

What Drives Us – The Schaeffler Powertrain Matrix

Symposium 2018

Mobility  
for  
tomorrow

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The Schaeffler  
Powertrain  
Matrix

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for  
tomorrow

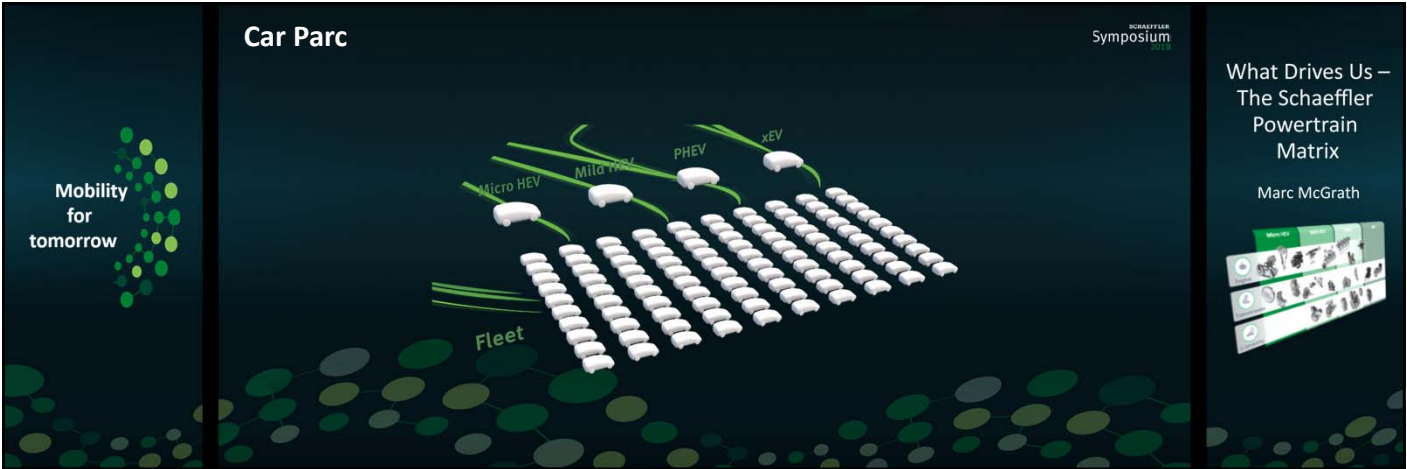
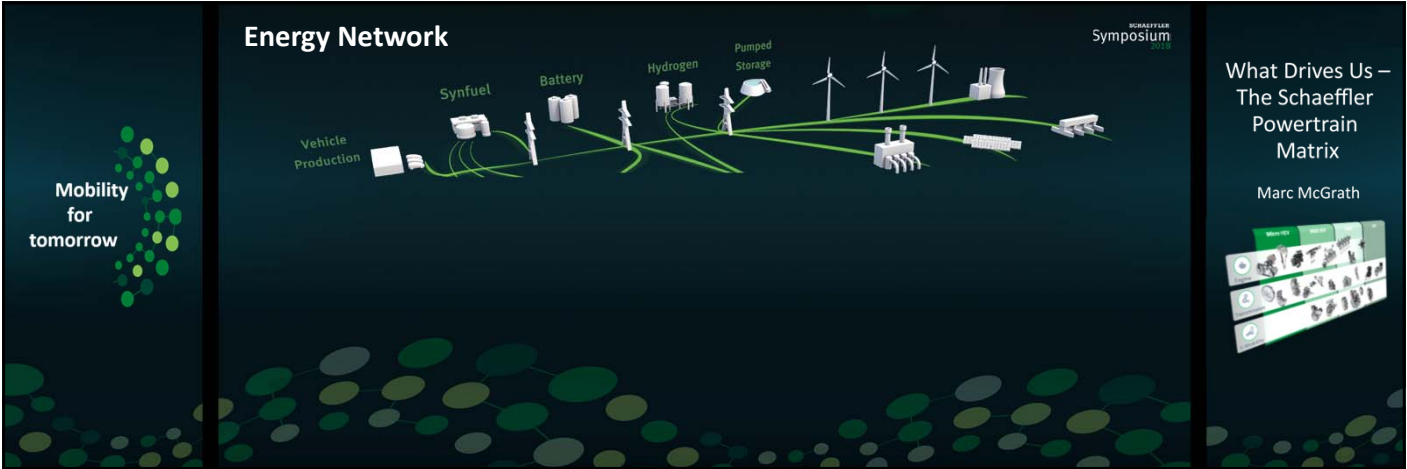
Energy Chain


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The diagram illustrates the 'Energy Chain' for future mobility. It shows a flow from 'Power Generation' (represented by wind turbines and solar panels) through various energy storage and conversion stages: 'Pumped Storage', 'Hydrogen', 'Battery', and 'Synfuel'. These energy sources then feed into different vehicle types: 'Micro HEV', 'Mild HEV', 'PHEV', and 'xEV'. The vehicles are shown in a 'Fleet' arrangement. The process also includes 'Vehicle Production' and 'Battery Production', with a 'Recycling' loop returning materials to the production stage.

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### Global Energy Chain Relative to Region Demands


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Country

Natural Resources


Demographics

Regulations


Consumer

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2014 Symposium



### 2014 Symposium: Solving the Powertrain Puzzle!


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Engine

Transmission


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### Mobility for Tomorrow Requires E-Mobility



Engine



Transmission





E-Mobility

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Engine

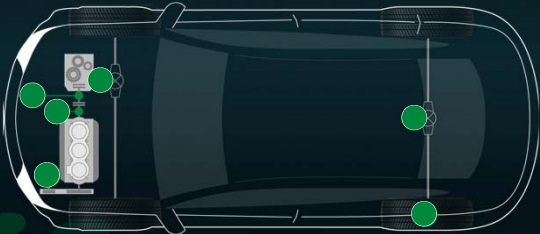


Transmission



E-Mobility


### Powertrain Architectures



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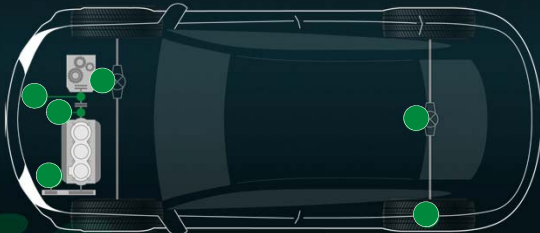


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### Powertrain Architectures


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Conventional ICE



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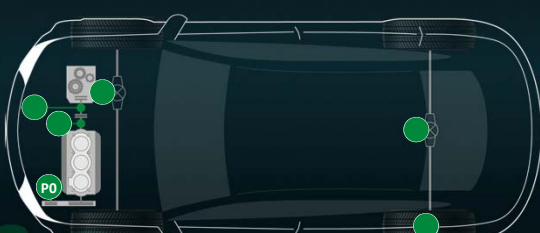


### Powertrain Architectures

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P0

- 48V
- Micro 12V P0
- ICE start/stop



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Powertrain Architectures

P1

FHEV

48V

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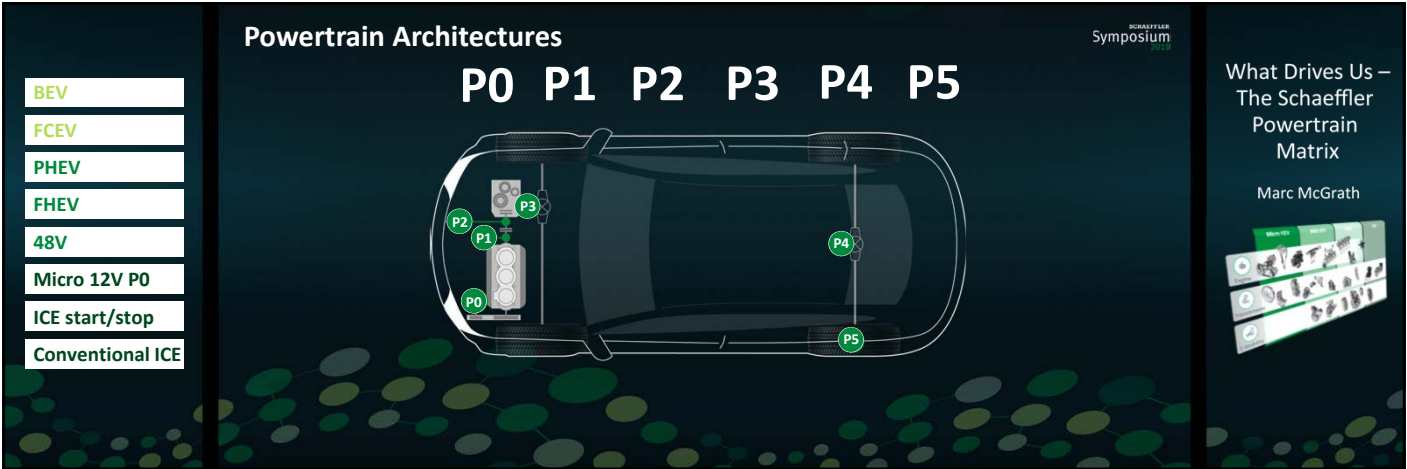
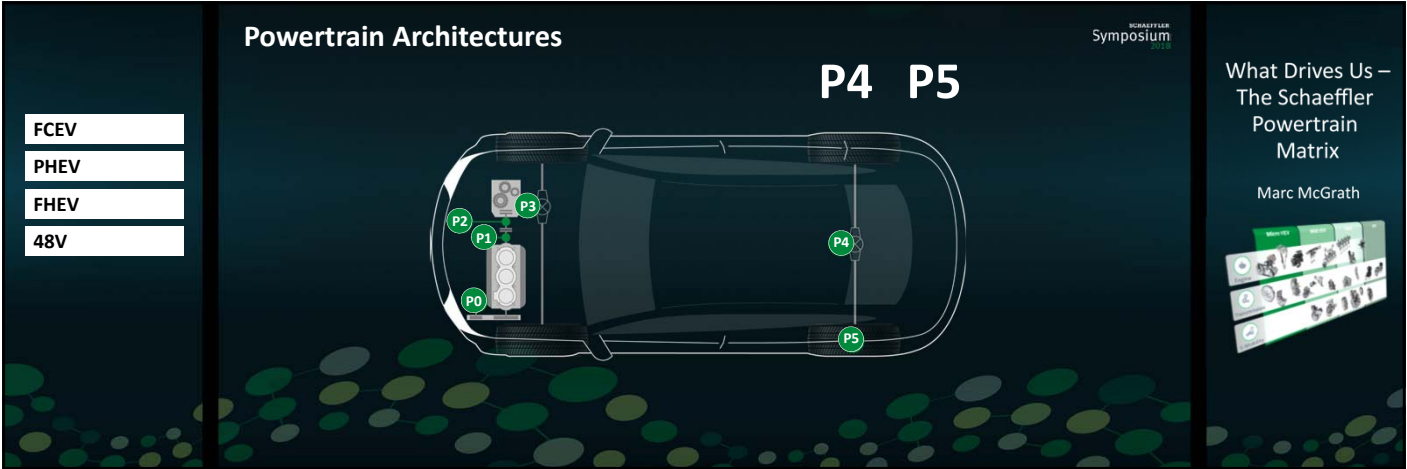
Powertrain Architectures

P2 P3

PHEV

FHEV

48V



BEV

FCEV

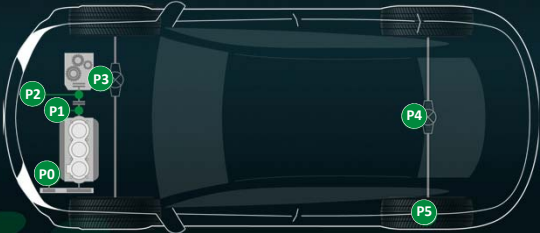
PHEV

FHEV

48V


ICE

Schaeffler 2030 Accelerated Scenario



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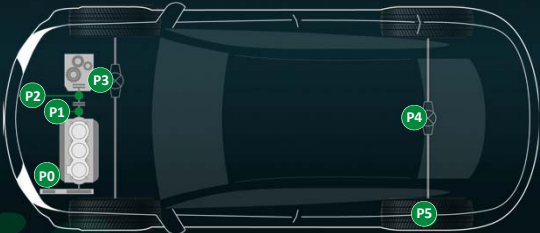
BEV

FCEV

HEV


ICE

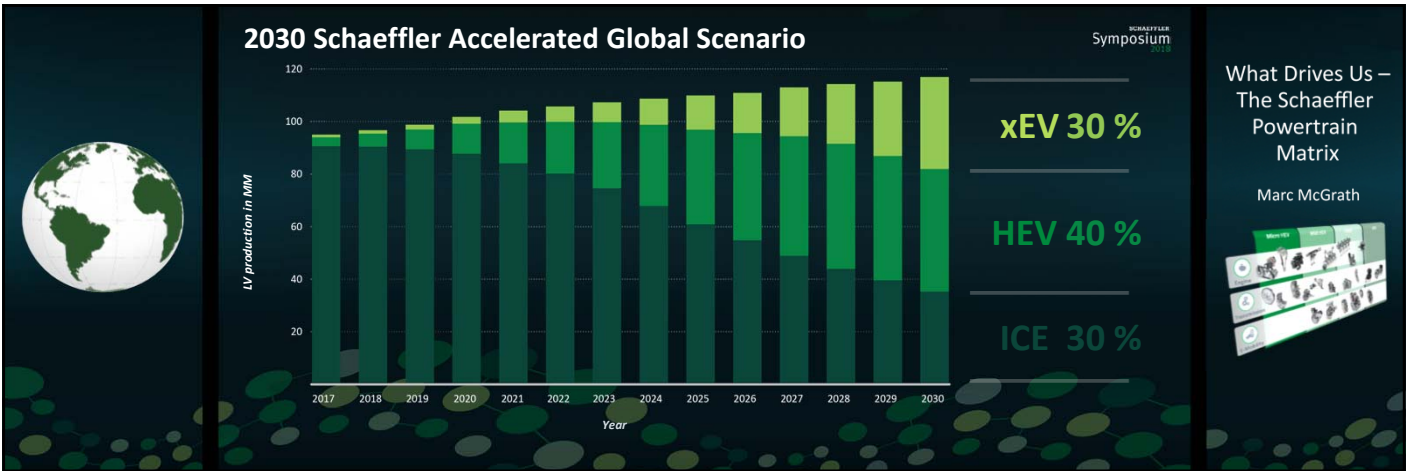
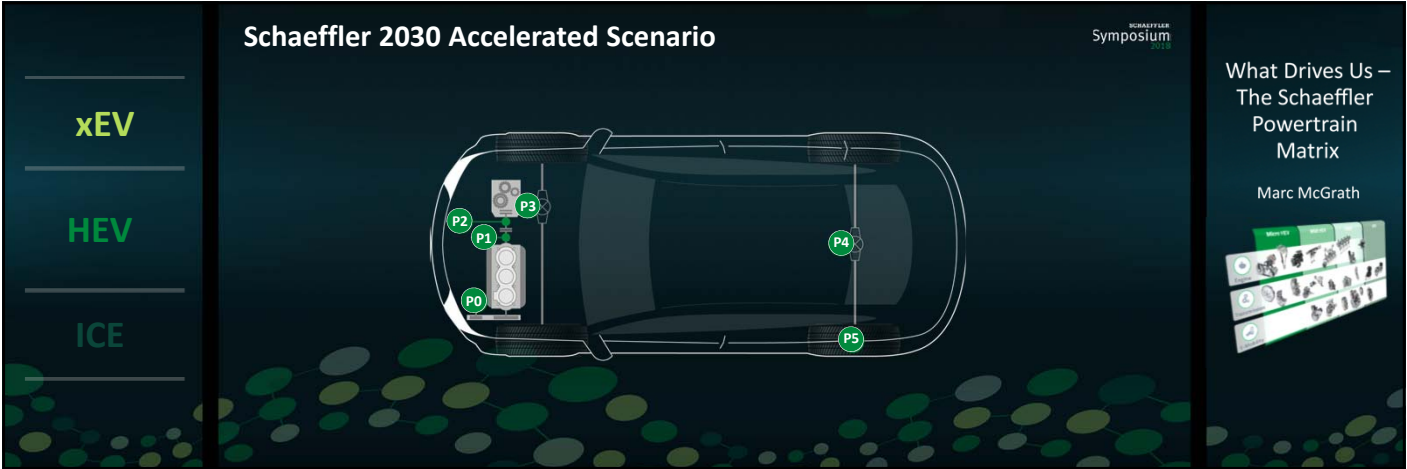
Schaeffler 2030 Accelerated Scenario



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# United States Unique Market



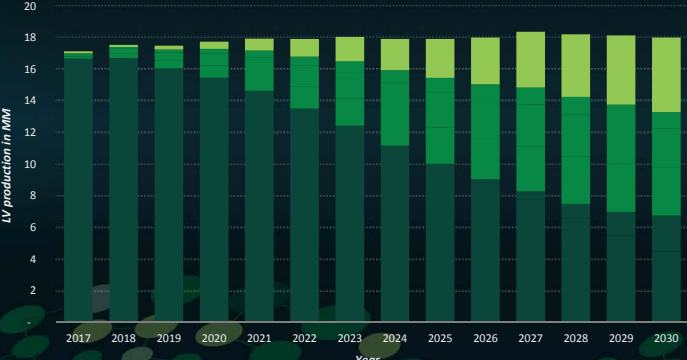
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# 2030 Schaeffler Accelerated US Scenario



Year	ICE	HEV	xEV
2017	16.5	0.5	0.0
2018	16.8	0.5	0.0
2019	16.5	0.5	0.0
2020	16.0	0.5	0.0
2021	15.0	1.0	0.0
2022	13.5	2.0	0.5
2023	12.0	3.0	1.0
2024	10.5	4.0	1.5
2025	9.0	5.0	2.0
2026	7.5	6.0	2.5
2027	6.0	7.0	3.0
2028	4.5	8.0	3.5
2029	3.0	9.0	4.0
2030	1.5	10.0	4.5


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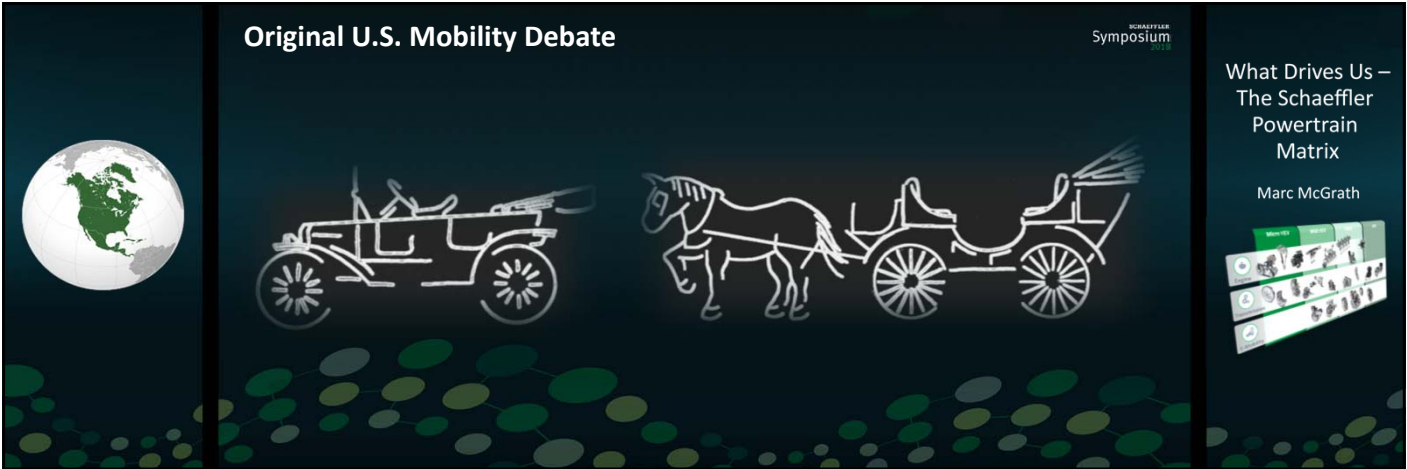
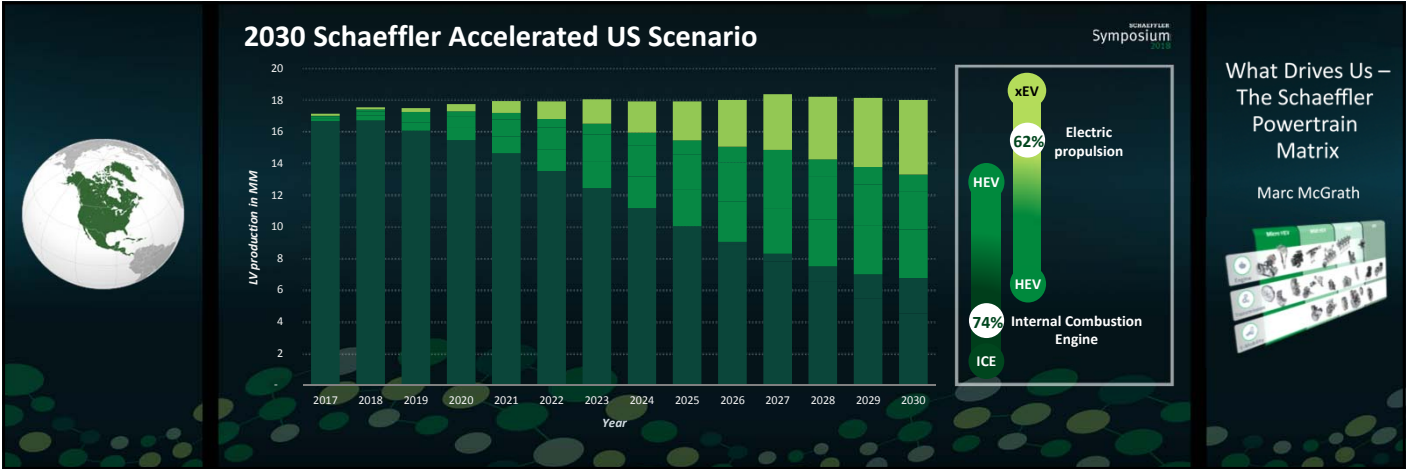
xEV 26 %


HEV 36 %

ICE 38 %


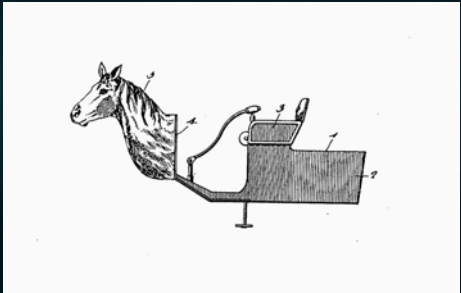
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### Early 1900s U.S. Hybrid Solution



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### Hybrid Architecture!



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### Technology Change





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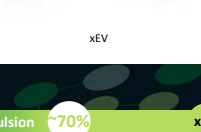
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### Mobility for tomorrow Optimization

ICE	HEV	xEV
		
ICE/Micro Hybrid	M/FHEV	PHEV
		
		xEV

ICE

Internal Combustion Engine ~70%

HEV

HEV


Electric propulsion ~70%

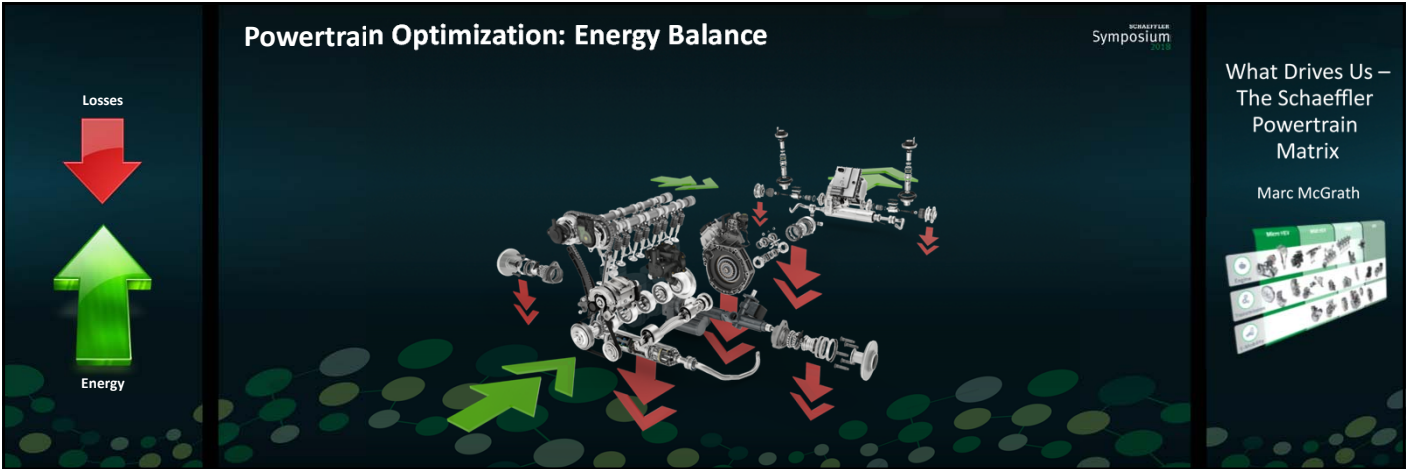
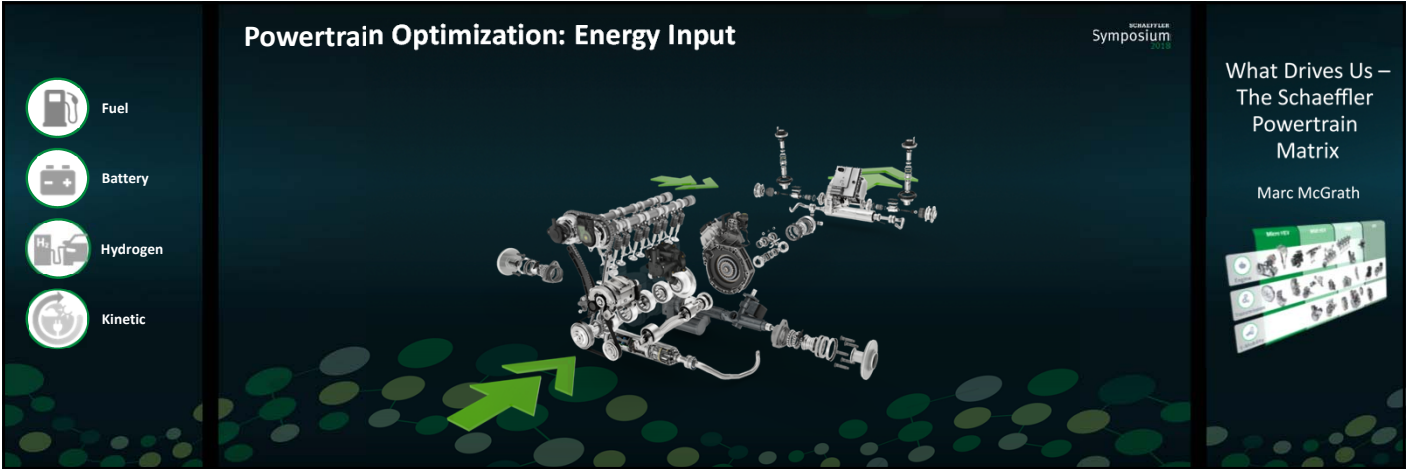
xEV

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Mobility for tomorrow

Engine

Transmission

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Micro HEV

Mild HEV

PHEV

xEV

Today

Tomorrow

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Schaeffler Powertrain Matrix

	Micro HEV	Mild HEV	PHEV	xEV
Engine				
Transmission				
E-Mobility				

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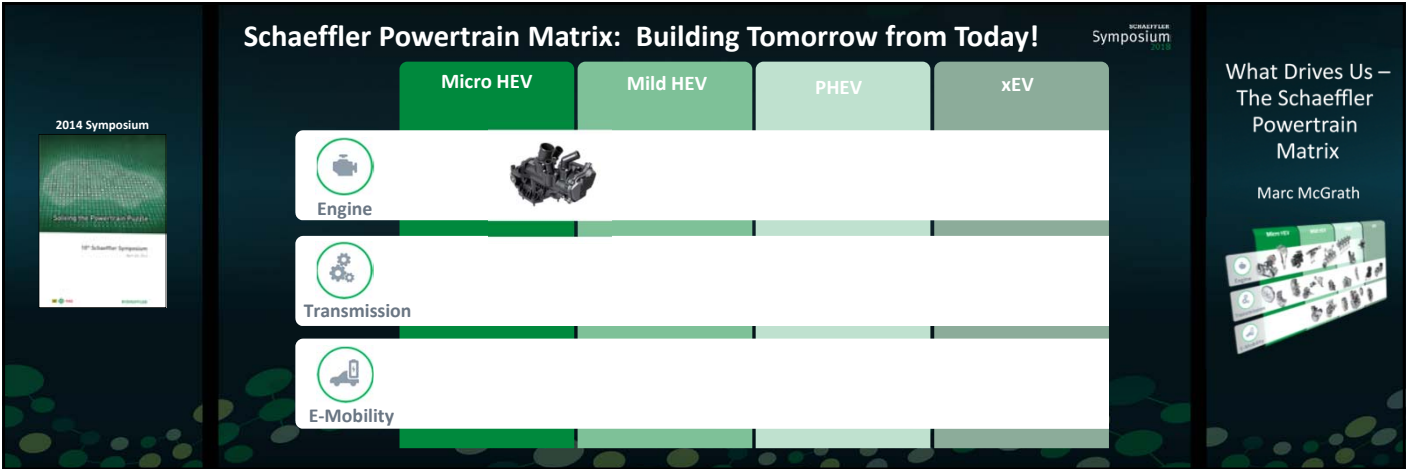
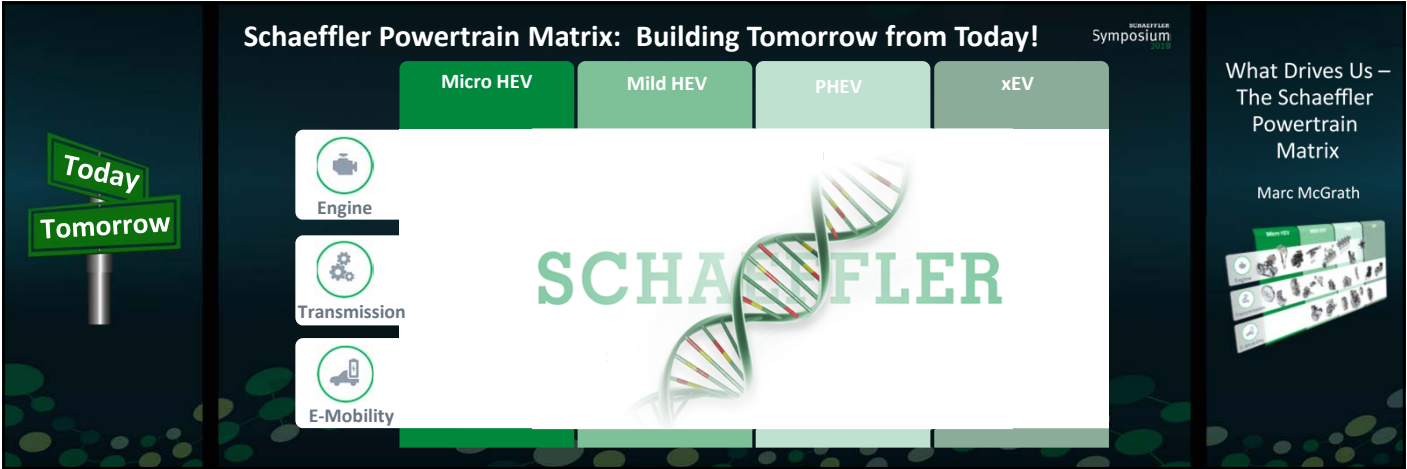
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Micro HEV

Mild HEV

PHEV


xEV




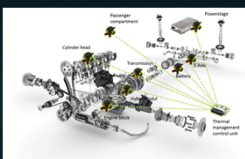
Today

Tomorrow

### Thermal Management TMM Today and Tomorrow



North America  
SOP Q3 2018



**Today**


- Up to 4% fuel saving
- Reduced engine and transmission drag
- Increased comfort through faster heating

**Tomorrow**

- Vehicle thermal management required for HEV and BEV
- Increased efficiency
- Thermal control unit with decentralized smart valves

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Today


Tomorrow

### Integrated Turbine Torque Converter iTC Today and Tomorrow

	Micro HEV	Mild HEV	PHEV	xEV
Engine	 			
Transmission	 			
E-Mobility				

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Today


Tomorrow

### Integrated Turbine Torque Converter iTC Today and Tomorrow



**Today**

- ▶ Reduced weight
- ▶ Increased damper space
- ▶ Front-cover flexibility




**Tomorrow**

- ▶ P2 FHEV or PHEV
- ▶ HV or 48V
- ▶ Reduced space requirement

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Today


Tomorrow

### The Schaeffler Powertrain Matrix: Mobility for tomorrow

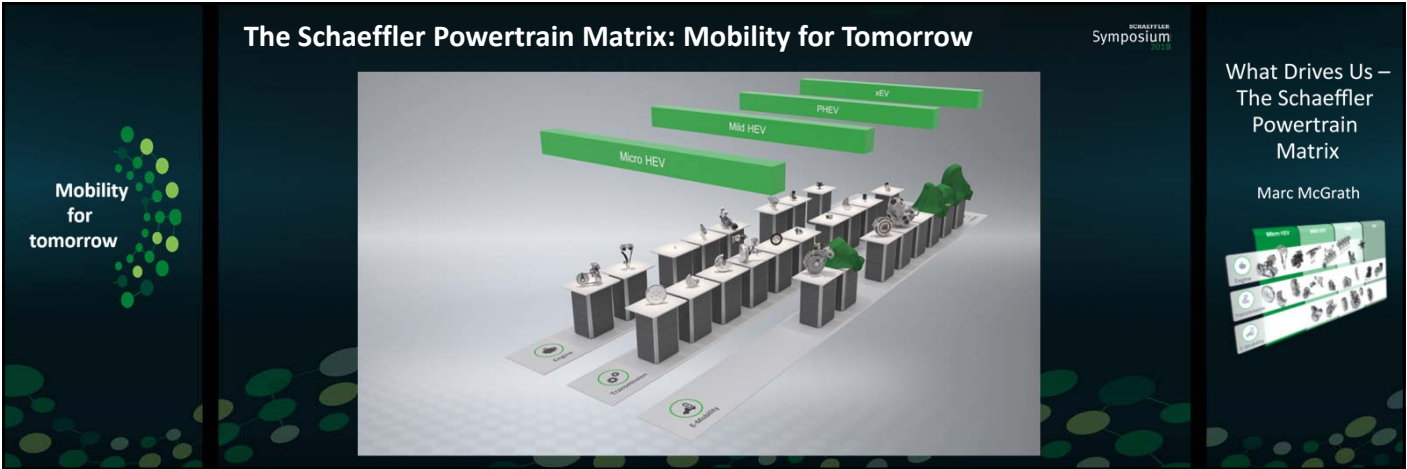
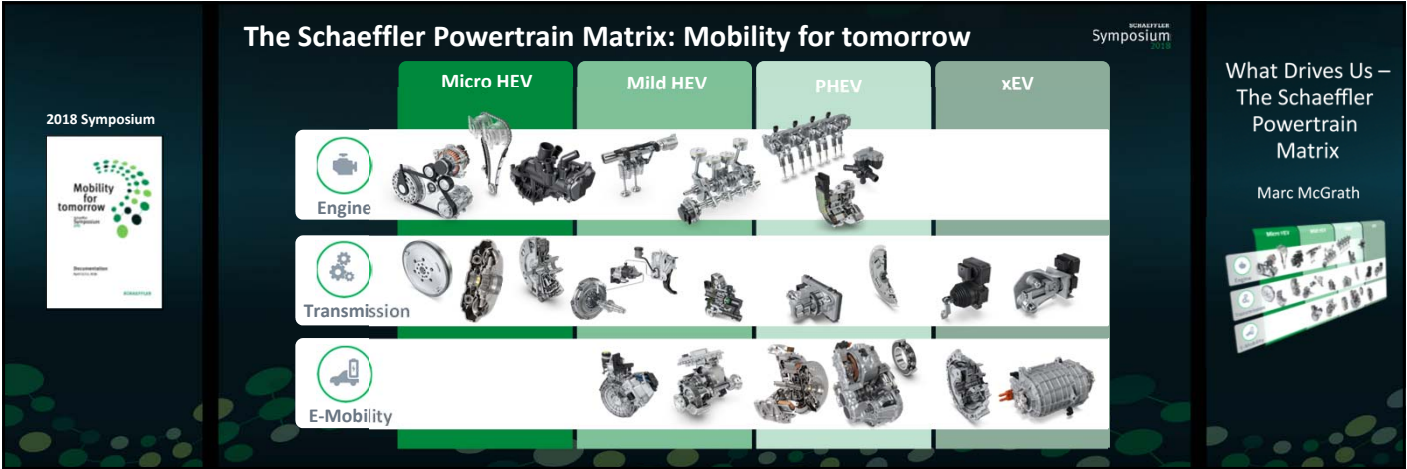
	Micro HEV	Mild HEV	PHEV	xEV
Engine				
Transmission				
E-Mobility				

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### Mobility for Tomorrow



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### Autonomous Driving

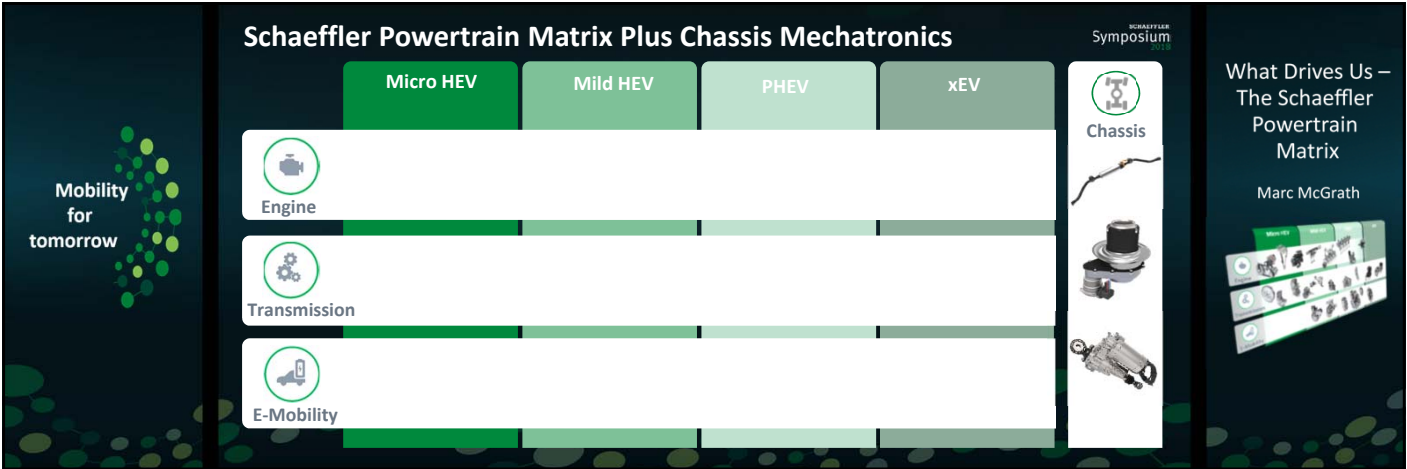
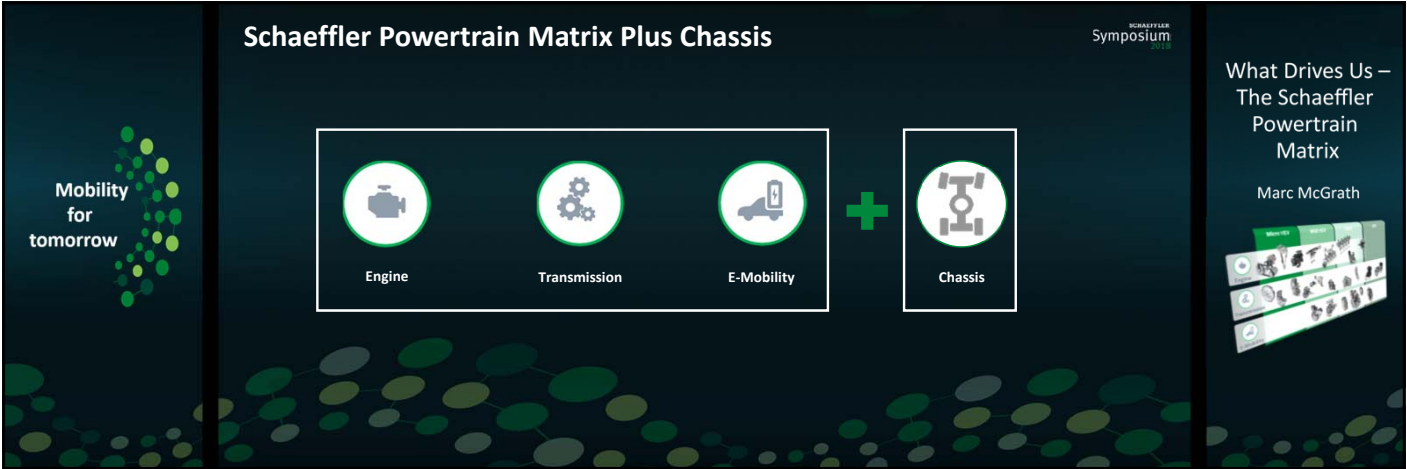


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
## 2018 Symposium: Mobility for tomorrow

Micro HEV
Mild HEV
PHEV
xEV


	Micro HEV	Mild HEV	PHEV	xEV
 <b>Engine</b>				
 <b>Transmission</b>				
 <b>E-Mobility</b>				

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
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Engine



Transmission





E-Mobility



Chassis


# Total Vehicle Optimization





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### Applying Schaeffler Tools



Engine

1


+



Transmission

1


+



E-Mobility

1

+



Chassis


1


=

?

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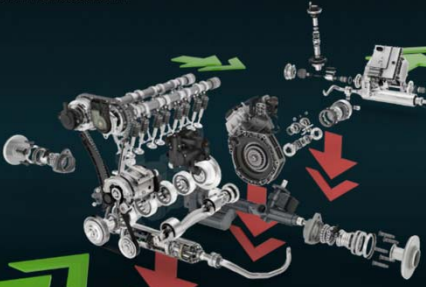


### Schaeffler Vehicle Simulation

NVH & acoustics




Torsional vibrations




Fuel efficiency

Virtual testing

Driving dynamics & comfort




Fleet simulation



Thermal management

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### Schaeffler Total Vehicle Optimization!

- ▶ RWD SUV - 4500 lbs
- ▶ Naturally-aspirated V6, 300 Nm, 240 hp
- ▶ 10-speed planetary automatic transmission

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### Car of Tomorrow

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