Environmental Protection Agency
Nationwide Laboratory Assessment

REPORT OF FINDINGS

Draft Final Report

February 2, 2015

SMITHGROUP

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1.0 Executive Summary

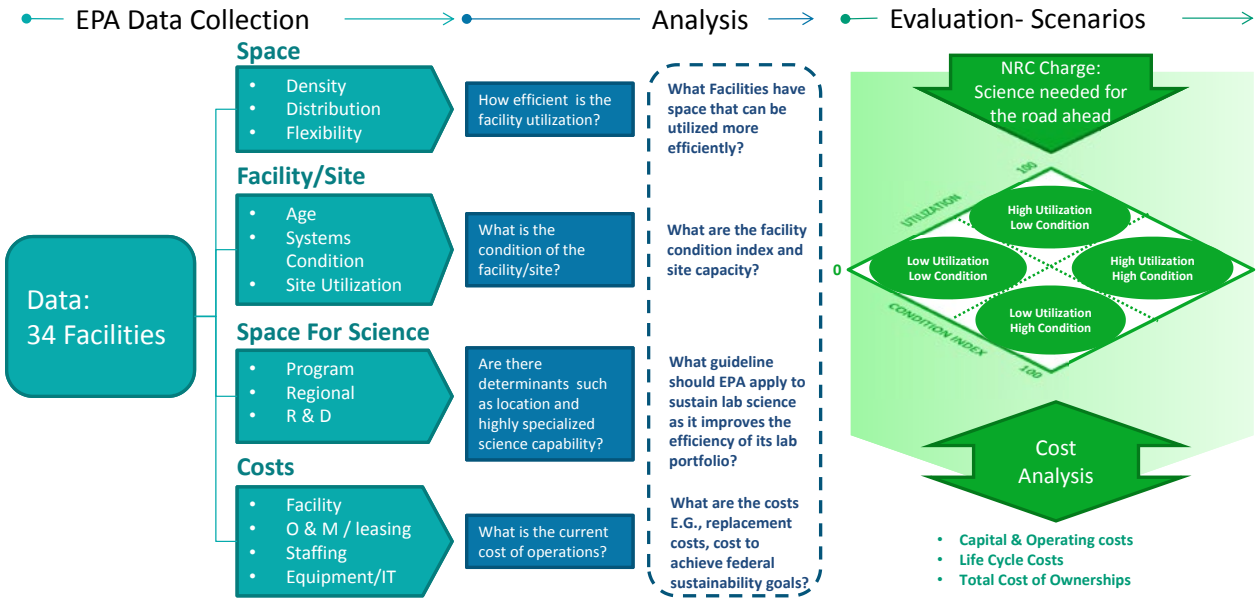

Figure 1.1
EPA Nationwide Laboratory Assessment Evaluation Process

The nationwide assessment of the EPA's laboratory enterprise was developed to study and evaluate the efficiency of the laboratory portfolio and provide the EPA with tools and options to assist with future decision making. In 2012, the nationwide EPA enterprise consists of 34 laboratory facilities and their associated sites. The assessment study was conducted over a 12 month period and followed a three phase process of EPA data collection, analysis, and scenarios evaluation, as noted in the figure above (Figure 1.1). The assessment study was conducted in consultation with the EPA and included numerous workshops, meetings, and reviews.

KEY FINDINGS

Based on the data compiled, a series of metrics and comparative analyses was developed to determine and measure the efficiency of space, facility condition, energy utilization, site utilization, and cost impacts of current operations. Key findings from these analyses are presented below and on the next two pages. More detailed information about these findings is presented in Section 3 of this report.

Space

The EPA nationwide portfolio consists of more than 3.75 million gross square feet (GSF) of laboratory facilities and 2.75 million of useable square feet (USF). The analysis identified a range of 15-20% of useable space (358,200 SQ FT – 477,500 SQ FT) in the laboratory portfolio that potentially can be better utilized. This finding is based on the comparison

of useable space for each type of EPA laboratory with benchmarks for that laboratory type.

Facility Condition

To conduct a detailed site survey of each laboratory facility was not economically feasible for the purposes of determining facility condition and calculating renovation costs at the required level of analysis. Therefore, facility condition was assessed based on GSA Guidance for Real Property Inventory reporting, modified by the NASA Deferred Maintenance Model. SmithGroup's modified version of the NASA method included assigning a rating on a scale of 1-5, to seven different architectural, mechanical, electrical, and plumbing systems and the use of a parametric estimating method to calculate renovation cost. Next, weighting factors - which represent the percentage of the system cost to the total facility cost - were applied to the system ratings. The final, cost-weighted, facility condition index was converted to a scale of 1-100 for ease of graphical interpretation. The analysis indicated that the average area-weighted facility condition index for the EPA laboratory portfolio was 64.4. For purposes of comparison, the facility condition index for a brand-new state-of-the-art laboratory facility would be 100. The target benchmarks for EPA lab facilities are 82 for owned and 60 for leased.

Energy Utilization

Energy and water use intensity (EUI and WUI, respectively) for FY 2012 were used to determine progress towards achieving federally mandated reduction targets. Based on the level of progress, the system ratings for each laboratory site were increased or decreased to reflect the investment delta (+/-) associated with energy and water efficiency measures. At the portfolio-level, the EPA is meeting its federally mandated targets for EUI and WUI for FY 2012. The EPA laboratory portfolio had successfully achieved a 23.6% reduction in EUI (21% target) and a 22.8% reduction in WUI (10% target) by FY 2012 from the baeline of FY 03. However, the analysis demonstrated that, at the level of individual laboratory facilities, the progress of smaller facilities typically lagged behind that of the larger facilities in EUI and WUI reductions.

Site Utilization

EPA sites vary considerably in their potential to accommodate new buildings or additions. Sites with a weighted average site assessment score of 6.5 or above (out of a possible score of 10) demonstrate the best potential capacity and quality to accommodate additional development if programs are relocated there due to consolidation. Excluding leased sites, EPA-owned sites that achieved this site assessment score include Narragansett, Edison, Fort Meade, Athens, Research Triangle Park,

Cincinnati-AWBERC, Cincinnati-Center Hill, Ada, and Corvallis.

Science Determinants

Laboratory facilities with capabilities that require proximity to aquatic ecosystems were not considered for relocation in any scenario. These facilities included:

- Narragansett, RI - Atlantic Ecology Division
- Gulf Breeze, FL - Gulf Ecology Division
- Duluth, MN - Midwest Ecology Division
- Newport, OR- Coastal Ecology Branch

Laboratory facilities with highly specialized capabilities were not considered for relocation in any scenario. These facilities included:

- Chapel Hill, NC. - Human Studies Facility
- Ann Arbor, MI - National Vehicle Fuel and Emissions Laboratory
- Montgomery, AL – Radiation Lab

Costs

Total operational costs for all laboratory-based functions in the 2012 baseline year were $455 million. Facility renovation and improvement costs were $18 million in 2012. Additionally, the EPA's capital building and facilities (B&F) average annual budget is $30 million/year, of which approximately $25 million/year has been spent on laboratory facilities over the past ten years.

SCENARIO MODELING

After the analysis of the existing EPA laboratory enterprise was complete, a series of hypothetical scenarios were developed to model efficiency and cost. The scenarios were used to evaluate portfolio-level capital and operating costs, life-cycle costs, and total cost of ownership.

This series of scenarios evaluates the FY12 portfolio of 34 lab facilities. The series also evaluates a range of efficiency improvements that hypothetically reduce the number of lab facilities from 34 to 19. All scenarios in this series include costs for relocating EPA personnel, lab decommissioning, and improvements to the facility condition. In addition, all scenarios retain the current laboratory science capability (lab science functions and workforce) to fulfill EPA program requirements. A more detailed discussion of this series of scenarios is found in Section 3 of this report. Each scenario was modeled relative to capital costs for renovation and/ or replacement, operational costs including operations and maintenance (O&M) cost savings, and life cycle costs on a 30 year

basis.

During the scenario planning phase, realistic minimum system condition index improvement targets were developed to ensure achievement of federally mandated EUI and WUI reduction goals. These targets also served to ensure continued operational performance and reliability of the laboratory facilities. Accordingly, the following minimum FCI renovation targets were utilized. No additional improvements were assessed for facilities with an FCI above these values in FY 2012.

Facility Type	FCI Renovation Target (Min.)
EPA Owned	82
Leased, Utilities Paid by EPA	60
Leased, Utilities Included in Rent	No Improvement

The results of the scenario evaluation indicate that portfolio-level efficiency can be improved through investments that achieve more efficient use of owned laboratory space, an improved facility condition index, and a modest reduction of laboratory facilities. The minor consolidation options (Scenario B Series, as defined in the report) potentially provide the highest value alternatives and life cycle cost savings if the capital financing is appropriated to achieve feasible implementation. Options in this series that analyze more extensive consolidation and co-location require similar levels of investment with no appreciable additional cost savings.

Observations from the Laboratory Assessment and Modeling Scenarios

Following the analysis of data from the existing laboratories and the evaluation of potential life-cycle and capital costs for scenario options, several preliminary observations and conclusions can be made regarding the EPA's nationwide laboratory enterprise.

- The potential savings from consolidating owned facilities is minimal.
- Savings may be realized by shifting from leased facilities to owned facilities where there is capacity within owned facilities.
- A breakdown of annual laboratory operating cost data for the entire portfolio indicates that:
    - Total annual laboratory costs represent less than 5% of the

total annual Agency-wide costs.

  - Laboratory facility costs are a small portion (~20%) of the total annual laboratory costs.
  - Labor costs are approximately 60% of the total laboratory operating costs
  - There are also non-lab costs associated with the laboratory facilities.
- Benchmarking (against EPA laboratories and similar laboratories in other organizations) indicates that there may be some under-utilized laboratory space that should be further evaluated in the master planning of individual sites.
- Hypothetical scenarios were developed for cost modeling:
  - Scenario cost models included cost of relocation of EPA personnel and lab decommissioning for potential consolidations and co-locations.
  - Lab facilities identified as dependent on proximity to aquatic ecosystems, or as including unique capabilities, were not considered for relocation in any scenario.
  - Utilization improvements are suggested in each scenario to align with benchmarks.
- To achieve the FCI targets of 82 for owned facilities and 60 for leased facilities, additional capital investment would be required.
- Without adequate investment in physical infrastructure the overall physical condition of laboratory facilities will degrade over time.

Next Steps

There are many factors that affect the future planning of facilities and budgets beyond the efficiencies and cost modeling that was included in this study. Among these factors, one of the most important is translating the scenario based observations about life-cycle and capital costs into an action plan that can be implemented in a series of annual EPA budgets. Directions regarding long range planning and implementation of any future plans are decisions for the EPA to undertake and beyond the scope of this study. This report on the nationwide assessment is provided to the EPA for its use as deemed appropriate in conjunction with other inputs and considerations to approach the planning of future laboratory

enterprise options as needed for strategic enterprise wide master planning and the master planning of individual facilities.

Additional Master Planning

The EPA should continue to (a) prepare master plans for its portfolio of laboratory facilities, and (b) update and develop master plans for the Agency's individual laboratories. The facility analysis, cost data and hypothetical scenario options developed in this report should feed into future master planning efforts.

Master planning updates are already underway at the following EPA laboratories:

- Fort Meade, MD
- Athens, GA
- Ann Arbor, MI

Tools and Templates

A large database of drawings, master plans and facility information for each EPA laboratory has been compiled and organized during this study. This database could be further developed into a future centralized facility management and planning tool. This tool could be used as a resource to assist in maintaining facility plans and data records, and for future planning purposes.

2.0 Introduction

OVERVIEW

The EPA engaged SmithGroup, Inc., a national architectural engineering and planning firm, as a consultant to develop a high level strategic assessment process to evaluate the efficiency of the EPA national laboratory enterprise. SmithGroup conducted an enterprise-wide facilities analysis, which is intended to help inform the EPA in the development of options regarding how the organization, programs and physical facilities resources could be positioned to most effectively achieve the mission of the EPA scientific enterprise and to assist with future planning.

To facilitate the study SmithGroup was charged with the development of a comprehensive planning process, evaluation metrics, planning templates and tools necessary to conduct the assessment. The highly interactive process has been ongoing for the past year and involved senior EPA leaders; key representatives from the EPA research, regional, and programs organizations and facilities managers.

This report summarizes the methodology, processes, metrics, analysis, and findings of the SmithGroup laboratory assessment.

OBJECTIVES OF THE STUDY

The objectives of the nationwide assessment study were defined as follows:

1. Develop and apply a process and tools to collect and analyze data for the EPA portfolio of laboratories.
2. Use the results of the analysis to characterize the EPA's existing portfolio
3. Use the results of the analysis to project the capital and life-cycle costs for the entire portfolio
4. Use the results of the analysis to model hypothetical scenarios to create a comparative range of options and to estimate potential life-cycle costs and savings at the portfolio level.

THE EPA LABORATORY PORTFOLIO

The 2012 EPA Laboratory Portfolio consists of 34 laboratory facilities. The laboratories are categorized into three types: Regional Labs, Research and Development Labs, and Program Labs. Many of the laboratory sites are owned by the EPA, but 12 sites are leased either through the General Services Administration (GSA) or private landlords, and three sites have use agreements at GSA facilities.

The Regional Laboratories are located in 10 distinct regions throughout the continental United States. They typically perform the following services: [1]

- Conduct physical, biological, microbiological, chemical (organic and inorganic) testing of environmental samples.
- Inspect state, local, and commercial laboratories for compliance with federal regulations.
- Provide analytical support, consultation, and technical assistance to EPA Regional Programs, civil investigations, criminal investigations, sensitive enforcement activities, and emergency response actions.
- Respond to homeland security and other emergency events and conduct method development and validation for homeland security response actions.
- Provide consultation and technical assistance to other Federal, State, Tribal and local government, and private laboratories.

The Research and Development (R&D) laboratories are responsible for developing the knowledge, assessments, and scientific tools that are the foundation for Agency policies, action, and decision. Research Triangle Park, NC and Cincinnati, OH are the two largest facilities, with additional laboratories located throughout the continental United States. Innovative research and development has a host of environmental achievements such as lead-free gasoline, no-smoking policies, low-emission vehicles, restored hazardous waste, and cleaner lakes, rivers, and coastal waters. The cumulative benefits of this work are restored ecosystems, improved public health, and increased overall life expectancy. A few examples of this research and development work include:

- Providing the basis for National Ambient Air Quality Standards that have helped increase life expectancies.

1 "Profile of the EPA's Laboratories Nationwide," provided by the EPA

- Ushering a new paradigm of faster, far less expensive chemical testing and screening tools that will provide insight into the pathways that link chemical exposure and health effects.
- Developing a host of tools, models, and databases – such as the EnviroAtlas, the Community-Focused Exposure and Risk Screening Tool, the Tribal-Focused Environmental Risk and Sustainability Tool, and the Directory of Sustainability Indicators and Indices – to support and advance safe and sustainable communities.

The National Program laboratories implement many of the EPA's regulatory programs, support specific voluntary programs, and provide direct scientific support to their respective national program offices.

The following chart enumerates the FY 2012 EPA Portfolio by laboratory name, location, laboratory type, and ownership.

2012 EPA Laboratory Facilities

Site	Lab Name	Location	Lab Type	Ownership
Region 1				
1	New England Regional Laboratory	Chelmsford, MA	Regional	GSA Leased
2	Atlantic Ecology Division	Narragansett, RI	R&D	EPA Owned
Region 2				
3	Edison Laboratory - DESA	Edison, NJ	Regional	EPA Owned
	Edison Laboratory - ERT	Edison, NJ	Program	EPA Owned
	Edison Laboratory - Urban Watershed Management Branch	Edison, NJ	R&D	EPA Owned
Region 3				
4	Environmental Science Center - EAID	Fort Meade, MD	Regional	EPA Owned
	Environmental Science Center - ACLML	Fort Meade, MD	Program	EPA Owned
5	Wheeling Field Office	Wheeling, WV	Regional	GSA Leased
Region 4				
6	Science and Ecosystems Support Division (SESD) Laboratory	Athens, GA	Regional	GSA Leased
7	Ecosystems Research Division (ERD)	Athens, GA	R&D	EPA Owned
8	Field Research Annex	Athens, GA	R&D	EPA Owned
9	Human Studies Facility	Chapel Hill, NC	R&D	EPA Leased
10	Page Road Facility	Durham, NC	R&D	GSA Leased
11	Reproductive Toxicology Facility	Durham, NC	R&D	GSA-Leased
12	Gulf Ecology Division	Gulf Breeze, FL	R&D	EPA Owned
13	Research Triangle Park	RTP, NC Main	R&D	EPA Owned
14	Environmental Chemistry Laboratory	Bay St. Louis, MS	Program	EPA Special Lease Agreement
15	National Air and Radiation Environmental Laboratory	Montgomery, AL	Program	EPA Owned
Region 5				
16	Federal Building, S. Clark Street	Chicago, IL	Regional	GSA Owned
17	Mid-Continent Ecology Division	Duluth, MN	R&D	EPA Owned
18	Large Lakes and Rivers Forecasting Research Branch	Grosse Ile, MI	R&D	EPA Owned
19	National Vehicle and Fuel Emissions Laboratory	Ann Arbor, MI	Program	EPA Owned
20	Test & Evaluation (T&E) Facility	Cincinnati, OH	R&D	EPA Owned; Land Lease
21	Andrew W. Breidenbach Environmental Research Center (AWBERC)	Cincinnati, OH	Program, R&D	EPA Owned
22	Center Hill Research Facility	Cincinnati, OH	R&D	EPA Owned; Land Lease
23	Experimental Stream Facility	Milford, OH	R&D	EPA Leased
Region 6				

2012 EPA Laboratory Facilities

Site	Lab Name	Location	Lab Type	Ownership
24	Ground Water and Ecosystems Restoration Division	Ada, OK	R&D	EPA Owned
25	Environmental Laboratory	Houston, TX	Regional	EPA Leased
Region 7				
26	Kansas City Science and Technology Center	Kansas City, KS	Regional	GSA Leased
Region 8				
27	National Enforcement Investigations Center	Lakewood, CO	Program	GSA Owned
28	Central Regional Laboratory	Golden, CO	Regional	GSA Leased
Region 9				
29	Central Regional Laboratory	Richmond, CA	Regional	EPA Leased
30	Environmental Sciences Division	Las Vegas, NV	Program, R&D	GSA Leased
Region 10				
31	Willamette Research Station	Corvallis, OR	R&D	EPA Owned
32	Western Ecology Division	Corvallis, OR	R&D	EPA Owned
33	Pacific Coastal Ecology Branch	Newport, OR	R&D	EPA Owned
34	Manchester Regional Lab	Port Orchard, WA	Regional	EPA Owned

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3.0 The Assessment Process

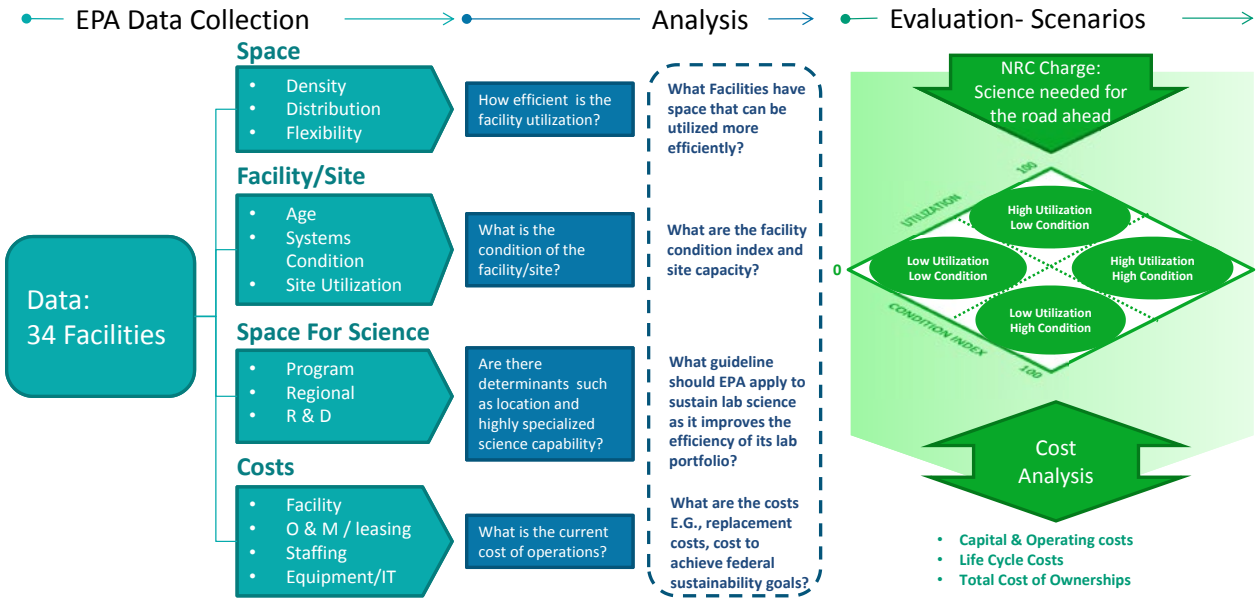

Figure 3.1
EPA Nationwide Laboratory Assessment Evaluation Process

THE LABORATORY ENTERPRISE ASSESSMENT PROCESS

As indicated in Figure 3.1, the overall approach implemented in the Nationwide Laboratory Assessment Study was a three-phase process based on an understanding of the EPA mission and the science programs conducted at each of the 34 EPA laboratory enterprise sites. The process included a series of interactive workshops conducted at EPA Headquarters with video conference involvement from representatives from Research and Development, Program and Regional Laboratories. Incremental presentations of the project status were conducted with the EPA Steering Committee and Senior Executives for review and input.

The three major phases of the assessment process included:

1. EPA Data Collection
2. Analysis of the Data
3. Evaluation and Scenarios

Each of the three major phases was further refined by the metrics that were developed by SmithGroup in consultation with the EPA for use in the assessments. The data collection and analysis phases were organized

around these metrics. The evaluation and scenario phase relied upon the metrics in determining efficiencies and projecting options for hypothetical scenarios.

The metrics for the nationwide laboratory assessment included four major categories:

1. Space
2. Facility/Site
3. Science
4. Costs

These metrics are further defined and incorporated in the following sections of this report.

3.1 Data Collection

To establish a normalized data base and data collection method for use in the laboratory assessment study the EPA established sub-committees on Space & Facilities, Workforce, Costs, and Science. The EPA then initiated a structured data call to each sub-committee to collect existing data on the current state of the laboratory enterprise for FY 2012. The data were reviewed and verified by EPA managers. Subsequently, EPA data were provided to SmithGroup – including record drawings, space tabulations, energy audits, budgeting and operation costs, facility maintenance and improvement reports, and on-board personnel. The data were reviewed and analyzed by SmithGroup and organized into an interactive database workbook.

A series of data confirmations were conducted by SmithGroup with the EPA at several individual sites to validate the information received from the initial data call. The facilities were then evaluated based on the data, drawings and renovation records received; on-site verifications were limited to Fort Meade, MD, Athens, GA, Chicago, IL, and Ann Arbor, MI sites.

SmithGroup, in consultation with the EPA Steering Committee, established a series of metrics to evaluate the laboratory facilities based upon the EPA data and the type of laboratory organization. The EPA laboratories are organized into three categories: regional laboratories, program laboratories, and research and development laboratories. The metrics established included space utilization (by lab organization); facility condition by major building systems, energy utilization, site capacity and amenities; science qualifiers; and the cost of operations. All of the data received from EPA were organized in the database workbook by metrics and type of lab organization.

Data received from the EPA were supplemented by SmithGroup through web-based research on zoning information, building codes, site/community infrastructures and amenities, and transportation systems near the individual sites. Additional information was supplied from the SmithGroup Laboratory Database for the development of comparisons and benchmarking with other laboratories of similar type.

Based on the data compiled, a series of comparative analyses were developed to determine and measure the efficiency of space, energy utilization, site utilization, and cost impacts of current operations.

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Space

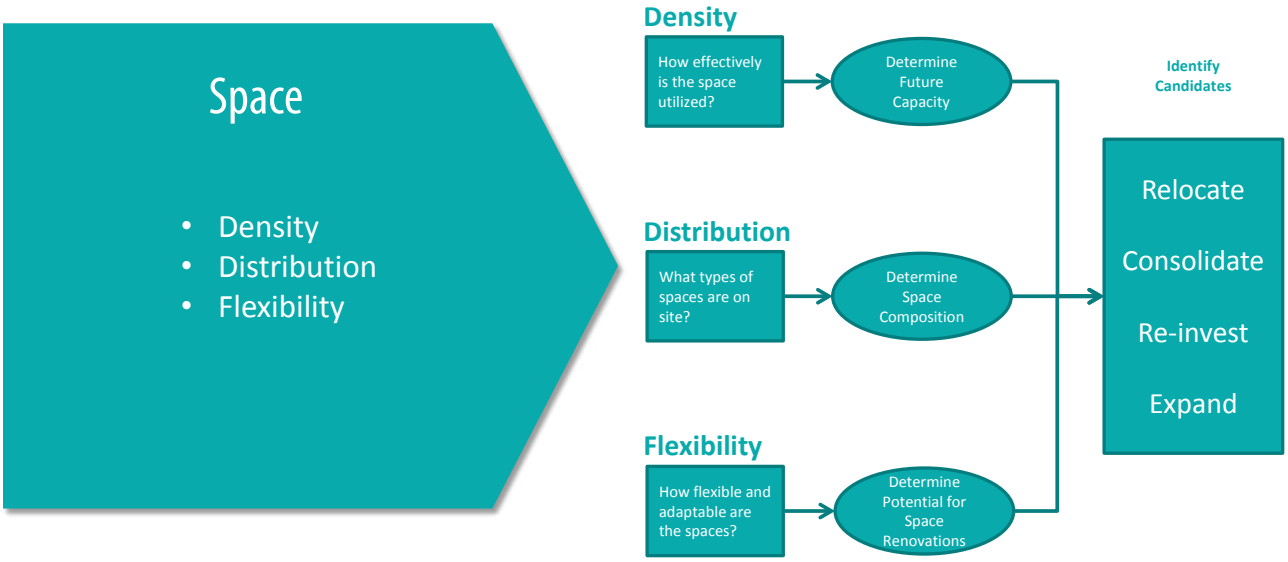

Figure 3.2
Space Evaluation- Inventory and Analysis

Space Inventory Data

The inventory data received from the EPA, as analyzed by SmithGroup, added up to more than 3.75 million gross square feet (GSF) of laboratory facilities and 2.75 million of usable square feet (USF), as defined by the Building Operations & Maintenance Organization (BOMA) standards. Based on the data received from the EPA data calls, SmithGroup developed additional categories to further quantify the information and evaluate space components and facilities.

Space utilization metrics included the following:

- Space Density was analyzed as a measure of space utilization by usable square foot (USF) per laboratory occupant. Occupant data was collected and analyzed from the EPA workforce sub-committee data call and confirmed with EPA laboratory organizations for all federal employees and contract workers using space for laboratory functions.
- Space Distribution was totaled for each facility in EPA's facilities data call and then reviewed to match drawings available. Data was classified by space type for laboratory, laboratory office, laboratory support, special laboratory space and totaled by laboratory site and space type. Non-laboratory related space types were not included in the study evaluations.

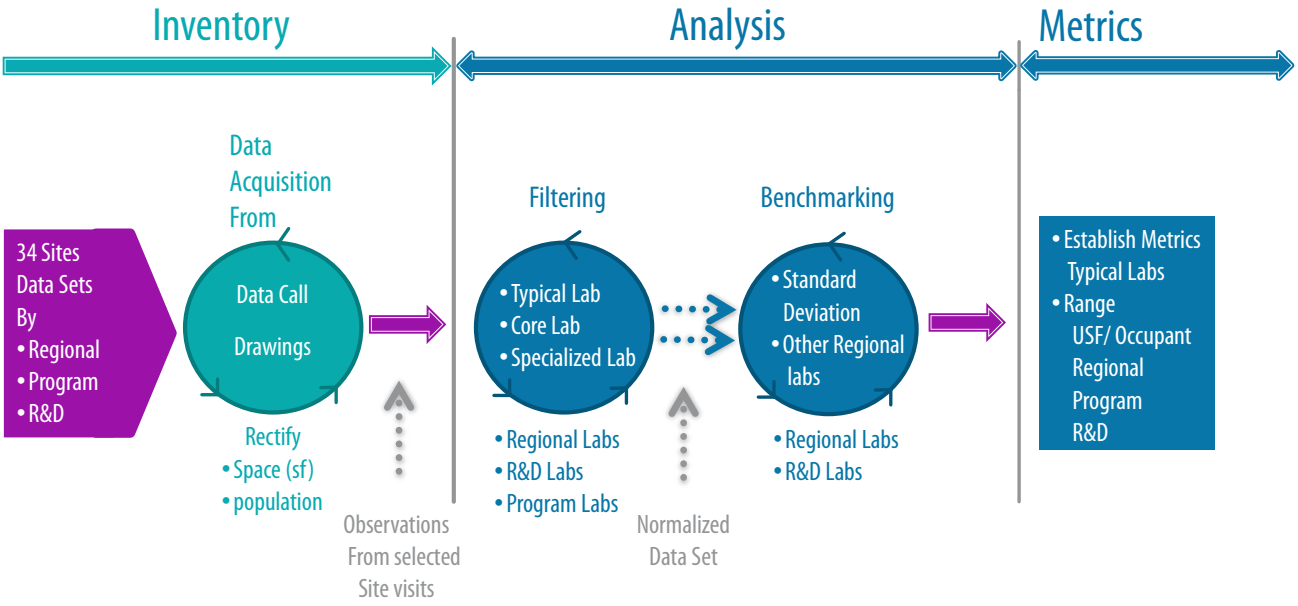

Figure 3.3
Space Allocation Data Analysis

- Laboratory Flexibility and Adaptability were determined by reviewing facilities drawings, and then evaluating modularity, arrangement of space zones, service distribution concept, and fixed equipment configuration. Spaces were then characterized to determine the feasibility of hypothetically accommodating a co-location of other laboratory programs.

Filtering

The space metrics were filtered or sub-divided for analysis by the three EPA lab types: program, research & development, and regional laboratories, since those laboratory types are organized specifically to fill EPA's various mission and program laboratory science needs and involve different types of diagnostic testing and/or research. The laboratory inventory was then further filtered to identify any outliers or anomalies that could skew data comparisons.

Site & Facility Condition

Data collection for the EPA laboratories yielded a wide variety of information. The evaluation process found several items to be of value in gauging system condition, including base building and renovation project drawings, commissioning reports, condition reports, and energy or water site assessments. These documents assisted in estimation of both system age and operating condition. The information data call also included an average of 10-15 years of historic energy and water usage data for all EPA-owned sites. This data was either not available, or provided in a different format (depending on level of Tenant sub-metering) for leased facilities.[1]

Site Data collected for each facility included:

- Site plans, property lines, and topography
- Existing Floor Area Ratio (FAR) and allowable FAR by zoning and code.
- Site utilities and easements
- Parking plans and parking allowances by zoning and code
- Nearby site amenities
- Transportation
- Zoning codes (if applicable) and special site conditions (if any are defined)

1 Energy and water profiles were not provided in the master format for Site 5 – Wheeling, WV, GA, Site 11 – Durham, NC, Site 14 – Bay St. Louis, MS, Site 16 – Chicago, IL, Site 23 – Milford, OH and Site 27 – Lakewood, CO.

Science Metrics

The EPA science sub-committee identified and evaluated several alternative metrics for science effectiveness and efficiency. Because the metrics are based on outcome-orientated lab capability and science contributions, the metrics are measured qualitatively by peer evaluation.

As a result of this evaluation, the EPA stipulated the following:

1. Laboratory science capability and contributions located in EPA laboratory facilities will be retained to fulfill the needs of EPA programs

2. Laboratory science capability and contributions that require access to aquatic ecosystems (Atlantic, Pacific, Great Lakes, and the Gulf of Mexico) are not feasible to relocate because the investment required would be unreasonable

3. Highly specialized laboratory functions and contributions are not feasible to relocate because the investment required would be unreasonable.

Cost

The EPA cost-sub-committee compiled total operational costs for FY2012 from all the laboratory facilities in EPA's portfolio.

Cost data were organized in categories for each lab facility. Examples of these cost categories include: facility costs, IT support, labor, laboratory equipment, expendable supplies, security, environmental health and safety, and transportation. For the purposes of conducting this analysis and developing hypothetical scenarios for evaluation, estimates of on-board personnel were based on FY2012 data only.

Costs to be considered for laboratory co-locations included employee relocation, laboratory decommissioning, required renovations and / or capital cost of additions to facilities.

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3.2 Analysis

The analysis process focused on developing a quantitative basis for measuring efficiency of several metrics for the laboratory portfolio:

- How efficiently is the space utilized compared to laboratory benchmarks?
- What is the facility condition as measured by facility condition index (FCI)?
- What is the energy utilization measured in energy utilization index (EUI)?
- What is the site capacity in floor area ratio (FAR) and site utilization in land area of buildings and parking?
- What are the current operational costs, facility replacement cost and required renovation costs based on each facility's FCI?

Based on the analysis for each site, a series of scenarios were modeled and evaluated for improvements to space utilization. The goals of the scenarios were to more closely align with internal and external benchmarks, and improve the facility condition index, across the portfolio, to acheive FCI 82 for owned space and FCI 60 for leased space, compared to current state FY 2012.

In addition, the overall space utilization USF/occupant by laboratory type was compared to the facility condition index for each site in an evaluation matrix to determine which sites were highly utilized in high condition index facilities, and conversely, which sites exhibited low utilization in low condition indexed facilities. The latter were likely candidates for improved utilization and relocation into facilities with higher condition index.

Each scenario's resulting costs were modeled for required renovation, new replacement capital costs, and 30-year life cycle costs. These were compared to the resultant operational rent, maintenance and utility cost savings for sites that were consolidated in each scenario.

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Space Utilization

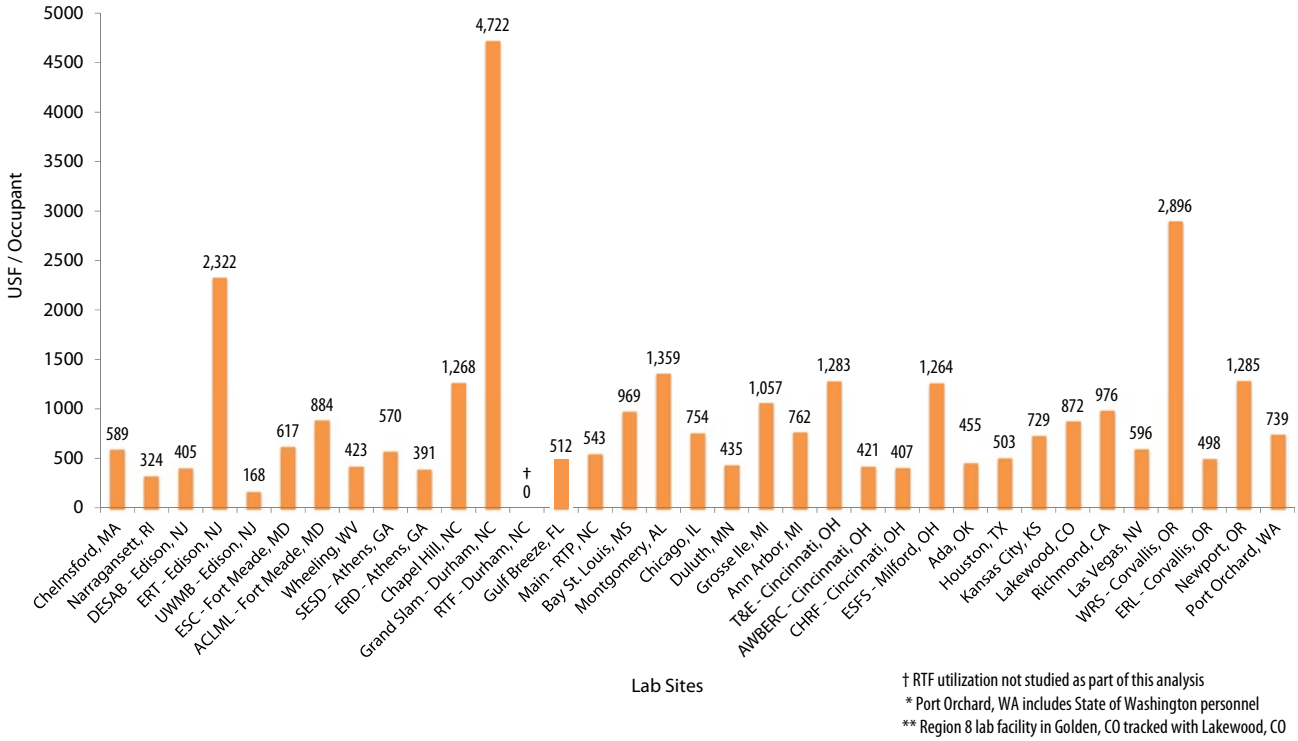

Figure 3.4
Laboratory Density:
Usable Square Feet / Occupants

"Figure 3.4" illustrates the comparative utilization of occupancy density measured in usable square feet per occupant (USF/Occupant). These values were refined over a series of user feedback and facilities support updates during the period of the assessment study. These utilization values were compared internally against similar EPA laboratory types and externally against non-EPA laboratories of similar type.

Comparative Data References for Analysis

Mean - Central (average) value of a discrete set of numbers. To calculate the Mean, sum the values and divide by the number of values.

Standard Deviation (Variance) - Variation of dispersion from the average (or Mean) value. To calculate the Variance, take each difference, square it, and then average the result.

Usable Square foot (USF) - Per BOMA Standard: Includes labs, lab offices, lab support and special spaces used for laboratory functions. Excludes mechanical, structural and public circulation.

Occupants - Includes federal laboratory employees and laboratory contract workers.

BENCHMARKING OF SPACE UTILIZATION:

The space inventory was compared internally across each laboratory type to establish an EPA laboratory mean and standard deviation of USF/occupant for each laboratory type (Regional, R&D, and Program).

In addition to the internal EPA data, space density of USF/occupant was compared against external benchmarks with similar lab science capabilities and research facilities, including bioscience and chemistry at university, corporate and government laboratories. Data for this benchmarking was gathered from public files and the SmithGroup Laboratory Database.

For the benchmarking of external Research and Development Laboratories, similar lab types were used from; college and university research labs, corporate research labs, and other government research labs.

For the benchmarking of external Regional Laboratories, similar lab types were used from; state analytical labs, crime lab analytical sections, and corporate labs.

The EPA Program Laboratories have unique missions and complex laboratory science capabilities developed in response to Congressional legislation and to the science needed to inform EPA regulations. Thus, there was no comparable external benchmarks applicable to the diversity of Program Laboratories.

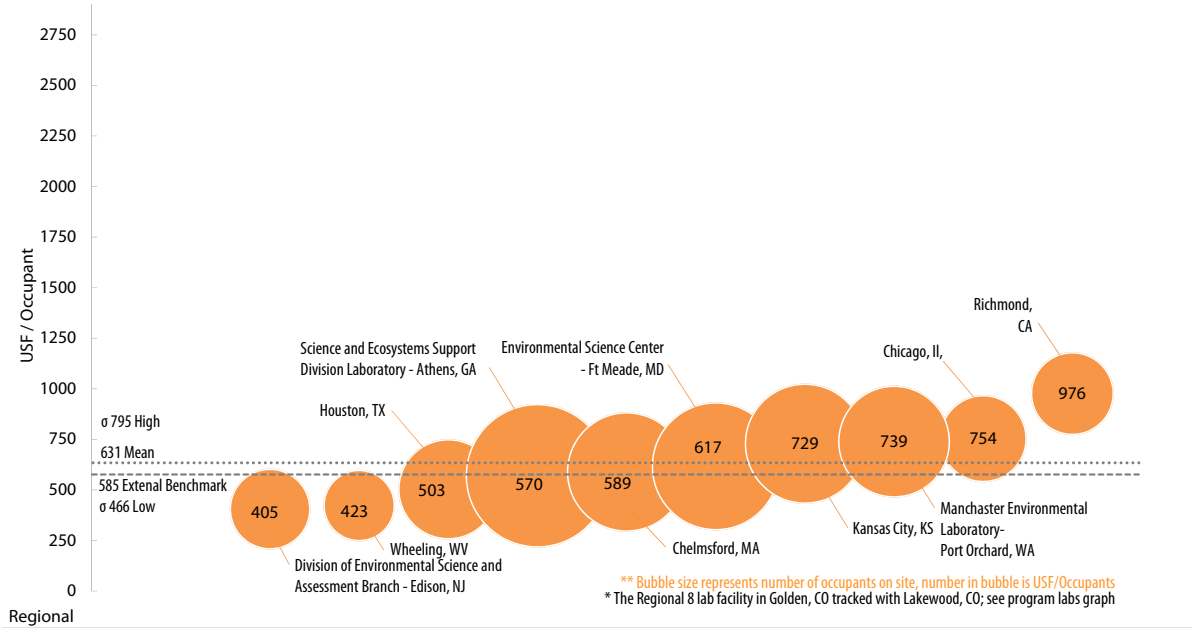

Figure 3.5
Regional lab comparison

Regional Laboratories

The Regional Laboratories are located in 10 distinct regions throughout the continental United States. These facilities perform sample collection, diagnostic testing and evaluation processes, and a wide variety of chemical and biological tests. These regional labs were compared to EPA internal benchmarks for mean utilization space density. The result was 631 USF/ occupant, which is consistently less dense than the other comparative EPA R&D lab types due to the amount of support space dedicated to lab.

Similar Lab Types (External)	Space Types	Benchmarks (External Range)	EPA Benchmark Range
State Analytical Laboratories	Lab	485 NASF/ Occupant	Standard Deviation: 466 to 795 USF/Occupant
Crime Lab Analytical Sections	Lab Support	585 USF/Occupant Mean	Mean: 631 USF/Occupant
Corporate Laboratories	Lab personnel Desks and Offices	850 GSF/Occupant	

External Benchmark used vs Scenario Factor for EPA Regional Labs is 585 USF/Occupant

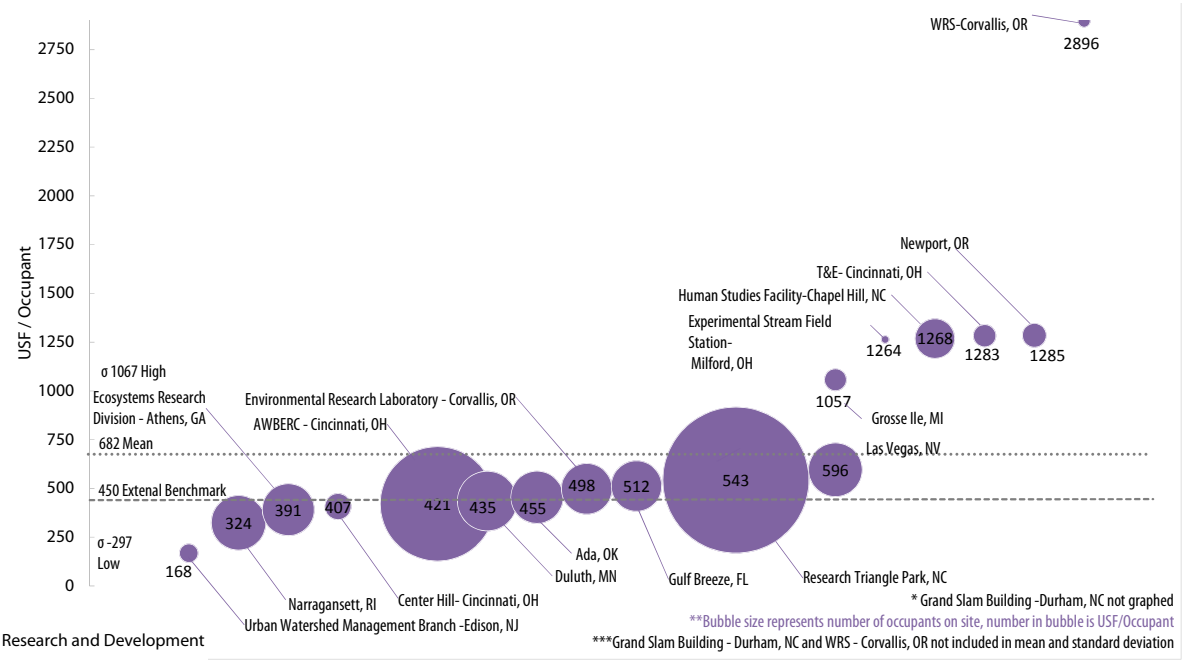

Figure 3.6
R&D lab comparison

Research and Development Laboratories

The R&D Labs exhibited the widest range of USF/occupant space density. A contributing reason for this wide range is that a number of R&D facilities include special purpose laboratory science functions that require a large area and low occupant density- such as exposure chambers, fluid modeling labs, and combustion labs. The R&D Labs were compared to the EPA mean of 682 USF/occupant. External benchmarks for similar government and corporate labs indicated a metric of 450 USF/occupant.

Other federal laboratories including NIH Bethesda, NIST Boulder and Gaithersburg, DOE NREL in Colorado, and DOE Argonne National Labs in Illinois were compared. These exhibited a slightly higher USF/occupant range at 490 USF/Occupant. However several of these accommodated materials and energy testing laboratories of lower occupancy densities. EPA has primarily biological and chemical laboratories.

University biosciences labs were evaluated and not considered to be comparable due to the higher level of graduate students and technicians in these facilities compared to the staffing profile of EPA labs.

Similar Lab Types (External)	Space Types
College and University Research Laboratories	Lab
Corporate Research Laboratories	Lab Support
Other Government Research Laboratories	Lab personnel Desks and Offices

Benchmarks (External Range)	EPA Benchmark Range
372 NASF/ Occupant	Standard Deviation: 297 to 1067 USF/Occupant
450 USF/Occupant Mean	Mean: 682 USF/Occupant
650 GSF/Occupant	

The benchmark ranged from 420 - 490 USF/Occupant.

The External Benchmark used vs Scenario Factor for EPA R&D Labs is 450 USF/Occupant

Figure 3.7
Program lab comparison

Program Laboratories

The EPA Program Laboratories have unique missions and complex laboratory science capabilities developed in response to Congressional legislations and to the science needed to inform EPA regulations. Thus, there were no comparable external benchmarks applicable to the Program Laboratories. The Program Laboratories space density, using EPA's mean utilization a comparison, was 911 USF/occupant. Although widely diverse in function, these labs exhibited reasonably similar factors. Figure 3.7 illustrates the range of Program Lab utilization.

The Office of Solid Waste and Emergency Response (OSWER) laboratory at the Edison, NJ lab facility contains a considerable amount of records and sample storage. This storage creates a significant deviation from the mean range; thus, the OSWER lab was discounted from the comparison.

"Figure 3.7" illustrates the comparative range without the OSWER lab.

Similar Lab Types (External)	Space Types
EPA Program Laboratories are unique	Lab
Tasks vary by lab mission	Lab Support
Space Allocation is based on task requirements vs. occupant basiss	Lab personnel Desks and Offices

Benchmarks (External Range)	EPA Benchmark Range[1]
No external benchmarks	Standard Deviation: 683to 1140 USF/Occupant
	Mean: 911 USF/Occupant

1 Bench mark Range for Program Labs does not include the Office of Superfund Remediation Technological Innovation/ERT- Edison, NJ (18,576 USF/Occupant), considered an outlier.

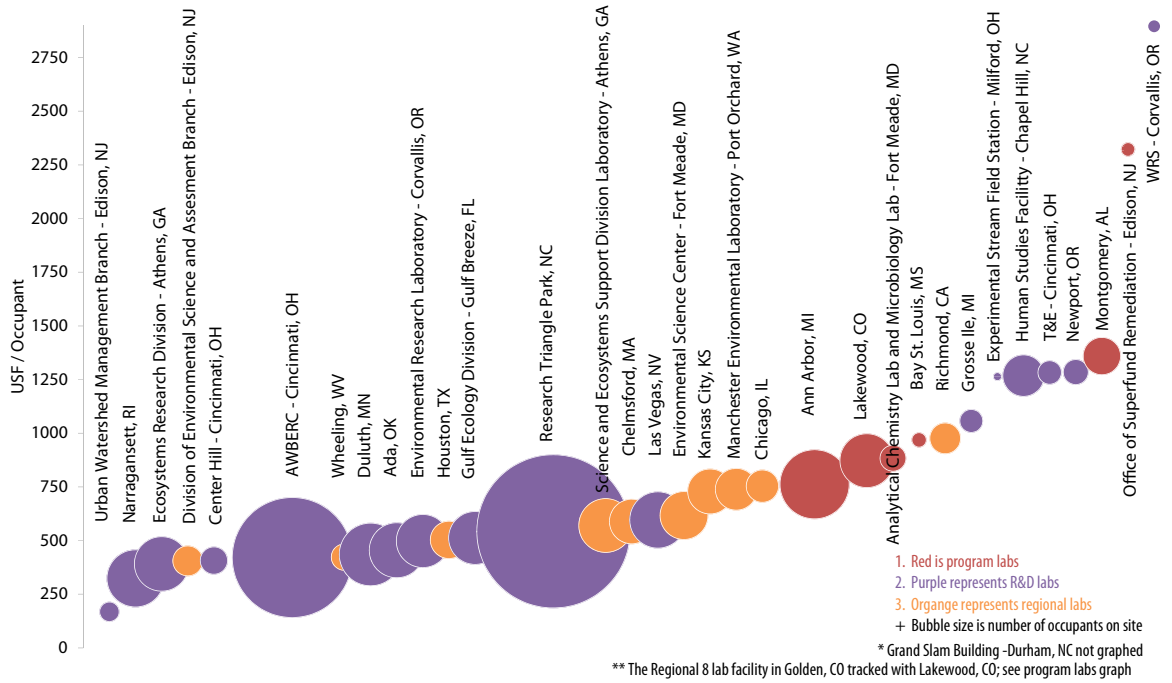

Figure 3.8
Comprehensive EPA lab comparison

Comparative Analysis

"Figure 3.8" illustrates a comparative analysis of the overall EPA portfolio of laboratories. This analysis resulted in an overall mean of 800 USF/occupant

For evaluation purposes, individual lab type benchmarks were used in the scenarios for rightsizing facilities. Co-location options in the scenarios were right-sized based on these benchmarks to improve overall utilization across the enterprise.

By applying these metrics differentially to each of the laboratory function types across the full enterprise, the result yielded a range of approximately 477,500 (20%) to 358,200 (15%) USF of potentially underutilized space.

This square footage is distributed throughout the majority of the laboratories across the country and therefore not easily re-allocated for use by programs in other locations. Furthermore, a number of laboratories contain special types of spaces like vivarium, high bay, test chambers, and analytical equipment, such as nuclear magnetic resonance (NMR) imaging, which is not cost-effectively reallocated or easily converted to modular wet laboratories.

Site Assessment

SITE CAPACITY AND AMENITIES

Each site was given a score for its potential capacity to accommodate building additions or new buildings and proximity to amenities. This score is a weighted average of the score of four criteria:

- Site Utilization - 10%
- Site Capacity to Accommodate Addition - 25%
- Site Occupancy - 30%
- Proximity to Amenities - 35%

Site Utilization

Site utilization is the Floor Area Ratio (FAR) of a site. This is defined as the gross building area divided by the site area and reflects the efficiency of development on a site. Thus, an FAR of 2.0 would indicate that the total gross floor area of a building is two times the area of the site on which it is constructed, as would be found in a multi-story building. This ratio is often used in zoning ordinances or development regulations to describe the limits of development density on a site.

For example, according to the local zoning ordinance, the current allowable FAR of the Cincinnati AWBERC site is 4. Since the site area is approximately 958,320 sq. ft., the current allowable density is approximately 3,833,280 (4 times the site area). The facilities currently occupy approximately 424,861 gross sq. ft., leaving approximately 3,408,419 gross sq. feet of development possible for this site (subject to other development restrictions including the potential for displacement of existing surface parking). (“Figure 3.9”)

Scoring: the lower the site utilization, the higher the score.

- Low current site utilization: 8-10
- Medium site utilization: 4-7
- High current site utilization: 1-3

Figure 3.9
Site 21 - Cincinnati, OH AWBERC Site Plan

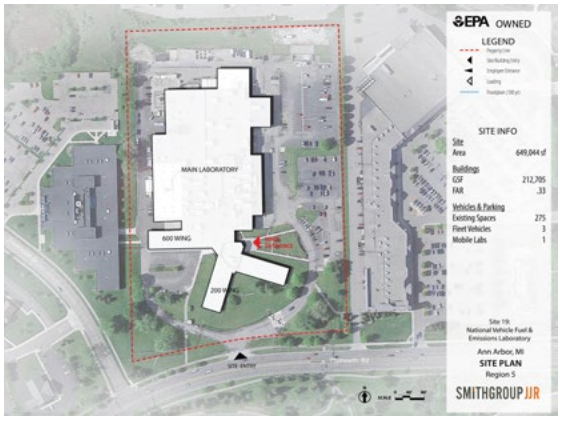

Figure 3.10
Site 19 - Ann Arbor, MI National Vehicle and Fuel Emissions Laboratory Site Plan

Figure 3.11
Site 34 - Port Orchard, OR Manchester Regional Laboratory Site Plan

Site Occupancy

Site Occupancy is the percentage of a site that is occupied by building footprints. It is one factor in helping to determine how much site area is available for new buildings. For instance, a site occupancy of 20% indicates that 20% of the land area is covered by buildings. This percentage is often used in zoning ordinances or development regulations to limit the amount of area that can be covered by buildings in order to maintain a certain amount of open or green space.

For example, the EPA Ann Arbor building has a footprint of approximately 177,077 square feet, or approximately 27% of the site area of approximately 649,044 square feet. This high occupancy, together with an examination of the site plan, indicate that there is little site area on which to place additional buildings or parking. Therefore, in the Ann Arbor case, the site could be added to through strategic additions or replacements of part of the building and expansion of surface parking. ("Figure 3.10")

Scoring: the lower the site occupancy, the higher the score.

- 10%-30% (Low Occupancy): 8-10
- 40%-70% (Medium Occupancy): 4-7
- 80%-100% (High Occupancy): 1-3

Site Capacity to Accommodate Addition

Site Capacity takes into account additional considerations relative to the site's potential to include additional buildings, including environmental encumbrances such as wetlands or floodplains, or hazardous conditions. For example, the EPA Port Orchard (Manchester) site is fairly large and open; however, a portion of the southeastern edge of the site is covered by wetlands, while a good part of the southern portion of the site contains a Superfund site. These areas would not be built on. ("Figure 3.11")

Scoring: the less encumbered the site, the higher the score.

- Good/ Unencumbered: 8-10
- Fair/Somewhat encumbered: 4-7
- Poor/Encumbered: 1-3

Proximity to Amenities

Proximity to amenities is a qualitative evaluation of a site, based on its proximity to major destinations, transit, and services. For example, the Fort Meade site is within a short drive of the city of Baltimore and BWI Airport, as well as local and regional transit stations. Within the Fort Meade military installation, the EPA building is farther than a 10 minute walk, but within a 5-10 minute drive, of most amenities within and outside the installation. ("Figure 3.12" and "Figure 3.13")

Scoring: the closer to amenities, the higher the score.

- Short walk or drive: 8-10
- Moderate walk or drive: 4-7
- Long walk or drive: 1-3

Summary

EPA sites vary considerably in their potential to accommodate new buildings or additions. Sites with a weighted average score of 6.5 or above demonstrate the best potential capacity and quality to accommodate additional development if programs are relocated there due to consolidation. Excluding leased sites, EPA-owned sites that achieved this score include Narragansett, Edison, Fort Meade, Athens, Research Triangle Park, Cincinnati-AWBERC, Cincinnati-Center Hill, Ada, and Corvallis.

Refer to "Figure 3.14" for the complete weighted

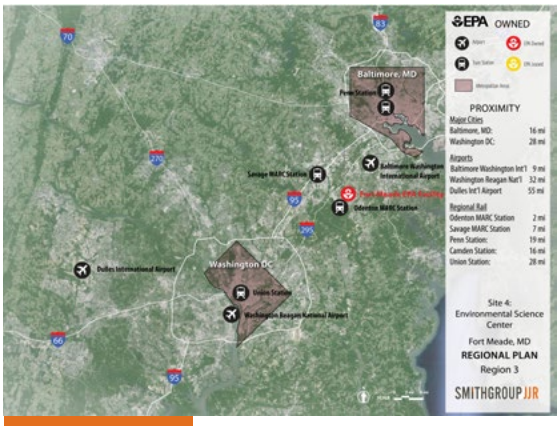

Figure 3.12
Site 4 - Fort Meade, MD Environmental Science Center Site Plan

Figure 3.13
Site 4 - Fort Meade, MD Environmental Science Center Area Plan

No.	Site	Site Utilization Score	Site Occupancy Score	Capacity to Accommodate Addition Score	Proximity to Amenities Score	Weighted Average
	WEIGHT	**10%**	**30%**	**25%**	**35%**	**100%**
1	Chelmsford, MA	9	7.5	7	7	7.4
2	Narragansett, RI	9	9.5	4	5	6.5
3	Edison, NJ	10	8.0	8	6	7.5
4	Fort Meade, MD	9	9.5	7	6	7.6
5	Wheeling, WV	1	2.0	1	6	3.1
6	Athens, GA - ESD	9	9.0	7	5	7.1
7	Athens, GA -ERD	9	9.5	8	5	7.5
8	Athens, GA - Annex	10	9.5	8	5	7.6
9	Chapel Hill, NC	1	2.5	1	5	2.9
10	Durham, NC	0	8.0	4	2	4.1
11	(Durham, NC) *	N/A	N/A	N/A	N/A	N/A
12	Gulf Breeze, FL	9	6.0	4	4	5.1
13	Research Triangle Park,, NC	9	8.0	8	6	7.4
14	Bay St. Louis, MS **	N/A	9.5	8	2	5.6
15	Montgomery, AL	9	7.5	4	2	4.9
16	Chicago, IL	2	1.0	1	8	3.6
17	Duluth, MN	9	8.5	6	4	6.4
18	Grosse Ile, MI	9	8.5	5	2	5.4
19	Ann Arbor, MI	8	5.0	3	6	5.2
20	Cincinnati, OH - T&E	6	2.0	1	2	2.2
21	Cincinnati, OH- AWBERC	8	8.5	9	7	8.1
22	Cincinnati, OH- Center Hill	9	10.0	9	4	7.6
23	Milford, OH	9	3.0	1	3	3.1
24	Ada, OK	9	10.0	9	3	7.2
25	Houston, TX	8	4.0	2	4	3.9
26	Kansas City, KS	6	5.5	3	3	4.1
27	Lakewood, CO **	N/A	2.0	1	3	1.9
28	Golden, CO	9	4.0	1	3	3.4
29	Richmond, CA	8	6.0	4	4	5.0
30	Las Vegas, NV *	N/A	N/A	N/A	N/A	N/A
31	Corvallis, OR - WRS	10	10.0	8	2	6.7
32	Corvallis, OR - Main	9	8.0	7	4	6.5
33	Newport, OR	8	4.5	2	4	4.1
34	Port Orchard, WA	10	7.5	7	3	6.1

** This site lease is being terminated by the EPA, thus not included as a weighted score.*

*** EPA lab facilities occupy a small portion of a larger federal property- full site data is unavailable and a weighted score not applicable*

Figure 3.14
Site utilization, occupancy, capacity and amenities scores by site

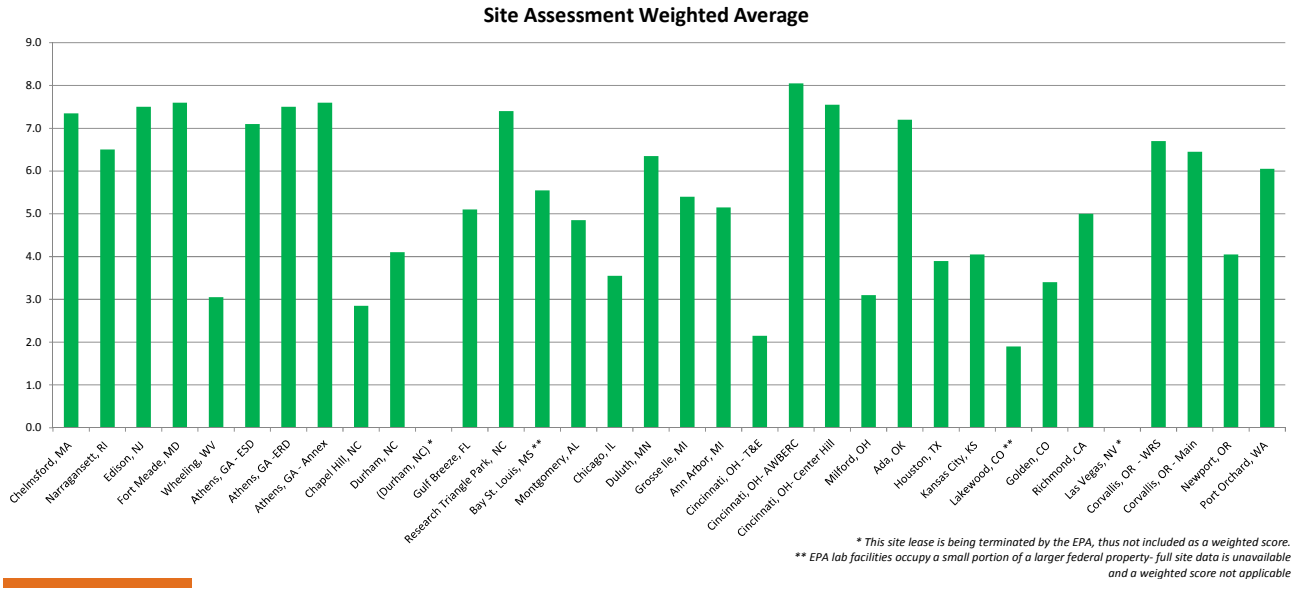

Figure 3.15
Site assessment weighted average score by site

average scores of all EPA laboratory sites.

Future Considerations

- Once prospective consolidation sites have been identified, a detailed zoning analysis should be conducted to confirm and expand on the high-level findings for each site in this report.
- A full analysis of existing site constraints should be studied as part of the master plan phase for each candidate site including environmental conditions and development constraints to confirm and expand on the high-level findings for the sites in this report.
- Structured parking may be necessary on some sites to accommodate displaced surface parking, allowing new buildings to be constructed on site. This, together with appropriate parking ratios for each site, should be examined in detail for candidate sites.

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Facility Condition Evaluation

SITE & FACILITY CONDITION

Facility Condition Index Methodology

The Federal Real Property Council (FRPC) defines the Condition Index (CI) as a ratio of the repair needs to the replacement value of particular facility. Further, the repair needs are considered the cost necessary to "ensure that a constructed asset is restored to a condition substantially equivalent to the originally intended and designed capacity, efficiency or capability."[1] The cost for facility repair (renovation) is assessed during detailed site analysis and cost estimation. The FCI is then calculated according to the following equation:

*FCI = (1 - Repair / Replacement) * 100*

Several issues were identified early in the assessment process that made the procedure as outlined by the FRPC problematic, including:

- Size (quantity) of the EPA lab buildings portfolio
- Amount and quality of data included in the inventory phase
- Study to be performed without detailed site visits

To move forward with the condition indexing process, SmithGroup adopted a slightly modified method typically employed by NASA in the assessment of their construction holdings. This method was selected because of its ability to index complex laboratory facilities and support sytems, rather than other methods (such as that used by GSA) which typically evaluate office buildings and other general building types.

Based on a system-level estimate of condition and parametric cost modeling, the chosen methodology made a portfolio-level comparison of the EPA lab sites possible despite the time limitations of the schedule for the EPA lab portfolio assessment. This method of system-level analysis yielded an acceptable degree of accuracy in the most time and resource efficient manner available to the project team.

1 Definition according to FRPC – 2013 Guidance for Real Property Inventory Reporting

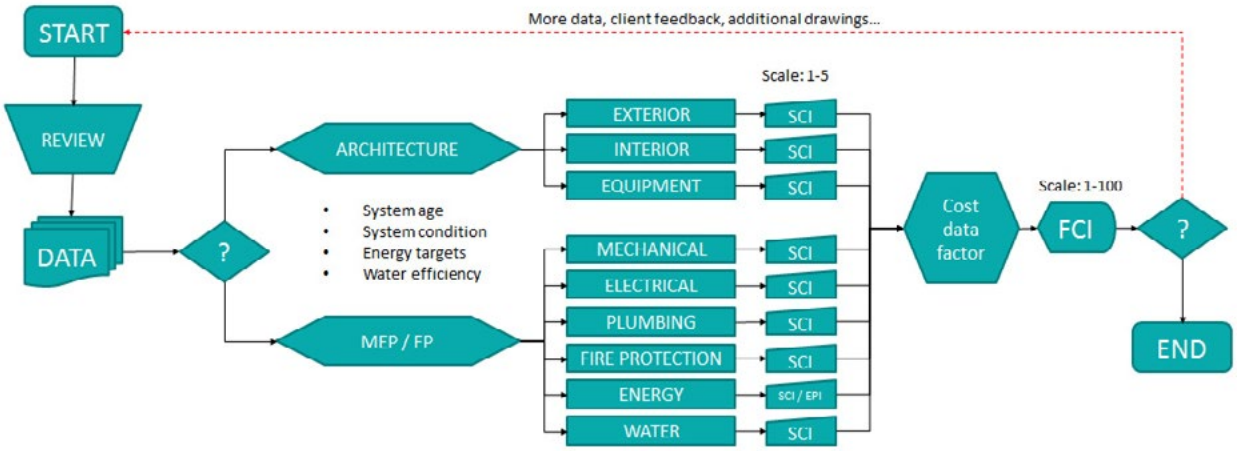

Figure 3.16
Facility Condition Index (FCI) process flow diagram

Systems Condition Index Evaluation

The process flow diagram shown in "Figure 3.16" provides an overall view of the development of the Facility Condition Index. The process was broken down into four main phases: data collection and review, system condition indexing, energy and water analysis, and facility condition indexing.

Data from each site was reviewed to assess a System Condition Index (SCI) for each of the following systems:

- Architectural – Exterior
- Architectural – Interior
- Architectural Equipment
- Mechanical (incl. Plumbing and Fire Protection)
- Electrical

Much of the evaluation of system condition was based on the age of the equipment at the various facilities and the remaining useful service life. Using drawings and reports, a list of equipment relevant to each discipline was compiled, including year of installation. Industry standard values for average service life were employed to determine the estimated remaining service life of each individual component. Equal weight was given to all equipment within a discipline and the remaining system service life was calculated as a percentage of the expected total service life to provide a numerical evaluation of system condition. A sample portion of the equipment service life evaluation worksheet has been shown for EPA Site 1:

Chelmsford, MA "Figure 3.17".

Additional input from past engineering reports (provided during the data call) was taken into consideration before determining a final SCI for each discipline. The criteria shown below provided the framework for the final SCI, where assignments ranged from one to five (with zero representing systems not utilized by a particular facility).

- 0 - Non-existent: System does not exist within this facility.
- 1 - Poor/Unacceptable: System nonfunctional. Major repair or replacement required to restore function. System may be unsafe to use. Does not meet codes.
- 2 - Marginal: System not functioning as intended. Significant repairs required. Excessive wear and tear clearly visible. Obsolete. Repair parts not easily obtainable. Does not meet all codes. Majority of equipment at or near end of its service life.
- 3 - Fair: System mostly functional. More minor repairs and some infrequent larger repairs required. System within second half of its service life.
- 4 - Good: System normally functions as intended. Some minor repairs needed. System within first half of its service life.
- 5 - Excellent: System functions as intended. Only normal preventative maintenance required.

Energy and Water Modifiers

While the FCI provides a means of relative condition comparisons across a portfolio of buildings, it is also used in this analysis to estimate the cost of renovation to an upgraded condition. To accurately overlay a cost analysis into the FCI calculation, a baseline cost model for new construction of a similar facility was required. The SmithGroup Laboratory Database, used as a basis for this modeling, included projects where a high level of energy and water efficiency was typical. As such, the ability to affect the individual discipline SCI based on historical energy and water performance

MECHANICAL SYSTEMS				
Equipment Type	***Installed***	***Average Life***	**Remaining Life**	
	Year	*Years*	*Years*	*%*
Air-Handling Unit	2001	20	8	40.0%
Return Fan	2001	25	13	52.0%
Exhaust Fan	2001	20	8	40.0%
Centrifugal Chiller	2001	23	11	47.8%
		. . .		
Piping	2001	30	18	60.0%
Ductwork	2001	30	18	60.0%
Insulation	2001	20	8	40.0%
Mechanical Systems Average				43.4%

Figure 3.17
Sample system service life evaluation (Chelmsford, MA)

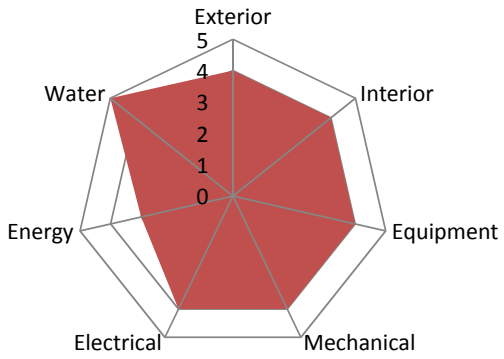

Figure 3.18
SCI Evaluation Chart

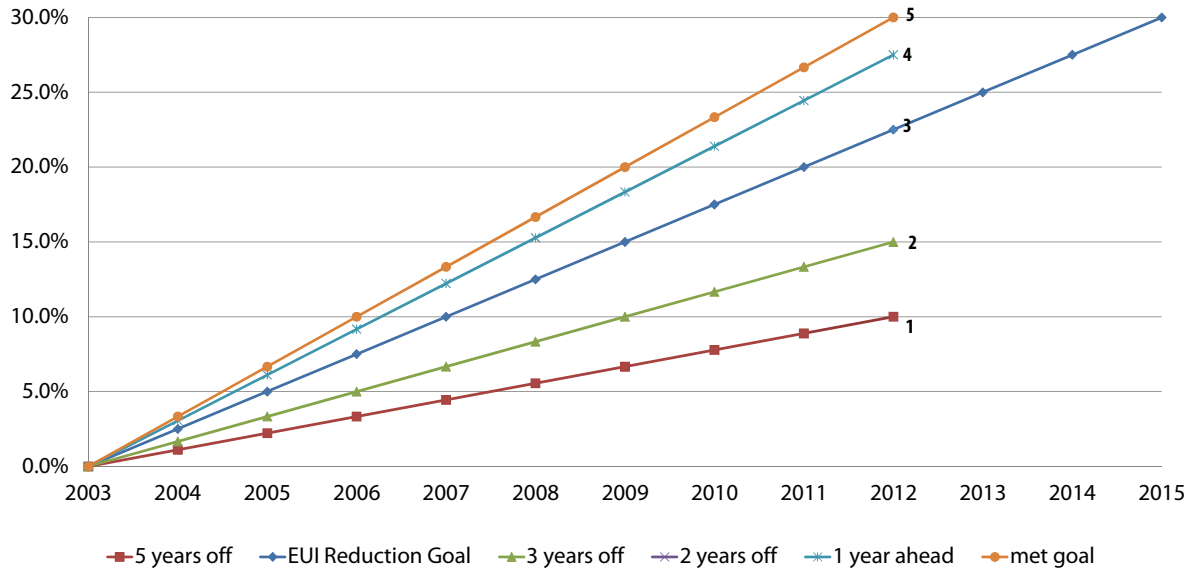

Figure 3.19
Energy use intensity reduction timeline

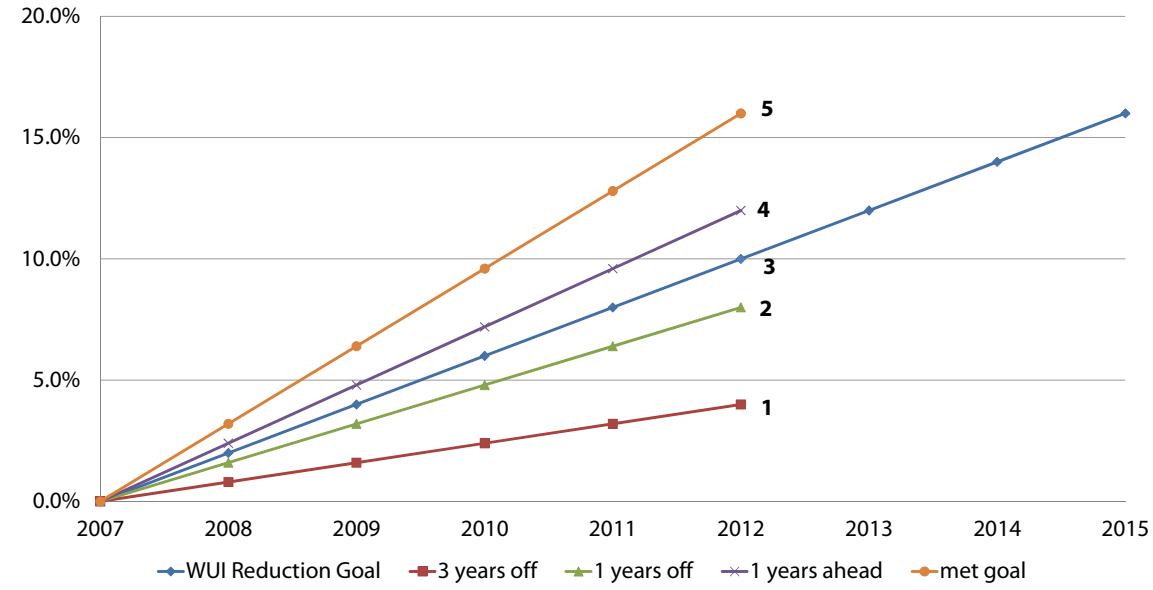

Figure 3.20
Water use intensity reduction timeline

was critical.

Federal mandates require a percentage reduction in the usage intensity of both energy (BTU/GSF/YR) and water (GAL/GSF/YR) by 2015 . The progress towards these reduction targets was the basis for the Energy and Water Modifiers. Where a facility may be ahead of energy and water reduction targets, the modifiers would increase the SCI proportional to the advanced achievement of the usage reductions, decreasing the investment required to renovate the facility to state of the art. Conversely, should a facility be lagging in the reduction of energy and water usage intensity, the modifiers would decrease the SCI, thereby increasing the investment necessary for the facility.

To calculate the value of the energy and water modifiers, the energy and water performance of each site in 2012 were assessed against the baseline year data. A modifier of one to five was assigned based on the sites position on a linear scale between five years behind on the mandated reduction to having already met the target ahead of the 2015 deadline. Graphical representations of the scales for energy and water reductions are shown in "Figure 3.19" and "Figure 3.20".

Each score was then applied proportionally to the SCI for each discipline likely to experience a cost impact due to energy and water performance. Energy usage scores applied primarily to mechanical and electrical systems, while water use reductions primarily affected plumbing systems. "Figure 3.21" and "Figure 3.22" provide a sample of the calculation methodology as

ENERGY MODIFIER				
Discipline	*Initial SCI*	*Energy Modifier*	Application Factor	Final SCI
Arch. Exterior	4	3	0	4.00
Arch. Interior	4	3	0	4.00
Arch. Equipment	4	3	0	4.00
Mechanical	4	3	15	3.87
Electrical	4	3	10	3.91
Plumbing	4	3	0	4.00
Fire Protection	4	3	0	4.00

Note: 1.2 Yrs Behind Energy Use Reduction Goal = 3

Figure 3.21
Sample energy modifier calculation methodology (Chelmsford, MA)

WATER MODIFIER				
Discipline	*Initial SCI*	*Energy Modifier*	Application Factor	Final SCI
Arch. Exterior	4	5	0	4.00
Arch. Interior	4	5	0	4.00
Arch. Equipment	4	5	0	4.00
Mechanical	4	5	10	4.09
Electrical	4	5	5	4.05
Plumbing	4	5	15	4.13
Fire Protection	4	5	0	4.00

Note: 7.7 years Beyond Water Use Reduction Goal = 5

Figure 3.22
Sample water modifier calculation methodology (Chelmsford, MA)

FCI CALCULATION					
Discipline	*SCI*	*Calc 1*	*% of Cost*	FCI Weighting	Final FCI
Arch. Exterior	4.00	75.0	36	27.00	75.8
Arch. Interior	4.00	75.0	11	8.25	
Arch. Equipment	4.00	75.0	10	7.50	
Mechanical	4.09	77.3	18	13.91	
Electrical	4.05	76.2	18	13.71	
Plumbing	4.13	78.3	5	3.91	
Fire Protection	4.00	75.0	2	1.50	

Note: % of Cost values = System Cost / (GSF*($/GSF))

Figure 3.23
Sample FCI summary and calculation methodology (Chelmsford, MA)

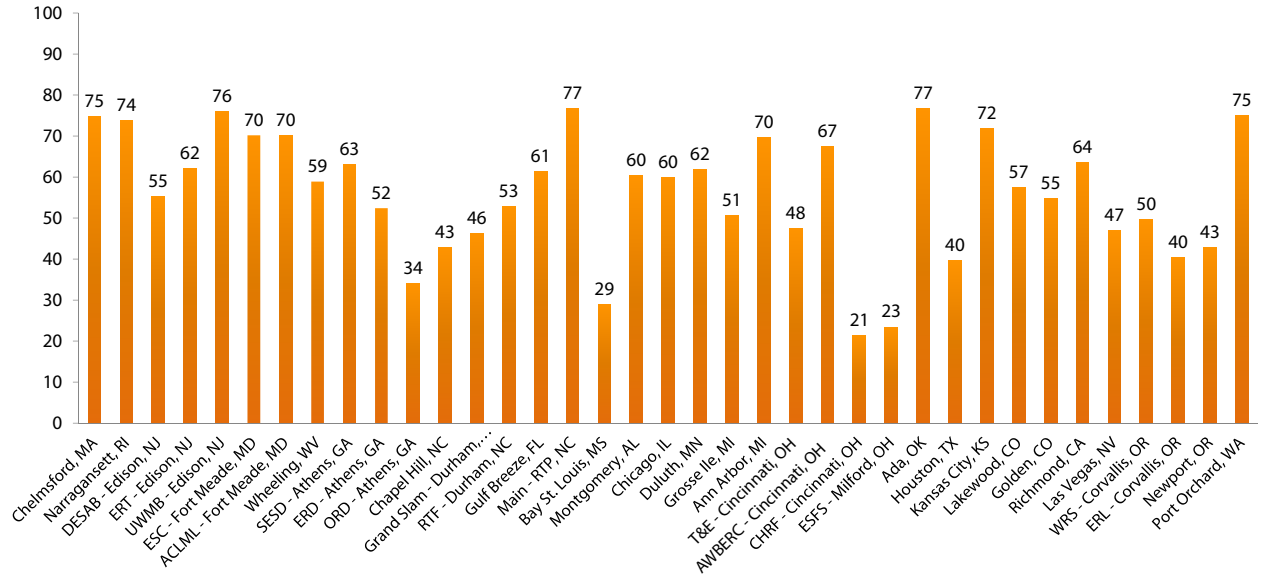

Figure 3.24
FCI values by EPA site

applied to EPA Site 1: Chelmsford, MA.

Facility Condition Index

Although the SCI provides information on the condition of each individual building system, the use of cost-based weighting leads to the development of an overall Facility Condition Index (FCI). This next step towards assessing facility infrastructure provides a consistent rating system for agency-wide value comparisons between facilities.

The SmithGroup Laboratory Database was used to establish the baseline cost model. The nature of the three facility types included in the EPA lab portfolio required two different cost models. ORD and Regional lab costs were based on biosciences lab data, and biotechnology / bioengineering labs were used to establish the Program lab cost model.

Using these CSI formatted cost estimates, a weighting factor for each discipline SCI was established as the percentage of system cost to total facility cost. The FCI was then calculated by multiplying the discipline specific weighting factors by the respective SCI value and summing the

products for all system.

A simple conversion from the 1-5 scale to a scale of 1-100 allows for a more comprehensible verbal and visual comparison of the overall condition of the EPA lab portfolio. A sample of this procedure has been summarized in "Figure 3.23". The final value for each of the EPA lab facilities FCI is shown in "Figure 3.24".

Given the varying size of the facilities included in this analysis, the use of area-based weighting provided metrics which more accurately represent the overall EPA lab portfolio. The average enterprise portfolio area-weighted facility condition index was calculated as 64.4.

Preliminary Cost Analysis

As previously stated, the SmithGroup Laboratory Database was utilized to establish a baseline cost model. In addition to providing discipline specific cost weighting factors, the cost models created during this phase of the analysis were used to establish Normalized Baseline Cost Factors ($/GSF). These factors represented the cost per unit area of construction for a new facility. To account for variations in construction cost throughout the country, relevant lab projects were further normalized to a location factor of 100 using published multipliers (RSMeans). On this scale, 100 represents a national average and all major cities are assigned a value between 0 and 200 (where 80 would indicate construction costs lower than the national average and a 120 showing costs higher than the national average). Finally, all cost data were escalated to a construction start date in 2014.

The Normalized Baseline Cost Factor provided the basis of the total facility replacement cost calculation where ORD and Regional labs assumed $406/GSF and Program labs assumed $439/GSF of equivalent new construction. Using the calculated value for the FCI and the value for the total facility replacement, the equation for FCI was rearranged to solve for renovation cost as shown below.

*Renovation Cost ($) = Replacement Cost ($) * (1 - FCI / 100)*

It is important to consider that based on the SmithGroup Laboratory Database of projects, the replacement cost represents the capital necessary to replace all systems with current best practice sustainable infrastructure. Inherent to this calculation was the assumption that any facility renovation would also include an energy upgrade consistent with 2014 construction standards. The use of the SmithGroup database, which includes largely LEED rated projects, was consistent with this

methodology.

The purpose behind the development of the facility condition index was to make an informed estimate of the value of a facility in its current state as compared to a similar, but newly constructed, facility. The method described herein for developing the FCI is based on detailed new construct cost estimation (normalized baseline cost factor) rather than in-depth cost analysis of existing conditions.

The final value obtained during the cost modeling phase was the Net Present Value of each facility, taken as the difference between replacement and renovation costs.

Comparative Analysis of Facilities

Effective Space Utilization

"Figure 3.25" summarizes graphically the USF effectively used as compared to the total Gross Square Feet (GSF) of the enterprise.

As previously noted, the metrics of USF/Occupant was applied to each of the laboratory function types across the full enterprise in comparison with benchmarks. The result yielded a range of approximately 477,500 (20%) to 358,200 (15%) USF of potentially underutilized space.

This square footage is distributed throughout the majority of the laboratories across the country and therefore not easily re-allocated for use by programs in other locations. Furthermore, a number of laboratories contain special types of spaces like vivarium, high bay, test chambers, and analytical equipment, such as nuclear magnetic resonance (NMR) imaging, which is not cost-effectively reallocated or easily converted to modular wet laboratories.

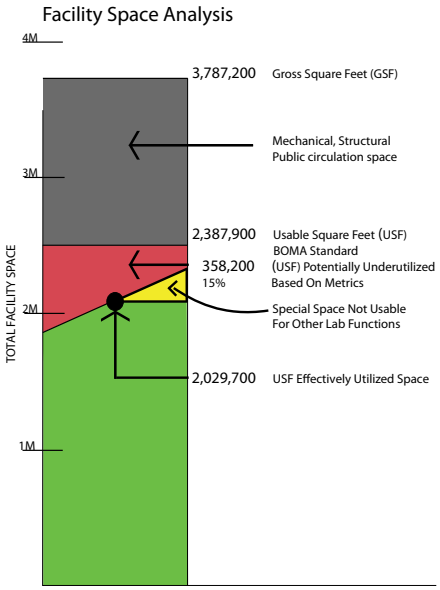

Figure 3.25
Facility space analysis

Facility Condition Analysis

"Figure 3.26" presents a summary of the range of FCI values and identifies the area (Sq. Ft.) that falls into each of three categories: <25, 25-50, and >50. A FCI range below 25 identifies facilities that should be considered for replacement. A FCI range of 25-50 identifies facilities that should be evaluated for renovation or replacement. A FCI range above 50 identifies facilities that should be considered for renovation. An FCI of 100 represents a new state-of-the-art facility. The area weighted portfolio FCI is 64.4 (per page 3.31).

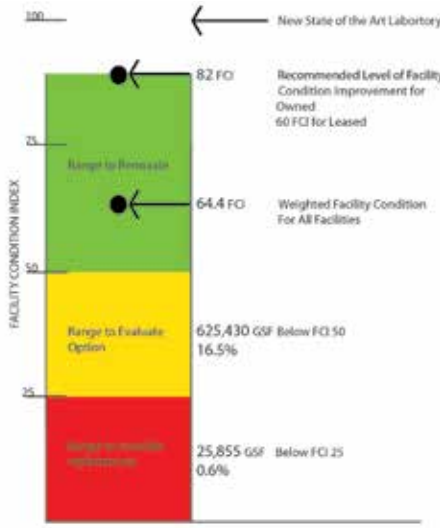

Figure 3.26
Facility condition analysis

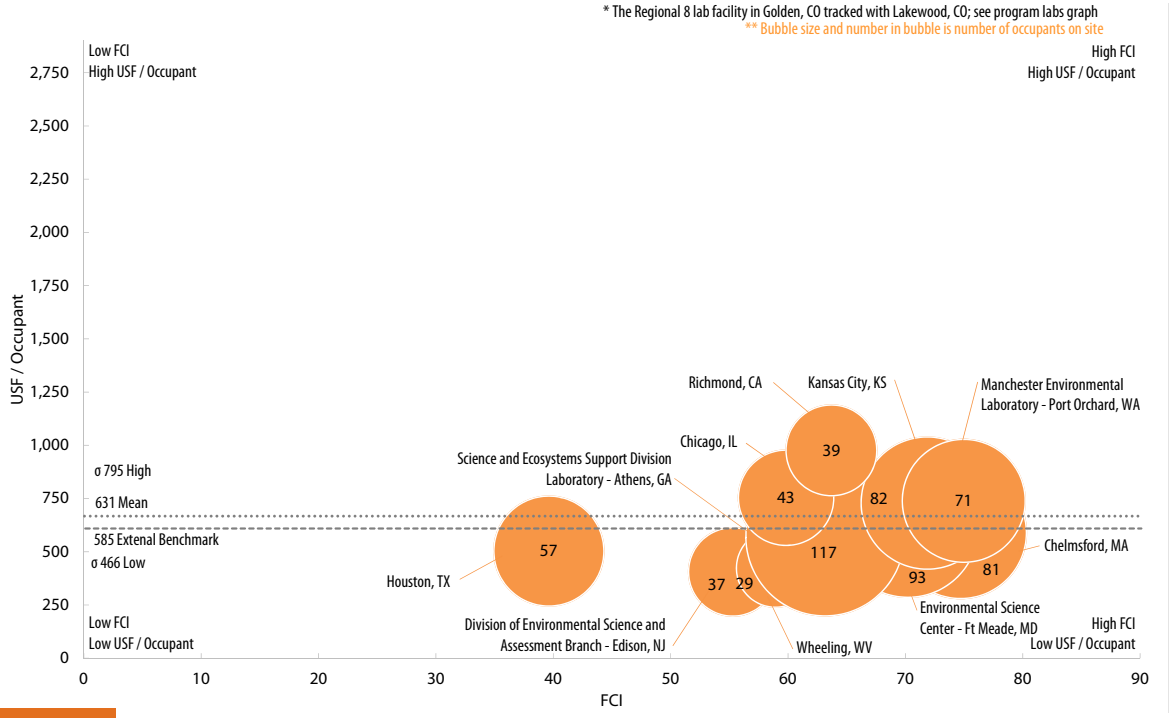

Figure 3.27
Comparison of regional labs

When the USF/Occupant for each laboratory is combined with the Facility Condition Index (FCI) for each laboratory, the result is an additional tool for comparative analysis. The following charts indicate the space utilization of each laboratory by type, with the corresponding FCI values. The vertical gray bar area in the middle of the charts defines the FCI range of 25-50, which is considered the range to evaluate the options. FCI below 25 is considered for replacement, and FCI above 50 is considered for renovation. These charts define facilities that range from high to low FCI and high to low USF/Occupant.

Regional Laboratories Evaluation

"Figure 3.27" illustrates a composite of the space utilization and facility condition index for the Regional labs. These sites exhibited a moderate range of space utilization and a relatively good condition index of facilities as potential co-location sites.

Sites exhibiting a high USF/occupant were evaluated for potential consolidation and co-location especially for moving into owned facilities with available space.

Sites exhibiting a low condition index, especially if leased, were considered for co-location into owned facilities.

Sites which exhibited high space utilization with lower USF/occupant and a low facility condition index, especially if owned, for replacement with new facilities on those sites.

R&D Laboratories Evaluation

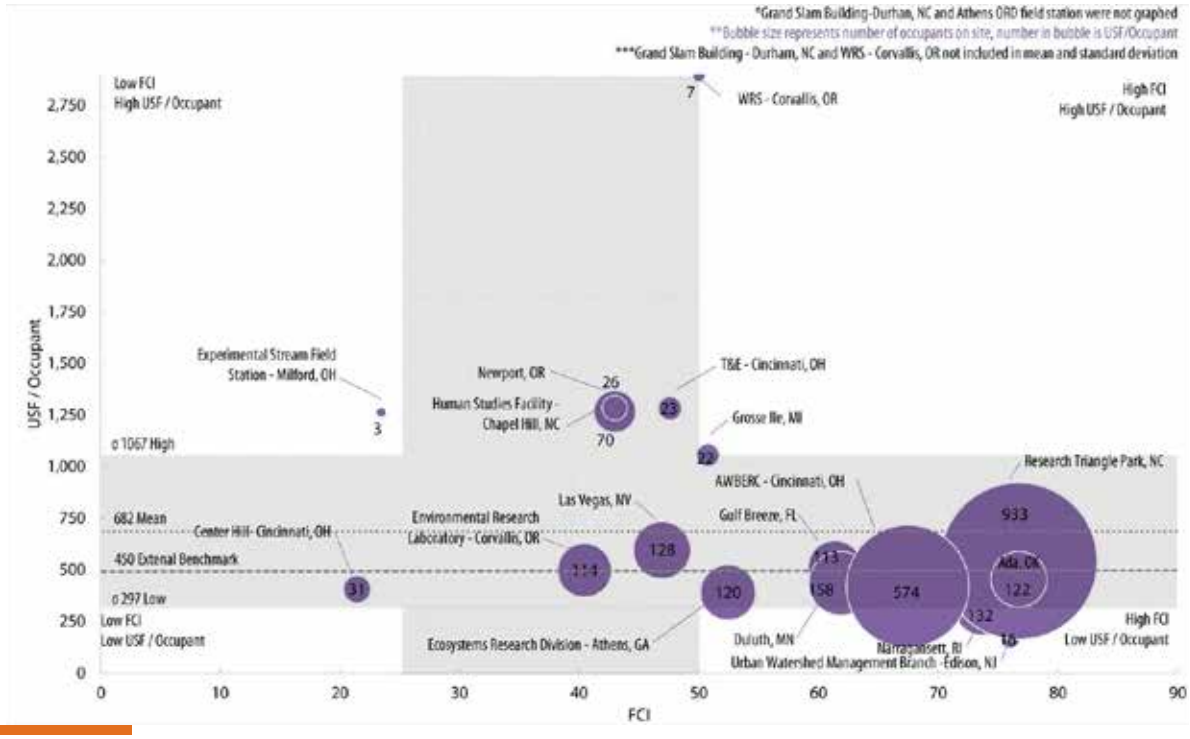

Figure 3.28
Comparison of R&D labs

"Figure 3.28" illustrates a composite of the space utilization and facility condition index for the Research & Development labs. These sites exhibited a wide range of space utilization and a relatively good condition index of facilities as potential co-location sites.

Sites exhibiting a high USF/occupant were evaluated for potential consolidation and co-location especially for moving into owned facilities with available space.

Sites exhibiting a low condition index, especially if leased, were considered for co-location into owned facilities.

Sites which exhibited high space utilization with lower USF/occupant and a low facility condition index, especially if owned, were considered for replacement with new facilities on those sites.

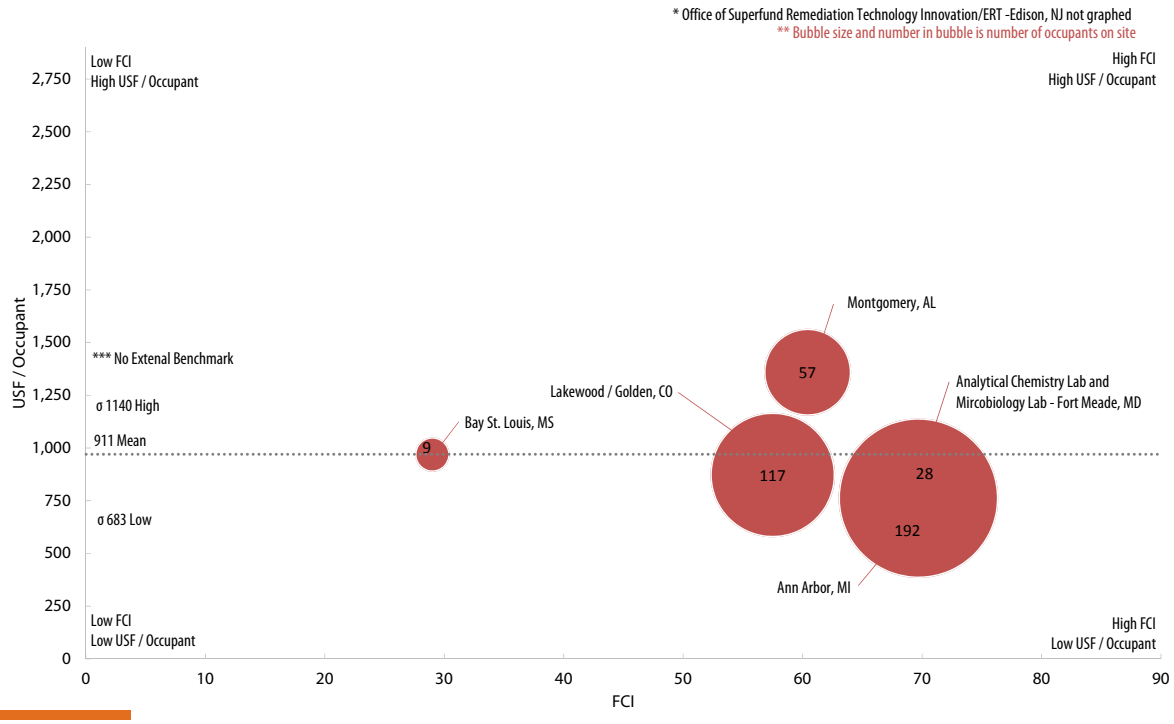

Figure 3.29
Comparison of program labs

Program Laboratories Evaluation

"Figure 3.29" illustrates the range of space utilization and condition index for the more unique types of program laboratories. Several of these labs contain highly specialized functions that are not feasible candidates for relocation.

These labs exhibited a reasonable range of utilization compared to the EPA mean.

Energy and Resource Use

FEDERAL MANDATES

The U.S. Environmental Protection Agency's (EPA's) mission is to protect human health and the natural environment.

As a federal agency, the EPA must further abide by policies set forth for all government entities. The following Government Regulations and Policies pertaining to energy and the environment apply to the EPA:

Executive Order 13423: "Strengthening Federal Environmental, Energy, and Transportation Management." EO 13423 was signed in 2007 and requires federal agencies to serve as leaders in advancing the nation's energy security and environmental performance. The EO includes, but is not limited to the following goals:

- Energy Efficiency: Reduce site energy use intensity 30 percent by 2015, compared to an FY 2003 baseline
- Greenhouse Gas (GHG) Emissions: Reduce GHG emissions through reduction of energy intensity 30 percent by 2015, compared to an FY 2003 baseline
- Renewable Power: At least 50 percent of current renewable energy purchases must come from new renewable sources (in service after January 1, 1999)
- Water Conservation: Reduce water consumption intensity 16 percent by 2015, compared to an FY 2007 baseline

Energy Independence and Security Act (EISA) of 2007. EISA reinforces the energy reduction goals set forth in EO 13423, while introducing routine energy and water evaluation requirements. For example, agencies are required to complete comprehensive energy and water evaluations at 25 percent of their reporting facilities[1] every year in a manner that ensures that an evaluation of each such facility is completed at least once every 4 years. Agencies are encouraged to implement and verify the efficiency measures identified within the evaluation reports. Concurrent with the evaluations, agencies are required to identify and assess re-commissioning measures, or if the facility has never been commissioned, retro-commissioning measures for each such facility.

Executive Order 13514: "Federal Leadership in Environmental, Energy and Economic Performance." EO 13514 was signed in 2009 and serves to enhance EO 13423 by requiring federal agencies to achieve the following additional goals as they pertain to those above:

1 Reporting facilities include those sites in which EPA has direct control over the facility operation and/or utility bills. Of the 175 nationwide EPA sites only 35 contain reporting facilities. Source: 4th Qtr FY12 Energy Report_12-28-2012.pptx

- Greenhouse Gas (GHG) Emissions: Establish reduction targets for Agency wide Scope 1, Scope 2 and Scope 3 GHG emissions to be achieved by FY 2020, compared to an FY 2008 baseline
- Building Performance: Ensure that all new construction and major renovations meet the Guiding Principles for Federal Leadership In High-Performance and Sustainable Buildings, and that 15 percent of existing buildings meet them by FY 2015. Starting in FY 2020, design federal buildings to achieve net zero energy by FY 2030. EPA signed the Federal Leadership In High-Performance and Sustainable Buildings Memorandum of Understanding (MOU) in 2006.
- Water Conservation: Reduce water consumption intensity 26 percent by FY 2020, compared to an FY 2007 baseline

As part of this nationwide laboratory assessment, SmithGroup collected FY 2012 energy and resource consumption data for all pertinent facilities. It should be noted that energy and resource consumption data were collected for a facility as a whole and not broken down or sub-metered by program group. More specifically, energy and resource consumption data for only the laboratory portions of the facilities were not available.

ENERGY AND RESOURCE REDUCTIONS

Analysis of reductions in energy and water usage provided a sensible metric by which to vary the value of the existing infrastructure at a site level. This analysis was also influential in the development of the renovation/relocation scenarios in the evaluation phase to ensure that the federally mandated reductions were achieved at the agency level. The following information represents the current track of the EPA lab portfolio in the three critical areas of the reduction mandates. Detailed discussion of scenario-based energy and water use reduction strategies is contained in Section 3.2-Analysis: Facility Condition Evaluation.

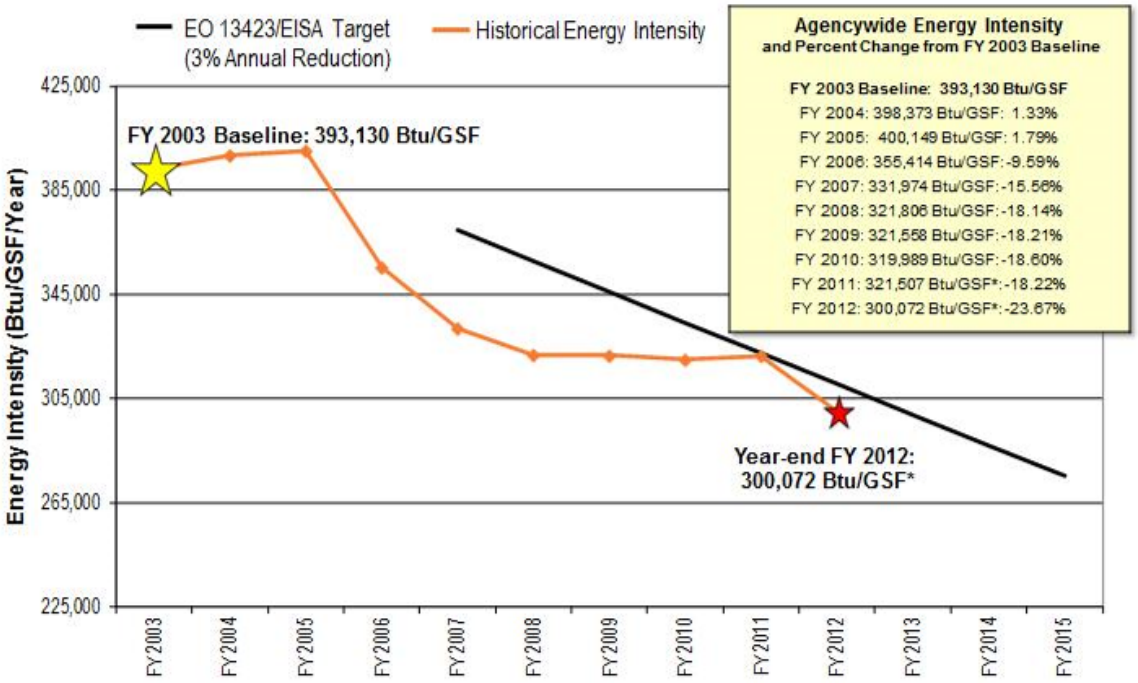

Figure 3.30
EUI reduction; Source: 4th Quarter FY2012 Energy Report, 12/28/2012

Energy Usage

The site EUI reduction goal for FY 2012 is 21 percent. While only six sites evaluated as part of this study have individually met this reduction goal, the Agency, as a whole, is just below their site EUI reduction target by the end of FY 2012 ("Figure 3.30"). The EUI mandate requires only an Agency-wide level of reduction as previously stated. While smaller sites may not have achieved the target percentages, the reductions in EUI of those sites having achieved 21percent or greater reductions by 2012 are a significant portion of the EPA lab energy consumption and overall area (GSF). As a result, the Agency EUI reduction is slightly ahead of the targeted values despite individual reductions less than 21percent at a majority of the EPA lab facilities.

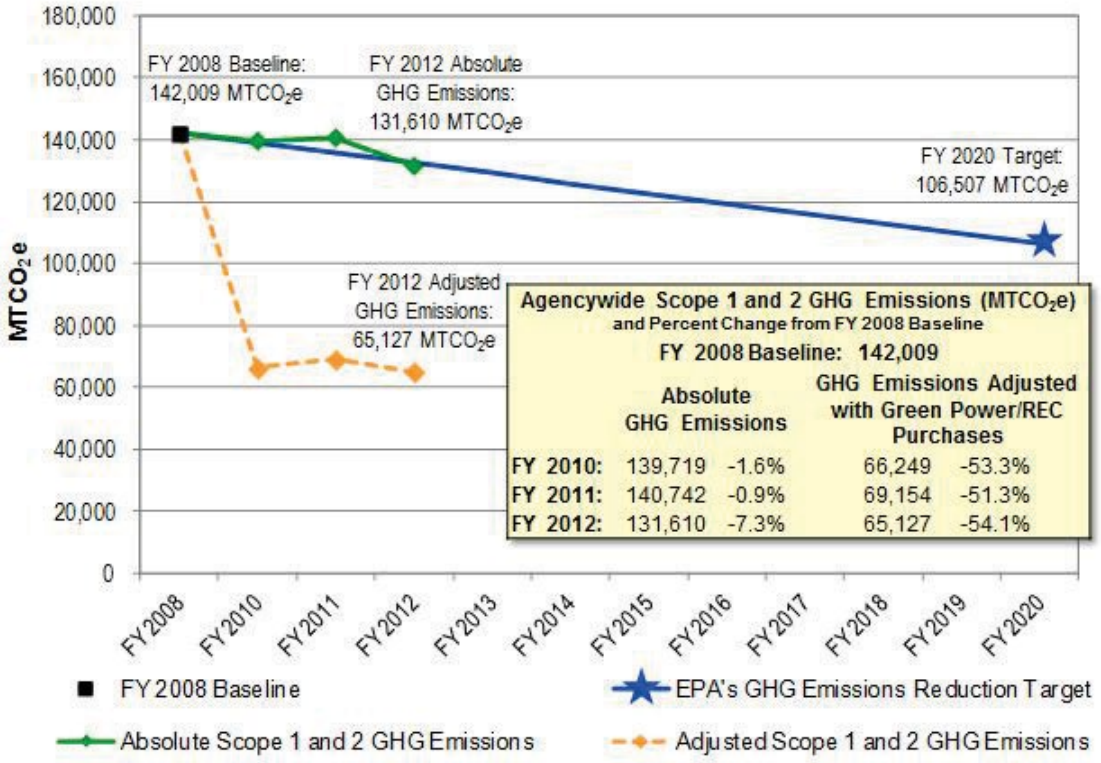

Figure 3.31
Greenhouse gas reduction; Source: 4th Quarter FY2012 GHG Report, 3/22/2013

Greenhouse Gas Emissions

The June 2012 revision of the EO 13514 Section 9 Guidance allows site greenhouse gas emissions to be adjusted for site delivered green power and renewable energy credits (RECs). EPA purchases RECs at the agency level and allocates them to sites. RECs are now allowed to be used to reduce GHG emissions from purchased conventional electricity. Since it is not 100% apparent how RECs are apportioned to sites, the data presented in the "Year End FY 2012 Report 3-22-2013" was used to determine each site's allocation.

Without adjustments (absolute), combined GHG emissions reduction for these facilities is 10%; with adjustments (adjusted) it is 61%. It is interesting to note that the baseline emissions data is not permitted to include purchased green power or RECs for that FY. "Figure 3.31" has been included for reference

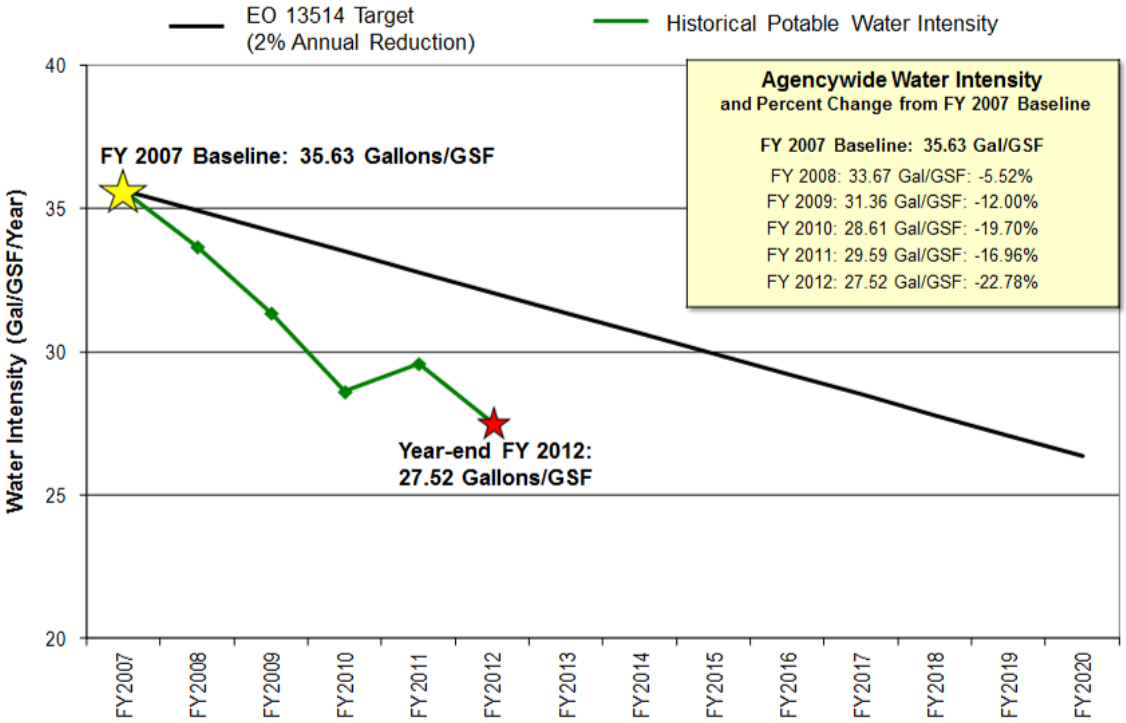

Figure 3.32
Water reduction; Source: 4th Quarter FY2012 Water Report, 12/28/2012

Water Usage

As evident in "Figure 3.32", the water reduction goal is being comfortably met. The primary strategies attributed to the overall portfolio reduction in water usage include:

- High efficiency fixtures
- Converting from single-pass process cooling to recirculating systems
- Xeriscaping (drought tolerant, native plants)
- Upgrades to central plant equipment to reduce water makeup requirements

Only site 2 – EERL Narragansett, RI also reported using reclaimed water, which, according to the Water Management Plan (WMP), was added recently to meet the new irrigation needs posed by the new green roof and to collect cooling coil condensate to be used at cooling tower makeup.

The data portrayed in this location indicates per-site percent reduction in the utilization of each resource.

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Science Determinants

As described under "Science Metrics" on page 14, EPA and SmithGroup have applied three guidelines to sustain the Agency's laboratory science capability and contributions as EPA improves the efficiency of its portfolio of lab facilities. These guidelines are applied as determinants in the scenarios and model evaluations described in this report. These determinants function as practical constraints on which existing laboratory capabilities and facilities may be considered for relocation in the scenarios and model evaluations:

Location Dependence

Lab facilities with capabilities that require proximity to aquatic ecosystems in the Atlantic, Pacific, Great Lakes, and Gulf of Mexico were not relocated in any scenarios. These facilities included:

- Narragansett, Rhode Island - Environmental Effects Research Laboratory
- Gulf Breeze, Florida - Gulf Ecology Division
- Duluth, MN - Mid-Continent Ecology Division
- Newport, OR - Coastal Ecology Branch

These laboratories use ambient water for their research piped directly from adjacent water bodies.

Highly Specialized Laboratory Capability

Lab facilities with highly specialized capabilities were not relocated in any scenarios. These facilities included:

- Chapel Hill, NC. - Human Studies Facility
- Ann Arbor, Michigan - National Vehicle Fuel and Emissions Laboratory
- Montgomery, AL- Radiation Lab

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Cost Modeling

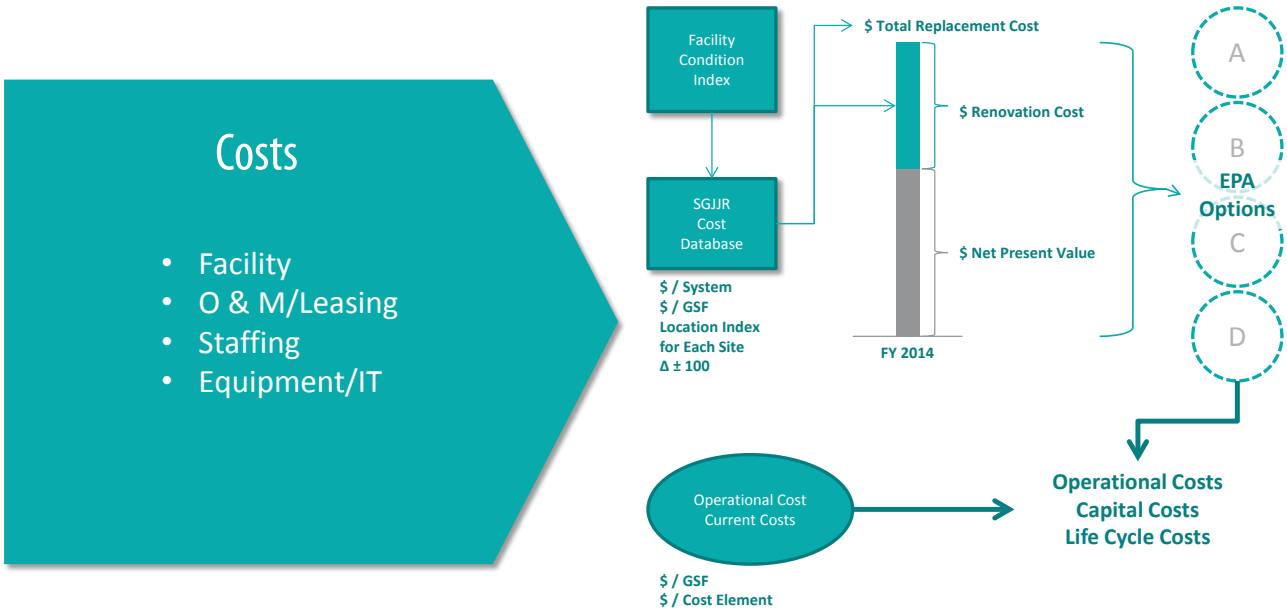

Figure 3.33
Cost evaluation - inventory and analysis

Economic Guidance for the EPA Laboratory Assessment Study

All cost modeling followed guidance in the Office of Management and Budget (OMB) Circular A-94[1]. This Circular applies to all agencies of the Executive Branch of the Federal Government.

The purpose of this circular as stated in the document, "is to promote efficient resource allocation through well-informed decision-making by the Federal Government. It provides general guidance for conducting benefit-cost and cost-effectiveness analyses. It also provides specific guidance on the discount rates to be used in evaluating Federal programs whose benefits and costs are distributed over time. The general guidance will serve as a checklist of whether an agency has considered and properly dealt with all the elements for sound benefit-cost and cost-effectiveness analyses."

The document goes on to say, "the guidelines in this Circular apply to any analysis used to support Government decisions to initiate, renew, or expand programs or projects which would result in a series of measurable benefits or costs extending for three or more years into the

1 Circular No. A-94 Revised (Transmittal Memo No.64) October 29, 1992 MEMORANDUM FOR HEAD OF EXECUTIVE DEPARTMENT AND ESTABLISHMENTS, Guidelines and Discounted Rates for Benefit-cost Analysis of Federal Programs

future." The Circular applies specifically to:

1. Benefit-cost or cost-effectiveness analysis of Federal programs or policies.
2. Regulatory impact analysis
3. Analysis of decisions whether to lease or purchase.
4. Asset valuation and sale analysis.

Current Costs of Operation

The EPA's cost sub-committee data call compiled total annual operational costs for FY 2012. Total operational costs for all laboratory-based functions in the 2012 baseline year were calculated at $455 million. Costs associated with personnel were fifty nine percent of the total operating costs. Personnel not involved in laboratory functions were excluded as non-lab costs even though these personnel currently occupy office space within various laboratory buildings. Facility renovation and improvement costs were $18 million in 2012. Additionally, EPA's capital building & facilities (B&F) average annual budget is $30 million/year, of which approximately $25 million/year has been spent on laboratory facilities versus other office non-lab projects over the past ten years.

Facilities and Site Costs - annual costs for facilities related to renovations and improvements including:

- Construction, minor construction projects
- Equipment storage, property management
- Laboratory up-fit and changes (required by program changes)
- Facility services
- Specialized research facilities
- Facility safety and repairs
- Energy conservation and environmental due diligence
- Lease costs (GSA leased and private leased facilities)
- Utilities (utility costs are sometimes included in the rental agreements for leased properties)

Lab Equipment Costs - annual costs for scientific and office equipment including:

- Laboratory capital equipment
- Equipment repair and maintenance
- Office Furniture
- Photocopying equipment, maintenance and repair
- Laboratory support
- Laboratory/Field Scientific Equipment

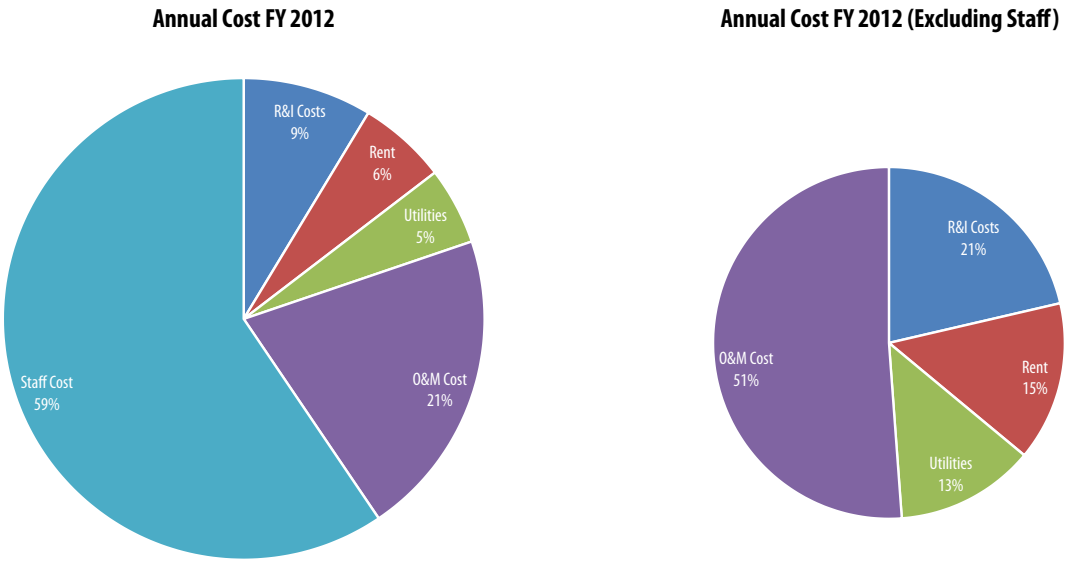

Figure 3.34
Total Annual Operating Costs for the EPA Portfolio of Laboratory Facilities in FY2012

Operations and Maintenance Costs - annual costs for O&M including:

- Facilities maintenance and operations
- Hazardous transport, Health unit medical, Safety health and environment
- Physical security
- Expendable supplies, general, non-scientific lab, field supplies
- Transportation, mail, travel, vehicles
- IT support, hardware, network and telecomm, software
- Licenses and Fees

Labor - includes costs associated with paying federal and contractor workforce located at each lab facility, including[2]

- Federal workforce costs including salary and benefits
- Non-federal workers including contractors and grantees
- National Older Worker Career Center (NOWCC) enrollee grants
- Training

2 Differential location based labor rates apply based upon location of facilities.

3.3 Scenarios and Evaluations

HYPOTHETICAL SCENARIO DEVELOPMENT

As illustrated in previous sections of this report, the Program, R&D and Regional laboratories were graphed for comparative analysis to indicate the assessed range of space utilization and level of facility condition at each laboratory site. Sites that fell into the low utilization range are potential candidates for rightsizing by reducing space upon lease renewal, for relocation to other low - utilized owned facilities, or for consolidation of other facilities at that site. Facilities that can be consolidated into existing space already in good condition have the potential to yield the greatest long term value to the EPA.

The hypothetical scenarios were also designed to improve the condition of facility infrastructure. Operational performance and reliability, along with achievement of energy use intensity reduction mandates, provided the framework for the minimum facility condition index targets of 82 for owned sites and 60 for leased sites.

To fully evaluate the potential for facility co-locations and consolidations, a series of alternative hypothetical options were modeled and grouped into five scenarios. The drivers for these scenarios are increased efficiency of space utilization, improved facility performance, and reductions in life cycle cost and operating cost.

The scenarios were modeled to create a gradient of options, from the current state of 34 sites to a down-sized portfolio of 19 sites. Improved facility condition, improved facility performance, and space utilization through consolidation and co-location shaped the scenarios. These theoretical options were modeled relative to:

- Space upgrade requirements
- Programs to be consolidated or co-located
- Facilities to be renovated
- Facilities to be leased
- New replacement facilities needed

Each scenario was analyzed relative to capital costs for renovation and/or replacement, operational costs including Operations and Maintenance (O&M) cost savings, relocation and lab decommissioning, and life cycle cost on a 30-year basis.

It is important to note that the specific laboratory moves within each scenario are not to be assumed as recommendations. Rather, they constitute plausible options by which a broad range of cost and efficiency estimates can be realistically modeled. This information can be used by the EPA to develop recommendations for an overall, enterprise-wide approach to improving the efficiency of its laboratory facilities. Actual laboratory-specific decisions will also need to consider organizational alignment, available funding for capital projects, timing, stakeholder input, and potential disruptions to Agency laboratory science capability and capacity, and science contributions to EPA programs and stakehoders.

SCENARIO FACTORS

The hypothetical scenarios ranged from all facilities remaining in their current locations to scenarios with increasing amounts of consolidations and co-locations to improve efficiency. All of the scenarios included improvements to the facility condition (to improve systems reliability) and to facility sustainability (to meet sustainability targets).

Leased versus Owned Space

During this study, it was identified that EPA-owned sites generally have lower energy use intensities and higher facility condition indices. Furthermore, in an effort to improve the efficiencies of space integration, it is easier and more cost effective for the EPA to divest themselves of poorer performing leased space than of higher performing owned space. As of 2012, eleven of the thirty-four sites consisted of leased space in buildings, and three sites were occupied under a special use agreement with GSA. The gradient of options SmithGroup developed with the EPA attempts to reduce the gross square footage of leased facilities where economically viable.

Location Dependence

An important factor for the unique science the EPA performs is the location dependence, or geographic necessity of a lab location to perform science. While looking for ways to reduce the EPA's gross square footage to bring about cost savings, SmithGroup cross referenced other consolidation criteria with the geographic necessity of the existing laboratory locations.

The EPA provided SmithGroup with a list of sites that had particular location dependence, such as ecosystem, proximity to study locations, or emergency response distance. SmithGroup's spectrum of options has not studied the relocation of these sites as it would hamper the science effectiveness at this time. The geographic necessity of EPA sites could change over time as the mission of the EPA evolves. The following sites were identified as locations with geographic necessity:

- Narragansett, Rhode Island - Environmental Effects Research Laboratory
- Gulf Breeze, Florida - Gulf Ecology Division
- Duluth, MN - Environmental Research Laboratory
- Newport, OR - Coastal Ecology Branch

Unique Capability

Sites deemed to have a unique capability are the laboratories that require special space or equipment beyond a typical biology, chemistry, or other R&D labs. The construction of a lab with unique capability usually requires a higher cost per square foot to build due to specialized requirements. SmithGroup did not exclude the potential for relocation of sites with unique capabilities, but judiciously relocated them if other factors indicated the EPA would see long term cost savings by relocating the unique space to another site. During this study, the necessity for additional unique capabilities was not identified for the next thirty years. As the mission of the EPA evolves, and the existing laboratory and infrastructure supporting the unique capabilities age, it is foreseeable that the current unique labs will have to be replaced. When it is time for the unique labs to be replaced, further consolidation could potentially take place and new state of the art facilities could be built on other sites. The following sites were identified as containing unique capabilities:

- Chapel Hill, NC- Human Studies Facility
- Ann Arbor, Michigan - National Vehicle Fuel and Emissions Laboratory
- Montgomery, AL- Radiation Lab

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Scenarios

Scenario A - Renovations and improvements with sustainability:

All laboratory sites would be maintained at their current locations. All owned facilities would be improved to FCI 82 and leased facilities to FCI 60 to achieve systems reliability improvements and meet sustainability targets.

Scenario B - Renovations and Improvements with Sustainability:

Four laboratories are co-located into owned facilities at other sites, improving space utilization efficiency and providing operational cost reductions. All 30 remaining facilities are improved to FCI 82 for owned facilities, and, FCI 60 for leased facilities to achieve systems reliability improvements and meet sustainability targets.

The four sites to be co-located include the following:

- Terminate the lease at Bay St. Louis and move those functions to Ft. Meade
- Move RTF to RTP Main
- Terminate laboratory activities in Grosse Ile (facility remains, but laboratory work in conducted in Duluth)
- Terminate the lease for Region 8 laboratory, co-locate with Golden, CO laboratory

All four of these co-location moves are currently underway or under consideration by the EPA.

Scenario C - Minor Consolidation:

Eight laboratories are co-located to owned facilities, improving space utilization efficiency and providing operational cost reductions.

Scenario C includes actions outlined in Scenarios A and B and the following:

- Consolidate the Wheeling Regional lab to Ft. Meade
- Consolidate 2 locations by moving:
  - Page Road location onto the RTP campus
  - Willamette Research Station to Corvallis
- Reconfigure and right-size Athens by:
  - Consolidating ORD Athens to ORD locations with capacity and similar science activities
  - Move Region 4 Athens to the current ORD Athens space (owned) and terminate the lease of the Region 4 Lab

All 26 remaining facilities are improved to FCI 82 for owned facilities, and, FCI 60 for leased facilities to achieve systems reliability improvements and meet sustainability targets.

Scenario D - Moderate Consolidation:

Scenario D reduces 12 laboratory locations through consolidation and co-location, and including the actions outlined in Scenarios A, B and C.

The additional laboratory consolidations and co-locations for Scenario D include the following:

- Terminate the Chelmsford lease and co-locate with Edison
- Relocate the Cincinnati - Center Hill facility to Cincinnati - AWBERC
- Create a Western Laboratory Hub by moving Regions 6 and 9 laboratories to a new facility on a new site in Las Vegas

All 22 remaining facilities are improved to FCI 82 for owned facilities, and, FCI 60 for leased facilities to achieve systems reliability improvements and meet sustainability targets.

Scenario E - Major Consolidation:

Scenario E reduces 15 laboratory locations through consolidation and co-location, and including the actions outlined in Scenarios A, B, C and D.

The additional laboratory consolidations and co-locations for Scenario E include the following:

- Consolidate Cincinnati – relocate T & E facility, and the Milford streams facility to Cincinnati – AWBERC
- Expand the Western Laboratory Hub by moving Region 7 laboratory to Las Vegas

All 19 remaining facilities are improved to FCI 82 for owned facilities and FCI 60 for leased facilities to achieve systems reliability improvements and meet sustainability targets.

Additional Scenarios

Following preliminary evaluation of the initial five scenarios a series of Workshops were held with the EPA to review the scenario options and their resulting vital statistics for utilization and cost. As a result of these workshops two additional hypothetical scenario options were developed, B1 and B2. Each of these additional scenarios combined scenario B with selected cost-saving options from other scenarios to create two additional categories for review and cost analysis.

Scenario B1-

Includes all of Scenario B plus the following:

- Move Wheeling to Fort Meade
- Move Willamette (WRS) to Corvallis (ERL)
- Consolidate current Las Vegas labs and offices into a single site (assuming a new site)

Scenario B2-

B2 is to include all of B and B1 plus the following:

- Move Chelmsford to Edison
- Relocate the two Athens Labs (ORD Athens to ORD locations with capacity and similar science activities, and the Region 4 Lab in Athens to the current ORD Athens site).
- Relocate Houston, Kansas City and Richmond to Las Vegas (combining labs for Regions 6, 7, and 9 with the consolidated Las Vegas lab/office from Scenario B1).

Continuing Scenario Refinement-

The EPA has the potentoial to mix and match within all of the scenarios in general to further test options. As an example. after the development of Scenarios B1 and B2 a potential Scenario B1+ was proposed by the EPA. This scenario combines B1 with portions of B2 . This potential scenario was not analyzed for cost as a part of this report.

Scenario B1+

B1+ is to include all of B1 plus the following from B2:

- Move Chelmsford to Edison
- Relocate the two Athens Labs (ORD Athens to ORD locations with capacity and similar science activities, and the Region 4 Lab in Athens to the current ORD Athens site).

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Performance Improvements

FACILITY RENOVATION TARGETS

As part of the initial Scenario planning process, it was determined that a number of facilities would not be relocated under any scenario. These exisiting (to remain) facilities would likely need to be improved to a level that would allow the enterprise as a whole to achieve the federally mandated sustainability goals while ensuring facilities were of acceptable condition to perform the science of their mission. In particular, facilities with a relatively low FCI score and where utilities are paid directly by EPA were candidates for renovation for the purposes of realizing operational cost savings. If the full replacement cost of a facility is equivalent to an FCI of 100 (new construction), the calculation for renovation cost, as previously shown, is:

*Renovation Cost ($) = Replacement Cost ($) * (1 - FCI / 100)*

However, the team questioned the feasibility, in terms of cost and operations, of achieving an FCI of 100, through renovation, for an existing facility. In addition, it was acknowledged that leased facilities are unlikely to upgrade base building systems and reap the rewards of these base building improvements through reduced rent and/or utility cost savings. Tests were performed on the data to determine the minimum system condition indices (SCIs) for both owned and leased facilities in order for the EPA to achieve their sustainability goals. Following the publishing of the FY 2012 Energy Report for EPA Reporting Facilities, the EPA required an additional 8.3% EUI reduction to meet their overall goal of 30% EUI reduction by FY 2015. "Figure 3.35" shows the minimum SCI values that were established and used as the basis of all Scenarios to ensure an additional Scenario-level EUI reduction of at least 8.3% (for the subset of the EPA portfolio that is laboratory).

As a result, owned facilities are renovated to a minimum FCI of 82. Leased facilities where utilities are paid by EPA are renovated to a minimum FCI of 60. In this case, it is assumed that only tenant systems such as FFE, lighting, tenant laboratory and office equipment, and lease space HVAC equipment are apt to be improved. For leased facilities where utilities are included in rent, no additional renovation investment is made.

SCI RENOVATION TARGETS				
Facility Type	***System Type***			
	Exterior	*Interior*	*Equipment*	*MEP/FP*
Owned	4	4	4.5	4.5
Leased, Utilities Paid by EPA	-	3	4	3
Leased, Utilities Included in Rent	-	-	-	-

Note: Ratings from 1-5, where 5 represents new construction

Figure 3.35
SCI target values

Area-Weighted FCI

For each site within a given Scenario, the FCI was calculated for existing to remain buildings based on the minimum upgraded SCI values. All new construction was assigned an FCI of 100, be it an addition or stand-alone new building. The area-weighted FCI was then calculated for each Scenario and is presented in "Figure 3.36". As the Scenarios progress from Scenario A, renovate in place, to Scenario E, major consolidation/right-sizing, the area-weighted FCI of the laboratory enterprise improves incrementally. The largest single incremental increase occurs when going from the current state (FY 2012 Baseline) to Scenario A. Additionally, as evident in "Figure 3.37" the investment in greater levels of renovation in owned facilities results in an increasing differential between leased and owned facilities FCI as the scenarios progress from A to E. The scenario-based area-weighted FCI for owned facilities is increased from 68.7 in the FY 2012 Baseline to between 82 – 85 for all scenarios, while the condition of leased facilities experiences an increase from 54.2 to a range of 58-62.

Energy Use Intensity

As new facilities or facility additions are constructed, the energy performance of new construction is assumed to equal that of a high performance laboratory (222 kBtu/GSF/YR).[1] As the Scenarios progress from Scenario A to D, the amount of new construction increases and then reduces slightly in Scenario E. Existing-to-remain laboratory building footprint decreases steadily between Scenarios A and E. Total Scenario building footprint is shown in "Figure 3.38". While most of the scenario impacts to a site involve down-sizing through consolidation, there are some exceptions where sites were categorized as having high space utilization and thus, were actually up-sized as a result of consolidation. This condition is most apparent in Scenario D.

The scenario site energy consumption, shown as a red

1 One exception to this applies to site 8 – Athens, GA ORD where a new 10,000 GSF field support warehouse is proposed to consolidate site 6.2 (Athens) along with two boat and equipment shelters. The assumed site EUI for the field support warehouse is 73.5 kBtu/GSF/YR.

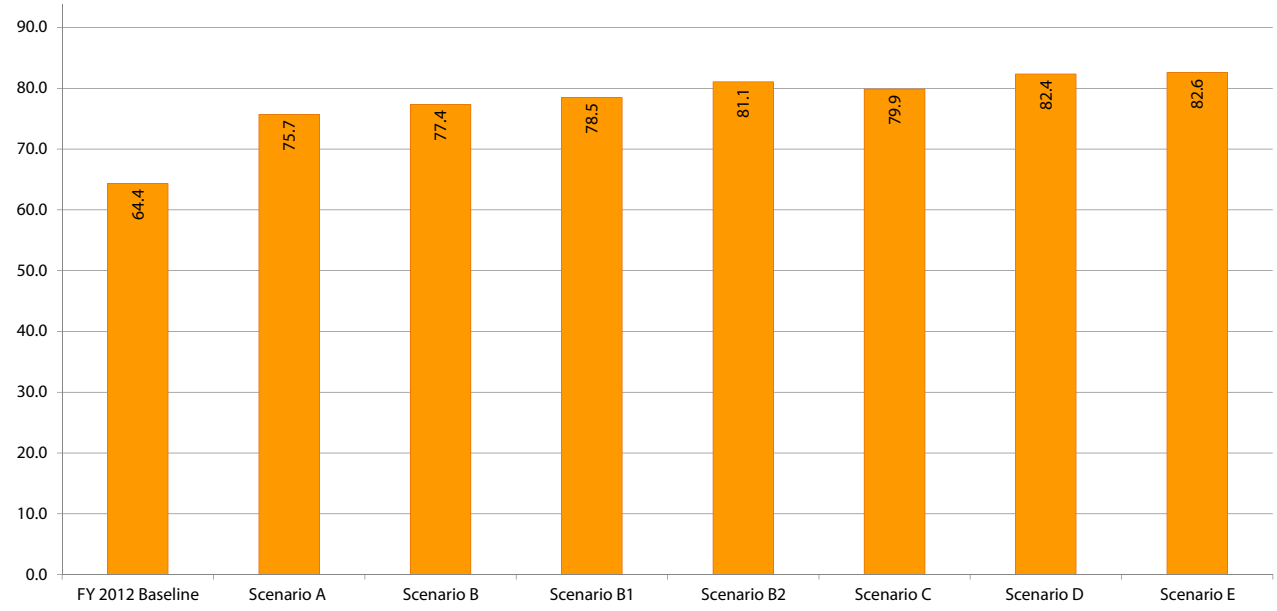

Figure 3.36
Area-weighted FCI by scenario

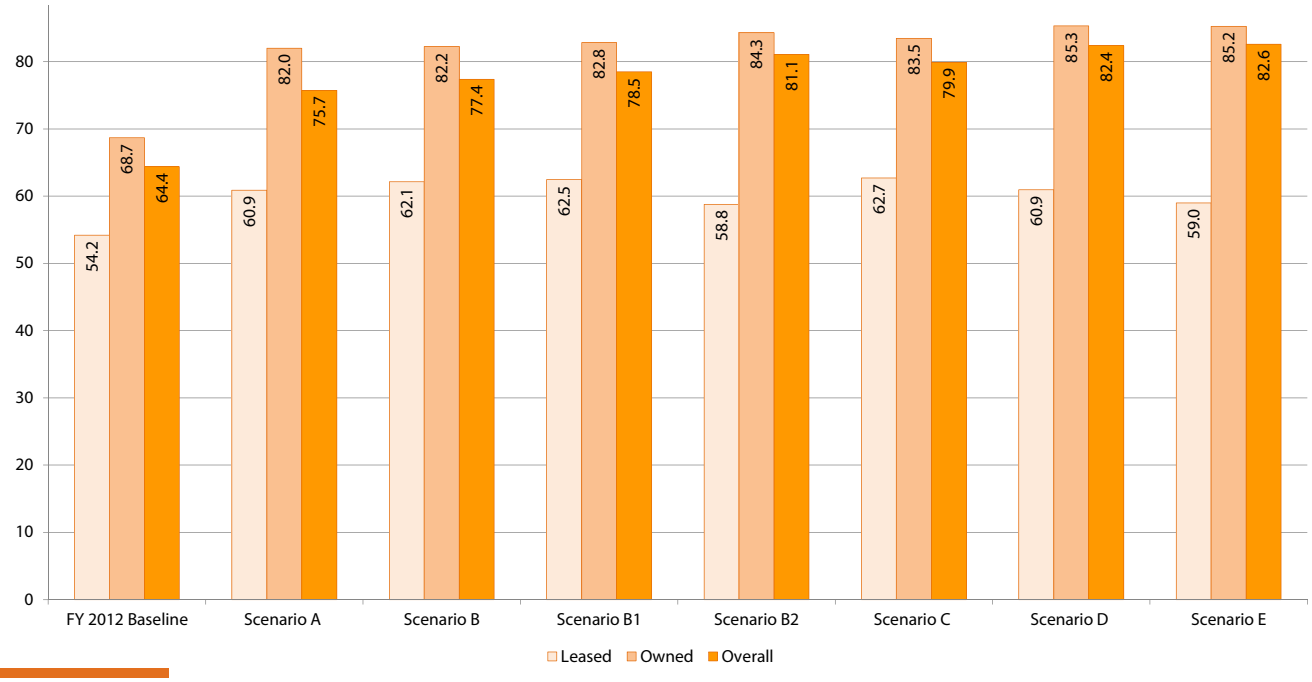

Figure 3.37
Area-weighted FCI by scenario, leased v. owned

line in "Figure 3.38", tracks building footprint to a great extent, whereas site EUI remains comparable between scenarios after the initial facility improvements are made in Scenario A. Additionally, it is evident that due to the decreasing footprint and lack of substantial efficiency improvements, area-weighted average EUI values for the leased portion of the EPA lab portfolio dramatically increase across the Scenarios ("Figure 3.39").

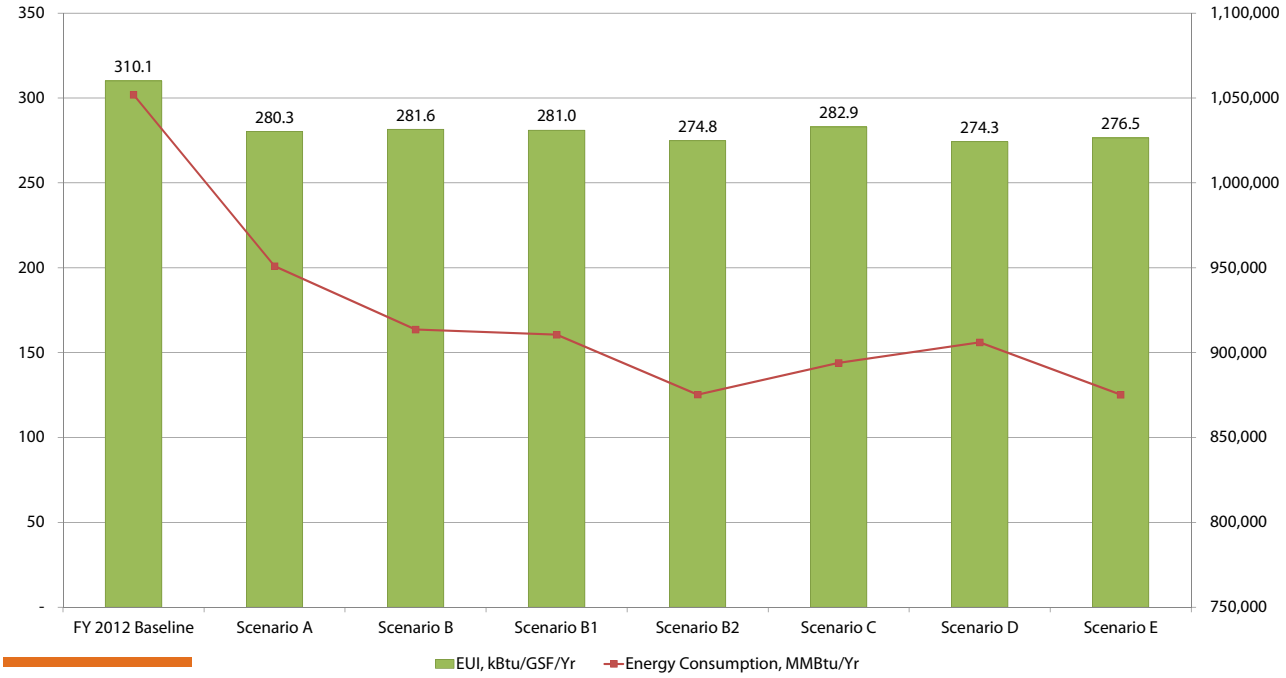

Figure 3.38
EUI v. total consumption by scenario

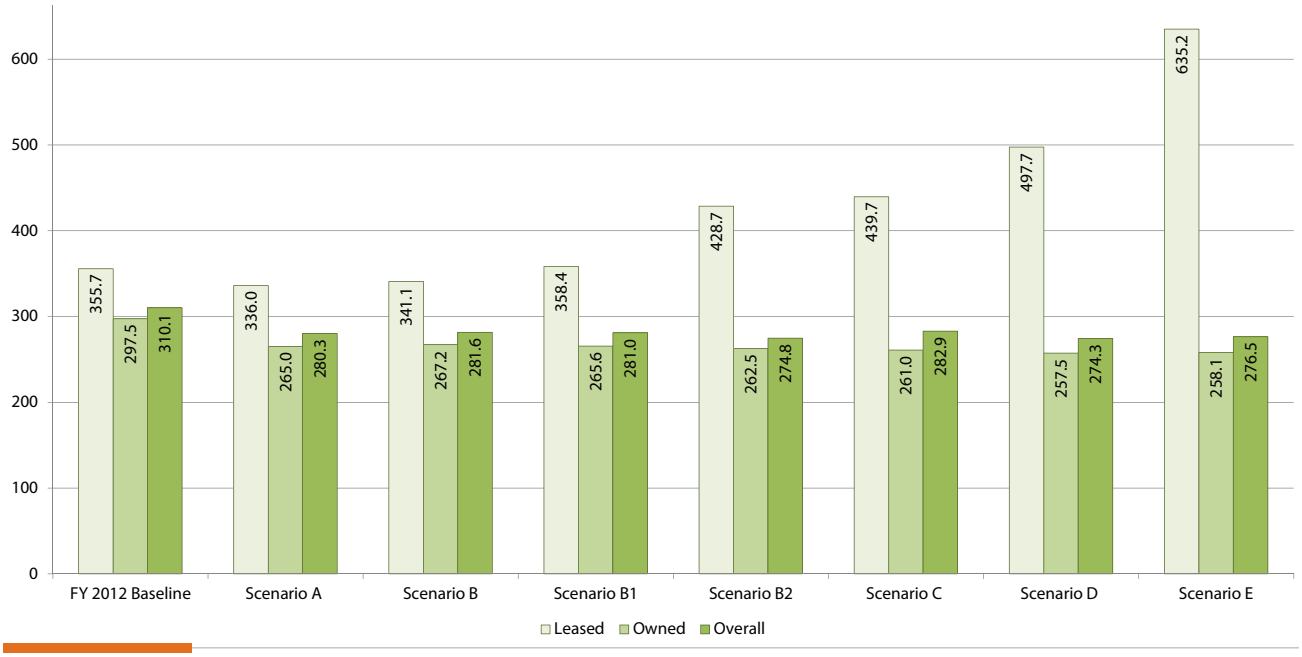

Figure 3.39
EUI v. total consumption by scenario

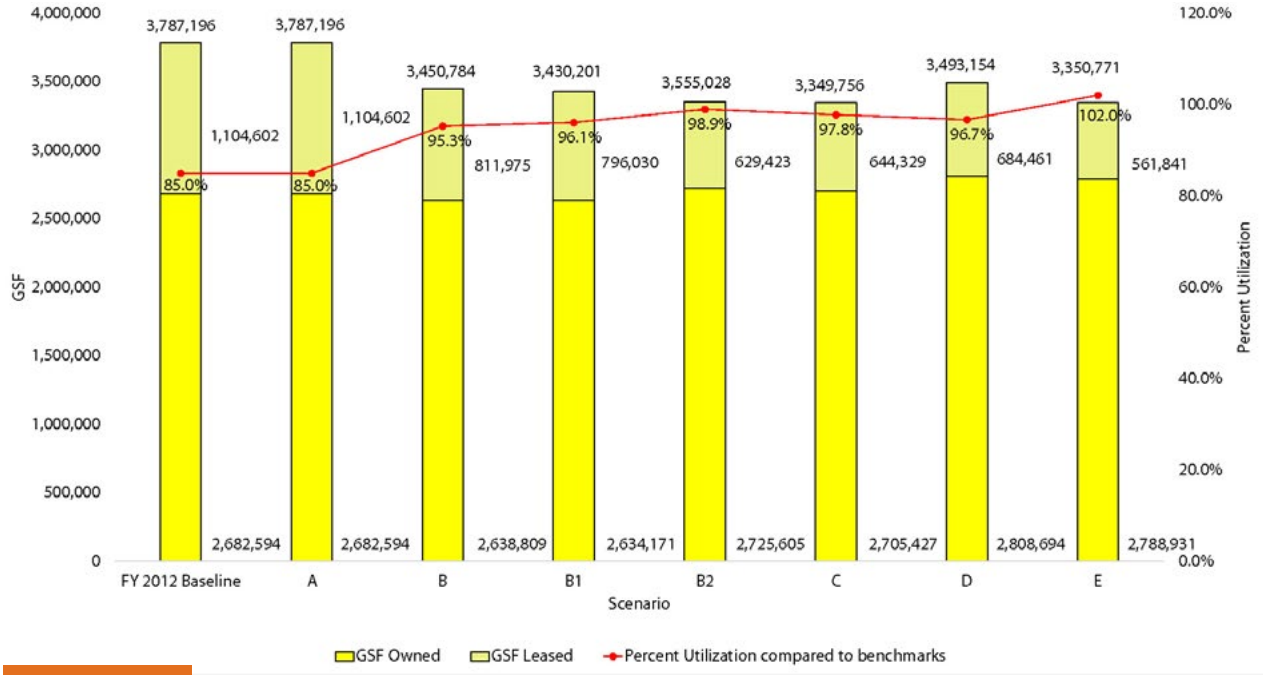

Figure 3.40
GSF utilization by scenario

Cost Analysis

SCENARIO-BASED ENERGY COST SAVINGS

An important factor in a site's life cycle cost analysis is the credit given for utility cost savings where energy improvements are anticipated as part of the effort to improve a facility's condition. As previously stated, the construction cost database employed for use in calculating renovation and replacement costs reflected the cost of constructing a current day, energy efficient laboratory building. The method for determining the value of yearly utility cost savings due to these upgrades for an existing facility was developed based on a review of past EPA Energy Conservation Measure (ECM) reports.

Data from nine sites and nearly 50 ECM proposals was recorded, including energy savings (BTU/yr), initial cost ($) and estimated energy cost savings ($/yr) attributed to each individual ECM. Additionally, the total yearly cost of energy for each site (as stated in the Energy Profiles provided during the data call) was recorded. Using the total area (GSF) and annual energy cost ($/yr) from FY 2012, the Energy Cost Intensity (ECI) ($/GSF) was calculated for each site.

Analysis of the ECM database demonstrated that a maximum investment in energy improvement measures typically accounted for a maximum of 25 percent savings in yearly energy costs. Based on this trend, it was determined that energy savings for each site would range from 10 percent to 25 percent based on the existing Energy Cost Intensity and assuming energy improvements brought the facility up to an FCI of 90.

For simplicity, the estimated percent reduction in energy cost is divided into four ECI bands as shown in "Figure 3.41".

The projected % energy cost savings is adjusted downwards from the maximum values in the Table above (Fig. 3.41) depending on the target FCI. This methodology was applied to calculate the utility cost savings line item included in each Scenario's cost analysis where renovation of an existing facility is pursued.

ECI Range ($/GSF/YR)	Maximum % Energy Cost Savings (FCI 90)
$0.00 – $3.13	10%
$3.13 - $4.14	15%
$4.14 – $5.06	20%
$5.06 - $19.56	25%

Figure 3.41
Energy Cost Savings Chart

LIFE CYCLE COSTING

Life Cycle Costing is an important tool during the evaluation stage of the master planning process. It was used to compare the economics of the current 34 sites with various scenario alternatives. Economic criteria was established based on OMB Circular A-94 and discussions with EPA management. Following is the criteria followed in the life cycle cost analysis:

• Project Life Cycle	30 years	Kirk Assoc. Suggestion,EPA Mgt. Approved
• Real Discount Rate	1.1%	OMB Circular A-94
• Treatment of Inflation	Constant Dollars	OMB Circular A-94
• Base Year Costs	2012	Latest EPA Information Available
• City Cost Index	RS Means Data	EPA Mgt. Approved

Unit Costs

• Baseline Lab Const. Cost	$406 per GSF	SG Historical Data, EPA Approved
• Lab Area Renovation	$375 per GSF	Kirk Suggestion, EPA Mgt. Approved
• Lab/Office Renovation	$150 per GSF	Kirk Suggestion, EPA Mgt. Approved
• Office Area Renovation	$75 per GSF	Kirk Suggestion, EPA Mgt. Approved
• Staff Move Cost	$80,000/ person	EPA Historical Data
• FF&E Move Cost	$5 per GSF	Kirk Suggestion, EPA Mgt. Approved
• Decommissioning Cost	$20 per GSF	EPA Mgt. Approved
• Resale Value	$0 per GSF	Costs Not Credited to EPA

Life Cycle Costs included in the analysis were provided for each site by EPA for the year 2012. These costs were broken down into the following categories:

Initial Costs

Initial Costs

- Facilities Costs
- Lab Equipment Costs
- Site Costs

Replacement Costs/ Salvage Value

Initial Costs

- Facilities Costs
- Lab Equipment Costs
- Site Costs

Annual Costs

Lease Costs

- Rent/ Lease Cost
- Other Lease Cost

Utilities Operations & Maintenance Costs

- Utilities Cost

Facilities Operations and Maintenance Costs

- Hazardous Transport Health Unit Medical Safety, Health & Environmental
- Security Costs
- Expendable Supplies
- Transportation Costs
- IT Support Costs
- Accreditation NRC License

Staffing Costs

- Employee Costs
- Non-federal Employee Costs
- Enrollees, Students Costs

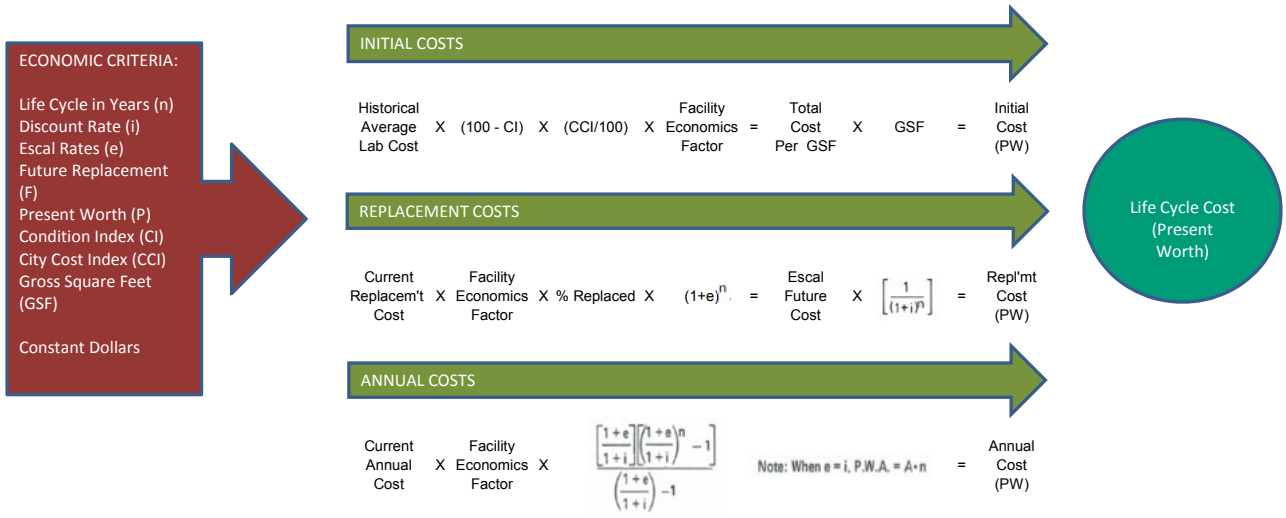

Figure 3.42
Life Cycle Costing (LCC) methodology

LCC Methodology

Each site life cycle cost was calculated based on net present value calculations following accepted engineering economic principles considering the time value of money. The present value (present worth) calculations convert the monies spent at various times to an equivalent cost as of today for comparison of scenarios. This was done for each of the Scenarios identified by the planning team.

Summary Matrix/ Vital Statistics

"Figure 3.43" illustrates the cumulative impact for each Scenario in terms of Area, Quality, and Cost. It also indicates the O&M Cost savings, LCC/ GSF, and Payback Period for each of the Scenarios. The Payback Period is shown in years and based upon funding at $40 million per year.

Cost

A summary of each of the Scenario life cycle costs is presented in present worth dollars in the Life Cycle Cost Executive Summary. For example the following is a summary of Scenario B:

- Capital Cost (for Comparison) $205,056,265
- Capital Cost (for Budgeting) $287,078,771[1]
- Life Cycle Cost (Present Worth) $9,738,858,628
- LCC/ GSF $2,822/ GSF
- O&M Cost (Annual) $374,837,095
- O&M Savings vs. Existing (Annual) $30,989,488
- Simple Payback (If 100% Funded Now) 6.62 years
- Years to Fund Capital Investment 5.13 years

  (Assuming funding level of $40 m/ Yr)
- Simple Payback (If $40 m Funded/ Yr) 8.50 years

1 40% increase includes: construction site work, escalation, A/E fees, contingency

			Scenarios	
		Existing State	A	B
	Number of Sites	34	34	30
Areas (GSF)	Total GSF	3,787,196	3,787,196	3,450,784
	GSF New Addition	--	--	52,864
	GSF Existing Deleted	--	--	384,799
	Change in GSF from Existing State	--	--	-336,412
	GSF Leased	1,104,602	1,104,602	811,975
	GSF Owned	2,682,594	2,682,594	2,638,809
Quality	USF Remaining	2,387,883	2,387,883	2,129,833
	Percent Utilization compared to benchmarks	85.00%	85.00%	95.30%
	Facility Condition Index (FCI weighted avg.)	64.4	75.7	77.4
	Energy Utilization Intensity (EUI)	310.1	280.3	281.6
Cost	Capital Cost	**	$166,958,101	$205,056,265
	Capital Cost for Budgeting	$750,000,000	$233,741,342	$287,078,771
	Life Cycle Cost (PW)	$10,322,005,184	$10,006,741,648	$9,738,858,628
	O&M Cost (annual)	$405,826,583	$386,867,247	$374,837,095
Metrics	O&M Cost Savings compared to existing (annual)	--	$18,959,335	$30,989,488
	LCC/GSF	$2,725.50	$2,642.26	$2,822.22
	Payback (Years) If funded at $40 million / year	--	4.2	5.1

Required USF, no staff changes:	2,029,648

Figure 3.43
Summary matrix of vital statistics

B1	B2	C	D	E
28	23	26	22	19
3,430,201	3,355,028	3,349,756	3,493,154	3,350,771
124,413	379,095	243,657	583,800	638,479
427,095	759,816	527,164	800,847	921,821
-356,995	-432,168	-437,440	-294,042	-436,425
796,030	629,423	644,329	684,461	561,841
2,634,171	2,725,605	2,705,427	2,808,694	2,788,931
2,112,497	2,051,207	2,075,710	2,098,627	1,988,946
96.08%	98.95%	97.78%	96.71%	102.05%
78.5	81.1	79.9	82.4	82.6
281.0	274.8	282.9	274.3	276.5
$231,169,552	$409,510,590	$283,794,653	$380,376,081	$407,301,780
$323,637,372	$573,314,825	$397,312,514	$532,526,513	$570,222,491
$9,682,195,699	$9,400,028,097	$10,029,623,658	$9,985,746,086	$9,902,713,415
$371,582,612	$353,476,959	$383,173,270	$377,650,894	$373,327,700
$34,243,971	$52,349,624	$22,653,313	$28,175,689	$32,498,883
$2,823	$2,802	$2,994.14	$2,858.66	$2,955.35
5.78	10.24	7.1	9.5	10.2

		Scenarios		
		Current State	Future State	
	Existing	A O & M + R & I Improvements	B Improve Footprint & Sustainability	B1
Number of Sites	34	34	30	28
GSF (Addition)		--	52,864	
GSF (Closed Down)		--	384,799	
Total GSF	**3,787,196**	**3,787,196**	**3,450,784**	
Change in GSF (From A to other scenarios)	-	--	(336,412)	
Total USF (Remaining)		2,374,083	2,090,290	
USF (Interior renovation / build out)		--	103,741	

			See Discussion:	
	Existing	**Scenario A**	**Scenario B**	
Capital Cost (for Comparison)		$166,958,101	$205,056,265	
Capital Cost (for Budgeting)		*$233,741,342*	*$287,078,771*	
Life Cycle Cost (PW)	$10,322,005,184	$10,006,741,648	$9,738,858,628	
LCC/ GSF	$2,725.50	$2,642.26	$2,822.22	
O&M Cost (Annual)	$405,826,583	$386,867,247	$374,837,095	
O&M Savings Compared to Existing (Annual)		$18,959,335	$30,989,488	
e Payback (Years) If 100% Funded Immediately		**8.81**	**6.62**	**6.75**

Figure 3.44
LLC Scenario Summary

B1 Improve Footprint & Sustainability	B2 Improve Footprint & Sustainability	C Minor Consolidation / Change	D Moderate Consolidation / Change	E Major Consolidation / Change
28	23	26	22	19
124,413	379,095	243,657	583,800	638,479
427,095	759,816	527,164	800,847	921,821
3,430,201	**3,355,028**	**3,349,756**	**3,493,154**	**3,350,771**
(356,995)	(432,168)	(437,440)	(294,042)	(436,425)
2,112,497	2,051,207	2,087,917	2,110,835	2,056,053
		164,912	164,912	141,512

Scenario B1	Scenario B2	Scenario C	Scenario D	Scenario E
$231,169,552	$409,510,590	$283,794,653	$380,376,081	$407,301,780
$323,637,372	*$573,314,825*	*$397,312,514*	*$532,526,513*	*$570,222,491*
$9,682,195,699	$9,400,028,097	$10,029,623,658	$9,985,746,086	$9,902,713,415
$2,822.63	$2,801.77	$2,994.14	$2,858.66	$2,955.35
$371,582,612	$353,476,959	$383,173,270	$377,650,894	$373,327,700
$34,243,971	$52,349,624	$22,653,313	$28,175,689	$32,498,883
6.75	**7.82**	**12.53**	**13.50**	**12.53**

LCC PER GSF

An economic measure of each site is the life cycle cost (LCC) per gross square foot (GSF) of building space. The LCC cost includes the capital investment cost plus the operations & maintenance, plus the staffing costs over 30 years expressed in present woth dollars.

A comparison of the cost for each EPA site across each of the five scenarios begins with the average LCC per GSF for Scenario A of $2,000/GSF. Moving from Scenario A to Scenario E, the life cycle costs generally decrease for most sites. Exceptions include those that are receiving EPA labs that are being moved from other locations. Opportunities exist to continue to reduce the higher cost sites on a LCC per GSF basis as refined master plans are developed for the sites.

SCENARIO SUMMARY

Scenario A- Renovations and Improvements with Sustainability

Scenario A includes O&M, R&I and sustainability improvements. Existing laboratory facilities are renovated to the recommended Facility Condition Index and meet EPA sustainability guidelines.

- Capital B&F funding assumed to increase from $25M/yr to$40M/yr.
- ROI 8.81 yrs if funded at 100% immediately.
- All 34 sites programs remain as currently distributed with 3.787M GSF
- Space utilization remains at current levels 85% compared to external benchmarks
- Facility condition Index improves to FCI 82 for owned facilities, FCI 60 for leased facilities – composite weighted avg. FCI 75.7
- Energy Utilization improves to EUI 280.3
- Lease space remains at 1.105M GSF, Owned space 2.682M GSF

Scenario B-Minor Consolidation + Scenarios B1 & B2 Minor Consolidation Plus Some Additional

Scenario B consolidates 4 sites to total 30 sites for 3.45M GSF, several of which are in process. Scenarios B1 & 2 are hybrids of B plus some additional 2- 5 sites at 3.43M GSF to 3.355M GSF

- Capital B&F funding needs to increase to $40M/yr threshold with various levels of return on investment periods, ROI 6.62 yrs.
- B1 / B2 - A special $150M appropriation is required for west hub consolidation, ROI 6.75 / 7.82 yrs
- Space utilization improves to range of 95.3% to 98.5 % utilized
- Facility condition Index improves to weighted avg. composite FCI 77.4
- Energy Utilization improves to EUI 281.6 or better
- Leased space decreases to 812K GSF to potentially 629K GSF

Scenario C- Moderate Consolidations

Scenario C consolidates programs to 26 sites with 3.35M GSF

- Capital B&F funding needs to grow to the $40M/yr threshold for initial capital plan years, ROI 12.53 yrs
- Space utilization improves to 97.8% utilized
- Facility condition Index improves to composite weighted avg. FCI 79.9
- Energy Utilization improves to EUI 282.9
- Leased space reduces 644.3K GSF

Scenarios D & E- Major Consolidations

Scenario D consolidates programs to 22 sites with 3.93M GSF

Scenario E consolidates programs to 19 sites with to 3.350M GSF

- Capital B&F funding needs to grow to $65M level/yr threshold for initial capital plan years. A special $150m capital appropriation is required for a western hub consolidation and new site acquisition.
- Space utilization improves to 96+% to fully utilized
- Facility condition Index improves–composite weighted average range FCI 82.4 for 3.49M GSF and FCI 82.6 for 3.35M GSF
- Energy Utilization improves to EUI 274.3 and EUI 276.5 respectfully
- Lease space reduces to range of 684.4K GSF - 561.8K GSF

Figure 3.45
Cash Flow Analysis: Scenario A (12 year pay back period)

CASH FLOW ANALYSIS

The following figures illustrate the pay back period for each scenario, based on $40 million annual funding. The point on the graph where the two lines cross indicates the payback period.

The actual budget for the scenario would include other costs, such as escalation and design fees, that are not known at this time and therefor are not reflected in this graph. Graph are provided for comparing alternatives only to select preferred alternative.

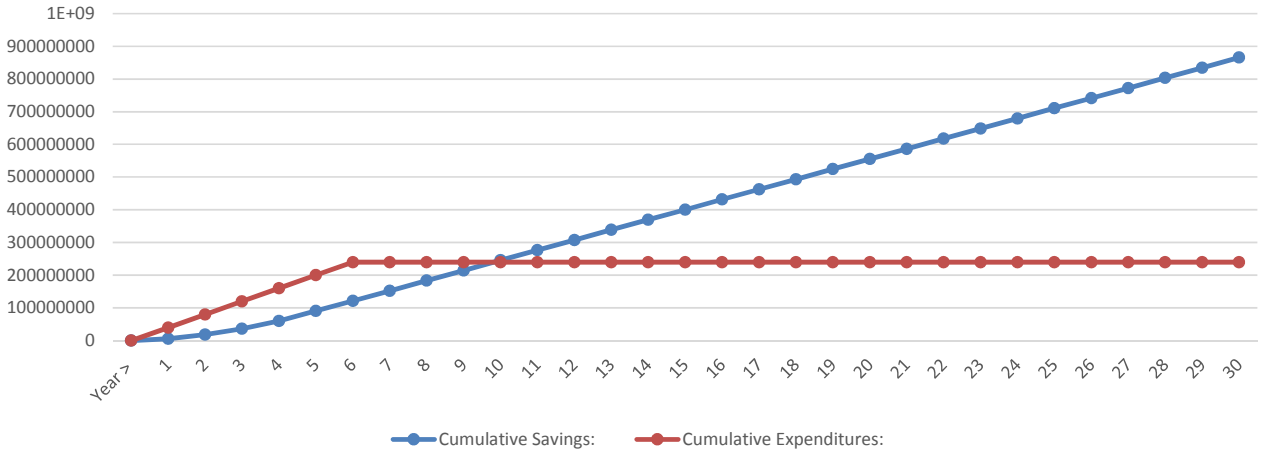

Figure 3.46
Cash Flow Analysis: Scenario B (10 year pay back period)

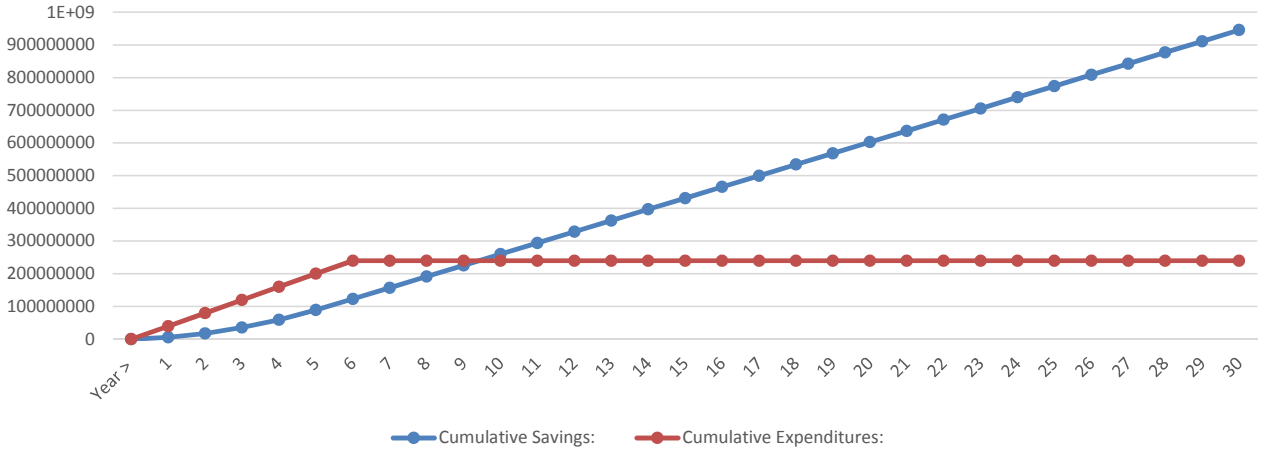

Figure 3.47
Cash Flow Analysis: Scenario B1 (9.5 year pay back period)

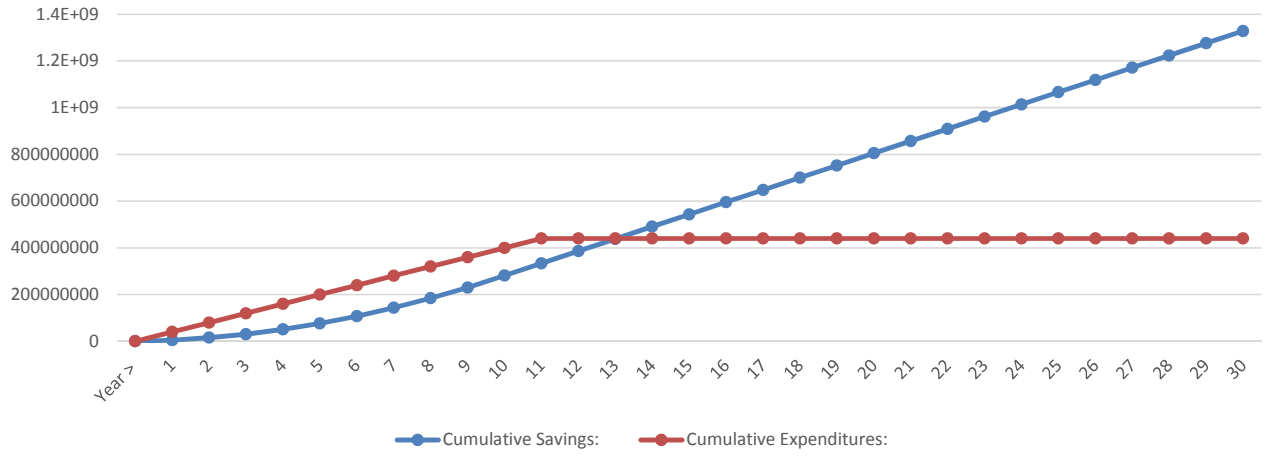

Figure 3.48
Cash Flow Analysis: Scenario B2 (13 year pay back period)

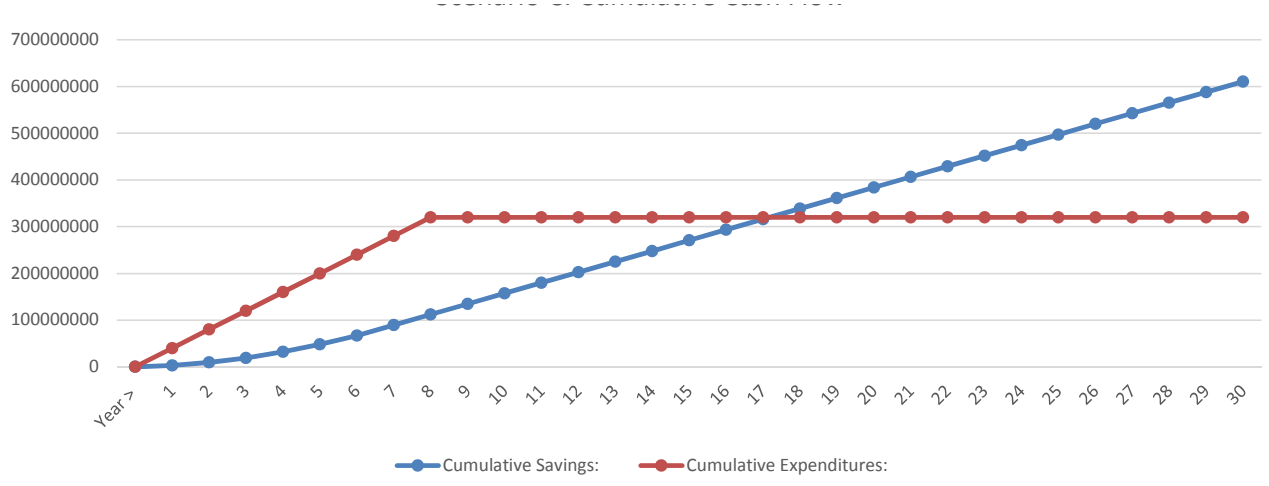

Figure 3.49
Cash Flow Analysis: Scenario C (17 year pay back period)

Figure 3.50
Cash Flow Analysis: Scenario D (15.5 year pay back period)

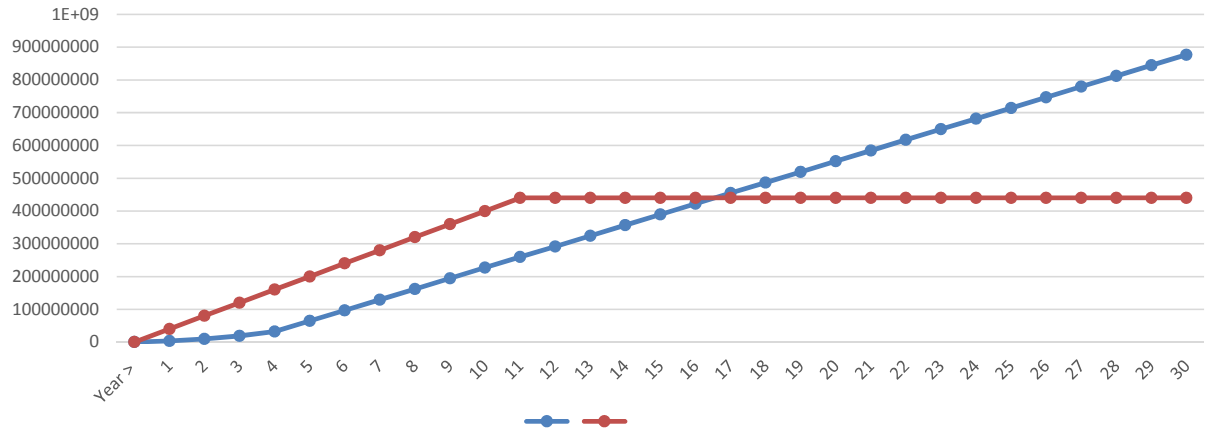

Figure 3.51
Cash Flow Analysis: Scenario E (16.5 year pay back period)

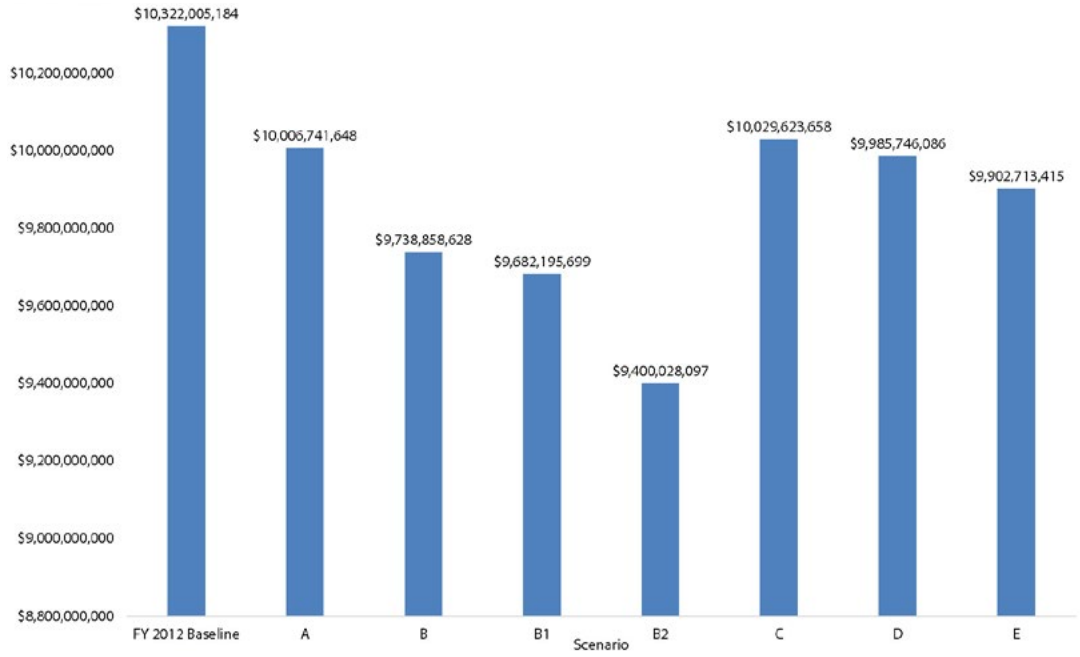

Figure 3.52
Life cycle cost present worth (30 years)

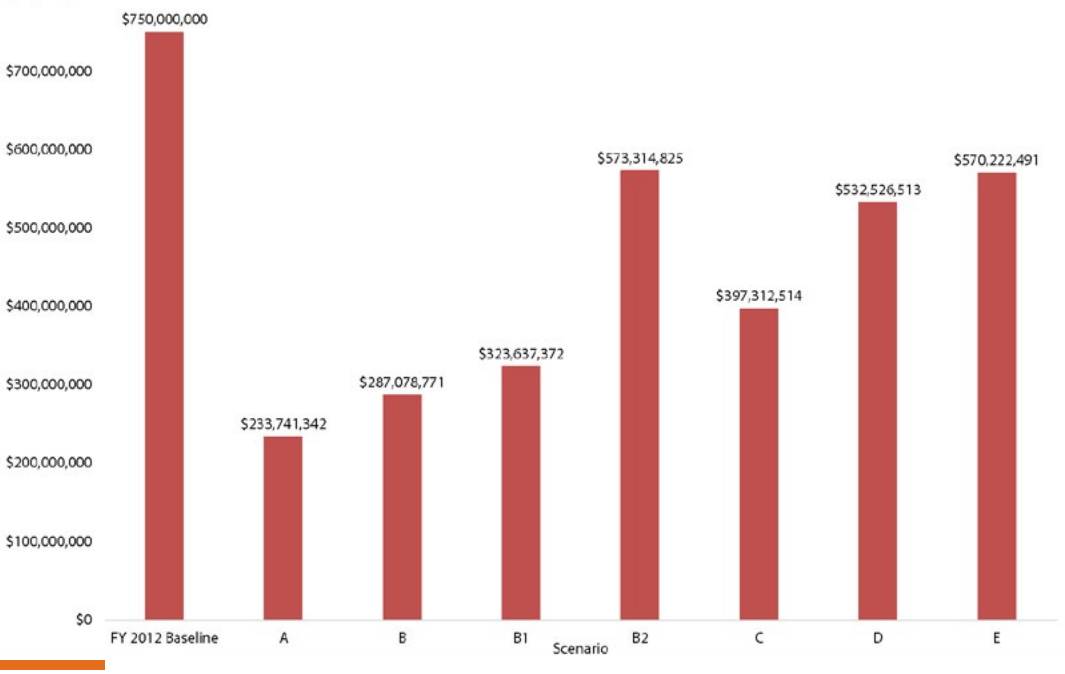

Figure 3.53
Capital cost for budgeting