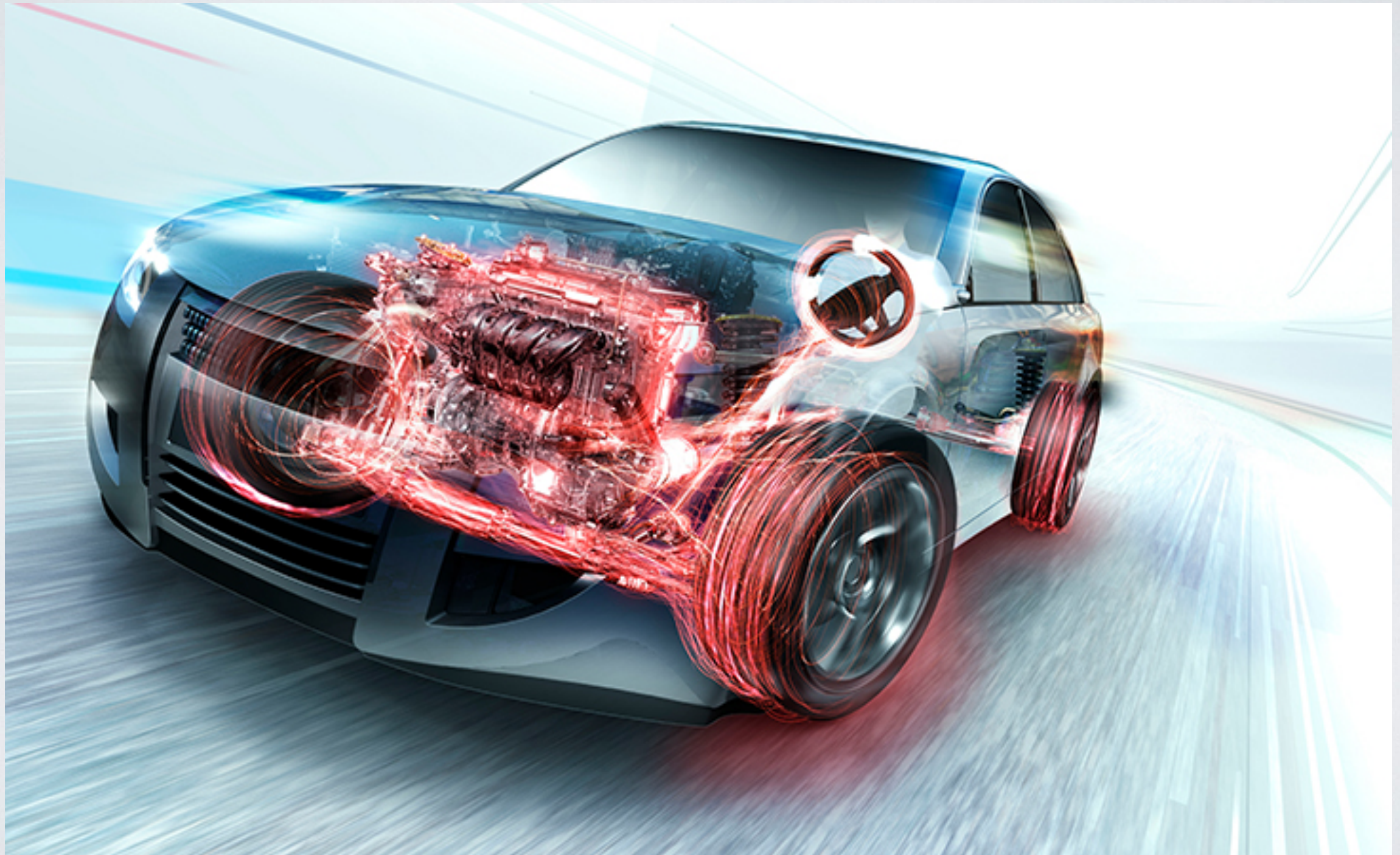


Powertrain and Control

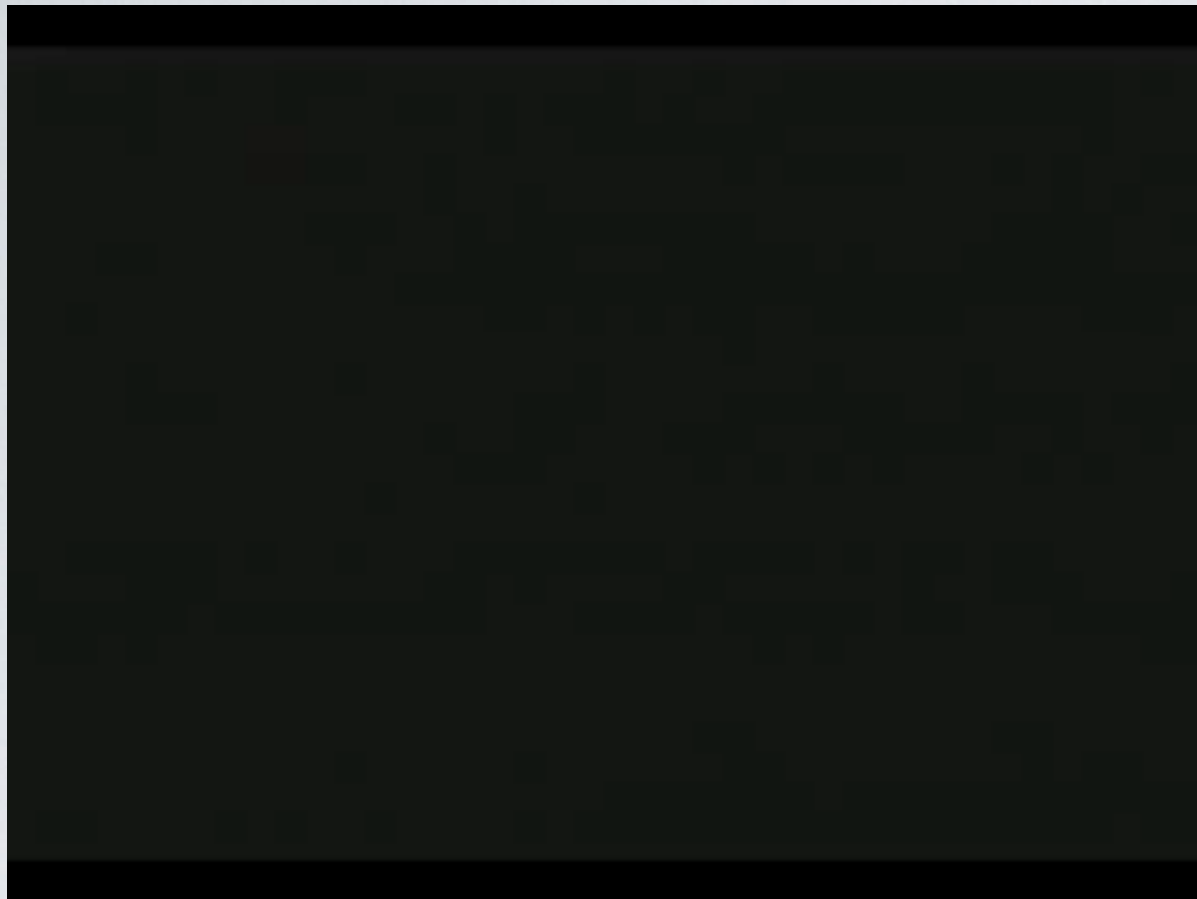
M5X00404



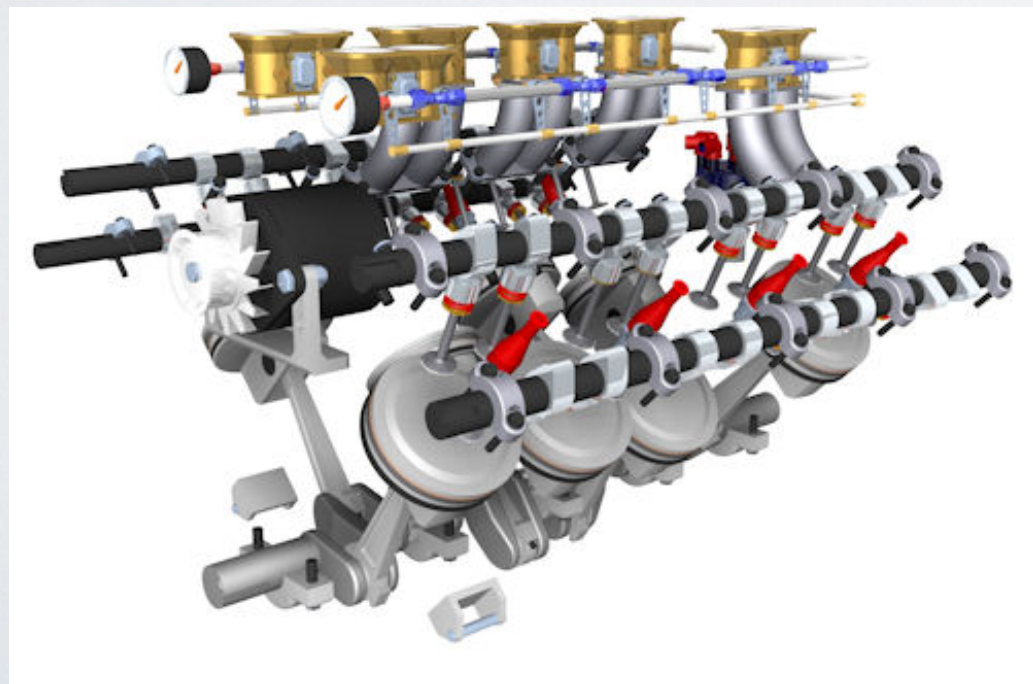


WHAT ARE WE TRYING TO ACHIEVE IN THIS
MODULE?

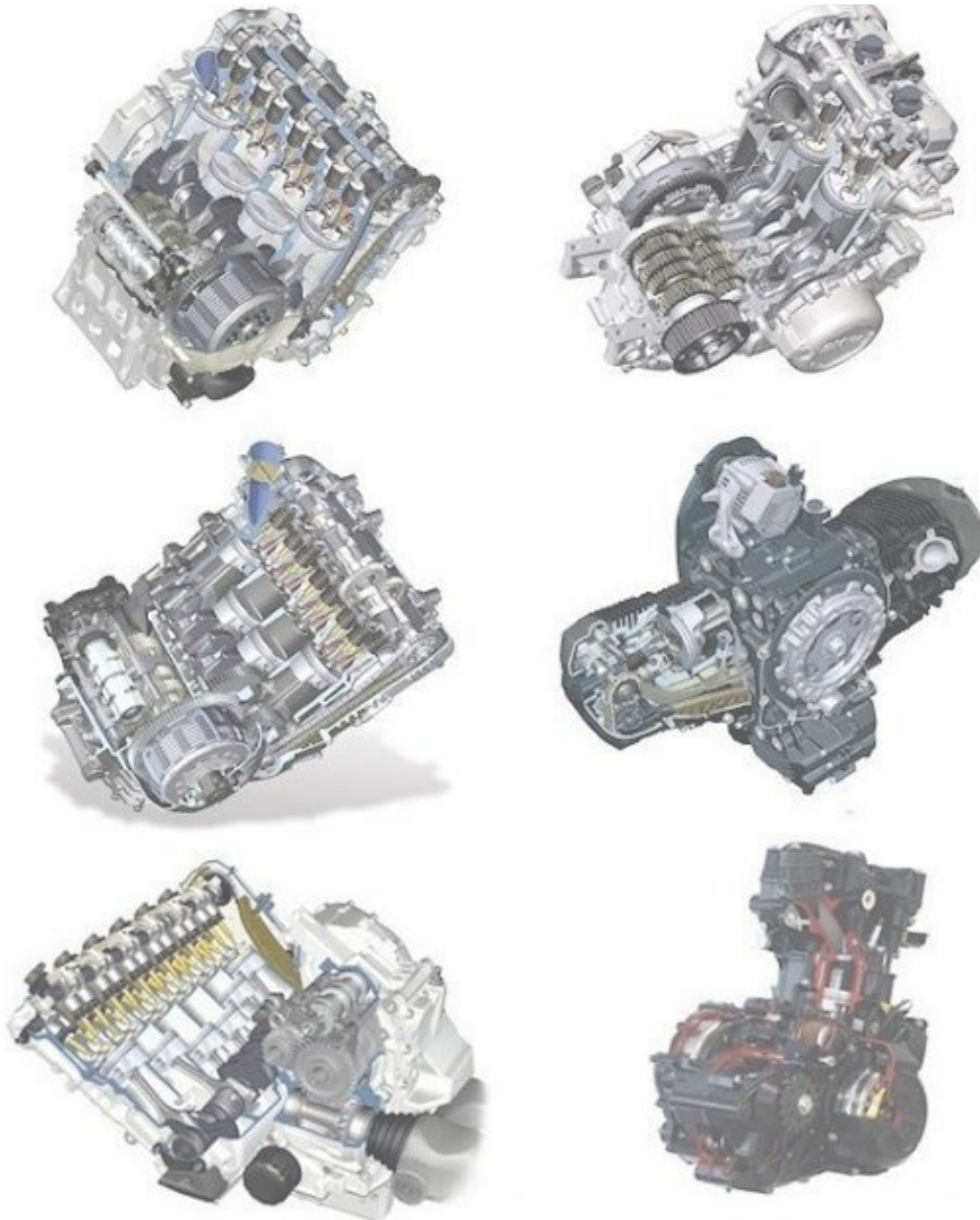
Power? Efficiency? Lower Emissions?
Assignments? Exams? Interesting experience?



How does an Engine work?



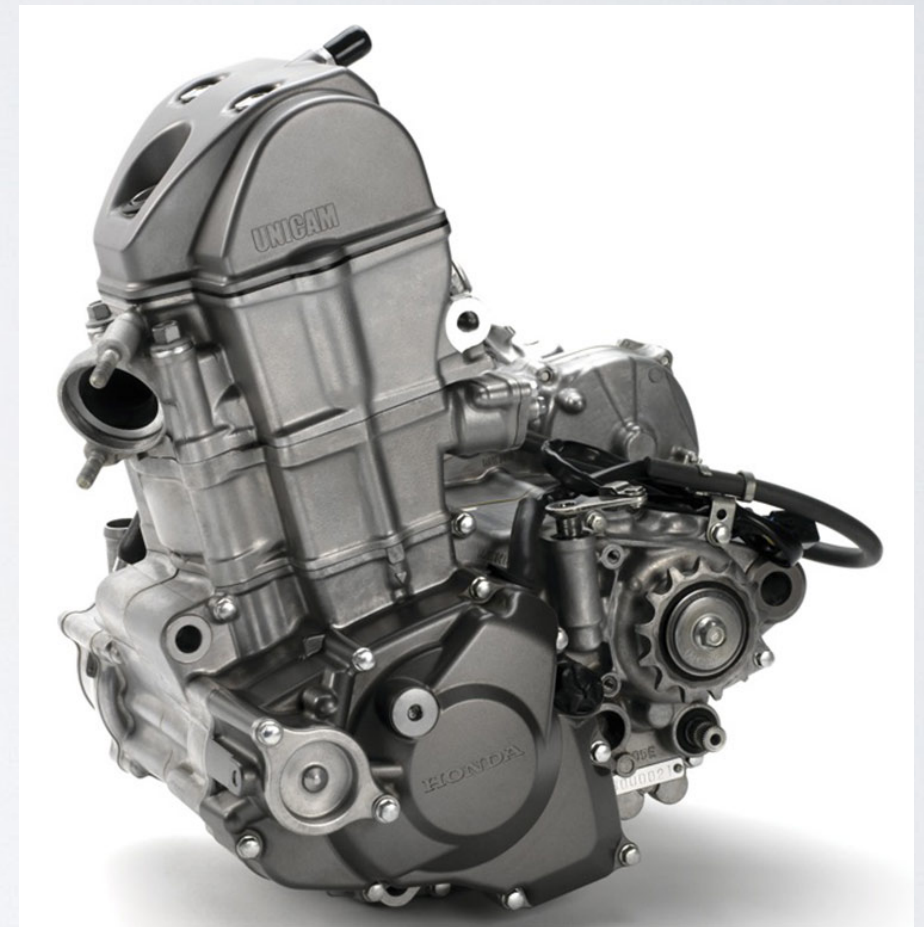
TYPES OF POWERTRAIN



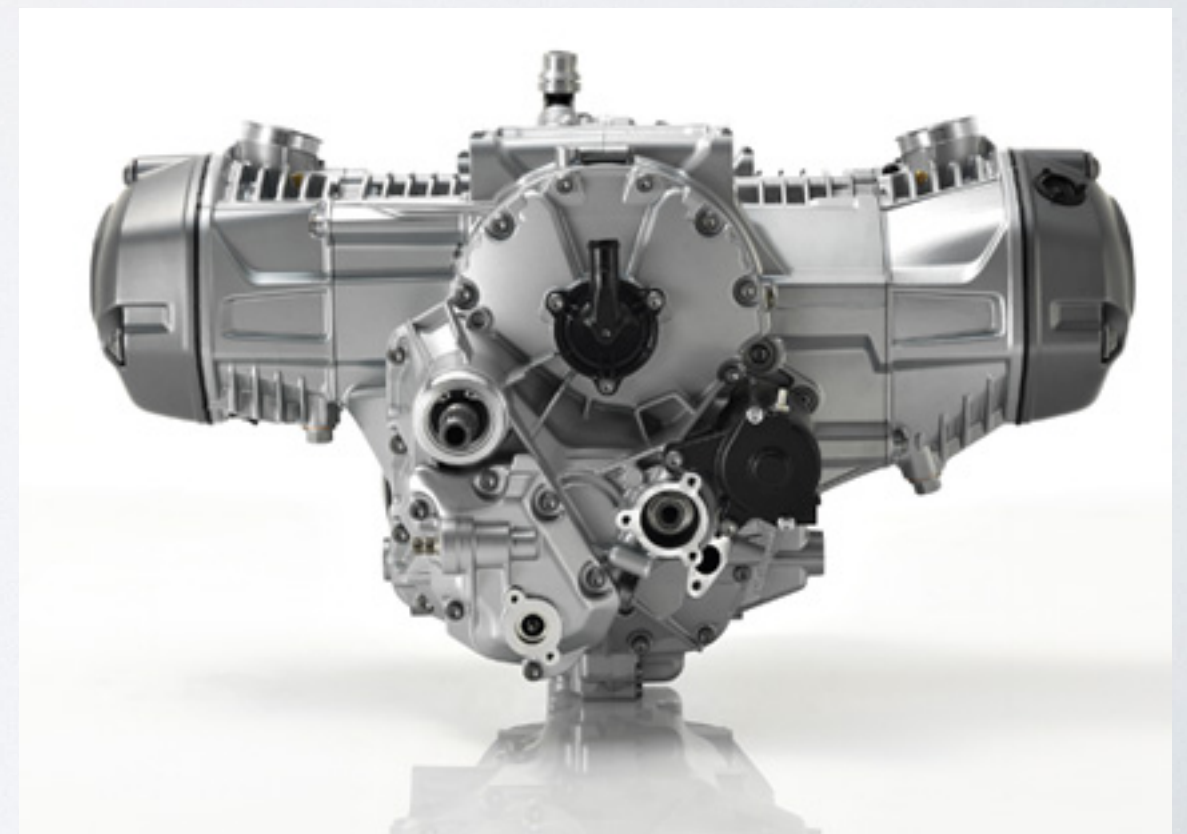
This is a key factor to Motorcycle Selection:

- Noise
- Power Delivery
- Tractability
- 'Feel'
- Weight
- Vibration
- 'economy'

SINGLE CYLINDER



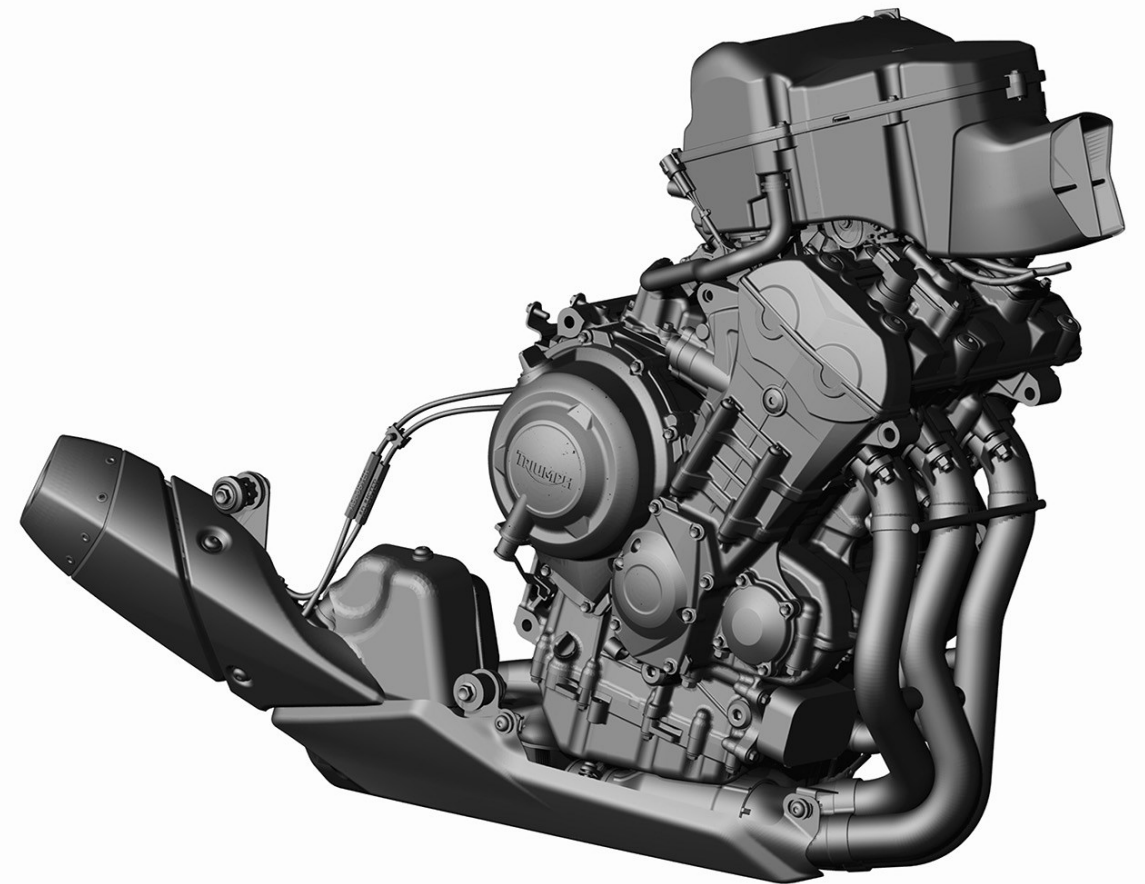
TWIN CYLINDER



TWIN CYLINDER



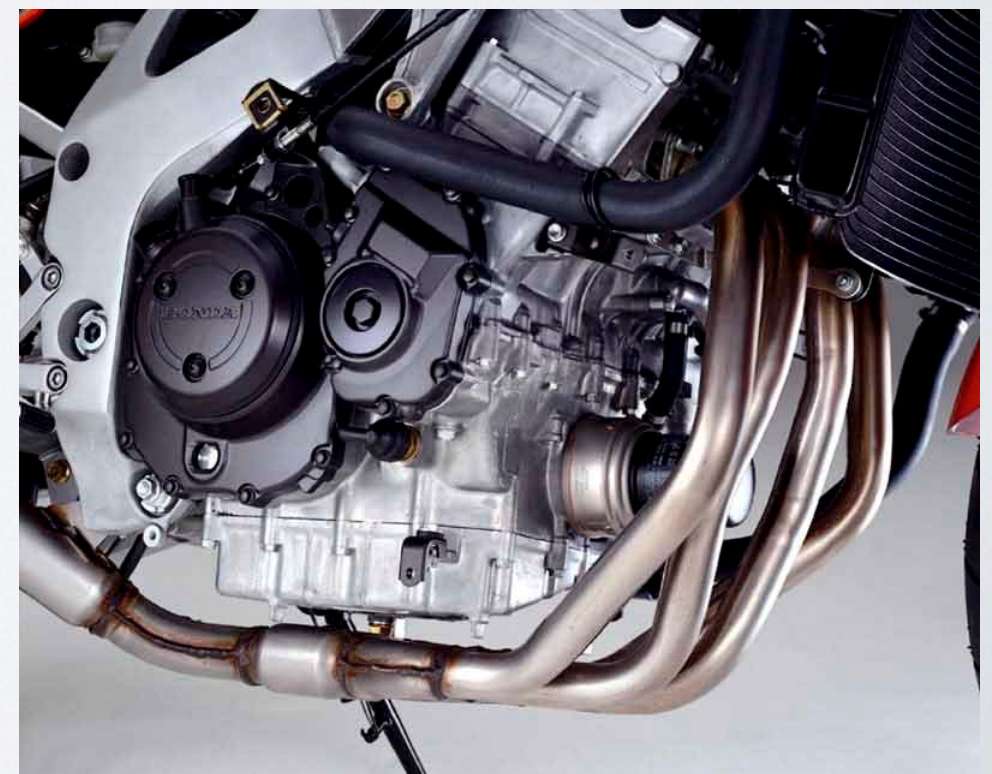
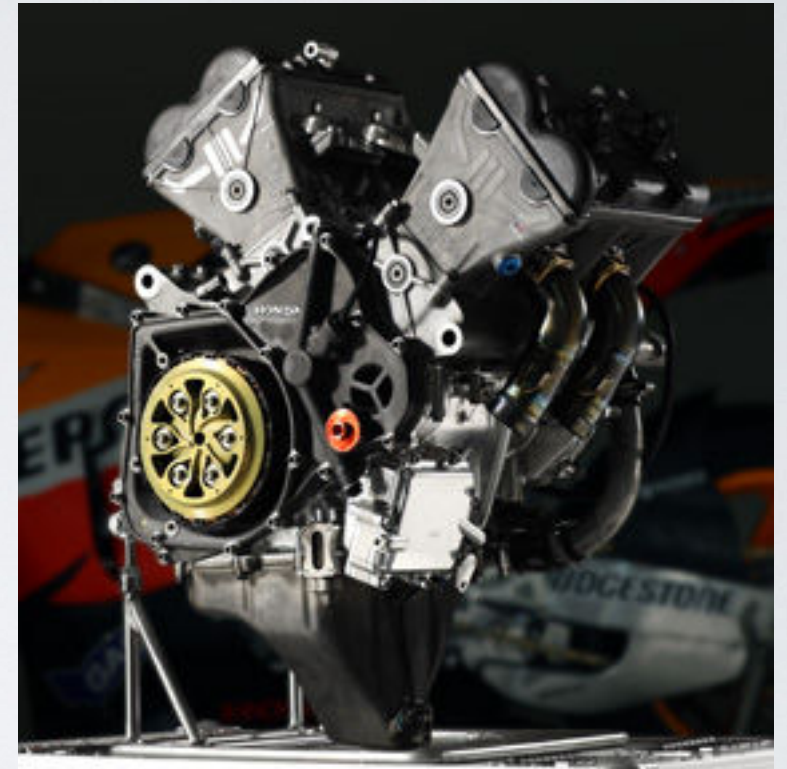
THE TRIPLE



THE TRIPLE



4 CYLINDER

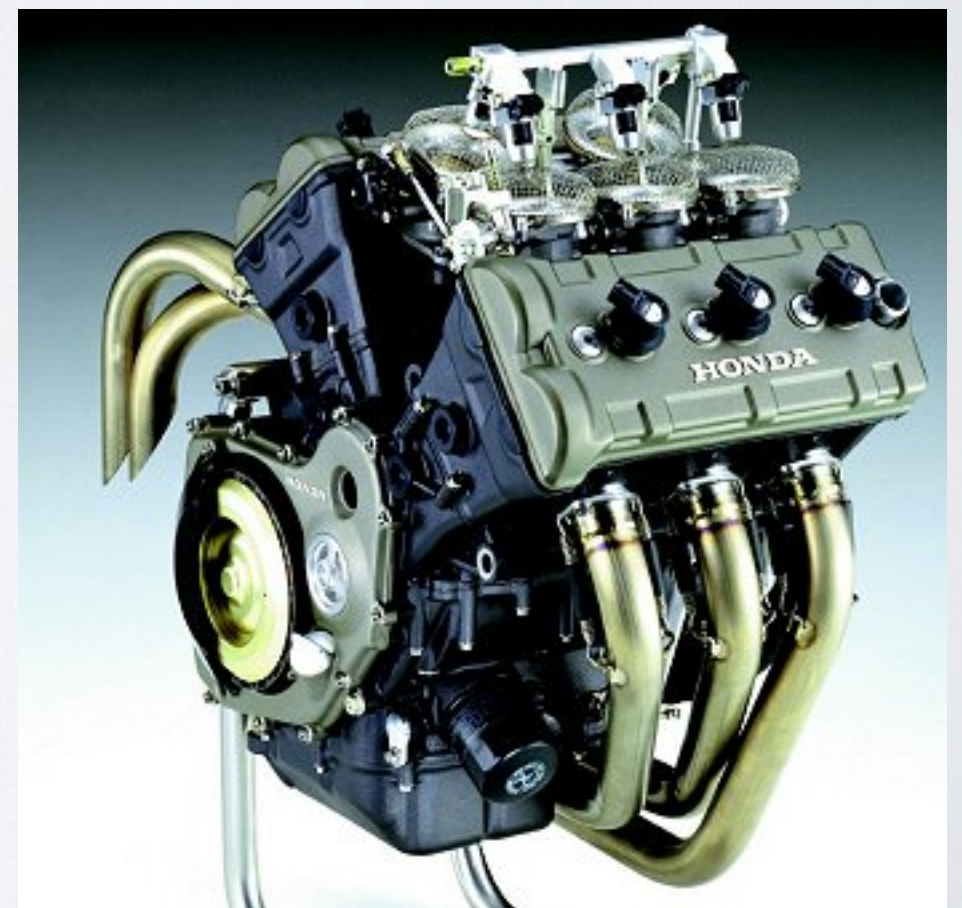


4 CYLINDER



5 CYLINDER

HONDA RC211V MOTOGP RACE BIKE

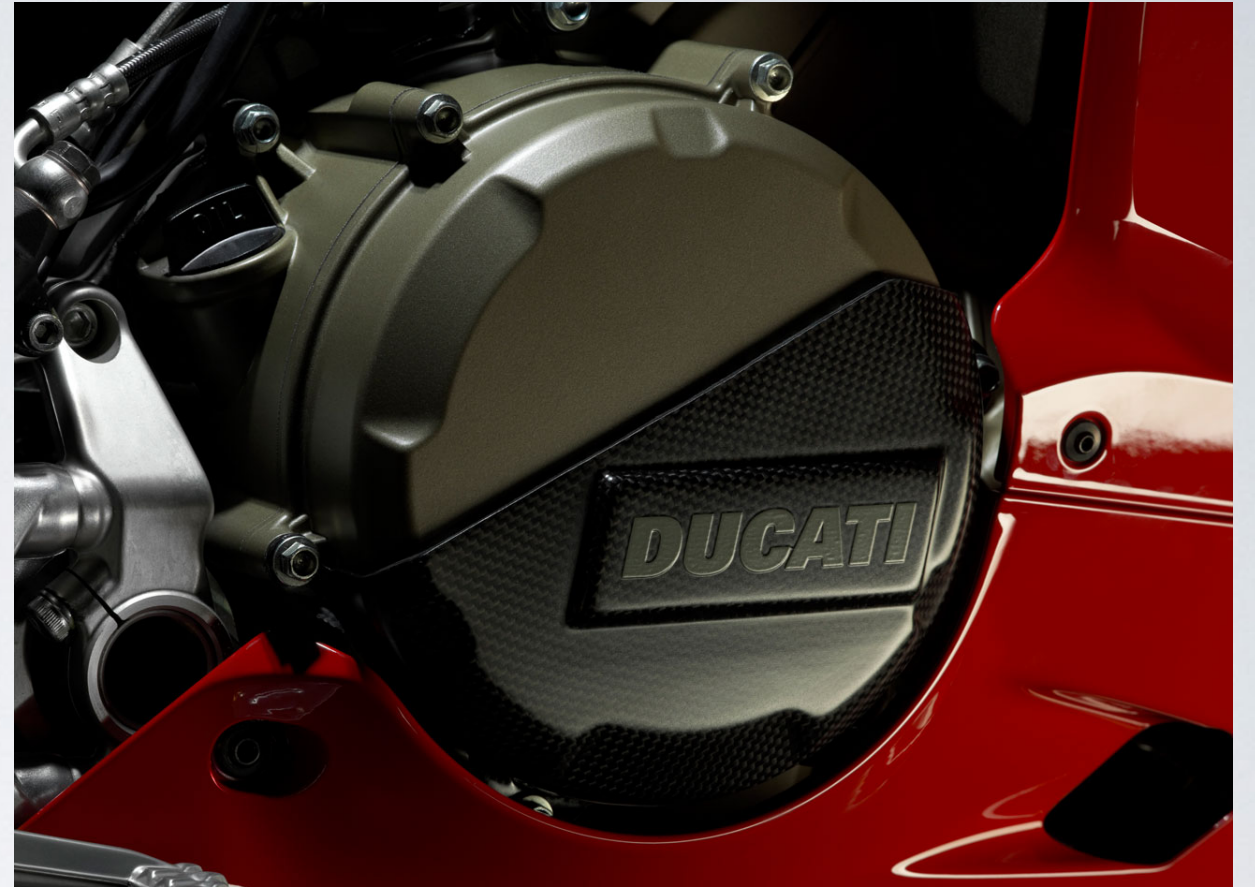


6 CYLINDER

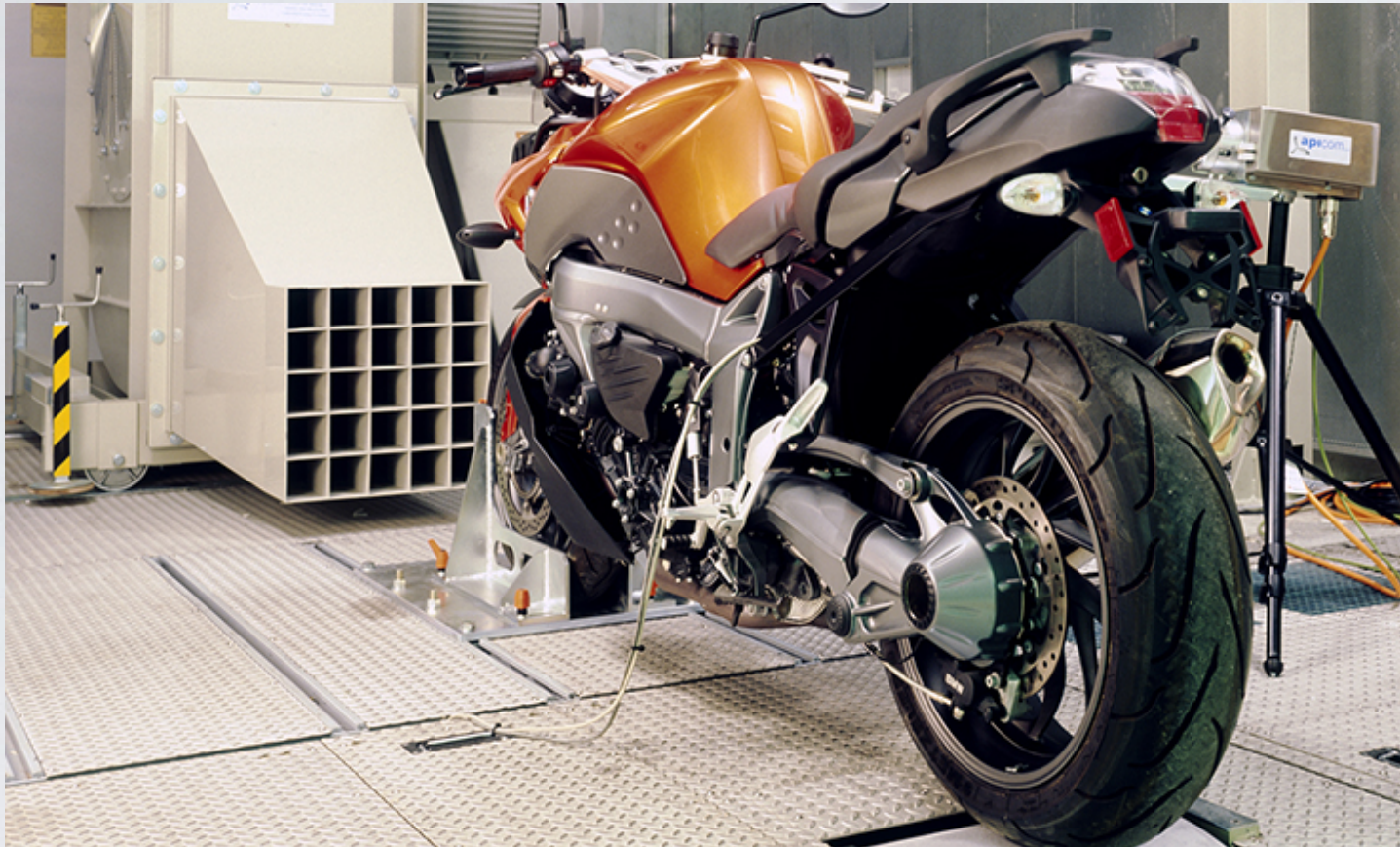


8 CYLINDER





THE MOTORCYCLE WORLD IS ABOUT TO CHANGE.....



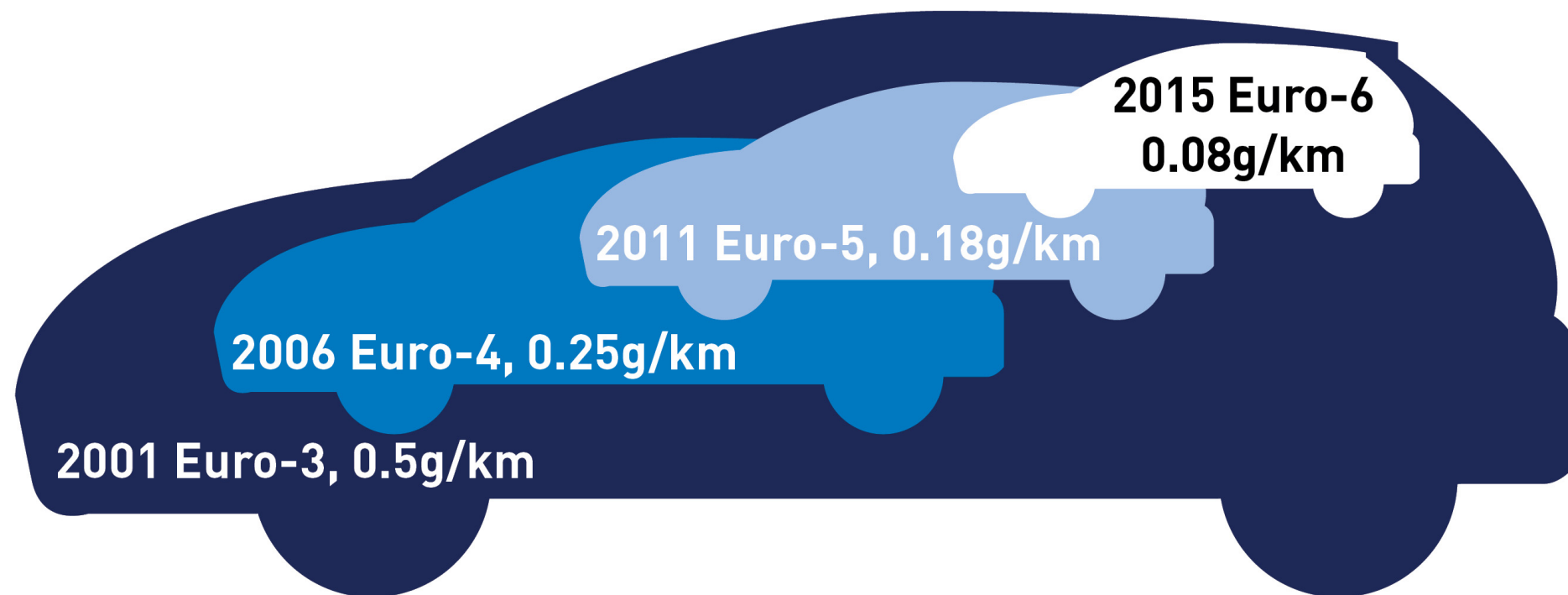
You can't afford to lose a single horsepower. No one wants to buy a bike that's less powerful than last year's

Franz Berndt, Head of Thermodynamic Development at Ricardo

THE AUTOMOTIVE WORLD IS MANY YEARS AHEAD.....

N0x reductions 2001-2015

Emissions of N0x from diesel cars have fallen by 84% since the millennium



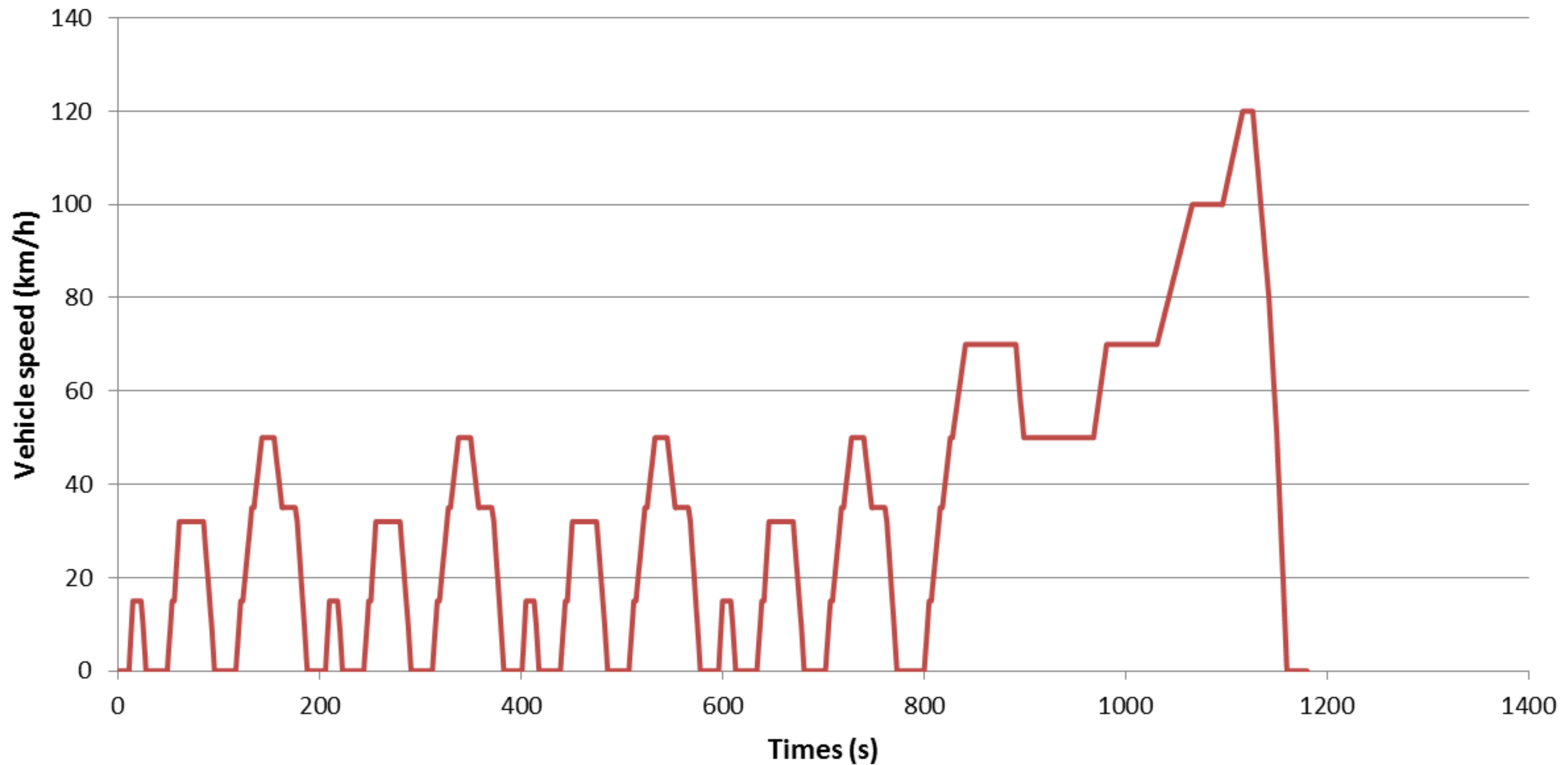
ARE YOU EURO 6? COMPLIANT

FIND OUT ABOUT
THE BENEFITS OF
EURO 6 VANS



THE AUTOMOTIVE WORLD DRIVE CYCLES

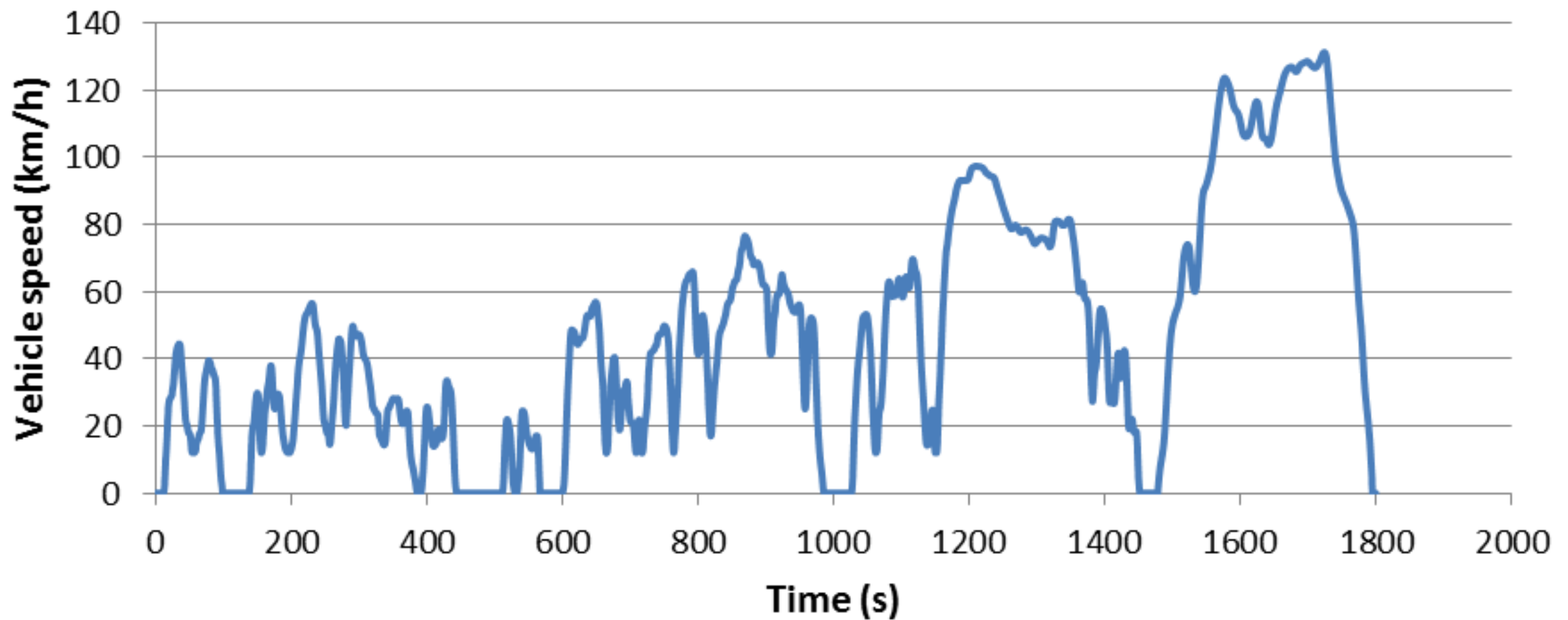
NEDC



THE AUTOMOTIVE WORLD

DRIVE CYCLES

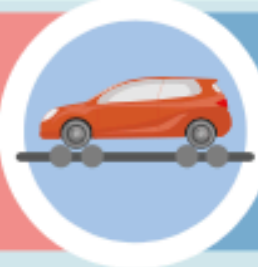
WLTC Class 3 cycle



FROM NEDC TO WLTP: WHAT WILL CHANGE?

TEST CYCLE

NEDC
Single test cycle



WLTP
Dynamic cycle more representative of real driving

CYCLE TIME

NEDC
20 minutes



WLTP
30 minutes

CYCLE DISTANCE

NEDC
11 kilometre



WLTP
23.25 kilometre

DRIVING PHASES

NEDC
2 phases, 66% urban and 34% non-urban driving



WLTP
4 more dynamic phases, 52% urban and 48% non-urban

AVERAGE SPEED

NEDC
34 kilometre per hour



WLTP
46.5 kilometre per hour

MAXIMUM SPEED

NEDC
120 kilometre per hour



WLTP
131 kilometre per hour

INFLUENCE OF OPTIONAL EQUIPMENT

NEDC
Impact on CO2 and fuel performance not considered under NEDC



WLTP
Additional features (which can differ per car) are taken into account

GEAR SHIFTS

NEDC
Vehicles have fixed gear shift points



WLTP
Different gear shift points for each vehicle

TEST TEMPERATURES

NEDC
Measurements at 20-30°C



WLTP
Measurements at 23°C, CO2 values corrected to 14°C

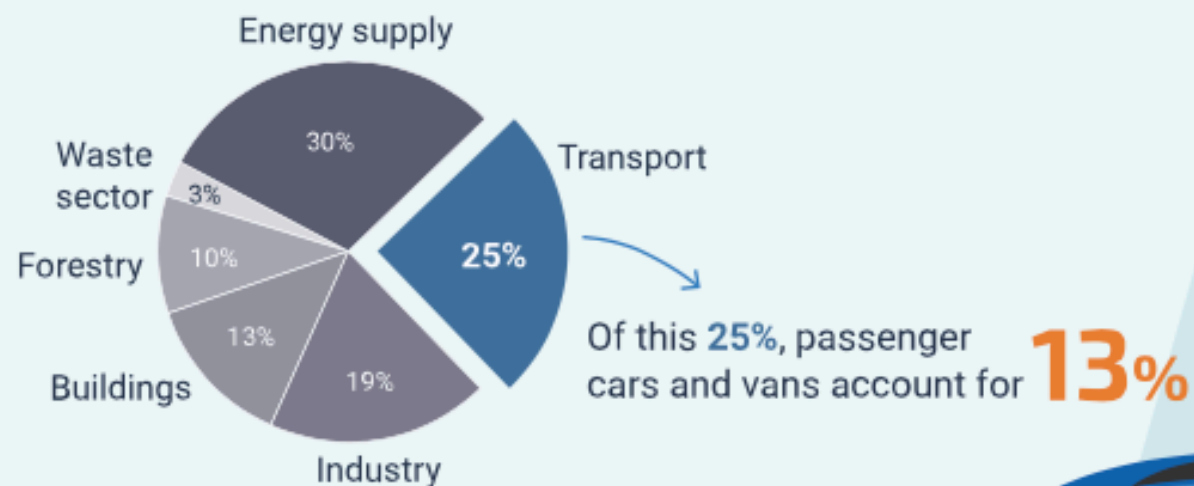
WHAT EMISSIONS ARE BEING TESTED?

CO2

What is it? Carbon dioxide (CO2), which has a relationship to fuel consumption.

Why is it tested? CO2 is a greenhouse gas that causes an increase in average global temperatures if its presence in the atmosphere becomes too high.

SOURCES OF CO2 EMISSIONS:



POLLUTANTS

What are they? Substances like carbon monoxide (CO), hydrocarbons (HC), oxides of nitrogen (NOx) and particles

Why are they tested? Pollutant emissions impact the quality of the air we all breathe.

SOURCES OF POLLUTANTS INCLUDE:



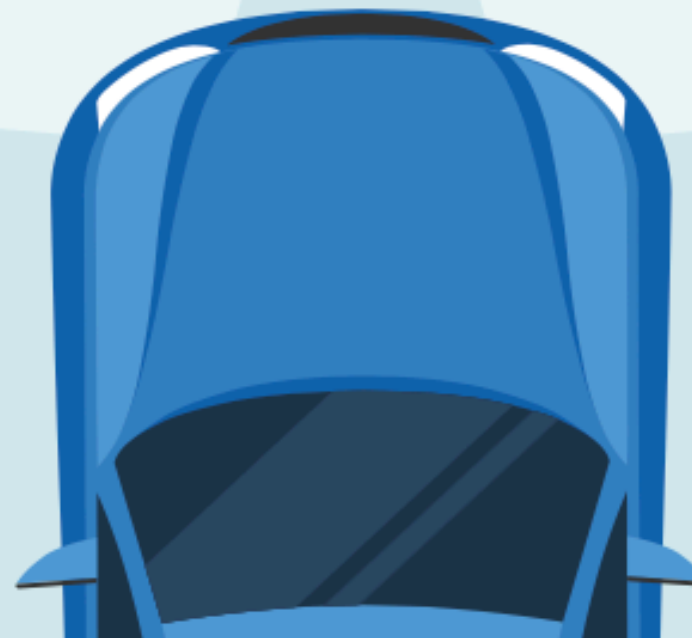
80% OF PARTICLE EMISSIONS ARE NOT RELATED TO ROAD TRANSPORT EXHAUST EMISSIONS

WHAT DO TESTS ENSURE?

Tests ensure that the CO2 fleet average targets are met

WHAT DO TESTS ENSURE?

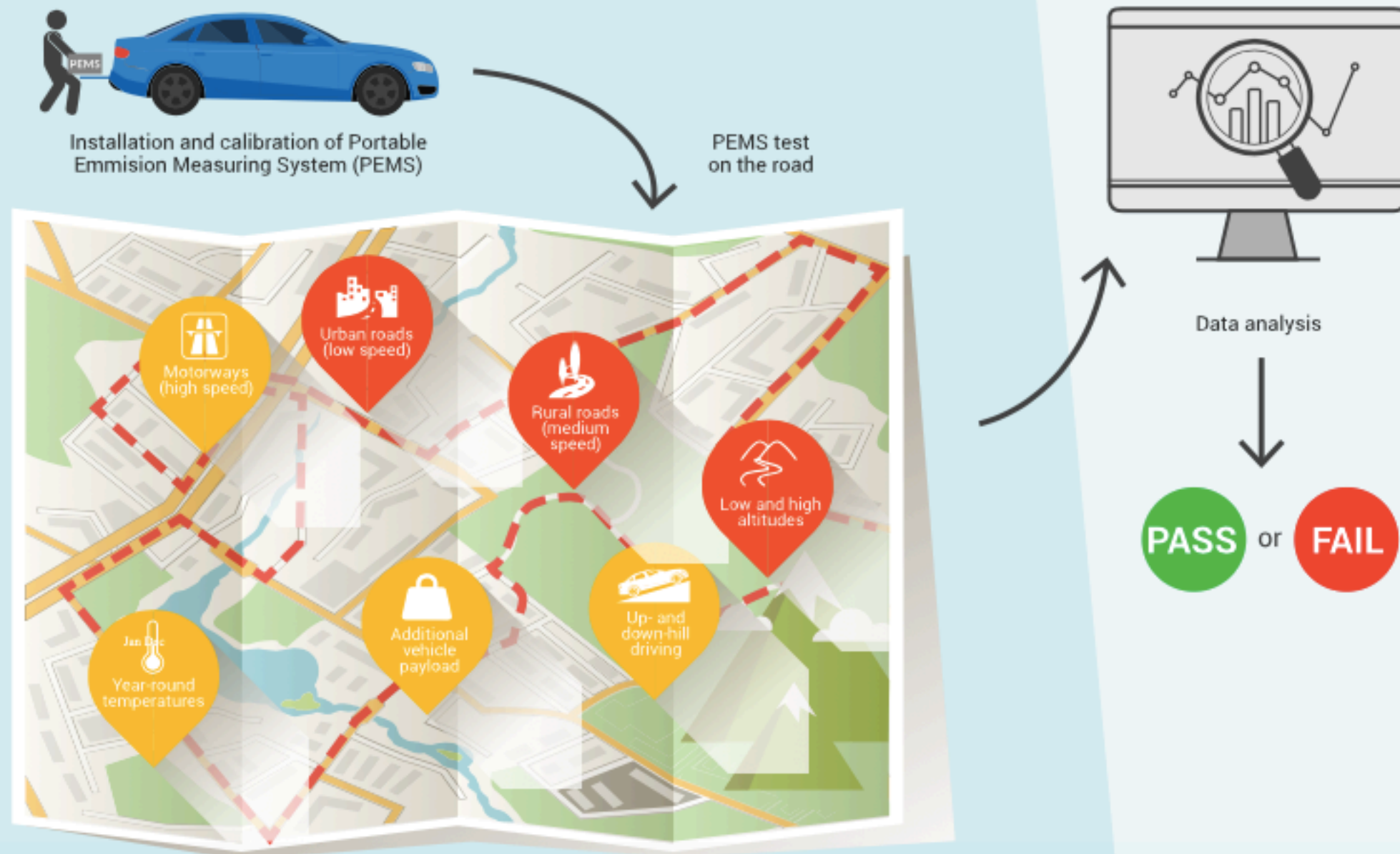
Tests ensure a car does not emit any more pollutants than allowed by Euro standards



The Real Driving Emissions (RDE) test measures the pollutants, such as NO_x, emitted by cars while driven on the road. RDE does not replace the WLTP laboratory test, but complements it. RDE ensures that cars deliver low emissions over on-road conditions. Europe is the first region in the world to introduce such on-road testing, marking a major leap in the testing of car emissions.



WHAT IS THE REAL DRIVING EMISSIONS (RDE) TEST?



INDUSTRY COMPARISONS



Toyota Aygo - 998 cc
50KW @ 6,000 rpm
93Nm @ 3,600 rpm

Triumph Tiger 800 - 800 cc
70KW @ 9,500 rpm
79Nm @ 8,050 rpm



AYGO TECHNICAL SPECIFICATIONS

ENGINE		Toyota Optimal Drive 1.0-litre VVT-i	
Type		3-cylinder in-line	
Fuel type		95 octane petrol (or higher)	
Valve mechanism		DOHC 12-valve VVT-i	
Displacement (cc)		998	
Bore x stroke (mm)		71.0 x 84.0	
Compression ratio		10.5:1	
Max. power bhp/kW @ rpm		67/50 @ 6,000	
Max. torque Nm @ rpm		93 @ 3,600	
TRANSMISSION			
Drive type		Front-wheel drive	
Clutch type		Dry, single plate	
Gearbox type		Five-speed manual or five-speed M/M (optional)	
Gear ratios	1 st	3.545	
	2 nd	1.913	
	3 rd	1.310	
	4 th	1.027	
	5 th	0.850	
	Reverse	3.214	
Differential gear ratio		3.550	
PERFORMANCE		5 M/T	5 M/M
Max speed (mph)		98	98
0-62mph (sec)		14.2	14.9
FUEL CONSUMPTION			
Combined (mpg)		65.7	62.7
Extra urban (mpg)		74.3	70.6
Urban (mpg)		55.4	52.3
Fuel tank capacity (l)		35	35
CO ₂ EMISSIONS			
Combined (g/km)		99	105
Extra urban (g/km)		88	93
Urban		118	124
VED Band		A	B

SPECIFICATION

TIGER 800 XR TIGER 800 XR_x TIGER 800 XR_T TIGER 800 XR_x LOW TIGER 800 XC_x TIGER 800 XC_A

ENGINE & TRANSMISSION

Type	Liquid-cooled, 12 valve, DOHC, in-line 3-cylinder
Capacity	800 cc
Bore	74.05 mm
Stroke	61.9 mm
Compression	11.3:1
Max Power EC	95 PS/ 94 bhp (70 kW) @ 9,500 rpm
Max Torque EC	79Nm @ 8,050rpm
System	Multipoint sequential electronic fuel injection
Exhaust	Stainless steel 3 into 1 header system, side mounted stainless steel silencer
Final Drive	O-ring chain
Clutch	Wet, multi-plate
Gearbox	6 speed

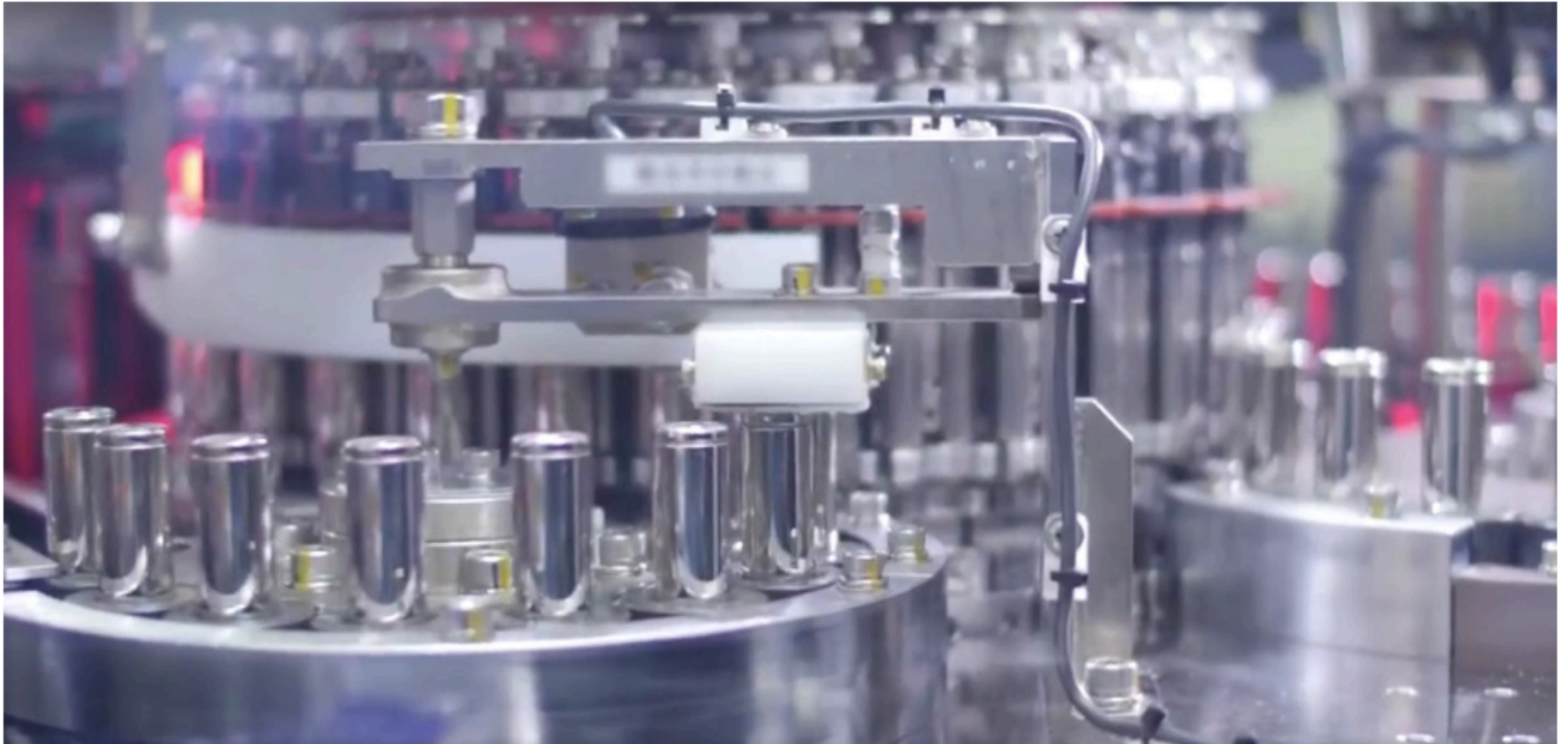


ELECTRIC POWERTRAIN?

Lots of interesting things to discuss here!

TESLA MODEL 3

Tesla Model 3 Battery Cell Has World's Highest Energy Density



🕒 MAY 3 2018 BY ERIC LOVEDAY 💬 26

That's according to **Tesla**, who made the claim in connection to cells in electric cars yesterday in its **Q1 2018 shareholder letter**.

LET'S TAKE A LOOK...

- 207 Wh/kg ... = 745200 J/Kg ... Very Nice!
- Petrol = 44×10^6 ... = 44000000 J/Kg
- 1.69% of the energy per Kg
- The Tesla weighs 1700kg!! (Batteries 540Kg)
- How do we charge it?

Britain to ban sale of all diesel and petrol cars and vans from 2040

Plans follow French commitment to take polluting vehicles off the road owing to effect of poor air quality on people's health



▲ Ministers believe poor air quality poses largest environmental risk to public health in UK. Photograph: Peter Macdiarmid/Getty Images

Nuclear energy is seeing a renaissance around the world – and new plants being built in the UK could significantly bolster our energy supply.

An energy crisis has been brewing in the UK for years. In the face of exponential population growth, a large proportion of older oil, gas and nuclear power stations have been closed.

By 2030, 35pc of our current energy capacity will no longer exist, and the Government estimates that energy reforms will cost up to £110 billion over the coming years.

“Horizon’s two sites could deliver power for around 10 million homes, 24 hours a day, seven days a week”

Shunsuke Utena, managing director,
Hitachi Nuclear Energy Europe

So, amid dwindling supplies and growing demand, it’s estimated that an extra 60GW of energy will need to be generated to break even.

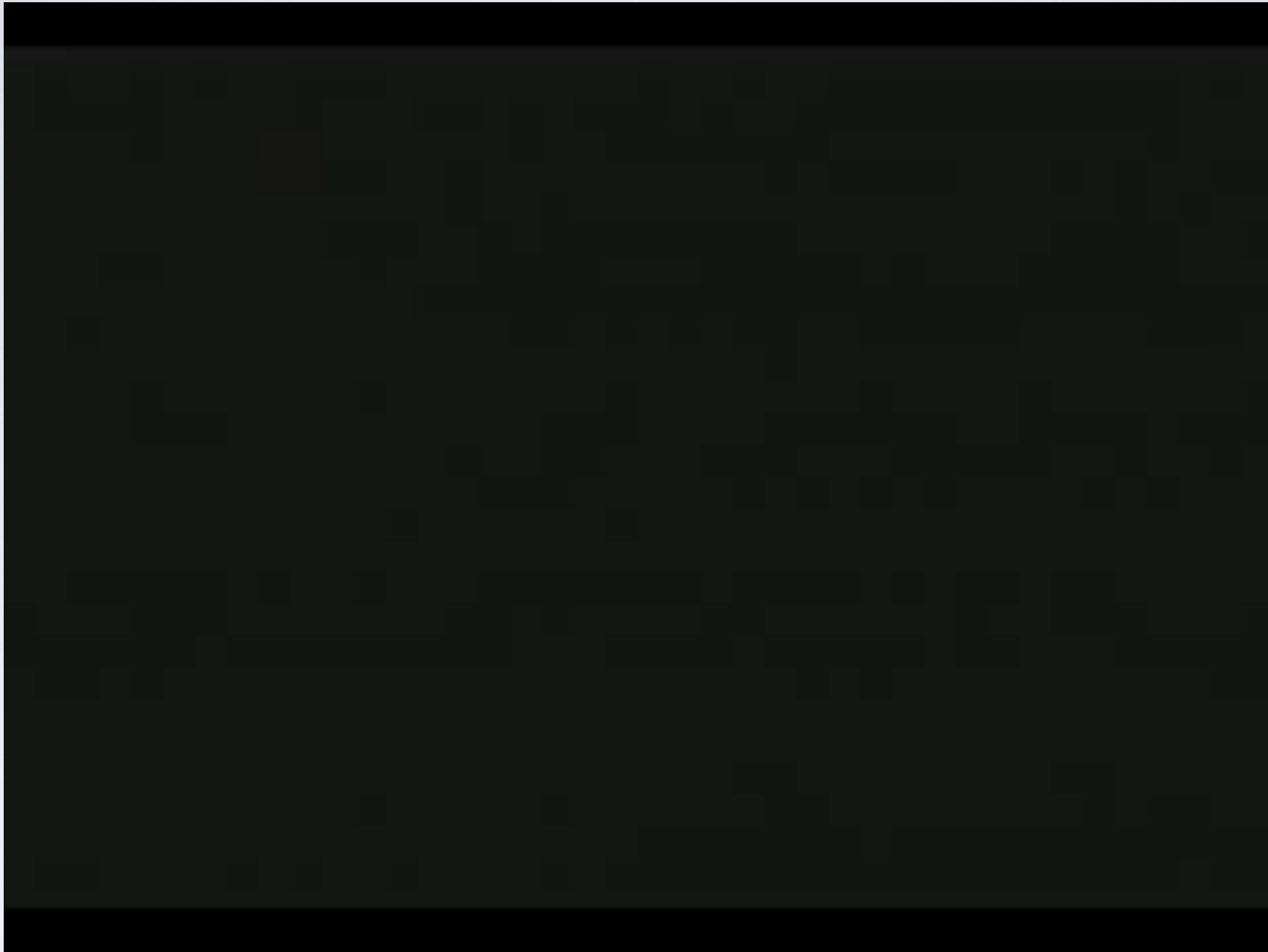
The issue is inescapable; so how do we redesign and renew our energy supplies so they are fit for the 21st century? While the goal may be to provide low-carbon,

sustainable, and affordable energy, the logistics of this have proved to be quite a challenge.

SO WHAT DO WE NEED TO LOOK AT TO UNDERSTAND HOW TO DEVELOP AN ENGINE?

- Combustion
- Compression Ratios
- Thermodynamic Cycles
- Heat Transfer
- Efficiencies





COMBUSTION

Can we understand what happens in cylinder?

STATES
SURROUNDING
SEPARATIVE
LAW
MECHANICAL
ENERGY
IRREVERSIBILITY
FLOW
SYSTEM
DERIVE
CHANGE
MASS
MECHANICS
EXTENSIVE
STATE
PROCESS
CONDITIONALLY
KINETIC
PARCEL
SIMPLE
THERMODYNAMICS
FUNDAMENTAL
STATISTICAL
THERMAL
MICROSCOPIC
RATE
EQUILIBRIUM
ATOMIC
LOCAL
HOMOGENEOUS
IDEALIZED
CYCLIC
LAW
ABSOLUTE
IRREVERSIBLE
CHEMICAL
AXIOMATIC
THERMODYNAMIC
INTENSIVE
ENTROPY
CLASSICAL
PROPERTIES
SPATIAL
MATTER
EXISTENCE
STEADY
PARTITION
CONSTANT
INTERNAL

Thermodynamic Basics

The First Law:

Every Thermodynamic system in thermal equilibrium has an important thermodynamic quantity called its 'Internal Energy'

$$dE = dQ + dW$$

Change in Internal Energy = Heat + Work Done

Zeroth Law

The Zeroth Law states that:

Every process that is in thermal equilibrium
has an important physical quantity called
'Temperature, T '

Ideal Gas Law

$$PV = nRT$$

An ideal gas will exactly obey the above equation

Real gases at low pressure are a good approximation to this law

We can also use the form:

$$PV = mRT$$

Specific Heat Capacity

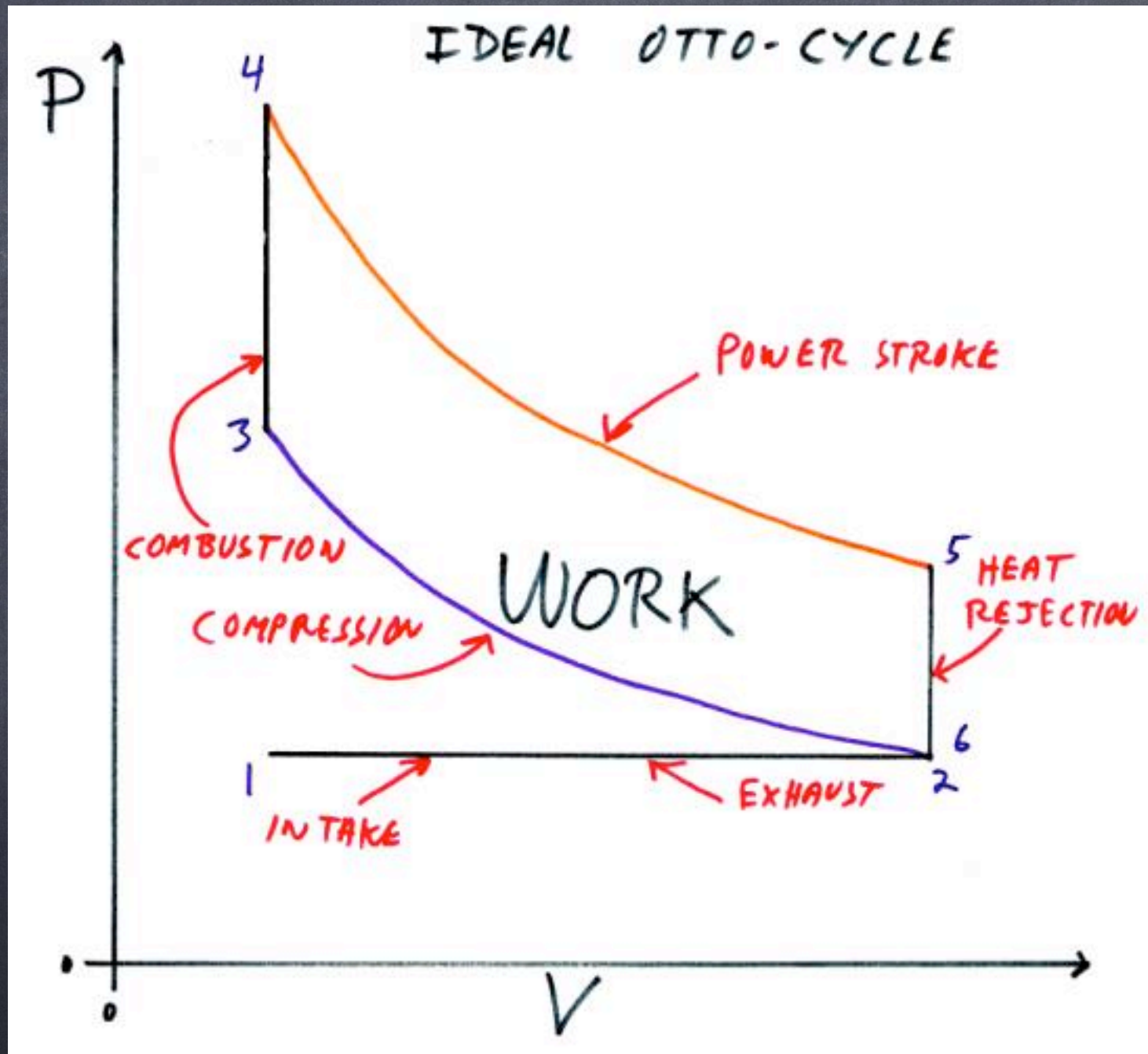
The quantity of heat energy that will raise the temperature of 1kg of a material by 1K without changing its state (Units J/kg.K)

We often use:

$$Q = m c \Delta T$$

Heat = Mass x Specific Heat x Temp Change

Engine Cycles



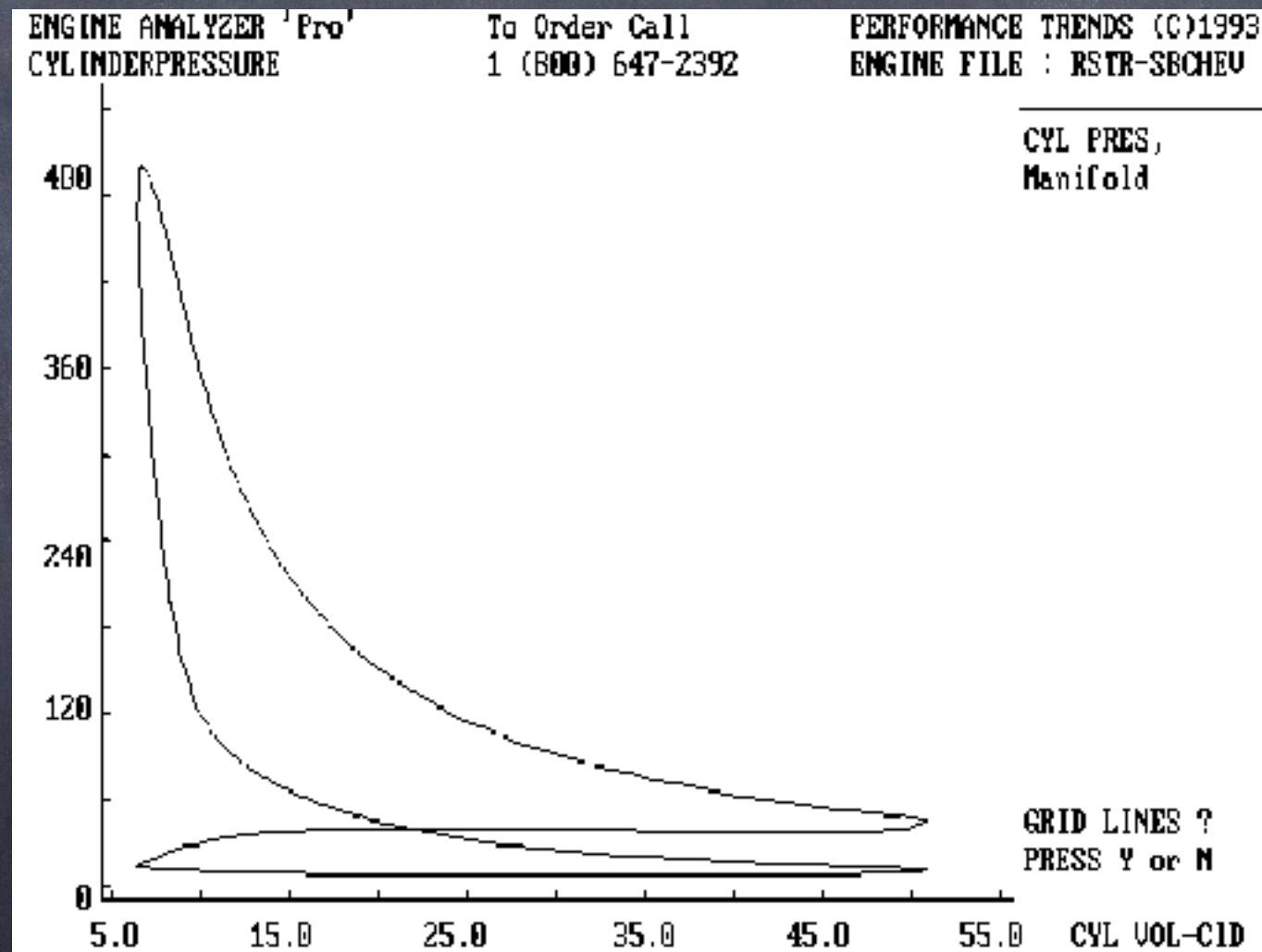
Isothermal Process

No Change in Temperature
(Similar to a 'very slow' process)

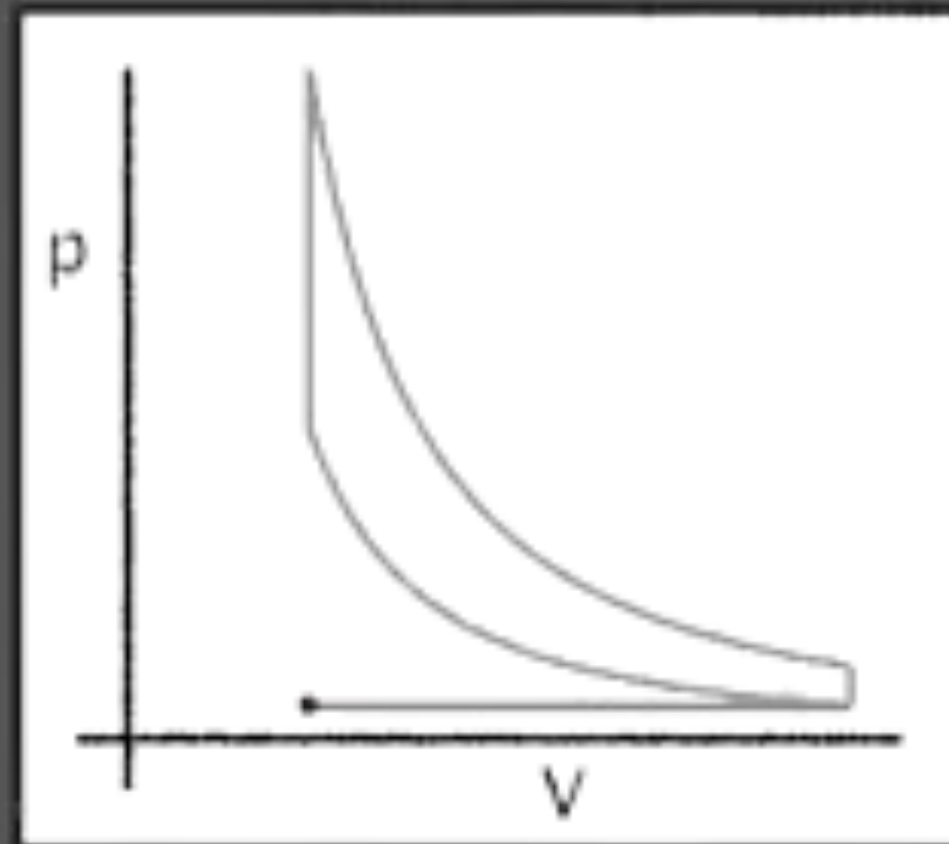
Adiabatic Process

No Heat Loss
(Similar to a 'very fast' process)

Pressure / Volume Diagrams

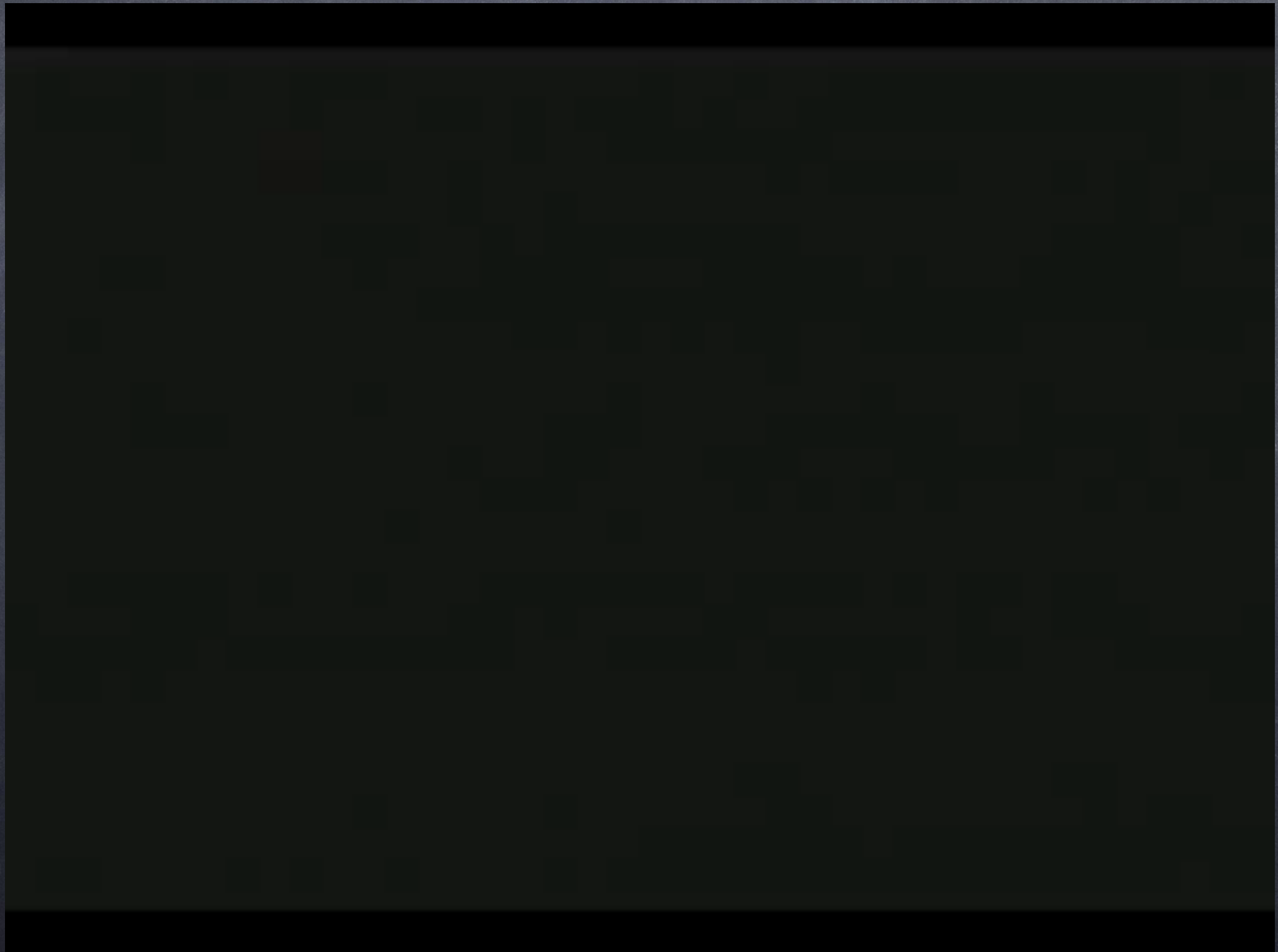


Otto Cycle



Intake

Real Engine Cycle



Pressure Diagrams

