PRESENTATION
“Stolichen Avtotransport” EAD
Improvement of the fleet after six transition years with EU funds, EIB loans and leasing
State of the company until 2012

Age of the fleet of all 559 Units

- Up to 5 years: 1%
- From 5 to 10 years old: 27%
- From 10 to 15 years old: 23%
- From 15 to 20 years old: 5%
- Over 20 years old: 44%

Level of pollution

- Euro 0: 32%
- Euro 1: 18%
- Euro 2: 23%
- Euro 3: 20%
- Euro 4: 6%
- Euro 5: 1%
State of the company until 2012

Ikarus 280
Euro 1
50 Units

Mercedes O305 and O305G
Euro 0
174 Units

Mercedes O405
Euro 1
10 Units

Average age of fleet: 21.8 years

18 m buses
Average
24.6 years

12 m buses
Average
18.8 years
The “STRATEGY”

• First Stage: PROGRAM 2012-2016
• Step 1 and 2

• Second Stage: PROGRAM 2016-2018
First Stage : 2012-2016
Step 1

• At the end of 2011, Sofia Municipality assigns development "Bus fleet renewal program 2012-2016"

• Finding a possibility of financing from a European fund
The EU program which Sofia Municipality is applying, is the Operational Program "Environment (2007-2013)", co-financed by the European Regional Development Fund and the Cohesion Fund of the European Community, for the project "Implementation of Actions for Improvement of Ambient Air Quality by Buying and Supplying Buses".

Amount of the deal for all 126 buses is € 34 028 500 - 20% own funds and 80% of the European fund
First Stage: 2012-2016
Step 1

- The Grant Agreement was signed on 21.10.2013
- Delivery contract was signed 28.02.2014
- Delivery starts on 01.09.2014
- All 126 Units are in Sofia on 01.05.2015
Result of Step One 2012-2016 in two aspects

**Ecological**
- Reduction of harmful emissions

**Economical**
- Reduce operation costs by using alternative fuels
Ecological Result of Step One
2012-2016

- Reducing pollution by nearly 665 tons per year
- Verified by the European Court of Auditors in 2017

<table>
<thead>
<tr>
<th></th>
<th>CH</th>
<th>NOx</th>
<th>micro particles</th>
<th>Total, kg</th>
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<tbody>
<tr>
<td>CO</td>
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<td>CH</td>
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<tr>
<td>NOx</td>
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<tr>
<td>micro particles</td>
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</tbody>
</table>

Annual Pollution of 126 old buses with engine EURO 0 with an annual mileage of around 60,000 km, kg

<table>
<thead>
<tr>
<th>CO</th>
<th>CH</th>
<th>NOx</th>
<th>micro particles</th>
<th>Total, kg</th>
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</thead>
<tbody>
<tr>
<td>75 220</td>
<td>115 337</td>
<td>582 952</td>
<td>15 671</td>
<td>789 179</td>
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</table>

Annual Pollution of 126 new CNG buses with engine EURO 6 with an annual mileage of around 60,000 km, kg

<table>
<thead>
<tr>
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<th>Total, kg</th>
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</thead>
<tbody>
<tr>
<td>80 744</td>
<td>10 497</td>
<td>32 298</td>
<td>807</td>
<td>124 346</td>
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</tbody>
</table>

Decrease, kg

<table>
<thead>
<tr>
<th>CO</th>
<th>CH</th>
<th>NOx</th>
<th>micro particles</th>
<th>Total, kg</th>
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</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>508 984</td>
</tr>
</tbody>
</table>
Economical Result of Step One 2012-2016

Advantage of using alternative fuel - CNG

• Similar fuel consumption per 100 km for diesel and natural gas (~50 L - diesel ; ~60 Kg - CNG)
• Approximately 60% lower price of natural gas
• With an annual mileage of 60,000 km, one bus saves an average of € 15 500 from fuel every year
• All 126 buses have saved € 5 800 000 of the company's funds for the past 3 years of operation
• For their useful life of 12 years, the saving of funds would increase to over € 23,000,000 only from fuel
What to expect if CNG buses are selected

**Initial investment (additional)**
- € 1,500,000 for CNG stations and equipment (in our case for 126 buses and 3 depots)
- From 6 months to 1 year for construction
- A higher single price (about 10%) for the CNG vehicles vs. Diesel

**Achievement**
- The most important is the high level of environmental friendliness
- Quite low running costs for operation (as our case, we save € 1,900,000 in one year)
- Lower maintenance cost
- The return of investment - after only 1 year of operation
Step 2

- In the summer of 2014, Sofia Municipality decided to start negotiations on a long-term loan in the amount of €40,000,000 of which €21,500,000 are for low-emission buses.

- At the same time, we obtain permission from the municipality to launch a tender for the purchase of 110 solo (12 m) diesel Euro 6 buses.
Step 2

- From July to September 2016, all 110 buses are in Sofia.
- The brand is Yutong ZK6126HGA certified model Euro 6 for the European market.
- Amount of the contract is slightly above € 17 000 000
- In December 2015 a contract was signed with the winner in the tender - Chinese producer Yutong
Result of Step Two 2012-2016 in two aspects

Ecological

- Reduce emissions by another 509 tons per year

<table>
<thead>
<tr>
<th>CO</th>
<th>CH</th>
<th>NOx</th>
<th>micro particles</th>
<th>Total, kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>52 764</td>
<td>80 905</td>
<td>408 921</td>
<td>10 992</td>
<td>553 582</td>
</tr>
</tbody>
</table>

Annual pollution of 110 old engines EURO 0, kg

Economical

- The ranking in the tender is "The most economically profitable offer"

- The company saves just over € 4,300,000 from the funds allocated

- In the future, the saved funds will be used to buy more eco-friendly buses

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<table>
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</tr>
</thead>
<tbody>
<tr>
<td>5 025</td>
<td>10 050</td>
<td>28 895</td>
<td>628</td>
<td>44 598</td>
<td>Decrease, kg</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>508 984</td>
<td></td>
</tr>
</tbody>
</table>
End of Stage: 2012-2016

Fleet

- Euro 3,2 49%
- Euro 4 6%
- Euro 5 1%
- Euro 6 44%
Second Stage of “Strategy” 2016-2018

- In the middle of 2016 Sofia Municipality adopts the next own development program
- Stolichen Avtotransport was assigned to make tenders for:
  - 60 CNG Solo (12 m) buses with a lease
  - 60 CNG articulated (18 m) buses with a lease
  - Another 22 CNG buses, with the money saved €4,300,000
  - 20 full electrical buses with a lease
  - 20 hybrid or other alternative fuel sources
Second Stage of “Strategy” 2016-2018

Where are we today?

- Contract for 60 CNG (12 m) is already signed and we waiting the buses from BMC Co. by the end of the year. Amount of contract is € 14 760 000 with a lease including the leasing cost.
- Contract for 20 full electrical (12 m) buses is already signed and we waiting delivery of 20 Yutong – E12 after a couple of months. Amount of contract is € 11 360 000 with a lease including the leasing cost.
- Contract for 22 CNG (12 m) buses is already signed and we waiting delivery of 22 units from Yutong by the end of the year. Amount of contract is € 4 126 000 with a lease including the leasing cost.
## Test results of 100% Electric Buses

<table>
<thead>
<tr>
<th></th>
<th>Yutong E12</th>
<th>SOR Ebn 11</th>
<th>SOR Ebn 8</th>
<th>Solaris Urbino 12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total mileage, km</strong></td>
<td>23 194,00</td>
<td>11 884,00</td>
<td>11 884,00</td>
<td>1 137,00</td>
</tr>
<tr>
<td><strong>Estimated consumption</strong></td>
<td>1,0099 Kw/km</td>
<td>0,9926 Kw/km</td>
<td>0,7704 Kw/km</td>
<td>1,2850 Kw/km</td>
</tr>
</tbody>
</table>

### Winter, whit heating
- **Total mileage, km**: 13 082,00
- **Estimated consumption**: 1,0672 Kw/km

### Spring, whitout heating
- **Total mileage, km**: 10 112,00
- **Estimated consumption**: 0,8593 Kw/km

### Summer, whit aircondition
- **Total mileage, km**: 4 986,00
- **Estimated consumption**: 0,9926 Kw/km

## Cost per km

<table>
<thead>
<tr>
<th>Possible mileage with one charge</th>
<th>Yutong E12</th>
<th>SOR Ebn 11</th>
<th>SOR Ebn 8</th>
<th>Solaris Urbino 12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over 250 km up to 290 km</td>
<td>0,0827 €</td>
<td>Over 160 km</td>
<td>0,0812 €</td>
<td>Over 200 km</td>
</tr>
<tr>
<td>Over 160 km</td>
<td>Over 200 km</td>
<td>0,0704 €</td>
<td>Over 200 km</td>
<td>0,1052 €</td>
</tr>
</tbody>
</table>

**Possible mileage with one charge**: Over 250 km up to 290 km, Over 160 km, Over 200 km
New 20 Units of YutongE12 expected in Sofia

Batteries capacity - 324 kW/h
Useful mileage with one charge - up to 320 km

Picture from:
“Busworld” 2017 - Kortrijk, Belgium
Overview of electric buses

Initial investment and weaknesses

- Very high unit price - More than three times compared to diesel/CNG bus, including charging stations
- Ensuring sufficient electrical power for the charging stations in depot
- A low mileage with one charge
- Moving emissions into areas with a power plant

Achievement

- Zero emissions in the city
- Extremely low operation cost, annual - about € 5000
- Almost without need of maintenance
- Silent
Summary of Operation costs

Operating costs (Energy or fuel) per 100 km, €

- Diesel bus: €40.00
- CNG bus: €25.00
- Electric bus: €0.00
General Summary

Diesel Euro 6
CNG Euro 6
100% Electric

Initial investment
Operation cost
Environmental factor

Pollution from Power plants
## Financial comparison of types of low-emission buses

<table>
<thead>
<tr>
<th>Initial Investment, €</th>
<th>BUS Type</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Diesel</td>
<td>CNG</td>
<td>Electric</td>
<td></td>
</tr>
<tr>
<td>For 100 Units, €</td>
<td>16 000 000</td>
<td>24 600 000</td>
<td>38 822 400</td>
<td></td>
</tr>
<tr>
<td>Difference relative to diesel, €</td>
<td>0</td>
<td>8 600 000</td>
<td>22 822 400</td>
<td></td>
</tr>
<tr>
<td>Additional Investment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For equipment(CNG or charging station, €</td>
<td>0</td>
<td>1 000 000</td>
<td>4 710 000</td>
<td></td>
</tr>
<tr>
<td><strong>Total Investment, €</strong></td>
<td><strong>16 000 000</strong></td>
<td><strong>25 600 000</strong></td>
<td><strong>43 532 400</strong></td>
<td></td>
</tr>
<tr>
<td>Difference relative to diesel, €</td>
<td>0</td>
<td>9 600 000</td>
<td>27 532 400</td>
<td></td>
</tr>
<tr>
<td>Difference relative to CNG, €</td>
<td>0</td>
<td>17 932 400</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

## Operational cost, €

| Fuel for 12 years | 28 800 000 | 10 800 000 | 5 700 000 |
| Difference relative to diesel, € | 0 | -18 000 000 | -23 100 000 |
| **TOTAL COST FOR 12 YEARS, €** | 44 800 000 | 36 400 000 | 49 232 400 |
| 100 buses + fuel for 12 years |  |  |  |
| Difference relative to diesel, € | 0 | -8 400 000 | 4 432 400 |
Expected state of the company at the end of 2018

**Fleet (Ecology)**
- Electric: 4%
- Euro 6: 69%
- Euro 5: 1%
- Euro 4: 20%
- Euro 3: 6%

**Fleet (Extras)**
- All Buses: 655
- CNG: 275
- Aircondition: 398
- Low Floor: 501
Thank you for your attention
More Information

For info or further questions on this seminar and the activities of the JASPERS Networking Platform, please contact the JASPERS Networking and Competence Centre at the following email:

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JASPERS Website:  jaspers.eib.org