

Commercial Vehicle & Off-highway Low Carbon Technology Roadmap

Initial assessment of categories & duty cycles provides four main commercial/off-highway vehicle classifications:

**Duty Cycle and classifications are a function of application rather than vehicle or product
However, typical applications and characteristics are listed below:**

**Typical
Engine
Disp.**

Light duty vehicle,
up to and including
3.5t GVW

Up to ~120 kW

1.5 – 3 litres



**Light duty
delivery**

Medium duty vehicle,
From 3.5 – 26t GVW
Rigid & drawbar

From ~ 90-200 kW

4 – 7 litres



**Medium duty
truck**

Bus/Coach – Heavy
Duty engine but
lighter duty cycle

From ~ 180+ kW

4 – 12 litres



Bus

Heavy duty vehicle,
From ~ 26 – 44t GVW
Rigid & drawbar

From ~ 180+ kW

7 – 16 litres



Heavy duty truck

Sample Off-Highway Applications



**Skid Steer
Loaders/Excavators**



Backhoe Loaders



Mobile Cranes



**Crawler
Excavators**



**Fork lifts &
Telehandlers**



**Compact Wheel
Loaders**

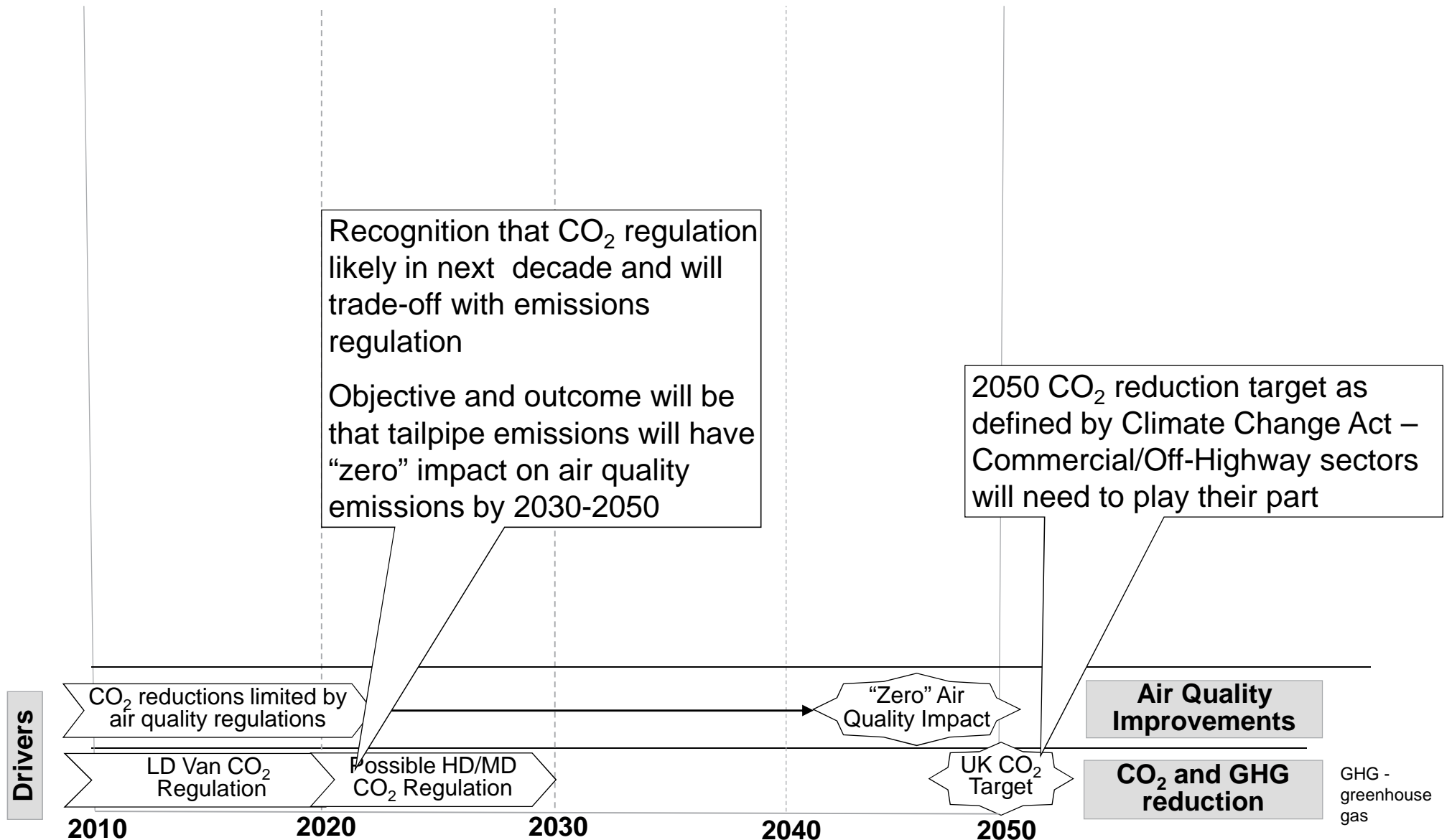


**Tractors – Utility
& 4WD**

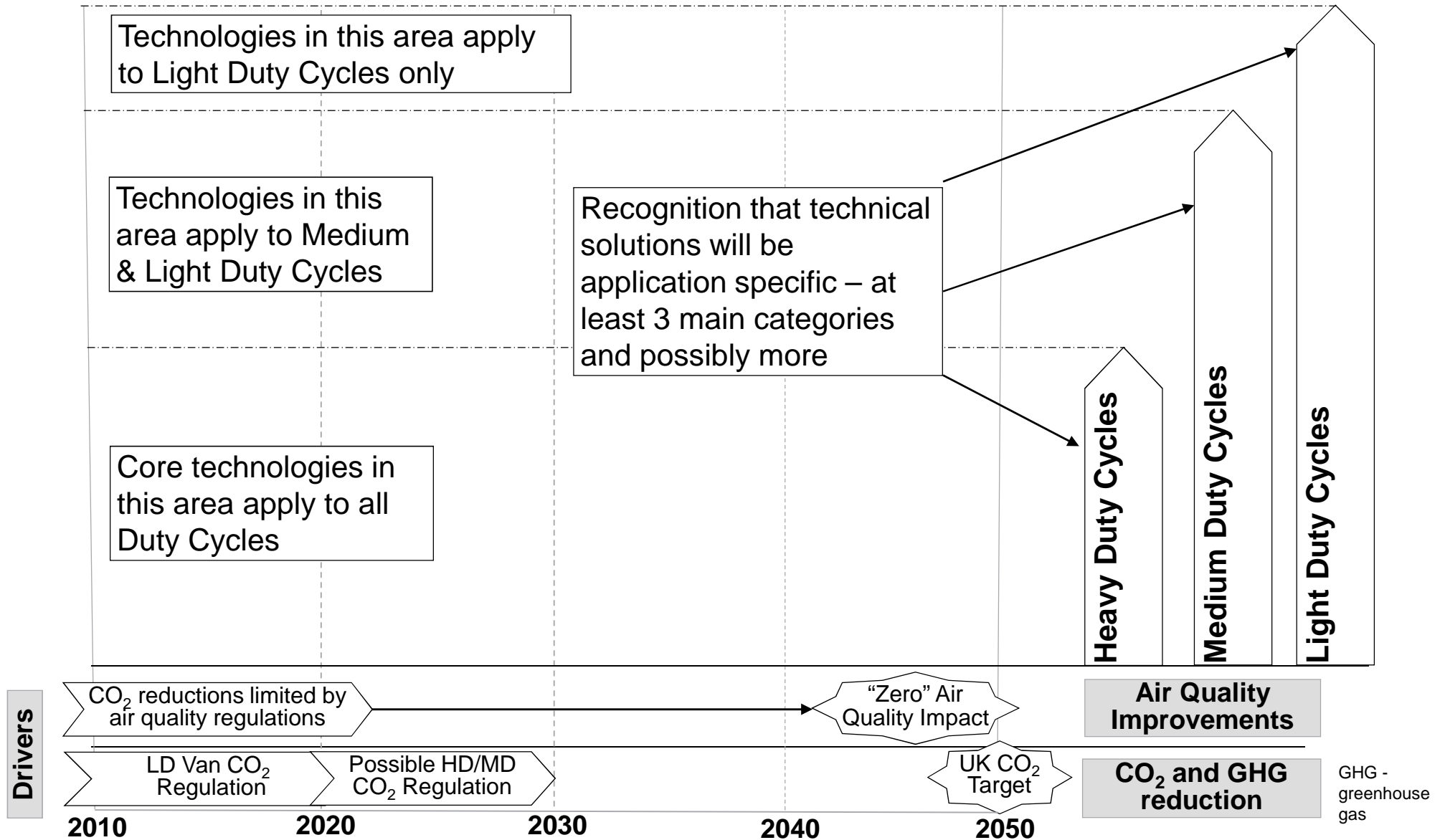


**Wheel / Track
Bulldozers**

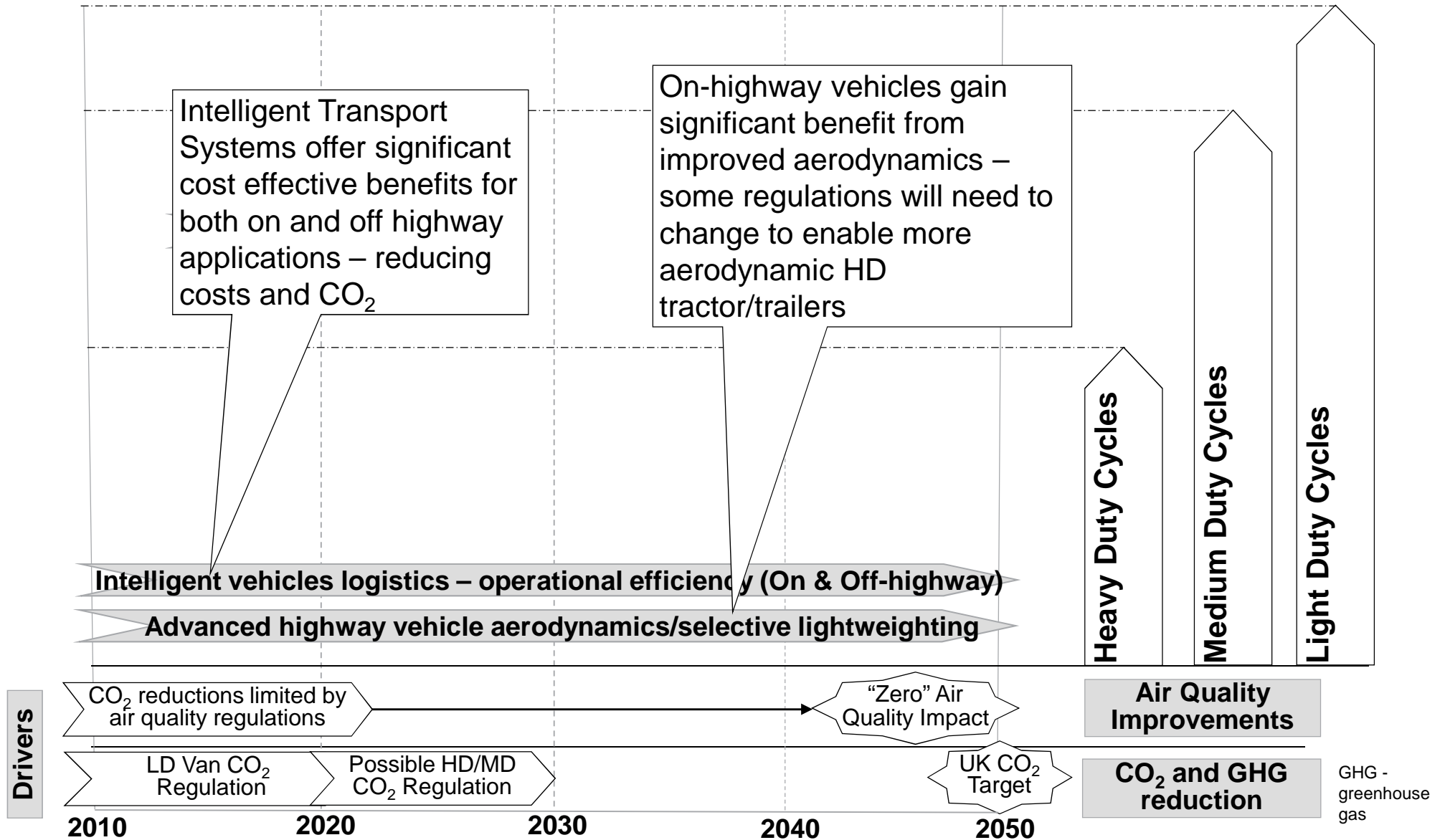
Low carbon Commercial Vehicle & Off-highway roadmap has parallel technology streams depending on duty cycle



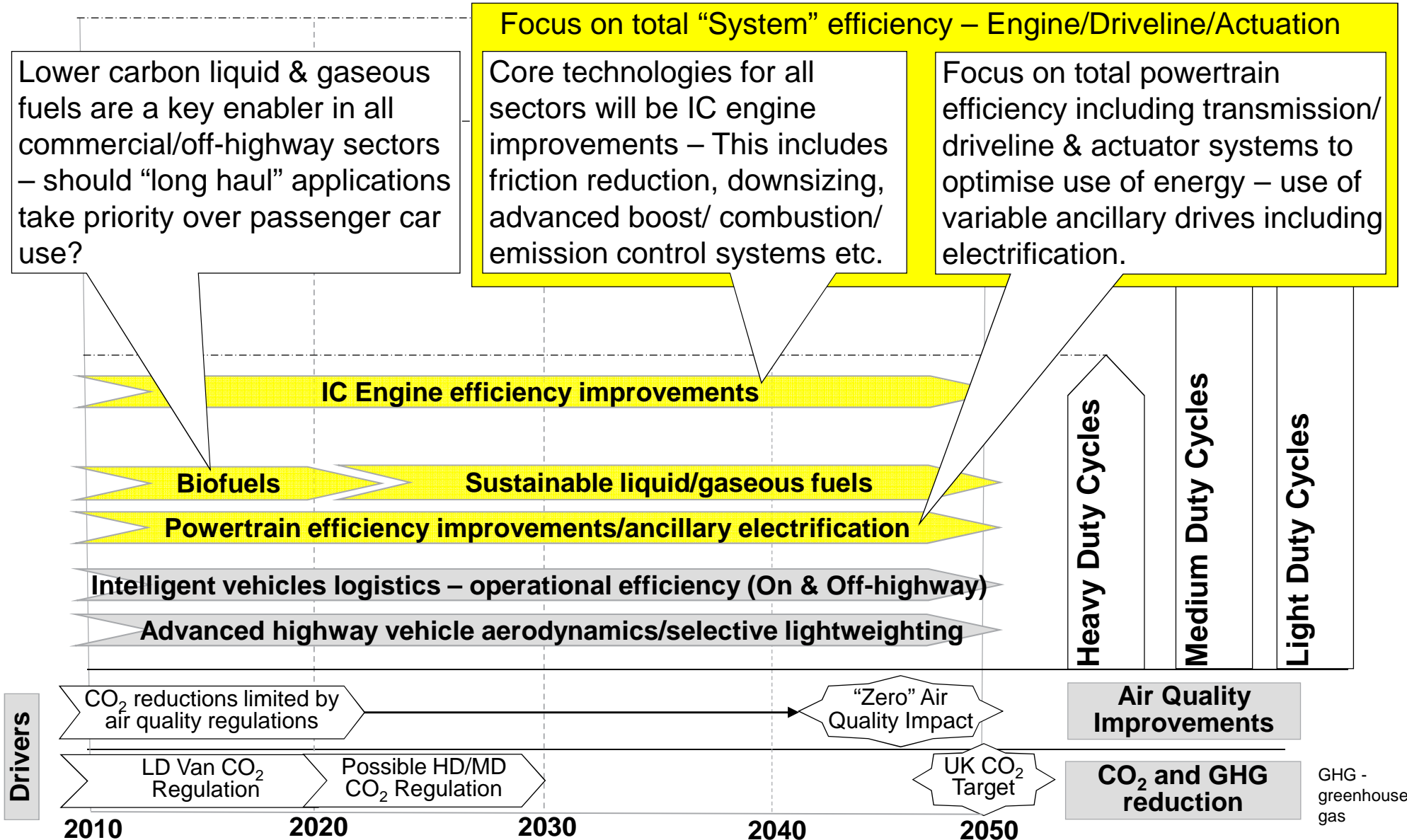
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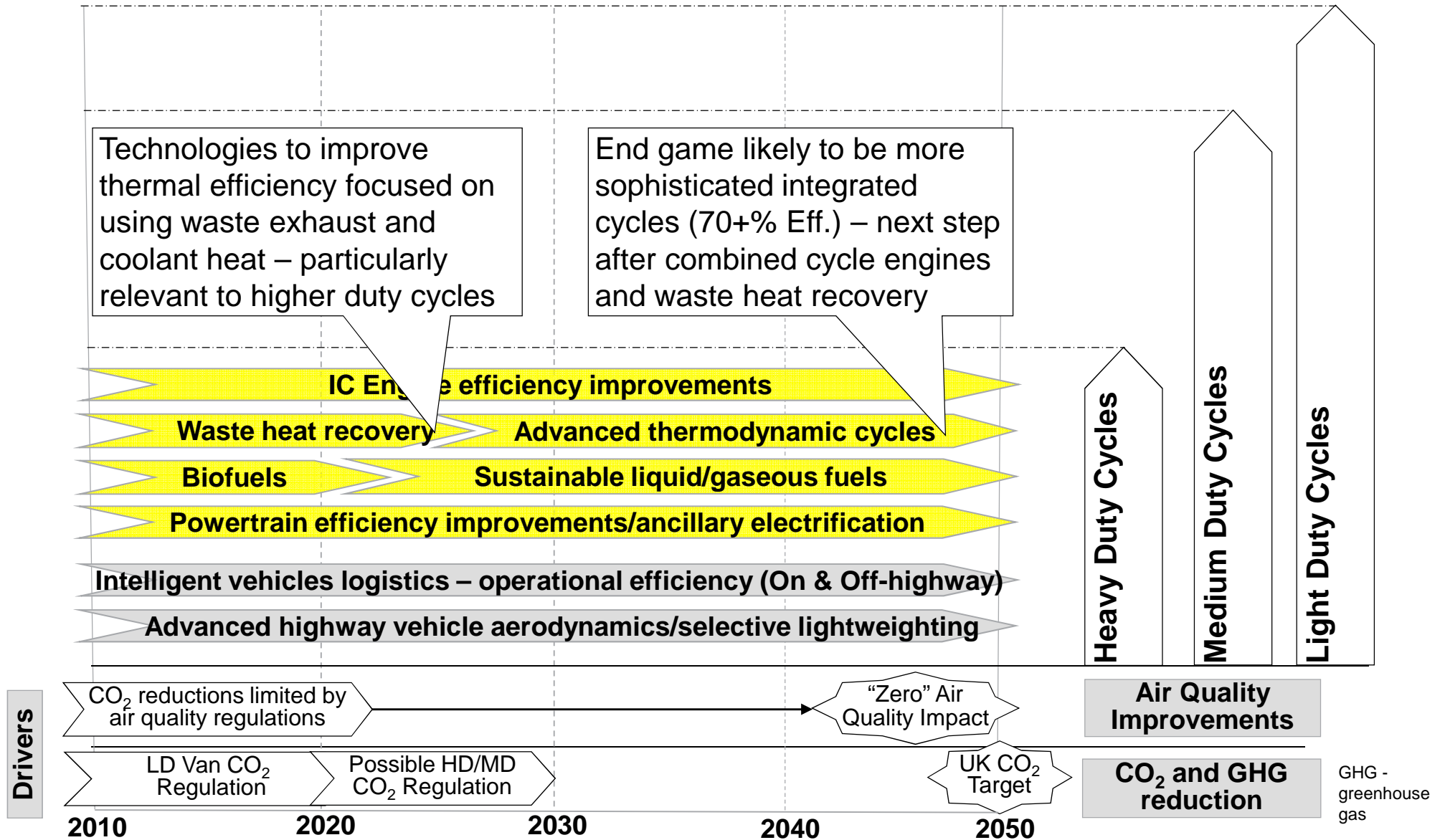
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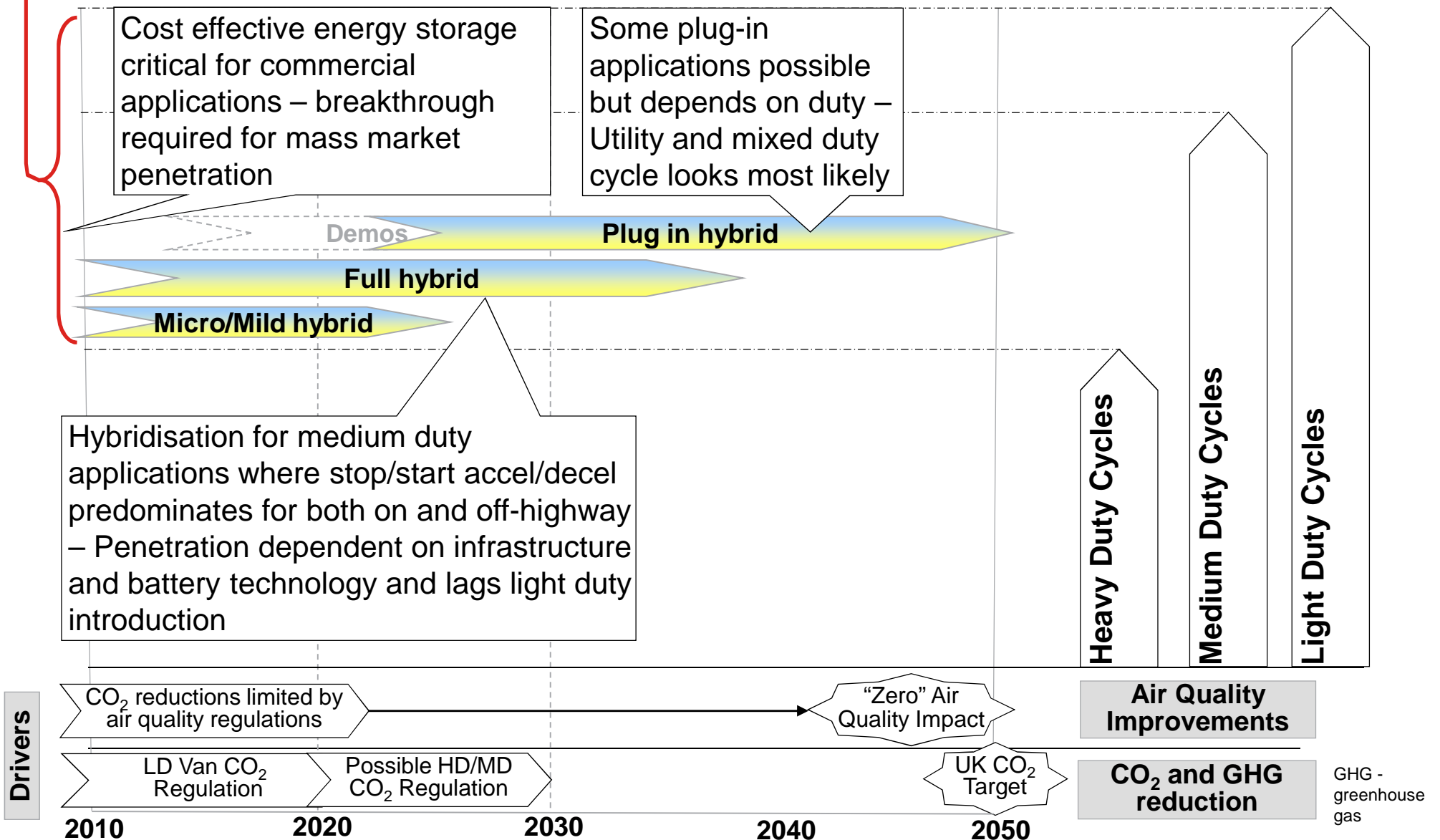
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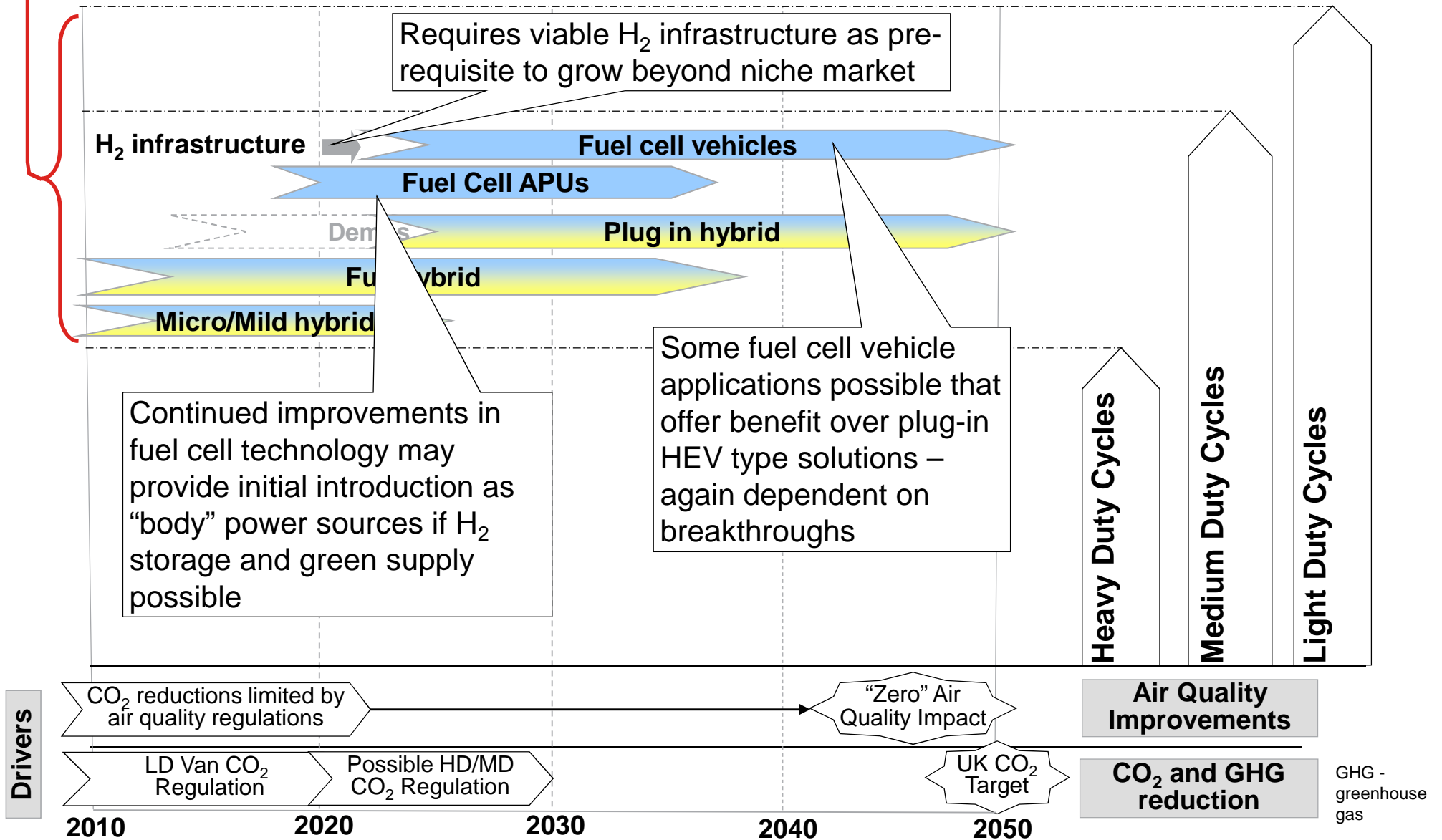


Breakthrough in energy storage



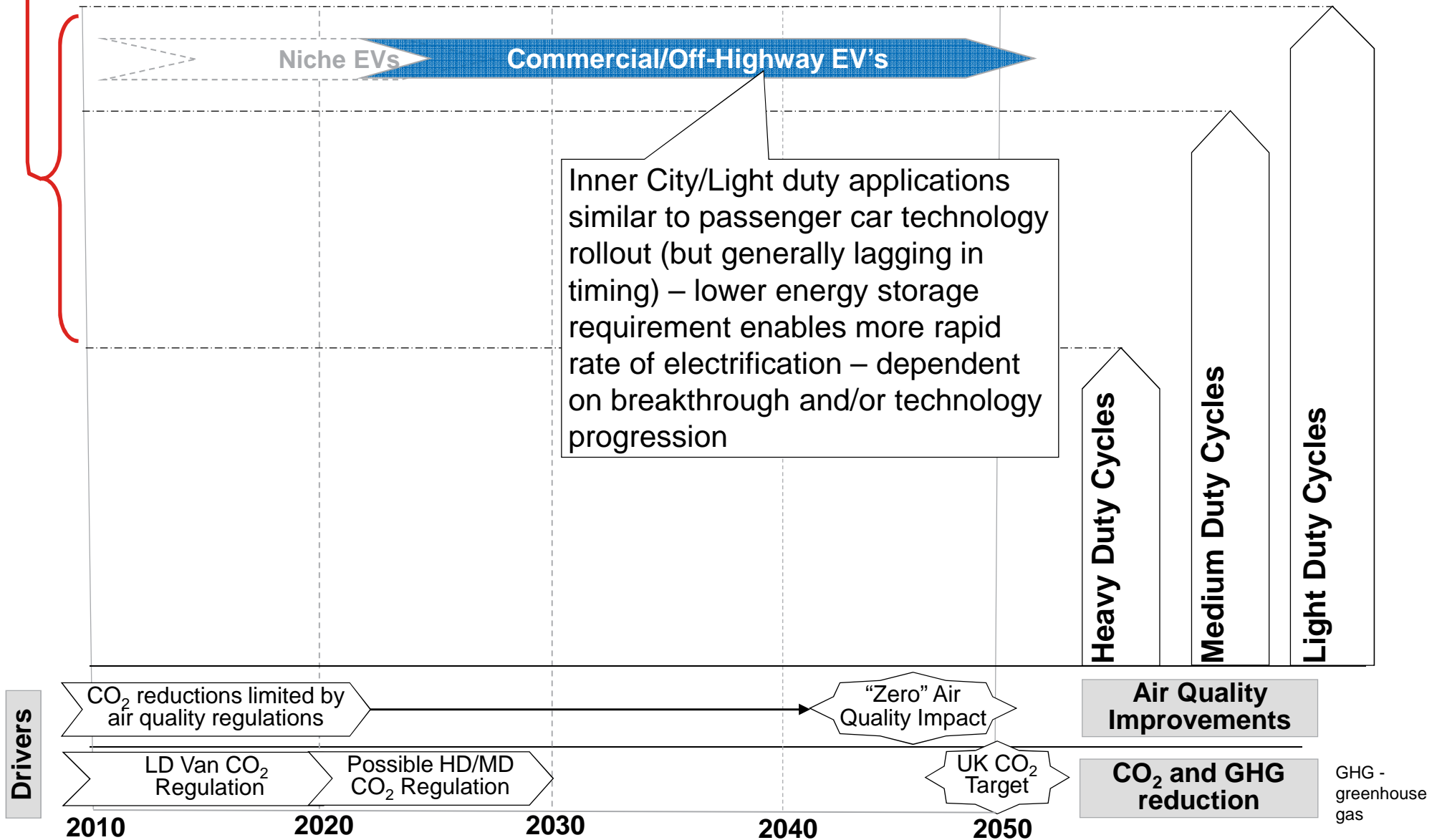
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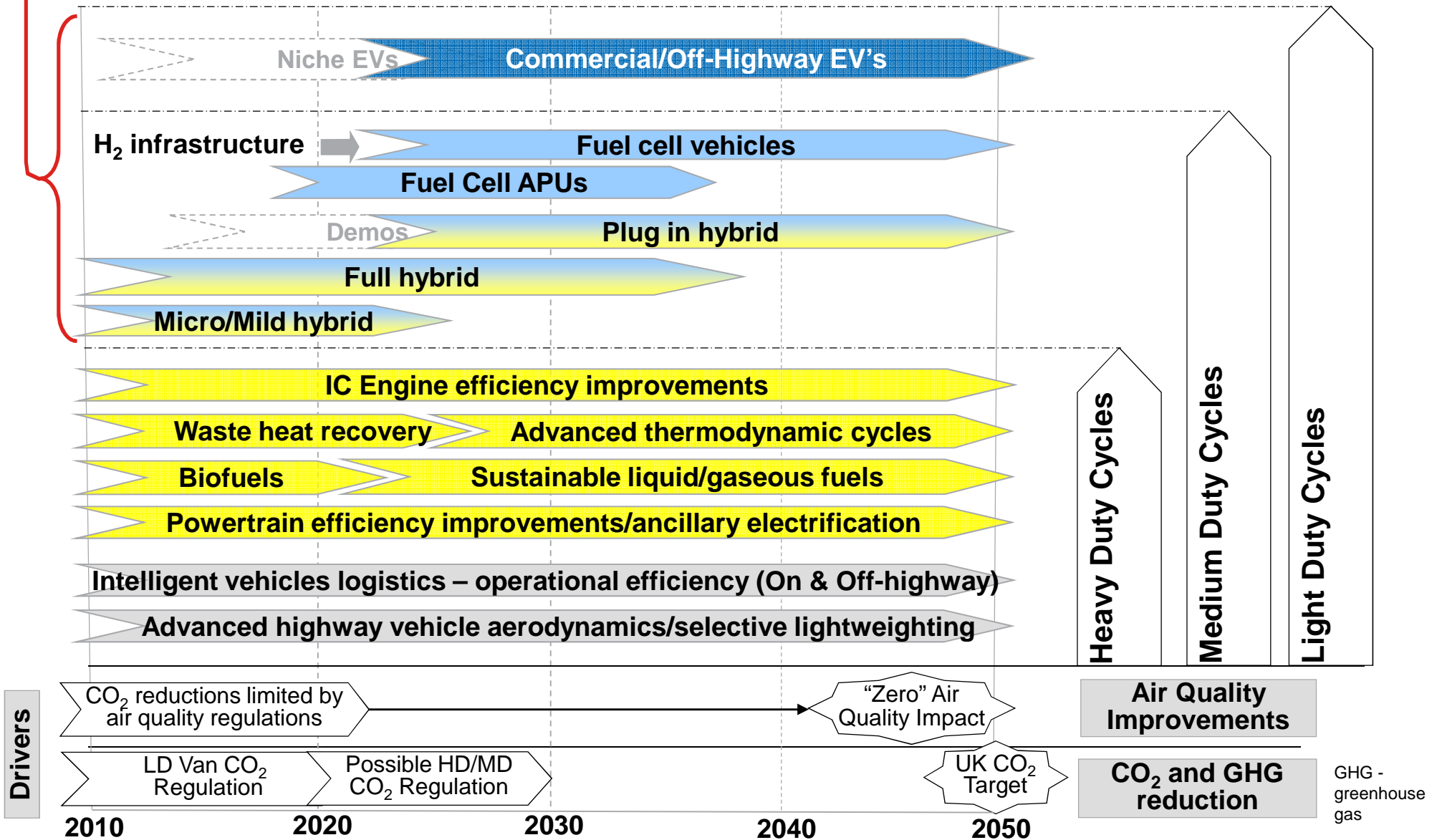
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Breakthrough in energy storage



Commercial Vehicle & Off-Highway share a similar future roadmap - CO₂ reductions require efficient combustion engines, low carbon liquid fuels & intelligent logistics



Key Points related to the low carbon Commercial & Off-Highway Vehicle roadmap

- Whilst there are many common technologies shared between on and off-highway vehicles with similar technical and commercial barriers, the relevance to specific products will be based on many other factors such as:
 - Specific duty cycle & overall power requirements
 - Re-fuelling & range requirements – particularly for higher power & heavy duty cycles
 - Total cost of ownership
- Reducing CO₂ emissions for long haul vehicles & high power products in the foreseeable future will be dependent on improvements in conventional powertrains & transmissions
 - A key requirement will be affordable & sustainable low carbon liquid fuels
- The shift to alternative powertrains and transmissions such as electrification will be limited to light duty products and short range/endurance products but will benefit from technologies developed for the passenger car market
- Centrally re-fuelled vehicles and products may offer opportunities for the introduction of low carbon fuels or electrification where this can be cost effective
- There are clear opportunities & benefits available from an integrated approach and the introduction of “Intelligent Logistics” for both on-highway & off-highway vehicles