U.S. Department of Transportation, Climate Change Center
Climate Strategies that Work

PUBLIC TRANSIT EXPANSION

Investing in public transit infrastructure supports thriving communities and mobility equity by improving connections to essential services and directly reduces carbon emissions by providing cleaner, more efficient travel options.

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OVERVIEW

Best Suited for:
Long Term & Short Term
Urban, Suburban, Rural & Tribal

Boosting public transit ridership can directly reduce greenhouse gas (GHG) emissions by displacing trips made by single-occupancy vehicles. **Public transit expansion includes both system expansion, such as building an entirely new light rail or bus rapid transit line, or service expansion, such as increased frequency or extended service hours for an existing bus line.** Expanding transit services can provide more people with more opportunities to use transit to reach their destinations, and in turn reduce GHG emissions. Transit investments also indirectly reduce GHG emissions by enabling compact, mixed-use development that reduces distances traveled between destinations. These indirect effects of transit funding are more difficult to measure, but potentially just as impactful or even more so than direct effects in the long run.

Expanded transit service could have the largest impacts in areas where the current level of service does not meet public transportation demand, or in areas with large populations unserved or underserved by public transportation.

Funding for increased transit service would help to address public transportation gaps, particularly in underserved communities. New service in "transit deserts" (i.e. area with limited public transit supply) can most effectively serve users and reduce emissions by providing transit service that is appropriate to the community context, including new viable transit options in suburbs.

Extending Service Hours

Providing increased transit service at different times of day can encourage more people to use transit rather than driving alone. Transit trips typically fall into three types: commute, non-commute, and special event/visitor. Weekday, morning-to-early-evening service meets the needs of many commute trips, but may not adequately serve other trip types or off-peak commutes. To increase transit trips, transit agencies can pilot providing increased nighttime, weekend, and off-peak service. Expanding off-peak service (late-night and early-morning service) can promote transit usage for both non-commuter trips and service worker commuting trips that require later and earlier hours. Weekend service can support trips for special events, trips made by visitors, service worker commuting trips, and other non-commute trips.

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A 2016 study found that service frequency and travel time were the two most important factors to riders deciding between taking a trip on transit or on another mode (TransitCenter, 2016). Other important factors include:

- Cost
- Shelters at stops
- Real-time arrival information
- One-seat trips (no need to transfer)
- Payment options
- Available seating
- "First and last mile" to a transit stop (Distance, perception of safety, streetscape elements)
- Service reliability
- Amenities around a transit stop
- Accessibility and wayfinding

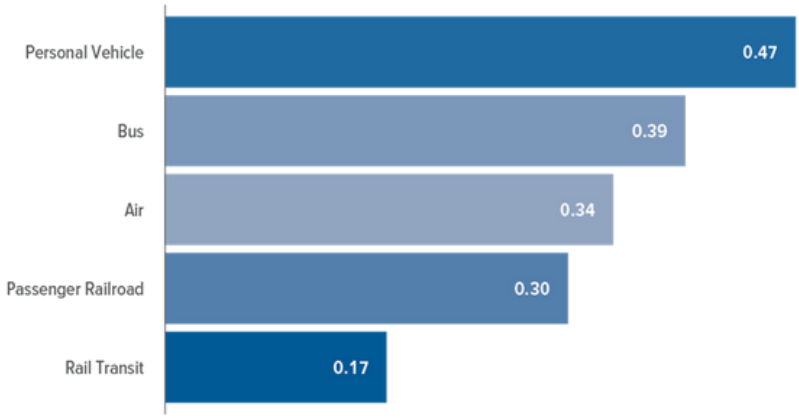
GREENHOUSE GAS REDUCTION POTENTIAL

This section provides an overview of greenhouse gas (GHG) emission reductions associated with the strategy. It highlights key findings and relevant metrics from GHG modeling resources, peer-reviewed studies, and real-world applications.

PUBLIC TRANSPORTATION IS MORE ENERGY EFFICIENT THAN SINGLE OCCUPANCY VEHICLES

Passenger vehicles produce on average 0.47 lbs. of CO_2 per passenger-mile compared to 0.17 lbs. of CO_2 per passenger-mile emitted from rail transit and 0.39 lbs. of CO_2 per passenger-mile from buses (Congressional Budget Office, 2022).

Average Carbon Dioxide Emissions per Passenger-Mile, by Mode of Transportation, 2019
(Source: Congressional Budget Office, 2022)



Did you know?

Replacing a single driver's 10-mile daily commute with public transportation can save a household an estimated 4,627 pounds of carbon dioxide per year – an 8.1% reduction in the typical American household's annual carbon footprint (Federal Transit Administration, 2010).

A typical trip on public transit emits 55% fewer GHG emissions than driving alone (NASEM, 2021).

ANNUAL GHG AND VEHICLE MILES TRAVELED (VMT) REDUCTIONS

In 2018, the U.S. saved an estimated 63 million metric tons of CO_2 equivalent emissions through public transit and avoided 148 billion miles of personal vehicle travel, or 5% of the 3 trillion total U.S. vehicle miles that year (NASEM, 2021).

Analyzing these savings reveals the impact of public transit on both individual travel choices and broader land-use patterns. Passenger surveys indicate that approximately one-third of transit passenger miles would otherwise have been driven by car. This translates to a direct reduction in emissions and traffic congestion by encouraging a change in modes from cars to public transit.

However, an even larger portion of the savings, 88%, is attributed to the indirect effects of public transit on the built environment.

These indirect effects include encouraging shorter trips, reducing overall vehicle use, and supporting more walking and cycling trips due to compact, transit-oriented development patterns (NASEM, 2021).

BENEFITS FROM SPECIFIC STRATEGIES

Increased Services and Extending Network Coverage or Hours: A study by the California Air Pollution Control Officers Association (CAPCOA) estimates that increasing transit service could mitigate up to 11.3% of GHG emissions from vehicle travel in a community, and up to an additional 4.6% by extending transit network coverage or hours (CAPCOA, 2021).

Line extensions, increased service frequency, and increased speed: A study from Lawrence Berkeley National Laboratory modeled the effects of six specific transit projects in the San Francisco Bay area. The study found that these interventions would shift up to 10 percent of new transit riders from personal and ridehail vehicles, and improve mobility (travel distances, speeds, and times) for existing transit riders. These types of projects likely have larger benefits over the long run, when travelers can change their home or work location in response to improved transit service (Poliziani et al., 2024).

CO-BENEFITS

This section outlines the multiple co-benefits associated with the strategy, including safety benefits, local air quality improvements, and improved accessibility. Each co-benefit presents examples that demonstrate how the strategy enhances regional or community well-being while addressing emissions.

SAFETY

Communities designed with transit riders in mind can reduce the incidence of collisions, injuries, and fatalities on shared roadways. A 2014 study found "public transportation passengers have about one-tenth the fatality rate per mile as automobile passengers" (USDOT, 2015). Safer streets and connecting trails can, in turn, encourage further shifts towards active transportation. *See the active transportation strategy guide here.*

Passenger transportation by transit is significantly safer than transportation on highways. A FTA analysis found that the number of fatalities per vehicle mile traveled in personal automobiles is more than three times that of buses, and nearly twice that of heavy rail (U.S. Federal Transit Administration, 2023). Because transit vehicles have a much higher average occupancy than personal vehicles, the safety benefit of transit is even greater. In 2021, there were 197 fatalities reported on transit in the country, compared to nearly 42,939 highway deaths (BTS, 2021).

ECONOMIC GROWTH

Transit is a $79 billion industry and employs more than 370,000 people across more than 1,000 private companies and 4,000 transit operators. According to the American Public Transportation Association's research, every $1 invested in transit generates $5 in economic returns. Every $1 billion invested in public transportation supports and creates approximately 50,000 jobs (APTA, 2020).

RURAL COMMUNITIES

Expanding transit can provide a critical and safe transportation connection for rural residents with few other modes to choose from. Increased service can be particularly impactful for those who were previously located in a transit desert (Jiao and Dillivan, 2013).

A Minnesota study analyzing six rural and small urban transit agencies found substantial quantifiable benefits, including improved access to healthcare (estimated value of $228.5 million), increased low-cost

mobility options (estimated value of $7.6 million), reduced reliance on public assistance programs (estimated value of $19.1 million), and decreased dependence on others for rides (estimated value of $18.3 million) (Mattson, 2020).

ACCESSIBILITY AND EQUITY

Public transit increases access to job opportunities, education, and everyday destination for those who cannot or do not drive, especially the elderly, disabled, youth, and people living in lower-income communities. An independent report published in 2017 found that 21% of users of public transit are low income, 49% do not have college degrees, 60% are people of color, and 46% do not have consistent access to a vehicle (APTA, 2017).

Public transportation is linked to decreased loneliness, increased access to family and friends, and greater levels of socialization enroute compared to driving alone (VTPI, 2024., Williams et al., n.d.).

Transit provides greater opportunities for lower mobility individuals, including people with physical disabilities and the elderly, to access healthcare and other important services.

RESILIENCE AND ADAPTATION

Public transit can help people deal with the impacts of natural disasters by supporting evacuation and emergency response activities. Public transit is one of the most widely used evacuation methods during emergencies. For example, the Baldwin Regional Area Transit System in Alabama ran special evacuation routes and microtransit service to provide communities with safe transportation during Hurricane Sally (Rosander, 2023).

Expanding public transit service to connect with or include mobility hubs also promotes community resilience during extreme weather events. Mobility hubs connect people with a range of transportation options, from public transit to shared micromobility and active transportation. Mobility hubs may be co-located with resilience hubs, facilities that provide essential services during and after weather crises (Rosander, 2023).

COST SAVINGS

Investments in public transit can reduce personal transportation costs by reducing the need for car maintenance, fuel, and parking costs. Those who stop owning a car and transition to using transit can save nearly $13,000 per year. These savings have increased in recent years due to rising new and used automobile prices and gas prices, while average monthly public transit fare prices have not increased (APTA, 2021).

In 2011, U.S. public transportation use saved 865 million hours in travel time (Texas A&M Transportation Institute, 2012). Those hours can be repurposed to additional workplace productivity or rest and recreation.

AIR QUALITY AND HEALTH

Reducing the number of emissions-emitting vehicles on the road through increased transit use (especially in densely populated areas) will decrease air pollutants that are harmful to human health (VTPI, 2024).

New or expanded public transit options can improve health outcomes by improving air quality, increasing physical activity, decreasing injuries from motor vehicle crashes, and improving mental health. Access to public transit can also reduce health disparities by increasing access to healthier food options, medical care, and other services (Health Affairs, 2021).

COST CONSIDERATIONS

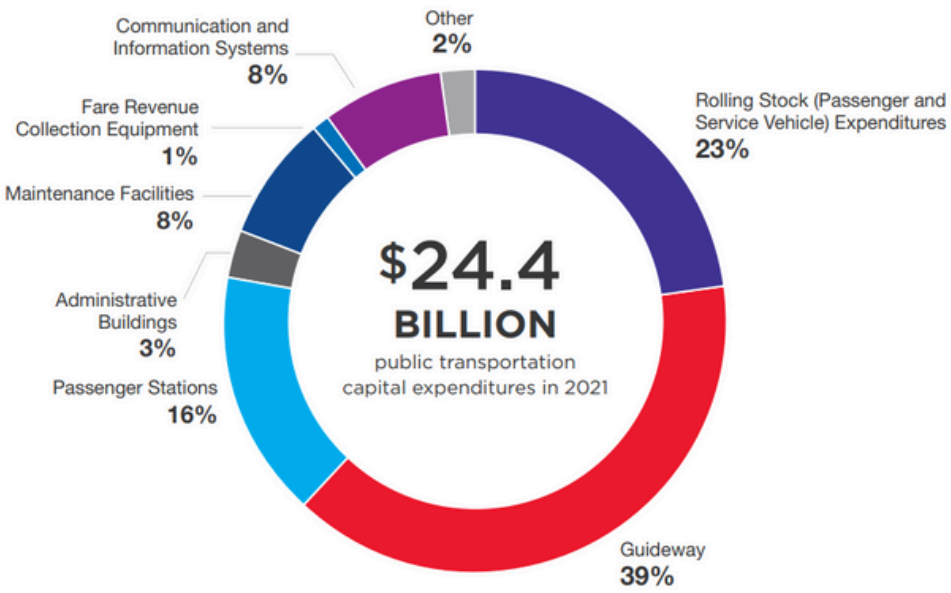
COST OF IMPLEMENTATION

The cost to expand public transit services can vary significantly based on what existing services are available and the scale of the expansion. Expansion could range from extending a bus line or providing service for additional hours, to building an entirely new light rail service or starting transit service in a previously unserved community.

Public transit capital improvements and operations are funded by passenger fares, public transit agency earnings, and financial assistance from different levels of government. The American Public Transportation Association (APTA) found that in 2021, capital expenditures totaled $24.4 billion in the U.S., with 39% of spending going towards guideway projects, 23% to rolling stock upgrades, and 16% to passenger station projects (APTA, 2023).

On a per vehicle mile basis, railway modes (commuter rail and light rail) are more expensive than roadway modes (bus, demand-responsive trips) due to the use of larger vehicles over shorter distances. In terms of cost per unliked passenger trip, heavy rail carries the lowest costs given its high capacity (APTA, 2023).

Public transit operating expenses (e.g., labor and fuel) are about two-thirds of all transit service expenses, while capital expenses (e.g., bus purchases) comprise about one-third (Mallet, 2024).



Total capital expenditures by type in the United States in 2021 (APTA, 2023).

Explore cost data for specific rail projects at Transit Costs Project. A few examples of cost per kilometer (in M$) for U.S. transit capital projects. Date of completion is given in parentheses.

- New York 7 Train Extension, 100% Tunnel (2014): $1,500
- Los Angeles Purple Line, Phase 1 (2024): $444
- Boston Green Line Extension (2022): $301
- San Franciso BART to San Jose, 83% Tunnel (2024): $1,270
- Miami Metrorail Extension (2012): $129

Bus rapid transit systems generally cost $5 million to $20 million per kilometer (ITDP, 2017).

An analysis by the ENO Center for Transportation (2020) found that light rail transit projects in the U.S. (excluding New York City outliers) averaged $107 million per kilometer, rising to $162 million when including New York City.

FUNDING OPPORTUNITIES

Federal Highway Administration (FHWA) Flexible Funds: In addition to FTA grant programs, certain funding programs administered by FHWA, including the Surface Transportation Block Grant (STBG) Program and the Congestion Mitigation and Air Quality Improvement (CMAQ) Program, may be used for public transportation purposes. These "flexible" funds are transferred from FHWA and administered as FTA funding, taking on the requirements and eligibility of the FTA program to which they are transferred. See 49 USC 5334(i) and FTA's Flexible Funding for Transit and Highway Improvements website for more detail.

FTA maintains a list of transit grants, here.

FTA's **Capital Investment Grants (CIG)** program funds transit capital investments including new and expanded rapid rail, commuter rail, light rail, streetcars, bus rapid transit, and ferries (49 U.S.C. § 5309). CIG makes transit more widely available, giving more Americans a low carbon transportation option.

FTA's **Public Transportation on Indian Reservations (Tribal Transit Program or TTP) Program** provides funding to Federally recognized tribes for capital, operating, planning, and administrative expenses associated with public transit projects. The TTP is a set-aside from the Formula Grants for Rural Areas program that includes a formula program and a competitive grant program.

FHWA's **Carbon Reduction Program** funds projects designed to reduce transportation CO_2 emissions form on-road highway sources, including public transportation projects eligible under 23 U.S.C. 142.

FTA's **Better Utilizing Investments to Leverage Development (BUILD) Transportation Grants Program** funds investments in transportation infrastructure, including transit.

FTA's **Buses and Bus Facilities Discretionary Grants** assist in the financing of buses and bus facilities capital projects, including replacing, rehabilitating, purchasing or leasing buses or related equipment, and rehabilitating, purchasing, constructing or leasing bus-related facilities.

FHWA's **Surface Transportation Block Grant (STBG) Program** provides flexible funding that may be used by States and localities for projects to preserve and improve the conditions and performance on any Federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects.

FTA's **State of Good Repair Grants Program** provides capital assistance for maintenance, replacement, and rehabilitation projects of high-intensity fixed guideway and motorbus systems to help transit agencies maintain assets in a state of good repair in urbanized areas.

FHWA's **Congestion Management and Air Quality Improvement (CMAQ) Program** supports surface transportation projects and other related efforts that contribute air quality improvements and provide congestion relief. The BIL continues the CMAQ Program to provide a flexible funding source to State and local governments for transportation projects and programs to help meet the requirements of the Clean Air Act, including many types of projects that improve public transit.

COMPLEMENTARY STRATEGIES

Like service expansion, free and reduced fare transit is an excellent strategy for increasing access to public transit, especially for low-income and fixed income riders. Free and reduced fares can also be used to encourage riding new systems, as exemplified in the North Carolina case study above.

Transit system integration involves connecting transit to other transportation modes to create seamless connections. Expanding transit can create additional or more frequent connections.

Public transit and transit-oriented development are mutually reinforcing strategies. TOD can increase the demand for public transit services by creating dense, mixed-use neighborhoods where residents have easy access to transit options. Public transit expansion can support TOD by providing reliable and convenient transportation access to and from these developments, thereby increasing their attractiveness and viability. Overall, combining TOD with public transit expansion can lead to lower GHG emissions, and more vibrant, livable communities.

Most transit trips start with a walking or biking trip segment, making safe connections between active transportation and transit infrastructure crucial. Transit is also key for extending active transportation trips beyond a bikeable or walkable range.

Bus rapid transit is a transit service type growing in popularity as a public transit expansion option, due to its ability to reduce travel times and increase capacity at a comparable level to light rail transit, while at a lower cost.

Zoning codes can have a significant impact on the expansion and effectiveness of public transit systems. By shaping land use patterns, densities, and development patterns, zoning can either facilitate or hinder the expansion of public transit infrastructure. Zoning codes that promote mixed-use developments, higher densities, and TOD can create supportive environments for public transit expansion.

Commuter benefits can serve as a support strategy to transit expansion by encouraging more people to use public transportation.

View All Strategies

CASE STUDIES

MBTA'S EARLY MORNING AND LATE-NIGHT BUS SERVICE PILOTS

Source: Massachusetts Bay Transportation Authority

The Massachusetts Bay Transportation Authority (MBTA) conducted two pilot programs in 2018 to provide late night and early morning bus service. In April 2018, MBTA started service before 5am, seven days a week, on Boston's busiest bus routes. In April 2019, early morning service was made permanent. Complementarily, in September 2018, MBTA expanded bus service from 10pm to 2 am with additional trips, later scheduling, and route variations to include areas where night service was most needed. In September 2019, some of these changes were made permanent.

RURAL NORTH CAROLINA'S TRANSIT EXPANSION

In 2018, Greenway Public Transportation, a transit provider for the Western Piedmont Regional Transit Authority in rural Conover, North Carolina, launched new flex service routes after securing grant funding. The routes aimed to serve low-income and underserved communities and featured a free promotional service period while riders learned about the new routes. Compared to the previous year, Greenway saw a ridership increase of almost 70% in 2019 and found the new service was especially useful for connecting riders to a health facility.

KING COUNTY METRO'S RAPID RIDE

The Seattle area's King County Metro transit agency currently operates seven bus rapid transit lines, with five additional lines planned. The use of semi-exclusive bus lanes, queue jumps, and off-board fare collection contribute to time savings of up to 20% over previous local bus routes. The system is not only faster but features increased frequency as well, attracting high ridership.

> Read more about Rapid Ride and bus rapid transit in the Bus Rapid Transit Strategy Guide.

Source: King County

UNALAKLEET TRANSIT PROGRAM

Administered by the FTA, the Tribal Transit Program provides critical funding to enhance public transportation in tribal communities across Indian Country. In 2023, the Native Village of Unalakleet in Alaska received $1.4 million to acquire equipment for the year-round maintenance of vital transit corridors leading to an assisted living facility. Situated on Norton Sound, 180 miles southeast of Nome, the village offers on-demand transit services that connect residents to important destinations, including the health clinic, grocery store, post office, tribal office, airport, and other essential services. In 2022, Jicarilla Apache Nation and the Pueblo of Santa Clara were both awarded $140,000 to upgrade two bus stops with shelters and passenger amenities, significantly improving accessibility for tribal residents. These enhancements will create a safer and more comfortable waiting environment, facilitating reliable transit service.

IMPLEMENTING PUBLIC TRANSIT EXPANSION: **WHAT TO READ NEXT**

The Federal Transit Administration website contains information and resources related to public transportation planning and funding. FTA's Planning Resource Library webpage is a good place to start for guidance on many transit related planning topics.

When planning for public transit expansion, it is important to involve the community to ensure the transit services meet their needs. The Transit Planning 4 All Inclusive Planning Guide details how to improve inclusivity in transportation planning efforts.

The American Public Transportation Association (APTA) publishes an annual Public Transportation Fact Book, containing data across all aspects of transit across the U.S. and Canada.

Source: New York Transit Museum

New York City MTA's new R211 subway trains improve accessibility and wayfinding in public transit. New features enhance travel experience through improved signage and audio announcements that ease navigation.

Additional design elements include dedicated seating for passengers with disabilities, larger and clearer digital displays, and improved lighting, all of which contribute to a safer and more intuitive travel experience. These enhancements ensure that everyone can navigate the subway system with confidence and ease.

For more information, visit MTA's site.

Expanding Public Transit with Bus Priority Lanes: Investing in bus priority lanes is a strategic approach to enhance public transit infrastructure and promote mobility equity. While a single lane of private vehicles on a city street might handle 600 to 1,600 people per hour, a dedicated bus lane can move a staggering 8,000 passengers in the same timeframe (NACTO, 2016).

Key Considerations for Bus Lane Implementation include:

Context-Specific Treatments

It is essential to tailor bus lane designs to fit the unique needs of each corridor. This may include accommodating commercial deliveries or ensuring that stopped buses can be passed by other buses to maintain efficient service. Agencies must also determine whether bus lanes will operate 24 hours a day or only during peak hours.

Maximizing Efficiency

Integrating features such as transit signal priority and off-board fare payment can significantly enhance the efficiency and reliability of bus services. Additionally, managing right-hand turns at intersections is critical, as these can disrupt bus flow.

For more information, visit NACTO's Urban Street Design Guide.

RESOURCES

GENERAL RESOURCES

American Public Transportation Association Recommended Practice: This resource provides information to transit agencies looking to quantify both GHG emissions generated and reduced by transit.

Transportation Research Board Public Transit as a Climate Solution Webinar: This webinar explores how to incorporate public transit as a climate solution featuring research from "TCRP Report 226: An Update on Public Transportation's Impacts on Greenhouse Gas Emissions."

- *A spreadsheet tool developed in conjunction with the report that allows the user to apply future scenarios to see how their transit agency's GHG impacts change with electrification, clean power, and ridership.*

National Aging and Disability Transportation Center (NADTC): This center provides technical assistance, training, and other resources on accessible transportation to empower older communities, people with disabilities, and their caregivers.

TOOLKITS AND MODELLING APPROACHES

FTA Transit Greenhouse Gas Emissions Estimator: This is a spreadsheet tool allowing users to estimate the GHG emissions generated from the construction, operations, and maintenance of public transit systems.

The California Air Pollution Control Officers Association Handbook for Analyzing Greenhouse Gas Emission Reductions, Assessing Climate Vulnerabilities, and Advancing Health and Equity: This handbook provides GHG reduction formulas for expanding transit network coverage or hours or increasing service frequency.

FHWA Congestion Mitigation and Air Quality Improvement (CMAQ) Emissions Calculator – The toolkit provides a number of modules that can help estimate the emissions reductions associated with transit improvements including service improvements and bus and system expansion.

WORKING WITH COMMUNITIES

Transportation Research Board Transit Cooperative Research Program's (TCRP) Inclusive Public Participation in Transit Decision-Making: This is a published resource featuring effective public participation methods for engaging communities of color, people with limited English-language proficiency, low-income populations, and people with disabilities.

American Cities Climate Challenge Transit Priority Toolkit: This toolkit gives cities an easy-to-use resource to engage with internal staff, stakeholders, decision makers, and the public about transit priority projects.

RURAL SPECIFIC

National Rural Transit Assistance Program (RTAP) Resource Library: This resource has a collection of resources and training materials specific to rural and Tribal transit systems, including the TRB TCRP's workbook "Methods for Forecasting Demand and Quantifying Need for Rural Passenger Transportation."

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For more information visit the DOT Climate Change Center, https://www.transportation.gov/priorities/climate-and-sustainability/dot-climate-change-center