



STRETCHING THE HORIZON

SAE INTERNATIONAL IN A DISRUPTIVE FUTURE

THE WORLD'S MOBILITY ENGINEERS ARE RESPONSIBLE FOR AN AMAZING SUCCESS STORY

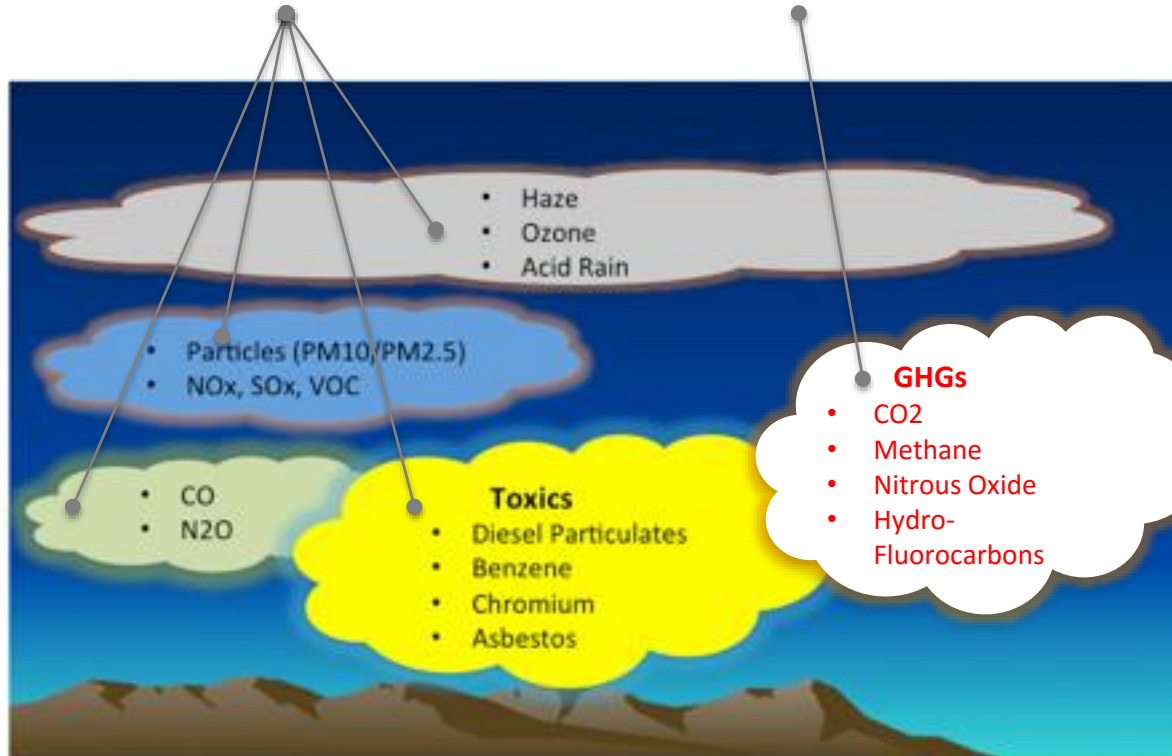
Year	1800	2000	Factor
Population (billion)	1	6	x6
GDP (trillion 1990 \$)	0.3	30	x100
Mobility (km/person/day)	0.04	40	x1000

Source: Nebojša Nakinehovic
International Institute for Applied Systems Analysis xx Technische Universität Wien

...BUT THERE WERE UNINTENDED CONSEQUENCES

Conventional Pollution

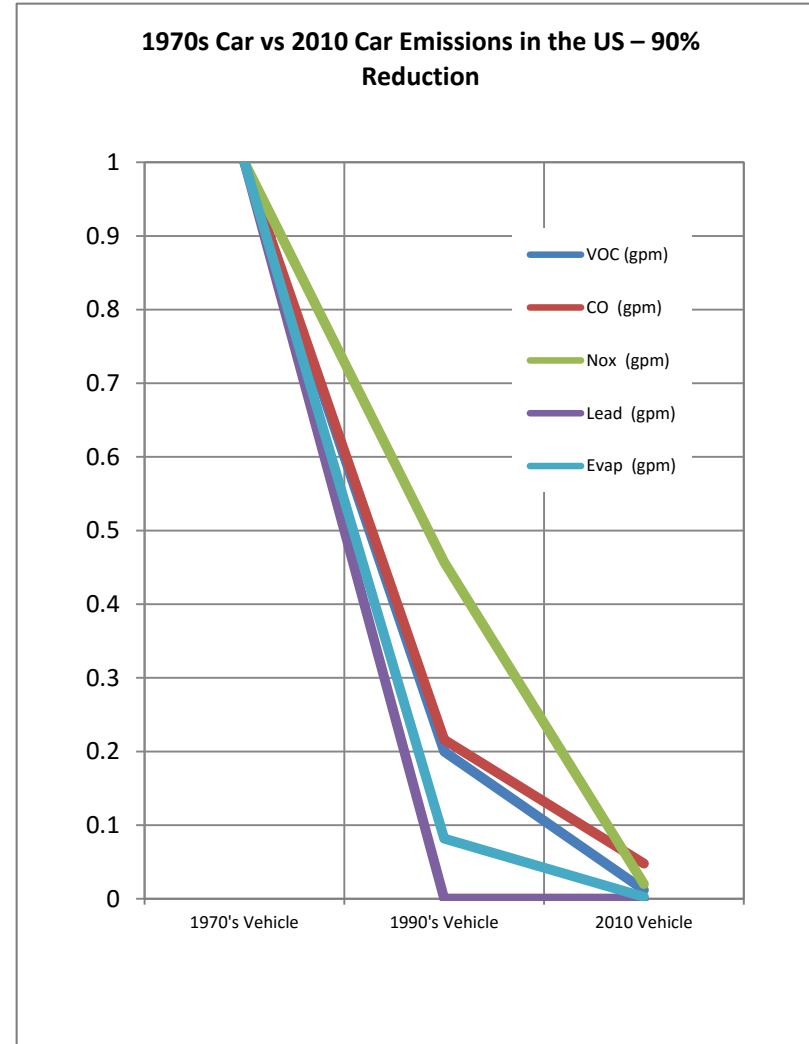
Greenhouse Gases



Traffic Congestion

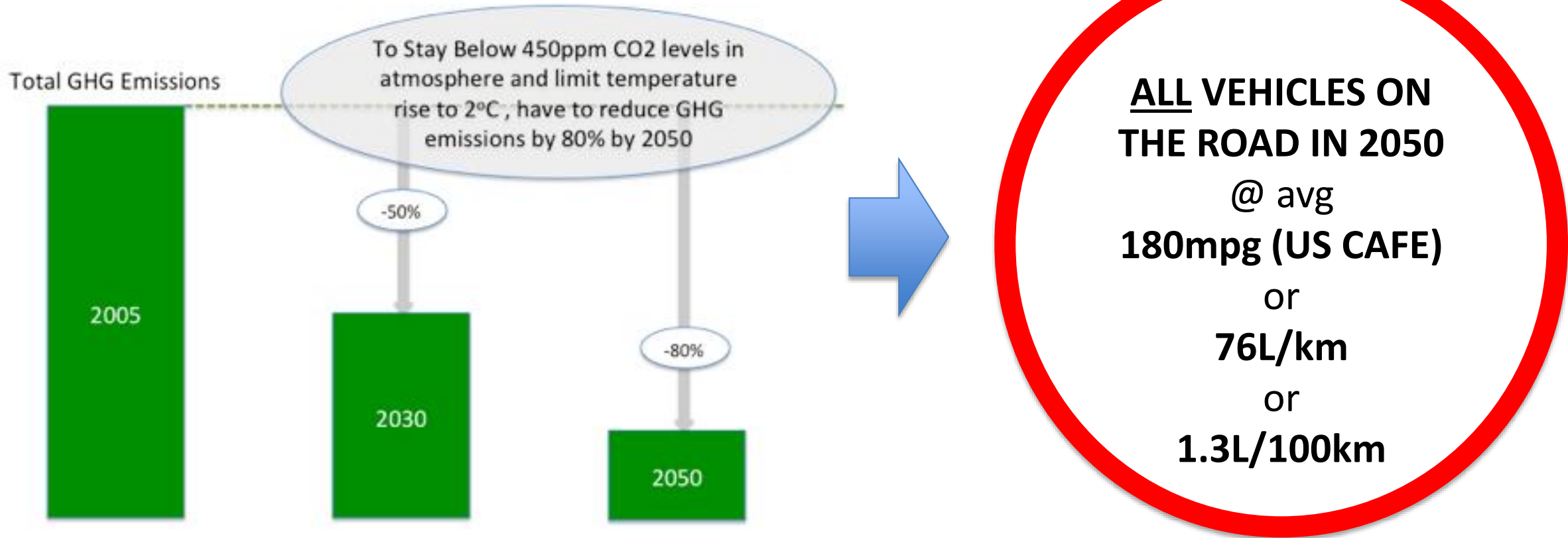


CONVENTIONAL POLLUTION STILL A PROBLEM...



...AND GHG EMISSIONS ARE A BIGGER PROBLEM

IPCC: “The Elephant in the Room”



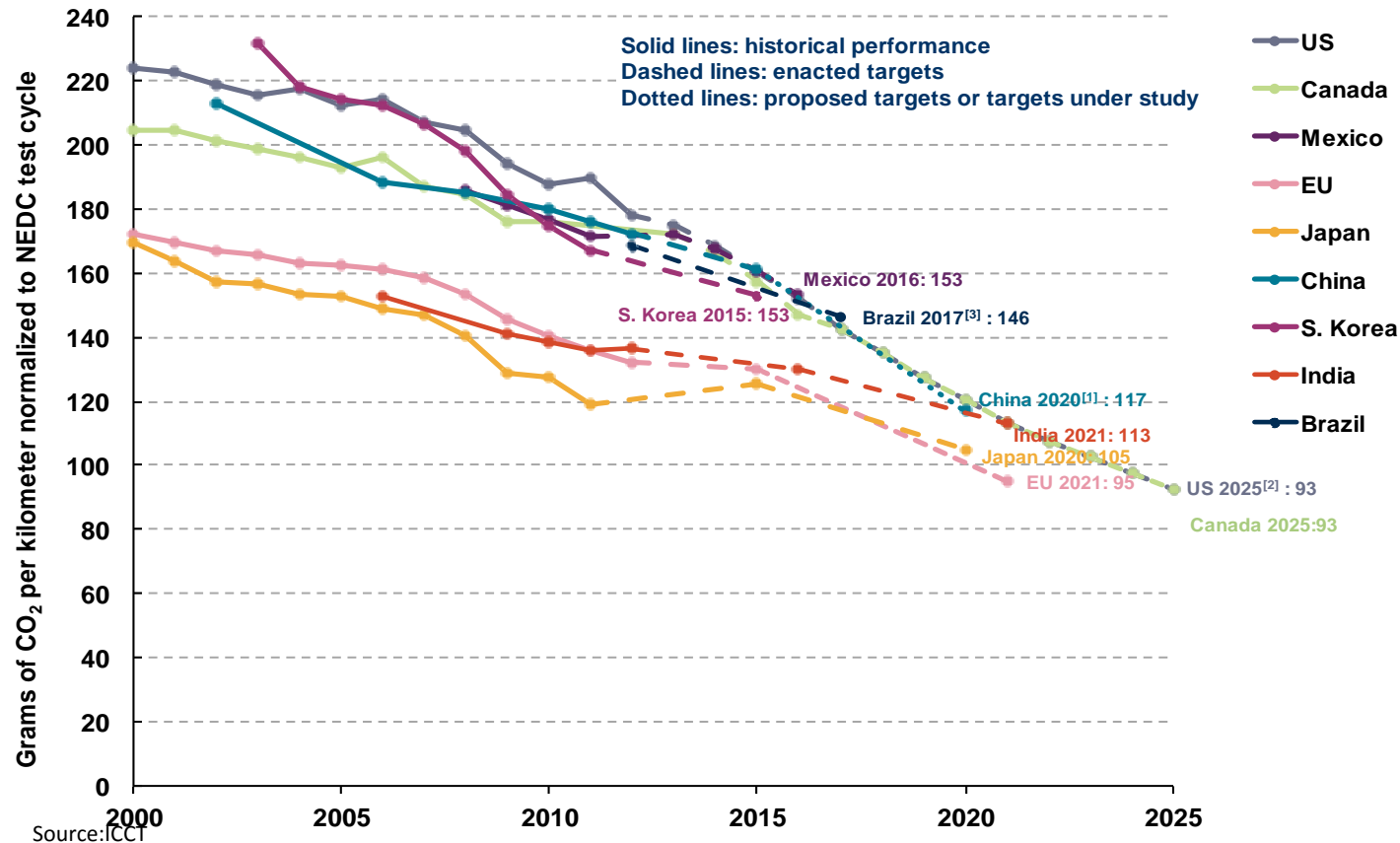
FACTORS DRIVING A REVOLUTION IN MOBILITY

1. **GLOBALIZING EMISSIONS STANDARDS** – Largest Markets – NA, Eur, China, Japan - Standards Converging by ~ 2020 -2025
2. **URBANIZATION & MEGA-CITIES** – By 2050 ~70% of the world's population in urban centers, up from 30% in 1950 → ~50 megacities worldwide (>10M people)
3. **CONNECTED LIVING AND WORKING** – Younger generation prefers being connected “virtually”... prefers not to own but use when needed...and vehicle miles traveled have been declining in the US ...while the “internet of things” wraps its hands around us

GLOBAL EMISSIONS STANDARDS ARE CONVERGING

But their trajectory will not take us to 180mpg by 2050

Passenger Cars

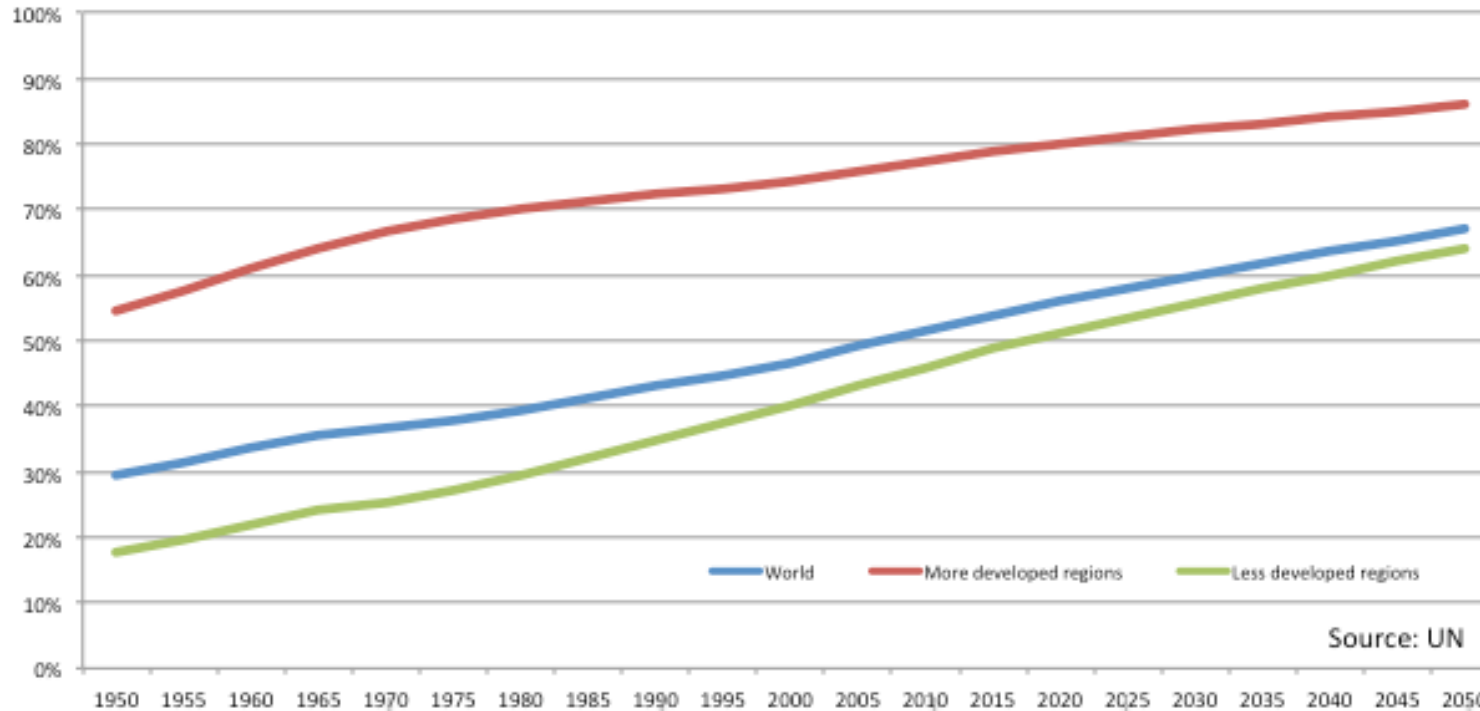


Extending the improvement curves at the same rate will not achieve the 80% reductions required by 2050

[1] China's target reflects gasoline vehicles only. The target may be higher after new energy vehicles are considered. !
[2] US standards GHG standards set by EPA, which is slightly different from fuel economy standards due to low-GWP refrigerant credits. !
[3] Gasoline in Brazil contains 22% of ethanol (E22), all data in the chart have been converted to gasoline (E00) equivalent !
[4] Supporting data can be found at: <http://www.theicct.org/info-tools/global-passenger-vehicle-standards> !

THE FUTURE: URBANIZATION, MEGA & SUPER-CITIES

Growth of World Population Living in Urban Areas



of Megacities (>10M)

2

10

23

37

~ 50 ?

"70% of World's GHG Emissions but only 2% of its Landmass"

The New York Times

July 19, 2015

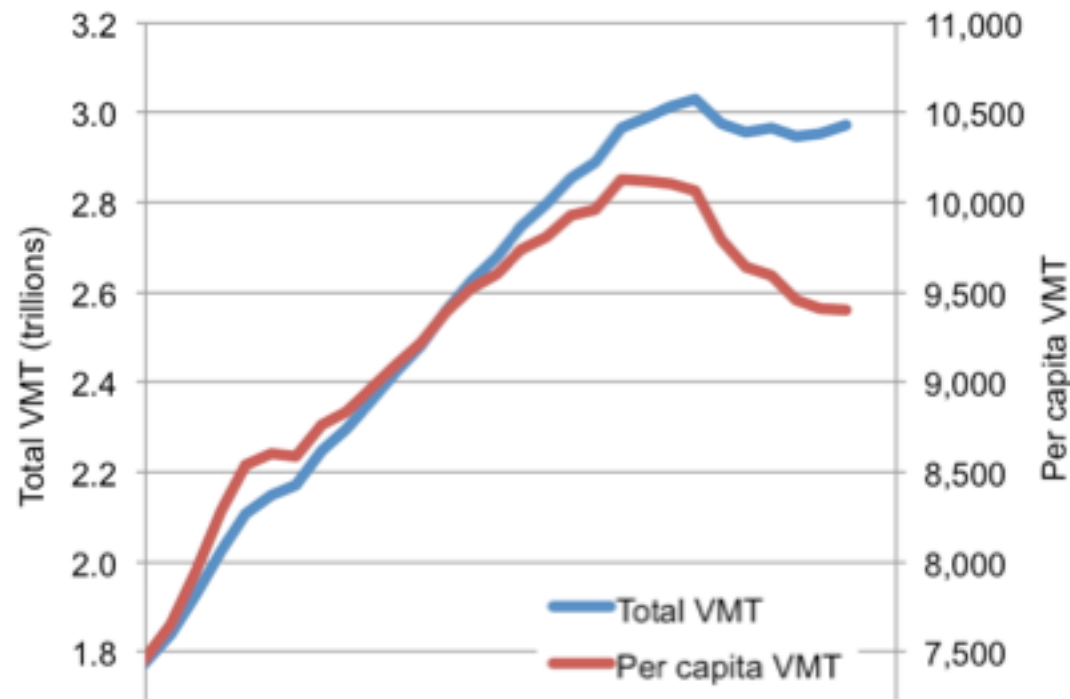
...China's government ...has embarked on an ambitious plan to make Beijing the center of a new **supercity of 130M** to be called **Jing-Jin-Ji**.

“CONNECTING/SOCIALIZING” W/O DRIVING

- More teens and 20 something olds are delaying obtaining a license, and often not bothering to get one at all. As late as the 90s, 87% of 19 year olds had a drivers license, today it is down to less than 70 percent.

Total Vehicle Miles and Per Capita Miles Traveled in the US

Source: FHWA and Census Bureau



- Cities encouraging biking, car sharing, walking to reduce emissions, congestion
- Some studies predict the size of the vehicle fleets in developing countries could decrease, while continuing to increase in the developing world

2050: WITHIN THE CAREER OF A 25 YR. OLD ENGINEER...



How We **POWER**,
How We **DRIVE**
And
How We **OWN** Our Vehicles
Are Changing...



HOW We Fly,
WHERE We Fly
And
WHY We Fly
Are Changing

IMAGINING AUTOMOBILITY & AEROMOBILITY 2050

9B Population

2-3 B
Parc

50+
Megacities
&
Supercities

Climate @
450ppm/
2°C

Driverless
Cars &
Trucks

Low
Carbon
Fuels

New Space
Business
Platforms/
Technologies

"AUTOMOBILITY" ECOSYSTEM - TODAY



"AEROMOBILITY" ECOSYSTEM - TODAY



NO LONGER HYPE ...THE INDUSTRY IS ACTING

*"We're at an inflection point here as an industry"
... "We're trying to disrupt ourselves rather than be
disrupted."*

Mark Fields, CEO Ford Motor Co., WSJ 11/19/2015

*"The auto industry will change more in the next 5 to 10
years than it has in the last 50"*

*Mary Barra, Chairman & CEO, General Motors , CES
1/8/2015*

*"We have spent a long time to develop the
[autonomous driving] technology. We have advantages
and we want to maintain them as we push forward"*

*Moritaka Yoshida, Toyota Chief Safety Executive
10/2015*



**"Google Pairs With Ford To Build Self-Driving
Cars"**

Justin Hyde, Sharon Carty, Yahoo Autos, 12/21/2015



**"General Motors, Gazing at Future, Invests \$500
Million in Lyft"**

Mike Isaac, NYT, 1/4/2016

**"GM Buying Self-Driving Tech Startup for More
Than \$1 Billion"**

Dan Primack, Kirsten Korosec, Fortune, 3/11/2016



**"Toyota Hires Entire Staff of Autonomous-Vehicle
Firm"**

Mark Ramsey, WSJ, 3/19/2016

SAE INTERNATIONAL HAS TO
“STRETCH ITS HORIZONS”
TO MAKE AUTO & AEROMOBILITY 2050
OPERATIONAL
&
REMAIN RELEVANT!

