Alternatives to fossil fuels in transport – example from Maribor, Slovenia

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Content

- Introduction
- „METAN“ Brand
- Vehicles on compressed natural gas
- Vehicle refueling station
- Achievements
- Development plan
- Problems
Participation of the general public and professional agencies

The name should be short,

It should sounds Slovenian, but it must have significance for foreigners too

It should be separated from the LPG, but not incite the impression, that LPG is not environmentally friendly fuel
What is CNG... and what LPG?

<table>
<thead>
<tr>
<th>kratica</th>
<th>kemična sestava</th>
<th>bl. znamka</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIQUID PETROLEUM GAS</td>
<td>propan, butan</td>
<td>AVTOPLIN</td>
</tr>
<tr>
<td>LPG</td>
<td>C3H8, C4H10</td>
<td></td>
</tr>
<tr>
<td>COMPRESSED NATURAL GAS</td>
<td>metan</td>
<td></td>
</tr>
<tr>
<td>CNG</td>
<td>CH4</td>
<td></td>
</tr>
</tbody>
</table>

**CNG PROPERTIES**

- It contains about 97% of methane
- It is lighter than air, colorless and odorless
- The explosion range from 4.4% to 16.5% (volumetric ratio with air)
- Calorific value in Slovenia: 34 362 kJ / Sm3 or 9.54 kWh (average 2010)
Use of NG in transport
- WHY?

➢ Caring for the environment

• Lower CO2 emissions
• Lower NOx emissions
• Up to 98% lower emissions of PM10 in comparison with diesel engines

➢ Price

• Half lower fuel costs per kilometer

➢ Accessibility

• Technologically advanced and commercially available technology in vehicles and charging stations
NG vehicles

- Using natural gas as fuel
  - In Otto engines (spark ignition)
  - In Diesel engines

- In liquid form
  - For heavy vehicles
  - For long range vehicle

- In gaseous form – CNG
  - The most common use
  - For personal cars and heavy vehicles
  - Special vehicles (forklifts, trucks, BUSES,...)
# CNG vehicles in Slovenia

<table>
<thead>
<tr>
<th>Picture</th>
<th>Brand</th>
<th>model</th>
<th>Moč</th>
<th>Consumption CNG [kg/100 km]</th>
<th>Consumption [l/100km]</th>
<th>Range on CNG</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Mercedes-Benz" /></td>
<td>Mercedes-Benz</td>
<td>B 180 NGT</td>
<td>85 kW 116 KM</td>
<td>4,2</td>
<td>7,3</td>
<td>380 km</td>
</tr>
<tr>
<td><img src="image" alt="Volkswagen" /></td>
<td>Volkswagen</td>
<td>Passat 1.4 TSI EcoFuel</td>
<td>110 kW 150KM</td>
<td>4,4</td>
<td>4,8</td>
<td>460 km</td>
</tr>
<tr>
<td><img src="image" alt="Volkswagen" /></td>
<td>Volkswagen</td>
<td>Touran 1.4 TSI EcoFuel</td>
<td>110 kW 150KM</td>
<td>4,7</td>
<td>4,7</td>
<td>500 km</td>
</tr>
<tr>
<td><img src="image" alt="Volkswagen" /></td>
<td>Volkswagen</td>
<td>Caddy Maxi Ecofuel</td>
<td>110 kW 150 KM</td>
<td>5,8</td>
<td>4,7</td>
<td>630 km</td>
</tr>
<tr>
<td><img src="image" alt="Volkswagen" /></td>
<td>Volkswagen</td>
<td>Golf VII</td>
<td>81 kW 110 KM</td>
<td>3,6</td>
<td>3,8</td>
<td>420 km</td>
</tr>
<tr>
<td><img src="image" alt="Volkswagen" /></td>
<td>Volkswagen</td>
<td>Up</td>
<td>50 kW 68 KM</td>
<td>2,9</td>
<td>3,0</td>
<td>380 km</td>
</tr>
<tr>
<td><img src="image" alt="Škoda" /></td>
<td>Škoda</td>
<td>Citigo CNG</td>
<td>50 kW 68 KM</td>
<td>2,9</td>
<td>3,0</td>
<td>380 km</td>
</tr>
<tr>
<td><img src="image" alt="Fiat" /></td>
<td>Fiat</td>
<td>Doblo 1,4 t-jet</td>
<td>88 kW 120 KM</td>
<td>4,9</td>
<td>5,1</td>
<td>330 km</td>
</tr>
</tbody>
</table>
Distribution of gas

Charging connector

Supply air nozzles

Pressure regulator

Set of gas cylinders
CNG: 21 kg / 131 l
p = 200 bar

Pressure in system
- 200 bar
- 5 do 9 bar
Technique

Tanks and cylinders for CNG
- NG under pressure 200 bar
- Installing more tanks
- Preservation of usable space
CNG petrol engines

High compression ratio
- Higher recoveries
- More power

Optimized operation:
CNG Diesel Engines

Dual-Fuel

- Thermodynamically stable operation of the engine
- NG consumption: up to 90% (full power)
- 25% reduction of CO₂

  - High compression ratio
  - lower NOx
  - Lower consumption

All without compromising power and torque
VRA (vehicle refueling appliance/stations)

- Public use
- Filling time 5 min/car, 10-15 min/bus
- Installation on the classic filling gas stations or separately
CNG bus
Achievements

- Continuing promotion of natural gas in transport
- Opening in 2014 (10.6)
- Definitely the right choice
- Increase power and storage in October 2016
- Obtaining EU grants
- 13 buses in Maribor on CNG
- Signing a letter of intent - municipality, public utility companies
- Cooperation - together we can make a step forward
Zemeljski plin kmalu tudi za pogon vozil

Stisnjen zemeljski plin je v Evropi kot zeleno gorivo za pogon vozil že precej razširjen, Slovenija ga uvaža predlaganje

ACHIEVEMENTS

Do leta 2020 na naših cestah morda že 20.000 takšnih vozil

Urbana vozila na plin v mestnih središčih

Umetnost na zemljišču

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Umetnost na zemljišču

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Development plan

- Continuing promotion of natural gas in transport
- Each of the partners in their local environment should try to provide as many cars on methane as possible
- We hope that other distributors of NG will join us in these efforts
- Building new high-speed public charging stations
- Participate in the organization of appropriate legislation
- Use of LNG facilities (for the production of CNG or direct)
- Biogas - biomethane
Problems

- Despite common plans and letter of intent certain matters on the Municipality does not take place according to the wishes
- Non-fulfillment of promises (still buying buses on Diesel)
- Poor tracking European objectives (on a larger scale)
- Slow growth of the private use of alternative fuel vehicles (especially CNG)
- Distrust in gas
- But we will not rest
Thank you for your attention!