STRATEGIES FOR IMPROVING OFF-ROAD VECHILE FUEL ECONOMY USING ELECTRIC DRIVES

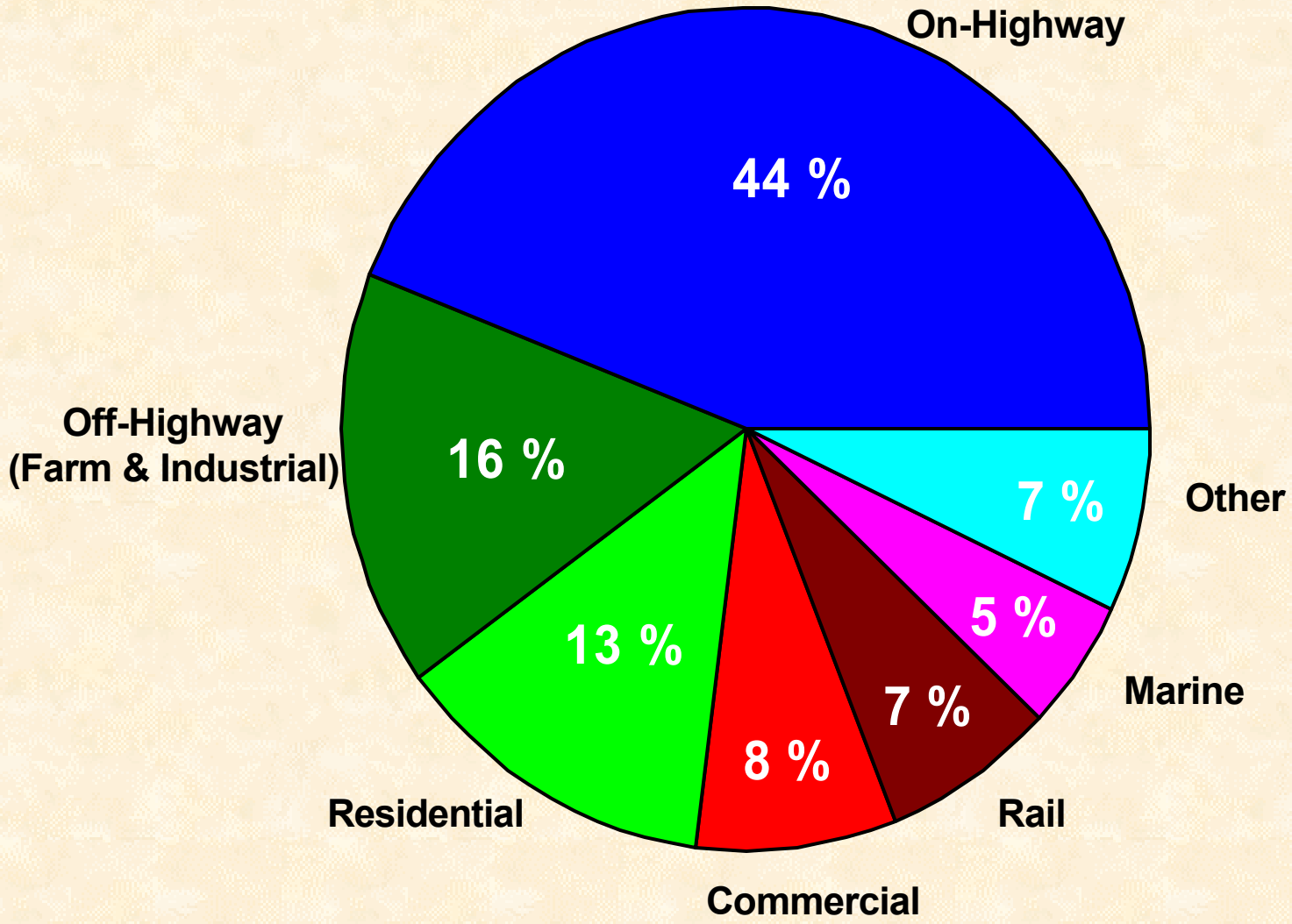
Carl T. Vuk

John Deere Power Systems

Waterloo, IA

JOHN DEERE

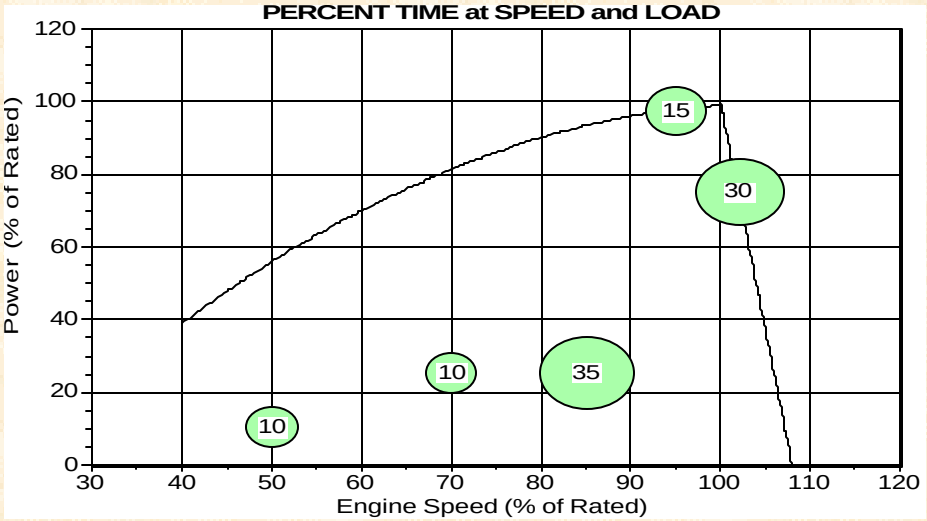
US FUEL OIL USAGE



JOHN DEERE

LOAD FACTORS

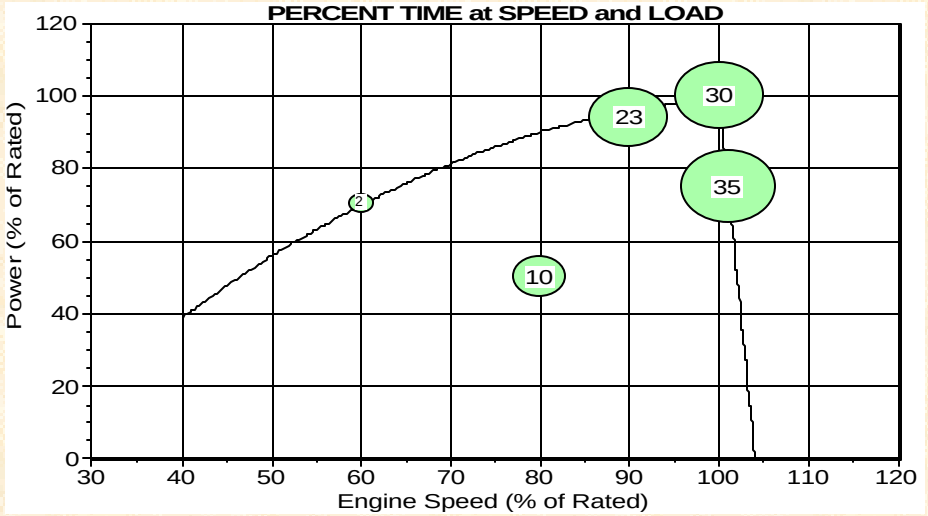
7200-7600 Ag Tractors



Power Based Load Factor

50%

8300-8400 Ag Tractors



Power Based Load Factor

90%

OPPORTUNITIES FOR IMPROVING FUEL ECONOMY

- Vehicles with significant operation at light load conditions will benefit mainly from reductions in auxiliary loads.

  Water Pump

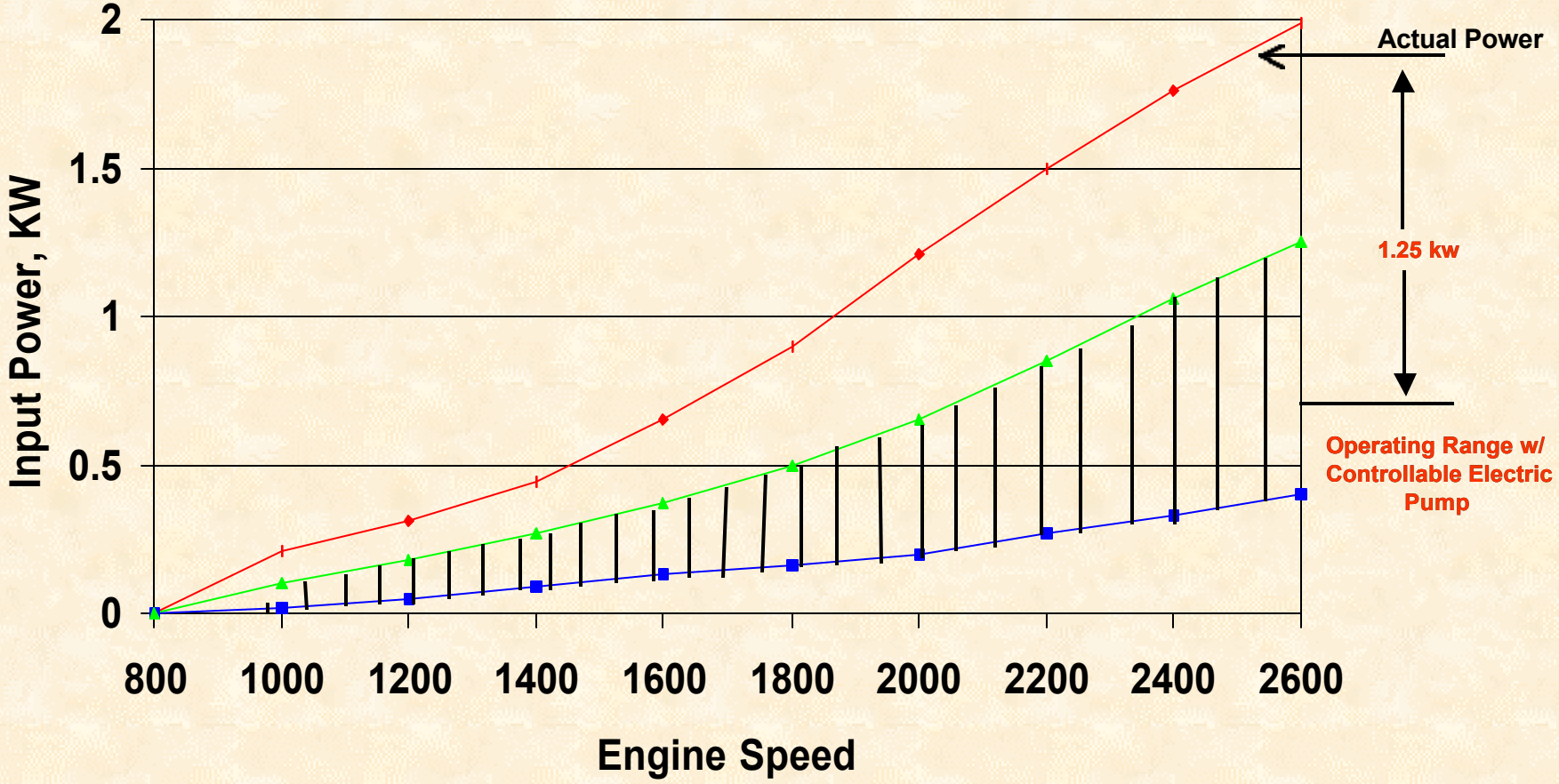
  Oil Pump

  Fan

  Accessories

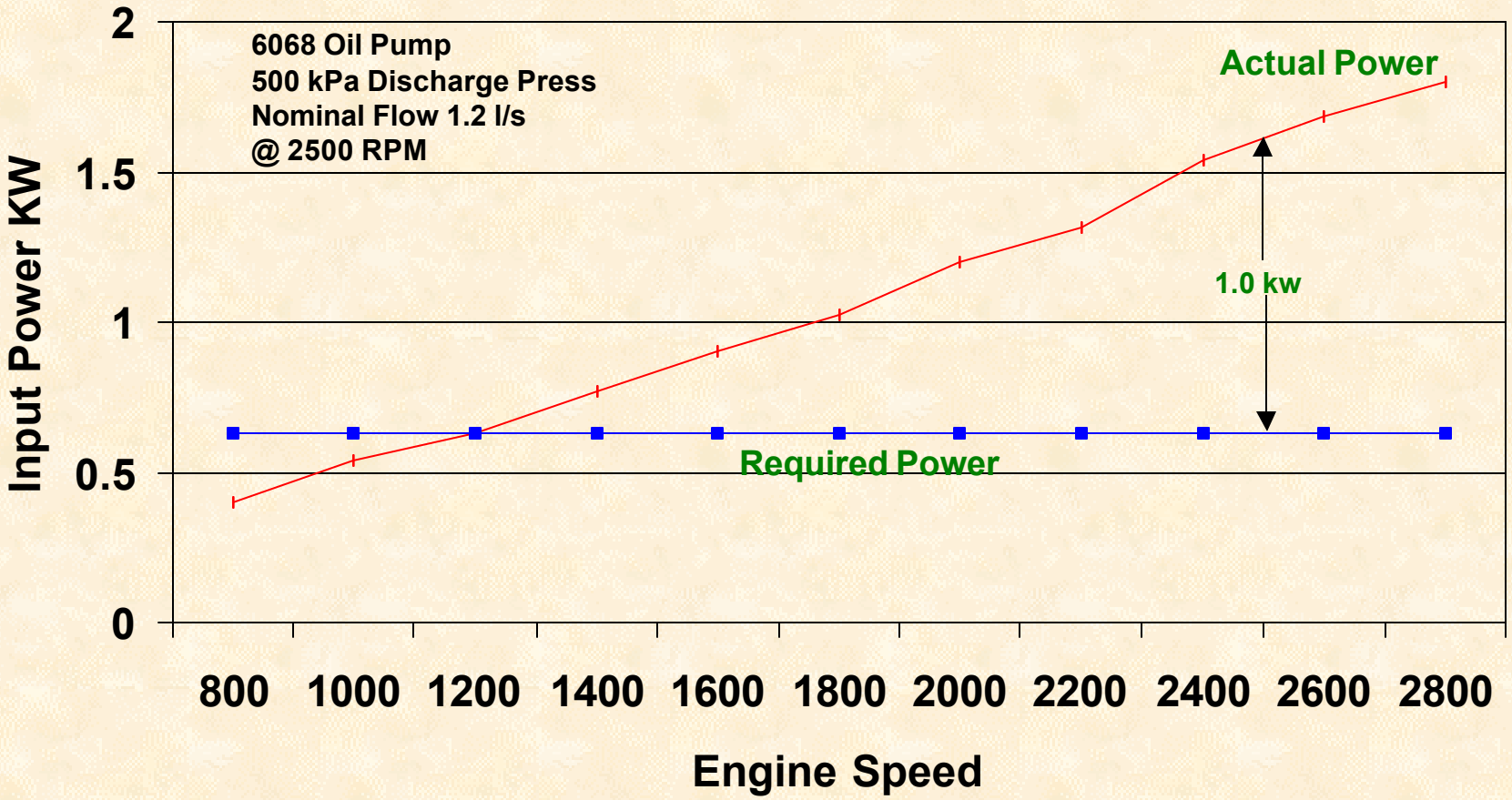
- Vehicles with high loads will respond well to Turbo Generation and Electric Propulsion systems.

WATER PUMP POWER REQUIREMENT



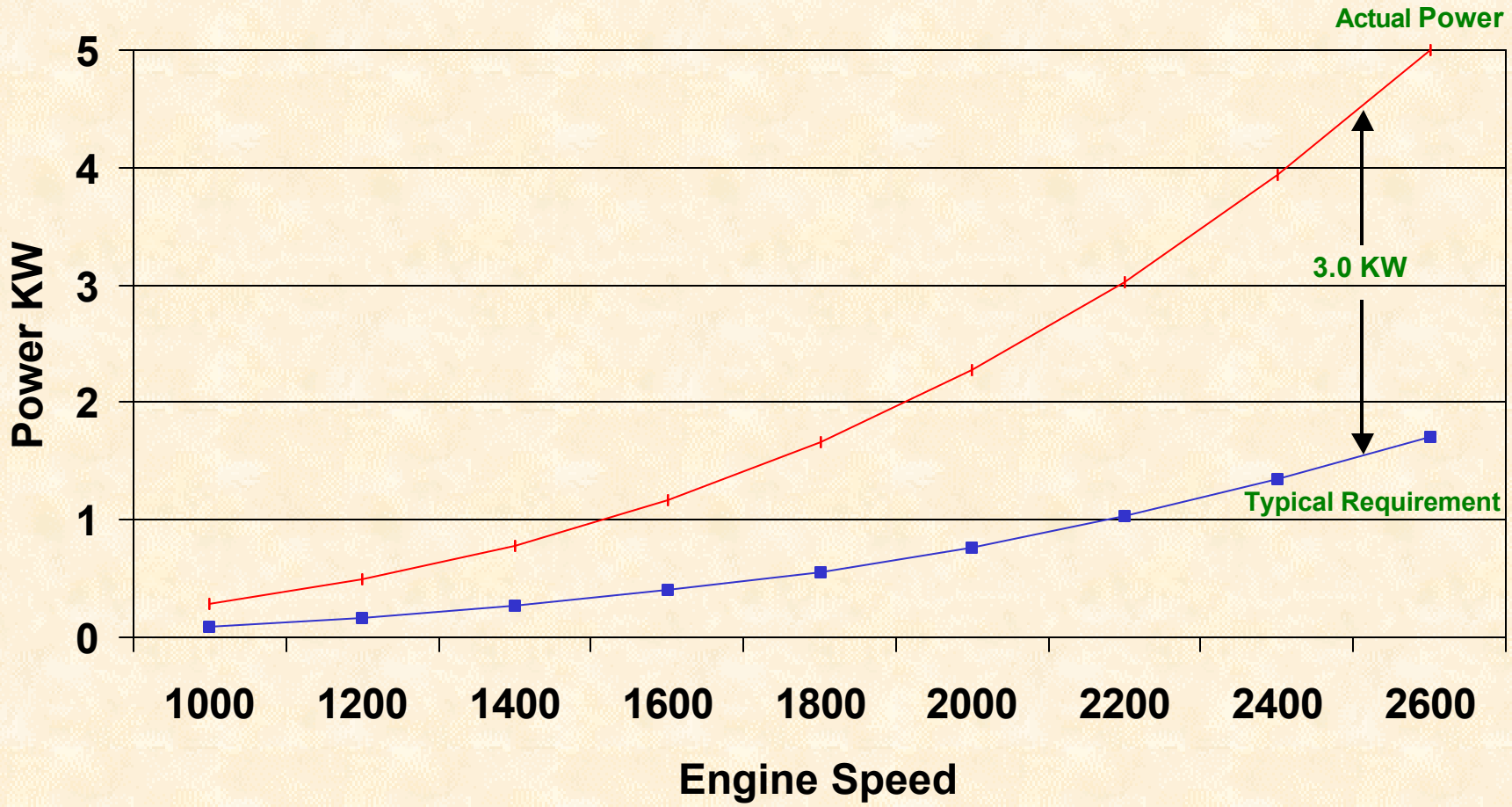
JOHN DEERE

OIL PUMP POWER REQUIREMENT



JOHN DEERE

FAN POWER REQUIREMENT



JOHN DEERE

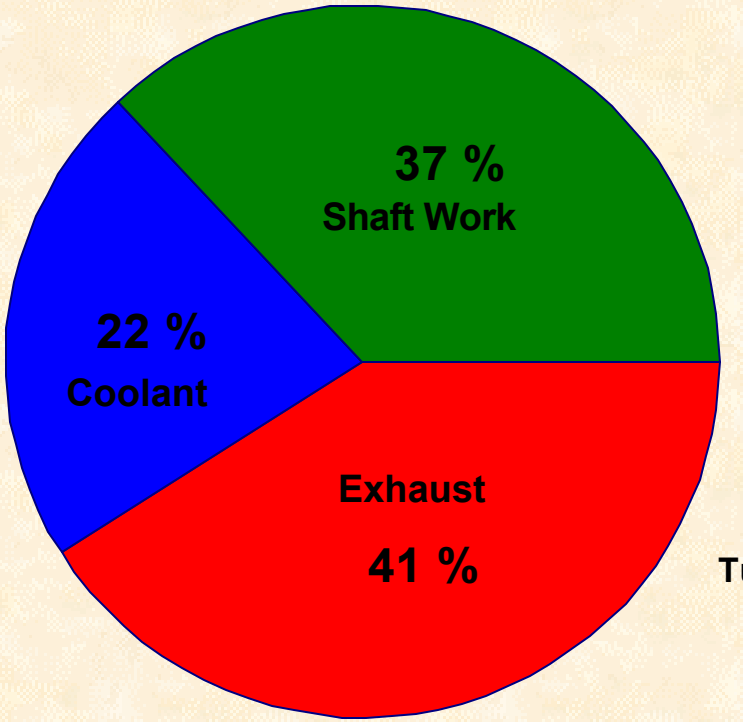
FUEL ECONOMY IMPROVEMENT POTENTIAL

Impact of Electric Water Pump, Oil Pump & Fan

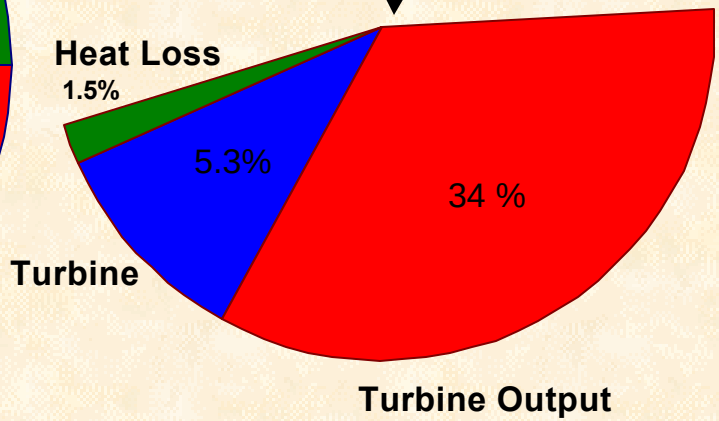
Full Load Conditions	5%
Half Load Conditions	10%
Quarter Load Conditions	20%

JOHN DEERE

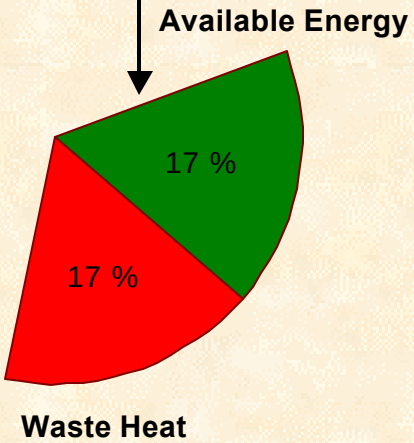
ENERGY DISTRIBUTION



Breakdown of Exhaust
(41%)



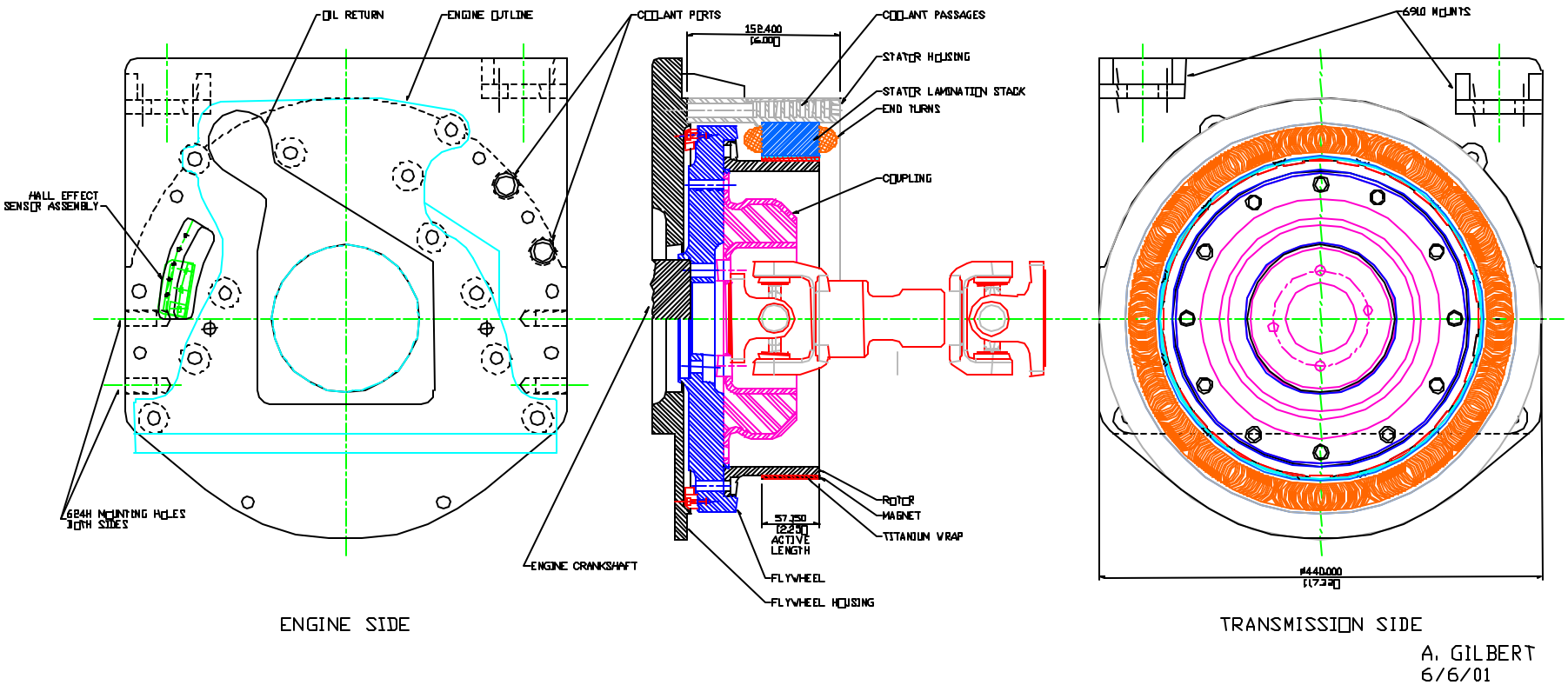
Breakdown of Turbine Output
(34%)



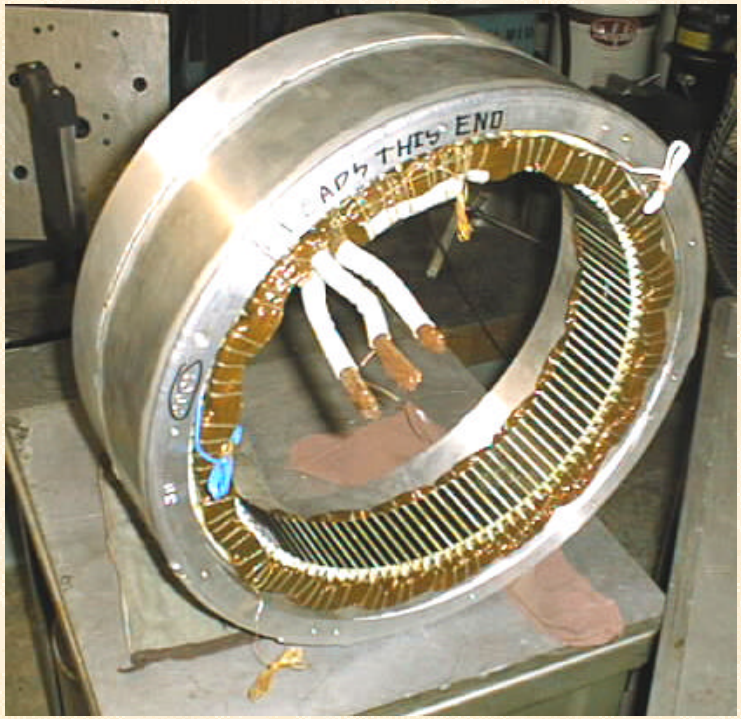
*All percentages based on Total Fuel Input Energy

JOHN DEERE

SYSTEM DEFINITION



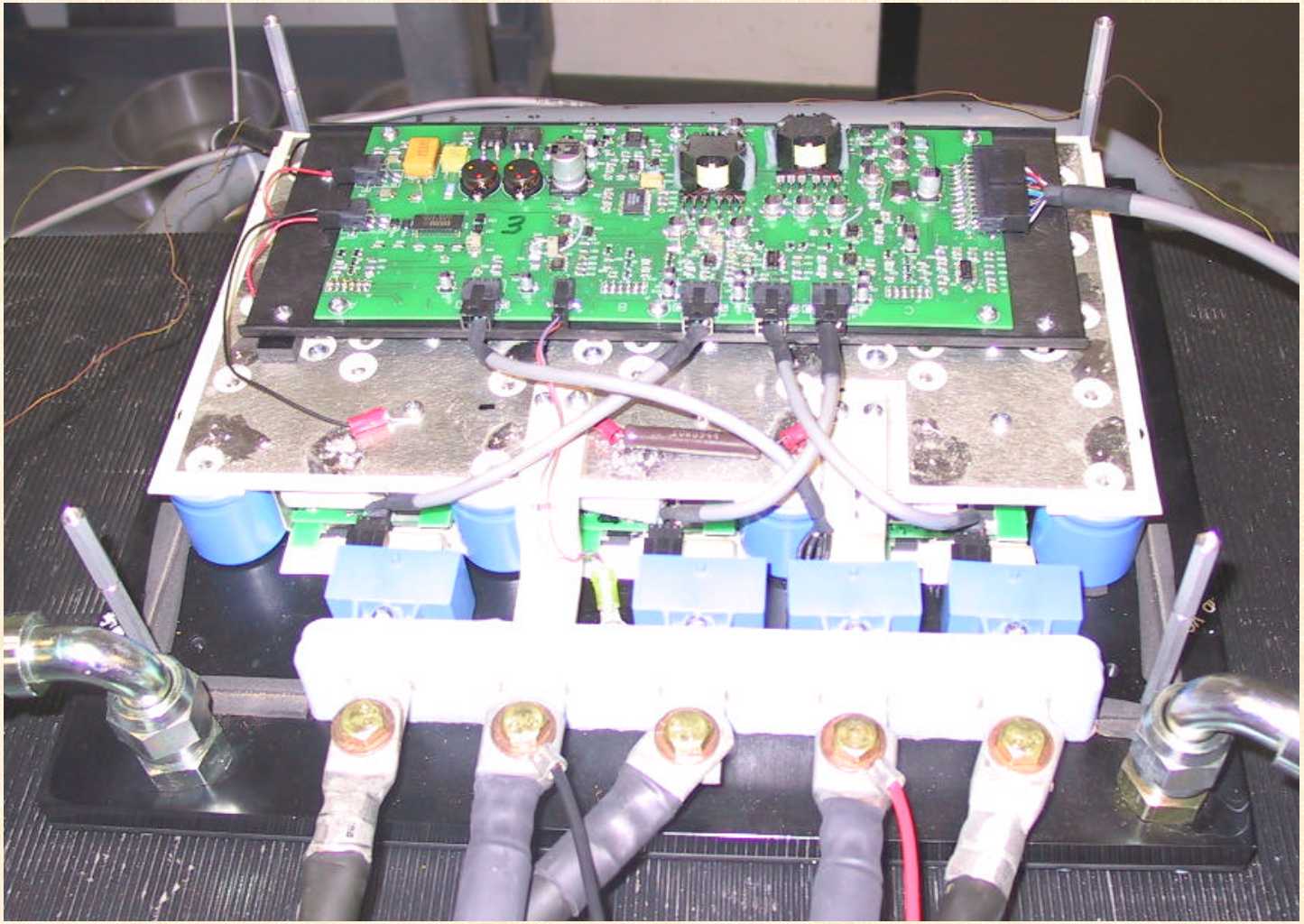
Flywheel / Coupling / Rotor Assembly (on balancing fixture)



Stator and Housing Assembly

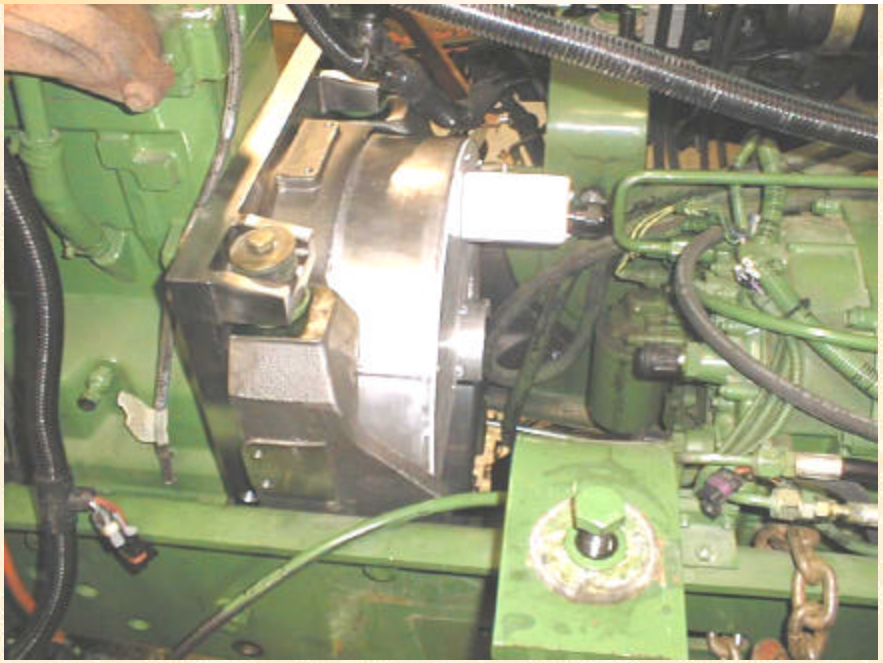
JOHN DEERE

Inverter / Controller Assembly



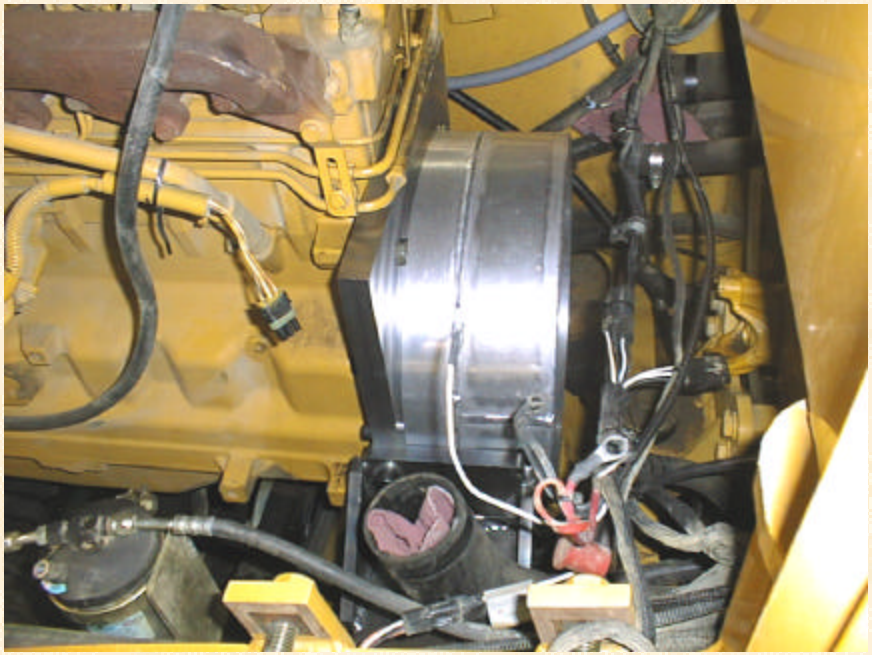
JOHN DEERE

INTEGRATION INTO VEHICLES



6910 Agricultural Tractor

624H Loader



JOHN DEERE

CONCLUSIONS AND LESSONS LEARNED

Turbo Generation has potential to increase system efficiency system efficiency by 10 - 20%on applications that operate at high duty cycles.

Electric auxiliaries have potential to increase system efficiency from 5 - 20% depending on operating loads. Light load applications will see maximum benefit.

Integrated starter generators are a viable means of converting turbo generated electricity into mechanical output. Efficiency must be maximized at operating conditions the specific application runs at.