EXIT FROM THE COMBUSTION ENGINE: WHAT NEXT FOR THE AUTOMOBILE INDUSTRY?

ETUI WORKSHOP

1-2 MARCH 2018
EUROPEAN AUTOMOTIVE INDUSTRY BACKGROUND – STATE OF PLAY AND FUTURE CHALLENGES

Anne-Gaëlle Lefeuvre & Stefan Guga, with the contribution of Emmanuel Palliet

Recovering from the crisis, overcapacities, cost pressures, fierce competition; employment structure in main regions/countries; share of individual transport in greenhouse gas emissions; climate policy objectives affecting the industry; Announced and likely regulatory changes by main regions; What can be expected within the next 20 years given the main climate policy and regulatory objectives and changes in technology (digitalisation); What is the likely impact on employment both in qualitative and quantitative terms in a post-combustion engine automobile industry?
## EUROPEAN AUTOMOTIVE INDUSTRY BACKGROUND – STATE OF PLAY AND FUTURE CHALLENGES

### PARTS  |  Ideas
---|---
### #1 - THE RECOVERY OF EUROPEAN AUTO MARKETS AND PLAYERS  |  • More volumes, new types of cars, energy evolution, commercial balances, more profitability, new repartition of production and employment  
  • ...But the end of the recovery is anticipated shortly, and the rules of the game are changing due to environmental constraints, the mobility revolution and new trends in the organisation of production (more connected, more personalised, more productive)

### #2 - ENVIRONMENTAL REGULATIONS AND NEW POWERTRAIN PATHWAYS  |  • European regulation on CO2 and NOx: trends and debate  
  • Powertrain forecasts: possible scenarios (diesel/gasoline; ICE/HEV – mild, full, plugin/BEV)  
  • Reshuffling of value chains in powertrain  
  • Employment impact (in the short / medium term) for R&D and production

### #3 - THE MOBILITY REVOLUTION  |  • Towards 2 kinds of vehicle: individual vs. shared  
  • Autonomous and connectivity development projects and forecasts  
  • New value chains (equipment losses/new equipment + data issues)  
  • Employment impact

### #4 - NEW SCHEME OF PRODUCTION  |  • more connected, more personalised, more productive process of production  
  • Industry of the Future implementation  
  • Employment impacts

### #5 - SYNTHESIS  |  A vision of the combined effects
#1 - THE RECOVERY OF EUROPEAN AUTO MARKETS AND PLAYERS

- More volumes, new types of cars, energy evolution, commercial balances, more profitability, new repartition of production and employment
- ...But the end of the recovery is anticipated shortly, and the rules of the game are changing due to environmental constraints, the mobility revolution and new trends in the organisation of production (more connected, more personalised, more productive)

DATA

- OICA – ACEA registrations by country and manufacturer
- ACEA and Eurostat employment data per country
- Reference documents of manufacturers and suppliers comparison and analysis (turnover, profitability, cash flow, dividend, CAPEX and R&D)
- PWC, R. Berger and IHS forecasts
#2 - CLIMATE REGULATIONS AND NEW POWERTRAIN TRAJECTORIES

- European regulation on CO2 and NOx: trends and debate
- Powertrain forecasts: possible scenarios (diesel/gasoline; ICE/HEV – mild, full, plugin/BEV)
- Reshuffling of value chains in powertrain
- Employment impacts in the short term:
  - R&D: a lot of work for now for powertrain teams… but after 2021?
  - Production: implementation of EURO 6d-temp – new equipments
- Employment impact in the medium term:
  - R&D: decrease of employment, new type of qualification needed, strategic suppliers (batteries), new organisations
  - Production: depends on the speed of electrification and the carmakers’ mastery of the value chain

DATA

- ACEA, GEAR 2030, FNH study...
- Analysts’, manufacturers’ and suppliers’ forecasts
- MEDEEM Syndex study
- Interviews with major players to illustrate – from our missions
  - We will mainly follow: Bosch, Delphi, Continental, Valeo, VW Poland, Renault, PSA, Toyota, Volvo Trucks, IVECO
#3 - THE MOBILITY REVOLUTION

- Autonomous and connectivity development projects and forecasts
- New value chains (equipment losses/new equipment + data issues)
- Towards 2 kinds of vehicle: individual vs. shared vehicles, with new type of production
- What employments and qualifications and functional organisational impacts?
  - In R&D: new strategic competencies: soft, data, power electronics …
  - In production: convergence toward aviation scheme of production?

DATA

- Reference documents of manufacturers and suppliers, comparison and analysis of strategy around mobility
- Interviews with major players to illustrate – from our missions
#4 - NEW TRENDS IN THE ORGANISATION OF PRODUCTION

- More connected, more personalised, more productive processes
- Industry of the Future implementation
- Potential employment impact

DATA

- Work by R. Berger
- Syndex study and inquiry
- Reference documents of manufacturers and suppliers, comparison and analysis (nature of CAPEX)
#5 – SYNTHESIS : A VISION OF THE COMBINED EFFECTS

<table>
<thead>
<tr>
<th></th>
<th>Quantitative effects</th>
<th>Qualitative effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volumes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electrification</td>
<td></td>
<td></td>
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<tr>
<td>Mobility</td>
<td></td>
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<tr>
<td>Industry of the Future</td>
<td></td>
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<tr>
<td>...</td>
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<tr>
<td>Combined effects</td>
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</tr>
</tbody>
</table>
THE EUROPEAN MARKET RECOVERED

European Registrations dynamic in light vehicles (in thousand of vehicles)
MORE PROFITABILITY FOR THE MAJORITY OF THE AUTOMOTIVE ACTORS

Profitability rate – main car makers (division Auto.)

<table>
<thead>
<tr>
<th>Car Maker</th>
<th>6 mois 2016</th>
<th>6 mois 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMW</td>
<td>9.4%</td>
<td>9.1%</td>
</tr>
<tr>
<td>Daimler</td>
<td>8.5%</td>
<td>7.7%</td>
</tr>
<tr>
<td>Toyota</td>
<td>7.3%</td>
<td>7.3%</td>
</tr>
<tr>
<td>VAG</td>
<td>6.1%</td>
<td>6.1%</td>
</tr>
<tr>
<td>PSA</td>
<td>5.0%</td>
<td>4.8%</td>
</tr>
<tr>
<td>FCA</td>
<td>5.9%</td>
<td>5.0%</td>
</tr>
<tr>
<td>Ford</td>
<td>4.8%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Nissan</td>
<td>4.8%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Renault</td>
<td>4.8%</td>
<td>4.8%</td>
</tr>
</tbody>
</table>

Profitability rate for a selection of suppliers

<table>
<thead>
<tr>
<th>Supplier</th>
<th>S1 2016</th>
<th>S1 2017</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faurecia</td>
<td>5.7%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Valeo</td>
<td>8.0%</td>
<td>8.0%</td>
</tr>
<tr>
<td>Sogefi</td>
<td>10.1%</td>
<td>10.1%</td>
</tr>
<tr>
<td>Continental</td>
<td>5.7%</td>
<td>5.7%</td>
</tr>
<tr>
<td>Bosch</td>
<td>4.8%</td>
<td>4.8%</td>
</tr>
<tr>
<td>Federal Mogul</td>
<td>4.8%</td>
<td>4.8%</td>
</tr>
</tbody>
</table>
EUROPEAN AUTOMOTIVE EMPLOYMENTS: A « RELATIVE » RECOVERY

Historical dynamic of European Automotive sector Employment (in thousand)

POSSIBLE STABILISATION OF THE EUROPEAN MARKET: DEMOGRAPHIC AND CONSUMPTION EFFECTS

Passenger car market in Western Europe

Sources: IHS, document de travail, février 2016
CO2 AND NOX REGULATION ISSUES

Efficacité élevée pour réduire les émissions de CO2

Moins d’émissions toxiques. Exemple : NOx

Des protocoles de test plus contraignants : RDE¹

¹ RDE: Real Driving Emissions
The dieselgate would have helped accelerate the decline. Retreat already engaged for many years

Source: ACEA et données associations des constructeurs automobiles nationaux en 2017
THE SHARE OF ALTERNATIVE ENERGY VEHICLES IS PROGRESSING, BUT VOLUMES REMAIN LOW

- These sales are mainly driven by hybrid growth since mid-2016.
Sales of pure electric and plug-in hybrid get moving in 2017, but remain below 300,000 vehicles.

Alternative energy vehicle registrations in EU + EFTA

<table>
<thead>
<tr>
<th>Year</th>
<th>Hybride</th>
<th>Electrique rechargeable</th>
<th>Pure electrique</th>
<th>Autres</th>
</tr>
</thead>
<tbody>
<tr>
<td>2016</td>
<td>302,363</td>
<td>176,819</td>
<td>90,859</td>
<td>108,738</td>
</tr>
<tr>
<td>2017</td>
<td>205,524</td>
<td>135,301</td>
<td>143,997</td>
<td>460,735</td>
</tr>
</tbody>
</table>

Source: ACEA, traitement Syndex
**WHAT ARE THE PROJECTIONS?**

<table>
<thead>
<tr>
<th>WW forecasts</th>
<th>Horizon</th>
<th>Thermal ICE</th>
<th>Hybrid FH-MH-PHEV</th>
<th>Electric BEV-REX-FCEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>ELAB ref. sc.</td>
<td>2030</td>
<td>40%</td>
<td>35%</td>
<td>25%</td>
</tr>
<tr>
<td>IHS Markit</td>
<td>2025</td>
<td>65%</td>
<td>30%</td>
<td>5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UE forecasts</th>
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<th>Electric BEV-REX-FCEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. Berger*</td>
<td>2025</td>
<td>55%</td>
<td>28%</td>
<td>15%</td>
</tr>
<tr>
<td>XX</td>
<td>2024</td>
<td>52%</td>
<td>32%</td>
<td>16%</td>
</tr>
<tr>
<td>LMC * EU ouest</td>
<td>2032</td>
<td>10%</td>
<td>49%</td>
<td>39%</td>
</tr>
<tr>
<td>BIPE</td>
<td>2035</td>
<td>31%</td>
<td>59%</td>
<td>10%</td>
</tr>
</tbody>
</table>

*2% autres: CNG/LPG

- The differences in forecasts between analysts in automotive data remain substantial.
- It is therefore important that the actors have a broad enough range of technologies to be able to adapt to market developments.
FUNCTIONAL DEVELOPMENT: HYBRID VEHICLE

- Electric charger
- Controller
- Turbo
- Electrical wiring
- Fuel system
- Exhaust system
- Combustion engine
- Emission control
- Batterie du GMP
- Electric motor
- Converter
- Inverter
- GMP battery cooling
- Nothing
- More added value
- Electricity distribution
- Electronics
- ECU
- Transmission
- Fuel tank
- Engine cooling
- Air filter
- Less added value
FUNCTIONAL DEVELOPMENT: ELECTRIC VEHICLE

More added value

- Electric charger
- Controller
- Electrical wiring
- ECU
- Electronic control

Less added value

- Transmission
- Engine cooling

New

- GMP battery cooling
- Recharging interface

SG3

- Electrical motor
- Converter
- Inverter

New features:

- GMP battery cooling
- Recharging interface
what does GMP stand for?
Ștefan Guga; 27/02/2018
POWERTRAIN EMPLOYMENT IMPACTS

- Employment impacts in the short term:
  - R&D: a lot of work for now for powertrain teams... but after 2021?
  - Production: implementation of EURO 6d-temp – new equipments

- Employment impacts in the medium term:
  - R&D: decrease of employment, new type of qualification needed, strategic suppliers (batteries), new organisations
  - Production: depends on the speed of electrification and the carmakers’ mastery of the value chain
MUTATION OF THE AUTOMOTIVE PRODUCT

Individual vehicle
- Attractivity
- Less polluant
- Security
- Costs

Clean

Design

Connected

Comfort

Connected

Autonomous

Electric

Durability
- Quality
- Security
- Services (PR,soft, app...)
+ TCO

Comfort

shared vehicle
MOBILITY EMPLOYMENT IMPACTS (INDUSTRY ONLY)

- Employmens, qualifications and functional organisational impacts?
  - In R&D: new strategic competencies: soft, data, power electronics...
  - In production: convergence toward aviation scheme of production, aftersales development, maintenance...
A PLANT OF THE FUTURE

D’après Etude Industrie 4.0, Les leviers de la transformation, Gimelec, septembre 2014

Cybersécurité
- Protection accrue des systèmes de production reliés à internet
- Produits et technologies à cycle de vie allongés

CLOUD COMPUTING
De l’espace dans les nuages

Big Data
- Traitement de la complexité
- Créativité
- Production collaborative

Maintenance à distance
- Prédiction

Cobot / Exo
- Traitement de la complexité
- Créativité
- Production collaborative

Usine
- Zéro défaut
- Réactivité
- Tracabilité
- Prévision

Systèmes avancés de production
- Système cyber physique
- Commandes numérique (automatisation complète, systèmes interconnectés, communication entre machines)

Fournisseurs
- Supply-chain intégrée
- Systèmes interconnectés
- Coordination totale

Logistique connectée
- Moindre pertes
- Personnalisation de masse
- Création rapide de prototypes

Impression 3D
- Temps réel, autonomie, productivité
- Transparence des reporting

Nano-électronique
- Optimisation des flux
- Sécurité
- Coûts

Robot
- Optimisation des flux
- Sécurité
- Coûts

Chariots autonomes
- Marquage d’objets
- Communication objet – internet via ondes radio basse fréquence
- Captures de données en temps réel
- Optimisation des stocks
- Rédution des déchets

Clients
- Personnalisation de masse

Internet des objets
- Fidélisation client
- Flexibilité
- Personnalisation et productivité
- Production à la demande

Ressources futures
- Energies propres renouvelables
- Stockage d’énergie
- Matières premières alternatives

D’après Etude Industrie 4.0, Les leviers de la transformation, Gimelec, septembre 2014
THE FRENCH AUTOMOTIVE INDUSTRY – STATE OF PLAY AND FUTURE CHALLENGES

Michel Sonzogni & Sebastian Schulze-Marmeling

Main trends, the future of the combustion engine and the spreading of electric cars, employment change
# THE FRENCH AUTOMOTIVE INDUSTRY – STATE OF PLAY AND FUTURE CHALLENGES

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<th>Ideas</th>
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| #1 – LITTLE HISTORY OF THE FRENCH PATHWAY | • An automotive ground of conception and production:  
  • 2 French carmakers + Toyota and Daimler plants + 3 truck and bus producers + presence of all the worldwilde automotive suppliers  
  • 8 engines and BV plants  
  • French attractivity in powertrain activities:  
  • PSA established partnerships on new technologies of injection for diesel with suppliers (Bosch, Delphi...), exhaust systems (Faurecia...), and produced engines for other carmakers (BMW, Ford)  
  • Renault produce engines for its partners (Nissan, Daimler). And France is its production base for electric motor production. |
| #2 – THE FRENCH AUTOMOTIVE SECTOR TODAY | • A recovery in the wake of the European dynamic, new social compromises, ... and despite everything, a decline in employment continue  
  • The transformation of the production automotive processes: robotisation, connected plants...  
  • The dynamic of powertrain employements today |
| #3 – PERSPECTIVES AND CHALLENGES | • Employments Scenarios have to be built, taking account:  
  • Regulations evolutions  
  • Carmakers strategies  
  • Projections of volumes in assembly and powertrain plants  
  • Dynamic of R&D in new tech...  
  • New trajectories challenges |
#1 – LITTLE HISTORY OF THE FRENCH TRAJECTORY

An automotive ground of conception and production:
- 2 French carmakers + Toyota and Daimler plants + 3 truck and bus producers + presence of all the worldwide automotive suppliers
- 8 engines and transmissions plants

French attractivity in powertrain activities:
- PSA established partnerships on new technologies of injection for diesel with suppliers (Bosch, Delphi...), exhaust systems (Faurecia...), and produced engines for other carmakers (BMW, Ford)
- Renault produce engines for its partners (Nissan, Daimler). And France is its production base for electric motor production.

DATA
- Syndex historic knowledge
- CCFA, Analysis and Statistic
#2 – THE FRENCH AUTOMOTIVE SECTOR TODAY

- A recovery in the wake of the European dynamic, new social compromises, ... and despite everything, a decline in employment continue
- The transformation of the production automotive processes: robotization, connected plants...
- The dynamic of powertrain employments today

DATA

- Syndex Bench 2017
- Syndex Survey of the Future 2017
- Syndex analysis of employments in the French powertrain sector (ongoing)
AROUND THE RECOVERY OF THE FRENCH MARKET

Registration - Passengers cars and light utilitary vehicles in France

Source: CCFA
A PERSPECTIVE: AROUND 2 MILLIONS

Assembly vehicle production of light vehicles in France
FRENCH MANUFACTURING EMPLOYMENT IS STILL DECREASING

manufacturing employments - France


Construction automobile  Equipements, accessoires
OUR FIRST ESTIMATION OF THE DYNAMIC OF EMPLOYEMENTS IN THE FRENCH POWERTRAIN SECTOR

Variation in powertrain sector by type of activity

- 5%

Employements in the French powertrain Sector - estimation

- 5%

2014 2016
#3 — PERSPECTIVES AND CHALLENGES OF THE FRENCH AUTOMOTIVE SECTOR

- Employments Scenarios have to be built, taking account:
  - Regulations evolutions
  - Carmakers strategies
  - Projections of volumes in assembly and powertrain plants
  - Dynamic of R&D in new tech...

- New trajectories challenges

DATA

- Syndex projections of employments in the French powertrain sector (ongoing)
- IHS last forecasts
- Projections of the national Observatory of Metallurgy Profession and Skills, 2017
- Interviews on R&D questions
STAKEHOLDERS GUIDED BY THEIR INTERESTS, AND NOT NECESSARILY SHARING THE SAME VISION FOR THE FUTURE