

Economic Analysis – Decision Support for Project and Policy Evaluation

Climate Adaptation/Mitigation and Resilience:

Rockefeller Foundation - The Urban Resilience Fund (TURF) Screen for Infrastructure Investments: Impact Infrastructure in partnership with Wood Group and Social Finance are developing the TURF Screen for water, waste, energy, transportation, communications, and social infrastructure investments. The TURF Screen is being developed as a multi-level multicriteria decision analysis (MCDA) tool to screen, evaluate and prioritize resilience infrastructure projects for funding by Rockefeller Foundation and 100 Resilient Cities (100RC)'s TURF. The TURF Screen is founded on the four core themes of resilience infrastructure: resilience based process, reliable performance, positive co-benefits, and resilience over delivery and is targeted to be > \$500 million in portfolio size.

Environmental Economic Analysis of Flood Risk to the City of Alameda, CA – Alameda Public Works: Led a project to estimate the potential damage to real estate from sea level rise. Using GIS – including various sea level rise raster layers and building footprints, I was able to determine how each property would be affected by different amounts of sea level rise. Creating a depth-damage model allowed me to estimate the potential damage this would cause to each individual house in the city, and to the city as a whole. A written report was delivered, as well as an online interactive map, allowing users to interrogate the data for specific results.

Low-Emissions Development Strategy – Economic Analysis Evaluation & Training: Engaged by the US Department of Energy (NREL) to build capacity in economic analysis in infrastructure development in Gabon, Africa. As part of a broader set of GHG mitigation initiatives training offered through NREL, provided multi-sectorial training on economic evaluation techniques with the Government of Gabon. The training included real-world assessments, valuation, and economic model development for a variety of key social and environmental impacts relating to: transportation systems (roadway); hydroelectric energy generation; wastewater management, and municipal solid waste investments.

New York State Energy Research and Development Authority (NYSERDA) – Carbon Neutral Roadmap Economic Analysis Support: Engaged to utilize economic analysis as a means to support the Carbon Neutral Buildings Roadmap aspect of the New York Climate Leadership and Community Protection Act (CLCPA) for NYSERDA. The goal is to use economics to provide policy-makers and public stakeholders with information to better understand the long-term value proposition – the life cycle costs, owner/occupant impacts, and public benefits - relating to decarbonization and those targeted investments under retrofit and new construction scenarios across the State of New York on five different building typologies: Academic; Mid-size office; Small-size office; Mid-size multifamily; Single family and small residential.

Lloyd's Register – The Resilience Shift: Wood Group and Impact Infrastructure prepared scoping research to help accelerate the integration of resilience by promoting resilience engineering as the new normal for infrastructure projects. The intent of this research was to identify and explore evaluation approaches to quantify the value associated with greater levels of resiliency within critical infrastructure sectors to help

perpetuate the acceptance and adoption of economic-based approaches to lead to more resilient infrastructure. We built a focus around the concept of 'Resilience Return on Investment' (RROI) within infrastructure projects – specifically, reviewing approaches to quantify the value of resilience engineering. The key opportunity identified to leverage CBA as basis for assessing value and resilience.

Report on Cost Benefit Analysis for Extreme Weather and Climate Change: Aided in the preparation and review of a report by the Transportation Research board which provided guidelines to incorporate cost benefit analysis (CBA) in transportation decision making in relation to extreme weather events and climate change. The report included a systematic overview of existing tools, methods, data, and models used in CBA of adaption and resiliency measures. Research and guidance provided focused on illuminating the need for triple bottom line and risk analysis in a climate change and extreme weather settings.

NYC DEP – Greenhouse Gas Reduction Transformation Planning: Engaged by NYC to assist in identify the investments and programs to achieve ambitious greenhouse gas reduction targets as part of its 80% GHG reduction commitment by 2050. Used economic analysis and cost-benefit techniques to inform the most cost-effective means to reduce its carbon footprint, as part of a broader energy analysis and policy guidance program.

City of San Antonio – Climate Action Plan Investment and Policy Planning: Support the SA Climate Action Plan to provide policy-makers with information to prioritize greenhouse gas reduction mitigation and adaptation strategies to reach the City's goal of carbon neutrality by 2050. Alternative analyzed includes benchmarking and disclosure requirements for commercial and multi-family properties greater than 50,000 square feet; electric vehicle and solar-ready requirements for new construction; white or cool roof requirements for new construction; zero net energy (ZNE) building codes for municipal buildings; and municipal streetlight LED conversion

City of San Francisco – Green Roof Policy Analysis Economic Evaluation: provided insights into the outcomes of changing the living/green roof building policy in the SoMa neighborhood to inform municipal decision-making for the Planning Department. The evaluation assessed the multitude of benefits from these investments, including water quality benefits, emissions reductions, recreations, flood risk reduction, and reduced heat island effect, amongst others.

City of St. Petersburg, FL Integrated Sustainability Action Plan (ISAP): The purpose of the ISAP is to advance the City's sustainability initiatives, including 100% clean energy goals and regional resiliency planning efforts. The ISAP will serve as a blueprint for the city's sustainability initiatives across departments. As part of the broader consultant group, Impact Infrastructure will provide capital planning prioritization support by conducting triple bottom line cost benefit analysis on a short list of infrastructure alternatives to help the city identify the most cost-effective and beneficial investments to pursue.

100 Resilient Cities National Green Infrastructure Challenge Sustainability and Resilience Analysis, City of New Orleans: Through a Rockefeller Foundation 100 Resilient Cities grant, Autocase's automated Triple Bottom Line Cost Benefit Analysis (TBL-CBA) platform leveraged additional ecosystem service data provided by Earth Economics to create an enhanced tool allowing local planners to measure the comprehensive economic, social, and environmental impacts of GI projects. The proposed Mirabeau Water Garden, a 25-acre urban stormwater park, in the City of New Orleans, LA, was selected as the ideal project through a '100 Resilient Cities Green Infrastructure Challenge'. The project is part of a suite of green infrastructure projects in New Orleans seeking to reduce flooding and subsidence, while providing environmental, social, health, educational, and economic co-benefits to communities.

Volusia County – Strategic Energy Efficiency and Climate Protection Plan Infrastructure Alternatives:

Engaged to provide a lifecycle cost and cost benefit analysis (CBA) for Volusia County, Florida, with respect to a series of seven sustainable infrastructure scenarios and alternatives at the Daytona International Airport and Speedway Boulevard as part of broader services of GHG inventory, identifying the County's energy reduction and GHG goals, and project prioritization services. Scenarios included solar PV parking covers; electric vehicle charging stations; purchasing plug-in electric vehicles; an organics recycling program; and a PACE program. The work was part of the federally funded Energy Efficiency and Conservation Block Grant (EECBG) program.

Biomass Wood Pellet Industry Evaluation – Research and CBA in California: For the Golden State Finance Authority and Rural County Representatives of California, evaluating preliminary concepts around the development of a wood pellet industry through forest restoration. Evaluating the triple bottom line, or ESG impacts such as forest fire hazard mitigation (damage and disruption avoided), cradle-to-grave lifecycle emissions reductions in power generation (comparing biomass to coal-fired), ecosystem service improvements to California forests, and benefits to the rural community from broadband internet access. Includes full lifecycle cost/total cost of ownership impacts, as well as Economic Impact Analysis determining jobs, GDP, and output in the region.

Institute for Catastrophic Loss Reduction - Cost Benefit Analysis (CBA) of Climate Resilience Standards for New Houses: Data-Driven Economic Insights (Canada): High risk regions across Canada are exposed to natural hazards including short-duration, high intensity rainfall events and extreme wind and tornadoes. Impact Infrastructure is conducting a CBA of the lifecycle costs and benefits of avoided damage from mitigated basement flooding and wind damage resulting from the installation of resiliency devices in new home construction. The analysis incorporates climate-change adjusted recurrence intervals of hazards coupled with probabilistic risk modelling.

Site Redevelopment and Sea Wall Project Assessment for Resilience and Community Impacts (Miami, FL): Downtown Miami is at risk of both sea level rise and storm surges, with a vast low-lying real estate portfolio as well as vulnerable infrastructure that could cause wider societal and economic impacts. Impact Infrastructure assessed the financial, social, and environmental impacts from a green infrastructure redevelopment project along the Baywalk waterfront (44,000 linear ft) as well as a flood risk mitigation assessment resulting from the implementation of traditional sea wall and sea wall with living shoreline features. The evaluation included GIS-based overlay and sea level rise projections for a 10-year storm event to determine the value at risk for property and contents damage. An Economic Impact Analysis was also conducted to estimate the direct and indirect regional jobs and GDP implications from the developments.

#ResilientYYC: Natural Infrastructure Management (Calgary, AB): collaborated with its project partner, Earth Economics, in the development of a blue print for natural infrastructure management in the City of Calgary. This blueprint was developed for Calgary's Resilience Strategy, which was incorporated as one of the four resilience pillars: The Future of Calgary's Natural Infrastructure. The blueprint identified actions to achieve the outcome that Calgarians are aware of the role and value of natural infrastructure in providing community benefits through communication and collaboration, bold natural infrastructure targets along with measuring, monitoring and valuing natural infrastructure. The blueprint also suggested actions to ensure the City of Calgary makes strategic investments in and accounts for natural infrastructure in processes and policy decision making.

Urban Farm Economic Assessment - Pima County, AZ: Autocase valued the financial, social, and environmental co-benefits of a community farm in an urbanized and low-income neighborhood in Tucson, AZ. Among the value provided by food provision, water savings, and CO2 sequestration, the benefits of education, recreation and community cohesions were a central piece to the project. By valuing these community benefits, it helps the sustainability team make a stronger case for using public land for urban farming.

Houston Parks Department Recreation and Naturalization Pilot Project, Houston Parks Department: Conducted a comparative analysis to assess the cost-benefit of two different alterations to a swath of undeveloped forest within the Houston city limits. The analysis leverages the Autocase software in order to delineate the outcomes related to a reversion of the space to natural habitat and the proposed build out of a sports and recreation complex. Impacts that are being emphasized are biodiversity and habitat quality, eco-literacy and public awareness, and public health and water quality.

Canadian Impact Infrastructure Exchange (CIIX) Economic Evaluation: CIIX is a national information platform that uses a market-driven approach to bring together investors - including Canada's largest pension plans - and infrastructure investment opportunities that feature high social and environmental impacts. CIIX improves the transparency of infrastructural requirements by providing analysis of the environmental, social and governance (ESG) aspects of these investments using Cost Benefit Analysis (CBA). Impact Infrastructure's role in the project delivery team was to value the ESG and resilience aspects on three proposed infrastructure projects – stormwater, wastewater, and energy - ensuring high ESG standards and resilience integrated in the infrastructure offering.

Aviation:

Airport Terminal Redevelopment Investment Evaluation - Port of Portland: Economic consulting, supported by the Autocase software will be used on the airport's \$1 billion terminal core redevelopment to assist in triple bottom line analysis and aid in prioritizing early-stage capital planning projects ranging from rainwater harvesting to comparing energy implications of various energy sources for baggage handling equipment.

Design Decisions and Capital Planning Evaluation, ATL Airport, Atlanta: Ongoing support from Autocase and its team of economists to help shape design decisions for project teams at the world's busiest airport - Hartsfield-Jackson Atlanta International Airport. Using analytics in a broad variety of airport capital planning projects.

Utility Master Plan – Alternatives Analysis, SFO Airport, San Francisco: For SFO airport, supported the broader utility master planning efforts using CBA to assess multiple utility types including water distribution (domestic, fire, and recycled), stormwater, sanitary sewer, and industrial wastewater, jet fuel sources, energy supply (heat and power) and distribution.

Terminal Redevelopment Design Analysis - LaGuardia Airport, NY: Conducted Cost Benefit Analysis of terminal redevelopment and updates design and planning project team on the new terminal building. One aspect of the efforts related to providing analysis for LEED Credits across a broad variety of design/investment elements such as optimize energy performance, indoor environmental quality and water efficiency, while the other related to

a cool roof analysis supporting an Envision Platinum certification. The analysis was conducted specifically to understand impacts and to communicate said impacts to various stakeholders.

SFO Airport – Terminal 1 Redevelopment – Economic Evaluation Design Support: Lifecycle cost-benefit economic evaluation of various energy use intensity investments, interior space designs, and a green roof for the \$2.1B dollar redevelopment of Terminal 1 and Boarding Area B at San Francisco International Airport (SFO). Worked with several design teams to assess the triple bottom line impacts of multiple design scenarios to inform project prioritization and satisfy SFO sustainability procurement requirements.

LAX Airport – Utility Master Plan Alternatives Analysis: For Los Angeles World Airports, conducted both a Financial Analysis and triple bottom line cost-benefit analysis (TBL-CBA). The analysis evaluated the triple bottom line lifecycle costs and social & environmental benefits relating to 17 alternative scenarios across six various utility-types (i.e., domestic water, fire water, sewage, electricity, chilled and heated water capacity, and chilled and heated water distribution) to provide recommendations for project prioritization.

Zero Net Energy Airport Campus - San Francisco International Airport: SFO has developed a set of ambitious goals in its Five-year Strategic Plan: to become the world's first Zero Net Energy (ZNE) airport campus by 2021. The 102,000 sqft Courtyard 3 Connector (C3C) project can be designed and constructed to ZNE performance in support of the Airport's mission.

San Diego Airport Facility Maintenance Department Building: Evaluated the incremental benefits from going beyond the airports minimum design (LEED silver) to LEED Gold or Platinum on a 13,000 sqft office space.

DFW Airport – TBL-CBA for Capital Planning: Supporting Dallas/Fort Worth International Airport on various projects to further justify existing projects and prove the case for funding and investments in the future.

Atlanta Airport – Triple Bottom Line Cost Benefit Analysis on Alternative Fuel Types for ATL Bus Fleet: Analyzing the Airport's decision to transition its existing fleet of shuttle buses toward alternative fuels such as electricity and CNG. This long-term strategic move is likely to generate a suite of financial, social and environmental impacts to various stakeholders. These impacts examine not only the financial differences in bus purchase and operation costs but also the broader environmental impact.

Philadelphia International Airport - Geothermal Analysis: For the Department of Aviation at Philadelphia International Airport, in partnership with VHB, the team at Autocase used TBL-CBA to outline a business case for using geothermal systems over a project period of 50 years. Evaluations included the lifecycle cost of ownership impacts as well as the environmental outcomes, such as avoided pollutant emissions, from investments into a sustainable HVAC system.

Philadelphia International Airport – Electric Fleet Vehicle Analysis: Engaged by PHL to investigate vehicle alternatives to replace aging vehicles in the existing fleet. The vehicles examined include a range of cars and SUVs with electric, hybrid or internal combustion engines. Triple bottom line cost benefit analysis was used to analyze potential new fleet vehicles in terms of financial, social, and environmental impacts, focusing on the total cost of ownership as well as the life cycle emissions from “well-to-wheel.” Further, the ongoing financial and environmental costs of existing fleet vehicles were also analyzed.

Cargo Infrastructure Development Program – Multiple Major US Gateway Airports: Supporting consortia of global cargo infrastructure developer and infrastructure owners in the economic evaluation of fiscal and public benefits, such as capacity increases and subsequent reductions in bottlenecks and roadway congestion, increased economic activity, and worker health and safety outcomes, related to proposed major innovative cargo infrastructure developments at land constrained, gateway airports LAX, JFK, ATL, and MIA.

Miscellaneous Real Estate and Facilities:

Defense Health Agency – Department of Defense, Facility Planning Framework Development: Engaged to provide general advisory services regarding multicriteria framework development for DHA facility management operations and capital planning. Developed a framework and methodology to integrate financial and economic impacts relating to functional condition improvements and capital investment return into the latest iteration of the Capital Investment Decision Model.

Miami-Dade County – Buildings Efficiency Policy Evaluation: Engaged with the County’s Sustainability and Resilience Department to conduct an economic analysis demonstrating the county-wide as well as building specific benefits of an initiative aimed to increase energy and water use efficiency in large buildings across the county. The analysis covered a massive set of 10,778 buildings, both publicly and privately owned, as well as seven building type case studies, and was commissioned to provide objective, third party validation of policy outcome projections as well as a tool for better communication to stakeholders.

Prologis – Sustainable Logistics and Warehouse Facilities Triple Bottom Line Evaluation Tool: Engaged by Prologis, a NYSE traded global industrial real estate investment trust, to develop a sustainability business case evaluation tool to assess the triple bottom line economic, social and environmental impacts of its facilities across North America. The project is a multistage effort to produce robust economic modeling on Prologis’ facilities. The tool was developed for internal capital planning, as well as a means to communicate the value of Prologis’ sustainable facilities to institutional investors and communities.

California State University: Multi-Criteria Analysis for Campus Expansion: Impact Infrastructure partnered up with HOK to analyze eight sites for campus expansion for California State University (CSU) using multi-criteria analysis (MCA). The MCA was set up to reflect a set of measurable environment and resilience criteria that reflected existing site conditions and capacity for expansion. Criteria evaluated included water scarcity, climate factors, sustainable food options, energy conservation policies, and waste management systems at the site and municipal level. A quantified assessment generated a list of scores for each campus site, thereby giving a ranking order of sites most feasible for additional CSU investment.

Rexford Industrial Properties REIT Sustainability Strategy Economic Analysis: Conducted Cost Benefit Analysis and Economic Impact Analysis for Rexford to supplement their Corporate Sustainability ESG Report. The outcomes of the analysis on their entire portfolio of warehouses were used to supplement the qualitative findings in the Sustainability Report. Specifically, Rexford wanted to analyze their strategic plan of renovating existing warehouses located in infill Southern California, which improves logistics and supply chains, resulting in lower vehicle miles traveled to end users and avoided embodied carbon from core reuse.

Urban Land Institute (ULI) Pilots – Economic Valuation of Sustainable Design Investments: for Jamestown Properties, LaSalle Investments, and Prologis, evaluated a series of sustainably-oriented large-scale major buildings projects to quantify the value produced over the life of the buildings to inform decision making, designs, and stakeholder outreach around energy efficiencies, water conservation, occupant health and productivity, and other design attributes.

California High Speed Rail Corridor Station Design Analysis – Economic Evaluation of Design Levels: for WSP Global, a major engineering firm, evaluated various designs for train stations seeking LEED submission

for the California High Speed Rail. The various designs ranged in LEED certification levels and included credits targeting energy, water, indoor environmental quality, and sustainable sites.

Municipal Building Portfolio LEED Silver Economic Analysis for Fairfax County, VA: Conducted Cost Benefit Analysis on 10 existing LEED Silver municipal projects built between 2015 and 2018, as compared to minimum code buildings. LEED scorecard and submission documents were leveraged to input all relevant information to conduct the analysis and evaluate the merits and trade-offs of those investments in sustainable design.

Pratt & Whitney Manufacturing Facilities Capital Planning Economic Analysis: for Pratt & Whitney, a global manufacturing company, utilized custom economic analysis and Autocase software on projects in North America to capture value of financial, social, and environmental impacts relating to alternate designs and its impact on employees in LEED and non-LEED manufacturing facilities, as well as to cost-justify investments in PV in many of their facilities across North America.

US Navy Joint Base Pearl Harbor-Hickam Pilot Sustainability Economic Analysis: Engaged by NAVFAC Pacific to develop a Sustainability Planning and Modeling Pilot for Joint Base Pearl Harbor-Hickam (JBPHH). As part of the master plan pilot study to support NAVFAC Pacific, engaged to apply its CBA analysis tool to evaluate the financial and triple bottom line viability of the capital improvement in its sustainability plan.

Cost-Benefit Analysis of Sustainable Initiatives at Fort Bliss Hospital – United States Army Corps of Engineers: Produced an economic analysis (life-cycle cost/SROI analysis) of all of the potential sustainable initiatives being considered for the new \$1.45B Army hospital in Fort Bliss, Texas. SROI was utilized as a decision-making tool and dashboard that evaluated and assessed sustainable design and evidence-based design alternatives during each design phase so that only the most efficient, synergistic and cost-effective combination of initiatives would be included in the project. Not only did the study identify the optimal mix of energy investments and other sustainability-related technologies, it also helped the project team meet all federal mandates and Executive Orders related to life-cycle costing.

Johns Hopkins University Sustainable Campus Initiative: Completed a Cost Benefit Analysis for Johns Hopkins University with respect to sustainable initiatives used to obtain a LEED for Existing Buildings certification. Monetized the triple bottom line of financial, environmental, and social returns on the long-term capital expenditures in order to get budgetary approval from decision makers and stakeholders. Quantified and monetized the externality impacts of initiatives such as efficient lighting, variable air volume systems, heat recovery wheels, recycling program, grey water system, and low-flow fixtures.

Fort Belvoir Community Hospital Economic Analysis – United States Army Corps of Engineers: Engaged to provide an economic analysis (life-cycle cost/cost-benefit) of the energy generation, emissions reduction, and water conservation measures that were included in the hospital design of the 1.27 million square foot LEED Silver Ft. Belvoir Community Hospital in Virginia.

US Army Garrison Humphreys, South Korea – US Army: Engaged to provide a Life-Cycle Cost Analysis (LCCA) and Cost Benefit Analysis (CBA) of energy and water conservation measures for the USAG Humphreys (USAGH) in South Korea. This draft report is based on the S5 submittal at 65% completion. LCCA is used to demonstrate if the operational savings of a project are sufficient to justify its additional investment cost. CBA builds on this framework and adds an additional dimension of risk analysis and provides a Triple Bottom Line view of a project's economic results.

Department of Energy - Argonne National Laboratory Energy Sciences Building: Engaged to provide a cost-benefit analysis and life-cycle cost analysis for the LEED Gold Argonne National Laboratory Energy Sciences Building in Illinois, for the Department of Energy. This report compared a group of sustainable strategies that were chosen to provide options for energy performance improvements, emissions reduction, and environmental enhancements.

Multimodal Transportation:

Institute for Sustainable Infrastructure – Transit Business Case Investment Tool: The Business Case Evaluator (BCE) for Transit was developed to enhance the Envision rating system, adding the ability for the Envision system to provide value-based and risk-adjusted analyses of infrastructure projects. This version of the BCE tool is designed to be applied to transit projects. The BCE for Transit was co-created by Impact Infrastructure, Inc and the ISI Economics Committee. The BCE for Transit is a standardization of the economic methodology as well as much of the data required to use triple bottom line cost-benefit and risk analysis for transit planning and design decisions.

Port of Long Beach, Fourth Track at Ocean Capacity Improvement Program Analysis: Part of Port of Long Beach's Rail Enhancement Program, the Fourth Track Project would eliminate a bottleneck in the railroad corridor serving the eastern portion of the Port of Long Beach. The project will add a fourth track in addition to the three existing tracks that cross under the Ocean Boulevard Overcrossing. The primary purpose of the project is to facilitate the movement of on-dock rail, thus reducing truck traffic congestion on regional roadways. Conducting CBA towards grant funding and valuing the broad-based public benefits from modal shift and improved operations.

Ford Site Redevelopment Multimodal Transportation Analysis: Engaged to conduct a CBA on transportation and transit alternatives a major urban redevelopment project in Saint Paul, Minnesota. Alternatives in the transportation master planning include transit investments such as increased bus transit routes, as well as new roadway alignments, signalling, complete streets, traffic calming measures, recreational areas and pedestrian and bike pathways.

City of Calgary – Alternative Transit Bus Fuels Triple Bottom Line Evaluation Tool: Engaged by City of Calgary to evaluate financial, social, and environmental impacts from the move away from diesel and gasoline fueled buses toward a fleet that is powered by electricity, the way of the future. This tool has given the City the ability to understand what those impacts are, who they affect, and valuing them in dollar terms so that various bus types can be compared on an apples-to-apples basis. This gave the opportunity to understand the impacts to each option not just from an upfront cost-minimization perspective, but a lifetime value-maximization perspective using a Triple Bottom Line Cost Benefit Analysis (TBL-CBA) approach. Engagement included the development of a custom TBL-CBA tool capable of multivariate and risk analysis, user guide, metrics dashboard, staff training, and reporting.

City of Ottawa Transportation Master Plan – Cost of Travel Model, City of Ottawa – Developing the cost of travel modeling to support policy development and planning for the updated TMP. To ensure the effective and efficient operation of a transit and transportation system, the cost of travel model effort must be made to attain the highest level of effectiveness (satisfying travelers' requirements) in the most efficient way (with minimum input). Modeling includes fixed vehicle costs, variable vehicle costs, parking; road construction; road maintenance; roadway land value; enforcement/protection services; personal

time; commercial delays; unaccounted accident costs; air pollution; noise pollution; water pollution, health outcomes, etc. across multimodal considerations across various neighborhoods in the City.

TransLink Regional Transportation Costs and Economic Analysis - Transport 2045 Strategic Plan: for TransLink, a regional transportation authority in Vancouver, British Columbia, assessed regional transportation costs, benefits, and payments. Provided an overview of literature on approaches to measuring the full costs of transportation and recommended a methodology to be adopted for the Metro Vancouver region. The developed methodology was used to estimate the full costs of transportation in the Metro Vancouver region for the major modes of transportation (private auto, commercial/truck, transit bus, SeaBus, SkyTrain, West Coast Express, bike and walk).

Project Connect North Corridor, Alternatives Analysis CBA: Engaged by the Capital Metro Transportation Authority to provide a multimodal transportation alternatives analysis using a cost-benefit analytical framework for the North Central Corridor in Austin, Texas. The goal was to quantify and value the societal-related benefits and costs of four proposed alternatives with various alignments and modes of bus and commuter rail transit investments by Capital Metro and prioritize these investments to help select the locally preferred alternative. Developed a project approach which incorporated risk assessment and an alternatives development and evaluation methodology that reflects the EPA-HUD-DOT livability principles.

Lake Tahoe US 50 Road Improvement & Revitalization SROI: Completed a cost-benefit and risk analysis on transportation options to identify private and public environmental and social benefit/cost categories causal to the implementation of US Highway 50 (US 50) improvements, which included streetscape enhancements, a roundabout, bike paths and pedestrian improvements, stormwater runoff investments, and a loop road system to reduce congestion.

Freight Hub Location Selection Tool - Kansas State Department of Transportation: Engaged to provide an economic analysis, including multi-criteria assessment tool development and an economic impact evaluation, to assist KDOT and its advisory group in selecting the most compelling freight rail transload sites within the state to develop. The assessment integrated engineering assessments, stakeholder and class I railroad feedback, and macroeconomic indicators to develop a comprehensive project evaluation framework.

Cost-Benefit Analysis for Intermodal Rail Facility: For Iowa Northern Railroad and the Iowa Department of Transportation (DOT), conducted a cost-benefit analysis for grant applications for the US DOT. Two major portions of the UMTH project were analyzed; namely 1) construction of infrastructure that will provide rail yard support, for trans-loading highway trailers and shipping containers, and; 2) the infrastructure for a sizeable intermodal facility and container. The analysis monetized impacts related to improved freight rail efficiency and capacity, diverted existing freight from truck to rail, reduced truck miles traveled, and reduced highway maintenance costs, transportation costs, congestion costs, and accident costs (fatalities and injuries).

Alaska Canada Rail Link Economic Analysis: Retained by the University of Alaska Fairbanks to complete a CBA for the proposed Alaska-Canada Rail Link. Determined that the project would generate economic benefits that exceed its costs and generate an economic return on investment of 5.9%. The CBA was developed from the perspectives of both the public (USA and Canada) and private sectors (rail operator) and output metrics were integrated into a P3 analytical framework to determine the optimal cost sharing mechanism (85% public contribution of capital costs versus 15% contribution from the rail operator). Net economic benefits were predicted in excess of \$14 billion.

Aurora Avenue North Multi-Modal Corridor Project: Conducted a cost-benefit analysis (CBA) in support of the Federal TIGER Grant Application for the City of Shoreline, Washington. The CBA, risk analysis, and economic impact analysis captured capacity needs through improvements to intersection geometry and capacity, signal improvements, and additional lane capacity for business access and transit.

Sustainable Places Public Benefits Analytical Tool: Through a grant from HUD and a regional partnership of local governments, City of Austin and the University of Texas at Austin developed an innovative analytics tool to more effectively plan municipal infrastructure in the region called the Sustainable Places Analytical Tool (SPT). Engaged to incorporate monetization principles developed in its Sustainable Return on Investment process into the next-generation SPT specifically related to HUD's six livability principles. Provided a database of monetization metrics to be used in the SPT, along with the methodology, data, and calculation framework for estimating the monetary value of key social and environmental impacts.

Georgia Ports Authority Regional and Multimodal Connector Evaluation: Evaluated the \$36.6 million Regional and Multimodal Connector project will enable the Port to accommodate growth in cargo and improve the Port's container-handling capacity and alleviate substantial traffic delays by reducing grade crossing blockages, reduce truck drayage to Savannah Yard due to long train dwell times, and protect 21,000 acres of land from flooding as part of an ancillary flood mitigation effort to accommodate the redesigned rail yard. Valued the financial and public benefit impacts including diverted truck to rail freight impacts such as reduced emissions, congestion reduction, safety enhancements, shipper and operational costs savings, and flood risk mitigation.

International port of Memphis - Memphis and Shelby County Port Commission – Cost Benefit Analysis for Infrastructure Investments: The International Port of Memphis on Presidents Island is the largest still water harbor on the Mississippi River and the fourth largest inland port in the country. The Port serves 150-200 distinct industry operations including warehousing and distribution, bulk loading, and intermodal transloading facilities including port to water, port to truck, and port to rail cargo handling. Due to rail service demand outpacing capacity at the port and storage limitations, any disruption to the transportation network magnifies the current congestion issue. Evaluated the expansion in capacity to expand the rail service on Presidents Island, in to investing in pedestrian/bicycling trail to link residents living on both sides of the Mississippi River.

Energy Sector:

City of Vancouver, Landfill Gas Conversion Alternative Development Analysis – Canadian Impact Infrastructure Exchange (CIIX) Pilot Program: Engaged by the City of Vancouver to prepare a cost benefit analysis and life cycle cost analysis on multiple ownership scenarios (third party (Fortis BC), joint venture, and City sole ownership) for a renewable natural gas recovery project at the Vancouver Landfill in Delta, BC. The project is designed to recover landfill gas (LFG) generated at the Vancouver landfill, upgrade it then add it to the provincial natural gas (NG) distribution system for use as Renewable Natural Gas (RNG).

Pickering Nuclear Generating Station Economic Impact Assessment, Ontario: Engaged to estimate the economic and financial impacts associated with the retirement of the Pickering Nuclear Generating Station

which is slated for decommissioning. The plant employs over 5000 individuals and fostered the creation of a supplier community that now services the plant. In order to properly assess the significantly negative expected impacts on the City of Pickering, we developed an integrated economic and financial model which will serve to inform the City's future economic and fiscal policies.

Decommissioning Alternatives Study, Martin Drake Power Plant - Colorado Springs Utilities, CO: Conducted investment analysis of decommissioning the Martin Drake Power Plant focusing on issues pertaining to the timing, energy source alternatives for replacement power, as well as a broad range of economic, environmental, and social impacts. Our work involved comparing the base case plan for the plant to a substantial set of alternatives, sensitivities, and risks. The broad scope of results helped inform stakeholder discussions and provide an understanding of the trade-offs involved for both Colorado Springs Utilities and the community.

Power Supply Options and Sustainable Return on Investment, James De Young Plant - Holland Board of Public Works, Holland, Michigan: Engaged to conduct a generation planning study that would evaluate base load power options against existing expansion plans. Holland needed to add generation and was considering a broad range of options: coal, gas, wind, solar, and biomass. These options brought different benefits, costs and risks such as emissions, the viability of its commercial harbor, the ability to do district heating or the ability to expand the snow melt system in the downtown. Provided a cost benefit analysis as well as proposed project development and cost estimating services for a thorough list of alternatives. The analysis equally considered the decommissioning of the James De Young Plant and returning it to a highly valued green space for the community.

Wind Generation – 100MW Wind Farm – Denver Metro Wastewater Reclamation District: Engaged to evaluate the financial, social, and environmental implications to a 100MW turbine installation on the land owned by Metro Wastewater to determine its viability.

Due Diligence for Wind Farms Purchase, Due Diligence: Engaged by TIAA-CREF/CIRI's Financial Services group to provide due diligence review for a preferred equity investment in a portfolio of wind projects in the United States. The Capistrano portfolio was owned by Edison Mission Group. As part of the work, independently validated the financial model provided, identified errors and areas of concern, performed a risk analysis of the model inputs, and estimated the potential financial impact of out of warranty serial defect risk in the wind turbines.

Risk Analysis of Pumped Storage Refurbishment Bids: For Consumers Energy and DTE, performed a Cost Risk Analysis (CRA) the Ludington Pumped Storage Plant, a six turbine 1,872 megawatt facility. This CRA considered the risk associated with the costs and schedule of bids from three selected vendors. In Phase I of the Project, analyzed three bids for the design-build contract to perform the overhaul. Each bidder's price offer was adapted into a CRA model, and the escalation, cost risk, and schedule risk associated with each bid was estimated. The risk-adjusted cost was used by the Owners to determine the contingency they should set aside. In Phase II of the analysis, the estimates were updated to reflect new risk information, and each bidder's best and final offer. Phase III updated the CRA further for the winning bidder only. Finally, in Phase IV, the terms of the signed contract between the Owners and the winning contractor were used to create a final CRA model. Additional risks were also estimated in the final phase, including possible contracted items such as variable direct labor costs, possible bonus payments and liquidated damages.

Risk Assessment of Financial Derivatives Backed Residential Gas Service: For Enbridge Solutions Inc., evaluated an entirely new to the market financial derivatives-based business and hedging strategy for a residential fixed price gas contract. The project included calibrating a theoretical call option pricing model to market quotes, evaluating the cost of the strategy and simulating the risks and rewards. The risk considered included: foreign exchange; interest rate; volatility; basis; NYMEX futures; delta; and other forecasting risks. In addition a business start-up plan was developed and financial forecasts developed.

Risk Analysis of Generation Options: For NV Energy, performed a Cost Risk Analysis (CRA) on six generation options including a supercritical coal plant - the Ely Energy Center (EEC), a 2,500 megawatt coal-fired power facility to be located in White Pine County, Nevada. This CRA considered Phase 1 of the coal plant construction with planned additions of 1,500 megawatts. While the Ely Energy Center was initially the main focus of the study, several other gas, and coal options were also evaluated.

Economic Analysis for Solar Panels: Conducted a Solar Photovoltaic Installation Feasibility Study for the Corpus Christi Regional Transportation Authority (RTA) to assess the feasibility of installing solar photovoltaic (PV) panels for on-site energy generation at the RTA headquarters complex. The team modeled multiple scenarios featuring varying levels of solar energy production on the site for four scenarios, featuring systems ranging from 468 to 2,250 kW in size. In anticipation of the RTA's pursuit of American Recovery and Reinvestment Act (ARRA) funds through the Federal Transit Administration, the team conducted a benefit/cost analysis and calculated Sustainable Return on Investment (SROI) for each of the scenarios under consideration. Calculated the economic, environmental, and social benefits of proposed projects, thereby quantifying benefits not captured by traditional return on investment calculations and helping to make a case for sustainable capital improvements.

Cost and Schedule Risk for New Electricity Generation Project: For Consumers Energy in Jackson, MI., contracted to provide a cost and schedule risk analysis of the Karn-Weadock Power Generating Complex in Essexville, Michigan - an 800 MW coal-fired unit. Using its Risk Analysis Process Decision Economics was to identify, analyze, model, and mitigate the risks to budget and schedule.

Cost-Benefit Analysis of Various Alternative Uses of Biogas from Wastewater Treatment – Madison Metropolitan Sewerage District: Conducted life-cycle cost analyses, as well as cost-benefit analyses to assess expansion at its current facilities. Studied a variety of alternatives to beneficially reuse the biogas that is a waste product from the wastewater treatment process. The project involved looking in great detail at the costs and benefits from a triple bottom line perspective, including greenhouse gas emissions and other air pollutants, trucking impacts, etc.

Cost-Benefit Analysis of Various Alternative Uses of Biogas from Wastewater Treatment – City of Portland: Studied a variety of alternatives to beneficially reuse the biogas that is a waste product from the wastewater treatment process. The triple bottom line cost benefit analysis project involved looking in great detail at the costs and benefits from a triple bottom line perspective, including greenhouse gas emissions and other air pollutants, trucking impacts, etc.

Carbon Credit Portfolio Valuation for Enbridge Gas Distribution: Provided a preliminary valuation of EGD's potential portfolio of carbon credit assets and an assessment of the resulting business opportunity. Given the uncertainty that exists with respect to carbon trading, developing a credible preliminary business plan that explicitly captures all of the risks is critical. As a result, used a Risk Analysis Process (RAP) to carry out this engagement. Made an inventory of EGD's potential portfolio of carbon credit assets. The quantity of the assets was evaluated and "tranches" of vintage and quality were created. Then

assisted in developing a strategy to monetize these credits. Finally it developed a carbon trading business plan.

Valuation of Refurbishment and New Pumped Storage Plants: For BPA, to determine the cost of increasing wind integration, the value of new and refurbishment of pumped storage plants were calculated using ratebase cost models and arbitrage revenue. In addition, the value from a possible ancillary services market was determined. The cost of providing balancing reserves for the next increment of wind capacity into BPA's balancing area by refurbishing the Keys Pumping Plant was estimated to be similar to the current cost of providing balancing reserves for wind with the existing hydro system. Balancing reserve costs provided by a new project were calculated to be much higher. While there is some potential for incremental benefit from energy arbitrage, that benefit was forecasted to be only about one percent of total revenue requirements. The economic analysis was published by BPA in "Hydroelectric Pumped Storage for Enabling Variable Energy Resources within the Federal Columbia River Power System" in September 2010.

Ontario Power Generation Pumped Storage Facility Ancillary Benefits: Prepared a briefing paper describing the potential ancillary services (e.g., load following, voltage regulation, frequency following, spinning reserve, etc.) with an overview of possible revenue values of these services based on experiences in Ontario and/or other North American jurisdictions to provide input to OPG's financial optimization model. A database of historical hourly ancillary services prices across North America was developed for estimating the benefits of pumped storage projects.

Pumped Storage Economic Feasibility: For Grasslands Renewable Energy, undertook an economic feasibility of the proposed 350MW Gordon Butte pumped storage plant. By simulating the ancillary services revenue and risks from spinning (in air and water) and non-spinning reserves, regulation up and down as well as energy arbitrage the benefit/cost ratio was determined.

Transmission Project Business Case: For Grasslands Renewable Energy, contributed to a business case for a \$1 billion transmission project for the Western Area Power Authority. The business case looked at the costs, revenues, risks and public benefits of the project and its alternatives (AC versus DC and lines serving different markets). The analysis developed a risk register and quantified the potential cost, schedule, and escalation risks. The public benefits that were quantified were competition (energy diversity) benefit; grid congestion benefit; and grid reliability benefit.

Cost Benefit Analysis for Alternative Pumped Storage Sites: For Chelan PUD, developed a CBA screening model that was used to evaluate nine potential pumped storage sites. The model calculated the energy (arbitrage and ancillary services) revenue or the revenue from wind integration. It also quantified the benefits of drought control, irrigation, downstream hydro, reduction in the risk of negative energy prices, and fisheries benefits. The model was used to analyze several water release scenarios and the risk adjusted results were presented in terms of the energy and water storage benefit/cost ratios.

Cost Risk Analysis of the Cass County Combined Cycle Project: Engaged by Omaha Public Power District to perform a Cost-Risk Analysis (CRA) for the Cass County Combined Cycle Facility in the State of Nebraska. The goal of this CRA model is to determine the cost of delaying this project by measuring the escalated project costs under three schedules. The cost-risk analysis model incorporated material and labor escalation factors in order to forecast the input prices that impact project costs. Risk analysis was used to simulate the cost-risk analysis probabilistically by assigning confidence bands to all the escalation inputs. This incorporates the price volatility and uncertainty associated with each commodity input. Monte Carlo analysis was then conducted to simulate probabilistic views of the escalated project costs.

Business Case and Risk Analysis for Carbon Trading: For Enbridge Solutions Inc., developed a risk and business assessment of two proposed carbon trading business strategies. Contacted several carbon trading companies to get information on the costs and expected revenues for working with ESI (e.g. costs for planning, validation, & registration of credits, costs for monitoring, verification, aggregation, & trading of credits, and price of credits). Based on this information a model of ESI's potential revenue and profit was constructed. Uncertainty in many of the inputs was explicitly modeled using Monte Carlo simulation techniques. The analysis led to a recommended approach for ESI's energy audit program and Mr. Parker led the commercial negotiations with the recommended carbon trading company.

Geronimo Wind Energy: Expert at open house for the Paynesville Wind Farm. To be located north of Paynesville and south and east of Lake Henry, in Stearns County, Minnesota with a capacity of 95 MW. Mr. Parker provided information to local residents on the impact of the wind farm on property values.

Energy Business Planning. For Enbridge Solutions Inc., an unregulated energy services firm, performed several economic, risk, and business planning studies for potential new businesses for Enbridge Solutions Inc. for the residential and commercial markets. Examples included a residential home audit program, a rental furnace, water heater and air conditioning business and a carbon trading business.

Human Risk Analysis: For We Energies, analyzed the operator tasks at the Milwaukee County Power plant (MCPP). Tasks were categorized, classified, and the probability of human error estimated. The tasks most likely to cause error were identified and the error producing conditions highlighted. The analysis looked at the impact shift work, maintenance, equipment redundancy, and training. Estimates were made of the impact on human error of making changes to training, the shift schedule, and instrumentation.

Analysis of Waste-to-Energy Market Study for the City of Omaha, Nebraska: Engaged to provide a cost-benefit analysis and risk analysis of comparing the economic and environmental performance of four proposed waste management facilities for the City of Omaha. The four alternatives were: Mass Burn Waste-to-Energy; Refuse Derived Fuel Waste-to-Energy, with combustion in waterwall furnace; Refuse Derived Fuel Waste-to-Energy, with combustion in fluidized bed; and Anaerobic Digestion. The alternatives were measured relative to a base case option of landfilled solid waste, with some glass and yard waste being recycled and composted, respectively. Took into account the full life-cycle impacts of the waste management alternatives using a third party municipal solid waste software.

Water/Wastewater/Stormwater:

Life Cycle Cost Analysis and Cost Benefit Analysis – Pittsburgh Water and Sewer Authority – Green First – Sewershed Prioritization: Supported the broader project team in triple bottom line economic modeling and analyzed the benefits of GI if implemented in targeted areas across the combined sewer system within the City of Pittsburgh and the hydraulically connected surrounding municipalities. The TBL impacts were calculated across 30 priority sewersheds for two different levels of GI implementation representing the expected range of implementation needed to meet the 85% combined sewerage capture goal in each of the sewersheds. Using Autocase, the evaluations concluded that both levels of GI implementation provide significant TBL benefits across seven benefit categories, including air pollution and carbon emissions, heat island, water quality, and recreational use benefits.

Los Angeles County Public Works – Pilot GSI/LID Studies and Economic Tool Gap Analysis: LACDPW has expressed a long-term vision of equipping their engineers with these analytics to assess project proposals for their risks, lifecycle costs, and broader sustainability and flood risk impacts associated with the variety of green infrastructure investments that may be under consideration. This project includes the assessment of six large scale GSI/LID projects across the region, along with a gap analysis and significant stakeholder outreach and facilitation.

Regional Green Infrastructure Evaluations - San Antonio River Authority: In the City of San Antonio, conducting a cost benefit analysis on regional center planning, including the Brooks Regional Center and Texas A&M campus green stormwater infrastructure scenarios. Using Autocase and economic consulting services to evaluate various growth and land-use coverage scenarios for long-term city stormwater infrastructure planning.

Metrolinx - Total Economic Valuation (TEV) Parking Infrastructure Project CBA: Engaged with PWC to assess the costs and benefits of various sustainable design options for a selected parking lot at Metrolinx – one of North America’s largest transit agency and owner of parking lots. This TEV approach and methodology used for the assessment of parking lot designs will then be integrated in Metrolinx’s capital planning, budgeting and asset management to optimize total impact for future projects.

Valuation of the McCoy Creek Restoration: The McCoy Creek Restoration project is a green infrastructure site designed to provide natural channel design and bioengineering treatments covering 142 acres along 2.8 miles of creek in Jacksonville, FL. Along with replacing wetlands and stream banks, many amenities will be provided as part of the restoration including: trails; playgrounds; a community garden; an outdoor classroom; fitness areas; bird watching opportunities; picnic areas; fishing docks; kayak launches; and potentially a sloped bank to host open-air performances.

Mobile Bay National Estuary Program (NEP) - Stream Restoration Assessment: Engaged by Mobile Bay NEP to prepare a triple bottom line cost-benefit analysis on the broad impacts of stream restoration in the D’Olive Watershed. Assessed in aggregate the entire portfolio of stream restoration initiatives, valuing impacts such as habitat and recreation in the coastal environment. Using peer-reviewed ecosystem valuation techniques, as well as leveraging methodologies in the Autocase software, the benefits of the program were estimated for the streams themselves, surrounding wetlands, and D’Olive Bay.

Metro Wastewater Reclamation District: Denver – Various Alternative Analyses and Services: Conducted life-cycle cost analyses, as well as cost-benefit analyses to assess expansion at its current facilities and planning of new facilities. Analyzed non-traditional energy generation systems such as combined heat power (CHP) systems using extracted biogas, nutrient removal alternatives, effluent temperature regulations, biosolids management systems, as well as a 100 MW wind-farm installation on the District’s land. 19 systems analyzed in total as part of various capital planning and facility design alternatives analysis. Additionally provided in-house economic tool development, risk analysis training, and modeling support for the District to conduct in-house economic analysis.

Cost-Benefit Analysis of Various Alternative Uses of Biogas from Wastewater Treatment – Madison Metropolitan Sewerage District: Conducted life-cycle cost analyses, as well as cost-benefit analyses to assess expansion at its current facilities. Studied a variety of alternatives to beneficially reuse the biogas that is a waste product from the wastewater treatment process. The project involved looking in great detail at the costs and benefits from a triple bottom line perspective, including greenhouse gas emissions and other air pollutants, trucking impacts, etc.

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Stormwater Management Cost-Benefit Analysis – Pima County Regional Flood Control: Collected data and calibrated AutoCASE software to provide a comprehensive assessment and a broad perspective, looking at the value to the community, government, and the environment specific to the arid southwest region. The analysis included the benefits of tree shade for road pavement life extension, the traffic calming benefits of chicanes containing green stormwater features, and the carbon benefits of trees.

City of Toronto, Urban Low Impact Development Analysis at Raindrop Plaza – Canadian Impact Infrastructure Exchange (CIIX) Pilot Program: Engaged by the City of Toronto to prepare a cost benefit analysis and life cycle cost analysis on an urban stormwater park. The City was considering investments in multiple street-level stormwater infrastructure projects to optimize stormwater management and public benefits. The selected site design enabled the project to meet Toronto Water’s Wet Weather Flow Management Plan and Toronto Green Standard by managing rain where it falls, with urban investments in green stormwater infrastructure/low impact development at Raindrop Plaza.

Credit Valley Conservation Authority, Canada – Low Impact Development Triple Bottom Line Evaluations – Partnering with the conservation authority to evaluate the benefits of conserved space held by the Authority to adjacent land holdings. These aspects include reductions in disruption of business functions resulting from nuisance ponding, cost savings on utility bills as a result of lower ambient temperatures near green spaces, and lower crime rates in surrounding areas. These models are being created with an eye towards expanding their scope to quantify similar benefits for conservation authorities across Canada as well as for Credit Valley.

Evergreen School Grounds Land Green Infrastructure Retrofit Evaluations, Canada: Evaluating both current and prospective schoolyard greening projects across twelve different schools in three separate districts of Ontario, Canada. These evaluations look to resilience aspects of the greening proposals (flood risk, urban heat island impacts, water quality uplift), as well as broader social benefits (public health and recreation valuations) and building level impacts (student productivity and employee absenteeism). This multi-faceted perspective on schoolyard greening aims to provide micro and macro-level insights to decision makers as they consider program or policy level decisions about these spaces.

Life Cycle Cost Analysis and Cost Benefit Analysis - Stormwater Management BMP Optimization - LADWP: Engaged by the City of Los Angeles Department of Water and Power (LADWP) to work alongside CH2M to conduct a lifecycle cost analysis and cost benefit analysis on various competing low impact development (LID) stormwater management scenarios at the East Valley District Yard in Los Angeles, CA using Autocase software. The three scenarios utilized LID BMPs such as bioretention areas, permeable pavement, green roofs, subsurface infiltration, and sand filters. Full lifecycle costs were assessed, as well as the broader social & environmental impacts such as water quality improvements, flood risk reduction, air quality, water supply, and property values.

City of Edmonton – Private and Public Green Infrastructure Sites Evaluations – City Wide: using Autocase and economic consulting services to evaluate land-use planning options for private sites and to better

understand the costs and co-benefits of GI on >33,000 sites across the city for project prioritization and GI policy planning.

City of Phoenix – Land Use, Green Infrastructure, and LID Features Analysis: supporting a city-wide policy planning project to better understand the value that GI/LID provides the community; prioritizing feature types, and assessing a variety of sites, costs and co-benefits using triple bottom line cost benefit analysis and Autocase for Sites software.

Life Cycle Cost Analysis and Cost Benefit Analysis - Ford Site Redevelopment Stormwater Infrastructure Master Plan Analysis, Saint Paul, MN: For a 135 acre major urban redevelopment project on a former Ford Company assembly plant site along the Mississippi River, the City of Saint Paul, MN and its consulting firm BARR Engineering, used Autocase software augmented by custom economic consulting as a means to prove the business case of incorporating a higher concentration of green stormwater BMP features in support of the vision to create a connected, liveable and green site. Investments included enhancements of existing wetlands, higher concentrations of BMP LID features, and a centralized green recreation space.

Cost-Benefit Analysis of Washington DC National Mall Green Infrastructure and Flood Risk Assessment: Assessed the triple bottom line – financial, social, and environmental – merits of an unconventional green infrastructure, flood storage, and congestion reduction project proposed by Dewberry at the DC National Mall.

EPCOR Water Treatment Plant Residuals Management and Drainage Total Loadings TBL-CBA: Given Alberta Environment regulator interests, EPCOR Utilities wishes to better understand the outcomes from reducing solids loadings into the North Saskatchewan River (NSR) by investing in residual management facilities at its water treatment plants and pursuing a drainage total loadings reduction strategy. The ongoing analysis intends to understand the broader externalities from trade-offs from the benefits such as improved aquatic habitat and recreational opportunities versus potential disbenefits such as increased energy, chemical usage and solid waste.

City of Charlottetown, Pollution Control Plant – Canadian Impact Infrastructure Exchange (CIIX) Pilot Program: Engaged by the City of Charlottetown to prepare a cost benefit analysis and life cycle cost analysis on multiple design alternatives under consideration by the Charlottetown's Pollution Control Plant. The analyses are being prepared as part of the CIIX pilot program which is designed to enable Charlottetown to bring a triple bottom line perspective to large scale infrastructure projects. The Pollution Control Plant is considering investments in geo-thermal energy production, technology to harness heat from liquid waste, solar photo-voltaic panels, an on-site greenhouse, a biosolids drying facility, and Smart Infrastructure sensors.

Blue Green Corridor, City of New Orleans: Stantec designed for a solution for the areas next to – and in between – streets in the Gentilly region of New Orleans to capture stormwater and act as a seasonal/temporary river and pond system. People would be able to recreate in these areas and Autocase worked with Stantec to estimate the value to the community of this activity.

Meander Bend Park & Southern Arizona Children's Advocacy Center Parking Lot, Pima County: Autocase was used to value the triple bottom line impacts of two potential projects in Pima County, AZ: Meander Bend Park – and 18 acre park, and a 0.3 acre parking lot attached to a children's advocacy center. Both projects used recreation in various ways - with the park having active amenities, while the parking lot

would be used by people being processed. Both projects yielded significant positive results – which helped secure further funding for the County’s green infrastructure initiatives.

American Rivers - Nelson Dam Replacement Project in Yakima County: Conducting a TBL-CBA on the removal and replacement of a small-scale dam that is impeding the flow of the Naches River. The dam that consists of three water diversions and starves a smaller creek, will be removed and replaced with a regrading of the riverbed. The intent of the research is to value the benefits gained from restoring the natural flow of water to the area including, increased salmon spawning grounds; lower flood risk and resulting property value retention; and reduced river bank erosion.

Port of Long Beach – Stormwater Capture and Treatment Assessment: Conducting an economic analysis to better inform the decision to capture stormwater at the Port of Long Beach. By choosing where to place, and how to treat and divert stormwater, the Port has the opportunity to improve water quality, lower the use of scarce imported water, and provide tenants with a grey water source option. Developing economic models to determine what combination of location, treatment system, and scale, will provide the Port and the area of Long Beach with the greatest financial savings, and benefits to the environment and human health. Evaluated over two dozen alternatives for water capture and reuse, in addition to various geographical uses cases, such as at the Port, within the City of Long Beach, and broader use for the LA County region as a whole.