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research & innovation

Sustainable Transport

Challenges and Opportunities in a Carbon Constrained World

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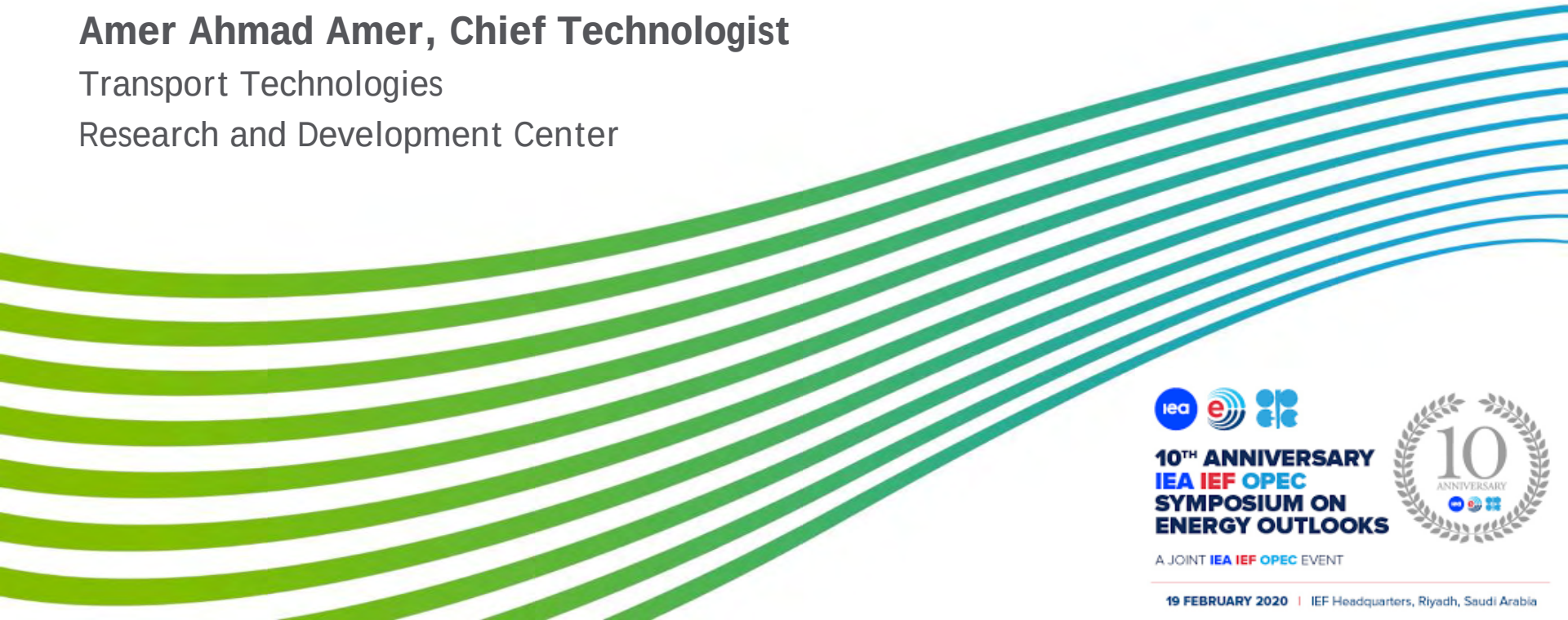
Transport Technologies

Research and Development Center

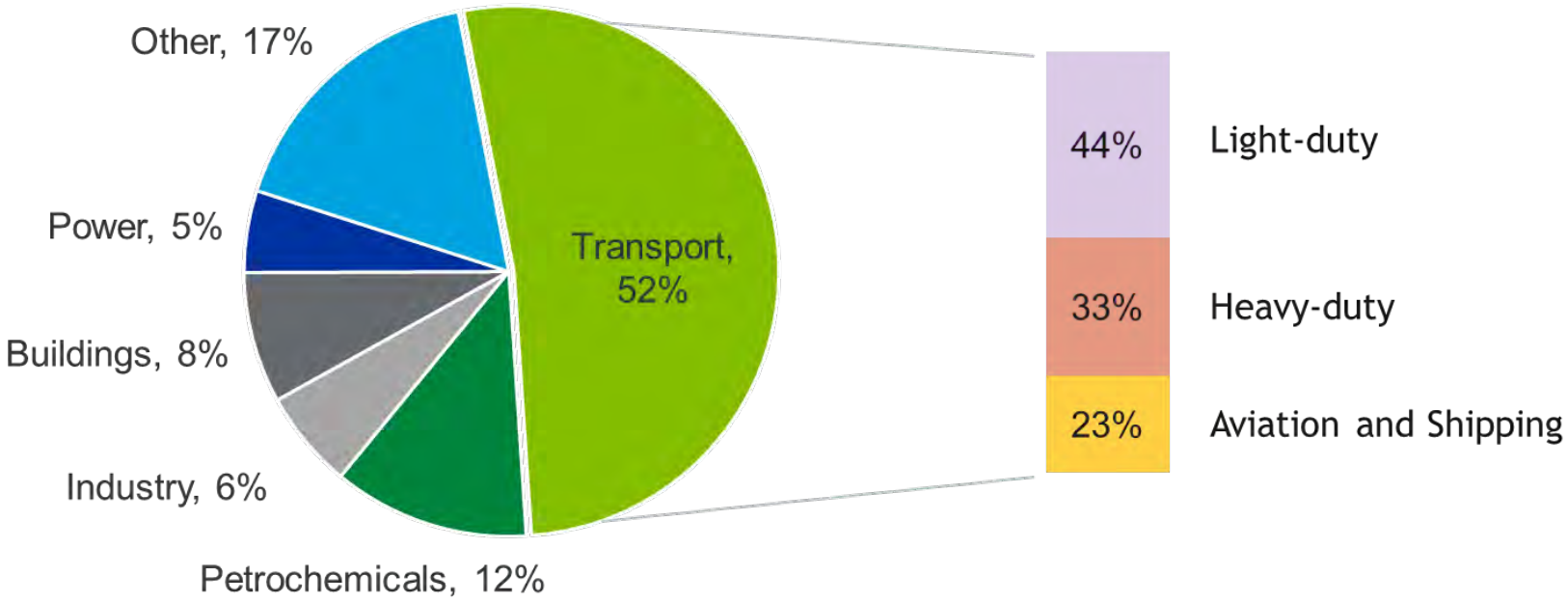


10TH ANNIVERSARY
IEA IEF OPEC
SYMPOSIUM ON
ENERGY OUTLOOKS

A JOINT IEA IEF OPEC EVENT

19 FEBRUARY 2020 | IEF Headquarters, Riyadh, Saudi Arabia

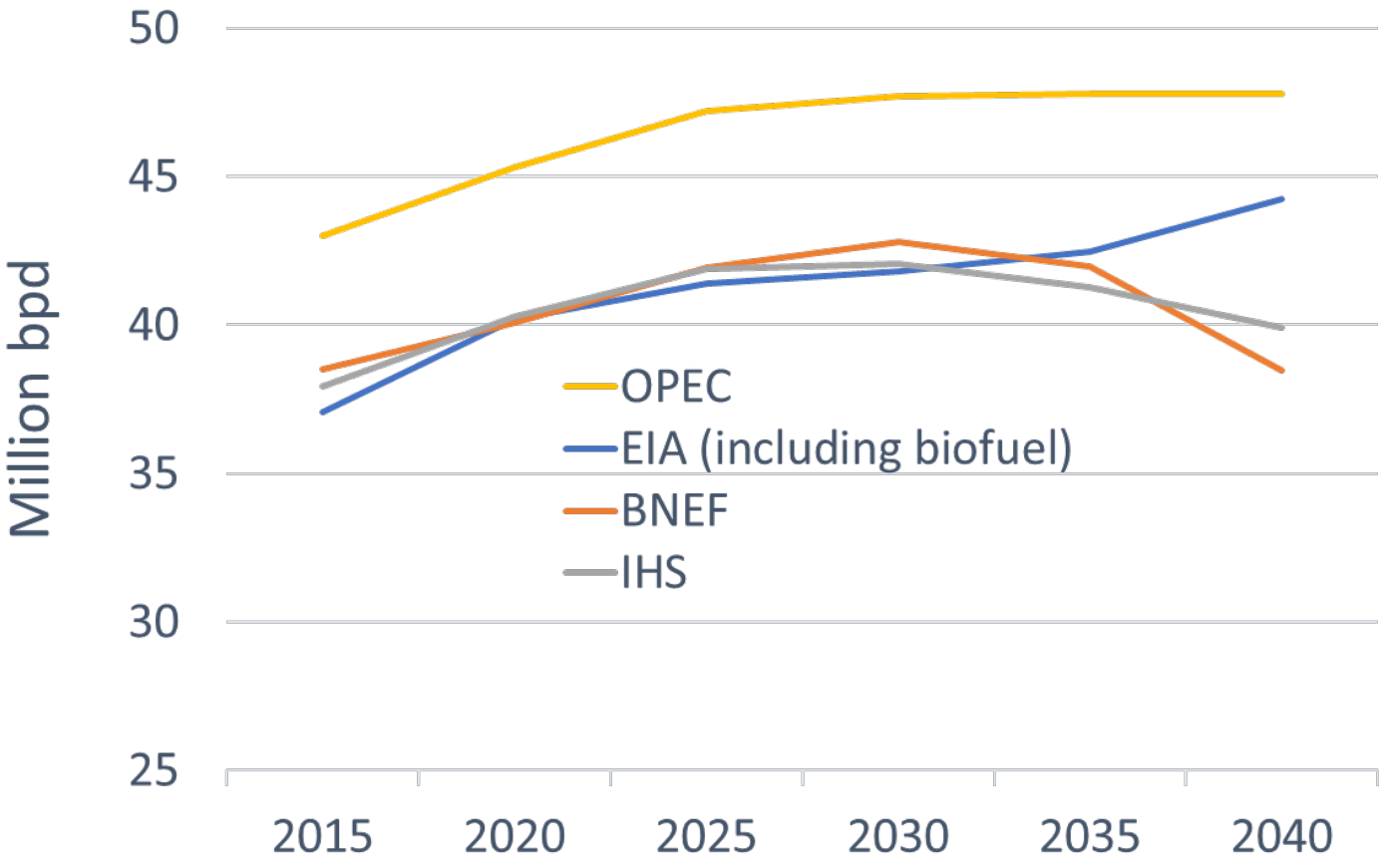
Petroleum and transport are closely linked



Today…50% of petroleum goes to transport fuels AND 95% of transport energy comes from petroleum

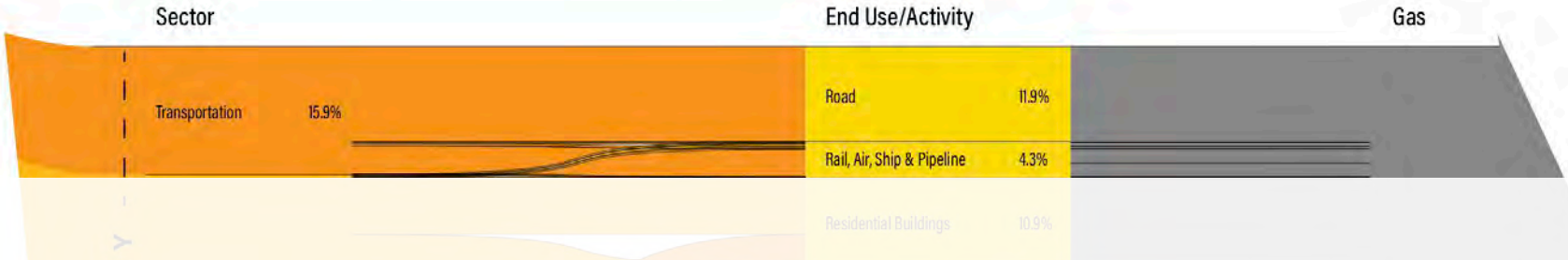
Source: IEA World Energy Outlook 2018

Future demand driven by population and energy access

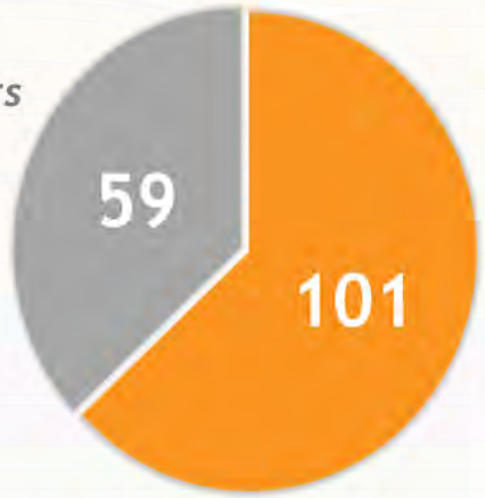


Energy, climate and health concerns must be addressed to ensure transport sustainability

60% of all GHGs commitments are transport related



Global Paris Agreement commitments (as of Dec 2018)*

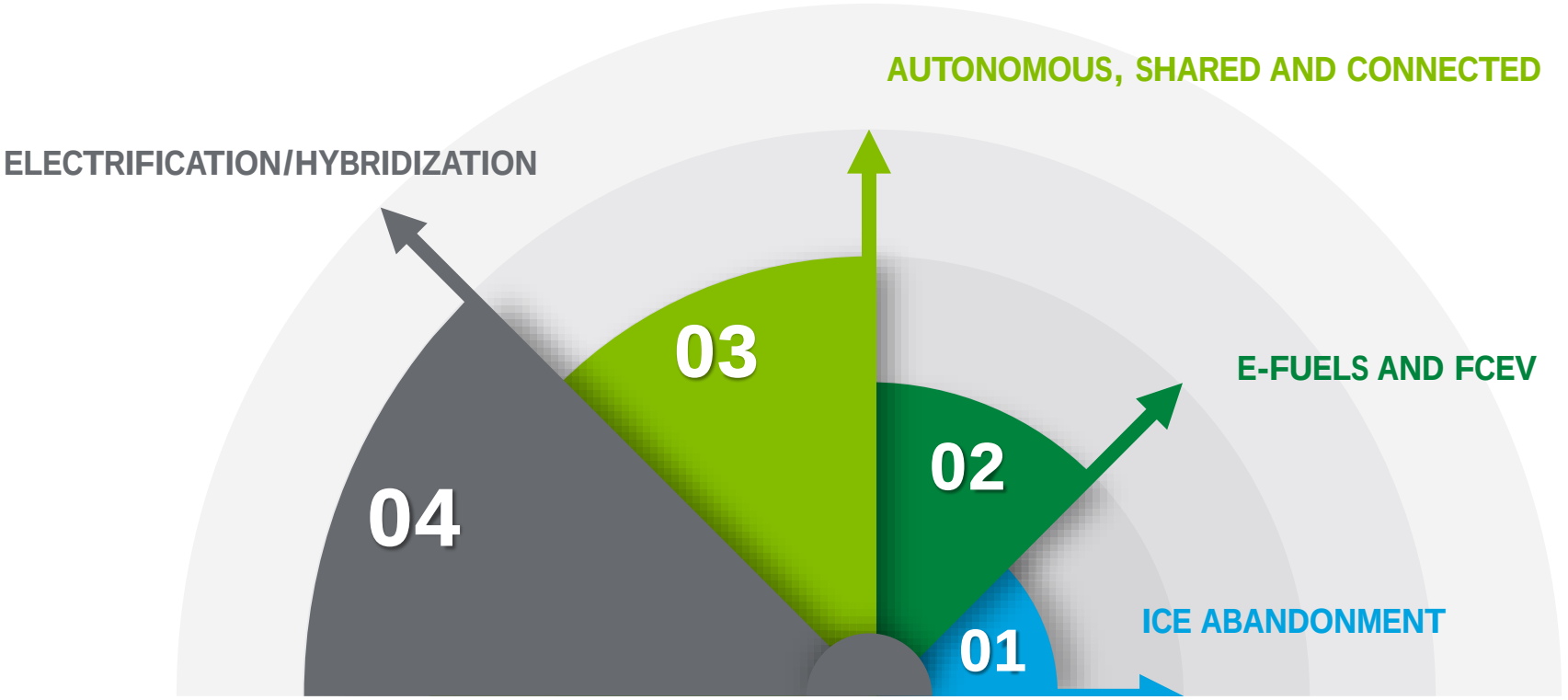


*160 national policy programs

Transport sector bears a disparate climate change burden – Promotion of alternative energies and powertrains

Figure from https://www.wri.org/resources/data-visualizations/world-greenhouse-gas-emissions-2016
* Data from IHS Markit (https://ihsmarkit.com/research-analysis/climate-change-regulations.html)

Dominant transport trends – A number of "Silver Bullets"



Right technology mix for the right sector, at the right time, and in the right location yields maximum impact

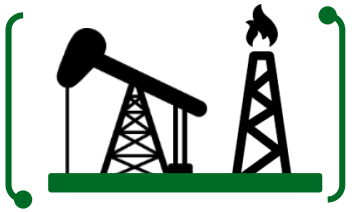
Technology agnostic approach to address climate concerns

Regulated

Vehicle Emissions

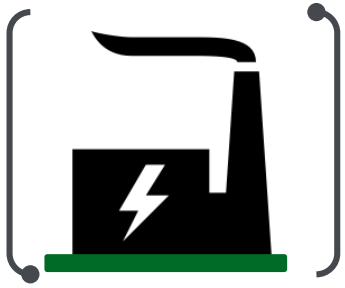
Well to tank and/or grid to tank | Tank to wheels | Production and Recycling

Non- Regulated



Oil Production Emissions

Refinery Emissions



Electricity Generation Emissions

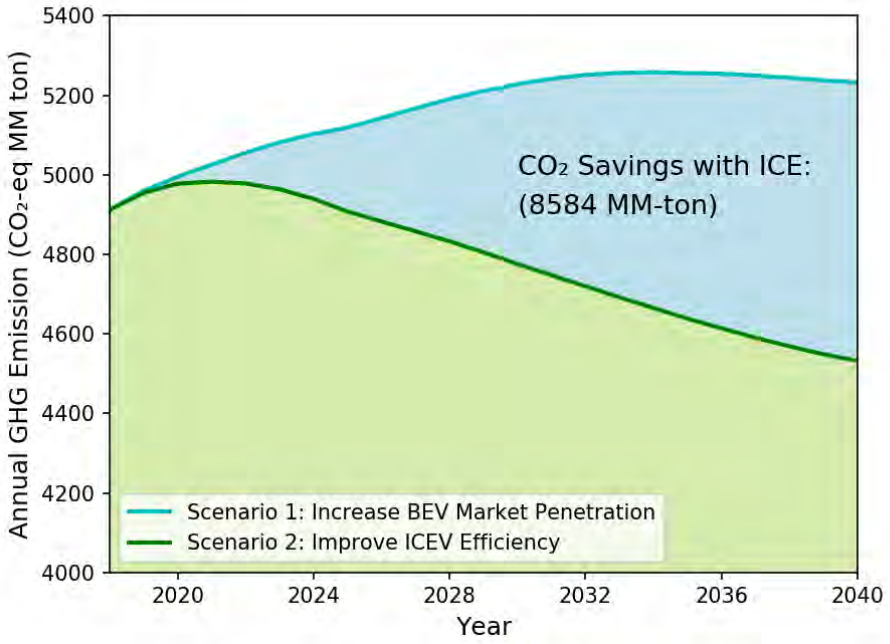
Vehicle Production Emissions

Recycling Emissions

Cradle to Grave LCA ensures an impact on CO_2 emissions

Analysis-guided policy will ensure the largest impact on CO_2

Global LD Vehicle GHG Emissions



Scenario 1: CAFE/CAFC met via 50% BEV penetration

Scenario 2: CAFE/CAFC met by improving ICEV only

Accumulated CO_2 Saving by 2040

8584 Million tons

Or

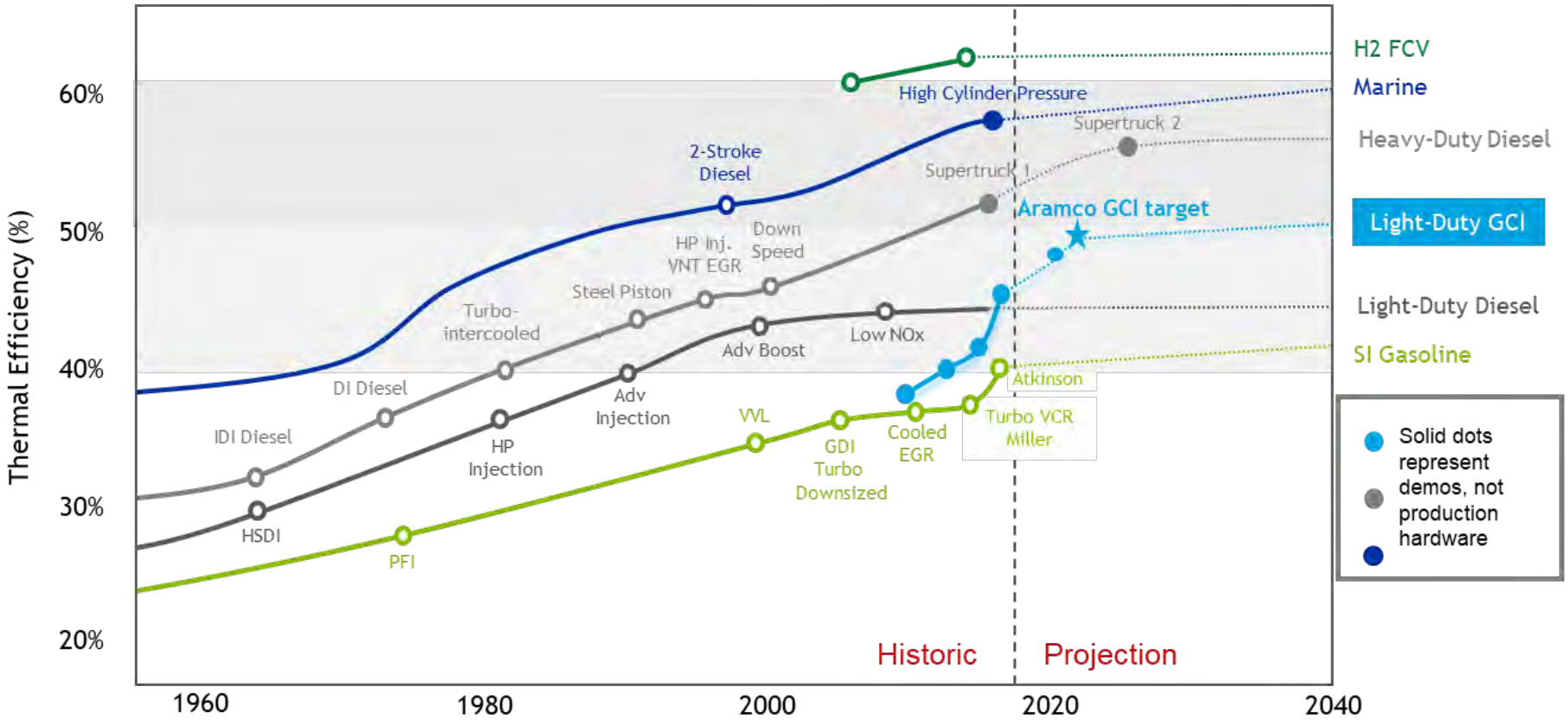
Equivalent to the CO_2 emissions of **1177 million** passenger car (40 mpg) driving around the earth equator

= 100 million

Improving the ICE has greater potential to improve CO_2 if BEVs are not counted as zero emissions

Source: Preliminary data, Aramco

ICE has abundant potential to improve CO_2



Leverages existing infrastructure and synergistic with hybridization, e-fuels and onboard carbon capture

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Continued investment in ICE for a bigger impact on GHGs

Gasoline Compression Ignition

+ 40% mpg

Opposed Piston

+ 33% mpg

Mobile Carbon Capture

>42% CO_2 capture

Zero Impact Emission Vehicle

0 Impact Pollutants

Hydrogen Fuel Cell

We're innovating across the vehicle to drive efficiency and lower emissions

Concluding Remarks

- No silver bullet - right technology mix for the right sector, at the right time, and in the right location yields maximum impact on GHGs
- ICE has abundant potential to deliver efficient, low emitting and competitive solutions especially through hybridization
- A holistic approach to reducing emissions is essential for achieving our climate goals
- Cross-sector collaboration will lead to optimized and sustainable transport solutions