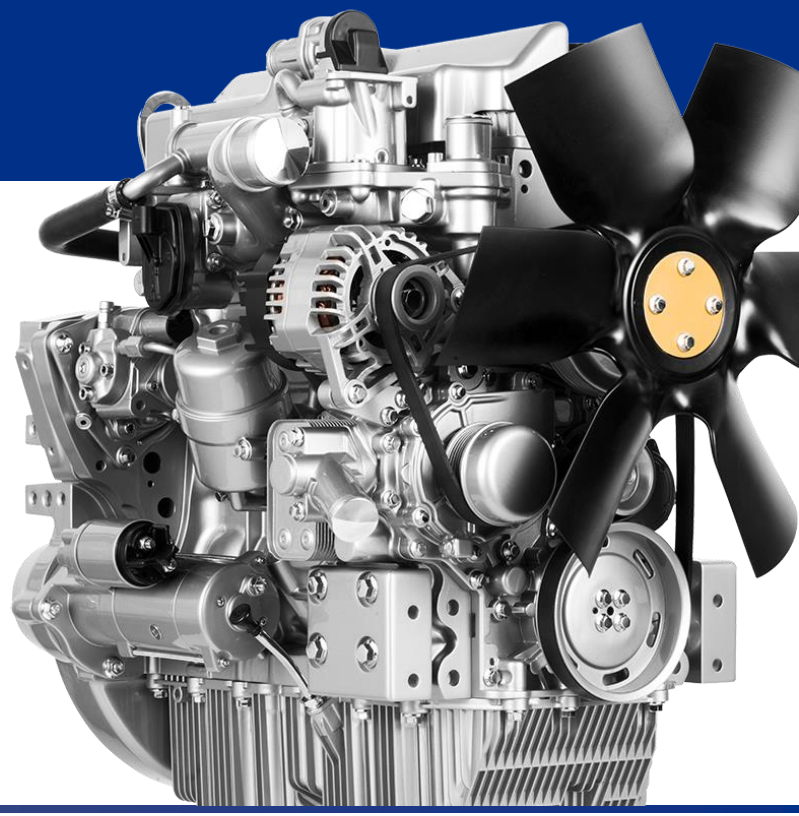
Perkins®

THE HEART OF EVERY GREAT MACHINE

Perkins Engines

Steve Mclone. Asia Pacific Service & Customer Support



The Future of Diesel Engines

Perkins®

Rental Focused, Rental Strong

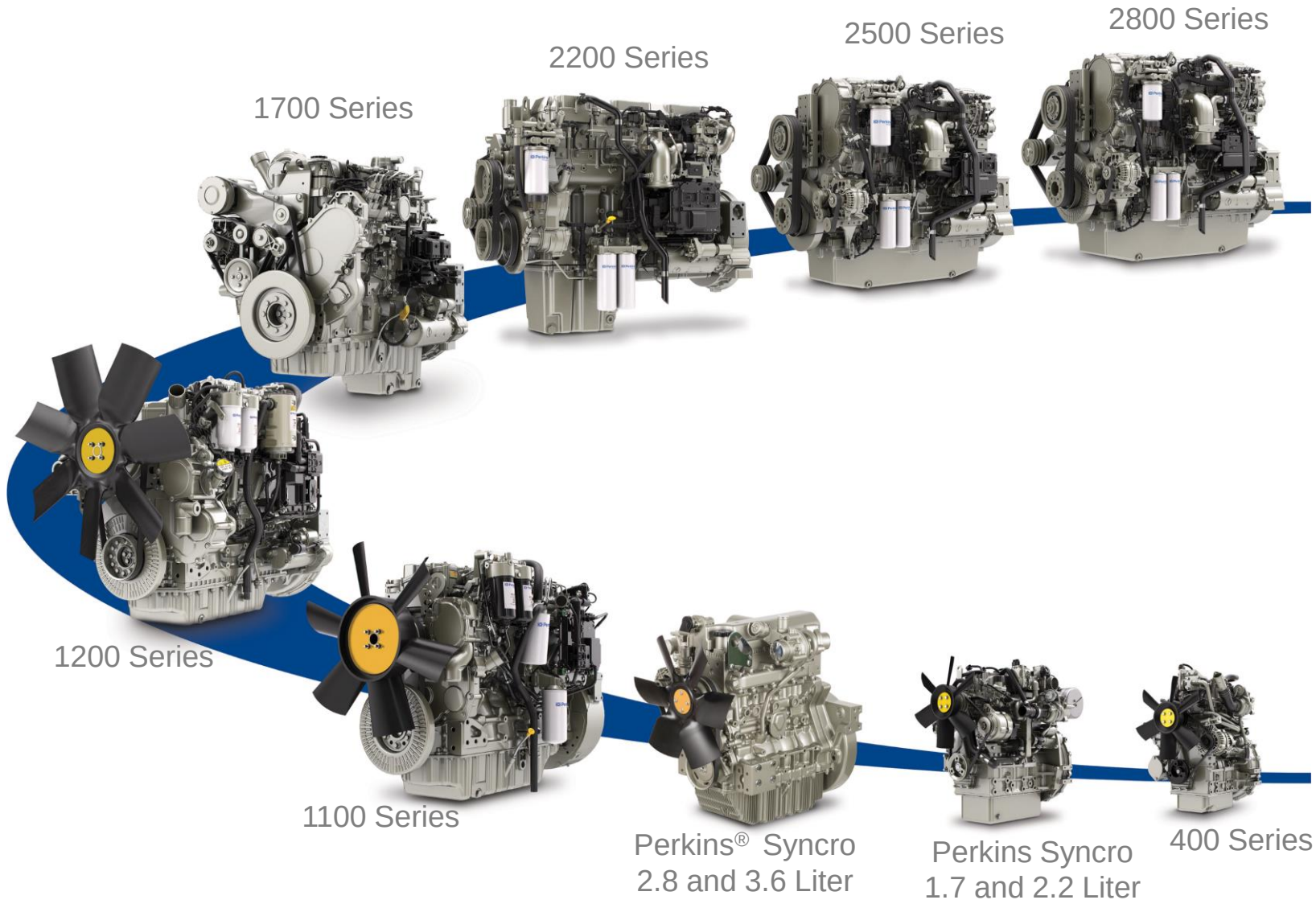
Heritage – Over **85 years** of engine manufacturing experience

Full range of engines for rental equipment 10kW - >560kW

Over 20 million engines manufactured since 1932

Powering over 5,000 machine applications

400 Series 40,000 running hours workhorse of rental



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Perkins Commitment to Rental

Our commitment to the highest standards in products and services we offer, is the rental channel's guarantee of satisfaction and our pledge to help maximize your ROI

Best in class logistics
Parts at your doorstep

Perkins parts online
The site for genuine Perkins parts

Continuous investment
in distribution network

Over 2800 outlets
Supplying parts, service and solution

Genuine Perkins Parts
available through SmartEquip™

Perkins® SmartCap and Perkins® My Engine App

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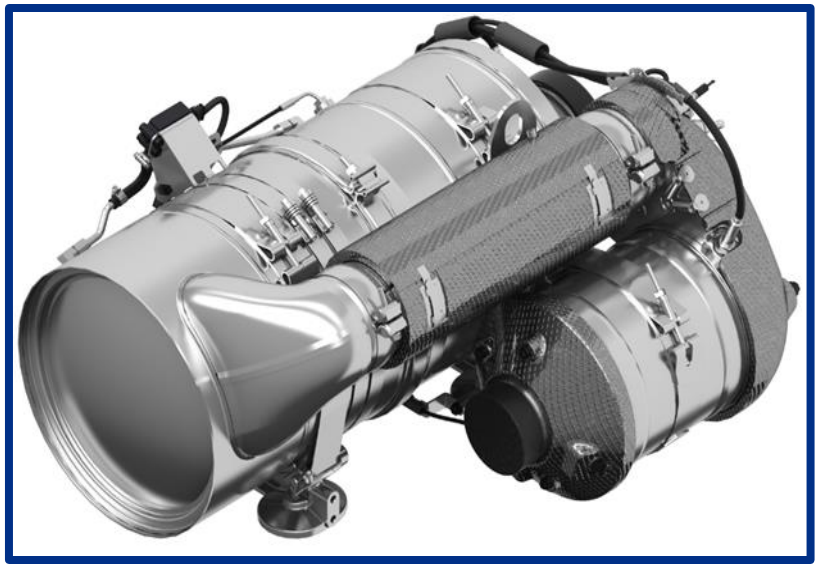
The Demand for Energy

Steve Mclone. Asia Pacific Service & Customer Support



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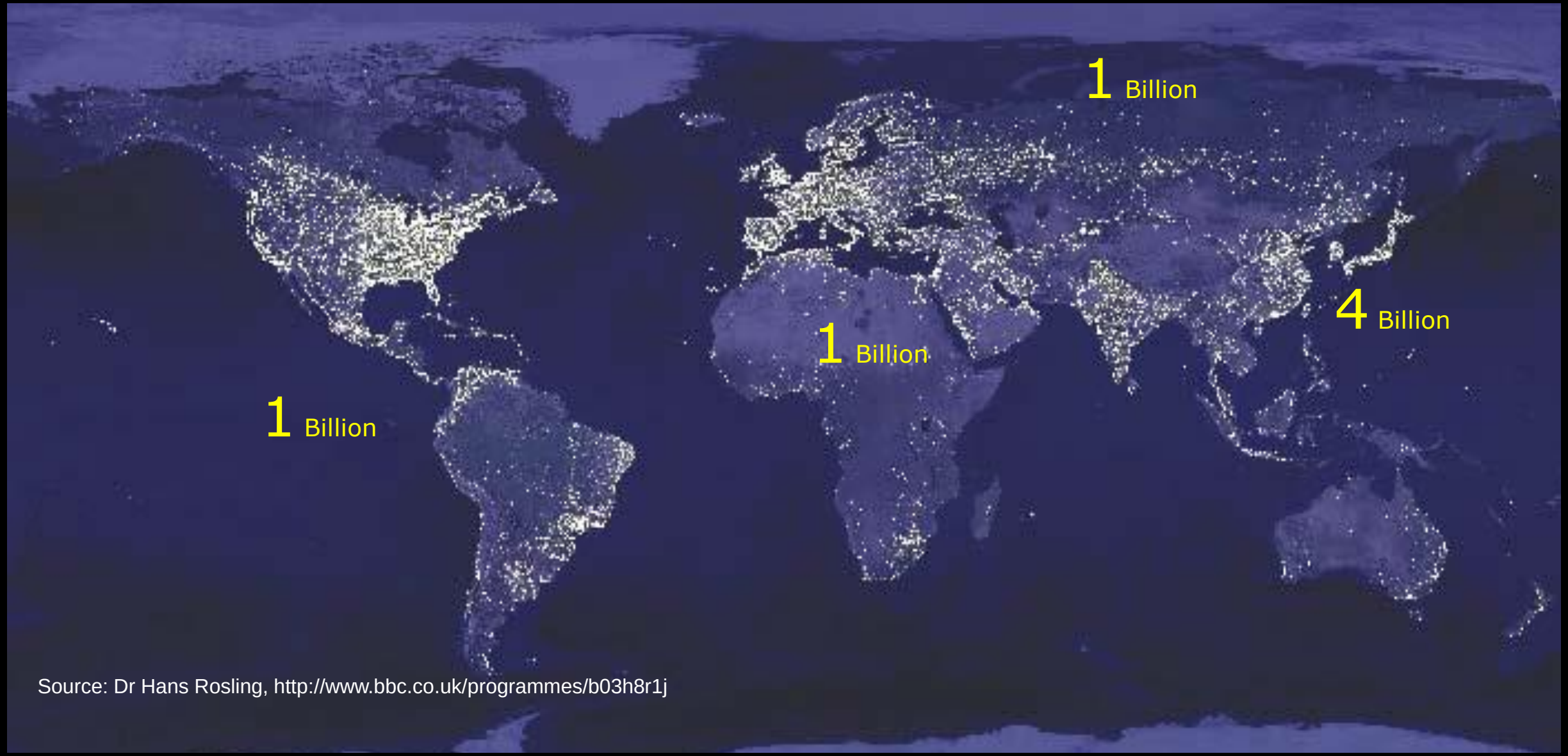
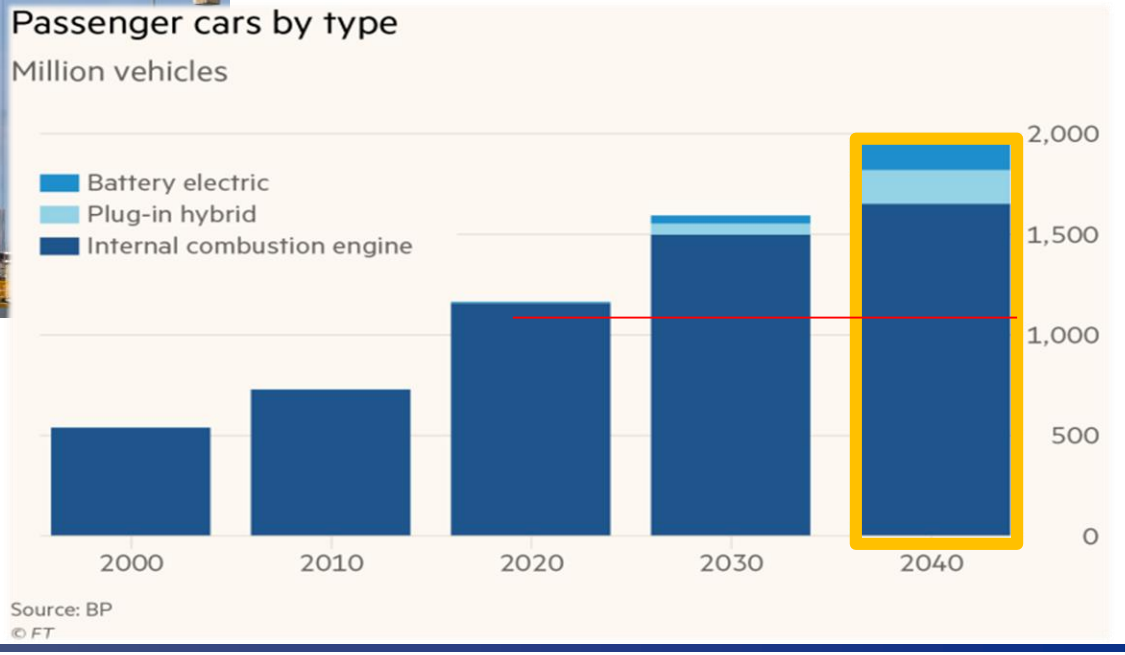
2011 Demand for Power: 7 billion people



Source: Dr Hans Rosling, http://www.bbc.co.uk/programmes/b03h8r1j

The Growth in Energy Demands

ENDLESS GROWTH



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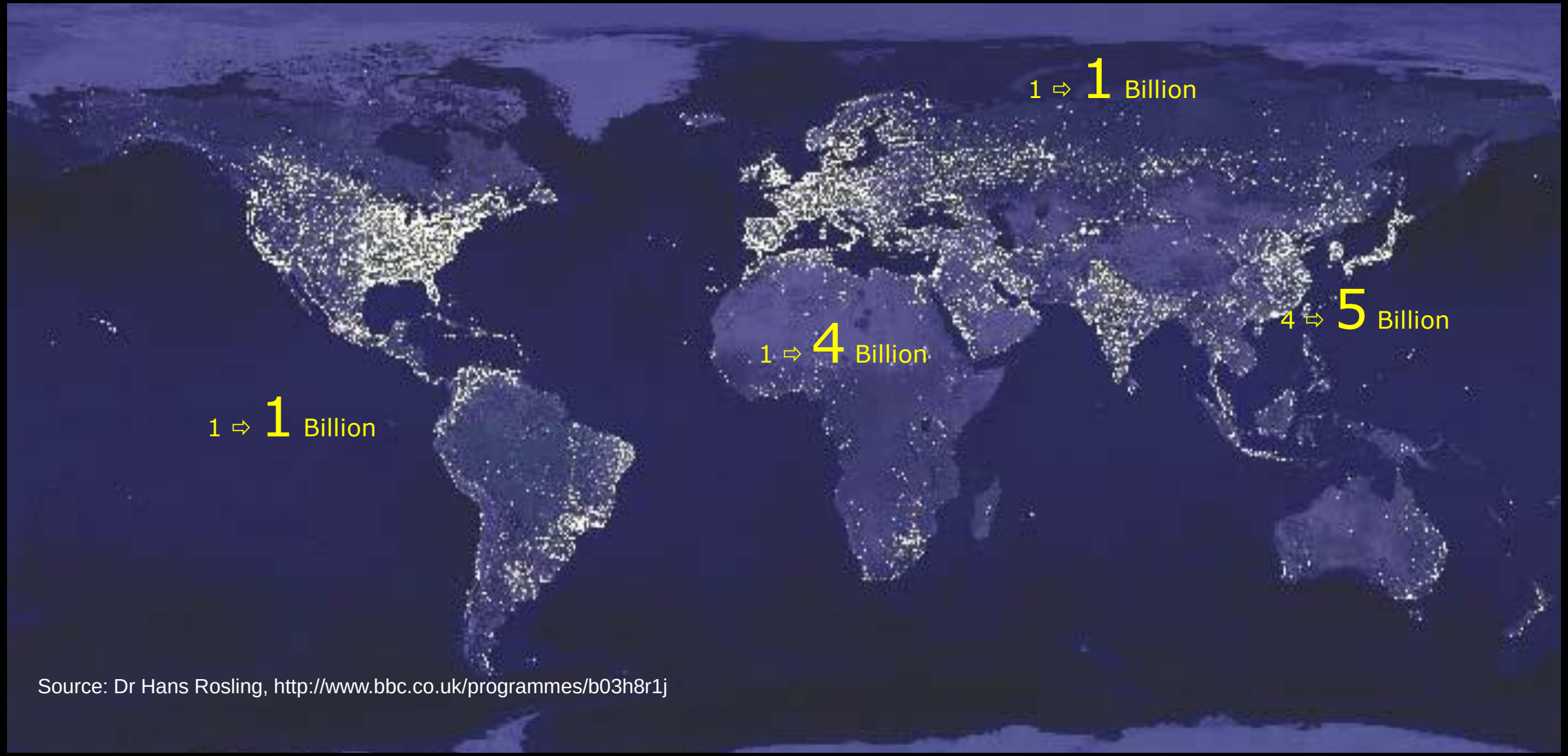
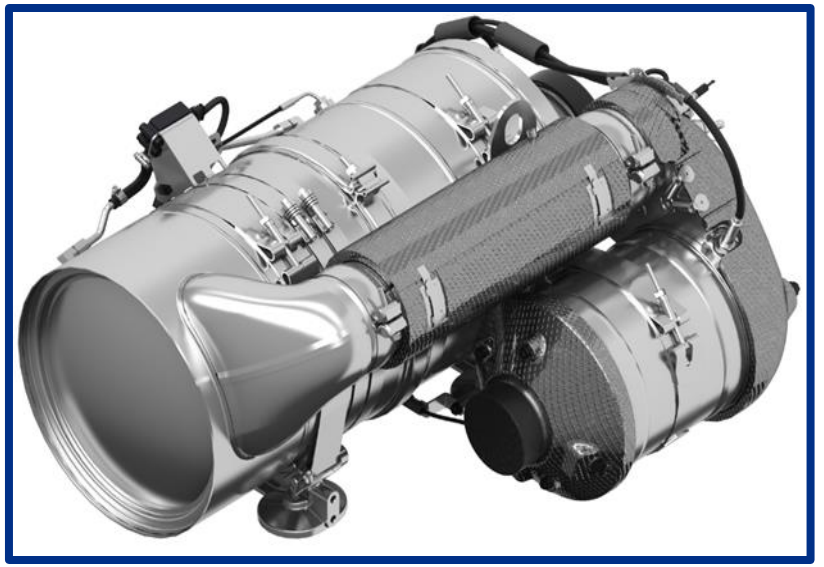
2100 Demand for Power: 11 billion people



Source: Dr Hans Rosling, http://www.bbc.co.uk/programmes/b03h8r1j

The Impact

Steve Mclone, Asia Service & Customer Support.



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Global Environment

https://www.grc.nasa.gov/www/k-12/airplane/atmosphere.html

The Earth's atmosphere is an extremely thin sheet of air extending from the surface of the Earth to the edge of space. The Earth is a sphere with a roughly **12874**Km diameter; the thickness of the atmosphere is about **96**Km.

Growing Demand for Power

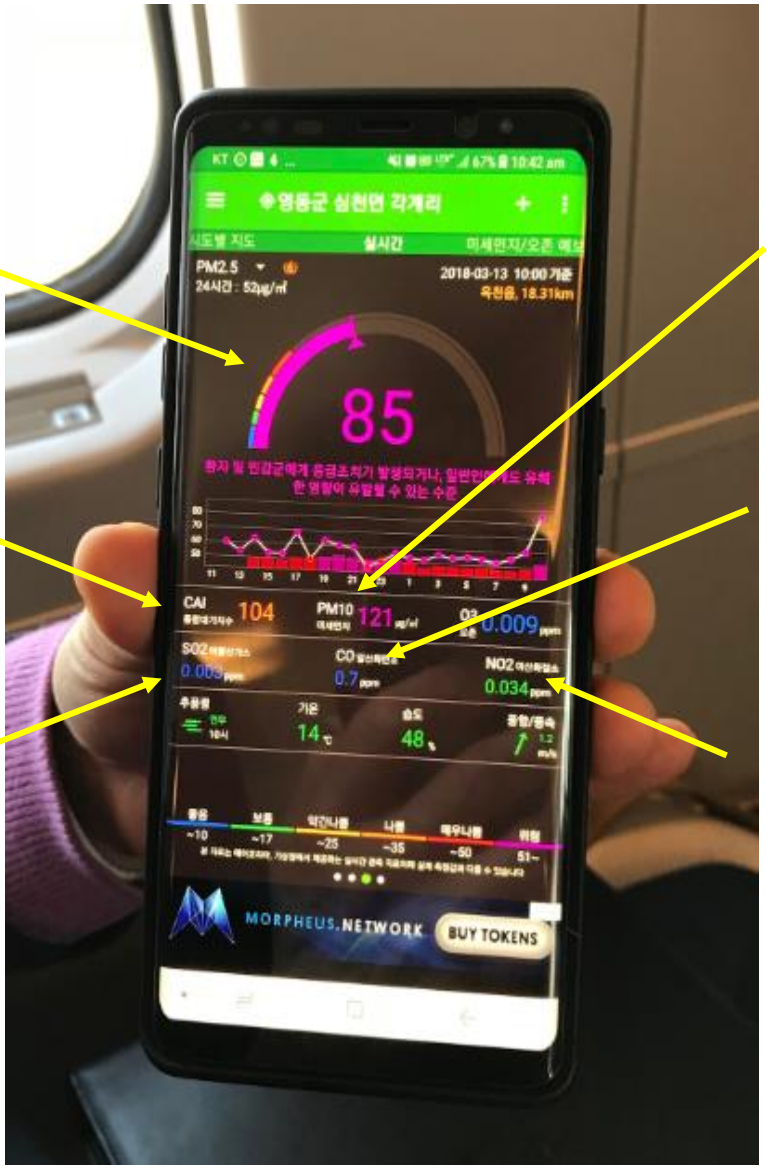
Emissions Standards target improved Local Air Quality

Local & Cross Border Air Quality

PM 2.5

Comprehensive Air Quality Index

SOx



PM 10

CO

NOx

Emissions Standards target improved Local Air Quality

Electrification

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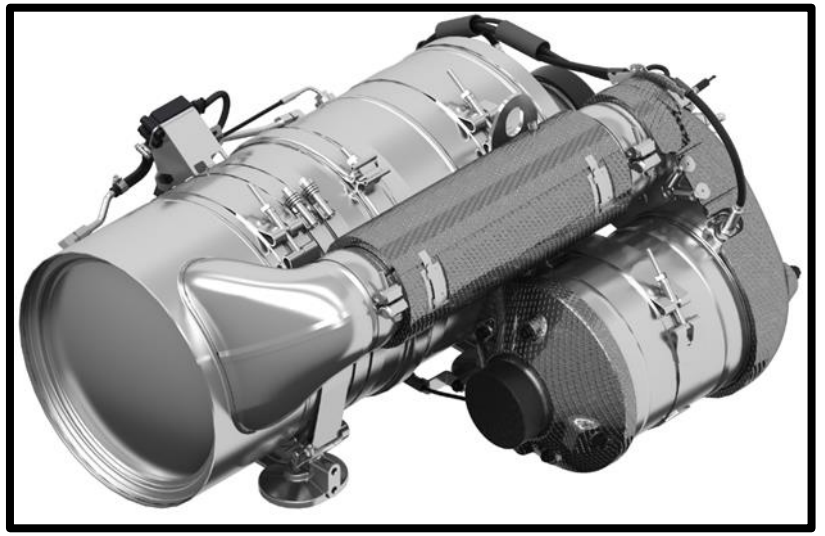

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Electrification – Power diversity

Source: Duncan Riding

http://www.weidemann.de/en/wheel-loader/model/5080/

3.0litres/180kW

3.4 litres/56kW

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Electrification – The Math

Range (hrs)

x

Maximum motor power (kW)

x

Load factor (%)

=

Battery energy (kW.hr)

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Off-highway Electrification: Direct Equivalence

Battery range: 10.0 Hours

X

Maximum motor power 56 kW

X

Load factor (60%)

=

335 KW.hr battery

Using todays Best battery technology:

Problem #1 Battery Cost $50,000

Additional Challenges

- Finite Battery Life
- Limited Temperature Range
- High Power / Weight Ratio 1700kg

Current Lithium ion Cost $150 kW/hr

Current Lithium ion Weight 200 Wh / kg

Current Lithium ion Life 3000 Cycles

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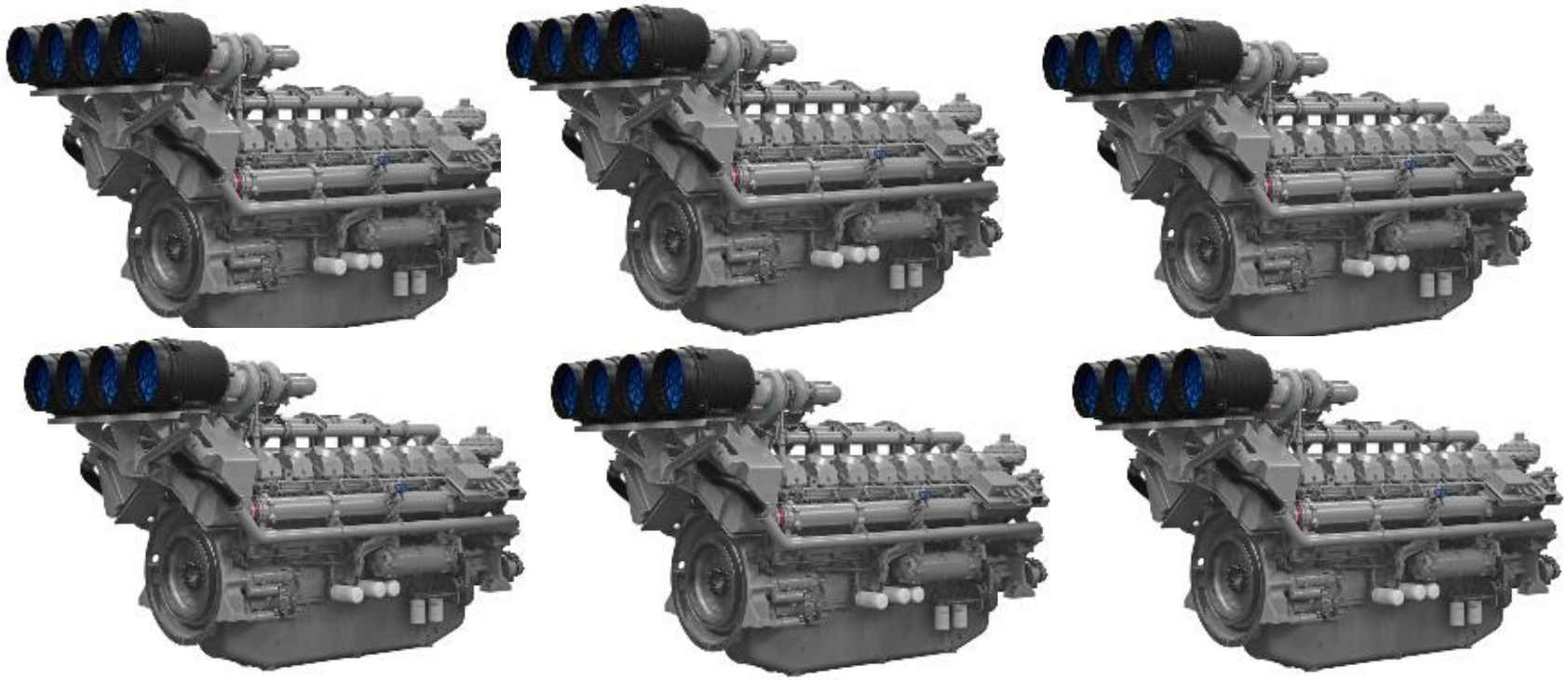
Off-highway Electrification: Charging



V16 4016 61TRG Diesel Engine

6 x Perkins 1.6mW Gensets to charge battery in 2 minutes

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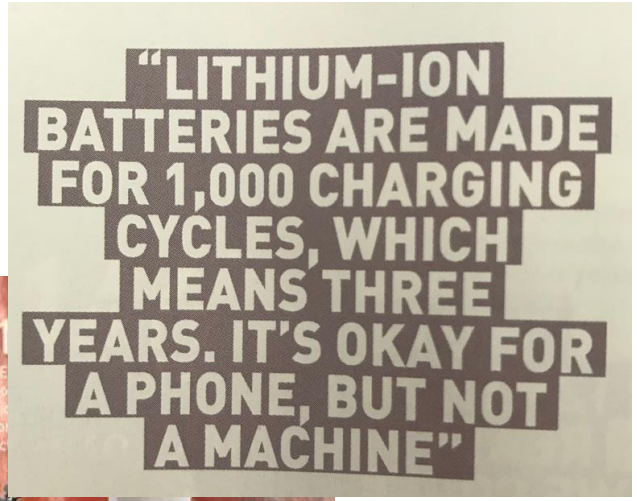
Sensationalism vs. Facts & Data?

free. But the limiting factor is battery capacity: with three hours charging time needed after every four hours of typical partial-load operation, for now at least John Deere has ruled out the of the SESAM becomin commercially viable pr



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Electrification Conclusion

Highway Vehicles

Niche Markets

All Machine Types

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Next Generation Diesel Engines

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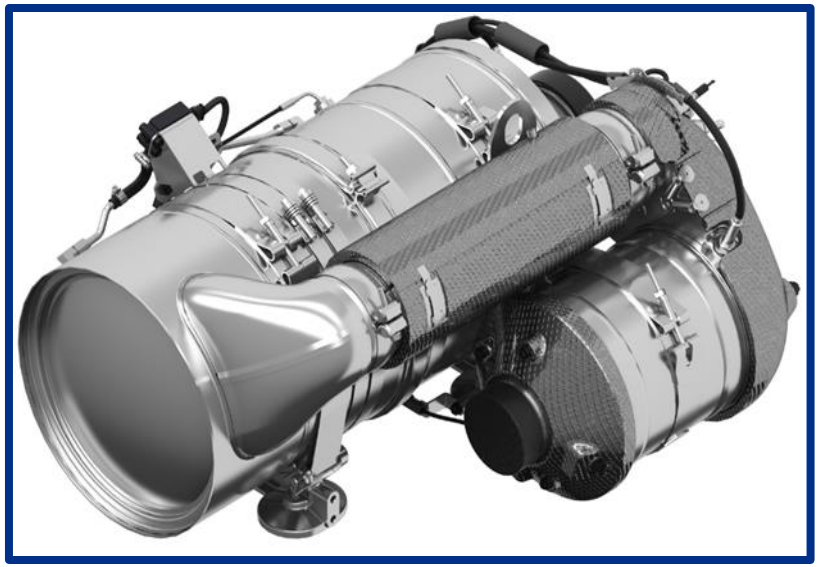

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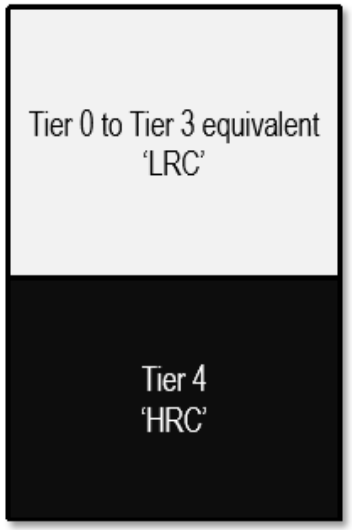
Multi Levels Emissions Standards

From
'higher' and 'lower' regulated territories



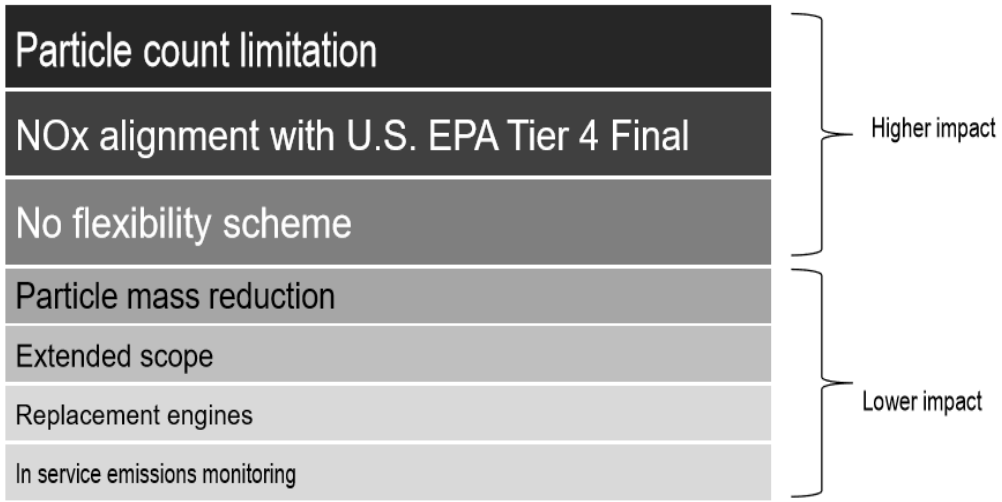
2015

To
multiple regulations by territory

2021

China NR4 and EU Stage V Regulations

Key requirement drives wall flow particulate filtration



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The Future - Clean Diesel Engines

75 kW / 100 hp engine

- Non-regula
- EU Sta
- EU Stag
- EU Stage I
- EU Stage

1999

20 Years

2019

S

also limits the number of P [illegible] >0.023µm

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PM Reduction Example

75 kW / 100 hp engine releases 6kg of PM:

1999

- Non-regulated = 2 months

20 Years

- EU Stage I ≈ 4 months
- EU Stage II ≈ 8 months
- EU Stage IIIB/IV ≈ 10 years

2019

- EU Stage V ≈ 20 years

Stage V & China NR4
also limits the *number* of Particles >0.023µm

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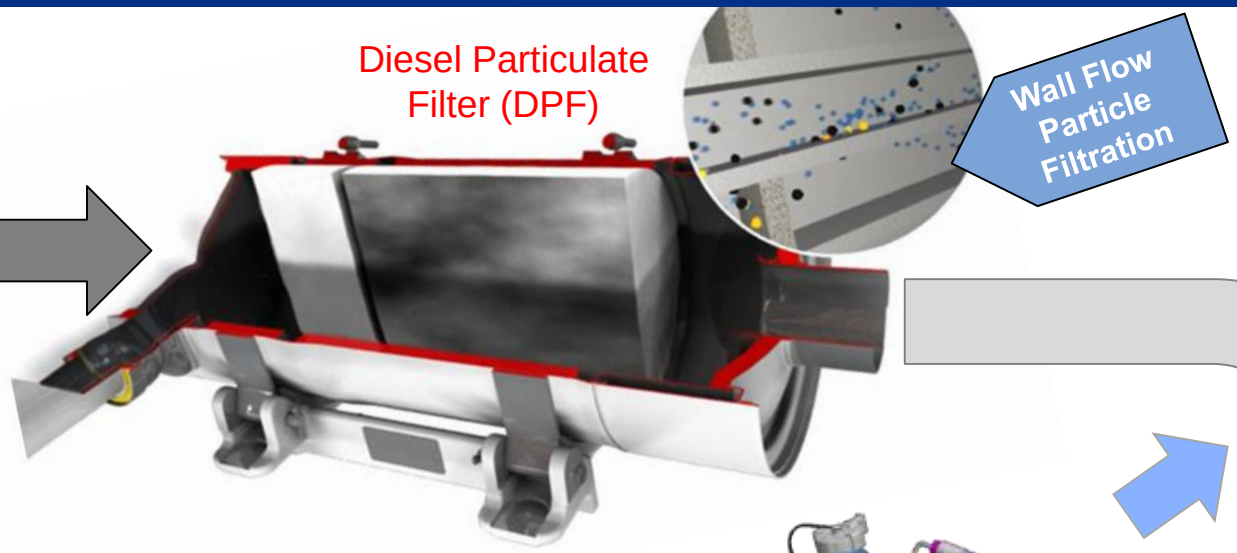
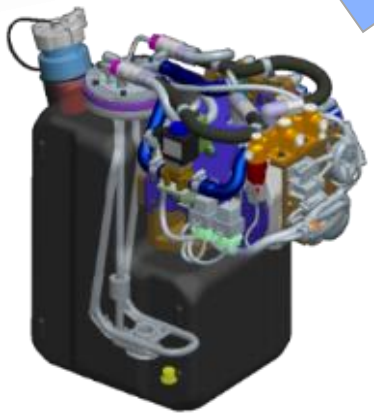
The Clean Up Operation

Diesel Particulate Filter (DPF)



95% NOx Reduction
98% PM Reduction



Diesel Exhaust Fluid (DEF)

Selective Catalytic Reduction (SCR)

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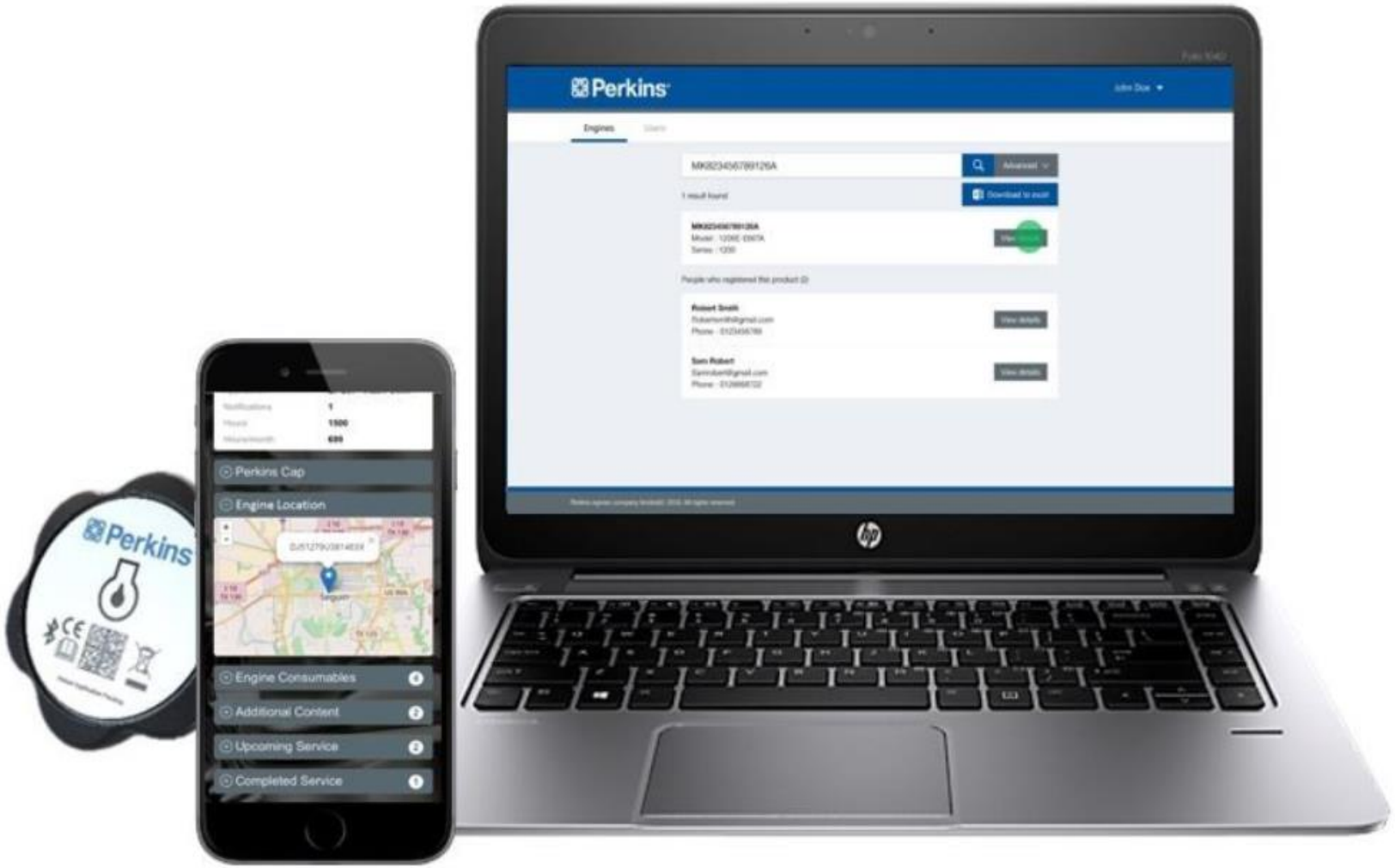
Connectivity & Service Responsiveness



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Future of Diesel Engines Conclusion

More Stringent Global Regulations

Connected Engines Enabling
Remote Optimization & Data Mining

Diesel Engines = Clean Technology

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Recap

- Population Growth is Increasing Energy Demands
- Electrification Technology Suits Niche Markets & Low Load Factors
- Diesel Engines Are Increasingly Clean & Increasing Complex
- Engine Connectivity Increases Uptime & Enables Rapid Service
- Diesel Engines Have A Place In The Rental Markets of the Future

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THE HEART OF EVERY GREAT MACHINE

Power, service and productivity in
exactly the way you want it