Chapter 5
Baseline

The baseline of an economic analysis is a reference point that reflects the world without the proposed regulation. It is the starting point for conducting an economic analysis of the potential benefits and costs of a proposed regulation. Because an economic analysis considers the impact of a policy or regulation in relation to this baseline, its specification can have a profound influence on the outcome of the economic analysis. A careful and correct baseline specification assures the accuracy of benefit and cost estimates. The baseline specification can vary in terms of sources analyzed (e.g., facilities, industries, sectors of the economy), geographic resolution (e.g., census blocks, GIS grid cells, counties, state, regions), environmental objectives (e.g., effluents and emissions versus pollutant concentrations), and years covered. Because the level of detail presented in the baseline specification is an important determinant of the kinds of analysis that can be conducted on proposed regulatory options, careful thought in specifying the baseline is crucial.

The drive for a thorough, rigorous baseline analysis should be balanced against other competing objectives such as judicial and statutory deadlines, and legal requirements. The analyst is responsible for raising questions about baseline definitions early in the regulatory development process to ensure that the analysis is as comprehensive as possible. Doing so will facilitate analysis of regulatory changes to the baseline regulation.

5.1 Baseline Definition

A baseline is defined as the best assessment of the world absent the proposed regulation or policy action.[1] This "no action" baseline is modeled assuming no change in the regulatory program under consideration. This does not necessarily mean that no change in current conditions will take place, since the economy will change even in the absence of regulation. A proper baseline should incorporate assumptions about exogenous changes in the economy that may affect relevant benefits and costs (e.g., changes in demographics, economic activity, consumer preferences, and technology), industry compliance rates, other regulations promulgated by EPA or other government entities, and behavioral responses to the proposed rule by firms and the public.

On occasion a regulatory program may be set to expire or dramatically change, even in the absence of the proposed action. In this case, the baseline specification might consider a state of the world different from current conditions. This situation, however, is less common.

The baseline serves as a primary point of comparison for an analysis of a proposed policy action. An economic analysis of a policy or regulation compares the current state of the world, the *baseline scenario*, to the expected state of the world with the proposed policy or regulation in effect, the *policy scenario*. Economic and other impacts of policies or regulations are measured as the differences between these two scenarios.

1 A policy action includes both regulations and the issuance of Best Management Practices (BMPs) or guidance documents, which do not carry the same force as a regulation, but do affect the decisions of firms and consumers.

In most cases, a single, well-defined description of the world in the absence of the regulation is generally all that is needed as a baseline. A single baseline produces a clear point of comparison with the policy scenario and allows for an unequivocal measure of the benefits, costs, and other consequences of the rule. There are a few cases in which more than one baseline may be necessary.

Multiple baseline scenarios are needed, for example, when it is impossible to make a reasonable unique description of the world in the absence of the proposed regulation. For instance, if the current level of compliance with existing regulations is not known, then it may be necessary to compare the policy scenario to both a full compliance baseline and a partial compliance baseline. Further, if the impact of other rules currently under consideration fundamentally affects the economic analysis of the rule being analyzed, then multiple scenarios, with and without these rules in the baseline, may be necessary.

The decision to include multiple baselines should not be taken lightly as a complex set of modeling choices and analytic findings may result. These must be interpreted and communicated to decision makers, increasing the possibility of erroneous comparisons of costs and benefits across different baselines. When more than one baseline is required, analysts should endeavor to construct scenarios that can provide benchmarks for policy analysis. The number of baselines should be limited to as few as possible that cover the key dimensions of the economic analysis and any phenomena in the baseline about which there is uncertainty.

In some cases, probabilistic analysis can be used to avoid the need for multiple baselines and still provide an appropriate benchmark for policy analysis. A probabilistic analysis is a form of uncertainty analysis in which a single modeling framework is generally specified, but statistical distributions are assigned to the uncertain input parameters. The policy scenario is then compared to a continuum of baselines, with a probability for any given outcome, rather than being compared to a single baseline. The benefit-cost analysis (BCA) would then report the probability that a policy intervention produces net benefits rather than reporting the net benefits compared to one (or more) deterministic baseline(s).

Analysts are advised to seek clear direction from management about baseline definitions early on in the development of a rule. Each baseline-to-policy comparison should be internally consistent in its definition and use of baseline assumptions.

5.2 Guiding Principles of Baseline Specification

In specifying the baseline, analysts should employ the following guiding principles each of which is discussed more fully below:

1. Clearly specify the current and future state of relevant economic variables, the environmental problem that the regulation addresses and the regulatory approach being considered;
2. Identify all required parameters for the analysis;
3. Determine the appropriate level of effort for baseline specification;
4. Clearly identify all assumptions made in specifying the baseline conditions;
5. Specify the "starting point" of the baseline and policy scenario;
6. Specify the "ending point" of the baseline and policy scenario;
7. Detail all aspects of the baseline specification that are uncertain; and
8. Use the baseline assumptions consistently for all analyses for this regulation.

Though these principles exhibit a general common-sense approach to baseline specification, the analyst is advised to provide her own explicit statements on each point. Failure to do so may result in a confusing presentation, inefficient use of time and resources, and misinterpretation of the economic results.

Clearly specify the current and future state of relevant economic variables, the environmental problem that the regulation addresses and the regulatory approach being considered. A clear written statement about the current state of the relevant economic variables (see Chapter 8 in particular to determine what variables are relevant) and environment will help decision makers and the general public to understand both the positive and negative consequences of a regulation. The statement should include a description of: (1) the pollution problem being addressed; (2) the current regulatory environment; (3) the method by which the problem will be addressed; and (4) the affected parties. There should also be a discussion of why a particular approach [e.g., best available technology (BAT), performance measures, market incentives, or non-regulatory approaches] was chosen.

In general, the most appropriate baseline will be the "no change" or "reality in the absence of the regulation" scenario; but in some cases, a baseline of some other regulatory approach may be considered. For example, if an industry is certain to be regulated (e.g., by court order or congressional mandate) but that regulation has not yet been implemented, then a baseline including this regulation should be used. To ensure that provisions contained in statutes or policies preceding the regulatory action in question are appropriately addressed and measured, it is common practice to assume full compliance with regulatory requirements, although sensitivity analyses assuming less-than-full compliance may be considered. However, analysts should consult with their management and the Office of General Counsel (OGC) before doing so.

Identify all required parameters for the analysis. To ensure that the baseline scenario can be compared to the policy scenario, there should be a clear understanding of the path from environmental damage to adverse impact on humans. The models and parameters required for the baseline analysis should be chosen so that the baseline assumptions can feed into all subsequent analyses. Measured differences between the baseline and policy scenario can include changes in usage or production of toxic substances, changes in pollutant emissions and ambient concentrations, and incidence rates for adverse health effects associated with exposure to pollutants. This does not mean that the analyst must identify all parameters that could possibly change, but the analyst should recognize all relevant parameters needed to compare the baseline scenario to the policy scenario. As a general rule of thumb, at a minimum, the analyst should identify the parameters that are expected to vary by option, the parameters that are expected to have the largest impact on cost and benefit differences, and the parameters that are anticipated to come under close public scrutiny.

Determine the appropriate level of effort for baseline specification. The analyst should concentrate analytic efforts on those components (e.g., assumptions, data, models) of the baseline that are most important to the analysis, taking into consideration factors such as the time given to complete the analysis, the person-hours available, the cost of the analysis, and the available models and data. If several components of the baseline are uncertain, the analyst should concentrate limited resources on refining the estimates of those components that have the greatest effect on the interpretation of the results. Analysts should pay special attention to the components that will be used to calculate costs and benefits and those that are important determinants of the policy option selected.

Clearly identify all assumptions made in specifying the baseline conditions. Whether variables are modeled or set by fixed assumptions, the analyst should explain the assumptions and uncertainties about the parameters in detail. Assumptions should include changes in behavior and business trends, and how these trends may be affected by regulatory management options. Analysts may observe trends in economic activity or pollution control technologies that occur for reasons other than direct environmental regulations. For example, as the purchasing power of consumer income increases over time, demand for different commodities may change. Demand for some commodities may grow at rates faster than the rate of change in income, while demand for other goods may decrease. Where these trends are highly uncertain or are expected to have significant influence on the evaluation of regulatory alternatives (including a "no-regulatory control" alternative), the analyst should clearly explain and identify the assumptions used in the analysis, with the goal of laying out the assumptions clearly enough so that other analysts (with access to the appropriate models) would be able to replicate the baseline specification.

Specify the "starting point" of the baseline and policy scenario. A starting point of an analysis is the point in time at which the comparison between the baseline and policy scenarios begins. This is conceptually the point in time at which the two scenarios diverge. For example, one approach is to organize the analysis assuming that the policy scenario conditions diverge from those in the baseline at the time an enforceable requirement becomes effective. Another convenient approach is to set the starting point as the promulgation of the final rule. These dates may be appropriate to use because they are clearly defined under administrative procedures or because they represent specific deadlines.

However, where behavioral changes are motivated by the expected outcome of the regulatory process, the actual timing of the formal issuance of an enforceable requirement may not be the most appropriate starting point to define differences between the baseline and policy scenarios. Earlier starting points, such as the date when authorizing legislation was signed into law, the date the rule was first published in a Notice of Proposed Rulemaking, or other regulatory development process milestones, may be justified when divergence from the baseline occurs due to the anticipation of promulgation.

Specify the "ending point" of the baseline and policy scenario. The ending point of an analysis is the point in time at which the comparison between the baseline and policy scenarios ends. Generally, the duration of important effects of a policy determines the period chosen for the analysis and baseline. However, other analytical considerations, such as the relative uncertainty in projecting out-year conditions, may also need to be weighed. To compare the benefits and costs of a proposed policy, the analyst should estimate the present discounted values of the total costs and benefits attributable to the policy over the period of the study. How one defines the ending point of the baseline is particularly important in situations where the accrual of costs and/or benefits do not coincide due to lagged effects, or where they occur over an extended period of time. For example, the human health benefits of a policy that reduces leachate from landfills may not manifest themselves for many years if groundwater contamination occurs decades after closure of a landfill. In theory, the longer the time frame, the more likely the analysis will capture all of the major benefits and costs of the policy. Naturally, the forecasts of economic, demographic, and technological trends that are necessary for baseline specification should also span the entire period of the analysis. However, because forecasts of the distant future are less reliable than forecasts of the near future, the analyst should balance the advantages of structuring the analysis to include a longer time span against the disadvantages of the decreasing reliability of the forecasts for the future.

In some cases, the benefits of a policy are expected to increase over time. When this occurs, analysts should extend the analysis far enough into the future to ensure that benefits are not substantially underestimated. For example, suppose a proposed policy would greatly reduce greenhouse gas (GHG) emissions. In the baseline scenario, the level of GHG in the atmosphere would steadily increase over time, with a corresponding increase in expected impacts on human health and welfare and ecological outcomes. A BCA limited to the first decade after policy initiation would likely distort the relationship of benefits and costs associated with the policy. In this case, the conflict between the need to consider a long time frame and the decreasing reliability of forecasting far into the future may be substantial. In most cases, primary considerations in determining the time horizon of the analysis will be the time span of the physical effects that drive the benefits estimates and capital investment cycles associated with environmental expenditures.

In some circumstances, it may make sense to model the annual flow of benefits and costs rather than model them over time. For example, if the benefits and costs remain constant (in real terms) over time, then an estimate for a single year is all that is necessary. The duration of the policy will not affect whether there are net benefits nor will it affect the choice of the most economically efficient option, although it will obviously still affect the magnitude of net benefits. In this case, an "ending point" may not be needed and a present discounted value of the net benefits may be unnecessary as well. However, the absence of these values should be explicit in the analysis. An alternative to providing no present discounted value is to conduct a single year estimate of costs and benefits, but calculate a present discounted value of net benefits assuming an infinite time period.

Detail all aspects of the baseline specification that are uncertain. Because the analyst does not have perfect foresight, the appropriate baseline conditions cannot be characterized with certainty. Future values always have some level of uncertainty associated with them, and current values often do as well. To the extent possible, estimates of current values should be based on actual data, and estimates of future values should be based on clearly specified models and assumptions. Where reliable projections of future economic activity and demographics are available, this information should be adequately referenced. In general, uncertainties underlying the baseline conditions should be treated in the same way as other types of uncertainties in the analysis. All assumptions should be clearly stated and, where possible, all models should be independently reproducible.

It is important to detail information that was not included in the analysis due to scientific uncertainty. For example, a health or ecological effect may be related to the regulated pollutant, but the science behind this connection may be too uncertain to include the effect in the quantitative analysis. In this case, the effect should not be included in the baseline, but a discussion of why the effect was excluded should be added — especially if the magnitude is such that it could significantly affect the net benefit calculation. A similar recommendation can be made for model choice or even the choice of parameter values; known aspects of the analysis, which are not included in the baseline due to scientific uncertainty, should be included in the uncertainty section.

Large uncertainty in significant variables may require the construction of alternative baselines or policy scenarios. This leads to numerous complications in policy analysis, especially in cost-effectiveness analysis (CEA) and the calculation of net benefits. While sensitivity analysis is usually a better choice, multiple scenarios may be beneficial in selecting policy options, especially if there is a significant probability of irreversible consequences or catastrophic events.

Use the baseline assumptions consistently for all analyses for this regulation. The models, assumptions, and estimated parameters used in the baseline should be carried through for all components of the analysis. For example, the calculation of both costs and benefits should draw upon estimates derived using the same underlying assumptions of current and future economic conditions. If the benefits and costs are derived from two different models, then the initial baseline conditions of costs and benefits should be compared to ensure that they are making identical assumptions. Likewise, when comparing and ranking alternative regulatory options, comparison to the same baseline should be used for all options under consideration.[2]

In some cases, an analysis may not have been anticipated during the baseline specification. For example, a sector might be singled out for more detailed analysis, or a follow-on analysis might be needed to assess impacts on a particular low-income or minority group. In this case, a complete baseline specification that would make this secondary analysis fully consistent with the primary analyses may not be available. Even in

2 In the less common case in which more than one baseline scenario is modeled, the analyst must avoid the mistake of combining analytic results obtained from different baseline scenarios. To limit confusion on this point, if multiple baseline scenarios are included in an analysis, the presentation of economic information should clearly describe and refer to the specific baseline scenario being used.

this case, however, some type of baseline will have to be produced in order to conduct the analysis. While it may not be identical to the baseline used to analyze the benefits and costs, the analyst should endeavor to make it as similar as possible. The analyst should explicitly state the differences between the two baselines or any uncertainty associated with the secondary baseline.

5.3 Changes in Basic Variables

Certain variables are very important for modeling both the baseline scenario and the policy scenario. Some of these variables, such as population and economic activity, are commonly modeled by other government agencies and are available for use in economic analyses. The values of these variables will change over the period of study and, as a result of the policy, may differ significantly between the two scenarios. Even when they are the same across scenarios, these values can have a substantial impact on the overall benefits and costs and should be explicitly reported over time. Other variables, such as consumer spending patterns and technological growth in an industry, are also important for modeling, but are more difficult to estimate. In these cases, the analyst should specify the variable levels and report whether these variables changed during the period of the study. When they are assumed to change, both over time and between scenarios, the analyst should explicitly state the assumptions of how and why they change.

5.3.1 Demographic Change

Changes in the size and distribution of the population can affect the impact of EPA programs and, as a consequence, can be important in economic analyses. For example, risk assessments of air toxics standards require assumptions about the number of individuals exposed. Therefore, assumptions about future population distributions are important for measuring potential future incidence reductions and for estimating the maximum individual risk or exposures. Another example is when population growth affects the level of vehicle emissions due to an increased number of cars and greater highway congestion. For most analyses, U.S. Census Bureau projections of future population growth and distribution can be used. In some cases, however, behavioral models may be required if the population growth or distribution changes as a consequence of the regulation. For example, demographic trends in an area may change as a result of cleaning up hazardous waste sites. EPA analyses should reflect the consequences of population growth and migration, especially if these factors influence the regulatory costs and benefits.

5.3.2 Future Economic Activity

Future economic activity can have a significant effect on regulatory costs and benefits because it is correlated with emissions and, in some cases, can influence the feasibility or cost-effectiveness of particular control strategies. Even small changes in the rate of economic growth may, over time, result in considerable differences in emissions and control costs. Assuming no change in the economic activity of the regulated sector, or in the nation as a whole, will likely lead to incorrect results. For example, if the regulated industry is in significant decline, or is rapidly moving overseas, this information should be accounted for in the baseline. In such a case, incremental costs to the regulated community (and corresponding benefits from the regulation) are likely to be less than if the targeted industry were growing.

Official government estimates of future economic growth are the most appropriate values to use. In many cases, however, the future economic activity of the particular sectors under regulation will have to be modeled. In both cases, the models and assumptions used should be made as explicit as possible. When economic growth is a significant determinant of the relative merits of regulatory alternatives or when there are significant differences between official and private growth estimates, then sensitivity analyses using alternative growth estimates should be included.

5.3.3 Changes in Consumer Behavior

The bundle of economic goods purchased by consumers can affect the benefits and costs of a rule. An increase in the price and decrease in the quantity of goods from the regulated sector should be included as part of the cost of the regulation. Likewise, a reduction in the number of goods (e.g., bottled water) that were previously purchased to reduce health effects caused by the regulated pollutant will result in economic benefits to the public. Thus, changes in consumer behavior are important in the overall economic analysis. Changes in consumer purchasing behavior should be supported by estimates of demand, cross-price, and income elasticities allowing changes in consumer behavior to be estimated over time and for the baseline and policy scenarios.[3]

One controversial extension involves the income elasticity for environmental protection. There is some evidence that the demand for environmental quality rises with income (Baumol and Oates 1988). However, this does not necessarily justify adjusting the benefit of environmental improvements upward as income rises. This is because the willingness to pay (WTP) for a marginal improvement in the environmental amenity, the appropriate measure of the benefits of environmental protection, may not necessarily have a positive income elasticity (Flores and Carson 1997). It is appropriate to account for income growth over time where there are empirical estimates of income elasticity for a particular commodity associated with environmental improvements (e.g., for reduced mortality risk). In the absence of specific estimates, it would be appropriate to acknowledge and explain the potential increase in demand for environmental amenities, as incomes rise.

5.3.4 Technological Change

Future changes in production techniques or pollution control may influence both the baseline and the costs and benefits of regulatory alternatives. Estimating the future technological change is quite difficult and often controversial. Technological change can be thought of as having at least two components: true technological innovation, such as a new pollution control method; and learning effects, in which experience leads to cost savings through improvements in operations, experience, or similar factors. It is not advisable to assume a constant, generic rate of technological progress, even if the rate is small, simply because the continuous compounding of this rate over time can lead to implausible rates of technological innovation. However, in some cases learning effects may be included in analyses.

Undiscovered technological innovation is often considered to be one reason why regulatory costs are overstated (Harrington et al. 1999). Because of the difficulty and controversy associated with estimating technological change in an economic analysis, analysts should be careful to avoid the perception of bias when introducing it. If technological change is introduced in the cost analysis, then it should be introduced in the benefits analysis as well. While technological innovation in the regulated sector can reduce the cost of compliance, technological innovation in other sectors can reduce the benefits of the regulation. For example, the cost of controlling CFCs has declined over time due to technological improvements. However, innovation in mitigating factors, such as improvements in skin cancer treatments and efficacy of sunscreen lotions — both of which decrease the benefits of the regulation — have also occurred. Further, the analysis should include the costs associated with research and development (R&D) for the innovations to correctly value cost-reducing technological innovation, but only if the costs are policy-induced and do not arise from planned R&D budgets. This distinction is sometimes difficult to make.

If technological innovation is included in the policy scenario, then it should be included in the baseline as well (see Text Box 5.1). While accepting that innovation will occur in the baseline and policy scenarios, rates across scenarios may differ because regulation may cause firms to innovate more to reduce the cost of compliance. In cases where small changes in technology could

3 Demand elasticities show how the quantity of a product purchased changes as its prices changes, all else equal. Cross-price elasticities show how a change in the price of one good can result in a change in the price of another good (either a substitute or a complement), thereby altering the quantity purchased. Income elasticity allows a modeler to forecast how much more of a good consumers will buy when their income increases. See Appendix A for more information on elasticity.

Text Box 5.1 - Technological Change, Induced Innovation, and the Porter Hypothesis

There are many proposed mechanisms by which environmental regulation could cause technological change. One mechanism is by induced innovation: the induced innovation hypothesis states that as the relative prices of factors of production change, the relative rate of innovation for the more expensive factor will also increase. This idea is well accepted; for example, Newell et al. (1999) found that a considerable amount of the increase in energy efficiency over the last few decades has been caused by the increase in the relative price of energy over that time.

A similar idea has also been described (somewhat less formally) as the "Porter Hypothesis" (Porter and van der Linde 1995, and Heyes and Liston-Heyes 1999). Jaffe and Palmer (1997) delineate three versions of the hypothesis: weak, narrow, and strong.

The weak version of the hypothesis assumes that an environmental regulation will stimulate innovation but it does not predict the magnitude of these innovations or the resulting cost savings. This version of the hypothesis is very similar to the induced innovation hypothesis. The narrow version of the hypothesis predicts that flexible regulation (e.g., incentive-based) will induce more innovation than inflexible regulation and vice versa. There is empirical evidence that this is the case (Kerr and Newell 2003, and Popp 2003). Analysts may be able to estimate the rate of change of innovation under the weak or narrow version of the hypothesis, or under induced innovation. However, this innovation may crowd out other forms of innovation.

The strong version predicts cost savings from environmental regulation under the assumption that firms do not maximize cost saving without pressure to do so. While anecdotal evidence of this phenomenon may exist, the available economic literature has found no statistical evidence supporting it as a general claim (Jaffe et al. 1995; Palmer, Oates, and Portney 1995; Jaffe and Palmer 1997; and Brännlund and Lundgren 2009). The strong version of the Porter Hypothesis may be true in some cases, but it requires special assumptions and an environmental regulation combined with other market imperfections (such as bounded rationality) that are difficult to generalize. Analysts should not assume cost savings from a regulation based on the strong version of the Porter Hypothesis.

dramatically affect the costs and benefits, or where technological change is reasonably anticipated, the analyst should consider exploring these effects in a sensitivity analysis. This might include probabilities associated with specific technological changes or adoption rates of a new technology, or it may be an analysis of the rate required to alter the policy decision. Such an analysis should show the policy significance of emerging technologies that have already been accepted, or are, at a minimum, in development or reasonably anticipated.

In some cases it may be possible to make the case that learning effects will lead to lower costs over time.[4] Estimated rates of learning effects often indicate that costs decline by approximately 5 percent to 10 percent for every doubling of cumulative production. If learning effects are to be included in an analysis, the analyst should carefully examine the existing data for relevance to the problem at hand. Estimated learning effects can vary according to many factors, including across industries and by the length of the time period considered. Also, because estimates of learning effects are based on doubling of cumulative production, inclusion of learning effects will have a greater influence on rules with longer time periods and may have little effect on rules with short time periods.

5.4 Compliance Rates

One aspect of baseline specification that is particularly complex, and for which assumptions are typically necessary, is the setting of compliance rates. The treatment of compliance in the baseline scenario can significantly affect the results of the

4 See U.S. EPA (1997b, 2007b).

analysis. It is important to separate the changes associated with a new regulation from actions taken to meet existing requirements. If a proposed regulation is expected to increase compliance with a previous rule, the correct measure of the costs and benefits generally excludes impacts associated with the increased compliance.[5] This is because the costs and benefits of the previous rule were presumably estimated in the economic analysis for that rule, and should not be counted again for the proposed rule. This is of particular importance if compliance and enforcement actions taken to meet existing requirements are coincident with, but not caused by, changes introduced by the new regulation.

Assumptions about compliance behavior for current and new requirements should be clearly presented in the description of the analytic approach used for the analysis. When comparing regulatory options on the basis of their social costs and benefits, the effect of compliance assumptions on the estimated economic impacts should be described, along with the sensitivity of the results to these assumptions.

In most cases, a full compliance scenario should be analyzed. If a baseline is used that assumes a scenario other than full compliance, the analyst should take care to explain the compliance assumption for the current regulation under consideration. The Agency is unlikely to propose a rule that it believes will not be followed, but if there is widespread non-compliance with previous rules then this suggests a persistent problem.

5.4.1 Full Compliance

As a general rule, when preparing analyses of regulations **analysts should develop baseline and policy scenarios that assume full compliance with existing and newly enacted (but not yet implemented) regulations**. Assuming full compliance with existing regulations enables the analysis to focus on the incremental economic effects of the new rule or policy without double counting benefits and costs captured by analyses performed for other rules.

Assuming full compliance with all previous regulations when current observed or reported economic behavior indicate otherwise may pose some challenges to the analyst. For example, it is possible to observe over-compliance by regulated entities with enforceable standards. One can find industries whose current effluent discharge concentrations for regulated pollutants are measured below concentrations legally required by existing effluent guideline regulations. On the other hand, evidence for under-compliance is apparent in the convictions of violators and negotiated settlements conducted by EPA.

As a practical matter, before rejecting full compliance assumptions for existing policies, the emissions from noncompliant firms should be known, estimable, and occurring at a rate that can affect the evaluation of policy options. In some cases, two baselines may have to be assumed: one assuming full compliance with existing regulation and a separate "current practice" baseline. In the case of a deregulatory rule, which is designed to address potential changes in or clarify definitions of regulatory performance that frees entities from enforceable requirements contained in an existing rule, it may make sense to perform the analysis using both baselines. A full-compliance scenario in this instance introduces some added complications to the analysis, but it may be important to report on the economic effects of failing to take the deregulatory action.

5.4.2 Under-Compliance

When compliance issues are important and there is sufficient monitoring data to support the analysis, a "current practice" baseline can be used. A "current practice" baseline is established using the actual degree of compliance rather than assumed full compliance. Current practice baselines are useful for actions intended to address or "fix-up" compliance problems associated with existing policies. In these cases, assuming a full-compliance baseline that disregards under-compliant behavior

5 An exception would be if the proposed regulation were designed to correct the under-compliance from the previous rule. This is discussed in Section 5.4.2.

could obscure the value of investigating additional or alternative regulatory actions. This was the case in a review of the banning of lead from gasoline, which was precipitated, in part, by the noncompliance of consumers who put leaded gasoline in vehicles that required non-leaded fuel to protect their catalytic converters, resulting in increased vehicle emissions (U.S. EPA 1985).

If under-compliance is assumed in the baseline, then the nature of that non-compliance becomes important. For example, in a case where under-compliance occurs uniformly (or at random) across an industry, then changing the compliance rate assumption will not affect the benefit-cost ratio nor the sign of net benefits, assuming the effect on ambient concentrations is also uniform (or random), although it will affect the magnitude of net benefits. In other words, a proposed regulation that can be justified from a net benefit perspective under full compliance can also be justified under any baseline compliance rate. However, if non-compliance with previous regulation occurs selectively when compliance costs are high, then the benefit-cost ratio will decline as higher rates of compliance are assumed, and net benefits could potentially switch from positive to negative for a proposed regulation. This occurs because the cost per unit of benefit will continue to increase as full compliance is reached. Analysts may elect to incorporate predicted differences in compliance rates within policy options in cases where compliance behavior is known to vary systematically.

While a baseline assuming under-compliance can be useful in some cases, it should be executed carefully or the issue should be examined with a sensitivity analysis. A partial compliance baseline has the potential for double counting both benefits and costs. A sequence of emissions tightening rules could be justified by repeatedly factoring under-compliance into the baseline, while assuming that entities will fully comply with the new rule under consideration. Summing the benefits from the total sequence of rules would overstate benefits because each rule claims part of the same benefits each time. Additionally, while the benefits flowing from previous regulations may not have been realized due to lack of compliance, the full costs of their implementation may not have been realized either. The additional costs associated with coming into compliance should also be included to avoid producing inflated net benefits. In the case where an under-compliance baseline (or sensitivity analysis) is justified, care should be taken to explain these potential biases.

5.4.3 Over-Compliance

Over-compliance may occur due to risk aversion, technological lumpiness, uncertainty in pollution levels, or other behavioral responses. Here the benefits (and potentially the costs) of the previous regulation have been understated rather than overstated. In this case, as with under-compliance, true societal net benefits of a regulation will not be calculated correctly under an assumption of full compliance.

In cases of over-compliance with existing policies, current practices can be used to define baseline conditions unless these practices are expected to change. For example, over-compliance may be the result of choices made in anticipation of more stringent regulations. If these stringent regulations are not implemented, the analyst will need to establish whether over-compliance will be reduced to meet the relatively less stringent requirements. If the regulated entities are expected to continue to over-comply despite the absence of the more stringent regulation, then the costs and benefits attributable to this behavior are not related to the policy under consideration. In this case, it would be appropriate to account for the over-compliance in the baseline scenario that describes the “world without the regulation.” However, if the regulated entities are expected to relax their pollution control practices to meet relatively less stringent requirements, then the costs and benefits of the over-compliance behavior should be attributed to the new policy scenario, and over-compliance should not be included in the baseline. In these situations, it may be useful to consider performing a sensitivity analysis to demonstrate the potential economic consequences of different assumptions associated with the expected changes in behavior.

5.5 Multiple Rules

Although regulations that have been finalized clearly belong in the baseline of a proposed rule, the baseline specification may be complicated if other regulations in addition to the one being implemented are under consideration or nearing completion. In this case it becomes difficult to determine which regulations are responsible for the environmental improvements and can "take credit" for reductions in risks. It is also necessary to determine how these other regulations affect market conditions that directly influence the costs or the benefits associated with the policy of interest. This is true not only for multiple rules promulgated by EPA, but also for rules passed by other federal, state, and local agencies. In addition to agencies that regulate environmental behavior, other agencies that regulate consumer and industrial behavior [e.g., Occupational Safety and Health Administration (OSHA), Department of Transportation (DOT), and Department of Energy (DOE)] develop rules that may overlap with upcoming EPA regulations. Even the *potential* implementation of another such rule may affect the benefits and costs of an EPA regulation being analyzed, due to the strategic behavior of regulated entities. Therefore, it is important to consider the impact of other rules when establishing a baseline. If another federal, state, or local agency is legally required to impose a regulation but is still in the process of finalizing that regulation, then a baseline which includes this impending regulation should be considered. The intent of the baseline is always to characterize the world in the absence of regulation being analyzed.

5.5.1 Linked Rules

In some cases it is possible to consider multiple rules together as a set. For example, some regulatory actions have linked together rules that affect the same industrial category. This was true of the pulp and paper effluent guidelines and National Emissions Standards for Hazardous Air Pollutants (NESHAP) rules (U.S. EPA 1997c). In other cases, multiple rules may not necessarily be a set of similar policies associated with the same industry, but rather are a set of different policies that are all necessary to achieve a policy objective. For example, EPA may issue effluent limitation guidelines (ELG) to provide technical requirements for a type of pollution discharge, and may then issue a complementary National Pollution Discharge Elimination System (NPDES) rule, providing details of the permitting system. Since ELG and NPDES work together to achieve one objective it would not make sense to analyze them separately.

The optimal solution in both of the cases described above is to include all of the rules in the same economic analysis. In this case, the multiple rules are analyzed as if they were one rule and the baseline specification simplifies to one with none of the rules included. While statutory requirements and judicial deadlines can inhibit promulgating multiple rules as one, coordination between rulemaking groups is still possible. The sharing of data, models, and joint decisions on analytic approaches may make a unified baseline possible so that the total costs and benefits resulting from the package of policies can be assessed.

5.5.2 Unlinked Rules

In some cases, it is simply not feasible to analyze a collection of overlapping rules together in a single economic analysis with a single baseline. This may be true for rules originating from different program offices or different regulatory agencies, or when the timing of the various rules is not clear. In this case, each rule should be analyzed separately with its own baseline, but the order in which the rules are analyzed may have a substantial effect on the outcome of a BCA. For example, in 2005, EPA promulgated both the Clean Air Interstate Rule (CAIR) and the Clean Air Mercury Rule (CAMR) to reduce pollution from coal fired power plants. While the primary purpose of CAIR was to reduce sulfur dioxide (SO_2) and nitrogen oxides (NO_x), the control technologies necessary to achieve this also reduced mercury emissions. Because the CAMR analysis assumed that CAIR had been implemented and was, therefore, in the baseline, the estimated incremental reduction in mercury from CAMR was much smaller than if CAIR had not been included in the baseline. In a similar fashion, if some of the costs of fully complying with the second rule are incurred in the process of complying with the first rule, then these costs are part of the baseline and are not considered as costs of the second rule. In general, only the incremental benefits and costs of the second rule should be included if the first rule is in the baseline.

The practical assumption commonly made when rules cannot be linked together is to consider the actual or statutory timing of the promulgation and/or implementation of the policies, and use this to establish a sequence with which to analyze related rules. However, this may not always be possible. For example, a rule may be phased in over time, complicating the analysis of a new rule going into effect during that same period. In that case, the baseline for the new rule should include the timing of each stage of the phased rule and its resulting environmental, health, and economic changes.

In the absence of some orderly sequence of events that allows the attribution of changes in behavior to a unique regulatory source, there is no non-arbitrary way to allocate the costs and benefits of a package of overlapping policies to each individual policy. That is, there is no theoretically correct order for conducting a sequential analysis of multiple overlapping policies that are promulgated simultaneously. The only solution in this case is to make a reasonable assumption and clearly explain it, detailing which rules are included in the baseline (see Text Box 5.2). If the costs and benefits from these rules are small, then this may be all that is necessary. It may not be worth additional time and resources to reconcile the overlapping rules. On the other hand, for major rules or if the number of overlapping rules is small, then a sensitivity analyses can be included to test for the implications of including or omitting other regulations. Under this sensitivity analysis, it may also be possible to use the overlapping nature of the regulations to allow for some regulatory flexibility in compliance dates and regulatory requirements.

5.5.3 Indirectly Related Policies and Programs

In some instances, less directly related environmental policies or programs can influence the baseline. For example, potential changes in farm subsidy programs may significantly influence future patterns of pesticide use. In an ideal analysis, all of the potential direct and indirect influences on baseline conditions (and on the costs and benefits of regulatory alternatives) would be examined and estimated. In other words, this situation can be handled in the same way as unlinked overlapping rules described above. Practically speaking, however, it is up to the analyst to determine if these indirect influences are important enough to incorporate into the regulatory analysis. If indirect influences are known but are not considered to be significant enough to be included in the quantitative analysis, they can be discussed qualitatively.

5.6 Partial Benefits to a Threshold

Some benefits only occur after a threshold has been reached. For example, the benefits associated with improving a stream to allow for recreational swimming are realized only when all of the pollutants have been reduced enough to allow for primary contact and an enjoyable swimming experience. Likewise, valued species populations may only recover when multiple limiting factors are addressed. However, a particular benefits threshold may not be met with a single rule. In such cases, associating the benefits only with the rule that actually passes the threshold could make it impossible to justify the incremental progress (via previous rules). It is generally reasonable to account for the benefits of making progress toward a goal, even if the threshold is not met in the rule under consideration.

For example, EPA's Office of Water has calculated the benefits associated with improving river miles for various designated uses (e.g., swimming, fishing, and boating) in a number of rules. In each case, some river miles were improved for the designated use, while other miles were improved, but not enough to change their designated use. Earlier rules claimed benefits only if a river mile actually changed its designation, implicitly giving a value of zero to partially improved river miles. More recent regulation claims partial benefit for incremental improvements toward the threshold. Neither approach is necessarily correct, but accounting for the benefits of partial gains provides better information to decision makers and the public and allows the Agency to justify incremental

Text Box 5.2 - Sequencing Unlinked Rules

It is impossible to identify all of the possible scenarios one might need to consider when determining which rules to include in a baseline, but a few illustrative cases are provided below.

Including final rules that have not yet taken effect: This is the most straightforward case. All final rules promulgated prior to the rule under consideration should be included in the baseline. The costs and benefits of the regulation under consideration must be evaluated against a baseline that assumes firms will comply with these promulgated rules. For example, on March 15, 2005, EPA issued the Clean Air Mercury Rule (CAMR) to reduce mercury emissions from coal-fired power plants. Five days earlier, on March 10, 2005, EPA finalized the Clean Air Interstate Rule (CAIR) to reduce sulfur dioxide (SO_2) and nitrogen oxides (NO_x) emissions from coal-fired power plants. Because the control technology assumed under CAIR included some mercury reductions, the baseline used for CAMR included the actions that firms would need to take to comply with CAIR.

Including rules anticipated to occur after a regulation is promulgated but before it takes effect: This is a more difficult case and only applies to regulations that have a long lag between the date on which they are issued and the date when they take effect. The longer the difference between these two dates, the more important it is to include rules that can be expected in the interim. For example, National Ambient Air Quality Standards (NAAQS) can have a number of years between the date on which a standard is announced and the date on which designations of attainment or nonattainment are made. In this case, if another rule is imminent and will take effect prior to the effective date of the new NAAQS, then it should be included in the baseline for the NAAQS. It is important, however, that the analyst not simply speculate that another rule will be implemented. Any other rule included in the baseline, other than those already promulgated, should be imminent or reasonably anticipated with a high degree of certainty. In addition, the analyst should be clear as to what assumptions have been made.

Including state rules that are legally required but not yet implemented: This is probably the most difficult case. Actions by state (and even local) governments can affect the costs and benefits of federal rules, particularly if they are regulating the same sector or pollutant. As with the case above, any state regulation that has been finalized should be included in the baseline. The more difficult case occurs when the state has a legal obligation to implement a regulation but either has not done so or is in the process of doing so. In this case, the analyst must use professional judgment to determine what would happen in the absence of EPA action. If the state would implement the regulation in the absence of EPA action, then a reasonable case can be made that this state regulation should be included in the baseline.

Two of the most important things to remember when sequencing multiple unlinked rules are transparency and objective reasoning. Transparency requires that the analyst clearly state all assumptions. Objective reasoning requires that the analyst not engage in speculation. If there is uncertainty about the anticipated rules, then two baselines, one with anticipated rules and one without, should be considered. If resources are constrained and only one baseline can be considered, then it should be constructed using only final rules and those that are reasonably expected with a high degree of certainty in the absence of EPA action.

progress to a threshold.[6] Note that once partial gains to a threshold have been claimed, there is a danger of double counting when evaluating the potential benefits of future rules. If partial gains have been valued in one rule, then subsequent rules cannot claim full credit for crossing the threshold. In effect, some of the benefits have already been used to justify the previous incremental rules and therefore claiming full credit in future rules would double count those benefits.

6 Sometimes calculating partial benefits to a threshold may not be a satisfactory solution, either because the progress to a threshold is uncertain due to multiple limiting factors (e.g., in some ecological improvements) or because it does not comport with the economic values (e.g., the value of avoiding the extinction of a species). In this case, a rulemaking incremental progress to the threshold might have to be justified on something other than a benefit-cost test. This, however, does not affect the choice of a baseline.

While the actual valuation of incremental progress is a benefits issue, the specification of that portion of the benefits that have been claimed in previous rules is a baseline issue. If previous rules have claimed partial benefits, the benefits available for the current rule should be clearly identified in the baseline specification. In the simplest case, this means calculating benefits in the same way as previous rules. However, this approach is not always possible, or even reasonable. New valuation studies or new models of ambient pollution may make the previous benefits estimates obsolete. In this more complicated case, the baseline specification should be developed so that the current benefits estimates can be compared with the previous estimates while avoiding double counting.

5.7 Behavioral Responses

To measure a policy's costs and benefits, it is important to clearly characterize the behavior of firms and individuals in both the baseline and the policy scenarios. Behavior is contrasted with the baseline and is often anticipated to change in response to the policy options. Some policies are prescriptive in specifying what actions are required — for example, mandating the use of a specific type of pollution control equipment. Responses to less-direct performance standards, such as bans on the production or use of certain products or processes or market-based incentive programs are somewhat more difficult to predict and commonly require some underlying model of economic behavior. Estimating responses is often difficult for pollution prevention policies because these options are more site- and process-specific when compared to end-of-pipe control technologies. Predicting the costs and environmental effects of these rules may require detailed information on industrial processes.

Parties anticipating the outcome of a regulatory initiative may change their economic behavior, including spending resources to meet expected emission or hazard reductions prior to the compliance deadline set by enforceable requirements. The same issues arise in the treatment of non-regulatory programs, in which voluntary or negotiated environmental goals may be established, leading parties to take steps to achieve these goals at rates different from those expected in the absence of the program. In these cases, it may be appropriate to include the costs and benefits of changed behavior in the analysis of the policy action, and not subsume them into the baseline scenario. Nevertheless, the dynamic aspects of market and consumer behavior, and the many motivations leading to change, can make it difficult to attribute economic costs and benefits to specific regulatory actions. Where behavioral changes are uncertain, an uncertainty analysis using various behavioral assumptions can provide insight into how important these assumptions may be.

Behavioral responses are usually characterized as reactions to proposed policy options. However, the behavioral assumptions used in the baseline, when no regulatory action is taken, are also very important. Individuals may attempt to mitigate the affect of pollution (e.g., by buying bottled water, using masks, or purchasing medication), or prevent their exposure altogether through some type of averting behavior (e.g., keeping windows closed or relocating). Careful consideration of this behavior is important to correctly measure the costs and benefits of regulation. Analysts should make explicit all assumptions about firm and individual behavioral in both the baseline and policy scenarios so that a proper comparison between the two can be made.

5.7.1 Potential for Cost Savings

Predicting firm-level responses begins with a comprehensive list of possible response options. In addition to the possible compliance technologies (if the technology is not specified by the policy itself) or waste management methods, less obvious firm-level responses should be considered. These include changes in operations (e.g., input mixtures, re-use or recycling, and developing new markets for waste products) to avoid or reduce the need for new controls or the use of restricted materials, shutting down a production line or plant to avoid the investments required to achieve compliance, relocation of the firm, or even exiting the industry. The possibility of noncompliance should also be explored, including the use of lawsuits to delay the required investment. In general, affected parties are assumed to choose the option that minimizes their costs.

In some cases, compliance implies a reduction in costs from the baseline. In other words, choosing the least costly regulatory solution would provide cost savings to the firms. In this case, it is important to provide an analysis of why these cost-saving measures are not undertaken in the baseline. It is not always obvious why firms would actively choose to not undertake a change that results in cost savings. If firms will eventually voluntarily undertake these changes without the regulation, then the regulatory intervention cannot be credited with the cost savings.

One possibility is that firms may not adopt cost-saving measures because of market failures (e.g., informational asymmetries or transactions costs) and other circumstances. In these cases, regulation can motivate economically beneficial actions, but there should be a reasonable description of the market failure or circumstances that the regulation is correcting. A second possibility is that firms are actively choosing a higher cost option in order to reduce legal liabilities or to achieve compliance with other implemented or proposed rules. In this latter case, firms will continue to choose the higher cost solution in both the baseline and the policy scenario and the costs savings can only be achieved by relaxing the legal liability or eliminating the other rule. In other words, the additional costs of compliance in excess of a least-cost strategy would be attributed to these other causes, but the rule itself will not achieve the cost savings.

5.7.2 Voluntary Actions

Occasionally, polluting industries adopt voluntary measures to reduce emissions. This can be implemented through a formal, government-sponsored voluntary program or a firm or sector may independently adopt measures. Such voluntary measures are adopted for a variety of reasons, including public relations considerations, to avoid regulatory controls, or to gain access to incentives associated with joining a formal program. When this is the case, it is important to account for these voluntary actions in the baseline and to be explicit about the assumptions of firms' future actions.

Typically, the economic baseline should reflect current circumstances, which means that voluntary reductions in emissions should be included in the baseline assumptions. This is not always possible, however, as voluntary actions are often difficult to measure (Brouhle, Griffiths, and Wolverton 2005). In the case of data or resource limitations, analysts may be compelled to adopt a "current regulations" baseline, which effectively ignores these emission reductions.

For the policy scenario, analysts should generally not assume that the current trends in voluntary reductions will persist. If firms are required to reduce emissions below their current level, then it should be assumed that the firms would meet the new standard without over-complying. While firms that go beyond compliance are often "good actors" who will continue to make reductions beyond the regulatory threshold, there is no a priori reason to expect this without a formal model explaining the firms' motivation. If the regulatory threshold is set above the emissions of these "good actions" then it is important to hypothesize why the voluntary actions were taken in the first place. If firms were making voluntary reductions in anticipation of the regulation or to dissuade the Agency from passing the regulation, then the firm can probably be expected to increase emissions to the regulatory level. On the other hand, if firms were making the reduction for some other incentive that continues to be present after the regulation is passed, then the voluntary emissions level may remain unchanged.

In some cases, it may be appropriate to demonstrate the significance of voluntary actions in a sensitivity analysis. This might involve analyzing competing assumptions of voluntary behavior. In all cases, the potential impact of the regulation on formal voluntary programs should be discussed. If participation in voluntary programs was motivated by the threat of the proposed regulation, then that voluntary program will likely be affected. In the extreme case, the voluntary program may be curtailed or eliminated as a consequence of the regulation. These potential implications should be included in the economic analysis.

5.8 Conclusion

Developing a baseline plays a critical role in analyzing policy scenarios, because it is the basis for BCA and option selection. However, developing a baseline is not a straightforward process, and analysts must make many decisions on the basis of professional judgment.

As stated in this chapter, a well-specified baseline should address exogenous changes in the economy, industry compliance rates, other concurrent regulations, and behavioral responses. The assumptions used in the baseline will be derived from models, published literature, or government agencies and should be clearly referenced. In cases where the data are uncertain, or not easily quantified, but may have a significant influence on the results, the analyst should describe the weaknesses in the data and assumptions, and include some type of sensitivity analysis. In some cases, multiple baselines or alternative scenarios may be required.