An Overview of MAP-21 Funding Options

Emphasizing CMAQ Programs

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FUNDING RESOURCES AND OPPORTUNITIES

>> What are my funding options?

The Moving Ahead for Progress in the 21st Century Act (MAP-21) was established in 2012, creating a streamlined, performance-based, and multimodal program designed to address the transportation system challenges currently facing the United States. A program with goals that have been growing and expanding since 1991, MAP-21 is structured into six core programs, two formula programs, and one discretionary program (see Appendix A for a complete list). Among the goals for these funds are to improve safety, maintain infrastructure conditions, reduce traffic congestion, improve system efficiencies and freight movement, protect the environment, and reduce delays in project delivery. Intersection projects aimed at improving capacity, upgrading traffic signal equipment, and traffic signal timing improvements, including adaptive signal control, can be funded through the Surface Transportation Program (STP), Discretionary Grant Programs, and the Congestion Mitigation and Air Quality Improvement Program (CMAQ).

>> What is STP?

The Surface Transportation Program (STP) was reinstated with MAP-21 and provides funds to states and localities for projects that seek to preserve or improve conditions and performance on any federal-aid highway, build facilities for nonmotorized transportation including public bus terminals and facilities, bridge projects on any road, and transit capital projects. Each year, an average of $10 billion in funds are allocated through this program. Half of this money is given to states for use in areas of their own discretion; the other fifty percent is suballocated to areas based on population.

>> What are Discretionary Grant Programs?

Discretionary Grant Programs provide funding for special categories of State Highway Projects. In 2012 alone, over $363 million was allocated to fund highway improvements through these grants, from interstate rehabilitation and reconstruction to technologies that will improve safety and reduce congestion. This program is established by the Federal Highway Administration (FHWA) and is organized into 12 grant programs (see Appendix B); funds are available to all 50 states, the District of Columbia, and Puerto Rico.

>> *What is CMAQ?*

One of the most popular funding mechanisms aimed at improving traffic flow and congestion in the United States, as well as improving air quality, is the Congestion Mitigation & Air Quality (CMAQ) Improvement Program. The main goal of this program is to provide flexible funding options for projects and programs that are seeking to meet the requirements and amendments of the Clean Air Act (CAA). Since the program's inception, it has funded over 16,000 projects that contribute to helping urban areas meet air quality goals, improving mobility, and reducing traffic congestion. These traffic flow improvement projects, which may include traffic signalization and intersection enhancement, are designed to improve traffic speeds and minimize delays experienced by drivers.

Improving air quality is a core goal of the CMAQ program, so the majority of the projects seek to reduce motor vehicle emissions. There are three ways this is achieved:

1. through the encouragement of alternate methods of travel, thus reducing motor vehicle miles traveled (VMT);
2. using technology to reduce emissions; and
3. improving traffic flow, which will be the main focus of this White Paper.

In order to apply for CMAQ funds and financially support this kind of project, applicants will need to analyze the data to estimate the expected delay and emissions reductions, including particular attention to pollutants. Although this can be tedious, there are effective solutions that have been developed to assist with the extraction and calculation of this data.

TIP:

Be sure to review local policies. In addition, several state or county agencies allocate funds for transportation project goals that are similar to those outlined within CMAQ.

CMAQ was created in 1991 and has been reauthorized through a variety of acts. Most recently, the program was expanded and improved to include particulate matter (PM) as one of the pollutants addressed through MAP-21. The average amount of federal funding received for CMAQ projects is 80 percent; if projects also focus on safety efforts, they may be covered up to 100 percent. The selection process is very transparent and public, and involves several parties: Metropolitan Planning Organizations (MPOs), a state's Department of Transportation (DOT), and transit agencies. Among the factors that are considered when selecting projects are emission benefits, cost effectiveness, and additional benefits, such as improved traffic flow.

Project Eligibility

This section discusses the standards that determine whether projects are eligible or ineligible to receive CMAQ funding. First and foremost, the funds are to be used in targeted areas of the country that have severe air quality problems (known as *nonattainment and maintenance areas*), which is measured by a state's ozone severity and carbon monoxide (CO) levels. Because funds are issued on a state-by-state basis, regions that do not have areas of concern can use their CMAQ funds as part of the Surface Transportation Program (STP). STP funds can be used by states and localities for projects on any federal-aid highway.

In addition, a project must also be included in the MPO's current transportation plan and Transportation Improvement Program (TIP) to be eligible for funds. When funds are being used in nonattainment and maintenance areas, the project must conform to the CAA, meet transportation conformity regulations, complete National Environment Policy Act (NEPA) requirements, and meet basic funding requirements set forth in titles 23 and 49 of the United States Code.

NEPA Requirements

- The federal government requires states to use all practicable means to create and maintain conditions under which man and nature can exist in productive harmony (known as the *Declaration of National Environmental Policy Act*).
- Federal agencies must incorporate environmental considerations in their planning and decision-making through a systematic interdisciplinary approach. They are required to prepare detailed Environmental Impact Statements (EISs), which assess the environmental impact of and alternatives to major federal actions significantly affecting the environment.

Title 23

Outlines the role of highways in the United States Code.

Title 49

Outlines the role of transportation in the United States.

As a general rule, CMAQ funds should accomplish at least one of the following:

- *Capital Investment.* Funds are put forth to establish or expand transportation projects or programs that reduce emissions.
- *Operating Assistance.* This category allocates funds towards projects where the costs are associated with starting up new, viable transportation services that can demonstrate air quality benefits in a fiscally responsible way.
- *Emission Reduction.* These projects should specifically reduce carbon monoxide (CO), ozone precursors (NOX and VOCs), particulate matter (PM), or PM precursor emissions. The ancillary benefits of projects may also be disclosed, including greenhouse gas reductions, congestion relief, safety, etc.
- *Planning and Project Development.* Activities and efforts that support eligible projects can also be funded. Some examples of this include preliminary engineering, major investment studies, transit master plans, etc.

>>*Typical Steps During the Grant Application Process*

Most agencies have several projects that could be considered for CMAQ Funding. The goal, however, is to select a project with a high benefit-cost ratio that also meets the additional requirements of the funding agency. Selecting the optimal project to compete with other projects from across a region can be a challenging task in and of itself. This section provides some insight into what most funding agencies are looking for in a CMAQ grant application.

Project Selection

In order for a project to be selected to receive funding, proposals seeking funds must include a precise description of the size, scope, location, and timetable of the project, as well as the expected reduction in emissions. The Air Quality Analysis should include the following components:

- The quantified emissions benefits and disadvantages of the project.
- Use reason and logic to provide a qualitative assessment of the project and how it will contribute to attaining or maintaining National Ambient Air Quality Standards (**NAAQS**).
- The comprehensive impact of a group of projects.
- Any tradeoffs that may occur as a result of the project.

NAAQS standards have been designed to protect human health, with an adequate margin of safety, as well as protect public welfare from any known or anticipated adverse effects of a pollutant.

Projects are ultimately chosen by the state or the MPO based on a state or metropolitan area's unique selection process. Each year, states should prepare an annual report that provides detail on how the CMAQ funds have been used; this is required by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), the legislation that reauthorized CMAQ.

Typically, projects that increase capacity, such as new left or right turn lanes, traffic signal equipment upgrades, signal interconnect, or signal timing, result in reducing air emissions along with a reduction in intersection delay. Within these types of projects, improving the experience of non-motorized users typically results in additional points during the ranking process and therefore should be considered. New curb ramps, pedestrian push buttons, bike lanes, etc. are a few examples that can often be included in a project at minimal cost.

>> *Project-Related Traffic Data*

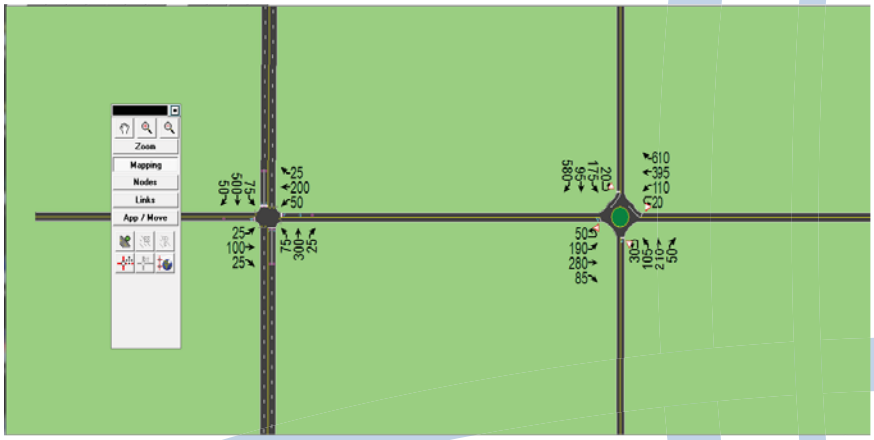
Typically, the project sponsor is required to provide project-related traffic data, such as functional classification, peak hour traffic volumes, average daily traffic (ADT) volumes, total vehicles entering/exiting intersections (peak hour or daily), travel speeds, etc. This information provides the funding agency with the basic information needed to compare similar projects within a region.

The next key element is to determine the expected benefits of the proposed improvement. The higher the expected benefits, the higher rank a project will typically achieve, thus increasing the likelihood that the project will be selected for funding. The following measures of effectiveness are typically calculated "before" and "after" project implementation:

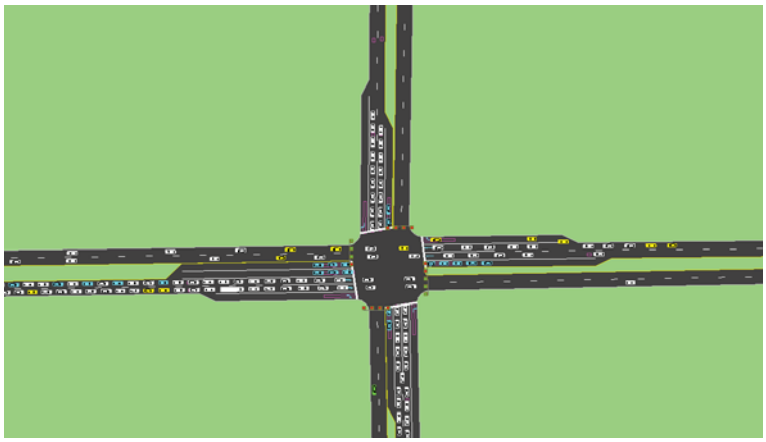
- Percentage change in air emissions
- Percentage change in average intersection delay/vehicle
- Percentage change in average movement delay/vehicle
- Percentage change in average travel speed along arterial

Whether you are seeking funding for a traffic signal upgrade or an intersection geometry (including roundabouts) improvement project, Synchro® and/or SimTraffic® can provide you with the necessary output (results) required to estimate a project's benefits. Both Synchro® and/or SimTraffic® allow the user to select from many different measures of effectiveness (MOE). Each of the above noted MOE's are available on an intersection, arterial, or network-wide basis.

Synchro® provides a user-friendly interface along with a powerful signal optimization engine that allows planners and engineers to quickly analyze arterial operations. The method used for roundabout analysis is based on the methods outlined within the 2010 HCM. Users of Synchro® can quickly compare intersection alternatives without having to reenter lane or volume data. Reports can quickly be generated based on various parameters selected by the user.



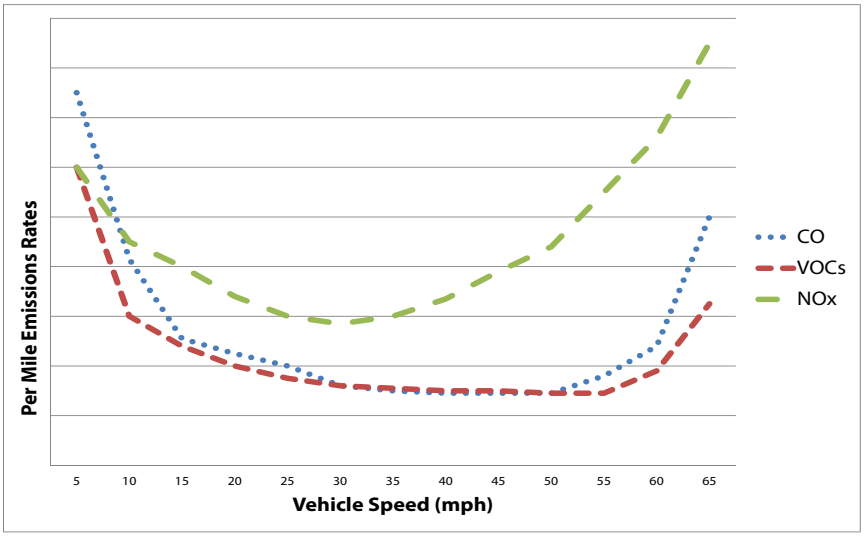
If a more detailed analysis is required, a SimTraffic® model can be developed to provide additional measures of effectiveness. Since SimTraffic® is a microscopic traffic simulation model, it can provide the user a more realistic comparison than a macroscopic model, for example, the overall effect of heavy vehicles upon a traffic stream. Once calibration of the SimTraffic® model has been completed, results on a per-lane basis can be generated.



>> *Vehicle Emissions 101*

Within the transportation industry, there are typically three types of emissions that most agencies are concerned about. The first three rows of Table 1 provide a brief definition of these pollutants. In Cities with higher levels of congestion and with high concentrations of air pollutants, the remaining four pollutants listed in Table 1 are sometimes of interest.

Determining actual vehicle emissions involves a series of complex calculations that vary based on several factors. One of the most obvious factors is related to the type of vehicle. There are several types of vehicles traveling along our nations' roadways, including SUVs, sedans, vans, sports cars, buses, single unit trucks, tractor-trailers, etc., leading to an overwhelming number of possible permutations. Not only are there several types of vehicles, but different engines, fuel types, and fuel consumption characteristics; in addition, you must also factor in the model year and location of the vehicle. Furthermore, vehicle emissions will also vary by operating speed. The figure to the right depicts the relationship between operating



speed and vehicle emissions for three of the most common vehicle emissions. Note that each pollutant has a somewhat different relationship with travel speed.

CO	***Carbon Monoxide***	Odorless gas produced whenever incomplete fuel combustion occurs.
HC or VOCs	***Hydrocarbons or Volatile Organic Compounds***	Product of incomplete fuel combustion, fuel evaporation, and refueling losses caused by spillage and vapor leakage. Ozone is formed from the reaction of HCs with NOX.
NO_X	***Nitrous Oxide***	Created when nitrogen and oxygen atoms chemically react to the high pressure and temperature conditions in an engine.
PM_{10} & PM_{25}	***Particulate Matter***	Airborne solid particles and liquid droplets. Coarse particles, smaller than 10 microns, are produced during grinding operations, or from physical disturbance, such as wind. Fine particles, smaller than 2.5 microns, can be a product of fossil fuel combustion.
TOG	***Total Organic Goods***	Compounds of carbon and hydrogen, including all of the ROG in addition to low reactivity organic compounds like methand and acetone.
ROG	***Reactive Organic Gases***	Sometimes referred to as VOCs, these compounds contribute to the formation of ground level photochemical smog.

Table 1

Due to the complexity of calculating vehicle emissions, many agencies have developed their own standard procedures for estimating vehicle emissions based on the type of improvement project being considered. The procedures vary from simple spreadsheet calculations to detailed use of EPA's MOVES2010a or Mobile Source Emission Simulator model (MOBILE6). Some MPO's will actually perform the vehicle emission calculations based on project data provided by the sponsor. Be sure to consult with your local funding agency to review if an existing procedure is in place.

>> *Air Emission Calculations Within Synchro and SimTraffic*

If a particular method is not specified for calculating air emissions, Synchro® and SimTraffic® include formulas for calculating the three most common required by most agencies (NOX, CO, and VOC). The method Synchro® uses is based on standard relationships, while the method used by SimTraffic® is more robust and calculates air emissions on an individual vehicle basis as they traverse through the roadway network.

Synchro® provides users with an estimate of vehicle emissions based on the users' selected roadway network. The calculation of fuel consumption is based on a series of formulas used within TRANSYT-7F. Fuel Consumption is calculated using the following formulas:

$F = TotalTravel * k1 + TotalDelay * k2 + Stops * k3$

$k1 = .075283 - .0015892 * Speed + .000015066 * Speed^2$
$k2 = .7329$
$k3 = .0000061411 * Speed^2$
F = fuel consumed in gallons
Speed = cruise speed in mph.
TotalTravel = vehicle miles traveled
TotalDelay = total signal delay in hours
Stops = total stops in vehicles per hour

The three most common vehicle emissions are then calculated by multiplying fuel consumption by an emissions rate. The rates are from an unpublished letter to the Federal Highway from Oak Ridge National Labs. The rates are:

F = Fuel Consumption (gal)
CO - F * 69.9 g/gal = Carbon Monoxide Emissions (g)
NOx = F * 13.6 g/gal = Nitrogen Oxides Emissions (g)
VOC = F * 16.2 g/gal = Volatile Oxygen Compounds Emissions (g)

For projects that require a more detailed analysis, SimTraffic® provides users with a more robust set of calculations for determining air emissions. SimTraffic® is a true microscopic traffic simulation model that simulates and tracks individual vehicles throughout the roadway network. Based on the vehicle composition (as determined by the user), fuel consumption and emissions are calculated using a series of rates that vary based on vehicle speed and acceleration. The rate tables are based on FHWA research and are the same as those used within CORSIM. Each table consists of seven vehicle types with travel speeds from 0 to 70 ft/s and acceleration rates from -10 to +10 ft/s^2. As vehicles traverse through the network, a series of calculations are continually being conducted and are available to the user based on their needs. Calibration of the SimTraffic® network should be completed when comparing alternative improvement scenarios.

Filename	Description
fuel_data.csv	Fuel table for all vehicles
hc_data.csv	HC Emission table for all vehicles
co_data.csv	CO Emission table for all vehicles
nox_data.csv	NOx Emission table for all vehicles

Table 2

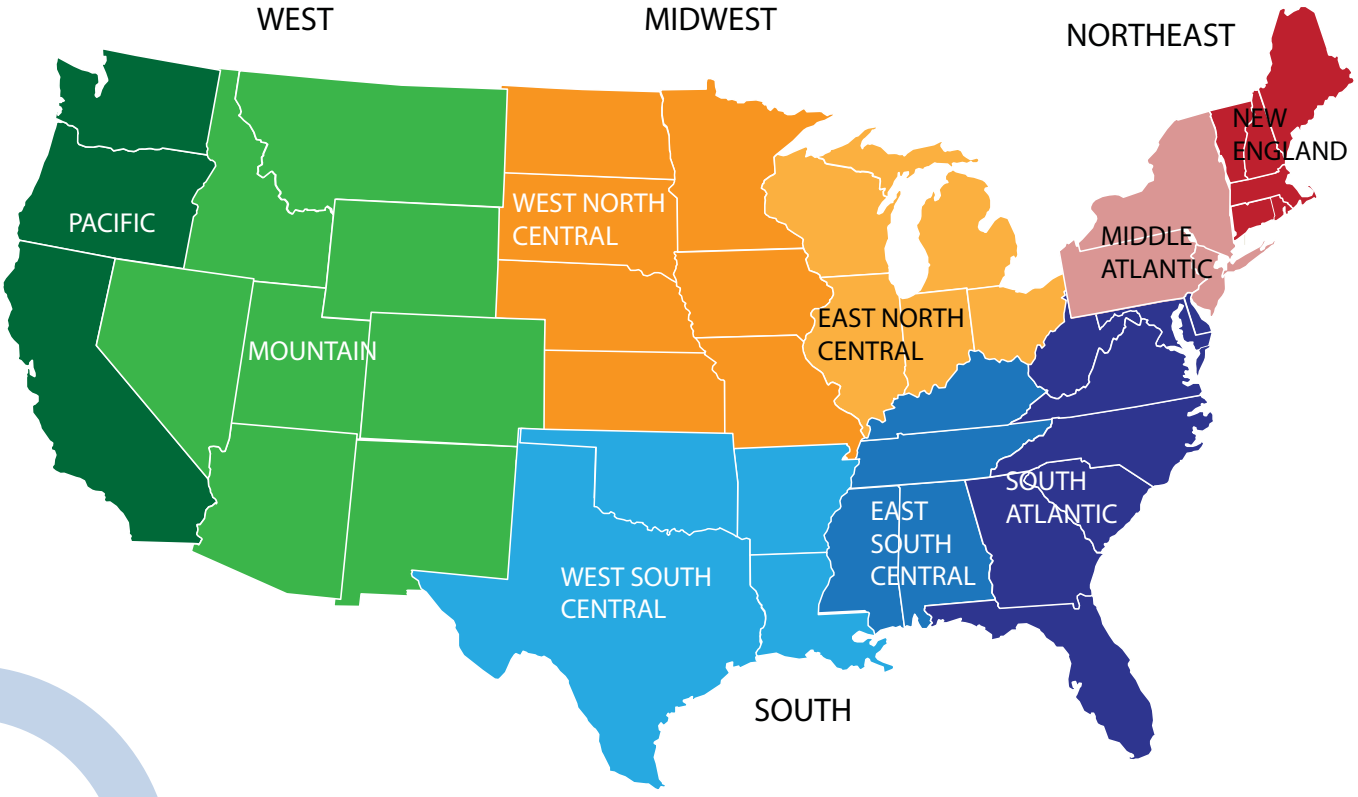
>> *Calculating Expected Benefits*

It is characteristic of agencies to request that the estimated reduction in fuel consumption and air emissions be reported on a daily or yearly basis. Many agencies have a preferred method for converting hourly values to daily or yearly for purposes of calculating a benefit-cost ratio. Be sure to check with your local agency to verify that your calculation methods will be accepted prior to submitting your grant. As previously noted, general project-related traffic characteristics, such as ADT volumes, total vehicles entering/exiting intersection, etc., can be critical data components that are required to complete the grant application. Not only do they provide general traffic characteristics related to your project, but they may also be required to complete a set of calculations. Be sure to review any standard calculations that the funding agency may require so any additional data can be collected prior to the application deadline.

APPENDIX A

>> *Average CMAQ and STP Funds for 2012-2014*

	CMAQ	STP
West	**$729,595,805**	**$2,102,412,930**
Pacific	$545,397,862	$1,300,661,403
Mountain	$184,197,943	$801,751,527
Midwest	**$2,007,834,417**	**$453,542,016**
West North Central	$106,724,186	$612,886,152
East North Central	$346,817,830	$1,394,948,265
South	**$267,769,335**	**$1,618,538,037**
West South Central	$181,572,572	$1,296,873,430
East South Central	$72,002,197	$705,946,1741
South Atlantic	$273,464,755	$1,827,124,534
Northeast	**$522,953,914**	**$522,953,914**
Middle Atlantic	$138,330,202	$440,584,700
New England	$384,623,712	$969,798,269



APPENDIX B

>> *MAP-21*

- National Highway System Program
- Interstate Maintenance Program
- Highway Bridge Program
- Appalachian Development Highway System Program
- National Highway Performance Program (NHPP)
- Surface Transportation Program (STP)
- Congestion Mitigation and Air Quality Improvement Program (CMAQ)
- Highway Safety Improvement Program (HSIP)
- Railway-Highway Crossings (set-aside from HSIP)
- Metropolitan Planning
- Construction of Ferry Boats and Ferry Terminal Facilities
- Transportation Alternatives (TA)
- Tribal High Priority Projects (THIPP)
- Projects of National and Regional Significance (PNRS)
- On-the-Job Training Supportive Services
- Disadvantaged Business Enterprise (DBE) Supportive Services
- Highway Use Tax Evasion (Intergovernmental enforcement projects)
- Work Zone Safety Grants

APPENDIX C

>> *Discretionary Grant Programs*

Program Title	Description	Available Funds
Delta Region Transportation Development Program (DRTDP)	The Delta Region Transportation Development Program (DRTDP) provides grants to support and encourage multistate transportation planning and corridor development; provide for transportation project development; and support transportation construction in the Delta region. The Delta region includes portions of Alabama, Arkansas, Illinois, Kentucky, Louisiana, Mississippi, Missouri, and Tennessee.	$8,518,388
Value Pricing Pilot (VPP) Program	The Value Pricing Pilot (VPP) Program supports a variety of strategies to manage congestion on highways, including tolling highway facilities through congestion pricing, as well as other methods that do not involve tolls, such as mileage-based car insurance and parking pricing.	$12,105,223
Highways for LIFE (HfL) Pilot Program	The Highways for LIFE (HfL) Pilot Program uses innovative technologies and practices to more quickly construct safe and efficient highways and bridges with longer life spans. The goal of the program is to promote proven but infrequently used innovations to accelerate project delivery.	$8,950,000
Innovative Bridge Research and Deployment (IBRD) Program	The Innovative Bridge Research and Deployment (IBRD) Program provides funds to promote innovative designs, materials, and construction methods in the construction, repair, and rehabilitation of bridges and other highway structures.	$5,848,655
Interstate Maintenance Discretionary (IMD) Program	The Interstate Maintenance Discretionary (IMD) Program provides funding for Interstate highway resurfacing, restoration, rehabilitation, and reconstruction work, including added lanes to increase capacity on most existing Interstate System routes.	$85,183,878
National Historic Covered Bridge Preservation (NHCBP) Program	The National Historic Covered Bridge Preservation (NHCBP) Program supports the rehabilitation, repair, and/or preservation of historic covered bridges.	$9,762,116

National Scenic Byways Program (NSBP)	The National Scenic Byways Program (NSBP) recognizes roads that have outstanding scenic, historic, cultural, natural, recreational, and archaeological qualities. NSBP funding supports projects that manage and protect these roads and improve visitor facilities.	$37,054,987
Public Lands Highway Discretionary (PLHD) Program	The Public Lands Highway Discretionary (PLHD) Program funds are available for any kind of transportation project eligible for assistance that is within, adjacent to, or provides access to federal lands or facilities. PLHD funds are available for transportation planning, research, engineering, and construction of the highways, roads, and parkways, and of transit facilities within the federal public lands.	$86,887,557
Railway-Highway Crossing Hazard Elimination in High-Speed Rail Corridors (HSR) Program	The Railway-Highway Crossing Hazard Elimination in High-Speed Rail Corridors (HSR) Program provides funding for safety improvements at both public and private highway-rail grade crossings along federally designated high-speed rail corridors. This program is jointly administered by the Federal Railroad Administration (FRA) and the Federal Highway Administration (FHWA).	$10,222,066
Transportation, Community and System Preservation Program (TCSP)	TCSP provides grant funding for strategies that promote improved planning and coordination among transportation, community, and system preservation plans. Program funds support improving the efficiency of the U.S. transportation system, reducing the environmental impacts of transportation, and ensuring access to jobs, services, and centers of trade.	$52,175,125
Truck Parking Facilities Discretionary Program	The Truck Parking Facilities Discretionary Program supports a wide range of projects and activities. They range from construction of commercial motor vehicle (CMV) spaces and other improvements that facilitate CMV parking, such as intelligent transportation systems (ITS) technology, to providing more information on the availability of both public and private CMV parking spaces.	$5,323,993
Ferry Boat Discretionary (FBD) Program	The Ferry Boat Discretionary (FBD) Program supports the construction of ferry boats and ferry terminal facilities.	$41,072,988

GLOSSARY OF TERMS

Acronym	Meaning
ADT	Average Daily Traffic
CAA	Clean Air Act
CMAQ	Congestion Mitigation and Air Quality
CO	Carbon Monoxide
DOT	Department of Transportation
FHWA	Federal Highway Administration
HC	Hydrocarbons
MAP-21	Moving Ahead for Progress in the 21st Century
MOE	Measure of Effectiveness
MPO	Metropolitan Planning Organization
NAAQS	National Ambient Air Quality Standards
NEPA	National Environment Policy Act
NO_x	Nitrous Oxide
PM	Particulate Matter
ROG	Reactive Organic Gases
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users
STP	Surface Transportation Program
TIP	Transportation Improvement Program
TOG	Total Organic Gases
VOC	Volatile Organic Compound

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