

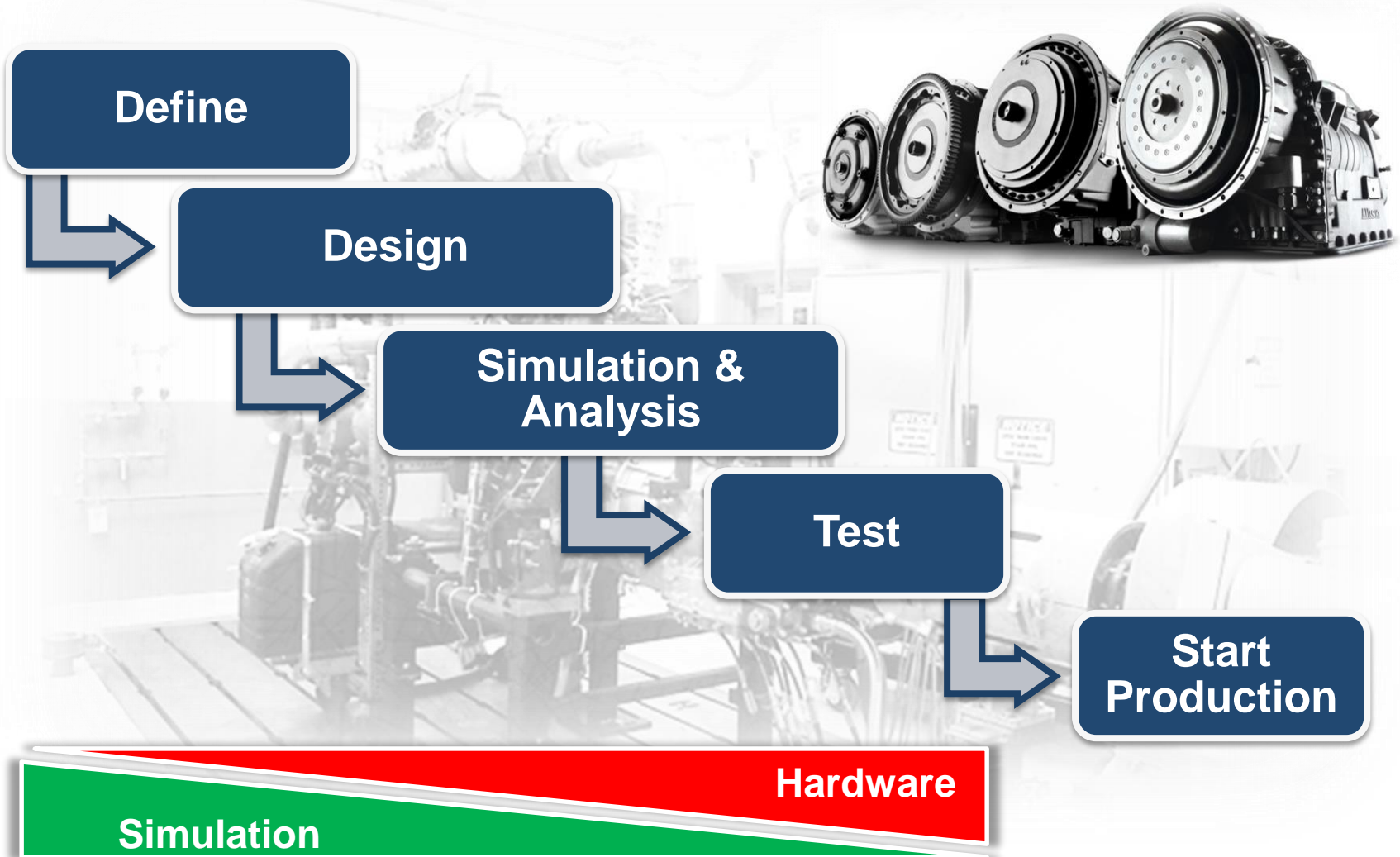


Product Development & Pollution Prevention

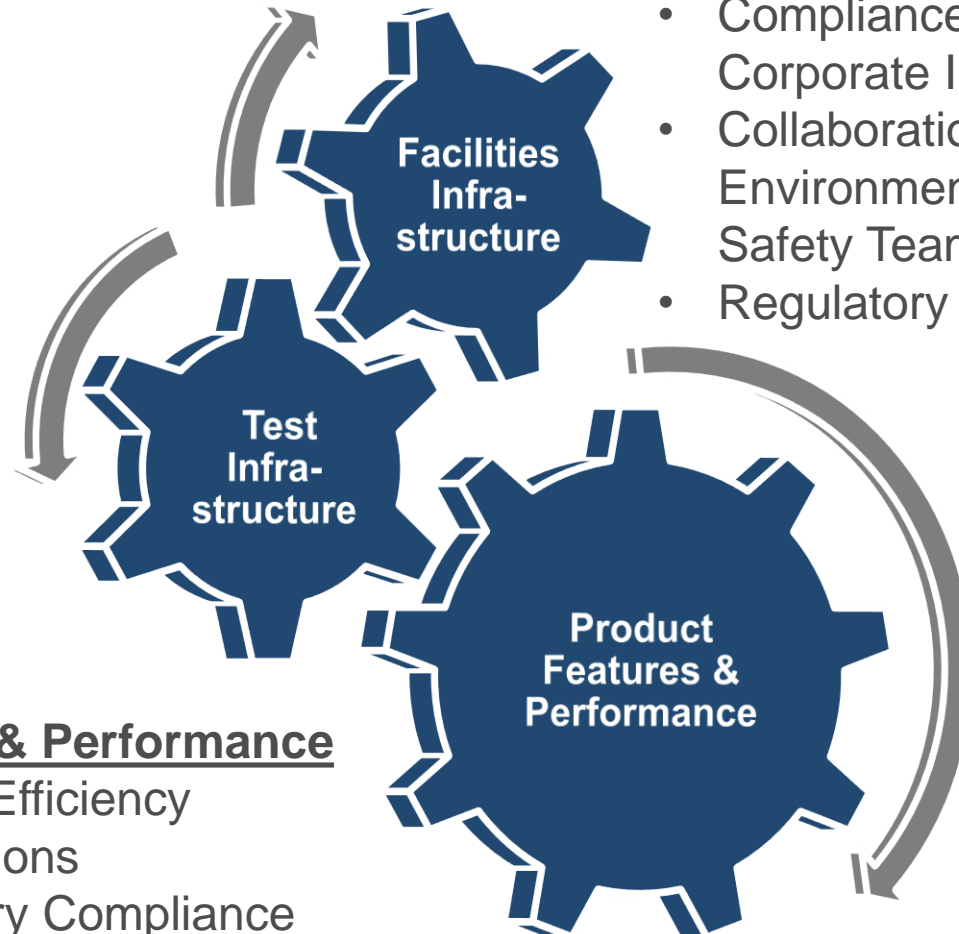
Jeanne Rues
Managing Director,
Engineering Services



Product Development Process



Product Development P2 Landscape



Facilities Infrastructure

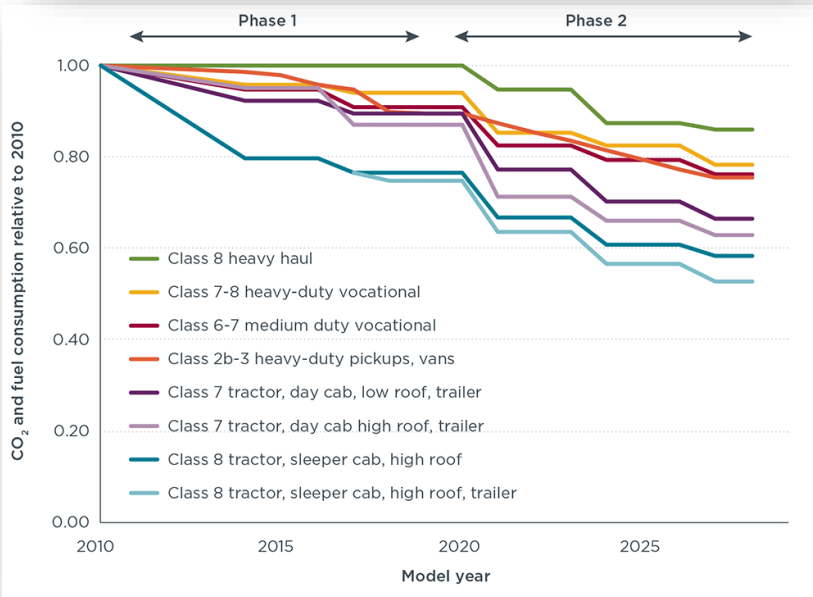
- Compliance with Allison Corporate Initiatives
- Collaboration with Environmental and Health & Safety Teams
- Regulatory Compliance

Product Features & Performance

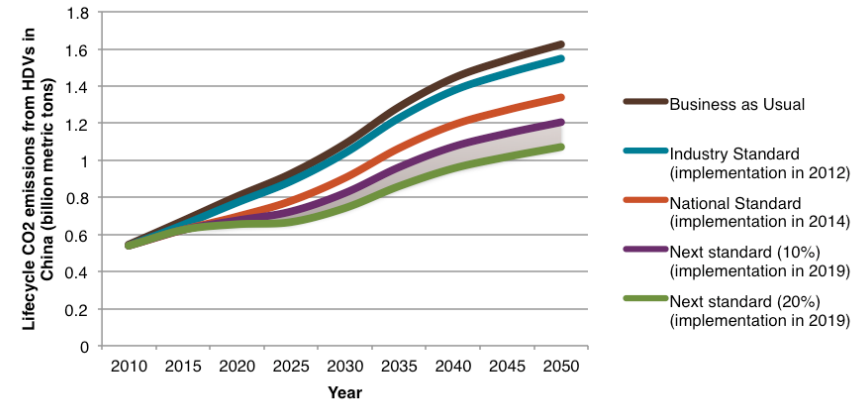
- Increasing Fuel Efficiency
- Reducing Emissions
- Global Regulatory Compliance

Increasing Global Stringency

Fuel Consumption & Emissions



<http://www.theicct.org/US-phase2-HDV-efficiency-GHG-regulations-FRM>



<http://www.theicct.org/news/chinas-commitment-improving-heavy-duty-vehicle-efficiency-press-statement>

U.S. Federal Phase 2 GHG

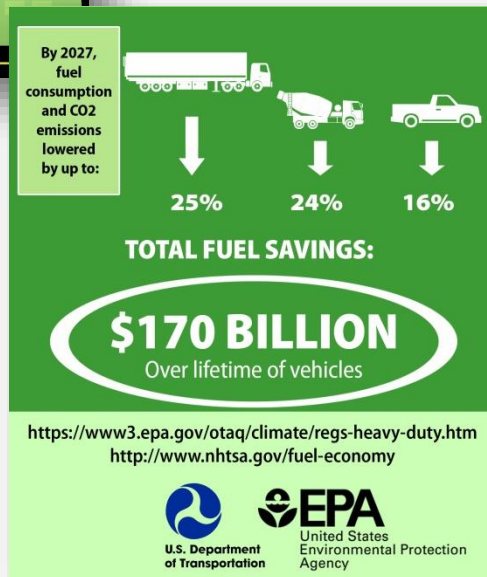

Phase 2 Greenhouse Gas and Fuel Economy Standards for Heavy-Duty Trucks will CUT CARBON POLLUTION & IMPROVE FUEL EFFICIENCY

Addressing GHG Emissions from Medium- and Heavy-Duty Vehicles is Critical

Medium and heavy-duty vehicles = 20% of GHG emissions from transportation sector, but make up just 10% of vehicles on the road.

GHG emissions from heavy-duty vehicles are growing rapidly and will surpass cars by 2030.

Trucks haul 70% of freight in US.



Vocational:

- Bus
- Emergency
- Motorhome
- Pupil/Shuttle
- Rugged Duty
- Highway
- Hybrid Bus™

Tractor/Trailer:

- Tractor
- Highway



Allison Product Technology



Increased # of Ranges
(TC10 Shown)



Hybrid & ZEV
(H40/50 Shown)



Optimized Gear Ratios
xFE Technology
(3000 Series Shown)

FUELSENSE

FUELSENSE 2.0

Neutral at Stop

Eco-Cal

Dynamic Shift
Sensing

Dynactive

Acceleration Rate
Management

Advanced Shifting Technology

Product Development P2 Landscape

Test Infrastructure

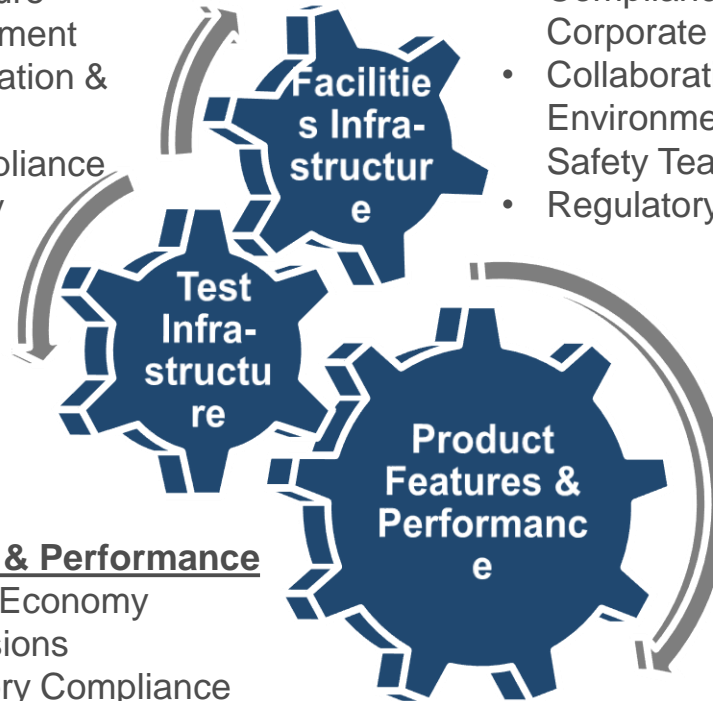
- Evolution for Future Product Development
- Increasing Simulation & Analytics
- Regulatory Compliance
- Reducing Facility Emissions

Facilities Infrastructure

- Compliance with Allison Corporate Initiatives
- Collaboration with Environmental and Health & Safety Teams
- Regulatory Compliance

Product Features & Performance

- Increasing Fuel Economy
- Reducing Emissions
- Global Regulatory Compliance



Test Capability

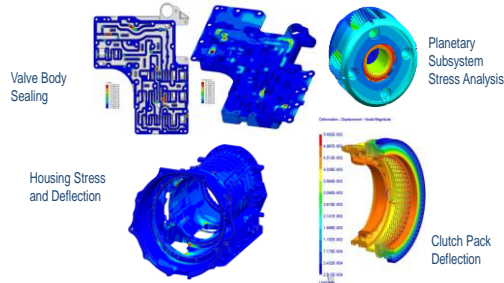
- Floor Space >15,000 m² (>160,000 ft²)
- Test Cells
 - 30 Engine Powered, including Class I and hybrid ; 300 – 2,000 hp
 - 14 Electric Dynamometer 50 – 4,000 hp (75Nm – 19,100 Nm)
 - AC simulation dynes 600 – 1,200 hp (2,300 Nm – 18,500 Nm)
 - EC Absorption Systems 600 – 1,600 hp (2,600 Nm – 27,000 Nm)
 - 40 Component Test Stands
- Powertrain and Vehicle Environmental Chambers
- Sound Lab
- Pitch and Roll Tilt
- Dynamics Test Lab
- Hybrid Test Lab
 - Electronic Control Unit Diagnostic Lab
 - Pack and Module Energy Storage System Labs
 - Power Electronic, Electric Machine and DC Power Labs
 - 2 Multi-Environment Over-Stress Test Chambers
- 2 Vehicle Garages; 7 bays
- 2 Test Tracks
- 54 Vehicle Test Fleet
- 2 Proving Grounds Facilities



Transmission Simulation & Analysis

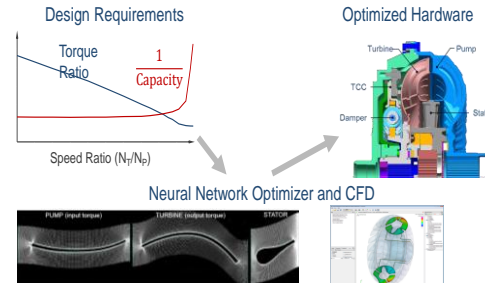
FEA (Finite Element Analysis)

Examples: Stress, Deflection and Valve Body Sealing



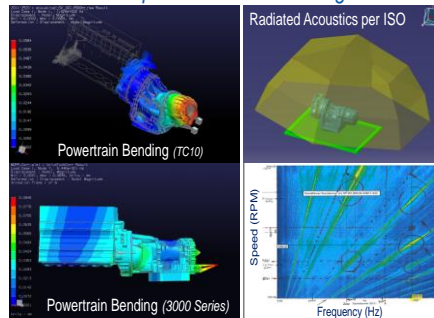
CFD (Computational Fluid Dynamics)

Example: Torque Converter Design



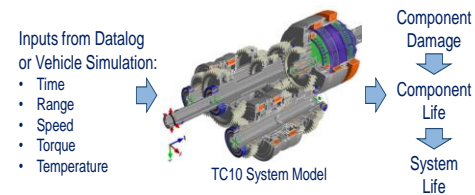
NVH (Noise, Vibration, Harshness)

Example: Powertrain Bending



Durability

Example: Gear and Bearing



Class 1 Test Cells

State-of-art high pressure nitrogen fire protection

Lifesafety and spill
monitoring

Pollution Prevention

Interstitial leak detection

Diesel Particulate
Filter

Leak
containment

Double wall
fuel piping

Selective Catalyst
Reduction

Automatic fuel
shutoff



Combustion air
conditioning

Emissions Test Capability

Exhaust pressure
control

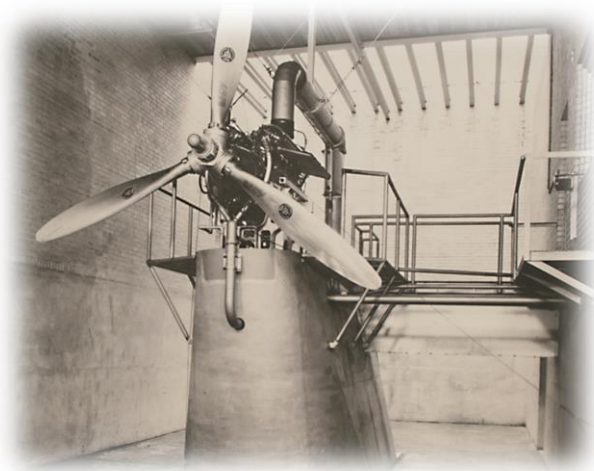
Test fuel control/conditioning

Road load simulation dynamometers

Summary



- Product Development
 - complex and demanding
 - P2 Practices are interwoven within products and infrastructure
- Allison is rapidly evolving to meet the challenges and needs of the future



Thank You