Complementarity and competition between technologies

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Business Development Executive, Low carbon mobility

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INTRODUCTION
• ENGIE, LOW CARBON MOBILITY
• LARGE RANGE OF ALTERNATIVE FUELS AND RELATED TECHNOLOGIES
• LIFE CYCLE ANALYSIS IS A MUST HAVE TO MEASURE GREENHOUSE GAS AND LOCAL POLLUTANTS

LIGHT VEHICLES,
• (GREEN) ELECTRICITY IS INCREASINGLY A NO BRAINER
• CAN WE SECURE A 100% SHIFT TOWARDS GREEN BEV?
• ENGIE IS CONTRIBUTING TO THIS TARGET

HEAVY DUTY VEHICLES : LONG TERM AMBITION & ACT TODAY
• BIOGAS IS THE ONLY SOLUTION AVAILABLE TODAY
• NO SINGLE BULLET ON THE LONG TERM?
• EACH ALTERNATIVE FUEL HAS OWN STRENGTHS & WEAKNESSES, THEY COULD COMPLEMENT EACH OTHER
• NEED TO REDUCE GREEN H2/BEV PRICE HANDICAP
• ENGIE IS INVESTING IN BIOGAS, GREEN ELECTRICITY AND GREEN HYDROGEN INFRASTRUCTURE

CONCLUSION : NEED FOR A SEGMENTED APPROACH

QUESTION : HOW TO SECURE BUSINESS MODELS TO ACCELERATE INVESTMENTS?
ENGIE PROVIDES CLEAN FUELS INFRASTRUCTURES AND RETAILS THE CLEAN FUELS REQUIRED FOR DECARBONIZATION OF TRANSPORT

Energy production and supply

Clean fuel infrastructure owner and operator

Clean fuel retail and related services

Design  Operate

Build  Maintain

Finance

WE SELECTIVELY CAPTURE VALUE ALONG THE VALUE CHAIN
**INTRODUCTION: LARGE RANGE OF ALTERNATIVE FUELS... AND RELATED INFRASTRUCTURE TECHNOLOGIES**

<table>
<thead>
<tr>
<th>Illustrations Alternative Fuels</th>
<th>Illustrations Infrastructure Related Technologies</th>
</tr>
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<tbody>
<tr>
<td><strong>Gasoline</strong></td>
<td>Gas</td>
</tr>
<tr>
<td><strong>Diesel</strong></td>
<td>Diesel</td>
</tr>
<tr>
<td><strong>LPG</strong></td>
<td>Gas</td>
</tr>
<tr>
<td><strong>Natural Gas</strong></td>
<td>Compressed Natural Gas (CNG)</td>
</tr>
<tr>
<td><strong>Biomethane (multiple sources)</strong></td>
<td>Liquid Natural Gas (LNG)</td>
</tr>
<tr>
<td><strong>E-methane</strong></td>
<td>Liquefied-to-Compressed Natural Gas (LCNG)</td>
</tr>
<tr>
<td><strong>Gas</strong></td>
<td>Electric</td>
</tr>
<tr>
<td><strong>Nuclear</strong></td>
<td>AC</td>
</tr>
<tr>
<td><strong>Wind</strong></td>
<td>DC (incl. MCS)</td>
</tr>
<tr>
<td><strong>PV</strong></td>
<td>Pantographs (up and down)</td>
</tr>
<tr>
<td><strong>..</strong></td>
<td>Electric roads</td>
</tr>
<tr>
<td><strong>Hydrogen</strong></td>
<td>Battery swap</td>
</tr>
<tr>
<td>« Carbonized »</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>« Low Carbon » (blue, turquoise, fluo)</td>
<td>Compressed (350 bars)</td>
</tr>
<tr>
<td>« Renewable » (white, indigo)</td>
<td>Compressed (700 bars)</td>
</tr>
<tr>
<td><strong>Hydrogen</strong></td>
<td>Liquid</td>
</tr>
</tbody>
</table>

**SIMPLIFIED VIEW:**

- This encompass a great variety of production and transport pathways.
- Blendings are also possible..
- Not exhaustive..

**WHICH LT SOLUTION FOR HYDROGEN?**
LIFE CYCLE ANALYSIS IS A MUST HAVE TO MEASURE GREENHOUSE GAS AND LOCAL POLLUTANTS

- X « Zero emission vehicles »
- V Grey hydrogen is worse than diesel
- V Biomethane can have up to net positive impact (e.g. Anaerobic Digestion)
- V Green electricity, green hydrogen and biomethane have a very positive impact
- V but we should first try to travel less, in a smarter and more efficient way (smaller vehicles, public transport,...)

ENERGY SOURCE IS KEY TO CONSIDER...
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LIGHT VEHICLES, ELECTRICITY IS INCREASINGLY A NO BRAINER

- Fit for 55 package (proposal): end of thermal from 2035
- Vehicles OEM’s:
  - Electrification: 300 bn$ investment committed by 2030
  - gas: end of R&D & new models.

H2: no sales worldwide, will not be needed

Clear consensus from stakeholders
Is the RES potential sufficient for carbon neutrality in NW-EU? It is increasingly difficult to find fields and secure permitting.

Sufficient raw materials?

Ability to install sufficient chargers in dense urban areas?

Sufficient fast charge parking places and capacity on highways to meet peaks?

Ability from the grid to secure large fleets and rural connections?

Other bottlenecks?

LIGHT VEHICLES, CAN WE SECURE A 100% SHIFT TOWARDS GREEN BEV?

WHAT ARE THE KEY BOTTLENECKS TO BE DEALT WITH?
LIGHT VEHICLES, ENGIE IS CONTRIBUTING TO THIS ELECTRIFICATION TARGET

Global leader in hardware/software solutions

Charging on motorways

ENGIE signe la charte « Objectif 100 000 bornes

Le 12 octobre 2020, ENGIE signe la charte « Objectif 100 000 bornes » du Ministère de la transition écologique, chargé des Transports en présence de Madame la Ministre de la Transition écologique et solidaire et de Monsieur le Ministre délégué chargé des transports. Cet engagement s’inscrit dans l’a

Electrification commitments

Partner of key manufacturers
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HEAVY DUTY VEHICLES, (BIO)GAS IS THE ONLY SOLUTION AVAILABLE TODAY

Heavy duty fuel mix (2020)

- No 44t BEV or H2 truck available for sale before 2024, lack of infrastructure
- Total Cost of Ownership
- No alternative on the market

No alternative on the market

Strong growth, aligned with PPE target

No shame..
HEAVY DUTY VEHICLES, NO SINGLE BULLET ON THE LONG TERM?

CONVENTIONAL FUELS ARE OMNIPRESENT, LARGE MARKET AVAILABLE FOR ALL.
EACH HAS OWN STRENGTHS AND WEAKNESSES

<table>
<thead>
<tr>
<th></th>
<th>Biogas</th>
<th>Electric</th>
<th>Green Hydrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATURITY (infra, vehicles,..)</td>
<td>V</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>LIMITATIONS OF RESOURCES</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>TOTAL COST OF OWNERSHIP</td>
<td>V</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>CO2</td>
<td>V</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>LOCAL POLLUTANTS (FRANCE)</td>
<td>~</td>
<td>V</td>
<td>V</td>
</tr>
<tr>
<td>OPERATIONAL CONSTRAINTS (charging time, payload, travel range..)</td>
<td>~</td>
<td>X</td>
<td>~</td>
</tr>
</tbody>
</table>

THEY COULD COMPLEMENT EACH OTHER.
**HEAVY DUTY VEHICLES, NEED TO REDUCE GREEN H2/BEV PRICE HANDICAP**

**Annual driving distance:** 110,000 km (~500 km / day assuming 220 days of operation) / **Duration of ownership of the vehicle:** 7 years.

NB: Considering daily routine constraint (i.e. autonomy of BEV lower than daily needs), Overnight + opportunity charging.

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### Fuel Costs

<table>
<thead>
<tr>
<th>Fuel Type</th>
<th>TCO €/t/km</th>
<th>TCO €/t/km</th>
<th>Fuel - excl infra</th>
<th>Fuel – infra only</th>
<th>Recurrent taxes (TVS, taxe l’essieu, insurance, …)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel</td>
<td>450</td>
<td>28.5</td>
<td>0.14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CNG</td>
<td>362</td>
<td>28.5</td>
<td>0.12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elec</td>
<td>634</td>
<td>16</td>
<td>0.36</td>
<td></td>
<td></td>
</tr>
<tr>
<td>H2-gaseous</td>
<td>545</td>
<td>26</td>
<td>0.19</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*payload estimated*
HEAVY DUTY VEHICLES, ENGIE IS INVESTING IN THE FUTURE

Gas

Electric

Hydrogen

France
+ Italy, Belgium, Romania, Mexico, Ivory Coast..

Europe/Global

France/Global

But also..
AND ALREADY A LEADER IN FRANCE

Gas
140 stations, 250+ carriers under contract with ENGIE Solutions

Electric
Partnerships with major OEM's

Hydrogen
Hydrogen stations operated by ENGIE

ENGIE Solutions (Bio)NGV public stations for HDV's

Territorial Projects
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ENGIE, LEADER IN FRANCE, IS BUILDING TODAY, THE LOW CARBON MOBILITY ECOSYSTEMS OF TOMORROW.
QUESTION: HOW TO SECURE BUSINESS MODELS TO ACCELERATE INVESTMENTS?

FOR BIONGV:
- SECURE LT PUBLIC SUPPORT, INCREASE TRAVEL RANGE (CNG) & SUPPORT BIOMETHANE PRODUCTION,

FOR EV/GREEN H2:
- REDUCE PRICE HANDICAP, IMPROVE MATURITY, ALIGN VISION AND FEDERATE STAKEHOLDERS,

FOR ALL:
- INCENTIVIZE CHANGE,
ENGIE PROVIDES CLEAN FUELS INFRASTRUCTURES AND RETAILS THE CLEAN FUELS REQUIRED FOR DECARBONIZATION OF TRANSPORT

<table>
<thead>
<tr>
<th></th>
<th>ENGIE 2021</th>
<th>AMBITION 2025</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(BIO)NGV STATIONS</strong></td>
<td># 1 (FRANCE)</td>
<td>140</td>
</tr>
<tr>
<td><strong>EV CHARGERS</strong></td>
<td># 2 (WORLDWIDE, excl. China)</td>
<td>300.000 (RETAIL &amp; INSTALLATION)</td>
</tr>
<tr>
<td><strong>(GREEN) H2 REFUELING STATIONS</strong></td>
<td># 4 (EUROPE)</td>
<td>9</td>
</tr>
</tbody>
</table>
ENGIE IS ACTIVE ON THE ALTERNATIVE FUELS MIX

Inner City
Passenger cars, utility vans
Electricity

Last mile
Utility vans, delivery trucks, bus
Electricity, (bio)CNG, (green)H₂

Long range
Trucks, bus, rail, maritime
(bio)LNG, (green)H₂

(bio) CNG
(bio) LNG
Electric
(green) H₂
DELIVERING UP TO END-TO-END SOLUTION

Primary
- Design
- DSO Actions
- Charging Stations
- Energy Management
- Installation & Maintenance

Options
- Financing & Insurance
- Payment Solutions
- Green Electricity Supply
- Subsidies
TRIPS OF ABOUT 700 KM ARE POSSIBLE IF RECHARGING IS INCLUDED IN THE DAILY OPERATIONS