Results Measurement System
Aggregate Report

As of December 31, 2018

Contents

I. Summary of Results

As of December 31, 2018, the North American Development Bank has certified and funded 254 environmental infrastructure projects, of which 215 have been built and are operational. A total of 106 of these operational projects have undergone a closeout process to verify their actual performance versus the intended performance at certification. This report documents the aggregate results of these 106 projects. An additional 81 projects are operational but have not yet been closed out, thus the actual impact of the Bank's projects is greater than the results verified and presented in this report.

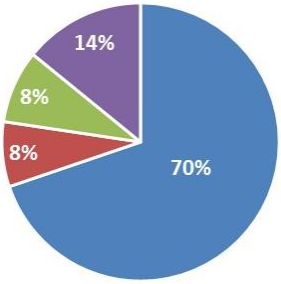
IMPACT OF 106 IMPLEMENTED PROJECTS WITH CLOSEOUT REPORTS

4	water treatment plants with a combined capacity of 57.7 mgd and 208 miles of water lines serving 106,116 people
28	wastewater treatment plants with a combined capacity of 260 mgd and 945 miles of sewer lines serving 3.6 million people
1	water conservation project for an irrigation district, saving 17 cubic feet per second of water
3	storm water projects with 21.5 miles of collectors and 386 acre-feet of reservoir capacity, safeguarding the homes of 820,647 people
3	sanitary landfills and 92 vehicles handling 1,363 metric tons/day of waste, benefiting 2.3 million people
5	roadway improvement projects providing 6.9 million square meters of paved streets and preventing 1,253 metric tons per year of airborne particles (PM_{10})
2	public transportation projects providing 343 low-emission vehicles, serving 3.5 million people and displacing 2,554 metric tons of CO_2e per year
15	clean energy facilities with a combined generation capacity of 1,134 MW producing 3,133 GWh of electricity to benefit 5.3 million people and displacing the emission of 1.7 million metric tons of CO_2e per year

CO_2e = Carbon dioxide equivalent; GWh = gigawatt-hour; mgd = million gallons a day; MW = megawatt

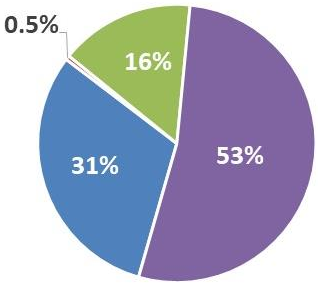
IMPACT OF 106 IMPLEMENTED PROJECTS WITH CLOSEOUT REPORTS

Number of Projects



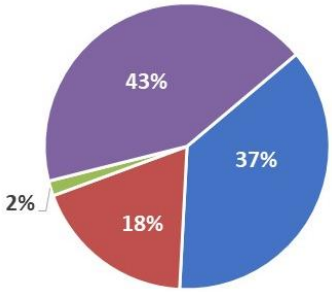
106 projects

Total NADB Funding



US$1,507 million

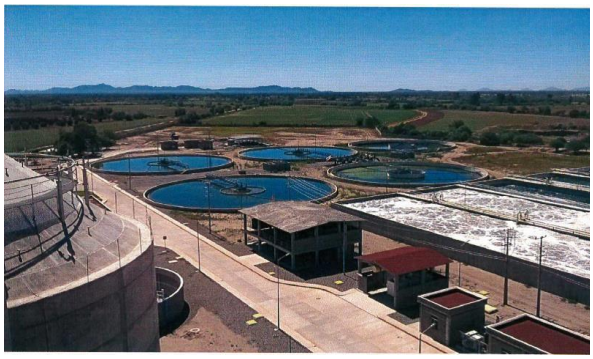
Population Benefitting



12.35 million*

Water	Waste Management	Air Quality	Clean Energy
▪ Drinking water ▪ Wastewater ▪ Storm water ▪ Water conservation	▪ Solid waste disposal ▪ Solid waste collection	▪ Concrete paving ▪ Asphalt paving ▪ Public transportation ▪ Basic urban infrastructure	▪ Wind energy ▪ Solar energy ▪ Biogas

* To avoid double counting populations benefitting from more than one project, the graph does not include 3.5 million people benefiting from public transportation projects.



II. Introduction

For the North American Development Bank (NADB), it is important to know that the projects it finances are not only completed as approved, but also that they perform as intended to improve the environment and related health conditions for border residents. To that end, a Results Measurement System (RMS) was developed that includes a closeout process (COP) for all projects certified and implemented since 2006.[1] NADB prepares and submits closeout reports for individual projects to its Board of Directors, as well as provides periodic reports of aggregate closeout results, which are also published in its annual reports. This second aggregate closeout report provides the cumulative results for the different infrastructure sectors based on several indicators, as well as lessons learned, for the projects that have undergone a closeout process through December 2018.

III. Results Measurement System

The purpose of the RMS is to provide an objective assessment of project outcomes and performance, as a means of determining whether implemented projects are generating the results anticipated at certification, as well as to measure those results. It also serves to provide important feedback on lessons learned and best practices to be applied to future projects.

The RMS reflects the experience and best practices of other multilateral development banks, with an emphasis on simplicity and cost-effectiveness. The logic-based results chain is designed as a continuous system where the inputs produce outputs that generate outcomes based primarily on access to the infrastructure (Box 1). By providing access, positive impacts should be achieved based on the intended use of the infrastructure.

Box 1: Results Chain Components

- ✓ ***Inputs*** – The resources used and actions taken to generate outputs, which are established in the project proposal and tracked as part of the day-to-day activities of project implementation (through funding disbursement and monitoring processes).
- ✓ ***Outputs*** – The tangible goods and services produced by the project, which are measured to determine whether the project deliverables were achieved as certified, in terms of their physical characteristics (i.e. size, capacity, technology), schedule, costs and funding structure.
- ✓ ***Outcomes*** – The results likely to be achieved from the project outputs, which are measured as access to or performance of the infrastructure.

A result matrix that defines the project objectives, baseline and target values, and the indicators for measuring results, is developed for every project and included in the project proposal submitted to the Board of Directors for approval.[2] Figure 1 illustrates the relationship between the project cycle and the results chain, with the RMS integrated on a parallel track to review and document the achievement of the anticipated results. Figure 2 illustrates the possible components for the results matrix of a wastewater project.

[1] In accordance with Board Resolution 2006-38.
[2] A result matrix began being applied to every project in 2008.

Figure 1
RELATIONSHIP OF THE RESULTS CHAIN TO THE PROJECT CYCLE

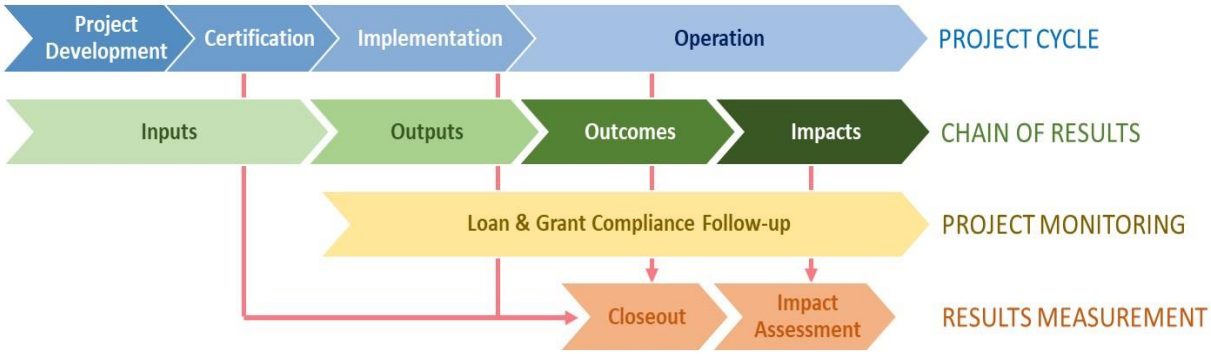
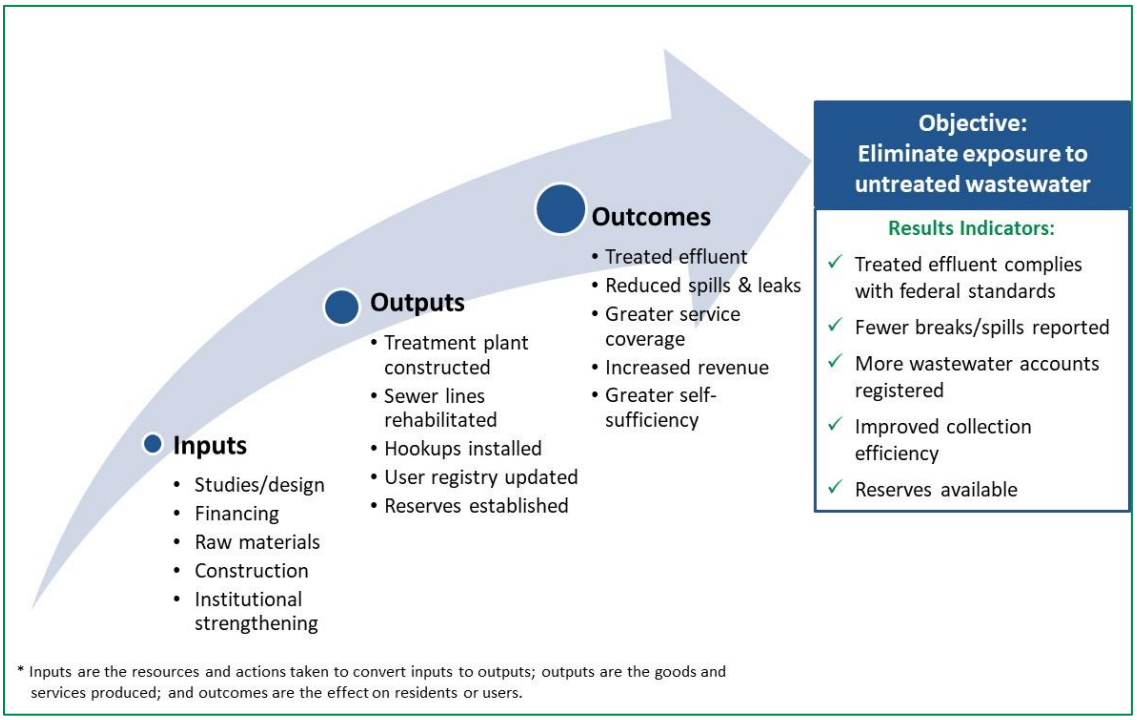


Figure 2
SAMPLE RESULTS CHAIN FOR A WASTEWATER PROJECT



To standardize the performance assessment of each project, a menu of output and outcome indicators has been developed for each sector under the NADB mandate. Each indicator was selected considering its appropriateness for representing the change in status of the most important environmental or human health conditions addressed by the project: prior to (baseline) and following (post intervention) project implementation; as well as for its simplicity, representativeness, feasibility and verifiability. Appendix A contains the list of output and outcome indicators used in the closeout reports and cumulatively reported in this aggregate report.

The RMS consists of two components: a closeout process conducted after the project has been in operation for at least a year and an impact assessment for selected projects. The closeout report verifies whether the project was constructed as approved and has been operating as intended, while the impact assessment is performed to ascertain the actual impact of the project on specific environmental and human health indicators in the long-term.

Project Closeout Process

The closeout process for environmental projects serves to assess and document the achievement of the fundamental objectives of a project with respect to the investments made and the infrastructure built, or equipment and services provided. It is an effective tool for measuring results, as it provides the opportunity to confirm the extent to which physical targets (outputs) were met and the intended results (outcomes) have been achieved. It's also a source of valuable feedback for improving practices (success factors and lessons learned) through on-site observations and direct dialogue with project sponsors and operation personnel.

The closeout process is usually conducted one year after initiation of project operations. Project data is collected from construction records, field visits and interviews with key stakeholders. Actual project results are then compared against those projected in the results

Box 2: Closeout Process Evaluation Objectives

Evaluate actual construction/operation conditions vs projected conditions at certification

- ✓ Were all construction components (outputs) completed?
- ✓ Is the infrastructure operating as anticipated?
  - Technical – capacity, efficiency, quality, operator training
  - Financial – revenue, reserves, management
- ✓ Were the uses and sources of funds modified?
- ✓ Was the anticipated access to service (outcome) achieved?

Determine causes for deviations (lessons learned)

- ✓ Identify what may have influenced the deviation
  - Insufficient funding / fluctuating costs
  - Design or operation issues
  - Unanticipated conditions – climate, land, customer factors
- ✓ Create a feedback loop to determine if the success factors and lessons learned can be applied to future projects.

matrix at certification to determine the level of achievement of the anticipated outputs and outcomes (Box 2). The results of this evaluation are documented in a closeout report.

In accordance with NADB Board instructions, a closeout process is completed for all certified projects funded by NADB since 2006. The resulting closeout reports are submitted to the Board as they are completed. Additionally, per the requirements of the U.S. Environmental Protection Agency (EPA), a closeout process must be conducted for all projects funded through the Border Environment Infrastructure Fund (BEIF) since program inception. A full report prepared in accordance with EPA guidelines is provided for BEIF projects funded since 2006; however, in the case of older BEIF projects, only a fact sheet is produced.

An electronic tracking tool was developed to document the universe of projects eligible for closeout and their status. The tracking tool is a database that includes the performance of each project with respect to its applicable output and outcome indicators. Its main purpose is to facilitate the aggregation of results by indicator and sector.

Impact Assessment

An impact assessment is the next logical step in the measurement of results by shedding light on whether the implemented project is indeed achieving its fundamental objective—having an impact beyond its physical outputs and outcomes—by providing environmental and health benefits to the intended population. Impact assessments are part of NADB's standard operating procedures and are conducted for projects where the assessment is deemed valuable and feasible. Due to limited resources, projects are selected carefully for development of an impact assessment.

IV. Aggregate Results

Closeout Reports by Funding Program

As of December 31, 2018, a total of 254 projects have been certified and funded, of which 187 implemented projects are eligible for closeout as they have been in operation for at least one year. As of the same date, a total of 106 closeout reports have been completed and their factsheets are available for review on the NADB website.[3] A pipeline of 81 projects were pending closeouts as of December 2018. A breakdown of the projects by funding program is provided in Table 1.

[3] A closeout report is considered complete once it is approved by the Chief Environmental Officer (CEVO) and delivered to the Board (in the case of NADB-funded projects) or to EPA (in the case of BEIF-funded projects).

Table 1
STATUS OF CLOSEOUT PROCESS BY FUNDING PROGRAM

Funding Source	Period	Projects Ready for Closeout	Closeout Reports Completed
BEIF	1997-2005	38	11
	2006-2018	38	29
Loan-BEIF	1997-2005	13	8
	2006-2018	17	13
Loan	2006-2018	58	30
Loan-SWEP	2006-2018	1	1
SWEP	2006-2018	7	6
CAP	2006-2018	12	7
WCIF	2006-2018	3	1
Total:		**187**	**106**

BEIF – Border Environmental Infrastructure Fund; CAP – Community Assistance Program; SWEP – Solid Waste Environmental Program; WCIF – Water Conservation Investment Fund

The total cost of the 106 projects that have completed the closeout process was US$3.93 million, approximately 2.2% less than the amount estimated at certification (US$4.01 billion). NADB provided loans and grants totaling US$1.5 billion to help finance those projects, as shown in the following table.

Table 2
PROJECT FUNDING COMPARISON – CERTIFICATION vs. ACTUAL
(US$ Millions)

NADB Funding for the 106 Closed-out Projects*	Estimated at Certification	Actual at Closeout
Loans	1,330.0	1,227.3
CAP grants	3.4	2.8
Other NADB grants	4.6	4.2
BEIF grants	281.9	272.7
Total	**1,619.8**	**1,507.2**

* BEIF – Border Environmental Infrastructure Fund; CAP – Community Assistance Program; Other grants were provided through the Solid Waste Environmental Program (SWEP) and Water Conservation Investment Fund (WCIF)

Closeout Reports by Project Type

The number of project closeout processes completed increased by 46 (77%) from the first Aggregate Report dated December 2016. Table 3 shows the breakdown of completed closeout reports by sector.

Table 3
EVOLUTION OF COMPLETED CLOSEOUT REPORTS

Sector	Total Reports Completed		Difference
	By December 2016	By December 2018	
Water and wastewater	48	70	22
Solid waste	7	8	1
Air quality	1	5	4
Clean energy	2	15	13
Water conservation	1	1	0
Public transportation	0	2	2
Basic urban infrastructure	1	2	1
Storm water management	0	3	3
Total:	**60**	**106**	**46**

The most significant change from the previous aggregate report is in the clean energy sector, which increased from 2 to 15 closeout reports.

Aggregate Results by Project Type

This second aggregate report compiles the results for all 106 BEIF and NADB-funded projects—67 in Mexico and 39 in the United States—which had completed the closeout process as of December 31, 2018. The most important aggregate indicators for those projects are presented below.

Drinking Water – 18 Projects
(10 water + 8 water/wastewater)

ACTUAL OUTPUTS		ACTUAL OUTCOMES		% OF GOAL ACHIEVED
4	water treatment plants with a combined capacity of **57.7** mgd	**106,116**	people benefitted	
208	miles of new distribution lines	**39.4**	mgd of water treated and distributed	→ **100%**
5.5	million gallons of water storage capacity constructed	**13,421**	residential hookups installed	→ **84%**

mgd = million gallons a day

Wastewater – 60 Projects

(52 wastewater + 8 water/wastewater)

ACTUAL OUTPUTS		ACTUAL OUTCOMES		% OF GOAL ACHIEVED
28	wastewater treatment plants with a combined capacity of **260** mgd	**3.6**	million people benefitted	
945	miles of collection lines and **30** lift stations	**204**	mgd of wastewater treated	→ **93%**
598	decommissioned septic tanks	**363,222**	residential sewer connections	→ **91%**

mgd = million gallons a day

Solid Waste – 8 Projects

ACTUAL OUTPUTS		ACTUAL OUTCOMES		% OF GOAL ACHIEVED
3	sanitary landfills with a combined capacity of **294,945** cubic meters	**2.3**	million people benefitted	
3	new transfer stations	**1,363**	metric tons/day of solid waste properly managed	→ **133%**
5	illegal/substandard dump sites closed	**1.9**	acres of dumpsites closed	→ **100%**
92	collection and landfill operation vehicles			

Water Conservation – 1 Project

ACTUAL OUTPUTS		ACTUAL OUTCOMES		% OF GOAL ACHIEVED
2	miles of improved water conveyance canals	**1,155**	people benefitted	
		17	cubic feet per second of water saved	→ **100%**

Storm Water Management – 3 Projects

ACTUAL OUTPUTS		ACTUAL OUTCOMES		% OF GOAL ACHIEVED
21.5	miles of storm water collectors	**820,647**	people benefitted	→ **100%** ●
386	acre-feet of reservoir capacity	**122,493**	households benefitting from storm water infrastructure	
175	cubic feet/second of pumping capacity			

Roadway Improvement (air quality) – 5 Projects

ACTUAL OUTPUTS		ACTUAL OUTCOMES		% OF GOAL ACHIEVED
6.9	million square meters of street and road surface paved	**183,980**	people benefitted	→ **126%** ●
		1,578	metric tons/day of suspended particulate matter (PM_{10}) prevented	

Clean Energy – 15 Projects

ACTUAL OUTPUTS		ACTUAL OUTCOMES		% OF GOAL ACHIEVED
1,134	megawatts (MW) of new generation capacity from renewable sources	**5.3**	million people benefitted	
6	solar photovoltaic parks	**3,133**	gigawatt-hours (GWh)/ year of power generation	→ **83%** ●
7	wind farms	**1.7**	million mTCO2eq/year of greenhouse gas emissions displaced	→ **86%** ●
1	biogas plant	**4,083**	metric tons/year of other harmful emissions displaced	→ **80%** ●

mTCO2eq = metric tons of carbon dioxide equivalent

Public Transportation – 2 Projects

ACTUAL OUTPUTS		ACTUAL OUTCOMES		% OF GOAL ACHIEVED
343	vehicles with low-emission technology	3.5	million people benefitting	
		2,554	$mTCO_2eq$/year of greenhouse gas emissions displaced	→ 381%
		173	metric tons/year of NOx and HC emissions displaced	→ 159%

$mTCO_2eq$ = metric tons of carbon dioxide equivalent; NOx = Nitrogen oxides; HC = Hydrocarbons

V. Lessons Learned in the Clean Energy Sector

Each closeout report contains a section on lessons learned, including what worked well (best practices) and opportunities for improvement. This data is also analyzed and included in the tracking tool to determine commonalities among the projects. The 2016 aggregate closeout report focused on the most common lessons learned for water, wastewater and solid waste projects. Since the clean energy projects now represent a significant portion of the completed reports, this report focuses on lessons learned for future projects in this sector.

Internal Process Perspective

- ✓ Operating report templates are now defined in advance and included in the loan agreement, which allows the Bank to receive the information required for project follow-up on time and in the format specified.

Technical Perspective

- ✓ A power performance test is not generally required but it should be performed when a new facility does not meet its performance expectations to find potential design flaws that may be the responsibility of the equipment supplier. If required, this test should be performed as soon as possible and within the warranty period.

Financial Perspective

- ✓ The loan agreement must require the performance of end-of-warranty turbine inspections. The scope and results of such inspections must be provided to lenders.

Schedule Perspective

- ✓ To avoid any delays in achieving project completion and the expected commercial operation date (COD), a thorough review of interconnection requirements and close coordination with the power grid operator are extremely important.

Communication Perspective

- ✓ Development and implementation of renewable energy projects on U.S. government property (*i.e.* military bases) represent additional challenges and require close coordination and effective communication among all parties involved, so that project delays can be avoided during the construction and commissioning phases.

VI. Conclusions

The cumulative results for most indicators demonstrate achievement of at least 90%, and in some cases over 100%, of the targets at project certification. This success indicates that an adequate planning and certification process was conducted, and that construction oversight and the required follow-up were performed correctly to ensure good project outputs.

The performance demonstrated by the closeout reports for projects in the clean energy sector is somewhat lower than that of other types of projects. Four major factors explain why these indicators are below expectations.

1. *Probabilistic nature of the wind/solar resource*. Wind and solar energy projects rely on the actual availability of the resource to produce electricity, yet the project development and design is based on historical data. Some degree of variability in the yearly production of energy is expected, but the closeout reports are based only on the first year of operation, which may or may not be representative of an average year throughout the life of the project. The Bank should consider using more than one year of performance data to evaluate these types of projects or periodically revisiting projects that showed lower than expected results during closeout.

2. *Development of the results matrix during the early stages of project certification*. NADB's processes call for the results matrix to be included in the certification proposal sent to the Board of Directors. Clean energy projects are typically certified with preliminary information available from the Sponsor. The in-depth technical due-diligence review performed by the independent engineer, which refines the project and the expected results, is typically done after certification. Changes in the project scope and expected performance provided by the independent engineer are then used during financial closing, but the results matrix is not updated. The actual project results evaluated during project closeout are compared to the original results matrix, disregarding any adjustments made to the scope and expected performance of the project. In these cases, projects may be performing as expected according to the final design but may not be aligned with the expectations set in the original results matrix at certification. The Bank should consider updating the data included in the results matrix for projects after certification or during the closeout process when necessary.

3. *Usage of emission factors that change over time*. As new power plants are connected to the grid, the state energy matrix and emission factors change. From the time of certification to the closeout of a project, these emission factors could change significantly. As the Bank's processes dictate, the performance of projects regarding displaced emissions is calculated with the actual power being generated and the emission factors for the corresponding state at the time of the closeout. The emissions displaced calculated in this manner are then compared to the results matrix, which in

some cases used different emissions factors, creating a "moving target" for our results measurement system, that is currently not being considered.

4. *Technical issues*. In projects of the magnitude of the wind farms and solar parks financed by the Bank, it is not uncommon for some technical issues to occur during the first year of operation. These issues include the failure of some solar panels, their components or their tracking systems; problems with blades on wind turbines that may even be covered by warranties; and other similar issues that are typically resolved during the first several months of operation. During these first few months of operation, performance of the facility is not at its peak, and yet it is the first year of operation that is used during closeout to evaluate performance. The Bank should consider using a longer operation period to evaluate performance of the clean energy projects or allow for a period of operational stability before conducting the closeout process.

As the Bank gains more experience in the closeout and results measurement processes, the actual results should fall closer to the expectations set forth during project development.

Appendix A: Output and Outcome Indicators

Outputs Indicators

Drinking water projects

- Length of distribution lines (miles)
- Number of domestic hookups
- Drinking water plant capacity (mgd)
- storage capacity (#, mg, % increase)
- Water meters (#)

Wastewater projects

- Length of collection lines (miles)
- Number of connections
- Number of lift stations (new or improved)
- Capacity of treatment plants (new, expansion or rehabilitation) (mgd)

Solid waste projects

- Solid waste transfer stations (new or improved) (#, metric tons/day)
- Capacity of sanitary landfills (new, expanded or rehabilitated (#, m^3)
- Acquisition of solid waste collection vehicles (#)

Roadway improvement projects

- Roadways paved w/concrete (sq. meters)
- Roadways paved w/asphalt (sq. meters)

Clean energy projects

- Number of power generation facilities by type
- Power generation capacity by type of facility (MW)

Water conservation projects

- Length of improved irrigation canals (miles)

Public transportation projects

Acquisition of low-emission technology vehicles (#)

Storm water projects

- Length of storm water collectors (miles)
- Reservoir capacity (acre-feet)
- Storm water pumping capacity (cubic feet/second)
- Culverts (#)

Outcomes indicators

Drinking water projects

- Population benefitting (#)
- Increased treatment/distribution (mgd)
- Improved water quality (mgd)
- Number of residential water hookups (#)

Wastewater projects

- Population benefitting (residents)
- Increased treatment capacity (mgd)
- Reduction in untreated WW discharges to water bodies (mgd)
- Number of residential sewer connections

Solid waste projects

- Population benefitting (residents)
- Improved solid waste disposal management (metric tons /day)
- Closure of illegal/substandard dumpsites (#, acres)

Roadway improvement projects

- Population benefitting (residents)
- Airborne particulate matter emissions avoided (mT PM_{10}/year)

Clean energy projects

- Population benefitting (eq. residents)
- Power generation (GWh/year)
- Greenhouse gas emissions displaced (metric tons CO_2 eq/year)
- Other harmful emissions displaced (metric tons/year: SO_2 and NOx)
- Biodiesel production (mg/year)

Water conservation projects

- Population benefitting (residents)
- Yearly volume of water saved (mg/year)

Public transportation projects

- Population benefitting (eq. residents)
- Greenhouse gas emissions displaced (metric tons CO_2 eq./year)
- Other harmful emissions displaced (metric tons/year: SO_2, NOx)

Storm water projects:

- Population benefitting (eq. residents)
- Households directly benefitting from storm water infrastructure (#)
- Pump station capacity (cubic feet/second)
- Length of storm water collectors (miles)