Mejorando la Calidad del Aire en Bogotá
Analisis de alternativa para el buses
Sonia Mangones

http://noticias.universia.net.co/ciencia-nn-nt/noticia/2012/08/10/958065/cuales-son-zonas-mas-afectadas-contaminacion-bogota.html
Colombia’s capital and largest city

- 8 million people in the city
- 15 million people in metropolitan area
- 13,500 person per sq mile ~ ranked 20th in the world

Total GDP $90 million
GDP per capita $11,000

- 15 million daily trips and 70 million VKT.
- ~15,000 road kilometers (quality).
- 1.5 million vehicles
  - 60,000 taxis
  - 15,000 transit buses
  - 400,000 motorcycles

- 20 million tons per year.

Dane, 2013
Dane, 2014
SDM, 2013
SDA, 2013

Bogota en números
Particulate matter

Iso-concentration of PM10 for 2012.

1 means the annual average is equal to the current regulation

[Behrentz, 2013]
More than 2,500 annual deaths from premature cardiovascular disease and lung cancer

This affects mostly vulnerable population: children and senior

Social and economic cost of poor air quality are around 8 billion in 10 years

PM10 and PM2.5 are pollutants that impose higher risk

50% of PM10 pollution comes from diesel vehicles (buses and trucks)

The problem - Implications
what actions, if any, should Bogota, Colombia city government take to reduce PM10 pollution from vehicles within its urban area?

- **Client: Gustavo Petro – Current Mayor**
  - Department of Environmental Issues
  - Department of Transportation
- Transit Operators – Bus Owners
- Society
- Environmental activists
- Motor vehicle industry
### Current regulation

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>Maximum level (µg/m³)</th>
<th>Time of exposure</th>
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<tbody>
<tr>
<td>PM$_{10}$</td>
<td>50</td>
<td>Annual</td>
</tr>
<tr>
<td></td>
<td>100</td>
<td>24 hours</td>
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<tr>
<td>PM$_{2.5}$</td>
<td>25</td>
<td>Annual</td>
</tr>
<tr>
<td></td>
<td>50</td>
<td>24 hours</td>
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<tr>
<td>Total PM</td>
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Established by the Ministry of Environment, Housing and Land Development Resolution 610 of 2010. Colombia WHO sets its recommendation in 20 µg/m³

- **Random roadside inspections**
- **Sulfur content**
- **Transit operators voluntary program**
- **Citation for vehicles with visible emissions**
2. The options
PM$_{10}$ pollution is not likely to be reduced
Areas PM10 pollution is not a problem will still have good conditions.

No additional costs or process needed
High social and economic costs

Low operational costs
Vulnerable population will continue to be unprotected

Transit operator companies will support this option
Society and activists groups will be unhappy

Status Quo
Highly (~80%) effective removing solid parts of PM$_{10}$ from diesel vehicles. 
Fuel efficiency in buses might be lower.

Implementation in Latin America has demonstrated that DPF are cost effective. Capital and operation costs for bus companies will increase.

Better air for people in Bogota, especially children and senior.
Economies of scale. Migration

Better overall image of public transportation and the city.
Transit bus operators will be against. Less profitable

Diesel Particulate Filters (DPF)
In the long run, having zero emission vehicle fleet eliminate social cost associated with pollution given current energy mix.

High cost. Replacement of the complete fleet may take around 10 years.

Even cleaner air for everyone including children and senior.
Unequal treatment for other technologies (natural gas)

Investment in charging facilities need to be solved
Complex to implement: Many actors

Electric buses
3. The comparison
<table>
<thead>
<tr>
<th></th>
<th>Effectiveness</th>
<th>Efficiency</th>
<th>Equity</th>
<th>Ease of Political Acceptability</th>
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<tr>
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<td>![Politics]</td>
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<tr>
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<td>![Target]</td>
<td>![Clock]</td>
<td>![Balance]</td>
<td>![Politics]</td>
</tr>
</tbody>
</table>

- **Effectiveness:** EB is the most effective: zero emissions. DPF highly effective to remove PM10
- **Efficiency:** DPF is the most cost and time efficient. EB require infrastructure investment
- **Equity:** DPF is the the alternative that supports equity in a best way
- **Political acceptability:** No additional actions is the easiest thing to do. Other two options will depend on the actual political power of transit operator companies
Comparing the three alternatives.
4. Recommendation
Of the three prioritized options, we believe the one with the most promise is to require **diesel particulate filter** in current transit buses because it is highly effective, performs more efficiently, and may be politically feasible. In addition, this policy option offers a short time frame to be implemented.

This policy is not occurring already because in the past Bogota’s government went for the improvement of diesel quality. Now with the improved diesel, more efficient vehicles make sense.

The government of Bogota can consider require buses equipped by DPF for new fleet, and then move forward to make the requirements to current buses. In doing so, they should give careful consideration to provide feasible time line for implementation and strategies to handle social and political power of those against the policy i.e drivers, bus owners and transit operators.