USA (3 % of world population) has used 50 % of world petrol.

SA population with USA level income uses MORE petrol than same American – cost?

FACT: USA lifestyle NOT sustainable (nor affordable) for planet
Ways to Green Transport ( & reduce economic impact)

1. Reduce transport distances or travel
2. Increase occupancy (public transport)
3. More efficient or lower GHG “vehicles” (Gautrain, NMT, hybrid, elec with Fuel Cells etc)
4. Greener fuels (biofuels/renewables) in existing & new vehicles

Commercially available sustainable biofuels

- **Ethanol**
  - 90 % of World’s biofuel
  - Local and global fuel
  - Sustainable volume production
  - CO2 reduction 0 – 70 %

- **Biogas**
  - Local waste to fuel
  - Good for local fleets
  - Can be combined with CNG
  - Expensive infrastructure
  - CO2 reduction 95 %

- **Biodiesel**
  - Many feedstocks
  - Similar to diesel
  - High and low blends
  - CO2 reduction 35 %
lot of energy in organic waste

1 ton of bio waste = 100 Liter petrol-equivalent
= 1‘000 km CO2-neutral car drive
## Ranking - the environmental impact

**Greenhouse gases CO₂**
1. Biogas
2. Ethanol
3. Biodiesel (RME)
4. Diesel

**Emissions NOₓ**
1. Biogas
2. Ethanol
3. Diesel
4. RME

**Emissions PM**
1. Biogas
2. Ethanol
3. RME
4. Diesel

**Noise**
1. Biogas
2. Ethanol, RME, Diesel

EUROPEAN Study: Biogas top grown transport fuel

The top position of bio methane results from:

- new, high yielding varieties
- Utilization of the whole crop
- Superior utilization of vegetation period
- High conversion efficiency

- Diesel equivalents per ha
Sweden: Progress with Gas Vehicles

Sold amounts of Vehicle Gas

Filling stations

Vehicles

Biomethane Plants
1. **Energy security and reduced fuel costs (FOREX)**
   a. use of domestic natural gas (and biogas)
   b. reducing foreign currency expenditure or increasing crude oil exports
      • e.g. Argentina, Brazil, Egypt, Iran, Malaysia, New Zealand, Pakistan, Thailand and Venezuela

2. **Reduction of urban pollution (HEALTH) from automobile exhaust emissions**
   • e.g. China, India, Korea, Malaysia and the US – whose governments have provided significant incentives

3. **Reduction of GHG emissions**
   • e.g. Australia and the EU – notably Germany and Sweden

4. **SUSTAINABLE** (means economic, enviro and for people/Jobs) – SA Focus
# BIOGAS SUPPLY POTENTIAL FOR SA

<table>
<thead>
<tr>
<th>Country</th>
<th>Biogas Toe pa per mil people</th>
<th>Biogas plants No.</th>
<th>Potential Mil TOE pa</th>
<th>Potential of national liquid fuels %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2002</td>
<td>2007</td>
<td>LFG</td>
<td>Sewage/Waste</td>
</tr>
<tr>
<td>Germany*</td>
<td>8</td>
<td>30</td>
<td>182</td>
<td>977</td>
</tr>
<tr>
<td>UK</td>
<td>18</td>
<td>35</td>
<td>365</td>
<td>90</td>
</tr>
<tr>
<td>Sweden</td>
<td>16</td>
<td>20</td>
<td>72</td>
<td>134</td>
</tr>
<tr>
<td>SA</td>
<td>&lt;1</td>
<td>&lt;10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Build ca 1000 new biogas plants per year

** Germany has already reached this level in 2013, but mainly supplied as CHP elec

SA “SUPPLY” potential has not been started to be developed

*** Believe 10 % of liquid fuels in long term is realistic. T/over ca R 25 bil pa
<table>
<thead>
<tr>
<th>Gas System</th>
<th>Jobs/R million Capex *</th>
<th>Jobs versus crude refining</th>
<th>Jobs per 10 % national fuel volumes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biogas from Waste</td>
<td>0.3</td>
<td>25x</td>
<td>40 000</td>
</tr>
<tr>
<td>Biogas from Crops</td>
<td>2</td>
<td>200x</td>
<td>350 000</td>
</tr>
<tr>
<td>Landfill Gas</td>
<td>0.4</td>
<td>20x</td>
<td>25 000</td>
</tr>
<tr>
<td>CNG Only</td>
<td>1</td>
<td>14x</td>
<td>14 000</td>
</tr>
</tbody>
</table>

* Includes vehicle conversions distribution & filling station capex
Baltic Biogas Bus Study findings

Total cost, operational and environmental cost (marginal cost kr incl infrastructure) per 100 km

- **Diesel**
  - Infrastructure: 900
  - Environment: 400
  - Operational: 700

- **Biogas**
  - Infrastructure: 1400
  - Environment: 100
  - Operational: 1200

- **RME**
  - Infrastructure: 1400
  - Environment: 100
  - Operational: 1200

- **Ethanol**
  - Infrastructure: 1500
  - Environment: 200
  - Operational: 1300
IDC Diesel dual fuel Commuter Bus trial

• Generated accurate fuel consumption & operating cost data

• Operating conditions evaluated mainly mix of urban stop-start and highway driving during peak traffic periods, on relatively congested highway
  – diesel substitution with gas 71%

• Fuel operating cost saving: 76c per km (19.2%) on 71% diesel substitution
• Gives payback of between 3-9 years (Minbus Taxis less than 2 years)

• Diesel dual fuel operation has no negative effect on engine durability and cost of maintaining vehicle compared to standard (diesel-only) operation
  – Oil drain interval could be extended by as much as 100%
    – Fuel operating cost saving is only portion of life cycle cost saving achievable from diesel dual fuel operation
Baltic Biogas Study Core Messages

- Almost 100 per cent renewable
- Very efficient as fuel
- Improves urban air quality
- Reduces Global Warming
- Produced locally
- Improves energy autonomy
- Creates jobs
- Stable and secure biogas supply is key, or link to natural gas
## Support for Green Energy in South Africa

<table>
<thead>
<tr>
<th></th>
<th>c/kWh (^1)</th>
<th>R/GJ</th>
<th>R/litre (_{\text{petrol eq.}})</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ELECTRICITY USAGE</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Wind</td>
<td>50</td>
<td>140</td>
<td>4.40</td>
<td>Locally produced</td>
</tr>
<tr>
<td>PV/CSP</td>
<td>90</td>
<td>250</td>
<td>8</td>
<td>Unreliable, low jobs</td>
</tr>
<tr>
<td>Biomass</td>
<td>56</td>
<td>157</td>
<td>5</td>
<td>Day time, low jobs</td>
</tr>
<tr>
<td>Land fill gas</td>
<td>40</td>
<td>110</td>
<td>3.70</td>
<td>Flexible (can peak)</td>
</tr>
<tr>
<td>Biogas</td>
<td>30</td>
<td>84</td>
<td>2.6</td>
<td>Jobs, flexible (can peak)</td>
</tr>
<tr>
<td><strong>LIQUID/TRANSPORT FUELS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bio- ethanol/diesel (^2)</td>
<td>28</td>
<td>77</td>
<td>2.50</td>
<td>High jobs (ca R20kpa/job)</td>
</tr>
</tbody>
</table>

1. REIPP tender less Eskom cost of generation (base load 50 c/kWh); Eskom peaking is 10x!
2. In development (indicative) and Fuel tax issues eg. none now for LPG, CNG/Biogas
Biogas: EU Findings on Major Challenges & Needs

- Political willingness to act eg. City Councils made decisions in EU as driving force
- Knowledge and information among population and decision makers
- Multi-sector policy (landscape) – local, regional, national (international)
- Economic structure - taxes, incentives
- Composition of energy mix and local energy markets
- Different resources have different ownership structures
- Resource of biogas are disperse

KEY: Match SUPPLY (Production & Distribution) with MARKET (Transport Sector)

- Regulatory (tax etc) to forbid, restrict or give advantage – a MUST ex National Govt.
- Availability of waste (biogas sources) and of fleets (buses) at scale
- Funding of infrastructure, production and fleet renewals
- Natural gas as enabler (transitional bridge and back-up) - use synergies
THANK YOU