ES-3 shows a simple schematic structure of the inside model created.

New construction expenditures, the largest share of recent SFD budgets, are driven by the state’s policies used to determine when new construction is warranted. Determination of the timing or necessity of new construction is based on facility condition (as proxied by the FCI measure), and future enrollment expectations. Additionally, necessary expenditures are also sensitive to construction cost assumptions. To derive expenditure estimates, recent historic patterns regarding facility condition, enrollment capacity and new construction were estimated and used to project future expenditure needs assuming a future construction price of $250 per square foot. A spreadsheet tool has been provided along with this report to allow SFD personnel, other
government staff and legislators to explore the sensitivity of future SFD expenditure levels to changes in construction policy and construction costs under alternative assumptions. Our estimates presented employ historic practices and specific cost and inflation assumptions.

Figure ES-3. Schematic of the Inside Model Developed for this report.

Part 3 utilizes revenue projections made in Part 1 and expenditure predictions made in Part 2 to define a projected SFD funding “gap” between 2017 and 2022. The results of this analysis are summarized in Figure ES-4. Our projections suggest that the SFD will face a significant gap between revenues and necessary expenditures in this period totaling $671.3 million over the three biennia. To put this in perspective, this gap is 131 percent of the average total biennial budget of the SFD between 2005 and 2014.

Figure ES-4: Forecast SFD Funding Gaps by Biennium through 2022.
The expenditure projections of the inside model suggest that just over half of this funding shortfall occurs in the 2017-18 biennium (50 percent of the gap) due to the fact that while new construction efforts over the past decade have been significant, new capacity is still necessary to accommodate anticipated enrollment increases.¹ The inside model does predict, however, that if the forecasted construction effort we project occurs, that overall improvements in facility condition and additional enrollment capacity will result in very little need for additional new construction for at least a decade. Unlike over the past decade, once 2017-18 expenditures are completed we see the SFD’s efforts switching from a focus on building new schools to one of maintaining the existing capital stock, with maintenance expenditures dominating the SFD budget for at least a decade. This change in focus and need will result in forecasted SFD expenditures of approximately 39 percent of the levels experienced in the decade from 2005-2014 and illustrated in Figure ES-5.

![Figure ES-5: Forecast SFD Expenditure by Biennium through 2022.](image)

Analysis of our expenditure predictions show little sensitivity to cost assumptions. The inside modeling indicates that if construction costs rise from the estimated $250 per square foot to $300, the expenditure gap increases by only 10 percent. Similarly changes in the inflation rate and minor maintenance assumptions could cause projected costs fall by approximately the same amount thus the expenditure needs we present are presumed to be approximately +/- 10 percent if the cost assumptions made are modified in a reasonable fashion.

Some discussion is presented regarding how the SFD gap could be dealt with. On the cost side, policy changes regarding the timing of new construction could slow projected expenditures and push some into the future. Our analysis finds this will not eliminate the gap for reasonable changes in facility condition or enrollment capacity threshold policies. At best, such efforts

¹ Some construction is also necessary to accommodate facility depreciation.
could reduce the projected $671.3 million shortfall over the next three biennia by an estimated $84 million.

Given this, the analysis suggests that new funding sources will be needed – and we consider two types. *The analysis is purely illustrative and we do not propose any as a potential policy recommendation, but provide the analysis to frame any policy considerations that may take place in response to the report results.* First we consider discretionary, one-time appropriations. Sources of revenue for these funds could come from two sources – unanticipated investment revenues or appropriations from the general fund (implying a potential tradeoff among other state expenditure needs). We do not attempt to project the potential from windfall investment earnings as such a financial market analysis would be outside the scope of this report. It may be noted, however, that recent past investment windfalls are likely not to continue given market returns over the past two biennia have been well above historic averages thus relying on investment revenues to fund such a gap over the next three biennia may imply some risk.

A significant amount of analysis is devoted to consideration of possible mineral revenue outcomes over the next three biennia and presented in the Appendix. The conclusion of this analysis is that forecast models utilizing Energy Information Agency projections suggest mineral revenues could be strong over the next few biennia despite concerns regarding market weakness or regulation. Given the possible improvements in state revenues these projections suggest are possible, it could be the case that the State’s general fund revenues will grow at a rate capable of accommodating the SFD expenditure-revenue gap without trading off other state expenditure needs. These findings, however, contrast with recent CREG projections that suggest a much more bearish outlook. Should this conservative forecast prove true, state general fund appropriations of the magnitude needed to close the SFD gap would require reductions in expenditure elsewhere since CREG-forecasted revenues do not grow enough to accommodate such increases in total expenditure.

Finally, as an alternative we consider potential changes to SFD ear-marked funding. The cause of the SFD gap projected is the fact that the agency relies on a fundamentally cyclical funding source for the majority of its funding (coal lease bonuses - note this cyclical nature is very evident in Figure ES-1). Given school construction expenditures are inevitable we suggest that legislators might consider changing the SFD funding streams to create a more stable primary source of funding. Such a change could be accomplished by a change in the distribution formulas currently in place or through the creation of a new source of revenue. In this regard, altering state distribution formulas with respect to mineral royalties could be one possibility. As noted previously, this source of SFD financing under current rules funds only a very small portion of current SFD expenditures, and is relatively invariant to market conditions. While we note this policy choice, we do not consider specific alterations to distribution models in this report.

Potentially, however, the state may consider an increase in the maximum amount of funding that can accrue for state capital construction from federal mineral royalties. In addition, the distribution formulas could allow additional school construction funding to accrue from severance tax revenues. This has two potential benefits. First it would add additional revenue for state expenditures that are inevitable as schools grow older and population in the state grows.
Secondly, while these revenues depend significantly on mineral revenues, because they are earned on all types of minerals and not just coal, and since severance taxes also depend on non-mineral revenues such a change in distribution rules could create additional stability in the SFD revenue stream through increasing the diversity of the mineral revenues it depends on.

We do explore another possibility - a new source of revenue using a mill-levy. Our analysis suggests at 4 mill levy on the State’s assessed valuation would more than close the funding gap projected for the SFD through 2022 (though it would still not avoid a shortfall in the 2017-18 biennium). Given that education funding in the state already utilizes a mill-levy, in principle this would be compatible with taxation principles already in use. We also show that a 2-mill levy would close more than half the total gap through 2022 (again this does not avoid a shortfall in 2017-18). Alternatively, a 5-mill levy would create a surplus over the entire period that could serve as a sinking fund, to be used when new construction expenses are eventually needed to improve facility depreciation or to accommodate future population growth that will eventually occur. In all mill-levy cases considered none avoids a shortfall in 2017-18 thus additional appropriations and/or expenditure reductions would be needed in that biennium. Such decisions regarding potential revenue and expenditure changes are ultimately left to legislators, however, and therefore this report remains agnostic with respect to a preferred policy reaction to the projected SFD funding gap our analysis identifies.
**Introduction:**

To evaluate the extent of the possible challenges in funding the School Facilities Department (SFD) may face in the near future, this study was commissioned and the authors tasked with:

(i) The creation of a set of revenue scenarios describing how SFD funding sources in the state may change in the next four biennia (2015 to 2022). Internally this effort was referred to as the development of an “outside” model.

(ii) The creation of a model describing the primary drivers of SFD expenditures to derive predictions of SFD funding needs over the period from 2016 to 2022. This model, a model of new construction, major and minor maintenance expenditure needs was referred to internally as the “inside” model.

(iii) A “gap analysis” comparing the projected revenue outcomes and costs to determine the scenarios under which a gap in revenues and costs occurs, how such a gap may evolve over time, and the degree to which SFD resources may be inadequate to cover predicted costs over the next four biennia.

Part 1 describes the development of an outside model projection describing the SFD’s funding sources and their anticipated income streams in the coming biennia from 2014-15 through 2021-22. Primary revenues for SFD expenditures come from three sources: coal lease bonuses, federal mineral royalty payments and state mineral royalty payments. The SFD revenue distributions from the state of Wyoming are defined and the resulting revenues anticipated are explained in this section. In Part 4 of the report these models are expanded as an analysis of the funding gap anticipated is discussed.

Part 2 of this report presents an econometric model developed for this project to forecast future SFD expenditures and the derived expenditure results. Construction of this “inside” model required the creation of an econometric model of SFD expenditures to identify the primary variables affecting these costs, and the magnitude of the effect each driver has on changes in these expenditures. The inside model predicts three components: (i) new capital construction, (ii) major maintenance of existing buildings, and (iii) minor maintenance and operating expenses. New capital construction is the largest component of overall costs and depends on the Facilities Condition Index (FCI) of existing buildings and district-level enrollment projections. Results are presented of the expenditure modeling based on the modeling done in preparation for this report. Expenditure results, like those for the potential revenue scenarios, are described through the 2021-2022 biennium.

Major maintenance and new construction expenditures are also driven by state policy used to determine when new construction or major maintenance activity is warranted, specifically the choice of the thresholds when new construction is deemed necessary based on facility condition (as proxied by the FCI measure), present and future enrollments. Such choices cause new construction, the largest component in recent SFD expenditures to be quite sensitive to legislative decision-making and SFD policy changes.
Additionally, SFD expenditures are also sensitive to construction cost assumptions. To derive expenditure estimates, recent historic patterns regarding facility condition, enrollment capacity and new construction were estimated and used to project future expenditure needs assuming a future construction price of $250 per square foot. A spreadsheet tool has been provided along with this report to allow SFD personnel, other government staff and legislators to explore the sensitivity of estimated SFD expenditure levels to changes in threshold choices and construction costs.

Part 3 describes the “gap” analysis performed using the information developed in Parts 1 and 2. Utilizing the State’s own revenue projections, the outside model estimated SFD revenue streams from 2014 to 2022 presented in Part 1 are mated with the inside model expenditure projections to estimate the potential “gap” between future expenses and revenues under various potential future scenarios. These are discussed briefly. The analysis then discusses potential revenue sources and options to cover any funding gaps in the future, and how these state revenues may evolve under possible future market scenarios. Since projecting state revenues that might be used to fund any gaps first requires an understanding of the potential revenues available, this discussion is prefaced with an overview of the primary drivers of Wyoming coal market changes along with recent changes in other energy markets. These findings are then used to justify a set of market projections necessary to compute state revenue forecasts which could be used to service SFD along with other funding needs. Using these results, as an extension of the outside model, a Wyoming revenue model was developed to determine how potential market changes would affect state general fund and budget reserve account revenues.

In addition to estimating revenues that the state could use to close anticipated gaps in SFD funding, a discussion is also presented outlining some SFD expenditure choices that could be used to reduce such gaps. Specifically, the sensitivity of estimated costs to changes in the thresholds used to determine new construction needs with respect to enrollment and facility condition are described under two different scenarios to show as examples their influence on resulting funding deficits between SFD expenditures and revenue streams.

The final section of this report presents a summary of conclusions. Recent new construction and major maintenance efforts by the SFD over the past decade have been significant, and have resulted in the anticipated expenditure projections from 2017 to 2022 being significantly lower than those experienced over much the past decade. This results from the fact that recent expenditures have expanded current capacity and improved facility condition significantly. Future enrollment increases due to anticipated population growth, coupled with depreciation of existing facilities, however, will eventually result in an increase in expenditure needs at some point in the future beyond 2022. We anticipate the need for eventual new rounds of construction to occur no earlier than approximately 2028.

In addition to dealing with possible shortfalls in revenues versus expenditures in the near term over the next few years, officials may wish to prepare for such expenditures when they are
eventually needed. Revenues to finance the anticipated shortfall in the next three biennia and in periods after that could be derived from investment account revenues, from changes to the State’s revenue distribution models, or from appropriations from the general fund as needed. They could also be financed from the assessment of new taxes such as a mill levy. A brief discussion is presented regarding possible market conditions that could be expected in the future that may affect general Fund revenues that might be used for such appropriations. Alternatively, a mill levy example is created to determine the approximate magnitude of such a levy to address the funding gap and the potential advantages of creating greater stability in SFD revenues.

Part 1: Estimating the Outside Model: Anticipated School Capital Construction Account Revenues under Wyoming’s Existing Funding Formulae:

Funding for School Facilities Department activities is provided for specifically in Wyoming’s Revenue Distribution formulas. This funding is non-discretionary, and is derived from three primary sources: coal lease bonus revenues, federal mineral royalties and state mineral royalties. State distribution formulas then determine how much from each of these sources is deposited in the School Capital Construction Account (SCCA).

Coal lease bonus (CLB) payments, those payments made by coal companies for the opportunity to lease new tracts of mineable federal land have recently accounted for the largest portion of SFD funding. These payments are based on federal coal lease “auctions,” in which bidding companies offer payments for federal land tracts based on the mineable coal and its quality the lands are thought to contain. The offers are made on a per-ton basis of the estimated coal available in the lease. Recent bids over the past decade have ranged from the mid-80 cent range per ton, to $1.35 per ton. The CLB payment made to the state is approximately half of the total value of the winning bid, and payable by the winning bidder firm in equal installments over the five-year period beginning in the year following the auction process. CLB payments in any given year can fluctuate as streams of bonus payments from previous leases end or begin, and the amount of these lease payments made in any given year will depend on the previous contracts made over the past five years.

In addition to these payments, mineral extraction royalties are also paid on the production of minerals (production x mineral royalty rate of the commodity extracted) from state and federal lands in Wyoming and distributed to the SCCA. State mineral royalties (SMRs) are derived from extraction of energy commodities such as coal, oil and gas along with other minerals on common school lands, which are held in trust by the state. In the past several years this has been the

---

2 SFD appropriations may also include discretionary funds allocated to the Department from several other sources of revenue including the General Fund, Budget Reserve and state investment income. These funds, however, are not ear-marked for SFD use in the distribution formulas and must be appropriated at the Legislature’s discretion.


4 Actual CLB payments made to Wyoming are currently 46.8 percent of the total accepted bid. This amount has been changed in the past, having been over 50 percent on some leases and less on others. Payments have also been affected by recent budgetary actions in Congress.
second largest source of earmarked revenues for the SCCA. Federal mineral royalties (FMRs) make up the remaining source of funds apportioned to the SCCA. Distribution rules describing how total CLB, SMR and FMR revenues are allocated to the SCCA are described in Figure 1.

As shown in Figure 1, only coal lease bonus payments are not capped at a maximum amount in existing Wyoming distribution formulas. Total CLB payments are first shared with the Federal government, with historic shares distributed to states being approximately half of total CLB payments made. Of the first half of these Wyoming payments, the first $7.5 million is distributed to cities, towns and counties up to $5.6 million, with the remainder distributed to the state’s Highway Fund up to $1.9 million. The remainder of this share is then deposited to the SCCA. Of the next 10 percent, the first $1.6 million is distributed to community colleges and the remainder, along with the remaining 40 percent of CLB funds is deposited to the SCCA. Overall, given the large CLB payments to the state in recent history, SCCA deposits from this source have totaled the entire CLB share allocated to Wyoming less $9.1 million over the past decade.

Like coal lease bonus payments, approximately half of all federal mineral royalties collected on federal lands in Wyoming are also shared with the federal government. Of the funds distributed to Wyoming, one percent are distributed to the state’s General Fund. Of the remaining funds from this source collected up to the first $200 million, the SCCA share is 2.7 percent, to a maximum of $5.3 million, thus the maximum FMR payment excluding CLB that can be made to the SCCA is $5.3 million, and in the past decade this has been how much this source has contributed to the SCCA on an annual basis.

State mineral royalties are derived only from mineral revenues generated on common school lands. As described in Figure 1, one third of these monies up to a maximum of $8 million are distributed to the school capital construction account. As with the FMR distribution, over the past decade this payment has also typically been the maximum amount. Both the FMR and SMR revenues to the SCCA are also expected to continue at these levels into the future and therefore this report assumes that from 2014 through 2022, the distribution to the SCCA in each biennium from both sources will be $26.6 million.

Overall, SFD revenue streams are very dependent on coal production due to the Department’s heavy dependence coal leases for funding. Royalty payments are more balanced, derived from all mineral revenues collected in the state on federal and common school lands. Oil and natural-gas revenues provide significant contributions to these streams – roughly two thirds and therefore help diversify royalty payment streams. Overall though, with CLB payments making up the majority of recent SFD revenues, the Department is very exposed to changes in this market affecting Wyoming coal production.
Figure 1: SFD Funding Sources and Distribution Formulas (source: Mineral Revenue Report and Wyoming state statutes)
Figure 2 shows the recent CLB payments made to the state in each biennium since 2003-04. It also includes projected payments through 2020 based on current leases and recent CLB activity. The figure makes clear how CLB activity is cyclical.\(^5\) Lands made available for auction must go through considerable screening, including geological estimates and environmental impact assessment processes. The latter process can take several years to complete. Leases therefore available at any point in time reflect the decision to evaluate these lands for potential lease several years before. After an auction takes place, bids are evaluated by the BLM and may be subject to litigation by outside groups. Overall, the availability of lands for lease and the time it takes to finalize such purchases leads to lags in potential payments leases may generate that exacerbate the cyclical nature of these revenues.

In the past decade, after receiving relatively low lease revenues prior to 2005, new coal leases led to a significant increase in these revenues in 2005-06 biennium. Declining leasing activities then resulted in falling CLB revenues through to the 2011-12 biennium. Between 2011 and 2012, however, several large coal leases were negotiated that will result in large increase in revenues projected in the 2013-14 and 2015-16 biennia. The volatility in coal lease bonus revenues shown in Figure 2 makes it clear that forecasting coal-lease sales is difficult. Because of this, Wyoming’s Consensus Revenue Estimating Group (CREG) does not even officially attempt forecast new leases. Instead, projections report only known lease deals already agreed to.


**Figure 2: Past and Anticipated Coal Lease Bonus Payments to Wyoming**

\(^5\) Lands made available for auction must go through considerable screening, including geological estimates and environmental impact assessment processes. The latter process can take several years to complete. Leases therefore available at any point in time reflect the decision to evaluate these lands for potential lease several years before. After an auction takes place, bids are evaluated by the BLM and may be subject to litigation by outside groups. Most recently groups have begun suing the BLM for a lack of consideration of the carbon impact such lease sales could have. See for example *Western Organization of Resource Councils/Friends of the Earth v. Bureau of Land Management* [http://libcloud.s3.amazonaws.com/93/c0/a/4968/BLM-complaint-asfiled-11-24-2014.pdf](http://libcloud.s3.amazonaws.com/93/c0/a/4968/BLM-complaint-asfiled-11-24-2014.pdf) (accessed November 26, 2014). Overall, the availability of lands for lease and the time it takes to finalize such purchases leads to potential lags in timing that exacerbate the cyclical nature of these revenues.
Coal leasing activity across the west has been controversial in recent years as the “auction” process has usually resulted in only one bid per parcel of land offered in Wyoming’s Powder River Basin (PRB). Members of Congress and tax-advocates have suggested the leasing process may need to be changed as auctions with only a single bidder may result in firms underpaying for federal resources owned by the national taxpayers. Adding to lease concerns in the state, in both 2013 and 2014, there have been no successful auctions. In 2013 the Bureau of Land Management (BLM) rejected the only bid made for the single lease offered that year, deeming it too low at $0.21/ton bid on a tract estimated to contain 167 million tons of mineable coal. In 2014, another coal lease was made available but received no bids. Both the low bid in 2013 and the failed auction in 2014 have fuelled concerns that national and global market uncertainty coal-producers face regarding pending emissions and climate change regulation will unfavorably affect state revenues. Adverse changes to the future profitability of coal mining in the state could translate into a long-lasting decline in the CLB stream of state revenues, with significant effects on SFD funding streams.

As shown in Figure 2, the current lack of coal lease sales in the past two years has resulted in a significant decline in CLB revenues anticipated in the 2017-18 and following biennia. These revenues, however, could also increase if successful sales are negotiated in the period between now and 2018. Currently, three potential coal leases thought to contain approximately 557 million mineable tons of coal may be available for auction in 2015 or later. After these three parcels of land, however, no other parcels are anticipated to be available until 2022 or 2023. Assuming no new CLB sales and assuming that SMR/FMR revenues remain at their maximums as given by the distribution formulas in Figure 1, Figure 3 presents the total non-discretionary revenue the SFD is expected to receive through 2022. If there are no new sales in 2015 through 2022, the 2017-18 biennium CLB revenues are anticipated to fall by over 74 percent relative to their 2013-14 levels. The coal lease bonus revenue base is further expected to be entirely depleted by 2018, resulting in no CLB revenues in each of the 2019-20 and 2021-22 biennia.

---

9 The 664 million ton estimate quoted here includes the North Hilight Field, the previously rejected Hay Creek II sale tract offered in 2013, and the Maysdorf II North tract offered in 2014, as well as the Maysdorf II South tract. Originally, the Maysdorf II North tract was part of the larger Maysdorf II South tract, which was split into two parcels prior to the attempted sale in 2014. The two Maysdorf tracts are assumed to contain 234 million tons of coal, and the North Hilight tract is assumed to contain 263 million tons using estimates reported in the Wyoming Mineral Revenue Report (revised January 2014). The same report listed the Hay Creek II tract as containing 60 million tons. At auction in 2013, the Hay Creek tract was reported to hold 167 million tons in 2013 (http://www.blm.gov/wy/st/en/info/news_room/2013/september/18-coalsaleresults.html). This report uses the later and more conservative figure of 60 million tons for this lease, thus the estimated mineable tons in the tracts assumed available as of 2015 sum to 557 million tons.
10 See the Wyoming Mineral revenue Report (revised January 2014). The Maysdorf II North tract is part of the larger Maysdorf II South tract, which was split into two parcels prior to the attempted sale in 2014.
these two periods, the SFD revenue stream would consist entirely of FMR/SMR revenues in the amount of $26.6 million per biennium.

Figure 3: Forecast SFD Biennial Revenue Streams assuming no new CLB Sales through 2022.

If the currently available leases in the PRB were to be sold, the SFD revenue picture improves only somewhat. To quantify the potential improvement under a best case scenario that assumes the all possible sales occur in the 2015 calendar year, three price scenarios are considered: (i) that the available leases receive $1/ton (the 2011-2012 average rate), (ii) due to poor market conditions sales occur at $0.75/ton, or (iii) $0.50/ton on average.\(^{11}\) The hypothetical coal lease sales presented also presume that the current state share of the sale continues unchanged.\(^{12}\) Under these assumptions, were such sales to occur, they could increase SFD revenues by between $26.1 and $52.1 million annually from those shown in Figure 3 from 2016 onward.\(^{13}\) These possible outcomes are shown in Figure 4.

Using the data presented in Figure 4, the currently scheduled declines in the coal lease bonus payments are more dramatic in the later biennia as CLB payments from the sales in 2011 and 2012 are exhausted. Alternatively, assuming the potential sales shown, which we assume in a

\(^{11}\) Note that the average price paid per ton in previous sales made in 2011 and 2012 was $1.007/ton, thus the average used for simplicity here is slightly below that level.

\(^{12}\) Throughout the scenarios presented here, we assume a Wyoming share of 46.8 percent of the total sale value.

\(^{13}\) Note that FMR revenue is assumed to remain at $5.3 million annually throughout the biennia considered. To cause FMR revenues paid to the SCCA to fall below this figure, total FMR payments excluding coal lease bonuses would have to fall by over 73 percent, an outcome we assume cannot happen for the purposes of this report. Such a complete collapse in mineral revenues would require a calamitous economic shock to the national economy that we presume will not occur. Similarly, SMR revenue is assumed to remain at $8 million annually throughout the period of this report as again to see revenues fall below this value would require a reduction in state mineral royalty income payable to income accounts of 62% (this computation uses data from the Summary of State Land Revenue, June 30, 2014), an outcome we deem entirely implausible.
best-case scenario occur in the 2015 calendar year, the decline through 2017-18 is limited to between 54 percent and 63 percent from 2013-14 levels depending on the lease prices assumed, and between 78 and 89 percent in the 2019-20 biennium. Afterward, even with the new sales assumed here, CLB revenues would still fall to zero in the 2021-22 biennium since BLM data currently suggests no new additional lands will be available for lease until after 2022. This result seems unavoidable regardless of whether available lands are sold in the coming year, as are severe CLB revenue base declines in the 2017-18, 2019-20 biennia. Further, the sales shown in Figure 4 are used only as examples. Given currently weak coal market conditions (described in more detail in Part 3 of this report), pessimistic market watchers could be forgiven they completely discounted the likelihood of these sales, as in all cases the assumed price is more than double the last bid offered on a coal lease in 2013.

![Figure 4: Forecast SFD Biennial Revenue Streams assuming new CLB Sales through 2022.](image)

Overall, using the state’s current distribution formulae, known coal lease bonus schedules and assuming federal and state mineral royalty payments remain at their maximum levels of $13.3 million annually, SFD revenue streams will fall by over 95 percent from 2014 levels by the beginning of the 2019-20 biennium. Even under the most optimistic scenarios envisioned here, this decline can only be postponed by one biennium as shown in Figure 4. Were coal lease sales to occur later in this forecast period the decline in 2021-22 could be reduced, however, they are destined to decline significantly in this period unless changes are made to the state distribution formulae, or additional appropriations are made to finance SFD expenditures from other funds at the discretion of the Wyoming Legislature.

---

14 The projected coal lease schedule produced by the State Economic Analysis Division in the Wyoming Mineral Revenue Report (revised January 2014) suggests no lands are anticipated for sale before 2022 after those considered here are leased.
Part 2: Estimating the Inside Model: Anticipated School Facilities Department Expenditures:

The goal of the “inside model” is to predict future expenses associated with building and maintaining school facilities in the state of Wyoming. The inside model and its predictions are a component of a larger project to analyze the “gap” between future expenses and revenues.

The inside model predicts three components: (i) new capital construction, (ii) major maintenance of existing buildings, and (iii) minor maintenance and operating expenses. New capital construction is the largest component of overall costs and depends on the Facilities Condition Index (FCI) of existing buildings and district-level enrollment projections. Major maintenance expenses feedback into new capital expenses by helping to improve the FCI. Figure 5 shows a simple schematic of the inside model.

![Figure 5. Schematic for Inside Model](image)

The model will be presented in an easy-to-use spreadsheet that allows the user to predict overall expenses for future biennium. The user of the spreadsheet can select six items:

- Biennium
  - 2017-18 through 2023-24
- FCI threshold
  - lower threshold implies more buildings will be replaced
- Size factor for future enrollment growth
  - higher number implies more square footage for new construction
- Capacity threshold for districts

---

- lower number implies more new construction to alleviate capacity constraints
- Inflation rate
- New construction costs per square foot

Figure 6 illustrates how the spreadsheet tool is used to predict SFD expenses in the 2017-18 biennium. The FCI threshold is set at 40% so that any existing building with a predicted FCI higher than 0.4 will be replaced. A size factor for enrollment growth equal to 10% implies that a new school will be built 10% larger than necessary to allow for future enrollment growth. A capacity threshold of 100% implies that a new school will be built for a district with elementary, middle school or high school capacity ratio exceeding 100%. The user can also select a predicted inflation rate that will increase future construction and maintenance expenses. Finally, the user can choose a cost per square foot for new construction.

Figure 6. Predicted Future SFD Expenses from the Spreadsheet Tool

Figure 6 shows the spreadsheet tool and total predicted SFD expenses for the 2017-28 biennium. The breakdown of expenses by category and expenses for other biennium are illustrated in Figure 7. This is an image from a worksheet in the spreadsheet tool. The numbers are difficult to see in the image, but capital construction expenditures are predicted to be high (~$350 million) in the 2017-18 biennium primarily to address capacity constraints. Much of the required new construction to replace deteriorating buildings (i.e., those with high FCIs) occurred in the

---

16 If the capacity ratio exceeds the chosen threshold in the current year and 2024, new construction occurs. If the capacity ratio exceeds the threshold in the current year but not in the future, new construction does not occur. This consideration of future and current enrollments is meant to avoid over-building of capacity given future enrollment projections.
2013-14 and 2015-16 biennia. Major maintenance expenditures are predicted to remain fairly stable at approximately $100 million per biennium.

The rest of the section is more technical and describes the econometric models for each expense component.

![SFD Expenditures by Category and Biennium from the Spreadsheet Tool](image)

**2.1 New Construction and Component Projects:**

New facility construction projects make up the largest portion of SFD expenses. New facilities are necessary when the condition of existing facilities is no longer adequate or when district enrollment growth dictates the need for a new school. Since the inside model predicts future SFD expenses, each of these two parts need to be forecasted.

Facilities Condition Index (FCI) Model. This model predicts the future condition of education facilities. The dependent variable is FCI for 313 facilities during the years 2006, 2009 and 2012. The explanatory variables are past maintenance expenditures (MAINTSQFT) for buildings of various ages, lagged FCI, and a constant. The econometric FCI model in algebraic form is

\[
FCI_{i,t} = \alpha + FCI_{i,t-3} + \sum_{age=1}^{8} (\beta_{age} \cdot MAINTSQFT_{i,t,age}) + \epsilon_{i,t}
\]

where \(i = 1, \ldots, 313\) indexes buildings, \(t = 2006, 2009\) and 2012 indexes years, and \(age = 1, \ldots, 8\) indexes age categories (0-10 years, 11-20 years, ..., 70 years and older). Equation (1) can
be rewritten as

\[ \Delta FCI_{i,t} = \alpha + \sum_{age=1}^{8} (\beta_{age} \cdot MAINTSQFT_{i,t,age}) + \epsilon_{i,t} \]  

(2)

where \( \Delta FCI_{i,t} = FCI_{i,t} - FCI_{i,t-3} \) is the change in FCI. Equation (2) shows that, all else equal, \( \alpha > 0 \) is the upward trend in FCI and \( \beta_{age} < 0 \) is the marginal impact of maintenance expenditures on FCI for buildings of different ages. We impose the restriction that the \( \beta_{age} \) coefficients decline geometrically by age category so that more major maintenance expenditures are required to maintain the quality of older buildings (only \( \beta_{age=1} \) is shown in Table 1). The estimation results are shown in Table 1.

<table>
<thead>
<tr>
<th>Table 1. FCI Econometric Estimates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td>FCI</td>
</tr>
<tr>
<td>INTERCEPT (( \alpha ))</td>
</tr>
<tr>
<td>MAINTSQFT (( \beta_{age=1} ))</td>
</tr>
</tbody>
</table>

Notes. The sample size is \( N = 454 \) and the goodness-of-fit measure is \( R^2 = 0.60 \).

To understand how the model works, consider a 45-year-old high school (age category = 5) with an FCI measure equal to 0.3 in the year 2014 and major maintenance expenditure of $3.00 per square foot over the past three years. The model predicts that the FCI in the year 2017 will equal

\[ FCI_{2017} = \hat{\alpha} + FCI_{2014} + \hat{\beta}_{5} \cdot MAINTSQFT \]

\[ = 0.0183 + 0.3000 - 0.0014($3) = 0.3141. \]  

(3)

Once the predicted FCI exceeds the chosen threshold, the school is replaced with square footage determined by projected district enrollments and sufficient capacity to allow for future enrollment growth.

**Enrollment Projection Model.** Enrollment projections are based a modified version of the current state enrollment model. The current model projects future enrollment using an average of past retention rates and the current K-12 enrollments to predict future enrollments. Our model modifies the current model with a more accurate method for predicting kindergarten enrollments. The modification uses an average ratio of kindergarten enrollments to the district population.
This ratio is coupled with future district-level population predictions to forecast future kindergarten enrollments.

Algebraically, the enrollment model is

\[ \text{Enrollment}_{d,g,t+1} = Retention_g \cdot \text{Enrollment}_{d,g,t} \]  
(4)

where \( d = 1, \ldots, 48 \) indexes districts, \( g = 1, \ldots, 12 \) indexes grade level, and \( t \) indexes time. For kindergarten (K), we use published population forecasts for the district multiplied by the district-level kindergarten/population ratio (\( \delta_d \)):

\[ \text{Enrollment}_{d,K,t+1} = \delta_d \cdot Population_{d,t+1}. \]  
(5)

The average kindergarten/population ratio across the 48 districts is \( \bar{\delta}_d = 0.018 \), varying from a low of \( \delta_d = 0.002 \) in Fremont 38 district and a high of \( \delta_d = 0.049 \) in Sheridan 3 district.

District-level predicted enrollments are then substituted into the square footage calculator to generate square footage needed in each district for elementary, middle and high schools. The required square footage for each school type is then divided by the current square footage available (and multiplied by 100) to generate a capacity index. If the capacity index exceeds the capacity threshold, a new building is constructed with sufficient square footage to handle future enrollment growth.

Component Projects. Component projects make up a small portion of the overall new construction expenses. These projects are special renovation and repair projects that do not fall squarely into any category. We lump them together with new construction. Examples of these projects include replacement of a fire alarm systems, replacement of a school roof, or the demolition of an old building. In the 2011-12 biennium, component projects totaled $5.9 million and represented only 1.8% of the overall SFD budget. We predict component project expenses in the future by multiplying the average component expense per square foot over the past 5 years times the predicted future square footage. The resulting number is then multiplied by the relevant inflation rate.

2.2 Major Maintenance:

Data for major maintenance are available for the years 2004 through 2013. We considered two models to predict major maintenance. Both models predict future major maintenance costs by building (\( i = 1, \ldots, 312 \)).

The first model is:

\[ MAINTSQFT_{i,t} = \alpha_d + \beta_1 MAINTSQFT_{i,t-2} + \beta_2 AGE_{i,t} + \beta_3 FCI_{i,t-1} + \epsilon_{i,t} \]  
(6)

where \( \alpha_d \) is the district-specific effect and \( t = 2004, \ldots, 2013 \). The regression results are given in Table 2. The coefficient on lagged \( MAINTSQFT \) is negative and statistically significant at the 10% level. A negative sign indicates that higher major maintenance expenditures in the previous
biennium lead to lower major maintenance expenditures in the current biennium. The AGE coefficient is significant and positive indicating that, all else equal, major maintenance expenditures are higher for older buildings. The coefficient on lagged FCI is negative. We expected the coefficient to be positive, but the negative sign could indicate that deteriorating buildings with higher FCI and closer to replacement are allowed to decline. The goodness of fit is low ($R^2 = 0.28$), which shows that maintenance expenditures are inherently hard to predict.

### Table 2. Major Maintenance Econometric Estimates

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean</th>
<th>Estimate</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAINTSQFT</td>
<td>Annual Major Maintenance Expenditures per Square Foot</td>
<td>2.722</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Intercept ($\alpha_d$)</td>
<td>District-Specific Effect</td>
<td>--</td>
<td>varies</td>
<td>--</td>
</tr>
<tr>
<td>Lagged MAINTSQFT ($\beta_1$)</td>
<td>MAINTSQFT in the Past Year</td>
<td>2.722</td>
<td>-0.029</td>
<td>(0.063)</td>
</tr>
<tr>
<td>AGE ($\beta_2$)</td>
<td>Age of Building in Years</td>
<td>33</td>
<td>0.028</td>
<td>(0.003)</td>
</tr>
<tr>
<td>Lagged FCI ($\beta_3$)</td>
<td>FCI in the Past Year</td>
<td>0.167</td>
<td>-0.00138</td>
<td>(0.060)</td>
</tr>
</tbody>
</table>

Notes. The sample size is $N = 1,467$ and the goodness of fit is $R^2 = 0.28$.

The second model is simpler and calculates average major maintenance expenditures per square foot by age category. These averages are then applied to buildings of various ages to forecast future expenditures. Figure 8 shows major maintenance expenditures per square foot for education, administrative and bus buildings. The second model seems to perform slightly better and is programmed into the spreadsheet tool.

![Figure 8. Major Maintenance Expenditures per Square Foot](image)
2.3 Minor Maintenance and Operating Expenses

Data on minor maintenance and operating expenses are available for the period 2006 through 2013. These expenses are stable over time but vary across school districts. We use a simple model that averages the past growth rates in minor maintenance expenses per square foot and allows for future inflation. The model is

\[ M\&OSQFT_{d,t} = \alpha + M\&OSQFT_{d,t-1} + \epsilon_{d,t} \] (7)

where \( M\&OSQFT \) is maintenance and operating expenses per square foot. The estimation results are shown in Table 3.

Table 3. Minor Maintenance & Operations Econometric Estimates

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean</th>
<th>Estimate</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>M&amp;OSQFT</td>
<td>Annual Minor Maintenance &amp; Operations Expenditures per Square Foot</td>
<td>0.529</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Intercept ((\alpha))</td>
<td>--</td>
<td>--</td>
<td>0.005</td>
<td>(0.002)</td>
</tr>
</tbody>
</table>

Notes. The sample size is \( N = 288 \) and the goodness of fit is \( R^2 = 0.88 \).

The results show that, on average, minor maintenance and operation expenses are $0.529 and grow slowly, by $0.005 per year.\(^7\)

\(^7\) Minor maintenance and operation expenses predicted by our model are approximately 3 times higher than past expenses reported by the SFD. This is due to data inconsistencies between the Wyoming Department of Education (WDE) and the SFD. We were unable to resolve these inconsistencies. Since minor maintenance and operation expenditures are a small portion of SFD’s overall budget, this does not have much of an impact on total cost estimates.
Part 3: Estimating and Addressing the School Facilities Department Funding Gap:

3.1 Estimating the SFD Revenue-Expenditure Gap:

Using the predicted School Facilities Department expenditure estimates developed using the model described in Part 2, and the revenue stream identified in Part 1, the potential funding gap facing the SFD can be described. It is shown in Figure 9 for the 2015-16 to 2021-22 biennia. Estimated revenues shown were described in Part 1 and assume only the existing coal lease bonus schedule and no new coal lease bonus sales, and that distribution formulae for federal and state mineral royalties remain unchanged, resulting in an annual royalty income flow from these sources of $26.6 million per biennium. Estimated expenditures by the SFD for new construction, major maintenance and minor maintenance were estimated as discussed in Part 2.\(^{18}\)

\[\text{Figure 9: Forecast SFD Funding Gaps by Biennium through 2022.}\]

As noted in Part 1, the potential funding gap that arises in the future could be affected by the sale of new coal leases between 2015 and 2022. Using the assumptions in Part 1, the change in the funding gap is shown in Figure 10. The coal-lease bonus sales presume that all coal lease tracts identified in 2014 containing an assumed 557 million tons of mineable coal are sold in 2015 at the indicated prices, and that FMR and SMR revenues do not change. It is also assumed no other

\[^{18}\] These expenditure estimates assume the default assumptions discussed in Part 2 - that either an FCI threshold of 0.40 or 100+ percent enrollment capacity over the planning horizon necessitates new construction, that new construction only builds to ten percent more than the projected enrollment in the period from 2014 through 2024, an inflation rate of 2.5 percent annually, and construction costs of $250 per square foot. 2015-16 biennial expenditures are not estimates and instead reflect the Department’s anticipated actual expenditures in the current SFD fiscal biennium.
coal leases come available for sale other than those identified in 2014 during the forecast period. Note the 2015-16 revenues anticipated exceed the estimated costs that have already been identified in SFD budgets by $68.4 million and do not include any additional appropriations made in the 2015-16 fiscal budget. The resulting funding gaps in the following biennia and assuming hypothetical coal lease sales are compared to the implied gaps without such sales and shown in Figure 9. For the hypothetical sales described this increases to the 2015-16 surplus to between $94 and $121 million. Since this represents the current fiscal biennium and budgets and appropriations have already been made for this period, the gap computation described in the remainder of this section is projected for the following three biennia, from 2017 to 2022.

![Estimated SFD Revenue Gap graph](image)

**Figure 10: Potential SFD Funding Gaps by Biennium through 2022 for Hypothetical Coal Lease Bonus Sales.**

As shown in Figure 10, the cumulative shortfall from 2017 to 2022 facing the SFD and assuming no coal lease sales occur across any of the illustrated biennia is $671.3 million, with 50.6 percent of this amount occurring in the 2017-18 biennium. The large deficit occurring in the 2017-18 biennium is due to the completion of a major new school construction program that has been occurring in the state since the 2005-06 biennium as an energy boom allowed funds to become available to accommodate excess capacity problems and to improve facilities condition. Over the last decade, new capital construction resulted in significant facility condition improvement and increased capacity to absorb current and projected enrollments over that time. The projections using the model described in Part 2 suggest that this construction program will be complete in 2017-18 and all major needs with respect to accommodating enrollment needs and improving facility condition will then be finished. Afterward the majority of SFD expenditures are anticipated to be major maintenance efforts meant to preserve this new capital stock recently constructed. For that reason projected expenditures fall dramatically in the final two biennia shown in the forecast period, averaging $192 million per year, or approximately 39 percent of the $493 million average biennial level of expenditure that occurred between the 2005-06 biennium and the current 2015-16 fiscal biennium.
The expected funding gap, however, does not fall by the same amount as expenditures due to the end of coal lease bonus payments by fiscal year 2018, assuming no new leases are sold. Under the optimistic hypothetical sales conditions assumed in Part 1, the shortfall in revenues relative to anticipated expenditures shown in Figure 10 falls to between $463 million (31 percent) and $567 million (15.5 percent) from 2017 to 2022. If actual new coal lease sales were to occur, the reduction in any funding gap they created would depend on the sales price and timing of the sales.\(^{19}\)

The estimated gaps are not very sensitive to the cost assumptions used in the expenditure analysis presented in Part 2. If instead of a 2.5 percent inflation rate, a lower two percent inflation rate in construction costs was used, the estimated gap falls by only $14.7 million dollars, or 2.2 percent of the estimated gap assuming no new lease sales. Similarly, if the construction cost per square foot rises from the $250 assumed to $300 per square foot, the gap increases by $68.7 million, a 10.2 percent increase over the estimated $671.3 million gap derived under default assumptions.\(^{20}\)

Some simulation was also attempted at moving further out in time with respect to estimating potential SFD expenditure needs. These are not reported, however it became clear in the analysis that due to the efforts made from 2005 through those anticipated in our estimates for the 2017-18 biennium, improvements in facility condition in the state and accommodation for projected enrollments suggest that no new major building costs will be needed for several more years beyond the 2021-22 biennium estimates presented here. FCI changes were simulated and through 2030 the results suggest there will be little need for new construction after the 2017-18 biennium to address facility deterioration in the State until late in the 2020s. While these simulations become less accurate for forecasts further into the future, using current construction thresholds significant new construction does not appear to be necessary to address FCI deterioration until 2028 and afterward.

Similar simulations were not attempted for population estimates due to the difficulty in presuming where and when changes in population growth patterns could occur. Given the fact

---

\(^{19}\) Note that they would also depend on the share of revenues Wyoming receives from the federal government. Throughout the scenarios presented in Part 1 and described here we assume a Wyoming share of the 46.8 percent of the total sale value. At $1/ton, to close the close a $671 million gap would require 1400 million tons of mineable coal being leased at this rate, or more than the total amount leased in 2012 (1345.7 million tons), which was a record-setting year.

\(^{20}\) It should also be noted that the minor maintenance component in these estimates is over-estimated due to the previously described discrepancy between the Wyoming Department of Education (WDE) and School Facilities Department data we received regarding these expenses. The estimates presented for the expenditures presented assume the higher of the two possible outcomes. Over the past four biennia (2009-10 to 2015-16) the actual minor maintenance portion of SFD expenditures has averaged $7.1 million per biennium. Using WDE data for the estimates of necessary minor maintenance expenses from 2017-16 to 2021-22, these expenditures rise to an average of $27.6 million per biennium. If the SFD data for minor maintenance expenditures are more accurate, the total expenditure estimates presented may be overstated by approximately $20 million per biennium or $60 million over the forecast period. Therefore overall, for varying the costs of construction and inflation as described, and accounting for minor maintenance policy discrepancies, the estimates presented have an approximate error of less than +/- 15 percent.
that current school construction efforts have been made with an eye to future enrollment growth, and assuming current population trends, results, however, suggest that significant new construction to accommodate population growth will not be necessary until the mid-2020s or later. Given these results, we anticipate levels of expenditure in the immediate biennia past 2022 to be much closer to the levels in 2019 to 2022 than to those experienced over the past ten years.\textsuperscript{21}

\subsection*{3.2 Potential Policies to Address the SFD Gap:}

Policies to address the potential SFD revenue shortfall described above can be delineated into two possible actions – policies with respect to new construction that reduce the necessary expenditures of the SFD, or through creating increased revenues streams or appropriations for the Department. In the following, effects of policy and revenue changes are compared to the gap estimates that assume no new coal lease sales after those that were in place in 2014 occur through 2022.

(i) Changing Construction Thresholds:

Reducing SFD expenditures would require changes in department practices and procedures that determine the timing of new construction, the primary determinant of total expenditures over the past decade.\textsuperscript{22} The two thresholds that determine the need for new construction are the facility condition as measured by the SFD’s FCI indicator, and over-enrollment measured as physical space in the school per student attending. The expenditure estimates presented assumed that the FCI threshold necessitating a new school being constructed was a value of 0.40 or greater. Similarly, if a school had more than 100 percent of the students it could accommodate given its square footage of instructional space, or if it was anticipated that this would occur within the planning horizon extending through 2024, a school of appropriate size was assumed to be built at a cost of $250 per square foot.

\textsuperscript{21} SFD expenditure is estimated in the medium term to average nearer to $200 million per biennium than the $400+ million per biennium experienced over the past decade.

\textsuperscript{22} We do not recommend changing major or minor maintenance policies to reduce expenditures in these areas as such actions would accelerate facility depreciation and potentially lead to operational difficulties.
Allowing the FCI threshold to be relaxed and only building new schools after an FCI of 0.45 occurred, would reduce the funding gap in each of the three biennia estimates as shown in Figure 11. This action results in an immediate reduction in funding needs in the 2017-18 biennium as it delays the need for new construction of several small schools. Simulating the construction need for increasing the FCI threshold to 45 percent results in six fewer new schools being constructed in 2017 and 2018, delaying one of these to the following biennium and then increasing new construction needs in the 2021-22 biennium from one school to two, resulting in four fewer schools being built over the 2017-2022 period. Further, through 2030 this threshold reduction is estimated to result in ten fewer schools being constructed using the FCI model predictions derived from the work described in Part 2. The reduction in the gap from SFD funding 2017 to 2022 shown in Figure 11 is $32.1 million. As shown in the figure, there is a tradeoff for this action – while it delays new construction and therefore reducing costs especially in the 2017-18 biennium, it also causes an increase in some major maintenance expenses in later years. Overall, however, the overall reduction in the $671.3 gap over the three biennia is only 4.8 percent, suggesting this policy would be of little financial benefit but could result in significant degradation in the physical quality of several schools.

Alternatively the SFD could allow greater over-enrollment to occur before capacity conditions necessitated the building of a new school. As shown, if over-capacity is allowed up to 110 percent of a school’s size, significant new construction could be avoided at the cost of more crowded classrooms. Such a change would result in a reduction in the estimated funding gap of $52.2 million through 2022 as shown in Figure 11. Implementing this capacity threshold and the 0.45 FCI threshold would result in a combined gap reduction of $84.3 million, or 12.6 percent of the original gap defined (assuming no new coal lease sales occur).23

---

23 We do not address the implied fairness or potential legality in such threshold changes. Effectively, the schools impacted by such changes would be paying the price of being “at the end of the queue,” with the affected school
There are also other possible construction policy changes that could be implemented to create additional construction savings. For example, these could include (but are not limited to) greater use of portable or temporary classroom structures on a longer term basis to address over-capacity, reduced new school construction standards or amenities and design aesthetics to reduce construction costs per square foot, or reduced space requirements per student. Estimating these effects was outside the ability of the cost model created and described in Part 2 as these considerations would potentially require knowledge of specific school conditions, knowledge of specific architectural plans and suggested designs, and/or changes to previous school adequacy standards, and therefore their potential impact was not or could not be estimated.

(ii) Increasing Department Funding Revenue

Several possibilities are available to the state with respect to addressing the potential SFD expenditure gap between anticipated revenue streams and expenditure needs. With respect to closing the gap on the revenue side, it is possible that investment revenues from several of the state’s investment accounts may be earned in excess of those anticipated, and that these could be appropriated to meet the funding gap. Since predicting financial market returns in the coming biennia would constitute an exercise outside the scope of this work, we did not attempt to determine if or when such excess revenues might be earned. We do note, however, that one means of addressing the gap identified would be to apply these one-time windfalls to school capital construction if they become available by legislative appropriation. We also note that relying on such investment windfalls to continue is inherently risky as recent investment revenues have exceeded historic or “normal” market returns in recent years by a significant margin.24

Another uncertainty that could have some impact on funding the gap reported is the possibility of new coal lease bonus monies coming available over the next five years. As previously shown, if currently available tracts of land were leased at between $0.50 and $1 per ton, this could result in a reduction of the estimated SFD expenditure gap presented of between 16 and 31 percent respectively. Further, the BLM could potentially have other tracts of land available for sale that are currently identified but not yet ready for offer by 2022, such sales could result in unanticipated revenues to the state.25

Assuming that the state does not experience windfall revenues from unanticipated investment income, coal lease bonus sales or from other sources, funding the anticipated SFD gap would require either legislative appropriation from general fund or similar revenues, from the
districts experiencing different adequacy standards from those districts benefiting from the new construction over the preceding decade.

24 We note that that the State’s Consensus Revenue Estimating Group also refrains from attempting to estimate such investment revenue forecasts. They do indicate that expected general fund revenues from investment income (Permanent Mineral Trust Fund and other Income funds) is projected to fall by 58% in 2015-16 relative to those in 2013-14 in their October 2014 report.

25 The Mineral Revenue Report (revised 2014) showed four potential tracts that could be offered in the next decade. Two have unidentified amounts of mineable coal but may be available for lease by 2022 and 2023, and two areas with an estimated mineable resource of between 1,155 and 1,397 tons of coal that currently have no established date of availability.
imposition of new taxes on the state revenue-base, or from a legislated change in the state distribution formulas affecting the SFD. With respect to changes in distribution formulas, two solutions to addressing the SFD funding gap would be changes in the state’s severance and federal mineral royalties (FMR) distribution rules. In the FMR rules, increasing the maximum amount of funds that could be diverted to school capital construction, or removing the limit entirely could result in significant increases in funding revenues being diverted to the SFD from this source.\textsuperscript{26} Distribution to school capital construction from state severance tax collections could also be added to the state’s distribution rules, as currently no funds come from this source. Both suggestions would not only increase the revenues earmarked for necessary school construction needs, but because they include revenues from other minerals beyond coal, and include non-mineral revenues in the case of severance taxes, they would also diversify and could potentially smooth the SFD’s revenue streams.\textsuperscript{27}

This study takes no position on whether or how such actions should or could be taken, however, such choices require some understanding of how future state revenues may evolve, and the remainder of this report focuses on describing the possible circumstances that could affect the state’s overall revenue picture. In the remainder of this report two possible responses with respect to financing future school construction needs are described briefly: (i) the potential use of a simple mill-levy is described that could be used to both fund the estimated revenue gap previously presented, and to create future revenues for inevitable construction activity increases that will be required to eventually address population growth (assuming it continues to occur in the State) and facility depreciation. (ii) Description of energy market forecasts available that could affect severance tax revenues and therefore general fund resources available for future SFD expenditure appropriations.

**Mill-levies**

Given that there is already precedent in the state to use mill-levies to support education expenditures, we outline a simple example to demonstrate the potential of such a new tax.\textsuperscript{28} It is presented not as a recommendation, but to describe the potential of such an action. We consider mill-levies of 2 mills, 4 mills, and 5 mills (0.5 percent) imposed on the total state assessed valuation from all minerals and property as a replacement for part or all of the coal lease bonus component of SFD funding. Using figures reported in the October 2014 CREG Report, Table 4 describes the potential revenue such a levy could generate assuming no deductions from other taxes paid on mineral production are allowed.\textsuperscript{29}

\textsuperscript{26} These would come at the cost of fewer revenues ear-marked for the Budget Reserve or School Foundation Accounts as shown in Figure 1.

\textsuperscript{27} As shown in Figure 13, severance taxes currently do not contribute directly to SFD funding, however they do flow to the General Fund where appropriations can be made to finance any revenue shortfall thus this suggestion replaces a potentially implicit means of funding the gap with an explicit one.

\textsuperscript{28} Currently 12 mills in property taxes are used to support school district expenditures statewide.

\textsuperscript{29} Figures used come from the CREG, Wyoming State Government Revenue Forecast Fiscal Year 2015-2020, October 2014, Table 9. Values for 2021-2022 are linear interpolations of the stated total state valuation data presented in the CREG Table 9 from 2014 to 2020.
Table 4: Mill-Levy Revenues for Hypothetical Ad Valorem Tax to Support SFD Funding

<table>
<thead>
<tr>
<th>Biennium</th>
<th>Total Projected State Assessed Valuation</th>
<th>Estimated Ad Valorem Tax Levied @ 0.2%</th>
<th>Estimated Ad Valorem Tax Levied @ 0.4%</th>
<th>Estimated Ad Valorem Tax Levied @ 0.5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017-2018</td>
<td>$54,610,400,000</td>
<td>$109,220,800</td>
<td>$218,441,600</td>
<td>$273,052,000</td>
</tr>
<tr>
<td>2019-2020</td>
<td>$56,890,000,000</td>
<td>$113,780,000</td>
<td>$227,560,000</td>
<td>$284,450,000</td>
</tr>
<tr>
<td>2021-2022</td>
<td>$58,781,457,143</td>
<td>$117,562,914</td>
<td>$235,125,829</td>
<td>$293,907,286</td>
</tr>
<tr>
<td>Total</td>
<td>$340,563,714</td>
<td>$681,127,428</td>
<td>$851,409,285</td>
<td></td>
</tr>
</tbody>
</table>

Table 4 values show that the total tax collected from a 4 mill levy in each of the three biennia would offset the projected funding gap of $671.3 million previously described and in fact would create a surplus of approximately $10 million (with a “break-even” of just about 3.9 mills). If the mill-levy were increased by 5 mills as shown in the rightmost column of the table, the tax would generate a surplus over the six-year period of $180 million. In the case of either levy, any surplus could be deposited in a School Capital Construction Account or a reserve account to be used in future biennia when additional construction expenditures are needed. In effect, the tax could be used as a sinking fund to support necessary future construction activity when enrollment growth necessitates an expansion in school capacity or facility condition depreciates below thresholds deemed acceptable by the state.

In addition to funding the shortfall in SFD expenditures projected, an advantage of such a mill-levy includes the fact that it could be used to replace the role coal lease bonus incomes currently play in the SFD revenue stream, creating greater certainty relative to the current distribution formulas used given their uncertain nature. Coal lease bonuses, when they were received in the future would then be available for other state funding activities. As with changes in the distribution rules, the use of a mill-levy potentially diversifies and smooths the revenue stream of the SFD. Alternatively, a smaller 2 mill levy would reduce the SFD shortfall over the next three years by just over 50 percent, and while this would not create any surplus for future needs, it could reduce the need from other sources while stabilizing the revenues earmarked for the School Facilities Department’s construction activities.

**Appropriations from the General Fund**

If instead of funding the SFD revenue gap projected using a permanent revenue change like the mill-levy just described or using a change in other state distribution formulas, appropriations

---

30 Note that we did not attempt to estimate any tax elasticity with respect to such a mill-levy, that is, any change in economic behavior or valuation caused by the increased taxes or efforts to avoid the new tax. There is little literature on tax-elasticity effects from such levies.

31 Note that in both cases the shortfall in the 2017-18 biennium is not avoided and would have to be dealt with.

32 All or a portion of these revenues could be collected by the state for use in construction anywhere in the state, or remain with districts as district-specific sinking funds.
from the State’s General Fund could instead be used on a discretionary basis by the Wyoming Legislature. The General Fund relies on several sources of revenue. Historically, the largest two sources have been Sales and Use Taxes and Severance Taxes respectively and this is anticipated to be the case in the future. Figure 12 shows the projected income shares by source in the General Fund for the 2015-16 biennium according to the October 2014 CREG projections.

Figure 12: General Fund Anticipated Revenue Shares by Source, 2015-16 (Source: October 2014 Wyoming State Government General Revenue report, CREG)

Income from mineral production makes up the greatest portion of severance tax income and sales and use taxes are also impacted by this activity. The distribution of severance taxes into the

---

Note here we are not assuming the use of a new or increased tax. We are only considering reappropriation of existing tax revenues. Applying an increase in taxes used for the General Fund for example would require an estimate of tax elasticity as an increase in sales and use taxes for example, would potentially lead to reduced sales in part due to the effect of the higher tax rate (it effectively increases the price of goods and therefore should reduce some expenditures at the margin) and reduce a portion of the tax revenues collected for an increased tax rate.

In the past two biennia large realized capital gains in the State’s Permanent Mineral Trust Fund and its pooled State agency accounts combined have been the General Fund’s largest source of income, accounting for 27.6 percent and 10 percent of the total revenues respectively in 2013-14. Compare this to a severance tax share of 16.1 percent and sales and use tax share of 36.3 percent in the same biennium. It is anticipated these abnormally high market returns will not continue and in future biennia, assuming normal market returns, sales and use taxes and severance taxes will again be the largest two sources of income.
General Fund is shown in Figure 13.\footnote{Note that severance taxes also fund a significant portion of Budget Reserve Account revenues, as do Federal Mineral Royalties as shown in Figure 1. Other sources of General Fund revenues include Federal Mineral Royalties as shown in Figure 1 where one percent of the total is paid as an administrative fee to the fund.} Using either severance tax revenues or sales and use taxes would mean a reallocation, with political repercussions by interest groups. Increasing the size of either to account for the shortfall would have other political repercussions we do not consider here.

Since the biennial gaps projected in Figure 9 vary with the biennium considered, a potential benefit of using discretionary revenues to fund an SFD revenue shortfall is that gaps can be dealt with as they arise. A drawback though is that funds have to be available when such gaps occur and these funds are impacted by the State’s mineral production. Gaps are more likely to occur when coal lease revenues are low, which may be more likely to occur when mineral production is weaker. As mineral production accounts for a significant portion of the severance tax revenue stream this positive correlation problem could complicate using discretionary appropriations as a solution to fund SFD revenue shortfalls.\footnote{Note that an investment windfall could also be appropriated to cover potential SFD revenue shortfalls, however, such market returns are as or more difficult to forecast than mineral production.}

![Severance Tax Distribution Formula](source: Mineral Revenue Report)

Understanding how changes with respect to economic and regulatory conditions could affect potential Wyoming’s revenue streams is therefore critical if better informed decision-making among Wyoming policy-makers is to be achieved. Forecasting the potential implications market changes could have on the state generally, and on the State and SFD revenues specifically is difficult given how activity in energy markets will evolve is highly uncertain. Since coal plays a significant role in the existing funding formula for the SFD, a summary of the important market determinants of Wyoming coal production is presented in the Appendix, along with a description of a series of market scenarios used to estimate potential revenue outcomes for state royalty and severance tax streams. Using a set of market projections developed in the Appendix, a description of how these revenues may change over the 2015 to 2022 period is also developed to inform policy-makers of possible market impacts on General Fund severance tax streams in the future.
Table 5: Historic Components of Mineral Severance Taxes by Contribution (Millions $)

<table>
<thead>
<tr>
<th>Fiscal Year Biennia</th>
<th>CREG Projections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coal</td>
<td>$261.4</td>
</tr>
<tr>
<td>Crude Oil</td>
<td>$142.5</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>$570.5</td>
</tr>
<tr>
<td>Other Minerals</td>
<td>$18</td>
</tr>
<tr>
<td>Total</td>
<td>$992.6</td>
</tr>
<tr>
<td>% change from Previous</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Source: CREG and Wyoming Department of Economic Analysis (October 2014)

The historical variation of severance tax revenues by mineral source is shown in Table 5. Overall, severance tax revenues across all commodities achieved a maximum in the 2007-2008 biennium. Since then they have remained relatively stable at between six and eight percent below that total. CREG projections suggest that by 2018 these taxes will have recovered nearly to the level set in 2007-08 due to projected increases in oil production revenues. Gas revenues have dominated state severance income over the past decade, but anticipated declines in natural gas production, combined with only small increases in prices result in these projected revenues falling to 32 percent of the total collected, less than the share due to crude oil sales. Coal revenues are anticipated to remain relatively stable, generating over $500 million dollars per biennia, a level they have achieved since 2009-10. As a share of total revenues, however, coal revenues are anticipated to decline slightly from their current 31 percent share in the 2013-14 biennium to 27.5 percent by 2018.

CREG estimates, however, are quite conservative and rely on a forecast that assumes current conditions and prices in energy commodity prices will continue into the following three biennia. Tables 6 and 7, compare CREG outcomes to those under alternative market and regulatory conditions described in the Appendix.

Table 6: Estimated Total Biennial Severance Tax Revenues Using EIA Market change Assumptions and CREG Forecast Outcomes (Millions)

<table>
<thead>
<tr>
<th>Biennium</th>
<th>Reference</th>
<th>High Econ Growth</th>
<th>Low Econ Growth</th>
<th>High Coal Costs</th>
<th>Low Coal Costs</th>
<th>High Nat. Gas Resource</th>
<th>Low Nat. Gas Resource</th>
<th>CREG (October 2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,799.5</td>
</tr>
<tr>
<td>2015-16</td>
<td>2,109.1</td>
<td>2,127.1</td>
<td>2,108.7</td>
<td>2,143.1</td>
<td>1,083.8</td>
<td>2,080.6</td>
<td>1,071.5</td>
<td>1,878.9</td>
</tr>
<tr>
<td>2017-18</td>
<td>2,261.5</td>
<td>2,306.6</td>
<td>2,255.1</td>
<td>2,342.6</td>
<td>2,199.0</td>
<td>2,190.7</td>
<td>2,184.4</td>
<td>1,860.8</td>
</tr>
<tr>
<td>2019-20</td>
<td>2,441.6</td>
<td>2,499.2</td>
<td>2,418.0</td>
<td>2,538.6</td>
<td>2,349.2</td>
<td>2,360.0</td>
<td>2,370.6</td>
<td>1948.9</td>
</tr>
<tr>
<td>2021-22</td>
<td>2,676.6</td>
<td>2,760.5</td>
<td>2,636.1</td>
<td>2,794.9</td>
<td>2,546.7</td>
<td>2,596.8</td>
<td>2,605.2</td>
<td>N/A</td>
</tr>
</tbody>
</table>

35
Table 7: Estimated Total Biennial Severance Tax Revenues Projections Using EIA Regulatory and CREG Forecast Outcomes (Millions)

<table>
<thead>
<tr>
<th>Biennium</th>
<th>Reference</th>
<th>National Coop w/ EE</th>
<th>National Coop w/o EE</th>
<th>Regional Coop w/ EE</th>
<th>Regional Coop w/o EE</th>
<th>CREG (October 2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,799.5</td>
</tr>
<tr>
<td>2015-16</td>
<td>2,256.9</td>
<td>2,239.0</td>
<td>2,239.0</td>
<td>2,224.1</td>
<td>2,212.1</td>
<td>1,878.9</td>
</tr>
<tr>
<td>2017-18</td>
<td>2,494.2</td>
<td>2,407.6</td>
<td>2,407.6</td>
<td>2,401.6</td>
<td>2,393.8</td>
<td>1,860.8</td>
</tr>
<tr>
<td>2019-20</td>
<td>2,874.4</td>
<td>2,695.3</td>
<td>2,695.3</td>
<td>2,597.5</td>
<td>2,595.9</td>
<td>1,948.9</td>
</tr>
<tr>
<td>2021-22</td>
<td>3,206.7</td>
<td>2,909.3</td>
<td>2,919.4</td>
<td>2,871.9</td>
<td>2,907.4</td>
<td>N/A</td>
</tr>
</tbody>
</table>

As can be seen in both tables, the degree to which additional appropriation income could become available to fund any SFD revenue shortfall predicted in the 2017-18 through 2021-22 biennia depends on the market conditions assumed. CREG predictions are not made beyond 2020, but those for 2017-18 and 2019-20 clearly do not indicate a significant enough increase in severance taxes due to mineral production increases to fund any additional appropriations necessary to cover the predicted gap SFD revenues to expenditure needs. EIA projections, however, do suggest such an increase could be possible, even if significant carbon controls are instituted on coal-fired power plant production as assumed in Table 7.

Overall, the ability to use appropriations to cover any SFD revenue shortfall to expenditures will depend on the probability of additional revenue growth from levels in the current biennium budget. These depend on many unknowns including financial market outcomes affecting revenue to state investment accounts and the Permanent Mineral Trust Fund, which cannot be forecast. They also depend on mineral production outcomes that determine a significant portion of severance tax income and royalty income for other revenue accounts. Again, energy commodity conditions are also very difficult to forecast though some attempt has been made to do so. Market scenarios presented suggest that there is some potential for continued growth in energy revenues if EIA models are to be believed, however, the CREG forecast does not assume such increases will take place.

**Study Conclusions:**

Given the preceding analysis presented in Parts 1 through 3 of this report the following conclusions regarding School Facilities Department funding and expenditure have been derived:

1) SFD revenues are likely to become very volatile in the coming biennia due to the pending termination of several coal lease bonus payment streams. Such CLB revenues make up the majority of School Facilities Department funding revenue and have done so over the past decade. New leases are very unlikely to be sold to make up for the lost revenues due to bonus payments ending, both due to a very low inventory of new leases that could potentially be offered by the Bureau of Land Management, and the fact that
anticipated weaker coal-market conditions imply that revenues from such sales would likely be significantly lower than those paid in the past. Other revenue streams from federal and state mineral royalties are not predicted to be affected by changes in market or regulatory conditions, but due to the limited amounts of funding these create under current state revenue distribution rules, the loss of coal lease bonus payments will cause projected School Facilities Department revenue to decline by over 94 percent from levels observed in the 2013-14 biennium by 2019. In dollar terms the projected decline in coal lease bonus revenues from those received in 2013-14 is $466 million. Absent new sources of revenue or new coal lease bonus sales we project total funding to the SFD accounts of only 26.6 million in the 2019-20 biennium.

2) School Facilities expenditures are anticipated to decline over the next two biennia as new construction slows due to previously completed construction efforts. Due to the major building program embarked upon by the SFD since the mid-2000s, significant capacity and condition improvements have occurred in education facilities throughout the state. We anticipate that new construction efforts required to meet state objectives with respect to enrollment and facility condition will result in little need for major new construction after the 2017-18 biennium. After this, the expenditure forecast model developed for this report suggests that new construction needs in the 2019-20 biennium will be only 8 percent of those in the preceding biennial budget period. In 2017-18 we project new construction needs to total $353.3 million, but in 2019-20 and 2021-22 these needs fall to $43.3 million and $45.0 million respectively.

Major maintenance expenditures anticipated over the next three biennia are forecast to grow predictably at approximately double the rate of inflation. Minor maintenance is anticipated to grow at the rate of inflation over the period from 2017 to 2022. Overall, we predict total SFD expenditure needs in 2017-18 to be $486.5 million, falling to $185.9 million in 2019-20 and $198.8 million in 2021-22. This includes a suspected overestimate of approximately $20 million per biennium in minor maintenance costs due to our use of Wyoming Department of Education (WDE) data in computing these amounts. As noted in the text, there is a significant deviation in the historic WDE and SFD minor maintenance data and this report used the higher of the two figures. Using SFD formulas reduces reduce these minor maintenance costs estimates by almost a factor of four.

Our projection model further suggests that given current enrollment trends, capacity increases and facility condition improvements made through new construction efforts since 2005, that major new construction efforts of the scale embarked on in the past decade will not be likely be necessary until the end of the next decade (between 2028 and 2030 at the earliest and not at the scale of past efforts), and potentially even further into the future. The majority of SFD expenditures in the period from 2019 and throughout the
next decade will be in capital preservation and not new construction as it has been over the past decade.

3) Given the analysis of estimated revenues and forecast expenditures, our modeling suggests a School Facilities Department revenue to expenditure gap of $671.3 million between 2017 and 2022. Over half of this gap (almost 51 percent or nearly $339.8 million) occurs in the 2017-18 biennium as the last of the SFD’s new construction boom that began in the mid-2000s is completed. The following two biennia account for approximately 24 and 26 percent of the remaining estimated funding gap respectively ($159.3 million and $172.2 million respectively). These estimates are not very sensitive to inflation assumptions, changing by approximately $15 million for a half-percent change in the inflation assumed around our default value of 2.5 percent. Increases in the assumed construction cost per square foot from $250 to $300 increase the estimated gap by approximately $69 million. As noted above, if SFD minor maintenance data is used instead of the WDE data used in the gap computation, the estimated gap would fall by an additional $60 million or approximately ten percent from the $671.3 million calculated.

4) Addressing the School Facilities department revenue-expenditure gap forecast could be accomplished in several ways. From the perspective of costs, changing SFD policies with respect to new construction thresholds with respect to capacity or facility condition primarily affects the forecasted SFD expenditures in the 2017-18 biennium as this is the period in which the majority of new construction forecasted occurs. If the FCI threshold used to estimate necessary new construction were increased from 0.4 to 0.45, the gap would be reduced by an estimated $32.1 million or 4.8 percent between 2017 and 2022, with the primary effect being to delay construction of some schools until later in the next decade. Allowing enrollment thresholds to be increased by 10 percent before necessitating new construction would reduce the gap by $52.2 million or 7.8 percent over the three biennia from 2017 to 2022. Implementing both changes would result in a reduction of the funding gap by an estimated $84.3 million or 12.6 percent.

Addressing the gap from the revenue side could be accomplished in several ways including combinations of methods. State revenue distribution formulas could be changed - in particular the revenue caps from state and federal mineral royalties could be raised or eliminated entirely. This could result in a greater portion of funding being derived from revenues other than coal lease bonus payments. Unanticipated capital gains associated with state investment account income could also be used. These have been considerable in past years and may continue to be. We suggest that given the uncertain nature of coal lease bonus and financial market returns, however, that this may be an imperfect solution. Instead, a more certain and permanent solution to reducing the volatility of the SFD funding stream could be to impose a mill levy. We consider examples of between two and five mills on the statewide assessed valuation and find that at 4 mills the gap would be more than funded and at 5 mills revenues could be generated and kept in
trust for future construction needs when they are needed, acting as a sinking fund to finance eventual future construction. A 2 mill levy could be used in conjunction with other appropriations and/or changes in SFD new construction thresholds or distribution formulas. We note that financing the gap using general fund appropriation could also be achieved, however, it is unclear what effects this would have on the rest of the state budget as future market conditions regarding mineral revenues, a significant source of state revenues is uncertain. Clearly, all choices and solutions are at the Legislature’s (and indirectly the voters’) discretion.
Appendix:

Identifying the primary drivers of Wyoming coal and energy output required an analysis of the coal market and the following section reviews historic data to show how these determinants were selected. Major influences of coal market outcomes can be broken into two different types of effects:

(i) “Fundamental” market effects driving coal market demand and production costs, specifically
   a. economic growth
   b. natural gas prices
   c. coal-mining production costs.

(ii) Regulatory changes affecting Wyoming energy markets, especially how the EPA’s proposed Clean Power Plan for new and existing electricity-generating power plants is implemented, if it is implemented.\(^{37}\)

To identify potential projections of future state revenue changes, this report used a series of well-known market projections derived from the US Energy Information Agency (EIA) 2014 Annual Energy Outlook (AEO2014) to identify potential changes in Wyoming coal output under a variety of market and regulatory assumptions. These EIA projections are widely utilized across government and the energy industry to understand how energy market conditions could change for fluctuations in economic fundamentals or for regulatory changes. The projections are derived from a complex and highly integrated model of the US energy economy called the National Energy Modeling System (NEMS), which produces a series of very detailed production and price outcomes across the nation’s energy markets.

Twelve different market and regulatory revenue scenarios were considered. Seven of these were derived from market forecasts publicly available at the Department of Energy AEO2014 website since April 2014. The other five forecast scenarios explore the potential impact of proposed US Environmental Protection Agency (EPA) regulations regarding coal-fired power plants announced June 2, 2014. These were derived from a set of proprietary NEMS-model derived market forecasts of national and regional coal, gas and oil market outcomes provided to the University of Wyoming Center for Energy Economics and Public Policy (UW CEEPP) by the Rhodium Group, a private consultancy based in New York.\(^{38}\)

---

\(^{37}\) Other major EPA regulations already approved but not yet in effect on electric power plants before June 2014 were considered in all scenarios presented.

\(^{38}\) To define a set of regulatory projections estimating the potential effects of these proposed EPA regulations, and to ensure these projections were consistent with those made by the EIA published in their AEO2014 Annual Energy Outlook (available here: [http://www.eia.gov/oiaf/aeo/tablebrowser/](http://www.eia.gov/oiaf/aeo/tablebrowser/)), creation of a set of NEMS-derived estimates was necessary. Given the short time-frame involved in this project, and the fact that the NEMS model is not currently available at the University of Wyoming, UW CEEPP solicited outside help to model the EPA outcomes from the Rhodium Group, who had already modeled them as part of a larger research project estimating the impact of the proposed regulations on the national economy (the initial results of this project are described here.
market estimates were then used by the authors to construct state revenue estimates using a Wyoming revenue model developed by UW CEEPP.

An additional revenue scenario was derived using the Wyoming Consensus Revenue Estimation Group (CREG) October 2014 forecast for comparison. The CREG forecast is traditionally used by Wyoming state government to guide future revenue expectations and has traditionally been quite conservative. CREG estimates are compared to EIA projections of output and revenues generated.

Coal and Energy Market Background: An Overview of Factors Influencing Wyoming Coal and other Energy Market Outcomes:

Coal production in the state has been a stable and robust source of SFD funds for over a decade, particularly due to the coal lease bonus revenue it has generated. Since the introduction of the 1990 Clean Air Act Amendments, which radically reduced allowable sulfur emissions from coal-burning industrial processes, the low-sulfur coal mined in the Powder River Basin (PRB) has been in high demand, transforming the area into the largest coal-producing region in the country. With coal-production growing steadily since the 1990s, the State of Wyoming, with major coal-mining activity in both the PRB and in southwest Wyoming, has produced the majority of the nation’s thermal coal used in electricity generation and industrial processes.

Since the mid-2000s, state coal production has accounted for approximately 40 percent of the country’s thermal coal output, which, as of 2012, was shipped to thirty-four states including Wyoming [see Figure A1]. Revenues from this coal output have provided a steady stream of funds for use by the SFD and other state agencies for over a decade. This revenue source is now potentially threatened by several market and regulatory factors.

http://csis.org/event/remaking-american-power ). Regional Wyoming-relevant results from this analysis were created and provided to UW at no cost in an effort to aid ongoing UW CEEPP research into the effects of this regulation on Wyoming. Personnel at Rhodium were very generous not only with their time but also the data provided, and should be recognized for their help in this aspect of the project.

October 2014 CREG forecasts of energy market price and production outcomes run only to 2020 thus projections for this series include one less biennium than the other projections. In some cases an extrapolation of CREG forecasts was created for comparison purposes only with other scenarios, and were created without consultation with CREG.

EIA forecasts are not out of line with major market forecasts, though they often predict outcomes slightly higher than other forecasts do. A summary of how EIA projection forecasts in the AEO2014 model compare to other professional forecasts can be found here: Annual Energy Outlook 2014: Comparison to other projections, pp. CP-2 to CP-16 http://www.eia.gov/forecasts/aeo/section_comparison.cfm (accessed November 16, 2014). CREG forecasts, while much shorter term than the EIA and other forecasts are still quite conservative if similar time periods are compared.
Figure A1: Wyoming and U.S. Coal Production: 2001-2012 (Source: Energy Information Administration)

Figure A2: U.S. Electricity Consumption by Sector, 1949-2013 (Source: Energy Information Administration)
The first concern is the fact that coal-derived revenues have recently stopped growing due to a slowdown in coal-demand growth. Growth in electricity demand, the most important use of Wyoming coal, has been flat and in some years actually declining slightly since 2008 [see Figure A2]. This has been due to several factors. In the past five years total growth in electricity demand has slowed drastically relative to the years prior to 2008, and these declines have closely followed national macroeconomic conditions. Industrial demand declines have been even greater and extend back to the mid-1990s. While economic growth has largely driven electricity demand since 1950 in a very close relationship, since the mid-1990s this relationship has proven less robust [see Figure A3]. From 1950 through 1970, annual electricity demand growth outpaced that of the entire economy. From 1970 to 1990, which corresponds with the period in which Wyoming coal became the most important source of national supply, both the growth rates of the economy and electricity demand approximately corresponded to one another. After 1990, however, electricity demand growth has trailed that of the national output as measured by gross domestic product (GDP).

As shown in Figure A3, the decline in electricity demand relative to economic growth after the early 1970s seems to occur simultaneously to the divergence of total industrial electricity demand relative to the rest of the economy shown in Figure A2. Overall, the weakened relationship between overall economic growth and electricity use reflects several other factors in addition to the decline in industrial demand, primarily improvements in energy efficiency. Overall, these trends have reduced the growth in coal used for electricity across the country, however, with respect to Wyoming coal these trends have been less relevant.

![Figure A3: Changes in Economic Growth and Electricity Use, 1950-2013](Source: Energy Information Administration)
State coal output has accounted for most of the growth in national sub-bituminous output since the 1990s [see Figure A4]. With the introduction of the Clean Air Act Amendments of 1990 and their imposition of stricter sulfur controls on the electricity generation sector, demand for bituminous coals, which have higher energy and sulfur content than Wyoming coals but are more expensive to mine and burn, have declined. Growth in the production of Wyoming coal, driven by these regulatory changes, was significant until 2008. Throughout the 1990s and early 2000s, the cost advantages due to Wyoming’s thick coal-seams that are found very close to the surface resulted in economies of scale and low mining costs relative to coal reserves elsewhere in the country. These, along with the low sulfur-content advantages of PRB coal, resulted in new coal-generation growth nationally being primarily fuelled by PRB coals. The result was the steady increase in sub-bituminous coal demand shown in Figure A4. This growth in output fuelled most of the electricity demand increase that occurred in the rest of the country over this period until 2008.

Figure A4: Coal Shipments by Grade, 1969-2011

Since 2008, other factors in addition to falling load-growth rates have affected the demand for Wyoming coal. The most important of these has been the rapid increase in national natural gas supplies due to new natural-gas production technologies developed in the past ten years (so called “fracking” techniques, along with technologies developed to produce natural gas from “tight gas” formations that were previously inaccessible until the early 2000s). Since approximately 2005 a rapid increase in new natural gas sources across the United States, has resulted in a significant increase in natural gas production. This has resulted in significantly lower natural-gas fuel prices and subsequently led to fuel substitution away from coal by many electricity generators for several reasons. From 2002 to 2009 when natural gas production
significantly increased nationwide, the average delivered price to electric power plants was over $6.80 per thousand cubic feet (mcf). Since that time, including a significant price spike in the winter of 2013-2014, the average price delivered to power plants has fallen by 30 percent from the previous period to an average of $4.78 per mcf (see Figure A5).

![Figure A5: Delivered Natural Gas Prices to Electric Power Plants](image)

These economic conditions have resulted in a dramatic increase in natural gas electricity generation, which has become competitive with coal generation in many areas. Further, these prices, coupled with future regulatory concerns regarding coal (discussed below) and expectations that future natural gas prices will remain low has resulted in almost all new fossil-fired power plant development (planned and constructed) in the past half-decade being natural gas-fired. The effects and influence of natural gas prices on the generation sector are apparent in Figure A6, and appear to have been the single largest factor responsible for the large decline in the amount of electricity generation due to coal. As is clear in the figure, the decline in coal-fired generation as a share of total generation occurred simultaneously with a significant increase in gas-fired generation since 2008.

Along with gas prices a second pressure on coal-fired generation has arisen in the market from the development of new renewable generation technologies. Particularly in the area of wind generation, since 2006 a portion of the generation that previously was produced by coal is now generated by renewable technologies. Because renewables have almost no marginal cost of production (the fuel is free and therefore the only cost in production comes from additional Operations and Maintenance (O&M) costs), the reduction in the cost of renewable generation manufacture and development, along with substantial improvements in output have led to renewables displacing fossil-fired generation when and where they are available. Figure A6
shows have these sources have also supplanted a portion of production previously generated by coal. This growth is expected to continue in the future, as is generation from solar resources.

Overall, much lower natural gas prices, the growth of renewables, have eroded coal-generation output and therefore demand for Wyoming coal resources. These effects, further magnified by the imposition of new and more stringent emissions regulations at coal-fired plants due to take effect in 2016, and coupled with uncertainty regarding future climate change regulations that threaten to impact coal use, appear to have resulted in an accelerated switch to cleaner and less carbon intense natural gas-fired and renewable generation nationwide. Incentives to build additional new coal-fired power-plants have also been undermined. The latter effect will be even more important with respect to coal-demand in coming years as climate change regulations begin to be introduced into the power-generation sector, and aging coal-fired power-plants, some over half a century old and nearing the end of their useful service lives, are retired.

![Figure A6: Net Electricity Generation by Source for All Sectors, 1949-2013](Source: Energy Information Administration)

In addition to a flattening of coal production in Wyoming, these market effects have also had a second effect on Wyoming’s minerals-based revenues. Natural-gas severance tax and royalty revenues, which grew rapidly in the state from 2004 through 2008 have declined steadily as national supplies of natural gas elsewhere in the country have reduced market prices. Coal-bed methane production, a promising area of natural gas expansion in the Powder River Basin area of the state from 2004 to 2008 when natural gas prices were above $6 per mcf, has since declined.
significantly since 2009 as shown in Figure A7. Expansion of tight-gas resources in the southwestern part of Wyoming has also slowed as national prices have fallen, thus while coal revenues have begun to decline due to the natural gas boom, natural gas revenues have not increased commensurately.

![Figure A7: Natural Gas and Crude Oil Production, Wyoming 2000-2013 (Source: Energy Information Administration)](image)

New techniques with respect to the recovery of oil in Wyoming, particularly enhanced oil recovery, where new methods are used to recover oil from fields previously thought to be depleted or unrecoverable, have resulted in a substantial increase in oil production, especially since the mid-2000s. Newer fracking and horizontal drilling techniques have also contributed to this oil production increase in the state. Overall the decline in natural gas production of almost 20 percent since 2009 has been offset in part by a 22 percent increase in oil production over the same period.

Summarizing, the primary market determinants of SFD revenues are coal production outcomes, which indirectly affect the value of coal lease bonuses and directly affect the level of royalties collected. They also affect a significant portion of the severance tax revenue used to finance the General Fund if additional appropriations beyond the normal SFD revenue streams are needed. The primary determinants of coal demand in recent years in Wyoming have been national natural gas prices along with the expansion of renewables on electricity generation. Electric generators are dispatched according to a “merit order” in which electricity generation is allocated to those generators with the lowest production costs first. Renewables, having zero fuel costs are dispatched first if available. Expansion of renewables generation potential, especially since 2006 has therefore displaced some coal generation reduced coal demand, but this has been relatively small compared to natural gas effects.
Historically nuclear power would be called upon next, with coal-fired generation called upon afterward in the merit order and natural gas following. Decreases in natural gas costs, however, have made gas-fired generation much more competitive relative to coal and resulted in some coal-generation being displaced by gas. As natural gas prices fall, some gas generation displaces coal in the merit order, and since 2009 this has driven much of the increase in gas generation shown in Figure A6. The rest of the increase has come from coal-fired generation retirements and the expansion of new gas-fired generation relative to coal being added to national generation capacity. All of these factors have caused coal demand to slow in Wyoming.

Electricity demand, if it were growing would mitigate some displacement of coal-fired generation by gas as it would expand the number of plants called upon to generate electricity, but as shown in Figure A2, such expansion in total demand has not occurred as the economy has become much more efficient. GDP growth now outstrips electricity demand growth, suggesting that the national economy now needs less electricity per unit of output than previously. In order of relative importance, since 2008 the primary market determinants of coal demand have been natural gas prices, load growth, and the rise of renewables due to their impact on the need for coal-fired generation.

Finally, concerns regarding regulation, particularly carbon regulation, have a significant effect on coal-fired generation and therefore have or will likely have an impact on coal demand also. Coal, which creates greater amounts of all pollutants including carbon, relative to natural gas will be especially sensitive to new regulatory requirements that require addition production costs to mitigate the pollutants the fuel creates or that favor less carbon intensive production fuels. Such requirements will further increase the substitution of gas for coal-fired production of electricity and therefore potential regulatory changes have to be considered when future changes in coal-demand are forecast.

**Regulatory Impact: Market Projections under Newly Proposed Carbon Regulations**

On June 2nd, 2014, the US Environmental Protection Agency (EPA) announced its long-anticipated regulatory proposals for the control of greenhouse gases (GHGs) emitted from power-plants. The greatest source of GHG emissions from power-plants are those caused by coal-burning electricity generators, thus the proposed rules create a real threat to the Wyoming coal industry. If these proposed regulations are not enacted, the threat of carbon regulation will still remain over the industry.

In the current scientific and political environment, both in the United States and internationally, it seems improbable to assume GHG regulation will not be introduced into the economy at some point in the near future. The Obama Administration is currently defining economy-wide GHG emissions targets, and has already mandated an improvement of over 100 percent from current
levels in automobile and light truck fleet mileage targets through 2025. The EPA proposals made in June 2014 reflect the most wide-ranging climate change regulations to date to be considered for the US economy.

Internationally, in October 2014, European Union nations pledged to reduce their emissions to 40 percent below their 1990 baseline levels. Current emissions were 12% below 1990 levels as of 2012. China and the United States also announced a carbon reduction agreement in November 2014, that, if enacted, pledges to reduce US carbon emissions by 26 percent from 2005 levels by 2025, while China promises to see their rapidly developing economy’s peak no later than 2030. In 2015, a major climate summit in Paris may result in a global agreement on carbon emissions over the period from 2020 to 2040.

While much of any future regulation is currently only in proposal form, the efforts now occurring suggest much stricter GHG requirements in the future. The proposals made in summer 2014 by the US EPA provide a potential guidepost to the shape and severity such regulations might take with respect to coal use in electricity generation, the primary driver of Wyoming coal demand. They also provide a context in which to estimate the potential impact such legislation could have on the Wyoming coal market, and by extension the carbon-based energy sector from which much of the revenue base that provides funds earmarked to support SFD expenditures is derived.

The rules proposed by the EPA are unlike most previous emissions regulations. Instead of creating a determination of emissions allowable at each plant or source of GHG emissions, or alternatively, limiting the total emissions across an industrial sector, the EPA’s “Clean Power Plant” rules, sometimes referred to as “111(d)” in reference to the code from the Clean Air Act under which they are proposed, define emissions rates that states must meet from their electricity-generation sectors. The overall reduction of GHGs the EPA proposes is ambitious and will have significant effect on coal-fired electricity generation nationwide. The EPA’s own modeling simulations suggest that the proposed regulations would result in the retirement of 46 GW of coal-fired electricity generation between 2016 and 2020, or 15 percent of the total coal-fired generation capacity in the United States in 2012. These retirements would occur on top of any already announced retirements before 2016, when the rules are scheduled to be adopted.

---

41 By 2025 automakers will have to achieve a fleet fuel mileage average of 54.5 miles per gallon as computed using the federal Corporate Average Fuel Economy (CAFE) standards.
44 EPA reference here
45 Due to market conditions, plant age and cost and existing regulations the EIA Annual Energy Outlook 2014 (AEO2014) reference case previously presented projects 60 GW of generation to be retired by 2020 due to mercury and other emissions regulation changes already adopted into law. Not all plants assumed to retire in the EIA or EPA simulations use Wyoming produced coal.
Targets by state differ, and the proposed rules allow each to design a unique plan to meet their mandated goals. States have been allowed the latitude to use several methods of reduction to meet their goals. These range from efficiency improvements at power-plants, to requiring the use of coal-fired plants be reduced, or “redispached,” in favor of gas-fired technologies or renewable generation. States may also require utilities and power providers to impose energy efficiency improvement mandates and incentive programs to reduce electricity demand and therefore the intensity of use of GHG generating fuels such as coal (See Appendix 2).

The effect of the EPA’s proposed legislation on curtailing coal-fired generation within states, and by extension on Wyoming’s coal production depends on two critical factors – the degree to which energy efficiency changes are allowed in the final regulations, and if they are whether this option is used by states; and the degree to which states cooperate with one another to achieve their mandated reductions. These remain unresolved issues. The first, energy efficiency, may be challenged in court or states may choose not to pursue them. Because energy efficiency represents not a control on electricity generation, but instead on electricity demand, courts may find this outside the EPA’s purview. States may also feel they are unwilling or unable to impose such requirements on energy consumers when designing their control strategies to meet the new rules.

The second issue of state cooperation results from the fact that while the EPA set state-specific targets for GHG emissions rates, they have also allowed states the choice in their rule-making to cooperate across state boundaries to meet their combined emissions goals. Since the options available to each state to reduce GHG emissions differ, and therefore the cost to do so also differs, it may be the case that by cooperating, states could meet their obligations collectively at lower cost. For example, employing additional renewable energy in one state sources beyond those needed to meet a single state target because that state has a better wind resource could allow several states to collectively meet their EPA-imposed targets though the emission mitigation may occur primarily in one state. Alternatively states could use an emission trading scheme across their borders to allow their collective emissions to be managed.

Both the option to use energy efficiency and to engage in cooperation across states could ease the pressure to otherwise reduce coal-fired generation to meet GHG targets by widening the potential scope of emission reductions made elsewhere in the economy. Because the effect these regulations could have on coal and other forms of generation, including natural gas, several regulatory scenarios had to be designed to account for such effects.

---

46 The EPA imposed different state by state emission targets in the proposed rules due to fact that states have different abilities to meet such requirements.
Impacts of Coal Market Changes on Wyoming Revenues: Defining Market-based Projections of future Wyoming Coal Production

To identify potential projections of future coal output and the effects this will have on State revenues and SFD funding sources, this report uses a series of publicly available market projections to identify potential changes in Wyoming coal output under a variety of economic and regulatory expectations. Give the long timeframes these projections encompass, These projections should not necessarily be considered absolute forecasts of market outcomes since they depend on only current information and conditions, which is bound to change over time, so much as market comparisons meant to illustrate how changes in economic or regulatory conditions could affect coal output in a comparative sense give market assumptions. The scenario outcomes are presented with changes in underlying assumptions in isolation to one another so that the anticipated effects of any single assumption can be demonstrated. In reality any forecast of future outcomes will include changes in more than one market or regulatory assumption, unlike the projection scenarios shown.

Projections presented here are derived from the US Energy Information Agency’s 2014 Annual Energy Outlook (AEO2014), which are derived from a complex and highly integrated model of the US energy economy called the National Energy Modeling System (NEMS). These projections are widely utilized across government and the energy industry to describe how energy market conditions could change for changes in economic fundamentals or for regulatory changes. NEMS was originally developed by the US Department of Energy to understand the inter-relationship of energy markets and to analyze the effects of potential policy changes on these outcomes. They have since continued to be used by policy-makers, along with academic organizations, industry and national laboratories for business forecasting, policy-work and energy-market research.47 The AEO2014 projections derived from the most recent version of the NEMS model consider a series of thirty-one different economic and regulatory cases to define thirty-one separate series of price, production, consumption and emissions projections from 2012 through the year 2040, each corresponding to the different market and regulatory assumptions used. The most widely referenced scenario is referred to as the “Reference case”, which provides projections utilizing current macroeconomic data, market conditions, and statutes regarding energy use and emissions. These reference case projections do not include any proposed legislation or assume any new regulation thus they are often referred to as the “business as usual” outcome.

Given the previous overview of the relationship between coal markets and Wyoming coal production, Energy Information Administration (EIA) projections from publicly available AEO2014 reports were used to derive Wyoming coal, natural gas and crude oil production and

47 See http://www.eia.gov/oiaf/aeo/overview/ for an overview of the NEMS system.
specifically, these included projections describing the potential impacts of high and low economic growth on energy markets relative to reference case assumptions, the impacts of higher and lower coal costs relative to the reference case, and the impact of higher and lower natural gas production conditions (lower and higher natural-gas prices respectively) than those found in the reference case.

a summary of the assumptions used in each scenario is provided in appendix 2. the reference growth scenario presumes an annual national economic growth rate of 2.4 percent extending through 2040. this is approximately the average rate of growth observed in the national economy since 2011. low growth scenarios show the evolution of outcomes assuming the long term economic growth rate falls to an average of 1.9 percent through 2040, while high growth scenarios increase this growth rate to 2.8 percent, the average rate of growth in the national economy observed since 1984. as described previously, different economic growth scenarios could significantly impact electricity demand growth in the future (even if the relationship has become less sensitive over time), and therefore derived coal demand outcomes would be expected to vary significantly with changes in economic growth.

coal production cost outcomes assume changes as described in the appendix 2 for mine productivity growth, wages, equipment and transportation costs relative to the reference case, with slower productivity growth and higher costs considered detrimental to the demand for wyoming output. natural gas outcomes are similarly defined in appendix 2, with assumptions regarding the ability to recover gas varying by 50 percent from the reference case. varying the combination of assumptions results in coal price changes relative to natural gas prices, causing fuel switching in the production of electricity. in the case of higher coal costs or lower natural gas prices (higher available gas resource), coal production would be expected to decline relative to the reference case while in the converse cases the opposite outcomes would be expected to occur.

the effects of each of the changes in economic conditions considered (higher or lower growth than forecast, higher or lower coal production costs than forecast, and higher or lower natural gas prices than forecast) relative to the reference case are shown in figures a8 through a10. each scenario includes two figures. the first describes the projected time-paths for each scenario under the most optimistic conditions considered, and the other under pessimistic assumptions. the reference scenario case is also shown for comparison. the second figure shows the resultant total wyoming production revenues from coal production under the same assumptions.

relative changes in total production revenues from all sources over the next four biennia are shown in figure a11. total energy revenues provide the basis for the federal and state mineral

48 all aeo2014 projections summaries are available this interactive website: http://www.eia.gov/oiaf/aeo/tablebrowser/, along with the results of previous years’ economic outlooks and studies prepared to consider specific federal energy programs.
royalty payments (FMR/SMR payments) made to the state, indicating how the revenues supporting State and SFD activity might be expected to change for the changes assumptions shown in Appendix 2. All revenues shown are inflation adjusted to reflect the purchasing power of a dollar in 2012, the first year shown in Figures A8 to A10, thereby showing the real effects of production and price changes caused by changes in scenario assumptions only.

Figure A8.1: Coal Production Projections 2012-2040 under Economic Growth Assumptions

Figure A8.2: Coal Revenue Projections 2012-2040 under Economic Growth Assumptions
Figure A9.1: Coal Production Projections 2012-2040 under Coal Cost Assumptions

Figure A9.2: Coal Revenue Projections 2012-2040 under Coal Cost Assumptions
Figure A10.1: Coal Production Projections 2012-2040 under Gas Resource Assumptions

Figure A10.2: Coal Revenue Projections 2012-2040 under Gas Resource Assumptions
Overall the following observations can be made

(i) Economic Growth Scenarios
Coal production under all economic growth scenarios (reference, low and high) is expected to rise, as are coal revenues relative to 2012. Note that revenues are given in inflation adjusted dollars thus real purchasing power of the appropriations tax base from coal is expected to increase, even under pessimistic economic growth assumptions through 2022.

(ii) Coal Cost Scenarios
Coal production is expected to rise in the reference and optimistic coal cost scenarios through the mid-2020s. If costs were to rise more quickly than currently anticipated, however, coal production would be expected to decline relative to current output by 2016, and then remain relatively stable at output levels just below those in 2012 for the remainder of the decade. Somewhat paradoxically, inflation adjusted revenues do not begin to show a corresponding decline until 2023 under any of the coal cost scenarios, and then only for the low cost case. While production rises, prices fall by a greater amount, lowering revenues. All other cases, including the high coal cost/declining production case anticipate rising revenues, and therefore a rising taxable revenue base for coal. It should be noted that even in the worst revenue scenario shown here, the revenue base does not decline below that in 2012 until the late 2030s at the earliest.

(iii) Natural Gas Scenarios
In the gas resource cases, coal production is also anticipated to increase through the mid-2020s before declining in both the reference and low gas resource cases (in the latter case, gas prices are higher than currently forecast). In the case of an exceptionally high gas resource, prices of natural gas in 2015 are anticipated to be 20 percent lower than in the current biennium, resulting in a decline in coal output through 2016. After 2016,
however, even in these unfavorable conditions the coal market recovers, and as in the other cases is anticipated to increase through the mid-2020s. It is important to note that only in this case is coal production ever projected to drop below 2012 levels, and then only late in the 2030s. Inflation adjusted coal revenues increase relative to those in 2012 throughout the entire projection period.

Across all three sets of economic scenarios considered, long-term Wyoming coal production is expected to increase until mid-way through the 2020s. This increase arises in large part due to regulations expected to impact the coal market in 2016 already in law. Due to an increase in mercury emission stringency in particular, these regulations will result in many older coal-fired power-plants closing, and result in greater demand for Wyoming coal as far fewer non-Wyoming coal-fired power-plants are anticipated to close. Reduced generation capacity and economic growth are then anticipated to cause Wyoming coal demand to increase to meet national electricity needs. These results, however, do not reflect future climate change regulations. A softening in demand for Wyoming coal in the late 2020s reflects the anticipated retirement of coal-burning plants due to age. These are anticipated to be primarily replaced with cleaner natural-gas, renewable or other forms of electricity generation.

Figure A11 describes projected changes in production revenues, adjusted for inflation for the coal, oil and natural gas production base from which severance taxes, FMR and SMR revenues are derived over the next four biennia. In these cases it is anticipated that total taxable revenues projected under all economic cases considered are expected to rise compared to projection for the current 2013-14 biennium. In those cases where coal production declines are projected in the next decade, revenues from gas and oil are expected to increase, offsetting the decline in this taxable base of production. Even in the most pessimistic revenue scenario (the low coal cost scenario, resulting in increased coal production but reduced coal and natural gas revenues due to the depressed coal and gas prices this creates), the total production revenue level that provides the severance and FMR/SMR tax base, increases by 32 percent in the 2021-22 biennium compared to those projected in the current biennium in inflation adjusted terms. In the most optimistic case (high coal costs), total production revenues rise to levels 50 percent higher than those projected in the 2013-14 biennium by the 2021-22 biennium. The other cases considered indicate increases in the real funding base for severance and FMR/SMR payments of between 42 and 49 percent relative to the current period. Overall, for every EIA-derived economic scenario considered the funding base shows steady increases over the next four biennia with average rates of increase between 7 and 11 percent per biennium depending on the scenario considered using EIA projections.

Comparison to State of Wyoming Forecasts

The results under the EIA scenarios suggest the potential resilience of the coal-production sector in Wyoming to changes in coal-market conditions caused by economic factors unrelated to regulation. By extension the results also suggest the potential resilience of the oil and natural gas
revenue base from which FMR/SMR and severance revenues earmarked for the SFD are derived. Alternatively, the State of Wyoming Consensus Revenue Estimating Group (CREG) has a set of much more pessimistic projections. These projections are not based on any larger modeling framework and largely extrapolate on the basis of several current trends.

With respect to coal production the CREG October 2014 forecast assumes that production, which has fallen to 380 million tons annually through 2013 will remain at similarly depressed levels (falling to 375 million tons annually in 2016 and remaining there through 2020). Prices are assumed to be similarly depressed, rising by only 1.8 percent by 2016, and then rising at less than a third of one percent through the rest of the decade, ending at a price of $13.95/ton. These trends largely extrapolate the previous two years of coal production and price trends. EIA reference case production is assumed 16 percent higher in 2020 and selling at a price 64 percent greater adjusted for inflation.

Natural gas production is presumed by CREG to decline over the decade, initially at a 6 percent rate, with the decline slowing until gas production remains constant in 2020 at a level approximately 10 percent below currently estimated production levels. Prices are assumed to fall from a projected price of $4.70/mcf in 2014 to $4.30/mcf in 2015, before rising through the rest of the decade, reaching $4.70/mcf again in 2018 and $4.90/mcf in 2020. This compares to an inflation adjusted price of $4.57 in the EIA reference case but at production rates 32 percent higher in 2020. The CREG estimates rely on observed recent decline rates statewide and an anticipated slowing in these decline rates. They also do not anticipate additional new natural gas production, in contrast to the bullish projections in the EIA scenarios where total gas production is presumed to increase by 14 percent over levels in 2013 in the reference case. Prices reflect an extrapolation of recently observed price changes.

Oil production in the CREG forecast is also more pessimistic than EIA projections. EIA projections assume an increase of over 10 percent in Wyoming oil output by 2015 but then growth falls dramatically to near zero by 2017, declines slightly in 2018 and 2019 before resuming growth again in 2020. Overall oil production rises from 20 barrels/day in 2013 to 0.25 barrels/day in 2020. CREG estimates forecast a more steady growth rate in oil production over the remaining years of the decade, averaging growth rates annually just over 3 percent and finishing the decade at a production rate of 0.24 barrels/day. EIA Wyoming oil price in 2020 is projected to be $100.38/barrel, while the CREG estimate is much more conservative at $90.00/barrel. CREG projections are largely derived by extrapolating on the basis of recent production growth and price change, and do not consider changes in economic conditions, or other considerations modeled by EIA.

Figure A12 describes how the EIA scenarios and CREG estimates compare. It is important to note that the October 2014 CREG forecast has nearly no inflation built into the price estimates it produces, with coal, oil and gas commodity prices rising by approximately 3 and 4 percent over the next six years. Assuming normal rates of inflation of 2 percent per year annually across the
general economy, this represents an anticipated decline in Wyoming energy commodity prices in real terms of almost 10 percent. To compare EIA and CREG projections, EIA projections in Figure A12 are not in constant dollars and instead are inflated assuming a 2% annual inflation rate. The figure demonstrates the conservative nature of the CREG projections relative to those from EIA. While extrapolation of current production trends is not necessarily a poor forecast algorithm, this deflation in Wyoming energy prices reflects a very bearish outlook in the current CREG report.

![Figure A12: Comparison of EIA market and Wyoming CREG Projected Total Mineral Production Revenues](image)

Using the State’s current fiscal revenue distribution model described in the main report and the EIA projections presented above, Table A1 summarizes the computed federal mineral royalty (FMR) estimates for the EIA market projections and the CREG October 2014 forecast. Table A2 summarizes estimated total severance tax outcomes for the same EIA and CREG projections. EIA projection values have been adjusted assuming a 2% annual inflation increase in both tables.

<table>
<thead>
<tr>
<th>Biennium</th>
<th>Reference</th>
<th>High Econ</th>
<th>Low Econ</th>
<th>High Coal</th>
<th>Low Coal</th>
<th>High Nat. Gas</th>
<th>Low Nat. Gas</th>
<th>CREG (October 2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>1,577.1</td>
<td>1,577.1</td>
<td>1,577.1</td>
<td>1,577.1</td>
<td>1,577.1</td>
<td>1,577.1</td>
<td>1,577.1</td>
<td>1,515.9</td>
</tr>
<tr>
<td>2015-16</td>
<td>1,961.4</td>
<td>2,005.9</td>
<td>1,953.7</td>
<td>2,042.3</td>
<td>1,901.6</td>
<td>1,874.6</td>
<td>1,900.4</td>
<td>1,741.9</td>
</tr>
<tr>
<td>2017-18</td>
<td>2,273.8</td>
<td>2,355.3</td>
<td>2,229.8</td>
<td>2,388.4</td>
<td>2,154.0</td>
<td>2,151.9</td>
<td>2,232.2</td>
<td>1,792.4</td>
</tr>
<tr>
<td>2019-20</td>
<td>2,605.0</td>
<td>2,735.4</td>
<td>2,564.3</td>
<td>2,766.9</td>
<td>2,411.1</td>
<td>2,498.8</td>
<td>2,575.3</td>
<td>1,859.4</td>
</tr>
<tr>
<td>2021-22</td>
<td>2,904.3</td>
<td>3,005.6</td>
<td>2,821.1</td>
<td>2,106.9</td>
<td>2,653.1</td>
<td>2,952.3</td>
<td>2,908.6</td>
<td>1,824.5*</td>
</tr>
</tbody>
</table>

*interpolation of CREG estimates since actual projection only defined to 2019-20
Table A2: Estimated Total Biennial Severance Tax Revenues Projections Paid to the State Comparison of EIA and CREG Forecast Outcomes (Millions)

<table>
<thead>
<tr>
<th>Biennium</th>
<th>Reference</th>
<th>High Econ Growth</th>
<th>Low Econ Growth</th>
<th>High Coal Costs</th>
<th>Low Coal Costs</th>
<th>High Nat. Gas Resource</th>
<th>Low Nat. Gas Resource</th>
<th>CREG (October 2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,799.5</td>
</tr>
<tr>
<td>2015-16</td>
<td>2,109.1</td>
<td>2,127.1</td>
<td>2,108.7</td>
<td>2,143.1</td>
<td>1,083.8</td>
<td>2,080.6</td>
<td>1,071.5</td>
<td>1,878.9</td>
</tr>
<tr>
<td>2017-18</td>
<td>2,261.5</td>
<td>2,306.6</td>
<td>2,255.1</td>
<td>2,342.6</td>
<td>2,199.0</td>
<td>2,190.7</td>
<td>2,184.4</td>
<td>1,860.8</td>
</tr>
<tr>
<td>2019-20</td>
<td>2,441.6</td>
<td>2,499.2</td>
<td>2,418.0</td>
<td>2,538.6</td>
<td>2,349.2</td>
<td>2,360.0</td>
<td>2,370.6</td>
<td>1,908.0</td>
</tr>
<tr>
<td>2021-22</td>
<td>2,676.6</td>
<td>2,760.5</td>
<td>2,636.1</td>
<td>2,794.9</td>
<td>2,546.7</td>
<td>2,596.8</td>
<td>2,605.2</td>
<td>1,948.9*</td>
</tr>
</tbody>
</table>

*interpolation of CREG estimates since actual projection only defined to 2019-20

From both tables it is clear that the outcome depends on the market assumptions and model used. The most conservative CREG estimates show an increase of 20.4 percent in FMRs collected, and an 8.3 percent increase in severance taxes from the 2013-14 to 2021-22. In comparison, EIA FMR projections suggest anywhere from a 68 percent (Low Coal Cost case) to a 97 percent increase (High Coal Cost scenario), while for severance taxes, EIA estimates suggest anywhere from a 36 percent (Low Coal Cost case) to a 49 percent increase (High Coal Cost scenario) between 2013-14 and 2021-22. 49

Regulatory Change Projections: The Potential Impact of EPA’s 111(d) Proposal on Wyoming

To define a set of projections consistent those EIA projections previously presented, the Rhodium Group was engaged as a collaborator on this work.50 As one of the few non-governmental operators of the EIA’s NEMS model, Rhodium agreed to provide this project a set of proprietary simulations to estimate the impact of the EPA’s proposed regulations. These projections were performed as four scenarios based on the policy-choices described above. Scenarios considered include allowing energy efficiency (EE) to be allowed in the rules or not, and the degree of state cooperation that might take place. Cooperation scenarios were defined to compare the impact of very limited state collaborative efforts, defined as “regional cooperation” wherein state cooperation to meet targets occurs only within the regional electricity markets

---

49 Note that out derived estimates of CREG severance tax revenues differ from those in their October 2014 report, in part due to differences in our procedure for computing estimated revenues. In the main text CREG’s own estimates are used while here our computed outcomes are shown. CREG estimates only run to 2020 and in that biennium our estimated severance taxes derived from projected CREG mineral production and price forecasts are $40 million lower than those shown by CREG. Our FMR estimates are much higher than those projected by CREG, with the difference being over $200 million higher in each biennium. These differences we attribute to differences in our projection methods.

50 See http://rhg.com/. Creation and programming of NEMS scenarios is a difficult task and could not be completed by UW in the timeframe allowed in this project.
states are located, or very wide cooperation, occurring across all states nationally. The design of the scenarios is described in Table A3. Wyoming was presumed to cooperate with Colorado only.

**Table A3: Design of Regulatory Scenarios Considered**

<table>
<thead>
<tr>
<th></th>
<th>Energy Efficiency efforts allowed</th>
<th>Energy Efficiency efforts not allowed</th>
</tr>
</thead>
<tbody>
<tr>
<td>National cooperation</td>
<td>Scenario 1: National Cooperation w/ EE</td>
<td>Scenario 2: National Cooperation w/o EE</td>
</tr>
<tr>
<td>Regional cooperation</td>
<td>Scenario 3: Regional Cooperation w/ EE</td>
<td>Scenario 4: Regional Cooperation w/o EE</td>
</tr>
</tbody>
</table>

The effect the proposed regulations could have on Wyoming’s coal-production depend on the degree to which the proposed regulations affect electricity generators using Wyoming coal. To meet the requirements of the regulation or due to the changes in costs faced by coal-fired plants, firms may opt to close coal-fired facilities, improve their efficiency (reduce their fuel use), or they may choose to reduce the intensity of their use. All three reactions would reduce the demand for coal as a fuel, reducing either Wyoming coal demand, or reducing coal prices nationally and the prices paid for Wyoming coal. Both outcomes would reduce the taxable revenue created by coal production in the state and therefore the taxable revenue base from which FMR/SMR and severance tax revenues are derived. This clearly could affect coal revenue streams earmarked for SFD appropriation. Potentially weaker coal-markets would also be expected to influence the demand and value of new coal leases, affecting coal lease bonus revenues also used to finance SFD expenditures.

The proposed regulations may also have other effects on energy revenue streams beyond those directly related to coal. Because the GHG regulations proposed are intended to increase incentives to use natural gas to generate electricity to take advantage of its reduced carbon intensity, the rules are expected to cause an increase in natural gas demand and prices, resulting in an increase in that portion of FMR/SMR revenues paid to the state. This effect could offset, or partially offset, the general revenue losses a reduction in national coal use could cause. Due to the complexity of the market dynamics the newly proposed EPA regulations potentially create, the NEMS framework previously used to identify market scenarios is also well-suited to analyze the regulatory effects these rules may cause as it captures the interrelationship of coal, natural gas and other energy markets affected by changes in electricity generation.

---

51 The NEMS framework does not allow electricity markets to be defined by state boundaries as electricity grids do not conform to these borders. Instead, NEMS defines regional electricity markets or balancing areas. States were assumed to regionally cooperate within these regions or they were assumed to be allowed to cooperate nationally. The latter might be considered consistent with allowing a national carbon trading market, a policy option that has been suggested as a means of meeting national carbon emission and climate change goals.
Production outcomes in Figure A13 show the potential significance of the EPA’s proposed 111(d) outcomes on Wyoming coal production. The “business as usual” reference case suggests that without the proposed existing plant GHG limits, Wyoming coal production could be expected to remain a strong sector with production levels increasing slightly over time from the current 400 million ton per year levels to 450 million tons in the late 2020s. Under the EIA reference case, total production of coal is projected to increase by approximately 12 percent over current levels by 2028 due to economic growth and other drivers of demand. The imposition of existing power-plant regulations like those envisioned in the EPA’s recent proposals, however, would result in declines in Wyoming coal output of between 31 percent and 51 percent from current levels depending on the scenario assumed.

![Figure A13: Coal Production Projections across 111(d) Regulatory Scenarios](image)

From the differences in projected outcomes shown in Figure A13, the potential impact of allowing energy efficiency and wide cooperation in limiting the effects of EPA’s proposed regulations on Wyoming are clear. Allowing GHG reductions to be accomplished by other sectors of the economy, as is the case when energy efficiency is included in the regulation, and by allowing wider cooperation, allowing re-dispatch of generation across a wider set of generators allowing electricity to be produced where it is cheapest and most effective, minimizes the amount of coal generation that is otherwise curtailed by the proposed rules. For Wyoming, wider cooperation allows coal production utilizing Wyoming coal to more often be used because it often is cheaper due to Wyoming PRB coal fuel costs. Further, it allows greater use of more

---

52 These simulations assume only incremental improvements in carbon-capture occur over the simulation period, resulting in a cost advantage throughout the projection period for natural gas over coal. The projections do not envision carbon capture being required for modern combined-cycle natural gas fired plants during the time-period of the scenarios.
renewables across states, allowing production general coal production declines to be minimized. While carbon-reducing GHG regulations will by definition reduce total coal production and electricity generation from coal-fired plants, (the EPA’s own simulations suggest these could decrease by as much as 25 to 30 percent by 2030), the choice of how such reductions are pursued is critical to protecting Wyoming’s coal industry to minimize such losses.

![Figure A14: Total Wyoming Energy Production Revenue Projections across 111(d) Regulatory Scenarios](image)

The EPA’s proposed existing power-plant regulation do not impact production revenues from all sources of energy in Wyoming as seriously as those from coal production only. This occurs for two reasons. First, in the EIA scenarios previously described that presume business as usual, an anticipated expansion in coal demand through 2018-2019 when the proposed GHG reductions begin to occur increases revenues by between approximately 11 and 17 percent relative to revenue levels in 2012, depending on the scenario assumed, and this in part offsets some of the losses in the following decade caused by the new regulations when losses are viewed relative to the current year. Secondly, because natural gas demand increases due to the increased generation share having to be produced with this fuel under the regulations, increased Wyoming gas production and price outcomes result in natural gas revenue increases that otherwise offset some of the coal revenue losses due to the proposed rules. The overall result of the regulations and changes in energy markets over the coming decade (through 2022) are lower total energy revenues than would be expected had no regulations been imposed, but revenues are still projected to be significantly higher than those experienced in 2012 (note that revenues presented are measured in real terms implying the revenues are net of any inflation effects). Using Rhodium’s NEMS model projections prepared for this report, in the worst years after the EPA’s proposed regulations take effect, in inflation adjusted terms, total energy revenues forming the
basis of FMR/SMR payments and severance taxes are still between 48 and 56 percent higher than those prior to the current biennium, depending on the scenario assumed.

Figure A14 shows this more clearly. While coal production is significantly impacted by proposed GHG regulations, the portion of State funding relying on FMR/SMR and severance tax payments is projected to grow in all scenarios throughout the next four biennia. In the early 2020s they decline before the overall growth trend in revenues previously observed prior to the new regulation begins again. Overall, total energy revenues are relatively constant regardless of scenario, suggesting that changes in the structure of the regulation are less sensitive than coal production to decisions regarding the policy implementation. The most favorable Wyoming revenue outcome once the regulations go into effect after 2020 is the scenario in which state cooperation is maximized and energy efficiency is allowed to be included as a means of reducing power-plant emissions as shown in Figure A14.

![Figure A14: Total Projected Biennial Energy Production Revenues by Scenario](image)

Figure A15 compares the projections of total oil, natural gas and coal revenues from the Rhodium simulations, to those currently forecast by CREG. Again note that while the previously described simulations assume the proposed rule under various implementation assumptions, CREG does not explicitly assume this will occur. Further, the Rhodium values shown in the previous figures from which they were derived have been inflated at an annual rate of 2 percent since CREG values are not inflation adjusted. As the implementation of the regulation takes effect the impact on the simulated data is pronounced, especially if compared to the AEO2014 reference case. As previously described, when the regulation is fully implemented Wyoming benefits most when national cooperation occurs and energy efficiency improvements are allowed to meet the regulation.

Total revenue effects are not as intuitive in the other cases. While less cooperation and not including energy efficiency are worse for coal outcomes, because they reduce coal generation
output they also increase natural gas demand and prices thus there is an offsetting effect that in some cases reduce Wyoming revenues relative to others. Overall, while Wyoming revenues fall for the implementation of carbon regulations, the Rhodium-provided NEMS projections still indicate an increase in total energy revenues created. Wyoming revenue outcomes would be expected to improve due to the underlying trend growth in energy consumption and despite coal production reductions. This growth is also present in CREG forecasts, although as previously noted these increases are far more muted. CREG forecasts presume a 14 percent revenue increase between 2013-14 and 2021-22, while the Rhodium forecasts indicate even under regulation an increase of between 33 and 50 percent in revenues over the same period. The regulations do, however, lead to very limited growth in the last biennium under these scenarios and increases are primarily due to growth projected in the previous biennia. Tables A4 and A5 show the estimated severance and FMR/SMR revenues using the total production revenue data presented in the previous figure.

Table A4: Estimated Total Biennial Federal Mineral Royalty Revenue Projections Paid to the State - Comparison of EIA and CREG Forecast Outcomes (Millions)

<table>
<thead>
<tr>
<th>Biennium</th>
<th>Reference</th>
<th>National Coop w/ EE</th>
<th>National Coop w/o EE</th>
<th>Regional Coop w/ EE</th>
<th>Regional Coop w/o EE</th>
<th>CREG (October 2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>1,793.1</td>
<td>1,788.0</td>
<td>1,788.3</td>
<td>1,787.4</td>
<td>1,788.5</td>
<td>1,725.6</td>
</tr>
<tr>
<td>2015-16</td>
<td>2,009.2</td>
<td>2,004.3</td>
<td>1,993.5</td>
<td>2,005.2</td>
<td>1,991.5</td>
<td>1,741.9</td>
</tr>
<tr>
<td>2017-18</td>
<td>2,331.4</td>
<td>2,277.8</td>
<td>2,284.1</td>
<td>2,239.1</td>
<td>2,256.4</td>
<td>1,792.4</td>
</tr>
<tr>
<td>2019-20</td>
<td>2,670.5</td>
<td>2,491.8</td>
<td>2,523.3</td>
<td>2,501.4</td>
<td>2,574.6</td>
<td>1,859.4</td>
</tr>
<tr>
<td>2021-22</td>
<td>2,951.5</td>
<td>2,694.4</td>
<td>2,622.9</td>
<td>2,547.6</td>
<td>2,550.4</td>
<td>1,824.5*</td>
</tr>
</tbody>
</table>

*interpolation of CREG estimates since actual projection only defined to 2019-20

Table A5: Estimated Total Biennial Severance Tax Revenues Projections Paid to the State - Comparison of EIA and CREG Forecast Outcomes (Millions)

<table>
<thead>
<tr>
<th>Biennium</th>
<th>Reference</th>
<th>National Coop w/ EE</th>
<th>National Coop w/o EE</th>
<th>Regional Coop w/ EE</th>
<th>Regional Coop w/o EE</th>
<th>CREG (October 2014)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013-14</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,872.2</td>
<td>1,799.5</td>
</tr>
<tr>
<td>2015-16</td>
<td>2,256.9</td>
<td>2,239.0</td>
<td>2,239.0</td>
<td>2,224.1</td>
<td>2,212.1</td>
<td>1,878.9</td>
</tr>
<tr>
<td>2017-18</td>
<td>2,494.2</td>
<td>2,407.6</td>
<td>2,407.6</td>
<td>2,401.6</td>
<td>2,393.8</td>
<td>1,860.8</td>
</tr>
<tr>
<td>2019-20</td>
<td>2,874.4</td>
<td>2,695.3</td>
<td>2,695.3</td>
<td>2,597.5</td>
<td>2,595.9</td>
<td>1,908.0</td>
</tr>
<tr>
<td>2021-22</td>
<td>3,206.7</td>
<td>2,909.3</td>
<td>2,919.4</td>
<td>2,871.9</td>
<td>2,907.4</td>
<td>1,948.9*</td>
</tr>
</tbody>
</table>

*interpolation of CREG estimates since actual projection only defined to 2019-20
Under the more optimistic outcomes using the EIA model, even for the imposition of new EPA regulations, growth earlier in the decade is presumed to cause FMR/SMR royalties paid to the state to rise by between 43 percent and 51 percent, and severance taxes to increase by between 53 and 56 percent between 2013 and 2022. As before, the CREG increases are much more modest at 5.7 and 8.3 percent during the same time-period. As previously, the primary reason for the discrepancy between CREG and EIA-model derived projections is the CREG assumption of falling gas and coal production in the state for the remainder of the decade, with natural gas and coal prices increasing over the period from 2014 to 2020 by only 4.3 and 3.3 percent respectively. EIA projections, especially those shown in the table, are significantly more optimistic, in part because they presume inflation of 2 percent per year, and that underlying prices improve much more significantly, and they also presume positive production increases in all energy commodities. The degree to which these outcomes occurs depends on the scenario considered.
Appendix 2: NEMS Model Assumptions used in AEO2014 EIA Market Projections

Table A.1: Macroeconomic Assumptions Used:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference Case</td>
<td>0.70%</td>
<td>0.80%</td>
<td>1.80%</td>
<td>2.40%</td>
<td>1.70%</td>
</tr>
<tr>
<td>Low Economic Growth</td>
<td>0.60%</td>
<td>0.70%</td>
<td>1.40%</td>
<td>1.90%</td>
<td>1.30%</td>
</tr>
<tr>
<td>High Economic Growth</td>
<td>0.80%</td>
<td>1.00%</td>
<td>2.00%</td>
<td>2.80%</td>
<td>1.70%</td>
</tr>
<tr>
<td>Low Coal Cost</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
</tr>
<tr>
<td>High Coal Cost</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
</tr>
<tr>
<td>Low Oil and Gas Resource</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
</tr>
<tr>
<td>High Oil and Gas Resource</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
<td>As in Ref. Case</td>
</tr>
</tbody>
</table>

Table A2.2: Oil Price Assumptions

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Oil Market Assumptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>All cases</td>
<td>Real Brent crude oil prices (in 2012 dollars) rise from $112/barrel in 2012 to $109 in 2025, rising slowly to $130 in 2035 and $141/barrel in 2040.</td>
</tr>
</tbody>
</table>

* real = inflation adjusted to 2012 dollars

Table A2.3: Coal Market Cost Assumptions:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Productivity Growth Rate</th>
<th>Coal Miner Wages</th>
<th>Mine Equipment Costs</th>
<th>Coal Transportation Rates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Coal Cost</td>
<td>2.3% greater than reference case</td>
<td>Lower than reference, falling to 25% below reference by 2040</td>
<td>Lower than reference, falling to 25% below reference by 2040</td>
<td>Lower than reference, falling to 25% below reference by 2040</td>
</tr>
<tr>
<td>High Coal Cost</td>
<td>2.3% lower than reference case</td>
<td>Higher than reference, rising to 25% above reference by 2040</td>
<td>Higher than reference, rising to over 25% above reference by 2040</td>
<td>Higher than reference, rising to over 25% above reference by 2040</td>
</tr>
<tr>
<td>Scenario</td>
<td>Ultimate Recovery per Shale Gas</td>
<td>Ultimate Recovery per Tight Gas</td>
<td>Ultimate Recovery per Tight Oil</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>Low Oil and Gas Resource</strong></td>
<td>50% lower than in the Reference case. All other resource assumptions remain the same as in the Reference case.</td>
<td>50% lower than in the Reference case. All other resource assumptions remain the same as in the Reference case.</td>
<td>50% lower than in the Reference case. All other resource assumptions remain the same as in the Reference case.</td>
<td></td>
</tr>
<tr>
<td><strong>High Oil and Gas Resource</strong></td>
<td>50% higher and well spacing is 50% than in the Reference case. Tight oil resources are added to reflect new plays or expansion of known tight oil plays and estimated ultimate recovery for tight and shale wells increases 1%/year to reflect additional technological improvement. Also includes 50% higher undiscovered resources in lower 48 offshore states, Alaska, and shale gas in Canada than in the Reference case.</td>
<td>50% higher and well spacing is 50% than in the Reference case. Tight oil resources are added to reflect new plays or expansion of known tight oil plays and estimated ultimate recovery for tight and shale wells increases 1%/year to reflect additional technological improvement. Also includes 50% higher undiscovered resources in lower 48 offshore states, Alaska, and shale gas in Canada than in the Reference case.</td>
<td>50% higher and well spacing is 50% than in the Reference case. Tight oil resources are added to reflect new plays or expansion of known tight oil plays and estimated ultimate recovery for tight and shale wells increases 1%/year to reflect additional technological improvement. Also includes 50% higher undiscovered resources in lower 48 offshore states, Alaska, and shale gas in Canada than in the Reference case.</td>
<td></td>
</tr>
</tbody>
</table>
References:


