DSD Conference: Applying the Triple Bottom Line in San Francisco
November 13th, 2014
Agenda

• Introduction to San Francisco’s Sewer System Improvement Program
• San Francisco Triple Bottom Line Model
• Questions / Discussion
Built on the principles of understanding the entire costs and benefits of a given investment to provide a better understanding of how these investments will change our built, natural, and social environments.
SAN FRANCISCO SEWER SYSTEM

- 1,000 miles of Sewers
- 2 All-Weather Wastewater Treatment Plants
- 1 Wet-Weather Wastewater Treatment Plant
- 8 Transport/Storage Structures
- 19 All Weather Pump Stations
- 25,000 Catch Basins
- 36 Combined Sewer Discharge (CSD) Structures
- Green Infrastructure
Sewer System Improvement Program (SSIP)

• $6.8 Billion Program

• 15-year Program - 30-year Implementation Schedule

• Includes entire system
  • Treatment plants
  • Collection system
  • MS4 separate areas

The Public Mandate

Sewer System Improvement Program
7 Public Workshops

2005-2010
2009-2010
June 2010
July 2010

Stakeholder Input

Sewer System Master Planning Effort

Digester Task Force 18 months

SSIP Levels of Service Goals Endorsed & Resolution Adopted
Sewer System Improvement Goals

- Provide a Compliant, Reliable, Resilient, & Flexible System that can Respond to Catastrophic Events
- Integrate Green & Grey Infrastructure to Manage Stormwater
- Provide Benefits to Impacted Communities
- Modify the System to Adapt to Climate Change
- Achieve Economic & Environmental Sustainability
- Maintain Ratepayer Affordability
KEY ELEMENTS

- Watershed approach to project planning
- Collaboration with other city agencies
- Public engagement
- Triple Bottom Line (TBL) analysis
URBAN WATERSHED ASSESSMENT

Projects + Programs + Policies

Green and Grey Infrastructure

Education, Grants, and Incentives

Stormwater Design Guidelines
GREEN AND GREY TECHNOLOGIES

GREEN

- Creek Daylighting
- Constructed Wetlands
- Vegetated Roof
- Bioretention Planter
- Rainwater Harvesting
- Permeable Paving

GREY

- Pump Stations
- Outfall Retrofit/Replacement
- Tunnels
- Transport/Storage Structures
- Pipe Upsizing/Replacement

URBAN WATERSHED GREY AND GREEN SOLUTIONS
### Recap of SSIP Validation

#### Budget Summary

<table>
<thead>
<tr>
<th>Categories of SSIP Capital Program</th>
<th>Phase 1 ($ Millions)</th>
<th>Phase 2 ($ Millions)</th>
<th>Phase 3 ($ Millions)</th>
<th>TOTAL</th>
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<tbody>
<tr>
<td>Treatment Plants</td>
<td>$2,233</td>
<td>$1,215</td>
<td>$407</td>
<td>$3,855</td>
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<td>Collection System</td>
<td>$354</td>
<td>$1,928</td>
<td>$476</td>
<td>$2,758</td>
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<td>City and Consultant Program</td>
<td>$125</td>
<td>$152</td>
<td>$43</td>
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<td><strong>TOTAL SSIP</strong></td>
<td><strong>$2,712</strong></td>
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<td><strong>$926</strong></td>
<td><strong>$6,933</strong></td>
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PLANNING

Master Plan
Identifies needs and potential projects

Validation
Confirms and refines projects

Final List of 85 Project Concepts

IMPLEMENTATION

Increased Granularity

Project Concepts

TBL

Design & Construction

- Level of Service
- Condition Assessment
- Modeling
- Refined Cost Estimates
TBL Primary Objectives

1. To inform and support the analytical process for developing alternatives by considering social and environmental components in the process alongside performance and economic considerations.

2. To provide decision-making support for SFPUC project leaders; and

3. To increase project selection transparency and facilitate a reporting-out of expected project benefits.
What is triple bottom line analysis?
Triple Bottom Line Principles

PEOPLE

PLANET

PROFIT

Economic

Growth

Cost

Revenue

Social

Charitable Contributions

Fair Trade

Employee Welfare

Environment

Resource Consumption

Land Use

Waste Management
<table>
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<th>4 Typical TBL Assessment Techniques</th>
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<tr>
<td><strong>Financial Analysis (SROI)</strong></td>
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<tr>
<td>• Pure cash-flow analysis over the project lifetime (Sustainable Return on Investment)</td>
</tr>
<tr>
<td>• ?: Is this option commercially viable? Which option has the lowest lifetime cost?</td>
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<tr>
<td><strong>Benefit-Cost Analysis</strong></td>
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<tr>
<td>• Economic valuation which tries to capture quantifiable costs and benefits</td>
</tr>
<tr>
<td>• Monetizes criteria; allows for direct comparison of environmental and social to economic criteria</td>
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<tr>
<td>• ?: Do alternative benefits outweigh the costs? How much should I invest to meet consumer demands?</td>
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<tr>
<td><strong>Cost Effectiveness Analysis</strong></td>
</tr>
<tr>
<td>• Non-financial benefits expressed in units, not monetary terms</td>
</tr>
<tr>
<td>• Similar to BCA, but not monetized</td>
</tr>
<tr>
<td>• ?: Which option offers the least cost alternative for reducing X emissions?</td>
</tr>
<tr>
<td><strong>Scoring and Ranking</strong></td>
</tr>
<tr>
<td>• Used to compare costs that can’t be monetized</td>
</tr>
<tr>
<td>• Allows for consideration of various stakeholders, government, community</td>
</tr>
<tr>
<td>• Limits false precision</td>
</tr>
<tr>
<td>• Simpler</td>
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</tbody>
</table>
Implementation Plan: Tools for Efficient Delivery


**Triple Bottom Line Sample Output**

- **Alt 1**: Islais GS-a - Islais Cr - project A (Valencia St)
- **Alt 2**: Islais GS-b - Islais Cr - project B (Valencia St)
- **Alt 3**: Islais GS-c - Islais Cr - project C (Guerrero St)
- **Alt 4**: Islais GS-d - Islais Cr - project D (Guerrero St)

**Key for Social Indicators**
- ++ Significantly Positive
- + Positive
- N Neutral
- - Negative
- -- Significantly Negative
- N/A Not Applicable

**Social Indicators**
- S1 System Resilience
- S2 Reliability/Fairness
- S3 Bicycle & Pedestrian Environment
- S4 Odors
- S5 Recreation/Play Space Amenities
- S6 Employment
- S7 Cultural Resources
- S8 Noise
- S9 Construction Impacts

**Environmental Indicators**
- E1 Climate
- E2 Habitat
- E3 Water Use
- E4 Water Quality
- E5 Air Quality
- E6 Natural Resource Inputs

**Financial Indicators**
- F1 Capital Costs
- F2 Operating and Maintenance Costs

**View Matrix**
The TBL Assessment Model is a module within the Citywide Sewer System Improvement Program (SSIP). The purpose of a TBL assessment is to provide a decision-support platform that facilitates the selection of SSIP projects and project alternatives that generate the highest value in terms of environmental improvement, social-benefit, and economic gain relative to criterion established. The determination of ‘value’ is carried out through a system of measurement that has two main aspects – the first is a set of **Indicators** that are designed to measure certain attributes of value, and second, is a **Rating System** that applies a consistent set of rules that can normalize, interpret, classify, aggregate and represent the measured indicator values in order to make them useful for decision-making. While indicators are primarily designed for measuring and monitoring performance of a system component, the Rating System is primarily designed to aid multi-criteria decision-making (MCDM) – a foundation of the TBL process.

**The TBL is essentially an Indicator-based Rating System that incorporates multi-criteria decision making.**

The main components of a robust TBL module are:

- A comprehensive list of indicators
- A collection of indicator measurement models and processes that utilize available data
- A scoring and representation model (Rating System) that makes sense of all the indicators and facilitates decision-making

**Characteristics of a good TBL Rating System:**

- Simple (easily understood but logically sound)
- Comprehensive (by topic/criteria and indicators)
- Consistent (across indicator types, project types)
- Structurally Unbiased between Indicators as a model (unless explicitly weighted)
- Computable/Measurable
- Scalable (expandable by number of indicators; can work at local, watershed, City scales)
- Aggregation capable (group indicators into indexes etc.)
- Visually Representable (in a compelling, easy to grasp way)
TBL Output Example

- Capital Costs
- O&M Costs
- System Resilience
- Ratepayer Affordability
- Employment
- Bicycle & Pedestrian
- Recreation & Open Space
- Cultural Resources
- Odors
- Noise
- Land Use Adjacency
- Construction Impacts
- Worker Safety
- Climate
- Air Quality
- Water Use
- Water Quality
- Natural Resources
- Habitat
### Triple Bottom Line (TBL) Assessment Model

**Environmental + Social + Financial Sustainability**

**Version 1.5**

**TBL HOME** | **MODEL INPUTS** | **MODEL CALIBRATION** | **TBL RESULTS** | **ALTERNATIVES** | **DATA ARCHIVE**
---|---|---|---|---|---

**TBL Project Results** | **Project Results Comparison** | **Archive Result for Project** | Generate Report for Printing | View Project Data Form

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**Evaluate Financial Criterion Ratings based on cost-effectiveness**

- **Ordinal ranking system limits impression of false precision**
- **Have the option to show or hide those criteria not impacted**

**Social**

- System Resilience
- Ratepayer Affordability
- Employment
- Bicycle & Pedestrian Environment
- Recreation & Open Space Amenities
- Cultural Resources
- Odors
- Noise
- Land Use Adjacency
- Construction Impacts
- Worker Safety

**Environmental**

- Climate
- Air Quality
- Water Quality
- Water Use
- Habitat
- Natural Resource Inputs

**Financial**

- Capital Costs
- Other Costs

**TRIPLE BOTTOM LINE RESULTS 8/29/2013**

- **Project Name:** Channel EIP Wiggle C - Partial Wiggle Alignment
- **Project Id:** CW/SIP-FC_DB_CHN_9
- **Primary Objective:** CSD Volume Reduction
- **Project Type:** Green Infrastructure
- **Location:** See Alternative C Figure
- **Description:** WNGC - Alternative C

**Size of radial slices can be sized according to community importance**

**Size of financial slices are proportional to their share of life cycle costs**

- $-282^*$
- $-390^*$
TBL Alternatives Evaluation (Scoring)

CUMULATIVE BENEFITS SUMMARY

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<td>3</td>
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<td>Total CSD Volume Reduced (MG/yr)</td>
<td>1</td>
<td>2</td>
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<td>Total LCA NPV ($K)</td>
<td>(38,982)</td>
<td>(56,660)</td>
<td>(173,723)</td>
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NORMALIZED EFFICIENCY METRICS

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<td>1</td>
<td>0.43</td>
<td>1</td>
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<tr>
<td>CSD Reduction Per million $ Annual Investment</td>
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<td>0.65</td>
<td>0.24</td>
<td>0.38</td>
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<td>Stormwater Managed Per million $ Annual Investment</td>
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<td>0.65</td>
<td>0.24</td>
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<td>Social</td>
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<td>------------------------</td>
<td>----------------------------------------</td>
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<tr>
<td>Capital Costs</td>
<td>Climate</td>
<td>System Resilience</td>
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<tr>
<td>Operations and Other* Costs</td>
<td>Habitat</td>
<td>Ratepayer Affordability</td>
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<tr>
<td></td>
<td>Water Use</td>
<td>Employment</td>
<td></td>
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<tr>
<td></td>
<td>Water Quality</td>
<td>Bicycle and Pedestrian Environment</td>
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<td>Air Quality</td>
<td>Recreation / Open Space</td>
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<tr>
<td></td>
<td>Natural Resources</td>
<td>Cultural Resources</td>
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</table>

* Mostly to address conditions at treatment plants

* Includes Operations & Maintenance, Replacement & Renewal, Decommissioning, Avoided Costs, and New Revenues
Triple Bottom Line (TBL) Community Benefits Assessment

Sample Metrics / Outputs

- Acres Mitigated Flood Risk
- Feet Bike/Ped Enhancement
- Acres Green Space Added
- Labor Hours Generated
- Tons GHG Reduced
- Acres Urban Habitat
- Tons Criteria Pollutants Reduced
LCA Components

- Installation and construction
- Operations and maintenance
- Capital equipment
- Replacement and renewal
- Design and planning
- Decommissioning
- Avoided cost/New revenue
- Avoided combined sewer discharge
- Sale of bio-fuel energy
- Avoided water treatment
TBL Folsom & 17th Street Example
17th and Folsom Street Alternative Analysis

Project 1
17th and Folsom St (future park)

Project 2
Nearby Parking Lot Acquisition

Project 3
Right-of-Way Storage Box

Project 4
Stormwater Parkway

Social
- System Resilience
- Stakeholder Affordability
- Employment
- Bicycle & Pedestrian Environment
- Recreation & Open Space Amenities
- Cultural Resources
- Noise
- Land Use Adjacency
- Construction Impacts
- Worker Safety

Environmental
- Climate
- Air Quality
- Water Quality
- Water Use
- Habitat

Financial
- Annualized Capital Costs
- Annualized Other Costs

Notes: Financial Criterion ratings are based on annualized costs NPV and select projects only.
* This criteria are not showing up in the pie charts but are in the legend because they are not applicable to any case.
17th and Folsom Street Alternative Analysis

**Project 1**
- 17th and Folsom St (future park)
- Reduces flooding in high consequence area
- Improves a new park in conjunction with the storage investment but not in an area of acute need
- Reduces odor in small area, only during flooding events
- Shortens construction schedule of 2 SF Public Works projects due to coordination
- Reduction in CSD Volume as a result of storage volume

**Project 3**
- Right-of-Way Storage Box
- Ratepayer cost >30% of projects evaluated
- Major boulevard disrupted during construction but not on arterial

Note: Financial Criterion ratings are based on annualized costs NPV and select projects only
* This criteria are not showing up in the pie charts but are in the legend because they are not applicable to any case.
Criteria Development
Example: System Resilience

- Sea level rise
- Flooding
- Redundancy
- Consequence of Failure
Governance Committees

BOARD OF SUPERVISORS

SFPUC COMMISSION

SFPUC GENERAL MANAGER

PROGRAM POLICY DECISIONS

MANAGEMENT OVERSIGHT COMMITTEE

PROJECT LEVEL DECISIONS

TECHNICAL STEERING COMMITTEE

PROJECT IMPLEMENTATION

SSIP PROJECT TEAM

EXTERNAL REVIEW ADVISORY COMMITTEES

GREEN INFRASTRUCTURE ADVISORY GROUP

PEER ADVISORY COMMITTEE

REVENUE BOND OVERSITE COMMITTEE

SOUTHEAST COMMUNITY FACILITY COMMISSION

WASTEWATER CITIZENS ADVISORY COMMITTEE
TBL Model Interface

Triple Bottom Line (TBL) Assessment Model
Environmental + Social + Financial Sustainability Version 1.5

TBL HOME | MODEL INPUTS | MODEL CALIBRATION | TBL RESULTS | ALTERNATIVES | DATA ARCHIVE

Alternative Control Panel | Alternative Results | Alternative Scoring Rules | Alternative Scoring Calculations

Alternative Creator Tool | Alternatives Control Panel

Select Projects | Create New Alternative | Save Alternative | Load Alternative

Solution Custom Alternative (13 projects selected)

1. 101 On-Ramp Detention Tank-2
2. Bryant Street Pipe Yard Detention Tank-2
3. Central Freeway Properties Detention Tank-2
4. DHS Offices Detention Tank-2
5. Fire Station #7 Detention Tank-2a
6. Fire Station #7 Detention Tank-2b
7. GG Park Panhandle Detention Tank-2
8. Hamilton Playground Detention Tank-2
10. Northern Police Station Detention Tank-2
11. SOMArts Cultural Center Detention Tank-2
12. UCSF Detention Tank-2
13. Victoria Manalo Draves Park Detention Tank-2

Alternative Summary

Key Metrics

- Total Stormwater Managed (MG/yr)
- Total LCA NPV ($K)
- Total Capital Costs NPV ($K)
- Total Other Costs NPV ($K)
- Equivalent Annualized LCA NPV ($K)
- Equivalent Annualized Capital Costs NPV ($K)
- Equivalent Annualized Other Costs NPV ($K)
- Parks and Open Space Added or Improved (SqFt)
- GHG Reduction (MTCO2e per Year)
- Service Population Affected (# of persons)
- Water Use Reduction (MG/yr)
- Quality Habitat Creation (acre)

- CSD Events Reduced Per million $ Annual Investment
- Stormwater Managed Per million $ Annual Investment
- CSD Reduction Per million $ Annual Investment
- CSD Reduction Per Improved Area (gals/sf/yr)
- Parks and Open Space Added Per Affected Population (SqFt/Srv. Pop.)

<table>
<thead>
<tr>
<th>Metric</th>
<th>Value</th>
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<tbody>
<tr>
<td>Total Stormwater Managed (MG/yr)</td>
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<tr>
<td>Total LCA NPV ($K)</td>
<td>($189,295)</td>
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<tr>
<td>Total Capital Costs NPV ($K)</td>
<td>($69,394.43)</td>
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<td>Total Other Costs NPV ($K)</td>
<td>($39,901.94)</td>
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<td>Equivalent Annualized LCA NPV ($K)</td>
<td>($3,000)</td>
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<tr>
<td>Equivalent Annualized Capital Costs NPV ($K)</td>
<td>($1,905)</td>
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<tr>
<td>Equivalent Annualized Other Costs NPV ($K)</td>
<td>($1,905)</td>
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<td>Parks and Open Space Added or Improved (SqFt)</td>
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<td>GHG Reduction (MTCO2e per Year)</td>
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<td>Service Population Affected (# of persons)</td>
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<td>Water Use Reduction (MG/yr)</td>
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<td>Quality Habitat Creation (acre)</td>
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<td>CSD Events Reduced Per million $ Annual Investment</td>
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<tr>
<td>Stormwater Managed Per million $ Annual Investment</td>
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<td>CSD Reduction Per million $ Annual Investment</td>
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<td>CSD Reduction Per Improved Area (gals/sf/yr)</td>
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<tr>
<td>Parks and Open Space Added Per Affected Population (SqFt/Srv. Pop.)</td>
<td>3.76</td>
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Model Interface

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission

Triple Bottom Line (TBL) Assessment Model
Environmental + Social + Financial Sustainability

1. Initiate SSIP Project
2. Define Project Data & Details
3. Assess TBL Results using TBL Model
**Triple Bottom Line Model Objective:** The TBL model is a decision support tool that transparently estimates the financial, social, and environmental consequences of SSIP projects in order to optimize and articulate the community benefits of SSIP investments.

**TBL Uses**
- Estimation:
  - Project Selection
  - Alternatives Formation
  - Community SSIP Outreach
- Track System Performance:
  - Design Reference
  - Targets Achieved

**Chinatown Green Street Retrofit (Spofford + Ross)**

- **Bike/Ped Enhancements:** 600 Linear Ft.
- **Passive Open Space:** 1,100 Sq. Ft.
- **Estimated Labor:** 0.5 FTE over life of project
- **Cultural Elements included in Design**
- **Urban Habitat Added:** 400 Sq. Ft.
- **Average Annual Contribution to CSD Volume Reduction:** 50K gallons/year
Questions

You are invited to...
the Watershed Planning Game

COME PLAY

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Director, TBL Model
Development AECOM
415.955.2982
Alexander.Quinn@aecom.com

San Francisco Water Power Sewer
Services of the San Francisco Public Utilities Commission
## Alternative Triple Bottom Line Approaches

### Summary of Non-monetary Benefit Scores

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<tr>
<th>Criteria Weight</th>
<th>Vehicle Traffic</th>
<th>Safety &amp; Health</th>
<th>CO2e Emissions</th>
<th>Criteria Air Pollutants</th>
<th>Net Energy Production</th>
<th>Site Impacts</th>
<th>Level of Complexity</th>
<th>Permitting Challenges</th>
<th>Outside Utility Involvement</th>
<th>Maturity &amp; Reliability</th>
<th>Load Variation Adaptability</th>
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<td>45</td>
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</tbody>
</table>

Figure 4-2 presents a graphical summary of the results for the technology alternatives. The MUA results showed that new IC engines are the most beneficial with the highest combined benefit score of 85 followed by biomethane for NG pipeline injection with an overall benefit score of 80.