New Toll Road vs. Toll Managed Lanes On Existing Motorways: Alternatives and Impacts In Metro Washington, DC

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Overview

- Key emerging issues in toll lane network design
- Case studies in metro Washington, DC region
  - Regional Value Pricing Task Force
  - DeCorla-Souza studies of Northern Virginia Beltway
  - Intercounty Connector new toll road vs. converting / adding toll lanes to existing motorways with improved public transport, with or without more balanced growth
- Summary of key findings
Key Issues for Toll Network Plans

- New toll motorways vs. enhance existing roads?
- Will tolls pay only for new road lanes or help support new corridor public transport services?
- Optimize for traffic-throughput and revenue maximization vs. person-throughput and environmental/community impact minimization?
Evolving U.S. Federal Toll Policies

- Federal law barred tolling federal aid highways until 1991
- 1991: transportation law allows 15 state tolling pilot programs
- 2005: By 265-155 vote, House rejects bill that would allow tolls only for new lanes and only to pay off bonds to build new lanes
- 2005: Senate bill allows tolls on new (or existing?) lanes with revenues for any transportation purpose, with goals, monitoring, reporting on impacts on system performance, equity, environment, use of alternate modes
- Final bill pending
Proposed Variable Priced Toll Lane Network for Metro Washington, DC

Adopted by Metropolitan Washington Transportation Planning Board for Testing in 2004-05
Current Toll Lane Planning In VA/MD

- Maryland considering add-a-lane/convert-a-lane
- No analysis of how express buses would link to public transport nodes and activity centers
- Uncertain prospects for tolls to fund transit
- Scarce ROW may be fully used for toll lane, precluding efficient Bus Rapid Transit design

Maryland’s Proposed Design

Proposed Virginia Network
Adopted Goals for Regional System

- Regional technology/policy harmonization for tolled lanes
- Design standards: 1 lane with shoulder or 2 lanes each direction
- Bus service an integral element in project planning and design, to maximize people movement over vehicle throughput
- Buses to have free-flow direct access from toll lanes to major activity centers, key rail stations, and park-and-ride lots, with accessible stops and signal priority or dedicated bus lanes to ensure efficient access to and from activity centers
- Toll revenues from variably-priced lane projects may finance construction, service debt, and pay for operation and maintenance of the priced lanes. Should toll lanes operate at a revenue surplus, consideration should be given to enhancing transit services
DeCorla-Souza (FHWA/TRB) study showed:

- Adding two new lanes in each direction to produce a 12-lane facility with 4 High Occupancy Toll (HOT) lanes boosts traffic 12% (36,000 VPD).
- Adding only one new HOT lane in each direction and better managing 2 of 4 existing lanes by converted them to HOT lanes (yielding a 10-lane facility with 6 HOT lanes), induces only 2% more traffic (6,400 VPD) while producing nearly equal delay reductions, less cost, 3 times more toll revenues.
**HOT vs. Express Toll Lane Tradeoffs**

- The best choice, from point of view of congestion mitigation and economic efficiency, is HOT lanes with Bus Rapid Transit.
- If High Occupancy Vehicle (HOV) enforcement is an issue, Express Toll lanes with Bus Rapid Transit (BRT) may be the second best choice.
- If both HOV enforcement and public tax support for new BRT service are issues, Express Toll lanes [which charge carpools] without BRT would be the third best choice.

Quoting from DeCorla-Souza, 2005 Transportation Research Board Annual Meeting.
New Outer Beltway Toll Road vs. Alternatives

- Independent evaluation of alternatives subject to separate official studies but omitted from draft EIS
- Used official traffic and air quality models with peer reviewed assumptions
Alternatives Evaluated

1. **No Build**: The baseline for all comparisons as in the state’s DEIS, it includes currently planned improvements.

2. **ICC Build**: This alternative would add the ICC to the region’s road network.

3. **Transit Oriented Land Use and Investment**: Build additional transit including the Purple Line and express bus with more jobs and housing near stations and improve the local job-housing balance.

4. **Add Toll Lanes & Express Bus**: Create toll lanes from new and some existing lanes. The fees would vary, based on congestion, but would be free to buses and van pools.

5. **High Occupancy Toll (HOT) Lanes**: Create toll lanes from some existing lanes, but high occupancy carpools of 3 or more would not be charged for use of the toll lanes.

6. **Hybrid**: Transit Oriented-HOT Lane-Rail and Express Bus: A hybrid scenario that combines expanded rail transit and transit oriented land-use (Alternative #3) and HOT lanes (Alternative #5).
Transit Oriented Investment Alternative
With Local Road Improvements

- Purple Line LRT Bethesda to College Park
- Metro extension Shady Grove to Metropolitan Grove
- New Metro station at Montgomery College
- New BRT buses on I-270 and Beltway
- Georgia Avenue Busway: Glenmont to Olney
- Rapid buses on New Hampshire, University Blvd, Viers Mill, Randolph
- Intersection improvements on local arterials
Balanced Jobs and Housing With More Transit Oriented Development

Trees with labels and numbers indicating job and household counts for Montgomery County and Northern Prince George's County.
Add & Convert Toll Lanes on Existing Expressways Plus New Toll-Financed Bus Rapid Transit (BRT) Services

- Convert 2 lanes
- Add 1 lane & convert 1 lane

I-270
I-495
Capital Beltway
I-95

Express bus service on the Capital Beltway (I-495) between River Road and US Route 1
Express bus service between Dulles Airport and Frederick, Maryland
Express bus service between Dulles Airport and Frederick, Maryland
Express bus service between West Falls Church Metro and New Carrollton

U.S. 1
U.S. 50
Combining HOT Lanes with BRT

Arterial BRT: like LRT-metro in travel markets served
HOT/BRT: more like commuter rail for station spacing, access, trip length
Multiple Visions for HOT/BRT Design

I-15 Managed Lanes
- Direct access ramp with Bus rapid transit station

Main Lanes
Managed Lanes
Park-and-Ride
Direct Access Road to Arterial
Direct Access Ramps
BRT Station

Source: San Diego Council of Governments

A concept drawing that sadly neglects pedestrian & bicycle access
Transit Supportive Toll Lane Design

vs. MD SHA Proposed I-495 Toll Express Lanes
Transit Supportive Toll Lane Design

The "Cross-Over" Design Allows Bus Providers to Use their Existing Fleet and Load from the Right

Buses, Pedestrians and Bicyclists Access the BRT Station from the Road Overhead
Convert Lanes Cheaper than New Toll Road, Transit, Integrated Strategies

Capital Costs of Alternatives

<table>
<thead>
<tr>
<th></th>
<th>Roads</th>
<th>Transit</th>
<th>Total cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICC Build</td>
<td>$1,900,000,000</td>
<td>$166,050,000</td>
<td>$2,073,676,667</td>
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<tr>
<td>Transit Oriented Land Use and Investment</td>
<td>$173,676,667</td>
<td>$1,839,007,917</td>
<td>$2,005,057,917</td>
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<tr>
<td>Add Toll Lane-Express Bus</td>
<td>$934,890,000</td>
<td>$321,586,667</td>
<td>$1,256,476,667</td>
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<tr>
<td>Convert HOT Lane-Express Bus</td>
<td>$304,860,000</td>
<td>$304,860,000</td>
<td>$626,446,667</td>
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<tr>
<td>Hybrid: Transit Oriented-HOT Lane-Rail and Express Bus</td>
<td>$1,673,857,083</td>
<td>$1,978,717,083</td>
<td>$3,652,574,166</td>
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</tbody>
</table>

- Roads
- Transit
New Toll Road Means More Time Driving, Alternatives Cut Vehicle Hours

- Hybrid: Transit Oriented-HOT Lane-Rail & Express Bus
- Add Toll Lane-Express Bus
- Transit Oriented Land Use and Investment
- Convert HOT Lanes-Express Bus
- ICC Build

VHT Increase

VHT Decrease

ICC Study Area
Montgomery and Northern Prince George's County Study Area
### Alternatives Cut Time Stuck in Traffic, New Toll Road Increases Traffic Delays

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Increased Delay</th>
<th>Hours Saved</th>
<th>Decreased Delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid: Transit Oriented-HOT Lane-Rail and Express Bus</td>
<td></td>
<td></td>
<td>120,000</td>
</tr>
<tr>
<td>Add Toll Lane-Express Bus</td>
<td>-20,000</td>
<td>40,000</td>
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</tr>
<tr>
<td>Transit Oriented Land Use and Investment</td>
<td>0</td>
<td>60,000</td>
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<tr>
<td>Convert HOT Lane-Express Bus</td>
<td>20,000</td>
<td>80,000</td>
<td></td>
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<tr>
<td>ICC Build</td>
<td>40,000</td>
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</tbody>
</table>

- **ICC Study Area**
- **Montgomery and Northern Prince George's County Study Area**
New Toll Road Spurs More Vehicle Miles of Travel, Convert Lanes Cuts VMT

- Convert HOT Lane-Express Bus
- Hybrid: Transit Oriented - HOT Lane - Rail and Express Bus
- Transit Oriented Land Use and Investment
- Add Toll Lane-Express Bus
- ICC Build
Convert Lanes Boosts VMT on Local Roads, Others Cut Local Road VMT

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Miles (x000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convert HOT Lane-Express Bus</td>
<td>7,689</td>
</tr>
<tr>
<td>No Build</td>
<td>7,550</td>
</tr>
<tr>
<td>ICC Build</td>
<td>7,494</td>
</tr>
<tr>
<td>Add Toll Lane-Express Bus</td>
<td>7,358</td>
</tr>
<tr>
<td>Hybrid: Transit Oriented-HOT Lane-Rail &amp; Express Bus</td>
<td>7,223</td>
</tr>
<tr>
<td>Transit Oriented Land Use &amp; Investment</td>
<td>7,141</td>
</tr>
</tbody>
</table>

ICC Study Area
Montgomery County and Northern Prince George’s County Study Area

- 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000
New Toll Road Spurs More Daily Vehicle Trips Compared to Alternatives

| Category                                      | Change
<table>
<thead>
<tr>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Transit Oriented Land Use and Investment</td>
<td>-5.36%</td>
</tr>
<tr>
<td>ICC Build</td>
<td>3.11%</td>
</tr>
<tr>
<td>Add Toll Lane-Express Bus</td>
<td>-1.21%</td>
</tr>
<tr>
<td>Convert HOT-Express Bus</td>
<td>-1.01%</td>
</tr>
<tr>
<td>Hybrid: Transit Oriented - HOT Lane - Rail and Express Bus</td>
<td>-5.48%</td>
</tr>
</tbody>
</table>

ICC Study Area

Montgomery County and Northern Prince George's County Study Area
New Toll Road Cuts Public Transport Use vs. Alternatives

Daily Work Trip Transit Share

- Hybrid: Transit Oriented-HOT Lane - Rail & Express Bus: 19.33% (ICC Study Area), 18.87% (Montgomery and Northern Prince George’s County Study Area)
- Transit Oriented Land Use and Investment: 19.53% (ICC Study Area), 18.81% (Montgomery and Northern Prince George’s County Study Area)
- Add Toll Lane-Express Bus: 18.14% (ICC Study Area), 16.58% (Montgomery and Northern Prince George’s County Study Area)
- Convert HOT-Express Bus: 18.12% (ICC Study Area), 16.46% (Montgomery and Northern Prince George’s County Study Area)
- No Build: 15.30% (ICC Study Area), 17.15% (Montgomery and Northern Prince George’s County Study Area)
- ICC Build: 13.86% (ICC Study Area), 15.98% (Montgomery and Northern Prince George’s County Study Area)
Convert Lanes Cuts Traffic Speed, Public Transport Alternatives Boost Speeds

- Add Toll Lane-Express Bus
- Hybrid: Transit Oriented-HOT Lane-Rail and Express Bus
- Transit Oriented Land Use and Investment
- ICC Build
- Convert HOT Lane-Express Bus

Speed Decrease
ICC Study Area
Montgomery and Northern Prince George's County Study Area

Speed Increase
-5.00% -4.00% -3.00% -2.00% -1.00% 0.00% 1.00% 2.00% 3.00% 4.00% 5.00%
Alternatives Produce 4x More Total Toll Revenue Than New Toll Road

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Toll Paying AM VMT</th>
<th>Toll Paying PM VMT</th>
<th>Toll Paying Off Peak VMT</th>
<th>Toll Paying 24hr VMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICC Build</td>
<td>242,881</td>
<td>406,813</td>
<td>505,225</td>
<td>1,154,919</td>
</tr>
<tr>
<td>Add Toll Lane-Express Bus</td>
<td>511,394</td>
<td>929,251</td>
<td>1,133,882</td>
<td>2,574,528</td>
</tr>
<tr>
<td>Hybrid: Transit Oriented-HOT Lane–Rail and Express Bus</td>
<td>546,895</td>
<td>925,093</td>
<td>1,617,092</td>
<td>3,089,080</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Per Mile Toll Rates</th>
<th>AM Peak</th>
<th>PM Peak</th>
<th>Off Peak</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICC Tolls</td>
<td>$0.20</td>
<td>$0.20</td>
<td>$0.15</td>
</tr>
<tr>
<td>Express Lane Tolls</td>
<td>$0.40</td>
<td>$0.40</td>
<td>$0.20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Gross 2030 Daily Revenue</th>
<th>Gross Yearly Toll Revenue (day x 300)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICC Build</td>
<td>$205,723</td>
<td>$61,716,791</td>
</tr>
<tr>
<td>Add Toll Lane-Express Bus</td>
<td>$803,035</td>
<td>$240,910,382</td>
</tr>
<tr>
<td>Transit Oriented-HOT Lane–Rail and Express Bus⁴</td>
<td>$912,214</td>
<td>$273,664,125</td>
</tr>
</tbody>
</table>
New Toll Road Increases Oil Dependence, Greenhouse Gas Emissions

- Alternatives could save 260,000 metric tons of CO₂ and $31M annually in crude oil costs by 2030
- Money saved boosts local economy and jobs, not foreign oil producers

### Regional impacts (Projections for 2030)

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Vehicle Miles Traveled (million miles per yr)</th>
<th>Change vs. no-build (%)</th>
<th>Petroleum Fuel Demand (million gals/yr)</th>
<th>Fuel used vs. no-build (million gals/yr)</th>
<th>CO₂ Emissions (MMT/yr)</th>
<th>CO₂ emitted vs. no-build (1000 metric tons/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No-build</td>
<td>7,955</td>
<td></td>
<td>265</td>
<td></td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>ICC</td>
<td>8,351</td>
<td>5%</td>
<td>278</td>
<td>+13</td>
<td>2.5</td>
<td>+117</td>
</tr>
<tr>
<td>Efficient alternative</td>
<td>7,474</td>
<td>-6%</td>
<td>249</td>
<td>-16</td>
<td>2.2</td>
<td>-143</td>
</tr>
</tbody>
</table>
New Toll Road Boosts Air Pollution, Hybrid/Convert Lanes Cuts Pollution Most

% Change in Emissions
Relative to the No Build Alternative
Washington, DC Metropolitan Region

- Hydrocarbons
- Nitrogen Oxides
- Carbon Monoxide

ICC Build

Hybrid: Transit Oriented-HOT Lane–Rail and Express Bus
Convert HOT Lane-Express Bus
Add Toll Lane-Express Bus
Transit Oriented Land Use and Investment
New Toll Road May Create Mobile Source Air Toxic & Fine Particulate Hotspots

% Change in Emissions Relative to the No Build Alternative

ICC Study Area

<table>
<thead>
<tr>
<th>Alternative</th>
<th>Hydrocarbons</th>
<th>Nitrogen Oxides</th>
<th>Carbon Monoxide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid: Transit Oriented-HOT Lane-Rail and Express Bus</td>
<td>-6.7%</td>
<td>-6.7%</td>
<td>-6.3%</td>
</tr>
<tr>
<td>Convert HOT Lane-Express Bus</td>
<td>-8.0%</td>
<td>-7.7%</td>
<td>-8.3%</td>
</tr>
<tr>
<td>Add Toll Lane-Express Bus</td>
<td>-0.6%</td>
<td>-0.8%</td>
<td>-1.2%</td>
</tr>
<tr>
<td>Transit Oriented Land Use and Investment</td>
<td>-2.4%</td>
<td>-0.8%</td>
<td>-0.8%</td>
</tr>
<tr>
<td>ICC Build</td>
<td>10.0%</td>
<td>9.3%</td>
<td>7.1%</td>
</tr>
</tbody>
</table>

Percent Change

-10.0% -8.0% -6.0% -4.0% -2.0% 0.0% 2.0% 4.0% 6.0% 8.0% 10.0% 12.0%
Low/Moderate Income Travelers Benefit Little From New Toll Road

Independent analysis shows ICC benefits go almost entirely to high income travelers, reducing access to jobs for low income households compared to other alternatives.

Percent of Total AM VMT on ICC by Income Quartile

- Poor: 0.07%
- Lower Middle: 4.36%
- Upper Middle: 32.84%
- High: 62.73%
# Alternatives Beat the New Toll Road in Boosting Access to Jobs

<table>
<thead>
<tr>
<th>Mode Share Weighted Regional Average</th>
<th>Differences from Constrained 2003 Long Range Plan</th>
<th>Add HDT Lane-Express Bus</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ICC Build (Master Plan Alignment)</td>
<td></td>
</tr>
<tr>
<td><strong>Automobile</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income 1 HH residents</td>
<td>21,336</td>
<td>17,156</td>
</tr>
<tr>
<td>Income 2 HH residents</td>
<td>18,808</td>
<td>20,313</td>
</tr>
<tr>
<td>Income 3 HH residents</td>
<td>17,118</td>
<td>22,705</td>
</tr>
<tr>
<td>Income 4 HH residents</td>
<td>14,298</td>
<td>28,056</td>
</tr>
<tr>
<td><strong>Public Transportation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income 1 HH residents</td>
<td>16,759</td>
<td>4,027</td>
</tr>
<tr>
<td>Income 2 HH residents</td>
<td>16,380</td>
<td>4,780</td>
</tr>
<tr>
<td>Income 3 HH residents</td>
<td>18,041</td>
<td>5,109</td>
</tr>
<tr>
<td>Income 4 HH residents</td>
<td>21,452</td>
<td>5,340</td>
</tr>
<tr>
<td><strong>Composite Automobile and Public Transportation</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income 1 HH residents</td>
<td>38,085</td>
<td>21,182</td>
</tr>
<tr>
<td>Income 2 HH residents</td>
<td>35,188</td>
<td>25,092</td>
</tr>
<tr>
<td>Income 3 HH residents</td>
<td>35,159</td>
<td>27,814</td>
</tr>
<tr>
<td>Income 4 HH residents</td>
<td>35,750</td>
<td>33,398</td>
</tr>
</tbody>
</table>
New Toll Road Has Huge Adverse Natural Resource Impacts

Irreparable harm to:
- Stream valley parks
- Rare species
- Forest interior habitat
- Vernal pools
- Trout streams.

Many of these impacts cannot be mitigated
### Rank Ordering of Alternatives

#### Cardinal Scale Rankings

<table>
<thead>
<tr>
<th>SCENARIOS</th>
<th>Avg. Rank</th>
<th>Vehicle Hours Of Travel</th>
<th>Vehicle Hours Of Delay</th>
<th>Vehicle Miles Traveled (VMT) All Facilities</th>
<th>VMT Local Roads</th>
<th>VMT Major Arterials</th>
<th>Total Transit Trips</th>
<th>Work Trip Transit Share</th>
<th>Travel Speed</th>
<th>Air Quality</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid: Transit Oriented Hot Lane Rail and Express Bus</td>
<td>1.8</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
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<tr>
<td>Transit Oriented Land Use And Investment</td>
<td>2.3</td>
<td>3</td>
<td>2</td>
<td>3</td>
<td>1</td>
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<tr>
<td>Add Toll Lane-Express Bus</td>
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<td>4</td>
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<td>3</td>
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<td>3</td>
<td>4</td>
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<tr>
<td>Convert HOT Lane-Express Bus</td>
<td>3.6</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>1</td>
<td>2</td>
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<tr>
<td>No Build</td>
<td>4.6</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
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<td>ICC Build</td>
<td>5.4</td>
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<td>4</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>
Toll Managed Lane Systems Can Be Designed To:

- Maximize road system expansion and traffic throughput
- Limit use of toll revenues to road system investment alone
- Such systems are likely to spur sprawl, traffic growth, increased pollution and greenhouse gas emissions, worse inequality of access to jobs and opportunities
- This may spur opposition, project delays, and backlash against toll projects and public-private partnerships
Or Toll Managed Lane Systems Can Be Designed To:

- Mitigate adverse impacts from expanded mobility
- Reduce and manage traffic growth and congestion
- Promote more efficient public transportation
- Expand transportation choices and value for all user groups
- Boost equitable access to jobs and public facilities
- Support compact, mixed use development, community reinvestment
- Incorporate these in community benefit agreements for public-private partnerships to cut opposition to projects

Good stewardship demands open consideration of alternatives with public involvement and sound analysis