Section 5: Appendix: Examples of cost of attaining standard alternatives for selected non-attainment areas.

As seen in the analysis presented in the 2008 ozone NAAQS RIA and the supplemental analysis presented in the body of the current update to that RIA, several areas cannot reach attainment by use of only known controls for our selected illustrative control strategy. Our approach for estimating the total cost for attainment is detailed in Chapter 5 of the 2008 Ozone NAAQS RIA. In section 5.2, Extrapolated Engineering Costs, beginning on page 5-10, we discuss our approach for estimating the cost of attainment when additional reductions are needed beyond those which are attainable from known controls. We presented two methods for estimating these costs. The following descriptions are from page 5-12 of the 2008 Ozone NAAQS RIA:

> EPA used two methodologies for estimating the costs of unspecified future controls: a new hybrid methodology and a fixed-cost methodology. Both approaches assume that innovative strategies and new control options make possible the emissions reductions needed for attainment by 2020. The fixed cost methodology was preferred by EPA's Science Advisory Board over two other options, including a marginal-cost-based approach. The hybrid approach has not yet been reviewed by the SAB.
>
> The hybrid approach creates a marginal cost curve and an average cost curve representing the cost of unknown future controls needed for 2020 attainment. This approach explicitly estimates the average per-ton cost of unspecified emissions reductions assumed for each area, with a higher average cost-per-ton in areas needing a higher proportion of unknown controls relative to known modeled controls. This requires assumptions about the average cost of the least expensive unspecified future controls, and the rate at which the average cost of these controls rises as more extrapolated tons are needed for attainment (relative to the amount of reductions from known, modeled controls). These factors in turn depend on implicit assumptions about future technological progress and innovation in emission reduction strategies.
>
> The fixed cost methodology utilizes a national average cost per ton of future unspecified controls needed for attainment, as well as two sensitivity values (presented in Appendix 5a.4.3). The range of estimates reflects different assumptions about the cost of additional emissions reductions beyond those in the modeled control strategy. The alternative estimates implicitly reflect different assumptions about the amount of technological progress and innovation in emission reduction strategies.

The hybrid methodology has the advantage of using the information about how significant the needed reductions from unspecified control technology are relative to the known control measures and matching that with expected increasing per unit cost for going beyond the modeled technology. Under this approach, the relative costs of unspecified controls in different geographic areas reflect the expectation that average per-ton control costs are likely to be higher in areas needing a higher ratio of emission reductions from unspecified and known controls. The fixed cost methodology reflects a view that because no cost data exists for unspecified future strategies, it is unclear whether approaches using hypothetical cost curves will be more accurate or less accurate in forecasting total national costs of unspecified controls than a fixed-cost approach that uses a range of national cost per ton values.

The following graphs are examples of marginal extrapolated cost curves for several areas that are unable to attain the various levels of the standard using known controls. These areas vary in the amount of extrapolated controls required to meet various levels of the standard, and should provide some insight as to how the curves differ between areas. Unfortunately, we are unable to provide a marginal extrapolated cost curve for Los Angeles-South Coast-San Joaquin, CA, one of the most challenging areas, because this area is not required to attain the standard by 2020. This is the first attempt to create such graphics, and is a work in progress. However, this preliminary analysis is intended to provide the public with a more transparent representation of how extrapolated costs were calculated using both the fixed cost and hybrid approach.

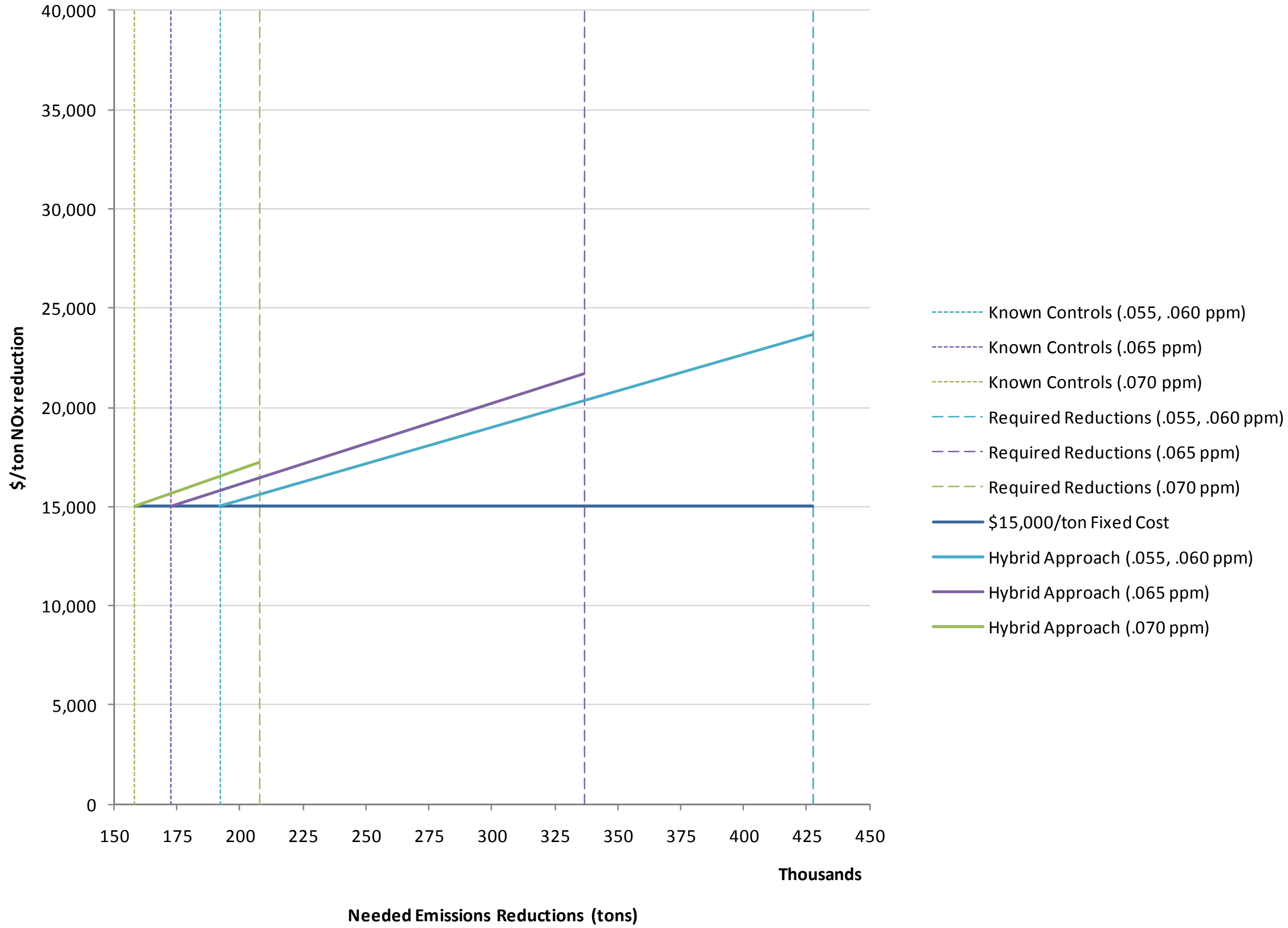
It should be noted, however, that the hybrid approach was designed to be a national strategy. It is difficult to present the results at the extrapolated cost area geographic level, because the size of the area itself changes between standard levels. Due to the manner in which extrapolated cost areas are created, there are changes in the assignment of counties to areas between levels of the standard. As a result, there may be more identified controls within an area at more stringent levels of the standard, which would affect both the starting point of the marginal extrapolated cost curve as well as the slope of the curve. If each curve for an area started from the same level of known controls, the slope would not be affected. In this case, there would be a single marginal cost curve for each area, and you would move farther along the curve for more stringent levels of the standard. The slope does vary significantly between extrapolated costs areas, but does not vary greatly between standards within each extrapolated cost area.

The goal of the hybrid approach was to calculate an increasing marginal cost curve rather than a fixed cost curve. That is, each additional ton of reduction should cost more than its predecessor. While this is the case for each marginal cost curve separately, there are instances in which some controls may appear to be cheaper at tighter standards. This is due to the manner in which the cost is calculated. For each level of the standard, extrapolated cost areas are determined by creating 200 km buffers around counties that are projected to not reach attainment and any other counties in existing non-attainment areas that these projected non-attainment counties intersect. As a result, at more stringent levels of the standard an individual extrapolated cost area may encompass more counties, thereby allowing the identification of supplementary known controls that may exist in these additional counties. The marginal extrapolated cost is a function of a fixed national cost per ton (*N*), a fixed multiplier that reflects technological change (*M*)[1], and the ratio of unknown emissions to known emissions within an extrapolated cost area (*R*). Between levels of the standard within an area, the additional of supplementary known controls affects both the starting point on the X-axis (i.e., the point at which controls move from known to extrapolated) as well as the slope of the curve (through the effect on the ratio of unknown to known controls). As a result, the curves are not directly comparable between standards in cases where there are different starting points. Additionally, while the price of the first ton of extrapolated control is $15,000 within each area, the interaction of the technological change variable *M* and ratio of unknown to unknown controls *R* variables determines the price of additional tons of controls as well as the maximum price within an area. In the graphs that follow, Baton Rouge, LA, has the lowest ratio of unknown to known controls, and faces a maximum extrapolated cost of just under $25,000/ton. The Northeast Corridor has a higher ratio of unknown to known controls, and as a result faces the higher maximum extrapolated cost of just under $40,000/ton. For additional details about the derivation of the hybrid approach as well as the determination of the extrapolated cost areas, the reader is referred to Chapters 4 and 5 of the 2008 Ozone NAAQS RIA[2]. The creation of extrapolated cost areas is discussed in Chapter 4 (p. 4-1), while the derivation of the hybrid approach is discussed in Chapter 5 (p. 5-10).

Presentation of the marginal extrapolated cost curves at this level of disaggregation leads to some anomalous results. For example, in the case of Baton Rouge, LA, reductions from known controls as well as the required reductions are the same for both the .060 and .055 standard. This is due to reductions coming from other nearby areas that are not represented in this graph. Because of the way the extrapolated cost areas are created and the resulting shifting of counties between areas at more stringent levels of the standard, Houston-Galveston-Brazoria, TX, appears to have fewer reductions from known controls as well as lower required reductions at the .055 level of the standard than at higher levels of the standard. Again, these costs would be assigned to other areas. While these costs are not represented in the graph, they are part of the national level estimates provided in the RIA.

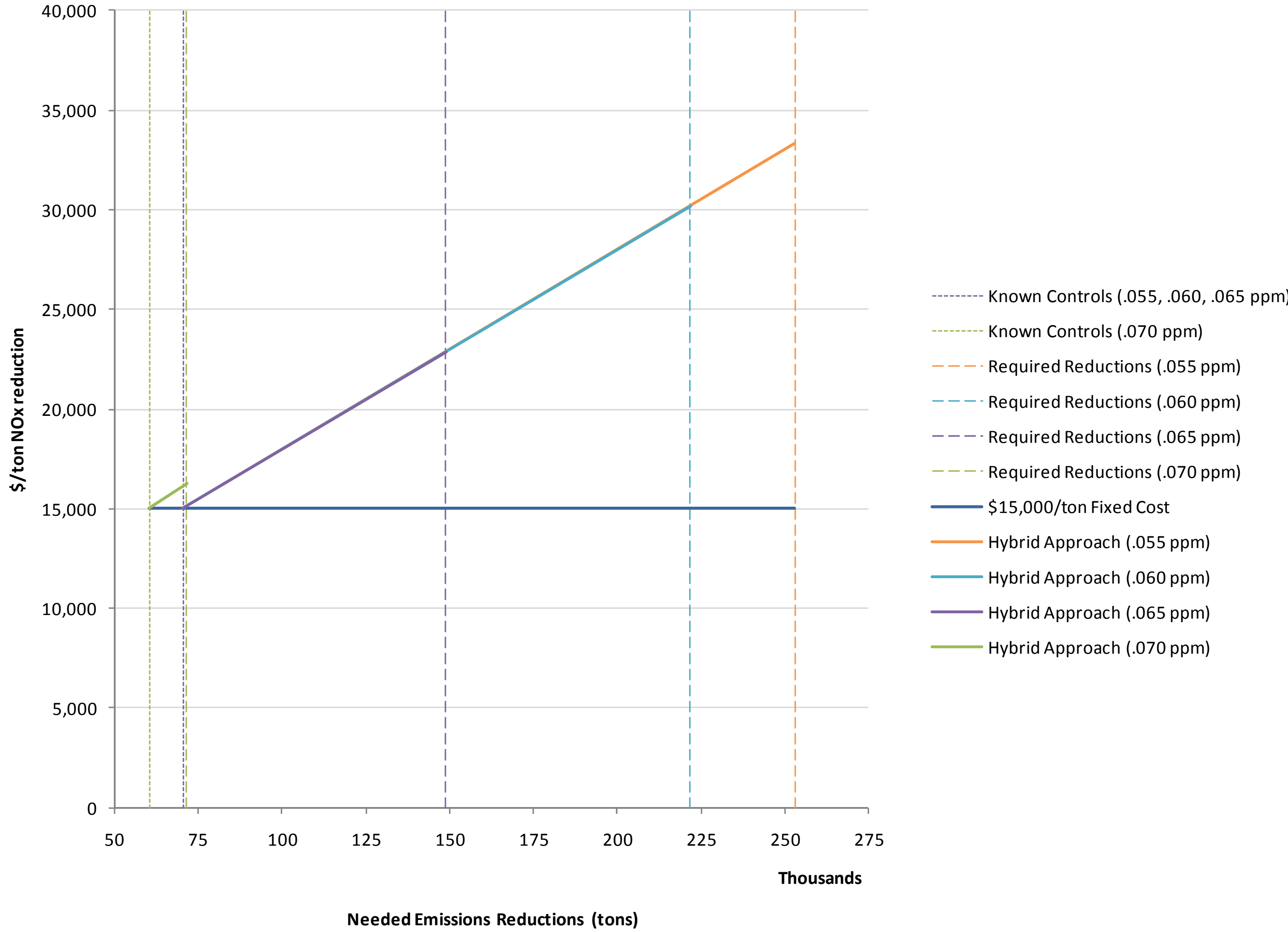
[1] While *M* is described here as a technological change parameter, it actually incorporates many different influences on the unit costs of control, such as technological change in control technology, change in energy technology, learning by doing, relative price changes, and the distribution of sources with uncontrolled emissions.
[2] Available on the Internet at <http://www.epa.gov/ttn/ecas/regdata/RIAs>.

Figure S5.1: Marginal Extrapolated Cost Curves – Baton Rouge, LA



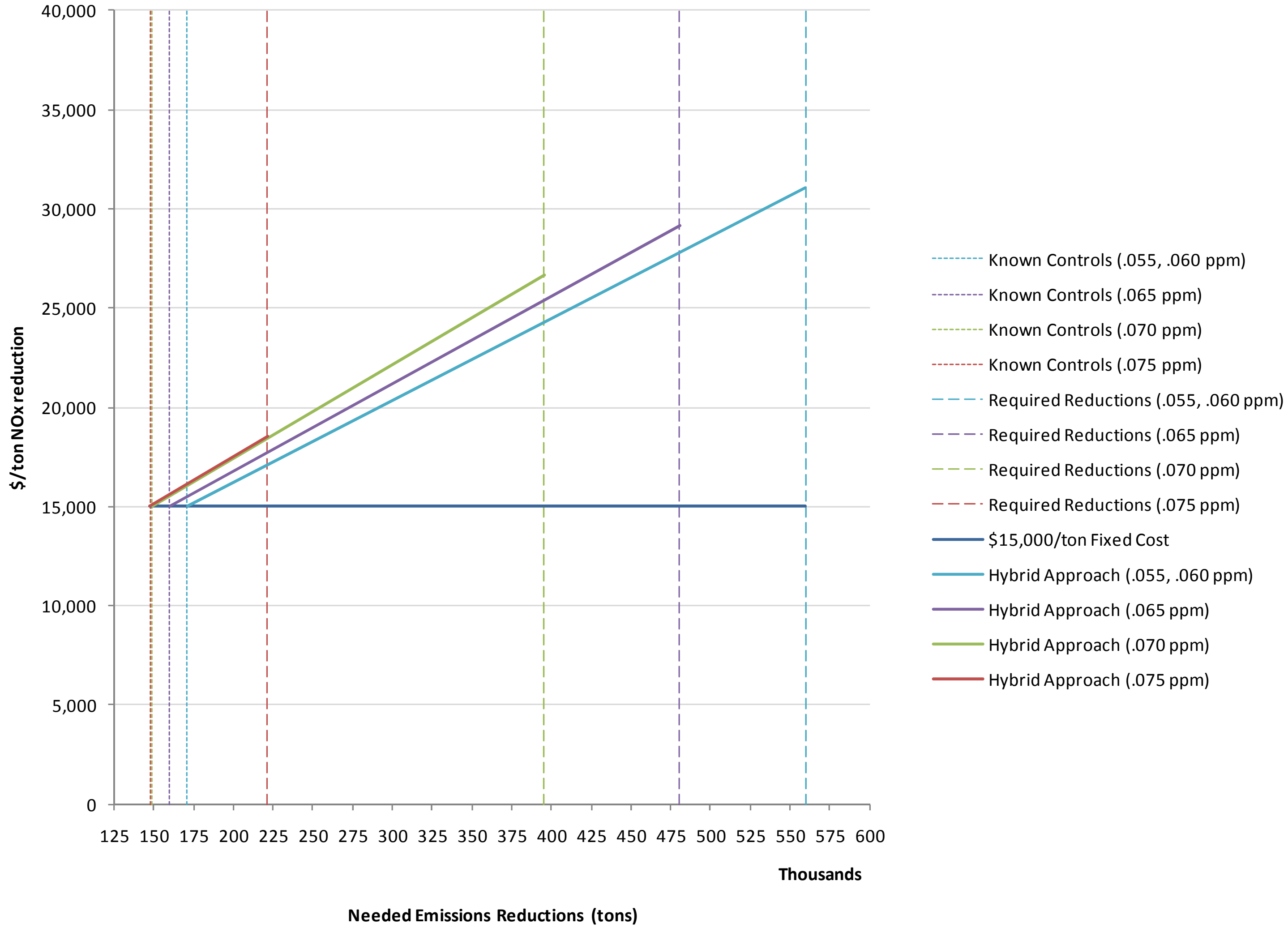
NOTE: The size of the geographic area for extrapolated cost areas varies between levels of the standard. Typically, more counties are included at more stringent levels of the standard, increasing the quantity of known controls available, affecting both the starting point and slope of the marginal extrapolated cost curve.

Figure S5.2: Marginal Extrapolated Cost Curves – Cleveland-Akron-Lorain, OH



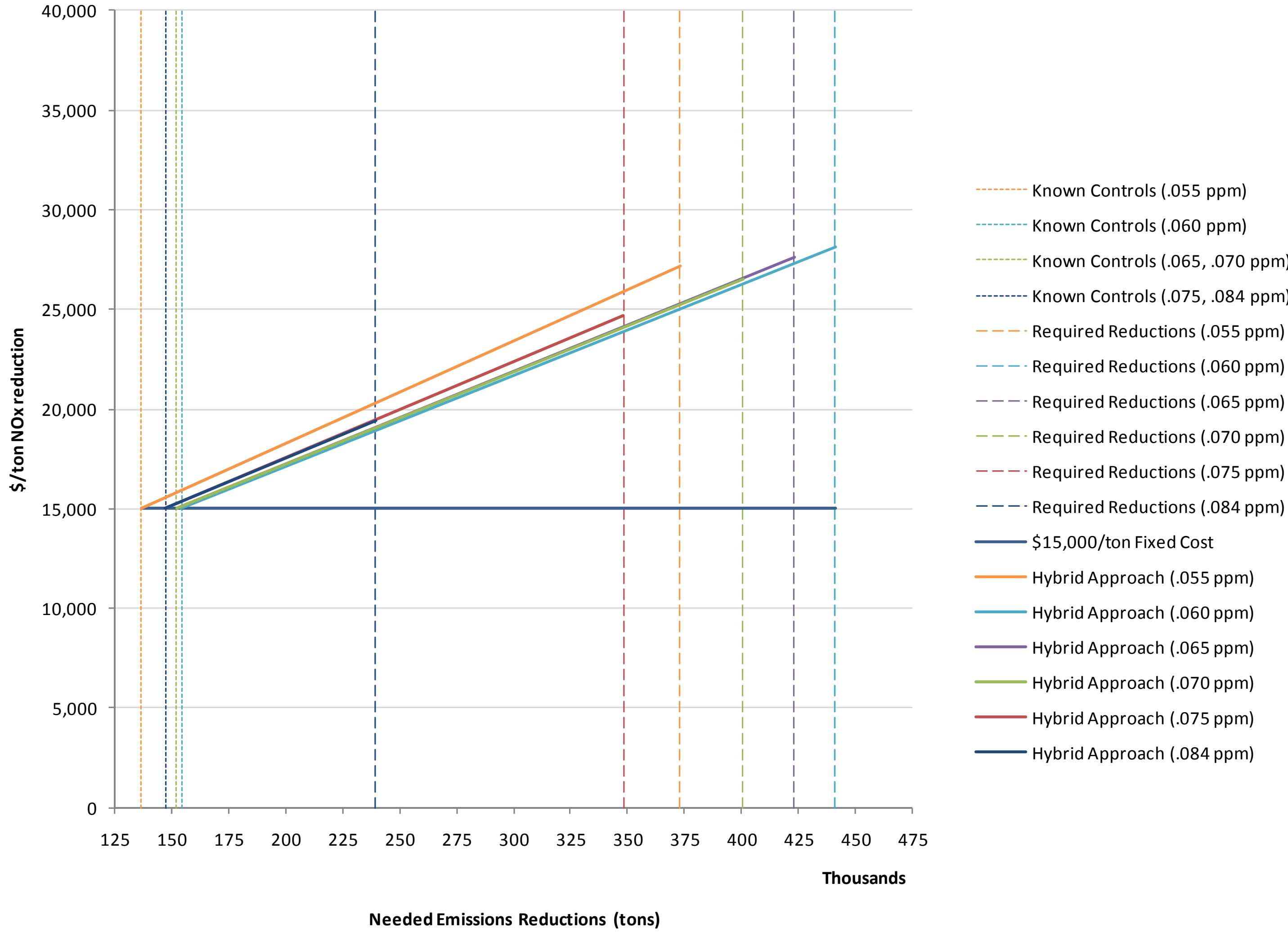
NOTE: The size of the geographic area for extrapolated cost areas varies between levels of the standard. Typically, more counties are included at more stringent levels of the standard, increasing the quantity of known controls available, affecting both the starting point and slope of the marginal extrapolated cost curve.

Figure S5.3: Marginal Extrapolated Cost Curves – Western Lake Michigan, IL-IN-WI



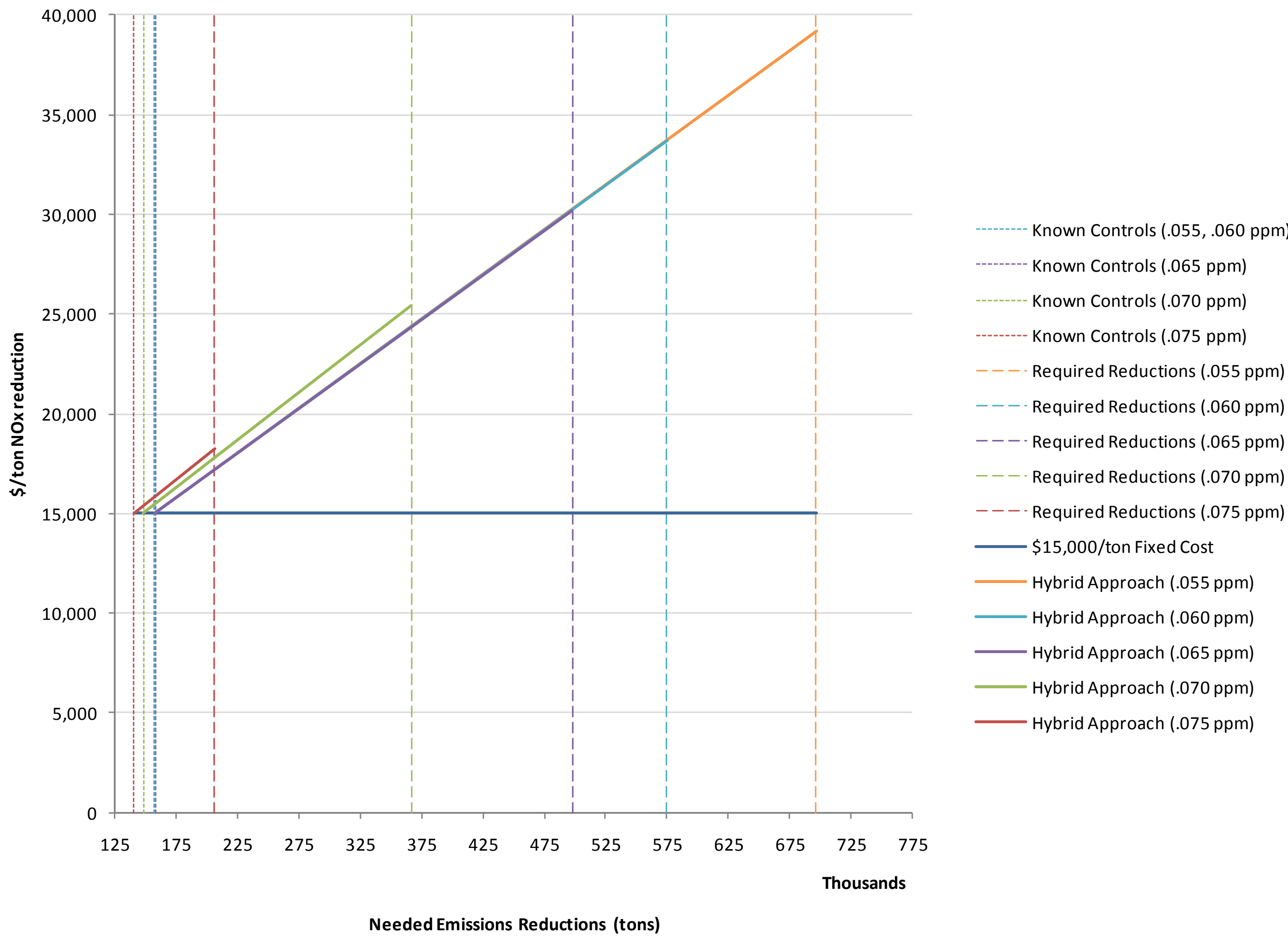
NOTE: The size of the geographic area for extrapolated cost areas varies between levels of the standard. Typically, more counties are included at more stringent levels of the standard, increasing the quantity of known controls available, affecting both the starting point and slope of the marginal extrapolated cost curve.

Figure S5.4: Marginal Extrapolated Cost Curves – Houston-Galveston-Brazoria, TX



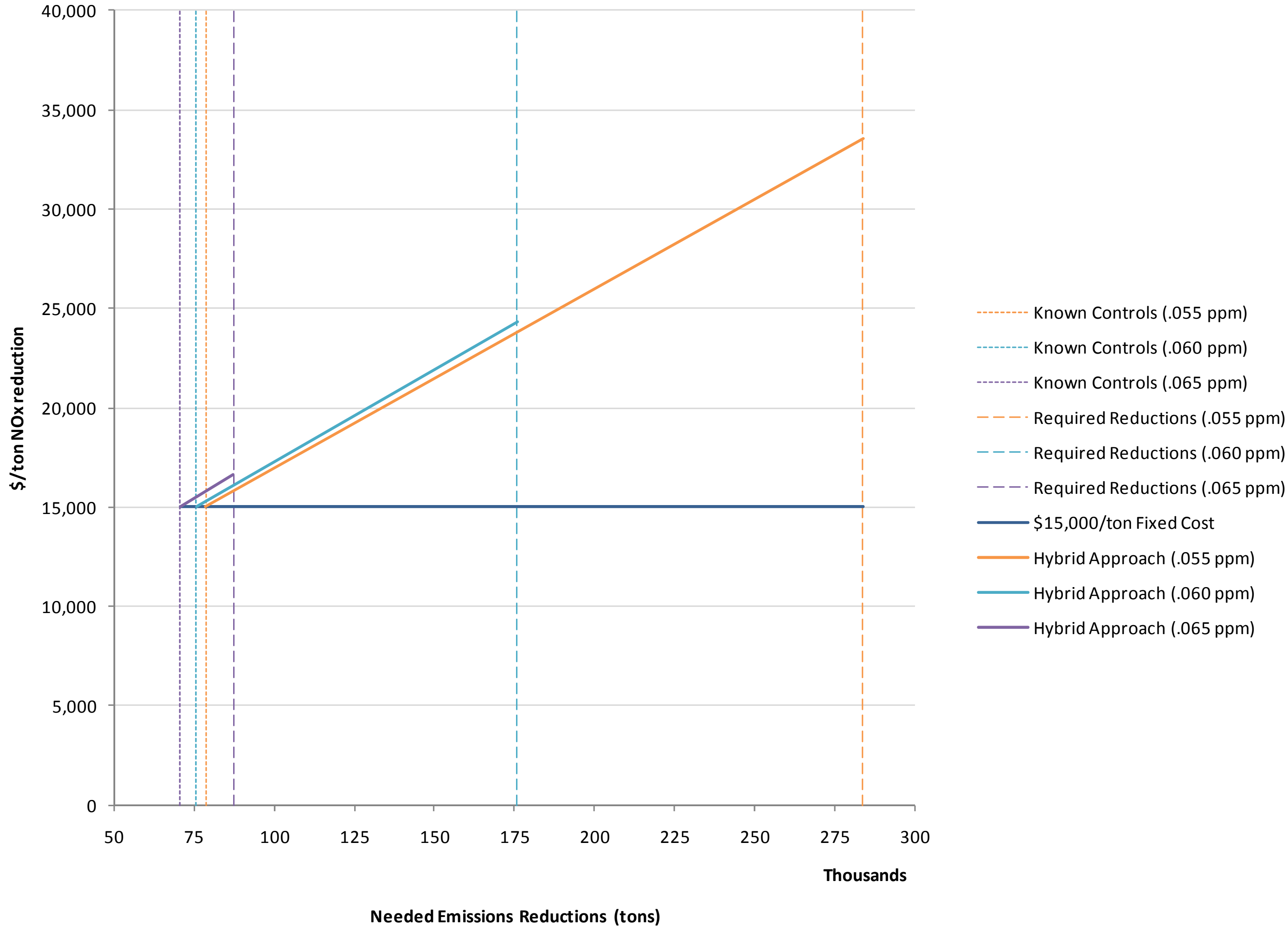
NOTE: The size of the geographic area for extrapolated cost areas varies between levels of the standard. Typically, more counties are included at more stringent levels of the standard, increasing the quantity of known controls available, affecting both the starting point and slope of the marginal extrapolated cost curve. In the case of the .055 level of the standard, some counties included in the Houston area at the .060 level of the standard were reassigned to the Dallas area. While this affects the amount of control required in the Houston area, this does not affect the overall national estimate.

Figure S5.5: Marginal Extrapolated Cost Curves – Northeast Corridor, CT-DE-MD-NJ-NY-PA



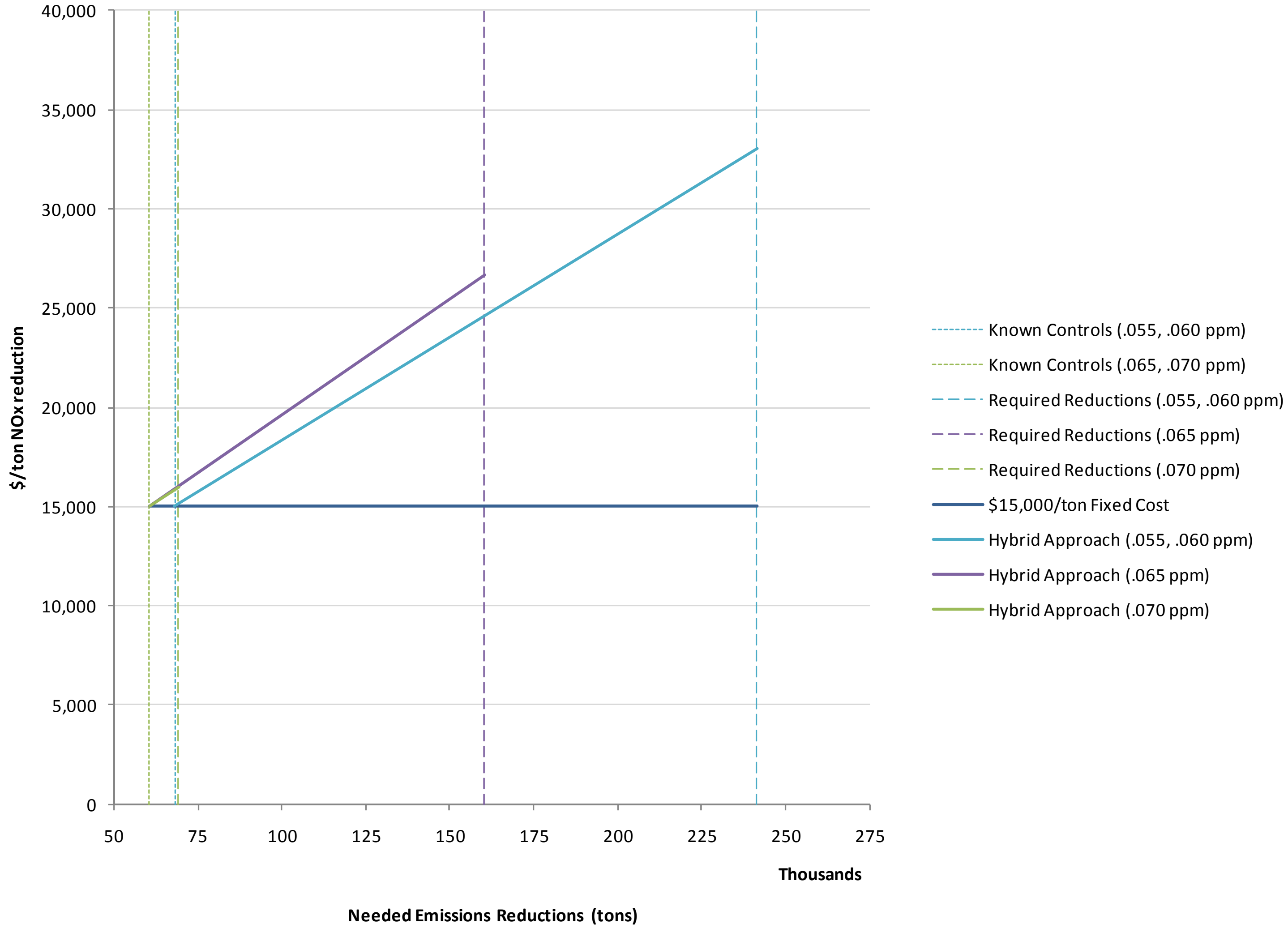
NOTE: The size of the geographic area for extrapolated cost areas varies between levels of the standard. Typically, more counties are included at more stringent levels of the standard, increasing the quantity of known controls available, affecting both the starting point and slope of the marginal extrapolated cost curve.

Figure S5.6: Marginal Extrapolated Cost Curves – St Louis, MO-IL



NOTE: The size of the geographic area for extrapolated cost areas varies between levels of the standard. Typically, more counties are included at more stringent levels of the standard, increasing the quantity of known controls available, affecting both the starting point and slope of the marginal extrapolated cost curve.

Figure S5.7: Marginal Extrapolated Cost Curves – Detroit-Ann Arbor, MI



NOTE: The size of the geographic area for extrapolated cost areas varies between levels of the standard. Typically, more counties are included at more stringent levels of the standard, increasing the quantity of known controls available, affecting both the starting point and slope of the marginal extrapolated cost curve.