

Engineers for the vehicles of tomorrow



Jeff Lowinger

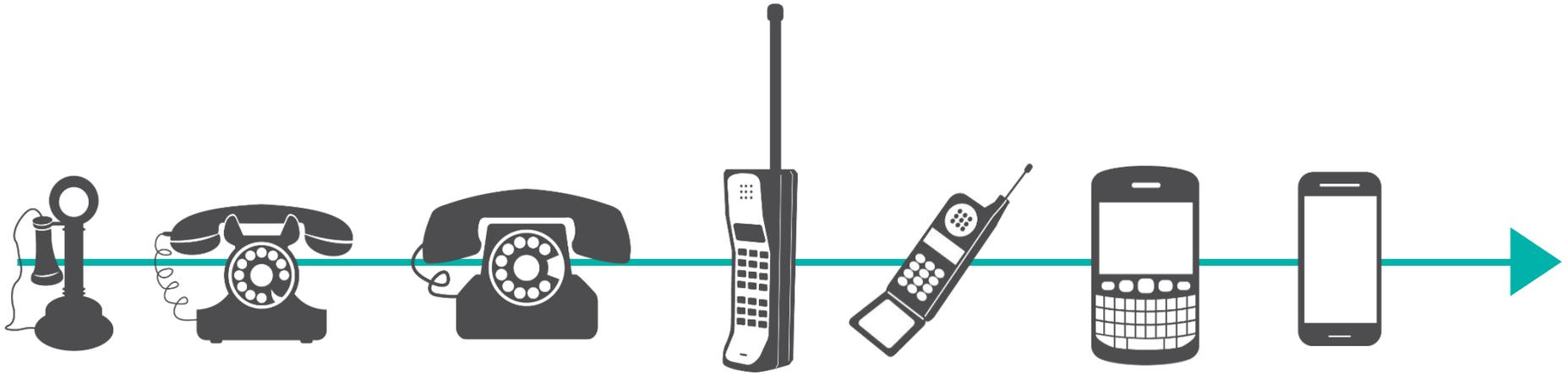
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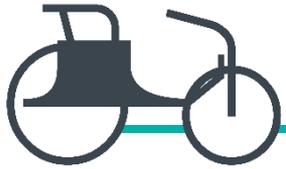
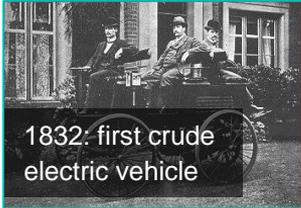
Powering Business Worldwide

Advancements in
technology impact our
daily lives.

Consider the **telephone**...



Vehicle technology is no different...





What drives this rapid transformation?

Megatrends are driving critical societal needs – creating opportunities for ingenuity.



Clean

Increasingly stringent regulations driving continued need for emissions reduction solutions (increased power density, electrification and advanced materials).



Intelligent

Increasing availability of data and processing power provide an opportunity for intelligent solutions.



Mobility

Urbanization, autonomous vehicles, ride-sharing and load-sharing services are evolving transportation business models to meet user expectations.

Regulations driving reductions in our carbon footprint.

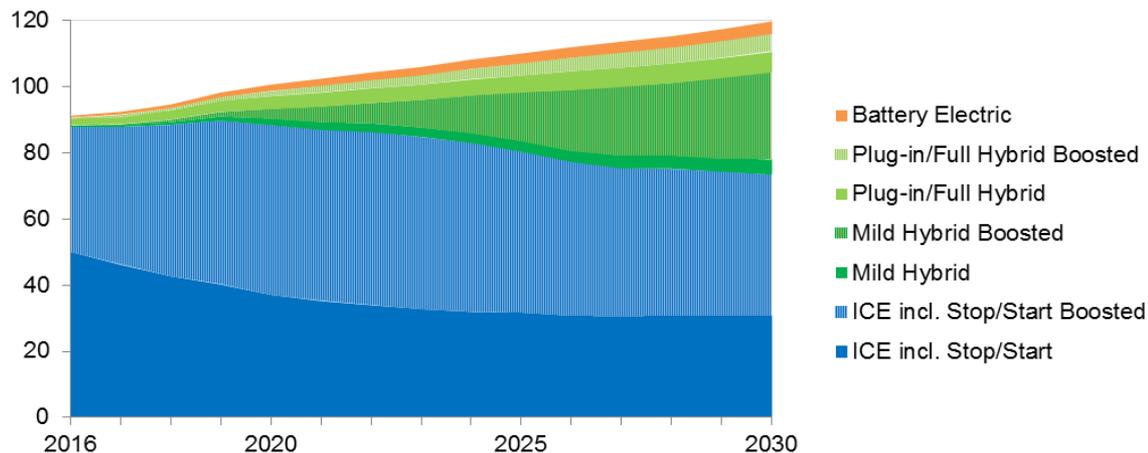
Clean

Intelligent

Mobility

Global Vehicle Production by Type of Powertrain (Millions)

Vehicle market growing at 2% Compound Annual Growth Rate (CAGR), **xEVs at 21% CAGR**



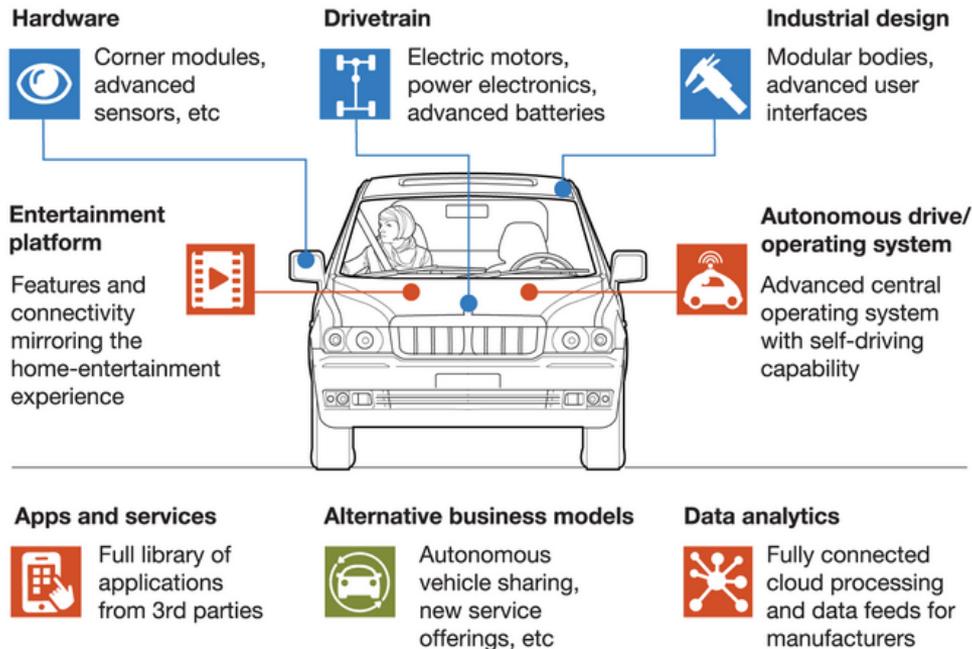
- BEVs grow at 15% CAGR
- HEVs grow at 12% CAGR
- Mild HEVs grow at 35%
- Boosting continues to grow, driving continued growth in hollow valves

Future is intelligent systems and an interconnected world.

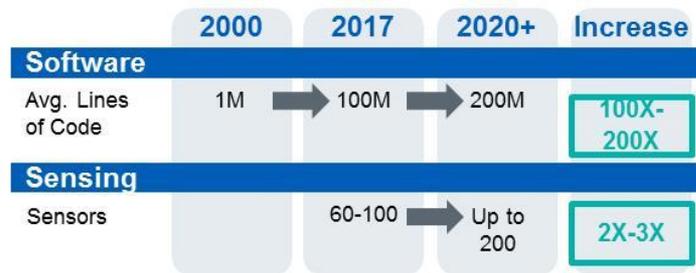
Clean

Intelligent

Mobility



- Vehicle hardware
- Vehicle software
- Alternative business models



Source: McKinsey

Transportation is transforming.

Clean

Intelligent

Mobility

Fractional
Ownership



Audi on demand

fair

Shared Services

UBER



M^AVEN

Logistics



Autonomous



Google

The rate of change is
accelerating.

Technology adoption rates are accelerating.



68 Years



62 years



50 years



46 years



22 years



18 years



12 years



7 years



4 years



3 years



2 years

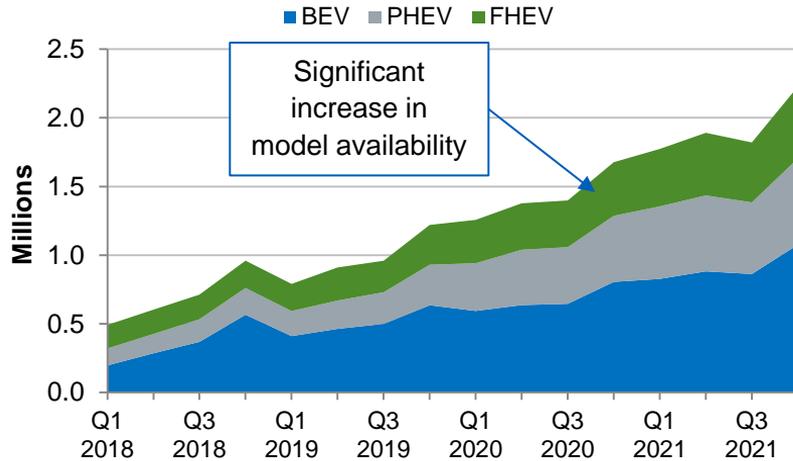


19 Days

Time to reach 50M users

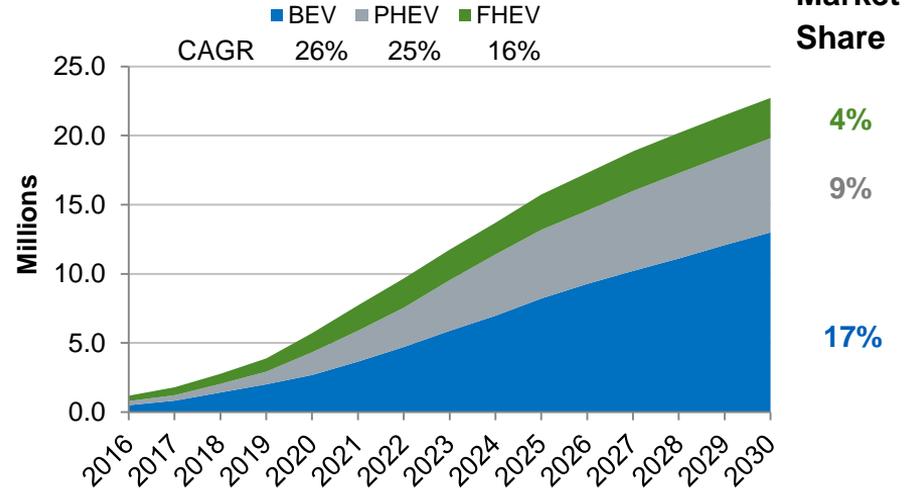
Changes in vehicles are accelerating.

Short-Term Quarterly Volumes



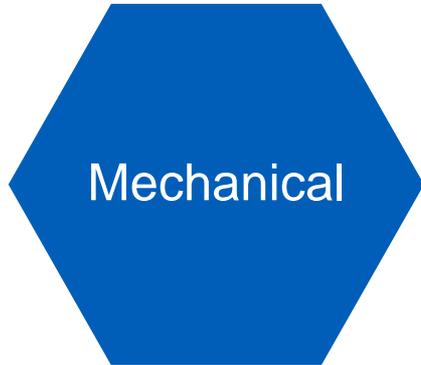
- **Full Hybrid Electric Vehicles (FHEV)** expected to out perform **Plug-in Hybrid Electric Vehicles (PHEV)** through 2018
- **Battery Electric Vehicles (BEV)** continues to outpace P/HEVs

Long-Term Yearly Volumes

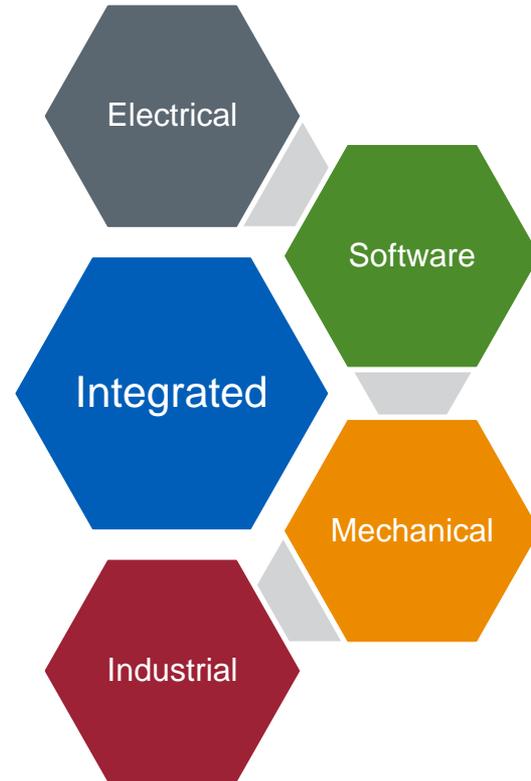


- BEV and PHEV grow at 26% and 25% CAGR respectively, with major growth beginning H2 2019
- FHEV flat beginning in the same period- H2 2019
- The outlook for BEV market share is increased as compared to last quarter

The complexity of problems is accelerating.



VS.



Changes in **engineering** are accelerating.



Everything is *electromechanical*.

Changes in **education** *need to accelerate.*

		1970	2016
Freshman	Int. Chem for Engrs	✓	✓
	Eng'g Orientation Lec	✓	✓
	Eng'g Graphics A&B	✓	✓
	Intro to Unifd Calc	✓	✓
	Anal Phys. I	✓	✓
Eng'g Mechanics	✓	✓	
Sophomore	Unified Calculus	✓	✓
	Engineering Mechanics	✓	✓
	Analytical Physics II	✓	✓
	Basic Computer Programming	✓	✓
Junior	Advanced calculus	✓	✓
	Cont. Mechanics I&II	✓	✓
	Thermodynamics I&II	✓	✓
	Eng'g Statistics	✓	✓
	Cont. Mechanics II	✓	✓
	Machine Anal I	✓	✓
Senior	Electrical systems	✓	✓
	Mach. Anal II	✓	✓
	MAE Exper I&II	✓	✓
	Heat Transfer	✓	✓
	Systems engineering	✓	✓
	Combustion	✓	✓

Accelerate **technology** – or someone else will.



In 2000, Blockbuster had option to buy Netflix for \$50M

In 2010, Blockbuster filed for bankruptcy

In 2019, Netflix is worth \$150+ Billion (more than Disney or Comcast)

Engineers and technicians
are **integral** in the evolution
of vehicles.

To accelerate the pace of innovation, we need 3 things:



Engineers with a **diverse knowledge base**

Progressive college curriculum

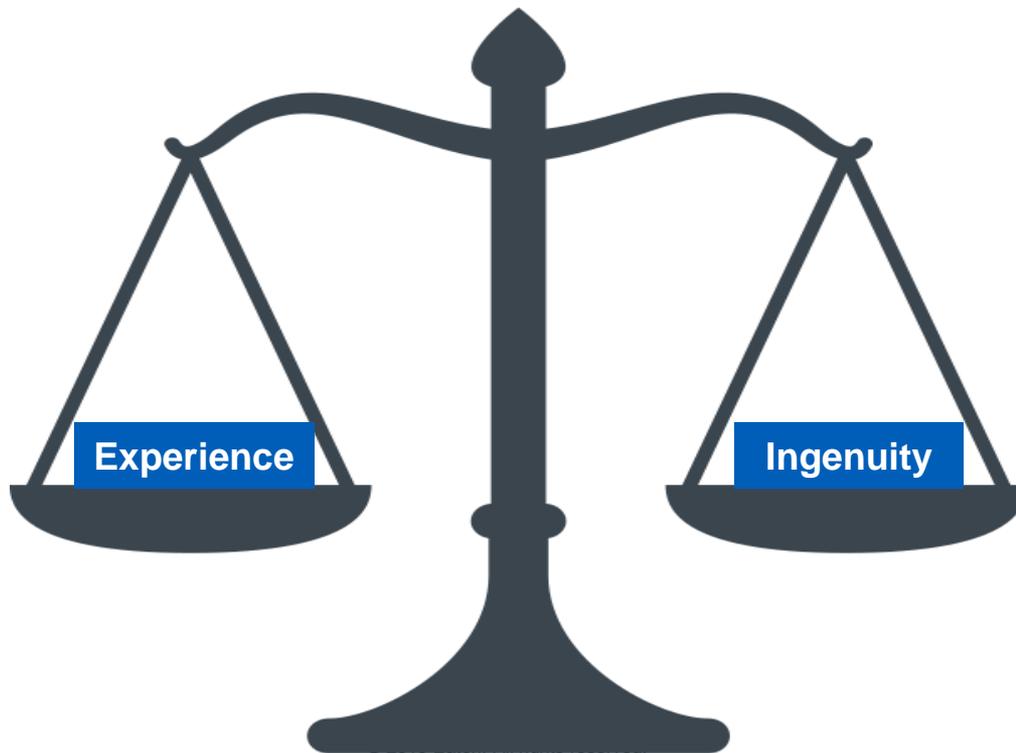
Companies to provide an environment
where **innovation can flourish**

Siloed engineering pillars are not what the world needs.

Diverse knowledge base

Progressive college curriculum

Companies fostering innovation



Improve preparation for the workforce.

Diverse knowledge base

Progressive college curriculum

Companies fostering innovation



Evolve training programs with more focus on industrial needs



Global knowledge and integration



Broader understanding to ask the right questions

Companies have a role to play as well.

Diverse knowledge base

Progressive college curriculum

Companies fostering innovation

- Create cultures that **value and fund innovation**
- Allow engineering teams time and resources to **fail and innovate**
- Nurture **creativity**
- Allow engineers to **experience other functions** early in their career



Tomorrow's vehicles will
come from more than
just technical skills.

Passion required to get and stay ahead.

Learning, agility and speed lead to success

- Seek out learning to keep pace with advancements
- Be an active part of the conversation
- Don't be afraid to fail – technology is moving quickly, keep up, adapt
- Don't assume it won't work today because it didn't yesterday



“One person with passion is better than 40 people merely interested.”
E.M. Forster



Opportunities to unleash the possibilities.

High school drop-outs

Richard Branson
Andrew Carnegie
Frank Lloyd Wright
Frederick Henry Royce
George Eastman
Isaac Merrit Singer
John D. Rockefeller Sr.
Simon Cowell
Wolfgang Puck
Walt Disney
Thomas Edison

College drop-outs

Abraham Lincoln
Steve Jobs
Ralph Lauren
Michael Dell
Sean John Combs
Bill Gates
Coco Chanel
Larry Ellison
Henry Ford
Benjamin Franklin
Mark Zuckerberg

We need the **engineer of tomorrow** today.

- Our educational institutions need to evolve to meet the world's changing needs and accelerate the pace of innovation
- We also need to evolve -- constantly learning and developing
- Our workplaces need to evolve to nurture this new reality

If you are sitting back waiting, you've lost a day where we could have **solved an important problem.**



The time is **now.**

EATON

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