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Towards Sustainable Individual Mobility: Challenges and Solutions

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AGENDA

- The Challenge
- The Solutions for Emissions
- Potential Solutions for Gridlock
- Summary

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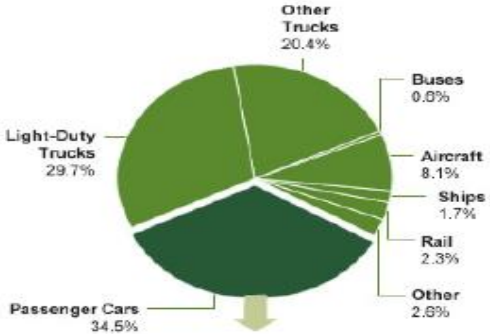
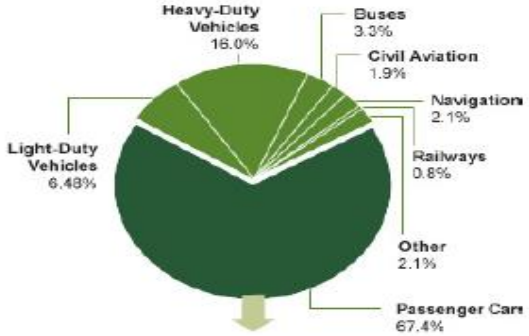
Challenge Global Warming

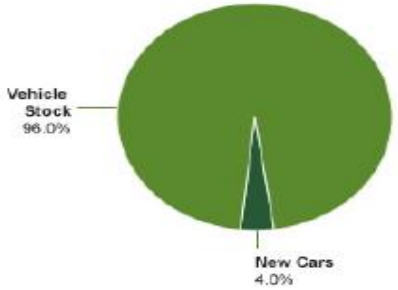
USA Transportation



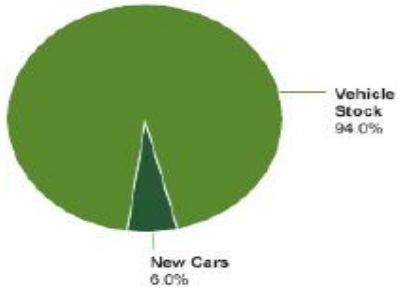
Europe (EU-27) Transportation



USA Passenger Cars



Europe (EU-27) Passenger Cars



Emissions (CO_2) is a key challenge – 20% from LDV and cars

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Global Population Increase

Population increase from current 7 billion to 9 billion by 2050

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1 Billion

Today

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Up to 2 Billion

by 2050

Need for Individual Mobility challenged by global gridlock

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Urbanization

Grid-lock will be worst in the 30+ Mega Cities; most in Asia

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Several Sustainability Challenges

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Main Challenges

Emissions & Gridlock

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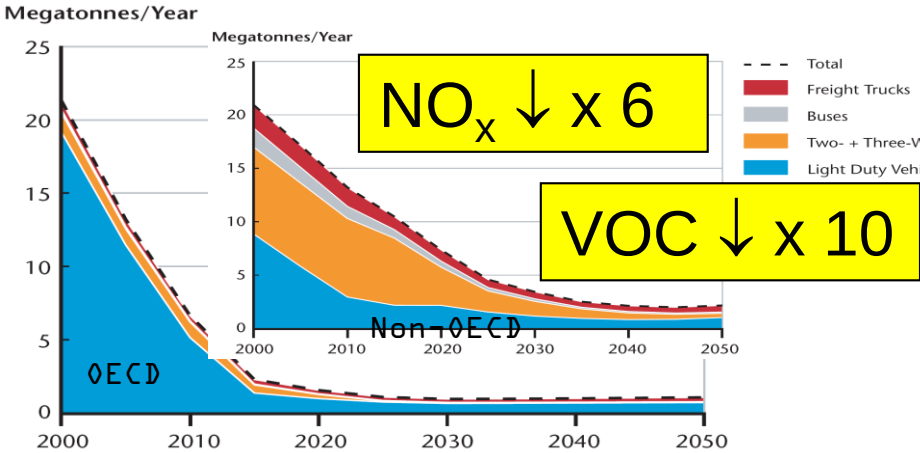
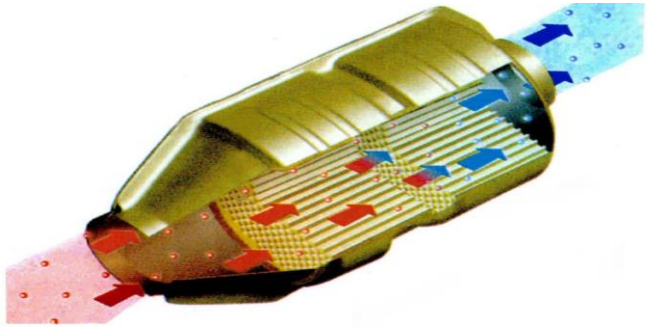
Main Solutions - Emissions





Traditional emissions decreased significantly
mainly by after-treatment technology – Fuel quality pre-condition

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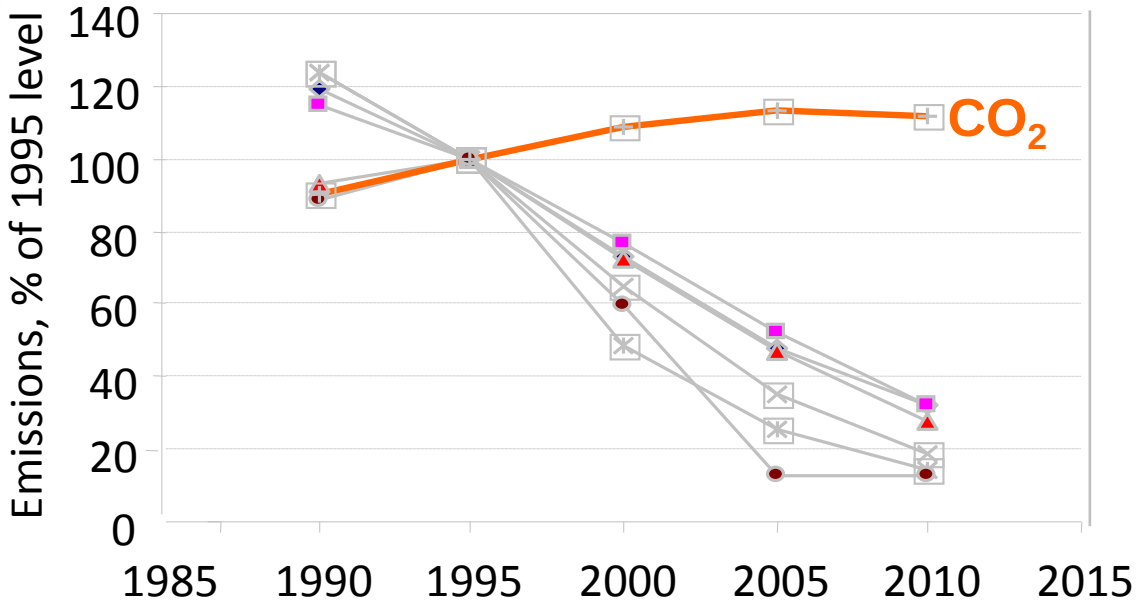
Emissions – all solved?



Source:

EC Auto-Oil-2 Program

CO2 remains the challenge

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Main Solutions – CO_2

Vehicles

Fuels&
Infrastructure

Driver

Integrated Approach

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Main Solutions – Low CO_2 Vehicles






Advanced Gasoline (EcoBoost) & Diesel (Econetic)

HEV

BEV

PHEV

AFV

FCEV

Model T "Tin-Lizzy"
> 350g CO_2/km Emissions
(ca. 25 l/100 km)

Portfolio Approach – Long Way But Big Progress

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Main Solutions – Low CO_2 Vehicles

Advanced Gasoline (EcoBoost) & Diesel (Econetic)

HEV

BEV

PHEV

AFV

FCEV

Ford Fiesta Econetic 87 g CO_2

Ford Focus Econetic 88 g CO_2

Ford Focus EcoBoost 99 g CO_2

Internal Combustion Drives Fleet to Low CO_2 Levels

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Main Solutions – Low CO_2 Vehicles

Advanced Gasoline (EcoBoost) & Diesel (Econetic) | HEV | **BEV** | PHEV | AFV | FCEV

Ford Focus Electric

1. Motor Controller and Inverter
2. High Voltage Electric HVAC Compressor
3. Electric Water Pump
4. Traction Motor
5. Electric Power Steering
6. Gearbox
7. Modular Powertrain Cradle
8. Electric Vacuum Pump
9. High Voltage PTC Electric Coolant Heater and Controller
10. Vehicle Control Unit
11. Battery Pack and Battery Cells
12. AC Charger
13. DC-DC Converter

* Image based on prototype, not production vehicle.

Integration in Renewable Grid

US

Electric Vehicles Available; Integration Is Key

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Ford' Electrification Strategy

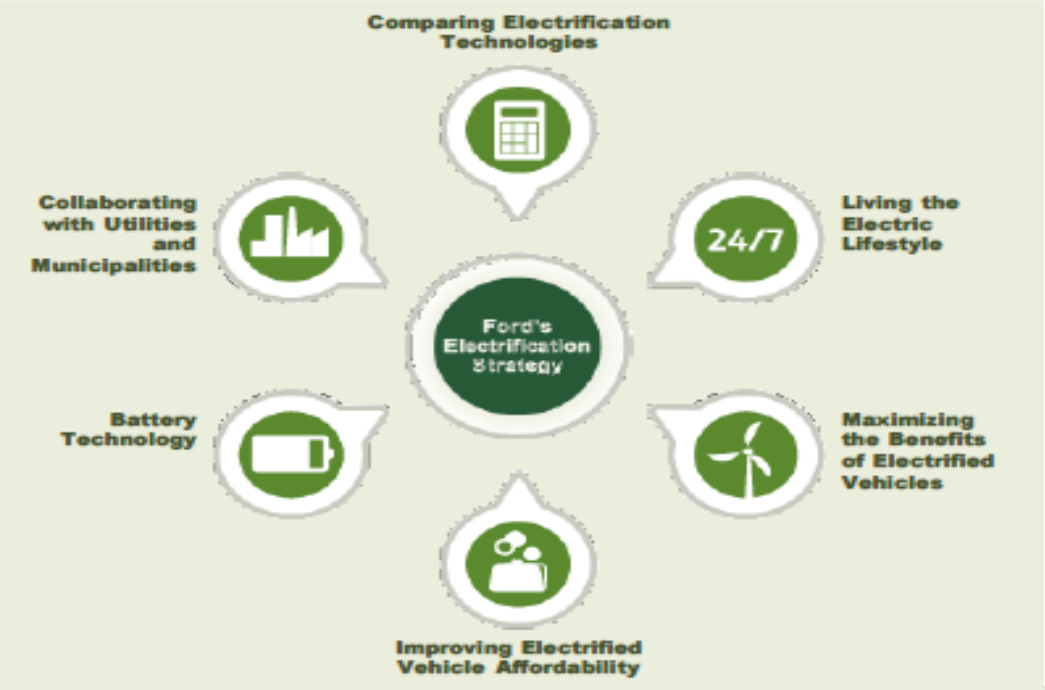
Power of Choice: Bringing a Range of Electrified Vehicles to Market

Using Global Platforms

Delivering a Total Electric Vehicle Lifestyle

Bringing EVs to Market Thoughtfully

Collaborating with Partners



EV Introduction Is Not Business As Usual

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Main Solutions – Low CO_2 Vehicles

Advanced Gasoline (EcoBoost) & Diesel (Econetic) | HEV | BEV | PHEV | AFV | FCEV

Indicator	Method	1.6l TDCi ECOnetic	1.0l EcoBoost Petrol	Focus Electric Germany	Focus Electric with recommended electricity
Life Cycle Global Warming	CO_2 and other climate change gases looking at all emissions from raw material extraction to material / part / vehicle production, driving period (150,000 km; incl. air conditioning) and final recycling / recovery (i.e. full vehicle life cycle, cradle-to-cradle)	23 tonnes CO_2	27 tonnes CO_2	33 tonnes CO_2	12 tonnes CO_2
Life Cycle Air Quality	Summers mog related emissions – cradle-to-cradle (see above)	21 kg Ethene	26 kg Ethene	8 kg Ethene	5 kg Ethene

Focus 2l Gasoline	Focus BEV CAL	Focus BEV MIN
37 tonnes CO_2	20 tonnes CO_2	42 tonnes CO_2

Holistic View - No Silver Bullet, Case-by-Case

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Main Solutions – Global Gridlock

Connected Vehicles

Smart Infrastructure

Driver/ Usage

Footprint

Logistical Concept/software

Business models

Need For Connected Network And New Partners

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Main Solutions – Global Gridlock short-term

Short-term expanded functionality of existing features

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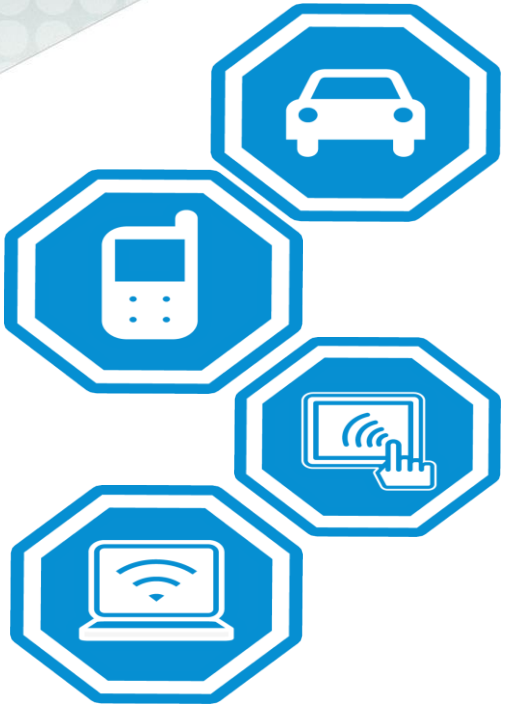
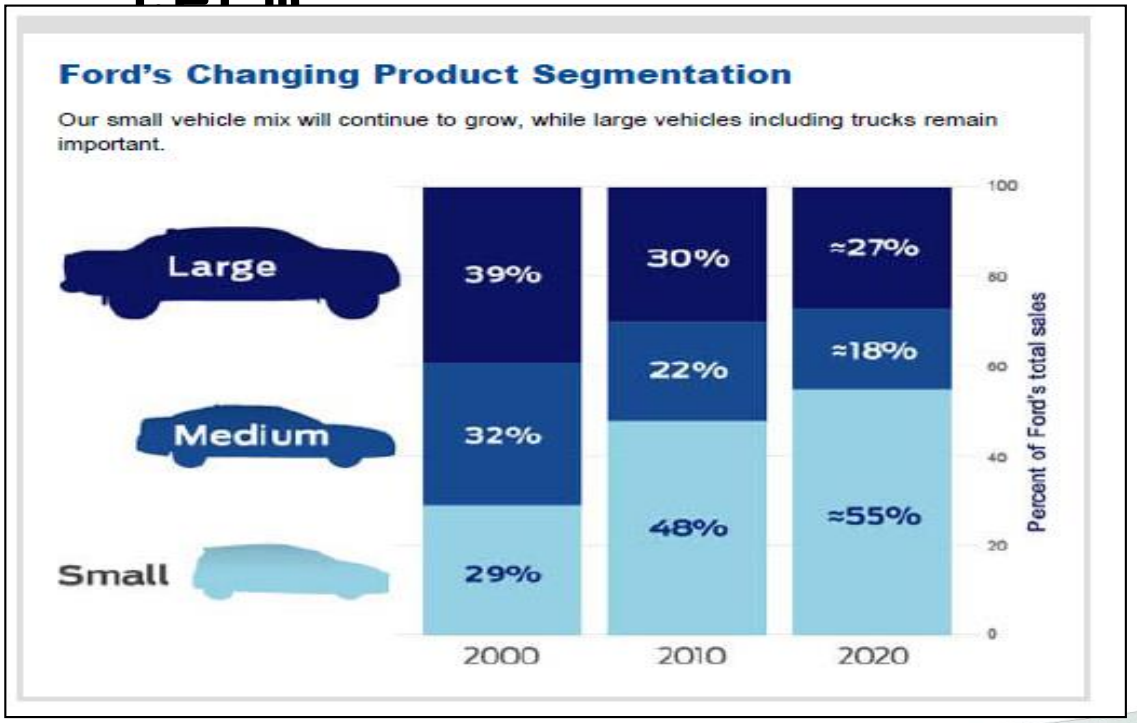
Main Solutions - Global Gridlock mid-term





Mid-term connected car

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Ford CARSHARING

IOS und Andriod APP

Maybe new business and usage models?

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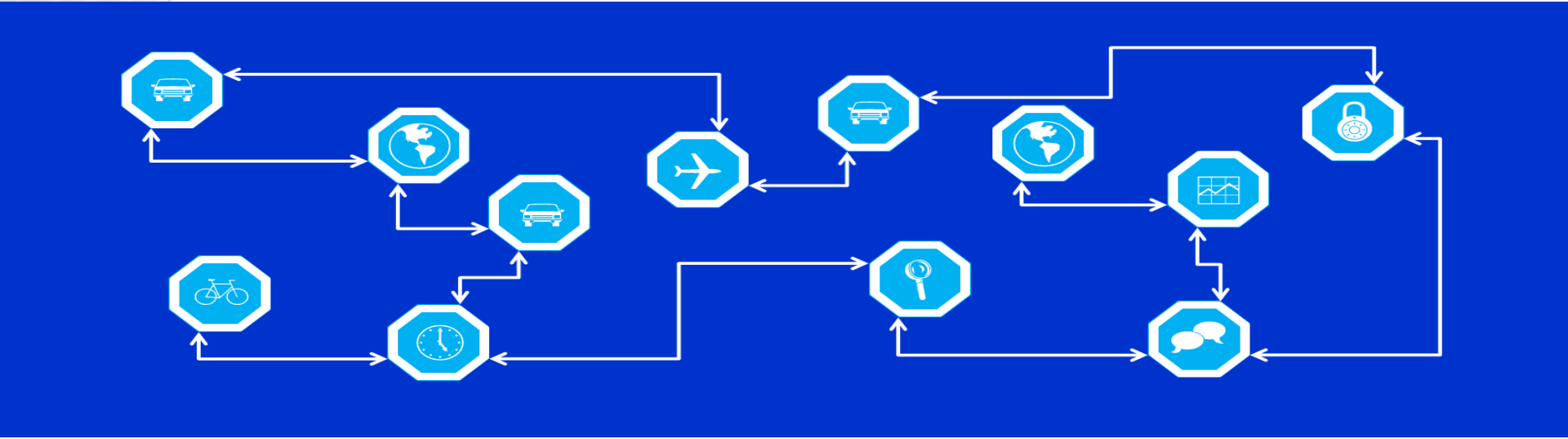
Main Solutions – Global Gridlock long-term



True Network Of Various Mobility Solutions Connected And Operating Together

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SUMMARY

Climate change, Air Pollution

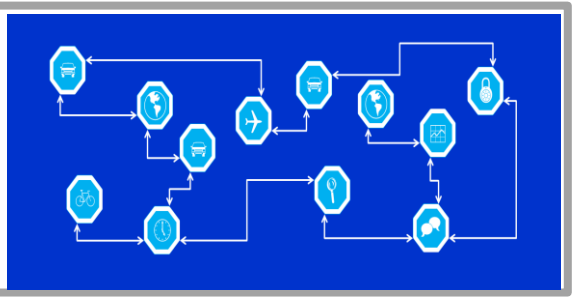
→ After-treatment technologies solved most emissions – requires also fuel quality

→ CO2 challenge only with broad portfolio and integrated approach

Global gridlock in Mega-Cities/-Regions

→ Also clean cars do not provide mobility anymore

→ Inter-modality, autonomous driving, new business models, connected networks + more



Major Sustainable Mobility Challenges Can Be Only Solved Together
Automotive Industry – Infrastructure – Driver – New Partners

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Back-up

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Customer Drivers of Powertrain Choice

In Europe, for regular vs. electrified vehicles if equally priced, the interest in electrification is 66%.

It drops steeply to 16% if there is a 4 year fuel economy payback period for the technology

Electrified Vehicles

Coming to Europe

FOCUS ELECTRIC

MONDEO HYBRID

C-MAX ENERGI

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Focus Electric

23 kWh liquid cooled Li-Ion battery

162 km range from a full charge
Top speed 137 km/h

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C-MAX Energi

2.0-liter Atkinson-cycle I4 engine

7.6 kWh Li-Ion battery

190 PS system power

Target data for Europe:
>40km electric range
<50 g/km CO_2

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Mondeo Hybrid

2.0-liter Atkinson-cycle I4 engine

190 PS system power

FE target for Europe:
<4.5 l/100km

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Fuel Cell Vehicles

MAIN TECHNICAL CHALLENGES

Durability
Cost reduction / commercialisation

CO-OPERATIONS

Automotive Fuel Cell Co-operation
Strategic Agreement with Daimler and Nissan

INFRASTRUCTURE AND FUEL CELL VEHICLES

Clean Energy Partnership Berlin Ford founding member in 2002

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